

## Towards a Strategic Roadmap for Decarbonizing Building Materials

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### Abstract

By 2060, the global building stock is set to double. With this anticipated surge in demand, it is imperative not only to prevent an increase but to actively diminish the greenhouse gas emissions stemming from construction activities. Collaboration among leaders is crucial in steering the transition towards sustainable construction on a global scale. It is urgent to articulate a collective vision of the future where cities serve as exemplars of sustainable development, fostering dynamic, habitable, and environmentally aware communities.

### Addressing Urgent Residential and Infrastructure Needs for Sustainable Growth in the Global South

SDG 11.1 targets by 2030 *to ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums*. Housing is a basic human requirement which underpins most of the SDGs. Yet, across the world a staggering one billion people live in slum conditions, many without access to decent sanitation.

In the Global South, particularly in Africa, India, and Southeast Asia, the population is projected to grow by one billion by 2050, driving substantial urban expansion. Globally, an estimated 600 million housing units will be constructed by 2030, with a vast majority in countries of these regions as they face the dual challenge of rebuilding existing constructions while also addressing the urgent need for new homes and infrastructure.

Growth in population and fast urbanization mean high demand for affordable construction materials. Concrete and other materials made from cement make up the overwhelming majority of construction materials and cannot be meaningfully replaced by anything else. Over the next three decades, the demand for cement – a material responsible today for 8% of all human-induced carbon emissions – is expected to soar in the Global South along with billions of tons of resulting emissions, unless prompt measures to decarbonize cement production are enacted. Access to eco-friendly solutions to support sustainable infrastructure developments and improvements are essential.

In the African context, there is an urgent need for more residential and commercial buildings and infrastructure to support growth across the continent. The challenge of construction in Africa is aggravated by the fact that existing infrastructure is already strained, and many people lack adequate housing and essential infrastructure. The need to rebuild existing

constructions is a challenge that African countries are already facing, while also responding to the urgent need of building new homes and infrastructure as the continent grapples with accommodating its growing population.

Africa lacks suitable limestone to manufacture clinker – the main component of cement and also the most carbon-intensive ingredient in overall concrete manufacturing. This material is scarcely available on the continent. Today, the costly import of clinker has a direct impact on costs causing severe affordability issues for housing and infrastructure. Considering the scarcity of limestone for clinker production in Africa, alongside the substantial greenhouse gas emissions it generates, it is prudent to explore alternatives, for example by substituting a portion of the traditional clinker used in cement production with locally available and less carbon-intensive materials. Blended cement formulas such as Limestone Calcined Clay Cement (LC3) that replace half of the clinker with clay and limestone is a realistic and scalable solution to meet these needs. This approach maintains cement's functionality, reduces the need for foreign currency to import clinker and creates local employment, all while limiting CO<sub>2</sub> emissions.

Given the inevitability of urban development across the Global South, it is imperative that new construction efforts prioritize sustainability. This is essential not only to mitigate the environmental footprint impacting the planet but to provide economic opportunities and enhance wellbeing of citizens. To meet these needs, leaders need to focus on constructing affordable housing and invest in building better offices and factories, hospitals and schools, roads and bridges, and public transportation. Tailored solutions for the Global South are critical in facilitating the transition to net-zero cement manufacturing, and the construction sector can serve as a driver for economic advancement and employment opportunities in these regions.

## Shifting Focus: Shedding Light on Embodied Carbon

Buildings and infrastructure contribute to approximately 40% of global carbon emissions, totalling 15 Gigatons annually. These emissions comprise two parts: one part originates from "upfront" *embodied* carbon released during the manufacturing of building materials, transportation, construction, and end-of-life phases of buildings and infrastructure, while the other arises from operating carbon used in their day-to-day operations, including heating, cooling, and lighting.

Improvements in energy efficiency of buildings and efforts to decarbonise the energy sector start to bear fruit. The share from embodied emissions is growing and will soon surpass operational carbon emissions as the primary source of carbon emissions from the built environment especially in developing regions.

To truly combat climate change, we cannot afford to overlook the significant impact of construction activities on carbon emissions. Addressing embodied carbon emissions is essential for achieving climate goals and ensuring the sustainability of our built environment. As such, it is imperative that we broaden our focus to encompass the entire lifecycle of buildings, from material extraction and production to end-of-life disposal or reuse. This holistic approach is necessary to effectively reduce the carbon footprint of the built environment and transition to a more sustainable future.

## Decarbonizing Cement and Concrete: Unlocking Sustainable Solutions Through Policy Incentives

It is imperative that actions to decarbonize building materials be taken urgently. Achieving substantial reductions in emissions will require more than just technological innovation; the implementation of appropriate policy incentives to facilitate the necessary changes will play a central role in shaping market behaviour and investment decisions. Governments and regulatory bodies must take proactive measures to incentivize the decarbonization of cement and other building materials and influence the adoption of cleaner technologies and practices.

In addition to carbon pricing, targeted subsidies, grants, and tax incentives can help stimulate the development and application of low-carbon technologies, and encourage investment in carbon-efficient construction practices. Public procurement

policies can be leveraged to prioritize the use of low-carbon building materials in government-funded construction projects, creating a market demand for sustainable products and driving innovation in the industry. The recent announcement from the US Department of Energy regarding the Biden Administration's multi-billion-dollar investment to transform the industrial sector and "slash planet-warming emissions" is a good example of such policies going in the right direction. By aligning economic incentives with environmental objectives, policymakers can accelerate the transition to a more sustainable built environment and contribute to the global effort to combat climate change.

Cement production alone accounts for 8% of worldwide emissions. Implementing measures to reduce emissions from its production and optimizing its utilization are crucial steps in addressing the climate challenge. We need to prioritize incentives that encourage the reduction of clinker in cement as well as the optimization of cement usage in concrete and concrete in buildings. These steps offer immediate opportunities for emission reduction that can be implemented swiftly, often at near-neutral or even negative costs. This approach contrasts with solely relying on carbon capture and storage (CCS), which presents significant challenges and expense when implemented on a large scale.

Incentivizing the reduction of clinker content in cement production are most efficient when encouraging the adoption of alternative cementitious materials, such as calcined clays, or pozzolans: substitutes for clinker that lower the carbon footprint of cement production. Similarly, incentivizing the optimization of cement usage in concrete mixtures can lead to the development and adoption of more sustainable concrete formulations that maintain structural integrity while reducing overall carbon emissions. For instance, overdesign in structural engineering practices is far too common and creates unnecessary embodied carbon in constructions that could be avoided. By optimizing designs to minimize material usage and incorporate more efficient construction methods, engineers can achieve substantial reductions in carbon emissions without compromising safety or performance.

While carbon capture and storage technologies will have a role to play in mitigating emissions from cement production and other industrial processes, they are very expensive and technically challenging to implement at scale. Therefore, relying solely on CCS as a mitigation strategy will not be sufficient to achieve

the rapid and deep emissions reductions required to combat climate change effectively.

### Recommendation: Designing a Strategic Roadmap for Decarbonizing Building Materials

The global community faces a critical challenge: decarbonizing building materials. While this effort holds significant implications for all regions, it is particularly relevant in the context of the Global South, where the need for development is immense. The implementation of sustainable practices is urgent and crafting a clear roadmap for decarbonization is an imperative to get there.

Stakeholders across the building supply chain must collectively commit and take action towards common goals. Architects, designers, prescribers, policymakers, manufacturers, and consumers must align their efforts towards a shared vision of sustainability. Each entity along the supply chain possesses unique leverage points and responsibilities that, when harmonized, can trigger transformative change.

Policies designed to incentivize the adoption of low-carbon building materials are central to the roadmap. But to drive widespread change policy measures need to be accompanied by education and awareness campaigns to help industry professionals make informed choices regarding materials and construction methods.

Collaboration is the key ingredient for a successful transition. Building a sustainable future demands knowledge-sharing and collective action among all stakeholders. Cross-sector partnerships, research networks, and collaborative platforms can facilitate the exchange of ideas, technologies, and expertise, accelerating progress towards decarbonization goals.

Ultimately, decarbonizing building materials is not merely a technical challenge but a necessity for humanity. The choices made today will impact the generations to come, shaping the resilience and health of communities, the prospects for equitable prosperity, and a world in which our children are spared from the devastating effects of climate change.