POLICY RECOMMENDATION

Climate Mitigation

Accelerating Low-Carbon Cement as a Pathway to Reducing Embodied Carbon in the Commonwealth

Author: Dawn Bonfield MBE and Peter Oborn

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Modern cement manufacturing complex. Image: Tewodros Hailemichael/iStock

Decarbonising construction materials, especially cement, is essential for sustainable infrastructure, and housing, across the Commonwealth. As a major source of embodied carbon, cement offers a critical entry point for emissions reduction. This paper sets out practical policies to accelerate low-carbon cement adoption within a whole-life approach aligned with climate goals, economic resilience and shared sustainability priorities.

Executive Summary

The Commonwealth faces an unprecedented infrastructure and housing challenge. Rapid urbanisation, population growth and economic development will require a massive expansion of buildings and infrastructure across member states over the coming decades. At the same time, countries are committed to achieving ambitious climate goals under the Paris Agreement and national net-zero strategies. These twin imperatives place the construction sector at the centre of the climate transition.

A growing share of emissions arises from embodied carbon in construction materials, particularly in rapidly urbanising countries where new construction dominates. Without intervention, material-related emissions are expected to increase significantly as infrastructure and housing demand expands. Addressing cement emissions is therefore a critical component of a broader strategy to reduce lifecycle emissions across the built environment.

Cement and concrete are the most widely used construction materials in the world and are essential to the development of resilient infrastructure, housing and urban systems. However, cement production accounts for approximately 7–8% of global carbon dioxide emissions due to the energy-intensive nature of clinker production and the process emissions released during limestone calcination.

Low-carbon cement technologies, including limestone calcined clay cement (LC3), supplementary cementitious materials (SCMs), alternative fuels and carbon capture technologies, can significantly reduce the carbon intensity of cement production while maintaining performance and cost competitiveness. Evidence from countries such as India, Ghana and Kenya[1] demonstrates that these technologies are technically viable and increasingly ready for scaling.

However, adoption remains constrained by regulatory barriers, fragmented supply chains, limited technical capacity and procurement systems that prioritise traditional materials. Without targeted policy interventions, the opportunity to decarbonise one of the most carbon-intensive industrial sectors risks being missed.

[11] See case studies in Appendix II

This policy recommendation calls for Commonwealth governments to accelerate the adoption of low-carbon cement through coordinated regulatory reform, green public procurement, industry transition roadmaps and international collaboration. By doing so, Commonwealth countries can reduce embodied carbon in infrastructure, support sustainable industrial development and position themselves at the forefront of the global transition to low-carbon construction.

Accelerating the adoption of low-carbon cement supports the Commonwealth Strategic Plan's pillars of environmental and economic resilience by reducing industrial emissions while strengthening green industrial development. It also advances cross-cutting priorities by supporting innovation, skills development and climate-resilient infrastructure across Commonwealth countries, particularly small and vulnerable states.

Policy Problem

The construction sector plays a central role in economic development, urbanisation and infrastructure delivery. Yet it is also responsible for a significant share of global greenhouse-gas emissions. Globally, the buildings and construction sector accounts for roughly 37% of energy-related carbon emissions, including emissions associated with construction materials such as cement and steel.

Cement production is one of the largest sources of industrial emissions. These emissions arise from two principal sources:

- process emissions from the chemical conversion of limestone into clinker during cement production;
- energy emissions from the fuels used to heat cement kilns and power industrial processes.

Process emissions alone account for approximately 55% of cement sector emissions, while energy use contributes around one-third of total emissions.

Demand for cement is expected to increase substantially over the coming decades as developing countries expand infrastructure and housing provision. In many rapidly urbanising regions, including parts of Africa, South Asia and Southeast Asia, cement consumption is projected to rise dramatically. The global demand for construction materials is also expected to nearly double by 2060.

This trend presents a critical challenge. If cement production continues to rely primarily on conventional ordinary Portland cement (OPC), global emissions from cement could increase sharply. Conversely, the large volume of future construction creates a unique opportunity to embed low-carbon materials and technologies into infrastructure systems from the outset.

A range of technologies already exists to reduce the carbon intensity of cement production. These include:

- **Clinker substitution** through supplementary cementitious materials such as slag, fly ash and calcined clay
- **Low-carbon cement formulations**, including limestone calcined clay cement (LC3)
- **Alternative fuels**, such as refuse-derived fuel derived from municipal waste
- **Energy efficiency improvements** in cement manufacturing
- **Carbon capture, utilisation and storage (CCUS)** technologies.

Together, these solutions can reduce cement-related emissions by 30–40% in the near term, with deeper reductions possible through carbon capture and industrial decarbonisation technologies.

Despite this potential, adoption remains uneven across many Commonwealth countries. Several structural barriers continue to slow the transition:

- **Regulatory barriers.**
  Many national standards and building codes remain based on prescriptive specifications developed around conventional Portland cement formulations. These standards may inadvertently prevent the adoption of alternative cement formulations even where they meet structural performance requirements.
- **Procurement practices.**
  Public infrastructure projects often rely on traditional design specifications rather than performance-based criteria, discouraging innovation in materials.
- **Market barriers.**
  Supply chains for supplementary cementitious materials are often underdeveloped, particularly in rapidly growing construction markets.
- **Knowledge and skills gaps.**
  Many engineers, contractors and regulators are unfamiliar with the design and specification of low-carbon concrete.
- **Investment barriers.**
  Industrial transitions require investment in new production facilities, alternative fuel supply chains and research and development.

Overcoming these barriers requires coordinated action by governments, industry, research institutions and international organisations.

Objective

The objective of this policy recommendation is to accelerate the adoption and scaling of low-carbon cement technologies across Commonwealth countries as a priority pathway for reducing embodied carbon in buildings and infrastructure in order to:

- reduce lifecycle emissions from construction
- support sustainable industrial transformation within the cement sector
- align construction sector growth with national and global climate commitments
- contribute to wider material efficiency and low-carbon construction strategies

Recommendations

A coordinated strategy for accelerating low-carbon cement adoption should focus on five priority areas.

1. **Reform building standards to enable low-carbon cement**
   Governments should review and update national construction standards to enable the use of low-carbon cement formulations. Moving from prescriptive material specifications toward performance-based standards would allow engineers to adopt innovative cement blends while ensuring structural safety and durability.

   Standardisation bodies should work with industry, research institutions and international organisations to develop guidance for low-carbon cement technologies, including LC3 and other blended cements.

2. **Introduce green public procurement policies**
   Public infrastructure programmes, including transport networks, housing projects and public buildings, should incorporate embodied-carbon targets and prioritise low-carbon cement and concrete.

   Public procurement policies can play a powerful role in stimulating market demand for low-carbon materials and encouraging manufacturers to invest in cleaner production technologies.

3. **Develop national cement decarbonisation roadmaps**
   Governments should establish national roadmaps outlining a long-term pathway for reducing emissions in the cement sector. These roadmaps should include clear targets for clinker substitution, alternative fuel use and emissions reductions.

   India's Cement Sector Decarbonisation Roadmap provides a useful example of how national governments can coordinate industry, regulators and researchers around shared transition goals.

4. **Strengthen supply chains for low-carbon materials**
   Scaling low-carbon cement requires reliable supply chains for supplementary cementitious materials such as slag, fly ash, calcined clay and recycled aggregates.

   Governments should support the development of these supply chains through industrial policy, waste-management strategies and investment in materials processing infrastructure.

5. **Build technical capacity across the construction sector**
   Universities, research institutions and professional organisations should strengthen education and training programmes focused on low-carbon construction materials and design approaches.

6. **Promote material efficiency and whole-life carbon approaches**
   Governments should encourage design approaches that reduce overall material demand, including structural optimisation, reuse of existing assets and circular construction practices. Integrating lifecycle carbon assessment into planning and design processes will ensure that low-carbon cement adoption is complemented by broader reductions in material use and embodied emissions.

Professional development programmes for engineers, architects and construction professionals can help ensure that low-carbon cement technologies are adopted confidently and correctly.

Rationale

Global frameworks, including the Global Alliance for Buildings and Construction, emphasise that achieving net-zero buildings and infrastructure requires a dual focus on operational and embodied carbon. Within this, construction materials—and particularly cement—represent one of the most significant and immediate opportunities for emissions reduction. Targeted action on cement, combined with material efficiency and lifecycle approaches, is therefore essential to achieving system-wide decarbonisation.

The International Energy Agency and the Global Alliance for Buildings and Construction[2] highlight the critical role of construction materials in achieving net-zero buildings and infrastructure. Policies addressing material efficiency and embodied carbon are essential components of any comprehensive decarbonisation strategy.

Several countries have already begun implementing such strategies. India's cement decarbonisation roadmap identifies three key levers for reducing emissions:

- increasing the use of alternative fuels
- expanding clinker substitution through supplementary cementitious materials
- deploying carbon capture technologies.

These measures demonstrate how industrial decarbonisation can be achieved through coordinated policy frameworks combining regulatory reform, market incentives and technological innovation.

Real-world projects also demonstrate the viability of low-carbon cement technologies. Infrastructure projects using LC3 and blended cement formulations have already shown significant emissions reductions while maintaining structural performance and cost competitiveness.

In addition, international initiatives such as the Buildings and Climate Global Forum recognise the need to reduce emissions associated with construction materials as part

Taken together, these developments demonstrate that low-carbon cement technologies are no longer experimental. The remaining challenge lies in scaling adoption across markets and embedding these technologies within mainstream construction practices.

[2] Global Alliance for Buildings and Construction Global Roadmap 2020-2050: https://globalabc.org/sites/default/files/inline-files/Global%20Roadmap_FINAL.pdf

Expected Outcomes

Short-term outcomes

- Updated national standards enabling low-carbon cement technologies
- Increased pilot projects demonstrating low-carbon concrete applications
- Greater awareness and technical capacity among engineers, contractors and regulators.

Medium- to long-term outcomes

- Significant reductions in embodied carbon in infrastructure and housing
- Increased investment in low-carbon cement production technologies
- Growth of green industrial sectors and associated employment opportunities
- Alignment of construction sector development with national climate targets.

Implementation Considerations

Implementation will require coordination among several government agencies, including ministries responsible for infrastructure, housing, industry, environment and energy. Industry associations, cement manufacturers, research institutions and professional bodies should also play a central role in developing technical standards and supporting innovation.

The transition to low-carbon cement production will require investment in:

- alternative fuel infrastructure
- materials processing facilities
- research and development
- carbon capture technologies.

Public finance, green bonds and climate funds can support early investment and accelerate industrial transformation.

Risks and mitigation

Risk	Mitigation
Industry resistance	Phased regulatory reforms and industry consultation
Supply chain constraints	Investment in SCM production and waste-material supply chains
Technical uncertainty	Pilot projects and demonstration programmes

Monitoring

National ministries responsible for industry, infrastructure and environment should coordinate monitoring and reporting.

Key indicators

- clinker-to-cement ratio
- proportion of cement produced using SCMs
- share of infrastructure projects specifying low-carbon cement
- embodied carbon intensity of concrete in public projects.

Progress should be reviewed every three to five years in line with national infrastructure and climate planning cycles.

Call to Action

The Commonwealth has a unique opportunity to lead the global transition to low-carbon construction. By reforming standards, aligning procurement policies and supporting industrial innovation, Commonwealth governments can accelerate the adoption of low-carbon cement technologies and significantly reduce the carbon footprint of future infrastructure.

Collaborative action through the Commonwealth Sustainable Cities Coalition can support knowledge exchange, policy alignment and capacity building across member states, enabling the Commonwealth to play a leading role in the transition toward sustainable and climate-resilient construction.

The Commonwealth Sustainable Cities Coalition (CSCC) can support the adoption of low-carbon cement through:

- facilitating knowledge exchange between member countries
- disseminating best practice across low-carbon materials and construction systems
- supporting technical dialogue between governments, industry and researchers
- promoting policy alignment across Commonwealth infrastructure programmes
- supporting the integration of embodied carbon metrics into national housing and infrastructure policy frameworks

The Commonwealth Sustainable Cities Coalition (CSCC) is uniquely positioned to support a system-wide transition to low-carbon construction. By convening governments, industry and practitioners, the CSCC can help align policy, procurement and practice around reducing embodied carbon, with low-carbon cement as a critical early priority.

This Policy Recommendation was draft jointly by Prof Dawn Bonfield MBE, Immediate Past President of the Commonwealth Engineers Council, and Peter Oborn, Immediate Past President of the Commonwealth Association of Architects. Sections of the report were drafted with assistance from Claude (Anthropic, 2025) and subsequently reviewed and edited by the authors.

Concrete construction, Kenya. Credit: Nirian/iStock

Appendix I:
Policy Levers for Accelerating Low-Carbon Cement Adoption

Governments across the Commonwealth can deploy a range of policy instruments to accelerate the adoption of low-carbon cement and concrete.

Regulatory and standards reform

- **Performance-based cement standards:** Updating building codes and cement standards to allow performance-based specifications rather than prescriptive material definitions can enable the adoption of innovative low-carbon cement formulations.
- **Embodied carbon reporting:** Introducing embodied carbon assessment in construction projects can encourage designers and contractors to select lower-carbon materials.

Public procurement

- **Green public procurement:** Governments can require or incentivise the use of low-carbon cement in publicly funded infrastructure projects such as roads, schools and affordable housing.
- **Carbon benchmarks for infrastructure:** Setting embodied carbon benchmarks for infrastructure projects encourages contractors to adopt lower-carbon materials and construction methods.

Industrial and market incentives

- **Tax incentives for low-carbon materials:** Fiscal incentives can encourage cement producers to invest in low-carbon technologies and manufacturing processes.
- **Support for alternative materials supply chains:** Governments can support the development of supply chains for supplementary cementitious materials such as calcined clay, slag and recycled aggregates.

Innovation and research

- **Support for research and pilot projects:** Public funding for pilot projects and research programmes can help demonstrate the performance and viability of low-carbon cement technologies.
- **University–industry partnerships:** Collaboration between universities, research institutions and industry can accelerate innovation in materials science and construction technologies.

Capacity building and knowledge exchange

- **Professional training programmes:** Training engineers, architects and regulators in low-carbon concrete design can accelerate adoption.
- **International knowledge exchange:** Platforms such as the Commonwealth Sustainable Cities Coalition can support peer learning between countries implementing low-carbon cement strategies.

Appendix II:
Scaling Low-Carbon Cement in Practice. Three Case Studies

India: Industrial-scale clinker substitution and LC3 innovation

India has emerged as one of the global leaders in reducing the carbon intensity of cement production. Through coordinated industry innovation, regulatory reform and research collaboration, the country has significantly increased the use of blended cements incorporating supplementary cementitious materials (SCMs) such as fly ash and slag. As a result, India's cement sector has one of the lowest clinker-to-cement ratios globally, substantially reducing emissions per tonne of cement.

India has also been at the forefront of developing Limestone Calcined Clay Cement (LC3), a low-carbon cement technology capable of reducing emissions by up to 40% compared with ordinary Portland cement. LC3 uses abundant materials such as calcined clay and limestone, making it particularly suitable for emerging economies.

The India Cement Sector Decarbonisation Roadmap[3], developed by NITI Aayog, demonstrates how coordinated policy frameworks can align industrial innovation, regulatory reform and climate commitments to accelerate sector-wide decarbonisation.

Ghana: Demonstrating the viability of LC3 in emerging markets

Ghana has played a pioneering role in demonstrating the feasibility of LC3 technology in African markets. Through collaboration between government agencies, research institutions and industry partners, Ghana established one of the world's first commercial-scale LC3 production facilities.

The project demonstrated that calcined clay—widely available in many developing countries—can be used to produce high-performance low-carbon cement while reducing clinker content. Because the technology relies on locally available materials rather than imported additives, it offers significant potential for reducing costs and strengthening domestic construction materials industries.

The Ghana experience illustrates how research partnerships, pilot projects and industry collaboration can help de-risk emerging low-carbon technologies and accelerate their adoption in new markets.

[3] Roadmap for Cement Sector Decarbonisation: https://www.niti.gov.in/sites/default/files/2026-01/Roadmap_for_Cement_Sector_Decarbonaisation_0.pdf

Kenya: Standards reform enabling blended cement adoption

Kenya has made substantial progress in reducing the carbon intensity of cement through the widespread adoption of blended cements incorporating pozzolanic materials. National standards allow the use of multiple cement formulations, enabling manufacturers to reduce clinker content while maintaining structural performance.

The Kenyan cement industry has therefore been able to increase production of blended cements that use locally available volcanic ash and other supplementary materials. These materials not only reduce emissions but also lower production costs and improve resource efficiency.

Kenya’s experience demonstrates the importance of flexible regulatory frameworks and performance-based standards, which allow industry to innovate while ensuring safety and quality.

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