





THE BUSINESS CASE FOR LOW CARBON CEMENT

Ryan Gilliam, Fortera, explores the business case for scaling low-carbon cement and explains why commercial execution will define the next phase of cement decarbonisation.

For much of the past decade, the cement industry's decarbonisation efforts have been defined by innovation. Supplementary cementitious materials (SCMs) like fly ash and slag, carbon capture technologies, alternative fuels (AFs), and process improvements have demonstrated that meaningful reductions in emissions are possible. More recently, progress has come through the addition of new chemistries like calcined clay and natural pozzolans, alongside new technologies that aim to recreate the feedstocks, chemistry, or processes.

The industry has proven it can innovate. Now the question is: how can the industry deploy these solutions to have a meaningful impact at a global scale while maintaining the reliability, profitability, and performance that producers and customers depend on every day?

The next chapter of cement decarbonisation will not be defined by laboratory breakthroughs alone. It will be defined by commercial execution.

Cement's dual challenge

Cement has always been the foundation of economic growth. Every bridge, highway, airport, manufacturing facility, school, hospital, data centre, and housing development depends on it. As populations grow and infrastructure ages, demand for cement continues to increase across both developed and emerging markets.

According to the UN Environment Programme, half of the buildings that will exist globally in 2050 have yet to be built. With governments focusing on emissions reduction policies, infrastructure owners tracking carbon emissions, and customers placing greater emphasis on sustainability, a strategy is clearly required to reduce the embodied carbon in the infrastructure to come.

The challenge for producers is manufacturing more cement while reducing emissions, all without compromising product performance or economic competitiveness. Success will require solutions that fit within the realities of industrial manufacturing rather than asking producers to choose between sustainability

and competitiveness. Green cannot be a compromise.

Bridging the adoption gap

Across industrial sectors, one consistent challenge emerges: the gap between pilot projects and commercial deployment. Many technologies perform exceptionally well in research environments and pilot projects, yet relatively few achieve broad commercial adoption. The reasons are rarely technical. More often, they are economic and operational.

Does implementation increase production costs? Does it require significant changes to existing operations? Can it be integrated into current manufacturing assets? Does it depend on ongoing subsidies or incentives? Will customers adopt it without fundamentally changing specifications or construction practices? Can the plants be operated at high capacity factors with traditional operating staff? These are the questions every producer must answer before investing in new technology. History reminds us that industrial transformation does not occur simply because better technology exists. It occurs because that technology creates measurable business value.

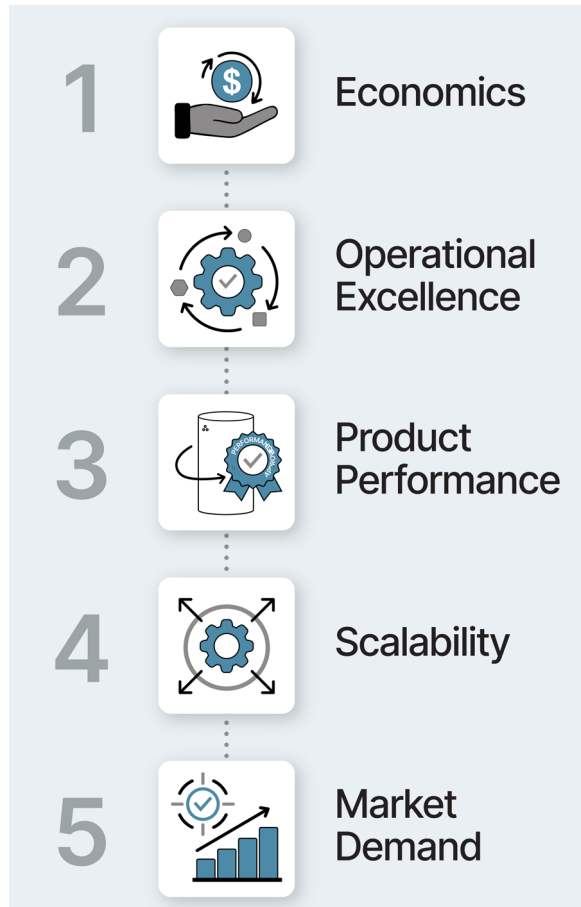
What drives adoption?

The cement industry has never been reluctant to innovate. It has consistently embraced technologies that improve productivity, strengthen competitiveness, and create long-term value. The transition from wet-process to dry-process kilns dramatically improved energy efficiency. AFs expanded because they reduced both operating costs and emissions. Uptake of SCMs like fly ash, slag, and now limestone has been relatively fast.

Each of these innovations has something in common: they strengthened the business while improving operations. That same principle will determine which low-carbon technologies achieve widespread adoption over the next decade.

Successful technologies should satisfy five key drivers for low-carbon cement adoption:

- ▶ Economics. Deliver a compelling return on investment and strengthen plant profitability.
- ▶ Operational excellence. Integrate into existing manufacturing and supply chains while improving efficiency, reliability, and productivity.
- ▶ Product performance. Meet or exceed the strength, durability, consistency, and quality customers expect.
- ▶ Scalability. Deploy efficiently across existing manufacturing infrastructure and supply chains with practical capital requirements.



Five drivers of low-carbon cement adoption.

- **Market demand.** Align with evolving customer expectations, procurement requirements, and regulatory frameworks while creating a competitive advantage.

Environmental performance is no longer separate from these drivers; it is becoming part of them. The technologies that will define the next generation of cement will not succeed simply because they reduce emissions. They will succeed because they make better business sense. When lower embodied carbon is paired with stronger economics, superior performance, and scalable manufacturing, adoption becomes a commercial decision rather than an environmental one.

Turning CO₂ into an asset

One of the more interesting shifts occurring across heavy industry is a changing perspective on carbon itself. Historically, CO₂ has been viewed almost exclusively as a liability, a waste stream that must be avoided, captured, transported, or permanently stored. Increasingly, however, new approaches are asking a different question: what if CO₂ could become a valuable manufacturing input? Carbon mineralisation is one example of this evolving mindset. Rather than treating industrial CO₂ solely as an emission, mineralisation technologies convert it into stable cementitious materials that become part of finished construction products.

This changes the conversation. Instead of focusing exclusively on carbon avoidance, producers can begin evaluating opportunities to improve resource efficiency, reduce process

emissions, increase product output, extend the value of existing assets, and position facilities for emerging carbon markets. More importantly, it reframes decarbonisation as an opportunity to create value rather than a cost centre.

Scaling through existing infrastructure

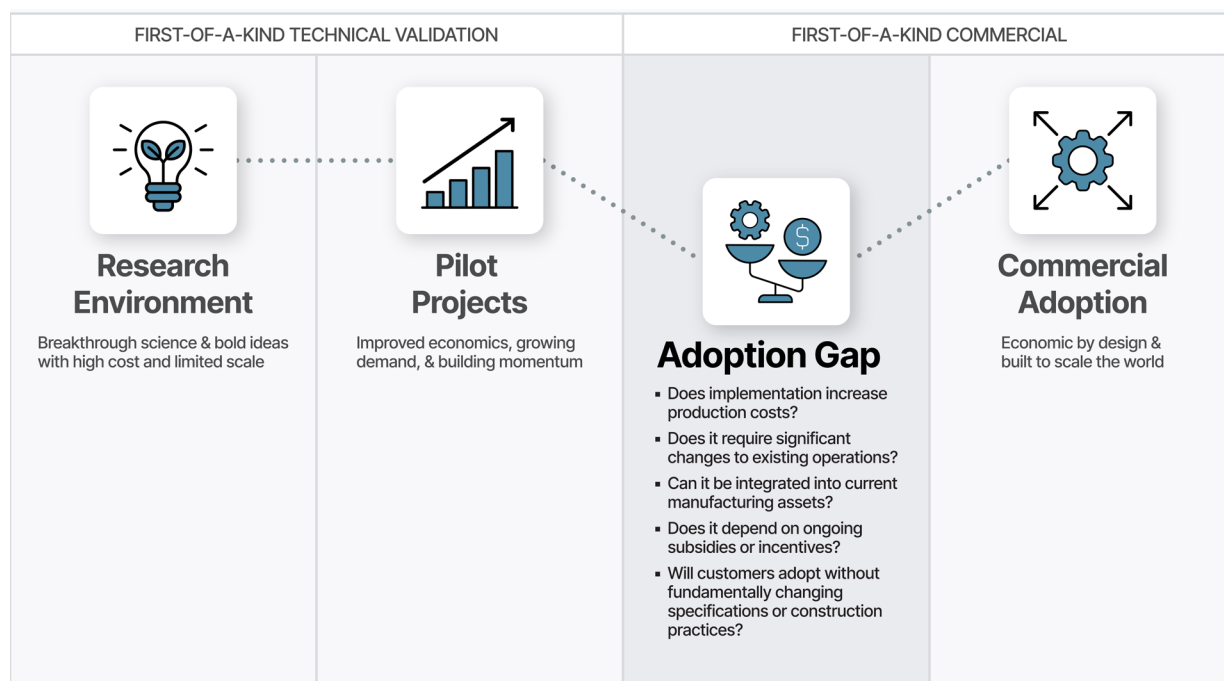
Another lesson repeated throughout industrial history is that scale follows infrastructure. The technologies that achieve the broadest adoption are often those capable of integrating into existing manufacturing systems and supply chains rather than replacing them entirely. For cement producers, existing plants represent decades of investment in equipment, permitting, workforce development, logistics, customer relationships, and regional supply chains.

Modernising these assets is often a faster and more capital-efficient pathway than building entirely new production systems. Technologies that leverage existing infrastructure reduce implementation and permitting risk, accelerate deployment, and improve the return on invested capital.

As global demand for cement continues to grow, enabling producers to extract greater value from assets already in operation may prove just as important as developing entirely new manufacturing approaches.

An emerging demand signal

The market is changing as well. Infrastructure developers, commercial builders, architects, public agencies, and owners are increasingly evaluating embodied carbon alongside



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traditional measures of cost, durability, schedule, and performance.

One of the strongest demand signals is coming from large-scale infrastructure investment. Data centres supporting AI, advanced manufacturing facilities, energy projects, transportation networks, and housing developments are driving unprecedented construction activity across North America. While these customers are committed to reducing their carbon footprints, they still expect reliable supply, competitive pricing, and proven performance.

For producers capable of delivering lower-carbon cement without sacrificing quality, scale, or pricing, this represents an emerging competitive advantage.

The next decade of cement decarbonisation

Looking ahead, the next decade of cement decarbonisation will be defined less by scientific discovery and more by commercial execution. The technologies that ultimately scale will be those that integrate seamlessly into existing manufacturing and supply chains, demonstrate attractive project economics, deliver consistent product performance, earn market acceptance, and make efficient use of capital.

Those characteristics are what transform promising technologies into widely adopted industrial solutions. Innovation will always remain essential. Research will continue to expand what is technically possible. But the industry's greatest opportunity now lies in translating those innovations into practical solutions that producers can confidently deploy and customers are eager to specify.

From possibility to practice

The future of low-carbon cement depends on more than innovation. It depends on adoption. As the industry works to meet growing global demand while reducing emissions, the most impactful technologies will be those that align environmental performance with business performance. Solutions that improve competitiveness while lowering carbon intensity will ultimately define the next generation of cement manufacturing. The path to large-scale decarbonisation is not simply creating new technologies. It is creating technologies that producers, customers, and investors have the confidence to scale. That is how meaningful industrial transformation occurs. And that is how the industry moves from innovation to adoption. ■