TEAM PENNSYLVANIA

EFI FOUNDATION

Opportunities for Low-Carbon Concrete in Pennsylvania

A collaboration between Team Pennsylvania and EFI Foundation

The Challenge

Concrete is the most widely used man-made material on Earth and the foundation of modern infrastructure. Its key ingredient, Portland cement, is responsible for nearly 8 percent of global CO_2 emissions. If cement were a country, it would rank as the world's third-largest emitter of greenhouse gases.

Pennsylvania has a unique legacy in this story: cement was first produced in the United States in Coplay, Pennsylvania, in 1871, marking the region as the birthplace of the nation's cement industry. That historic innovation set the stage for America's modern infrastructure and positions Pennsylvania to lead once again in defining the next generation of low-carbon building materials.

Today, the commonwealth remains among the nation's largest producers and consumers of concrete. Yet the industry faces major challenges, including:

- High embodied carbon from traditional cement and concrete production;
- Fragmented supply chains that slow the adoption of low-carbon alternatives;
- Permitting and procurement processes that make it difficult to test and scale new technologies and mixtures;
- A lack of coordinated market signals that reward emissions reduction and innovation.

Without strategic action, Pennsylvania risks losing competitiveness in one of its legacy industries at a time when global markets are shifting toward cleaner, more efficient materials.

The Opportunity

The Low-Carbon Concrete Initiative, a collaboration between Team Pennsylvania and the EFI Foundation, builds on both organizations' strengths in convening diverse partners, aligning incentives, and advancing practical lower carbon strategies.
Pennsylvania is uniquely suited to lead for several reasons:

- **Industrial heritage and expertise**: Pennsylvania's status as the birthplace of American cement provides deep technical knowledge, skilled labor, and production capacity that can accelerate innovation and adoption.

- **Public procurement leverage**: State and local governments procure roughly 40 percent of all U.S. concrete, giving Pennsylvania substantial influence over demand-side market transformation.

- **Resource advantage**: The region's energy and manufacturing sectors generate valuable byproducts, including coal ash and ground granulated blast furnace slag, which can serve as supplementary cementitious materials (SCMs) to replace high-carbon clinker.

- **Innovation ecosystem**: Pennsylvania's research institutions and companies are developing AI-optimized concrete mixtures, carbon-mineralized cements, and electrochemical production methods that eliminate process emissions, creating an opportunity to pair early-stage innovation with strong commercialization potential.

- **Cross-agency collaboration**: The Office of Transformation and Opportunity (OTO) and Department of Transportation (PennDOT) are working to streamline approval pathways for new materials consistent with the state's Economic Development Strategy priorities in advanced manufacturing, energy innovation, and regional competitiveness.

Together, these advantages position Pennsylvania to connect its industrial legacy with its innovation future, creating a pathway to both decarbonize and grow the concrete sector.

Scaling into the Future

Through insights gathered from the October 2025 Low-Carbon Concrete Workshop, Team Pennsylvania and EFI Foundation identified four major areas for progress.

1. Scale Innovation Through Policy Alignment

States such as New York, Minnesota, and Oregon are already implementing policies that reduce embodied carbon in concrete through procurement standards and incentives. Pennsylvania can follow suit by:

- Requiring Environmental Product Declarations (EPDs) with procurement bids, sharing cost and carbon intensity data to increase market data transparency
- Setting Global Warming Potential (GWP) thresholds for materials used in state-funded projects
- Creating incentives or bid preferences for suppliers providing verified low-carbon products
- Revising prescriptive specifications for cement and concrete with performance-based metrics, allowing for increased material innovation

These actions would signal that Pennsylvania is ready to accelerate innovation and provide a clear framework for market participation.

2. Unlock Circular Supply Chains

Pennsylvania's power and manufacturing sectors already generate industrial byproducts that can be used in low-carbon concrete. Fly ash, bottom ash, ground granulated blast furnace slag, and synthetic gypsum can directly replace portions of cement while improving performance and extending the life of roads and bridges.

Expanding "beneficial use" policies and supporting coal ash harvesting could reduce waste and emissions simultaneously, turning legacy materials into valuable inputs for sustainable construction.

3. Support Market Development Through Advanced Procurement Tools

Market confidence and demand signals are essential for scaling low-carbon concrete. Emerging mechanisms such as the book-and-claim framework separate physical materials from their verified carbon attributes, enabling credible emissions accounting, flexible procurement, and new revenue streams for producers investing in lower carbon production.

By piloting such tools, Pennsylvania can lay the groundwork for a more transparent and investable concrete market by:

- Testing book-and-claim pilots for concrete and cement to verify carbon attributes and facilitate participation from producers of all sizes
- Developing standardized approaches for assessing the carbon intensity of concrete mixtures to support fair, comparable market evaluation
- Integrating verified carbon attributes into procurement processes to reward performance rather than prescriptive material choices
- Supporting early market-making activity that attracts private capital, aligns buyers and producers, and accelerates adoption of novel low-carbon technologies

These strategies would build trust in performance-based carbon reduction systems, expand access to innovative products, and strengthen Pennsylvania's position as a leader in modern procurement and market development.

4. Streamline Permitting and Demonstration Pathways

Under current procedures, new materials without established PennDOT specifications can take up to two years to be approved for use. Aligning OTO's Speed to Market goals with interagency coordination can significantly reduce approval times and accelerate real-world demonstration projects.

Why Team Pennsylvania and EFI Foundation

Team Pennsylvania and the EFI Foundation share a commitment to advancing pragmatic solutions for industrial innovation and energy security. Together, we bring a balanced approach that combines Pennsylvania's statewide convening capacity with EFI's technical expertise in energy systems, industrial decarbonization, and market design.

Team Pennsylvania serves as the commonwealth's public-private platform for collaboration across government, industry, and academia. Its experience facilitating Strategic Impact Initiatives, such as forestry, nuclear energy, and AI scaling, ensures that complex challenges are addressed through coordinated partnerships and shared accountability.

EFI Foundation brings national experience in designing and implementing industrial decarbonization pathways. EFIF's work on technology innovation and market formation, including demand-side invectives to support offtake for the regional clean hydrogen hubs, provide a model for Pennsylvania's low-carbon policy and market development.

Together, both organizations are uniquely positioned to connect the technical, policy, and commercial elements necessary to translate low-carbon concrete from pilot to practice. This partnership ensures that Pennsylvania's leadership is both economically competitive and grounded in sound science and stakeholder trust.

Next Steps

In the coming months, Team Pennsylvania and EFI Foundation will:

- **Launch a Low-Carbon Concrete Working Group** to align public, private, and academic partners on key priorities and strategic actions.
- **Develop pilot projects** to demonstrate low-carbon concrete performance, cost, and emissions benefits in state infrastructure.
- **Coordinate with agencies and producers** to streamline specifications, data collection, and procurement processes.
- **Explore advanced market commitments and EPD systems** to advance market transparency and verification.

Through these efforts, Pennsylvania can reassert its leadership in one of its most historic industries and model how states can link innovation, economic growth, and decarbonization in practical, measurable ways.

Sources

The Historical Marker Database, First Portland Cement (Coplay, Pennsylvania, 1871);

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Talen Energy, *Scaling Up: Enabling Opportunities of Low-Carbon Concrete Policy in Pennsylvania* (2025).