May 2025

Recasting the Future: Policy Approaches to Drive Cement Decarbonization

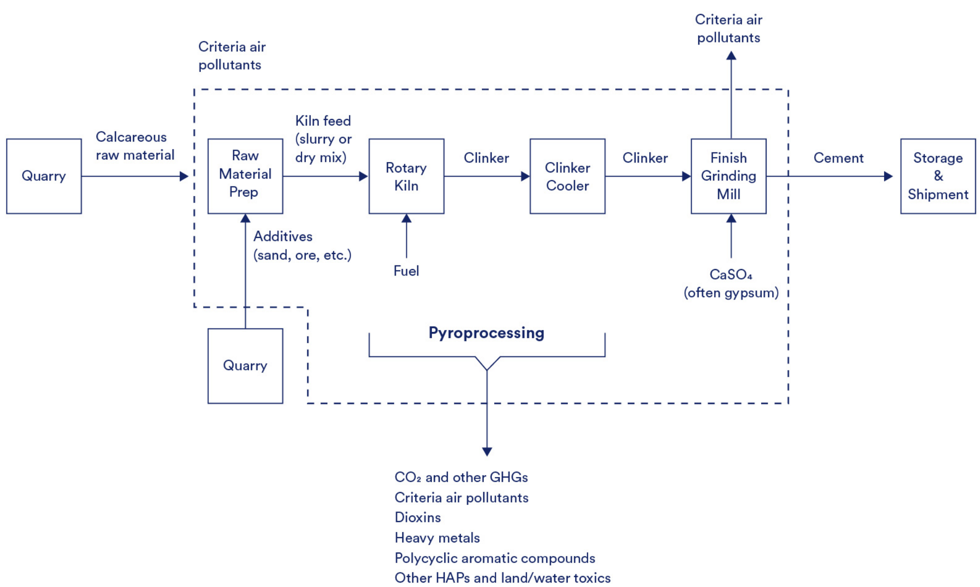
Executive Summary

Cement is a crucial element of infrastructure development and economic vitality in the United States. Production of cement in the United States employs approximately 14,000 workers and generates 91 million metric tons of cement annually. However, the cement manufacturing process is responsible for a substantial share of greenhouse gas (GHG) emissions: 71.3 million metric tons annually or 4.4 percent of U.S. total industrial emissions and 1.1 percent of total gross U.S. GHG emissions. To support reducing GHG emissions while preserving economic growth and infrastructure resilience, this whitepaper presents key technological pathways, adoption strategies, and policy recommendations for transitioning to a low-carbon cement industry.

Cement Sector Overview

The U.S. cement industry consists of 92 manufacturing plants, which have become more efficient over time through conversion to dry production processes and reuse of waste heat from fuel combustion. The remaining efficiency gains available to the industry are relatively limited, as kilns with outdated production technology represent only 7.3 percent of the 2019 kiln capacity in the United States. **Figure ES-1** illustrates the key stages of cement manufacturing, emphasizing the processes responsible for GHG emissions and other pollutants. Cement plants release 140 different regulated pollutants into air, land, and water, and particulate emissions from cement production are responsible for hundreds of premature deaths annually in the United States, among other adverse health impacts.

Figure ES-1. Cement production process diagram



Notes: The dotted line shows the boundary of the facilities that we categorize as Scope 1 in this report.

Over time, the cement sector has undergone a transition from coal to natural gas, as demonstrated in **Table ES-1**. Despite this shift, many of the largest and most recently constructed kilns still use coal or coke as their primary fuel (**Figure ES-2**). Because coal typically costs less than natural gas on a dollars per MMBtu basis in the industrial sector, the economic incentives for fuel-switching from coal to gas at cement kilns depend on the characteristics of local fuel markets and infrastructure availability, rather than a universal advantage of one fuel over the other. Existing cement kilns that burn coal or coke are priority candidates for GHG emission control technologies such as carbon capture, utilization, and storage (CCUS), both because these plants are currently high emitters and because CCUS generally has a lower cost per ton of carbon captured at facilities with higher concentrations of carbon dioxide (CO_2) in their exhaust streams.

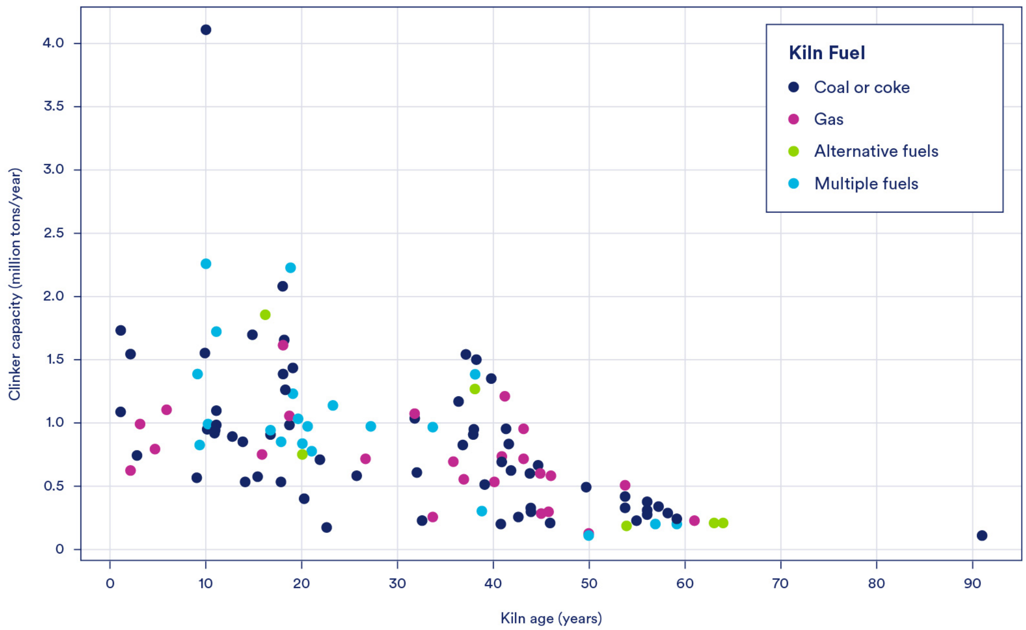
While fuel combustion is a key source of GHG emissions, nearly 60 percent of the emissions from cement-making are non-energy-related and result from the calcination process, which releases carbon from limestone. Importantly, because these process emissions result from chemical reactions involved in cement production rather than fuel combustion, the industry cannot abate them through fuel-switching.

Table ES-1. Fuel consumption by U.S. cement plants in 2000 and 2022

Category	Fuel	Energy Consumption (TBtu)		Share of Total Energy Consumption (%)	
		2000	**2022**	**2000**	**2022**
Scope 1: Conventional fuels	Coal	214.7	100.6	57.4%	31.5%
	Petcoke	49.0	50.8	13.1%	15.9%
	Oil	4.57	1.25	1.2%	0.4%
	Natural gas	12.3	77.5	3.3%	24.2%
Scope 1: Waste fuels	Tires	11.2	12.3	3.0%	3.8%
	Solid waste	11.6	12.8	3.1%	4.0%
	Liquid waste	29.5	24.5	7.9%	7.7%
Scope 2	Purchased electricity	41.0	39.9	11.0%	12.5%
Total	**All**	**373.9**	**319.8**	**100%**	**100%**

Source: USGS. (2024). "Cement 2022 tables-only release." Minerals Yearbook 2022, v. I, Metals and Minerals. Available at: https://www.usgs.gov/centers/national-minerals-information-center/cement-statistics-and-information; USGS. "Cement Minerals Yearbook 2000." Available at https://d9-wret.s3.us-west-2.amazonaws.com/assets/palladium/production/mineral-pubs/cement/170400.pdf.

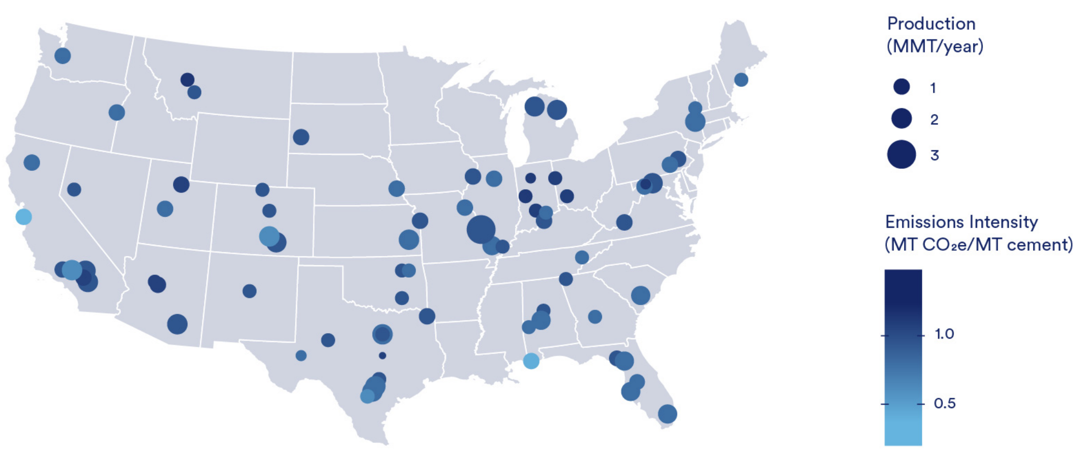
Figure ES-2. Summary of U.S. cement kiln capacity, age, and fuel in 2019



Source: Portland Cement Association. (2021). U.S. Portland Cement Industry: Plant Information Summary. Includes data through December 31, 2019.

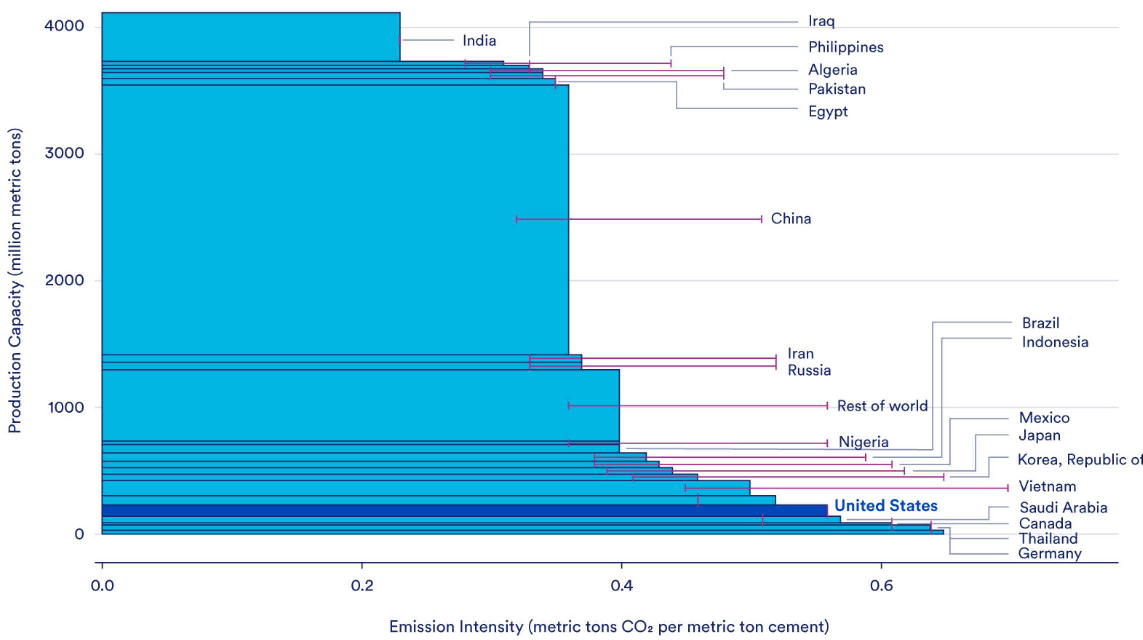
Emissions from cement production vary regionally, as shown in **Figure ES-3**, which showcases locations where targeted early interventions may be most impactful. However, because cement production is highly regionalized due to the weight and transport costs of raw materials, deep sectoral decarbonization will require targeting facilities throughout the United States. Compared to global markets, U.S. cement production remains more emissions-intensive (**Figure ES-4**). This underscores the urgency for policy interventions to spur decarbonization.

Figure ES-3. Map of facility-level production capacity (point size) and Scopes 1 and 2 emissions intensity (color)



Source: Synapse Energy Economics. (2023). "Coming Clean on Industrial Emissions: Final Database 2023-06." Prepared for Sierra Club. Available at: https://www.sierraclub.org/articles/2023/09/overview-coming-clean-industrial-emissions-report. Darker blue indicates higher emissions intensity. Larger point size indicates higher production capacity.

Figure ES-4. Comparison of U.S. cement emission intensity to global supply



Source: Synapse analysis of data from USGS, Global Carbon Budget, and GCCA. Excludes emissions from onsite power generation. Error bars indicate 95 percent confidence interval for countries that do not appear in the GCCA dataset. Note, GCCA and Global Carbon Budget emission accounting protocols differ from U.S. EPA data used elsewhere in this report, which may cause appearance of inconsistent results.
USGS. (2024). Cement Statistics and Information. Mineral yearbook 2022. Available at: https://www.usgs.gov/centers/national-minerals-information-center/cement-statistics-and-information.
Our World in Data and Global Carbon Budget. (2024). Accessed October 16, 2024. Available at: https://ourworldindata.org/grapher/annual-co2-cement.
Global Cement and Concrete Association. (2024). "GNR 2.0 – GCCA in Numbers." Accessed December 19, 2024. Available by request at: https://gccassociation.org/sustainability-innovation/gnr-gcca-in-numbers/.

The U.S. cement industry is structured with a concentrated supply side dominated by a few multinational corporations. The demand side is heavily influenced by government procurement, which accounts for nearly half of total cement purchases. The supply chain is fragmented in the middle, with numerous intermediaries such as ready-mix concrete producers, wholesalers, and contractors. Despite this fragmentation, market concentration remains below regulatory thresholds and further consolidation is possible. Major companies such as Holcim and Heidelberg have pursued CCUS projects in Europe, but similar investments in the United States remain limited due to policy uncertainty and inadequate incentives.

On the demand side, the reliance on spot transactions and short-term procurement strategies makes it challenging for cement producers to secure low-cost financing for decarbonization projects. Unlike other industries that benefit from long-term off-take agreements, the cement sector largely operates on cyclical demand patterns tied to macroeconomic trends such as infrastructure spending and housing construction. Cement prices, which have seen substantial fluctuations, are driven more by demand-side changes than by supply constraints. While decarbonization measures such as CCUS could increase cement prices by 20–40 percent, their impact on overall construction costs would be minimal, emphasizing the need for market structures that support the financial viability of low-carbon cement production.

Technology Pathways to Decarbonize Cement Production

Several technological pathways exist to reduce emissions, including:

1. **Plant Efficiency Upgrades:** Making cement plants more energy-efficient is one of the simplest ways to cut emissions. This includes upgrading kilns, improving heat recovery, and using better grinding equipment. Plant operators have already made the most cost-effective of these improvements, however, and the remaining potential emissions reductions based on current technologies is unlikely to exceed 8 percent. These upgrades are widely used today and are **ready for full deployment**.

2. **Alternative Feedstocks and Production Processes:** Traditional cement relies on limestone, which releases a large amount of CO_2 when processed. Using alternative raw materials such as certain types of rock, industrial waste, or mining leftovers can reduce these emissions. New production methods, such as using electricity instead of fossil fuels for heating, could also help. Some companies are building pilot plants to test these methods, and they could be **market-ready within a few years**.

3. **Clinker Substitution and Alternative Binder Chemistries:** Cement's key ingredient, clinker, is responsible for most of its emissions. By mixing in other materials such as limestone, fly ash (from coal plants), or industrial byproducts, producers can use less clinker while maintaining quality. Some of these substitutions are already common, while newer blends could cut emissions even further. Simple substitutions are **fully ready**, while newer blends are **still being tested**.

4. **Carbon Capture, Utilization, and Sequestration:** Technologies exist to capture CO_2 emissions from cement plants and store them underground or use them in other products. Some large-scale projects are already underway in Europe, but widespread adoption is still limited due to high costs and the need for better infrastructure. These systems are **close to commercial scale but still need more investment and incentives**.

5. **Alternative Fuels:** Cement plants traditionally burn coal or petroleum coke for energy, but they could use alternatives such as biomass, industrial waste, or even hydrogen. Some plants already use waste fuels, though their impact is limited. Hydrogen could play a role in the future, but it requires major infrastructure changes. Waste fuels and biomass are **already in use**, while hydrogen is **still in early stages**.

6. **Decarbonized Electricity:** Instead of burning fossil fuels, some new technologies aim to use electricity from renewable sources to power cement production. While some electric heating methods have been tested, fully electric cement plants are still in the early stages of development. If successful, this approach could greatly cut emissions. Some parts of the process are **almost ready**, while others **need more research**.

7. **Biocement:** Researchers are developing novel production methods to make cement using bacteria or other biological processes. These approaches could eliminate emissions from traditional heating and chemical reactions. So far, this technology has only been used for small-scale projects, and it is unclear how well they will scale up. This technology is **in early research and development**.

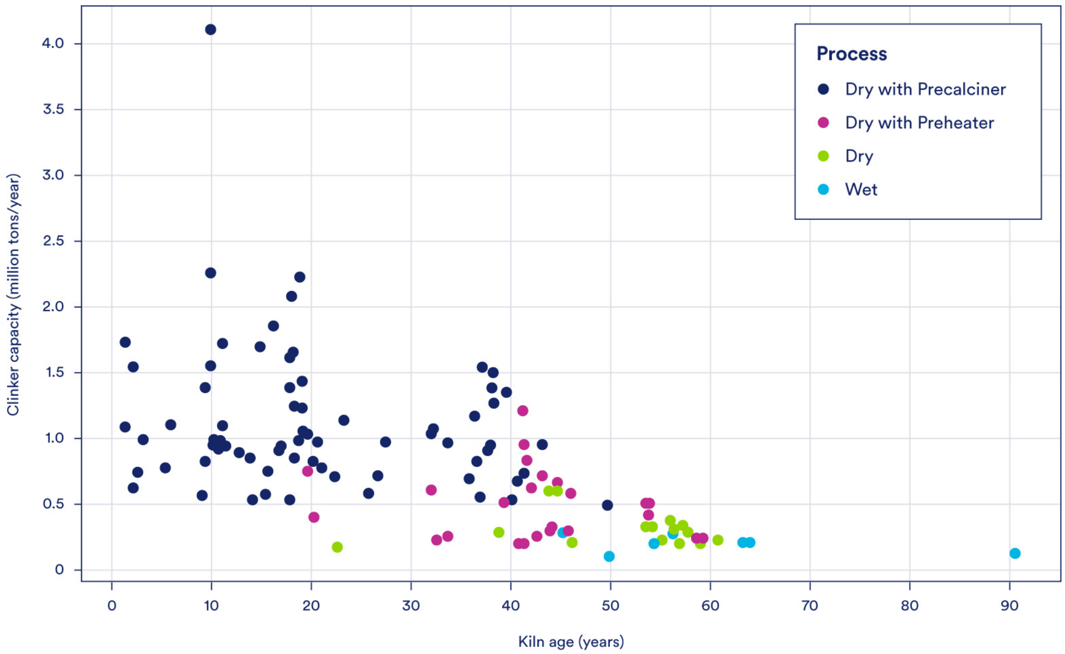
8. **Concrete Recarbonation and Circularity:** Once cement is used in buildings and roads, it naturally absorbs CO_2 from the air over time. Several companies are developing approaches to accelerate this process or inject captured CO_2 into fresh concrete, locking it in permanently. Some methods are **already in use** in construction, while others **still need further testing**.

9. **Concrete End-Use Design Optimization and Construction Site Efficiencies:** Improved construction techniques can reduce the overall demand for cement by using it more efficiently. Approaches include better design, using recycled materials, and extending the life of buildings. These approaches depend on architects, engineers, and construction firms adopting more efficient building techniques. Improved construction techniques could cut emissions by over 20 percent by 2050. Since these techniques rely on existing construction knowledge, they are **ready for adoption today**.

U.S. cement kiln capacity, age, and process type (**Figure ES-5**) provide insights into the industry's ability to adopt these technologies, with newer kilns better-suited for retrofit technologies such as CCUS to reduce their GHG emissions. Older cement kilns that use less efficient production processes are likely to be approaching the end of their useful lives and it is not economically viable to invest in capital-intensive pollution control retrofits for these kilns.

Instead, these older kilns should be replaced at end-of-life with kilns that use newer low- or zero-carbon production methods.

Figure ES-5. Summary of U.S. cement kiln capacity, age, and process in 2019



Source: Portland Cement Association. (2021). U.S. Portland Cement Industry: Plant Information Summary. Includes data through December 31, 2019.

Adoption Strategies

The U.S. cement sector's path to net-zero emissions by 2050 requires a coordinated policy portfolio integrating **financial support**, **market-based approaches**, and **regulatory interventions** to address technical, economic, and infrastructural barriers. Together, these strategies create a reinforcing cycle: public funding bridges innovation gaps, market incentives align producer and consumer interests, and regulations ensure compliance while mitigating carbon leakage. This triad of interventions—targeted across the technology lifecycle from R&D to commercialization—enables scalable decarbonization without sacrificing competitiveness. These solutions leverage cross-sector collaboration and infrastructure investments to lock in emissions reductions across regional production clusters.

Financial Support

Financial mechanisms such as research, development, and deployment funding and pilot project grants de-risk early-stage technologies (e.g., biocement, CCUS retrofits). **Figure ES-6** below provides further details and considerations for available financial support strategies.

Figure ES-6. Financial support strategies for U.S. cement industry emissions reductions

Targeted Support for Low Technology-Readiness Level Technologies: Direct funding for early-stage technologies like biocement, electrochemical calcination, and hydrogen-fueled kilns to advance them from lab-scale to pilot-ready stages.

- **Benefit:** Accelerates innovation in breakthrough technologies that could achieve near-zero emissions in cement production.
- **Design Considerations:** Grants prioritized for technologies with high emissions reduction potential (e.g., greater than 50 percent reduction).
- **Policy Gaps/Barriers:** High research and development costs, investor risk aversion, and lack of scalable prototypes.
- **Risks:** Potential failure to commercialize; competition from entrenched fossil-based processes.

Pilot and Demonstration Project Funding: Public-private partnerships to de-risk first-of-a-kind projects (e.g., CCUS retrofits, alternative feedstock plants).

- **Benefit:** De-risks commercialization of key decarbonization pathways, attracting private sector investment.
- **Design Considerations:** Mandate equity-sharing (e.g., 50 percent industry cost-matching) and emissions monitoring.
- **Policy Gaps/Barriers:** Long permitting timelines, supply chain gaps for novel materials.
- **Risks:** Cost overruns; underperformance of unproven technologies; failure to commercialize.

Policy and Regulatory Support for CCUS Deployment: Streamlined permitting for CO_2 pipelines and storage, expanded 45Q tax credits, and federal liability coverage for sequestration.

- **Benefit:** Enables large-scale carbon capture at existing plants, reducing emissions from both combustion and calcination processes.
- **Design Considerations:** Index 45Q credits to inflation; extend eligibility to smaller facilities (less than 50,000 MT CO_2 per year).
- **Policy Gaps/Barriers:** Public opposition to CO_2 pipelines; slow Class VI well approvals (24+ months).
- **Risks:** Leakage liability; reliance on fossil-fueled plants for cost-effective capture; limited opportunity for cost reduction compared to alternative feedstocks and production processes.

Market-Based Approaches

Market-based tools such as carbon advantage tariffs and advance procurement commitments stimulate demand for low-carbon products through price signals and guaranteed markets. **Figure ES-7** provides further details and considerations for available market-based strategies.

Figure ES-7. Market-based strategies for U.S. cement industry emissions reduction

Transparent and Verifiable Third-Party Labeling: Fostering a market for low-carbon cement through Environmental Product Declarations (EPDs) that are product-specific and based on verifiable data.

- **Benefit:** Builds market trust in low-carbon products, driving demand for low-carbon cement.
- **Design Considerations:** Align with ISO 14025 standards; regionalize low-carbon cement thresholds to account for feedstock variability.
- **Policy Gaps/Barriers:** Lack of standardized EPD methodologies; slow adoption by small producers.
- **Risks:** Expertise to produce a product-specific EPD requires workforce training and technical assistance; market fragmentation from inconsistent state and federal criteria.

Advance Market Commitments: Federal procurement guarantees to purchase low-carbon cement at premium prices.

- **Benefit:** De-risks market entry for low-carbon cement manufacturers by guaranteeing demand at scale.
- **Design Considerations:** Tie funding commitments to technology readiness (e.g., limit contracts for near-commercialized technologies to 10 years).
- **Policy Gaps/Barriers:** Budget uncertainty related to unknown production volumes; resistance from contractors reliant on traditional materials.
- **Risks:** Over-reliance on a few producers; price volatility if demand outpaces supply.

Clean Cement Buyers Association: Coalition of private and public purchasers (e.g., ConcreteZero) committing to procure cement with lower emissions intensity—(e.g., less than 0.6 tons CO_2e per ton cement by 2035.)

- **Benefit:** Creates a unified market signal, encouraging producers to invest in lower-carbon production methods.
- **Design Considerations:** Tiered membership fees based on procurement volume.
- **Policy Gaps/Barriers:** Administrative startup challenges due to lack of U.S. participation in existing coalitions; time and effort to build consensus among buyers.
- **Risks:** Limited supply of low-carbon cement could create mismatch with procurement commitments; setting emission standard at incorrect stringency would fail to effect change.

Government Procurement Models: Federal or state mandates requiring low-carbon cement in public projects.

- **Benefit:** Leverages government purchasing power to create stable, long-term demand for low-carbon cement, accelerating market transformation and investment in cleaner technologies.
- **Design Considerations:** Phase-in periods for proportion of cement that must be low carbon (e.g., 20 percent threshold by 2027, 40 percent by 2030).
- **Policy Gaps/Barriers:** Lack of regional low-carbon cement availability; could conflict with prescriptive ASTM standards.
- **Risks:** Project delays if supply chains lag; setting procurement "strike" price too low would fail to effect change, but too high could incur unnecessary costs.

Carbon Advantage Tariff with Reinvestment: Border adjustment fees on imports exceeding U.S. emissions intensity, with revenue directed to domestic R&D.

- **Benefit:** Levels the playing field for domestic producers, discourages carbon leakage, and channels new resources into U.S. innovation and decarbonization efforts.
- **Design Considerations:** Align tariff rates with EU policy; exempt allies with comparable climate policies.
- **Policy Gaps/Barriers:** U.S. cement is more emissions-intensive than imported cement from top trade partners.
- **Costs:** $1.2 billion for monitoring/enforcement infrastructure.

Regulatory Approaches

Regulatory measures, including binding low-carbon standards and performance-based specifications, enforce accountability and accelerate industry-wide adoption of cleaner practices. **Figure ES-8** provides further details and considerations for available regulatory strategies.

Figure ES-8. Regulatory strategies for U.S. cement industry emissions reduction

Low-Carbon Standards: Binding emissions thresholds for cement used in federally funded projects.

- **Benefit:** Drives sector-wide emissions reductions by setting clear, enforceable limits, which provide strong market signals for investment in low-carbon technologies.
- **Design Considerations:** Allow regional emissions intensity variation; clinker ratio and material composition flexibility; integration with procurement and EPD requirements; phased stringency and ratcheting.
- **Policy Gaps/Barriers:** Opposition from coal-dependent plants in Midwest and South.
- **Risks:** Plant closures in regions lacking CCUS infrastructure; cost pass-through to consumers.

Construction Regulations: Updates to building codes (e.g., International Building Code) to favor low-carbon concrete in structural applications.

- **Benefit:** Encourages widespread adoption of low-carbon materials in the built environment, reducing lifecycle emissions from new construction and major renovations.
- **Design Considerations:** Exempt small-scale residential projects; address fragmented state/local code adoption with model codes and technical assistance; support contractor training and risk reduction; phase in requirements to allow industry adaptation.
- **Policy Gaps/Barriers:** Fragmented local code adoption; contractor lack of familiarity with new materials.
- **Risks:** Slower project approvals; liability concerns over novel materials.

Performance-Based Material Standards: Replace prescriptive standards with outcome-focused criteria (e.g., compressive strength, durability) that can accommodate alternative feedstocks and production processes.

- **Benefit:** Unlocks innovation by allowing low-carbon cement blends and technologies to compete based on performance, not composition, accelerating market entry for advanced products.
- **Design Considerations:** Robust testing, validation, and workforce training; address risk aversion with pilot projects and data collection; provide sufficient lead time for industry adaptation.
- **Policy Gaps/Barriers:** Risk aversion among state transportation departments; lack of performance data for LC3 and blended cements.
- **Risks:** Interim supply shortages during transition period.

Federal Air Regulations: Expand existing New Source Pollution Standards (NSPS) for new cement plants under Clean Air Act Section 111(b) to include CO_2 and a 111(d) standard for CO_2 emissions from existing cement plants.

- **Benefit:** Provides consistent, sector-wide emission standards; can serve as a policy backstop or a driver of more ambitious emissions reductions; can reduce harmful air co-pollutants and associated health impacts.
- **Design Considerations:** Differentiate standards for new vs. retrofitted plants; regulations can tighten over time as technological options for decarbonization improve.
- **Policy Gaps/Barriers:** Legal challenges from industry groups; increased operating costs for older kilns.
- **Risks:** Premature retirement of plants unable to comply; job losses in fenceline communities.

Capital and Public Spending Requirements

The U.S. cement sector will need substantial capital and policy investments to decarbonize by 2050. Between $69 billion and $120 billion in cumulative capital expenditures are needed through 2050, primarily for new, alternative feedstock production facilities (e.g., electrochemical calcination) and for CCUS retrofits at existing plants. These investments aim to address the sector's reliance on coal- or coke-fueled kilns and high process emissions from limestone calcination, with CCUS retrofits prioritized for newer, more efficient plants.

A comprehensive suite of policies to support cement decarbonization could require $11.4 billion (2024$ with a zero percent discount rate) or $10.1 billion with a 2.15 percent federal discount rate, as shown in **Table ES-2.** These public funds must de-risk private sector investments, particularly for first-of-a-kind projects such as hydrogen-fueled kilns or LC3 (limestone calcined clay) cement plants, which face high upfront costs and uncertain returns.

Table ES-2. Public spending on cement decarbonization policies, 2026–2035 (2024$, million)

Approach	Total cost (0% discount rate)	Total cost (2.15% discount rate)
Research and Development	$76	$69
Pilot Projects	$3,885	$3,600
Increased tax credit (e.g., 45Q) for carbon capture	$2,729	$2,345
Support CO_2 infrastructure buildout through CIFIA	$1,480	$1,305
Clean Buyers Association	$8	$7
Government Procurement	$2,832	$2,464
Advance Market Commitment	$45	$39
Third Party Labeling	$20	$18
Low-Carbon Standard	$42	$37
Construction Regulation	$25	$22
Performance-Based Standard	$216	$195
Federal Air Regulations	$41	$36
Grand Total	**$11,399**	**$10,136**

Source: Discount rate of 2.15 percent based on an inflation-indexed 10-year treasury constant maturity rate—Board of Governors of the Federal Reserve System. (Accessed April 14, 2025). "H.15 Selected Interest Rates," available at: https://www.federalreserve.gov/releases/h15/.

Conclusions and Recommendations for Policymakers

Decarbonizing the U.S. cement sector by 2050 demands synchronized financial, market, and regulatory interventions. Near-term priorities include scaling CCUS at coal-dependent plants, accelerating demonstrations of alternative feedstocks (e.g., electrochemical calcination), and aligning federal and state procurement policies with verified EPDs. The included **Policy Matrix** ranks interventions by feasibility, cost, and emissions impact, and it identifies CCUS retrofits and alternative feedstock scaling as high-priority pathways requiring urgent public investment. Success hinges on bridging critical infrastructure gaps (e.g., CO_2 pipelines), workforce training for CCUS operations, and resolving permitting bottlenecks for novel technologies. Without rapid action, investments spurred by federal infrastructure programs such as the *Bipartisan Infrastructure Law* and *CHIPS Act* risk locking in high-emission production for decades, thereby undermining climate goals.

To achieve net-zero emissions by 2050, policymakers should prioritize the following actions, informed by the report's analysis of capital needs, stakeholder support, and policy risks:

1. Financial Intervention Recommendations

- **Expand Research, Development, and Deployment Funding**: Allocate **$4 billion by 2035** for research and development coupled with pilot and demonstration projects. Target lower-readiness technologies, such as emerging alternative production and feedstock processes. Prioritize grants with industry cost-sharing requirements to de-risk private investment.

- **Strengthen 45Q Tax Credits**: Index credits to inflation and extend eligibility to smaller facilities (less than 50,000 tons CO_2 per year) to incentivize CCUS adoption at regional plants.

- **Accelerate CCUS Infrastructure**: Direct an additional **$2 billion via an extension of the CIFIA program** to build shared CO_2 transport/storage networks near cement clusters in the Midwest and South, where coal-dependent plants are concentrated.

2. Market-Based Strategy Recommendations

- **Advance Market Commitments**: Leverage the U.S. General Service Administration's (GSA) **$2.15 billion low-carbon materials fund** to guarantee 10-year procurement contracts for cement meeting less than 0.6 tons CO_2e per ton cement thresholds by 2035.

- **Clean Cement Buyers Association**: Launch a federal-state-private coalition to pool procurement demand, offering tiered membership incentives for contractors committing to low-carbon materials.

3. Regulatory Lever Recommendations

- **Federal Low-Carbon Standards**: Enforce binding emissions thresholds (e.g., less than or equal to 0.75 tons CO_2e per ton cement by 2030) for federally funded projects, with grandfathering provisions for plants transitioning to CCUS.

- **Performance-Based Specifications**: Replace the prescriptive ASTM C-150 Standard with outcome-focused criteria (e.g., compressive strength) by 2028, validated through Federal Highway Administration's Mobile Concrete Technology Center.

- **Fast-Track Permitting**: Pre-approve CO_2 pipeline corridors in priority states such as Texas, Indiana, and California and streamline Class VI well approvals to less than 18 months to avoid project delays.

4. Workforce and Equity Measure Recommendations

- **Fund Regional Training Programs**: Allocate funds forpartnerships between unions, community colleges, and manufacturers to upskill workers in CCUS operation and low-carbon cement production.

- **Prioritize Local Community Benefits**: Mandate community benefit agreements for CCUS projects in disadvantaged areas, ensuring local hiring and air quality monitoring.

Recommended Implementation Roadmap

Figure ES-9 below shows a potential timeline for when the above actions should be complete in order to achieve net-zero emissions for the U.S. cement industry by 2050.

Figure ES-9. Recommended deadlines for a decarbonized U.S. cement industry