



Pathway to Commercial Liftoff

Cement production accounts for ~1-2% of U.S. and ~7-8% of worldwide emissions. Decarbonization is technically challenging as ~51% of total cement production emissions are intrinsic to the chemistry of the process and ~34% are related to the high industrial heat at which it takes place. Completely abating these emissions will require commercializing and scaling solutions currently characterized by relatively low technological and commercial readiness. The U.S. can leverage its strengths in innovation to take a leading role, building a competitive low-carbon industry domestically and exporting transformative technologies and business models around the world.

The U.S. cement industry has an immediate opportunity to abate ~30% of emissions by the early 2030s using deployment-ready technologies that are economically competitive, particularly clinker substitution. Aggressively scaling these measures could drive more than \$1 billion per year in potential savings for producers. Despite this, industry has been slow to move, largely due to a long adoption cycle for new materials and uncertain demand from key customers.

Government is uniquely well-positioned to accelerate progress. State and federal spending on infrastructure and public buildings drives ~50% of domestic demand for cement. Effective coordination of public procurement can create the demand signal needed to pull adoption forward. Government can also speed adoption by convening stakeholders to expedite validation of low-carbon materials, build confidence, and address coordination bottlenecks along the cement value chain.

Beyond 2030, deep decarbonization will require commercializing and scaling technologies like carbon capture, utilization, and storage (CCUS) and alternative production methods using alternative feedstocks. DOE investments have helped unlock first-of-a-kind deployments for many of these technologies, but scaling new approaches across the entire industrial base will be capital-intensive and require a strong demand signal, particularly from public procurement, to unlock the investment needed.

Milestones on the Pathway to Net Zero

1. **Clinker substitution:** Average clinker-to-cement ratio reduced to 0.65 by early 2030s
2. **CCUS:** 3-5 commercial-scale demonstrations by 2030
3. **Alternative production methods:** 3-5 commercial-scale demonstrations by 2030

Market Status

Metric	Value	2030 Target
Domestic Clinker-to-Cement Ratio Source: IEA 2022	.89	.65 ¹
Number of Commercial-scale CCUS Demonstrations at Domestic Cement Facilities Source: OCED 2024	0 ²	3-5
Number of Domestic Commercial-scale Alternative Production Method Demonstrations Source: OCED 2024	0 ²	3-5

1. Target from 'aggressive deployment' modeling scenario required to reach ~30% emissions reduction in near term. Industry organizations have set 2030 targets closer to .75 2. Two qualifying projects have been selected for award negotiations in OCED's Industrial Demonstrations Program, though are not yet constructed

Possible Near-term Actions³

1. Convene producers, standards organizations, customers, and technical experts to promote testing and validation of materials and facilitate the development and adoption of new standards
2. Convene major buyers and suppliers by region to build coordinated regional procurement models and provide investable offtake for low-carbon cements
3. Convene major industry players and labor organizations to develop approaches for focused, aggressive scaling of clinker substitution and material efficiency
4. Develop integrated, public perspective on domestic availability and location of raw materials for clinker substitution
5. Develop alternative government procurement models that can provide low-carbon cement projects with firm, long-term offtake agreements needed to attract investment

3. Actions 1-4 currently undertaken by interagency working group led by Office of Science & Technology Policy and Council on Environmental Quality