Concrete solutions: how carbon capture is driving cement decarbonization

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Key messages

- **The latest update to the Green Cement Technology Tracker** is now published on our website. The tracker covers CCUS[1] projects and calcined clay kiln projects in the cement industry and has information on over 175 projects globally.

- **This report focuses on carbon capture and storage (CCS) and carbon capture, utilization and storage (CCUS) projects. The first commercial CCS facility for cement is now operational.** Heidelberg Materials' Brevik plant in Norway began capturing approximately 0.4 megatonnes of carbon dioxide per year (Mt CO_2/year) in June 2025 – the world's largest installation of its kind.

- **The pipeline is growing but impact remains limited.** Several other projects are expected to come online by 2026–27, with over 30 plants projected by 2035. Even so, captured CO_2 volumes would represent less than 2% of total sector emissions.

- **Government capital co-investment is the decisive project enabler.** For the Brevik capture facility in Norway, the state funding model amounted to more than 80% support for investment costs and 75–100% support for eligible operating costs for 10 years. Conversely, the Heidelberg Slite project in Sweden was put on hold when it failed to secure the requested government funding and the Vicat Lebec project in California stalled when federal funding was withdrawn.

- **CO_2 transport and storage infrastructure access is a key constraint.** Every advancing project connects to shared networks such as Northern Lights in the North Sea, Porthos in the North Sea, or the Ravenna Hub in the Adriatic Sea. Without access to both storage and transportation of CO_2, projects cannot progress regardless of other conditions.

1 Carbon capture, utilization, and storage (CCUS) is treated as an umbrella term throughout this document and covers carbon capture and storage (CCS) and carbon capture and utilization (CCU) in addition to CCUS itself. Unless one of these subgroups is mentioned explicitly, the whole category is being referred to in the document.

Why is carbon capture critical to cement decarbonization?

Concrete is the world's most consumed material after water at about 30 billion tonnes annually. Global production of cement, the primary binding agent for concrete, reached 4 billion tonnes in 2024. Cement is also responsible for roughly 8% of global CO_2 (carbon dioxide) emissions, making the decarbonization of cement production a critical component of any credible pathway to net zero.

Unlike the energy or transport sectors, fuel-switching alone will be insufficient to achieve meaningful emissions reductions in cement. About 60% of the sector's CO_2 output arises not from burning fuel, but from the calcination of limestone – a chemical reaction inherent to the production of clinker, the key active ingredient in cement. Calcination requires heating limestone (calcium carbonate) to approximately 1450°C in rotary kilns, during which limestone decomposes into lime and CO_2. The remaining 40% of concrete's emissions is attributable to the combustion of fuel required to sustain these extreme temperatures.

As a result, every major decarbonization roadmap identifies carbon capture and storage as the single largest abatement lever available to the sector. The Global Cement and Concrete Association, for instance, estimates that carbon capture alone can account for 36% of cumulative emissions reductions needed to reach net zero for the sector.

This report draws on data from our Green Cement Technology Tracker, which monitors CCUS and calcined clay kiln projects globally. Both CCUS and calcined clay kiln projects represent important but distinct decarbonization pathways: calcined clay kilns reduce the clinker content of cement using low-emission, cost-effective calcined clay, though with more limited overall mitigation potential than CCUS. The insights presented here reflect our 2026 Q2 data update and focus on CCUS projects. A companion report covering calcined clay kiln projects will follow later this year.

Data for both types of projects are updated on the tracker, available for download on our website.

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State of progress in 2025

Asia overtakes Europe in project announcements as global momentum moderates

After nearly a decade of steadily rising annual project announcements, 2025 marked a notable deceleration. Only 12 new projects were announced globally, which is a significant step down from recent years. Asia led in new project announcements in 2025 (Figure 1).

Figure 1. Total carbon capture project announcements in cement plants by year and continent

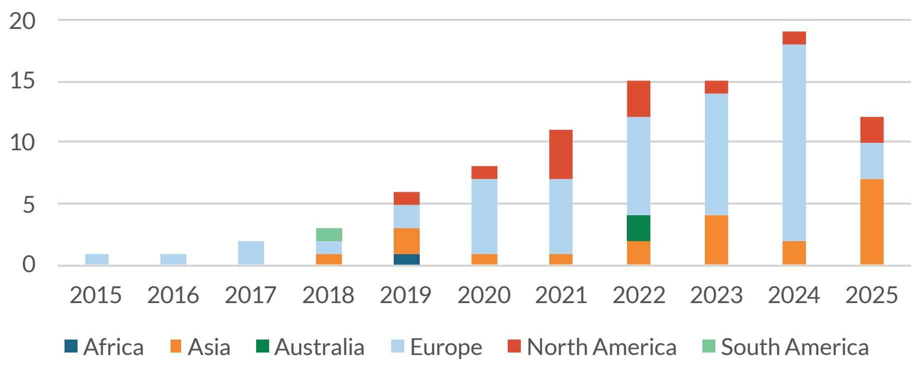
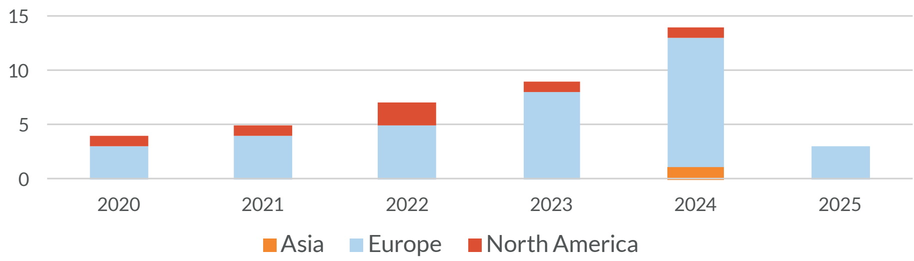


Figure 2. Commercial-scale carbon capture project announcements in cement plants by year and continent



However, only three of these 12 projects were commercial-scale announcements – the definition of which varies by company but typically amounts to more than 0.1 Mt annual CO_2 capture – compared to a peak of 15 in 2024 (Figure 2). The ambition slowdown is most pronounced in Europe, which has historically been the clear frontrunner in cement decarbonization. For the first time, Asia surpassed Europe in total new project announcements, but the three new commercial-scale announcements were all in Europe.

This slowdown should nonetheless not be overinterpreted. Carbon capture in cement production is still in the early phases of commercialization, and annual announcement counts alone do not accurately signal the underlying progress. What matters most at this stage is that first-of-a-kind commercial projects are brought successfully to operation. Each one that demonstrates technical and commercial viability reduces the risk profile of subsequent investments and will likely catalyse further commitments across the industry.

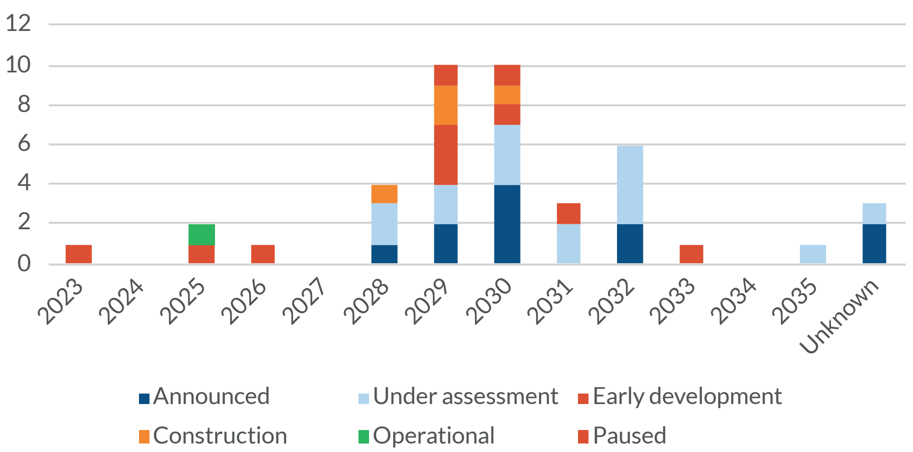
The first commercial-scale facility opens – and more are on the way

On 18 June 2025, Heidelberg Materials' Brevik plant in Norway became the world's first commercial-scale carbon capture facility at a cement plant (Figure 3). Operating at 50% capture rate, the facility sequesters approximately 0.4 Mt CO_2 per year. While modest in absolute terms, it is the largest installation of its kind anywhere in the world, and a landmark proof of concept for the industry. The project was made possible in large part by the Norwegian government's Longship program, which provided the financial backing and the critical CO_2 transport and storage infrastructure operated by the Northern Lights joint venture.

Figure 3. Brevik Cement Works, September 2025. Photo: Heidelberg Materials

Brevik will not be an isolated achievement for long. Several further commercial-scale projects are expected to reach operation in the coming years, contingent on current project timelines being met (Figure 4).

Figure 4: Planned year of commissioning of commercial-scale carbon capture projects at cement plants by year and current project status



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Here, "announced" refers to a public announcement of a project where there is limited information on project progress, "under assessment" refers to projects that are confirmed to be undergoing Pre-Front-End Engineering and Design (Pre-FEED), FEED, or similar assessment, and "early development" refers to projects with completed feasibility assessments and that are in advanced stages of planning without ongoing construction.

Based on the latest project updates from over two years ago, Heidelberg plans to commission its Edmonton CCS Project in late 2026. This plant is designed to capture approximately 1 Mt CO_2 per year from a plant and produce 1.4 Mt/year cement capacity. This project will have a carbon capture capacity over twice that of the Brevik plant.

We also anticipate three more smaller-scale projects to go online in 2026, namely:

- Ash Grove Carbon 1 (Canada) – Demonstration project at a plant with a cement production capacity of 2.2 Mt/yr
- Heidelberg Ennigerloh Leilac-2 (Germany) – Demonstration project to capture 0.1 Mt CO_2 per year at a plant producing 1 Mt of cement annually
- Rohrdorfer Zement Gmunden CryoCEM (Austria) – Demonstration project to capture 0.03 Mt CO_2 per year at a plant producing 0.05 Mt of cement annually

Cumulative carbon capture capacity and cement production capacity will increase multifold over the next decade

Looking further ahead, the number of commercial-scale CCUS plants in operation is expected to grow from one in 2025 to 38 by 2035. Notably, many of these future projects are planned at considerably larger capture rates than Brevik, meaning the sector should expect a succession of headline-grabbing milestones as increasingly ambitious facilities come online. The cumulative cement manufacturing capacity linked to operational CCS plants is projected to reach approximately 58 Mt per year by 2035, a nearly 60-fold increase from today, yet less than 2% of total global cement production.

Figure 5. Cumulative carbon capture capacity of active commercial-scale projects by planned commissioning year and current project status

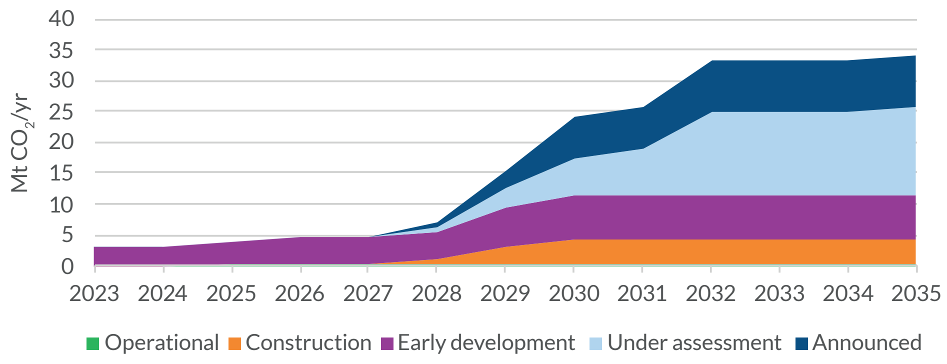
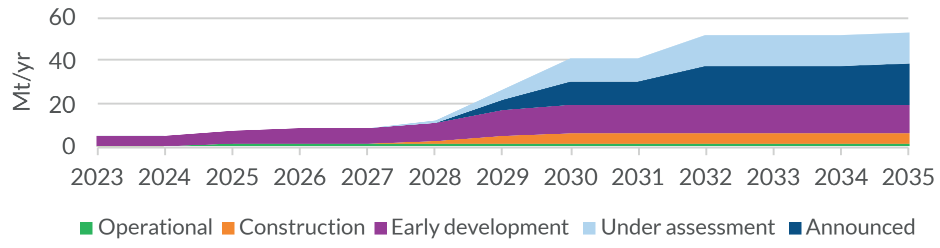


Figure 6. Cumulative cement production capacity at carbon capture-linked commercial-scale plants by planned commissioning year and current status



The pipeline of committed projects remains heavily concentrated in Europe, which is consistent with the global distribution of investment, accounting for USD 10.4 billion in investments.[2] Europe's advantage reflects its uniquely supportive policy architecture: the EU Emissions Trading System (EU ETS), the EU Innovation Fund, financing arrangements such as carbon contracts for difference in Germany and the Netherlands, and the Northern Lights infrastructure backbone. Outside Europe, Canada represents the most active non-European market.

The United States, which had been a significant prospective market, has receded sharply following the cancellation of approximately USD 3.7 billion in Department of Energy Industrial Demonstrations Program funding in May 2025.

Our data shows public funding is very common for commercial-scale carbon capture projects in the cement industry. Of the 33 commercial-scale projects in our tracker where some information on investment was publicly available, we estimate that nearly 25, or just over three-quarters, of all projects have some significant government funding either confirmed or proposed.

2 The aggregated total cited in this report reflect broader CCUS ecosystem costs including CO_2 pipeline and storage infrastructure rather than cement plant-level expenditure alone. Readers should treat the larger aggregate investment figures as indicative of the wider system cost rather than plant-specific capital deployment. For more detail, information is provided in the dataset online with hyperlinks to sources.

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Key success factors for a CCUS project

Our analysis indicates a mix of factors have led to either the successful development of these projects or, when a factor is absent, put the project at risk.

Success factors:

1. **Government-funded de-risking of capital expenditure** has been critical for most progressing projects. Norway's Longship framework was critical for Heidelberg Materials' Brevik plant. Upon failure to secure public funding or withdrawal of funding, other projects have been paused, such as the Heidelberg Slite plant in Sweden or the Vicat Lebec plant in the US. It is important to note still that these projects are incredibly expensive, even for industrialized economies which can afford to de-risk these projects. Deployment of this technology in Global South economies will require significant North-South collaboration and green financing opportunities.

2. **Financial instruments to supplement revenue** such as carbon contracts for difference and the EU ETS benefit any industrial decarbonization project regardless of technology category or industry. The downward trend in carbon prices over the past few months has been a discouraging development, and long-term decline or stagnation in carbon prices will inevitably affect the business cases for many decarbonization projects.

3. **Proximity to CO_2 transport and storage infrastructure** is a critical success factor. Often these individual projects are tied to larger and multi-stakeholder carbon transportation and storage networks such as Northern Lights, Porthos, Ravenna Hub or CCS Baltic Coalition. When this partnership is at risk, projects become less feasible, unless local utilization is implemented, such as in carbon capture and utilization projects. Mike Edelmann, Rohrdorfer Zement CEO, captured the standalone challenge directly: "The lack of planning security regarding CO_2 transport and storage, uncompetitive electricity prices and an uncertain mining landscape are holding us back." Some regions are naturally at an advantage due to geological features such as depleted oil and gas fields or saline aquifers, where liquid CO_2 can be pumped as a form of carbon storage.

4. **Green public procurement** is a key demand-side driver of green cement adoption as governments are often major customers of the construction materials industry. Governments such as Canada and Germany already have green public procurement policies in place. The United Nations Industrial Development Organization (UNIDO) estimates that if countries adopt the UNIDO Industrial Deep Decarbonization Initiative's

(IDDI) Green Public Procurement Pledge Level 3 – a commitment to mandate low-emission cement in public construction projects applying highest ambition possible in national circumstances – they can reduce emissions of public construction projects by upwards of 80%.

To showcase the importance of these success factors, we shall look at some projects, primarily by Heidelberg as early movers in this space, where these factors were present or absent:

- Heidelberg's Brevik CCS facility was supported by the Norwegian government through its Longship CCS project which provides an open-source, cross-border infrastructure to ship liquid CO_2 from industrial sites to an offshore storage location subsea in the North Sea.

  Here, Norway entered a dedicated state-aid agreement with Heidelberg Materials covering both investment and operating costs for the Brevik CCS project. For the capture facility, the state covered 100% of investment costs up to an agreed threshold and 75% of costs above that threshold up to a maximum limit. For operating costs, the state covered a similarly layered share of eligible costs for 10 years, with support level between 75 and 100% up to specified maximum limits. The agreement also provided additional compensation, at the EU ETS allowance price, for captured CO_2 not covered by the EU ETS, including biogenic CO_2.

  Taken together, this is a risk-sharing package that has reduced Heidelberg's exposure to high upfront costs, early operating losses, and the absence of ETS incentives for part of the captured CO_2.

  The Longship project itself has a total 10-year projected cost of NOK 34 billion (USD 3.58 billion) and, based on media reports, has supported the Brevik project directly with USD 320 million. In addition to this significant financial derisking, the project's success was also fuelled by its proximity to the Longship project and its access to carbon storage in the North Sea.

- Across the Atlantic, Heidelberg is also advancing its Edmonton CCS facility in Canada, planned to go online in late 2026, where significant funding of CAD 275 million (USD 199 million) was provided by the government's Innovation, Science and Economic Development Canada department. Heidelberg has also praised the Alberta Carbon Capture Incentive Program that offers a 12% grant on new eligible CCUS projects. The project's proximity to other heavy industrial polluters and access to the Edmonton region's excellent carbon capture, transportation and storage facilities are key success factors for the cement manufacturer's decarbonization effort.

  Finally, Canada has established green public procurement policies, mandating that government agencies use concrete with 10% lower emissions than regional industrial average baseline for any large-scale

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  public projects upwards of CAD 5 million (USD 3.6 million). If these regulations are broadened or made more stringent, as is recommended by the IDDI green public procurement pledges, then the business case for low-emission carbon is further strengthened and can favor Heidelberg and other players in Canada who manufacture low-emission cement.

- Heidelberg's Slite CCS facility received initial funding for a feasibility study, but it is now paused after the Swedish Energy Agency denied an application for SEK 7.9 billion (USD 850 million) funding. Heidelberg's request exceeded the funding made available in the Swedish Energy Agency's Industrial Leap program. In the US, Heidelberg's Mitchell K4 CCS (USD 500 million) and the Vicat Lebec CCS (up to USD 500 million) facilities were put on hold when the Department of Energy withdrew the funding for around 24 industrial decarbonization projects.

  These setbacks suggest that, in many cases, the business case for carbon capture in the cement industry rests on the availability of public funding.

- Holcim's Obourg CCS facility (GO4ZERO) in Belgium was a project with a total investment of over EUR 500 million (USD 585 million), of which EUR 320 million (USD 374 million) was provided by the EU Innovation Fund with planned sequestration in the North Sea. However, early in February 2026, the plant was put on hold due to concerns about the uncertainty of Belgium's CO_2 transport and storage infrastructure.

Conclusion

Despite positive signals in 2025, the fact remains that current ambitions, even taken with highest optimism, would at best capture less than 2% of the total emissions from the cement and concrete industry. In order for the sector to rapidly decarbonize and achieve net zero, a combination of smart policies to de-risk carbon capture projects, well-planned and strategically located carbon transport and storage infrastructure, and demand-side factors such as green public procurement that can drive adoption and aid in market creation will be vital to decarbonize the cement and concrete industry.

Acknowledgements

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