CEMENT WITH CCS: THE BASICS

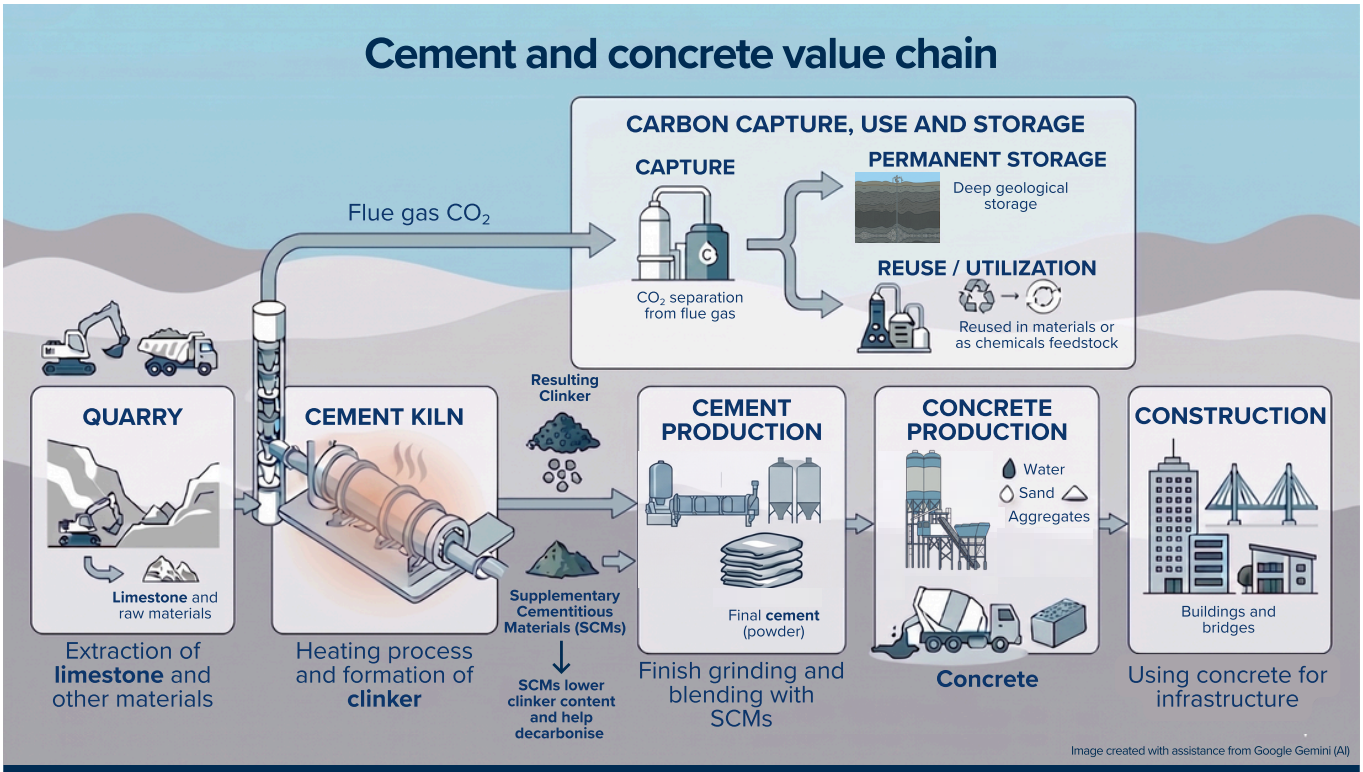
GLOBAL CCS INSTITUTE

Industry Sector Overview

Cement and concrete are essential to global development and infrastructure. Due to the widespread use of cement products, the cement sector is responsible for around 7-8% of global CO_2 emissions, making it a critical industry to decarbonise. Carbon capture and storage (CCS) is indispensable, not optional, for decarbonising the cement sector.

Why is CCS important for decarbonising cement?

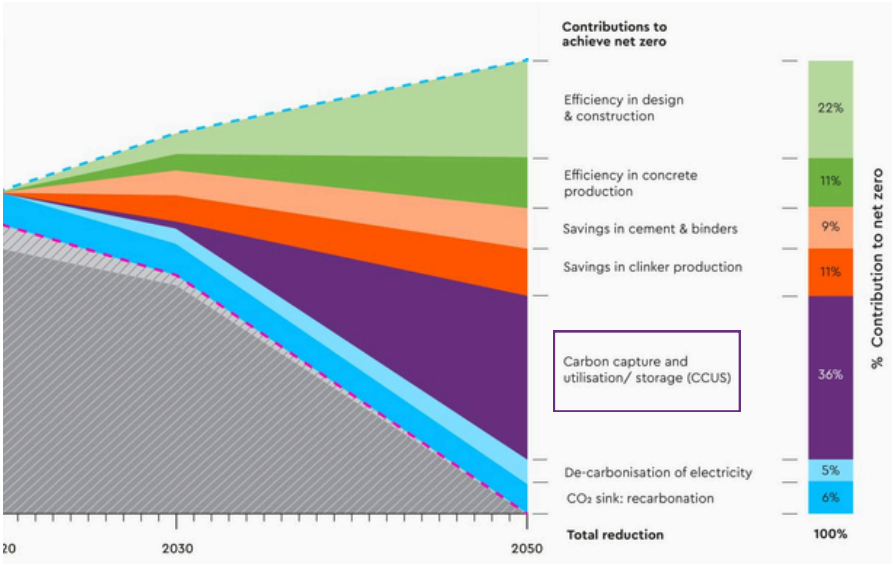
Unlike many other industrial sectors, cement emissions are not driven solely by energy use. Roughly **two-thirds of cement CO_2 emissions come from process chemistry**, when limestone (calcium carbonate) is heated to produce clinker, releasing CO_2 as an inherent part of the reaction. This means that even if a kiln maximises its use of renewable energy, a large share of its emissions remains unavoidable unless CO_2 is captured and permanently stored in geologic formations. In some cases, at a smaller scale, captured CO_2 can be reintegrated into the value chain in concrete and construction materials.



Limestone and other raw materials are extracted from a quarry and heated in a cement kiln to form clinker, a process responsible for the majority of cement's CO_2 emissions. CO_2 generated during clinker production can be captured for permanent storage or reuse. Replacing clinker with SCMs, such as pulverised fly ash, ground granulated blast furnace slag or calcined clay, is also a key decarbonisation lever because it reduces emissions from fuel combustion and raw materials heating, thereby lowering the total CO_2 that must be captured. Lastly, cement is mixed with water, sand, and aggregates to form concrete used in construction.

The role of CCS in cement decarbonisation

Global cement demand is expected to grow, particularly in emerging economies. Business as usual could result in cement-related CO_2 emissions reaching 3.8 gigatonnes (Gt) by 2050. The Global Cement and Concrete Association (GCCA) Net Zero Roadmap identifies CCS as a critical lever for addressing emissions, on top of other mitigation measures such as energy efficiency, alternative fuels, clinker substitution, and low-carbon electricity. According to the roadmap, around **1.4 Gt of CO_2 capture will be required by 2050** necessitating a rapid scale-up of projects in this sector.[1]



Credit: Global Cement and Concrete Association (GCCA). (2021), *The GCCA 2050 Cement and Concrete Industry Roadmap for Net Zero Concrete.*

Has CCS ever been done in the cement sector?

Y**es.** CCS projects are operating in the cement sector, and dozens more have been announced globally. The projects listed below illustrate the feasibility of CCS and growing commercial deployment in the cement industry.

- **Brevik CCS, Heidelberg Materials (Norway):** Capture volume: ~400,000 tonnes per annum (tpa)
- **Qingzhou Oxy-Fuel Combustion Carbon Capture Project, China United Cement (China):** Capture volume: ~200,000 tpa
- **BBMG Beijing Cement Environmental Technology Co., Ltd. (China):** Capture volume: ~100,000 tpa
- **Padeswood CCS, Heidelberg Materials (UK):** Planned capture volume: ~800,000 tpa

Beyond capture, what enables CCS at scale?

Deploying CCS at scale in cement requires a full value-chain approach, including:

- CO_2 transport and storage infrastructure, often developed through shared industrial hubs
- Clear regulatory frameworks covering permitting, liability, and long-term stewardship of CO_2 storage
- Bankable business models, supported by carbon pricing, public funding, and demand signals supported by green product standards, certificates, and labelling
- Robust monitoring, reporting, and verification and traceability tools

What can be done now?

Governments, investors, and industry leaders can act now to scale CCS in the cement sector by funding projects, building CO_2 transport and storage infrastructure, and creating clear policies that make low-carbon cement competitive. Feasibility studies, geologic assessments, and regional CO_2 infrastructure can lay the groundwork, while policies, like public procurement, can create reliable demand for low-carbon cement, enabling investment in all mitigation measures, including CCS.

[1] Source: Global Cement and Concrete Association (GCCA). (2021), *The GCCA 2050 Cement and Concrete Industry Roadmap for Net Zero Concrete.*