Carbon capture, usage and storage (CCUS)

Key facts

1 **CCUS is a critical technology for net zero UK concrete and cement.**

2 **CCUS with waste biofuels can help concrete and cement go beyond net zero.**

3 **CCUS must be made affordable for cement manufacturing.**

Clinker is the principal ingredient of cement. Clinker production is the main source of carbon dioxide (CO_2) emissions.

These arise not only from the combustion of fuels in the kiln but also from 'process emissions' which are a by-product of clinker manufacture.

During calcination CO_2 separates from the calcium carbonate (limestone) when it is heated to ~900°C. Around two thirds of the emissions from a cement plant are 'process emissions' from this calcination reaction.

Capturing process CO_2 is one of the few techniques to reduce process emissions. Captured CO_2 can be stored or utilised, for example, to make fuels or to cure (harden) concrete which permanently removes CO_2.

When CCUS is combined with waste biomass fuels, and deployed with other decarbonisation levers, concrete and cement could go beyond net zero but this relies on cost-effective deployment where the adverse cost impact on UK competitiveness is avoided.

CCUS for cement manufacture

A wide range of capture technologies e.g. post-combustion capture, oxyfuel combustion capture, indirect heating capture and calcium looping for use in cement manufacture are at various stages of research, development and demonstration but are not yet ready for deployment at scale.

Many of the capture technologies would require fundamental changes to cement manufacturing plant and would be costly to both build and operate.

Important technical considerations for the cement plants include:

- access to CO_2 transport, storage or utilisation infrastructure
- operational power demand increases
- physical space constraints on-site
- impacts on the production process

Important financial considerations for cement plants include:

- lack of full chain business models for CCUS
- absence of Government fiscal stimulus for addressing the significant capital and operational cost of CCUS
- competitive pressure from imported cement due to higher carbon, less regulated suppliers or sources without the high costs of implementing CCUS.

Contribution of CCUS to net zero

CCUS, when combined with biomass fuels, provides the greatest reduction potential of all of the technology levers to achieve net zero UK concrete and cement. Around 4.6 $mtCO_2$ could be captured annually by 2050 to deliver net zero and go beyond.

Progressing a full-scale cement CCUS demonstration in the UK has to be a strategic priority. However, there are significant risks with being a first mover. **Support from Government will be required to ensure competitiveness is maintained during the transition to net zero carbon cement production.**

The Government assistance should cover both capital and operational cost increases and needs to extend to providing CO_2 transport and storage infrastructure to provide confidence for CCUS investment.

CCUS barriers and accelerators

The concrete and cement industry as one sector alone cannot deliver net zero and we will only be able to go beyond net zero with concerted support from Government and other stakeholders to facilitate technology deployment.

1. **Supportive policy framework:** To provide the right structure for inward investment.
2. **Eliminate the risk of carbon leakage:** To ensure that the preferred option is local decarbonisation and not product imports.
3. **Choose local:** A market for 'carbon captured' products produced in the UK, through standards or Government procurement, will help drive investment.
4. **Accessible infrastructure:** Access to CO_2 transport and storage (T&S) facilities for all cement plants including remote or isolated plants.
5. **Cost and risk mitigation:** CCUS will incur large capital, operational and T&S costs. Associated with these costs are the risks of installing unproven technology, commercial risk associated with production failure and risk of leakage from T&S. Financial support is required for capital and long term ongoing operational costs in order to maintain competitiveness of UK production.
6. **Technological maturity:** CCUS is immature and unproven in cement production. A commercial scale demonstration would provide vital technical and financial information. Research undertaken to date has indicated that oxyfuel technologies are lower cost, but post combustion technologies are more advanced. There may be a trade-off to consider between speed of deployment and cost.

Key Government enablers

1. **Introduce a 'Beyond Net Zero Cement Support Programme' to finance a commercial scale UK cement industry waste biomass-fuelled carbon capture demonstrator.**
2. **A robust financial support model for the capital and operational costs of carbon capture no later than 2021, so that the technology can be developed, deployed and become an investable proposition in the 2030s.**
3. **Government support for the creation of a public/private UK CO_2 transport and storage (T&S) network available to all cement producers and for Government to underwrite the main costs and risk of T&S.**
4. **Government to provide support for the development of CO_2 utilisation processes and markets for products consuming captured CO_2 to enable emissions removals.**

CCUS in action

There are a number of CCUS projects underway in the cement and lime sectors (this list is not exhaustive);

- **ECRA project[1]:** Investigating the technical and economic feasibility of CCS in the cement industry.
- **Norcem Brevik[2]:** Norwegian Government supported project to test four post-combustion capture technologies.
- **LEILAC[3]:** Pilot plant at the Lixhe cement plant using a direct separation reactor.
- **CEMCAP[4]:** Investigation of four different capture technologies and their integration into a cement plant.
- **SCARLET[5]:** Scale up of the calcium carbonate looping process and pre-engineering of a 20MWth plant.
- **CLEANKER[6]:** Demonstrate Calcium Looping. A regenerative process which takes advantage of the capacity of Calcium Oxide-based sorbents in capturing the CO_2.
- **CO2MENT project[7]:** To demonstrate and evaluate a CO_2 Capture System and a selection of carbon **utilization technologies**.

1 https://ecra-online.org/research/ccs/
2 https://www.norcem.no/en/CCS%20at%20Brevik
3 https://www.project-leilac.eu/
4 https://www.sintef.no/cemcap
5 https://cordis.europa.eu/project/id/608578
6 http://www.cleanker.eu/the-project/project-contents
7 https://www.lafargeholcim.com/lafargeholcim-launch-carbon-capture-project-canada

UK Concrete is part of the Mineral Products Association, the trade association for the aggregates, asphalt, cement, concrete, dimension stone, lime, mortar and silica sand industries.

www.mineralproducts.org

Follow us:
@thisisconcrete
this-is-uk-concrete
www.ThisisUKConcrete.co.uk

MPA UK Concrete
Gillingham House
38-44 Gillingham Street
London SW1V 1HU

Tel 020 7963 8000

mpa UK Concrete