Cement and Carbon Capture Use and Storage - FAQs

This position paper discusses some of the frequently asked questions about cement and the use of carbon capture with use and storage (CCUS).

1. How certain is CCUS? Why is the industry relying on such an uncertain technology?
CCUS is a proven technology, with CCUS projects operating safely across the globe in Norway, the USA and Canada. In Norway the Sleipner gas field has captured and stored 17 million tonnes of CO_2 over the past 20 years. Data from the International Energy Agency shows there are 50.5Mt / year of operational CCUS across the world, including 2.7Mt / year in Europe.

The Climate Change Committee (CCC) has described Carbon Capture, Usage and Storage (CCUS) as a 'necessity, not an option' for the transition to net zero (Net Zero - The UK's contribution to stopping global warming - Climate Change Committee). DESNZ are providing backing to CCUS through £21.7 billion of committed funds and associated business models.

Instead, the challenge is integration with the transport and storage of the captured CO_2 along with the financial case for investment.

The Global Cement and Concrete Association has a technology tracker which shows all the cement CCUS projects under development. The first large scale CCS plant at a cement site, will capture 400,000 tonnes per year, half of its emissions, has been mechanically completed and will begin operation in 2025. This is at Heidelberg Materials Brevik site, also in Norway.

In the UK the government is providing support for two track 1 clusters (Teesside and Merseyside, which includes the Padeswood cement site) and is developing its CCUS Vision for the future.

CCUS is vital to the cement industry due to the material changes that happen during the making of clinker, with calcium carbonate becoming calcium oxide with carbon dioxide (CO_2) released. These emissions, which are not related to the burning of fuels, account for around 70% of a site's emissions.

This means that simply transitioning to zero carbon fuels will not decarbonise the cement sector. CCUS is widely recognised as a critical component in supporting the decarbonisation of the sector.

2. CCUS is considered continuation of business as usual and is the sign of reluctance for a real change.
The UK consumes 15 million tonnes of cementitious materials every year. The production of Portland cement requires raw materials that are abundantly available, its properties are known and understood, and its applications are broad. Portland cement is deeply valued for all these qualities as shown by 200 years of continuous use in the UK. The one issue it faces is currently high embodied carbon as a result of the manufacturing process.

Portland cement producers take the responsibility of reducing embodied carbon very seriously and inroads are being made to reduce emissions as far as possible before residual emissions are captured. To date the sector has reduced emissions by 53% compared to 1990. This has been achieved through increasing the use of supplementary cementitious materials (SCMs) and significantly reducing reliance on fossil fuels by utilising waste fuels. Further work is underway in exploring decarbonated raw materials. In addition, MPA supports the

efforts to improve the efficiency of the use of concrete and thus cement to minimise the quantity needed.

Portland cement producers are working hard to innovate and find solutions to the carbon dilemma whilst limiting the impact on Portland cement properties to ensure it can continue to be used in the current broad range of applications.

There is substantial research going into novel materials which can use alternative raw materials to Portland cement. However, the potential for these cements to be produced at scale and used in load bearing structural applications is uncertain, they often still require clinker to activate them, or they rely on GGBS, and their carbon savings can often be matched by Portland-based cements such as a CEM III or CEM IV.

In summary, the cement sector is addressing the challenges head on to transition from business as usual to help deliver low carbon and net zero Portland cement, so that construction can continue as usual with the least disruption possible. The timeframe of change over the next 10-years will be rapid compared to Portland cement's 200-year history and companies are investing significant effort and resources.

3. Many believe the main strategy should be to avoid emitting carbon, not trying to capture it. CCUS should be considered as the last resort, not the main solution.
Portland cement producers agree with this and are working hard to reduce emissions before capturing the residual emissions. To date the sector has reduced emissions by 53% compared to 1990. This has been achieved through increasing the use of supplementary cementitious materials and reducing reliance on fossil fuels by utilising waste fuels. Further work is underway in exploring decarbonated raw materials.

MPA supports the efforts to improve the efficiency of the use of concrete and thus cement to minimise the quantity needed.

Other organisations also note the importance of carbon capture, including the UK Committee on Climate Change and the International Energy Agency.

The MPA consider the two strategies of avoiding emitting carbon and capturing carbon as complementary, both are strong decarbonising levers and both approaches have their merits and challenges.

4. Why is the industry relying on such an expensive and complicated technology?
The chemistry of Portland cement production means that when the raw materials are heated to high temperatures it results in the release of CO_2. Portland cement producers aim to reduce these emissions as far as possible by reducing the high carbon clinker content of cement through using more SCMs and switching away from fossil fuels to use waste derived fuels. However, the chemistry of production means there will always be some residual process emissions that will have to be captured to reach net zero.

Carbon capture may be expensive now but developing it for many industries, like Portland cement, will build up the transport and storage networks and reduce the cost of the technology over time.

5. What would be the impact on cost of cement?
While MPA cannot comment on specific product prices, we are working with the DESNZ CCUS team to implement a business model (financial support) for CCUS that would ensure the cement produced with carbon capture can compete in the UK cement market. However, we understand that demand for low carbon and net zero cement could be high which will

have an impact on cost. The Mission Possible Partnership estimate the total impact on project cost of net zero concrete could be only 1.5 to 3%.

6. Who is paying for CCUS? There are lots of concerns about public money being spent for CCUS.
Investment in carbon capture at a cement plant requires significant investment by the companies themselves. To help accelerate and attract this investment to the UK, there is a need, at least in the short to medium term for Government support. This is in the form of a business model that provides support and risk sharing towards the additional capex and operating costs of the carbon capture plant, along with CO_2 transport and storage.

The UK government has committed to providing support to two of the track 1 clusters, this is partly through taxpayer funding and then through a levy.

The government aim is for the CCUS market to be 'self-sustaining', i.e. without government funding, by 2035.

7. How much storage capacity is available under seabed and how long we can store carbon there?
The UK has a very large CO_2 storage capacity, primarily due to the previous extraction of oil and gas. The capacity is 78 billion tonnes, if emissions continued at the current rate of 400 million tonnes per year that would be 195 years of storage.

8. What are the environmental impacts? Some people claim that it is not an ethical choice considering the next generations.
The process of capturing CO_2 via some technologies does require additional electricity, heat and water. Innovators are already considering how to reduce these impacts and the more interest and investment there is in the technology the quicker the capture technology will develop.

Life Cycle Analysis for CCS has shown there is rapid payback, for example carbon emissions from Peak Cluster onshore project – including the raw materials, construction, operation and decommissioning – will be offset in under six months of the project's operation.

9. There is a high risk associated with transporting carbon, what are the mitigations measures?
There is low risk from transporting CO_2 by pipeline. The transport and transfer of liquids and gases by road, rail, ship and pipeline is well established, for example, natural gas is transported by pipelines across the country. The UK is highly regulated and risk averse. Operating permits and licenses will not be granted unless it can be shown risks of leakage are mitigated.

10. What about dispersed sites in the UK? Can they be converted to another type of production like calcined clay?
The use of CCUS at dispersed sites is more challenging than cluster sites but not impossible. The continued production of Portland cement or a shift to producing other products is a commercial decision that only individual companies and sites can comment on. The emerging calcined clay technology can off-set some of the limestone used in cement making, but not all.

11. There are also concerns about using mass balance principle, many believe that it is green washing and difficult for proper accounting.
MPA understand that there is already considerable demand for net zero cement. An unintended consequence of CCUS at a handful of initial sites globally, is that cement

produced in e.g. Norway might be demanded by consumers in Spain. With considerable time and resource on decreasing CO_2 emissions to zero, it does not make sense to then emit lots of CO_2 in transporting these materials around the world. A chain of custody / mass balance approach based on book and claim is the most sensible approach to allow a consumer further away to benefit without the potentially damaging environmental consequences. MPA recognise that any mechanism designed to enable this will have to be rigorously controlled and standardised to avoid any double counting or false claims.