Embracing CCUS, energy management and digitisation

As the cement industry increasingly considers carbon capture, utilisation and storage (CCUS) as a pathway to decarbonisation, Schneider Electric explains why it is vital to acknowledge the significance of embracing electrical, automation and software solutions for a sustainable future.

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To meet global net zero targets, data from the International Energy Agency (IEA) shows that the cement industry's emissions must fall by an average of three per cent annually through to 2030. However, if CO_2 production is inescapable, how can the hard-to-abate cement industry successfully decarbonise in time for 2050?

Technologies for carbon capture

For the cement industry to contribute to global energy and climate goals, focussing on removing CO_2 from their emissions through carbon capture, usage and storage (CCUS) is considered an effective approach. By adopting CCUS technologies, the cement industry can actively contribute to mitigating climate change and achieving sustainability goals.

CO_2 can be isolated using different technologies: post-combustion capture, pre-combustion capture, oxyfuel combustion, mineral carbonation and chemical looping combustion. In other cases, unorthodox methods such as the engineering of algae biomass can permanently sequester carbon from the wider atmosphere at the gigaton scale.

According to the US Center for Climate and Energy Solutions (C2ES), CCUS technology can capture more than 90 per cent of CO_2 emissions from power plants and industrial facilities.

Although numerous CCUS projects and trials are underway in multiple sectors, there is slower progress in the cement industry. Business leaders may feel that carbon capture is an expensive, complex and futile process, however, it is highly achievable and cost-effective – if cement producers are equipped with the right support.



Energy management, digitisation and analytics are strategic keystones that can propel carbon capture projects towards improved performance

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Energy management, digitisation and analytics for every stage

When considering investing in CCUS, it is vital to acknowledge the significance of embracing electrical, automation and software solutions. While the focus may primarily be on the CCS technology itself, it is essential to understand that the energy-intensive nature of carbon capture solutions and the automated cement process requires a strategic integration of energy management, digitisation and analytics throughout the project: from front-end engineering design (FEED) and engineering to operations and maintenance. Recognising the significance of these aspects from the outset and incorporating them into a project's planning and execution will be pivotal in maximising the success and sustainability of CCUS endeavours.

As organisations embark on their decarbonisation journey through carbon capture, they must remember that energy management, digitisation, and analytics are the strategic keystones that will propel projects towards improved performance, profitability and environmental responsibility.

Data management: the foundation for collaboration and efficiency

To ensure project success, organisations need to set up a data management platform to articulate communications, cooperation and ultimately save time on project management activities.

A robust data management platform serves as a central repository for all project-related data, including design documents, technical specifications,

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process data, and performance metrics. This platform facilitates collaboration among multidisciplinary teams, ensures data integrity and streamlines project management activities. During FEED, the data management platform allows stakeholders to access and analyse data, track project progress and make informed decisions based on real-time information.

Efficient energy management architecture

Designing an efficient energy management architecture is crucial for optimising energy consumption and reducing costs during FEED. It is essential to assess the energy requirements of the carbon capture system and integrate it into the cement plant's existing energy infrastructure and grid. This involves developing a comprehensive digital single line diagram that illustrates the electrical connections, equipment and energy flows. By analysing and optimising this diagram, energy losses can be minimised, resulting in improved energy efficiency for the plant.

Implementing a digital twin of the process and single line diagram allows for virtual modelling, simulation and optimisation of the carbon capture system's integration. This digital twin enables engineers to analyse different scenarios, assess the impact of design choices and identify potential bottlenecks before implementation.

By leveraging data from the digital twin and other sources, advanced analytics provide valuable insights for making informed decisions, predicting system performance and optimising the carbon capture process.

High energy demand equipment, such as the carbon capture units, requires careful consideration of cable length strategy. Longer cable lengths can result in power losses and increased costs. In the FEED phase, engineers need to analyse the electrical requirements, equipment locations and cable routing to minimise energy losses, and ensure efficient power distribution. This strategy optimises the performance and reliability of the carbon capture system.

Integrating the power and process automation systems is critical for seamless operation and control of the carbon capture system. During FEED, engineers must design an integrated automation architecture that enables efficient communication and coordination between the power distribution system and the carbon capture process. This integration allows for real-time monitoring, control, and optimisation, ensuring the safe, reliable, and efficient operation of the carbon capture solution.

Accessing subsidies and support

Inevitably, integrating carbon capture and energy management as new processes in cement plants will be a considerable challenge. Not just from their physical integration into the site and infrastructure themselves, such as new CO_2 pipelines, storage terminals, and networks for sequestration, but also their financing, high capital expenditure, and indeterminate profitability. After all, this is likely to be a brand new project, in which plants may face a lack of experience and uncertainty, particularly in cost estimations.

Financially, government incentives and subsidies, such as the UK's GBP1bn (US$1.25bn) Carbon Capture and Storage Infrastructure Fund or the EUR3bn European Innovation fund are important steps to realising carbon capture projects. Meanwhile, the potential risk of penalisation if plants fail to act, such as carbon taxes, should also energise business leaders into change, regardless of their readiness.

Here, industrial automation is an ideal way to navigate initial operational difficulties. It promises enhanced efficiency in energy consumption and throughput. A holistic understanding of carbon capture projects is vital, adopting the capabilities to support on all phases, from design to maintenance, stretching across project management, energy management, and industrial automation.

Partnerships for the future: paving the way to net zero

Embarking on a carbon capture project is no small accomplishment. The risks, from cost to efficacy and inexperience, are evident. However, given the paramount importance of this endeavour as we strive towards net-zero targets, going it alone is simply too risky.

This is where collaboration becomes crucial. However, not just any collaboration – what is needed is a partnership with an expert. A partner who goes beyond a mere transactional relationship and instead provides holistic solutions, leading the way in digital transformation, electrification of carbon capture, energy management, and automation.

The cement industry, while indispensable in construction and development worldwide, is a significant contributor to CO_2 emissions and climate change so must find a way to reduce its emissions. Fortunately, CCUS technologies offer a viable solution.

Implementing carbon capture solutions successfully requires comprehensive approaches that address both carbon capture and energy management challenges. This involves leveraging digital solutions, utilising appropriate hardware, and establishing strategic partnerships. These partnerships play a vital role in helping cement businesses navigate the complexities of carbon capture implementation.

By collaborating with solution-oriented partners, the cement industry can pave the way to a sustainable future. Together, we can achieve the ambitious goal of net-zero emissions and create a better world for generations to come. ■



A holistic understanding of carbon capture projects is vital

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