



# A TWO-WAY STREET TO DECARBONISATION

**Aniruddha Sharma, Carbon Clean, UK,** considers how the relationship between CCUS technology providers and the oil and gas industry can be strengthened to drive decarbonisation.

**A**cross the globe, there is an increasing understanding of the rapidly narrowing window to raise climate ambition and implement existing commitments to limit global warming to 1.5°C by 2030. This is a real challenge with no single solution. Experts continuously emphasise that reducing emissions requires a multifaceted approach. Nowhere is this more relevant than for hard-to-abate industries, like oil and gas, steel and cement. For these sectors, it is essential to use all available tools and technologies, including carbon capture, utilisation and storage (CCUS).

This rings particularly true for the oil and gas industry which faces a unique set of challenges and opportunities when it comes to achieving net zero. In 2022, the production, transport and processing of oil and gas accounted for 15% of total energy-related greenhouse gas (GHG) emissions, while the use of oil and gas contributed an additional 40%. To align with the International Energy Agency (IEA)'s Net Zero Scenario, total emissions from oil and gas operations will need to decrease by 60% by 2030.<sup>1</sup>

Within this context, pressure is mounting for the industry to make progress on the targets it has committed to, especially as recent geopolitical developments have made it clear that petrochemicals will continue to play a key role in the energy mix for the foreseeable future. Expectations are high.

## **CCUS: a key decarbonisation solution for oil and gas**

Among several decarbonisation options being explored by the oil and gas industry, CCUS has been identified as one of the most impactful, alongside electrification, biomass and clean hydrogen. CCUS is proven and established within the industry, including across key parts of the oil and gas value chain.

### **Upstream**

There is significant potential for CCUS in the upstream industry, which is projected to maintain its 2023 hydrocarbon investment level of approximately US\$580 billion in 2024.<sup>2</sup> Instead of releasing CO<sub>2</sub> into the atmosphere through flaring or venting,



capturing it from high-CO<sub>2</sub> gas fields and using it or storing it underground can help reduce production emissions. As a number of the leading oil and gas companies have committed to ensuring flaring comes to a permanent halt, carbon capture can contribute to securing these commitments.

It is clear that carbon capture has the potential to extend across the upstream industry, however the level of commitment and investment necessary is yet to be realised. Important applications of CCUS in exploration and production (E&P) are gas turbines, boilers, floating production storage and offloading (FPSO), onshore and offshore drilling rigs, and gas processing facilities.

## Midstream

Midstream has seen extensive application of CCUS technologies in natural gas processing, with significant opportunities for application in the LNG and compressor segments. In natural gas processing, CCUS is used to separate CO<sub>2</sub> from the gas stream and capture it at a lower cost, helping to decarbonise the midstream application. According to research and energy intelligence company, Rystad Energy, there are currently more than 100 operational CCUS projects globally, more than 40% coming from gas processing. This is in addition to more than 60 planned projects in the field and more than 10 projects under development, demonstrating the viability and strong momentum of CCUS in this key part of the hydrocarbons industry.

Carbon capture has further applications in this vertical when considering LNG plants, where CO<sub>2</sub> can be captured from the natural gas liquefaction process, and compressors used for long distance transport of natural gas. Here, the remote locations of many compressors make alternative decarbonisation options, such as electrification, impossible. This makes CCUS the preferred solution.

## Downstream

The downstream oil and gas sector is a great example of not only the potential of carbon capture, but also the importance of using every tool available to achieve net zero.

Refineries face some of the toughest challenges when it comes to decarbonisation, in part due to the combination of multiple unit operations with multiple point sources of emissions



**Figure 1.** CycloneCC industrial unit, UAE.

requiring abatement through a combination of solutions, namely CCUS, electrification and hydrogen.

Modular, skid-mounted technology solves this challenge through a cost-effective and scalable solution that can be integrated within existing operations without requiring additional site footprint, which rapidly reduces installation time compared with more conventional options that can take years to implement. This brings the downstream industry much closer to meeting its net zero targets – and crucially within the existing 2030 timeline that larger scale projects risk lapsing on.

To date, there are more than 20 commercial CCUS projects in oil refining and more than 15 pilot projects. As this sector continues to expand, there remains a huge opportunity to fully develop tried and tested solutions to rapidly decarbonise oil and gas operations.

## Hydrogen

Hydrogen is essential in various refining and chemical processes within the oil and gas industry, with CCUS being an enabler of least-cost low-carbon hydrogen production. Blue hydrogen in combination with carbon capture and storage (CCS) will play a major role in decarbonising many industries, including oil and gas, as evidenced by more than 150 commercial CCUS projects. First adopters will likely be the US and Europe, which have already published hydrogen strategies, followed by the Asia-Pacific region. There has been a clear commitment and regulatory support for CCUS and its value for hydrogen. Last year, the US Department of Energy (DOE) selected seven regional clean hydrogen hubs to receive US\$7 billion in federal funding. Four of the seven hubs will include the production of blue hydrogen.

## The case for modular point source carbon capture

Point source carbon capture technology, where CO<sub>2</sub> is captured at the source of emission, is a financially and logistically viable means of decarbonisation for the oil and gas industry. Point source carbon capture solutions have been proven across sites globally and are having a measurable impact every year following installation. Moreover, by modularising the technology for ease of installation, there is a real opportunity to reduce the cost of carbon capture and make it significantly more commercially viable for the industry, enabling companies to increase deployment in accordance with their decarbonisation targets.

Carbon Clean's breakthrough modular CycloneCC technology eliminates the two biggest barriers that have held back widespread adoption: cost and space. It significantly cuts the total cost of ownership (TCO) by reducing CAPEX and OPEX by up to 50% compared to conventional carbon capture solutions. In terms of size, the equipment is up to 10 times smaller, reducing the height of the unit by 75%, and enabling a modular, road-transportable design. The technology is therefore focused on scalability – achieving significant reductions in cost, deployment time and physical space by being fully modular, prefabricated, and skid-mounted.

Innovations such as this can only be scaled in the oil and gas sector through collaboration. Partnerships with oil and gas majors across the globe have already been instrumental in the deployment of CycloneCC, such as with Chevron, where a

collaboration is underway to develop a technology demonstration pilot at one of the company's co-generation plants in California, US.

More recently, ADNOC selected CycloneCC for a carbon capture pilot at Fertigllobe's nitrogen fertilizer plant in Abu Dhabi, UAE – the first deployment of a 10 tpd CycloneCC industrial unit anywhere in the world. The pilot illustrates the transformative change that fully modular carbon capture will bring to the industry, with the standardised, pre-fabricated unit installed on site in under a week, ready to be commissioned. Considering that the industry standard for installation can be four to six months, this demonstrates why modular technology will become the next generation solution for the oil and gas industry and for hard-to-abate emitters at large.

## Delivering on the two-way street promise

Few industries are as well-positioned as the oil and gas industry to drive forward decarbonisation. If net zero targets are to be achieved, the relationship between CCUS technology providers and the industry must be strengthened, and provide a blueprint for adoption across other hard-to-abate sectors. Three pillars are key to success:

- Recognising the imperative: put simply, CCUS is essential to the decarbonisation of the oil and gas sector. A mix of technologies will be required to achieve net zero goals, but carbon capture is available now. With next generation technology coming on stream, clean tech innovators are bringing deployment to the next level.

- Channelling the expertise: the oil and gas sector has been involved as an investor or project partner in over 90% of CCUS capacity in operation globally, while over 40% of CCUS investment since 2010 has been directed towards projects directly related to oil and gas value chains. Thanks to expertise in key areas like project management, transportation and storage, there is unique potential for knowledge sharing and collaboration on technological advances. This is a huge opportunity to leverage.
- Championing the change: leading CCUS businesses are constantly innovating and incorporating the latest feedback from customers and partners. The key lessons learnt are on the importance of standardisation across geographies, a need to build hardware capacity, and why materials development is crucial. It is important that these changes are now championed among key industry, policy and business stakeholders – by CCUS providers and the oil and gas industry.

There is both an imperative and an opportunity for partnership between the oil and gas and CCUS industries. With strong foundations already laid, in the next few years there is potential to drive forward adoption if the right steps can be taken on investment, expertise and change. If done comprehensively, CCUS adoption by oil and gas can serve as a blueprint for all heavy industries. 🏗️

## References

1. 'The oil and gas industry in net zero transitions', IEA, (2023).
2. '2024 oil and gas industry outlook', Deloitte, (2023).