Is carbon capture the climate fix we need?

To date, carbon capture, utilisation and storage has been long on promises and short on delivery. But hard-to-abate industries are likely to rely on the technology to get to net-zero emissions. Michael Yamoah and Shoa Hirosato examine the implications for companies and investors.

Setting the scene

Proponents of carbon capture, utilisation, and storage (CCUS) argue that it will be a critical component in hard-to-abate sectors such as energy, cement, and other industrials. This is due to technical challenges related to high heat requirements and carbon emissions.[1] The International Energy Agency's Clean Technology Scenario, which is in line with the Paris Agreement ambition, estimates that one-fifth of emissions reductions needed across such industries will come from CCUS. However, to date, attempts to commercialise CCUS at scale have disappointed, and sceptics decry it as a fig leaf for business-as-usual.

For further information please contact:

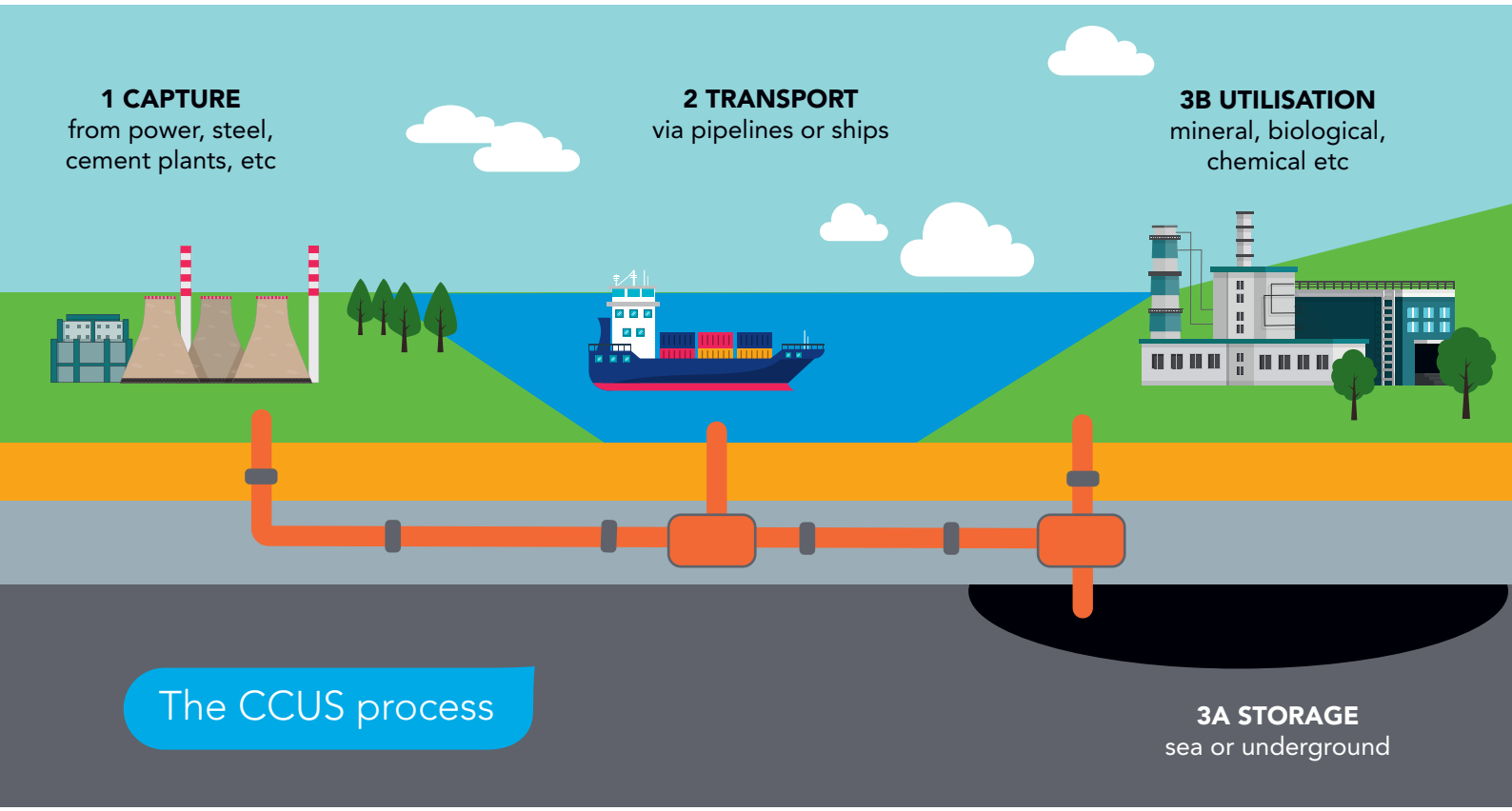
Michael Yamoah
Theme lead: Wider Societal Impacts
michael.yamoah@FederatedHermes.com

Shoa Hirosato
Theme: Climate Change
shoa.hirosato@FederatedHermes.com

The world faces a significant challenge in limiting global warming to 1.5°C. Achieving this goal will require drastic reductions in greenhouse gas emissions, particularly CO_2 and methane, to reach near zero by mid-century. While essential, this transition presents major hurdles for certain sectors and regions due to technical and economic limitations. In this context, carbon capture, utilisation, and storage (CCUS) has emerged as a critical potential solution.

CCUS is a set of technologies capturing carbon from different sources such as power plant exhausts or directly from the air, which is then transported. This is either for use in various industrial purposes or for permanent storage underground. Most Intergovernmental Panel on Climate Change (IPCC) models aligned with the 1.5°C target rely on carbon dioxide removals (CDRs), which is why CCUS is seen as a crucial tool for tackling the climate crisis, particularly for hard-to-abate sectors.

[1] Scaling the CCUS industry to achieve net-zero | McKinsey



Source: International Association of Oil and Gas Producers https://www.iogp.org/blog/news/developing-low-carbon-technologies/

Where is CCUS expected to be needed?

Hard-to-abate industries such as steel, cement and other building materials, and chemicals require high temperature heat from the burning of fossil fuels and emit carbon dioxide from unavoidable chemical reactions. These industries currently lack commercially viable alternatives that can reduce carbon emissions in operations. CCUS technologies therefore present an opportunity to reduce emissions where fuel substitution or complete electrification is not feasible or cost effective, and can be retrofitted to existing facilities.

In the utilities sector, CCUS is considered as "an enabler of least-cost low-carbon hydrogen production".[2] Hydrogen is an emerging green energy solution, which can be produced from many sources, including natural gas and electricity from the grid. The most common type - grey hydrogen - is produced from natural gas but emits a significant amount of CO_2.[3] This has prompted interest in so-called blue hydrogen, whereby CCUS technologies are used to capture and store CO2 underground.

The oil and gas sector has made significant investment in various CCUS technologies. For example, natural gas processing makes use of CCUS technologies to separate CO_2 to form purer gas streams. Captured CO_2 is widely used in enhanced oil recovery (EOR) - injecting CO_2 into existing oil fields to increase pressure and oil yields,[4] and in some cases resulting in storage. With few decarbonisation alternatives, oil and gas companies are heavily reliant on CCUS to offset the unavoidable emissions. However, there is doubt that it will be

used at scale. One study notes that "without EOR and [the] efforts of oil giants, CCUS technology would not survive as a mitigation option considering its poor project record."[5]

What are the pros and cons?

Besides being labelled the most cost-effective option for CO_2 emissions reductions in hard-to-abate industries, proponents also hope the technologies could help reduce other gases, such as sulphur oxides (SOx) and nitrogen oxides (NOx). These contribute to climate change due to their impact on the ozone layer.[6]

However, realising these benefits has proven challenging over the last 50 years, as a scalable and viable commercial solution for CCUS has remained elusive. Currently, there are fewer CCUS projects than are needed under the International

[2] A new era for CCUS – CCUS in Clean Energy Transitions – Analysis - IEA
[3] Hydrogen (irena.org)
[4] Can CO2-EOR really provide carbon-negative oil? – Analysis - IEA
[5] What went wrong? Learning from three decades of carbon capture, utilization and sequestration (CCUS) pilot and demonstration projects - ScienceDirect
[6] CCUS Technologies | AGCS (allianz.com)

Energy Agency's Net Zero Emissions scenario[7] and studies have shown significant failures in the number of demonstration and pilot projects over the past three decades.[8] Another scale challenge relates to the energy intensity requirements of some of the technologies, such as direct air capture. To make these projects efficient would require large scale use of renewable energy sources, otherwise they may end up producing more CO_2-using energy than would be captured from the air.[9]

The economic viability and business case dependencies have also been called into question. This is due to the low or negative internal rates of return that result without a reliably high prevailing price for carbon emissions. This has made it difficult to incentivise the required funding options, particularly from private capital.[10]

The safety of carbon transportation and storage has also been scrutinised. A 2020 accident in Sataritia, Mississippi reportedly left residents convulsing, confused or unconscious due to a ruptured pipeline carrying compressed CO_2 mixed with hydrogen sulphide.[11]

What is the current state of development?

Most CCUS projects are still at the prototype or demonstration phase. Emerging research also shows that increasing the size of the CCUS project can lead to it being terminated or put on hold, as the failure rate leaps by nearly 50% when raising capacity by 1Mt CO_2 per year.[12] The vast majority of operational CCUS projects around the world are in the oil and gas sector.[13] This has raised concerns about CCUS projects under development enabling oil and gas activities that could lead to business-as-usual scenarios in the energy transition.

On a more positive note, government policies have emerged to help mobilise capital to demonstrate and drive CCUS market uptake. In the US, the Inflation Reduction Act (IRA) and the Infrastructure Investment and Jobs Act (IIJA),[14] have spurred activity in CCUS, especially in storage and direct air capture.[15] There are similar public policy regimes taking shape in other jurisdictions, such as the EU, China, and Japan, to identify and support CCUS projects.

The UK, Australia and Canada have also instituted tax credits and grant programmes to shore up private market interest. Various industrial hubs are being developed to bring together industry players to share knowledge, with the added benefit of driving down the cost of CCUS related activities. Innovations around CCUS are also increasing in the utility, chemical and iron and steel sectors, including Net Power's 50MW plant in the US, Net Zero Teeside Power's 860MW in the UK, and ArcelorMittal's CCU demonstration project in Belgium.

Implications for engagement

EOS has been engaging with companies across relevant sectors on their decarbonisation strategies and the role that CCUS plays within them. So far, we have discussed carbon capture with around 60 companies, particularly in the oil and gas, chemicals, utilities, and heavy industries sectors. Several companies, especially in the US, have recently committed to CCUS, potentially at scale, as part of their long-term operational emissions reduction. In our engagements, we have been asking for clearer disclosure on CCUS strategies and associated risks, while monitoring progress.

We have discussed carbon capture with around 60 companies, particularly in the oil and gas, chemicals, utilities, and heavy industries sectors.

This is because we often encounter limited detail in companies' disclosures, and investors need detail to assure them of the credibility of the decarbonisation strategies. Through our engagements, we ask companies to provide investors with additional disclosures related to CCUS risks and opportunities. This may include solutions for commercialisation, risks relating to CO_2 storage, and the economic evaluation of these risks. Going forward, we believe that investors need to advocate for further insights, including:

- More detail on CCUS cost competitiveness and how it compares with alternative emerging low-carbon technologies, and the associated financial returns on projects.
- Ensuring that company disclosures address varying degrees of other socioeconomic and environmental risks that enhance the long-term sustainability of CCUS projects.
- How the company is leveraging industry collaborations, such as regional hubs across industries that support effective CCUS technology deployment.
- Public policy engagements essential to the scaling up of CCUS technologies and alignment with company decarbonisation and business strategies.

As we continue to engage with companies, particularly in hard-to-abate sectors, we expect companies to be able to demonstrate a credible pipeline of projects against these four areas and how they align with their decarbonisation strategies. We will also further these dialogues via collaborative engagements with investors, including Climate Action 100+.

[7] Carbon Capture, Utilisation and Storage - Energy System - IEA.
[8] What went wrong? Learning from three decades of carbon capture, utilization and sequestration (CCUS) pilot and demonstration projects - ScienceDirect
[9] Direct Air Capture: 6 Things To Know | World Resources Institute (wri.org)
[10] What went wrong? Learning from three decades of carbon capture, utilization and sequestration (CCUS) pilot and demonstration projects - ScienceDirect
[11] Go read the harrowing story of the world's first CO2 pipeline explosion - The Verge; and A pipeline rupture in Satartia, Mississippi has lessons for future CO2 projects : NPR
[12] What went wrong? Learning from three decades of carbon capture, utilization and sequestration (CCUS) pilot and demonstration projects - ScienceDirect
[13] Carbon capture/CCUS M&A market 2022: Oil and gas companies dominated the deal activities | S&P Global (spglobal.com)
[14] The Infrastructure Investment and Jobs Act (IIJA) passed in November 2021 included more than $10 billion for CCUS projects. See: 1 Introduction and Scope | Carbon Dioxide Utilization Markets and Infrastructure: Status and Opportunities: A First Report | The National Academies Press
[15] From Act to action: How the Inflation Reduction Act is accelerating decarbonization in the United States with carbon capture and storage – Clean Air Task Force (catf.us)

CASE STUDY

Occidental Petroleum

Occidental Petroleum's climate strategy is heavily dependent on the success of CCUS technologies. Back in 2018, we acknowledged that the company had a competitive advantage in carbon capture for enhanced oil recovery (EOR) but cautioned that its climate strategy should be more comprehensive.

In 2020, the company was confident that EOR was economically viable through its continued development of carbon capture and storage (CCS) technologies coupled with the US government's tax credit (45Q) and other carbon pricing mechanisms. We questioned whether CCS for EOR would only be economically feasible if oil prices stayed high, considering the uncertainties of future oil demand. It had also explored direct air capture as a possible solution, which we challenged due to the higher costs relative to capturing carbon from sources of concentrated CO_2.

In 2022, we recommended support for a shareholder proposal asking the company to set clear goals to reduce emissions in line with the Paris Agreement and report on its progress. We were still concerned by the company's heavy reliance on CCUS technology, which was unproven at scale, to achieve these goals. However, the company insisted that its CCUS plans were both economically viable and beneficial for the environment.

In 2023, Occidental highlighted its new CCUS project – Stratos/Direct Air Capture 1 (DAC1) – on which it was materially relying to achieve its emissions targets. We expressed concerns about it having no backup plan if DAC1 failed to meet expectations, but the company remained confident in its ability to deliver on this strategy. We continue to closely monitor the project's progress.

We regularly question the potential environmental and social risks of storing liquid carbon dioxide underground or in water, given safety concerns and the potential for earthquakes, as this technology is still being studied. The company cited its long experience with CCS of some 40 years, and argued that the environmental benefits of CCS outweighed the costs. It has already received some permits for these projects and pointed to existing research supporting the safety of these technologies.

CASE STUDY

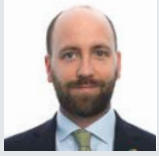
Eagle Materials

Eagle Materials is a US-based producer of building materials, primarily cement and wallboard. Carbon capture is seen as a crucial component in addressing the majority of emissions linked to cement production. While there are currently limited scalable and economical solutions, there is potential for Eagle Materials to aid in the testing of various technologies to accelerate progress.

We welcomed the confirmation in 2021 that the company was to partner with Chart Industries, an engineering equipment firm, to pilot its carbon capture technology at scale. The technology being tested involves rapidly cooling the gases being emitted from the cement kiln, causing the CO_2 to freeze and separate from other gases.[16]

> **The goal is to prove that the system can capture over 95% of CO_2 from a source and produce a CO_2 stream that is more than 95% pure.**

The goal is to prove that the system can capture over 95% of CO_2 from a source and produce a CO_2 stream that is more than 95% pure. The technology, if it proves successful and is implemented, will increase cement production costs markedly. Chart Industries estimates an increase of 24%, although the contention is that this is significantly lower than that forecast for other carbon capture technologies. Testing is ongoing with assessments and conclusions about the technology's effectiveness to be reached in 2025.



Will Pomroy
Head of Impact Engagement – Equities, FHL

[16] Frontiers | A mini-review on cryogenic carbon capture technology by desublimation: theoretical and modeling aspects (frontiersin.org)

EOS001248 0016822 03/24

Federated Hermes

EOS

Federated Hermes

Federated Hermes is a global leader in active, responsible investing.

Guided by our conviction that responsible investing is the best way to create long-term wealth, we provide specialised capabilities across equity, fixed income and private markets, multi-asset and liquidity management strategies, and world-leading stewardship.

Our goals are to help people invest and retire better, to help clients achieve better risk-adjusted returns and, where possible, to contribute to positive outcomes that benefit the wider world.

Our investment and stewardship capabilities:

- **Active equities:** global and regional
- **Fixed income:** across regions, sectors and the yield curve
- **Liquidity:** solutions driven by five decades of experience
- **Private markets:** private equity, private credit, real estate, infrastructure and natural capital
- **Stewardship:** corporate engagement, proxy voting, policy advocacy

Why EOS?

EOS enables institutional shareholders around the world to meet their fiduciary responsibilities and become active owners of their assets. EOS is based on the premise that companies with informed and involved investors are more likely to achieve superior long-term performance than those without.

For more information, visit **www.hermes-investment.com** or connect with us on social media: