Progress Towards Operating a Viable Business in CO2

The report from the Carbon Dioxide Capture and Conversion (CO2CC) Program explores how to operate a viable business in CO2, from capturing at point sources or directly from air, to converting into a marketable commodity of value or storing it safely underground. It discusses the economic and environmental implications of a carbon management system, regional variability in carbon management components and how to optimize system builds to maximize economic benefit.

The report, "Progress Towards Operating a Viable Business in CO2" presents, considers and explores each element in the full CO2 supply chain and places major focus on developing a sensible methodology for selecting components in the carbon management value chain that connect in order to minimize costs and maximize revenue.

This report examines the question: with billions of tonnes of CO2 standing ready to exchange hands, how will this be achieved, and can it be done profitably? The pathways described in the report fall under the umbrella of carbon management, a catch-all term to describe, generally, engineered approaches to move CO2 between Earth's subsystems, with the ultimate goal of lowering the atmospheric stock of CO2.

The goal of the report is to equip the reader with enough detail about the various options in the CO2 supply chain to construct sensible options for starting and/or operating a business in CO2 management. The report discusses:

• Goals for the carbon management projects in terms of achieving emission reductions, net removals of carbon dioxide, or both

• Options for procuring CO2, e.g., capture or removal and storing CO2

Converting CO2 into a marketable commodity

How the procurement, storage and/or utilization components fit within corporate climate goals on a collective basis

The report explores how to operate a viable business in CO2, from capturing at point sources or directly from air, to converting into a marketable commodity of value or storing it safely underground. It also profiles several existing and promising new technical approaches and the report ends with a pair of case studies to illustrate how one might approach the formation of carbon management value chain using the tools provided in the report, and in two different contexts.

After an overview aimed at equipping the reader with a foundational knowledge in carbon management practices and technologies, key areas of concern, and metrics for evaluation, the reader is invited to explore the various areas of value in a carbon management chain. The final three chapters discuss progress in capture, utilization, and the entire value chain.

The most impactful method for decarbonisation of all value chains is summarised by sources with a range of boundary conditions in the respective life-cycle analyses. Different routes to a range of different substances are covered including, as appropriate, routes from bio-based, CO2-based and waste-polymer based feedstocks.

Key takeaways from the report

• Enhanced oil recovery is the dominant mechanism for support in CCS projects worldwide. Of the 21 active CCS projects, 16 are tied to EOR. This illustrates the importance of establishing a secure and stable off taker and consistent form of revenue.

• The most important attributes in successful CCS projects are low capital cost, high technical readiness, and credible project revenues. Projects with these traits have a higher chance of success. The EOR trend outlined above plays into these characteristics. High TRL (technical readiness level) projects have much lower risk but are often beset by incumbent competition.

• Carbon utilization remains expensive and will struggle to reach cost parity with incumbent routes. Elevated feedstock costs plus operational costs associated with conversion of CO2 are major cost drivers that place many utilization routes at a disadvantage so long as demand is market driven. It is difficult to quantify the impact of low carbon premiums, though this could help lower the barrier to entry for CO2-derived products.

• CO2 storage remains less popular due to economic and political barriers. The lack of financial incentive to store CO2 underground is a major contributor to the lack of CCS projects that terminate in secure, geological storage. Political barriers, such as Class VI permitting in the US contribute to the disproportionate number of projects associated with EOR.

Scope of the report

It is important to understand whether a company is directly involved in the capturing of carbon or whether it is in the supply chain of using the carbon (companies that are involved in both are modeled using sum-of-the-parts).

Attributes that can impact CCS project success include:

• Engineering economics (plant siting and capital costs)

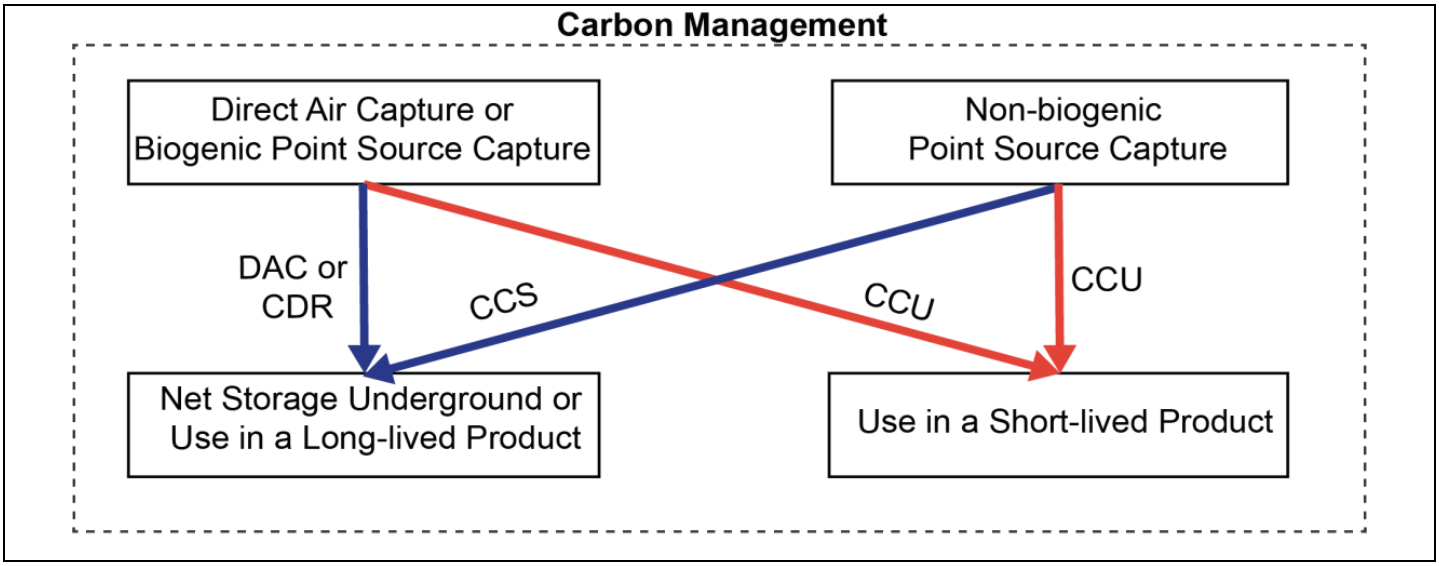

Figure 1 – Schematic representation of the terminology used in the report. Source: Authors

• Financial Credibility revenues and incentives)

• Local Political Features (population and institutional setting)

• Broader Political Features (regulatory challenges and public opposition)

Carbon capture is most practical and energy-efficient at large point sources, such as fossil fuel or biomass energy facilities, natural gas electric power generation plants, industries with major CO2 emissions, natural gas processing, synthetic fuel plants, fossil fuel-based hydrogen production plants, cement plants, and steel making facilities.

It is important to distinguish between CCS or avoiding/reducing the amount of CO2 that is released to the atmosphere, and carbon dioxide removal (CDR), where CO2 is physically removed from the atmosphere resulting in a net lowering of the atmospheric stock of carbon dioxide.

Carbon utilization is a solution proposed to address the issue of local CO2 storage while potentially generating useful revenue by converting CO2 into valuable products. This approach has great potential to subsidize the costs associated with carbon management and even generate positive revenue, and can be realized through several different pathways. However, only a rigorous life-cycle analysis can reveal if the pathway results in emission reductions or net removal of carbon over a significant time period.

The report goes on to summarise CCUS supply chain economics and cost levers in CO2 utilization pathways. It then gives an overview of the current status of commercial CCS projects and commercial CDR projects followed by a review of the status of CO2 storage.

Key conclusions

The findings of the report (see box text) have led the authors to the following conclusions:

• Political support can help to create a demand pull for carbon markets. The current market for CO2 utilization is 200 MtCO2/yr, a mere fraction of global carbon output. Most of this demand is earmarked for incumbent processes. Procurement of low carbon products can assist in creating demand and driving innovation in the utilization space.

• Major storage projects can help promote local momentum for carbon management. Dedicated storage projects, like the Northern Lights storage project in Norway, can act as an incubator for CCS deployment and development. Similar projects could arise in the US, strategically located to assume captured CO2 from nearby industries.

• Utilization should continue to be the dominant mechanism of CCS support over the next decade and until storage is ready. Policy can assist in transitioning utilization products to storage projects over time. It is important to deploy CCS rapidly and set projects down technical learning and cost curves. Utilization should continue to support CCS efforts until storage logistics, including infrastructure and political support emerge.

• Government support should rise to meet the incentive gap in carbon management practices. Subsidizing carbon management is a key strategy in developing these approaches, lowering costs across the space, and creating momentum in the market for CO2-derived goods.

Next articles

This is a series of articles summarising recent key reports from The Catalyst Group Resources Carbon Dioxide Capture and Conversion (CO2CC) Program.

Look out for forthcoming issues featuring: Catalogue of Most Important Scientific Advances in CCUS Over the Past 3 Years; and Permanent Sequestration of CO2 in Industrial Wastes/Byproducts.

More information

More information about this report and other services of the CO2CC Program can be found at:

www.catalystgrp.com/tcg-resources/member-programs/co2-capture-conversion-co2cc-program/