

CARBON CAPTURE AND STORAGE SUPPLY CHAIN

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ABSTRACT

Carbon capture and storage (CCS) is the process of capturing waste carbon dioxide (CO₂) usually from large point sources, transporting it to a storage site, and depositing it where it will not enter the atmosphere, normally an underground geological formation. Due to the high investment and operating costs for CCS supply chains, this technology has not been widely adopted, but this is bound to change as emission rights become more expensive. Pipelines in combination with marine transport of liquified CO₂ are seen as an effective solution for CCS that is both flexible, as well as capable to economically move large volumes to a storage site. Accurately predicting the networks costs is crucial in making the best design decisions for the supply chain. Given the network interaction, variability, storage requirements and operating policies, simulation is a great technology to accurately predict the supply chain cost range for various design choices.

1 CARBON CAPTURE & STORAGE SUPPLY CHAIN

To minimize the impact of climate change, global industry is tasked with a major challenge to reduce CO₂ emissions. Carbon capture and storage (CCS) is the process of capturing waste carbon dioxide (CO₂) usually from large point sources, such as a cement factory or biomass power plant, transporting it to a storage site, and depositing it where it will not enter the atmosphere, normally an underground geological formation. It is a potential means of mitigating the contribution to global warming and ocean acidification of carbon dioxide emissions from industry and heating. Due to the high investment and operating costs for CCS supply chains, this technology has not been widely adopted, but this is bound to change as emission rights become scarcer and more expensive. (Figure 1)

2 CCS PROJECTS

According to the Global CCS Institute, there are now 51 large scale CCS projects around the world of which 19 in operation, 4 under construction and 28 in various stages of development. The next wave of CCS facilities will most likely be characterized by hubs and clusters. Instead of relying on a single sink and source, hubs and clusters aggregate emissions from numerous industrial and power plants, and can reduce operational and commercial risks, leading to lower costs through economies of scale. Over 15 CCS hubs and clusters are currently under development, where multiple CO₂ sources are connected in order to lower the cost and reduce the investment risk. Simulation modelling is a key technology during the design of these new supply chains. (Figure 2)

3 SIMULATION MODELLING OF CCS HUBS & CLUSTERS

CCS hubs and clusters need to transport large quantities of CO₂ in order to have both an impact as well as to benefit from economy of scale. Pipelines in combination with marine transport of liquified CO₂ are seen as an effective solution that is both flexible, as well as capable to economically move large volumes to the storage site. Accurately predicting the networks costs is crucial in making the best design decisions for all parties involved. To determine the required storage volumes (tanks), berth requirements, number of tankers in combination with operating policies, simulation modelling plays a key role as it not only calculates the CO₂ capture costs, but also includes the impact of risk and variability in elements such as transport times, water levels, production fluctuations, venting and berth interference. Simulation modelling is key in determining the optimal tradeoff between minimizing supply chain cost & maximizing carbon capture. (Figure 3)

4 ABOUT SYSTEMS NAVIGATOR

Systems Navigator is a global leader in advanced and predictive decision support technology. Since 2003, our employees are working around the globe for a wide range of customers on the most challenging projects. We assist our customers in making better decisions on where to spend their capital by demonstrating the impact of change through simulation modelling. Our Dropboard platform for planning & scheduling helps companies optimize their operations, improve customer service and maximize the use of their assets.

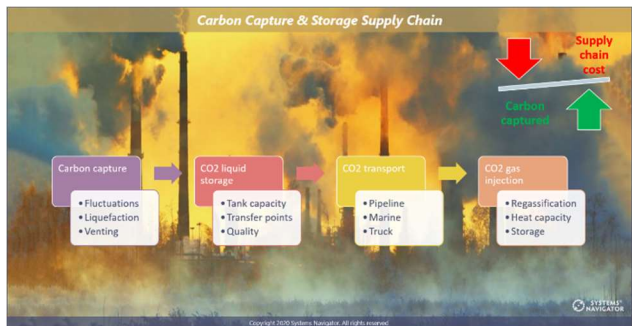


Figure 1: Modelling framework for CCS supply chains.

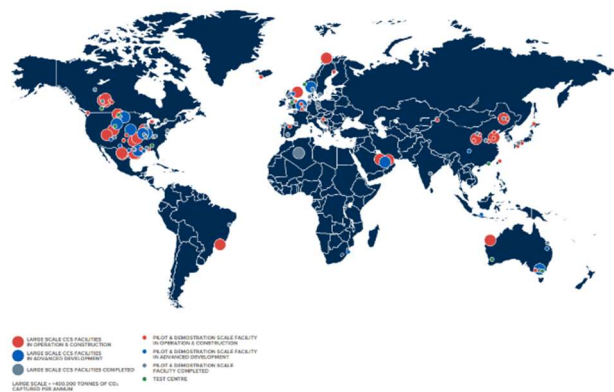


Figure 2: Global CCS projects.

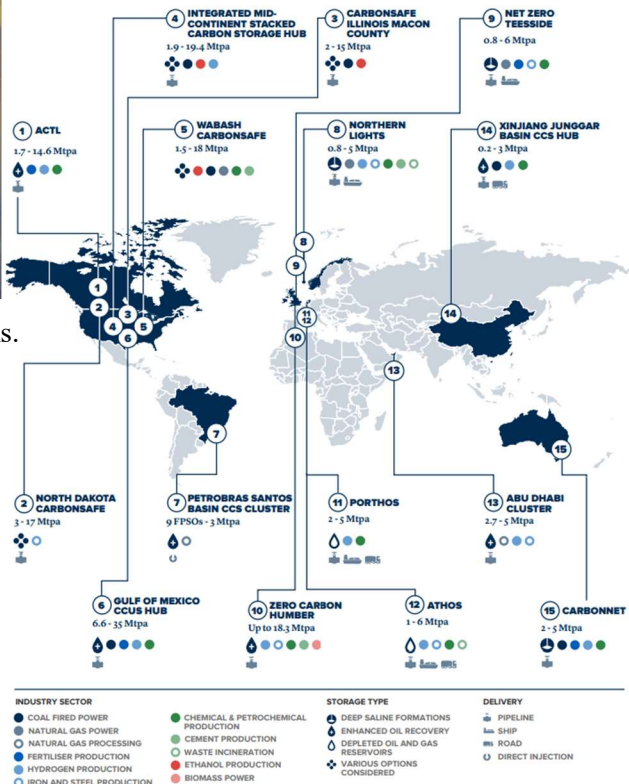


Figure 3: CCS hubs & clusters in development.