Between Capture and Storage: Insights from Piecing Together the CCUS Value Chain

Introduction

Carbon capture and storage (CCS) is an emerging but essential industry required to achieve national and global climate targets (Department for Energy Security & Net Zero, 2023). As the sector develops, both ends of the value chain are advancing in parallel: emitters are assessing capture technologies, while storage developers are characterising geological stores and maturing development plans. This approach is proving effective in industrial clusters where the government plays a role to coordinate and underwrite the full value chain. As a result pipeline solutions are progressing – as can be seen with, the HyNet and East Coast Cluster projects within the UK Track process, and the Aramis project in the Netherlands. However, outside these structured processes, integration across the CCS chain remains limited. With capture and the injection and storage elements being the most developed, while the intermediary steps-transport, conditioning and intermediate storage, are comparatively underdeveloped, Figure 1-1.

Around 50% of UK industrial emissions occur outside major clusters, with little prospect of accessing a suitable pipeline within the next decade. This highlights the need for more flexible solutions utilising road, rail and ship transportation, to enable broader participation in CCS and accelerate decarbonisation efforts (Chemical Industries Association, 2025).

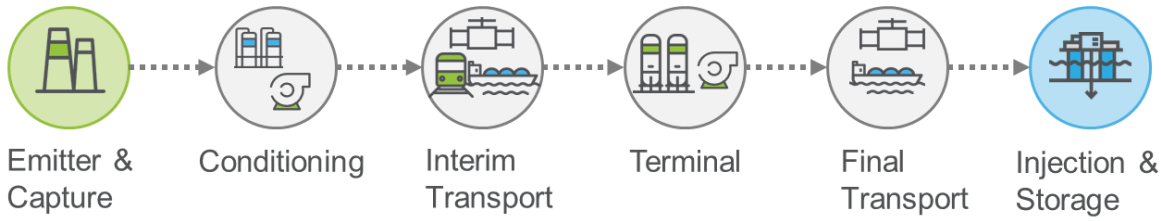

Figure 1-1: The Gap Between the Emitter and the Store

To date Goal7 has completed 55 full CCS value chain techno-economic assessments (and counting). These system wide reviews bridge the gap occurring between the detailed capture engineering and the maturing carbon storage development plans, considering the whole system feasibility and cost. This approach aligns key boundary points across the chain, identifies design optimisations, reduces energy demand and allows accelerated development pathways, ultimately producing CCS systems that are credible and cost effective.

Given that CO_2 is a waste molecule with limited inherent value, CCS solutions must be optimized holistically to minimise costs and risk in order for much needed ambitions to become a reality.

Method

Goal7 has worked across 55 full CCS value chain techno-economic assessments, these assessments consider:

- Technical: emitter site constraints, transport logistics, storage developer plans, technology readiness level, site footprints, power demand, emissions
- Schedule : key constraints across the supply chain, emitter time line, store timeline
- Economics: value chain costs, impact of power, emissions trading scheme (ETS) allowance price, duration of storage and evaluate the influence of key cost blocks
- Risks: proportioning of risk across the value chain, mitigation and opportunities

Key Insights

Figure 1-2 below shares and overview of some of the key insights that Goal7 has uncovered through the cross value-chain assessments.

From why non-pipeline transport (NPT) plays a key role in CCS even if pipelines are at face value the lowest cost solution for transport. To the importance of understanding CO_2 phase requirements across the value chain to ensure energy demand of the system minimised by limiting the number of phase changes.

Figure 1-2: Summary of Key Cross Value Chain Assessment Learnings

Pipeline are almost always the most cost effective transportation option initially but they come with a complex and long planning process and a high upfront cost with substantial stranded asset risk if there is a failure of any part of the value chain. Figure 1-3 provides an insight into this.

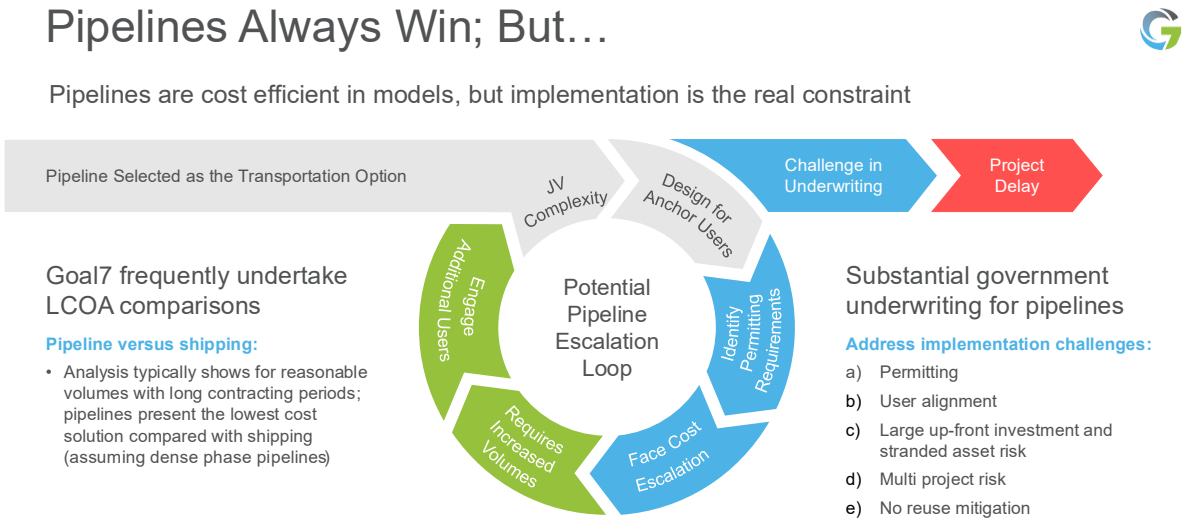

Figure 1-3: why does NPT play such an important role when pipelines are the most optimal solution?

When considering different transport modes it's important to remain aware of the CO_2 phase as the reconditioning of the molecule requires energy and so multiple phase changes adds cost to the system. Figure 1-4 illustrates different conditions on a pressure enthalpy diagram to indicate the work required to change conditions.

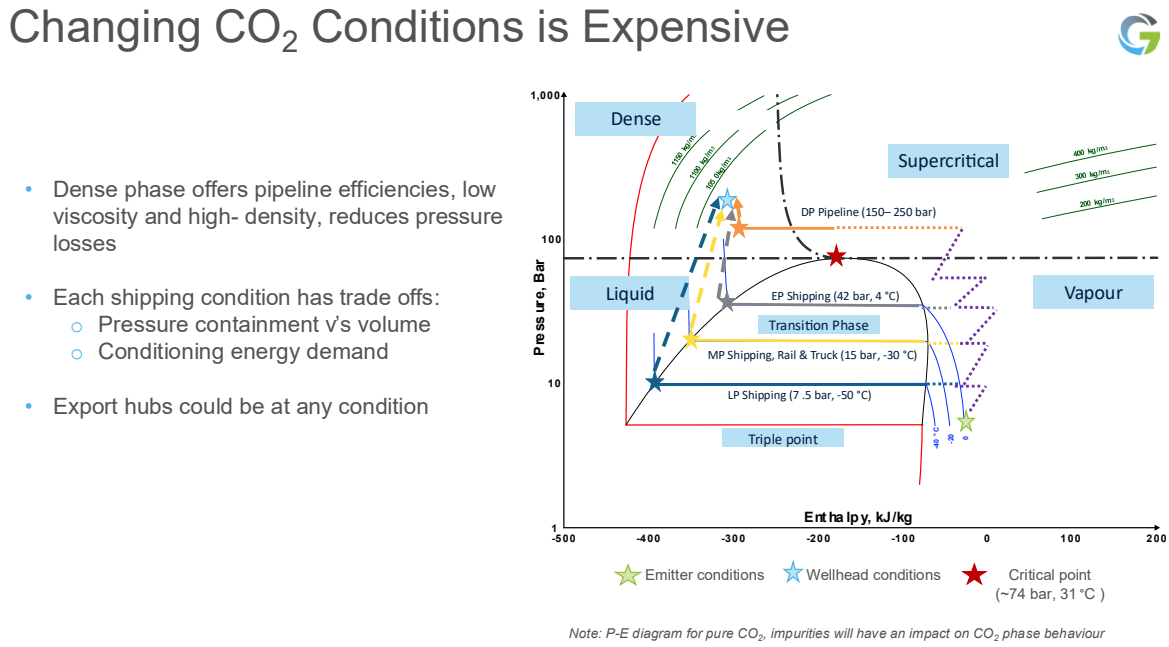

Figure 1-4: a chemical engineering perspective on value chain efficiency

Conclusions

Pipeline solutions carry significant implementation challenges and by their very nature are not very adaptable. These projects require significant government underwrite due the significant upfront investment that is required.

To develop CCS at the pace required and to provide a solution for dispersed emitters, other value chain solutions are required that lower the threshold to progress and reduce the level of government support that is required. These solutions need to be more adaptable to manage the stranded asset risk which exist in market that will remain nascent for a number of years. Transportation solutions such as road, rail and shipping will be key due their flexibility.

These solutions are more complex and cross value perspective is essential to minimise cost and risk. It is also important to consider scalability, as it is reasonable to assume initial volumes may be limited as the market establishes.

The large number of full value chain assessments that have been completed provide valuable insights for the optimisation of value chain solutions. These will be refined as further assessments are undertaken and operating experience is gained from systems that are in operation.

About Goal7

Goal7 is an energy transition advisory business. We deliver tailored services and insights to underpin strategic decision making.

The business was founded in Aberdeen in 2020, by energy industry professionals with the purpose of developing and accelerating solutions which work in balance with the world around us. Our name is inspired by the United Nations Sustainable Development Goal Number 7: clean and affordable energy.

In the current geopolitical and economic climate, we recognise that combining energy security, affordability and sustainability is essential to deliver successful, commercially viable projects.

Energy transition projects are our passion and sole focus at Goal7. Our expertise is in energy transition strategy, carbon capture, utilisation and storage (CCUS), hydrogen and emissions reduction.

We have considerable cross-value chain CCUS experience, including:

- Supporting numerous emitters with their decarbonisation and transport and storage strategy development
- Technical, logistical and economic assessment of pipeline, rail, barge, road and shipping options
- United Kingdom, Norwegian, and Netherlands carbon storage licence application support

Our expertise across the CCUS chain, and understanding of the key challenges and opportunities enables us to support our clients with pragmatic solutions, focused on credibility, efficiency and cost effectiveness.

Our team consists of engineers, chemists and scientists, as well as finance and commercial backgrounds. We support our clients with multidisciplinary teams on all our projects to integrate technical and commercial considerations, which we believe is key to success in progressing nascent energy transition projects.

References

Chemical Industries Association, 2025. *Kick-starting clean growth in the UK's industrial clusters*. Available at: https://www.cia.org.uk/energy-and-climate-change/kick-starting-clean-growth-in-the-uks-industrial-clusters/1401.article (accessed 28 February 2026)

Department for Energy Security & Net Zero, 2023. *Carbon Capture, Useage and Storage: a vision to establish a competitive market.* Available at: https://www.gov.uk/government/publications/carbon-capture-usage-and-storage-a-vision-to-establish-a-competitive-market/carbon-capture-usage-and-storage-a-vision-to-establish-a-competitive-market#fn:2 (accessed 28 February 2026)