Overview of transportation technologies for CO2

Day 2

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Overview

How to transport CO2?

There are mainly four methods to transport captured CO2.

- Pipelines
- Ships
- Train
- Truck
CO2 Transport corridors, reference scenario 2050

Pipeline Network for CO2 & Hydrogen

**Long-term Target**

- Connect industrial clusters to create a wide range CO2/Hydrogen-network

**Mid-term Target**

- Create local-scale infrastructure, to which emitters can access to.
- Boost the transition to hydrogen, by combining CCS with ‘blue’ hydrogen.

Source) https://www.porthosco2.nl/en/project/
Source) Excelling in Hydrogen: Dutch technology for a climate-neutral world (RVO)
Repurpose Gas Pipelines

Financial Hurdles

● Large investments needed to build an infrastructure of pipelines, injection wells, storage sites and compressor stations etc.

Utilise existing assets

● Several studies that aim to repurpose old gas pipelines, to reduce initial spending.

Source: https://theacornproject.uk/acorn-sapling/
Technical Challenges

Managing CO2 streams in multi-source networks, with varying flow level, flow rates or CO2 quality

What to do?

- Build a resilient pipeline-system that can cope with a changing capacity
- Create a balancing margin through intermediate storage sites
- Define quality specifications for the CO2 to be injected

Source) A Trans-European CO2 Transportation Infrastructure for CCUS: Opportunities & Challenges (Zero Emissions Platform)
Shipping

Ships for liquified CO2

Merits of CO2 Shipping

- High adaptability in changing transport distance and water depth.
- High degree of flexibility in connecting emission sources and storage sites, as well as phase to phase expansion and scale changes of individual projects.
- Less initial investments required, than to construct a pipeline.

Downsides

- Shipping induces more associated CO2 transport emissions than pipelines, due to additional energy use for liquefaction and fuel use in ships.

Offshore Unloading

Loading from ship to ship

- There are several technologies for transferring CO2 from the carrying ship. Tower-systems, Anchor-systems, Buoy-systems.
- The Ministry of Environment, Japan is conducting a demonstration project for a ship-to-ship transferring system, with an injection ship connected to the injecting well.

Source: Ministry of Environment Japan, Toward a Carbon Neutral Society Deployment of CCUS Technologies
Technical Challenges

Conditioning the CO2 at transportation and unloading, to meet injection requirements and avoid operational issues.

What to do?

- Include an intermediate offshore-storage site as a buffer, that can also manage the CO2 condition. (This would be the injection ship tested by MoE)
- Analysis of the total energy consumption and optimize the transportation chain from the point of energy efficiency.

Source) A Trans-European CO2 Transportation Infrastructure for CCUS: Opportunities & Challenges (Zero Emissions Platform)
Scaling up CO2 transportation

Comprehensive Pipeline-network

- Enable permanent and cost effective cross-border transportation, reducing operative costs of individual CCS projects and increasing the value of CO2 as an asset for possible utilization.

Larger Maritime vessels

- Connect emitting sources and injection sites over a long distance and add flexibility to maximize the efficiency of CO2-cargo logistics.