Carbon Sequestration leadership Forum
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CSLF Task Force
on
CO_2 Hubs and Infrastructure

Results and recommendation from Phase 0

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Definitions of concepts

- Cluster From GCCSI, 2016)
  - An industry cluster is a geographic concentration of interconnected businesses, suppliers, and associated institutions in a particular field. Clusters can emerge for many different reasons, including proximity to raw materials, to transport options such as ports, to labour supply, and to markets.
- Hub (from GCCSI, 2016)
  - CCS hubs are the central collection or distribution points for CO2. One hub would service the collection of CO_2 from a capture cluster or distribution of CO_2 to a storage cluster
  - Hubs could be located at the capture end or the storage end of a multi-user pipeline (forming capture/collection or storage hubs), or both.
- Network (from GCCSI, 2016)
  - A CCS hub and cluster network (network for short) brings together many of the elements along the CCS value chain (CO_2 source, capture, transport, injection, storage) with multiple co-located (clustered) source capture facilities (of the same or different types) supplying CO_2 to a shared 'oversized' transport and storage system.
- Infrastructure
  - The physical parts of the network (single or shared capture facilities; temporary storage facilities; injection facilities, pipelines, ships)

Definitions apply onshore as well as offshore.

According to these definitions, a plant or facility can be part of network without being part of a cluster.

TRM 2017: Targets and recommendations

Priority Recommendation:

Facilitate CCS infrastructure development.

- Governments and industry should work together to:

- Towards 2020
  - Design and initiate large-scale CO_2 hubs that integrate capture, transport, and storage, including matching of sources and sinks.
  - Develop commercial models for industrial and power CCS chains.
- Towards 2025:
  - Implement the first large-scale (i.e., >10 Mt CO_2/year aggregate throughput) CCS chains in power, industrial, and bio-CCS, in industrial regions that have the potential to share infrastructure,.
  - Implement initial shared infrastructure for a limited number of plants within industrial clusters.
- Towards 2035:
  - Continue progressive rollout and expansion of full-scale CCS chains and clusters in power, industrial, and bio-CCS. This includes large-scale CO_2 transport networks that integrate CO_2 capture, transport, and storage, including matching of sources and sinks.

Potential benefits of CCS networks (from TRM 2017)

- Lowering costs in building early infrastructure by utilizing benefits of connecting low-cost industrial sources with storage sites.
- Lowering costs by sharing infrastructure.
- Lowering the entry barriers for participating CCS projects, such as emitters with small-volume sources and emitters with limited or no access to local storage.
- Securing sufficient CO_2 for CO_2-EOR projects, which is likely to be an important element of some clusters because of the revenue it can contribute.
- Minimizing the environmental impacts associated with infrastructure development, as well as the impact on communities.
- Minimizing and streamlining efforts in relation to planning and regulatory approvals, negotiations with landowners, and public consultations.
- Sharing and utilizing surplus heat in the capture processes of industrial clusters.

Few technology gaps for implementing CCS networks

(GSSCI, ZEP, IEA, IEAGHG)

- Gaps, risks, and challenges are commercial and political and may include:
  - Cooperation of different industries across the CCS value chain
  - Lack of project-on-project confidence
  - Completion of projects on cost and on schedule,
  - Operational availability, flexibility, reliability
  - Financing and political aspects, and last but not least
  - Lack of business models for larger CCS systems.

Three operational networks

The Denver City

Gulf Coast

Rocky Mountains

One under construction

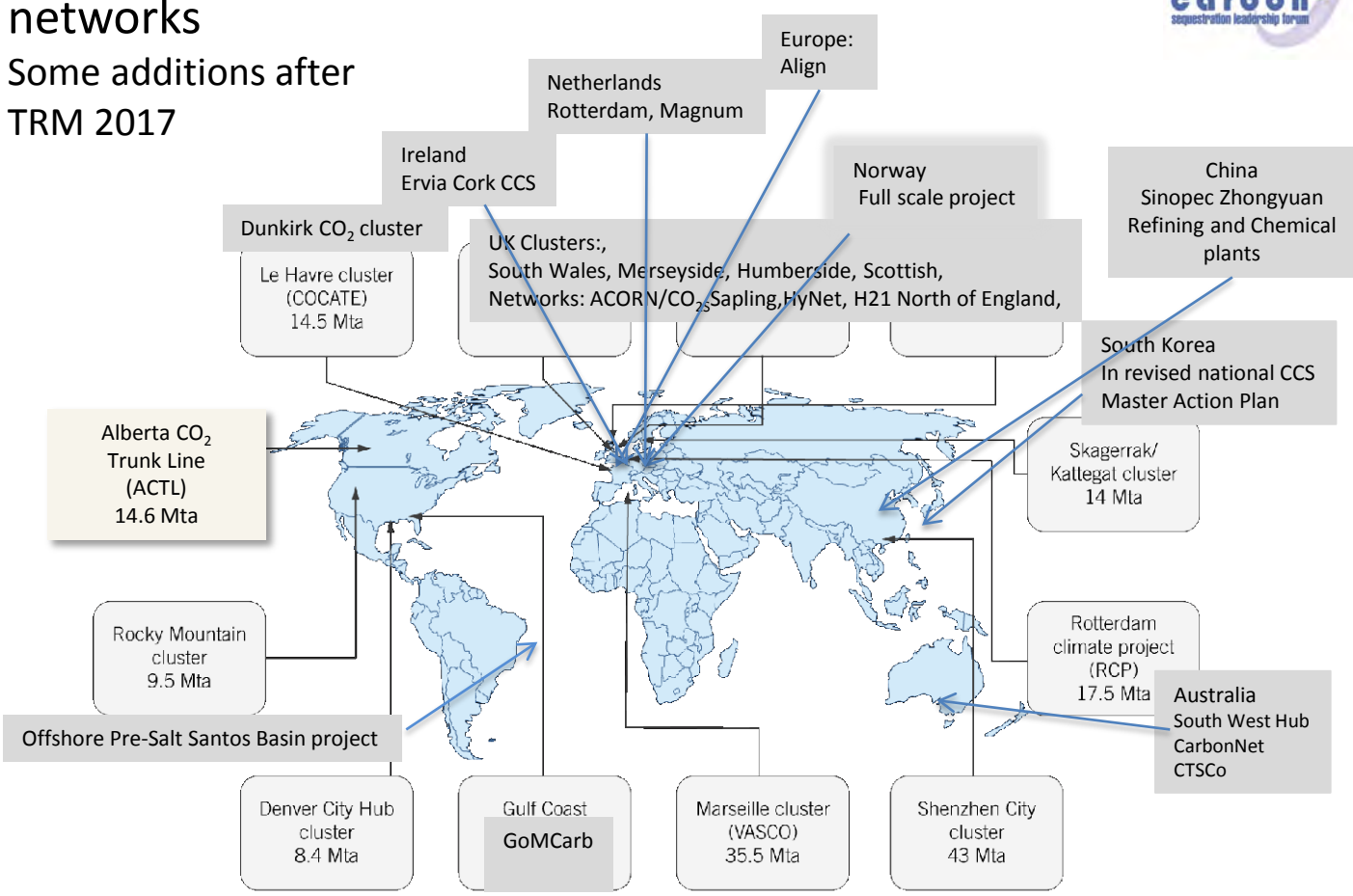
Alberta CO_2 Trunk Line

A Brazilian offshore CO_2 network

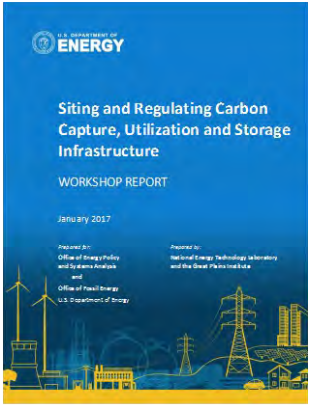
A set of FPSOs unit that incorporates CO_2 separation and injection facilities, specifically, CO_2 capture from natural gas and reinjection system for enhanced oil recovery (EOR) purposes.

Hubs, clusters and networks

Some additions after TRM 2017



Some documents not in TRM on hubs, clusters and infrastructure



Conclusions

- Only one offshore CCUS network has come online the last 15 years, no onshore infrastructure/network projects
- Only one CCUS network is in construction, with anticipated start up in 2019, increasing capacity by several Mt CO_2/y
- No project passed the Final Investment Decision (FID) gate in 2018
- Projects in advanced or early development will only add 35 -40 Mt CO_2/y by 2025, at best.
- Progress on infrastructure development is lacking behind what is necessary to reach the storage target. Strong action is required.

A clear message from the UK CCUS Cost Challenge Taskforce Report July 2018

”CCUS infrastructure is key to unlocking huge clean growth potential in the UK and can contribute to a cost-effective pathway for reducing UK CO_2 emissions”

Recommendations

CSLF:

- The Task Force continues to monitor the development of networks for CCUS, including clusters, hubs and infrastructure.
- The Task force presents updates on an annual basis (no need for an extensive Task Force report)
- CSLF should consider organising workshops in cooperation with GCCSI, IEAGHG, International CCS Knowledge Centre, CO2GeoNet, MI

Decision makers:

- The CEM Ministers and decision makers from industry should

  Facilitate (e.g., through co-funding) cross-industry projects *to ensure lowest total cost for the combined capture, transportation, utilization and/or storage infrastructure and networks.*

  This because CCUS networks are important to reach the target.

Back up

EU SET plan CCUS Implementation

- Target 4 in Plan
  - At least 1 active Project of Common European Interest for CO2 transport infrastructure, for example related to storage in the North Sea
  - Mechanism: EU Projects of Common Interest (PCI) for CO_2 transport infrastructure
  - Status. Four applicants, two received grants

Project	Promoter	Status
Teesside CO_2 Hub	Tees Valley	
CO2Sapling Transport and infrastucture	Pale Blue Dot Energy Ltd	Funded by EC
Port of Rotterdam	Rotterdam Port Authority	Funded by EC
CO_2 cross-border	Equinor	

Encouraging developments infrastructure projects

Country	Project	Status	Comments
Norway	Norway industrial CCS hub	FEED, working towards FID in 2020	FEED funding from government, exploitation permit storage site
UK	CO2Sapling	Feasibility study, working towards start of FEED in 2019	€ 3.0 mill from EU as PCI project
Netherlands	Port of Rotterdam	Feasibility study completed in April 208, continue to consolidate business case towards investment decision in 2019	€ 6.5 mill from EU as PCI project
UK	H21 North of England	Feasibility study delivered November 2018	Converting gas network to CCS decarbonised hydrogen
France	Dunkirk CO_2 cluster	In planning, pilot demonstration 2Q2021-3Q2022	CO_2 from steel plant and other ind. sources

Other developments infrastructure projects

Country	Project	Comments	Status
Australia	CarboNet	Includes multiple CO_2 capture projects in Victoria's Latrobe Valley, a shared pipeline and offshore storage in Gippsland	Several studies published; Project development, funded until 2020
	Southwest Hub	Staged project to test a potential feasiblity of geologic formations as reservoir for CO_2 from industrial sources	Extensive geologic studies completed
EU	Align	European RD&D project to tranform six industrial regions into CCUS centres	Funded
China	Sinopec Zhongyuan	CO_2 from refining and chemical plants for EOR	Operational

Other developments infrastructure projects

Country	Project	Comments	Status
Ireland	Ervia Cork CCS	Collecting CO_2 from power and refining	Studies
UK	HyNet	CCUS-equipped hydrogen network	Bids delivered for funding og Phase 1 - planning
	Teesside, Humberside, Merseyside, Scottish and South Wales clusters	Clusters of energy intensive industries with offshore storage	Extensive studies

Other developments infrastructure projects

Country	Project	Comments	Status
US	Gomcarb (w/Seacarb)	Stoarge offshore Gulf of Mexico, includes transport options and existing infrastructure	Funded by US DoE
		Workshop on siting regulatory issues for CCUS infrastucture	Workshop report January 2017
Korea		Infrastructure taken into CCS Master Action Plan	