CARBON SEQUESTRATION LEADERSHIP FORUM
TECHNICAL GROUP
Task Force on Clusters, Hubs, and Infrastructure and CCS
Update 1, period March 2019 – September 2020

September 2020

https://www.cslforum.org/cslf/sites/default/files/documents/Clusters-Hubs-and-Infrastructure-Task-Force-Report_September-2020.pdf

Report from the Clusters, Hubs, and Infrastructure Task Force of the Carbon Sequestration Leadership Forum

A Summary with updates

Lars Ingolf Eide, Research Council of Norway

Presented at
US Department of Energy and USEA
Workshop September 30, 2021

Background

Recommended priority action from CSLF Technology Roadmap (TRM) 2017 and 2021:

- Facilitate CCS infrastructure development.

The CSLF Technical Group should

- Monitor the progress
- Report the findings and suggest adjustments and updates of the TRM

https://www.cslforum.org/cslf/Resources/Publications/CSLF_Tech_Roadmap_2021_final

A Task Force established to

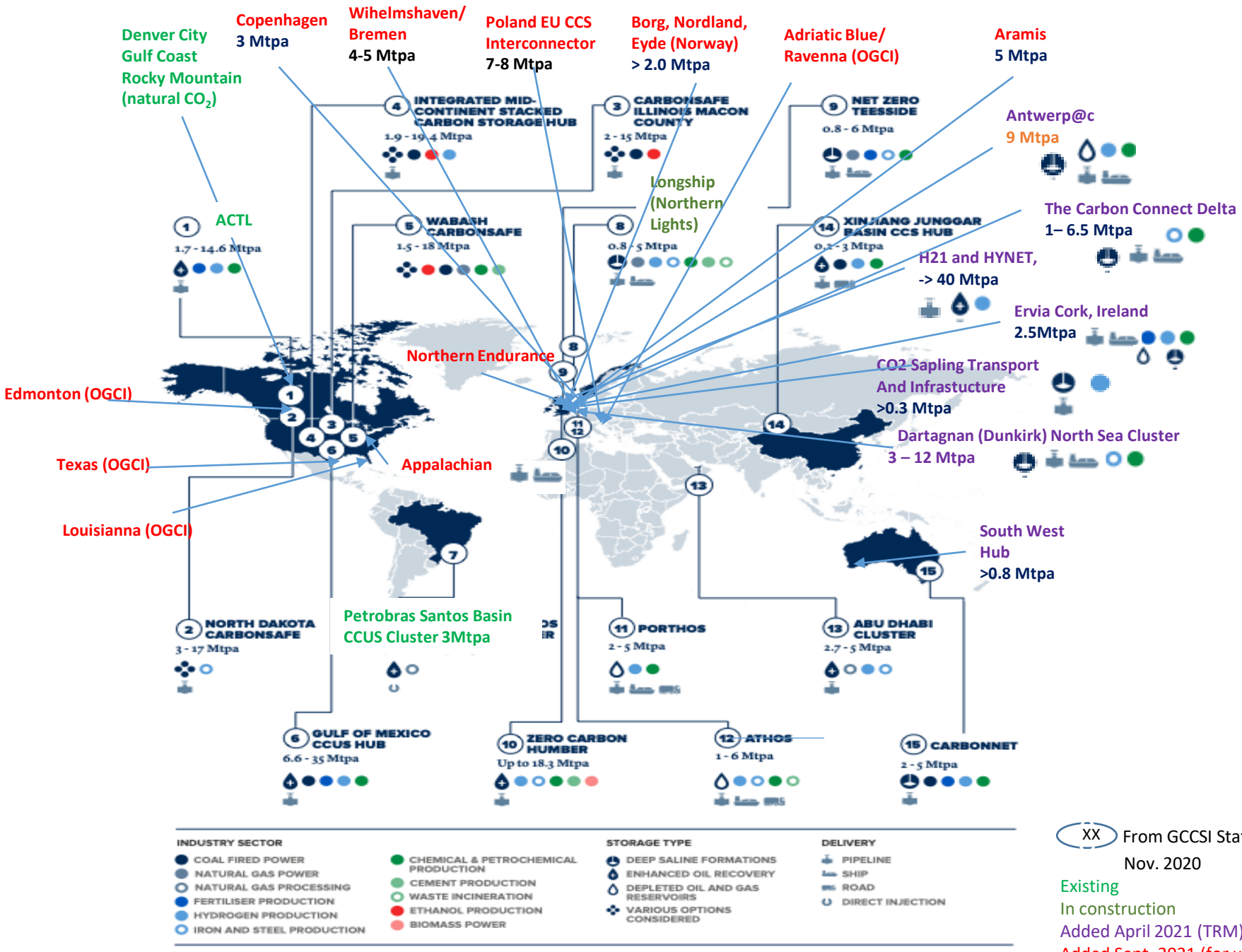
- Review of networks, existing or in construction
- Identify and review
  - Projects that have moved forward toward technically and financially
  - New studies and concepts
  - Publications that aim to progress the implementation of CCUS networks

Why clusters, hubs and infrastructure?

- Cost-sharing
  - Lowering costs in building early infrastructure by utilizing benefits of connecting low-cost industrial sources with storage sites.
  - Distributing investment and operational costs by sharing infrastructure, i.e., the cost per unit CO_2 transported will be lowered.
- Lowering the entry barriers for participating CCS projects.
- Securing sufficient and reliable CO_2 for CO_2–EOR and other CO_2 utilisation projects.
- Minimizing the environmental impacts associated with infrastructure development, as well as the impacts on communities.
- Minimizing and streamlining efforts in relation to planning and regulatory approvals, negotiations with landowners, and public consultations.
- Sharing and utilizing resources, such as heat in the capture processes of industrial clusters.

Some definitions

- 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 (modified from GCCSI, 2016)
  - CCS hubs have two meanings:
    - The central collection or distribution points for CO_2. May be common to one or more clusters
    - The storage hub, where CO_2 from the CO_2 from a collection and distribution hub are injected.
  - 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.
- Infrastructure
  - The physical parts of the network (single or shared capture facilities; temporary storage facilities; injection facilities, pipelines, ships)



XX From GCCSI Status Nov. 2020

Existing

In construction

Added April 2021 (TRM)

Added Sept. 2021 (for update)

Who participates

Types of industries

- Oil and gas companies
- Power utilities and gas distributors
- Chemical industry (fertilizers, gas, refineries etc)
- Cement industry
- Metal industry
- Waste-to-energy industry
- Port authorities

Some companies

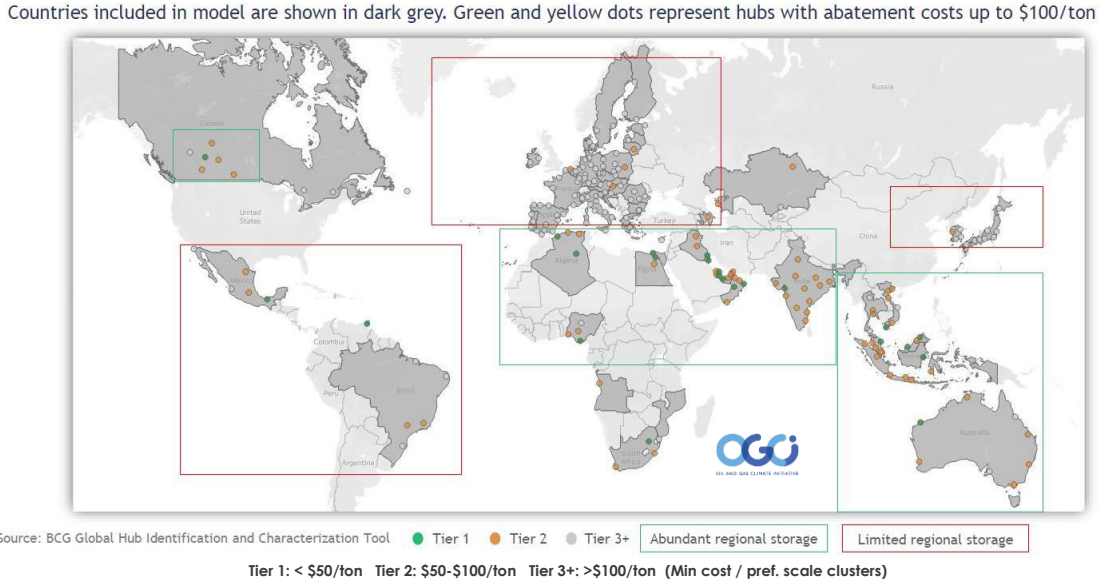
- BP, Shell, TotalEnergies, Equinor, ExxonMobil
- Drax Power, National Grid
- Air Liquide, Air Products
- Heidelberg Cement
- ~~Tata Steel~~, ArcelorMittal

The Oil and Gas Climate Initiative (OGCI)

KickStarter Global CCUS Hub Search –

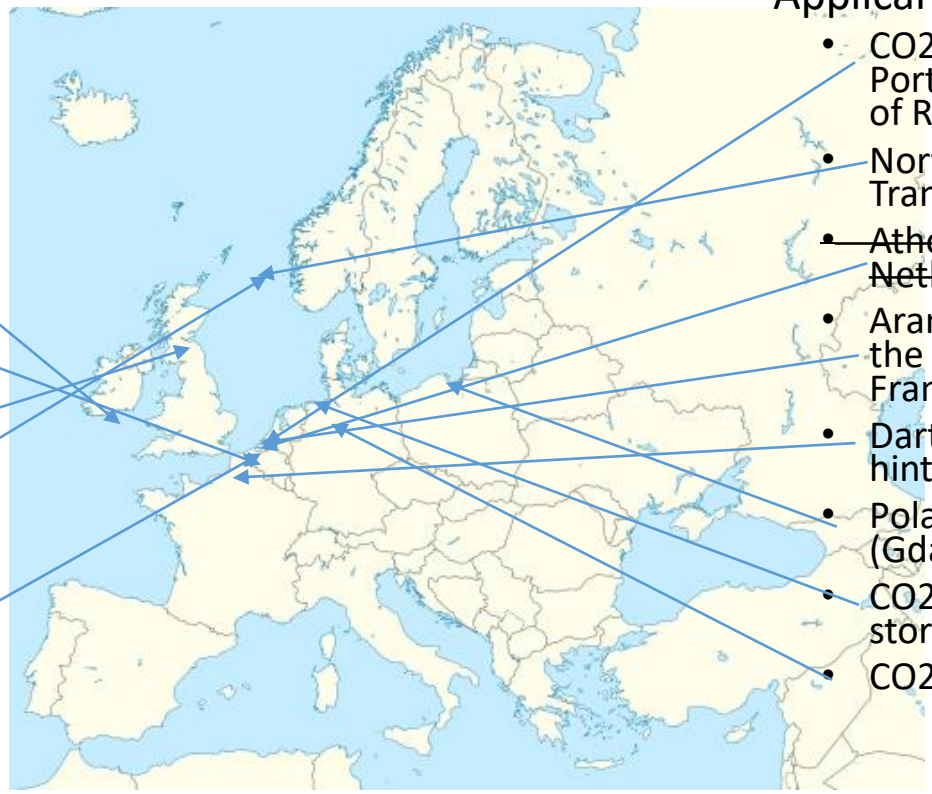
A phased approach

- Across 52 countries 212 Clusters identified accounting for 5.7 Gt CO2 annual emissions
- A total of 91 clusters (927 Mt annual emissions) identified with abatement costs below \$100/ton CO_2
- Phase II identified 82 such clusters (868 Mt annual emissions)



EU Projects of common interest (PCIs) are key cross-border infrastructure projects that link the energy systems of EU countries

- Fourth list includes five projects for cross-border CO_2 networks:
  - Ervia Cork, Ireland;
  - Port of Rotterdam (Porthos), the Netherlands;
  - Acorn (CO_2 Sapling Transport and Infrastructure Project), UK;
  - Northern Lights, Norway;
  - Port of Amsterdam (Athos), the Netherlands.



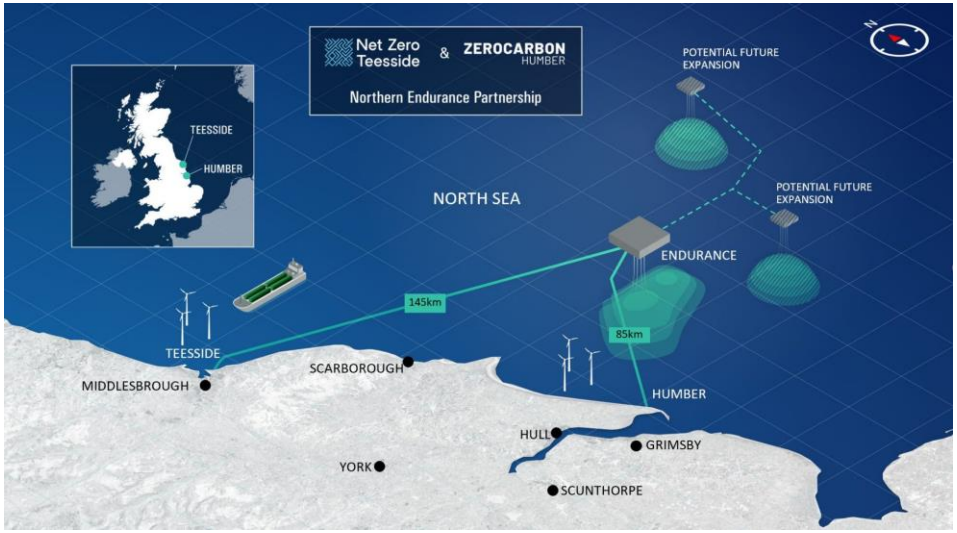
- Applicants for fifth list:
  - CO2TransPort (North Sea Port, Port of Antwerp, and the Port of Rotterdam (Porthos)),
  - Northern Lights European CO2 Transport EcoSystem (N-Lites)
  - ~~Athos (Port of Amsterdam, the Netherlands~~
  - Aramis, with member states the Netherlands, Belgium, France and Germany
  - Dartagnan (Dunkirk and hinterland)
  - Poland EU CCS Interconnector (Gdansk and hinterland)
  - CO2 liquefaction and buffer storage, Wilhelmshaven
  - CO2 pipeline Hastedt - Bremen

Synergies and status UK

Collaboration:

The UK East Coast Cluster

- A collaboration between Net Zero Teesside, Zero Carbon Humber and Northern Endurance Partnership



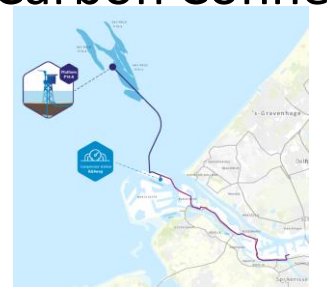
Status:

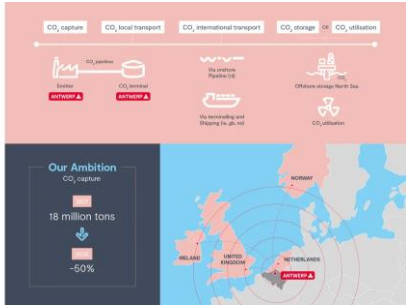
- UK - East Coast Cluster
  - Submitted common bid to BEIS as East Coast Cluster in July 2021 on behalf of Northern Endurance Partnership, Humber and Teesside

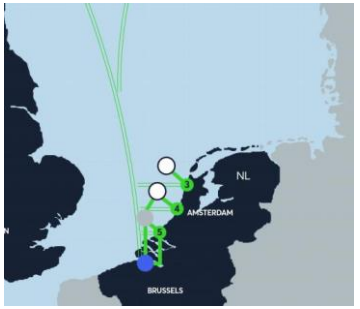
Synergies/collaboration in Europe

CO2TransPorts

- A platform for coordination between Port Authorities of Rotterdam (Porthos), Antwerp (Antwerp@c) and North Sea Ports (Carbon Connect Delta), on EU PCI candidate list







The Aramis Project

- CO_2 transport infrastructure project to aims to develop pan-European CO_2 transport and storage system (the Netherlands, Belgium, France and Germany)

Status Netherlands/Belgium/France

- September 2021: Athos terminated , decision by Tata to go for DRI
- Dutch government allocated 2.1 billion EUR to Porthos June 2021
- Projects Aramis and Dartagnan on candidate list for fifth round of EU PCIs (march 2021)

Porthos

- Final investment decision (FID) in 2022 pending on:
  - Technical development of the transport and storage infrastructure
  - Environmental Impact Assessment and permits
  - Agreements with companies to supply CO2 and with the Dutch government to enable CCUS
  - Contract awarded to Denys for design and laying onshore pipeline (June 2021)

Northern Lights/Longship
Example of how established infrastructure can attract emitters

Creation of a European CCS ecosystem and a virtuous circle

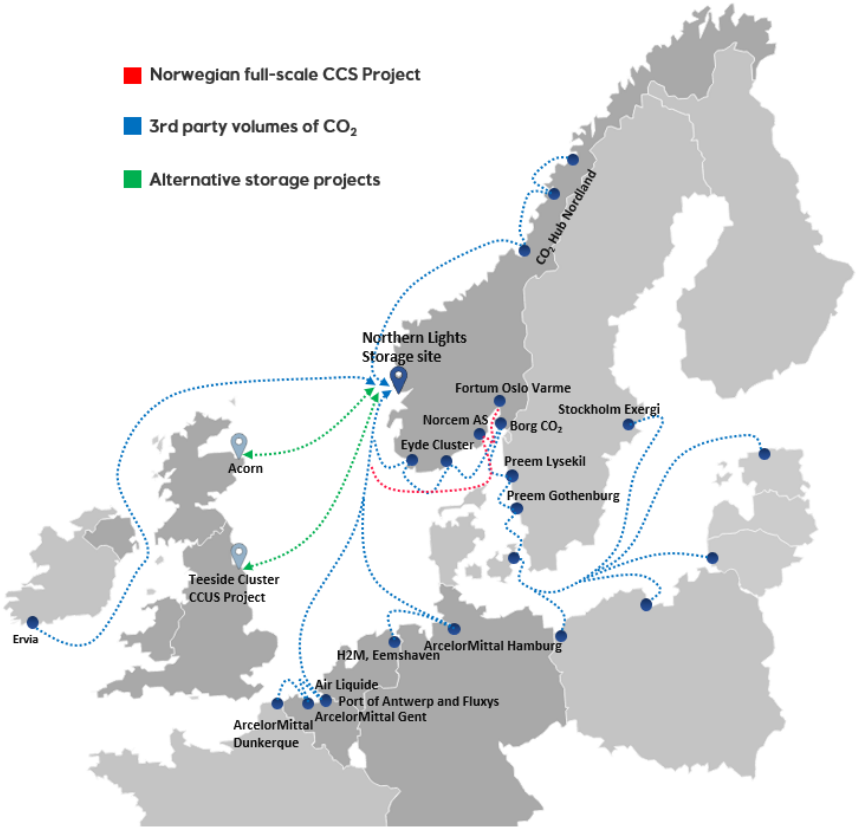
- Northern Lights CCS are being contacted by a number of companies that would like to play a role in the value chain
  - Capture
  - Transportation
  - Storage
  - Non-technical disciplines

- The Northern Lights PCI*
  - 15 partners
  - 7 countries
  - 3 reciprocal alternative storage sites

- This will stimulate
  - Innovation
  - Cost reductions
  - Jobs creation

* Projects of Common Interest (PCIs) are infrastructure projects that link the energy systems of EU countries

- A ship-based solution means for CO2 emitters across Europe



Other important initiatives

- The ALIGN-CCUS project is an ACT project funded by the European Commission and participating states, and led by the Netherlands. A strong focus of the transport work package is ship transport of CO_2. The industry clusters considered were
  - North Rhine–Westphalia, Germany;
  - Rotterdam, the Netherlands;
  - Grenland, Norway; Oltenia, Romania;
  - Grangemouth and Teesside, United Kingdom.
  - https://www.alignccus.eu/about-project

- The CarbonSAFE programme in the United States.

Some further reading

- OGCI: https://www.globalccsinstitute.com/wp-content/uploads/2021/07/Developing-CCS-Projects-in-Alberta.pdf (OGCI Kickstarter a bit down in presentation)
- EU PCI: https://ec.europa.eu/energy/sites/default/files/detailed_information_regarding_the_candidate_projects_in_co2_network.pdf
- IEA: https://www.iea.org/reports/ccus-in-clean-energy-transitions/regional-opportunities (also in IEA Energy Technology Perspectives, Special Report on CCUS)
- IOGP: https://www.oilandgaseurope.org/wp-content/uploads/2020/06/Map-of-EU-CCS-Projects.pdf

Thank you for the attention

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