Panel Discussion International CCUS Activities

Update and European Perspectives from IEAGHG

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Pittsburgh, 30 August 2023

Who are we?

Our internationally recognised name is the IEA Greenhouse Gas R&D Programme (IEAGHG). We are a Technology Collaboration Programme (TCP) and are a part of the International Energy Agency's (IEA's) Energy Technology Network.

Disclaimer

The IEA Greenhouse Gas R&D Programme (IEAGHG) is organised under the auspices of the International Energy Agency (IEA) but is functionally and legally autonomous. Views, findings and publications of the IEA Greenhouse Gas R&D Programme do not necessarily represent the views or policies of the IEA Secretariat or its individual member countries.

IEA Greenhouse Gas R&D Programme (IEAGHG)

- A collaborative international research programme founded under International Energy Agency in 1991
- Aim: To provide information on the role that technology can play in reducing greenhouse gas emissions from use of fossil fuels and biomass in power and industrial systems.
- Focus is on Carbon Dioxide Capture and Storage (CCS)
- Producing information that is:
  - ✓ Objective, trustworthy, independent
  - ✓ Policy relevant but NOT policy prescriptive
  - ✓ Reviewed by external Expert Reviewers


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ELECTRIC POWER RESEARCH INSTITUTE
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IEAGHG Primary Activities

- Funding research into development and deployment of CCUS technologies
- Technical Reports >356 reports published on all aspects of CCUS
- International Expert Networks Risk Management; Monitoring; Modelling; Environmental Research; High Temperature Solid Looping; Costs; Social Research
- Conferences
  - GHGT conferences (the largest global conference on CCS)
    - GHGT16 – 23-27 Oct 2022, Lyon France
    - GHGT17 – 20-24 Oct 2024, Calgary
  - PCCC conferences – PCCC7, NETL Pittsburgh, 25-27 Sep 2023
  - Negative CO_2 Emissions conference – Summer 2024 Oxford
  - International CCS Summer Schools
    - 15th in the Series held July 2023, Regina, Canada
    - 16th TBC – Australia, July 2023

Recent reports (2022-2023)

- 2022-01 Criteria for Depleted Reservoirs for CO_2 Storage
- 2022-02 Current State of Knowledge Regarding the Risk of Induced Seismicity- at CO2 Storage Projects
- 2022-03 Prime Solvent Candidates for Next Generation of PCC Plants
- 2022-04 From CO_2 to Building Materials – Improving Process Efficiency
- 2022-05 Feasibility Study on Achieving Deep Decarbonization in Worldwide Fertilizer Production
- 2022-06 Blue Hydrogen: Beyond the Plant Gate
- 2022-07 Low-Carbon Hydrogen from Natural Gas Global Roadmap
- 2022-08 Start-Up and Shutdown Protocol for Power Stations with CO2 Capture
- 2022-09 Defining the Value of CCUS for a Low Carbon Future

Recent reports (2022-2023)

- 2022-10 Mineral Carbonation using Mine Tailings – A Strategic Overview of Potential and Opportunities
- 2022-11 Applying ISO Standards to Geologic Storage and EOR Projects
- 2023-01 Integrating CCS in International Cooperation and Carbon Markets under Article 6 of the Paris Agreement
- 2023-02 Prospective Integration of Geothermal Energy with Carbon Capture and Storage
- **Technical Reviews**
- CDR Workshop Bergen Norway 28 June 2022
- 5th International Workshop on Offshore Geologic CO_2 Storage

IEAGHG events 2023

- High Temp Solid Looping Capture Network – 14-15 March, Piacenza, Italy
- Cost Network – 12-13 April, Groningen, The Netherlands
- Risk Network – 28-29 June, Edinburgh
- Summer School – 9-15 July, Regina, Canada
- Monitoring Network – 8-9 Aug, Baton Rouge, USA
- Offshore CCS Workshop – 13-15 Sept, Aberdeen (virtual option)
- PCCC7 – 25-27 Sep, Pittsburgh

- The largest international conference for the CCUS community, the 17th in the series takes place in Calgary, Canada 20-24 October, 2024
- Hosted by Emissions Reduction Alberta (ERA)
- Call for abstracts opens September 2023 to select 355 oral presentations and posters for the 7 stream technical programme
- Sponsor prospectus available September 2023
- www.ghgt.info

Input to WPFE

United Nations Framework Convention on Climate Change

CCS Side Events at COP20, COP21, COP22, COP23, COP24, COP25, COP26, COP27

carbon sequestration leadership forum

CSLF Technical Group
IEAGHG inputs

Knowledge Transfer

ipcc INTERGOVERNMENTAL PANEL ON climate change

Expert Reviewers, Accredited Observer
AR6 reviews
AR6 – 98 comments provided

CLEAN ENERGY MINISTERIAL
Advancing Clean Energy Together

CCUS Initiative
IEAGHG inputs

Zep Zero emissions platform

IMO

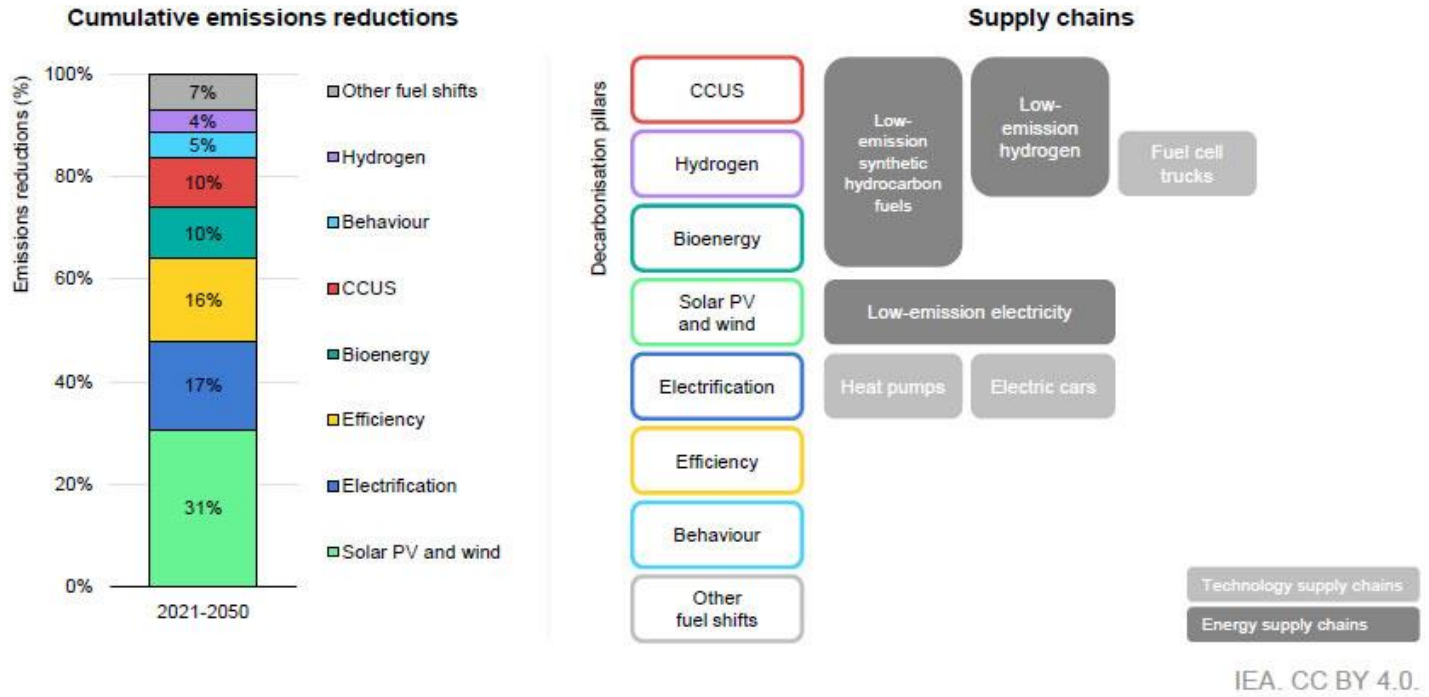
London Convention:
Regular updates on CCS:
ROAD permit assessment, Offshore workshops
CO_2 Export Resolution 2019

ISO TC-265
IEAGHG inputs

ISO

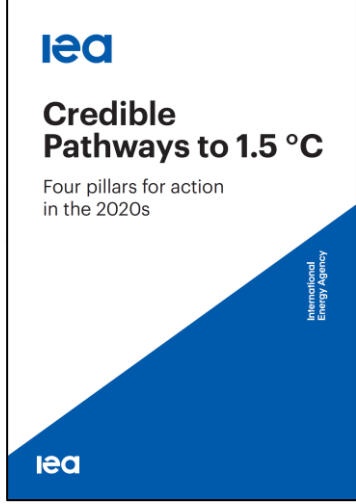
IEA – Net Zero Emissions by 2050 (NZE)

Figure 1.5 Global cumulative energy sector CO_2 emissions reductions by decarbonisation pillar and clean energy and technology supply chains studied in *ETP-2023*, 2021-2050



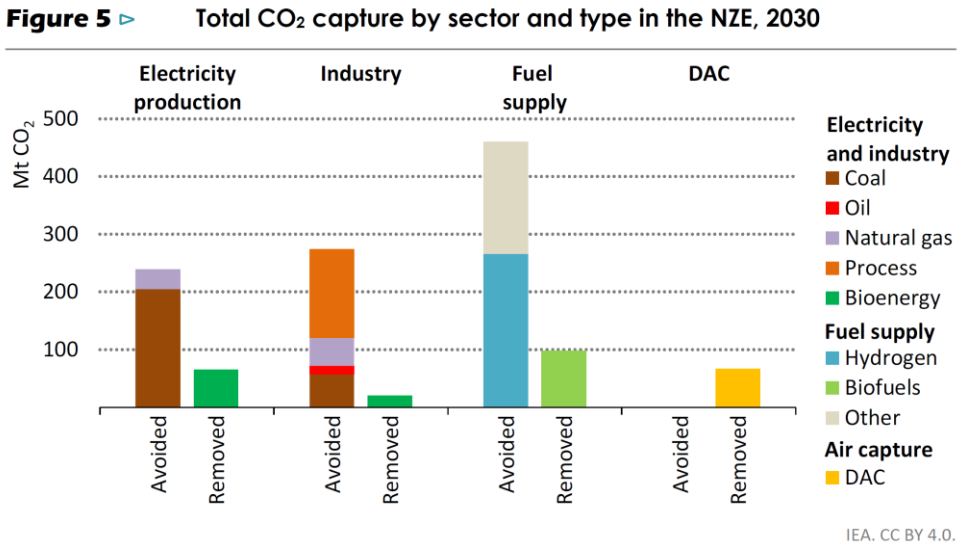
Six clean energy and technology supply chains hold the potential to unlock around 50% of cumulative emissions reductions to 2050 in the NZE Scenario.

IEA Credible Pathways to 1.5C (2023)



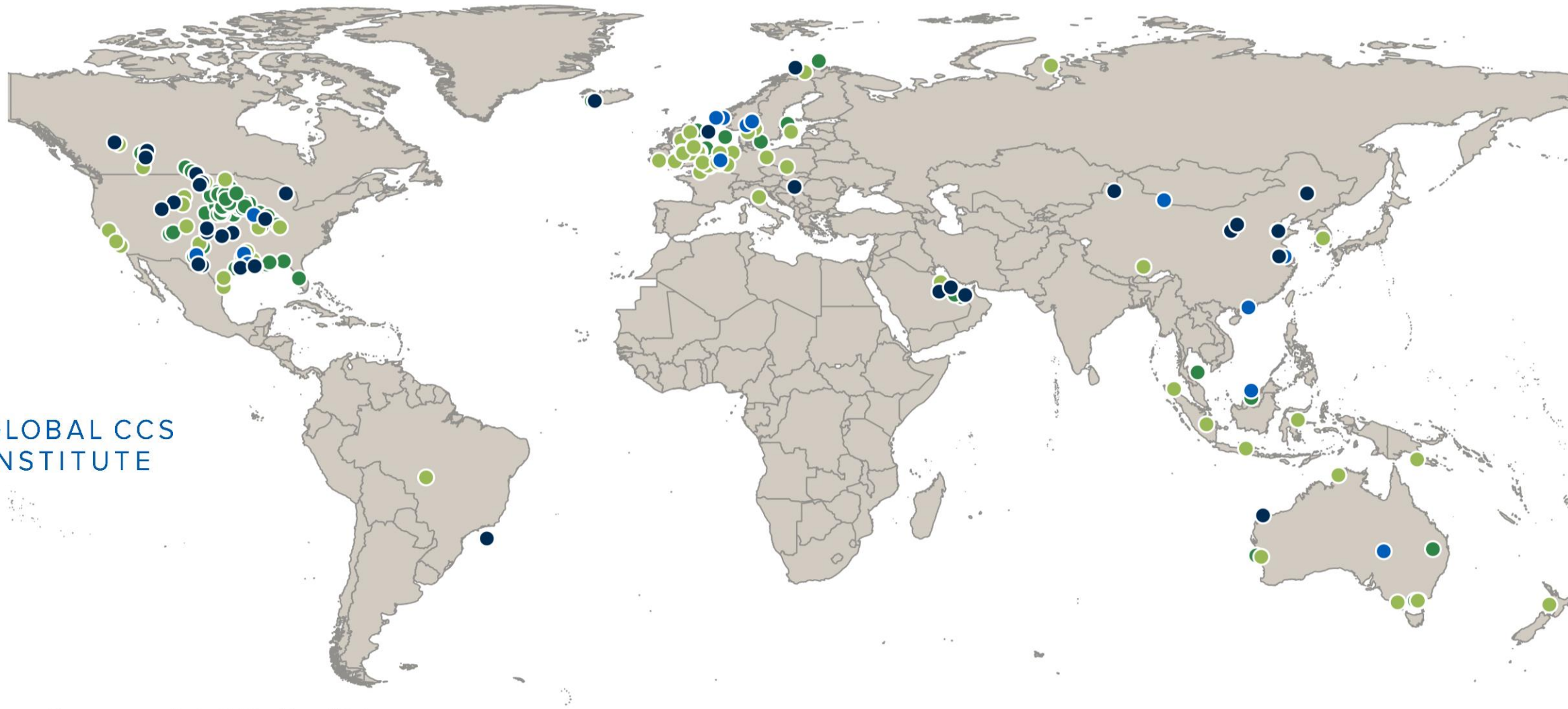
Four Pillars for action in the 2020s:

1. Decarbonising electricity
2. Reducing deforestation to zero
3. Tackling non-CO2 emissions
4. Carbon Management: CCS and CDR
   - 1.2Gt pa by 2030



President Biden supports these Four Pillars at MEF and announced a "COP28 Carbon Management Challenge"

- To accelerate development and deployment of CCUS and CDR. To be launched at COP28.
- Supported by Denmark, Australia, Canada, Egypt, the European Union, Japan, Saudi Arabia, UAE, Norway, UK, Brazil, Sweden. And IEAGHG and other CCS organisations



GLOBAL CCS INSTITUTE

2023

Commercial CCS Facilities

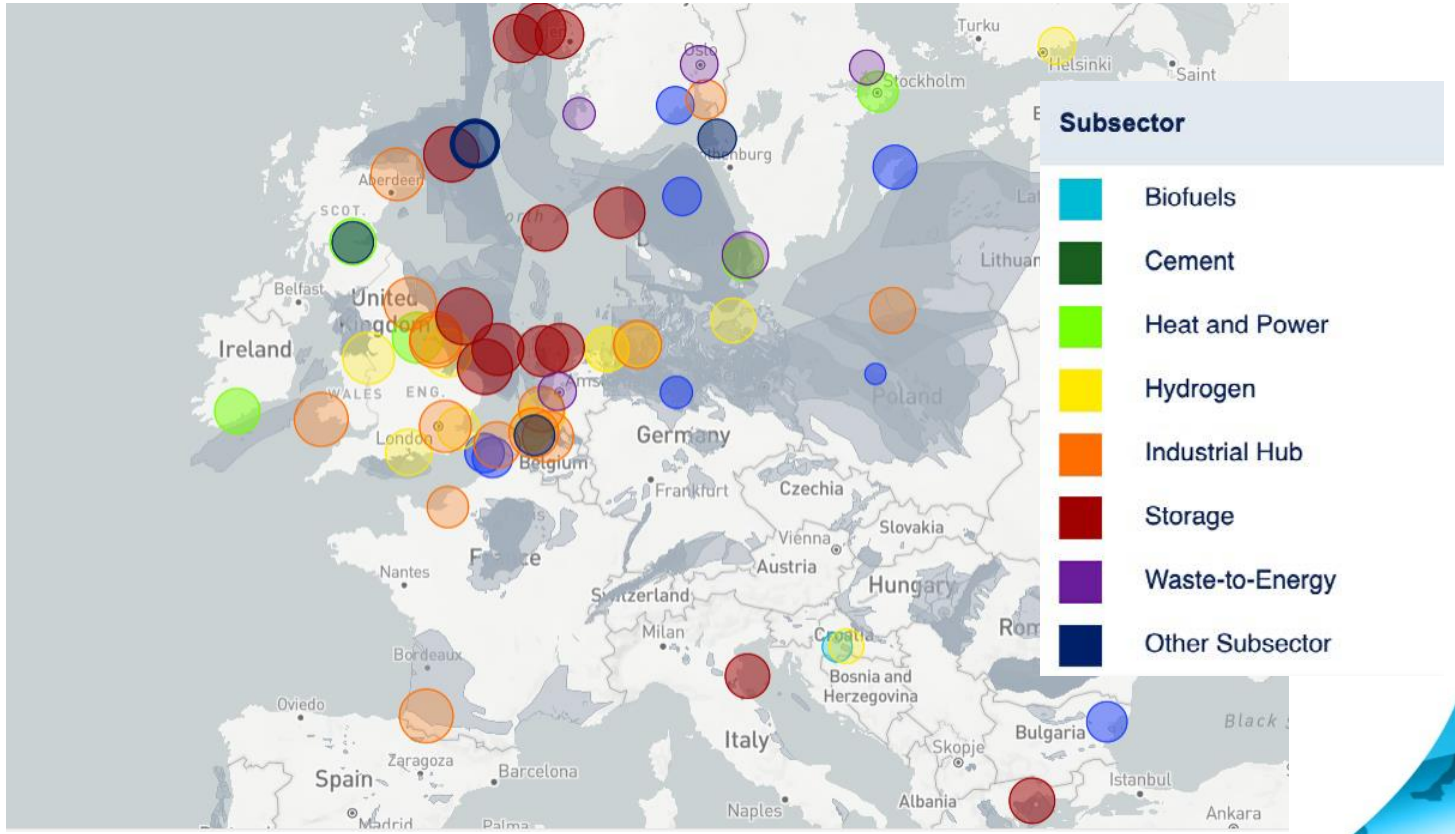
Operational · In Construction · Advanced Development · Early Development

International Updates

- **Europe** Nicola Clarke, IEAGHG
- **Canada** Saviz Mortazavi, Natural Resources Canada
- **Japan** Yumiko Hata, Ministry of Economy, Trade and Industry, Japan
- **China** Tao Wang, Zhejiang University

CCS Projects in Europe

- Over 100 projects in Europe are at various stages of development
- 13 CCS projects supported by EU's Innovation Fund
- Long term support in the Netherlands, Denmark, UK, Sweden based on carbon contracts for difference model
- Emerging support in France, Germany and Austria
- Most projects face economic shortfall and inadequate access to storage
- FID for projects associated with Norway's Northern Lights



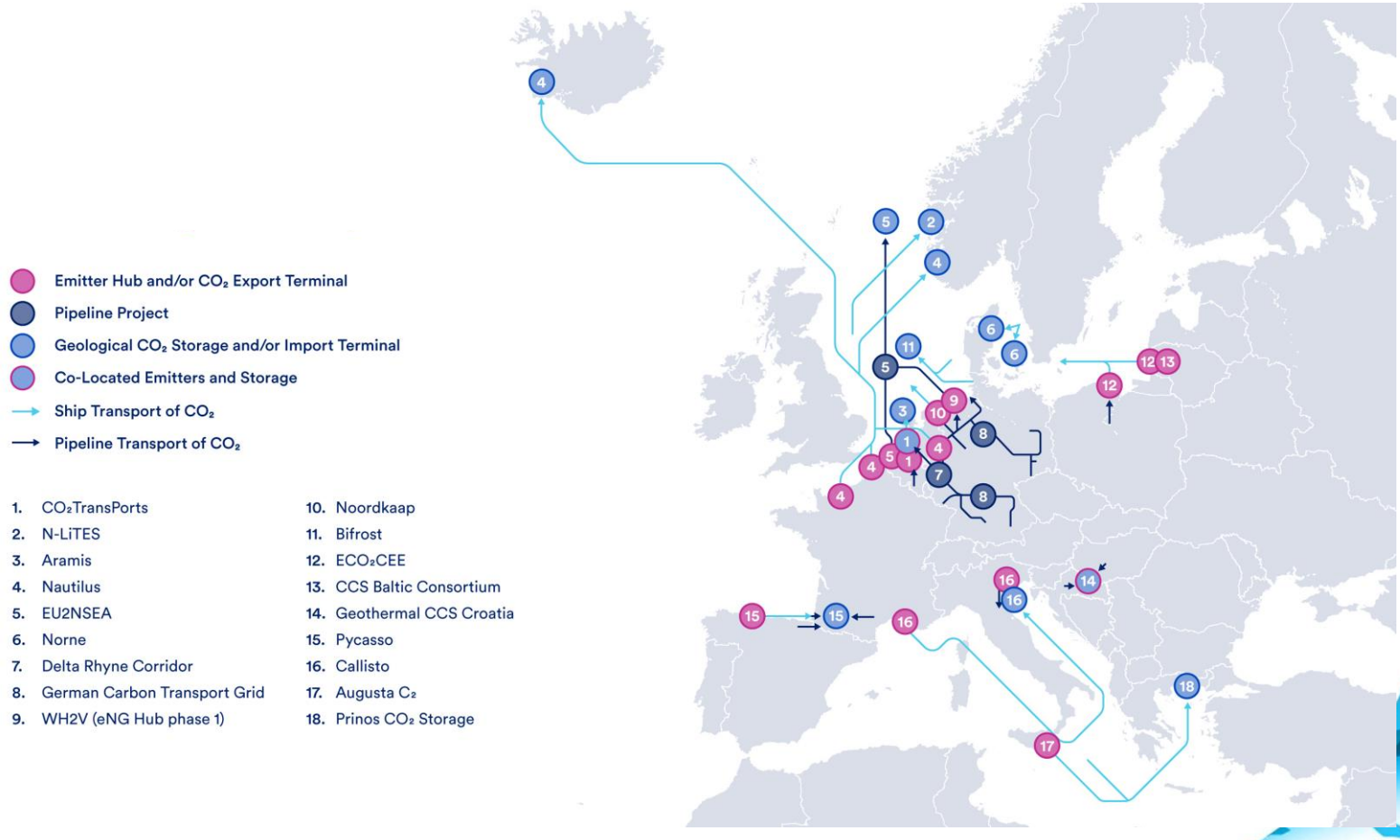
https://www.catf.us/ccsmapeurope/

Net Zero Industry Act

- Sets a 50 Mt target for storage capacity in the EU by 2030 (not including Norway) – *(art 17) storage is currently a bottleneck in Europe.*
- An obligation on Member States to share storage data and declare carbon capture and storage plans and needs – *(art 18) create European Storage Atlas*
- An obligation on oil and gas companies to share data and develop storage capacity in proportion to their production – *(art 18 & 19)*
- Accelerating CO_2 Storage site development – *(art 13, 10) storage permit within 18 months and streamlined process*

Projects of Common Interest (PCI) under the Trans-European Network for Energy (TEN-E) regulation

- EU scheme to promote cross-border energy infrastructure
- 18 projects in latest list – growing momentum. Across broader geographical reach
- North Sea still major focus with shipping a popular choice, but ambitions to include pipeline
- Onshore projects are starting to emerge
- Inland projects need to connect to export terminals
- Southern Europe emergent with new wave of proposals



Carbon Price as a driver to decarbonisation

- Carbon price under ETS is the primary driver of decarbonisation
- Projected to rise to over 120 Euro/t by 2030
- Increased interest in CCS fuelled by recent strength in price
- How many facilities can do carbon capture and storage at this cost?
  - Many inland facilities will struggle without support e.g. infrastructure and/or policies
- New transport links and storage site could help lower the cost.

Key takeaways

- Renewed focus on wider storage development benefitting geographically dispersed industries. NZIA will be a key driver
- An extensive cross-border transport network is needed to establish level playing field away from North Sea periphery or coastal clusters
- There will be more detail in the EU Industrial Carbon Management Strategy (November 2023), including regulatory framework and technical standards for CO_2 transport networks.
- Only one FID has been taken, to meet CO_2 storage ambitions many more will be required over next 25 years.

Country overview I

- Norway:
  - $1.8 billion state funding for Northern Lights (storage), capture at cement and WtE plants. Provides surplus storage.
  - Awards of new storage exploration licences, 2 licences (March 2023)
- UK:
  - £20 billion over 20 years funding for CfD-based support to CCS in power, industry, hydrogen, CDR and £1 billion grant for infrastructure. Target 20-30 Mtpa by 2030.
  - Priority clusters selected, Track-1 (HyNet and East Coast Clusters) and Track-2 (Acorn, Scotland and Viking, Humber region). Other clusters include Solent, South Wales and Peak Clusters
  - Storage licence round completed, 20 licences granted (May 2023).
- Denmark:
  - Significant support in a short amount of time. $3.9 billion package announced Aug 23, capture 3.2 MT/a by 2029
  - Offshore storage licences awarded and onshore projects being developed e.g. Greensands, pilot inj March 2023
  - First FID awarded (Kalundborg Hub June 23).
- Netherlands:
  - Capture projects supported under CCfD based SDE++ fund.
  - Porthos project (Rotterdam) received green light to proceed, 2.5 Mt/a CO2 reduction (Aug 2023)
  - Aramis offshore storage and pipeline under development

Country overview II

- Sweden:
  - CfD based support scheme for BECCS. EU funding for bioenergy plant in Stockholm. Other projects include Slite CCS (Heidelberg Cement) capture 1.8 Mt/a CO_2.
- Germany
  - Carbon Management strategy expected 2023.
  - Eligibility under new CCfD scheme for industrial decarbonisation
  - Country-wide CO_2 pipeline network proposed by OGE.
- France
  - CCUS strategy out for consultation (closing Sept 2023) – 4-8.5 Mt/a CO2 captured by 2030 and reduce GHG emissions by 50% by 2030 and carbon neutrality by 2050.
  - Several low-carbon industrial clusters under development and an onshore storage site proposed.
  - EU funding for two projects (Dunkirk)
- Belgium
  - National CO_2 pipeline network planned.
  - CO_2 capture and export hub planned in Antwerp (EU funding)
  - Regulatory mechanism for CO_2 transport in Flanders.

Country overview III

- Italy:
  - Major offshore storage hub proposed (Ravenna, ENI) but no funding support yet.
- Poland:
  - Recent move to allow large scale CO_2 storage
  - EU funding for capture plant at Kujawy cement
  - Export facility planned for Gdansk (coordination between Poland and Lithuania)
- Greece:
  - Offshore storage planned at Prinos
- Iceland:
  - Long term strategy is net zero by 2040 (2020 Climate Action Plan) – broad political support, cheap renewable energy, favourable geology, and growing ecosystem of innovative companies.
  - Climeworks Orca is still largest active DAC project in the world
- Other:
  - Baltic consortium, cross border project Lithuania and Latvia with export terminal Klapeda in Lithuania
  - Combined capture/storage projects proposed in Bulgaria (EU funded) and Croatia (EU funded)
  - Ireland Cork CCS project, using depleted gas fields in Celtic Sea

Update on Europe from IEAGHG

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