ETS Innovation Fund’s closed-door knowledge sharing workshop:

The emerging EU CO2 transport and storage market

*Closed Door Workshop*

30 March 2023, 09:30h-17:30h
Welcome and Information

The goal: Joint discussion with EU co-funded CO2 capture operators and CO2 cross-border network developers & prospective CO2 storage operators in the EU & Member States experts

The Topic: Timely operational availability of the CO2 storage sites.

The Modus: Chatham House rules, i.e. the topics discussed can be referred to in general terms, but one cannot disclose who said what.

The Results:
- An anonymised public summary of the meeting discussion will be prepared and published.
- Useful contacts & exchanges of views among front-runners

Your Comments & Questions: Post your questions and comments for the open discussion on Slido and vote up the topics that most interest you.
Overview

• Innovation Fund projects will in total capture around 4.6 Mt CO2 per year that need to be transported and stored in Europe by 2028. With ANRAV (own carbon storage on the Black Sea) the total GHG to be stored in Europe is 5.3 Mt CO2 per year.

• Connecting Europe Facility Projects of Common Interest (PCI) will contribute to the workshop with the most recent developments on planned cross-border CO2 infrastructures.

• CO2 storage operators will provide an update on the development stage of their storage sites and the capacity they plan to offer to the market until 2030.
## Timeline and volumes of the storage needs

<table>
<thead>
<tr>
<th>Project acronym</th>
<th>Location</th>
<th>EU contribution (EUR)</th>
<th>Entry into Operation</th>
<th>GHG emission avoidance per year (Mt CO2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kairos@C</td>
<td>Belgium</td>
<td>356,859,000</td>
<td>Q4 2026</td>
<td>1.4</td>
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<tr>
<td>Beccs Stockholm</td>
<td>Sweden</td>
<td>180,000,000</td>
<td>Q2 2027</td>
<td>0.78</td>
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<td>GO4ECOPLANET</td>
<td>Poland</td>
<td>228,210,004</td>
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<td>K6</td>
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<td>Q1 2028</td>
<td>0.8</td>
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<td>CalCC</td>
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<td>125,198,197</td>
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<td>ANRAV</td>
<td>Bulgaria</td>
<td>189,694,949</td>
<td>Q2 2028</td>
<td>0.78</td>
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<td>1,233,348,748</td>
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</tbody>
</table>
Agenda

1. Policy introduction & update by the Commission services (9:30 - 10:00h)

2. CO2 storage developments in MS – part 1 (10:00 - 11:00h)

   11:00 – 11:30h Coffee break

2. CO2 storage developments in MS – part 2 (11:30 - 12:30h)

3. Storage support programmes in Europe (12:30 - 13:15h)

   13:15 – 14:30h Lunch break

4. Needs of CO2 capturing projects supported by the Innovation Fund (14:30 - 15:15h)

5. Cross-border CO2 network developments supported by TEN-E (15:15 - 16:00h)

   16:00 – 16:30h Coffee break

6. Questions and moderated open discussion (16:30 - 17:30h)

   17:30h End of the meeting
INNOVATION FUND
Deployment of net-zero and innovative technologies

Funding through Grants and Auctions → EUR 40 billion* to invest from 2020-2030 in EU’s climate neutral future → Avoid emissions and boost competitiveness

Supporting manufacturing, production and use in:

- Energy intensive industries
- Renewables
- Energy storage
- Carbon capture, use and storage
- Net-zero mobility and buildings

*based on a carbon price of 75 EUR/tonne
**Innovation Fund project portfolio**

**Green:** Large-scale projects (23 awarded or pre-selected for grant)*

**Blue:** Small-scale projects (47 awarded or pre-selected for grant)*

- Biofuels and biorefineries
- Chemicals
- CO₂ transport
- Hydrogen
- Intra-day electric power generation and heating/cooling
- Iron and steel
- Non-ferrous metals
- Glass, ceramics and construction material
- Manufacturing of components for renewable energy
- Manufacturing of components for energy storage
- Other energy storage
- Geothermal energy
- Pulp and paper
- Refineries
- Cement and lime
- Use of renewable energy outside Annex 1
- Other energy intensive industries

*The number of symbols is higher than the number of projects, as some projects are implemented in multiple locations

4.6 mt/a CO₂ with EU support on offer by 2028!
Within its first two years, the Innovation Fund has already awarded 70 projects with more than EUR 3bn

- GHG emission avoidance reduction planned over the first 10 years of operation: 213 Mt CO$_2$eq
- Projects awarded or still under grant preparation (23 large and 47 small): 70 projects
- Grants already committed or under commitment: $\approx$ EUR 3 bn grants
- $\approx$ 450 large-scale proposals
- $\approx$ 300 small-scale proposals received

Innovation Fund website, Current Large Scale Call for EUR 3bn, Dashboard, Project fiches
More to come: 3\textsuperscript{rd} LSC with EUR 3 billion

<table>
<thead>
<tr>
<th>Topic</th>
<th># proposals received</th>
<th># proposals that can be funded based on average grant request</th>
<th>Factor of budget oversubscription*</th>
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<tbody>
<tr>
<td>General Decarbonisation</td>
<td>98</td>
<td>8</td>
<td>12</td>
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<tr>
<td>Industry electrification and hydrogen</td>
<td>71</td>
<td>9</td>
<td>8</td>
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<tr>
<td>Clean tech manufacturing</td>
<td>39</td>
<td>12</td>
<td>3</td>
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<tr>
<td>Pilots</td>
<td>31</td>
<td>14</td>
<td>2</td>
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<tr>
<td>Total</td>
<td>239</td>
<td>32</td>
<td>8</td>
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</table>

* Subject to admissibility and eligibility verifications

- General Decarbonisation EUR 1 bn
- Industry electrification and hydrogen EUR 1bn
- Clean tech manufacturing EUR 700 m
- Pilots EUR 300 m

Launch: 03 Nov. 2022
Deadline: 16 March 2023
Results: July 2023
Towards a **CCUS Strategy for the EU**

- **Autumn 2022**
  - Stakeholder inputs to CCUS Forum plenary meeting
  - Launch of two EC studies on:
    1. JRC: transport and storage infrastructure needs;
    2. markets, business cases, regulatory options

- **Q1 2023**
  - Launch of update CCS Guidance Documents
  - CCUS Forum WGs finalise position papers

- **Q2-Q3 2023**
  - Public consultation launched
  - IF projects find storage services (TBC)
  - Regular CCUS Forum WG meetings
  - National CCS Directive Implementation reports (04/23)
  - GD review stakeholder workshop (07/23)
  - Draft updated National Energy and Climate Plans (NECP) (06/23)
  - More IF capture projects? (07/23)

- **Q4 2023 +**
  - COM on CCUS strategy for EU
  - Adoption 6th PCI List (*with storage*) under new TEN-E
  - Revised GDs for CCS Directive

- **Ongoing**
  - IF/PCIs projects are « regulatory and market sandboxes » we continue to work with IF projects to see EU framework working in practice & to remove regulatory barriers.
  - Regular meetings of CCS Dir. Information Exchange Group: operational knowledge sharing, permit storage forward planning, etc.
Studying the evolution of a trans-European CO₂ transport network

**WHO**
The Joint Research Centre with a mandate from DG ENERGY

**WHAT**
Cost optimal match of CO₂ sources with CO₂ sinks

**WHEN**
Time horizon 2050

**HOW**
Energy and Industry Geography Lab + optimization software and tools

Source: https://energy-industry-geolab.jrc.ec.europa.eu/
Net-Zero Industry Act

- **Wide definition for net-zero technologies**, with nevertheless a focus on 8 specific areas
- **Ambition**: scale up net-zero technology manufacturing in the EU to provide at least 40% of the EU’s annual deployment needs by 2030
- **Target**: CO2 storage capacity 2030
Net-Zero Industry Act: Chapters

Permitting
- Streamlined permitting deadlines and procedures
- One-stop shops
- Information sharing

Investment
- Crowding-in private investments in net-zero strategic projects by Commission and MS
- Net-Zero Industry Europe Platform to advise on financing of projects

Markets
- Sustainability & resilience criteria in auctions
- Sustainability & resilience criteria in public procurement
- Sustainability & resilience criteria in public support measures

Skills
- Skills for quality jobs through Net-Zero Industry Academies
- Credentials for skills transparency, transferability & cross-border mobility

Innovation
- Regulatory Sandboxes to promote innovation and to test innovative net-zero technologies in a controlled environment for a limited amount of time

Governance
- Net-Zero Europe Platform as a reference body for the Commission to coordinate actions jointly with Member States including international partnerships

CO₂ storage
- Sets objective and obligations aimed at removing one of the main barriers to CCS
<table>
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<tr>
<th>Benefits</th>
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<tr>
<td><strong>Net-Zero Technologies (All)</strong></td>
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<tr>
<td>• Simplification: One-stop shop, online access to info, faster permitting (12-18 months)</td>
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<td>• Innovation: Regulatory Sandboxes</td>
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<td>• Competences and skills</td>
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<tr>
<td><strong>Net-Zero Strategic Technologies (Annex)</strong></td>
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<tr>
<td>• Facilitated access to markets through benefitting from sustainability and resilience criteria in auctions (15-30% weight of award criteria), public procurement and other public schemes</td>
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<tr>
<td>• Benchmark for manufacturing capacity of strategic net-zero technologies to reach at least 40% of EU's annual deployment needs by 2030</td>
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<td>• Possibility to become a Strategic Net-Zero Technology Project</td>
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<tr>
<td><strong>Strategic Net-Zero Technology projects</strong></td>
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<tr>
<td>• Priority status and obligations for Member States to process the permitting process faster via shorter time-limits.</td>
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<td>• Shorter permitting deadlines (9-12 months)</td>
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<td>• Overriding public interest</td>
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<td>• MS and COM to support through crowd-in private investments in net-zero strategic projects to accelerate their implementation</td>
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<tr>
<td>• Benefit from finance coordination by the Net-Zero Europe Platform</td>
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</table>
A CO2 storage objectives for the EU

• EU-wide objective to achieve an annual CO₂ storage capacity of 50 million tonnes by 2030, to reassure industry investors that their captured emissions can be stored in the EU (storage in combination with enhanced hydrocarbon recovery excluded)

• Obligation to publish all geological data relating to oil and gas production sites when decommissioning

• Net-Zero Strategic Projects are supported if:
  ✓ Operational CO₂ injection capacity by 2030 or earlier, and
  ✓ Applied for a CO₂ storage permit CO₂, in accordance with Directive 2009/31/EU
Oil and Gas transition to net-zero

• **Contribution**: Oil and gas producers have to provide an individual contribution for reaching the Union-wide CO2 injection target.

• Individual companies needs to **contribute in accordance with their share in overall EU oil and gas production**

• Flexibility: Oil and gas producers can **use their own assets, cooperate with each other or third parties** to provide new CO2 storage and injection capacity commissioned by 2030.

• Monitoring based **storage needs in Member States (NECP)** with bi-annual **progress reports from industry**
CCS Workshop – State aid
ETS Innovation Fund’s knowledge sharing workshop
30 March 2023

The views expressed in this document are those of the author and may not in any circumstances be regarded as stating an official position of DG Competition or of the European Commission.

Nadine Müller
COMP.H2 – Deputy Head of Unit
IPCEI, Environment & Innovation I
Policy introduction & update by the Commission services
Revision of State aid rules and context

**Main objectives of revision of the CEEAG and GBER:**
- Facilitate support for Green Deal-relevant projects ➔ Enlarging the scope to cover new areas and technologies
- Limiting the possibility for Member States to grant aid that locks in fossil-based technologies and processes
- Ensuring alignment and coherence with relevant EU legislation and policies in the environmental and energy fields (Green Deal, Fit for 55 initiatives, etc.)
- While ensuring competition distortions are kept to the minimum
## Aid for CCUS projects (dedicated infrastructure)

<table>
<thead>
<tr>
<th>Article 36 GBER</th>
<th>Section 4.1 CEEAG</th>
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<tbody>
<tr>
<td><strong>Eligible projects</strong></td>
<td>Investments reducing direct emissions + dedicated infrastructure</td>
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<tr>
<td></td>
<td>Incl. investments in CO₂ capture and transport (+ buffer storage) which:</td>
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<td>• Are integrated into a complete CCS and/or CCU chain</td>
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<td>• Have negative NPV throughout the project’s lifetime</td>
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<td>Excludes: permanent storage</td>
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<td><strong>Treatment of fossil fuels</strong></td>
<td>May not increase the demand of fossil fuels or expand production capacity of the beneficiary</td>
</tr>
<tr>
<td><strong>Aid amount calculation</strong></td>
<td>Alternative options:</td>
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<td>• 30% of extra investment costs + SME/assisted areas’ bonuses</td>
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<td></td>
<td>• Competitive bidding (up to 100% invest. costs)</td>
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<td></td>
<td>• Investment costs minus operating profit + clawback</td>
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<td>Maximum EUR 25 million per undertaking per project</td>
</tr>
<tr>
<td><strong>Form of aid</strong></td>
<td>Only investment aid</td>
</tr>
<tr>
<td><strong>Cumulation with EU funds</strong></td>
<td>Allowed if total amount of public funding for same eligible costs ≤ most favourable funding rate</td>
</tr>
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<td></td>
<td>Allowed if total amount of public funding does not lead to overcompensation</td>
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</tbody>
</table>
## Aid for energy infrastructure

<table>
<thead>
<tr>
<th>Article 48 GBER</th>
<th>Section 4.9 CEEAG</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Eligible projects</strong></td>
<td>Construction or upgrade of energy infrastructure subject to full third-party access and tariff regulation</td>
</tr>
<tr>
<td>Including CO2 infrastructure:</td>
<td>Same as GBER + permanent storage + energy infrastructure that is fully or partially exempted from regulation (but significant or total exemption makes proportionality more difficult to establish)</td>
</tr>
<tr>
<td>- Pipelines</td>
<td>Excludes:</td>
</tr>
<tr>
<td>- Facilities for liquefaction and buffer storage of CO2</td>
<td>- Dedicated infrastructure for a small group of users</td>
</tr>
<tr>
<td>- Essential equipment for operating the system (e.g. monitoring and control systems)</td>
<td>- Capturing equipment</td>
</tr>
<tr>
<td><strong>Excludes:</strong></td>
<td>- Permanent storage</td>
</tr>
<tr>
<td>- Dedicated infrastructure for a small group of users</td>
<td><strong>Aid amount calculation</strong></td>
</tr>
<tr>
<td>- Capturing equipment</td>
<td>- Aid may reach up to 100% of the funding gap</td>
</tr>
<tr>
<td>- Permanent storage</td>
<td>• Claw-back mechanism may be needed to limit windfall profits</td>
</tr>
<tr>
<td><strong>Aid amount calculation</strong></td>
<td>Maximum aid amount: <strong>EUR 70 million</strong> per undertaking per project</td>
</tr>
<tr>
<td>• Aid may reach up to 100 % of funding gap (but max. 100% of investment costs)</td>
<td>• Aid may reach up to 100% of the funding gap</td>
</tr>
<tr>
<td><strong>Form of aid</strong></td>
<td>• Investment aid</td>
</tr>
<tr>
<td>Investment aid</td>
<td>• Operating aid under specific conditions</td>
</tr>
<tr>
<td><strong>Cumulation with EU funds</strong></td>
<td>Allowed if total amount of public funding does not lead to overcompensation</td>
</tr>
<tr>
<td>Allowed if total amount of public funding for same eligible costs ≤ most favourable funding rate</td>
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</tbody>
</table>
Thank you
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6. Questions and moderated open discussion (16:30 - 17:30h)

17:30h End of the meeting
CO₂ reduction through storage under the North Sea

Alexander Vink, Commercial manager
30 March 2023
Porthos project
Port of Rotterdam, the Netherlands

- CO₂ capture by customers

- CO₂ transport and storage by Porthos:
  - Collection pipeline (~ 30 km)
  - Compressor station
  - Offshore pipeline (~ 22 km)
  - Storage in empty gas fields, more than 3 km under the North Sea
Porthos project
Port of Rotterdam, the Netherlands

- EBN, Gasunie, Port of Rotterdam Authority
- Air Liquide, Air Products, ExxonMobil, Shell
- ~ 37 Mton
- ~ 2.5 Mton per year for 15 years (Sold Out)
- CAPEX ~ € 450-500 million
- Final investment decision in 2023, operational in 2026
Thank you for your attention!

For more information, please visit: www.porthosCO2.nl
EMERGING ENERGY SOLUTIONS
Cleaner Energy Together

Shell CO₂ Storage Projects in Europe
Alistair Tucker, General Manager CCS Europe
Shell CO2 Storage Projects in Europe

**UK Northern North Sea – Storage Projects**
- Shell is partner in Acorn in UK
- Developing the GoldenEye field and associated fairway, part of wider Scottish Cluster decarbonization
- Shipping and pipeline connections to Scotland central belt

**Projects in Southern UK**
- Participating in the UK Carbon Storage licensing round, including large-scale storage opportunities in the Southern North Sea that could be connected to UK infrastructure and/or Aramis & CO2Next infrastructure
- South Wales Industrial Cluster to export CO2 via shipping

**Norway – Storage Projects**
- Shell is partner in Northern Lights
- In construction, on stream 2025
- Customers connected via Shipping

**Projects in EU**
- Developing open-access Aramis infrastructure with partners (22 Mtpa)
- System to be connected via marine links and wider pipeline network to Belgium, France and Germany (incl. Delta Rhine Corridor)
- K14-FA storage for Launch of Aramis at pre-FEED stage, storage license application is published & under review (2.5 Mtpa by Q4 2027)
- Shell and partners are developing growth stores (depleted gas fields) for connection to Aramis. At feasibility stage, possibly 3 - 7 Mtpa by 2030
- 2 Aquifer Exploration licenses published & under review (2030+)
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TotalEnergies

CO₂ Transportation and storage development

ETS Innovation Fund’s closed-door knowledge sharing workshop: the emerging EU CO₂ transport & storage market

30 March 2023, Bruxelles
Alexia GENIN
Berend-Jan KLEIN-SWORMINK
Aramis connected Storage Development

- **Phase 1 - Brownfield CO₂ Storage Project moving into FEED-phase Q3-2023**
  - Re-using gas production facilities L4A/K6C with 4 injection & 2 monitoring wells
  - Target is 2.5 Mtpa storage capacity in Q1-2028, Shell doing the same
  - Based on 41,1 MT storage capacity in 2 license applications
  - Timeline below is driven by the infrastructure development, storage development not on critical path
  - Shell/TTE Joint marketing for open access T&S services: 5 Mpta @ 15 yrs (majority 3rd party) 50/50 stored

- **Design criteria**
  - Build a cost-effective store on a fit-for-purpose basis at an affordable tariff
  - 97% injection availability, post ramp-up
  - Balancing principle (in steady state operation) in case of under-injection of Shell store; requirement to injection up to 5 Mtpa for a max. 3 months (1st 5 yrs)

- **Phase 1 Challenges**
  - Aggressive schedule: requiring no significant delays in permit award or appeal
  - Maintain an affordable tariff range whilst developing the project in FEED phase

- **Growth beyond Phase 1**
  - Growth volumes marketing: open access for European customers
  - 3 additional stores planned to be connected to Aramis in 2029/30
  - TTE storage ambition is 8 Mtpa after 2030, with plateau maintained until beyond 2050

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**Timeline**

<table>
<thead>
<tr>
<th>CCS NL - Phase 1</th>
<th>Pre-FEED</th>
<th>FEED</th>
<th>Approval</th>
<th>EPM</th>
<th>Operations, FID</th>
<th>RFSU</th>
<th>1st CO₂</th>
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</tr>
</tbody>
</table>

**Offshore Storage Licenses**

<table>
<thead>
<tr>
<th>L4A Appl Launching process</th>
<th>K6C Appl Submission</th>
<th>Awards</th>
<th>Award (no appeal)</th>
<th>CCS NL - Phase 1</th>
</tr>
</thead>
</table>
**Bifrost CO₂ transportation and storage project**

- **Offshore storage** based on 2 licences awarded to TotalEnergies as operator on Feb’23, to deliver more than 5 MTPA
  - Future depleted gas fields of Harald, currently operated by TotalEnergies
  - Nearby saline aquifer structure, appraisal campaign starting (seismic acquisition & well)
- **Full project potential** connecting additional storage sites offshore Denmark to increase capacities above 10 MTPA over 25 years.
  - Project timeline contingent to CO₂ licence tenders opening.

- **Storage development**: combination of re-use of existing O&G and new built facilities
- **Transportation development**: combination of shipping/ marine facilities and pipeline transport
  - Large-scale pipeline transportation for competitive T&S service. Main backbones in DK and GE. Interconnection possible with other transportation projects. Pipeline infrastructure in the critical path towards 2030 (permitting).
  - Shipping solution (either directly offshore or via an onshore hub, under investigation) to open the service to more remote market in the Baltic Sea or early birds in the North Sea: acceleration opportunity contingent on availability of depleted gas fields and market appetite for such solution.
- **T&S services** based on open access principles to serve European emitters. Multiple cooperations along the CCS chain to deliver the service as per planning.
Définition TotalEnergies / Compagnie

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ETS Innovation Fund’s closed-door knowledge sharing workshop
Neptune Energy
30 March 2023
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Neptune Energy ambitions

- Aiming to store more carbon than is emitted from its operations and the use of its sold products by 2030
- Aiming for 6.0 kg CO₂/boe carbon intensity by 2030; Zero methane emissions by 2030; Zero routine flaring by 2030
- Working together to achieve climate goals by storing CO₂ safely
Our North Sea CCS Vision

A X-border network of CO2 stores to meet customers' need for flexibility and redundancy.

01 Our strategic relationships enable shared success

02 Focus on shipped and pipeline solutions

03 Uniquely-placed to provide customer focused solutions

Note: Locations are illustrative.
Progress on ambitions

**L10 CCS**: 5MTPA store accessible via the Aramis value chain

- **Mid 23***: FEED
- **YE 24***: Construction
- **YE 27***: Operations

*Anticipated timeline, final timeline influenced by Aramis timeline*
Thank you
Putting words into action
Ship construction
Delivering on commitments

1. **Deliver Phase 1** - operational in 2024
2. Develop **commercial expansion** (Phase 2)
3. Deliver on **growth ambitions**, planning for further expansion initiated
Phase 2 expansion plans

- FEED completed
- FID planned 2023
- Expected operational in 2026

<table>
<thead>
<tr>
<th>Year</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>2024</td>
<td>1.5 Mtpa</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2025</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>2026</td>
<td>0</td>
<td>5.2 Mtpa</td>
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<td>2027</td>
<td>0</td>
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<td>2028</td>
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<td>2029</td>
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</tr>
<tr>
<td>2030</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
EU Project of Common Interest (PCI)

- Infrastructure projects that link the energy systems of EU countries
- Eligible for European Connecting Europe Facilities (CEF) funding, accelerated permitting and authorisation processes
- Preselected for EU funding €4.25 M for Phase 2 FEED studies

Northern Lights is on the 5th PCI list with 18 promoters and 22 affiliates
- Capture potential of ~19 Mtpa in 2030 by promoters only (~32 Mtpa including affiliates)
- Promoters in Norway, France, Belgium, Netherlands, Germany, Sweden, and Finland
- Capture sites and promotion on standardisation
Public - private collaboration

Experiences Northern Lights:
- Proven technology
- New value chain
  - First contracts of this type
  - Little/no operational experience
  - Mindset change needed
- Risks management
  - Non-performance
  - Liabilities
- Costs
  - De-risking subsurface is expensive
  - Inflationary environment
- Regulatory requirements – many firsts
  - Currently oil and gas based
  - Clarify financial guarantees
- Timing – chicken and egg
Project Timeline

- **2022**: Start of IF Grant Agreement
- **2023**: Design and licensing
- **2024**: Construction and development
- **2025**: Operation with scale-up
- **2026**: 500ktCO$_2$/yr
- **2027**: 1MtCO$_2$/yr
- **2028**: 3MtCO$_2$/yr
- **2029**: Operation
- **2030**: End of IF Grant Agreement

**Location:** Straumsvík, Iceland

**Funded by the European Union**

**Coda Terminal**

**Carbfix**
Agenda

1. Policy introduction & update by the Commission services (9:30 - 10:00h)

2. CO2 storage developments in MS – part 1 (10:00 - 11:00h)

   11:00 – 11:30h Coffee break

2. CO2 storage developments in MS – part 2 (11:30 - 12:30h)

3. Storage support programmes in Europe (12:30 - 13:15h)

   13:15 – 14:30h Lunch break

4. Needs of CO2 capturing projects supported by the Innovation Fund (14:30 - 15:15h)

5. Cross-border CO2 network developments supported by TEN-E (15:15 - 16:00h)

   16:00 – 16:30h Coffee break

6. Questions and moderated open discussion (16:30 - 17:30h)

   17:30h End of the meeting
INEOS in the CCUS space - Greensand Project Overview

Turning the Siri area into a CO₂ storage hub

INEOS CCUS project involvements:
- Greensand
- Acorn
- Zero Carbon Humber
- HyNet
- Antwerp@C
Greensand Project Phases and Timelines
Development maturation is ongoing towards offshore transport & storage of CO2 in 2025/26

<table>
<thead>
<tr>
<th>Phase 1</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
<th>2024</th>
<th>2025</th>
<th>2026</th>
<th>2027</th>
<th>2028</th>
<th>2029</th>
<th>2030</th>
<th>Storage Capacity</th>
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<tr>
<td>Phase 2 - Pilot (Nini West)</td>
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<td></td>
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<td></td>
<td></td>
<td>Up to 1.5 MTPA</td>
</tr>
<tr>
<td>- Offshore injection period</td>
<td></td>
<td></td>
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<tr>
<td>Full Scale (Nini West/Main)</td>
<td></td>
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<td></td>
<td></td>
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<td>Up to 8 MTPA</td>
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<tr>
<td>Siri Fairway Expansion Project</td>
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</tbody>
</table>

ANTS, Belgium
CO2 in Nini West Reservoir
EUDP O (Eugasol-INEOS operational development project)
(Annexed facility of CFBK's existing CO2 capture project)
"This is a big moment for Europe’s green transition and our clean tech industry. The first ever, full value chain for carbon capture and storage in Europe. You are showing that it can be done. That we can grow our industry, through innovation and competition. And at the same time, remove carbon emissions from the atmosphere, through ingenuity and cooperation."

Speech by President Ursula von der Leyen at the “First carbon storage” event celebrating the first full value chain cross-border offshore carbon storage.
Smeaheia – bringing scale
Building on Northern Lights and >25 years of CO$_2$ storage in the North Sea

**Equinor ambition**
15-30 Mtpa CO$_2$ transport and storage capacity by 2035

**Equinor share**

1. **Operation experience** – technology works!
2. **Northern Lights** – Market opener
3. **Cost down by bringing scale**
European CO\(_2\) pipeline anchored by Smeaheia
Connecting large emissions in Europe with storage opportunities in Norway

Large CO\(_2\) storage capacity in the North Sea. Gigatonn (kapasitet)

Candidate PCI ‘EU2NSEA’:
- 16 emitters
- 32 Mtpa CO\(_2\)
- 10 Countries
- 2 Storage sites

Source: NPD Storage Atlas
THE EMERGING EU CO2 TRANSPORT AND STORAGE MARKET
## CO2 Storage Developments in MS

### Storages Overview & Perspective

#### Indicative Figures

<table>
<thead>
<tr>
<th>Project</th>
<th>Country</th>
<th>Ind. start-up</th>
<th>Gross capacity [mtpa]</th>
<th>WD capacity [mtpa]</th>
<th>Supply</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Luna</td>
<td>Norway</td>
<td>2026</td>
<td>5</td>
<td>3</td>
<td>Ship/pipeline</td>
<td>Awarded Q4/2022</td>
</tr>
<tr>
<td>Havstjerne</td>
<td>Norway</td>
<td>2027</td>
<td>3.7</td>
<td>1.5</td>
<td>Ship</td>
<td>Submitted Q3/2022</td>
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<tr>
<td>Utsira South</td>
<td>Norway</td>
<td>2031</td>
<td>5</td>
<td>2.5</td>
<td>Ship/pipeline</td>
<td>Submitted Q1/2023</td>
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<tr>
<td>Greensand</td>
<td>Denmark</td>
<td>2026</td>
<td>8</td>
<td>3.2</td>
<td>Ship</td>
<td>Pilot injection Q1/2023</td>
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<tr>
<td>Q18</td>
<td>Denmark</td>
<td>2028</td>
<td>2</td>
<td>0.9</td>
<td>Pipeline (Aramis)</td>
<td>SLA Submission 2024</td>
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<tr>
<td>P6</td>
<td>Netherlands</td>
<td>2028</td>
<td>1.5</td>
<td>0.7</td>
<td>Pipeline (Aramis)</td>
<td>SLA Submission 2024</td>
</tr>
</tbody>
</table>

The emerging EU CO2 transport and storage market - Brussels
CO2 STORAGE DEVELOPMENTS IN MS

OUR CCS VALUE PROPOSITION:
TAILORMADE ONE STOP SHOP CCS SOLUTIONS
FOR INDIVIDUAL EMITTERS OR CLUSTERS

- Large emitters can be connected directly to WHV via the railway system, allowing consideration of individual needs of emitters.
- Emitters could be connected in local clusters for joint CO₂ evacuation via railways or pipelines which increases economies of scale.
- With the CO₂ hub, we increase economies of scale and provide security of offtake by realizing portfolio effects with the connected storages.
- We can offer CCS solutions with a single CCS service fee and take the CO₂ at a delivery point at emitters plant gate, e.g. at the outlet flange of a train loading station.

OUR ROLE: THE CARBON MANAGER

<table>
<thead>
<tr>
<th>Project Development</th>
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<tbody>
<tr>
<td>CO₂ Sourcing</td>
</tr>
</tbody>
</table>

WD makes
WD makes/buys services
WD/Emitter buys services

Train
Ship
Pipeline
The Norne Carbon Storage Hub
Norne Carbon Storage Hub – Onshore CO2 storage in Denmark

A cross-region, cross-border, large-scale carbon storage network on Danish soil to deliver true climate impact in a European context

### Key figures

<table>
<thead>
<tr>
<th>Item</th>
<th>Capacity</th>
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<tbody>
<tr>
<td>Combined pipeline capacity to sinks</td>
<td>30 mTPA¹</td>
</tr>
<tr>
<td>Combined marine volume capacity with expansion option</td>
<td>12 mTPA</td>
</tr>
<tr>
<td>2030 injection ambition</td>
<td>&gt;20 mTPA</td>
</tr>
</tbody>
</table>

### Main infrastructure items

1. **Three, 4 mTPA liquid CO2 ("LCO2") receiving facilities with expansion options**
2. **In aggregate, 20 mTPA CO2-dedicated high-pressure trunklines to carbon sinks**
3. **High-pressure compression equipment**
4. **LCO2 intermediary storage at receiving facilities**
5. **New onshore CO2 injection wells, targeting >20 mTPA injection rate**

¹ Million tons per annum
Norne Carbon Storage Hub and its key risks

The Norne Carbon Storage Hub

- Piped emitters
- Marine emitters

Regulatory wheel

Norne’s ambition

COD end 2026

Key risks

- Authority case handling (Time and complexity)
- Regulatory uncertainty
- Licensing process, effects on (Speed, customer, and funding)
Ruby – an Onshore CO₂ Storage Site in Denmark

ETS Innovation Fund closed-door knowledge sharing workshop:
‘The emerging EU CO₂ transport and storage market’
Brussels, 30 March 2023
Our Goals
- Contribute to reaching the Paris Agreement's 1.5-degree goal
- Build and Operate a deep geological CO2 storage site

Our Priorities
- Partnering with the local community
- Collaboration and sector coupling with local energy and CCU industry
- Innovation and knowledge sharing

Our Heritage
- Development and operation of large subsurface projects is our expertise
- Many years experience in gas injection, production, storage and geothermal energy projects

Our Investor
- Noreco – Norwegian Energy Company
- Strong presence in Denmark and partner in the offshore CO2 storage project Bifrost
Geological on-shore storage in deep saline aquifer

- Significant storage capacity of +300MT
- Favourable for high injection:
  - 1 MT/year from 2027 planned
  - Increasing to 5-10 MT/year from 2030
- Local project support - strong municipal pull and public accept
- Excellent harbour facilities located for Baltic Sea region
- Short shipping distances in “safe” waters
CCS PILOT IN STENLILLE IN DENMARK

- 8 MT capacity, with 0.5 MTA from 2026

- Close to existing natural gas storage, that continue to be in operation for 30 years

- Potential for fast and efficient deployment utilising existing infrastructure, expertise and knowledge
CRUCIAL STEP FOR ONSHORE-CCS IN DK

- Pilot Project supports initial CO2 capture in DK
- On-shore licenses will be awarded in 2024 in DK
- Truck and train are flexible and fast and immediate
- Pipelines are efficient, but requires long-term commitment and timelines

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
<th>Cost: €/Ton</th>
<th>Transport options</th>
</tr>
</thead>
<tbody>
<tr>
<td>2024</td>
<td>On-shore licenses</td>
<td>25-50</td>
<td>Truck/Train</td>
</tr>
<tr>
<td>2026</td>
<td>Stentille CCS Pilot</td>
<td>7-10</td>
<td>Ship</td>
</tr>
<tr>
<td>2030</td>
<td>Full-scale DK CCS</td>
<td></td>
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</tr>
<tr>
<td>2040</td>
<td>Pan-European Network</td>
<td></td>
<td>Pipelines</td>
</tr>
</tbody>
</table>
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   11:00 – 11:30h Coffee break

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   17:30h End of the meeting
Status on CCS in Denmark
STATUS ON CCS IN DENMARK

Political agreements:

- **Climate agreement on energy and industry 22 June 2020**
  - Decision to make CCS legal and to be used in hard to abate sectors
  - Emphasizing CCS does not mean less-ambitions on the climate agenda

- **Agreement on CCS roadmap part 1, 30 June 2021 + part 2, 14 December 2021**
  - Decision to make import/export of CO2 legal
  - Decision to give GEUS funding for investigating potential storage sites
  - Decision to make DK a European hub for CCS, and to roll out CCS on market terms in the long run in CCS strategy
  - Decision to involve municipalities, regions and citizens + industry dialogue + CCUS stakeholder forum

- **Agreement on framework conditions for CO2 storage June 21 2022**
  - State co-ownership of storage permits at 20%
  - Onshore pilot project in Stenlille
STATUS ON CCS IN DENMARK

Legislation
• Speedier and less extensive approval process for storage pilot projects in the North Sea entered into force on 1 July 2022.
• Exempting storage and transport of CO2 from the prohibitions against dumping in the Marine Environment Act entered into force 1 August 2022.

Implementation
• First pilot project permit given for exploration and storage of CO2 in a delimited area in the Danish part of the North Sea.
• Three full scale exploration permits given as of beginning February 2023 (Bifrost and Greensand)
• Prequalification of three organizations in the first round of the CCUS funds.
• GEUS has begun seismic preliminary studies of possible storage structures on land and near the coast and Danish Energy Authority has started the Environmental Impact assessment.
• MoU on CCUS with the Netherlands. MoU on CCUS with Belgium + bilateral arrangement on CO2 transportation.

Overall:
• Total funding for CC(U)S of approx. 37 billion DKK (approx. 5 bill. EUR) in 2023 prices.
• Total expected reduction estimate from CC(U)S of DKK 3.2 million tonnes of CO2 annually from 2030.
<table>
<thead>
<tr>
<th>Year</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020</td>
<td>June 2020 Klimaafgift for energi og industri</td>
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<tr>
<td>2021</td>
<td>December 2020 Nordseafaftalen</td>
</tr>
<tr>
<td>2022</td>
<td>June 2021 Køreplan for lagring af CO2 (del 1)</td>
</tr>
<tr>
<td>2023</td>
<td>June 2022 Rammevilkår for CO2-lagring i Danmark</td>
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<tr>
<td>2024</td>
<td>January 2021 Køreplan for lagring af CO2 (del 2)</td>
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<tr>
<td>2020</td>
<td>September 2021 MoU with the Netherlands</td>
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<tr>
<td>2021</td>
<td>August 2021 MoU with the Netherlands</td>
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<tr>
<td>2022</td>
<td>September 2022 MoU and bilateral arrangement with Belgium, Flanders</td>
</tr>
<tr>
<td>2023</td>
<td>January 2022 Environmental law changes + LP</td>
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<tr>
<td>2024</td>
<td>January 2023 Legislative changes, state ownership etc.</td>
</tr>
<tr>
<td>2020</td>
<td>December 2020 Nordsøaftalen</td>
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<tr>
<td>2021</td>
<td>December 2021 Gæn delafslut (PL22)</td>
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<tr>
<td>2022</td>
<td>December 2021 Udmøntning af første CCUS-pulje i Danmark</td>
</tr>
<tr>
<td>2023</td>
<td>February 2023 Three full-scale exploration permits in the North Sea</td>
</tr>
<tr>
<td>2024</td>
<td>March 2023 Greensand first injection</td>
</tr>
<tr>
<td>2022</td>
<td>GEUS seismic data gathering campaign</td>
</tr>
<tr>
<td>2023</td>
<td>DEA strategic environmental impact assessment</td>
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<tr>
<td>2023</td>
<td>February 2023 Three full-scale exploration permits in the North Sea</td>
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<tr>
<td>2023</td>
<td>December 2022 Pilot permission Greensand</td>
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<tr>
<td>2023</td>
<td>December 2022 Greensand first injection</td>
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OVERVIEW OF FUNDS
## OVERVIEW OF FUNDS

<table>
<thead>
<tr>
<th></th>
<th>CCUS</th>
<th>NECCS</th>
<th>GSR</th>
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</thead>
<tbody>
<tr>
<td>Eligible for funding</td>
<td>Negative emissions and reductions from technological flue gas processes</td>
<td>Negative emissions from technological processes</td>
<td>Negative emissions and reductions from technological processes, agricultural sector excluded</td>
</tr>
<tr>
<td>Eligible sources of CO2</td>
<td>Fossil and biogenic</td>
<td>Biogenic (incl. DACCS)</td>
<td>Fossil and biogenic (incl. DACCS)</td>
</tr>
<tr>
<td>Contract period</td>
<td>Up to 20 years per contract w/ opt-out option w/ retention penalty</td>
<td>Up to 8 years per contract w/ opt-out option (limited retention penalty)</td>
<td>Up to 15 years per contracts w/ opt-out option (limited retention penalty)</td>
</tr>
<tr>
<td>First reduction year</td>
<td>2025/26</td>
<td>2024/25</td>
<td>2026/27</td>
</tr>
<tr>
<td>Support period</td>
<td>2025-2049</td>
<td>2024-2032</td>
<td>2026-2043</td>
</tr>
<tr>
<td>Budget</td>
<td>16,6 billion DKK</td>
<td>2,6 billion DKK</td>
<td>17,2 billion DKK</td>
</tr>
</tbody>
</table>
The annual long-term CO₂ capture potential from Danish point sources is estimated to be 5.4-10.8 million tonnes of CO₂.

Major emitters in Denmark are waste incineration, industry and combined heat and power plants.

In addition, biogas plants.

Most are centered around the major cities, all of which have port facilities.

Once CO₂ is captured, it must be transported for e.g. storage:

- To port by truck or pipe - and on to storage by ship (or pipe) if storage is offshore.
- To port by truck or pipe and then further in pipes at sea or direct pumping at storage near-shore.
- In truck or pipe on land at onshore storage solution.
## OVERVIEW OF POTENTIAL CO2 STORAGE SITES – PHASE 1

<table>
<thead>
<tr>
<th>Site</th>
<th>Municipality</th>
<th>Type</th>
<th>GEUS planning starts</th>
<th>GEUS conducting seismic survey</th>
<th>GEUS report</th>
<th>Danish Energy Agency conducting EIA</th>
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<tr>
<td>Havnsø</td>
<td>Kalundborg</td>
<td>Onshore</td>
<td>March 2022</td>
<td>Aug. 2022</td>
<td>April 2023</td>
<td>Started, expected to finish end 2023</td>
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<tr>
<td>Inez</td>
<td>-</td>
<td>Nearshore</td>
<td>Not necessary, structure mature enough</td>
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<td>Started, expected to finish end 2023</td>
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<td>Jammerbugt</td>
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<td>Nearshore</td>
<td>Aug. 2022</td>
<td>April 2023</td>
<td>Jan. 2024</td>
<td>Started, expected to finish end 2023</td>
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<td>Lisa</td>
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<td>Nearshore</td>
<td>Not necessary, structure mature enough</td>
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<td>Started, expected to finish end 2023</td>
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<tr>
<td>Rødby</td>
<td>Lolland</td>
<td>Onshore</td>
<td>Oct. 2022</td>
<td>Late spring 2023</td>
<td>Spring 2024</td>
<td>Started, expected to finish end 2023</td>
</tr>
<tr>
<td>Thorning</td>
<td>Ilkast-Brande, Silkeborg, Viborg</td>
<td>Onshore</td>
<td>Oct 2022</td>
<td>August 2023</td>
<td>Spring 2024</td>
<td>Started, expected to finish end 2023</td>
</tr>
</tbody>
</table>

Note: Timeline subject to change, and dependent on dialogue with relevant municipalities.
Projects

- **Project Greensand (offshore):**
  - INEOS consortium (Maersk Drilling, GEUS, Wintershall DEA etc.)
  - Expected storage capacity of up to 1.5 million tonnes CO₂/y in 2025 up to 8 million tonnes CO₂/y in 2030.

- **Project Bifrost (offshore):**
  - TotalEnergies consortium (Noreco, Nordsøfonden, Ørsted, DTU etc.)

- **Project Norne:**
  - Expected storage capacity of 2.3 million tonnes CO₂/y in 2026 and 18.7 million tonnes CO₂/y in 2030.

- **Project Ruby:**
  - Expected storage capacity of 1 million tonnes CO₂/y in 2027 and 5-10 million tonnes CO₂/y in 2030.

- **Stenlille demo project (onshore)**
  - Storage capacity of 0.5 million tonnes CO₂/y in 2025.

- **Total expected capacity up to 52 million tonnes CO₂/y in 2030-2032**
THE PROCESS - OVERVIEW

1. Tender area must have undergone a strategic environmental assessment (SEA)
   - Danish Energy Agency (DEA) receives applications.

2. DEA evaluates the applications and recommends to the Minister of Climate, Energy and Utilities which licenses to award.

3. Awarding of the new licenses takes place after the Minister of Climate, Energy and Utilities has presented a report to the Climate, Energy and Utilities Committee of the Danish Parliament explaining which licenses the minister intends to issue.

4. Licenses can initially be granted for exploration for up to six years, during which the exploring company has exclusive rights to the area.

5. All activities regarding specific storage projects must be approved by the DEA before establishment. If a suitable location for CO2 storage is identified, the license can be extended for up to 30 years for storage operations.
WHAT DOES A LICENSE ENTAIL?
EXCLUSIVE RIGHT TO EXPLORE, INVESTIGATE AND STORE CO₂

- **Exploration**
  - Awarded up to 6yrs
  - Possible extension up to 10 yrs
  - Work program

- **Storage**
  - Up to 30yrs
  - Plan for activity, monitoring and closure

- **Closure**
  - 20yrs
  - Post-closure plan

Environmental impact assessments are required before collecting new seismic data or drilling wells.

Monitoring required before, during and after injection.

Environmental impact assessments are required before collecting new seismic data or drilling wells.

Monitoring required before, during and after injection.
GENERAL APPLICATION PROCESS – OFFSHORE

- Application window opens

- Application deadline
- Press release disclosing company names of applicants

- DEA evaluation of applications with GEUS, NSF and DWEA
- Meetings with DEA and applicants

- Expected grant of licenses
- Press release disclosing licenses
NEXT STEPS
- ENABLING CCS IN DENMARK

- Future tenders for subsidy schemes
- The legal framework for transport infrastructure for CO₂
- Clear regulatory framework for CCS on waste incineration and combined heat and power plants
- Bilateral agreement/arrangements on import and export of CO₂ for off-shore storage
- Cross border infrastructure
- International and EU regulation on CCS
KEY LEARNING POINTS
- WHAT TO CONSIDER

Political vision:
• Is there a will? What is the vision/scope of the activity?

Technical knowledge:
• Geological agency, companies etc.?
• Large emitters?

Legislative frameworks:
• Different framework offshore/onshore
• Not just about the storage site, also emitters, transport, temp. storage site etc.
• Regulations in other areas need adjustment to enable CCS value chains

Local engagement:
• Local acceptance and support will be key to the actual implementation
Questions?
CCS support programma – The Netherlands

Presentation at the EC – 30 March 2023
Disclaimer

This presentation is designed for an informal and open exchange of views. It is written with the utmost care and precision. However it does not reflect the final and official position of the government of The Netherlands.
Supporting CCS via policy framework

› Contract of difference subsidy for most cost effective solutions (SDE++)
› Investment in Research and Development: ACT, CETP
› Public private partnerships / State owned Enterprises active in CCS market
› Sufficient legal framework in place
2030 targets, the Climate Agreement and ‘Fit for 55’ adjustment

2020 - 14.3 mton CO₂ reduction in 2030
2022 – ‘Fit for 55’+ 5.9 mton
Total budget reservation of €22 billion in Coalition Agreement

Achieve emissions reductions while:
• Improving the competitiveness and investment climate
• Prevention of carbon leakage

How to get there?
1. Regulation, minimum emission price, standards
   • CO₂ levy, energy efficiency requirements, renewable hydrogen offtake obligations
2. Expanding and adding new subsidy instruments
   • SDE++, DEI+, VEKI, EIA, MIA, VAMIL
3. Tailored agreements with large industrial emitters
   • Step 1: Inventorisation
   • Step 2: Agreement framework
   • Step 3: Letters of intent
   • Step 4: Binding agreements
   • €7 billion reserved
Policy overview – SDE++

› SDE stands for Stimulating Sustainable Energy Production and Climate Transition.

› Broadened in 2020 to include industrial CO2 reduction techniques.

› The unprofitable top of investments is covered by an operating subsidy (capex and opex).

› The budget will be determined annually; €5bn in 2021, up to €11bn in 2022, up to €9bn in 2023.

› All techniques compete with each other, the cheapest techniques win the subsidy.

› Necessary technologies such as hydrogen, electric cracking, process efficiency, bio-based and recycling do not fit in the SDE system or fit in only very poorly.
Draft of the financial flows

SDE++ → Industry → Usage fee → T&S operator
Bid evaluation and grant agreement

The bids need to be accompanied with:

- Relevant permits
- Feasability study describing the technical and financial side of the project
- For CCS: proof that the captured CO2 can be stored;

After tender close all bids will be evaluated by RVO within 13 weeks: subsidies for winning applicants;

For CCS: after letter of positive subsidy decision: execution agreement (within 2 weeks) and a bank guarantee (within 4 weeks).
SDE++ process (simplified)

1. Start advice PBL on technology categories and costs
2. Market consultation on categories and costs
3. Agreement with MEAC and adoption into implementation regulation
4. Application of the CCS ‘sieve’
5. Opening of SDE++ over 6 week period
6. Evaluation of applications by Netherlands Enterprise Agency
7. Notification of successful applications with ~3 months
Current projects
Financing transport and storage infrastructure developments

- Initial CO₂ transport and storage infrastructure ‘Porthos’ started in 2017 is a public initiative from Gasunie, EBN and Port of Rotterdam to act as a ‘market-maker’ for CCS.
- Since 2020, the SDE++ policy now provides a robust business case to facilitate commercial T&S solutions.
- Aramis is a commercial initiative, whereby EBN (a state-owned enterprise) has received an exceptional consent from Minister EZK to participate in the pre-FEED phase.
- Independent bottom-up expert calculations of transport and storage tariffs for T&S infrastructure have been conducted to verify SDE++ subsidised amounts for T&S tariffs.
Towards a (NW) European CCS Market

› Smart policy design for cost effective solutions and to prevent fossil lock in

› A contribution by all member states

› EU target that is ambitious and realistic, and implementable
Norwegian CCS policy

Bjørnar Gilje, Alex Engh
Brussels 30 March 2023
The government’s objectives for CCS

1. Demonstrate that CCS is part of the solution
2. Speed up the development of CCS globally
3. Develop new green industry
4. Facilitate development of CO₂ storage on a commercial basis
5. Permanent and safe storage
A Comprehensive CCS approach
New licences for exploration of CO$_2$-storage awarded in June and October last year

EXL002: Equinor

EXL003: Equinor, Horisont Energi and Vår Energi

EXL004: Wintershall Dea & CapeOmega
Six companies have applied for area in the southern North Sea

- Aker BP
- Altera Infrastructure Group
- Horisont Energi
- Neptune Energy
- OMV
- Wintershall Dea

(Deadline was 3 January 2023)
Five companies have applied for latest announced area in the North Sea

- Equinor
- Neptune Energy
- Storegga
- Sval Energi
- Wintershall Dea
Agenda

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   11:00 – 11:30h Coffee break

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6. Questions and moderated open discussion (16:30 - 17:30h)

   17:30h End of the meeting
Kairos@C
Kairos@C: Air Liquide & BASF in Antwerp

- Development of a full cross-border CCS chain
- Capture of the emissions of 5 plants on the Zandvliet Industrial platform
- 14 million tons of CO2 over 10 years
- Will enable to kick start Antwerp@C infrastructures in Antwerp harbour (backbone and liquefaction terminal)
- FiD Q3 2023, Entry into Operation Q4 2026
- Shipping of CO2 to sinks in the North Sea
  - Looking into own shipping solution, permanent storage options considered: Norway and Denmark
- FEED of on-site capturing facilities very advanced, FEED of infrastructure within the port of Antwerp almost finished
Challenges

- **Cost + model, and no “excessive profit” principle, considering**
  - Significant amount of public support involved on all sides
  - PCI status
  - Current scarcity of capacity and lack of fluidity in the market and risk of abuse of dominant position
  - Still challenging CCS economics and overall high cost of the CCS value chain (even more after Ukraine war), need to find a fair allocation of rewards
  - Need to remain competitive on global scale
  - No indexation on ETS

- **Transparency on tariff and its various components**, as per CCS directive and state aid rules

- **Balanced terms & conditions**
  - Need to find a right balance between need of “predictive cash flow” for investors and need of flexibility for emitters (CO2 is a by product)
  - Capped liabilities

- **Unbundling storage & shipping and open access to receiving terminals and infrastructure from day 1**, as per the CCS directive
K6
Lumbres K6 Project

**CO2**
- 20% with incremental innovations
- 80% with disruptive innovations

**Phase 1**: Modern process kiln suitable for oxy-fuel and alternative fuels

**Phase 2**: Carbon Capture and Storage

1884
1,1
850
2028
153
A timetable linked to the development of the transport and hub infrastructure of the **D'Artagnan Project**...
The Net Zero Industry Act is a positive step forward. As EQIOM, CRH we would like to highlight a few points

<table>
<thead>
<tr>
<th>Topic</th>
<th>Public Policy request – Summary</th>
</tr>
</thead>
</table>
| **Regulation**         | • Ensuring unbundled and common access to the CCS infrastructure  
                          • Cost-based and transparent tariffs: tariffs should be based on a “cost +” model rather than on “supply & demand” principles. |
| **Infrastructure**     | • Plan the CO2 transport infrastructure  
                          • Assess the needs and plan the infrastructure to provide the energy |
| **Funding**            | • Support both CAPEX and OPEX costs  
                          • Introduce a Carbon Contracts for Difference scheme for industrial installations  
                          • Funding amounts should be able to evolve over the life of the project |
| Specification / tech   | • Harmonised specifications |
| **Risk management**    | • Clear EU guidelines on risk management of leaks and losses and CO2 ownership are needed. |
| **Acceptability**      | • Enable an informed debate with civil society. |
CalCC
THE CalICC Project

CO₂ Capture and Storage for Lime Production Funded by the EU Innovation Fund Large Scale

Nicolas Perrin, Andreas Bode
March 30, 2023 | CCS knowledge exchange workshop
Scope and objective of the project:

First industrial-scale carbon capture for lime production integrated with transport of CO₂ to coastal hub and shipping to geological storage in the North Sea

Coordinator: Chaux et Dolomies du Boulonnais (Lhoist Group)

Beneficiary: Air Liquide France Industrie

Location:
capture in Réty, pipeline from Réty to Dunkirk
Terminal, shipping to North Sea storage
Expected volumes of CO$_2$ captured to be stored: > 600 ktpy

Targeted Financial Close on 31/12/2024 and Entry into Operation on 31/12/2027

CO$_2$ Transport: onshore dense phase pipeline & shipping

Permanent storage option/s considered: offshore NO, DK, NL...

Under way: Capture FEED, Pipeline & Terminal Pre-FEED & FEED, permitting preparation, public consultation...

Other relevant points or challenges:

- **Storage offer development**: open & non-discriminatory access, cost+, unbundled offshore transport
- **Availability of cost-effective storage by 2027/28**
- **Permitting duration, inflation, regulatory framework, €/t ETS uncertainty**...
**KUJAWY GO4ECOPLANET, POLAND**

- Lafarge Cement S.A. is planning to implement the Kujawy Go4ECOPlanet Project.
- The project aims to fully decarbonize cement production at **Kujawy Plant** located in Piechcin, Poland.

**Kujawy Go4ECOPlanet** involves a world-unique **CryoCap™FG** technology designed by Air Liquide.

The scope of the project includes the capture and liquefaction of CO2. The solution will capture ~100% of the plant’s CO2 emissions, which will be transported to storage areas in the North Sea.

The project is a key part of Holcim Group’s decarbonisation roadmap to meet its Net Zero Pledge.
FIRST OF ITS KIND PROJECT AT KUJAWY PLANT

Inside Kujawy site
Block 1 - Capture and Liquefaction

- Kujawy cement plant
  (1.2 Mtpa CO₂ emissions with biomass CO₂)

- CO₂ Capture & Liquefaction
  Cryocap™ FG (1.05 Mtpa)

- Air Separation Unit
  (Oxygen supply)
  O₂ 360 TPD

- LCO₂ Storage

Block 2
Transport

- LCO₂ Train

- LCO₂ terminal in the port of Gdansk

Block 3
Storage

- CO₂ Storage in the North Sea
  (1.04 Mtpa)

- LCO₂ sea going vessel

Go4ECOPeplant
ECO2CEE
CO2 TRANSPORT & STORAGE NEEDS: 1.1MTPA FROM 2027

Nov 2022 - June 2024

• Volumes of CO2 captured and stored - 1.1mt/a

• Financial Close - 30 June 2024

• Entry into Operation - 30 April 2027

• LCO2 will be transported from Kujawy by train to a Hub in Gdańsk, then via ship to a CO2 storage site in the North Sea.

• The ECO₂CEE project aims to create the Hub (consortium led by Orlen with Air Liquide, Lafarge)

• Project activities on going - FEED documentation for the capture, Environmental Decision, Building Permit file

Work Package 1: Project Preparation

Key steps:
- Grant agreement signed
- Final design approved
- Engineering, permitting
- Signed contracts (EPC with Air Liquide, Transport, Storage)
- Green energy delivery / power grid extension

Timing: end of H1 2024 (Financial Close)
Beccs Stockholm
**Beccs Stockholm**

**Objective:** Capture of 800 kt biogenic CO\(_2\) by the end of 2026 from an existing bio fuel fired heat & power plant (KVV8)

**Location and participants:** Located at Värtaverket, Stockholm, in the heart of Stockholm’s district heating system. Implemented by Stockholm Exergy, Sweden’s largest district heating company. (Owned by the City of Stockholm and Ankhiale.)

**Project overview:** Investment in a post-combustion Carbon Capture facility based on HPC technology, as well as liquefaction and intermediate storage for further transport of the CO\(_2\)
**CO2 transport and storage needs**

- The project will capture 140 t per hour or ~100 kt per month at full load. 800 kt on a full season due to seasonality (lower summer load)

- FID planned to Q1 2024 with hot commissioning Q4 2026. Contracting of EPC partners will be finalised during April 2023

- Optimisation of transports ongoing with multiple storage sites in consideration. 11 m draft with day light restrictions. ~16 000 ton on site storage planned. (Base case 12-18 kton vessels)

- Final storage site not yet appointed/selected. Coordination of time lines and project milestones crucial

- CO2 HUB in Norvik south of Stockholm investigated together with Port of Stockholm and other potential CO₂ Capturers in the region

- Aim is to finance the project in a combination of EiF grant, Swedish reversed auction and the voluntary carbon market

- Pre studies on further CCS implementation on two WtE-plants in Stockholm Exergi´s network initiated

---

**Europe-wide 
Research and Innovation**

**Funded by the European Union**
CCUS ANRAV / Bulgaria

Anrav is the first project funded by the Innovation Fund in Eastern Europe and first CCUS project in that region. Devnya Cement AD, part of Heidelberg Materials, is the Coordinator and main beneficiary.

**Amount of Innovation Fund Grant:** EUR 189,694,949

**Strategic Partner:** Petroceltic Bulgaria EOOD

- **CO₂ capturing**
  - Amine technology
  - Oxyfuel technology

- **CO₂ transport.**
  - Through a pipeline

- **CO₂ storage**
  - Storage in the Black Sea (depleted gas field)

Konstantin Bojinov
Project Manager of ANRAV
**CO2 TRANSPORT AND STORAGE NEEDS**

**Technology:**
Combining two innovative technologies Amine and Oxyfuel

**Range:**
Capture, liquefaction, transport and safe storage

**Annual quantity of captured carbon emissions:**
Approximately 800 kt/CO2 per year (approximately 99.2% of the emissions of Devnya Cement AD on an annual basis)
ANRAV TIMELINE

- **2023**: Project Start
- **2024**: Final Investment Decision
- **2025**: Construction Phase
- **2028**: Commissioning

**FIRST CCUS PROJECT IN EASTERN EUROPE**

Co-funded by the European Union
PROCESS OF CAPTURING AND STORAGE

CO₂ driven enhanced oil recovery

CO₂ injection into deep saline formations & depleted oil & gas reservoirs

Co-funded by the European Union

- CAPROCK
- DEPLETED OIL OR GAS RESERVOIR
- CAPROCK
- SALINE RESERVOIR
- CAPROCK
- OIL RESERVOIR
ANRAV CHALLENGES & BENEFITS

Challenges:
• No history of Bulgarian projects;
• First CCUS project in Eastern Europe;
• Choosing the right team;
• Public acceptance;

Benefits:
• Carbon capture and storage focus of the fund;
• Fund scope;
• Clear and transparent application;
• Easy application platform;
• Clear reporting structure;
• Know-how and professional CCUS background of Innovation Fund;
• Good experience within the group Heidelberg Materials.
Agenda

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Antwerp@C
Antwerp@C CO2 Export Hub

• Participants: Air Liquide, Fluxys & Port of Antwerp-Bruges
• Location: Antwerp port platform, Belgium
• Open-access and modular CO2 transport & export facilities:
  • 22-km pipeline connecting emitters on the Antwerp port platform
  • First-of-a-kind CO2 liquefaction and export terminal
  • Innovative, energy-efficient CO2 liquefaction process
• First phase of broader Antwerp@C initiative:
  • 2.5 Mtpa initial export capacity, scalable to up to 10 Mtpa
  • Launching customers: Kairos@C (Air Liquide & BASF)
  • Open to all interested CO2 emitters in Antwerp and beyond
• Supported under CEF-Studies and CEF-Works programs
Development status and challenges

• Overall progress:
  • Permit applications:
    • Terminal: submitted in Dec 2022
    • Network - South: granted; North: submission foreseen in April 23
  • Front-end engineering studies completion: 2Q 2023
  • FID: end of 2023
  • Entry into Operation: H2 2026
• Open to all permanent storage options (no “bundled” offers)
• Challenges:
  • Capex and energy cost increasing due to Ukraine & energy crisis
  • No harmonized CO2 specifications
  • How to ensure consistent commercial & operational principles along the CCS chain (scheduling rules, liability scheme…)

[Image with a map and flowchart]
D’Artagnan
**D’Artagnan**

**Standalone PCI in the 5th list**

**Part of the Nautilus candidate PMI for the 6th list**

- Main D’Artagnan participants: Air Liquide France Industrie (coordinator), Chaux et Dolomies du Boulonnais (Lhoist), EQIOM & ArcelorMittal France
- GRT Gaz & Dunkerque LNG are now part of the Dunkirk area of the Nautilus candidate PMI

- **Overview:**
  - Open access CO2 primary infrastructures.
  - CO2 collection from various emitters’ sites in the Dunkirk harbour and its hinterland
  - Liquefaction and collection in intermediate storages in the Dunkerque harbour prior to its export by ship to permanent storage locations in the North Sea
  - In total, it is expected to start in 2027 and capture up to 2.0 Mtpa of CO2 by the end of 2028, 4.4 Mtpa by 2031 and further expand later on
D’Artagnan
Status and challenges

- CEF Energy E Studies award for the transportation infrastructure including terminal
  - CO2 transport by pipeline: routing defined, detailed studies and permitting initiated
  - CO2 terminal: permitting initiated, FEED studies to start in April 2023

- Construction to begin early 2025, after the Final Investment Decision, until end 2027

- Open to all storages - no privileged access to any storage provider

- Sinks & receiving terminals listed in Nautilus PMI application: Errai (Horisont Energi & Neptune Energy), Northern Lights, Carbfix, Fidelis, BiFrost, CO2Next

- Challenges:
  - Cost-based and transparent tariffs, based on a cost+ approach rather than on supply and demand principles
  - Fair and balanced terms and conditions / fair sharing of risks and liabilities
  - Open access to CO2 transport and storage infrastructures
  - Unbundled access to shipping and storage services
Ghent Carbon Hub
Ghent Carbon Hub
CO₂ hub for Belgium

- Fluxys aims to provide an efficient transport solution for CO₂ emitters
- Ghent Carbon Hub is an exit location of the envisaged Fluxys’ CO₂ network in Belgium
- The project concerns the development of an open access scalable CO₂ terminal for North Sea Port industry & hinterland, led by Fluxys and supported by ArcelorMittal and North Sea Port
- Providing pipeline transport solution for emitters located in Ghent and Wallonia
- Contacts are ongoing with multiple emitters, some of them are currently applying for Innovation Fund

ETS Innovation Fund workshop  March 2023
We are here ▪ Scalable terminal up to 6 Mtpa, developed at market pace
▪ Kick-start of network accommodating CO₂ transport from Belgian emitters and neighbouring countries towards Belgian exit points in Ghent, Antwerp, Zeebrugge,…
▪ Export of CO₂ will be possible to multiple storage sites
▪ International standard for CO₂ specifications (P, T, quality) to be developed urgently
▪ Success of project driven by simultaneous development of the full CO₂ value chain

CO₂ cross-border network developments

Screening ▪ Feasibility ▪ FEED ▪ Construction ▪ Commercial operation

Funded by the European Union

Signed contracts

Sep-2023 ▪ Mid-2023 ▪ 1H 2025 ▪ End 2028
Aramis
The emerging EU CO2 transport and storage market

Aramis Project of Common Interest (PCI 12.7)

Joep Sweeney (EBN) / Lex Backer (Shell)

30 March 2023
• Aramis offshore pipeline has a capacity of 22 Mtpa enabling use of the 7.5 Mtpa overcapacity of the Porthos onshore pipeline
• CO₂ next terminal will be able to hold up to 40,000m³ of liquid CO₂ and serve both barges & coasters
• Aramis will enable connections to several European clusters (incl. the Delta Corridor project)
• 7 Launching emitters (close to 5 Mtpa) signed Heads of Terms and applied for subsidies (SDE++). More expected in 2023 SDE++ call
• Overall storage capacity expected >400Mt. First license applications for storage in depleted gas fields have been submitted
• In permitting since Jan’22
• Re-applied for PCI-status
Timeline

**STEP 1**
2019-2021
Feasibility study and setting-up of partnerships. Received EU PCI-status

**STEP 2**
2022-2024
Design of the concept jointly with emitters and other stakeholders. Apply for CEF subsidies. Aim to start FEED in summer 2023

**STEP 3**
2025-2026
Construction phase. Modular design for Terminal & Compression. First phase possibly up to 10 Mtpa capacity

**STEP 4**
End-2027
Go-live. First CO₂ transport & storage (will include a start-up and ramp-up period)

**STEP 5**
Beyond 2027
Expansion with cross-border CO₂ transport and eventually scale-up to >20 Mtpa after 2030 depending on demand for storage
EBN, Gasunie, Shell and TotalEnergies entered into a cooperation agreement to explore the possibility of setting up a joint venture to jointly develop a CO\textsubscript{2} transport activity unlocking a large Dutch offshore storage area. The present documentation and related discussions are entirely prospective and non-binding. They create no obligations on EBN, Gasunie, Shell, TotalEnergies or the prospect.
PL-EU CCS Interconnector
PL-EU CCS Interconnector (currently ECO2CEE) Project – the scope and objectives of the project

PL-EU Interconnector (currently ECO2CEE) Project has an ambition to establish an open access multi-modal CO₂ import - export terminal (‘CO₂ Hub’) in Poland with related CO₂ transport infrastructure as well as linking the biggest Lithuanian emitters to the planned multi-modal export terminal in the Lithuanian port of Klaipeda. The Project will create a common area on the Southern Baltic coast from which CO₂ can be shipped to storage sites in the North Sea basin and the Baltic Sea basin (in the future).

The Project will rely on 4 key promoters (Air Liquide Polska, Lafarge Cement, PKN ORLEN and ORLEN Lietuva) as well as several affiliated entities. The project objective is to connect the main industrial CO₂ emitters in Poland and Lithuania to the CCS chain (under development in the North Sea) for permanent storage.

**What are the expected volumes of captured CO2 that can be collected, liquified and stored?**

The project is scheduled to transport 2.5M Ton of CO₂ per year between 2027-2030 period, reaching 8.7M Ton of CO₂ between 2031-2032 period and up to 9M Ton of CO₂ from 2033 leading to a significant impact in global warming prevention.

Circa about 8.7 Mt of CO₂ will come from Poland and rest of CO₂ will come from Lithuania. Thus, this project will directly contribute to the ambitions of the Paris Agreement, the Polish low carbon strategy until 2040, the National energy and climate action plan of the Republic of Lithuania, and more globally to the objectives of the European Union towards carbon neutrality in 2050.
What are the permanent storage option/s considered for the collected CO2 emissions?

LCO₂ ships will follow normal shipping lanes between the ports and different potential connections to storage sites in the North Sea. Potential locations are: Kollsenss (Norway), Peterhead (UK), Teeside (UK), Rotterdam (the Netherlands), Bifrost location in Denmark, terminal in Wilhelmshaven (Germany). At these locations, CO₂ might be unloaded and sent by pipeline to the local sequestration site.

The ECO2CEE project provides for the construction of the LCO2 Hub in the port in Gdansk. Thanks to the location, the accessibility to many possible storage locations by sea or inland waterway will allow to reach them in a typical round-trip time of 3 to 8 days, depending on the selected location.

How advanced is the project implementation, e.g. the activities completed?

Work done: Location study (confirmed location).

In the middle of the Conceptual / Cost Estimation Studies and Feasibility Studies for transportation
Agenda

1. Policy introduction & update by the Commission services (9:30 - 10:00h)
2. CO2 storage developments in MS – part 1 (10:00 - 11:00h)

   11:00 – 11:30h Coffee break

2. CO2 storage developments in MS – part 2 (11:30 - 12:30h)
3. Storage support programmes in Europe (12:30 - 13:15h)

   13:15 – 14:30h Lunch break

4. Needs of CO2 capturing projects supported by the Innovation Fund (14:30 - 15:15h)
5. Cross-border CO2 network developments supported by TEN-E (15:15 - 16:00h)

   16:00 – 16:30h Coffee break

6. Questions and moderated open discussion (16:30 - 17:30h)

   17:30h End of the meeting
Challenges to turn into opportunities

- Sufficient capacity
- Open access
- Easy, fast, secure, agile T&S service / infrastructure
- Reasonable prices: what does this mean?
- Technical specifications
- Public support
Open discussion: How can we structure the market in the best way? Who? EU/MS/projects alone/bilaterally?

- **Regulation**
  - Transparency: CO2 storage and capture capacities
  - Match-making?
  - Regulated tariffs and other rules to ensure open access

- **Infrastructure**
  - Planning: EU, regional, MS, projects

- **Risks: technical, financial, regulatory, liabilities**
  - Common liabilities/risk fund? EU, MS, insurance market, projects

- **Public acceptance**
  - Should the EU do more? How? MS? Or left to each project?

- **Funding**
- **Technical specifications & Standards**
Next steps for the Commission

- **Public summary report** of the discussion today

- We will continue to host **knowledge-sharing meetings for projects and/or Member States** ("regulatory & market sandbox").

- By the end of 2023:
  - Adoption of **CCUS Strategy Communication** (Q4 2023)
  - Assessment of CO2 capture and storage needs in MS as notified in draft National Energy and Climate Plans (NECPs) (due by June 2023)
  - 6th PCI list will be adopted in Q4 2023, with CO2 Storage eligible
Thank you & see you next time!
Where to find more information on the Innovation Fund?

All (past) call documents available on the Funding and Tenders Portal including:

- Guidance and calculation tools on GHG emissions and relevant costs
- Frequently asked questions

https://europa.eu/1QB67by

Further info, planning of new calls, recorded webinars and videos available on the IF Website:

https://europa.eu/1rx34Dt

Innovation Fund - YouTube

https://bit.ly/2WxK8w7