Northern Lights

A European CO_2 transport and storage network

International Symposium on CCUS and Hydrogen organized by
Ministry of Environment, Japan
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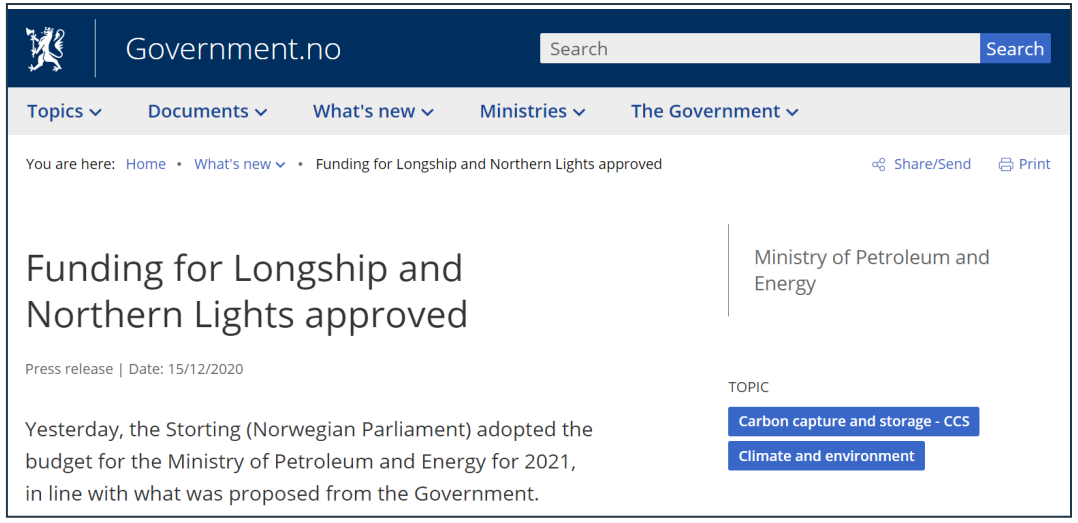
TOTAL

Northern Lights CCS have taken FIDs, in operation 2024

***15 May 2020** : NL CCS confirm our conditional FID*

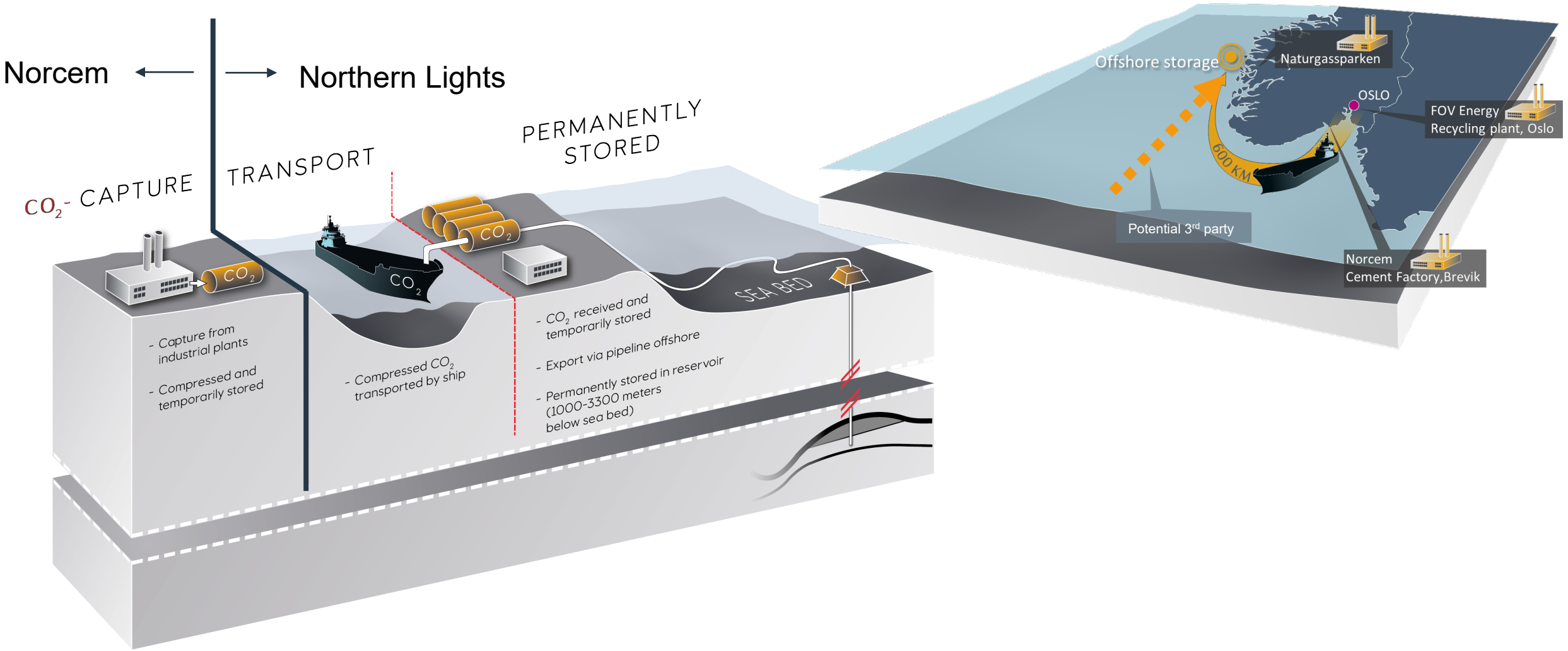
***21 September 2020** : The Norw. Gov't confirmed their*



***14 December 2020** : The Norw. Parliament confirmed their support*

***15 December 2020** : Press Conference with the three CEOs and the Minister*

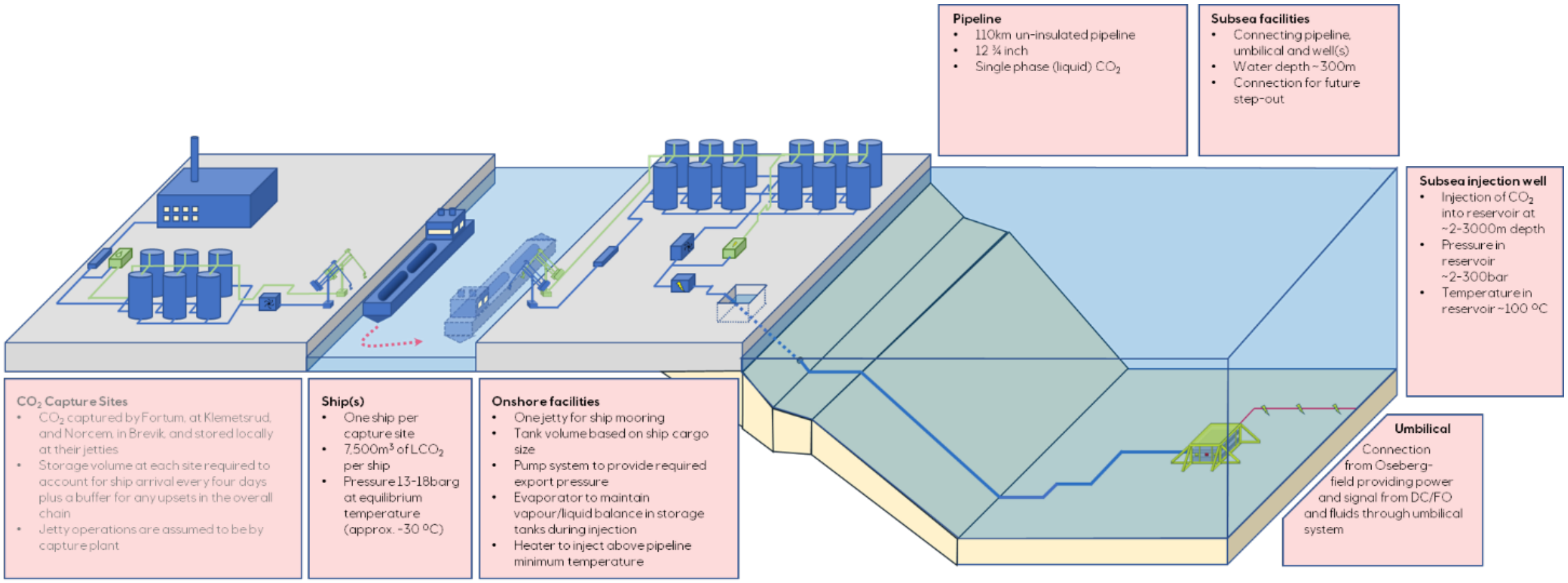
Northern Lights – transport, injection and permanent storage of CO_2



Visualisation of onshore facilities, West Coast Norway

Construction Activities have Commenced

Concept Overview



Pipeline
- 110km un-insulated pipeline
- 12 ¾ inch
- Single phase (liquid) CO_2

Subsea facilities
- Connecting pipeline, umbilical and well(s)
- Water depth ~300m
- Connection for future step-out

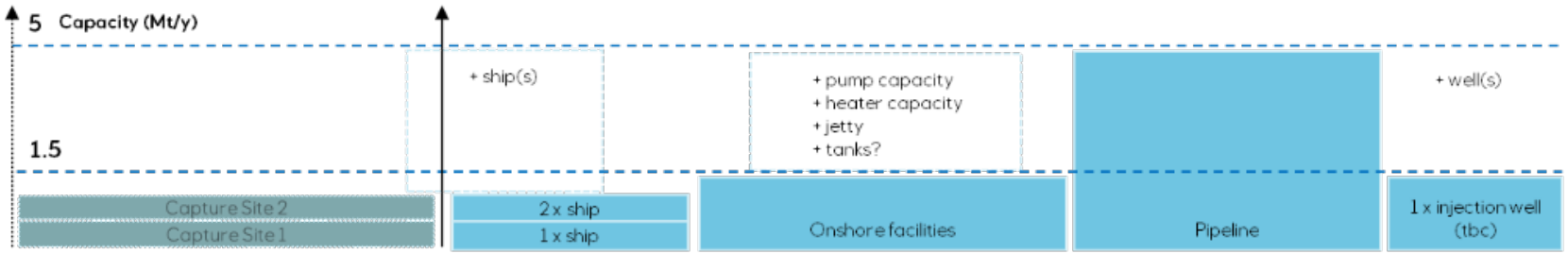
Subsea injection well
- Injection of CO_2 into reservoir at ~2-3000m depth
- Pressure in reservoir ~2-300bar
- Temperature in reservoir ~100 °C

CO_2 Capture Sites
- CO_2 captured by Fortum, at Klemetsrud, and Norcem, in Brevik, and stored locally at their jetties
- Storage volume at each site required to account for ship arrival every four days plus a buffer for any upsets in the overall chain
- Jetty operations are assumed to be by capture plant

Ship(s)
- One ship per capture site
- 7,500m³ of LCO_2 per ship
- Pressure 13-18barg at equilibrium temperature (approx. -30 °C)

Onshore facilities
- One jetty for ship mooring
- Tank volume based on ship cargo size
- Pump system to provide required export pressure
- Evaporator to maintain vapour/liquid balance in storage tanks during injection
- Heater to inject above pipeline minimum temperature

Umbilical
Connection from Oseberg-field providing power and signal from DC/FO and fluids through umbilical system



Storage complex
- Planned in the Johansen formation south of Troll ("Aurora)

CO_2 capture Norcem Cement Plant – the first user of Northern Lights

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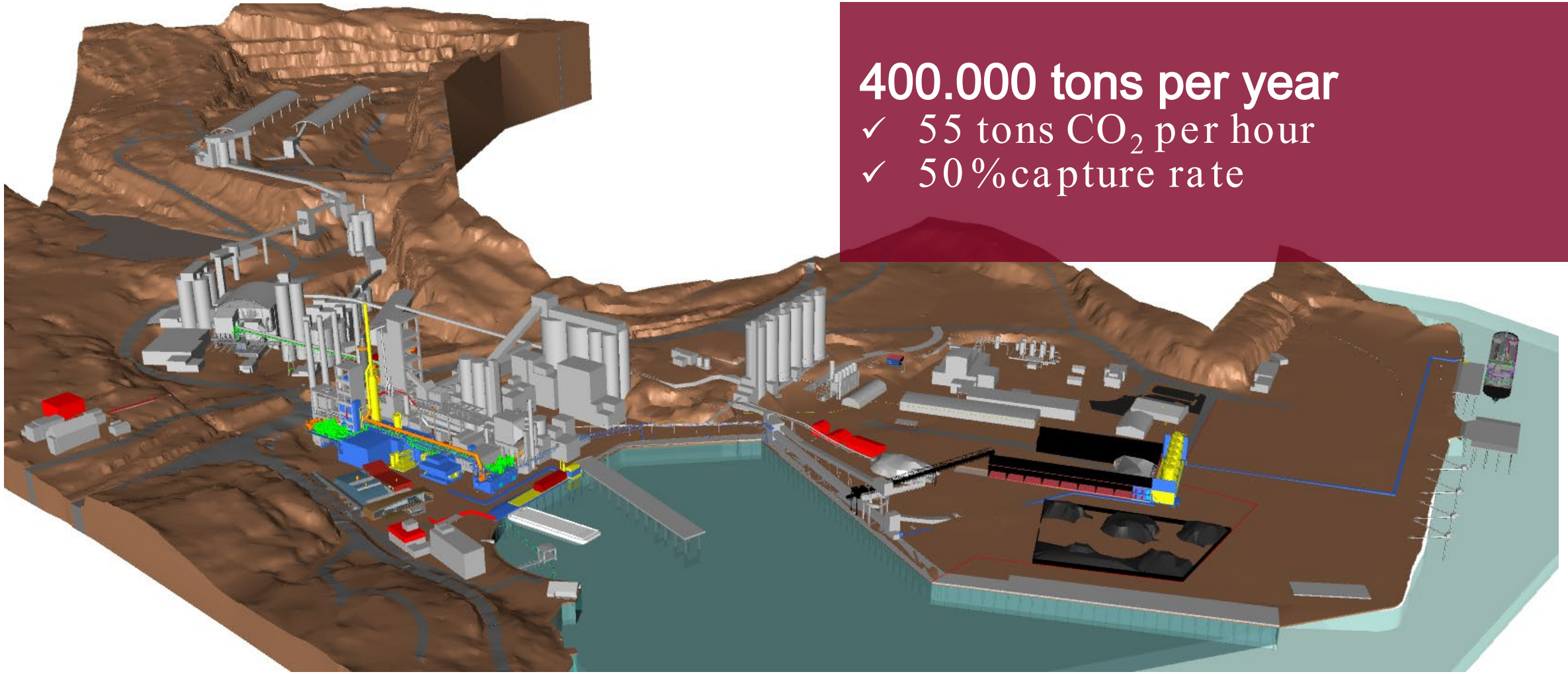


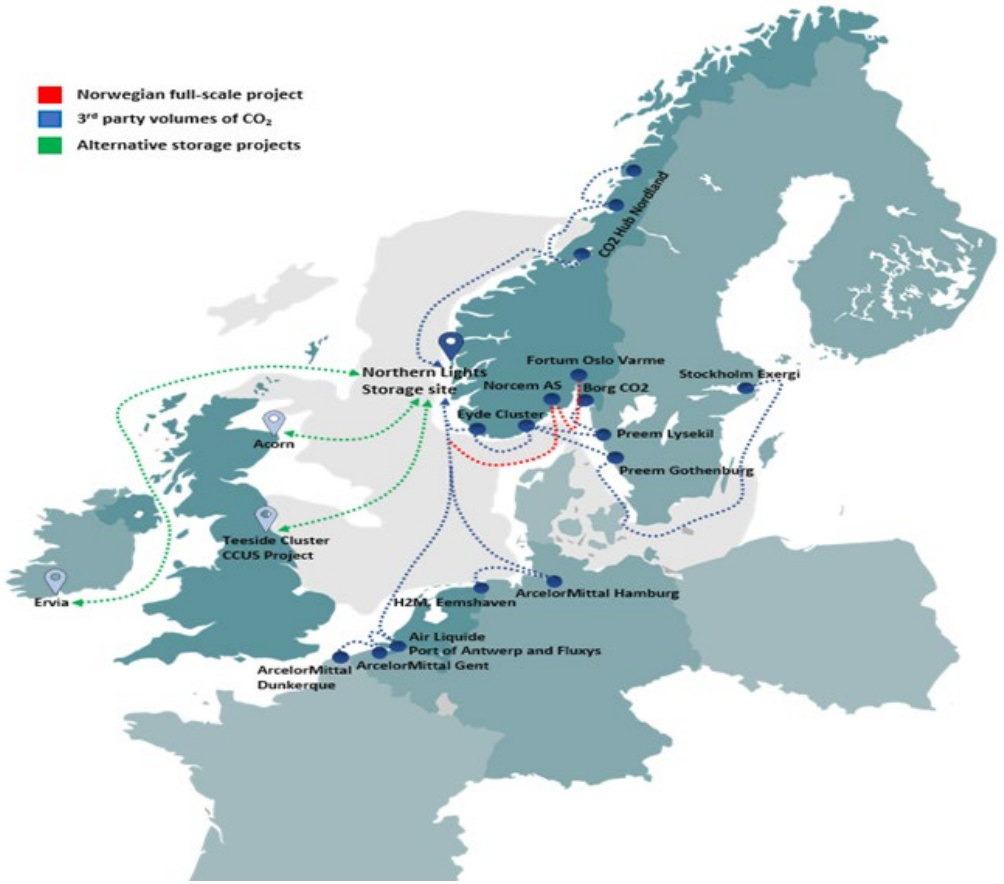
400.000 tons per year

- ✓ 55 tons CO_2 per hour
- ✓ 50 %capture rate

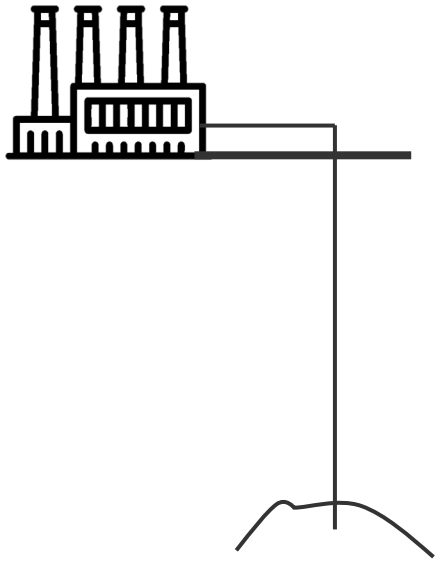
HEIDELBERGCEMENT
Open

CO_2 ship transport

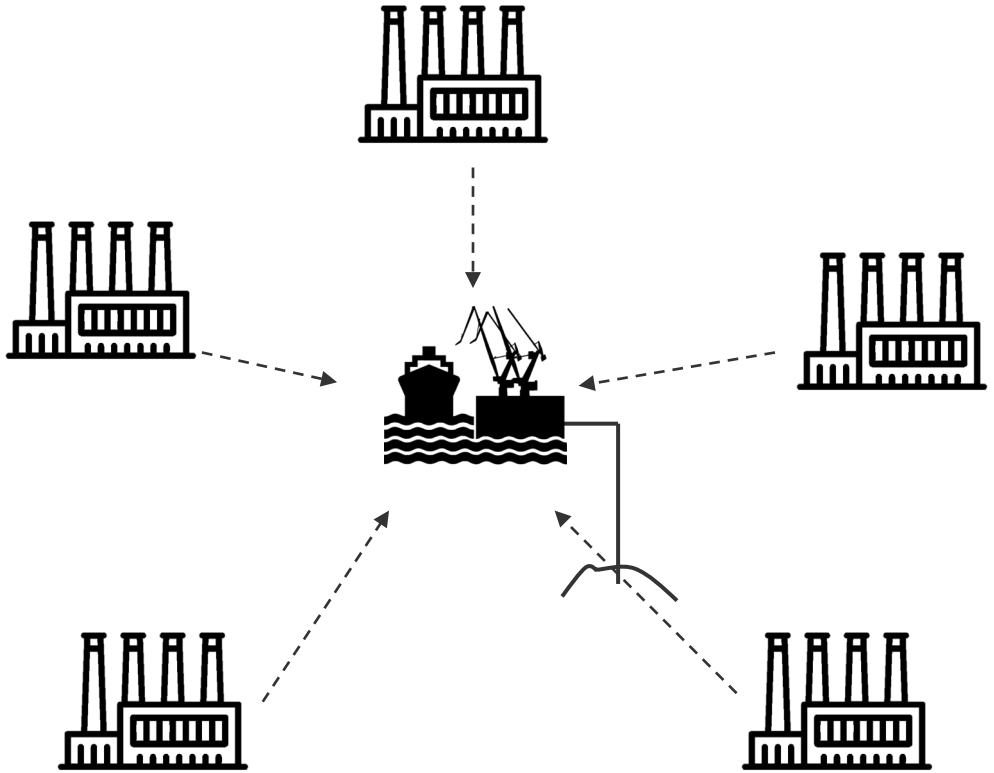
- Cargo Systems for CO_2
  - 7500 m^3 capacity
  - Tank Operating Condition: 15 barg, c.-26°C
  - Offloading @max 800 m^3/hr
- 'LPG standard' design
  - Proven concept (based on food industry model)
- Flexible model - milking route could work - Each ship completes trip in ~ 5/6 Days to Copenhagen



Northern Lights innovates the value chain: Separating source and sink - open source business model - open innovation

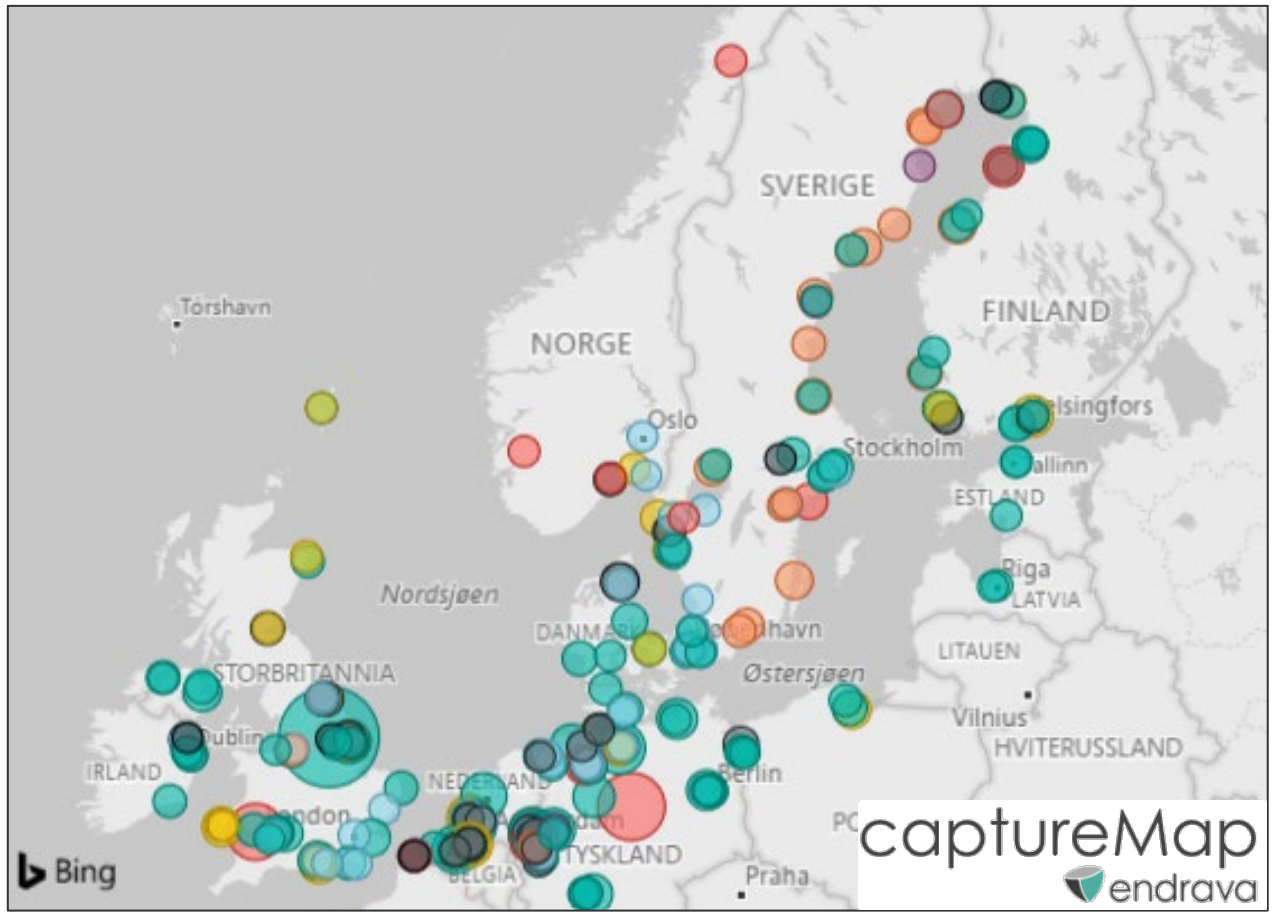


Traditional



Northern Lights

Enables “open source” offer for CO_2 emitters to establish capture



Large potential with long-life sectors:

- Hydrogen and power from natural gas
- Waste incineration
- Cement
- Biomass and biofuel
- Steel
- Refinery

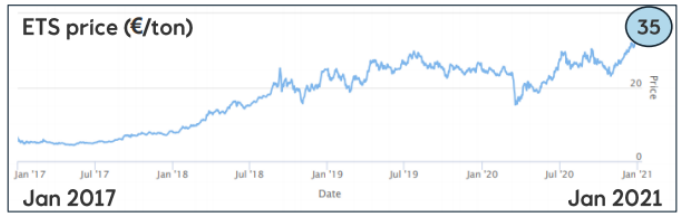
- *Northern Lights is relevant and within reach for about 350 facilities and 300 MTPA of these “most attractive candidates”*

Northern Lights indicative tarrifs – public information

"In order for the Northern Lights project to become a successful business operation we will need to offer our future industrial clients transport and storage tariffs that are competitive with alternative decarbonation measures. Actual tariffs will depend on a ***sustainable business model, the level of volumes handled, market maturation and optimization of transport and storage facilities*** *. It is the ambition of the Northern Lights partners to achieve* ***by 2030*** *cost levels for transport and storage in the range for this type of project of around* ***30€ -55€ per ton of CO2"***

A mulititude of climate ambitions - important growth drivers

- **Sweden** carbon tax increased by + 480% since 1991 (**118 €/ton in 2021**)
- Dec 2019: « **Denmark Climate Act** » → future carbon tax to reduce emissions by 70% by 2030 from 1990
- May 2020: « **Dutch Climate Agreement** » reflected in 2021 Budget → reduction by 49% by 2030 from 1990
  - CO2 national tax applicable from 1st January 2021
  - Raise CO2 tax (industries) from 30 €/ton in 2021 to **125 €/ton in 2030** (including ETS price)
- Dec 2020: « **EU Green Deal** » → cut net greenhouse gas emissions by 55% by 2030 from 1990
  - Delay in carbon permit auctions → ETS price reached record-high **35 €/ton in Jan 2021**
  - Progressive reduction of emission allowances → ETS prices further up by 2030
- Jan 2021: « **Norway's Climate Plan 2021-2030** » → reduce emissions by 50%-55% by 2030 from 1990
  - Plan to raise CO2 tax from 74 €/ton today to about **185 €/ton in 2030** (including ETS price)



Seven MoU's signed in September '19

COMPANIES

- Fortum Group; Finland*, waste to energy*
- Ervia, Ireland, *gas power & refinery*
- Air Liquide, Belgium*, hydrogen*
- Stockholm Exergi, Sweden, *biomass CHP*
- ArcelorMittal, Luxembourg (France), *steel*
- Preem, Sweden, *refinery*
- Heidelberg Group, Germany, *cement*

TYPICAL CONTENT

- Logistics studies
- CO_2 specifications optimized across value chain
- Roadmap towards potential start of operations
- Joint advocacy for CCS and its importance for decarbonization of European industry
- Initiate dialogue with National and Norwegian Governments

Collaboration with Microsoft on Northern Lights value chain

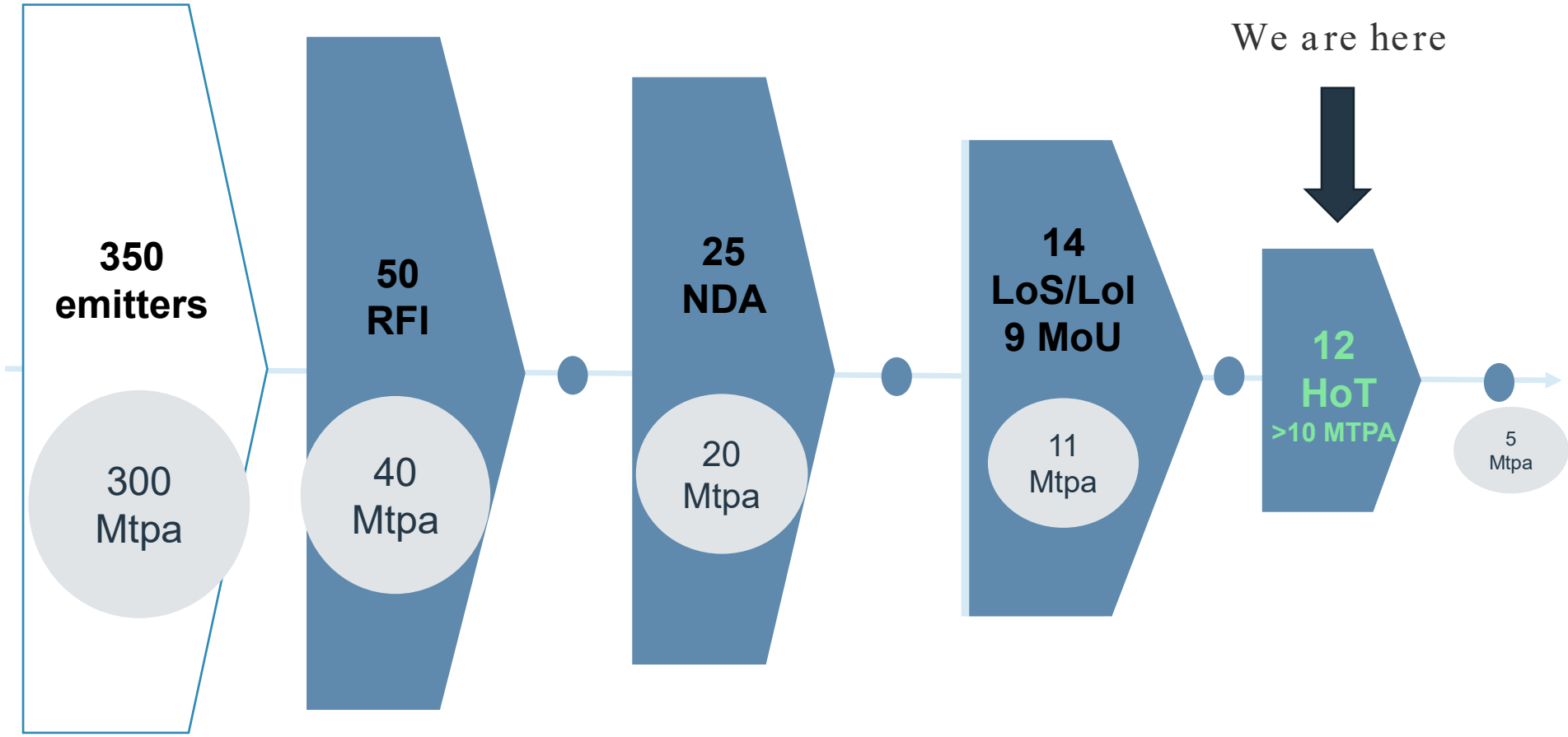
By Anne Cavendish - 14 okt. 2020 17:40

Irene Rummelhoff, Equinor's executive vice president for Marketing, Midstream and Processing (MMP), and Brad Smith, president of Microsoft.

Equinor has signed a Memorandum of Understanding (MoU) with Microsoft to explore ways to support the Northern Lights carbon capture and storage (CCS) project as a technology partner. Microsoft will explore using the project to enable the transportation and storage of captured CO_2. Equinor is developing the project together with Shell and Total as equal partners.

…and we signed a new MoU in October '20…

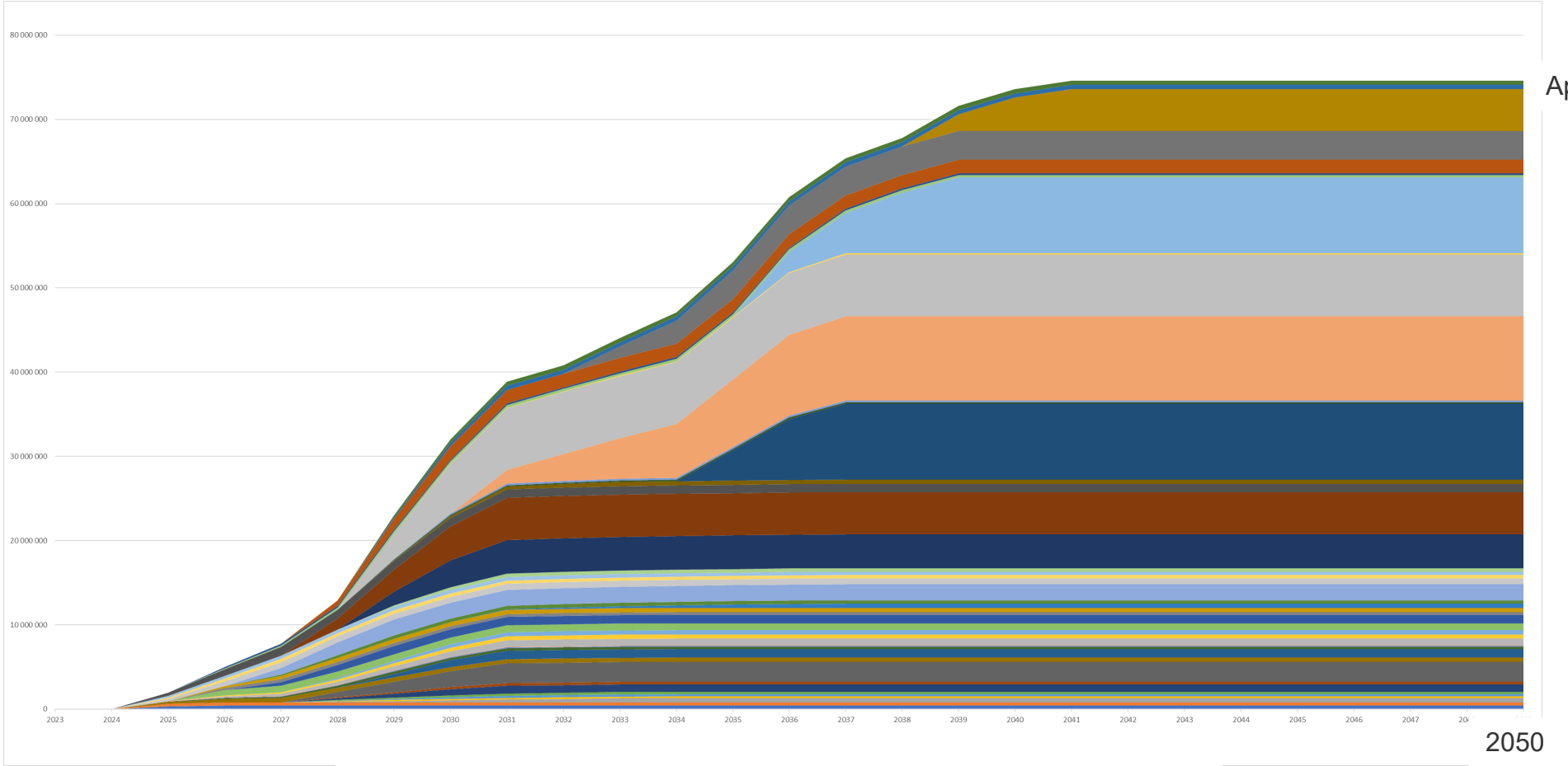
3rd party CO2 sourcing for Longship - progress



In good track to fulfill volumes requirements for Phase 1 and 2

NW Europe based companies that NL CCS have a positive dialogue with, MoU-partners +++

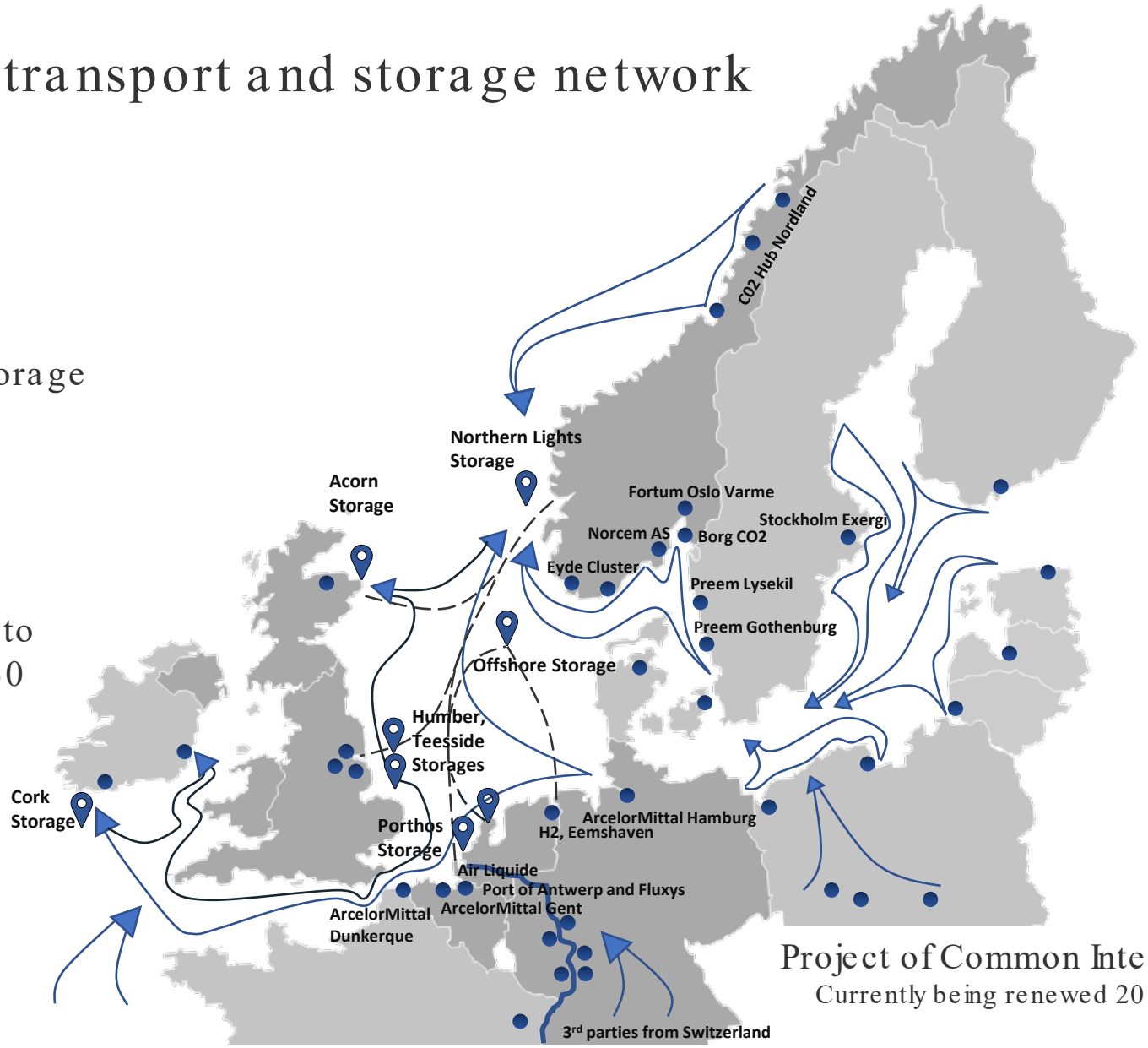
- *This is a dynamic picture, subject to change*
- *This will not be realized, but provides an impression of the scope/size of the prize*



European eco-system for CCS I towards and integrated European transport and storage network

Full cycle carbon removal and storage

- Create eco-system for CCS – a community
- Emitters as well as integrated network with other storage locations - safe, secure and cost efficient
- Position for CEF funding (under TEN E)
- A specific, concrete solution for industry by 2024/5, to maintain jobs and reach emission reductions by 2030
- Flexible to scale up as market develops



Project of Common Interest

Currently being renewed 2021