Sleipner, Snøhvit, Smeaheia, Northern Lights & CO2 Storage Kalundborg

A status on CO2 storage projects in Norway and Denmark

7th International Workshop on Offshore Geologic Storage

Port Arthur | Texas
September 17-19 | 2024

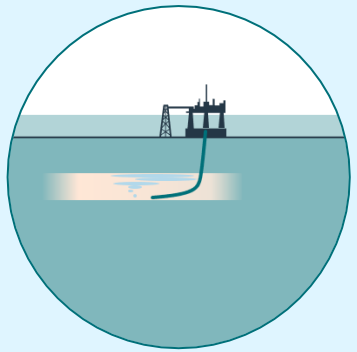
Michael Schoemann | Manager Low Carbon Solutions

CCS in Equinor | Stepwise build of new industry

28 year of experience

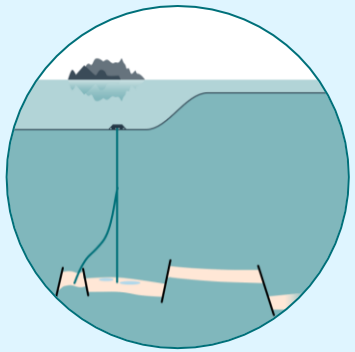
- Nearly 30 Mt stored to date
- Wide range of concepts

Sleipner | 1996



CCS works!

Snøhvit | 2008

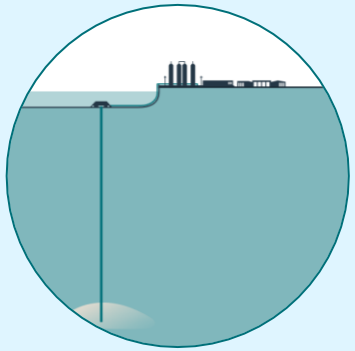


Expand technologies

TCM | 2012

Reduce capture cost

Northern Lights | 2024

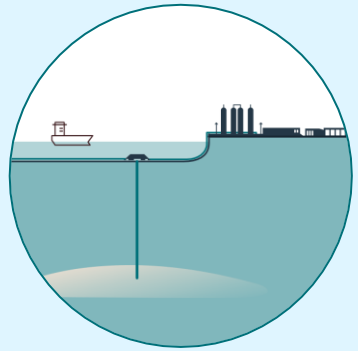


Market opener

NEP | 2027
Bayou Bend | 2027

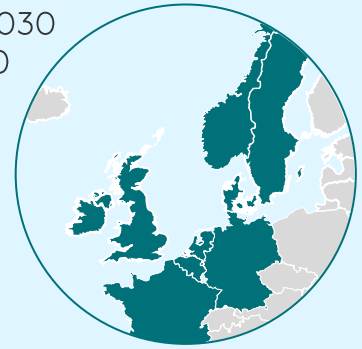
Beyond NCS

Smeaheia | 2029
CO2 Highway | 2030
CO2 Storage Kalundborg | 2030
Kinno & Albondigas | 2030



Bring costs down through scale-up

Future potential



NWE & US

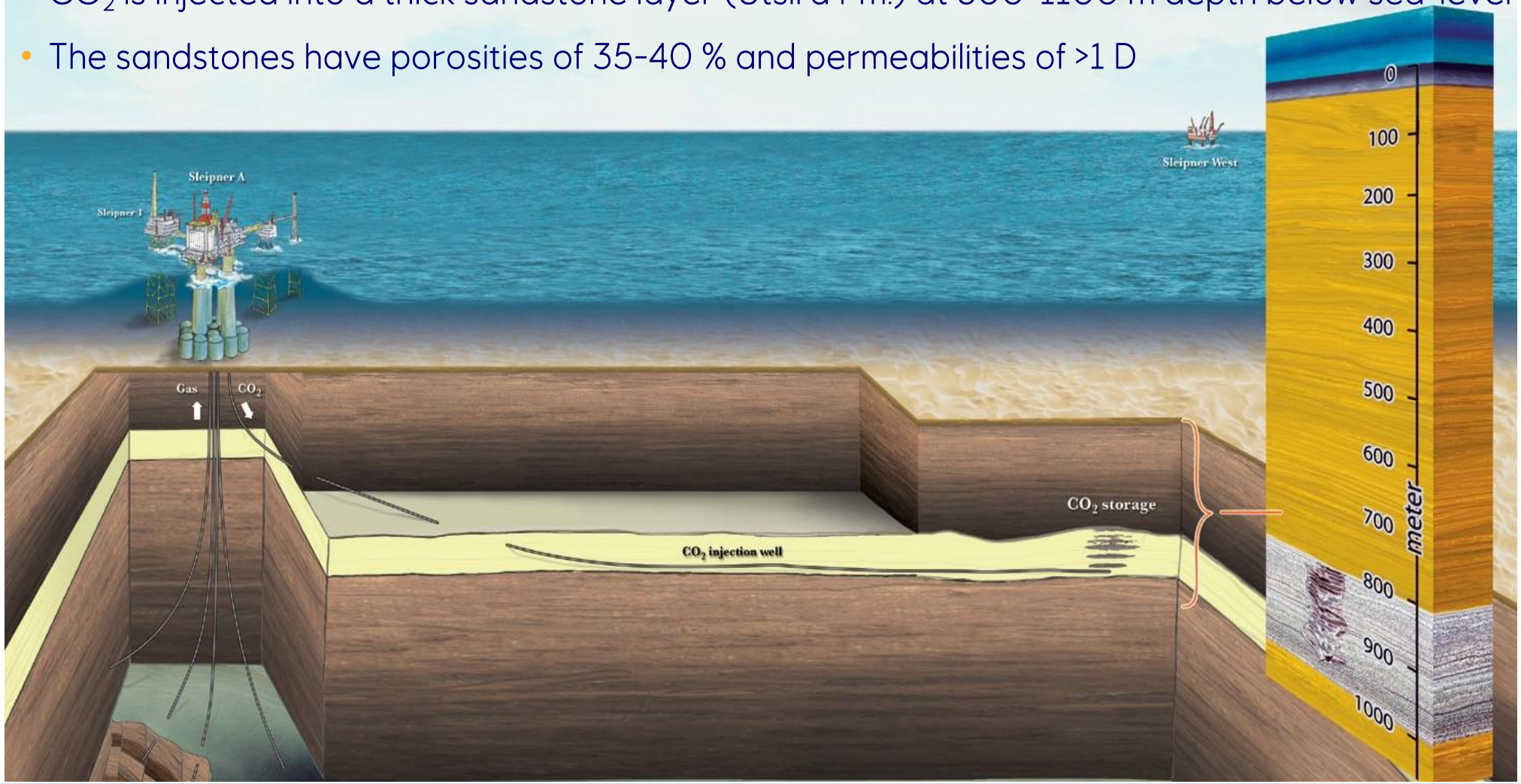
Future CCS ambitions

- 30 – 50 Mtpa by 2035 (Equity)
- Focus: North Sea Basin and Texas coastal area

Sleipner

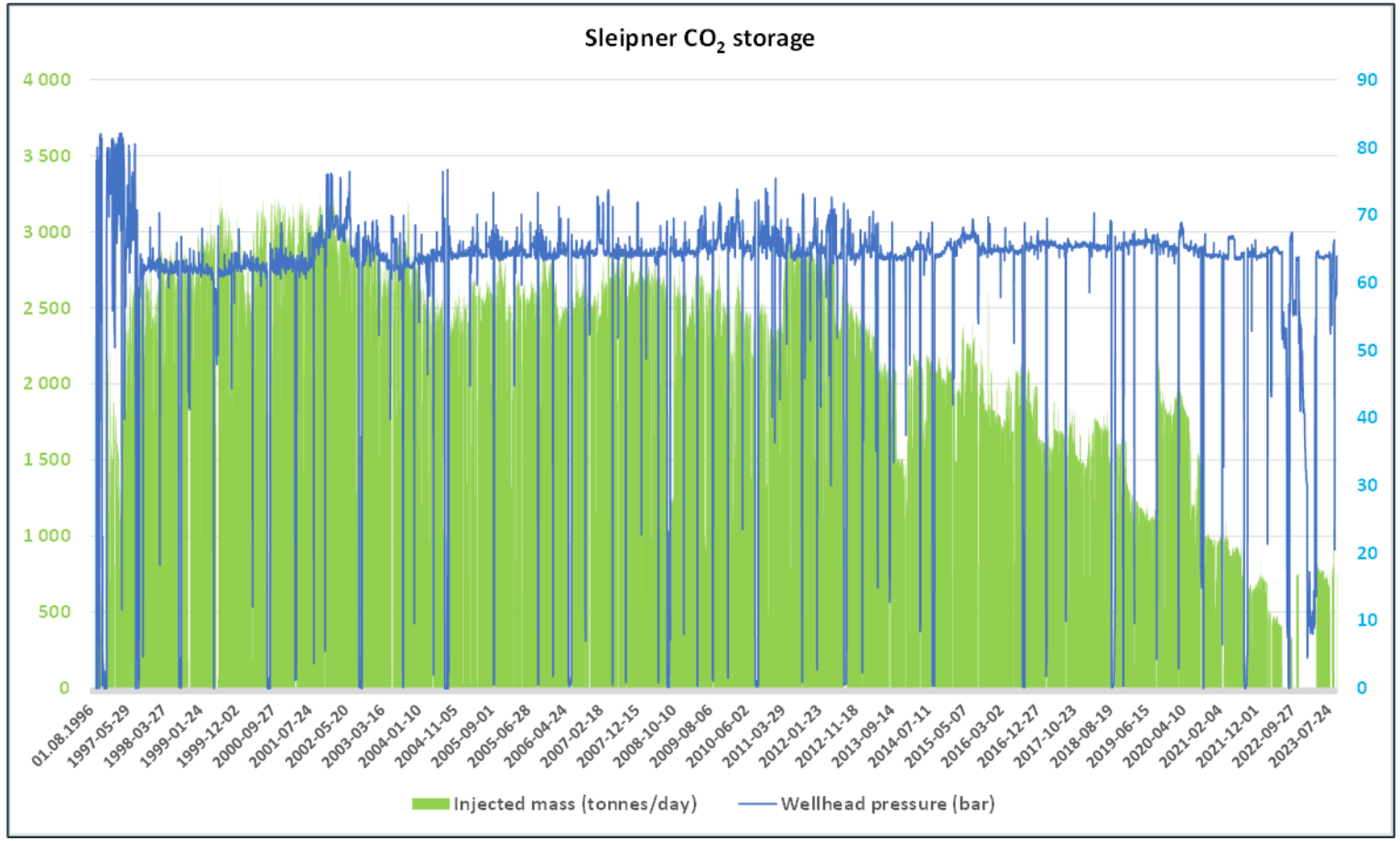
The Utsira Formation

- CO_2 is injected into a thick sandstone layer (Utsira Fm.) at 800-1100 m depth below sea-level
- The sandstones have porosities of 35-40 % and permeabilities of >1 D



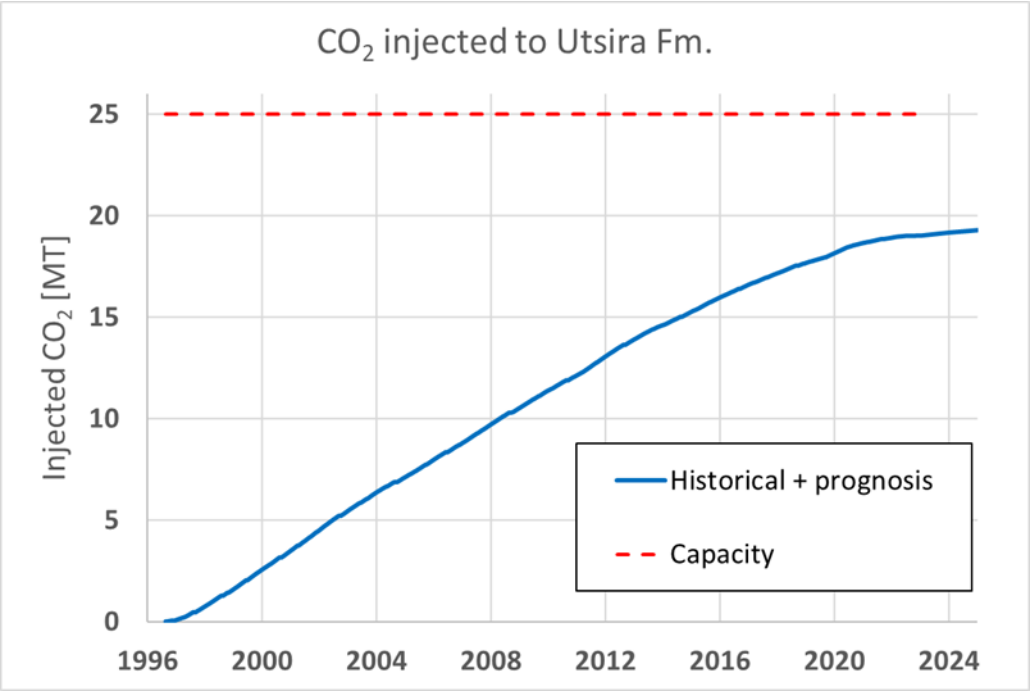
CO_2 injection status

- Up to 1 million Sm^3 / day
- Up to 1 million tonnes annually
- Declining rates due to natural decline in the gas production
- Injection temperature is stable around 25°C
- Injection pressure is stable around 65 bar
- Total injection (so far): Around 20 Mt CO2



Way Forward

- The monitoring strategy is to acquire 4D seismic for every 2 Mt CO_2 injected
- The injection rate is declining due to natural production decline on Sleipner Vest and Utgard
- At the end of the injection period, one final 4D seismic or seabed survey will be acquired

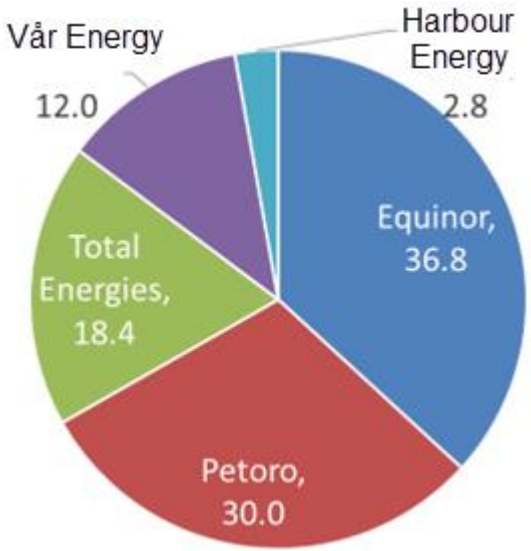


Historical and predicted CO_2 injection to Utsira Fm.

Snøhvit

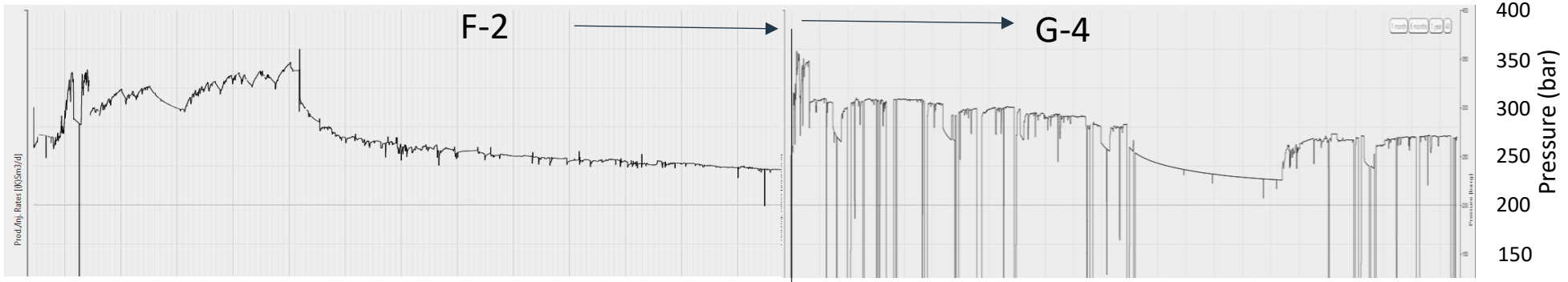
Snøhvit Gas Field

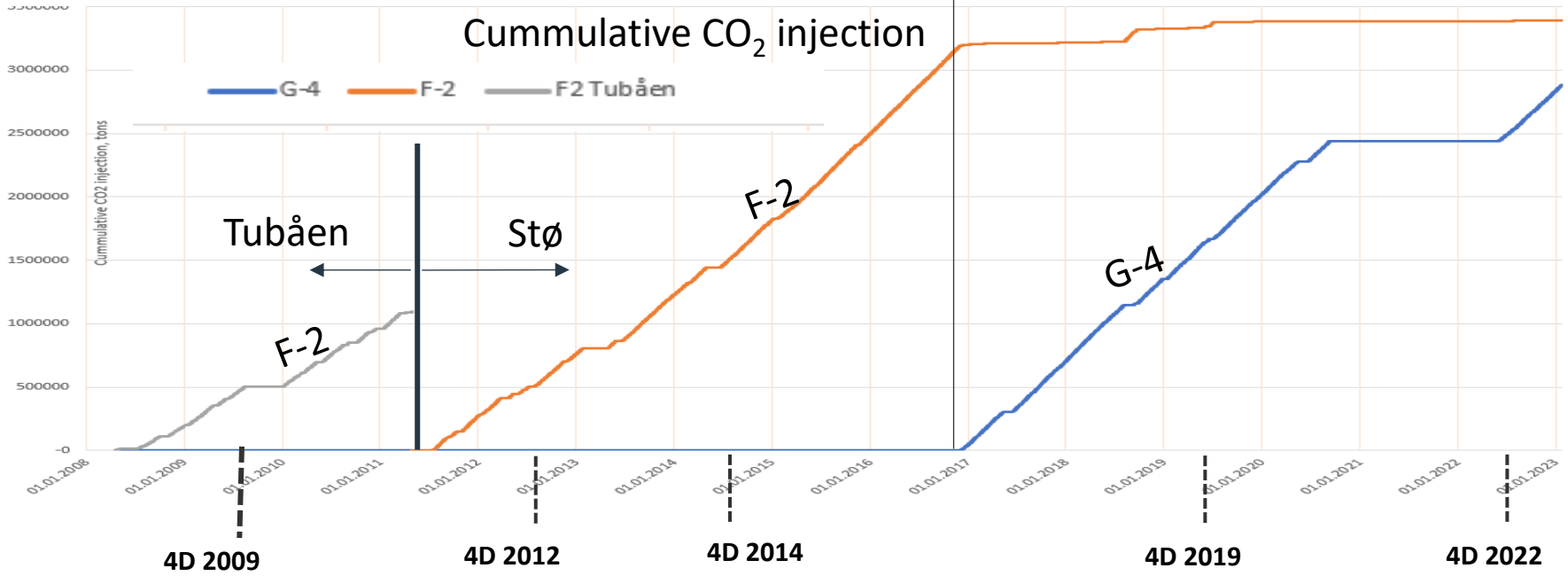
- Subsea Field offshore Barents Sea, 140 km from Hammerfest
- Onshore LNG plant in Hammerfest
- Production start 2007
- CO_2 is separated from field gas and injected back into the aquifer of Stø FM.
- More than 8,2 Mt CO2 injected today

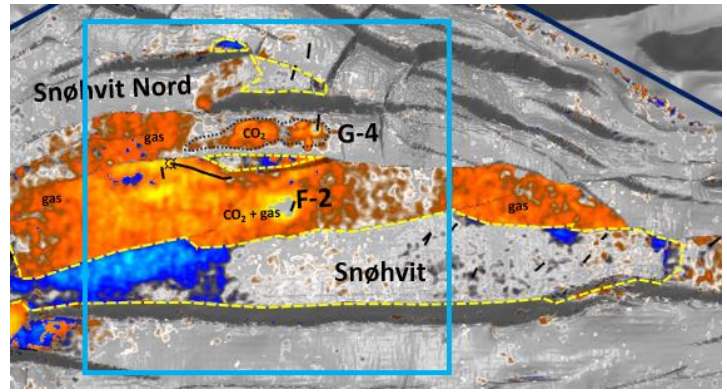


CO2 injection history

Downhole pressure



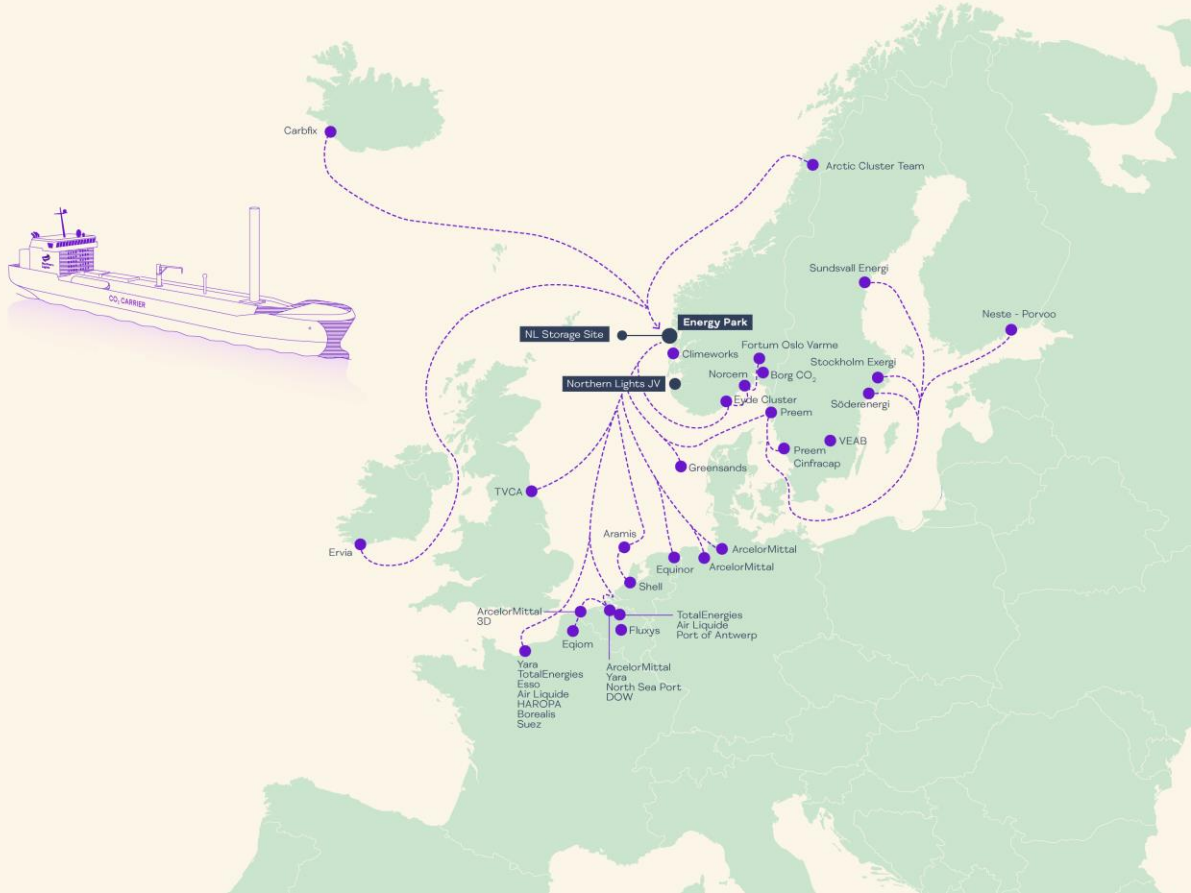




Northern Lights

Longship

- → Northern Lights was born from the Norwegian State's Longship project
- → A demonstration of large-scale, end-to-end CCS value chain consisting of:
  - Cement manufacturing plant
  - Waste-to-energy facility
  - Northern Lights CO2 transportation and storage
- → Enabled by grants through a State Support Agreement
- → Longship has co-financed Northern Lights Phase 1 with a capacity of 1.5 million tons of CO2 per year
- → State participation critical to de-risk initial investment and operation period



Northern Lights Joint Venture

- June 7th - 2021 | The Northern Lights JV DA was formally established
- The JV is owned by Equinor, Shell and TotalEnergies
- JV employees are seconded from the owner companies, have also started to employ dedicated staff
- Service agreements and technical service provider
- Operator of EL001

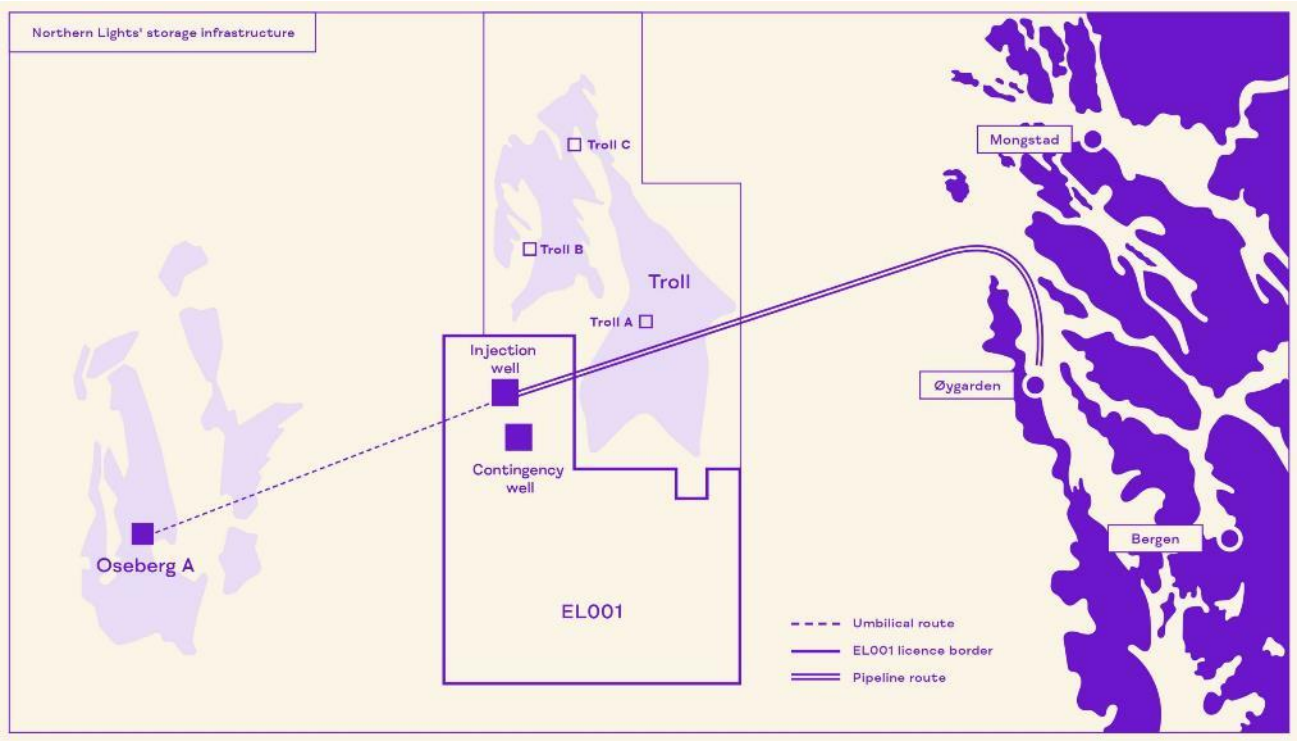
Northern Lights

CO_2 transport by ship

- → **Cargo size:** 7,500 m3
- → **Length:** 130m
- → Medium pressure **cargo containment**
  - C. 15 barg and -26°C
- → **Purpose-built** pressurised cargo tanks
- → **Primary fuel:** LNG
- → Wind assisted propulsion system and air lubrication will **reduce carbon intensity by around 34%** compared to conventional systems
- → To be **registered in Norway (NOR)**
- → **Classed** by DNV
- → **Additional ships** needed
  - Subject to Phase 2 FID

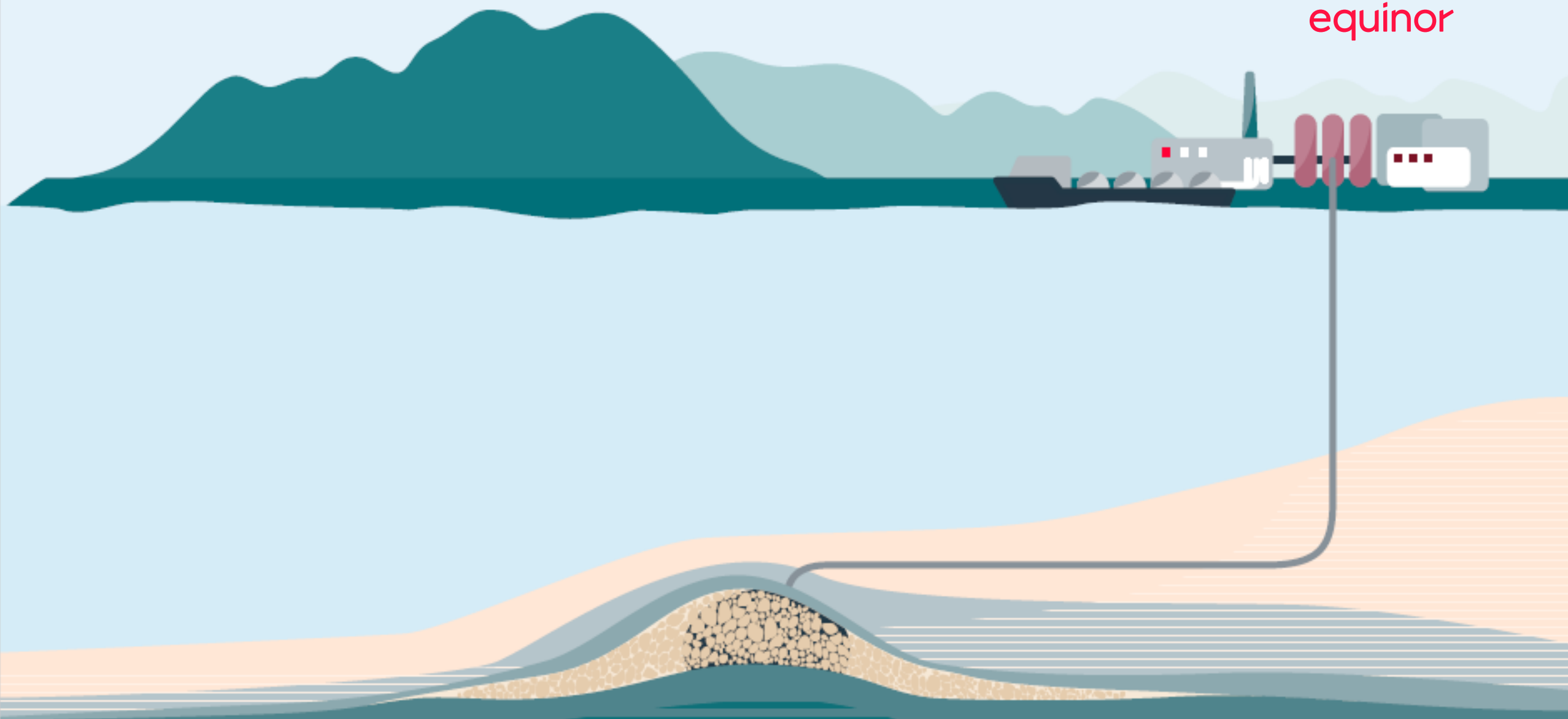
Phase 1 wells drilled

- 2 wells drilled, completed and ready for hook-up
  - 1 injection well, 1 contingent well
- Results confirm the storage capacity of the reservoir of at least 5 million tonnes CO_2 per annum



Smeaheia

equinor



Smeaheia Norwegian Hub

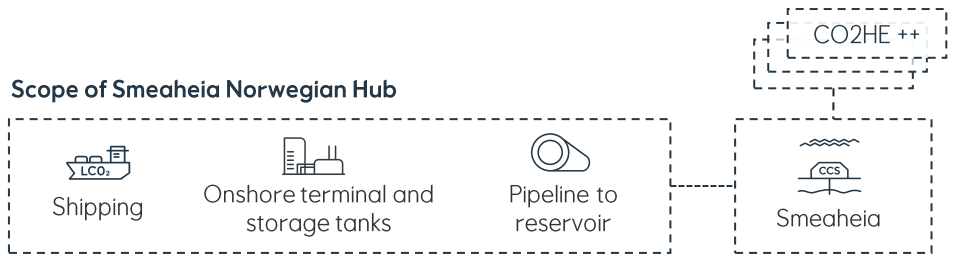
EARLY SHIP-BASED CO2 TRANSPORT TO EMITTERS IN EUROPE

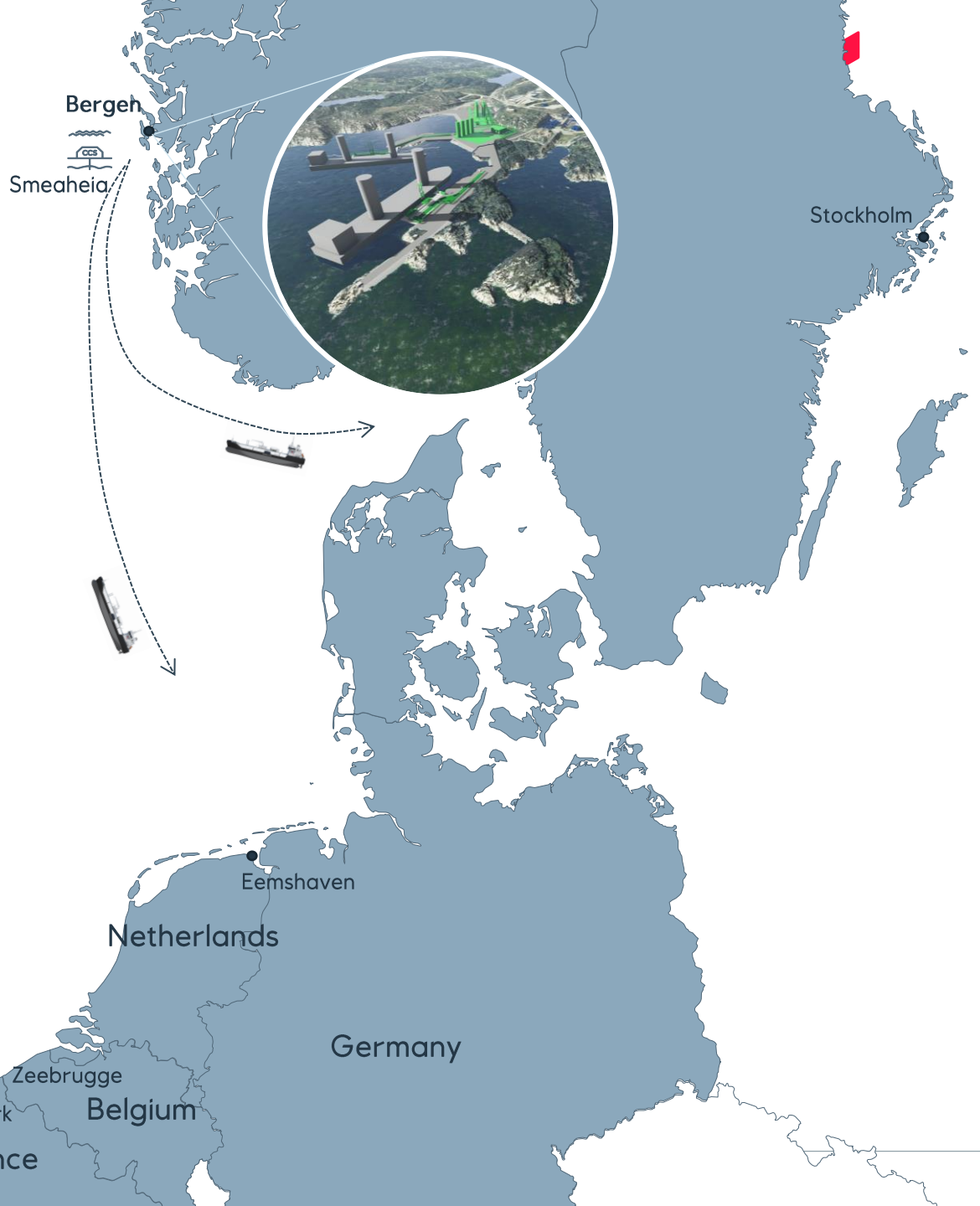
Smeaheia as anchor storage and key enabler for realizing Equinor's CO2 ambition of 30-50 Mtpa by 2035

Ambition to mature Smeaheia reservoir to inject up to 20 Million tons of CO2 annually

Norwegian Hub as early ship-based transport solution for European industry

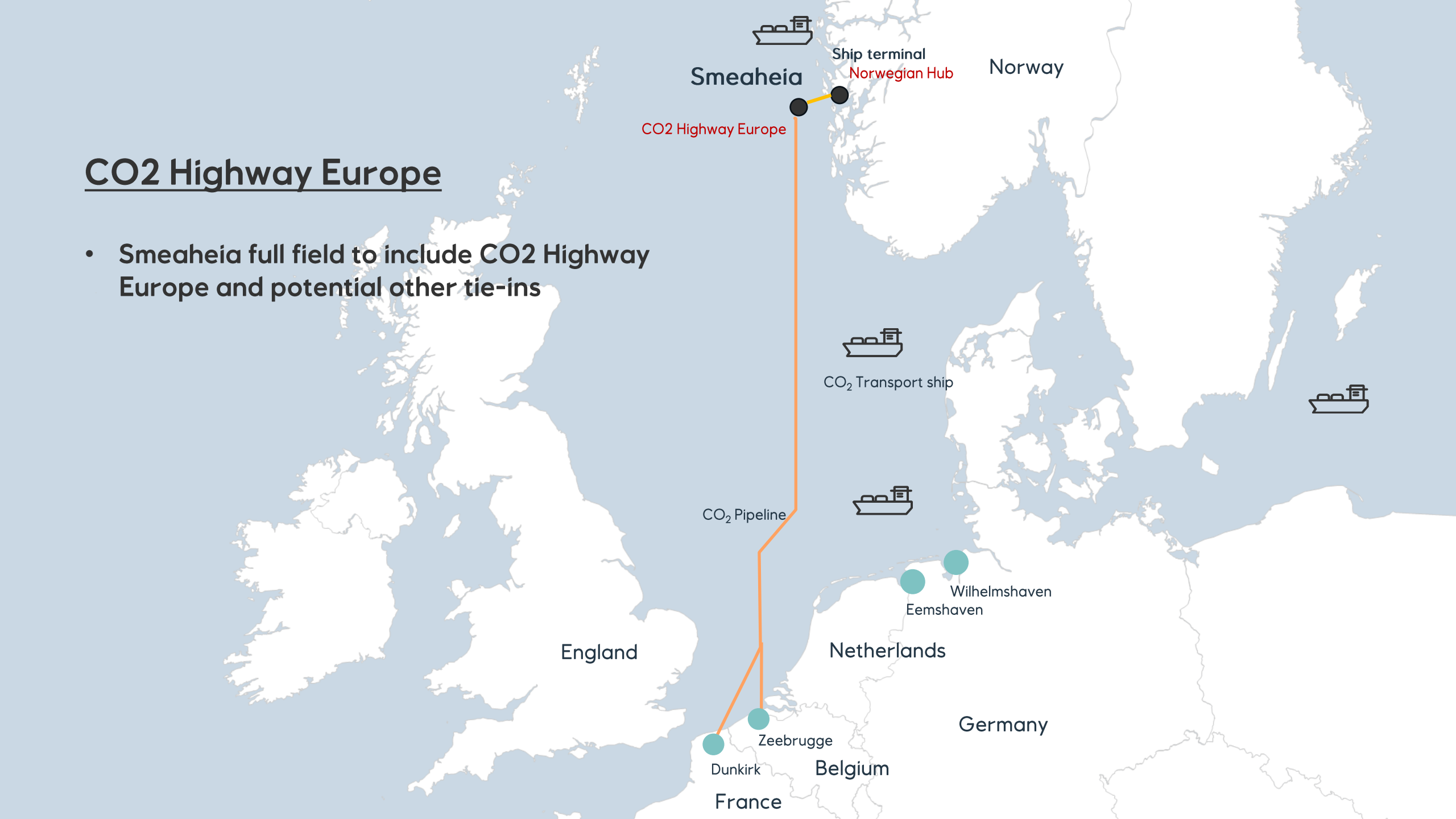
5 Mtpa transport capacity by 2029, Medium Pressure ships, receiving terminal at Sture, Øygarden.





CO2 Highway Europe

- Smeaheia full field to include CO2 Highway Europe and potential other tie-ins



CO2 Storage Kalundborg

License

- 6 yrs exploration license
- Equinor (60%, operator), Ørsted (20%), Nordsøfonden (20%)
- Preliminary analysis suggests large storage potential

Work Program

- 3D seismic acquisition and processing + two confirmed wells (EQN)
  - 1st well primarily for exploration
  - Apply for permanent CO2 storage license or return the area

Value Chain (If suitable for storage and injection permits given)

- CO2 import terminal in Kalundborg (Ørsted)
- 20 km pipeline from terminal to storage site in Havnsø (Ørsted)
- One or more injection wells – maybe later ramp up

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