

ANICA workshop 6 October 2021

From being a problem to be
part of the solution

The Brevik CCS project

Per Brevik
Director Public affairs and liaison
with authorities

«Langskip»

Government launched «Langskip» on 21 Sept.2020

- Full scale CCS plant at Norcem Brevik
- Northern Lights responsibility:
 - Develop transport solution
 - Intermediate storage at Øygarden (Western coast of Norway)
 - Permanent storage in the Aurora formation in the North Sea
- Partly support of the FOV project in Oslo if EU is contributes through Investment Fund

➔ Total cost 25,1 BNOK (2,5 B€) incl 10 years of operation

- Gov.'s share: 16,8 BNOK (1,7 B€)

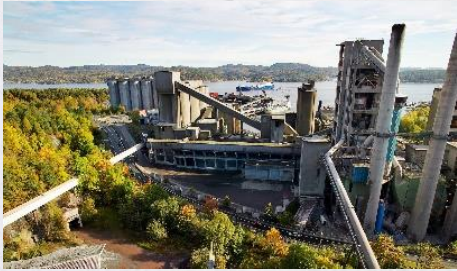
Final decision made by Parliament 14th of December 2020

Project startup January 4th, 2021



Carbon capture at Norcem Brevik – the first global CCS project in Cement

CO₂ capture



- Aker Carbon Capture's technology (more than 7,500 hours of testing at Brevik completed)

CO₂ transport



- By ship
- Responsibility – Northern Lights

CO₂ storage



- Offshore storage in the North Sea
- Planning by Equinor and partners

Facts

Technology:

Amine - Post combustion capture

Scope:

Capture, liquefaction, pipe transfer, storage on quay

Strategic Partners:

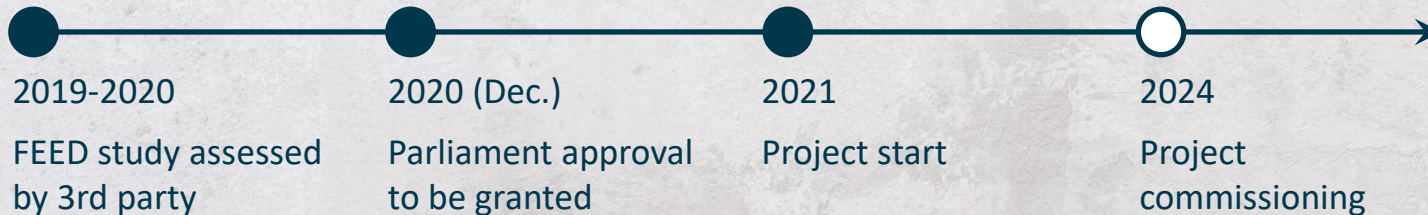
Aker Carbon Capture's (capture technology), Northern Lights (Equinor, Shell and Total) (transport & storage)

Annual CO₂ captured:

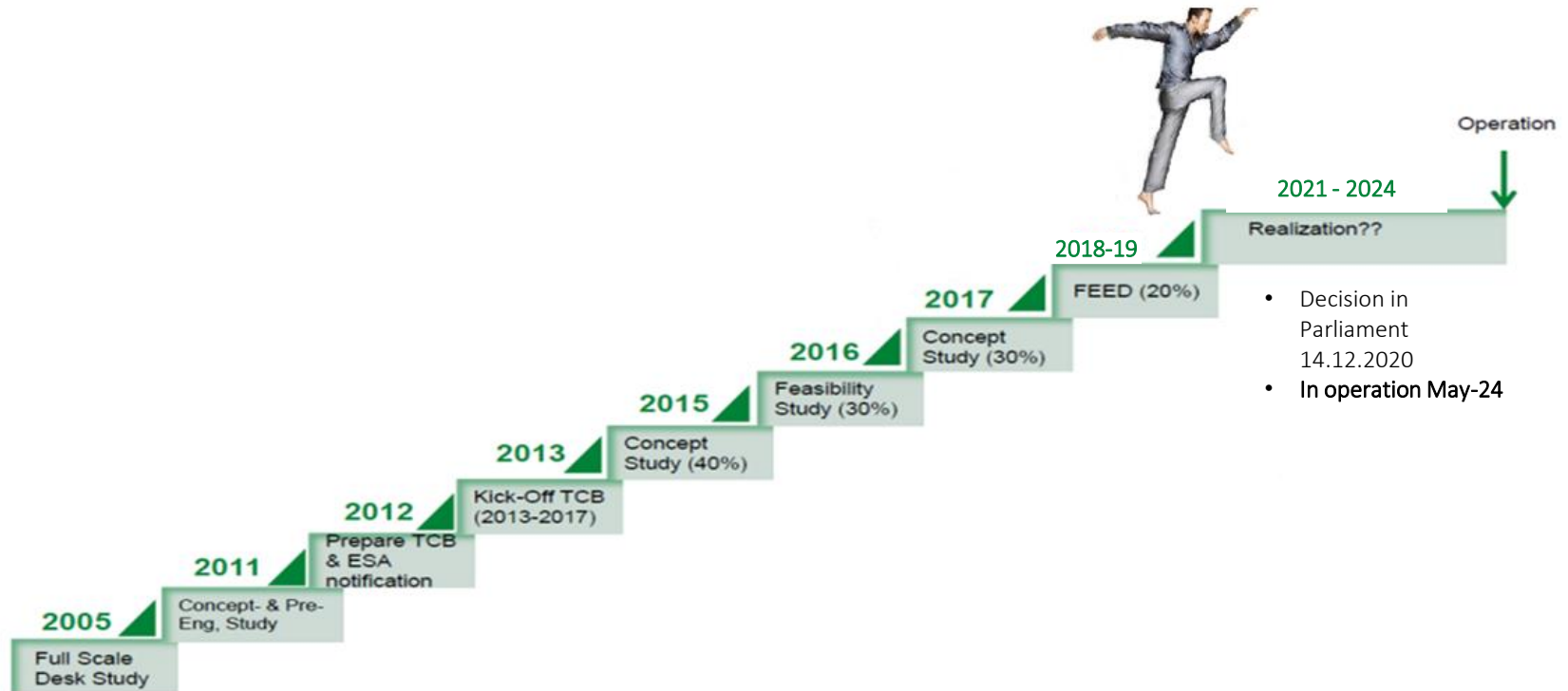
approx. 400,000 t per year (approx. 50 % of plant emission)

External funding:

>80%



A long and winding road towards Brevik CCS ...



CLIMIT–project 2013–2017

Aker Solutions amine technology – TRL 9



Air Products/ NTNU membrane technology – TRL 5



RTI solid sorbent technology – TRL 4



Testing of 4 capture technologies on real flue gas

Conclusions

1. Technologies are available
2. Technical feasible, but dependent on economic support
3. In a 2020 perspective, Aker Solutions' amine technology the only one ready for a full scale project

Alstom Power Calcium Looping – TRL 3

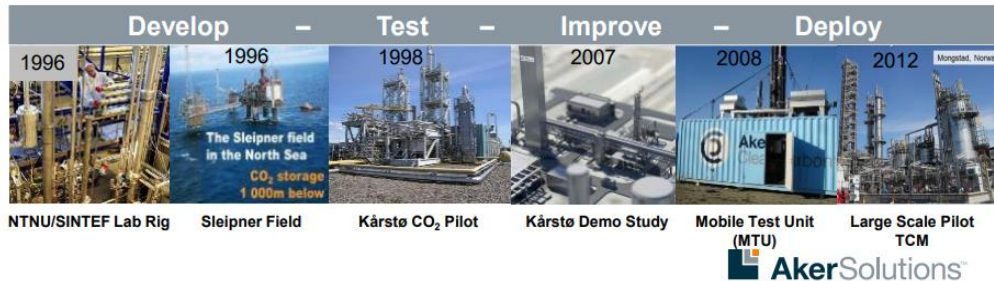


Aker Carbon Capture – our main partner

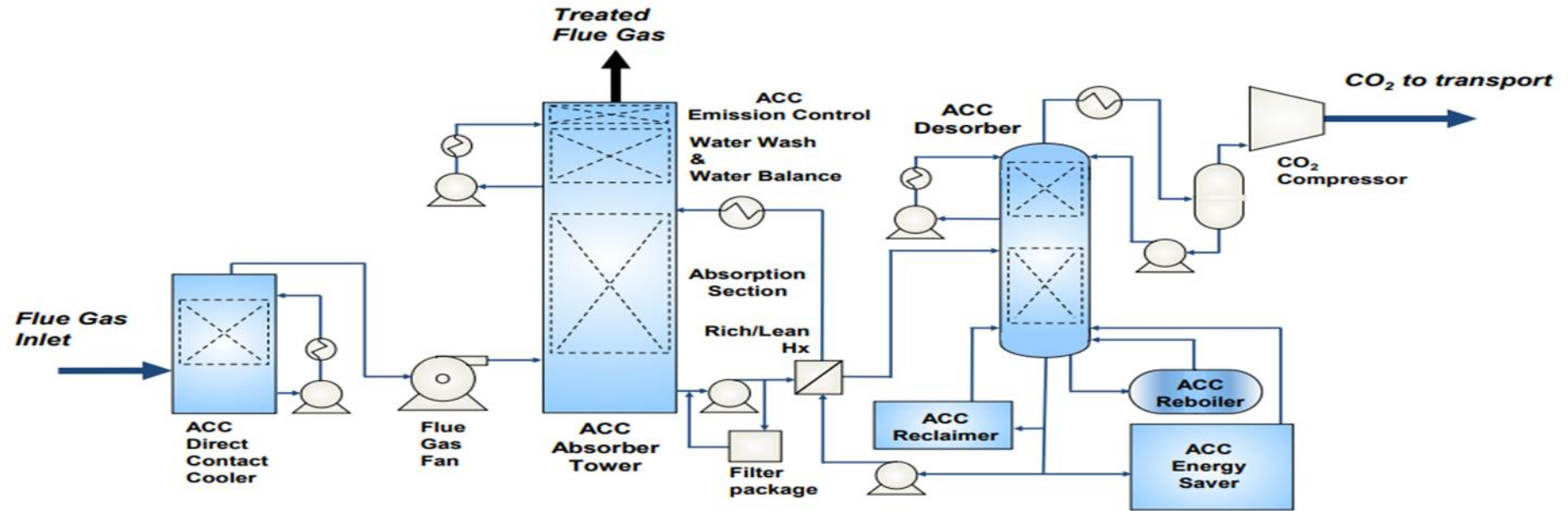
Development of Aker Solutions' ACC™ process

- Aker Solutions' Advanced Carbon Capture™ (ACC™) process has been developed based on 20 years design and operating experience with amine technology
- Several novel amine solvents have been developed through Aker Solutions' SOLVit R&D program
- Substantial field testing with the Mobile Test Unit (MTU) since 2008 at various coal and natural gas fired power plants
- Scale-up and validation of technology demonstrated through design, delivery and operation of the amine plant at Technology Centre Mongstad (TCM)

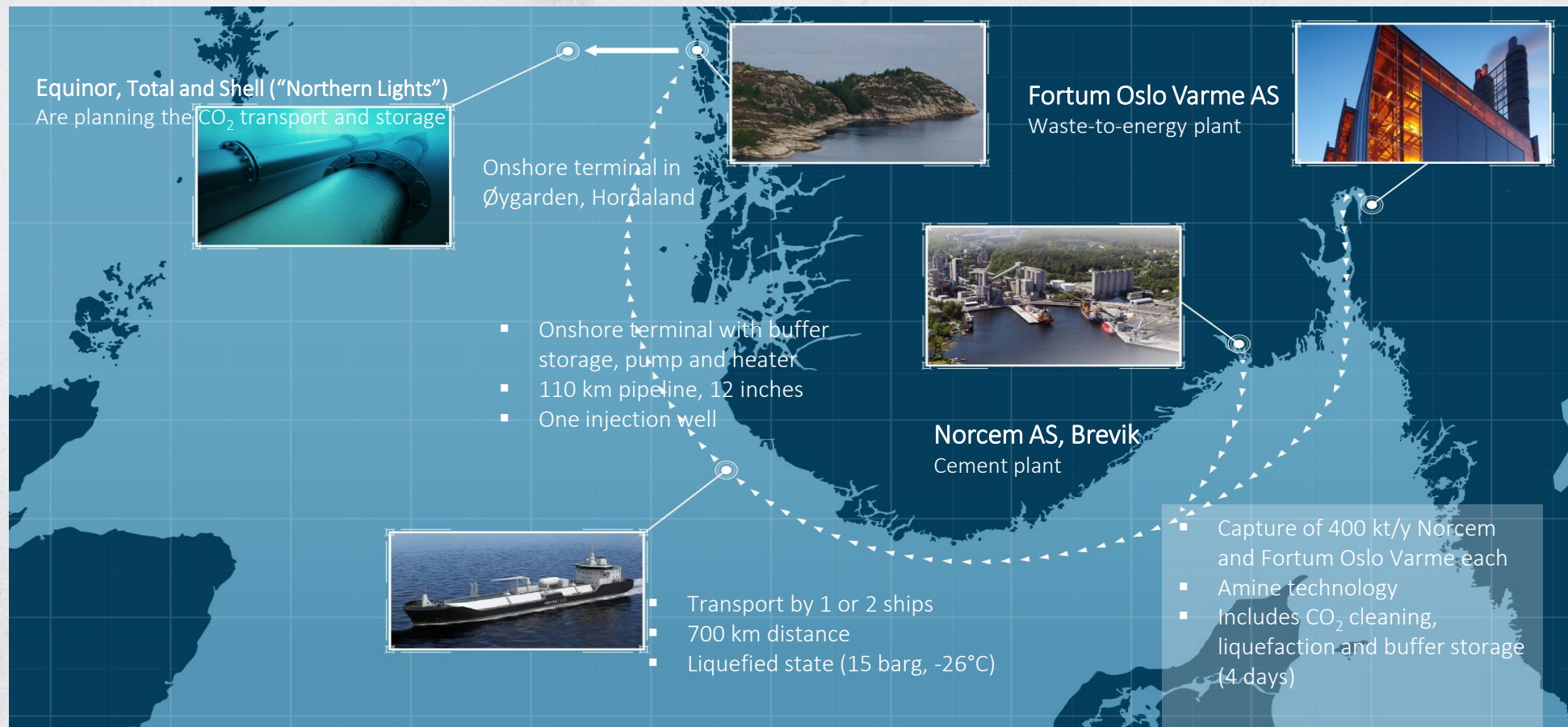
- Long involvement in carbon capture projects, and have more experience than most other technology providers
- Mobile Test Unit available
- 18 months of testing in Brevik showed a professional team



Generic flow sheet of Aker Solutions ACC™ process



The Norwegian Carbon capture Demonstration project

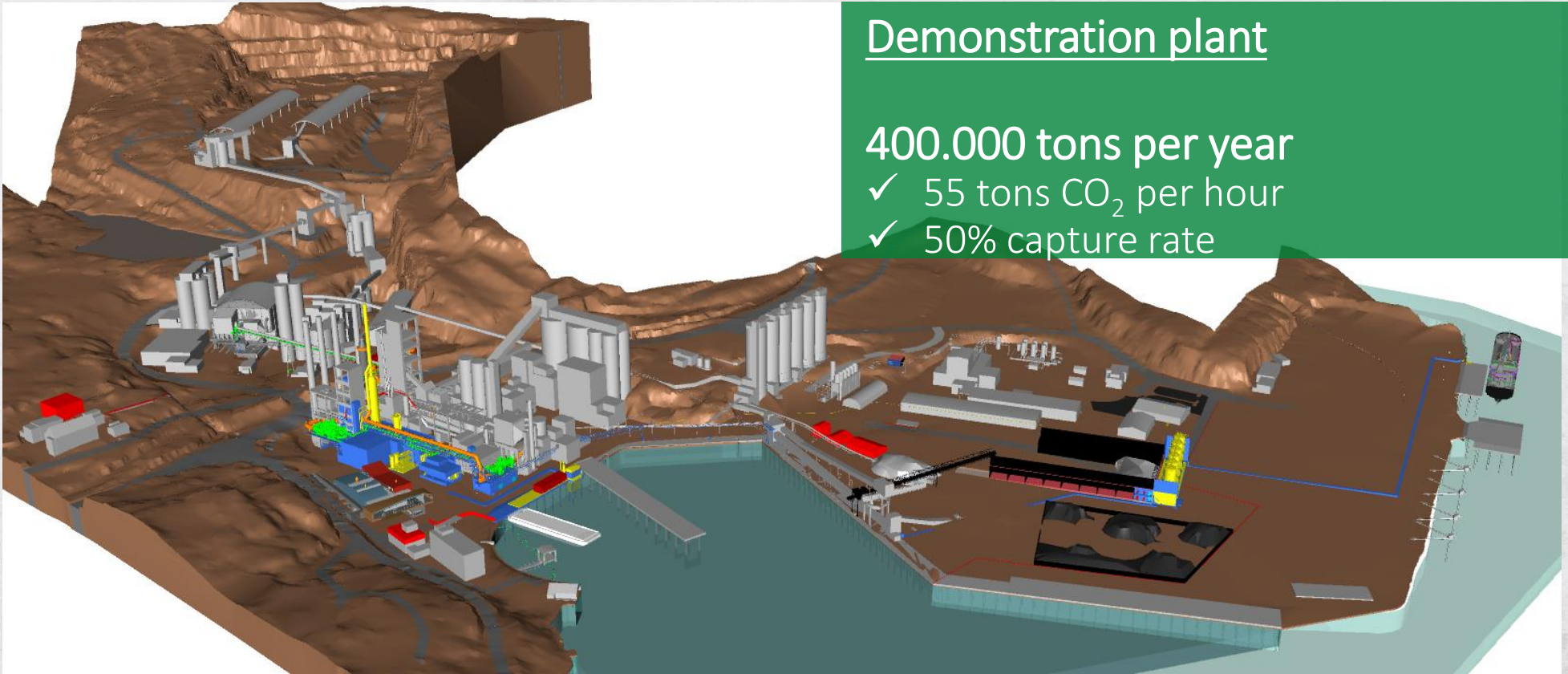


CO₂ capture Brevik

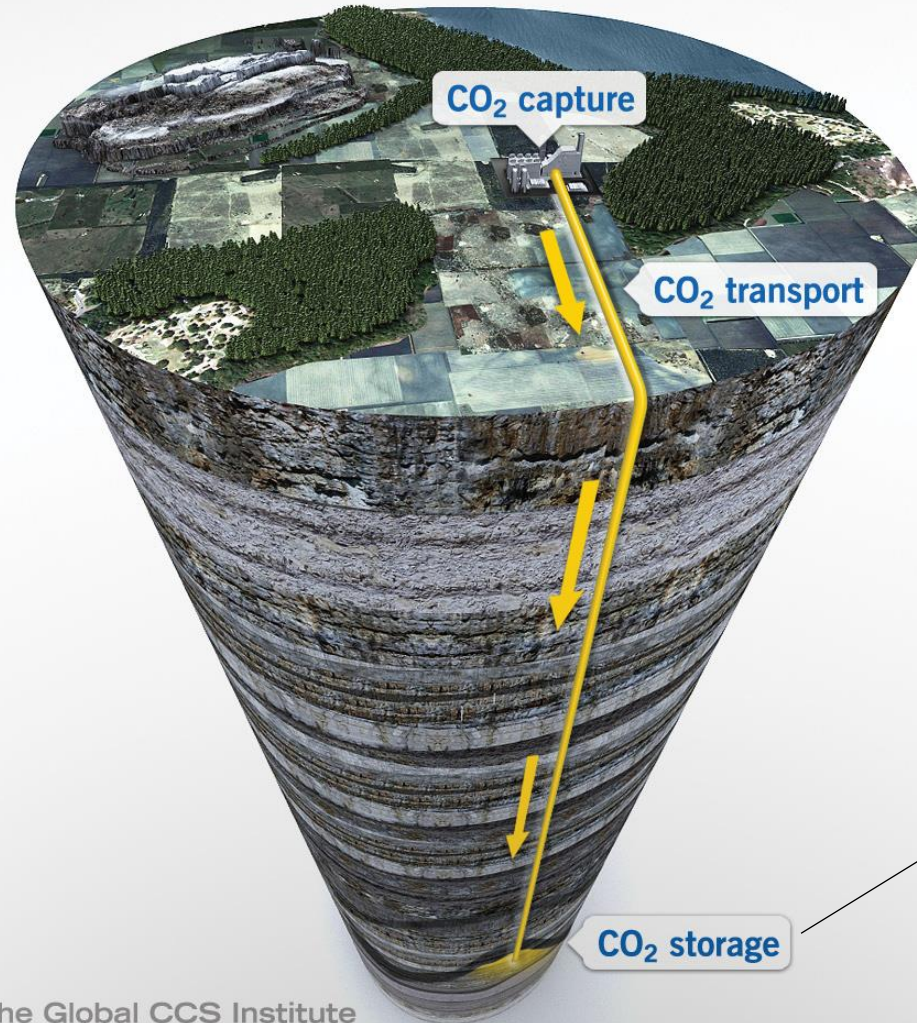
Demonstration plant

400.000 tons per year

- ✓ 55 tons CO₂ per hour
- ✓ 50% capture rate



THE CARBON CAPTURE AND STORAGE PROCESS



2600m below seabed. Well drilling completed 15/1-20

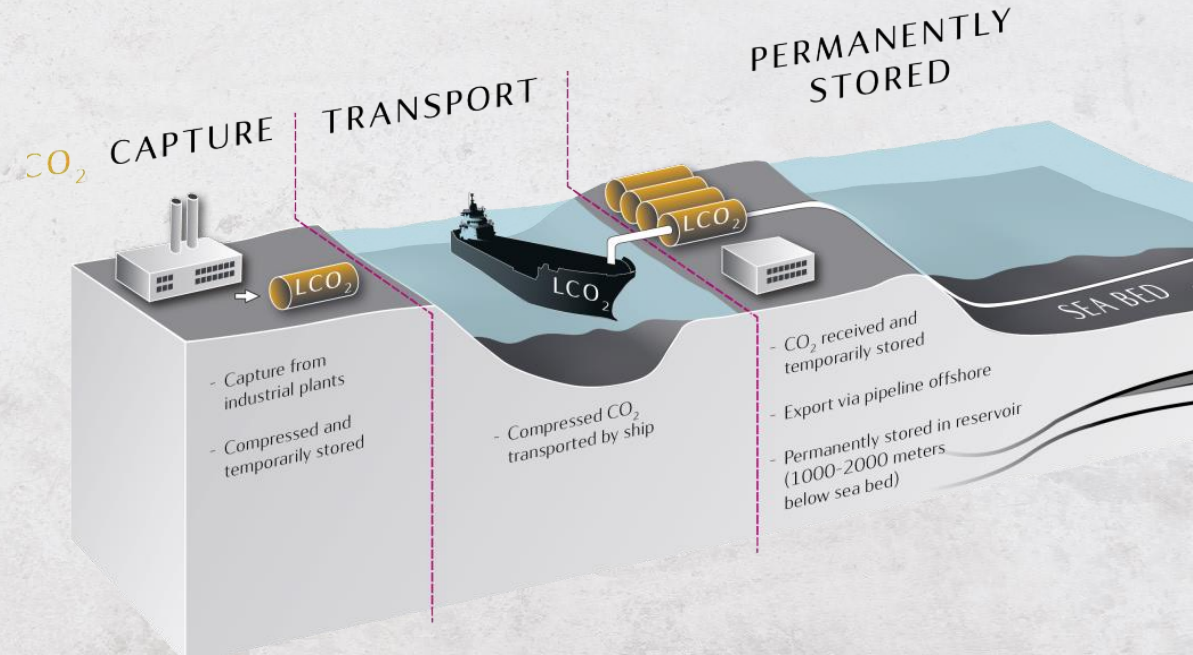
The unique elements of «Langskip»

The worlds first CCS complete value chain

The worlds first full-scale CO₂-capture plant from cement industry

The worlds first network for shipment transport of CO₂

Establishment of centralized storage for CO₂ at Norwegian shelf



Political project

High number of Stakeholders

- Government / Ministry / Politicians
- EU / EEA
- Norcem/HeidelbergCement
- Academia – R&D

Biggest climate project in Norwegian industry ever

- «Norwegian tax payers' money»
- Public procurement
- Communication and media

Benefits realization

- Responsibility as a big emitter
- Control regarding progress and costs
- «Lessons learnt» - sharing experiences
- «Brevik – the first capture project in a row!»



Prime minister Erna Solberg. With two fellow cabinet members visiting Norcem in Oct. 2020

We have started the journey towards 2024



2021



2024



1. HC has a strong track record of reducing CO₂ emissions and clear measures for driving down emissions in 2025 and 2030.
2. CCS is an important part of HC's development plans
3. Brevik CCS will be the first in a row of capture projects. Amine solutions are the most mature as per today, but new technologies and solutions will be developed.

Thank you for your attention!