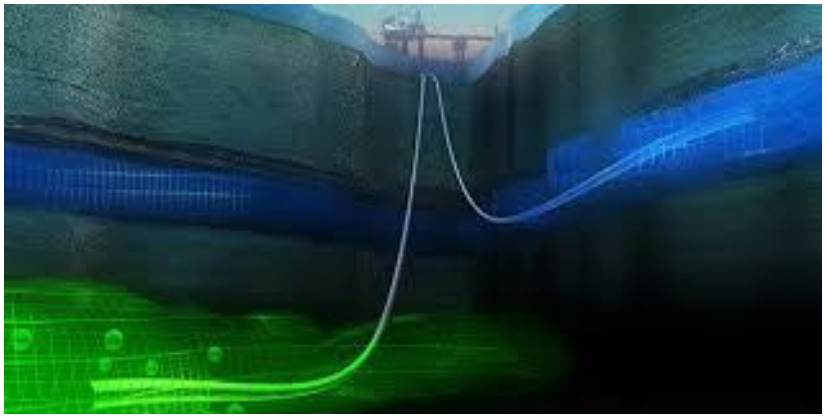
The Research Council of Norway

Norway – a European CSS driver

CO_2 GeoNet, Venice 9 May 2016



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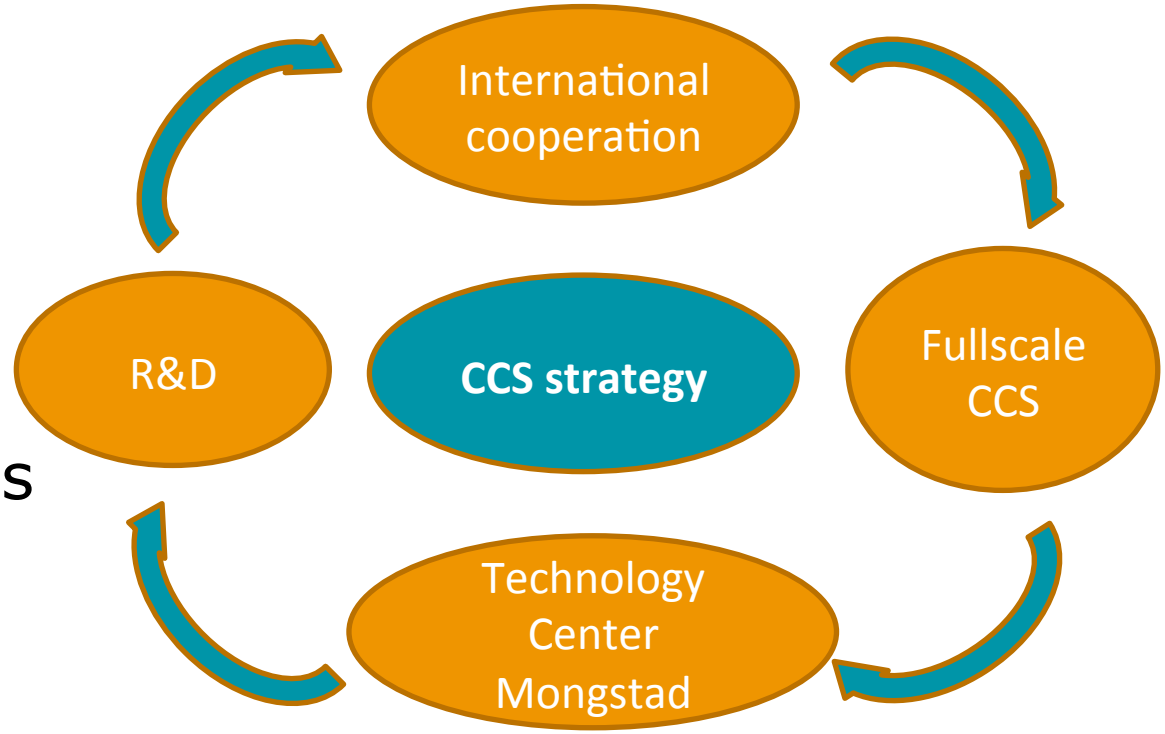
Agenda



- History
- Policy instruments
- TCM
- Climit projects
- Feasibility studies
- Why CCS is important to Norway
- International cooperation

Norway's CCS-history

Prime minister Kjell Magne Bondevik, resigns March 2000

- **Since 1996**: **Sleipner** with CO_2 capture from natural gas and offshore storage
- **2000:** First time on history that a prime minister resigns because of to climate issues. He resigned due to lack of support for CCS on Gas-power plant.

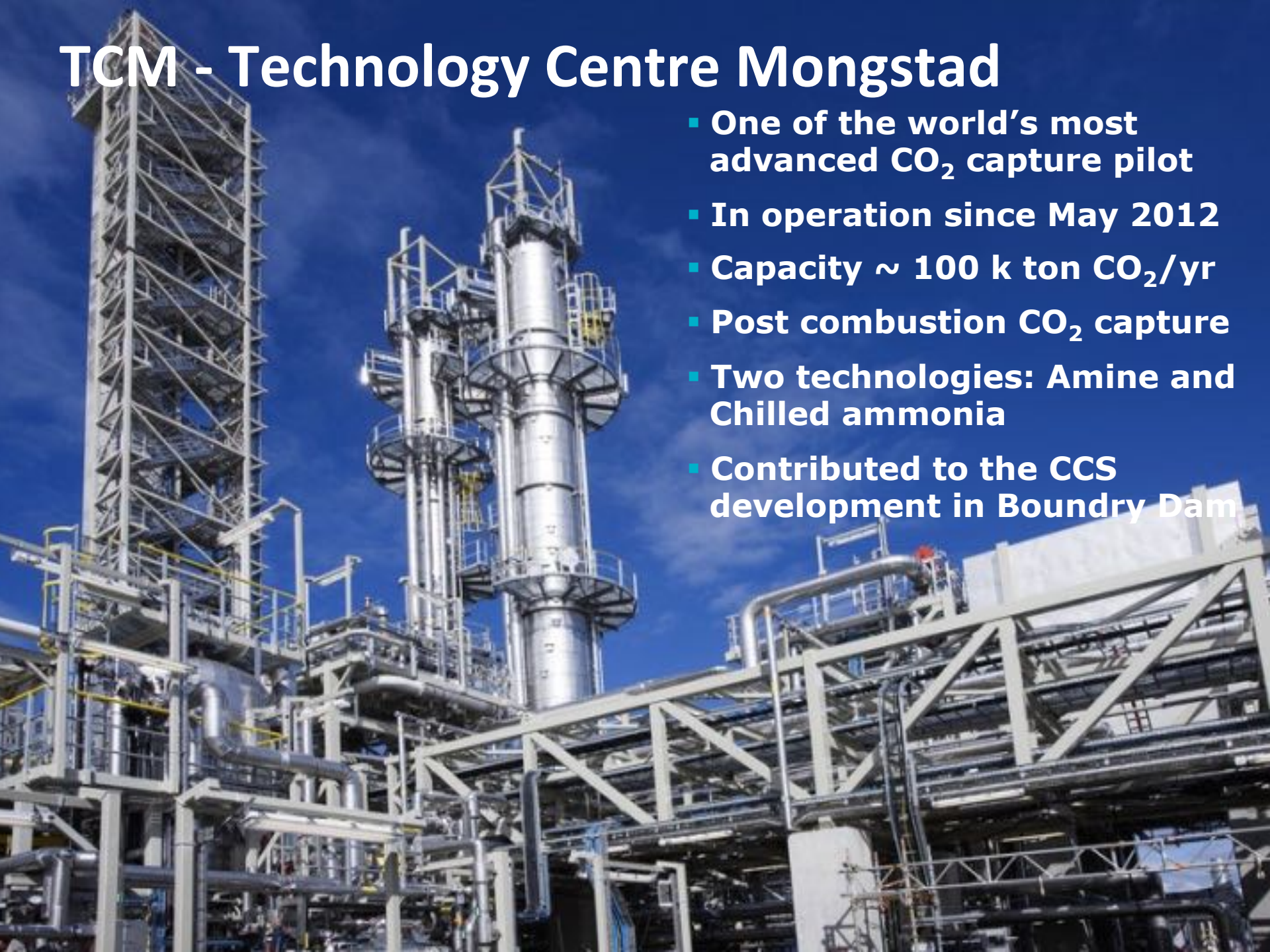
- **2008: Snøhvit** (gas field)
- **2012**: **TCM -** Test centre Mongstad (CO_2 capture pilot)
- **2013:** Full scale CCS at Mongstad gas power plant terminated
- **2015**: Ongoing feasibility studies with ambition of full scale demonstration by 2020

- All in all:
- 20 year practice
- More than 10 years of development.
- RD&D projects (CLIMIT programme) and TCM could pave way for full scale CCS in near future…

- **Norway is a leading CCS nation**

Prime minister Erna Solberg, since September 2013

TCM - Technology Centre Mongstad



- One of the world's most advanced CO_2 capture pilot
- In operation since May 2012
- Capacity ~ 100 k ton CO_2/yr
- Post combustion CO_2 capture
- Two technologies: Amine and Chilled ammonia
- Contributed to the CCS development in Boundry Dam

Policy Instruments for CCS in Norway

Accelerated development of CCS technology

The Research Council of Norway

GASSNOVA

Industry

INFRA → R&D-Centers → CLIMIT → TECHNOLOGY CENTRE MONGSTAD → Demo → Invest.

Norwegian R&D&D-instruments for CCS-development:

- CLIMIT R&D: yearly budget € 21 M
- CLIMIT Demo: yearly budget € 23 M

- CCS Research Centres
  - FME BIGCCS & FME SUCCESS
  - Yearly budget € 3.3 M for 8 years

success
SUbsurface CO2 storage- Critical Elements and Superior Strategy

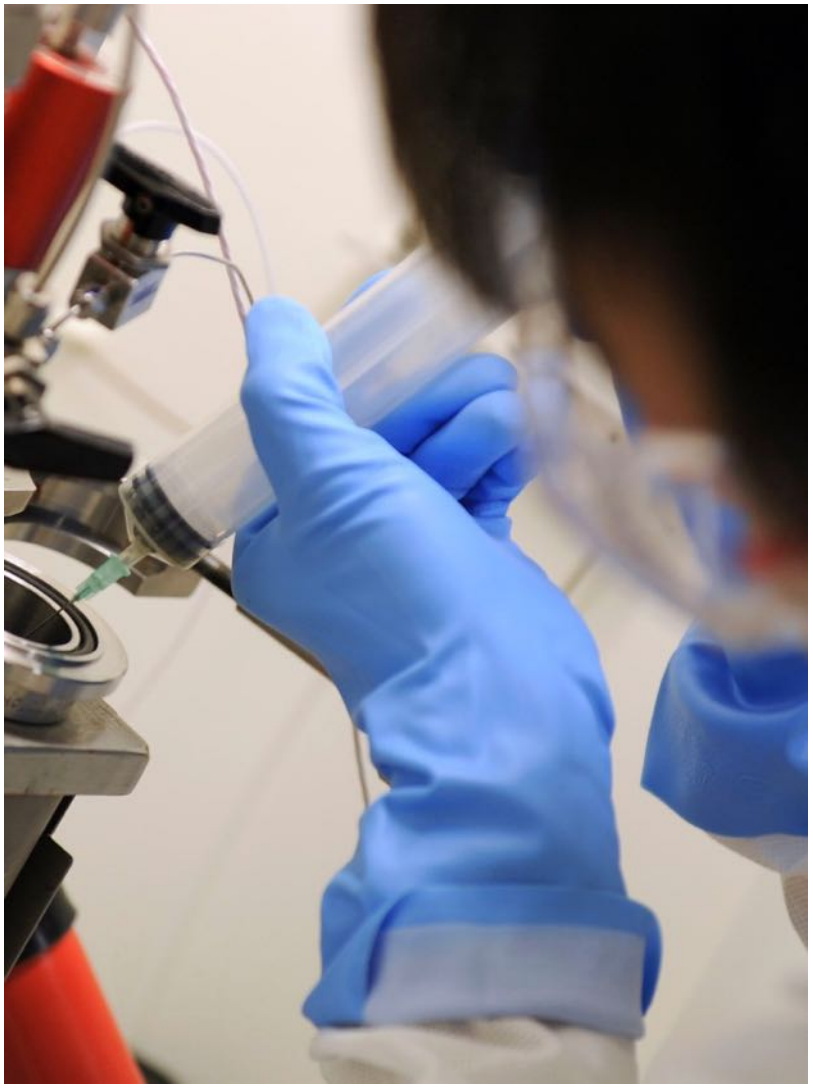
BIGCCS
International CCS Research Centre

- Research Infrastructure:
  - ECCSEL: € 22 M from RCN

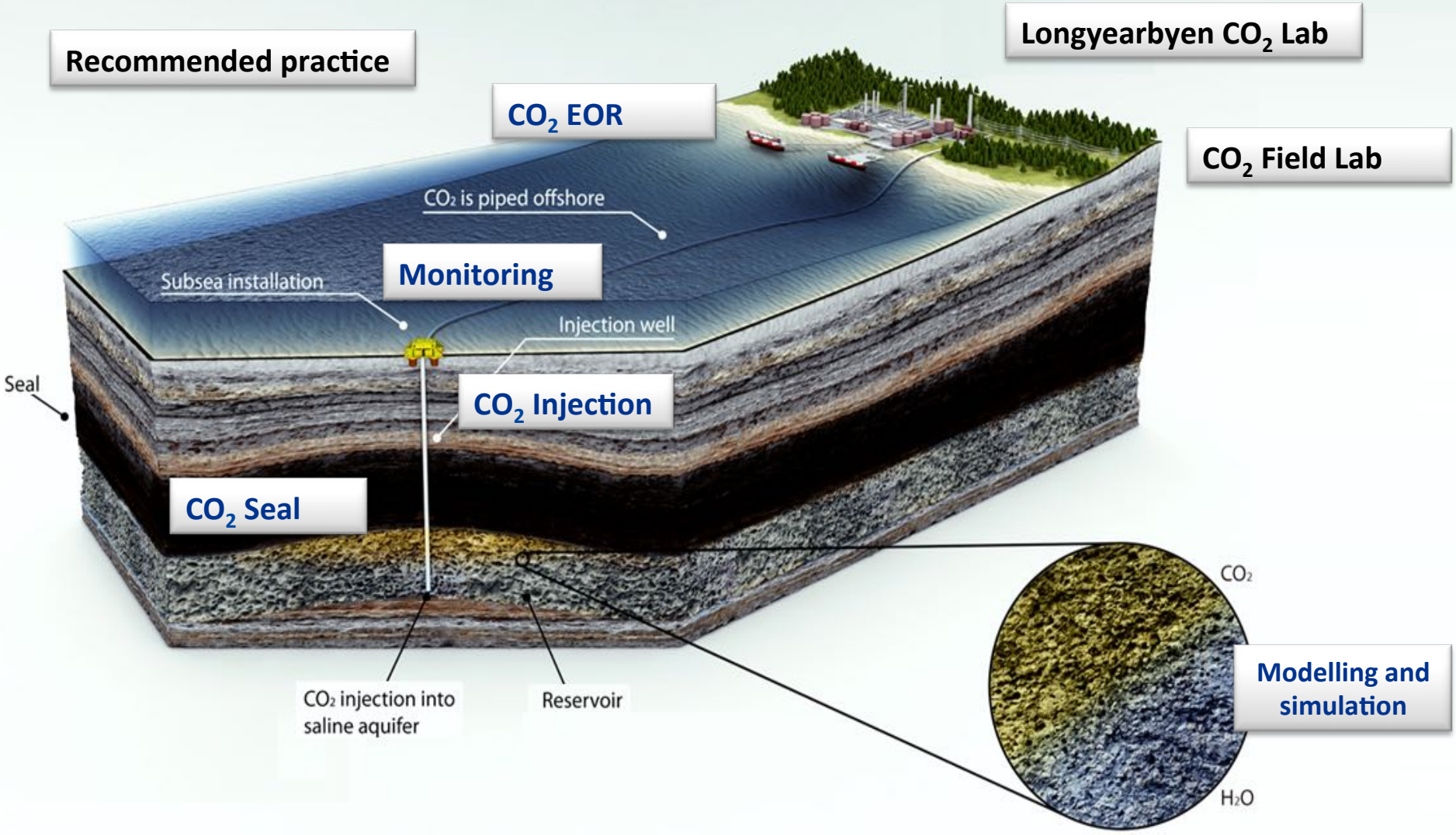
eccsel

CLIMIT: From research to demo…

- More than 200 projects have received support since 2005
- Approx. 130 mill Euros in funding
  - In addition, the CLIMIT Demo projects have triggered an average of 50% industry financing
- Support for research, development, pilot and demo projects



CLIMIT-R&D funded projects - Examples

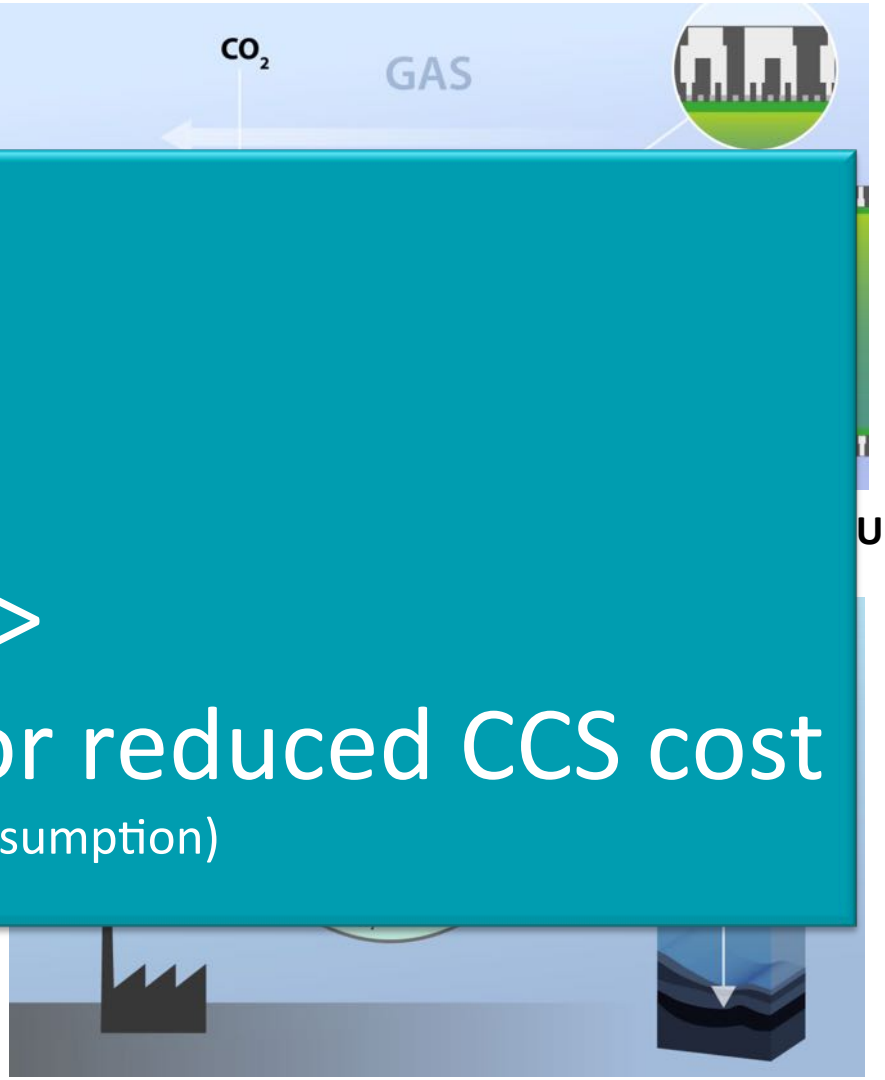


New concepts for CO_2 capture

- Very un-mature
- High risk
- High potential
  - If they succeed -> paradigm shift for reduced CCS cost

(mainly in relation to energy consumption)

Combining two promising looping capture technologies (SINTEF MK)



CO_2 capture using magnetic nanoparticles (SINTEF MK and NTNU)

Illustration: Eivind Vetleseth

Feasibility studies - Capture

- **Diversity**: 3 different industries – different requirements/ solutions
- **Large potential** for new knowledge that can be implemented world wide
- **Motivation**: competition in the low-carbon-emission society
- Business model and financial aspects

Norcem Cement plant
0.8 $MtCO_2$/yr

Yara Ammonia plant
0.56 $MtCO_2$/yr

Klemetsrud Waste plant
0,4$MtCO_2$/yr

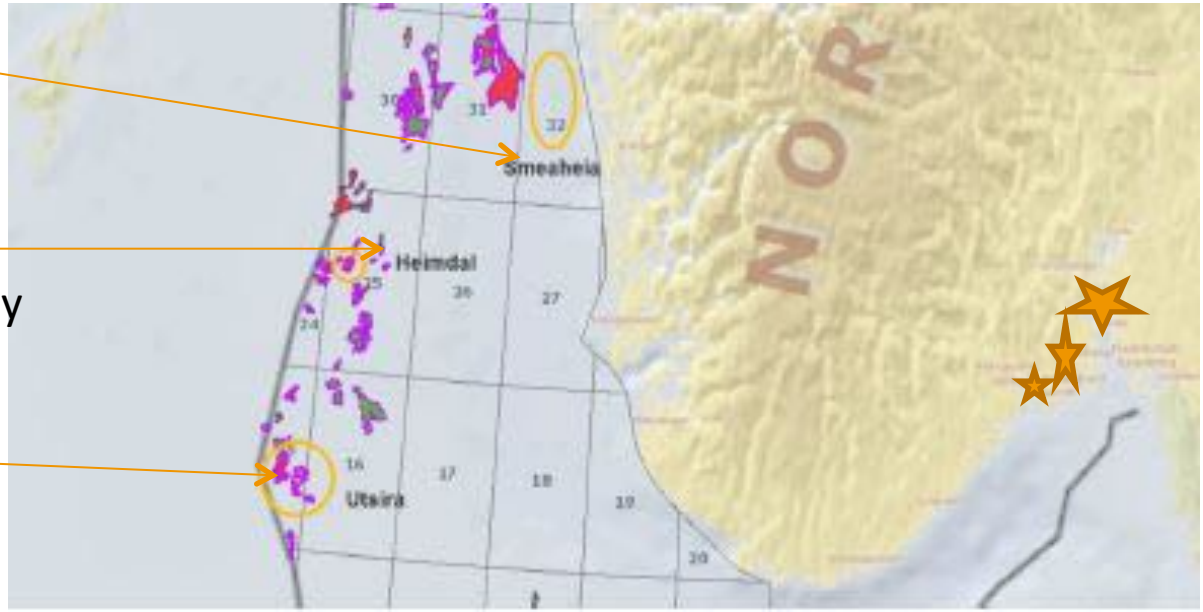
Feasibility study – Transport

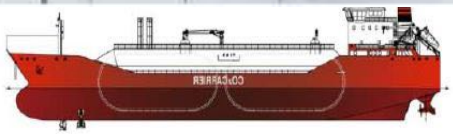
- The State will handle transport and storage
- Gassco with mandate to assess ship and pipeline possibilities for transport of CO_2 from capture site to three storage (South-West coast of Norway)

Smeahaia: well known, seismics, large potential

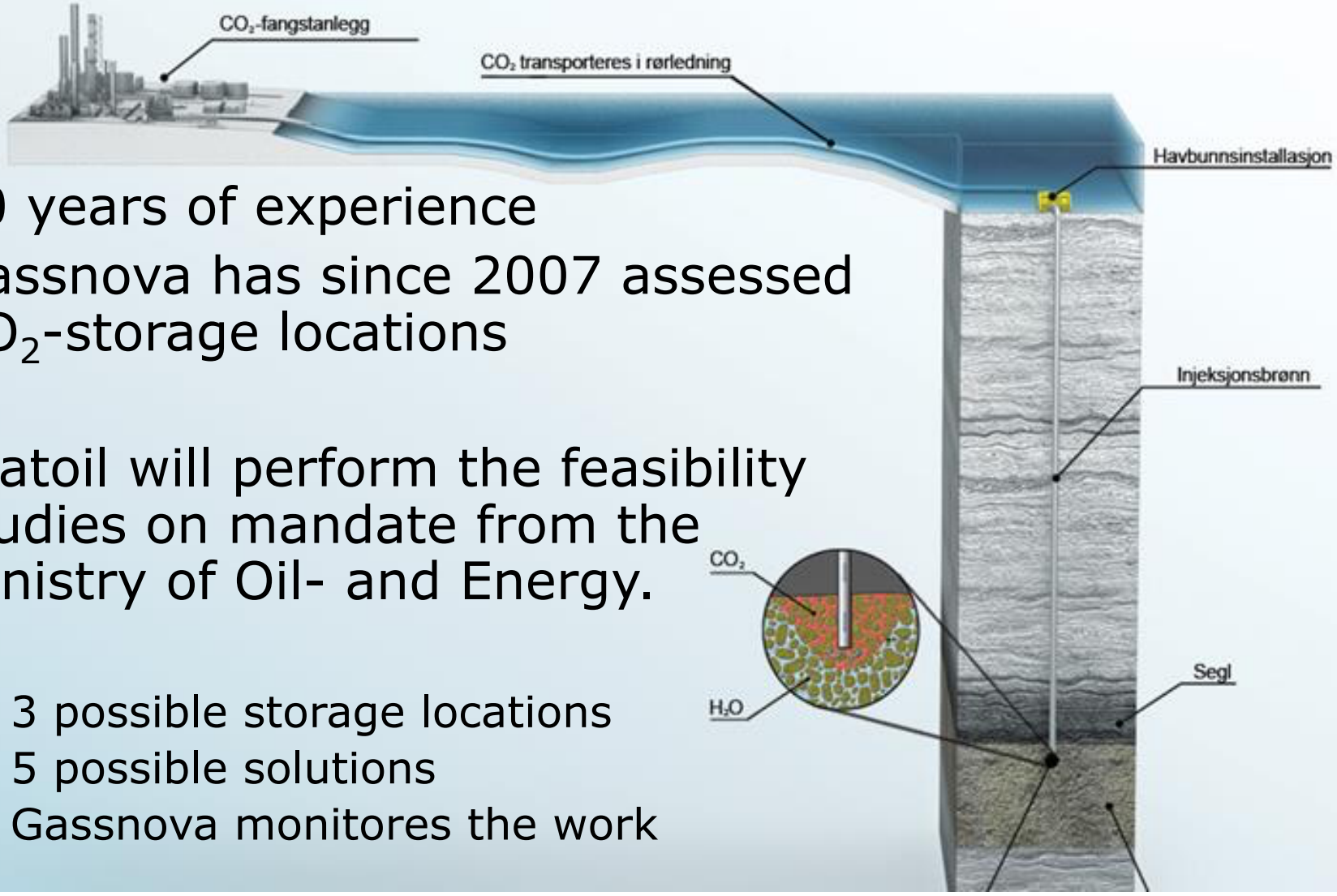
Heimdal: re-use existing infrastructure. Technically challenging

Utsira: build on experiences from injected CO_2 from Sleipner since 1996.



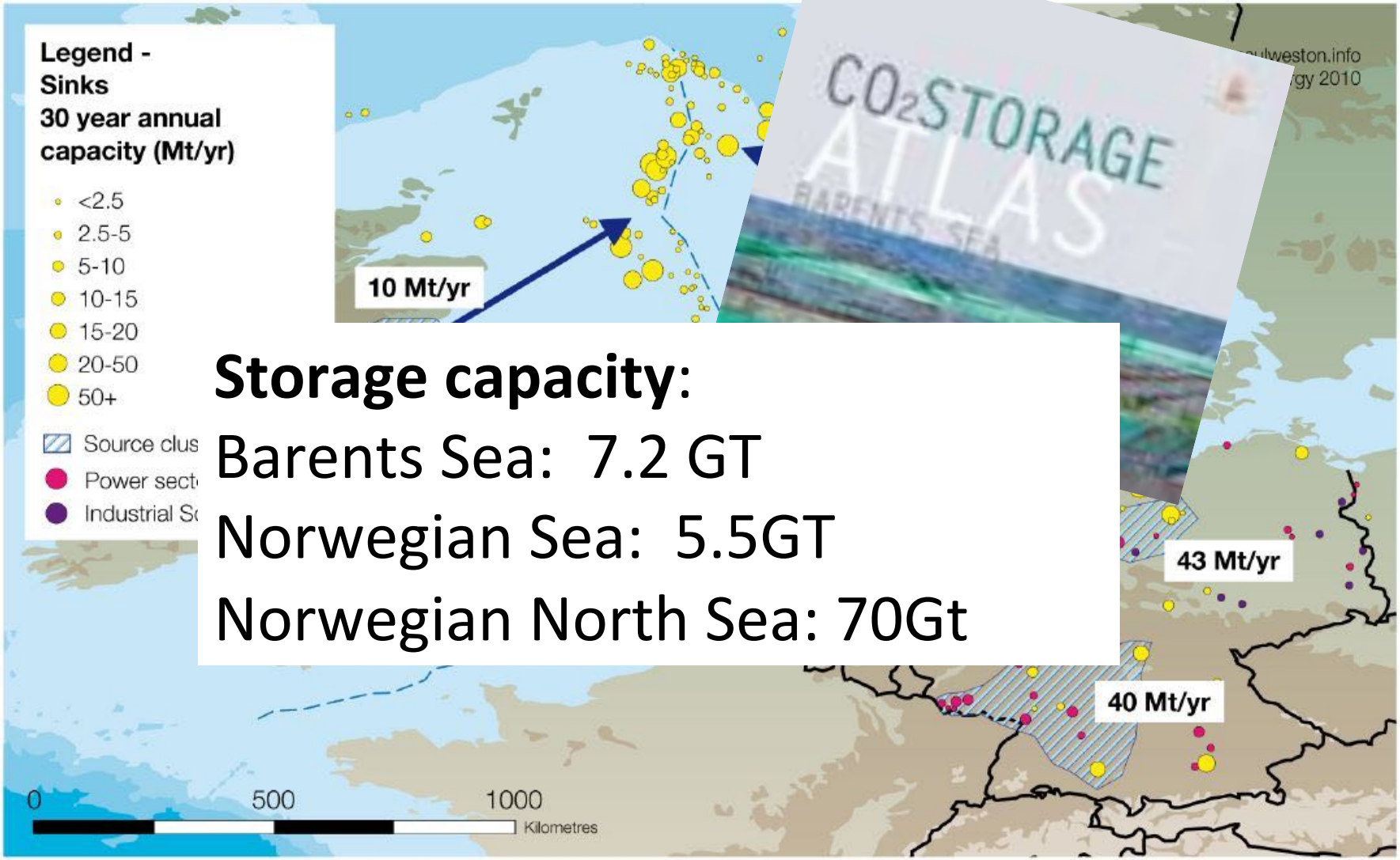


Feasibility study – Storage



- 20 years of experience
- Gassnova has since 2007 assessed CO_2-storage locations
- Statoil will perform the feasibility studies on mandate from the Ministry of Oil- and Energy.
  - 3 possible storage locations
  - 5 possible solutions
  - Gassnova monitores the work

Large storage capacity in the North Sea ++



Storage capacity:

Barents Sea: 7.2 GT

Norwegian Sea: 5.5GT

Norwegian North Sea: 70Gt

The 'Very High' scenario in 2030 – where 270 Mt CO2/yr is captured and stored

Decisions to be taken


Minister of Oil and Energy, Tord Lien


Minister of Finance, Siv Jensen

- Which of the Capture-sites
- Ship design for transport
- Which location for storage

- Next step is FEED studies

- **Investments for full scale**
  - **Fight between Ministers ?**
  - **Support from the public is crucial**

- Decision of investments autumn 2018
  - Challenging to realise a full scale within 2020, but early 2020'ies could be possible

CCS – important for Norway

- Large oil and gas producer with huge export income
- Large process industry
- Take responsibility on a local level, but also regional and global
- Commitment – COP21
- The transition to the low emission society
- The role of academia is important
- Transition to green competitiveness

Oslo – the capital in Europe with high(est) ambitions:

International co-operation

Benefits

- Collaboration
- Quality
- Meeting global challenges
- Giving access to industry

Arenas

- EU: Horizon2020
- Bilateral/multilateral outside EU
- MoU USA-Norway

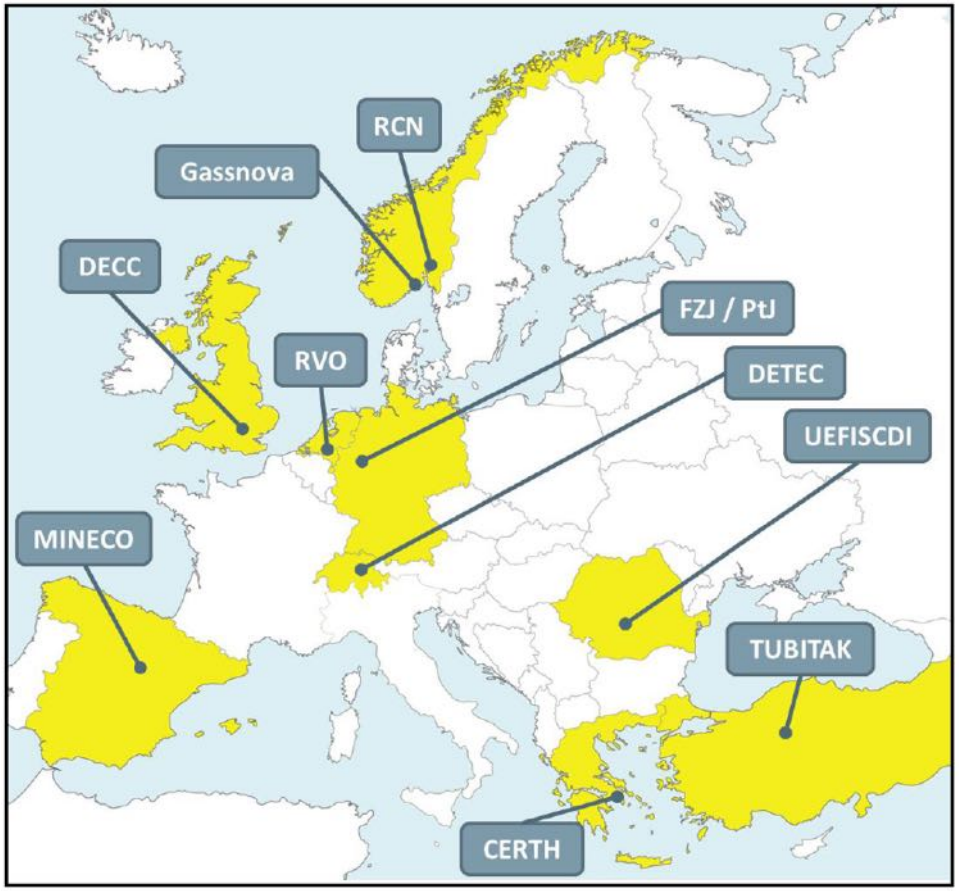
ACT – Accelerating CCS Technologies, European cooperation

Countries setting up large common calls.

A call in June 2016 will address RD&D that can contribute to pilot and demonstration activities.

Budget: 41 million euro

ACT is coordinated by the Research Council of Norway



Summing up

- CCS is a part of the solutions to combat global warming.
- We need realisation of a full scale (in Europe)
  - The goal of building a full-scale CCS plant is to reduce the global GHG emissions.
  - Aa full-scale should use available technology in a way that improves technology, which makes future CCS projects more probable
- **Norway has a leading position within CCS**
  - Sleipner, Snøhvit, TCM
  - Feasibility studies and ambition of full scale by 2020
  - Significant budget for R&D
- Norway can and should continue to play a vital role in this area
- International collaboration is needed to deploy CCS
  - ACT, Horizon 2020, bilateral cooperation

Thank you for your attention

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