
# Technology Centre Mongstad

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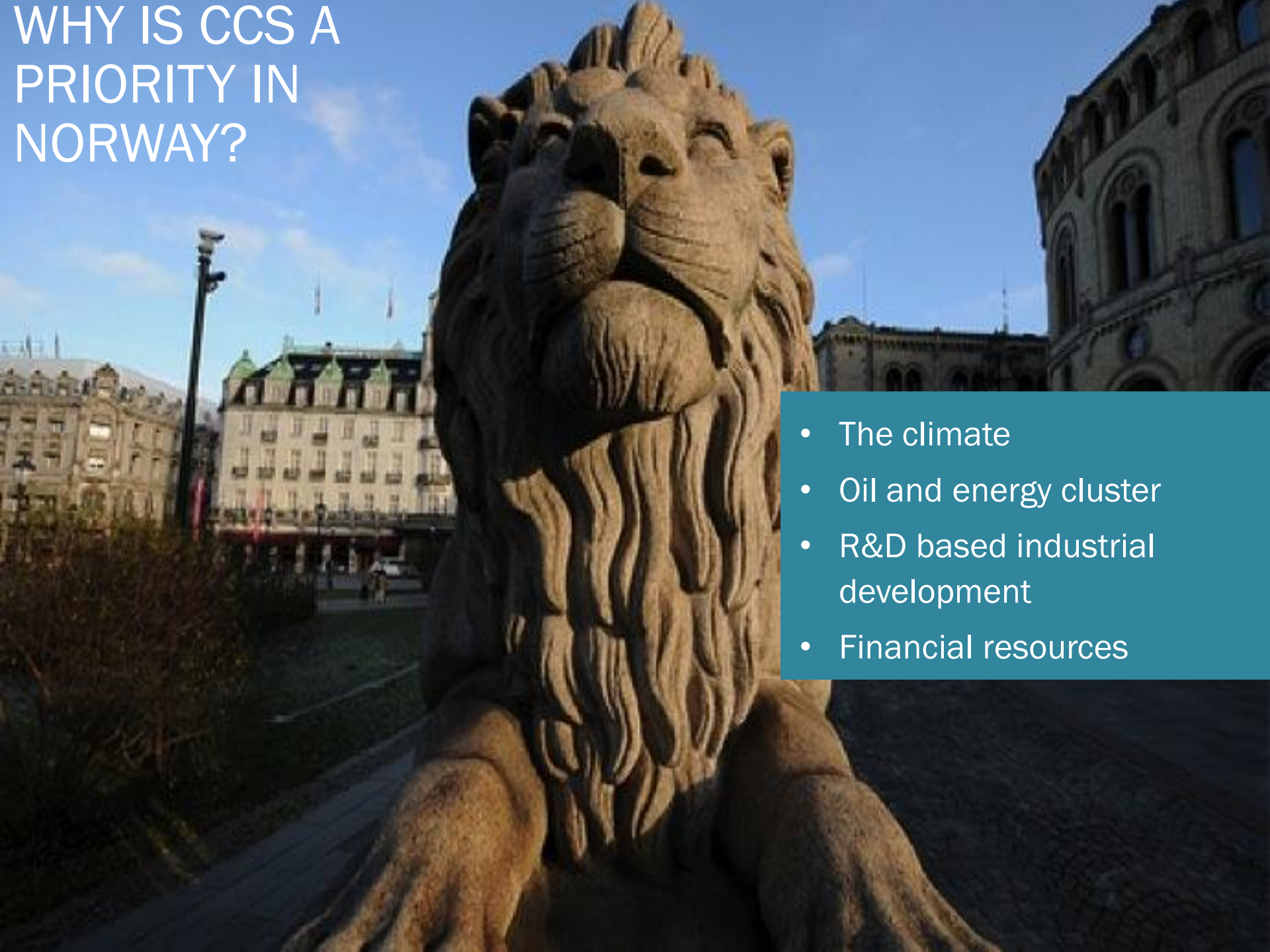
Head of Communicatons
Vegar Stokset


OUR MOST
IMPORTANT
STAKEHOLDER

# WHY IS CCS A PRIORITY IN NORWAY?



- The climate
- Oil and energy cluster
- R&D based industrial development
- Financial resources

# GASSNOVA SF – THE NORWEGIAN STATE ENTERPRISE FOR CARBON CAPTURE AND STORAGE

GASSNOVA

- R&D
  - CLIMIT Programme
- DEMO projects
  - $CO_2$ Technology Centre Mongstad
  - Full-scale CCS
- Advisor to the authorities

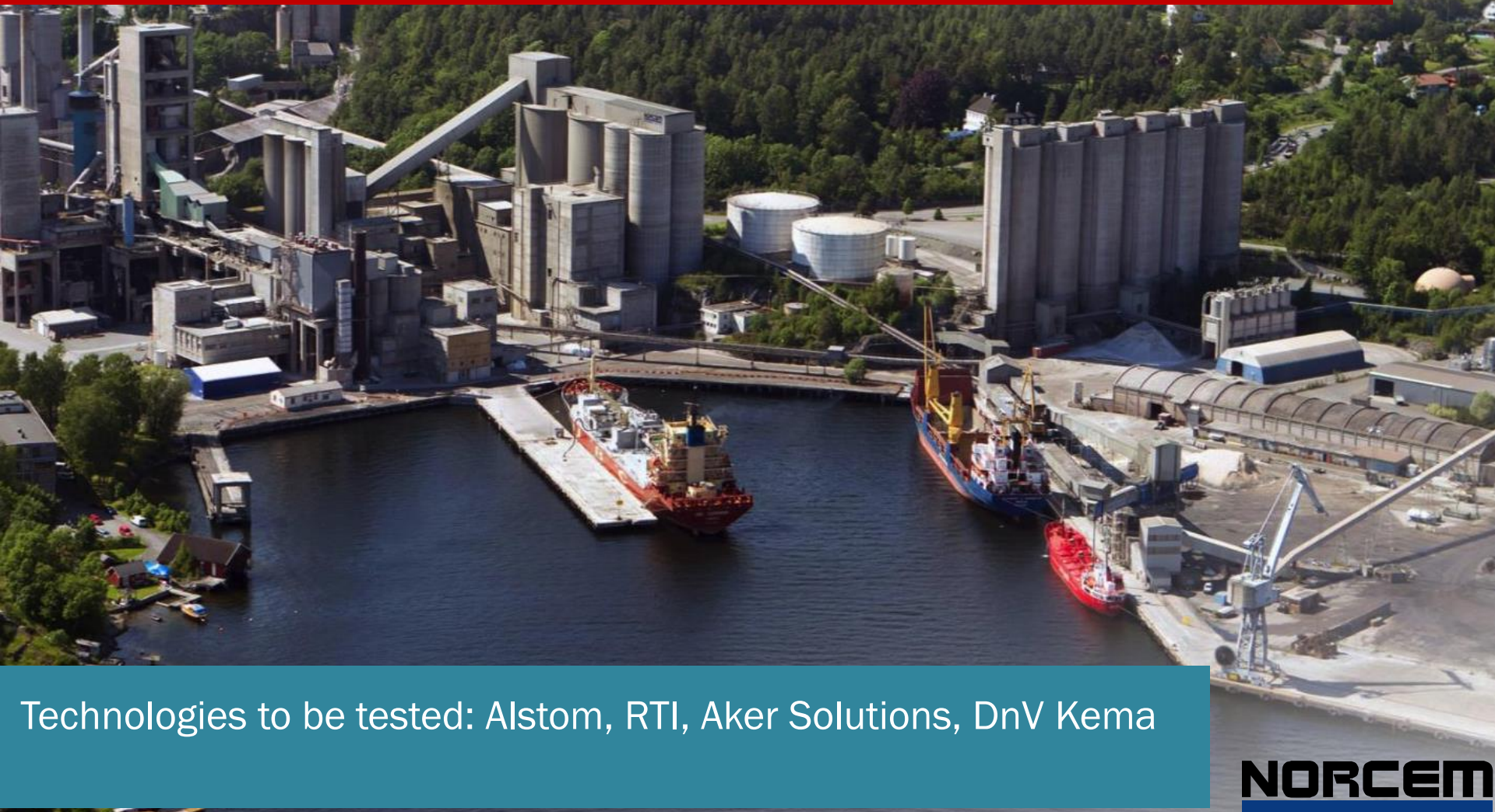
# THE NORWEGIAN ACCOMPLISHMENTS

- Pioneering political decisions
  - $CO_2$-tax is introduced (1991)
- Industrial response
  - Statoil decides $CO_2$-storage at Sleipner (1996)
  - Storage of $CO_2$ from LNG plant at Hammerfest (2007)
- From R&D to full scale
  - Government sponsored R&D program (1996)
  - Gassnova established (2005)
  - $CO_2$ Technology Centre Mongstad (2012)

  → **Full scale CCS demonstration, 2020**

# CCS IN NORWAY
# SLEIPNER: 17 YEARS OF SUB SEA BED $CO_2$ STORAGE

# EUROPE'S FIRST $CO_2$ CAPTURE TEST FACILITY IN CEMENT INDUSTRY – NORCEM BREVIK, NORWAY



Technologies to be tested: Alstom, RTI, Aker Solutions, DnV Kema

NORCEM

HEIDELBERGCEMENT Group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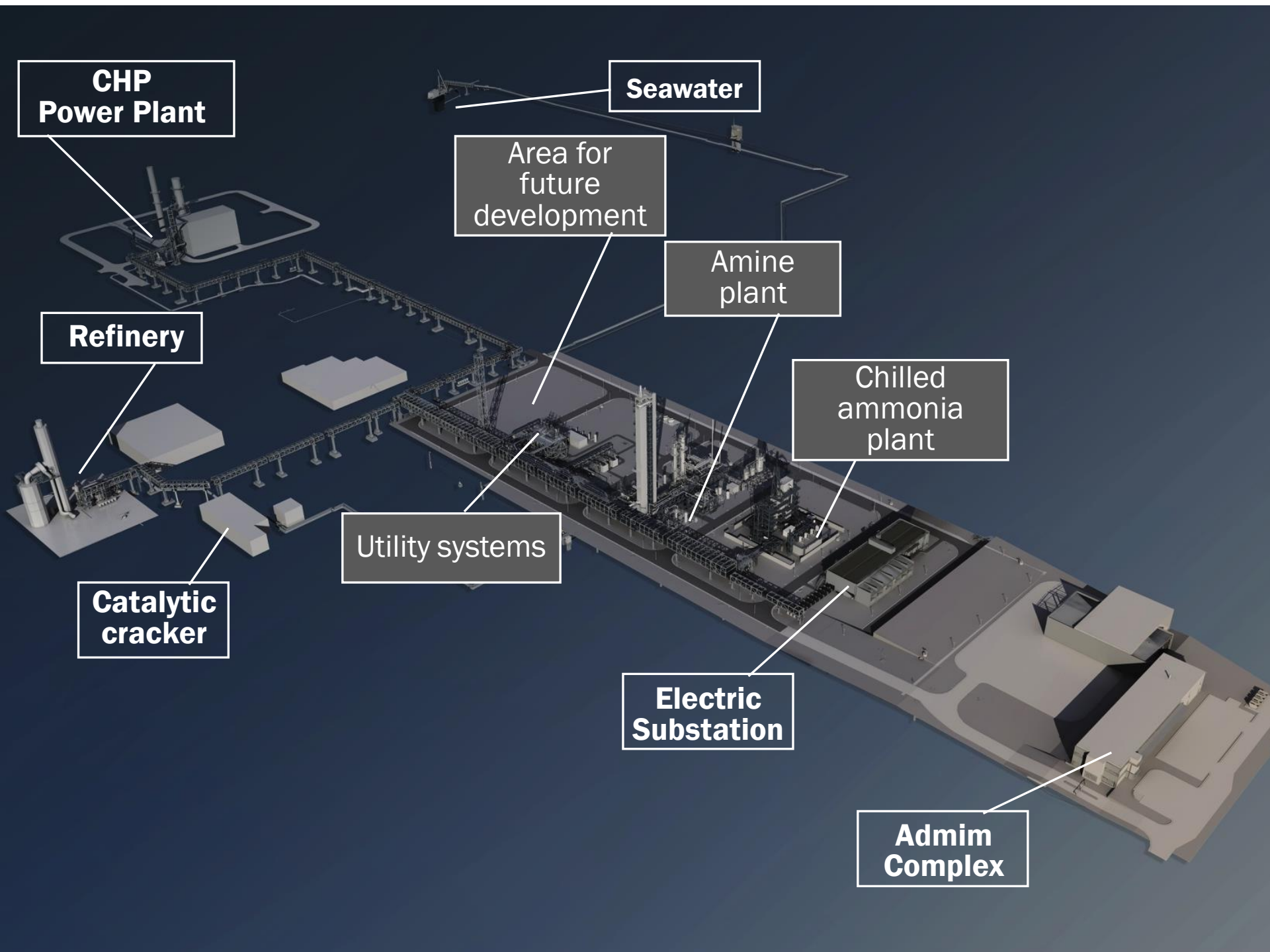
MONGSTAD
catching our future
GASSNOVA
Statoil
sasol
reaching new frontiers

# TCM GOALS

Reduce the cost and the technical, environmental and financial risks of implementing full scale CO2 capture technology

Test, verify and demonstrate $CO_2$ capture technologies owned and marketed by vendors

Be a key player in the development of the emerging market for $CO_2$ capture technology


CHP Power Plant
Seawater
Area for future development
Amine plant
Refinery
Chilled ammonia plant
Utility systems
Catalytic cracker
Electric Substation
Admim Complex

# TEST CAMPAIGNS AT THE AMINE PLANT

- Demonstrated two solvents developed by Aker
- MEA- campaign: baseline established
- Stable operations of approximately 6000h on CHP flue gas
- Capture rate: approx. 90%
- Negligible environmental and health risk
- Very low emissions
- Scale-up methodology explored
- Material selection explored

# Alstom's Chilled Ammonia Process

- TCM has demonstrated the Alstom CAP technology
- Stable operations of approximately 6000h (RFCC and CHP flue gas)
- Negligible environmental and health risk
- Very low emissions
- Extensive process development
- $CO_2$ Capture rate: 85 to 90%

# REDUCING RISKS

# REDUCTION OF TECHNICAL RISK

- Extensive operational experience in an industrial scale of two years of testing can contribute to reduced technical risk in future full-scale projects.
- Documented and transferable operational experience at TCM:
  - Energy optimization, performances, load variations
  - Operating shut down/start-up procedures
  - Scale-up
  - Verification of simulation models
  - Solvent degradation
  - Material design

# REDUCTION OF ENVIROMENTAL RISK

- Industrial scale experience with emissions gives realistic data applicable for full-scale projects.
- Learnings from TCM:
  - Systematic approach to manage amine emissions
  - Toolbox for monitoring emissions
  - Increased knowledge related to:
    - Chemistry, spread and degradation of amines
    - Emissions of amines to air
    - Effects on health and environment.

# REDUCTION OF FINANCIAL RISK

- The most important learning happens through obstacles and challenges faced during the operation of the test facilities.
- Challenges discovered and solved at TCM will contribute to reduced financial risk in other, forthcoming full-scale projects.

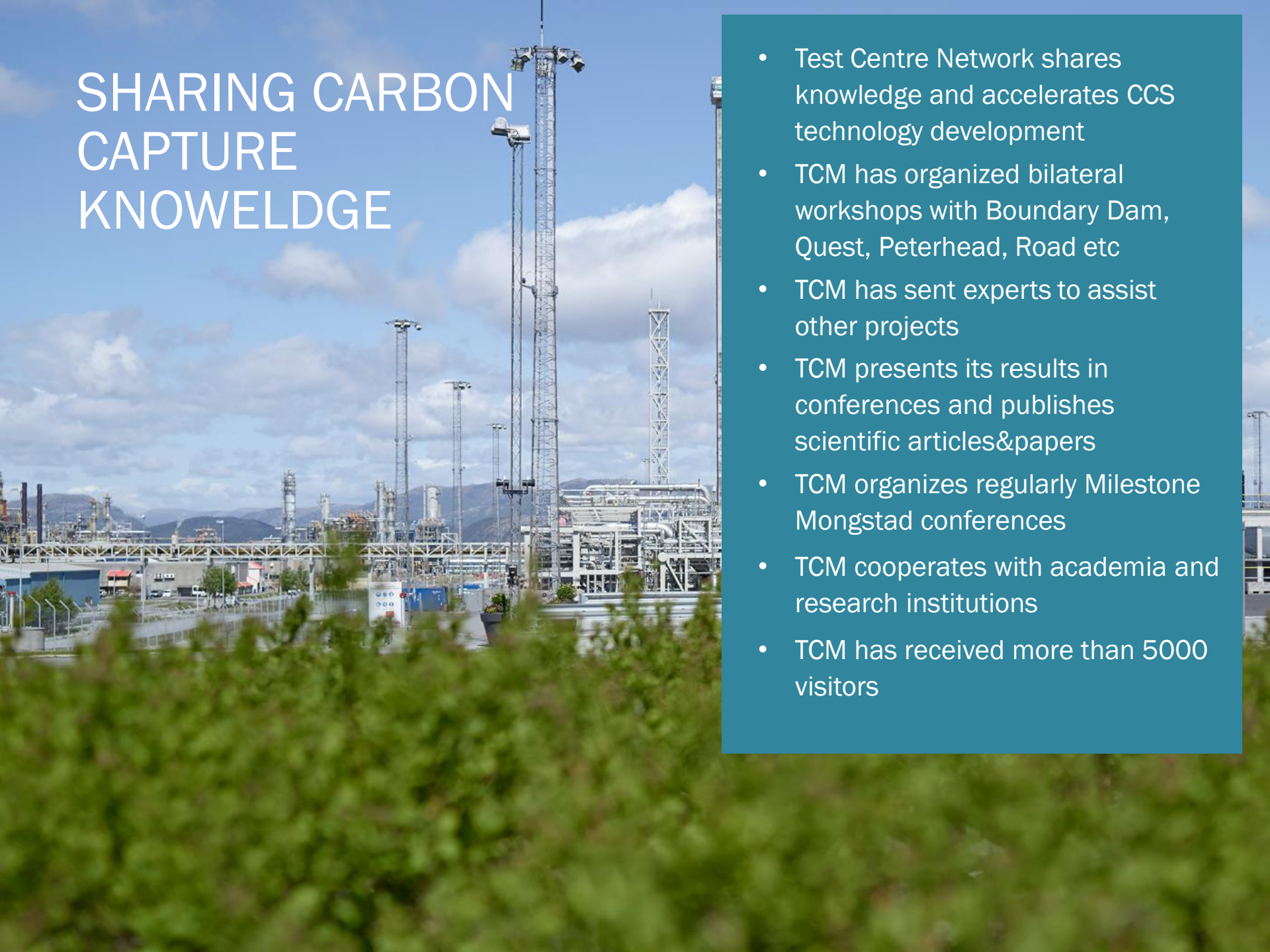
  Learnings from TCM:

  - MIST
  - Material (Corrosion)
  - Constructed and verified the use of concrete absorbers with polymer (PP) lining
  - Design optimization: Simulation models verified in an industrial scale can contribute to design optimization

# REDUCING ENVIRONMENTAL RISK

# EMMISSION PERMITS

Integrating this information to establish a scientific platform for defining  emission permits for CCS applications



# SHARING CARBON CAPTURE KNOWELDGE

- Test Centre Network shares knowledge and accelerates CCS technology development
- TCM has organized bilateral workshops with Boundary Dam, Quest, Peterhead, Road etc
- TCM has sent experts to assist other projects
- TCM presents its results in conferences and publishes scientific articles&papers
- TCM organizes regularly Milestone Mongstad conferences
- TCM cooperates with academia and research institutions
- TCM has received more than 5000 visitors

# FUTURE DEVELOPMENT OF TCM

# UTILIZATION OF THE EXISTING FACILITIES

- The existing facilities will be used to further develop amine- and ammonia technologies through test activity within the agreed framework.
- To consolidate TCM as a global reference test facility through:
  - Cooperation with technology vendors
  - Cooperation with academia and research institute (e.g. JIP, JV)
  - Development of test programs with industrial partners, i.e. sponsorship
  - Active participation from authorities and governments


TCM
OFFERS

# AN ARENA FOR TESTING POST-COMBUSTION TECHNOLOGIES:


- Industrial size plant operation experience
- Two major test facilities which have proven their capability

- Access to real flue gas from gas power
- Access to real flue gas from refinery source
- Advanced laboratory services

# VALUE CREATION FOR THE PARTNERS:

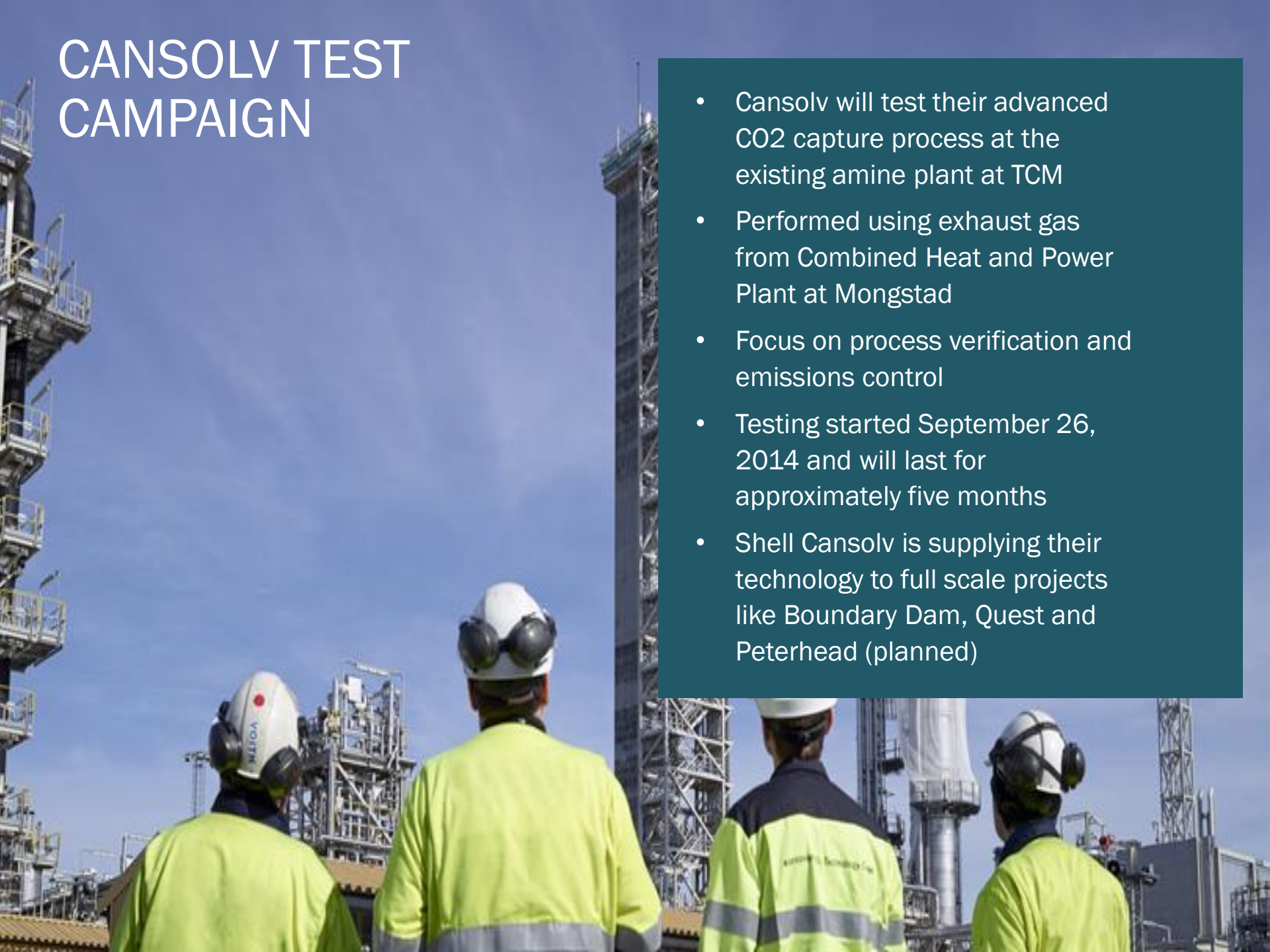
- Detailed insight in design and performance of carbon capture technology
- Access to substantial planning, contruction and operating experience
- Access to test results from campaigns
- Co-operation and knowledge sharing with other market players

# MEA TESTS SET NEW BENCHMARK

**World's first open-source, large-scale CO2 capture tests of amine solvent MonoEthanolAmine (MEA) on flue gas from a gas-fired power plant**

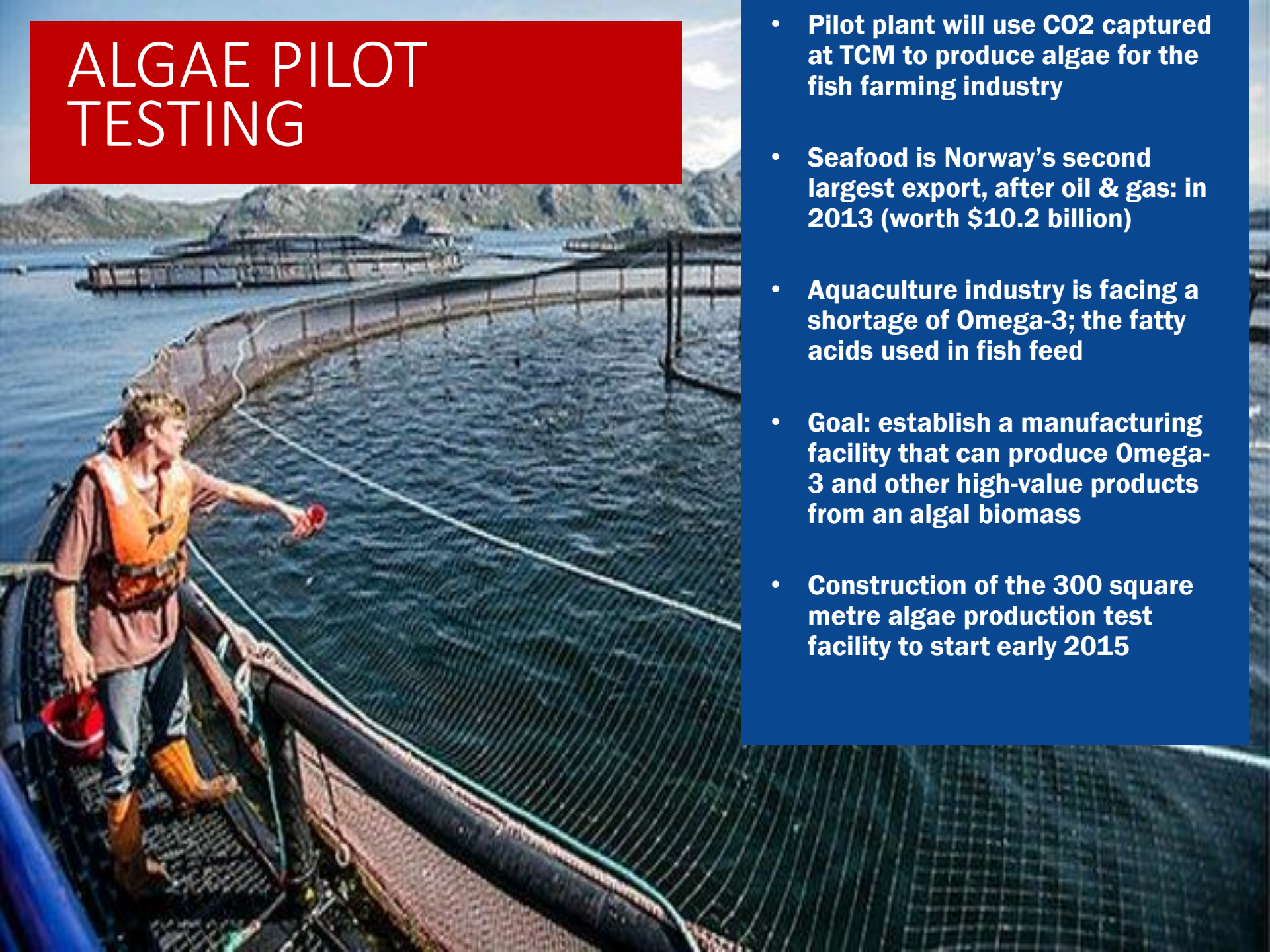
- Independently verified, open-source Amine tests performed at TCM prove industrial-scale flue gas CO2 capture more efficient and lower cost than ever before
- CO2 capture rate of 85%-90%
- Results will stand as the baseline for future vendor testing at TCM, and likely any future CCS projects based on flue gas treatment
- MEA testing at TCM proves CCS projects based on flue gas treatment are technically feasible with no emissions of any harmful compounds

# CANSOLV TEST CAMPAIGN



- Cansolv will test their advanced CO2 capture process at the existing amine plant at TCM
- Performed using exhaust gas from Combined Heat and Power Plant at Mongstad
- Focus on process verification and emissions control
- Testing started September 26, 2014 and will last for approximately five months
- Shell Cansolv is supplying their technology to full scale projects like Boundary Dam, Quest and Peterhead (planned)

# ALGAE PILOT TESTING



- Pilot plant will use CO2 captured at TCM to produce algae for the fish farming industry
- Seafood is Norway's second largest export, after oil & gas: in 2013 (worth $10.2 billion)
- Aquaculture industry is facing a shortage of Omega-3; the fatty acids used in fish feed
- Goal: establish a manufacturing facility that can produce Omega-3 and other high-value products from an algal biomass
- Construction of the 300 square metre algae production test facility to start early 2015


Thank you
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