

NORWAY'S CLIMIT PROGRAM AND CO₂ TECHNOLOGY CENTRE MONGSTAD



GASSNOVA



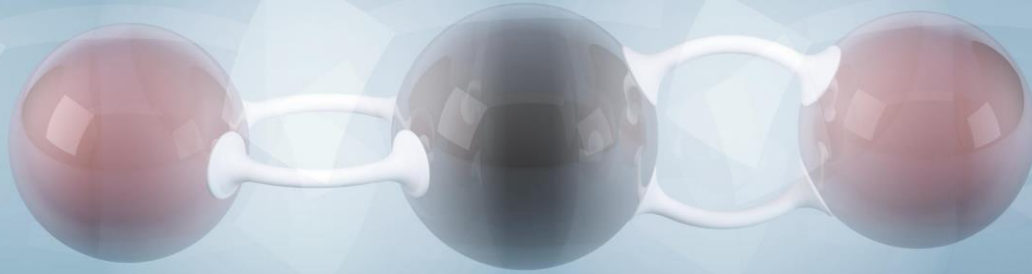
NORWAY HAS AN EXCEPTIONAL POSITION

A world-class oil and gas nation

- Our oil and gas position
- Our technical expertise
- Our financial resources

- Cooperation government, research and industry

CLIMIT PROGRAM



ACCELERATE COMMERCIALISATION OF CO₂ CAPTURE AND STORAGE (CCS) THROUGH FINANCIAL STIMULATION OF RESEARCH, DEVELOPMENT AND DEMONSTRATION.



CLIMIT: FROM RESEARCH TO DEMO ...

A COOPERATION BETWEEN GASSNOVA AND THE RESEARCH COUNCIL OF NORWAY

- **More than 200 projects have received support**
- **Approx. NOK 1.4 billion awarded**
 - In addition, the CLIMIT Demo projects have triggered 50% industry financing on average
- **Support for research, development, pilot and demo projects**
- **Budget grants: 200 MNOK (2014)**

CLIMIT: UNIQUE INSTRUMENT FOR PROMOTING AND SUPPORTING TECHNOLOGY DEVELOPMENT

- **We are proactive and we build networks**
- **International cooperation**
- **New measures to encourage more applications**
- **Exchange of knowledge and experience**

CLIMIT PROJECT: CCS ON INDUSTRIAL EMISSIONS

1st in Europe with CCS for cement

4 capture technologies to be tested

10.5 mill US\$ from CLIMIT 2013-2017



CLIMIT PROJECT: ALSTOM CARBONATE LOOPING CO₂ CAPTURE BASED ON LIMESTONE

Photo: iStock.

- Next generation capture technology
- Improved energy efficiency
- Project cost: 4 mill US\$
- Power production, coal-based with CCS
- Industry, particularly cement production



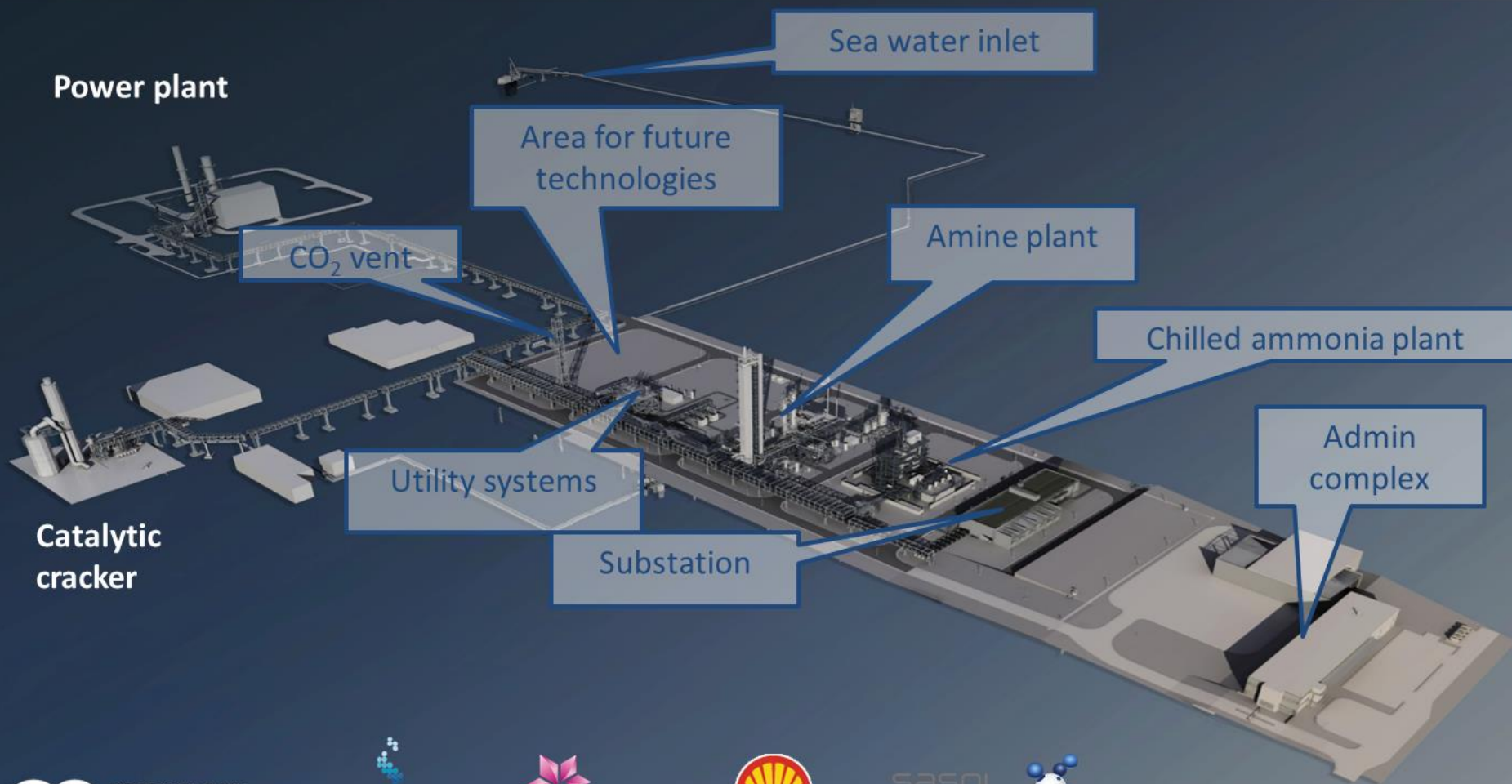
CLIMIT PROJECT: SOLVit DEVELOPMENT OF AKER SOLUTIONS AMINE TECHNOLOGY

- **New environmentally-friendly amine based solvents for CO₂ capture**
- **Improved energy efficiency**
- **Project cost 50 mill US\$**
- **Application: Power production and industrial emissions, both retro-fitting and new facilities**

CLIMIT PROJECT: MEMBRANE TECHNOLOGY

- Fixed Site Carrier Membranes
- Norwegian patented technology
- Cooperation with US membrane producer
- Project cost: 2.3 mill US\$
- Tested with coal and cement flue gas

CO₂ TECHNOLOGY CENTRE MONGSTAD (TCM)



TCM: TEST CAMPAIGNS AT THE AMINE PLANT

- Demonstrated two solvents developed by Aker (“S21” and “S26”)
- MEA-campaign: Baseline established
- Stable operations of approximately 7000h on CHP flue gas
- CO₂ capture rate: approx. 90%



TCM: ALSTOM'S CHILLED AMMONIA PROCESS

- Demonstrated the Alstom CAP technology
- Stable operations of approximately 7000h (RFCC and CHP flue gas)
- Extensive process development
- CO₂ capture rate: 85 to 90%



TCM: HAS MADE CO₂ CAPTURE TECHNOLOGY CHEAPER, SAFER AND READY FOR FULL-SCALE

- Matured technologies
- Operational experience at industrial scale
- Reduced cost risk
- Reduced environmental risk



TECHNOLOGY
CENTRE
MONGSTAD



TCM: THE WAY FORWARD

- The existing facilities
 - Further develop amine and ammonia technologies
- Development of the available site
 - Smaller scale testing and demonstration for:
 - Qualification of less mature technologies
 - Identification of next generation capture technologies



THANK YOU!

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CLIMIT program
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