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Head of Communications



OGV
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catching our future

Prime minister conducted inauguration



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Environment Carbon capture and storage (CCS)

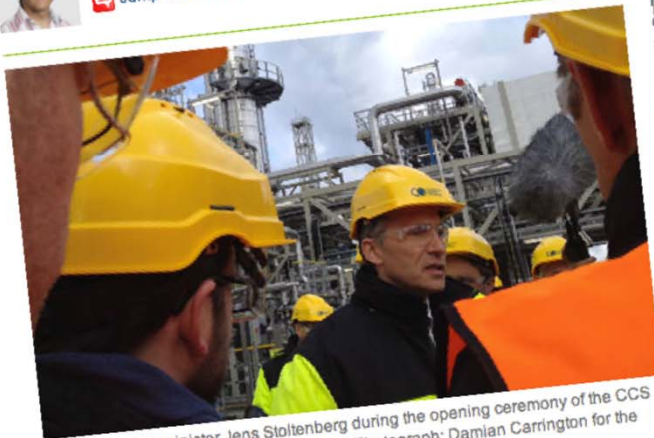
Whatever happened to carbon capture in the fight against climate change?

CCS has been hobbled by the economic crisis, and Europe is far behind the US – but a new Norwegian plant provides hope



Damian Carrington, Mongstad, Norway
guardian.co.uk, Wednesday 9 May 2012 17.18 BST

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Norway's prime minister Jens Stoltenberg during the opening ceremony of the CCS Technology Centre in Mongstad, Norway. Photograph: Damian Carrington for the Guardian

Science and technology



Carbon capture and storage

A shiny new pipe dream

Capturing the carbon dioxide from power stations is not hard. But it is expensive. A new project in Norway aims to make it cheaper

The Economist May 12th 2012

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Economist.com/science

ing to Howard Herzog, a chemical engineer at the Massachusetts Institute of Technology who has made a study of the matter that implies a cost of between \$50 and \$100 per tonne of carbon stored. Carbon dioxide can sometimes be sold to oil companies for injection into partially depleted wells, in order to force more petroleum out of them. For that use it fetches at most a tonne. But much CO₂ is not produced



TCM – Highlights

- 2005 Government policy: No carbon based power generation in Norway without CCS
- 2006 State and Statoil agreed 2-staged approach:
 - 1: Demonstrate and develop capture technologies (TCM)
 - 2: Build large scale (1 mTons CO_2 /year) capture plant
- 2009 Investment decision taken for TCM: = USD1Billion
Partnership established (TCM DA)
- 2012 Initial test period started

Mongstad refinery

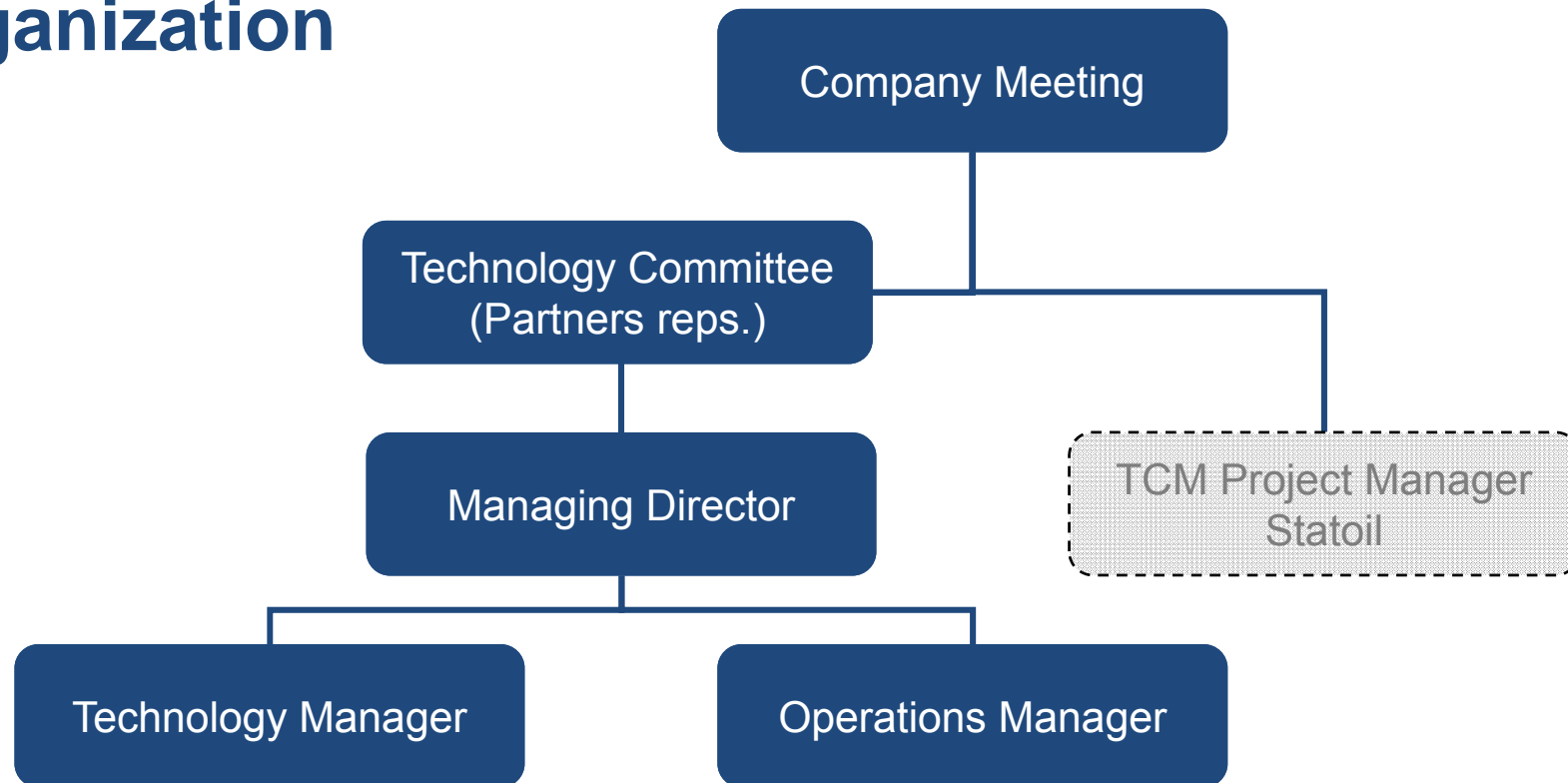


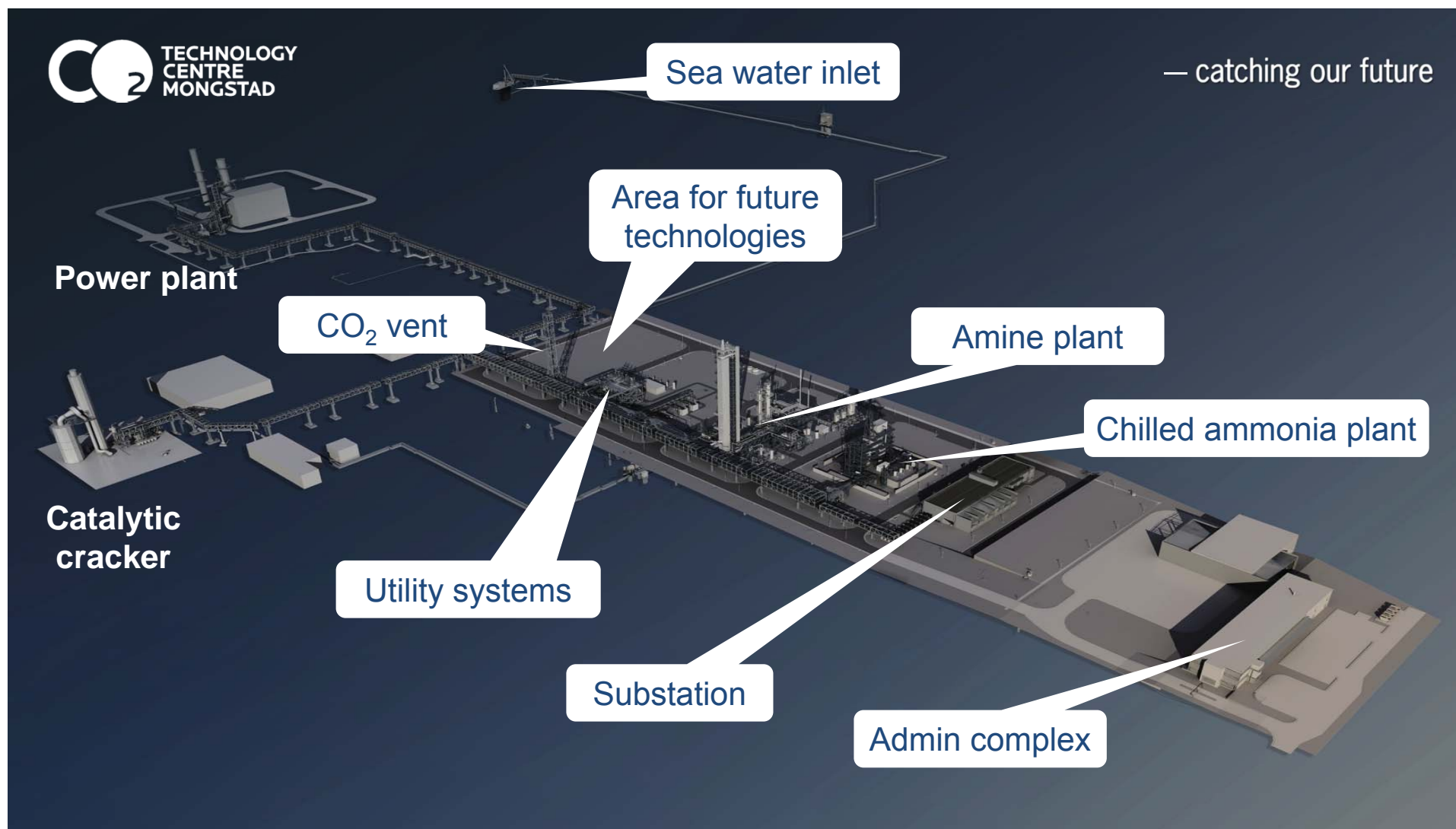
TCM is the world's largest facility for testing and improving CO₂ capture.

Knowledge gained will prepare the ground for CO₂ capture initiatives to combat climate change.



Organization

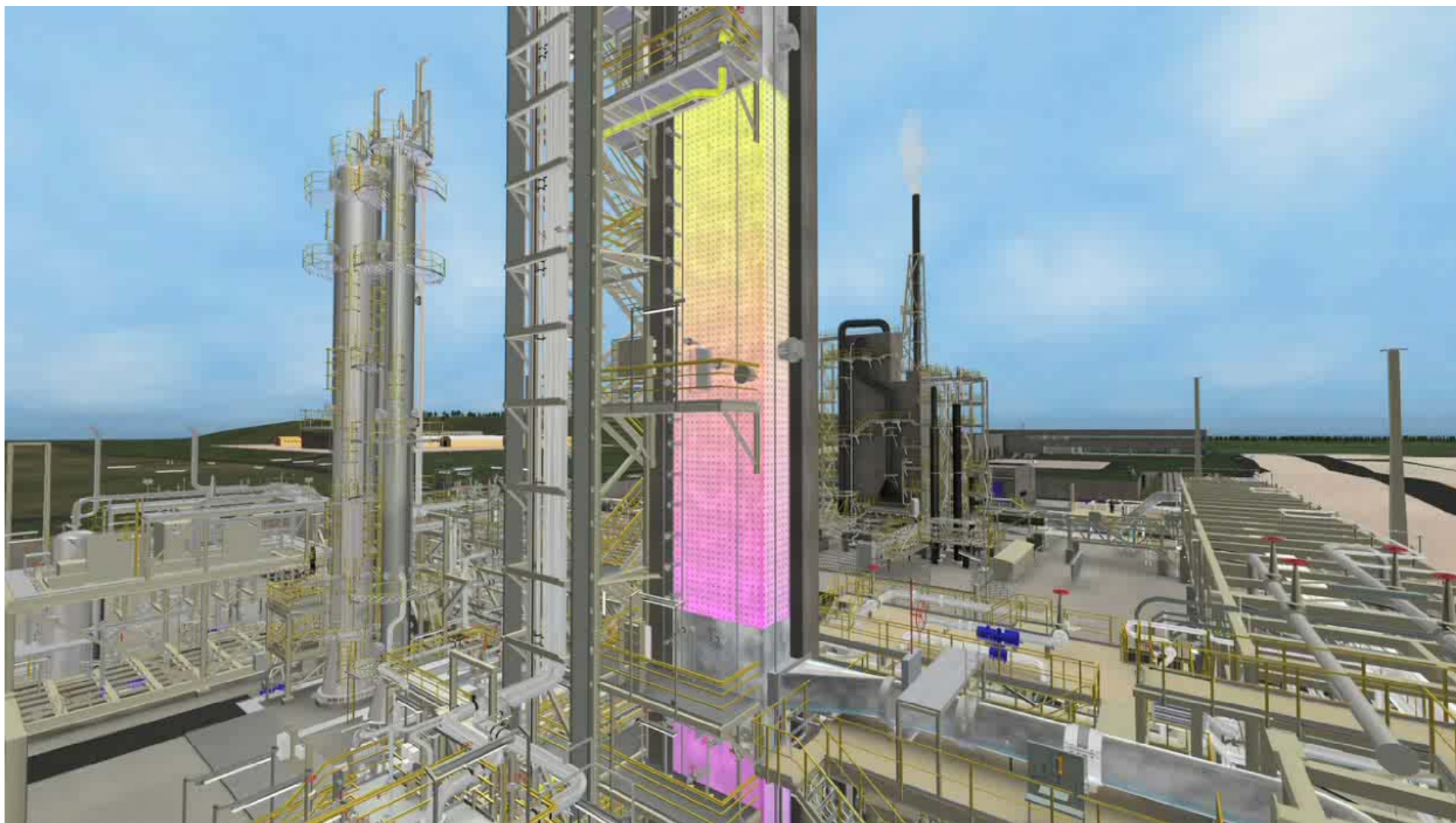




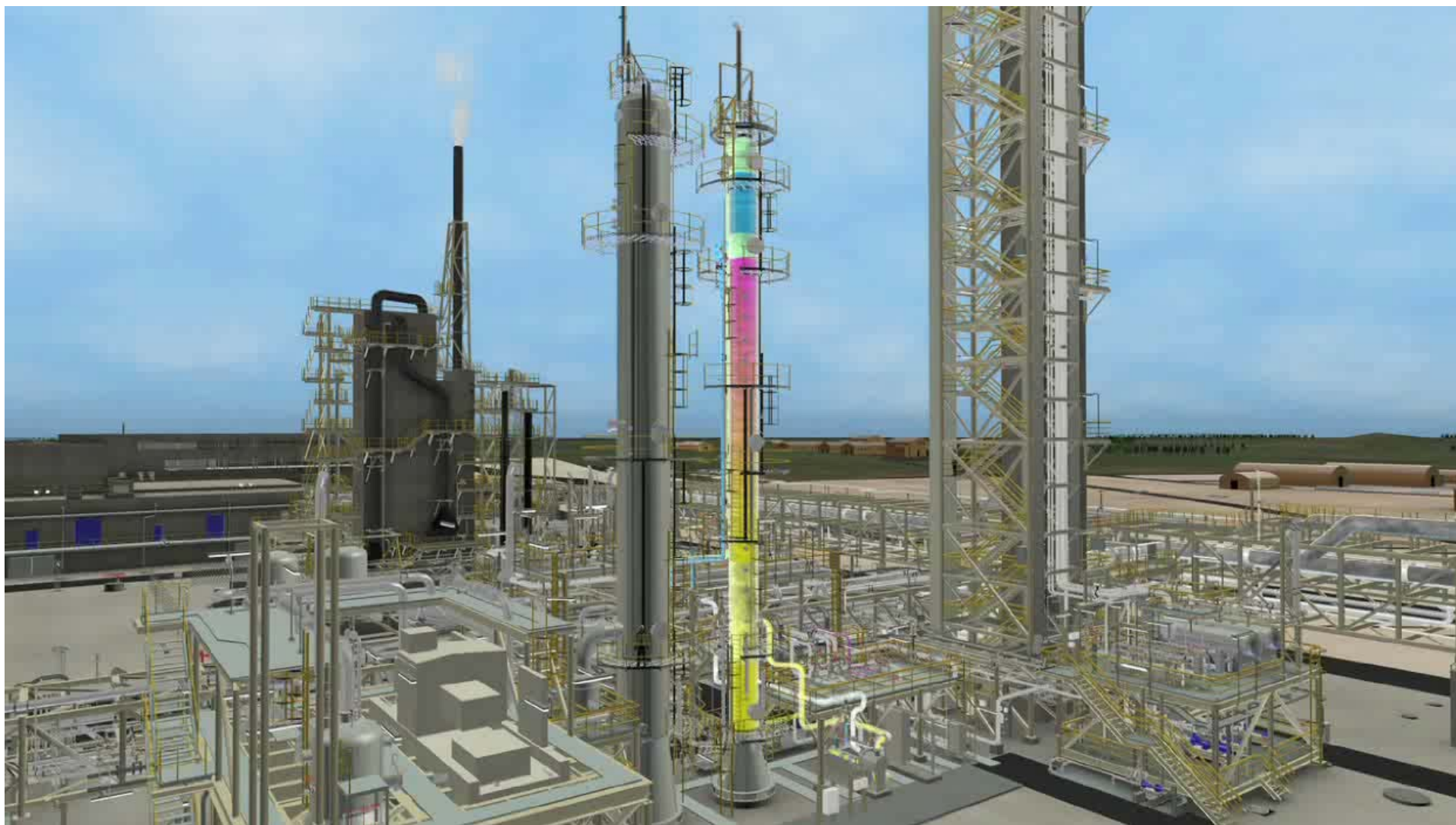
Refinery
RCC flue gas
= 13% CO₂

Power plant flue
gas = 3.5% CO₂



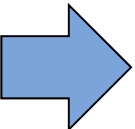
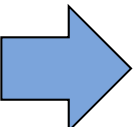
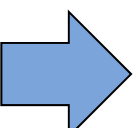
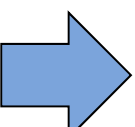










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|---|---|---|---|
| 1 | Establish CCS as cost efficient climate solution with acceptable risk |  | <ul style="list-style-type: none">▪ Reduce costs (NOK/kWh)▪ Mitigate risks preventing full-scale solutions |
| | | | |
| 2 | Drive technology development |  | <ul style="list-style-type: none">▪ Take active part in shaping the technology landscape |
| | | | |
| 3 | Position TCM at centre of a global knowledge network |  | <ul style="list-style-type: none">▪ Be a centre in global network▪ Exploit synergy with other players and institutions |
| | | | |
| 4 | Establish operating model which is attractive for users of TCM |  | <p>Set-up that is attractive for technology suppliers and R&D institutions to secure high activity level</p> |

Testing activities at the Amine Plant

- Initial test period for 15 months with Aker Clean Carbon
- Focus on process performance, mainly energy efficiency - steam and electricity consumption - and emissions monitoring.
- Several hundred online instruments monitoring the plant performance and emissions.
- An extensive lab programme with focus on monitoring solvent performance, degradation and emissions to air and water.
- Goal: an energy efficient process and minimal emissions to air and water.

Testing activities at the Chilled Ammonia Plant

- Initial period of 18 months based on test program developed by Alstom.
- Focus on process optimization, including: energy efficiency, ammonia consumption and low emissions, steady state and transient operations, impact of flue gas impurities.
- The solvent developed by Alstom do not produce degradation products and is based on a low cost and available solvent. This design allow the development of reliable simulation tools, based on the tests, for calculation of the heat and mass balances.
- Lab data, as well as sampling and third party verification measurements will back up the online metering to enhance monitoring of a wide range of emissions components.

Discharge permit

- No negative HSE impact
- Many studies performed
- University of Oslo, SINTEF, CSIRO, Climate and Pollution Agency (Klif), Nilu, MIT etc was involved

Future utilization of Amine plant

- Good response to invitation (RFI) to reuse the existing Amine plant, i.e. Aker, Siemens, Hitachi, Mitsubishi
- Available for other users towards the end of 2013/beginning 2014.



Utilization of available site

- Invitation to vendors to use the available open slot/land, utilities and other infrastructure
- Open for acceptance until 31.12.2012
www.tcnda.com/Global/Dokumenter



Central control room



Advanced lab facilities



Multi-discipline technical staff



Knowledge exchange on CCS

General guidelines

Objective

- Maximize utilization of test capacities
- To share knowledge of upcoming technology
- Established standard for bench mark and performance indicators
- To promote a possible need for technology certification
- To establish an arena to leveling condition towards technology vendors regarding cost and data sharing.
- HSE knowledge sharing
- Laboratory and field-measurement knowledge sharing
- Legislation / regulatory frame-condition
- Public relation experience

Planed members and start-up

Participants

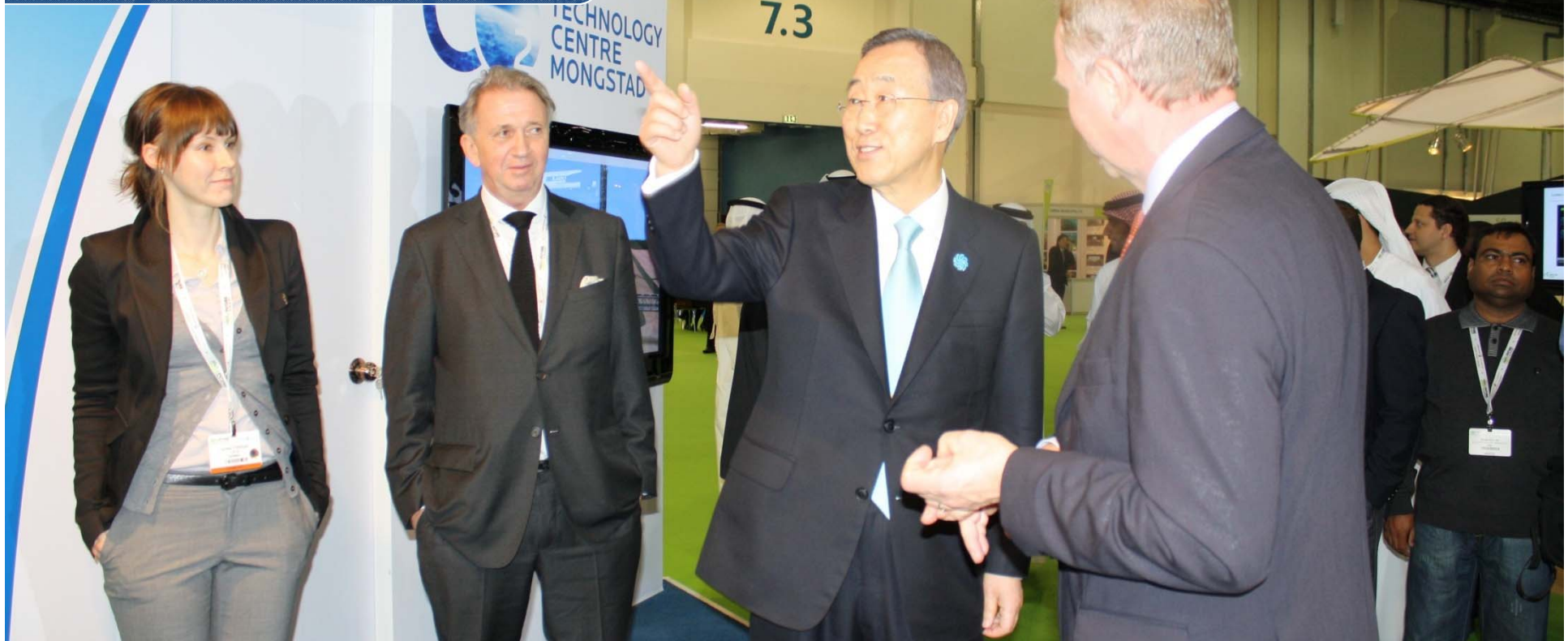
- | | |
|--|----------------------|
| ▪ TCM DA (Norway) | - Tore Amundsen |
| ▪ NCCC (Alabama, US) | - Frank Morton |
| ▪ Plant Barry (Alabama, US) | - Michale Ivie |
| ▪ Boundary Dam (Canada) | - Mike Monea |
| ▪ Wakamatsu Research Institute | - Hiroshi Sasatsu |
| (the Eagle IGCC development project and CoolGen for CO2 capture) | |
| ▪ ENEL | - Cristiana La Marca |
| ▪ E.ON | |
| ▪ DOOSAN power SSE (UK) | |

4000 visitors

US Energy Minister,
Steven Chu visit



Worldwide exhibitions





TECHNOLOGY
CENTRE
MONGSTAD

— catching our future

Partnership invitations



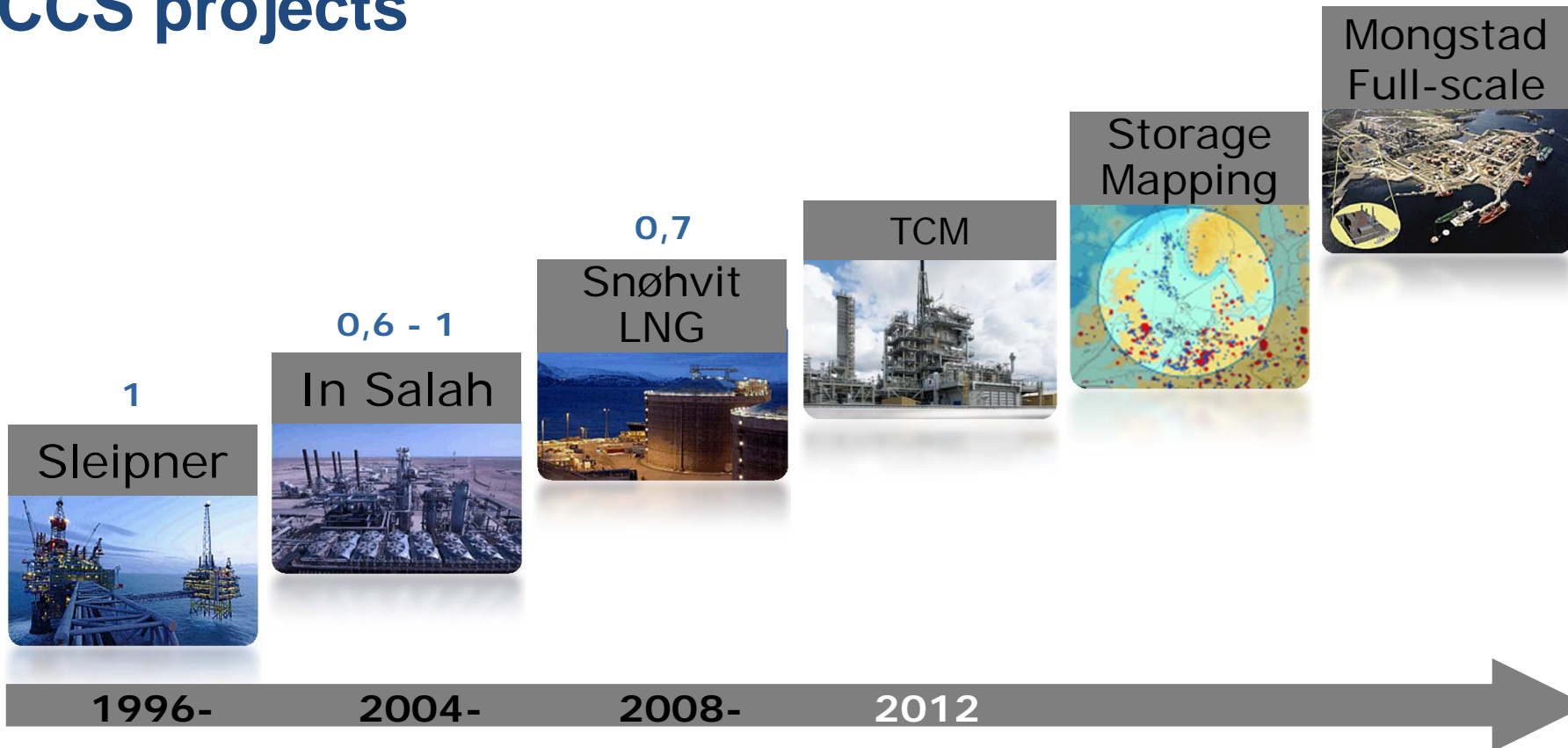
Norway Punching Above its Weight in CCS



- Financial resources
- Technical competence and resources
- Fossil fuels and Norwegian gas export sustainable in the long term

Source: Gassnova SF

CCS projects



Targeted CCS related R&D since 1997

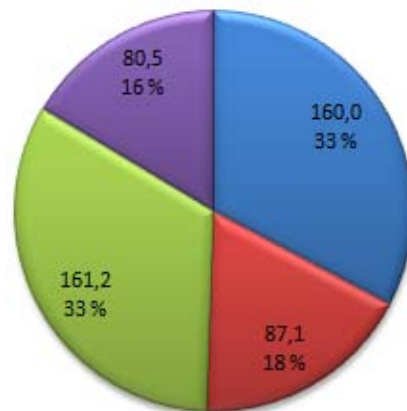
Klimatek, CLIMIT:

- around 300 projects
- more than \$ 150 Million

CLIMIT today:

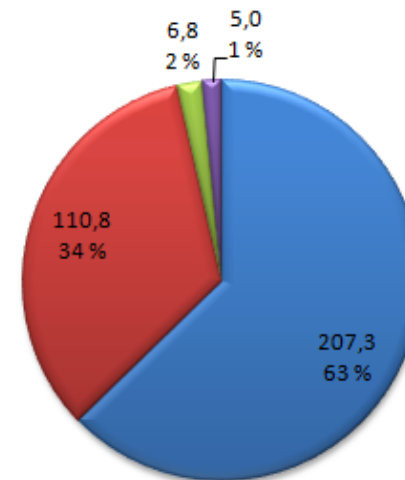
- broad and relevant portfolio
- Research and Industry

■ Capture
■ Transport
■ Storage
■ Chain



CLIMIT R&D: Per area

Current projects 2011, allocated (MNOK)



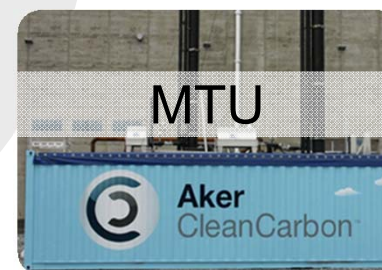
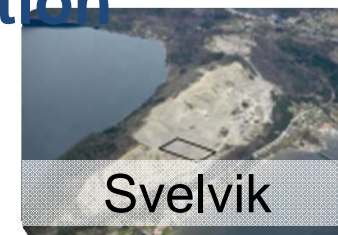
CLIMIT Demo: Per area

Current projects september 2011, allocated (MNOK)

Norwegian CCS research efforts

- **Competence:** leading R&D hubs
- **Infrastructure:** Test rigs, field labs etc ..
- **Concrete project results:**
 - Storage test facilities gives increased understanding: Svelvik and Longyearbyen (SINTEF, UNIS)
 - Analytical and numerical tools for improved risk evaluation CO₂ storage
 - CCS Technology Guidelines for Capture, Transport & Storage (DnV)
 - New capture technologies with BIGCO₂ (SINTEF)
 - Improved solvents gives reduction of capture costs "SOLVIT" (ACC, SINTEF)
 - Identification of environmental effects from amine gives increased understanding
 - Compact desorber gives improved capture efficiency (Statoil, Tel-Tek)

Unique network for R&D, piloting and demonstration



Combat climate change through technology

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[Technologies](#)

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TCM - The world's largest carbon capture



MILE STONE MONGSTAD

NEWS



Groundbreaking environmental surveys

TCM has during the last year, prior to the start-up, conducted environmental surveys of air, vegetation and water in a



TCM Inauguration makes headlines globally

News about the inauguration of the world's largest carbon capture test facility at Mongstad, Norway, has spread



Stoltenberg: TCM is important for the world

Yesterday, the Norwegian Prime

ABOUT TCM

Technology Centre Mongstad is the world's largest facility for testing and improving CO₂ capture.

Knowledge gained will prepare the ground for CO₂ capture initiatives to combat climate change. TCM is a joint venture between the Norwegian state, Statoil, Shell and Sasol.

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NEWS

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EXTERNAL NEWS