



TECHNOLOGY
CENTRE
MONGSTAD

A YEAR OF PROGRESS

NOVMBER 2013

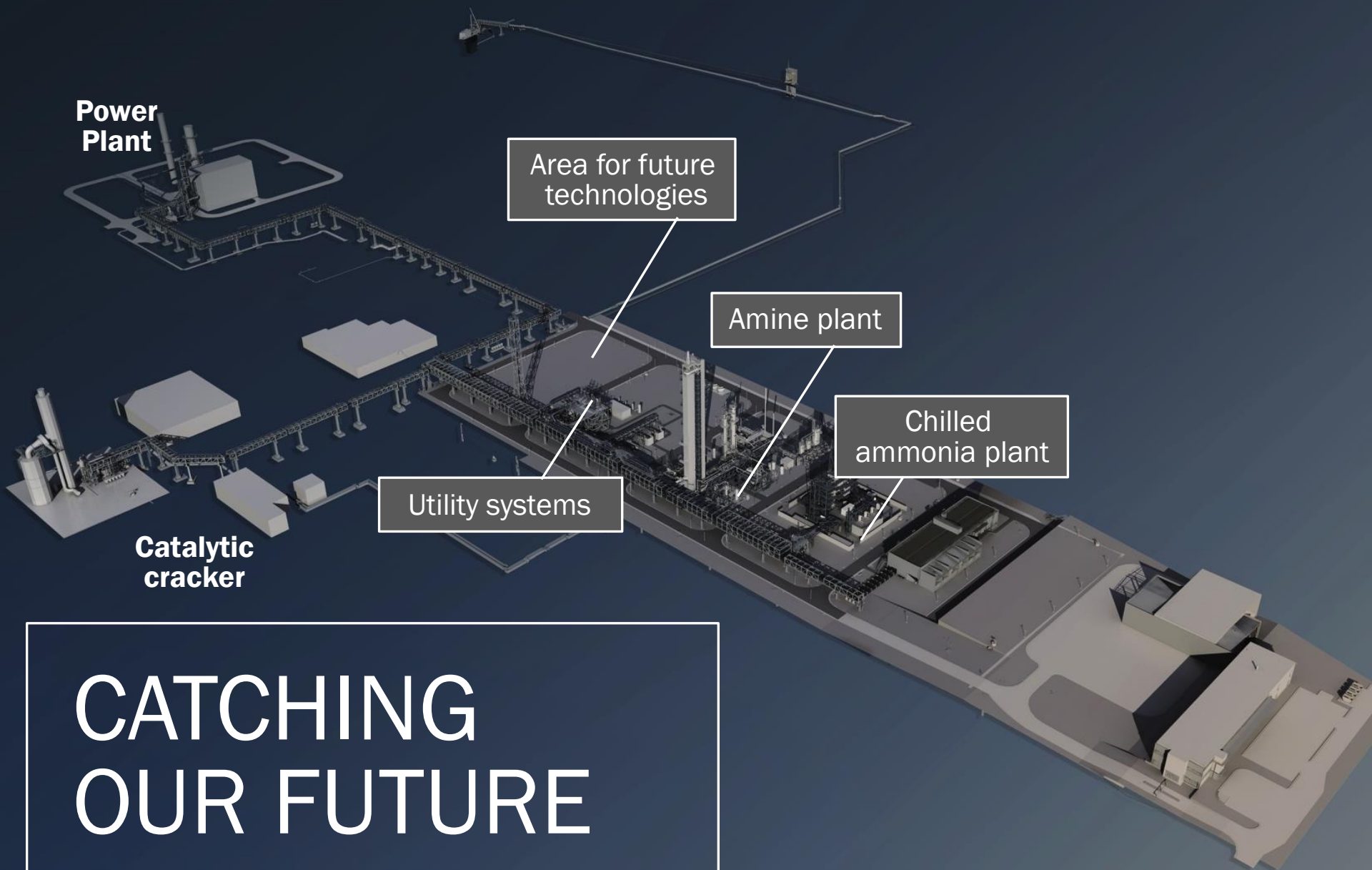


OUR MOST IMPORTANT STAKEHOLDER



WHO ARE TCM?





**Power
Plant**

Area for future
technologies

Amine plant

Chilled
ammonia plant

Utility systems

**Catalytic
cracker**

CATCHING OUR FUTURE

TO PREVENT THIS
SCENARIO WE NEED
TECHNOLOGY WHICH HAS:



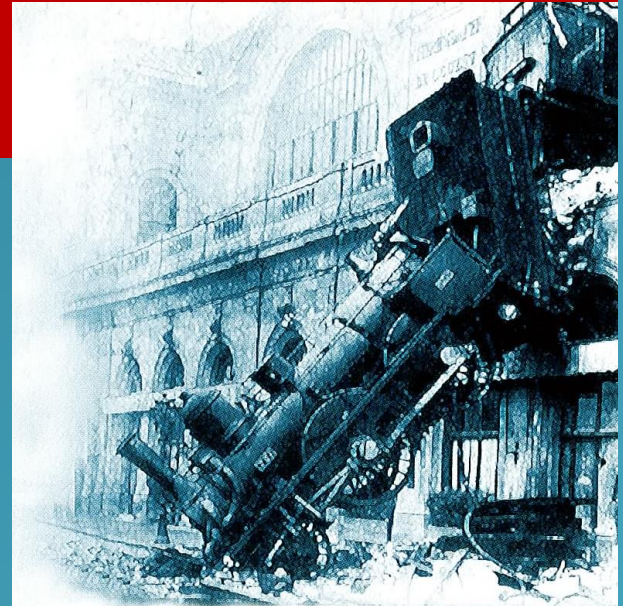
LOW...



FINANCIAL RISK



ENVIRONMENTAL RISK



TECHNICAL RISK

TCM GOALS

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

Test, verify and demonstrate CO₂ capture technologies owned and marketed by vendors

Be a key player in the development of the emerging market for CO₂ capture technology



THE FIRST YEAR IN A SNAPSHOT

OPERATION OF THE AMINE PLANT

Period 1 **CHP gas**
October 2012 – April 2013 – 26 weeks

Target: **Stable operation**

Achievement: Operation during the first 26 weeks
about 93% operability.
CO₂ capture rate about 90 %.

Emission: Amine plant about 0.2 ppm
(MTU < 0,01 ppm – with Aker's
proprietary acid wash system)
All nitrosamines and nitramines are below
detection limit

Degradation: Very stable solvent with low degradation.
Main degradation products amines,
amino acids with low volatility.
Very low concentration of solvent specific
nitramines

Reclaiming: The amount of waste is low (0,26 Kg/ton CO₂)

OPERATION OF THE AMINE PLANT



Period 2

May – Oct 2013 – RFCC gas

The RFCC flue gas seems to have a high content of SO_3 and SO_2 .

Initial tests indicate MIST generation with emissions above permit – further tests postponed

Evaluation on-going

Period 3

MEA campaign (planned late 2013)

Targets:

Develop the base line for MEA, explore the operation window, optimize the process with respect to energy.

OPERATION OF THE CAP PLANT



PERIOD 1

NOV 2012 – APRIL 2013

Trouble shooting -
modification, process
development and design
adjustments

PERIOD 2

MAY – PRESENT

(Period 2 ends Nov 2013)

Target: Stable operation
Operability around 90%

PERIOD 3

CAP PLANT

Further operation and
process development
planned through out 2014

REDUCING TECHNICAL RISK

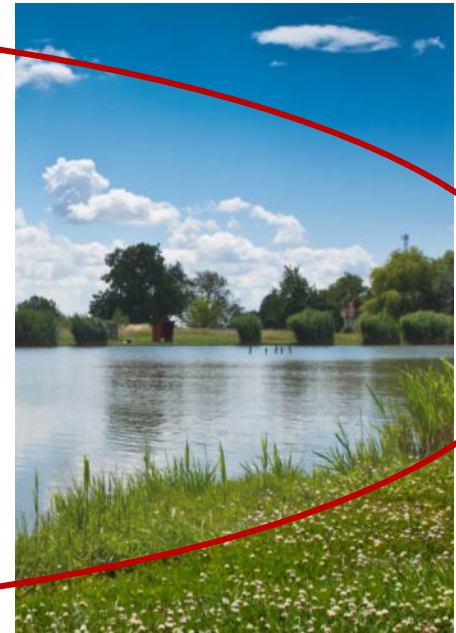
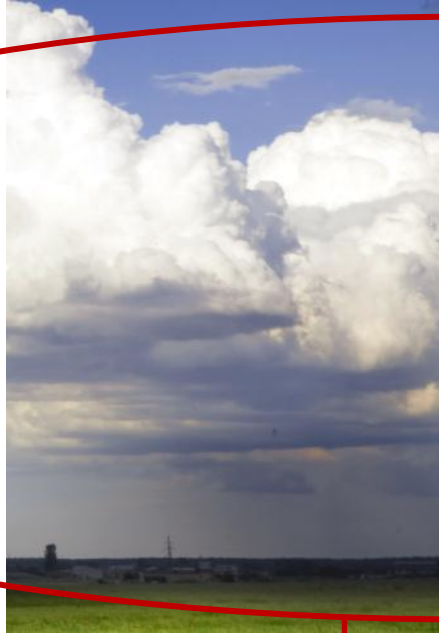
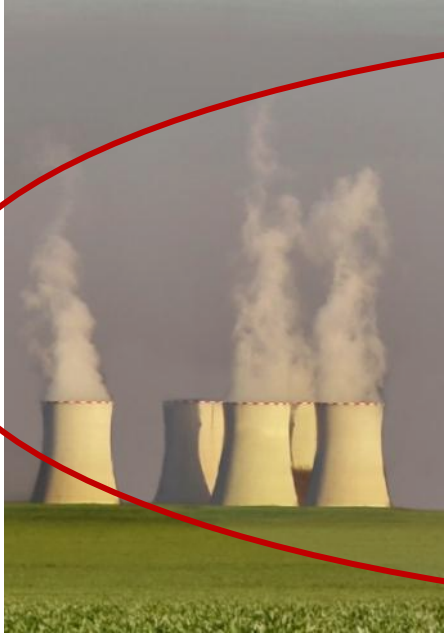
REDUCTION OF TECHNICAL RISK

- Operational experience from more than 7,000 hours of testing (Amine and CAP plant combined)
 - Aker Solutions S21-CHP Campaign – 93% (incl. utility)
 - Alstom CAP-CHP 2013 Campaign – 90% (incl. utility)
- Developed documented and transferable experiences with respect to operation, start-up, shut downs, emergency shut downs etc. All available to the CCS community.
- Developed simulation tools for the total facilities based on NH₃ and MEA, (to be used in the planning, operation and evaluation of day to day activities at)
- Established an available analytical laboratory tool box
- Operated with zero injuries and environmental impacts
- Toolbox for process monitoring including emissions
- Established a good network with national and international institutes and research organisations. More than 55 external studies have been performed

REDUCING ENVIRONMENTAL RISK



EMISSION PERMITS



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



REDUCING FINANCIAL RISK

REDUCTION OF FINANCIAL RISK

The tests have confirmed successful operations of a scaled up plant

- CAP plant- a significant process development from a precipitating system to a solution based technology and further energy optimization and design modification for preventing salt precipitation
- Amine plant- important input with respect to material selection. Gasket material needs to be replaced in certain areas. Material selection for other key components verified
- Achieved knowledge from two different construction methods (modular and on site construction)
- Constructed and verified the use of concrete absorbers with polymer (PP) lining. Experienced and verified the easiness of repairing leakages i.e. welding and change parts of the PP lining
- The TCM simulation tool is to be verified by testing with real exhaust in our industrial sized test units.
- Established a good embryo for a future industrial CO2 cluster of vendors, supply industry, academia

SHARING CARBON CAPTURE KNOWLEDGE

In January 2013, TCM launched the first International Test Centre Network to accelerate CCS technology development, by:

- Sharing knowledge of developments, construction and operational experience
- Establishing benchmarks and performance indicators
- Promoting technology certification and standardization

The Network includes:

- TCM (Norway)
- National Carbon Capture Center NCCC (Alabama, US)
- Southern Company's 25 MW CCS demonstration facility (Alabama, US)
- Wakamatsu Research Institute (Japan)
- ENEL Engineering and Research (IT)
- E.ON (Germany) and DOOSAN Power (UK)

SHARING CARBON CAPTURE KNOWLEDGE

TCM has engaged in broad knowledge sharing, nationally and internationally, earning a reputation as a world leader in CCS research.

Around 5,000 people have visited the TCM site, including national and international representatives from government, industry, scientists, academics and journalists, plus students from national and international colleges and universities

TCM has presented at 12 major knowledge sharing events to date:

- World Future Energy Summit, Abu Dhabi
- Tekna CO2 Conference, Trondheim
- Platts Conference, London
- ARPA-E Energy Innovation Summit, Washington DC
- Trondheim CCS Conference
- Carbon Capture, Utilization and Sequestration Conference, Pittsburgh
- Abu Dhabi CCS Workshop
- All Energy Aberdeen, Scotland
- CCS Conference, Edinburgh, Scotland
- International Conference on Greenhouse Gas Technologies, Kyoto, Japan
- Doha Climate Change Conference
- Global CCUS Summit, Beijing, China

TCM HAS A SOLID PLATFORM GOING AHEAD

- TCM has short listed four major companies for further utilization of the Amine test plant
- Alstom continue their test and process development throughout 2014
- Fourteen applications to test and innovate at the available test area are received

and

TCM has proven its key role in reducing;

- Environmental risk
- Technical risk
- Financial risk

A nighttime photograph of a coastal town, likely Mongstad, Norway. The town is built on a hillside overlooking a body of water. Numerous buildings are illuminated with warm yellow lights, and their reflections are visible in the calm water. A prominent church with a tall, dark spire stands out among the buildings. Several boats are docked along the waterfront, also reflecting in the water. The sky is a deep blue with some wispy clouds.

Thank you