

EXPERIENCE FROM TCM

OLAV FALK-PEDERSEN



GASSNOVA

TCM GOALS

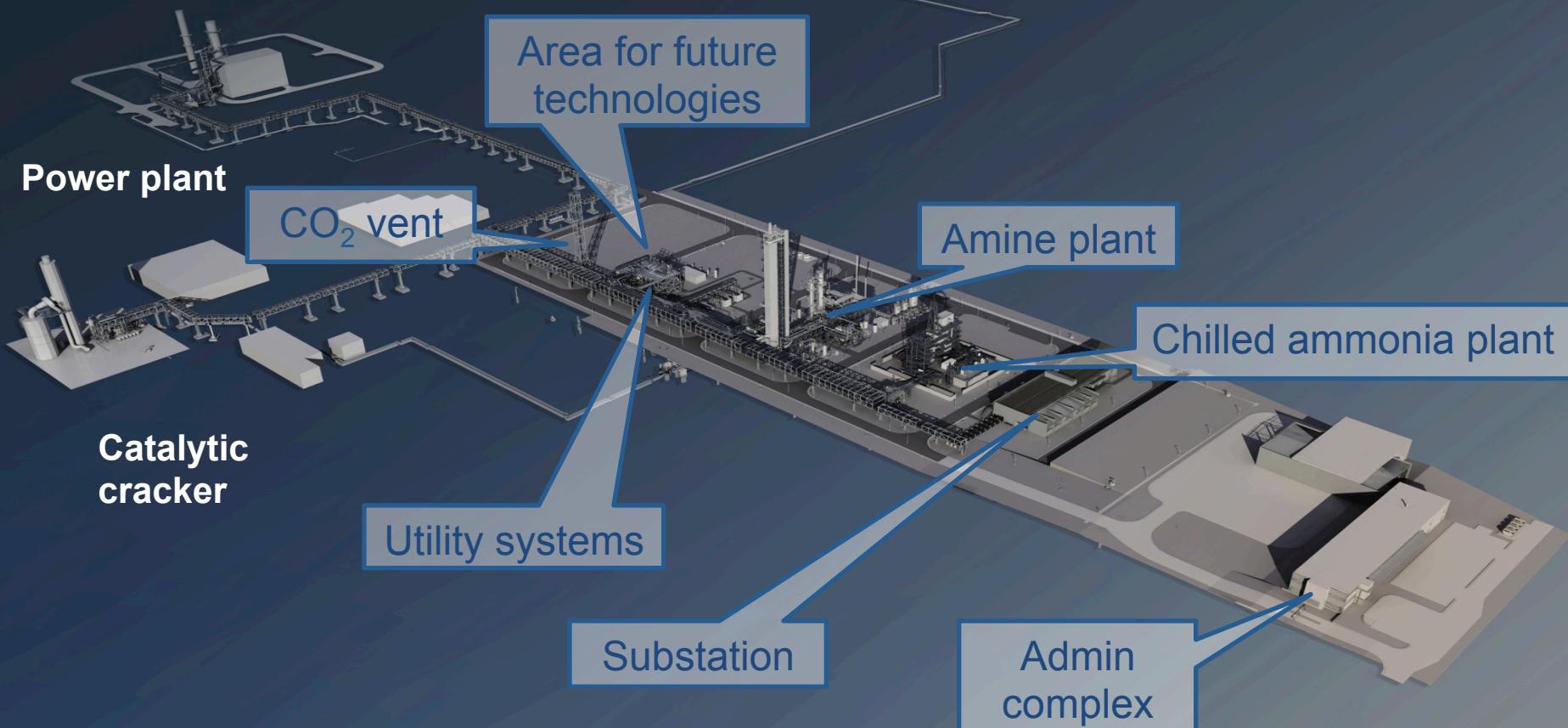


Reduce the cost
and the
technical,
environmental
and financial
risks of
implementing
full scale CO₂
capture
technology

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

CO₂ TECHNOLOGY CENTRE MONGSTAD



CONSTRUCTION



PARTNERS



REINERTSEN

**simonsen
vogtwiig**



amesto®



ALSTOM

Multiconsult

Caverion



Manpower®

proactima
PRO-ACTIVE MANAGEMENT



VOITH

vassbakk & stol



Europcar



gyro



LAB



FORCE



NTNU

TNO innovation
for life

SINTEF



Deloitte.



AMINE PLANT

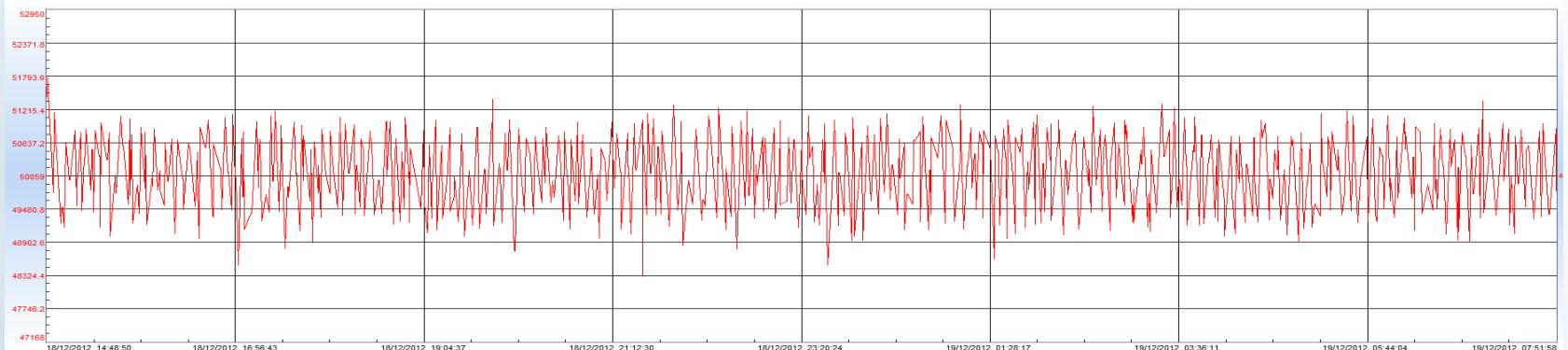


- **Aker:**
 - Test/verification of 2 solvents.
 - Technology commercial available from Aker.
- **MEA test**
 - First baseline MEA testing using industrial CHP exhaust gas.
 - Emissions, energy consumption, design and process optimization/limitations.
 - Published at GHGT 12.
 - New test starts summer 2015.
- **Shell Cansolv:**
 - Verification of solvent/technology.
 - Ongoing.

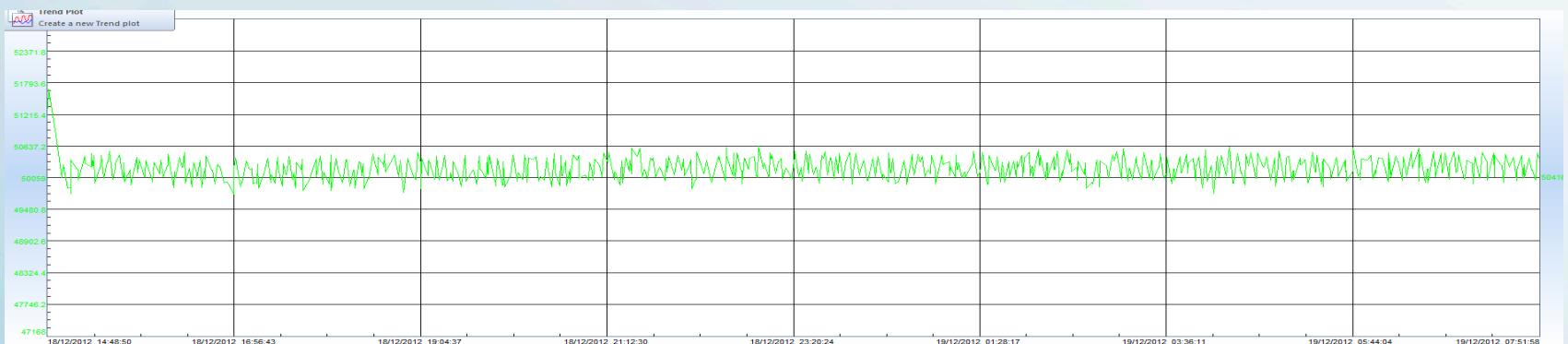
MASS BALANCE - AMINE PLANT

- Before start-up, all measurements needed for safe operation and plant balance were calibrated.
- Capture rate of CO₂ initially ranged from 50-94 %, depending on data source used for calculation.
- Extensive work has since been carried out to achieve a higher mass balance accuracy.
 - Mass balance accuracy now 3 – 4 %

MASS BALANCE EXAMPLE - CHP FLOW METER

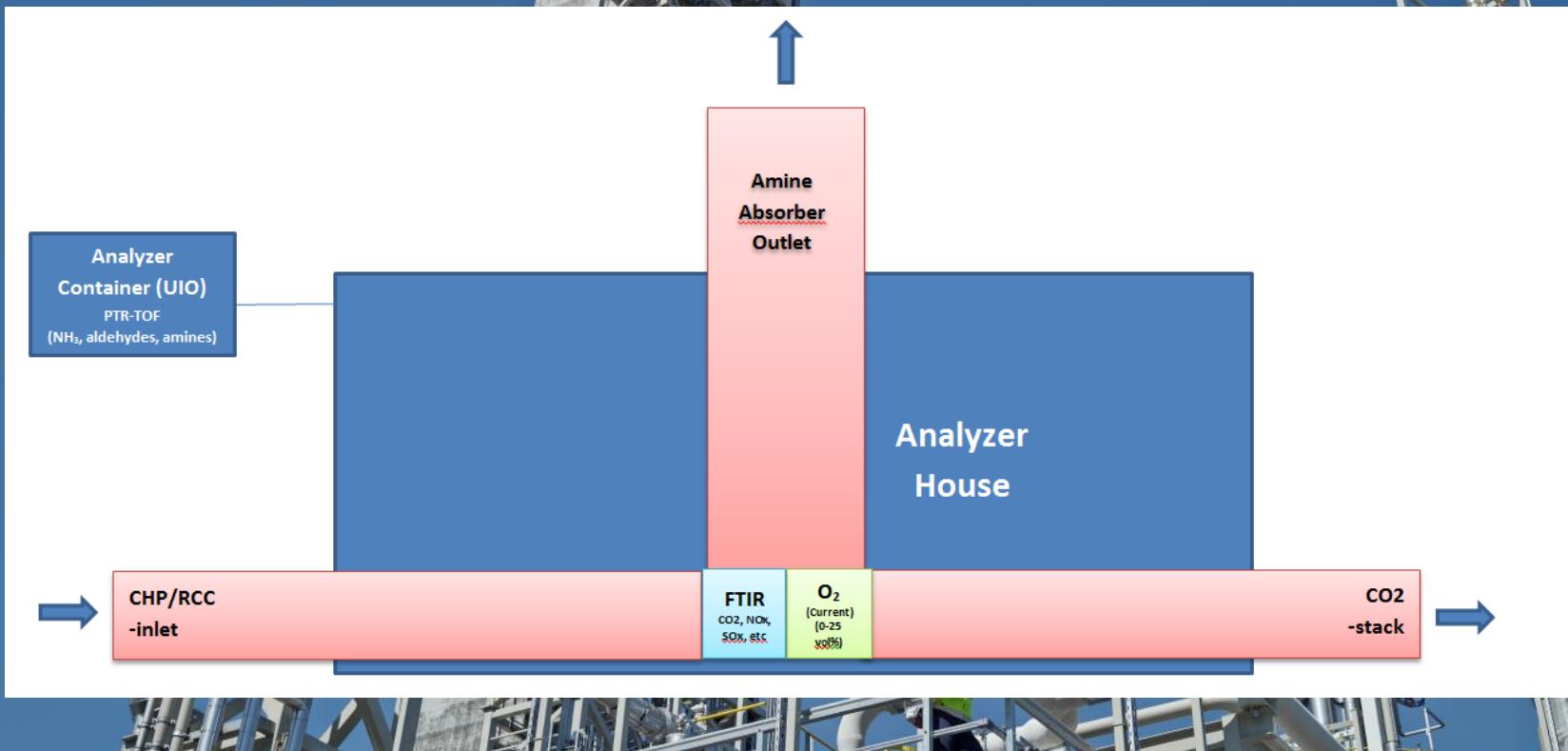


Pitot tube: Overall uncertainties typically 2,6%



Ultrasonic Meter: Overall uncertainties typically 1,0%

AMINE PLANT



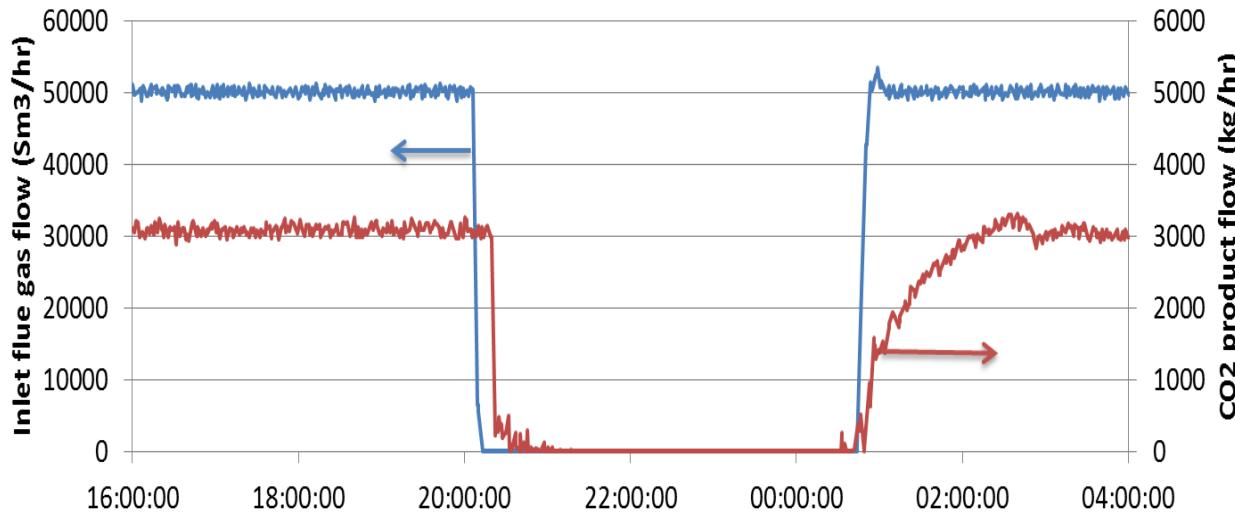
Collecting data from 4000 online measuring points

AMINE PLANT

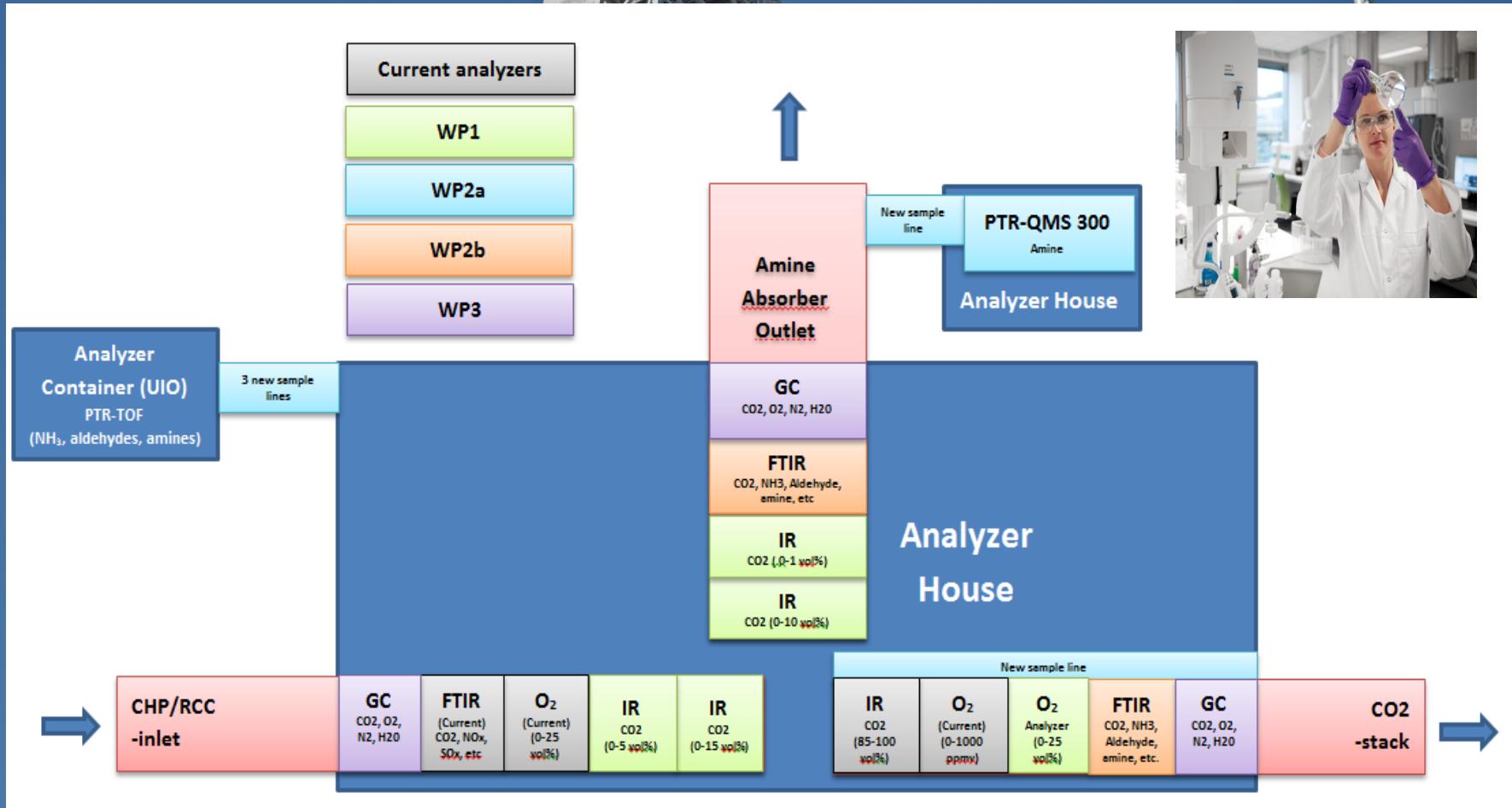


- Testing the capture during dynamic transitions, replicating a fluctuating grid power consumptions
- Supporting growth of renewables

- The graph below shows an example of tripping and starting the amine plant.



AMINE PLANT



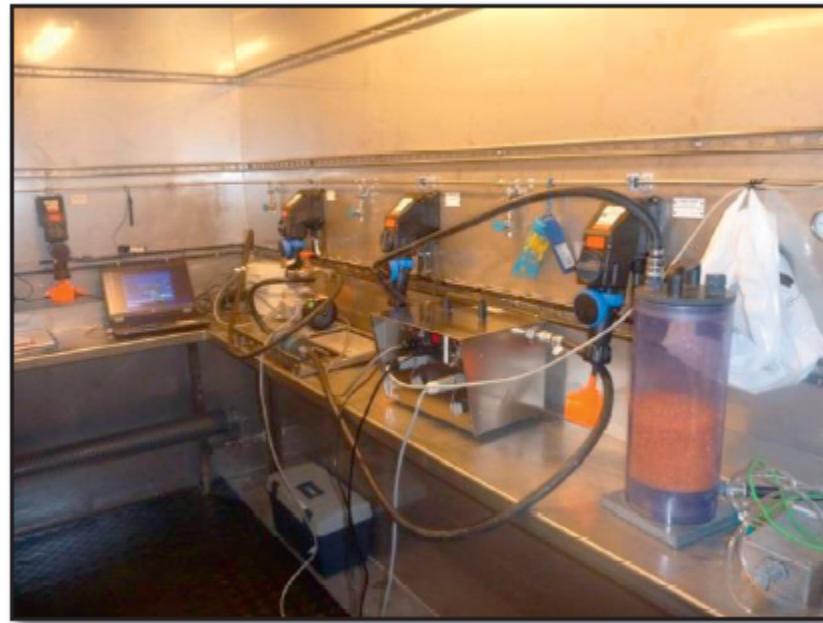
MANUAL SAMPLING



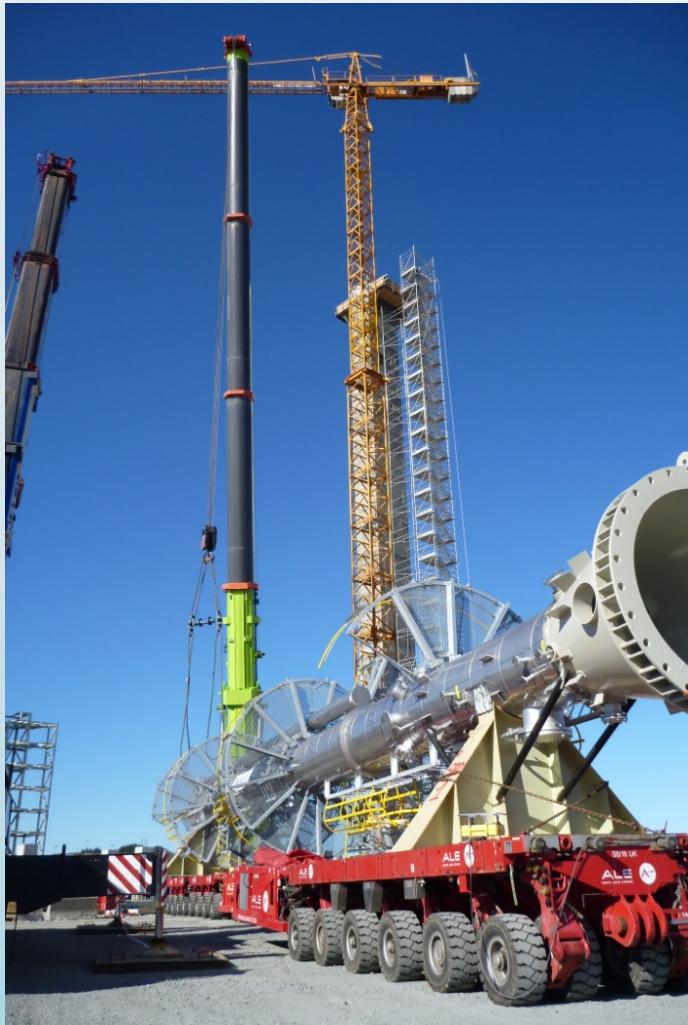
Lifting modules to the absorber top



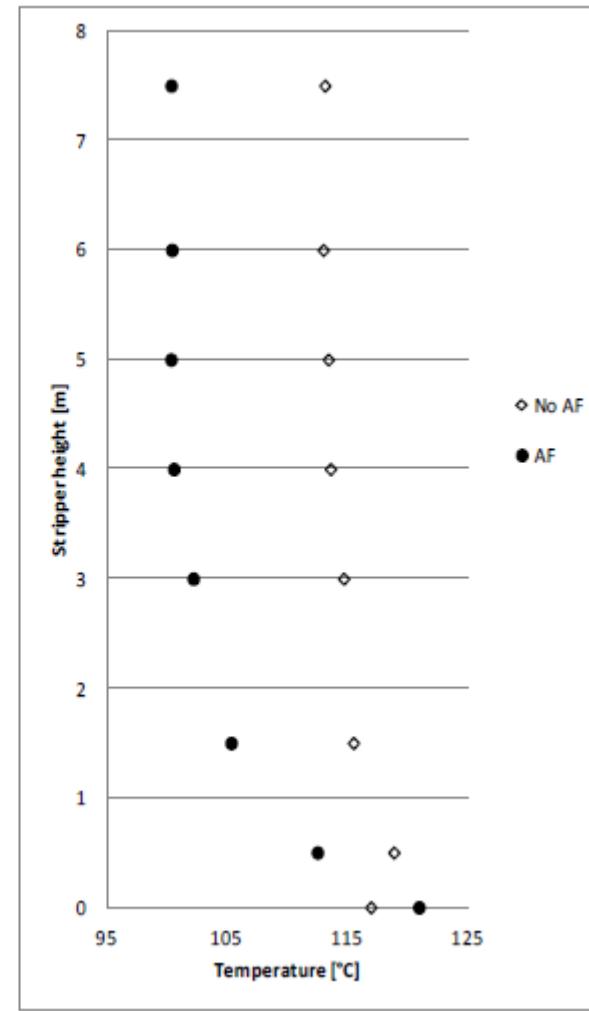
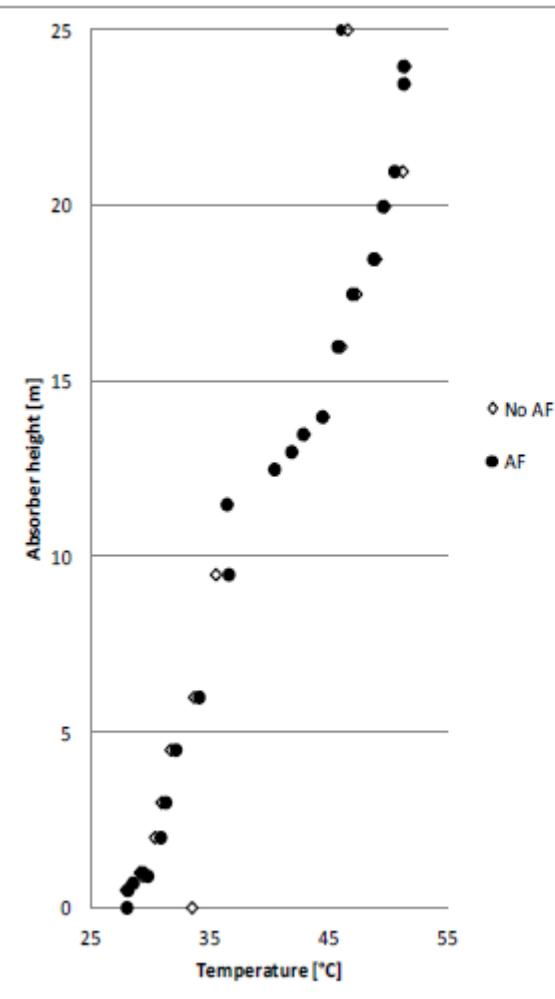
MANUAL SAMPLING



OPTIMIZATION OF PROCESS COMPONENTS

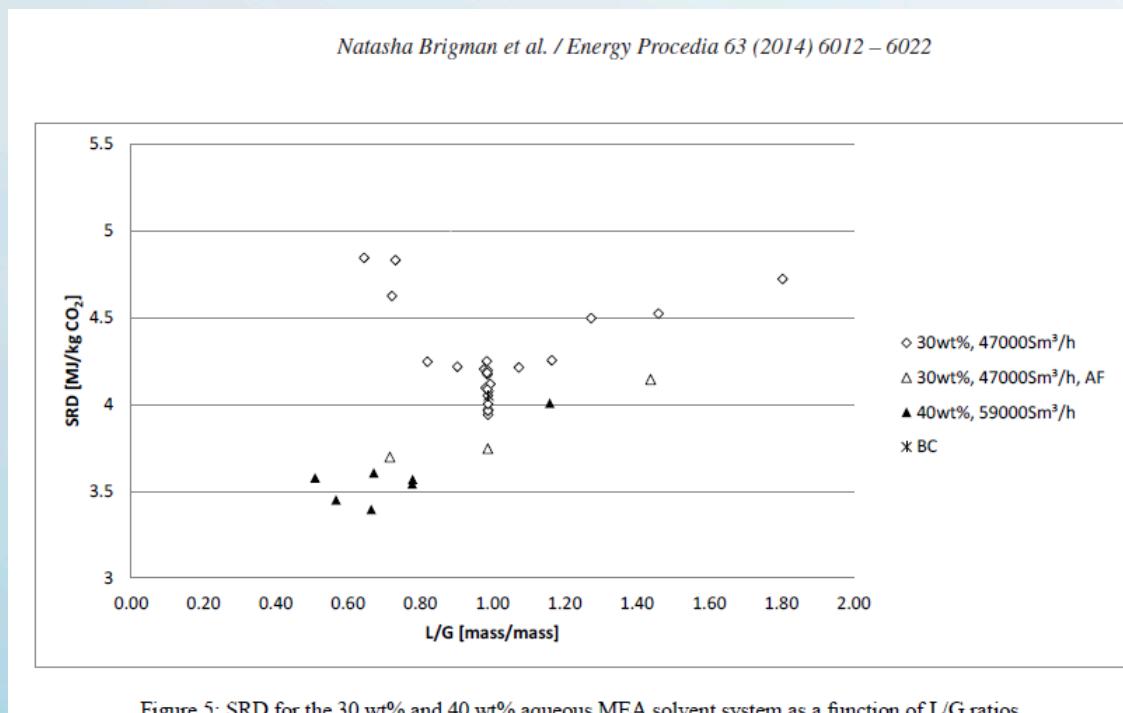


OPTIMIZATION OF PROCESS COMPONENTS



OPTIMIZATION OF PROCESS

- Minimum specific reboiler duties (SRD) of respectively 4.0 MJ/kg CO₂ and 3.7 MJ/kg CO₂ were obtained for the aqueous 30 wt% MEA solvent system without and with the addition of anti-foam solution.
- A minimum SRD of 3.4 MJ/kg CO₂ was obtained for the aqueous 40 wt% MEA solvent system.
- Lower SRD and absorber liquid to gas (L/G) ratios were obtained with higher concentration MEA solvents.



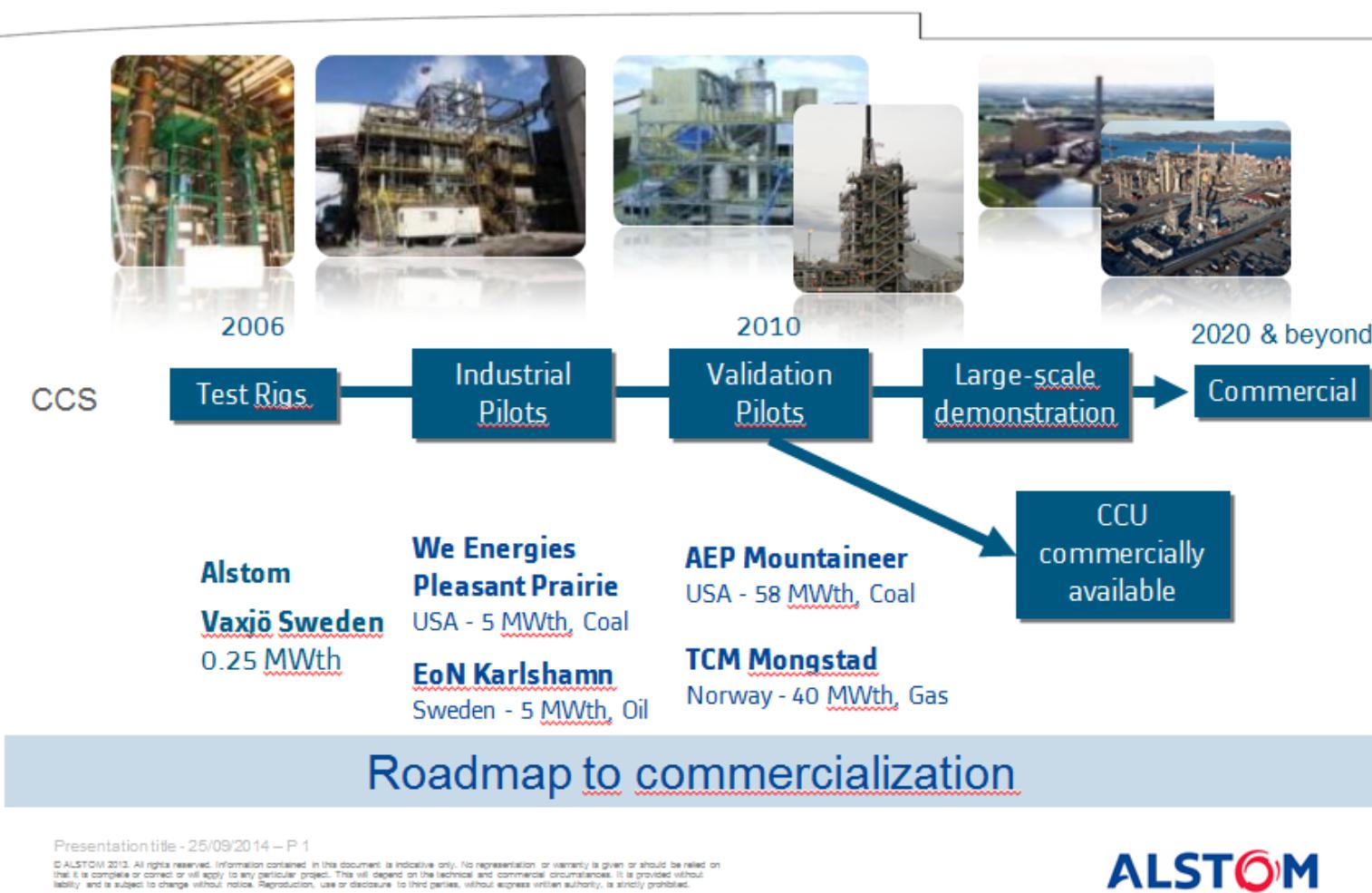
CAP PLANT

- **Alstom:**
 - Test/verification of 2 exhaust gas sources.
 - Technology commercial available from Alstom.



CAP PLANT

Chilled Ammonia Process Update on Alstom roadmap



UNIVERSITY OF TEXAS AUSTIN AND TCM

- **The Parties agree to explore opportunities of collaboration and establish a frame of work in certain areas:**
 - Developing a test program for use of the SDR rig at TCM.
 - Perform testing of MEA and one UT's proprietary amine.
 - Analysis work and publication of test results.



REDUCTION OF FINANCIAL RISK



The tests have confirmed successful operations of a scaled up plant

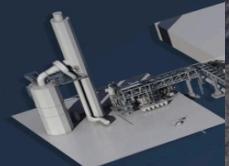
- CAP plant- a significant process development from a precipitating system to a solution based technology and further energy optimization and design modification for preventing salt precipitation
- Amine plant- important input with respect to material selection. Gasket material needs to be replaced in 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



GASSNOVA

CO₂
TCCN

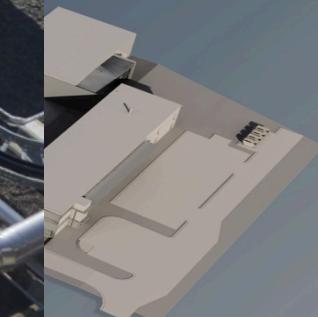
Power plant



Catal
crack



ammonia plant



A photograph of a large industrial gas processing facility. In the center-left, a worker wearing a white hard hat, yellow vest, and dark pants stands on a metal walkway next to a large, curved, silver-colored pipe. The facility is a complex network of steel structures, pipes, and walkways. In the background, there are mountains under a clear blue sky.

MIST GAS CHARACTERISATION EVALUATION OF CONCEPTS