



# TCM

## Post-combustion testing at TCM

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**TCM:** One of the key components in the Norwegian route to CCS implementation





# TCM – A new partnership until 2020

Has been operational since 2012, and will continue until at least 2020 with 3 Industrial partners





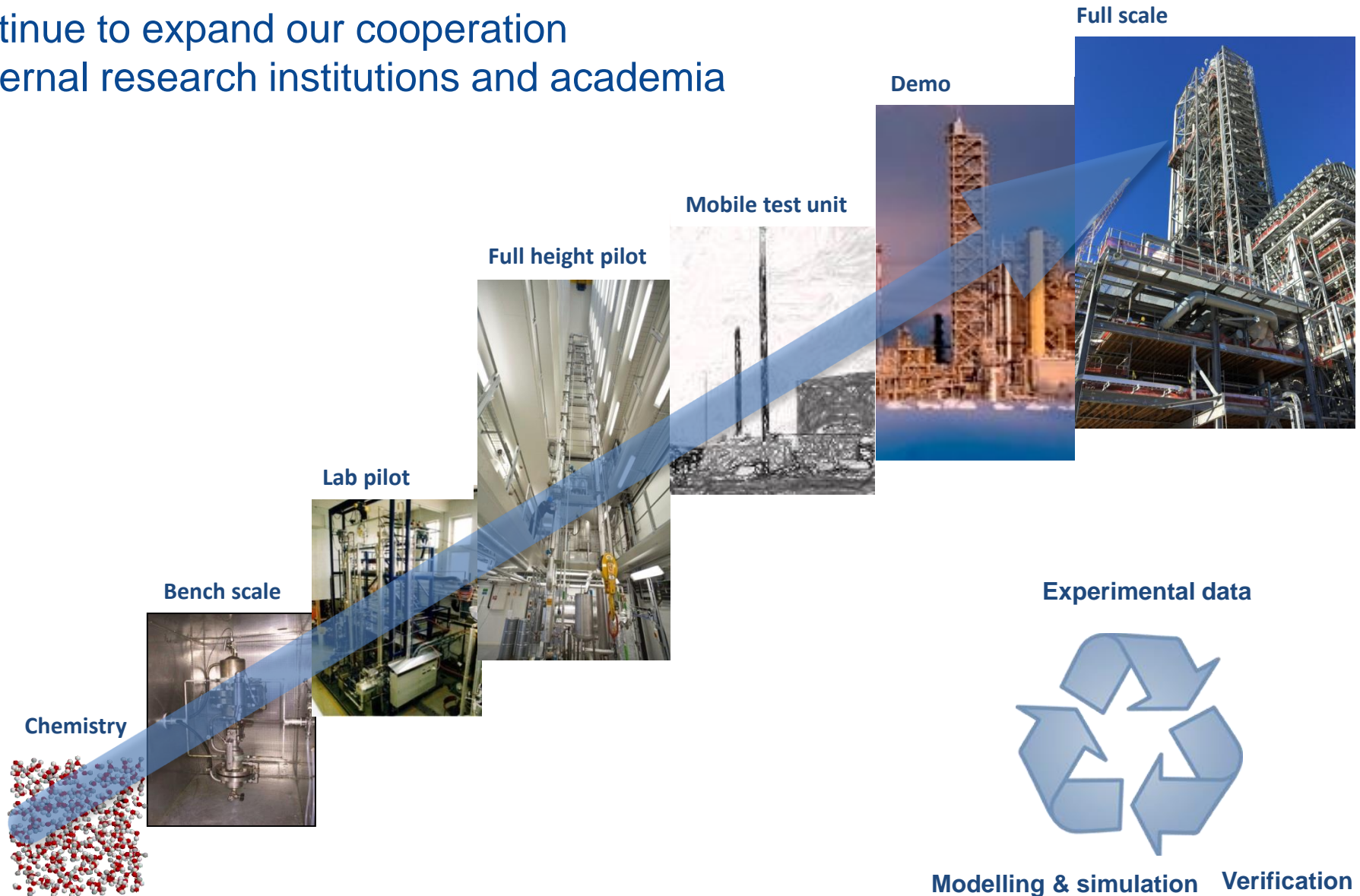
# The three main activities at TCM

Competence development for our owners



# TCM and the «Research world»

We continue to expand our cooperation with external research institutions and academia



# TCM – an arena for training, problem-solving and development

- Reduce the cost and risks of CO<sub>2</sub> capture technology deployment
- Providing an arena where vendors can test, verify, and demonstrate proprietary CO<sub>2</sub> capture technologies.
- Scientific support to vendors
- Non-proprietary technology development





# The TCM offer to technology vendors

An opportunity to get technology to market faster and cheaper

- Large scale 24/7 testing on real industrial flue gas (10 MW)
- Scientific support, test design and trouble shooting
- Emission control and environmental chemistry
- Support on approval processes with environmental authorities
- Analytical methods
- Operator training facilities for full scale capture operations





# Continuous testing since inauguration in 2012

Five companies have already validated their technology at TCM.

## Completed test campaigns:

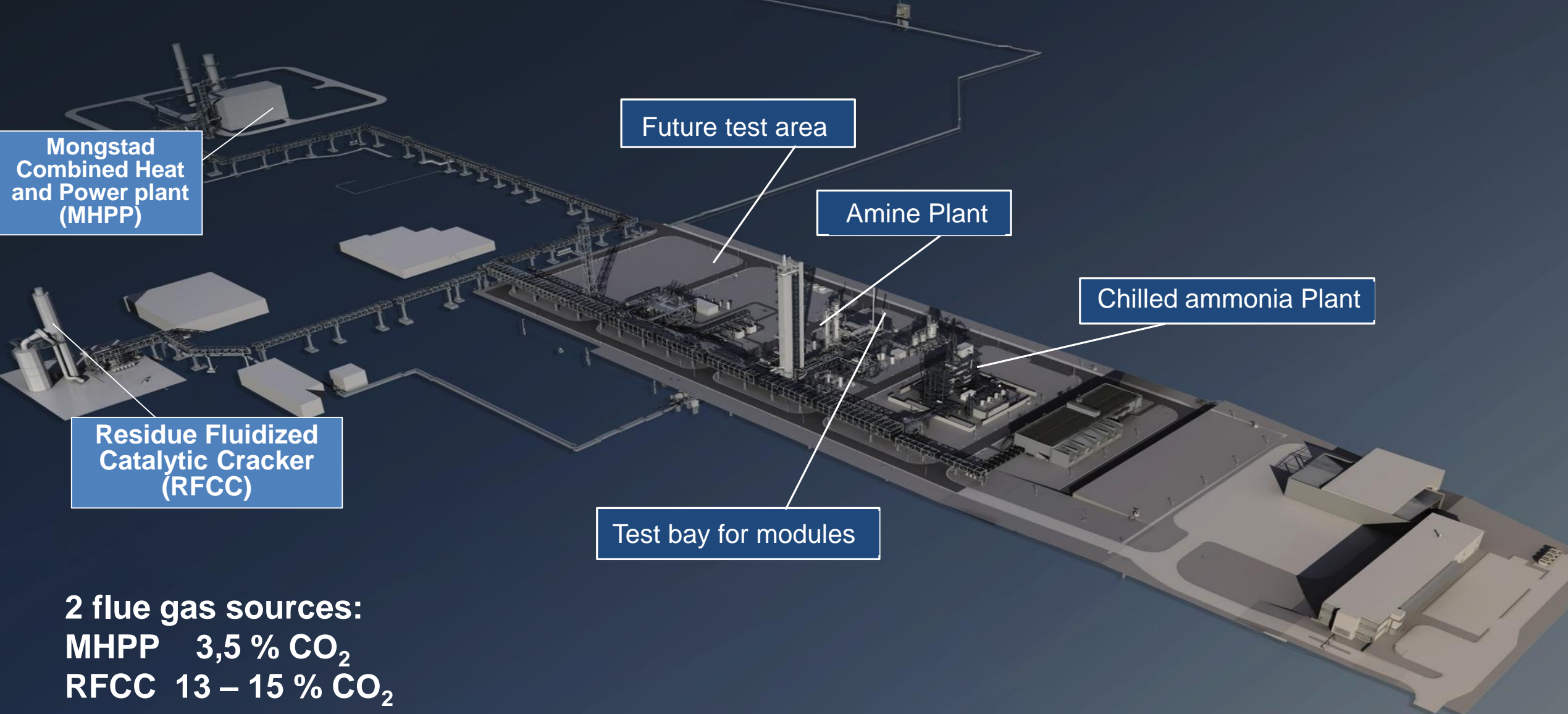
- Aker Solutions (Norway)
- Alstom/GE (US)
- Cansolv Technologies (Canada)
- Carbon Clean Solution (UK/India)
- ION Engineering (USA)





# TCM - the world's largest and most advanced test centre

This enables vendors unique opportunities

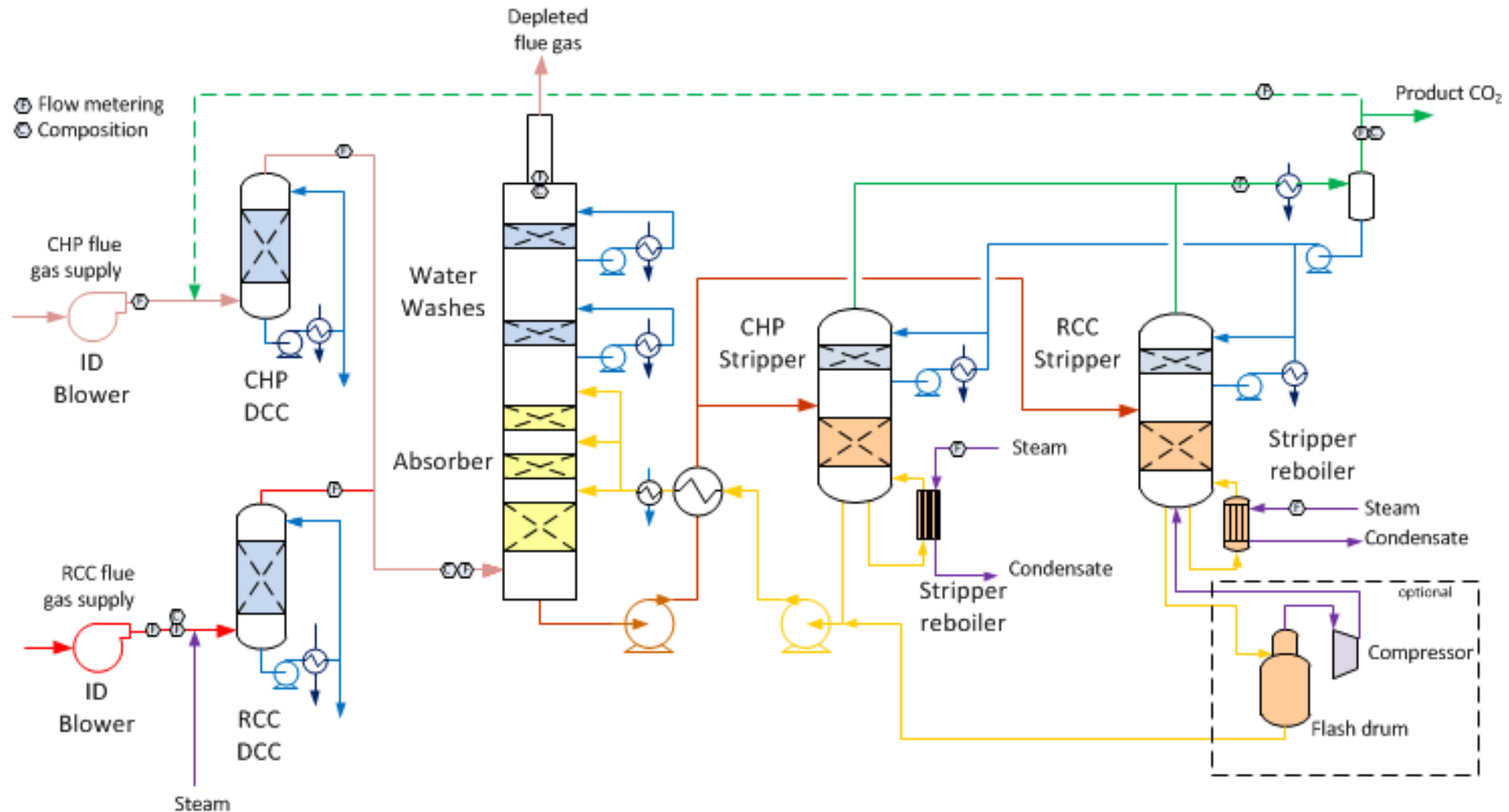


2 flue gas sources:

MHPP 3,5 % CO<sub>2</sub>

RFCC 13 – 15 % CO<sub>2</sub>

# Amine plant at TCM – overview





# Research in Non-proprietary technology aspects

Also essential for accelerating capture technology...some examples..

- Development of advanced plant control schemes
- CO<sub>2</sub> product composition
- Workplace monitoring
- Emission monitoring and water wash operations
- Corrosion monitoring
- Flue gas composition and impurities, and further flue gas pretreatment
- Absorber and stripper column distributions and mass transfer measurements
- Detailed degradation mechanism and products
- Impact of dynamic operations

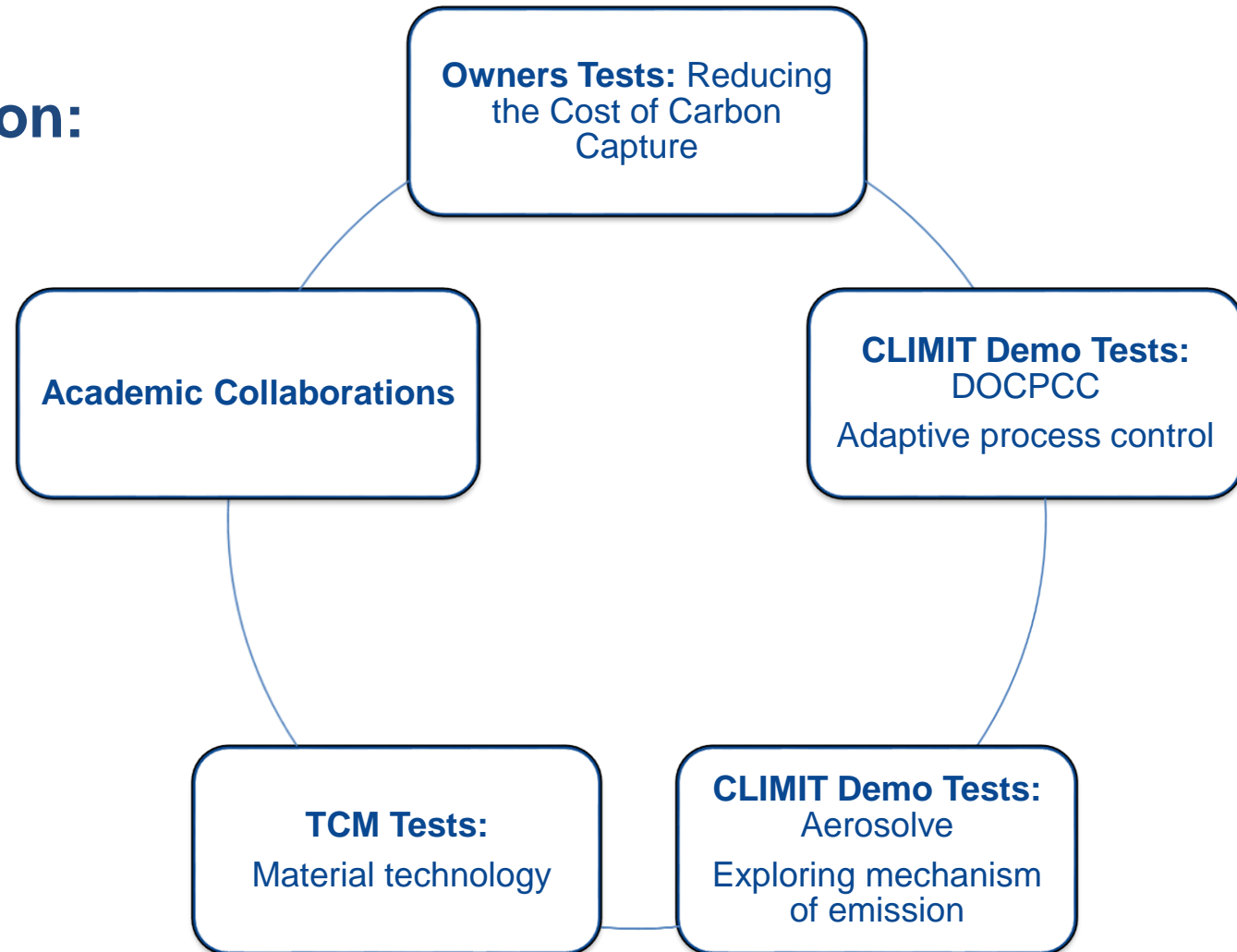


# TCM's third scientific “open” campaign will be conducted later this year

The campaign has several sponsors, including industry, scientific institutions and public funding

## A very broad collaboration:

**Statoil** (Industry)  
**Shell** (Industry)  
**Gassnova** (Public)  
**SINTEF** (Research)  
**TNO** (Research)  
**NTNU** (Academia)  
**Imperial College** (Academia)  
**DTU** (Academia)  
**Cybernetica** (Industry)  
**Engie** (Industry)  
**Uniper** (Industry)





# OPERATION OF THE CAP PLANT

## PERIOD 1

NOV 2012 – APRIL 2013

Trouble shooting - modification, process development and design adjustments

## PERIOD 2

MAY 2013 – NOV 2014

Target: Stable operation  
Operability around 90% and prove technology

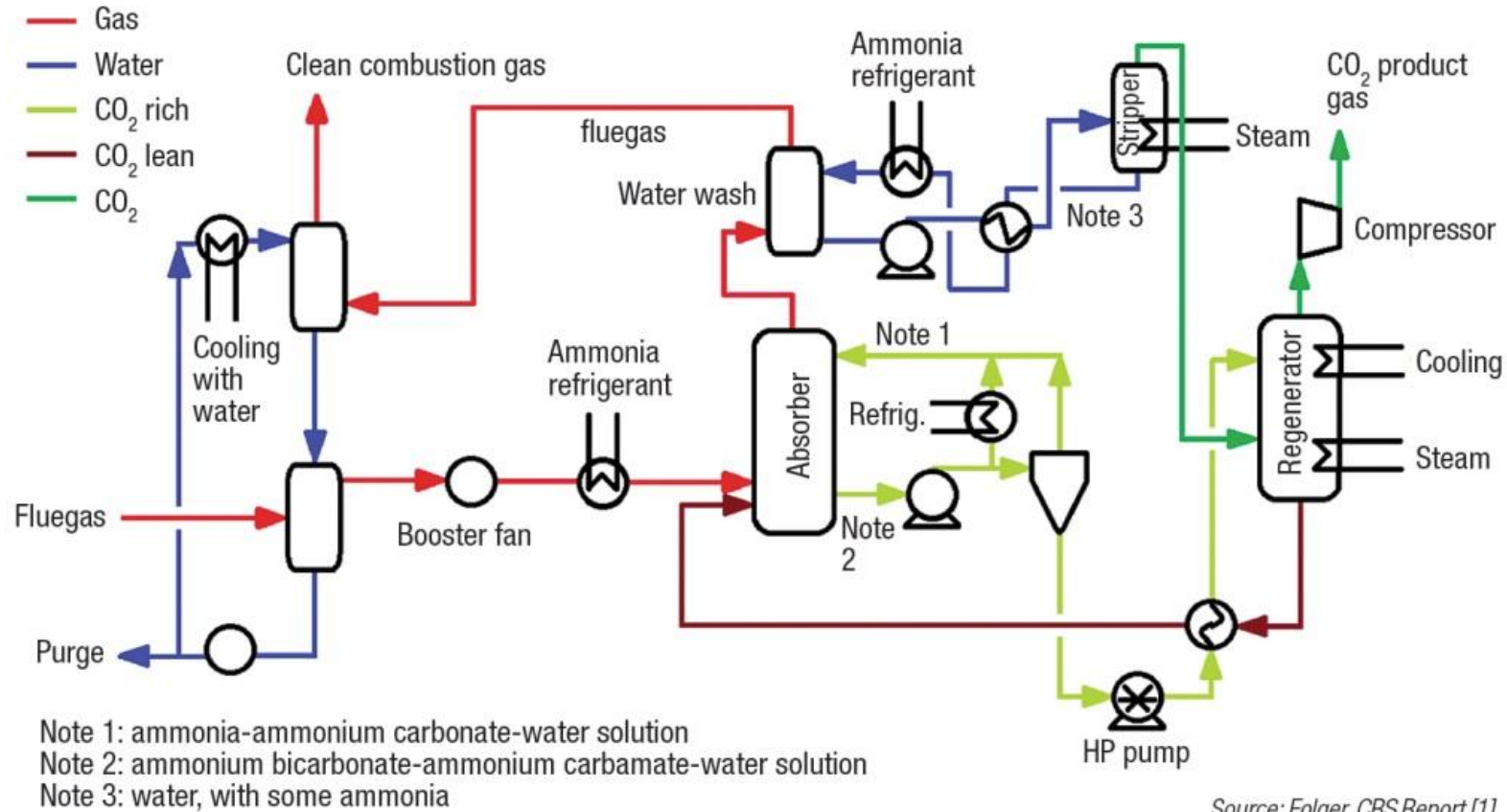
## PERIOD 3

FUTURE

Further process development conducted throughout 2015 with Alstom/GE

On-going dialogue regarding the use of the CAP.

# CAP plant – overview





# Networking and competence sharing is essential for TCM

Also a crucial part of developing and implementing CO<sub>2</sub> capture technology

- **Bilateral international agreements and participation in the International test center network (ITCN)**
- **Collaboration agreements with academia and research institutions (eg. SINTEF/TCM)**
- **Support agreements with CCS projects globally.**
- **Dedicated conference sessions (eg. GHGT-13)**



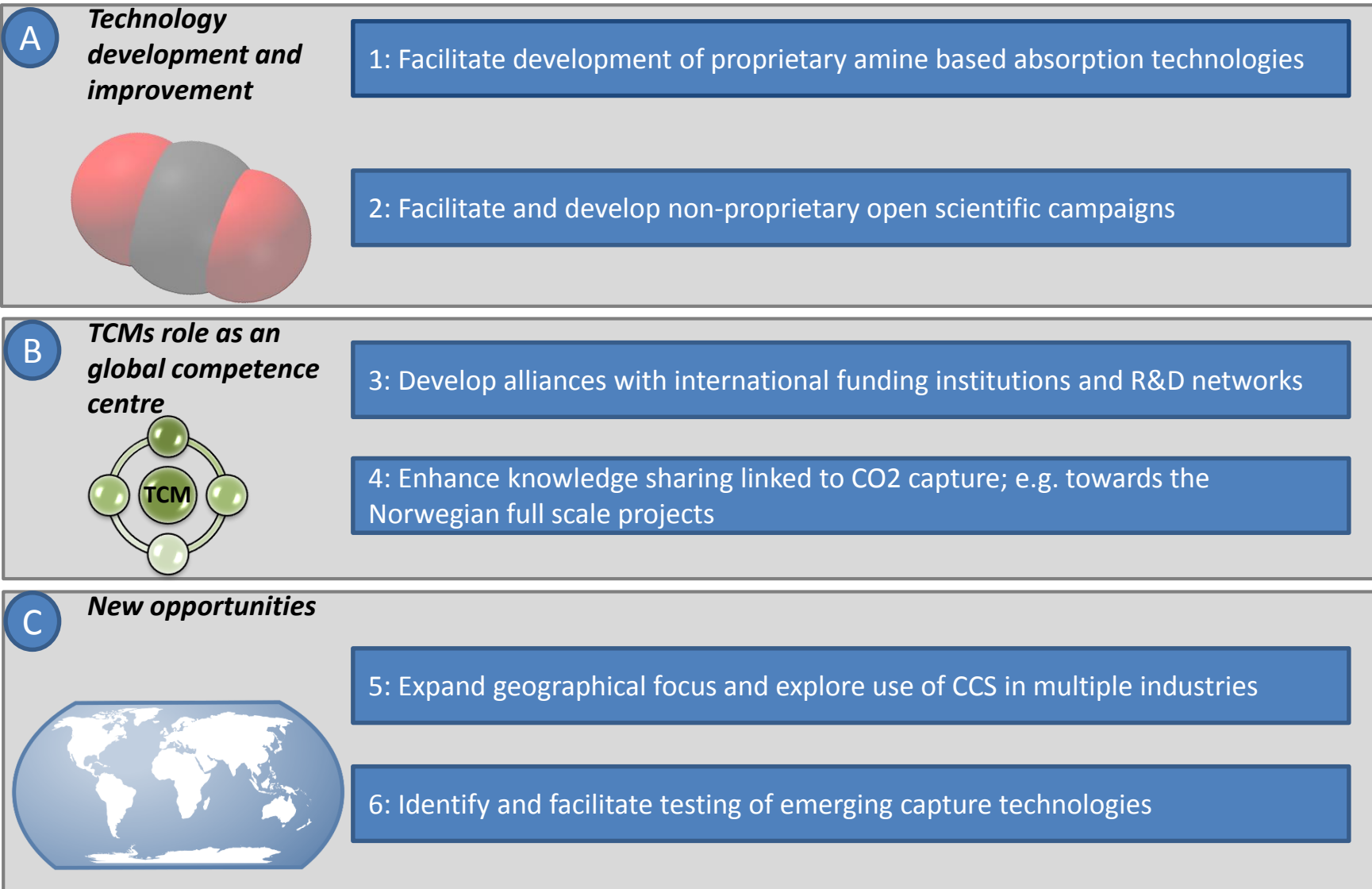




# THE WAY FORWARD



# TCM strategy



# THANK YOU!

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