Technology Centre Mongstad

28.09.2022

TECHNOLOGY CENTRE MONGSTAD

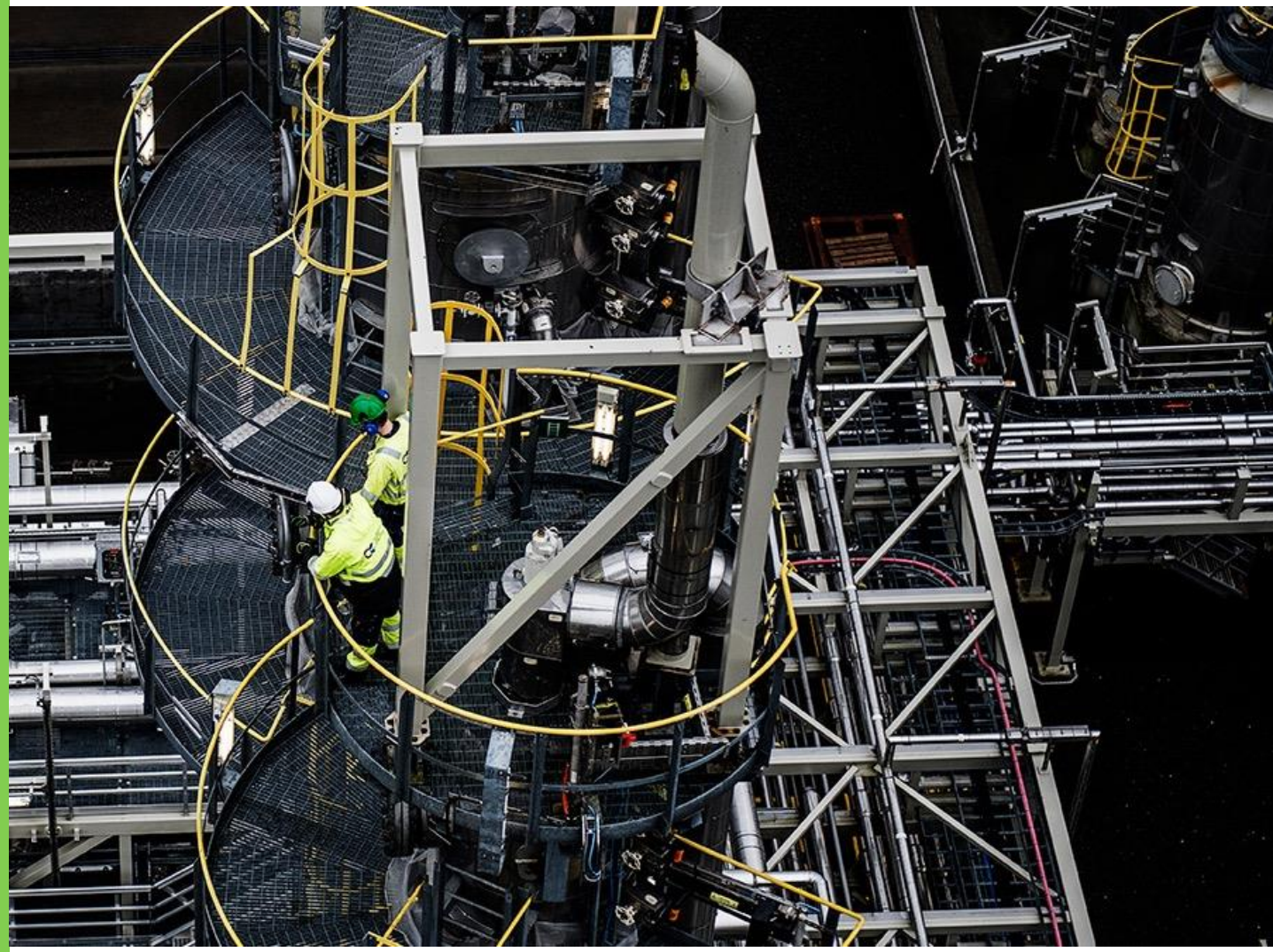
– catching our future

Agenda

09:00-09:10:	**Welcome**	**(Robert)**
09:10-09:20:	**About TCM**	**(Robert)**
09:20-09:40:	**Technology status and what TCM has achieved**	**(Blair)**
09:40-10:00:	**Discussions – preparation for plant tour**	
10:00-11:00:	**Guided tour in the plant – by bus**	
11:00:	**Departure by bus to Øygarden**	

Content

1. **Introduction to TCM**
2. CCS Technology upscaling
3. Sharing Knowledge
4. Advisory services
5. Way forward



TECHNOLOGY CENTRE MONGSTAD

The world’s largest open access test centre for carbon capture technologies

Technology Centre Mongstad (TCM) facilitates the advancement of carbon capture technology for mass deployment across industries.

We test, verify and demonstrate different post-combustion technologies related to cost-efficient and industrial scale CO_2-capture

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Joint venture established in 2009

TCM was established to support development and testing of carbon capture technologies at an early stage. Today, the company is a joint venture between the Norwegian state (managed by Gassnova) (73.9%), Equinor (8.7%), Shell (8.7 %) and TotalEnergies (8.7 %).

GASSNOVA

«We see an increasing interest for testing at TCM, and we are very pleased that we can continue our important work with testing and research necessary for the deployment of large-scale carbon capture.»

equinor

«TCM has contributed to maturing the carbon capture supplier market and will remain relevant with the increasing number of technology suppliers lining up for testing.»

«TCM plays a key role in further developing and reducing the cost of CCS – a crucial technology to help society and economies thrive through the energy transition.»

TotalEnergies

«TCM is a cornerstone in Total's strategy to tackle climate change by accelerating the development and adoption of innovative CO_2 capture technologies.»

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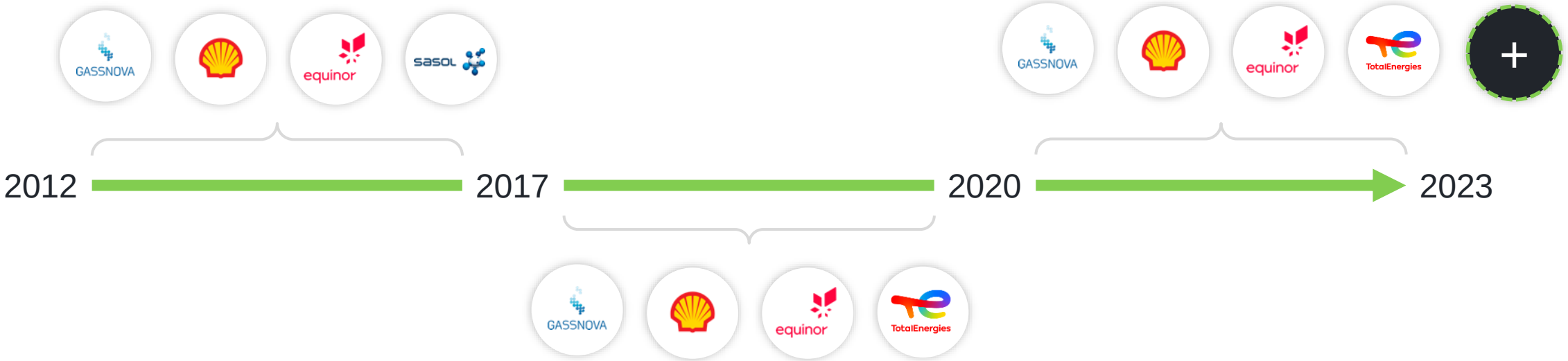
TCM has renowned owners that are willing to make a difference in combating climate change



The Participants' Agreement (PA) and operational owner period is active in a defined time period. The current owner period from August 2020 lasts until end 2023.

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Gassnova is coordinating the Norwegian CCS initiative, where TCM is a key component

CLIMIT Research Program

Gassnova grants financial support for development, demonstration and piloting of Carbon Capture and Storage (CCS) technologies.

Technology Centre Mongstad

Gassnova manages the Norwegian state's interest in the Technology Centre Mongstad and will facilitate the sharing and dissemination of these experiences in order to reduce the costs and risks of carbon capture.

Full-scale CCS Project

Gassnova manages and coordinates the work of the Norwegian full-scale project for CCS and has entered contracts with:

Norcem - Heidelberg Cement
Celsio Oslo - Waste to Energy
Equinor, Shell and Total - Northern Lights

History and development of TCM

2006
The Norwegian state and Statoil (now Equinor) agree to build test centre (EUR 600 million investment)

2009
TCM DA established and Gassnova, Equinor and Shell become owners

2010
Sasol becomes owner

2012
TCM officially opened and starts testing operations

2017
Establishment of new ownership period, where Total enters as new owner and Sasol departs

2023
The current ownership period was extended in August 2020 until the end of 2023

2025
TCM has ambitions to deliver more testing, broader advisory services and applied research and development to the CCUS industry

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Proprietary Testing

>28,000 hrs

Non-Proprietary Testing

>20,000 hrs

Advisory Services

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Site for Emerging Technology

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Key facts

Capture technologies: Post combustion capture technologies:

Source: RFCC (13-15% vol) and Refinery Heater (Gas boiler) 8%. Flue gas composition can be simulated anywhere 1->20% CO_2 to mimic flue gas compositions from numerous sectors.

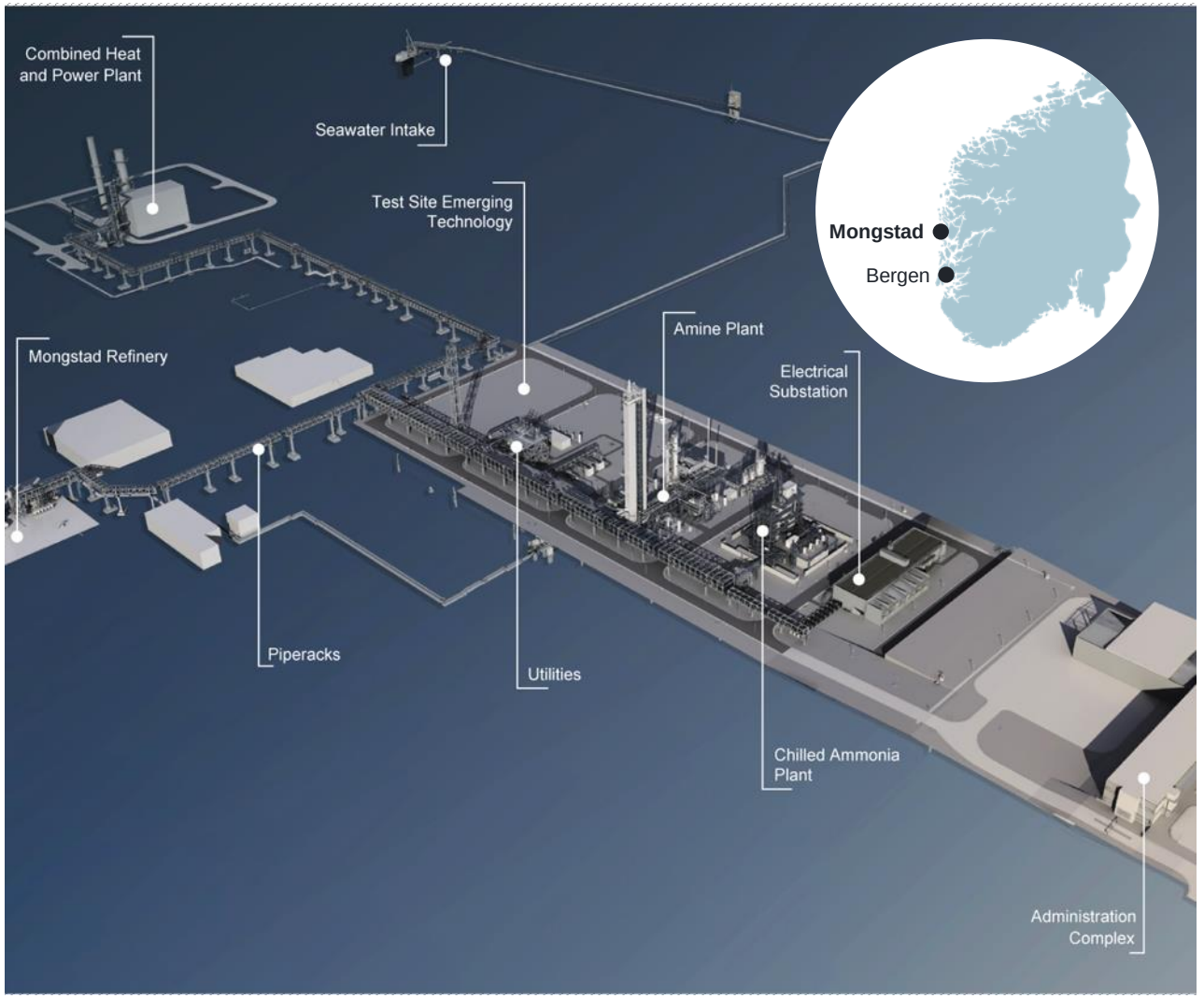
Capacity:

Amine plant: 12MWe or 75000 tons CO_2/yr

Chilled Ammonia plant: 12MWe or 75000 tons CO_2 /yr

Site for emerging tech: Capacity up to 18,000 tons CO_2 per year using up to 3 MWe modules.

Monitor and control: 4,000 online instruments, and 100 manual sampling points,



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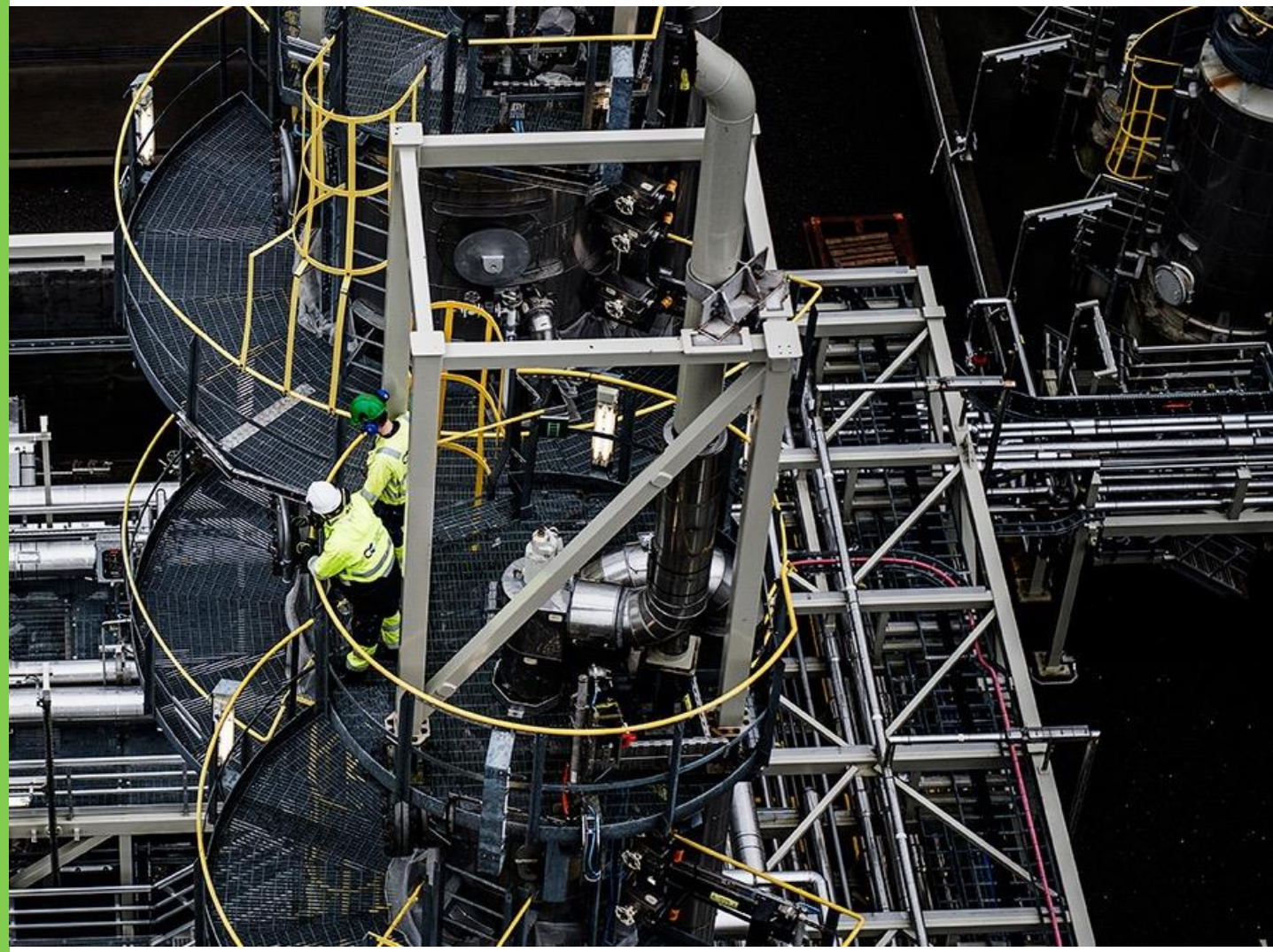

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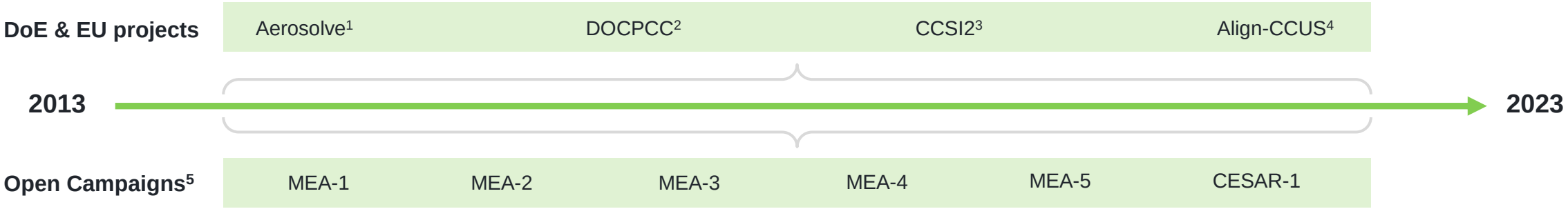
Test campaigns conducted in 10 years of operation

Proprietary test campaigns

Vendors conduct proprietary testing with their own technology.

Non-proprietary test campaigns

Several open scientific campaigns with non-proprietary solvent in collaboration with universities and research organisations, as well as several projects together with the EU.



[1] Project regarding aerosol-related emissions
[2] Demonstration of Optimal Control of Post-Combustion Capture Processes
[3] Carbon Capture Simulation for Industry Impact
[4] Accelerating Low carbon Industrial Growth through CCUS
[5] Long-term testing with monoethanolamine solvents and CESAR-1 (AMP+PZ) solvent

Proprietary testing >20,000 hrs

Non-proprietary testing >20,000 hrs

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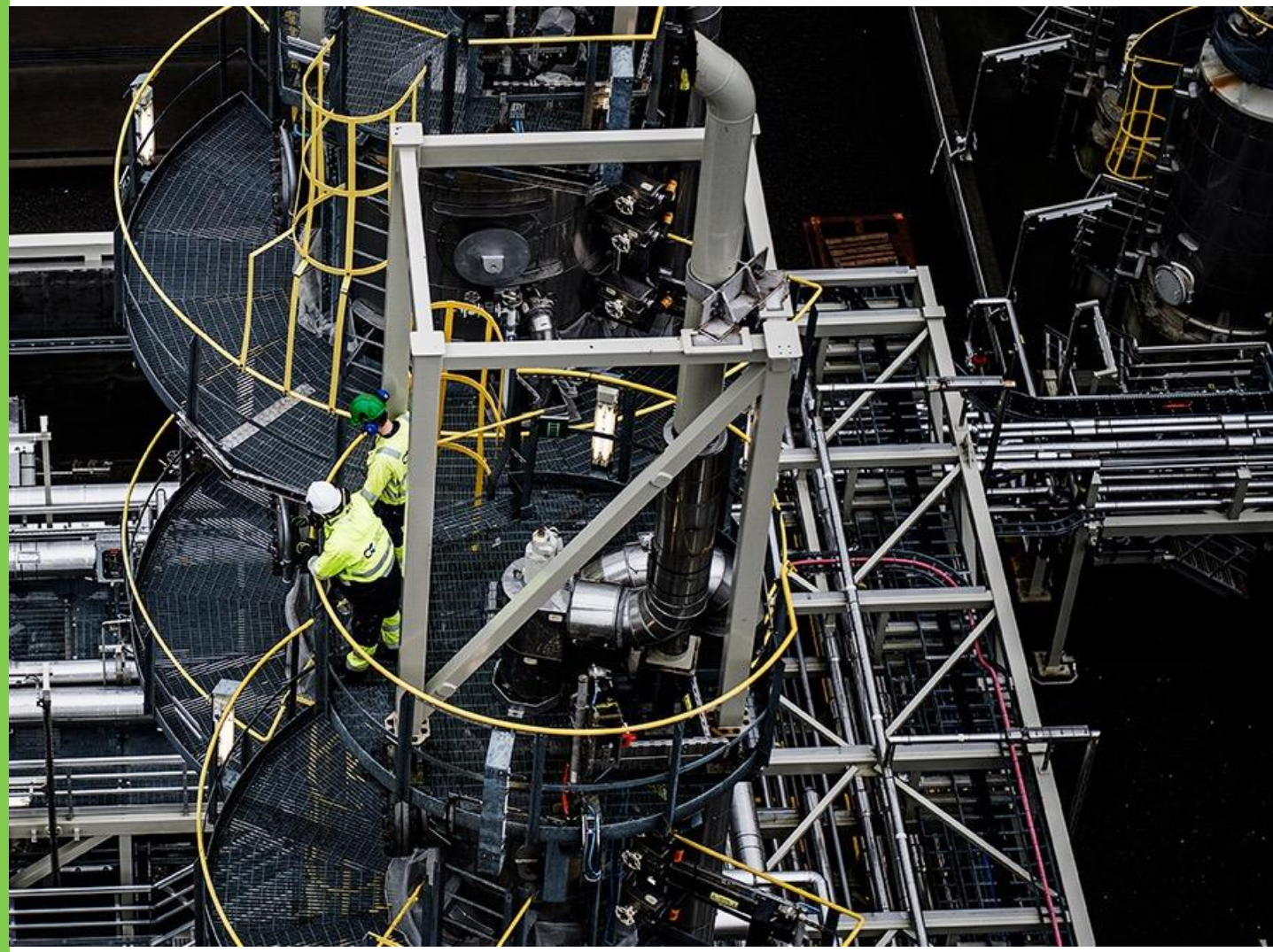

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Sharing knowledge from open campaigns

- TCM has established 4 different 3rd party verified baselines with open solvents (MEA, CESAR1)
- Total accumulated hands-on experience with open solvent >20,000 hrs
- Large operating windows are explored
- Different mode of operations explored, dynamic, cold and hot startups, shutdowns etc.
- HSE aspects successfully demonstrated
- 60+ different scientific papers published

https://tcmda.com/sharing-our-findings/

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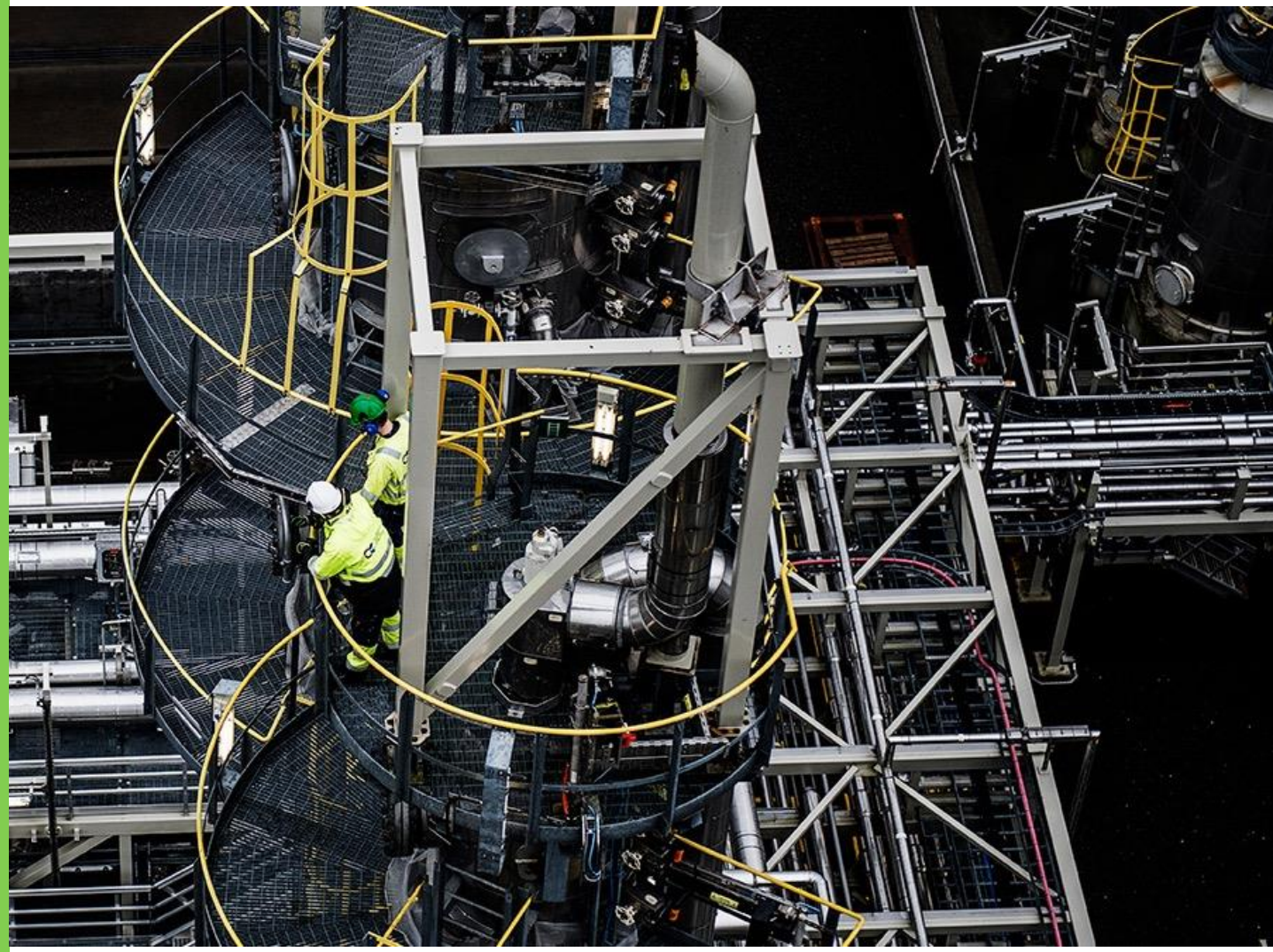

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We support project owners to become smart buyers of CC technology utilizing our know how from open campaigns.

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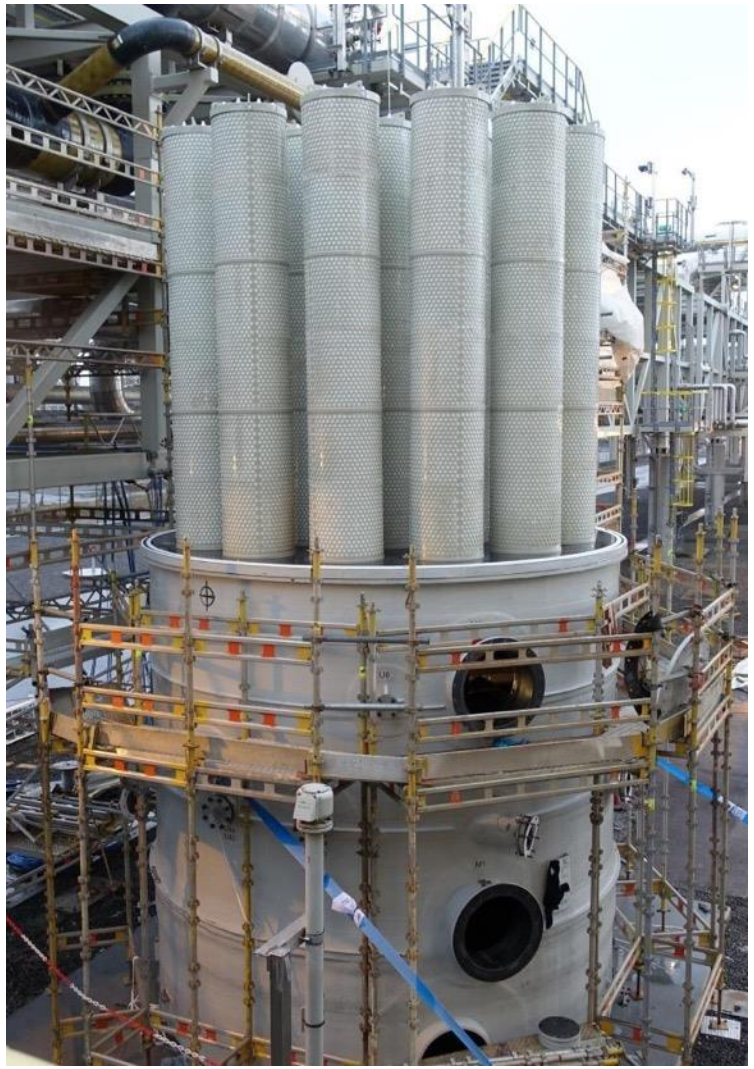

We provide risk intelligence

We help you to reduce HSE, technical and financial risks of technology deployment at scale

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Advisory Services

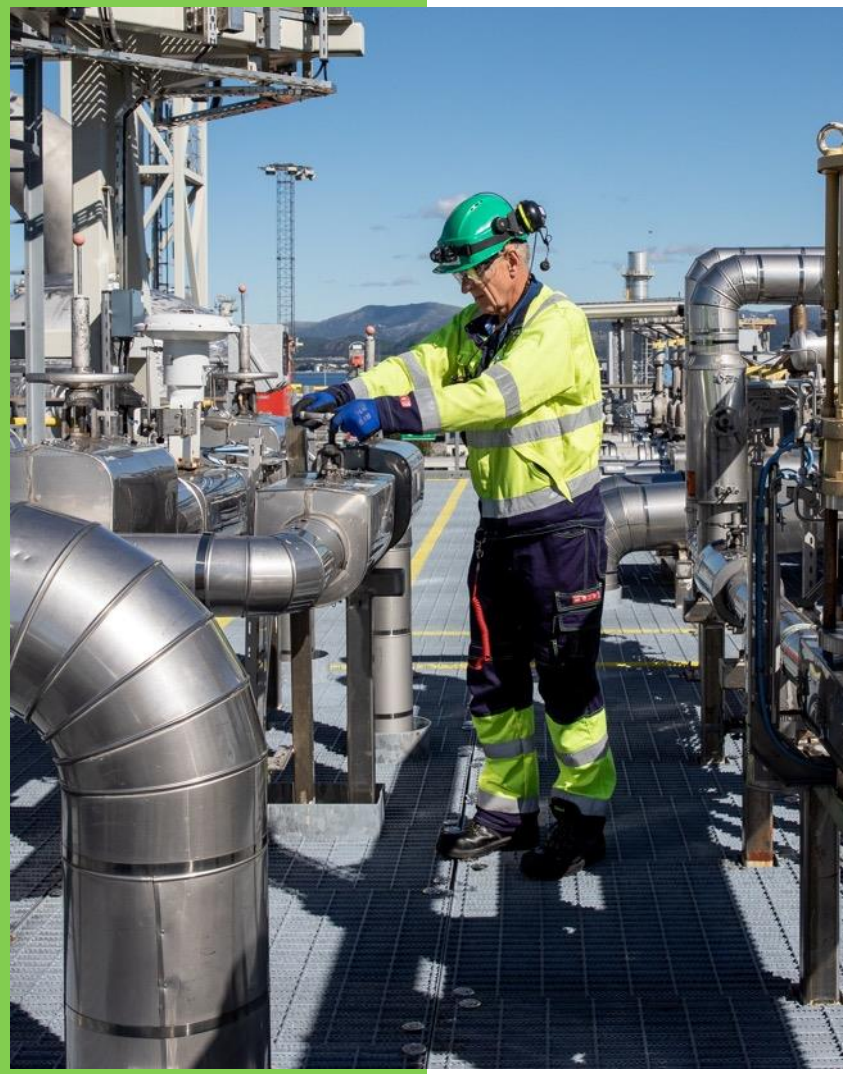
Typical pitfalls in CCS projects lead to:

- Budget overruns
- Poor reliability
- Frequent downtime and performance insufficiency

TCM helps to reduce:

- HSE
- Technical
- Financial

risks of technology deployment at scale



The core strengths

- Well-earned reputation built on public research, vendors proprietary testing and a highly qualified workforce with unique competence.
- Unique knowledge from nine years of operations
- Simulating real-world conditions
- Large-scale testing step before full-scale deployment.
- Flexible facilities with thousands of measuring points.
- Full priority to customers and 24/7 operations.
- Comprehensive non-proprietary datasets and industrial-scale baseline for benchmarking purposes.
- Relentless focus on health, safety and environment.
- Strong partnerships bringing together clients, vendors and other key stakeholders.

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Our Advisory Services Clients

OGCI
OIL AND GAS CLIMATE INITIATIVE

HEIDELBERG CEMENT

Statkraft

sse

fortum Oslo Varme

TDA

CRODUX ENERGETIKA

中英（广东）CCUS 中心
UK–China (Guangdong) CCUS Centre

RTI INTERNATIONAL

vallourec

Net Zero Teesside

WÄRTSILÄ

DAIMYO

PHILLIPS 66

HÖEGH LNG

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