

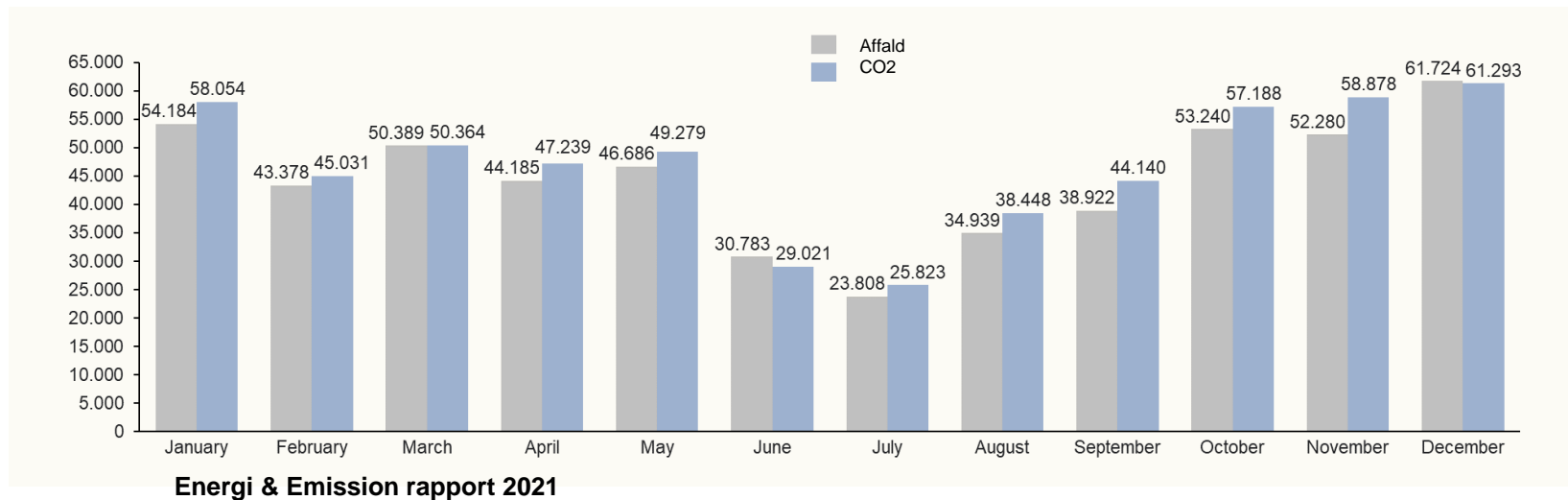
Carbon Capture Demonstration plant at ARC

Projektleder
Jannik Kappel

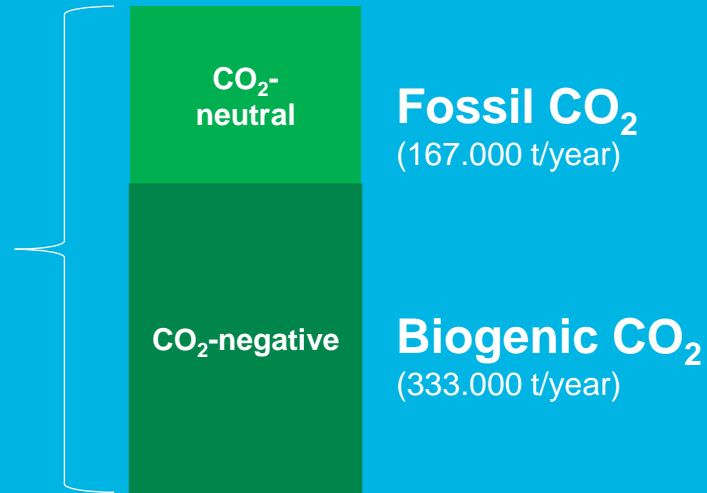
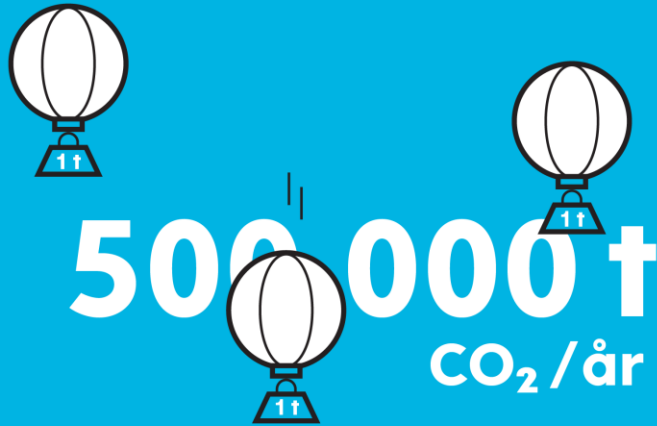
arc



Municipal solid waste and CO₂ 2021



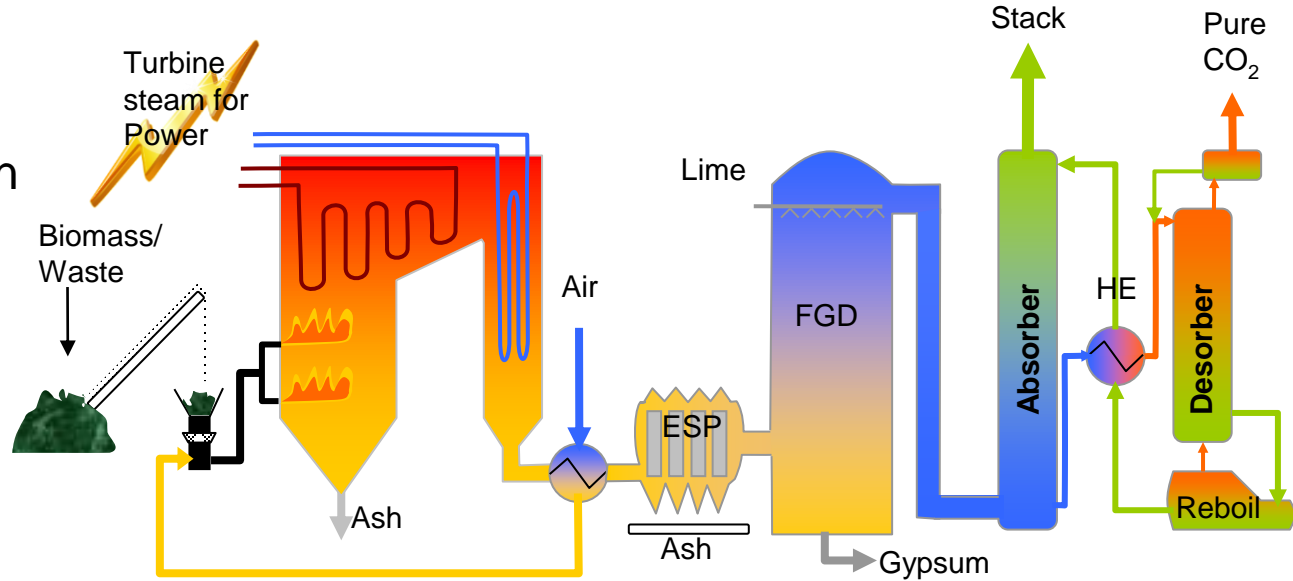
The Potential of CO₂-capture



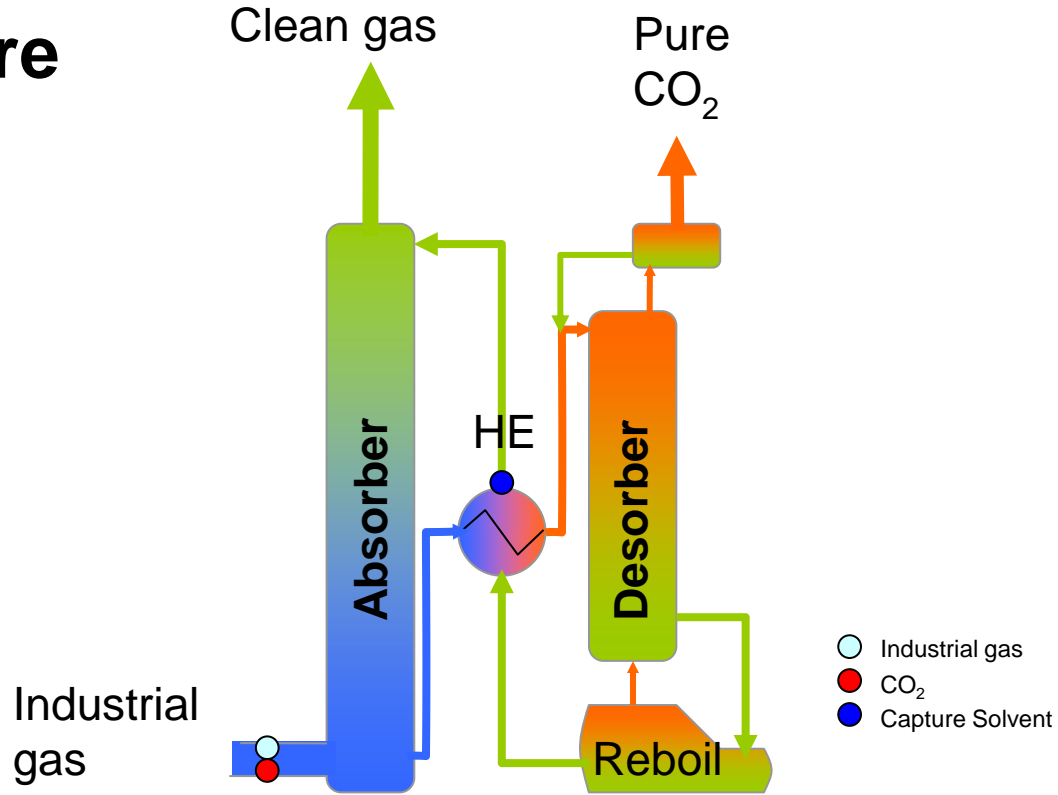
Post-combustion capture & industrial CO₂ removal

ARC

65% Biogen
34% Fossil



Solvent based CO₂ capture





Pilot plant

- Stop n' go
- Test several solvents
- Energy optimization
- Catch and release

Summer 2021

20-40 kg/h

Own money plus funding from EUDP

ARC/Pentair/DTU/Rambøll

Demonstration

- Built for stable operation
- Simulation of DH integration
- CO₂ dried, cooled and liquified. Ready for utilization

Summer 2023

160 kg/h



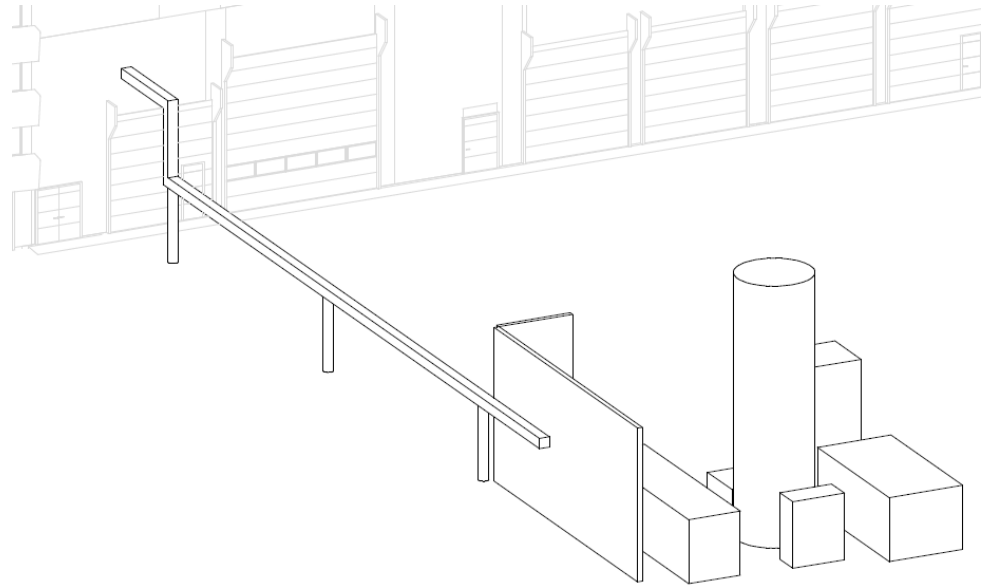
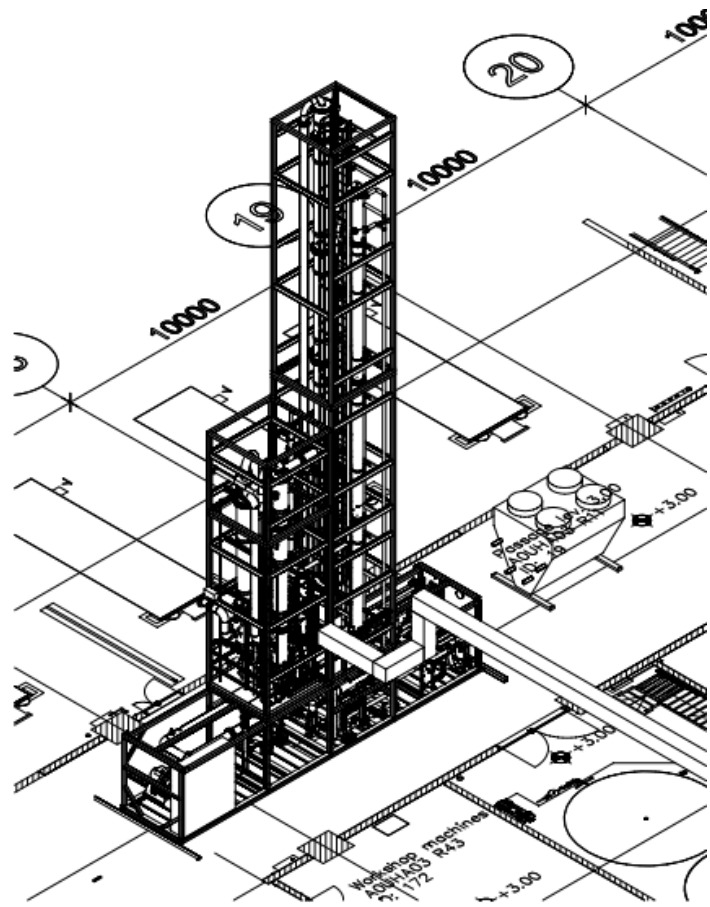
Full scale

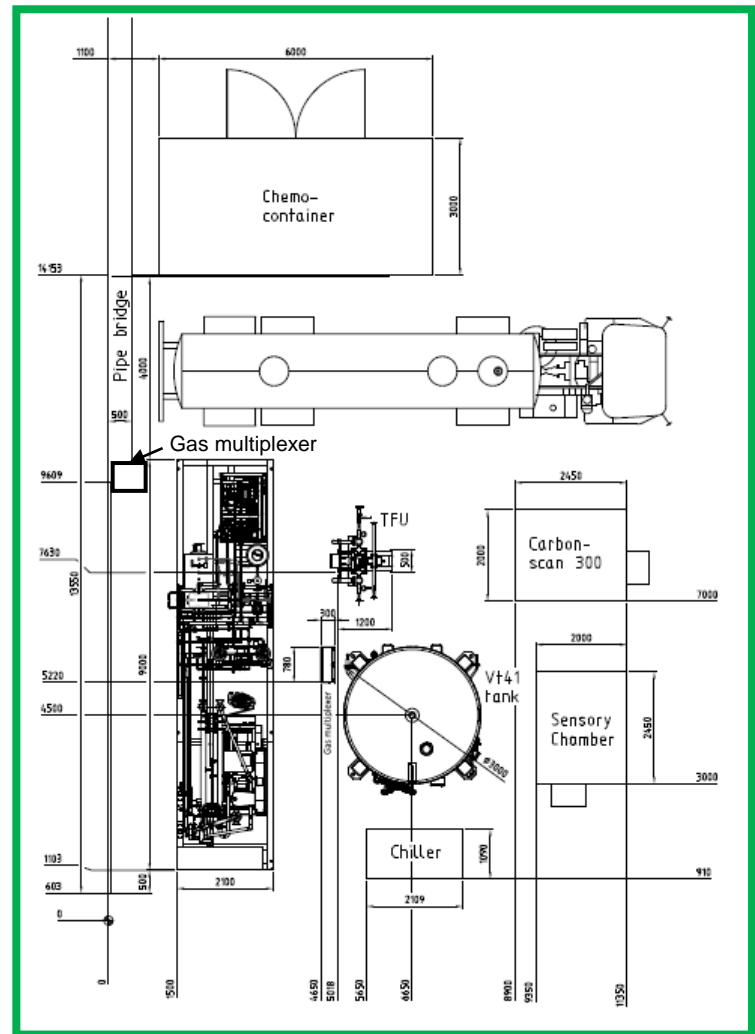
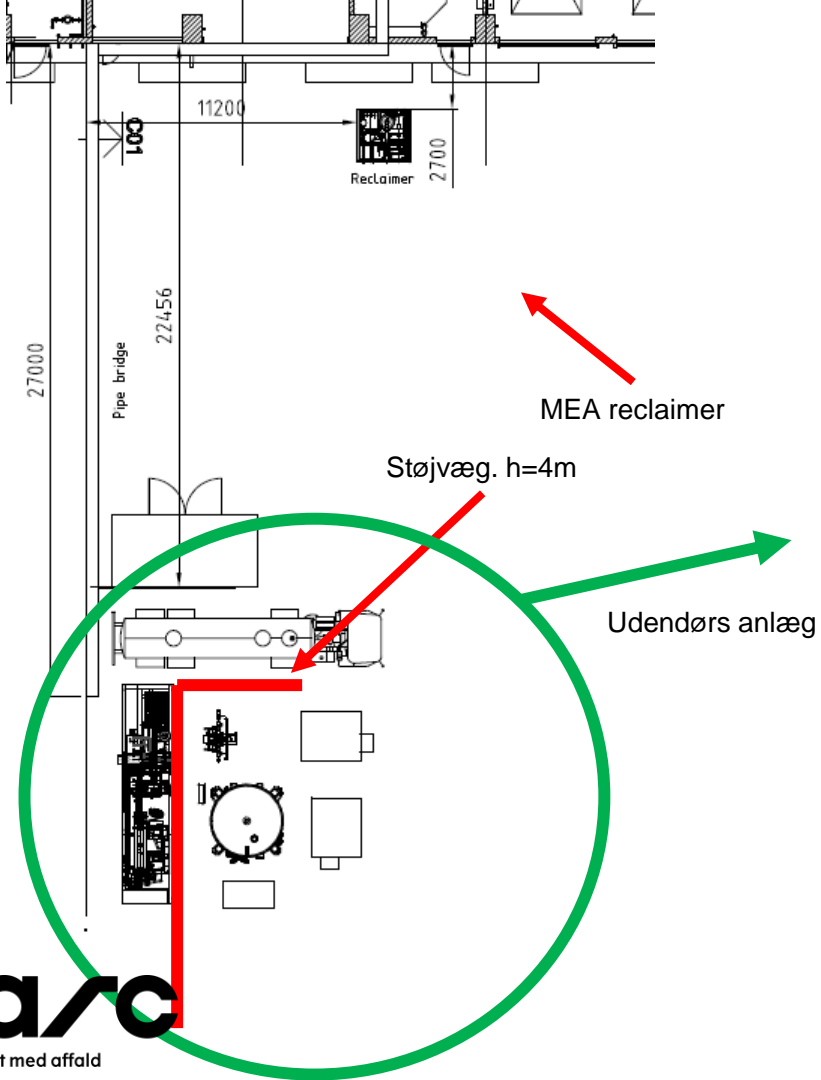
Soon..

500.000 ton/year

Funding to be found..

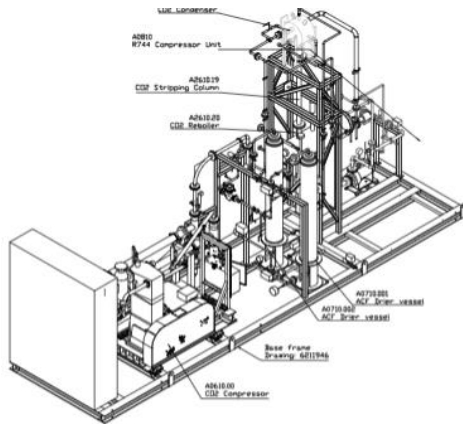
ARC/CMP/??





Liquifaction

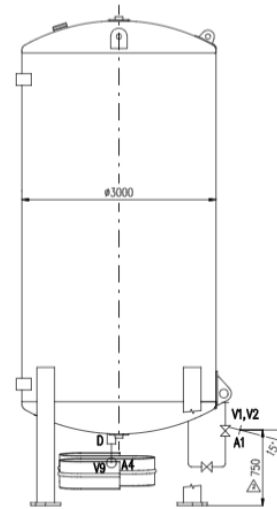
Liquifaction unit



Carboscan 300

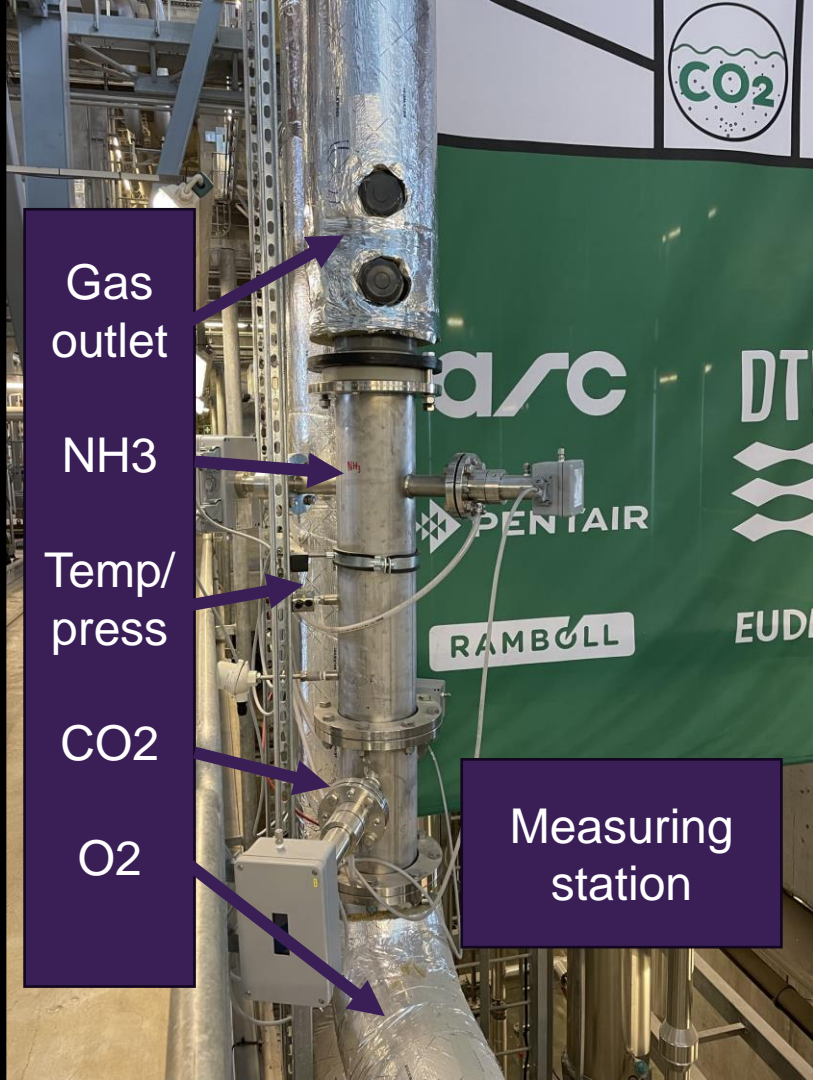


CHART tank
VT41 22 bar



Picked up by truck





Carboscan and sensory chamber



Campaigns

MEA Base case

- Using existing abs. Heat pumps
- District Heating (DH) simulation
- Different cooling configurations

CESAR

- Lowest possible specific energy demand
- Solvent stability
- Emissions

MEA Base case

- Warm flue gas, enhanced DH production
- DH simulation
- More cooling configurations

Autumn 2023

160 kg/h

Winter 2023

160 kg/h

Spring 2023

160 kg/h

CO₂ is captured, compressed, liquified and put in the tank

4 Præstationsmålinger



Continuous emission Measurements

- Continuous Measurements
- Lasergas + zirkonium stick:
 - $\text{CO}_2 + \text{NH}_3 + \text{O}_2$ (temp + pressure)

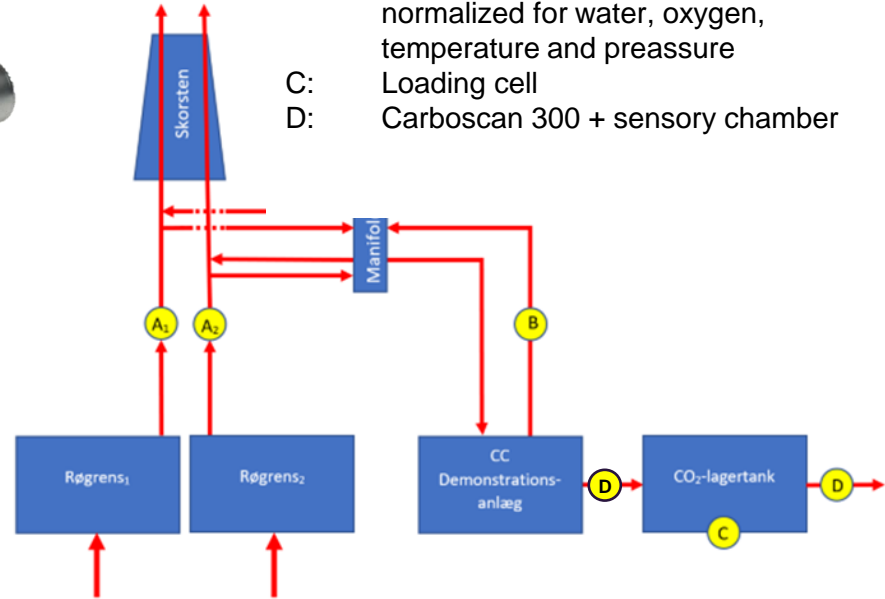


- Gas sampling (live nitrosamine while sampling)

Aminer	Nitroso-mix US EPA
MEA (monoethanol amine)	NDMA
DEA (diethanol amine)	NDELA
TEA (triethanol amine)	NPIP
Piperazine	NDBA
AMP	NMEA
Nitrosopiperazin	NMOR
di-nitrosopiperazin	NDPA
Alkylamines	NPYR
Methylamine	Nitroso-HeGly
dimethylamine	Total nitrosamine (TONO)
ethylamine	Aldehyder og ketoner
diethylamine	Formaldehyd
Amider	Acetaldehyd
Formamide	Acetone
Acetamide	

Measuring points

- A₁+A₂) Existing station
- B) New equipment O₂, NH₃ + CO₂ normalized for water, oxygen, temperature and pressure
- C: Loading cell
- D: Carboscan 300 + sensory chamber



CCDP konfiguration

Designed for 90-95% CO₂-capture, can capture 160kg CO₂/h.

Automatic control via temp, pressure, flow and dew point measurements.

Approximately 30 minutes circulation time for solvent molecule.

The absorber has two intercoolers. One in the middle of the absorber, and one that can be shifted between top and bottom. This gives five configurations:

Config.	1	2	3	4	5
TOP IC			x	x	
MID IC	x			x	x
BOTTOM IC		x			x

Possibility of cold split, where a part of the loaded CO₂ solvent is lead directly to the top of the stripper rather than through the central heat exchanger.

Heat stable salts and other impurities are removed from the solvent in a reclaimer.



Results from pilot-project

September 2021 –
April 2022



Solvent analyse pilot

- Installation of filters
- Operating conditions are reflected in solvent stability.
- Limited degradation of solvent, during stable operation.

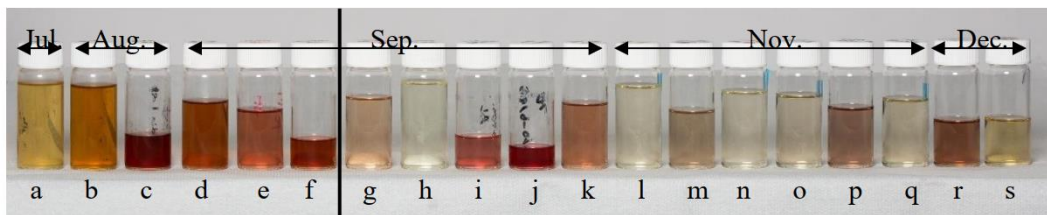
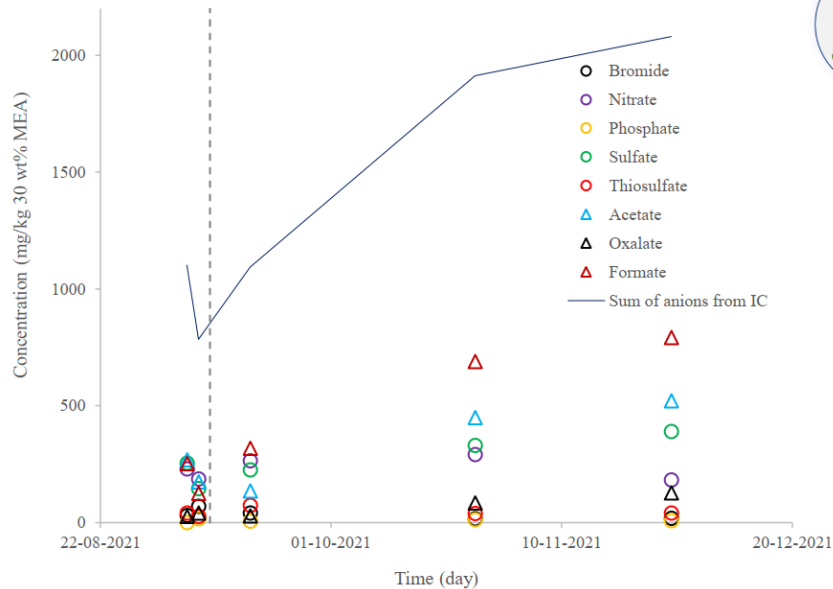


Figure 9. Lean 30 wt% MEA samples taken from July to December 2021. Vertical black line indicates installation of solvent filter.

Scientific publications

- [Pilot-scale Post Combustion CO₂ Capture at Amager Ressourcecenter \(ARC\) Denmark: Challenges and Experiences](#)
- [Emission measurements and degradation of solvent from waste incineration plant Amager Resource Centre \(ARC\), CO₂ capture pilot campaign](#)
- [A Call for Standards in the CO₂ Value Chain](#)
- Base-case results from pilot-scale CO₂ capture testing using 30 wt% MEA at a Waste-to-Energy facility
- Pilot-scale CO₂ capture demonstration of split-flow configuration using 30 wt% MEA at a Waste-to-Energy facility

List is updated here:

- [a-r-c.dk/co2](#)
- [https://a-r-c.dk/english/demonstration-plant-for-carbon-capture-2023/](#)