DRIVE

Newsletter No 10
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DEEP REMOVAL OF CO_2 & INNOVATIVE ELECTRIFICATION CONCEPTS

Welcome to the DRIVE project!

DRIVE envisions a future where industries achieve carbon neutrality or negativity, paving the way for a sustainable environment by 2050 through innovative technological solutions and comprehensive guidance on CO_2 reduction.
In this issue of the newsletter, we present insights in the unique long-term test program at the CO_2 capture-pilot plant at Niederaussem. Here, DRIVE has boldly broken new ground in CO_2 capture technology by finalizing a 6-month 24/7 test campaign with Deep Removal.

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ABOUT

In the DRIVE project, for the first time a holistic evaluation of Deep Removal technologies is carried out, comprising technical, economic, and environmental analysis and validation of process models in long-time tests at real industrial conditions.

Before the DRIVE project, tests on Deep Removal were limited to a few hours of operation at research facilities and focused only on energy-related aspects and the associated costs. Significant technical and economic implications of highest capture rates, like possible changes in emission behaviour and emission mitigation performance, solvent degradation, solvent management, and CO_2 purity were not considered. DRIVE has closed this knowledge gap based on more than 7000 operating hours at Niederaussem with capture rates > 98%.

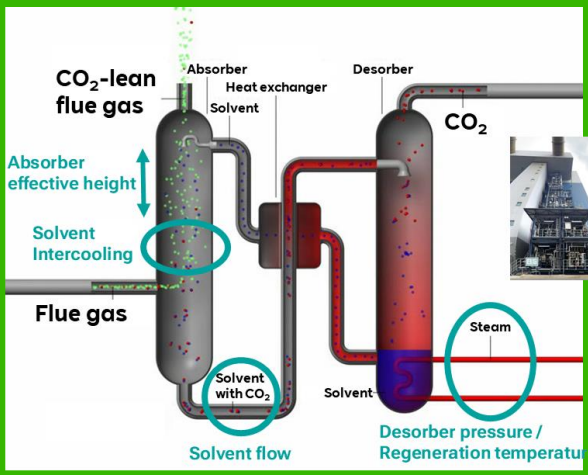
Energy demand: The highest capture rate that was achieved was 99.95%, which means a CO_2 content in depleted flue gas of only 91 ppm, but at 50% higher energy demand for the CESAR1 solvent regeneration compared to 90% CO_2 capture. With the solvent used, the energy demand strongly increases for capture rates >99%.

Emission control: Effective emission control has been demonstrated for the CESAR1 solvent, regardless of the capture rate.

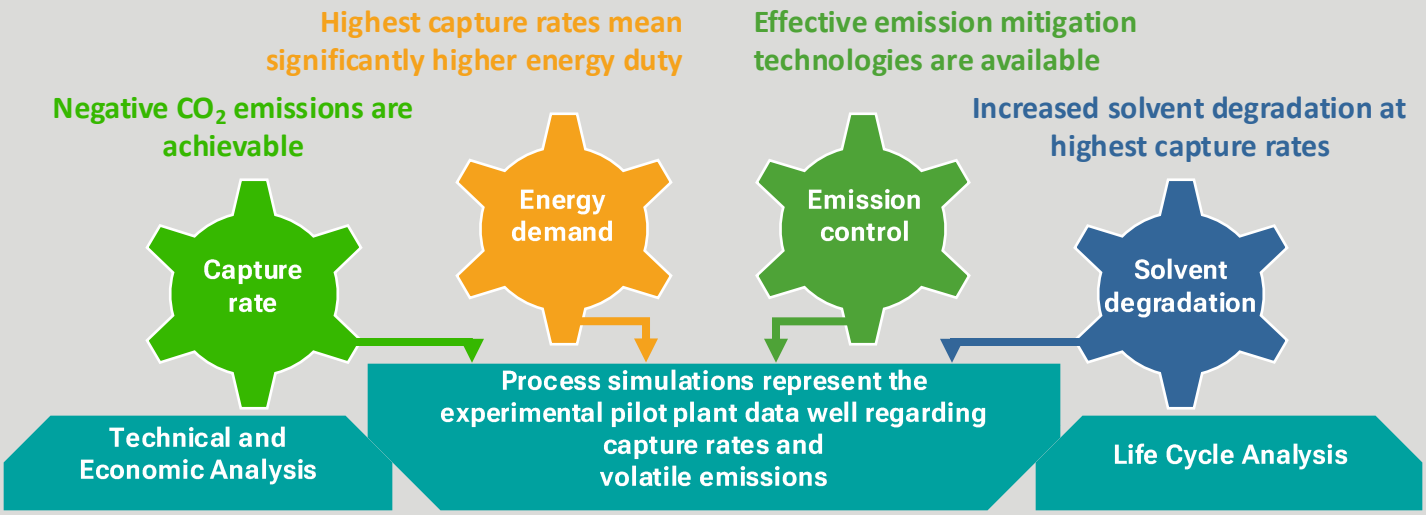
CESAR1 solvent degradation: An increase of the degradation rate by up to 100% can occur at highest capture rates depending on the operating parameters.

How was Deep Removal realised at the capture pilot plant at Niederaussem?

No additional components have been installed to achieve highest capture rates. To increase the CO_2 capture rate an increase of the solvent flow of up to 100%, a raise of the steam temperature from 120 to 130°C for the desorption from the solvent and the use of the full height of the absorber can be applied. It was shown that the location of solvent cooling in the absorber has just a minor effect. In addition, the amine content of the solvent is an important parameter, as a at lower concentrations the capture capacity of the solvents decreases .



RESULTS OF THE TEST CAMPAIGN AT NIEDERAUSSEM AND THEIR USE



Deep removal is feasible but means an environmental and economic trade-off in terms of high CO_2 capture rate, energy demand, solvent consumption and cost.

The results of the test campaigns at Niederaussem are used to optimize and validate process simulations which are the basis for the ongoing technical and economic analyses and the Life Cycle Analysis for Deep Removal with amine-based CO_2 capture and thermal regeneration of the solvent. In addition, the results are used to analyse cause and effect relationships between Deep Removal and solvent degradation. At this time, everything points to the fact that the technology developed in DRIVE is more cost-effective than other Direct Air Capture technologies.

NEXT: DRIVE AT GHGT-18

The results will also be shared with the international CCUS community at GHGT-18 in Perth, Australia. Peter Moser from RWE will deliver an oral presentation in Session 4A, “Absorption: Pilot Plants – 1”, and is currently preparing an accompanying paper based on the DRIVE results for the conference.

OUR PARTNERS

NEW DRIVE VIDEO
DISCOVER ZEUS

DRIVE has released a new video introducing ZEUS, an innovative electrochemical concept for CO_2 capture and solvent regeneration.

While conventional capture processes use heat to regenerate the solvent, ZEUS investigates an alternative route based on electricity, electrochemical cells and specialised membranes.

ZEUS contributes to DRIVE's ambition to electrify key stages of CO_2 capture and explore more energy-efficient alternatives to conventional thermal solvent regeneration. By reducing dependence on high-temperature heat, the concept could improve the flexibility of capture systems and facilitate their integration with increasingly low-carbon and renewable electricity grids. This is particularly relevant for industrial sites where access to suitable heat sources is limited or where electrification can support wider decarbonisation strategies. Through its development and testing, ZEUS will provide valuable evidence on the technical performance, energy requirements and future scalability of electrochemical CO_2 capture solutions.

WATCH THE VIDEO

Scan to watch the ZEUS video

DRIVE

← ACTIVITIES

Testing at Niederaussem

2024

Three two-month testing campaigns have been carried out with systematic variation of the operating parameters (process temperatures, solvent flow) and process configurations (variation of the height of the solvent feed into the absorber and of the locations of solvent cooling in the process) to investigate the deep removal regime at highest CO_2 capture rates. Also, the effect of the amine concentration in the solvent was analysed. The received performance and process data have been used to optimize computer models for Deep Removal.

2025

Based on the results from the analysis of the previous campaigns and the identified optimal process setting the fourth campaign focused two months on the emissions from the capture plant during operation at highest capture rates. From the wide range of different emission mitigation configurations that have been tested at Niederaussem the optimal was selected for the long-term test on solvent degradation with optimal parameter setting.

2026

After six months operation 24/7 with capture rates between 98.5 to 99.5% this unique test campaign on monitoring of the changes of the concentration of degradation products and contaminants in the solvent inventory ended in April 2026. Such a long testing is needed as generally degradation processes of CESAR1 are slow and need sufficient time to be appraisable. The analysis of the degradation behaviour is ongoing with the objective to minimize the solvent loss at Deep Removal conditions.

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