



## CLEAN - Large-Scale CO<sub>2</sub> Storage for Enhanced Gas Recovery in a depleted German Gasfield

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The joint research project CLEAN is a German research and development (R&D) alliance of 16 partners from science and industry. The main theme of this pilot project is to enhance gas recovery (EGR) by injection of CO<sub>2</sub> into an almost depleted natural gas field. The research focus is on the assessment of all processes associated with the injection. At the same time, the CO<sub>2</sub> long-term storage safety of Europe's second largest onshore gas field is analysed and evaluated. The CLEAN study site is located in Saxony-Anhalt (Germany) and is part of the natural gas field Altmark owned by GDF SUEZ E&P Deutschland GmbH. Here, the test field Altensalzwedel, which covers an area of 14 km<sup>2</sup>, represents a structurally and hydraulically enclosed substructure. The structure is characterized in detail by 12 existing deep wells.

Fluviatile silt- and sandstones from Upper Rotliegend built the reservoir in around 3,500 metres depth. The caprock above the reservoir consists of massive Zechstein formations with significant deposits of evaporites. These salt layers with average thickness of several hundred metres represent a natural seal of the reservoir.

At present the reservoir temperature is about 125 °C and reservoir pressures decreased from initially 425 bar to pressures between 30 and 50 bar, due to the gas production. For the substructure of Altensalzwedel it is assessed that the natural gas reservoir is depleted by 90 %.

In the course of the pilot project CLEAN, less than 100,000 tonnes of CO<sub>2</sub> will be injected for the EGR measures. An enhanced R&D program is performed to control existing wells, to advance the monitoring, and to improve the process modelling as a solid basis for a decent risk assessment, which is prerequisite for a future large-scale EGR project associated with the injection and storage of CO<sub>2</sub>. Within this field, some fundamental scientific, ecological and economical questions will be addressed and answered: Which technology is the most efficient and safe one to store CO<sub>2</sub> at lowermost costs into the reservoir? How can the safety of wells be guaranteed especially of 30-year-old wells? How to abandon wells safely in such a setting? Is the Altmark field suitable for a long-term safe CO<sub>2</sub> storage? Which processes occur in the underground? How can the process parameters during EGR be chosen to obtain a maximum exploitation and recovery ratio of the reservoir? Which are appropriate injection regimes without risk for the environment and the residents? How to assess, model and remedy possible risks. How can we monitor a safe storage of CO<sub>2</sub>? How can we realize an objective and transparent information of the public on „Enhanced Gas Recovery“ and how to enhance public acceptance of this new technology?

Starting from the central questions mentioned above, which are a prerequisite for a safe storage of CO<sub>2</sub> while enhancing natural gas exploitation, the R&D activities are organized in five thematic networks:

1. Technikum for CO<sub>2</sub> Injection (EGR-PS)
2. Well Bore Integrity (CO<sub>2</sub>SAFE)
3. Evaluation of Geo-Processes (GEO-PROCESSES)
4. Environmental and Process Monitoring (CO<sub>2</sub>-MONITOR)
5. Public Acceptance (CO<sub>2</sub>-AKZEPTOR)

Acknowledgement: CLEAN is part of the geoscientific R&D program “GEOTECHNOLOGIEN” funded by the German Federal Ministry of Education and Research (BMBF).