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# Performance Study of Underground Hydrogen Storage in a Saline Aquifer for a Prospective Hydrogen Pore Storage Site in Northeast Germany

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To address seasonal fluctuations in supply and demand for renewable energy, hydrogen ($H_2$) can be produced using excess electricity and temporarily stored in geological formations [1]. Due to their large volumes, widespread occurrence and distribution in sedimentary basins, saline aquifers have significant potential for underground hydrogen storage (UHS). However, large-scale UHS of pure $H_2$ in the porous subsurface has not been demonstrated yet. The Helmholtz research project GEOZeit focuses on preparatory research for the construction of a hydrogen pore storage demonstrator in a saline aquifer.

The precursor research contains numerical reservoir simulations with the reservoir software CMG GEM. It targets to assess the capability of UHS operations at the Triassic Stuttgart anticlinal formation near Ketzin, Germany. This formation is lithologically heterogeneous, consisting of mudstone and siltstone, and the reservoir sandstone varies in reservoir properties and thicknesses [2]. In the recent past, a large-scale $CO_2$ storage research project was successfully realised at the flank of the anticline [3]. Now, the top of this structure is explored to serve as a structural trap for storing $H_2$. However, seismic surveys revealed the presence of a fault zone at the top [2,4], indicating possible migration pathways for the gas. To study fluid flow across the fault system, different fault leakage scenarios are carried out by adjusting fault transmissibility to represent sealing or leaky faults.
To access areas situated at an increased distance from the fault zone, we are exploring the option of horizontal directionally drilled (HDD) wells to bypass the fault zone. Although vertical drilling is acknowledged as a cost-effective method, HDD excels in exploring a wider expanse of the reservoir. Given that the performance of a storage operation is strongly dependent on the well location, orientation and integrity, the comparative gas injection and withdrawal performance of a vertical versus a horizontal well layout will be presented.

For all evaluated scenarios, crucial metrics are applied to assess the quality and effectiveness of the storage operation, such as gas purity, sweep efficiency, and cyclic efficiency. The findings from the numerical studies on UHS, encompassing both general considerations and site-specific analyses at the Ketzin site, will play a crucial role in preparing and developing a prospective hydrogen demonstrator and evaluating its feasibility.

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## Country

Germany

## References

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