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GPSFLOW: A Novel Simulator for Modelling Underground Hydrogen and Gas Mixture Storage in Rough Reservoir

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Underground hydrogen storage can store grid-scale energy for balancing both short-term and long-term inter-seasonal supply and demand. However, there is no numerical simulator which is dedicated to the design and optimisation of such energy storage technology at grid scale. A novel multi-phase simulator, GPSFLOW (**G**eneral **P**urpose **S**ubsurface **Flow** Simulator), has been developed for modelling reservoir-scale hydrogen and gas mixture (e.g., H2-CO2-CH4-N2) storage in deep saline aquifers and depleted gas fields. The simulator is capable of modelling multiple gas mixture storage over a range of temperatures from 20-200 C and pressure up to 1000 bar on multiple parallel computing platforms. The accuracy of GPSFLOW is verified by comparisons against the NIST online thermophysical database and reported lab experiments, as well as benchmarked against an existing model.
This study built on our newly developed modelling capability and conducted scenario analysis to investigate CO2 cushion gas migration pathways and reservoir pressure in Rough according to the CO2 supply chain in the region, existing wells and historical natural gas data. Hydrogen storage analysis was built on the plausible CO2 cushion gas storage scenarios and investigate the impact of hydrogen injection/withdrawal cycle and storage location on the quality of the extracted hydrogen gas.

Participation

In-Person

References

Cai, Z., Zhang, K., & Guo, C. (2022). Development of a Novel Simulator for Modelling Underground Hydrogen and Gas Mixture Storage. International Journal of Hydrogen Energy, 47(14), 8929-8942. https://doi.org/10.1016/j.ijhydene.2021.12.224

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