

Large-scale energy storage under saline aquifers

Do saline aquifers need a large storage capacity?

However, H_2 requires a large storage capacity because of its low volumetric energy-density nature. Underground H_2 storage sites provide ample space for H_2 storage. In this work, we proposed a general workflow to select saline aquifers' optimal H_2 storage sites, considering the capacity and operational efficiency.

Why do we need a saline aquifer?

As an energy carrier, hydrogen can play a significant role in the security, affordability, and decarbonization of energy systems. Saline aquifers offer a significant opportunity for cost-effective long-term hydrogen storage due to their worldwide geographical accessibilities and high storage capacities.

Can saline aquifers be used for hydrogen storage?

Recent underground carbon dioxide storage activities in saline aquifers have also led to a wealth of transferable knowledge with regard to storage site screening and selection, which could be helpful in choosing suitable storage sites for hydrogen.

How many natural gas storage sites are there in saline aquifers?

Currently, there are 47 active natural gas storage sites in saline aquifers with a total working gas capacity of more than 111 billion m^3 world-wide [36], the obtained experiences from which can considerably help UHS projects in terms of, for example, monitoring facilities, cyclic operations, and site performance observations and predictions.

What is aquifer natural gas storage?

Aquifer natural gas storage provides knowledge which can be used for other underground energy storage technologies like CAES.

Does permeability hysteresis affect Underground hydrogen storage in saline aquifers?

Impacts of relative permeability hysteresis, wettability, and injection/withdrawal schemes on underground hydrogen storage in saline aquifers
Influence of capillary threshold pressure and injection well location on the dynamic CO_2 and H_2 storage capacity for the deep geological structure

Large-scale impact of CO_2 storage in deep saline aquifers: ... This work was funded by the Assistant Secretary for Fossil Energy, Office of Sequestration, Hydrogen, and Clean Coal Fuels, National Energy Technology Laboratory, of the U.S. Department of Energy, and by Lawrence Berkeley National Laboratory under Contract No. DE-AC02-05CH11231 ...

CO_2 storage in saline aquifers offers a realistic means of achieving globally significant reductions in

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greenhouse gas emissions at the scale of billions of tonnes per year. We review insights into the processes involved using well-documented industrial-scale projects, supported by a range of laboratory analyses, field studies, and flow simulations. The main topics we address are (a) the ...

Geological CO₂ sequestration (GCS) has been proposed as an effective approach to mitigate carbon emissions in the atmosphere. Uncertainty and sensitivity analysis of the fate of CO₂ dynamics and storage are essential aspects of large-scale reservoir simulations. This work presents a rigorous machine learning-assisted (ML) workflow for the uncertainty and ...

Zhang et al. [33] introduced an innovative carbon cycle centered on salt cavern CO₂ storage (SCCS), which is designed to absorb surplus off-peak renewable energy and provide a substantial power output during peak demand. This approach validated the short-term feasibility and stability of SCCS. In addition, various methods for utilizing CO₂ in CCUS can ...

Within the process of CO₂ injection into subsurface reservoirs, the phenomenon of pore-scale salt precipitation holds significant importance due to its potential to impact the efficiency, safety, and environmental sustainability of these operations. Pore-scale salt precipitation can potentially jeopardize the long-term integrity of CO₂ storage sites, such as clogging of reservoir pores ...

Deep saline aquifers have the largest identified storage potential, with estimated storage capacity sufficient to store emissions from large stationary sources for at least a century. This makes CCS a potentially important bridging technology in the transition to carbon-free energy sources. Injection of CO₂ into deep saline aquifers leads to ...

Compressed CO₂ energy storage in aquifers (CCESA) is new low-cost large scale energy storage technology. To further improve the energy efficiency of CCESA, we propose to combine the geothermal system with CCESA. In order to study the influence of geothermal energy on CCESA, aquifers with large vertical interval and different geothermal gradients from ...

Hydrogen energy has tremendous potential as a clean fuel in this energy transition. To build up the full-scale hydrogen energy supply chain, large-scale hydrogen storage is of vital importance. Underground hydrogen storage in saline aquifers has been perceived as an important means to achieve large-scale hydrogen storage. Therefore, we investigated ...

A review of carbon storage in saline aquifers: Mechanisms, prerequisites, and key considerations ... it separates CO₂ from the Sleipner natural gas field and injects it into a deep saline formation which locates under the North ... The large-scale subsurface storage of hydrogen is a crucial element of the hydrogen economy value chain and is an ...

CO₂ migration in saline aquifers. Part 1. Capillary trapping under slope and groundwater flow - Volume 662

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... J.-P. 2008 Evaluation of large-scale CO₂ storage on fresh-water sections of aquifers: ... R. 2009 A simple but rigorous model for calculating CO₂ storage capacity in deep saline aquifers at the basin scale. Energy Procedia ...

Assessment of CO₂ geological storage capacity of saline aquifers under the North Sea. ... while Norway can store 48 Gt from just 10 large saline aquifers. ... Comprehensive technology and economic evaluation based on the promotion of large-scale carbon capture and storage demonstration projects. 2023, Reviews in Environmental Science and ...

Large-scale energy storage is already used to meet energy demand fluctuations in electricity power grids. ... deep saline aquifer formations, unmined deep coal beds) or stabilisation ... Investigation of stability of underground salt caverns for natural gas storage under different operating conditions. The Scientific and Technological Research ...

Boxplots of modelled storage rate under the a Reference and b ... Given the rate of acceleration observed in large-scale energy ... K. et al. CO₂ storage in saline aquifers I--current state of ...

In order to deploy CCUS technology on a large scale in saline aquifers or hydrocarbon fields, a technically sound, safe, and cost-effective CO₂ injection strategy must be developed while ensuring maximum storage capacity and site integrity . Achieving this goal requires accurate characterization of the storage site and reservoir, which is a ...

For the decarbonisation of entire energy sectors and regions, large-scale storage in porous media, such as depleted gas fields and saline aquifers, is considered more promising [8]. Working Gas (WG) is the gas volume that can be injected, stored and withdrawn during the normal commercial operation in a gas storage facility.

Deep saline aquifers have the largest identified storage potential, with estimated storage capacity sufficient to store emissions from large stationary sources for at least a century. This makes CCS a potentially important bridging technology in ...

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