Underground space energy storage technology

What are underground energy storage systems?
This paper clarifies the framework of underground energy storage systems, including underground gas storage (UGS), underground oil storage (UOS), underground thermal storage (UTS) and compressed air energy storage (CAES), and the global development of underground energy storage systems in porous media is systematically reviewed.

What is deep underground energy storage?
Deep underground energy storage is the use of deep underground spaces for large-scale energy storage,which is an important way to provide a stable supply of clean energy,enable a strategic petroleum reserve,and promote the peak shaving of natural gas.

Why is it important to develop an underground energy storage system?
Therefore, it is urgent to improve the efficient utilization of renewable energy represented by wind energy and solar energy and to construct an underground energy storage system, which is an important direction for promoting the implementation of the "carbon peaking and carbon neutrality" strategy and the transition to low-carbon energy.

What is underground thermal energy storage (SHS)?
SHS can be developed at a small-scale (<10 MW) above surface technology or at a large-scale system in the subsurface. Underground Thermal Energy Storage (UTES) is a form of energy storage that provides large-scale seasonal storage of cold and heat in underground reservoirs [74, 75, 76, 77].

How has China improved the underground energy storage system in porous media?
China has gradually improved the underground energy storage system in porous media,especially underground gas storage in depleted natural gas reservoirs,and the current working gas volume of UGS projects is more than 16.4 billion m 3. Thermal energy storage in shallow aquifers is widely developed,and the technology is mature.

Can underground energy storage systems be mined?
On one hand,during construction or operation of underground energy storage systems,water inflow could be so great that mining or operation would be impossible. On the other hand,in arid regions or within the unsaturated zone,absence of both capillary water and water at hydrostatic head may prevent storage within a mined cavern.

Underground storage. We are working on efficient and feasible underground storage options for compressed air, and for hydrogen, which could provide excellent stability to the energy network. In the case of hydrogen, underground storage can also ensure we have enough supply for domestic use and export. Distributed energy

These deal with various aspects of the topic, including the use of underground space for storing energy [1], [5], [43], technology of energy storage in the form of hydrogen [2], [6], [44], technical aspects [9], [25], [45], [46], [47], evaluation of the potential of underground hydrogen storage worldwide [48] and in individual European ...

Devoting all the salt cavern storage in France to this use would store around 60 GWh.As for compressed air (the term used is Compressed Air Energy Storage, or CAES), the available storage space ranges from 40 to 130 GWh. When released, the compressed air would be used to drive a turbine generator.

Underground space, a significant and abundant land resource with broad application prospects (Xia et al., 2022), can provide a novel solution for the planning and operation of energy storage systems. First, underground space can provide a stable and ample operation space for the energy storage system, protecting the devices from the impacts of ...

HEATSTORE - Underground Thermal Energy Storage ... 1 GEUS, 2 PlanEnergi, 3 IF Technology, 4 Storengy, 5 BRGM, 6 GZB, 7 UniGe, 8 TNO Geological Survey of Denmark and Greenland, GEUS, C.F. Møllers Allé 8, Bygn. 1110 DK-8000 Aarhus C ... One of the disadvantages to keep in mind is that the system is space demanding. The storage requires ...

As an important support technology of renewables, energy storage system is of great significance in improving the resilience of the power system. In this paper, a resilience enhancement method for power systems ...

Deep Underground Science and Engineering publishes cutting-edge, open access research to connect interdisciplinary experts around the world. The journal"s scope includes exploration and extraction of geo-resources, energy extraction and storage, underground infrastructures, geo-environments, and waste disposal, research and testing space in deep underground, and ...

Global energy demand is set to grow by more than a quarter to 2040 and the share of generation from renewables will rise from 25% today to around 40% [1].This is expected to be achieved by promoting the accelerated development of clean and low carbon renewable energy sources and improving energy efficiency, as it is stated in the recent Directive (EU) ...

Low-carbon energy transitions taking place worldwide are primarily driven by the integration of renewable energy sources such as wind and solar power. These variable renewable energy (VRE) sources require energy storage options to match energy demand reliably at different time scales. This article suggests using a gravitational-based energy storage method ...

Driven by urbanization growth, in recent years, the relationships among energy systems and underground space are becoming more and more intense for many reasons: the severe competition in the land use, the

security of energy commodities management, the need of huge infrastructures for mass and energy transportation (e.g. pipelines), the safety ...

Underground hydrogen storage is a long-duration energy storage option for a low-carbon economy. Although research into the technical feasibility of underground hydrogen storage is ongoing, existing underground gas storage (UGS) facilities are appealing candidates for the technology because of their ability to store and deliver natural gas.

The proposed technology, called Underground Gravity Energy Storage (UGES), can discharge electricity by lowering large volumes of sand into an underground mine through the mine shaft.

The recent development of underground space technology makes underground space a potential and feasible solution to climate change, energy shortages, the growing population, and the demands on urban space. Advances in material science, information technology, and computer science incorporating traditional geotechnical engineering have been extensively applied to ...

provide a stable and ample operation space for the energy storage system, protecting the devices from the impacts of extreme weather like rainstorms, typhoons, and blizzards (Zhang et al., 2021).

longer term and even seasonal thermal energy storage. When large volumes are needed for thermal storage, underground thermal energy storage systems are most commonly used. It has become one of the most frequently used storage technol-ogies in North America and Europe. UTES systems started to be developed in the 1970s for the purpose of energy

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Alternatives are natural gas storage and compressed hydrogen energy storage (CHES). For single energy storage systems of 100 GWh or more, only these two chemical energy storage-based techniques presently have technological capability (Fig. 1) [4], [5], [6]. Due to the harm fossil fuel usage has done to the environment, the demand for clean and ...

Unlike a single-source surface power station, construction of the groundwater network enables the integrated utilization of groundwater and thermal energy, allowing further exploration to integrate technology for underground energy storage, geothermal and hydraulic power, and heating (Renz et al., 2009, Raymond and Therrien, 2008, Lund et al ...

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trenchless technology.. The journal is committed to publishing ...

Hydrogen storage underground has emerged as a prospect for terawatt-scale energy storage and can benefit from a range of geophysical similarities to both subsurface CO ...

This review paper provides a critical examination of underground hydrogen storage (UHS) as a viable solution for large-scale energy storage, surpassing 10 GWh capacities, and contrasts it with aboveground methods. It exploes into the challenges posed by hydrogen injection, such as the potential for hydrogen loss and alterations in the petrophysical and ...

This Special Issue is dedicated to promoting the exchange and sharing of research on tunnel construction and underground space technology. The collection of papers brings the latest research results from scholars and practitioners in the field, including standard construction systems, underground engineering technology, information collection and ...

Underground hydrogen storage (UHS) will be an essential part of the energy transition. Over 45 pilot projects are underway to reduce the technical and regulatory risks of UHS, but negative ...