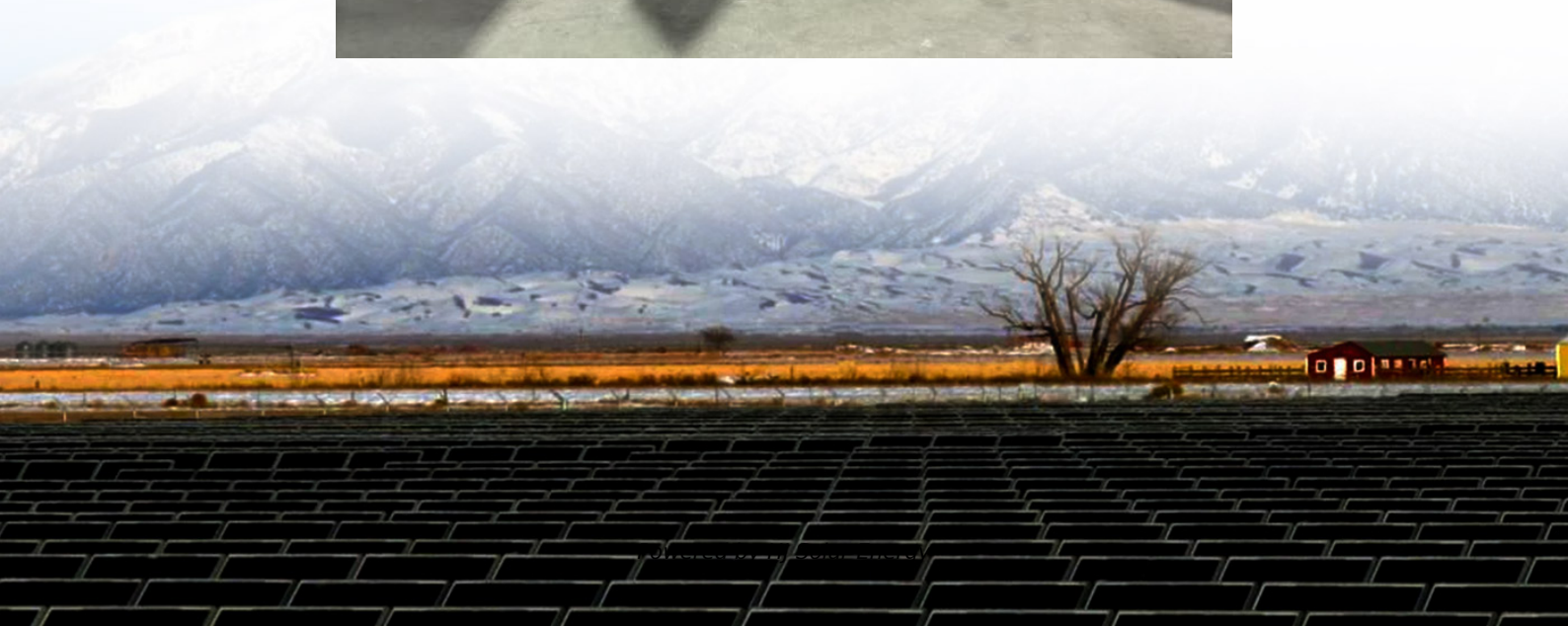


Development direction of underground energy storage





Overview

Abstract Large-Scale Underground Energy Storage (LUES) plays a critical role in ensuring the safety of large power grids, facilitating the integration of renewable energy sources, and enhancing overall system performance.

Abstract Large-Scale Underground Energy Storage (LUES) plays a critical role in ensuring the safety of large power grids, facilitating the integration of renewable energy sources, and enhancing overall system performance.

Based on the types of underground space storage facilities, combined with the construction of global underground space storage facilities and related research experiments, this paper deeply compares and analyzes the development status of oil and gas storage in the world and China, so as to put.

Subsequently, it proposes a low-cost underground pumped storage scheme based on hard rock boring machine (TBM) excavation. Further, it expounds the development status of three different types of underground pumped storage, namely, underground pumped storage with artificial excavation of underground.

China, which already boasts the world's largest energy-storage capacity, is set to nearly double that level by 2027, with an anticipated investment of 250 billion yuan (US\$35 billion), according to Beijing's latest action plan. As outlined in the action plan, China's "new-energy storage system". 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.

How deep is the underground space for energy storage?

The underground space for energy storage mainly includes porous or



fractured porous media (e.g., depleted oil and gas reservoirs, aquifers) and caverns (e.g., salt caverns, rock caves, abandoned mines or pits) (Jannel and Torquet, 2021) (Fig. 3). The depth can range from several hundred meters to several kilometers (Kabuth et al., 2017).

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.

Is underground energy storage a solution for low-carbon energy transformation?

Improving the energy storage system is the key step and global solution for low-carbon energy transformation. Compared with above-surface energy storage, underground energy storage in geological spaces, especially in porous media, is significant and accounts for the largest proportion.

What is a systematic underground energy storage engineering?

The systematic underground energy storage engineering requires integrated geological formation–wellbore–ground monitoring to track the migration of fluid, pore pressure, temperature, formation displacement, chemical variation in shallow groundwater, etc. (Dethlefsen et al., 2013).

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 m³. Thermal energy storage in shallow aquifers is widely developed, and the technology is mature.



Development direction of underground energy storage



Development status of underground space energy storage at ...

Based on the types of underground space storage facilities, combined with the construction of global underground space storage facilities and related research experiments, this paper ...

Advance in deep underground energy storage

Articles Current Issue , Archive , Adv Search ,
Advance in deep underground energy storage
YANG Chunhe,WANG Tongtao (State Key
Laboratory of Geomechanics and Geotechnical ...



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Underground Gas Storage in China

These four cornerstones could serve as a useful reference for gas storage operators and regulators in China in developing and implementing a world class underground gas

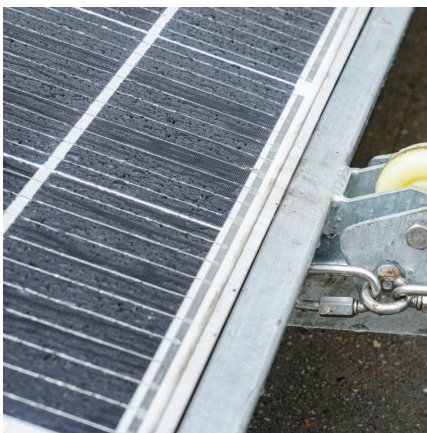


storage ...



[The most comprehensive analysis of underground...](#)

This article will analyze underground thermal energy storage from aspects such as its characteristics, usage scenarios, energy distribution, operating ...



An overview of underground energy storage in porous media and

Then, the current state of art of underground energy storage engineering in porous media in China, including the construction status, policy environment, technical ...



[Handbook of Underground Gas Storages and ...](#)

This book summarizes achievements and technology of China's underground gas storage in the past 20 years based on years of experience and technology ...





(PDF) The development, frontier and prospect of Large-Scale Underground

Large-Scale Underground Energy Storage (LUES) plays a critical role in ensuring the safety of large power grids, facilitating the integration of renewable energy ...



(PDF) The development, frontier and prospect of Large-Scale ...

Future research trends in LUES include the integration of intelligent and renewable energy systems, the development of hybrid energy storage technologies, ...

Overview of the development of underground pumped hydro storage

This paper introduces the key technologies and challenges associated with underground pumped storage, including the current situation of underground engineering construction and operation, ...



Natural gas market and underground gas storage development in ...

The purpose of this study is to investigate the peak-shaving demand of the NGM in China, as well as to estimate the status and trend of underground gas storage (UGS) ...



Development direction of underground energy storage

The development of underground space energy storage is a key issue to achieve carbon neutrality and upgrade China's energy structure; (2) Global underground space energy storage ...



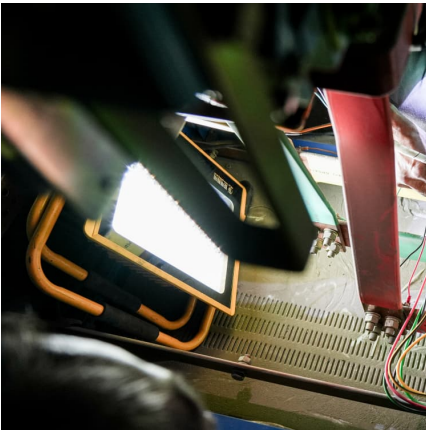
A novel numerical analysis method for the stability of sediment ...

Utilizing the void space of sediment within salt caverns for energy storage is a significant development direction for large-scale energy storage in the future. However, the existing ...

Integration of large-scale underground energy storage ...

Large-scale underground energy storage technology uses underground spaces for renewable energy storage, conversion and usage. It forms the technological basis of ...





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Large-scale storage of natural gas, compressed air, petroleum and hydrogen by deep salt caverns is one of the key development directions of deep underground energy storage in China.

Underground hydrogen storage: A review of technological ...

Hydrogen energy (HE) is a promising solution for large-scale energy storage, particularly for integrating intermittent renewable energy sources into the global energy system. A key enabler ...



Underground hydrogen storage: A review of technological ...

Hydrogen energy (HE) is a promising solution for large-scale energy storage, particularly for integrating intermittent renewable energy sources into the global energy system. ...



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Much of the technology for geologic energy storage is still undergoing research and development (Crotono and others, 2017; Matos and others, 2019), although several industrial-sized ...



Opportunities and challenges of large-scale salt cavern hydrogen

Underground hydrogen storage (UHS) offers significant advantages, including large-scale capacity, long cycle times, and the ability to store energy across seasons, making it ...



Insight into Underground Hydrogen Storage in Aquifers: Current ...

Aquifers are considered one of the most eco-friendly forms of underground hydrogen storage due to their widespread availability, natural porosity, minimal requirement for ...



[Underground hydrogen storage: A comprehensive review](#)

Underground storage is a proven way to store a huge amount of energy (electricity) after converting it into hydrogen as it has higher energy content per unit mass than ...





Theories, technologies, and prospects for the utilization of deep

In this process, the utilization of low-carbon, clean energy typified by natural gas, wind power, solar energy, and hydrogen energy needs to be coupled with deep underground storage space ...



Fracture identification and characteristics of carbonate ...

However, the complex surface and underground conditions, as well as the constraints of reservoir fracture development, have posed difficulties for the reconstruction of underground ...

[Overview of Salt Cavern Oil Storage Development ...](#)

Salt cavern storage, characterized by its safety, stability, large scale, economic viability, and efficiency, stands out as a cost-effective and ...



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(1) The utilization of underground space for energy storage is an important direction of future energy storage maintenance. This is an effective way to peak regulation of natural gas, ...



Advances in Geo-Energy Research

Keywords: Underground storage compressed air energy storage salt cavern construction wellbore integrity cavern tightness operation experience
Cited as: China: Development and outlook. ...



Development status and prospect of salt cavern energy storage

The rapid development of energy storage technology has provided tremendous support for the energy transition in countries worldwide. Salt cavern energy storage, as a form ...

Advances in Geo-Energy Research

by the advancement of underground space construction and the growing demand for renewable energy storage. Under-ground storage spaces are particularly suitable for constructing large ...



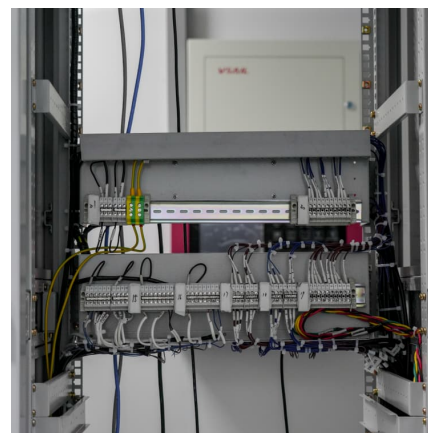


New framework of low-carbon city development of China: Underground

Cities play a vital role in social development, which contribute to more than 70% of global carbon emission. Low-carbon city construction and decarbonization of the energy ...

(PDF) Integration of large-scale underground energy storage

Utilizing energy storage in depleted oil and gas reservoirs can improve productivity while reducing power costs and is one of the best ways to achieve synergistic ...



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