

What is the future of underground energy storage?

2023: Research directions in UHS and other underground energy storage technologies further expanded, emphasizing enhancing storage efficiency, ensuring safety, and maximizing the renewability of stored energy.

Can underground reservoirs be used to store energy?

By utilizing underground reservoirs (e.g., abandoned mines) to store energy, they offer a more flexible deployment in regions closer to energy demand centers, providing a cost-effective and environmentally friendly energy storage solution [223,224].

Is underground energy storage better than surface energy storage?

Fig. 1. Comparison of surface and underground energy storage. Compared to surface energy storage, underground energy storage is highly favored due to its large capacity (exceeding 10<sup>12</sup> kW·h), long-term storage capability (spanning several months), safety, cost-effectiveness, and reduced land use and ecological impact [.,].

Does a pilot borehole thermal energy storage model reduce observation errors?

Tordrup et al. developed an FEM model for a pilot borehole thermal energy storage to infer underground thermal properties, reducing observation errors from 12.5 % to 4.0 % compared to thermal response tests.

Are HECMs a transformative approach to energy storage?

HECMs represent a transformative approach in the field of energy storage, particularly for LIBs, SIBs, KIBs, and AIBs. The integration of high-entropy strategies into cathode design has opened new avenues for enhancing the electrochemical performance, stability, and longevity of energy storage devices.

What are borehole and aquifer thermal energy storage?

Borehole thermal energy storage and aquifer thermal energy storage represent two advanced methods for long-term geothermal energy storage, utilizing surplus heat (or cold) from summers (or winters) stored underground to achieve seasonal energy use adjustments [.,].

High-entropy (HE) MXene is the current research hotspot in the field of two-dimensional (2D) MXene materials. Unlike MXene, which contains only one or rarely two transition metals, HE MXene consists of multiple transition metals, which have both the excellent chemical properties of MXene and inherit the outstanding mechanical properties of HE materials.

Biochar is a versatile material in agriculture, environment, and energy sectors (Liu et al. 2019; Rawat et al. 2023; Yin et al. ). Its fused aromatic structure facilitates carbon storage (Lee et al. 2010; Lehmann 2007) and aids in belowground carbon sequestration (including plant litter and rhizodeposits), while also mitigat-

In this regard, photofunctional materials<sup>3,4</sup> that can undergo energy transformation as desired provide an ideal option to cope with the current issues, and the related research area has become one of the frontier hotspots in multidisciplinary research ...

In the realm of energy storage, MXenes have demonstrated remarkable potential as electrode materials in rechargeable batteries and supercapacitors. Their high electrical ...

Our study reveals 19 research frontiers in ESTs distributed across four knowledge domains: electrochemical energy storage, electrical energy storage, chemical energy storage, and...

Supercapacitors have become a popular form of energy-storage device in the current energy and environmental landscape, and their performance is heavily reliant on the electrode materials used.

There is a demand for advanced materials designed for higher energy and power densities that are also low-cost and safe. Advanced materials play an important role in charge storage as ...

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. To explore the research hotspots and development trends in the LUES field, this paper analyzes the development of LUES research by examining literature related to five ...

Table 1 presents the total count and proportion of various article types within the domain of power systems and innovative energy storage solutions. The analysis includes ...

The development of advanced materials with high energy storage capacity, fast charging/discharging rates, and long cycle life is crucial for the advancement of energy storage technologies. In recent years, MXenes has emerged as a promising class of materials with great potential for energy storage applications.

Compressed air energy storage (CAES) in underground mine tunnels using the technique of lined rock cavern (LRC) provides a promising solution to large-scale energy storage.

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