Design of solar energy cross-seasonal heat storage system

How can cross-seasonal thermal storage improve solar energy utilization?
As heat storage volume increases,hot water preparation costs and heat loss per unit volume decrease. Thus,developing large-scale cross-seasonal thermal storage systems is an effective solution to improve the thermal efficiencyand solar energy utilization of solar heating systems.

What is seasonal thermal energy storage (STES)?
Seasonal thermal energy storage (STES) harvests and stores sustainable heat sources,such as solar thermal energy and waste heat,in summer and uses them in winter for heating purposes,facilitating the replacement of fossil fuel-based heat supply and coordinating the seasonal mismatch between heat supply and demand .

Can solar thermal energy be used for cross-seasonal heating?
The increase in the tank temperature at the end of the heating period was beneficial for shortening the duration of the heat storage period for the following year. The feasibility of utilizing solar thermal energy and cascaded phase change heat storage for cross-seasonal heating has been demonstrated in this study.

What are heat storage methods for solar-driven cross-seasonal heating?
Heat storage methods for solar-driven cross-seasonal heating include tank thermal energy storage (TTES), pit thermal energy storage (PTES), borehole thermal energy storage (BTES), and aquifer thermal energy storage (ATES) 14, 15, 16. As heat storage volume increases, hot water preparation costs and heat loss per unit volume decrease.

Why is cross-seasonal heat storage important?
The mismatch between solar radiation resources and building heating demand on a seasonal scalemakes cross-seasonal heat storage a crucial technology,especially for plateau areas. Utilizing phase change materials with high energy density and stable heat output effectively improves energy storage efficiency.

Can solar energy be used for cross-seasonal heating in highland areas?
Thus,the solar-driven cascaded phase change heat storage system for cross-seasonal heating holds significant application valuein highland areas. The system utilizes solar energy as the primary energy source,which is abundant in the plateau region,effectively reducing reliance on traditional fossil energy sources and mitigating carbon emissions.

Heat storage methods for solar-driven cross-seasonal heating include tank thermal energy storage (TTES), pit thermal energy storage (PTES), borehole thermal energy...

In this project, a model of cross seasonal solar coupled soil source heat pump (SCSSHP) drying system was established, which replaced electric heating to dry the lithium battery coating process, and the thermal

performance of the system was studied by TRNSYS, and the heat storage efficiency and energy consumption of the system were analyzed.

The seasonal solar thermal energy storage (SSTES) systems have gained attraction for space heating purpose in cold climate location due to their alignment with Goal 7 of the United Nations" Sustainable Development Goals (SDGs). The thermal energy storage system also has applications in energy management of buildings [1]. However, the optimum ...

A few studies have focused on one or two specific STES technologies. Schmidt et al. [12] examined the design concepts and tools, implementation criteria, and specific costs of pit thermal energy storage (PTES) and aquifer thermal energy storage (ATES).Shah et al. [13] investigated the technical element of borehole thermal energy storage (BTES), focusing on ...

This study addresses these challenges by optimizing the design and control strategies of an energy system that meets the heat and electricity demands of a community. The proposed system integrates solar and wind power with energy storage, including seasonal thermal energy storage (STES) and battery, coupled via a heat pump.

Buildings consume approximately ¾ of the total electricity generated in the United States, contributing significantly to fossil fuel emissions. Sustainable and renewable energy production ...

The goal of this study was to evaluate the long-term energy and exergy performance of a large-scale seasonal borehole thermal energy storage system for industrial waste heat and...

Seasonal thermal energy storage (STES) harvests and stores sustainable heat sources, such as solar thermal energy and waste heat, in summer and uses them in winter for heating purposes, facilitating the replacement of fossil fuel-based heat supply and coordinating the seasonal mismatch between heat supply and demand [7].

Seasonal thermal energy storage (STES) can be utilized to cover a portion or meet the whole space and water heat demands in residential and commercial buildings. ... To study the feasibility and the feasibility of such STES system, the design was simulated using the TRNSYS® tool where the STES medium was charged by a solar thermal system. The ...

The cross-seasonal borehole thermal storage technology is based on the solar heat source exchanging heat with the underground soil through the buried pipe heat exchanger, transporting low-quality heat sources in non-heating season to the underground soil for collection and storage, and extracting and utilizing the stored heat during the heating period (Fisch et al. ...

In this study, a solar seasonal thermal storage heating (SSTSH) system is proposed and applied in Tianshan Shengli Tunnel in Xinjiang, China. The system utilizes solar energy seasonal storage of the SSTSH system to address the long-term thermal imbalance in the portal of the cold-region tunnel.

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The Dronninglund district heating plant aimed for a 50 % solar contribution, but the cross-seasonal solar radiation variation in Denmark posed a significant challenge. This led to the consideration of large-scale solar thermal systems paired with seasonal thermal storage to retain excess summer heat for winter use [29].

This model is an important tool for sensitivity analysis and optimization of key parameters such as the aperture area of heliostat field, solar seasonal heating storage (SSHS) volume, geometric shape, mass flow of solar heat collection field and internal rate of return of funds.

Seasonal thermal energy storage (STES) offers an attractive option for decarbonizing heating in the built environment to promote renewable energy and reduce CO 2 emissions. A literature review revealed knowledge gaps in evaluating the technical feasibility of replacing district heating (DH) with STES in densely populated areas and its impact on costs, ...

In Alberta, Canada, the homes of the Drake Landing Solar Community (in operation since 2007), get 97% of their year-round heat from a district heat system that is supplied by solar heat from solar-thermal panels on garage roofs. This feat - a world record - is enabled by interseasonal heat storage in a large mass of native rock that is under a central park.

It consisted of solar collection, the Energy Centre with short-term energy storage, the seasonal Borehole Thermal Energy Storage (BTES) system, the district heating system, and energy efficient homes (shown in Fig. 8). In the BTES system, 144 boreholes were drilled to a depth of 35 m and covered an area 35 m in diameter under the ground. After ...

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