

# Solar energy cross-season heat and cold storage

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 scale makes 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.

What is seasonal solar thermal storage?

Seasonal solar thermal storage using PCMs as the thermal storage medium is usually done in two ways. One is to store the PCMs directly in the thermal storage unit, similar to the seasonal thermal energy storage of sensible heat, i.e., the direct-type. One is to use the supercooling of the PCMs for thermal storage, i.e., the supercooling-type.

Can solar thermal energy be stored in winter?

Seasonal storage of solar thermal energy through supercooled phase change materials (PCM) offers a promising solution for decarbonizing space and water heating in winter. Despite the high energy density and adaptability, natural PCMs often lack the necessary supercooling for stable, long-term storage.

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 value in 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.

Seasonal thermal energy storage ... is the storage of heat or cold for periods of up to several months. The thermal energy can be collected whenever it is available and be used whenever needed, such as in the opposing season. ... such as in the opposing season. For example, heat from solar collectors or waste heat from air conditioning ...

The cold accumulation problem can lead to performance degradation of heat pumps. This paper presents the design and optimization of a solar-assisted storage system to solve this issue.

The built environment accounts for a large proportion of worldwide energy consumption, and consequently, CO<sub>2</sub> emissions. For instance, the building sector accounts for ~40% of the energy consumption and 36%-38% of CO<sub>2</sub> emissions in both Europe and America [1, 2]. Space heating and domestic hot water demands in the built environment contribute to ...

This study integrates cascaded phase change with a cross-seasonal heat storage system aimed at achieving low-carbon heating. The simulation analyzes heat distribution and temperature ...

Industrial excess heat is the heat exiting any industrial process at any given moment, divided into useable, internally useable, externally useable, and non-useable streams [5]. Waste heat can be recovered directly through recirculation or indirectly through heat exchangers and can be classified according to temperature as low grade (<100 °C), medium ...

The solar-driven cascaded phase change heat storage cross-seasonal heating system proposed in this study focuses on remote plateau areas with abundant solar radiation resources,...

Thermochemical energy storage, a promising candidate for seasonal solar thermal energy storage, offers an economic solution to mitigate the use of fossil fuels and CO<sub>2</sub> emissions due to its large storage density and almost zero-loss long-term storage. The present article explored the potential of the thermochemical seasonal energy storage system using ...

It is proved that the application of cross-season heat storage is feasible for energy tower coupled with buried pipe system of ground-source heat pump in cold and severe cold area. Discover the ...

The cold thermal energy storage (TES), also called cold storage, are primarily involving adding cold energy to a storage medium, and removing it from that medium for use at a later time. It can efficiently utilize the ...

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 ...

Research status and development prospect of solar energy cross-season heat storage heating technology. Management and Technology of Small and Medium-sized Enterprises (ten-day issue) Jan 2018

Research Progress on Solar Seasonal Thermal Energy Storage: ZHAO Xuan 1, ZHAO Yan-jie 2, WANG Jing-gang 1, BAO Ling-ling 1: 1. Hebei University of Engineering, Handan 056038, China; 2. Key Laboratory of Efficient Utilization of Low and Medium Grade Energy (Ministry of Education), Tianjin University,

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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 ...

In the high-cold and high-altitude area in western China, due to the abundant solar energy and hydropower resources, the use of electric auxiliary cross-season solar heat ...

In the high-cold and high-altitude area in western China, due to the abundant solar energy and hydropower resources, the use of electric auxiliary cross-season solar heat storage heating system (CSHSHS) is an effective way to achieve clean heating.

Solar energy storage has been an active research area among the various solar energy applications over the past few decades. As an important technology for solving the time-discrepancy problem of solar energy utilisation, seasonal/long-term storage is a challenging key technology for space heating and can significantly increase the solar fraction.

The cold thermal energy storage (TES), also called cold storage, are primarily involving adding cold energy to a storage medium, and removing it from that medium for use at a later time. It can efficiently utilize the renewable or low-grade waste energy resources, or utilize the night time low-price electricity for the energy storage, to ...

Energy storage at all timescales, including the seasonal scale, plays a pivotal role in enabling increased penetration levels of wind and solar photovoltaic energy sources in power systems. Grid-integrated seasonal energy storage can reshape seasonal fluctuations of variable and uncertain power generation by 2017 Energy and Environmental Science HOT articles

The proposed system can meet most thermal loads and has a high potential. Maximov et al. [30] used solar energy with seasonal thermal storage to provide domestic heating. The study found that solar heating with seasonal heat storage is economically advantageous if pollution costs are considered.

Jin G, Chen R, Guo S, Hao N and Wang B (2019) Experimental study on heat pump heating performance of solar energy cross-season heat storage in severe cold areas. *Building Science* 35(12): 33-37.

The sorption continuous cool-heat storage method can be used for cross-season cold-heat adaptive control owing to its advantages of high cooling and heating storage density, long-term and stable ...

The full use of renewable energy sources such as solar energy to meet the various energy supply needs of

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buildings is now a research focus and an industry development trend, as energy consumption has been increasing and environmental pollution has become a serious problem. In the high-cold and high-altitude area in western China, due to the abundant solar energy and ...

The concept of seasonal/long-term heat storage presents great opportunities for making the utmost use of solar energy. Stored "excess" heat can compensate for the heat ...

The finding, by MIT professor Jeffrey Grossman, postdoc David Zhitomirsky, and graduate student Eugene Cho, is described in a paper in the journal *Advanced Energy Materials*. The key to enabling long-term, stable storage of solar heat, the team says, is to store it in the form of a chemical change rather than storing the heat itself.

In engineering applications and specific experimental research, V. Tirilat-Berdal et al. [[44], [45], [46]] used simulation and experimental method to study the analysis of the solar-soil source heat pump coupled system for cooling, heating and domestic hot water. The experimental results showed that after the system is operated for 11 months, the average heat ...

Sometimes two is better than one. Coupling solar energy and storage technologies is one such case. The reason: Solar energy is not always produced at the time energy is needed most. Peak power usage often occurs on summer afternoons and evenings, when solar energy generation is falling. Temperatures can be hottest during these times, and people ...

a Concept of storing solar thermal energy in summer for space and water heating in winter by seasonal thermal energy storage (TES).  
b Comparison between erythritol and other PCMs with high degrees ...

pipe network, and there is not enough roof or other space to install solar collectors, the air source heat storage system can also achieve cross-season utilization of natural energy, provides a ...

Study on Operation Strategy of Cross-Season Solar Thermal Storage Heating System in Alpine Region ... there is little research on the operation and dispatching technology of heat storage system in high altitude and cold area. In this paper, starting from the heat storage device, the working principle is explored, and the working process is ...

The building sector is a significant contributor to global energy consumption and CO<sub>2</sub> emissions. It accounts for >30 % of energy consumption and CO<sub>2</sub> emissions in Europe and China [1, 2]. The burning of fossil fuels meets approximately 85 % of the global residential heat demand [3]. Many countries and regions have promised to achieve carbon-neutral targets.

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