Air energy heat pump and phase change energy storage heating

What are phase-change energy storage devices based on a Pvt-air source heat pump?
In order to solve these problems, two kinds of phase-change energy storage devices are combined on the basis of a PVT-air source heat pump system, namely, a low-temperature phase-change energy storage (ice tank) and a medium-temperature phase-change energy storage (phase-change thermal storage device (PCTSD)).

Can phase change thermal storage technology be used in air-source heat pump?
The application of phase change thermal storage technology in three fields of air-source heat pump was summarized. The problems still existing in three applications were presented. The future research directions of latent thermal energy storage air-source heat pump are pointed out.

Can a dual-source heat pump use phase-change energy storage?
Conclusions In this study,a novel dual-source heat pump system was proposed,which used phase-change energy storageto realize the cascade utilization of heat and the complementary advantages of solar energy and air energy.

What is a phase change thermal storage unit?
By combining a phase change thermal storage unit with the evaporative side of the air-source heat pump, the thermal storage unit is used to defrost the outdoor unit and delay the reduction of heat production of the air source heat pump due to the low-temperature environment by thermal storage.

How latent thermal energy storage air-source heat pump can improve performance?
The future research directions of latent thermal energy storage air-source heat pump are pointed out. Combining phase change thermal storage technologywith air-source heat pumps can improve the performance coefficient and stability of air-source heat pumps operating in low-temperature environment.

How ASHP compared to dual-source heat pump system?
The increased initial investment costof the dual-source heat pump system compared with the ASHP system was mainly the PVT module and energy storage system,which is 49,000 CNY. The economic benefits of the system were mainly reflected in the reduction of energy consumption and the utilization of power generation.

The International Energy Agency (IEA) includes the heat pumps for space heating and cooling and hot water as one of the technologies which has the greatest long-term potential for reducing CO 2 emissions. According to the proposed BLUE Map scenario (a scenario in which energy-related CO 2 emissions are reduced by 50% in 2050 from 2007 levels), it is estimated ...

Reasonable scheduling and control of air-source heat pumps (ASHPs) contribute to reducing operational costs for users while encouraging ...

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Energy conservation and improving energy efficiency have long been at the center of global attention (Wang et al., 2022 a).Additionally, climate change is one of the greatest threats facing the world today (Dong et al., 2023) and energy and environmental issues need to be urgently addressed.Heat pump is an energy-saving device that uses a small amount of high ...

Thermal energy storage technology is an effective method to improve the efficiency of energy utilization and alleviate the incoordination between energy supply and demand in time, space and intensity [5].Thermal energy can be stored in the form of sensible heat storage [6], [7], latent heat storage [8] and chemical reaction storage [9], [10].Phase change energy storage ...

In this article are therefore presented different kinds of heat pump systems for heating and cooling of buildings (with a focus on air and ground heat pumps) that have integrated thermal energy storage either in the form of water (ice) storage tanks, ground or ...

Over the past few decades, various types of multi-energy complementary systems have been developed [1], [2].Among them, systems based on solar collector (SC) and air source heat pump (ASHP) have been well documented in the current technology [3], with the solar assisted ASHP exerting as the most promising one [4], [5].However, solar energy suffers from ...

The innovations of this investigation are as follows: (i) A solar-assisted heat pump system, utilizing phase change heat storage is proposed, and proposes an optimal operation control strategy for the composite system; (ii) The average coefficient of performance of the system is 5.42, which greatly improves the heating supply efficiency of the ...

Liu [12] proposed a new solar-assisted heat pump hot water system, which uses stored solar energy to defrost an outdoor unit, compared to a traditional system using reverse circulation for defrosting. The results showed that the COP of the new system is 82% higher than that of the traditional system. Wu [13] analyzed solar air source absorption heat pumps to ...

Based on the proposed energy storage air-type solar collector, a novel solar heat pump heating system was designed by integrating the solar collector and an air source heat ...

Air-source heat pumps (ASHP) are widely used in heating applications because they are environmentally friendly, energy-efficient, and two to three times more efficient than traditional gas and electric water heaters [1], [2], [3].However, in low-temperature environments, air-source heat pumps are accompanied by increased compression ratios and reduced ...

The energy efficiencies of the three heating modes were 48.59 % for direct solar heating, 96.46 % for a GSHP heating mode, and 97.95 % for solar assisted heat pump heating, with the GSHP heating mode having the highest efficiency and being the most advantageous over the other two modes.

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As one of the most widely used low-carbon heating technologies, the energy consumption of an air source heat pump (ASHP) is 55-70 % less than that of an electric heating system, and its CO 2 emissions are 12 % less than that of a gas-fired boiler [6].However, the performance of an ASHP is greatly affected by the outdoor ambient temperature, which widely ...

The "Heat Roadmap Europe" (HRE) [7] predicts that the CO 2 emissions produced in Europe"s heating and cooling sector can be reduced by more than 85 % by 2050 compared to 1990 using only known technologies. As stated in the roadmap, electricity-driven heat pumps will be key to facilitate the switch from traditional oil and gas boilers and thus enable the efficient ...

This study aims to utilize solar energy and phase change thermal storage technology to achieve low carbon cross-seasonal heating. The system is modelled using the open source EnergyPlus software ...

Scientists in China have designed a photovoltaic-thermal integrated air-source heat pump hot water system that uses a phase change tank to lower energy consumption and ...

In another work, a system, air-type solar heat pump with phase change energy storage used for indoor heating, was investigated by Li et al. [26] and found that in comparison with the electric boiler, the system is able to decrease annual operating cost by more than 72 %.

Phase change materials (PCMs) absorb a large amount of energy as latent heat at a relative constant phase transition temperature and are thus used for passive heat storage ...

In order to solve these problems, two kinds of phase-change energy storage devices are combined on the basis of a PVT-air source heat pump system, namely, a low ...

Simulation study on thermal performance of solar coupled air source heat pump system with phase change heat storage in cold regions ... While there have been numerous studies on combined solar energy and air source heat pump heating systems, there is a lack of research on the impact of a dual heat source variable operation PCHS unit on the ...

Chen et al. [56] addressed the issue of insufficient heating in cold areas by proposing a phase-change energy storage heat pump system that uses heat from solar energy and air energy to provide a heat source for secondary heat pumps. Phase change energy storage technology is applied in the system to fully integrate the "low power" strategy ...

An air source heat pump (ASHP) takes low grade heat from the air, and boosts it to high grade that can be used for domestic heating or other purposes. The heat pump uses less energy input, as electricity, than the energy output it produces as heat. ASHPs are either air-to-water and air-to-air heat pumps. Air-to-water HPs

take advantage of wet ...

Among the low-carbon heating technologies, air source heat pump (ASHP) is one of the most popular heating systems due to its advantages of consuming 55-70% less energy than an electric heating system and emitting 12% less carbon dioxide than a gas-fired boiler [6].However, in northern China, the decrease in the heating capacity and coefficient of ...

Energy crisis and environmental problems motive a variety of research strategies to increase energy efficiency, decrease stress on energy infrastructure, and consequently reduce CO 2 emissions. Improving efficiency of building heating applications by advanced techniques such as solar collectors and heat pumps, is considered as one research strategy.

The combination of energy-saving heat pump (HP) and phase change material (PCM) with high heat storage density can greatly improve the performance of HP. Therefore, HP coupled with PCM has received wide attention.

An experimental and numerical study by Long et al. [50] investigated the performance of an air source heat pump water heater utilizing PCM thermal energy storage. The heat pump with a rated input power of 1.1 kWe and a COP approximately 3.1 was used to charge the paraffin wax with an average melting temperature of 56 °C. Experimental data was ...

Combined with a double-effect quasi-two-stage heat pump, wide-temperature-range phase change materials are used in both heat and cold storage. Targeting global areas with seasonal heating and cooling demands, preferred materials ...

As can be seen from Fig. 8, compared to the traditional system, the system coupled with phase-change tanks can not reach the demand for domestic hot water in the initial stage, this is due to the initial stage of the air-source heat pump to heat the phase-change tank, due to the presence of phase-change materials, the tank temperature can not ...

This study introduced a novel air source heat pump-assisted solar heating system integrated with phase change energy storage (ASHP-SC-PCES). It explored the system"s ...

Performance and optimization of a novel solar-air source heat pump building energy supply system with energy storage. ... Jin et al. [33] combined the phase change heat storage with the SAHP system. The study showed that the overall efficiency of the system in the multi-heat source heating mode increased by about 57.5%, and the volume saving ...

A UK research group has proposed the combination of solar-powered heat pumps and thermal storage based on phase-change materials for residential applications. They said such a system could ...

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The combination of energy-saving heat pump (HP) and phase change material (PCM) with high heat storage density can greatly improve the performance of HP. Therefore, ...

In order to improve the application of renewable energy in cold regions and overcome the drawback of the low performance of traditional air source heat pumps (ASHP) in a low temperature environment, a novel type of dual-source heat pump system is proposed, which includes a heat pump, photovoltaic-thermal (PVT) modules, an air heat exchanger, and phase ...

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