

Are phase change materials a viable alternative to energy storage?

Phase change materials (PCMs) can alleviate concerns over energy to some extent by reversibly storing a tremendous amount of renewable and sustainable thermal energy. However, the low thermal conductivity, low electrical conductivity, and weak photoabsorption of pure PCMs hinder their wider applicability and development.

How can Liberia expand energy access?

These resources hold immense potential, with Liberia boasting abundant solar irradiation and promising bioenergy in specific regions. Efforts to expand energy access also hinge on vital factors such as international partnerships, public-private collaborations, and innovative off-grid and mini-grid solutions.

How can Liberia reduce its dependency on imported fuels?

To overcome these challenges, Liberia has been exploring alternative solutions to reduce its dependency on imported fuels for thermal power generation. One strategy is to diversify the energy mix by increasing the share of domestic renewable energy sources, such as solar and wind power, for electricity generation.

Does Liberia's energy strategy extend beyond its borders?

The outcomes of this study, elucidating Liberia's energy dynamics and strategies, extend beyond its borders, offering pertinent recommendations for researchers, planners, and engineers in analogous regions globally.

How can Liberia improve energy reliability?

As exemplified by Liberia's import initiatives, regional energy cooperations should be considered to bolster energy reliability. Engineers are advised to optimize energy mixes, incorporating wind, biomass, and solar energy into existing grids, and developing mini-grid initiatives for rural areas to address energy access challenges.

How does energy poverty affect Liberia's Development?

Analysis of the impact of energy poverty on Liberia's development Energy poverty significantly impacts Liberia's development, as it hinders economic growth, social development, and environmental sustainability. It affects social development, particularly in education, health, and gender equality.

Latent heat storage using alloys as phase change materials (PCMs) is an attractive option for high-temperature thermal energy storage. ... Sar?, A., Alkan, C., Karaipekli, A. & Uzun, O ...

the fundamental physics of phase change materials used for energy storage. Phase change materials absorb thermal energy as they melt, holding that energy until the material is again solidified ...

Phase-change materials (PCMs) offer tremendous potential to store thermal energy during reversible phase transitions for state-of-the-art applications. The practicality of ...

The energy changes that occur during phase changes can be quantified by using a heating or cooling curve. Heating Curves. Figure (PageIndex{3}) shows a heating curve, a plot of temperature versus heating time, for a 75 g sample of water. The sample is initially ice at 1 atm and  $-23^{\circ}\text{C}$ ; as heat is added, the temperature of the ice increases ...

Phase change materials (PCMs) can enhance the performance of energy systems by time shifting or reducing peak thermal loads. The effectiveness of a PCM is defined by its energy and ...

The use of phase change material (PCM) is being formulated in a variety of areas such as heating as well as cooling of household, refrigerators [9], solar energy plants [10], photovoltaic electricity generations [11], solar drying devices [12], waste heat recovery as well as hot water systems for household [13].The two primary requirements for phase change ...

While TCS can store high amounts of energy, the materials used are often expensive, corrosive, and pose health and environmental hazards. LHS exploits the latent heat of phase change whilst the storage medium (phase change material or PCM) undergoes a phase transition (solid-solid, solid-liquid, or liquid-gas).

**INTRODUCTION** Liberia has seen a growing interest in renewable energy initiatives as the nation strives to improve its energy access and sustainability. The demand for reliable electricity continues to rise in the nation making "renewable energy" a promising solution to address power shortages in reducing the country's dependence on expensive and polluting ...

Form-stable phase change materials with high phase change enthalpy from the composite of paraffin and cross-linking phase change structure Appl. Energy, 184 ( 2016 ), pp. 241 - 246, 10.1016/j.apenergy.2016.10.021

Sarbu, I. & Dorca, A. Review on heat transfer analysis in thermal energy storage using latent heat storage systems and phase change materials. Int. J. Energy Res. 43, 29-64 (2019). Article CAS ...

In a context where increased efficiency has become a priority in energy generation processes, phase change materials for thermal energy storage represent an outstanding possibility. Current research around thermal energy storage techniques is focusing on what techniques and technologies can match the needs of the different thermal energy storage applications, which ...

Phase change materials (PCMs) in solid-liquid form have the benefits of minimal volume alteration, high energy storage capacity, and appropriate phase transition temperature. They ...

The current energy crisis has prompted the development and utilization of renewable energy and energy

storage material. In this study, levulinic acid (LA) and 1,4-butanediol (BDO) were used to synthesize a novel levulinic acid 1,4-butanediol ester (LBE) by both enzymatic and chemical methods. The enzymatic method exhibited excellent ...

Thermal storage is very relevant for technologies that make thermal use of solar energy, as well as energy savings in buildings. Phase change materials (PCMs) are positioned as an attractive alternative to storing thermal energy. This review provides an extensive and comprehensive overview of recent investigations on integrating PCMs in the following low ...

Solar energy is a renewable energy source that can be utilized for different applications in today's world. The effective use of solar energy requires a storage medium that can facilitate the storage of excess energy, and then supply this stored energy when it is needed. An effective method of storing thermal energy from solar is through the use of phase change ...

Solar energy is a clean and inexhaustible source of energy, among other advantages. Conversion and storage of the daily solar energy received by the earth can effectively address the energy crisis, environmental pollution and other challenges [4], [5], [6], [7]. The conversion and use of energy are subject to spatial and temporal mismatches [8], [9], ...

Phase change materials (PCMs) can alleviate concerns over energy to some extent by reversibly storing a tremendous amount of renewable and sustainable thermal energy. However, the low ...

Among the many energy storage technology options, thermal energy storage (TES) is very promising as more than 90% of the world's primary energy generation is consumed or wasted as heat. TES entails storing energy as either sensible heat through heating of a suitable material, as latent heat in a phase change material (PCM), or the heat of a reversible ...

Phase change materials (PCMs) have attracted tremendous attention in the field of thermal energy storage owing to the large energy storage density when going through the isothermal phase transition process, and the functional PCMs have been deeply explored for the applications of solar/electro-thermal energy storage, waste heat storage and utilization, ...

The management of energy consumption in the building sector is of crucial concern for modern societies. Fossil fuels' reduced availability, along with the environmental implications they cause, emphasize the necessity for the development of new technologies using renewable energy resources. Taking into account the growing resource shortages, as well as ...

Thermal energy storage (TES) using phase change materials (PCM) have become promising solutions in addressing the energy fluctuation problem specifically in solar energy. However, the thermal conductivity of PCM is too low, which hinders TES and heat transfer rate. In recent days thermally enhanced PCMs are a promising candidate for TES and ...

Thermal energy storage (TES) techniques are classified into thermochemical energy storage, sensible heat storage, and latent heat storage (LHS). [ 1 - 3 ] Comparatively, LHS using phase change materials (PCMs) is considered a better option because it can reversibly store and release large quantities of thermal energy from the surrounding ...

In recent papers, the phase change points of solid-solid PCMs could be selected in a wide temperature range of  $-5\text{ }^{\circ}\text{C}$  to  $190\text{ }^{\circ}\text{C}$ , which is suitable to be applied in many fields, such as lithium-ion batteries, solar energy, build energy conservation, and other thermal storage fields [94]. Therefore, solid-solid PCMs have broad application ...

The materials used for latent heat thermal energy storage (LHTES) are called Phase Change Materials (PCMs) [19]. PCMs are a group of materials that have an intrinsic capability of absorbing and releasing heat during phase transition cycles, which results in the charging and discharging [20].

Phase-changing materials are nowadays getting global attention on account of their ability to store excess energy. Solar thermal energy can be stored in phase changing material (PCM) in the forms of latent and sensible heat. The stored energy can be suitably utilized for other applications such as space heating and cooling, water heating, and further industrial processing where low ...

Effects of phase-change energy storage on the performance of air-based and liquid-based solar heating systems. *Solar Energy*, 20 (1978), pp. 57-67. [View PDF](#) [View article](#) [View in Scopus](#) [Google Scholar](#). Nallusamy et al., 2007. N. Nallusamy, S. Sampath, R. Velraj.

The energy storage application plays a vital role in the utilization of the solar energy technologies. There are various types of the energy storage applications are available in the today's world. Phase change materials (PCMs) are suitable for various solar energy systems for prolonged heat energy retaining, as solar radiation is sporadic. This literature review ...

Thermal energy storage (TES) plays an important role in industrial applications with intermittent generation of thermal energy. In particular, the implementation of latent heat thermal energy storage (LHTES) technology in industrial thermal processes has shown promising results, significantly reducing sensible heat losses. However, in order to implement this ...

Energy security and environmental concerns are driving a lot of research projects to improve energy efficiency, make the energy infrastructure less stressed, and cut carbon dioxide (CO<sub>2</sub>) emissions. One research goal is to increase the effectiveness of building heating applications using cutting-edge technologies like solar collectors and heat pumps. ...

Phase Change Materials for Energy Storage Devices. Thermal storage based on sensible heat works on the temperature rise on absorbing energy or heat, as shown in the solid and liquid phases in Figure

(PageIndex{1}). When the stored heat is released, the temperature falls, providing two points of different temperature that define the storage ...

Thermal energy storage technologies utilizing phase change materials (PCMs) that melt in the intermediate temperature range, between 100 and 220 °C, have the potential to mitigate the intermittency issues of wind and solar energy. This technology can take thermal or electrical energy from renewable sources and store it in the form of heat. This is of particular ...

Conventional phase change materials struggle with long-duration thermal energy storage and controllable latent heat release. In a recent issue of *Angewandte Chemie*, Chen et al. proposed a new concept of spatiotemporal phase change materials with high supercooling to realize long-duration storage and intelligent release of latent heat, inspiring the design of ...

Phase change materials can improve the efficiency of energy systems by time shifting or reducing peak thermal loads. The value of a phase change material is defined by its...

Thermal energy storage can shift electric load for building space conditioning 1,2,3,4, extend the capacity of solar-thermal power plants 5,6, enable pumped-heat grid electrical storage 7,8,9,10 ...

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