

Simulated energy injection and extraction and heat extraction efficiency of the borehole thermal energy storage system at various soil intrinsic permeability values in the unsaturated model. The red line indicates the permeability values for which the calculated two-dimensional Rayleigh number ( $Ra$ ) exceeds the critical Rayleigh value ( $Ra_c$ ).

Based on their masses, the heat stored by the in-situ energy storage system was 349 kJ and 169 kJ, respectively. When the average temperature of the heat pipe was 830.15 K and the average temperature of the lunar soil energy storage blocks was 774.15 K, the Stirling generator started to work and generate electricity.

TES systems are divided into two categories: low temperature energy storage (LTES) system and high temperature energy storage (HTES) system, based on the operating temperature of the energy storage material in relation to the ambient temperature [17, 23]. LTES is made up of two components: aquiferous low-temperature TES (ALTES) and cryogenic ...

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However, the use of peat in energy provision always has an adverse impact on soil C storage as the combustion of peat releases, in a short period of time, C that accumulated over thousands of years. Even if peatland restoration is successful, any C sequestration possible as a result of subsequent plant inputs will provide negligible ...

In the context of climate change and the circular economy, biochar has recently found many applications in various sectors as a versatile and recycled material. Here, we review application of biochar-based for carbon sink, covering agronomy, animal farming, anaerobic digestion, composting, environmental remediation, construction, and energy storage. The ...

Seasonal Thermal Energy Storage (STES) takes this same concept of taking heat during times of surplus and storing it until demand increases but applied over a period of months as opposed to hours. ... PTES uses excavated ground to create a sunken storage area. The excavated soil can be used to raise the banks at the sides of storage, increasing ...

For water storage in combination with gravel, soil, or sand, the top may be built with a liner and insulation material, often the same as the walls [20]. The most time-consuming and costly aspect of a water-filled PTES is the fabrication of the lid. ... The energy storage medium for aquifer heat energy is natural water found in an underground ...

Energy storage is critically important for success of any intermittent energy source in meeting demand. Soil is used as heat transfer, heat collector and energy storage media in place of conventional used phase change materials (PCM), synthetic oils and molten salts. Thermal energy storage capacity of three soil samples such as black soil, red soil, arid/desert soil from ...

Biochar for agronomy, animal farming, anaerobic digestion, composting, water treatment, soil remediation, construction, energy storage, and carbon sequestration: a review ... such as an alternative energy source or a soil amendment agent. Biochar can be added to the animal's diet and the impact on litter evaluated, or it can be directly applied ...

It is a versatile renewable energy source with the capacity to produce heat, electricity, and liquid biofuels [10]. ... Biochar's two natural properties that make it capable of long-period carbon storage in the soil [32, 36]: 1) stability, which includes resistance to living and non-living decay in the soil, and 2) ...

Energy Storage is a new journal for innovative energy storage research, covering ranging storage methods and their integration with conventional & renewable systems. Abstract Borehole thermal energy storage (BTES) is an innovative renewable energy technology for building heating and cooling. The lack of studies about BTES in unsaturated soils ...

The use of biochar and hydrochar carbon precursors from biomass as gas storage, energy storage, and conversion materials involves many challenges. Human activities result in the emission of substantial amounts of toxic gasses (e.g., CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, and SO<sub>2</sub>), which are one of the main causes of global climate change.

Sensible thermal energy storage is a well-proven storage technique which has been employed long time ago in various thermal applications where water, rock and soil are common storage mediums [11]. Such systems are cheap and simple and rely on the storage material specific heat capacity through increasing the temperature without changing the ...

Global land-use changes are major drivers of soil organic carbon (C) dynamics, affecting the equilibrium between stored C and carbon dioxide (CO<sub>2</sub>) emissions into the atmosphere (Beillouin et al., 2023). Most studies worldwide have been focused on the conversion of natural ecosystems to croplands and plantations (Lark et al., 2020, Wang et al., 2021, Zhang ...

Soil-borehole thermal energy storage (SBTES) systems are used to store heat generated from renewable resources (e.g., solar energy) in the subsurface for later extraction and use in the heating of buildings (59; 53; 42; 4; 19). Seasonal storage of thermal energy in geothermal borehole arrays has been proposed as an alternative to energy storage in shallow ...

for energy storage applications requires additional functionalisation. Keywords Climate change mitigation

• Biochar applications • Carbon sink • Biochar-based fertilisers • Environmental remediation • Energy storage • Biochar in construction Ahmed I. Osman and Samer Fawzy have contributed equally. \* Ahmed I. Osman

Additionally, biochar influences soil nitrogen cycling, affecting the nitrification rates, ammonia adsorption, and the storage of ammonium by increasing soil cation exchange capacity [171]. Biochar application also can help to reduce nitrate leaching and losses of gaseous nitrogen, contributing to improved nutrient management in agriculture [ 13 ].

where  $H$  is the sensible heat flux,  $LE$  is the latent heat flux, both of which are most directly measured using the eddy-covariance (EC) technique,  $G$  is the soil heat flux at the surface, which can be quantified by a combination of heat-flux plates, soil temperature, and soil water content sensors (energy storage in the canopy can potentially also be included here), ...

Borehole thermal energy storage (BTES) in soils combined with solar thermal energy harvesting is a renewable energy system for the heating of buildings. The first community-scale BTES system in North America was installed in 2007 at the Drake Landing Solar Community (DLSC) in Okotoks, AB, Canada, and has since supplied >90% of the thermal ...

Soil microbial and faunal communities interact in complex food webs, driving the carbon, nutrient and energy flows central to biogeochemical cycles (Gessner et al., 2010; Grandy et al., 2016; Schimel and Schaeffer, 2012) the soil decomposer system, the detrital food chain forms two main pathways for carbon and energy, which are based on bacteria and fungi (Crotty et al., ...

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