UNDERGROUND CONCRETE SPACE AIR ENERGY STORAGE

Proceedings World Geothermal Congress 2020+1 Reykjavik, Iceland, April - October 2021 1 HEATSTORE ??? Underground Thermal Energy Storage (UTES) ??? State of the Art, Example Cases and Lessons Learned Anders J. Kalles?e1, Thomas Vangkilde-Pedersen1, Jan E. Nielsen2, Guido Bakema3, Patrick Egermann4, Charles Maragna5, Florian Hahn6, Luca Guglielmetti7 ???

study the coupled thermodynamic and geomechanical performance of underground compressed air energy storage (CAES) in concrete-lined rock caverns. The paper focuses on CAES in lined caverns at relatively shallow depth (e.g., 100 m depth) in which a typical CAES operational pressure of 5 to 8 MPa is Along with pumped hydroelectric storage

Space heating and cooling represent 63% of total building energy demand. In the present study, the concept of concrete foundation piles was used as an underground storage medium.

1. Introduction. Large scale energy storage (LSES) systems are required in the current energy transition to facilitate the penetration of variable renewable energies in the electricity grids [1, 2].The underground space in abandoned mines can be a solution to increase the energy storage capacity with low environmental impacts [3], [4], [5].Therefore, ???

Low-carbon energy transitions taking place worldwide are primarily driven by the integration of renewable energy sources such as wind and solar power. These variable renewable energy (VRE) sources require energy storage options to match energy demand reliably at different time scales. This article suggests using a gravitational-based energy storage method ???

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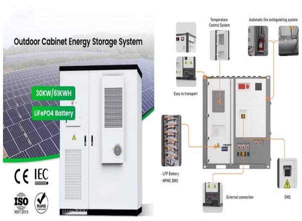
Underground compressed air energy storage and capacity analysis In principle, caverns can be excavated to large volumes and lined with concrete and steel to ensure no permeability. A single natural gas storage plant has demonstrated the feasibility of this type of storage in Gr?ngesberg, Sweden with pressures or 500 bar achieved [65].

The core principle of compressed air energy storage [13] is to utilize surplus electricity generated from renewable energy sources to compress air into large-scale storage facilities bsequently, during periods of peak energy demand, the compressed air is released (or supplemented with natural gas for combustion) to drive turbines for electricity generation, ???

The underground energy storage technologies for renewable energy integration addressed in this article are: Compressed Air Energy Storage (CAES); Underground Pumped Hydro Storage (UPHS); Underground Thermal Energy Storage (UTES); Underground Gas Storage (UGS) and Underground Hydrogen Storage (UHS), both connected to Power-to-gas ???

With the demand for peak-shaving of renewable energy and the approach of carbon peaking and carbon neutrality goals, salt caverns are expected to play a more effective role in oil and gas storage, compressed air energy storage, large-scale hydrogen storage, and temporary carbon dioxide storage. In order to effectively utilize the underground space of salt ???



Another gap is the large-scale air storage space construction, which can determine the feasibility and capacity of the large-scale CAES. Fig. 17 b shows the variation in underground energy storage efficiency. In both schemes, the overall efficiency is higher than 95.8%. The second scheme demonstrates improved performance throughout the cycle.

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In this paper, we investigate the influence of the excavation damaged zone (EDZ) on the geomechanical performance of compressed air energy storage (CAES) in lined rock caverns. We conducted a detailed characterization of the EDZ in rock caverns that have been excavated for a Korean pilot test program on CAES in (concrete) lined rock caverns at shallow ???


reduced fuel usage by 25%. A storage cavern was located at more than 450 m underground in rock salt, with a storage volume at over 500,000 m3. Air storage pressure is about 7.4 MPa, and at full decompression, air pressure is about 4.5 MPa. Note that these two commercial CAES facilities were


In the present study, the stability of a compressed air energy storage cavern was numerically assessed by concrete plug shapes in order to investigate the optimal shape of concrete plug. The concrete plugs were cylindrical, embedded cylindrical, tapered, and wedged in shape. The stability assessment was carried out based on factor of safety through a strength reduction ???


The liquid hydrogen fuel used as rocket propellant in the space programme is stored in the large tanks (stored at about ???253 ?C). Compressed Air Energy Storage (CAES), Underground Pumped Hydro Storage (UPHS) and Thermal (2008) Energy storage in salt caverns/Developments and concrete projects for adiabatic compressed air for Hydrogen


The green evolution of energy storage technology can be exemplified by underground space energy storage, including compressed air energy storage systems. It is also possible to use concrete storage volumes when low air pressures are considered . Compressed air systems have been used successfully for many years. They are commonly used in

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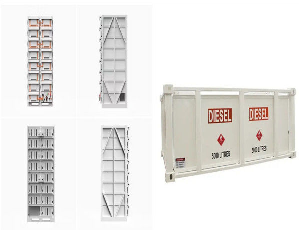

Stability of the underground space will strongly influence the size of the underground reservoir and the construction cost of the project. Years passed after the excavation, and the condition of the underground space may have changed. The underground space conditions depend on the system behavior (i.e. rock mass and the support system behavior).

Compressed air energy storage (CAES) is a large-scale energy storage technology that can overcome the intermittency and volatility of renewable energy sources, such as solar and wind energy. Although abandoned mines can be reused for underground CAES of large scale, their feasibility requires further investigations.

A promising large-scale energy storage is underground compressed air energy storage (CAES) in lined rock caverns. To ensure the safety and stability of storage caverns because of the influence of

The authors adopted a simplified structure of a lined CAES cavern in this study for convenient calculation. The lined rock cavern was characterized by the host rock, the concrete lining, and a sealing layer (Zhou et al 2015).Therefore, some detailed constructions ordinarily seen in natural gas storage, for example, drainage area and sliding layer (Johansson 2003), ???

Mechanical responses induced by temperature and air pressure significantly affect the stability and durability of underground compressed air energy storage (CAES) in a lined rock cavern. An analytical solution for evaluating such responses is, thus, proposed in this paper. The lined cavern of interest consists of three layers, namely, a sealing layer, a concrete lining ???

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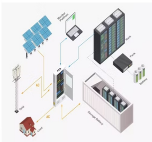
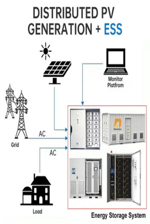
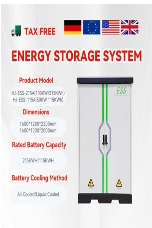


This study focuses on the renovation and construction of compressed air energy storage chambers within abandoned coal mine roadways. The transient mechanical responses of underground gas storage chambers under a cycle are analyzed through thermal-solid coupling simulations. These simulations highlight changes in key parameters such as displacement, ???

Additionally, we introduce the concept of utilizing sediment space for large-scale energy storage purposes. Finally, we anticipate the future development of salt caverns for energy storage in China to focus on large-scale, integrated, and intelligent projects, emphasizing their significance in achieving enhanced efficiency and sustainability.



Compressed air energy storage (CAES) is considered one of the critical technological approaches to bridging the gaps between clean electricity production and electricity demand. An in-situ air storage test in a shallow buried underground cavern was introduced to understand better the connection and mutual influence between aerothermodynamics and ???


The number of abandoned coal mines will reach 15000 by 2030 in China, and the corresponding volume of abandoned underground space will be 9 billion m 3, which can offer a good choice of energy storage with large capacity and low cost for renewable energy generation [22, 23].WP and SP can be installed at abandoned mining fields due to having large occupied area, while ???


3 There are mainly two types of suitable geological formations for large scale energy storage: i) Engineered cavities which refers to the construction of underground caverns with a well- defined geometry, usually taking an area of hundreds of m2, where the stored fluid may occupy all the available space in the cavity.

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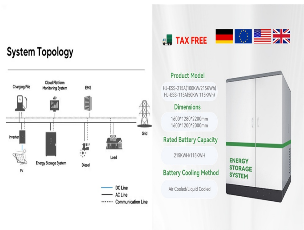
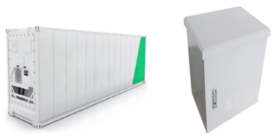
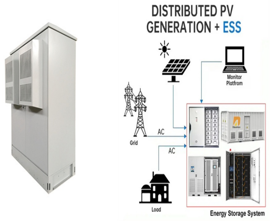


Compressed Air Energy Storage (CAES) is a commercial, utility-scale technology that is suitable for providing long-duration energy storage. Underground air storage caverns are an important part of CAES. In this paper, an analytical solution for calculating air leakage and energy loss within underground caverns were proposed. Using the proposed ???

1. Introduction. Compressed air energy storage (CAES) systems among the technologies to store large amounts of energy to promote the integration of intermittent renewable energy into the transmission and distribution grid of electric power. 1 CAES can be carried out in underground salt caverns, naturally occurring aquifers, lined rock caverns or storage tanks. 2, ???



A large number of voids from closed mines are proposed as pressurized air reservoirs for energy storage systems. A network of tunnels from an underground coal mine in northern Spain at 450 m depth has been selected as a case study to investigate the technical feasibility of adiabatic compressed air energy storage (A-CAES) systems.



Underground thermal energy storage (UTES) is a form of STES useful for long-term purposes owing to its high storage capacity and low cost (IEA I. E. A., 2018).UTES effectively stores the thermal energy of hot and cold seasons, solar energy, or waste heat of industrial processes for a relatively long time and seasonally (Lee, 2012) cause of high thermal inertia, the ???

Compressed air energy storage (CAES) is a large-scale energy storage technology that can overcome the intermittency and volatility of renewable energy sources, such as solar and wind energy.Although abandoned mines can be reused for underground CAES of large scale, their feasibility requires further investigations. This study performs a comparative ???

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We discuss underground storage options suitable for CAES, including submerged bladders, underground mines, salt caverns, porous aquifers, depleted reservoirs, cased wellbores, and surface pressure