



Aquifer cross-level energy storage

What is a aquifer thermal energy storage (ATES) system?

Author to whom correspondence should be addressed. Aquifer Thermal Energy Storage (ATES) systems are a promising solution for sustainable energy storage, leveraging underground aquifers to store and retrieve thermal energy for heating and cooling.

What is low-temperature aquifer thermal energy storage (ATES)?

Low-temperature aquifer thermal energy storage (ATES) systems can provide heating and cooling to large buildings in a green and sustainable way saving on average 0.5 kg of CO₂ for every cubic meter of water extracted (Fleuchaus et al. 2018; Ramos-Escudero et al. 2021; Jackson et al. 2024).

Does aquifer thermal energy storage exist in Germany?

This paper reviews the current research on aquifer thermal energy storage (ATES) and mine thermal energy storage (MTES) in Germany providing descriptions of 3 low-temperature ATES (LT-ATES), 8 high-temperature ATES (HT-ATES), and 2 MTES research sites.

Are aquifer thermal energy storage smart grids a distributed energy management solution?

Rostampour, V.; Jaxa-Rozen, M.; Bloemendal, M.; Kwakkel, J.H.; Keviczky, T. Aquifer Thermal Energy Storage (ATES) smart grids: Large-scale seasonal energy storage as a distributed energy management solution.

Does aquifer heat capacity affect thermal recovery efficiency?

Altogether, this analysis shows that the effects of the aquifer heat capacity C_0 on the thermal recovery efficiency is highly dependent on the geometry of the thermal plume, not only in magnitude, but also in a qualitative sense (i.e., positive or negative). Note that this also applies to the thermal retardation coefficient λ , as $\lambda \propto C_0$.

What is the thermal load of the aquifer?

With reference to the local ambient groundwater temperature of around 13°C, the thermal loading of the aquifer therefore can only vary between 10 and 16°C. The plant went into operation in June 2024.

It uses natural underground saturated aquifers as an energy storage medium that can provide an effective seasonal energy storage method for matching the interseasonal ...

This study investigates the impact of climate change and intense urbanization on Low-Temperature Aquifer Thermal Energy Storage (LT-ATES) systems. A synthetic ...

Abstract A transition to a low carbon energy system is needed to respond to global challenge of climate change mitigation. Aquifer Thermal Energy Storage (ATES) is a ...



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The study aims to investigate the utilization of CO₂ for aquifer thermal energy storage from the perspectives of energy storage and carbon sequestration, termed as CO₂ ...

Principle of Aquifer Thermal Energy Storage Aquifer Thermal Energy Storage is a sustainable energy supply in which heat and cold are stored via a heat exchanger (counter-current device, TSA) in a water-carrying sand ...

As such, ATEs systems can be used to address energy storage challenges that arise from the intermittent nature of renewable energy and other sources. There are many ...

This study investigates the performance of an aquifer thermal energy storage system (ATES) that is coupled with the cooling tower of a seasonally-running thermal plant. ...

Abstract. Evaluating uncertainties of geological features on fluid temperature and pressure changes in a reservoir plays a crucial role in the safe and sustainable operation of high-temperature aquifer thermal ...

Aquifer Thermal Energy Storage (ATES) uses excess thermal energy to heat water which is stored in an aquifer until it is needed, at which time the hot water is recovered ...

Aquifer thermal energy storage (ATES) systems are gaining popularity worldwide. ATEs utilizes groundwater aquifers to store excessive heat and conserves energy. ...

High-temperature aquifer thermal energy storage (temperature differences between 35 and 65 K) presents lower energy recovery rates, from 53 to 71%, with all other ...

Description of the technology In an aquifer thermal energy storage (ATES), excess heat is stored in subsurface aquifers in order to recover the heat at a later stage. The thermal energy is ...

The site-specific three-dimensional computational fluid dynamics (CFD) simulation of an aquifer thermal energy storage (ATES) system was investigated ...

Aquifer Thermal Energy Storage (ATES) systems are a promising solution for sustainable energy storage, leveraging underground aquifers to store and retrieve thermal energy for heating and cooling.

Compressed air energy storage in aquifers (CAESA) is a novel large-scale energy storage technology. However, the permeability effects on underground processes and ...

Schematic of an aquifer showing confined zones, groundwater travel times, a spring and a well An aquifer is an underground layer of water -bearing material consisting of permeable or fractured rock, or of unconsolidated ...



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In the context of aquifer thermal energy storage, we conducted a hydrogeophysical experiment emulating the functioning of a groundwater heat pump for heat ...

Aquifer Thermal Energy Storage (ATES) utilizes the abundance of free geothermal energy in the subsurface to reheat injected fluids, store it in the aquifer and produce it when demand rises. ...

Aquifer thermal energy storage (ATES) is a widely implemented UTES technology that uses cyclic water injection and extraction to satisfy heating requirements [3]. ...

In application, an ATES keeps large quantities of thermal energy in groundwater-saturated aquifers. Normally, an ATES system comprises two (one for heat and ...

For a successful global energy transition, more seasonal thermal energy storage (STES) and district heating and cooling systems are needed. Hence, the...

Aquifer thermal energy storage (ATES) has great potential to mitigate CO₂ emissions associated with the heating and cooling of buildings and offers wide applicability. ...

What's All the Hype About Aquifer Energy Storage? a giant, natural battery hidden beneath your feet. That's essentially what underground aquifer energy storage offers. ...

Sustainable and climate-friendly space heating and cooling is of great importance for the energy transition. Compared to conventional energy sources, Aquifer ...

Using the ground as a seasonal thermal energy store is referred to as underground thermal energy storage (UTES). In the vast majority of cases there are only two ...

The ATES system is an open-loop system that temporarily stores heat and cold in the underground aquifer through fluid injection and production [5, 6]. To address the issue of ...

Thus, cross-scale dynamic simulation research on the compression process of a saline aquifer CAES system is conducted. Under baseline conditions, the temporal variations in gas ...

The majority of Aquifer Thermal Energy Storage (ATES) systems studies have been conducted in aquifer systems located in large sand aquifers. Esker formation present a ...

Simple dimensionless analytical solutions for the thermal recovery efficiency of Aquifer Thermal Energy Storage (ATES) systems are derived, subject to heat losses caused by thermal diffusion and ...

Principle of Aquifer Thermal Energy Storage Aquifer Thermal Energy Storage is a sustainable energy supply



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in which heat and cold are stored via a heat exchanger (counter-current device, ...

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