

# Shallow groundwater energy storage

Is a shallow geothermal system a seasonal energy storage system?

However, a shallow geothermal system is not designated for seasonal energy storage. The system uses the steady earth temperature closer to the surface for daily cooling and heating. Therefore, this system's collector area is relatively equivalent to the building's cooling or heating load.

Where is shallow geothermal energy stored?

Shallow geothermal energy is stored in the Earth's uppermost layers, up to a few hundred meters deep, and can be extracted using a geothermal heat exchanger or ground source heat pump (GSHP). The heat exchanger is placed 1 to 2 m below the surface from the shallow geothermal energy.

Are underground thermal energy storage systems sustainable?

The study aims to explore the potential of Underground Thermal Energy Storage (UTES) systems, including Aquifer Thermal Energy Storage (ATES) and Borehole Thermal Energy Storage (BTES), as sustainable solutions for managing energy supply and demand.

What is shallow groundwater?

Shallow groundwater is defined here as groundwater within the near-surface critical zone where annual aquifer temperature is highly variable (within approximately 6 m from land surface), and this variability is transferred to streams through groundwater discharge zones causing annual temperature signal mixing with characteristic outcomes.

Can shallow groundwater storage buffer plant water stress?

We show that as warming shifts the balance between water supply and demand, shallow groundwater storage can buffer plant water stress; but only where shallow groundwater connections are present, and not indefinitely. As warming persists, storage can be depleted and connections lost.

What are the standards for shallow geothermal energy?

There are national, local and industry standards (DB37/T 4308-2021) and specifications (DZ/T 225-2009) about the investigation and evaluation of shallow geothermal energy that provide calculation and assessment methods based on general geological and hydrogeological conditions.

It is demonstrated that aquifer thermal energy discharge can affect aquifer bacteria and fauna, while at the same time controlling only a minor part of the total seasonal and spatial variability and therefore posing no likely threat to ecosystem functioning and drinking water protection in uncontaminated, shallow aquifers. The use of groundwater as a carrier of thermal ...

Impacts of Shallow Geothermal Energy on Groundwater Quality : A Hydrochemical and geomicrobial study of the effects of ground source heat pumps and aquifer thermal energy storage

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@inproceedings{Bonte2013ImpactsOS, title={Impacts of Shallow Geothermal Energy on Groundwater Quality : A Hydrochemical and geomicrobial study of the ...

Thermal use of the shallow subsurface for heat generation, cooling, and thermal energy storage is increasingly gaining importance in reconsideration of future energy supplies. Shallow geothermal energy use is often promoted as being of little or no costs during operation, while simultaneously being environmentally friendly.

water Article Site Selection of Aquifer Thermal Energy Storage Systems in Shallow Groundwater Conditions Qais Al-Madhloom 1,2, Nadhir Al-Ansari 1, \*, Jan Laue 1, Bo Nordell 1 Hussain Musa Hussain 3 1 2 3 \* and Department of Civil, Environmental and Natural Resources Engineering, Lulea University of Technology, 97187 Lulea, Sweden College of ...

Currently, shallow geothermal energy home use for heating (cooling) could account for 19% of commercial buildings, and for 30% of the new construction. By the joint action of gravity potential, temperature gradient and moisture gradient, groundwater heat storage and transfer is an important part of the hydrological cycle.

Underground thermal energy storage (UTES) systems are well known applications around the world, due to their relation to heating ventilation and air conditioning (HVAC) applications. There are six kinds of UTES systems, they are tank, pit, aquifer, cavern, tubes, and borehole. Apart from the tank, all other kinds are site condition dependent (hydro ...

Aquifer thermal energy storage (ATES) ... Shallow (<400 m) geothermal installations" legal status is diverse among countries. [14] ... The presence of ATES and chlorinated ethenes offers the potential for of integration of sustainable energy technology and sustainable groundwater management. [18]

The shallow groundwater drought indicator is based on terrestrial water storage observations derived from GRACE satellite data and integrated with other observations, using a numerical model of land surface water and energy processes. The drought indicators describe current wet or dry conditions, expressed as a percentile showing the ...

More than 30% of Germany's final energy consumption currently results from thermal energy for heating and cooling in the building sector. One possibility to achieve significant greenhouse gas emission savings in space heating and cooling is the application of aquifer thermal energy storage (ATES) systems. Hence, this study maps the spatial technical potential ...

Mean decline rate of shallow groundwater level slowed by approximately 1 m a<sup>-1</sup> during the entire future period (2041-2100) under three SSPs with a greater reduction for SSP5-8.5. The average contribution rate of future climate toward the balance of shallow groundwater pumping and replenishment was 62.9%.

With the rapid growth of shallow or ambient geothermal energy systems (GES) for heating, cooling, and underground thermal energy storage (UTES), groundwater flow and heat transport modeling have become

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essential tools for the planning, design, and implementation of GES. The development of more advanced assessment and management tools has been ...

The data show that the groundwater circulation by the ATEs system can impact chemical groundwater quality by introducing shallow groundwater with a different chemical composition at greater depth, but the observed concentration changes are sufficiently small to keep groundwater suitable for drinking water production. We used data from an aquifer ...

Groundwater warming in shallow aquifers is closely associated with increasing average land surface temperatures and has already reached + 1 K compared to pre-industrial times. ... Hijnen W (2011) Effects of aquifer thermal energy storage on groundwater quality and the consequences for drinking water production: a case study from the Netherlands ...

Injection of CO<sub>2</sub> into the deep subsurface will affect physical and chemical conditions in the storage environment. Hence, geological CO<sub>2</sub> storage can have potential impacts on groundwater resources. Shallow freshwater can only be affected if leakage pathways facilitate the ascent of CO<sub>2</sub> or saline formation water. Leakage associated with CO<sub>2</sub> storage cannot be ...

Groundwater storage in the Indo-Gangetic Basin increased by ~420 km<sup>3</sup> during the 20th century before large-scale groundwater withdrawal began in the late 1990s and early 2000s . Leakage from surface water irrigation increased groundwater storage by ~20 km<sup>3</sup> in the Columbia Plateau in the northwestern United States between ~1940 and ~1970 .

The use of shallow geothermal energy increasingly receives attention as a suitable alternative to fossil fuel-based space heating and cooling, warm water provision, as well as for seasonal heat storage throughout Europe. With the advent of shallow geothermal energy use on large scales, a vivid discussion of potential ecological and economic impacts has ...

Geothermal energy plays an increasingly important role as a renewable energy source. However, it induces temperature changes in natural thermally static groundwater ecosystems. Temperature impacts can considerably alter the groundwater chemical composition and quality, the metabolism of organisms, and, consequently, biogeochemical processes and ...

DHC systems are a well-established option for space heating and cooling in high-demand density areas because they are more efficient than individual systems and are recognized as a critical technology for the energy transition [[1], [2]]. These criteria make them suited for places with high heating demand, which explains why they have been installed mostly in Central and Northern ...

Comparison of the shallow groundwater storage change estimated by a distributed hydrological model and GRACE satellite gravimetry in a well-irrigated plain of the Haihe River basin, China ... Simulating and assessing the effects of seasonal fallow schemes on the water-food-energy nexus in a shallow groundwater-fed

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plain of the Haihe River basin ...

The importance of considering ground water and surface water as a single resource has become increasingly evident. Issues related to water supply, water quality, and degradation of aquatic environments are reported on frequently. The interaction of ground water and surface water has been shown to be a significant concern in many of these issues.

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