8 thermal energy storage solutions ready for integration

09 February 2025, 21:46

Pieter Jan Jordaens

Explore them in the 2nd LDES deep-dive

Thermal Energy Storage (TES) technologies are emerging as a game-changing solution to decarbonize heat and balance energy supply & demand in intermittent conditions. In an upcoming event on February 20, 2025, we showcase 8 fully operational industry cases. Join us as we explore how these technologies are ready to scale, drive cost savings, and make net-zero production achievable.

This article is co-authored with Giuseppe Casubolo - Director at Vola Alto Consulting

Crushed rock thermal energy storage

Brenmiller Europe

Sensible heat storage using crushed rock is a cost-effective solution for high-temperature heat storage. This system supports large-scale energy storage of **10–100+ GWh** at an incremental cost of $2–4/kWh, suitable for producing steam for electricity, hot water, or industrial hot air. Brenmiller's

ompetitive **levelized**
e renewable energy,

Molten salt thermal energy storage

John Cockerill
The power sector has already adopted TES on a commercial scale with Concentrated Solar Power (CSP) Plants. A CSP plant can indeed store energy in the form of heat using molten salts: a low-cost, flame-proof, and non-polluting fluid made of sodium nitrate and potassium nitrate. In 2020, a molten salt storage capacity of over **21 GWh** was installed worldwide. Since an additional 14 GWh came online. Electrical heater systems are also currently considered, allowing electricity (usually from renewable sources such as photovoltaics) to directly heat to the molten salts ("Power to X" technology). In the future, high-efficiency TES technologies such as next-generation molten salt,

Fluidized sand bed technology

Magaldi Power

MGTES (Magaldi Green Thermal Energy Storage) is an innovative and patented electro-thermal energy storage system based on a fluidized sand bed. The system stores clean energy, either from renewable sources or directly from the grid during off-peak hours, and releases it as high-temperature thermal energy, such as superheated steam, for industrial applications. MGTES operates in three phases: charging (heating the sand via electrical heaters or high-temperature fluids), storage (retaining energy for extended periods with minimal loss by deactivating fluidization), and discharge (delivering thermal energy to industrial processes). With a modular design offering storage capacities from **5 MWh to 100 MWh**, MGTES provides flexibility to meet diverse industrial needs, addressing renewable energy intermittency and advancing decarbonization in industries such as food and beverage, pulp and paper, chemical production, and desalination.

Concentrated solar thermal and decarbonization of industrial heat with thermal energy storage

ENERGYNEST

ENERGYNEST's ThermalBattery™ solutions capture, store, and repurpose power, heat, or steam as clean energy, enabling flexibility, cost reduction, and decarbonization for sectors like chemicals, food and beverages, and pulp and paper. With **high thermal efficiency (>95%)**, robust design, and plug-and-play installation, the ThermalBattery™ supports applications such as **24/7 green steam supply and waste heat recovery.** Projects like those with Avery Dennison in Belgium and YARA International in Norway showcase its potential.

Thermalpod heat battery: flexible electrification of industrial heat

Brabetech

Molten salt is a highly efficient heat transfer medium for high-temperature applications, and Brabetech has developed an innovative ternary molten salt with enhanced properties. This new molten salt features a lower melting point, reduced corrosiveness, high thermal conductivity, and long lifespan while being biologically degradable, making it suitable for smaller-scale industrial heat transfer and storage. With an operating range of 150-500°C, it is durable for up to 25 years and supports reduced CO2 emissions by enabling renewable energy usage. Brabetech's ThermalPod® heat battery, capable of providing flexible electric process heat up to 400°C, optimizes charging times based on energy prices, allowing users to save costs, reduce emissions, and trade energy

urces like solar

High-temperature underground thermal energy storage

PUSH-IT, Energyville

The PUSH-IT project stands for Piloting Underground Seasonal Heat Storage in Geothermal Reservoirs. Its ambition is to overcome the seasonal mismatch between heat demand and heat generation from sustainable sources using underground heat storage. The EU-funded project focuses on three innovative technologies for high-temperature heat storage, —Aquifer, Borehole, and Mine Thermal Energy Storage (ATES, BTES, and MTES)—at six European sites, as well as enabling technologies, societal engagement, and governance policies and business models. PUSH-IT focuses on extending storage temperature ranges to high temperatures, up to 90 °C.


Optimal system integration
Enabling technologies
Delft (NL)
Darmstadt (DE)
Bochum (DE)
United Downs (UK)
Litoměřice (CZ)
Berlin (DE)

Packed-bed thermal energy storage

Energyville

Packed-bed thermal energy storage (TES) systems, utilizing sand in insulated pits, have demonstrated high efficiency for seasonal solar thermal energy storage, achieving **energy savings of 64% to 91% depending on the storage size**. These systems have proven effective in both residential and district heating applications, even in freezing climates. Sand's high thermal conductivity and specific heat capacity make it an ideal medium, with a circulating through the sand to store heat during low-demand periods (e during high-demand periods (e.g., winter). Experimental facilities in Finl packed-bed sand TES for **district heating** since 2020, further validatin **providing 65–75% of domestic hot water needs in daily storage sy**

High-temperature pump design for molten medium energy storage applications

Sulzer

Sulzer's molten salt circulation pumps are engineered to handle extremely high-temperature molten salt, a key heat transfer fluid in concentrated solar power (CSP) systems. These vertical line shaft pumps are used in heliostat central towers and parabolic troughs for applications such as heating molten salt in solar receivers, feeding steam generators, storing thermal energy, and **extending CSP plant operations beyond sunset**. Featuring capacities up to 4,000 m³/h, heads up to 350 m, and **temperatures up to 600°C**, the VEY and VNY pumps deliver high efficiency, durability, and reliability. In heliostat systems, molten salt enables the generation of high-rate superheated steam, while parabolic troughs utilize molten salt for heat storage to extend operating hours. Sulzer also supports hybrid solar-fossil configurations and cost-efficient linear Fresnel reflector technologies, providing advanced solutions for optimizing solar energy integration. Their experienced service engineers ensure peak equipment reliability and performance.

Read more

- IEA-ES Factsheet on Liquid Salt Heat Storage
- IEAS-ES Factsheet on Solid Medium Heat Storage

Upcoming events

February 20, 2025 - **Deep-dive into LDES-technologies: thermal energy storage**
March 25, 2025 - **How to grow a future-proof battery storage industry**

Authors

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