



# Thermal energy storage definition

## Thermal energy storage definition

Thermal energy storage involves heating or cooling a substance to preserve energy for later use. In its simplest form, this process includes heating water during periods of abundant energy, storing it, and later using the stored energy. This utilizes storage options like water, ice-slush-filled tanks, earth, or large bodies of water below ground.

Defined as a technology enabling the transfer and storage of heat energy, thermal energy storage integrates with modern energy solutions like solar and hydro technologies. During off-peak electrical demand, chilled or hot water is generated and stored, later withdrawn and distributed during peak periods. The storage tank, equipped with diffusers at the top and bottom, facilitates the stratification of water, creating a transition layer between warm and cold water regions. The cost-effectiveness of electricity used for thermal energy generation is higher at night than during the day.

Thermal energy storage employs various technologies, offering storage times ranging from hours to months. Different material properties are utilized in Thermal Energy Storage (TES) applications, categorized into three methods based on thermal mechanisms: sensible heat, latent heat, and thermochemical heat.

1. Sensible thermal energy storage is a viable option for lowering energy consumption and CO<sub>2</sub> emissions, particularly in residential buildings. This method involves using water or rock to store and release heat by varying the temperature of the material.
2. Latent heat storage systems store energy by changing the state of the medium without altering its temperature. Phase change materials, applied in solar technologies and building materials, can store heat as latent heat, allowing for the absorption and storage of excess building heat.
3. Thermochemical heat storage systems rely on chemical reactions or sorption processes on the material's surface, enabling the material to absorb or emit heat.

Many countries prioritize decarbonization strategies, emphasizing renewable energy and increased electrification, as these approaches can achieve up to 90% of emission reductions. The decreasing costs of renewable energy underscore the importance of this transition. However, the inherent variability of renewable energy sources necessitates increased energy storage to ensure a consistent supply of clean energy during periods of fluctuation, such as when the wind is calm or the sun is not producing solar energy.

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While battery storage technology is developing rapidly, there are alternatives that help meet the challenges of

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renewable energy intermittence and grid stability, for example thermal energy storage.

Thermal energy storage means heating or cooling a medium to use the energy when needed later. In its simplest form, this could mean using a water tank for heat storage, where the water is heated at times when there is a lot of energy, and the energy is then stored in the water for use when energy is less plentiful. Thermal energy storage can also be used to balance energy consumption between day and night. Storage solutions include water or storage tanks of ice-slush, earth or bedrock accessed via boreholes and large bodies of water deep below ground.

Many different technologies can be used to achieve thermal energy storage and depending on which technology is used, thermal energy storage systems can store excess thermal energy for hours, days or months.

Sensible thermal energy storage is considered to be the most viable option to reduce energy consumption and reduce CO2 emissions. They use water or rock for storing and releasing heat energy. This type of thermal energy storage is most applicable for residential buildings.

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