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The world"s first commercial "sand battery" stores heat at 500 degrees Celsius for months at a time. It can be used to heat homes and offices and provide high-temperature heat for industrial ...

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Researchers at the US National Renewable Energy Laboratory (NREL) have developed a technology that reveals how heaters powered by renewable energy sources like wind and solar can raise the temperature of sand particles, which can then be deposited into silos for storage and later use.

The patented technology is based on thermal energy storage, or TES, which normally uses molten salts or even superheated rocks to store energy and shows promise as a low-cost alternative to existing storage solutions.

A laboratory-scale prototype validated the technology and allowed researchers to create a computer model that shows a commercial-scale device would retain more than 95% of its heat for at least five days.

"Lithium-ion batteries have really cornered the market at two to four hours of storage, but if we want to achieve our carbon reduction goals, we will need long-duration energy storage devices--things that can store energy for days," Jeffrey Gifford, a postdoctoral fellow at NREL who is involved in the development, said in a media statement.

"Particle thermal energy storage doesn"t rely on rare earth metals or materials that have complex and unsustainable supply chains. For example, in lithium-ion batteries, there are a lot of stories about the challenge of mining cobalt more ethically."

In addition to TES, Gifford"s expertise is in computational fluid dynamics. That knowledge is important because the sand needs to flow through the storage device. Other TES media include concrete and rocks, which can easily retain heat but remain solidly in place.

"Your heat transfer is much higher and much quicker and much more effective if you’re moving your media," Gifford said.

TES also has another key advantage: the cost. Head researcher Zhiwen Ma has calculated sand is the cheapest option for energy storage when compared to four rival technologies, including compressed air energy storage (CAES), pumped hydropower, and two types of batteries.

CAES and pumped hydropower can only store energy for tens of hours. The cost per kilowatt-hour for CAES ranges from $150 to $300, while for pumped hydropower it is about $60. A lithium-ion battery would cost $300 a kilowatt-hour and only have a capacity to store energy from one to four hours. With a duration lasting hundreds of hours, sand as a storage medium would cost from $4 to $10 a kilowatt-hour. To ensure low cost, the heat would be generated using off-peak, low-price electricity.