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The key is to store energy produced when renewable generation capacity is high, so we can use it later when we need it. With the world"s renewable energy capacity reaching record levels, four storage technologies are fundamental to smoothing out peaks and dips in energy demand without resorting to fossil fuels.

Here are four innovative ways we can store renewable energy without batteries. Giant bricks are not what most people think of when they hear the words "energy storage", but they are a key element of a gravity-based system that could help the world manage an increasing dependence on renewable electricity generation.

Energy storage involves converting energy from forms that are difficult to store to more conveniently or economically storable forms. Some technologies provide short-term energy storage, while others can endure for much longer.

To enable a high penetration of renewable energy, storing electricity through pumped hydropower is most efficient but controversial, according to the twelfth U.S. secretary of energy and Nobel laureate in physics, Steven Chu. A combination of new mechanical and thermal technologies could provide us with enough energy storage to enable deep ...

Pumped storage is possibly one of the oldest forms of modern grid-tied energy storage, and it certainly packs the most punch as far as megawatt-hours delivered.

The way it traditionally works is simple: the system has a bottom reservoir of water to draw from and a top reservoir that"s topographically higher than the bottom reservoir. When there"s not a lot of demand for electricity, you use that power to "charge" the battery by pumping water up to the top reservoir. When demand for electricity is high, that reservoir can be drained via a hydroelectric generator, back down to the bottom reservoir.

In the future, Germany is looking at using old coal mines for pumped storage, and some German researchers have been working on building giant concrete spheres that can function as pumped storage containers after they"re placed on the ocean floor.

Compressed air energy storage, or CAES, is a lot like pumped hydro energy storage, except power producers use electricity during periods of low demand to pump ambient air into a storage container instead of water. When electricity is needed, the compressed air is allowed to expand and used to drive a turbine to generate power.

According to the Energy Storage Association, since air heats up as it"s compressed, that heat has to be removed from the high-pressure air before it"s stored. Then that heat has to be added back to the high-pressure

air as it"s released. This is done via a generator (usually a natural gas generator) or in a more environmentally friendly way using heat saved from the storage process in an adiabatic CAES system.

Although compressed air energy storage schemes have been discussed for decades, the expense of building storage facilities means there are only a handful of deployed systems and a slightly larger handful of test systems.

Molten salt can retain heat for a long time, so it"s generally found in solar thermal plants, where dozens or hundreds of heliostats (large mirrors) use the heat from sunlight to create energy. In some plants, sunlight is directed toward a large central thermal tower that heats up quickly and boils a working fluid inside. In other plants, pipes full of fluid run in front of parabolic mirrors, and the fluid heats up in those pipes. Either way, that heat can be used immediately to drive a steam turbine, or it can be transferred to molten salt, where the heat can be stored for hours. This helps solar plants extend their working hours and provide electricity well into the evening.

On the horizon, molten salt seems to have a clear future. Researchers have been looking into perfecting molten salt batteries for a variety of uses, and just recently, SolarReserve announced plans for a solar thermal plant in Chile that would run for 24 hours a day thanks to a massive molten salt storage area.