Compressed air storage power plant

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The clean energy revolution will require huge amounts of energy storage, to buffer against the intermittent power delivered by solar and wind. Some of that will come in the form of big battery installations - but there"s a huge lithium supply shortage coming that"ll raise the price of lithium-based batteries and make it very tough for Tesla-style operations to handle a big chunk of the work.

China has diversified its efforts, and indeed just this week it switched on the world"s largest flow battery, a 100-MW, 400-MWh vanadium flow battery installed in Dailan that offers relatively low-cost energy storage without using any lithium. But according to Asia Times, China is planning to lean heavily on compressed air energy storage (CAES) as well, to handle nearly a quarter of all the country"s energy storage by 2030.

Now, after several years of development by the Chinese Academy of Sciences, it has connected the world"s first 100-MW advanced CAES system to the grid, ready to begin commercial service in the city of Zhangjiakou in northern China. By designating it as "advanced," the Academy is distinguishing it from the McIntosh Plant that"s been online since 1991 in Alabama - a 110-MW CAES facility that burns its stored air with natural gas to recover energy, and is thus not a green energy storage solution.

The new Zhangjiakou plant does away with fossil fuels, using advances in supercritical thermal storage, supercritical heat exchange, high-load compression and expansion technologies to boost system efficiency. According to China Energy Storage Alliance, the new plant can store and release up to 400 MWh, at a system design efficiency of 70.4%.

The Chinese Academy of Sciences says the Zhangjiakou plant is capable of supplying the local grid with more than 132 GWh of electricity annually, taking on the peak consumption of some 40-60,000 homes. It"ll save around 42,000 tons of coal from being burned in power stations, and reduce annual carbon dioxide emissions by around 109,000 tons - the equivalent of taking about 23,700 average American cars off the road.

The Academy says this design"s low capital costs, long lifetime, safety and efficiency, along with its green credentials, position it well as "one of the most promising technologies for large-scale energy storage."

The growth of renewable power generation is experiencing a remarkable surge worldwide. According to the U.S. Energy Information Administration (EIA), it is projected that by 2050, the share of wind and solar in the U.S. power-generation mix will reach 38 percent, which is twice the proportion recorded in 2019. The incorporation of Compressed Air Energy Storage (CAES) into renewable energy systems offers various economic, technical, and environmental advantages.

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By 2030, it is anticipated that renewable energy sources will account for 36 percent of global energy production. Energy storage systems will be instrumental in attaining this objective. Mechanical storage systems stand out among the available energy storage methods due to their reduced investment expenses, prolonged lifetimes, and increased power/energy ratings. Notably, commercialized large-scale Compressed Air Energy Storage (CAES) facilities have arisen as a prominent energy storage solution.

Since the late 1970s, (CAES) technology has been commercially available. This energy storage system functions by utilizing electricity to compress air during off-peak hours, which is then stored in underground caverns. When energy demand is elevated during the peak hours, the stored compressed air is released, expanding and passing through a turbine to generate electricity.

As per anarticle published in Energies, the CAES system follows the conventional three-phase model of a conventional gas turbine, encompassing charging, storing, and discharging.

In the charging phase, CAES makes use of off-peak and cost-effective electricity to compress ambient air. The compressed air is then stored in a dedicated pressurized reservoir, which can be either an underground cavern or an aboveground tank, typically maintained at a pressure of 40-80 bar.

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