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Rabi, A.M.; Radulovic, J.; Buick, J.M. Comprehensive Review of Compressed Air Energy Storage (CAES) Technologies. Thermo 2023, 3, 104-126. https://doi /10.3390/thermo3010008

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Compressed-air-energy storage (CAES) is a way to store energy for later use using compressed air. At a utility scale, energy generated during periods of low demand can be released during peak load periods.[1]

One ongoing challenge in large-scale design is the management of thermal energy, since the compression of air leads to an unwanted temperature increase that not only reduces operational efficiency but can also lead to damage. The main difference between various architectures lies in thermal engineering. On the other hand, small-scale systems have long been used for propulsion of mine locomotives. Contrasted with traditional batteries, systems can store energy for longer periods of time and have less upkeep.

Compression of air creates heat; the air is warmer after compression. Expansion removes heat. If no extra heat is added, the air will be much colder after expansion. If the heat generated during compression can be stored and used during expansion, then the efficiency of the storage improves considerably.[4] There are several ways in which a CAES system can deal with heat. Air storage can be adiabatic, diabatic, isothermal, or near-isothermal.

Packed beds have been proposed as thermal storage units for adiabatic systems. A study [7] numerically simulated an adiabatic compressed air energy storage system using packed bed thermal energy storage. The efficiency of the simulated system under continuous operation was calculated to be between 70.5% and 71%.