

# **Current status and perspectives on carbon dioxide energy storage**

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## **Extended Abstract**

Compressed gas energy storage systems are among the large-scale solutions to integrate intermittent renewable energy sources into the electrical grid and guarantee its stability. They offer also a green option for off-grid remote communities. The first large-scale conventional facility working with air has been installed and operated in Huntorf (Germany) in 1978, with a global energetic efficiency ranging between 42 and 54% (290 MW). Since then, several adiabatic or isothermal systems have been developed at the prototype scale. Their main drawback remains the huge required volume of the reservoir, limiting their deployment to regions with available underground abandoned mines or caverns. Carbon dioxide presents the advantage of having a critical temperature near the ambient temperature with a larger density. Therefore, liquid aboveground storage under non-extreme temperature condition is conceivable. This plenary lecture will review the existing experimental studies on carbon dioxide energy storage systems and discuss the limitations of current steady-state models. The emphasis will be placed on the recent developments done in collaboration with IMT Atlantique (Nantes, France). Progress on dynamic modeling showed that the energy efficiency reaches around 25% with an energetic density of 1-2 kWh/m<sup>3</sup>, far from the predicted values obtained by idealized models. However the storage energetic density can be improved by adding adsorption materials like active carbon or zeolite to the reservoirs. Potential avenues to enhance the performances of these systems are also identified like the development of new pressure relief devices admitting higher inlet pressures, the introduction of passive components (ejector, vortex tube) for thermal management among other examples.

**Keywords:** Remote communities; Carbon dioxide; Energy storage; Prototype, Thermodynamics modeling