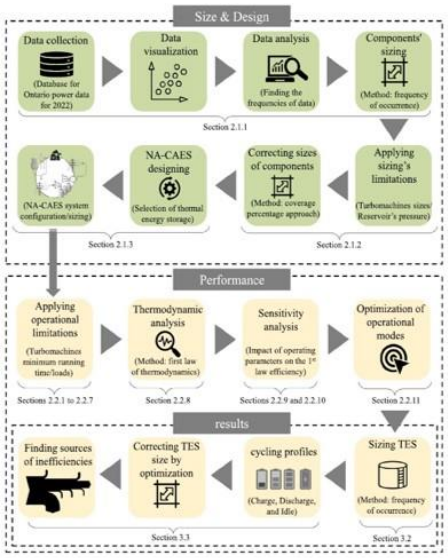

STORING ENERGY MORE EFFICIENTLY WITH COMPRESSED AIR

Prof. Roydon Fraser and Prof. Maurice Dusseault

Compressed air energy storage (CAES) offers a way to buffer mismatches in energy supply and demand, on scales from megawatt hours to gigawatt hours. The principle is simple. Excess electricity is used to run an air compressor. The compressed air is stored in underground caverns, boreholes or tanks and then expanded to drive a turbine when energy is required.

But no energy storage system is practical unless it's efficient. In the case of CAES, a big part of that is managing the heat created when you compress air. Near-adiabatic CAES systems attempt to do that using heat exchangers and thermal energy storage. Unfortunately, experimental projects have failed to achieve the 50–70 per cent efficiency levels predicted by thermodynamic models.

WISE researchers Roydon Fraser and Maurice Dusseault suspected better design could make a big difference. With the help of two doctoral students, they ran more than 80,000 scenarios based on Ontario's electrical grid data to determine optimal component sizes. Next, they assessed three different system configurations over a year of operation.

Using sensitivity analyses, they pinpointed which operational parameters created the greatest impact, looking at everything from minimum compressor loads to the temperature levels within the cavern.

A number of insights emerged from the research, including the fact that the system charges and discharges several times throughout the day, rather than once a day as assumed in earlier models.

Ultimately, Fraser and Dusseault conclude that with the right design, near-adiabatic CAES systems can achieve efficiencies of more than 60 per cent.

Researchers: *Roydon Fraser, Maurice Dusseault, Sepideh Sarmast, Kamyar Rouindej*

Source: *Sarmast, S., Rouindej, K., Fraser, R., & Dusseault, M. (2024). Optimizing near-adiabatic compressed air energy storage (NA-CAES) systems: Sizing and design considerations. Applied Energy, 357, 122465.*

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