PARTICIPATING PROFITABLY: HOW COMPRESSED AIR ENERGY STORAGE CAN MAKE THE MOST OF ELECTRICITY MARKET

Prof. Kankar Bhattacharya & Prof. Claudio Cañizares

Compressed air energy storage (CAES) facilities offer an attractive way for bulk power systems to buffer the intermittent nature of renewable energy, storing excess energy when it's not needed and retrieving it during peak demand. But few studies have examined their operation in electricity markets.

For WISE researchers Claudio Cañizares, Kankar Bhattacharya and Matheus Zambroni de Souza, the question was how to maximize daily profits for these facilities. To find out, they developed two mathematical models to determine the optimum schedule for dispatching power to electricity markets.

The first leverages a Robust Optimization (RO) approach, which maximizes profit under worst-case scenarios, while the second uses Affine Arithmetic (AA) techniques. To hedge against price uncertainties, both approaches consider a wide range of parameters, including the thermodynamic characteristics of CAES, variable operational costs, air flow rates and more.

The researchers then used historical data from Ontario's electricity market to test the performance of their models, which considered both energy and spinning reserve markets simultaneously, enabling CAES owners to opt for the most profitable choice.

Both methods performed better than Monte Carlo simulations: a common modelling approach in situations with lots of uncertainties. The RO model offered the lowest computational burden and multiple possible schedules for operators to choose from. However, it was the AA model that yielded the most desired schedule, albeit at a higher computational cost.

As CAES systems become more widely adopted, these results will give owners the tools they need to confidently participate in electricity markets.

Researchers: Matheus F. Zambroni de Souza, Claudio A. Cañizares and Kankar Bhattacharya

Partners: The Natural Sciences and Engineering Research Council of Canada and the Ontario Centres of Excellence

Source: Souza, *M., Cañizares, C., & Bhattacharya, K. (2021). Self-Scheduling Models of a CAES Facility Under Uncertainties. IEEE Transactions on Power Systems, 36(4), 3607-3617.*

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