Operation of Large-Scale Energy Storages Under Imperfect Foresight

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Australia's National Energy Market is becoming increasingly weather dependent as the system transitions to renewable energy sources. Accurate weather forecasting is now essential not only for predicting energy demand, but also for estimating wind and solar generation. Given the weather-driven variation in renewable output, it is necessary to deploy long-duration energy storages to ensure a stable and reliable power supply. The value of these systems will be heavily reliant on the ability of operators to accurately predict periods of high and low renewable energy yield well in advance. However, this presents a significant challenge, as weather forecasts become increasingly uncertain beyond 3-4 days.

This project, based on analysis undertaken as part of an ongoing collaboration between Powerlink and the Bureau of Meteorology, aims to use ACCESS (Australian Community Climate and Earth-System Simulator) data to benchmark the impact of current forecast uncertainty on energy storage systems. Using historic forecasts, and stochastic optimisation methods, our work demonstrates how ensemble forecasting models can enable power systems to efficiently manage and account for potential risks, thereby improving reliability, reducing system costs, and decreasing overall emissions.

This study has also highlighted the utility of high-resolution weather models in accurately inferring wind power production, as wind speeds can vary widely over 10-50km grid cells, leading to substantial differences in power output. Our presentation will further analyse how improving the temporal resolution of numerical models allows operators to better predict the short-term variations in solar panel output caused by changing cloud conditions. These weather models will help ensure the power industry is well-equipped to manage the increased uncertainty inherent in a highly renewable energy system.