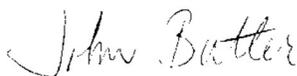


24X7 LOAD MATCHING WITH WIND, SOLAR PHOTOVOLTAIC, AND BATTERY STORAGE POWER PLANTS

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ABSTRACT

Corporations and cities with decarbonization targets have to date accounted for green energy achievements by offsetting fossil-fuel power consumption with renewable energy certificates (RECs) on annual region-agnostic bases. In 2018 Google pronounced the decarbonization and risk-management benefits of time-matching procurement of regionally generated zero-carbon energy with consumption, asserting that the pathway toward deep decarbonization of the grid will require solutions that ensure low-cost power at all times across all regions. This thesis explores the viability of using portfolios of wind, solar photovoltaic (PV), and lithium-ion battery energy storage systems (BESS) to provide competitively priced 24x7 load-matched power in Texas, where these technologies comprise 95% of the power plant queue seeking to interconnect to the Electric Reliability Council of Texas (ERCOT) grid. The first stage of analysis develops a linear program that identifies capital-cost-minimized portfolios of wind, PV, and four-hour Li-ion BESS capacity capable of servicing a data center's load every hour in the year. In a second stage of analysis, a tax-neutral financial model compares the unsubsidized economics of use cases for an optimized portfolio, including selling power production on a merchant basis, selling ancillary services using the BESS, and selling a long-term 24x7 renewable energy service. The linear program finds that least-cost 24x7 portfolios capable of servicing a steady 50 MW load include on average 77 MW solar PV, 78 MW coastal wind, 74 MW north Texas wind, and 165 MW / 660 MWh BESS. At a BESS capital cost of \$300 per kWh, a 24x7-capable renewable energy portfolio reaches economic parity with a fully merchant PV + wind use case when the load-matching service is priced at the long-term average wholesale energy price. While further study is necessary to assess risk-management costs, this analysis provides initial indication that a 24x7 load-matching service may be an economically viable long-term contracting pathway in regions with diversified intermittent resources and wholesale markets for BESS services.



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