Abstract

Exploring the Trade-offs Between Battery Storage and Transmission

Sarah Emilee Dodamead, M.S. EER
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Supervisor: Dr. Michael Webber

This thesis analyzes the financial, political, and technological trade-offs between two technologies–transmission and battery storage–within a capacity expansion framework in ERCOT, motivated by the need to make renewable energy affordable and reliable to decarbonize the electricity grid. The quantitative aspect of this analysis consists of modeling three scenarios in the SWITCH capacity expansion model: Base Case, Carbon Tax, and Heavy Electrification. The objective function that the model solves for is least cost. The qualitative aspect of this analysis consists of research to summarize the technological, political, and financial factors that influence deployment for which the model is unable to account. The qualitative analysis reveals it is easier to raise capital and gain political support for battery projects compared to transmission projects. Analysis of the SWITCH model results reveals that regardless of decarbonization goals, to build out the most reliable and affordable grid, ERCOT should construct the majority of new capacity with solar and wind in west texas where the resources are rich and a proportional amount of a combination of transmission and energy storage capacity, though transmission capacity deployment is more significant. Battery storage should be co-located with renewables and also sited near demand centers, although more should be constructed near the demand centers. The qualitative analysis suggests that a larger percentage of energy storage should be deployed relative to the model's outputs based on the positive technological, political, and financial considerations.

Michael Webber

Supervisor