

ANALYSIS OF ECONOMIC AND TECHNICAL FEASIBILITY OF WIND FARM PARTICIPATION IN ELECTRICITY MARKETS

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Project Overview

The objective of the proposed project is to identify obstacles to the participation of wind farms in electricity markets and recommend solutions to these obstacles. A variety of scenarios, that pair wind with other resources in various ISO markets, will be considered. The markets of interest are i) the day-ahead market for which uncertainty in wind generation forecasting affects unit commitment and scheduling, ii) the hour-ahead market in which the variability of wind output affects system load following capability, and iii) ancillary services markets of spinning reserves and load following, for which wind generation *may* be able to participate with the installation of recently developed control equipment.

Approach and Tasks

The research methodology will involve five elements, drawing upon the results of ongoing research in the wind generation industry;

1. Characterize resources to pair with wind farms in order to improve wind farm performance in terms of market participation
 - a. We will analyze the coupling of wind paired with hydro-storage facilities, and wind paired with responsive load. The objective will ultimately be to determine if these pairings will decrease the net variability of wind enough to facilitate the participation of wind in the markets
 - b. Technology modeling (including wind farms) will include specifying ramp capability, availability, and fixed and variable costs
2. Analyze the uncertainty inherent in both load and wind speed,
 - a. Using results of the most recent statistical techniques, examine the magnitude and correlation in forecasting errors.
3. Briefly address the economic/market benefits, actual and anticipated, for wind generation in terms of pollutant emissions and the potential for emissions credits and/or emissions trading markets.
4. Perform a case study of wind participation in markets of a selected ISO
 - a. We will perform an initial search to choose a region for analysis, selecting one of the following: California, New England, New York, the Pacific Northwest (BPA and PacifiCorp), PJM or ERCOT
 - b. Develop statistical representations of wind speed and load for the selected region of the country
 - c. Examine the relevant market rules for the day-ahead, hour-ahead, real time and ancillary services (load following and reserves) markets as they relate to wind participation
 - d. Identify existing market rules that could potentially benefit and/or discriminate against the participation of wind farms in electricity markets

- e. Briefly examine the renewable portfolio standards for the selected market, if one exists, and identify potential benefits for wind farm participation as a result of the RPS
 - f. Account for known network constraints by only pairing resources on the same side of these known constraints
5. **Goal/Product:** Analyze the potential market participation for wind farms
- a. Use the analysis of the paired technologies from Step 1 along with the statistical/forecasting analysis from Step 2 to determine the range of expected performance (expected MW output and variability) of wind farms, for the selected ISO
 - i. when paired with specified technologies (load and hydro),
 - ii. at different penetration levels: 10%, 20% and 30%, as time permits
 - b. Operational feasibility: Address methods for the paired technologies to overcome the discriminatory market rules
 - c. Economic/Market feasibility: Using historical price data from the selected ISO, analyze the economic viability of wind farm participation in electricity markets