INTERMITTENCY AND UNCERTAINTY IN WIND AND SOLAR ENERGY: IMPACTS ON THE FRENCH ELECTRICITY MARKET

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Overview

Renewable energy technologies are critical to reducing greenhouse gas emissions from the electricity sector. However, intermittency and uncertainty (forecast error) of renewable energy sources create challenges for the operation of electricity grids and markets. We analyze the impacts of intermittency and uncertainty from wind and solar energy in a novel setting: the French electricity intraday market. Particular attention is given to the residual demand variation in relation to price change.

Methods

To do this, we collect price data from the EPEX SPOT exchange website, renewable energy generation and forecasting data and interconnection (import&export) data from the French Transmission System Operator (TSO) website. We statistically analyze the collected data, focusing specifically on intermittency and uncertainty. We then run a fixed-effect regression to measure the impact of these factors on prices. To see how prices evolve with increasing residual demand, we segmented our data set into percentiles based on residual demand and performed a regression analysis to explore the relationship between price changes and increasing residual demand.

Results

The results indicate that wind uncertainty and solar intermittency significantly affect prices on the intraday market, more so than generation forecasts. Price fluctuations depend not only on residual demand levels, but also on the merit order curve's shape. On the other hand, demand uncertainty and intermittency are better managed than those of Renewable Energy Sources (RES). In addition, interconnection and the conventional generation mix play an essential role in stabilizing prices during RES uncertainty occurring during peak-hour.

Conclusions

In the future, our research aims to investigate how demand flexibility could offset the costs of uncertainty and manage congestion in less interconnected regions, particularly in Brittany and south-east France. The results will help determine whether the development of demand response and interconnection can facilitate the integration of RES.

References