The Impact of Virtual Trading on Wholesale Electricity Markets

a.

In recent years wholesale electricity markets have introduced financial products such as virtual load and virtual generation with the intention of providing tools for physical participants to hedge their positions and allow financial participants to engage in price arbitrage. The belief is that financial participants will seek out profitable bidding opportunities and in the process provide for price convergence between the Day Ahead and Real Time markets as the result of better commitment of generation resources. More recently PJM Interconnection, the RTO for the Mid-Atlantic region, introduced a spread bid product named an Up-to-Congestion transaction (UTCs), which is a paired virtual generation and virtual load bid. Trading volume in UTCs rapidly surpassed the volume of the other financial products and in recent times UTCs represent about one third of all the volume in the Day Ahead market, including actual load and generation. There are questions about the effectiveness of UTCs on providing price convergence, improving the commitment of generation resources and their impact on out-of-market payments. The role of UTCs in the wholesale power markets, which differ considerably from traditional frequently traded markets, have been under scrutiny by many including the Federal Energy Regulatory Commission. The purpose of this paper is to use a scaled version of PJM interconnection’s commitment and dispatch model to discern possible impacts that the trade of UTCs have on market outcomes such as price convergence between the Day Ahead and Real Time Market, grid congestion, welfare impacts on different market participants, and out-of-market payments. Additionally the model will be used to compare the impact on market outcomes of UTCs with that of virtual load and virtual generation bids for price arbitraging purposes.

b. Methodology

As previously stated a scaled version of PJM interconnection’s commitment and dispatch models are used to simulate different scenarios. The commitment and dispatch models are based on the DC approximation optimal power flow model. The Day Ahead models optimize commitment and dispatch over a 24 hour period. The Real Time models are run once for every hour, for a total of 24 times, and it optimizes over a 15 minute period, similar to PJMs which optimize over a 5 minute period. The Real Time models use as an input the commitment from the Day Ahead model and it can commit additional generation, peaking only, to satisfy any ramping constraints. Some scenarios do not include virtual bids while others include the different virtual bids and the purpose is to compare the results.

c. Results

The research is currently ongoing but there are some preliminary results. It has been observed that given the unique nature of wholesale electricity markets (lumpiness in commitment, constrained supply curves, uncertainty of exact real time demand, lack of perfect information, etc.) it is unlikely that virtual trading improves the unit commitment process and provides price convergence between the Day Ahead and Real Time Markets. However there are differences in the effectiveness of different financial products. Virtual load and generation have the right incentives and thus are more likely to be able to provide for price convergence than Up-to-Congestion bids. Up-to-Congestion bids have the effect of increasing congestion in the Day Ahead market and this has some potentially large distributional impacts where financial participants extract rent payments from load paying consumers without providing any value to the market.

d. Conclusions

As previously stated this research is currently ongoing and I would like to run more simulations and scenarios before making any final conclusions.