Competition and Cooperation Among Wind Farms

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I. Abstract

We investigate group formation and strategic behaviors of wind power producers in the electricity market. Currently, wind farms bid into the day-ahead market in a conservative fashion to reduce the possible real-time penalty of not meeting their bid amount. It has been suggested in the literature that wind farms would bid less conservatively if they can form large groups to take advantages of spatial diversity to reduce uncertainty in their aggregate output. We show that if this group act strategically, it would artificially lower the aggregate output because of market power. In fact, we show that under a wide range of operating conditions, the power production of a a grand coalition of wind producers is less than the total wind production if each wind farm individually bid into the market. To maximize the amount of wind power production, we characterize the tradeoff between market power and generation uncertainty as a function of the size of groups. We show there is a sweet-spot in the sense that there exists groups that are large enough to achieves the uncertainty reduction of the grand coalition, but small enough such that they have no significant market power. We validate our claims using PJM and NREL data.

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