

(Anti)Competitive effects of RES infeed in a transmission-constrained network

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1. Motivations underlying the research

In the process of the decarbonization of the power industry many countries are adding substantial capacities of wind and solar based power generation to their portfolio. While ownership of conventional capacities is often highly concentrated for historical reasons, in some countries renewable energy is mainly provided by small, independent producers. In such a setup, one might expect competitive pressure in the electric power industry to increase as renewable energy production grows. It is hoped that RES production might also curb the market power of conventional producers.

However, energy from renewable sources often has to be transported over long distances and current transmission systems are poorly designed for this task. In Europe, this is particularly true for wind power produced in coastal areas. In this paper we analyze the effects of regionally concentrated RES-infeed in a transmission-constrained network in which incumbent conventional producers have market power. Surprisingly we find that an increase of RES infeed in a surplus region might lead to a decline in total generation and consumer surplus in the market if transmission capacities are insufficient. We also show that volatility might arise endogenously from strategic interaction. Conventional generation and nodal prices may be stochastic even if RES infeed, generation cost and demand are perfectly predictable and known to all market participants.

2. A short account of the research performed

We use a simple two nodes / one line network model of spatial Cournot competition. First we explain the intuition behind the potential for an anti-competitive effect of increased wind in-feed using simple graphs. We illustrate the switch from an equilibrium in which the market is fully integrated to an equilibrium in which transmission constraints are binding. The resulting fragmentation of the market allows the dominant conventional producers to exploit their local market power more aggressively. For certain parameter combinations, only equilibria in mixed strategies exist. In these cases even a deterministic environment yields stochastic conventional generation and prices. Then we calibrate the model with German data on consumption and transmission and numerically characterize pure and mixed strategy equilibria for various levels of wind in-feed. We find that for a large range of realistic parameters, wind in-feed in the surplus region has the potential to aggravate market power and decreases consumer welfare. Finally we discuss measures to mitigate this effect, such as maintaining enough competition among conventional producers and increasing transmission capacity.

3. Main conclusions and policy implications of the work

Our main conclusion is that spatially concentrated RES infeed has a potential for anti-competitive effects if transmission capacities are sufficiently small and conventional generation is sufficiently concentrated. The effects on prices and consumer welfare can be substantial if large generators enjoy local market power. Even though the share of conventional generation in total generation declines as the importance of RES generation by new entrants increases, the need to maintain vigorous competition between large incumbents is increased.

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