LOAD AGGREGATION PRICING IN GERMANY – ZONAL PRODUCER PRICES WITH UNIFORM CUSTOMER PRICE

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Overview

Increasing renewable feed-in in Germany leads to growing network congestion forcing transportation system operators to (geographically) redispatch power plants. The introduction of a load aggregation pricing (LAP) system following Californian experiences offers an alternative to this form of system rebalancing. As a hybrid between zonal pricing and a single pricing zone (then including redispatching), LAP uses zonal prices for producers while at the same time maintain uniform pricing for electricity customers. This solution faces less political opposition and gives incentives for efficient investment and dispatch—also for renewables being linked to market prices. In addition, incentives for network investment will be increased.

Methods

We take a two-stage optimizing model out of the MPEC class (Mathematical Programming with Equilibrium Constraints, [1]) to analyze impacts the LAP introduction. The first stage includes capacity planning by the network operator, who is assumed to act as a profit-maximizing (profit-)constrained monopolist. On the second stage power plant operators decide about dispatch of their units as well as the export share to other zones. Moreover, power plant operators decide about investment in production capacity. They behave as profit maximizers as well, considering spatially differentiated prices for producers, but at the same time keeping the uniform customer price throughout the zones. This uniform price is considered in the market clearing on the demand side. In the application, different model specifications are considered to shed light on possible impacts of a LAP. For this purpose, we model three cases: uniform price, zonal price, and LAP in a two zone model for Germany and compare them with regard to market outcomes (prices, dispatch, investment) and welfare results (zonal consumer and producer rents as well as the network operator's rent). In a second model with three zones we show possible effects of export/import with neighboring countries. The cases "neighbor participates in the LAP" and "Neighbor does not participate in the LAP" are considered.

Results and Conclusions

We find great advantage regarding social welfare for the LAP compared both to the ZP and UP, whereas the advantage relative to UP and ZP as well as relative advantages for different stakeholders change substantially under the respective regimes. With a monopolist grid operator, line investment is smallest under UP, increases for ZP and is highest for LAP. Welfare increases alike, with the LAP being the most favorable market organization for consumers. The picture changes when the grid operator serves as a social planner. Then consumers are more or less indifferent to market organization rules and the grid operator will install identical capacities under UP and LAP and no line capacity under ZP. Producers, however, see similar prices under LAP and ZP differing mainly for grid charges. They further generate higher rents under both LAP and ZP compared to UP with the exception of the ZP under effective grid regulation. Due to the zero line capacity generators set prices at marginal costs in each zone. This empirical analysis has implications for the ongoing electricity market reform process not only in Germany, but in many other countries in Europe and the rest of the world being confronted to very similar problems. It should be of major interest for policy makers to implement this alternative, which is not only politically feasible, but promises substantial welfare gains.

However, the impact of neighboring countries depends on relative productivity. When costs are higher abroad, the inclusion of the neighboring country will increase the LAP price for homeland customers and vice versa. Only in this case will neighboring countries have an incentive to participate in the LAP.

References

[1] Gabriel, S., Conejo, A., Fuller, J., Hobbs, B., Ruiz, C., Complementarity Modeling in Energy Markets, Springer New York, 2014