[REGIONALLY DIFFERENTIATED NETWORK FEES TO PROVIDE PROPER INCENTIVES FOR GENERATION INVESTMENT

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Overview

In many liberalized electricity markets uniform prices for large market areas are determined at the electricity spot market (the major platform being usually a power exchange). Potentially arising network congestion is then alleviated through a system of redispatch. This system is found for example in most European countries and Australia (whereas the US, Canada and New Zealand are relying on a system of nodal prices which does not require redispatch). Such a system does not provide incentives for proper location choice of production capacities taking into account potentially arising network congestion. Missing incentives for proper regional choice of producing facilities might then result in an excessive need of network expansion. To at least partially overcome this problem several countries are considering or already have introduced regionally differentiated network fees that have to be paid by generators as proposed for example by the Monopolies-Commission in Germany (Monopolkommission 2014) and as it is already used in the UK or Scandinavia. An overview about the application of g-components in European countries is given in ENTSO-E (2016). The objective of such regional mechanism is to better incentivize producers to locate closer to the load centers and thus leads to a potential reduction of congestion of the transmission grid. This in principle then allows to avoid excessive transmission line expansion.

Methods

We propose an equilibrium model that allows to compare different market mechanisms which provide incentives for locationally differentiated choices of production facilities. Our framework takes into account both generation investment decided upon by private investors and redispatch as well as network expansion decided upon by a centralized network planner. In order to take into account the different objectives and decision variables of those different agents in our equilibrium framework, our approach exhibits a multi level structure. We analyze the case of nodal pricing, where potentially arising regional price difference provide long run investment signals. Alternatively we analyze the case of regionally differentiated network fees which have to be paid by production facilities (a so called g-component). The calculation mechanisms for the zonal generation tariff is as follows: The applied method considers differences of nodal prices which determine the differences of the regionally differentiated network tariffs. Let us denote, that the g-component is not temporally differentiated in our model. The regionally differentited values stay the same over the considered time period.

The resulting investment and production decisions can be compared to an equilibrium model in the absence of such regional differentiated investment incentives and an overall optimal (first best) benchmark, which is derived by nodal pricing. In contrast to nodal pricing or price zones, in the Status Quo a g-component has no influence on the electricity price. This might lead to more acceptance in politics and society.

To provide economically and politically relevant statements based on our computation we calibrate our framework for the German electricity market. The nodes of the network considered represent the German federal states and the neighboring countries. Potential network and generation capacity expansion are taken from publically available data provided by the German authorities (BNetzA) which serve as an input for the regulated network expansion of the German electricity transmission grid (the German Netztentwicklungsplan).

Results

In our analysis we found, that the introduction of regionally differentiated g-component only slightly increases welfare, but, as the results show, too high chosen g-tariffs might also lead to welfare losses. However, a g-component is able to shift the localization of generation capacities. Low g-tariffs lead to a shift of generation capacities, which results in a spatial distribution that is close to the system optimum. Too high g-tariffs can lead to overincentives for generation investment and dismantling, which in turn leads to a welfare decreasing inefficient distribution of

generators across Germany. The analysis shows, that the necessary network expansion is strongly influenced by hourly peaks in positive and negative regional residual load but less of annual values. Even if all generators are optimally located, under a uniform pricing system there is a lack of price signals from the market which regulate both production and consumption. For this reason, in all scenarios with a uniform pricing system extensive network expansion is required. The current market design of the German electricity market performs worst with 14 new transmission lines. The introduction of a g-component can only slightly reduce the peaks, so that 13 new lines still have to be installed. In FB, price signals lead to a reduction of the peaks in positive and negative residual load, so that only 8 new transmission lines have to be built.
In addition, we have found that the introduction of a g-component tends to increase consumers´ electricity price.

Conclusions

We have analyzed the impact of introducing a regionally differentiated capacity-based gcomponent for conventional generators in Germany on welfare and network expansion by using the GATE model. We consider policy-relevant scenarios for differently scaled g-components, which are calculated from nodal prices of the system optimum. Therefore, the study uses extensive data from the German electricity market, regards must-run reguirements of renewable energies and takes into account the basic principles of network expansion.
Even if our analysis refers to Germany, the results and conclusions are relevant not only for Germany but also for other countries shifting towards renewable production. We conclude that introducing a g component for conventional generators is able to shift generation capacities between different regions within a market area. However, there is no potential for significant welfare gains or a significant reduction of network expansion. Hence, as a guideline for policy makers we suggest:

(i) Introducing a g-component for conventional generators is an effective tool to control the localization of new generation capacities.
(ii) However, it is not an efficient measure in order to increase welfare. An expansion to include renewable energies could significantly increase the effects.
(iii) If a g-component is introduced, make sure that the g-component does not cause an overincentivizing impact.
(iv) Additional mechansims are required to eliminate positive and negative residual load peaks and thus reduce network investment costs.

A further research question that remains for the future is the endogenization of investment decisions in renewable technologies in the GATE model. This will allow us to consider not only the g-component for conventional generators but also locally differentiated incentives for renewable technologies. In consequence, an analysis of further effects on welfare and network expansion would be possible.

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