Cross-border Effects of Capacity Remuneration Mechanisms: The Swiss Case

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European electricity markets are becoming more and more integrated as a consequence of internal market guidelines and the so-called Energy Union Strategy. Integration of the electricity markets is mainly driven by two intertwined processes: On the one hand, European markets are more tightly linked by implicit auctions and combined by the Price Coupling of Regions run by eight European power exchanges. On the other hand, the physical transmission grid is expanded and, in particular, the interconnectors will be further enhanced according to the 10-year network development plan of the European Network of Transmission System Operators.

As a result, various cross-border effects can be observed: Energy flows from market areas with higher prices to those with lower prices result in a convergence of electricity prices in connected market areas, given that sufficient interconnection capacity is available. Price convergence stops, if the available interconnector does not allow any further flow of electricity and, in this case, a certain price difference remains. However, an additional interconnection line between two market zones can increase price assimilation, resulting in positive welfare effects.

In this article, cross-border effects of different market design options are analyzed using Switzerland as a case study. Switzerland is largely influenced by surrounding (mainly large) electricity markets and needs to analyze political decisions regarding market design changes and to react to developments in the neighboring countries. The extent of this influence is studied with the help of an agent-based simulation model that is applied to two different scenarios describing possible developments. In one scenario all market designs are represented according to the current legislation (CRM Policies). In the other scenario energy-only markets (EOM) are assumed in all countries considered. Furthermore, two additional sensitivity scenarios based on the current legislation are applied to support the conclusions: First, with less capacity for the German strategic reserve and second, with a dry year regarding stored hydropower.

This study considers a long-term time horizon (until 2050) that allows to analyze generation adequacy not only for the current energy system with a comparably low share of intermittent renewables, but also for a time period with very large shares of intermittent sources in the energy system that may not be available when they are needed during peak demand hours.

In general, the model results indicate a strong price increase in the Central Western European electricity markets, which is mainly due to rising carbon certificate prices and increasing demand. Due to the planned larger interconnector capacities, this increase is evident in all simulated markets. However, the wholesale prices in the CRM Policies scenario are lower by up to 27 EUR/MWh than in the EOM scenario in the long term. This is caused by the introduction of national capacity remuneration mechanisms (CRMs) with high targets for domestic generation adequacy, which lead to higher installed capacities in the entire coupled market area. In the EOM scenario, by contrast, the capacities are scarce, resulting in price peaks.

Cross-border effects can strongly influence the investments in neighboring countries, thus increasing or decreasing the level of domestic generation adequacy. For this reason, it is essential to assess and anticipate these effects. The results indicate that the planned market design changes in

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the neighboring countries decrease investments in Switzerland. However, generation adequacy is still guaranteed due to the high Swiss hydropower storage capacity. Our results suggest that, under the current circumstances, a domestic CRM in Switzerland is not required.

Regarding the cross-border effects on the country without a CRM, in this case Switzerland, it is found that higher capacities in the neighboring countries lead to reduced domestic investments. In the CRM Policies scenario, the Swiss market can rely on higher import flows from neighboring countries. Hence, Switzerland remains dependent on neighboring countries, although it has a very limited influence on their market designs. However, it also found that sufficient generation capacity is available to serve the electricity demand in each time step in all scenarios. The reasons for that are large interconnector capacities and the high hydropower capacity in Switzerland. This means that although there is an influence on prices, generation adequacy in Switzerland is not adversely affected by market design changes in neighboring countries.

The results and subsequent conclusions are very interesting for countries that have large neighboring countries with highly interconnected electricity markets and are not limited to Switzerland. For the rollout of storage capacities due to falling battery prices, Switzerland may serve as an example, because these facilities (and flexible loads) have been used intensively in its market area for decades. Sensitivities with a dry year or with a reduced strategic reserve in Germany underlines that our conclusions are still valid even under difficult conditions, which is beneficial for a generalization of the results.