Impact of Coordinated Capacity Mechanisms on the European Power Market

Michael Bucksteeg[*], *Stephan Spiecker*[†], *and Christoph Weber*[‡]

Executive summary

Over the last two decades, power markets in Europe have been liberalized and competition has been introduced into wholesale markets. At the same time a European emissions trading scheme has been introduced and renewable technologies have been supported in most European countries. As a consequence previously regulated utilities face a more dynamic world with various uncertain and stochastic parameters. In this new environment, investment decisions in generation facilities are based on revenues gained in the energy-only market and are therefore dependent on adequate price signals.

In theory, competitive energy-only markets incentivize optimal investments in new generation capacities in line with the peak load pricing approach. In practice however, market imperfections like long lead times for generation investments, absence of demand response and too low price caps prevent reaching a situation of market equilibrium with adequate generation investments to maintain security of supply.

Consequently, in order to ensure adequate long-term allocation of generation capacities, capacity mechanisms have been proposed. Mainly national debates brought out several market designs in recent years and resulted in an implementation of uncoordinated and heterogeneous capacity markets throughout Europe. However, as the European member states aim for an internationalization of the electricity sector and integration of national power systems, the implementation of unilateral national capacity markets is not expedient. While several studies investigate the optimal design of capacity mechanisms using simplified test systems, so far few studies have addressed the impacts of capacity markets in interconnected power markets.

The present paper analyses the impacts of different capacity market designs on the European power market. Considering the current evolution at the European level, it comes down to asymmetric capacity markets. Consequently, we assess economic effects and impacts on security of supply by comparing asymmetric capacity markets with symmetric, coordinated and Europe-wide capacity markets. The capacity requirements are determined utilizing a probabilistic approach, which is extended to a multiregional level in case of the coordinated and Europe-wide capacity market. The long-term development is assessed using an investment model considering interactions between both energy-only and capacity markets.

We consider designs of a general capacity market, where either national or supra-national (European) regulatory authorities determine ex-ante the level of capacity that results in the

[*] Corresponding author. Chair for Management Science and Energy Economics, University of Duisburg-Essen (Campus Essen), Universitätsstr. 11, 45117 Essen, michael.bucksteeg@uni-due.de.

[†] Chair for Management Science and Energy Economics, University of Duisburg-Essen (Campus Essen), Universitätsstr. 11, 45117 Essen, stephan.spiecker@uni-due.de.

[‡] Chair for Management Science and Energy Economics, University of Duisburg-Essen (Campus Essen), Universitätsstr. 11, 45117 Essen, christoph.weber@uni-due.de.

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welfare-optimal duration of supply shortages. In order to implement this solution to the adequacy problem, the regulators hold centralized auctions for the required level of capacity and thus control the installed generation capacity. For the capacity auctions, we consider a uniform pricing system which is in line with applying a single constraint and dual variable to all (firm) capacity in the considered system. In practice, this would allow new and existing capacity to bid a capacity price, whereby all accepted bids receive the marginal price of the capacity auction. Consequently, generators are able to cover their missing money and are incentivized to remain in or to enter the market.

The analysis indicates that coordinated capacity markets lead to lower capacity requirements compared to unilateral national capacity markets. Under a Europe-wide capacity market, the joint provision of firm capacity reduces capacity requirements by about 10% (661 GW instead of 727 GW). Following the model results, we come to the conclusion that coordinated capacity markets result in efficiency gains of up to 5 billion Euros per year. Besides lower capacity requirements, the reduction in system costs is also a consequence of a geographical relocation of generation investments to more centrally located regions with lower fuel prices and a higher utilization of existing (base load) generation units.

In terms of security of supply, it is however shown that coordinated capacity markets with a joint provision of firm capacity lead to a higher dependency on import capabilities especially for Belgium and Denmark. Accordingly, the level of security of supply and the self-sufficiency would decrease in the case of simultaneous scarcity situations. One main reason for this result is the observed relocation of generation investments under a Europe-wide capacity market.

The simulations indicate that asymmetric capacity markets induce adverse cost effects and a distortion of generation investments. It is shown that unilateral capacity markets have strong negative effects on the energy markets in interconnected countries. In general, spot markets would allocate available transmission capacity to countries with a supply shortage in the case of non-simultaneous scarcity. In particular, Germany would become a net-importer and free-ride on capacity markets in neighboring countries in the short-term. However, in the long run the missing money problem increases in countries with energy-only markets and domestic generators are pushed out of the market. Consequently, generation investments shift to countries with reliability mechanisms and security of supply in countries without capacity markets decreases.

From the analysis it can be concluded that an asymmetric or unilateral introduction of capacity markets should be avoided in Europe. Asymmetric capacity markets would compromise the overall level of security of supply and unilateral national capacity markets would lead to efficiency losses. Given national energy policies and ambitions to achieve national self-sufficiency a Europe-wide mechanism may be difficult to realize. Hence, it is recommended to develop common rules for a design and coordinated introduction of capacity mechanisms with a coordinated determination of capacity requirements to maintain security of supply throughout Europe.

Keywords capacity markets, system adequacy, market design, security of supply

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