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Capacity market design options: a dynamic capacity investment model and a GB case study

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Conventional electricity generation is increasingly unprofitable in several European markets. The major reason is that increasing feed-in from renewable energy sources (RES) decreases revenues of conventional generation through decreasing electricity prices and load factors. At the same time, conventional generation is still needed to ensure security of supply due to the intermittency of RES. This challenge currently leads to a resurgence of the discussion around capacity mechanisms as a suitable measure to ensure generation adequacy. We focus on the capacity market scheme to facilitate this discussion through a quantification of effects of different capacity market design options on market prices and generation mixes. We quantify the difference between three scenarios: 1) an energy-only market, 2) a capacity market for new capacity only and 3) a capacity market for new and existing capacity through a dynamic capacity investment model. We apply this model in a GB case study to show its practicality in a case where exactly these policy decisions are currently discussed. We compare the three previously described scenarios along the three dimensions of electricity policy---affordability, reliability, and sustainability.

Our case study shows that the introduction of a capacity market has a positive effect on the market in terms of affordability and reliability because the total bill of generation decreases and lost load does not occur as opposed to the no capacity market case. There are two reasons to explain that difference. First, lost load which is priced at a high cost occurs more frequently without a capacity market due to investors providing less capacity to increase the profits per plant. Second, capacity margins that lead to more potential for strategic behavior and bidding above marginal costs get tighter in an energy-only market. By contrast, with the introduction of a capacity market, there is always sufficient capacity in the market and hence less potential to exercise market power. Sustainability is not affected by a capacity market for new and existing capacity, while it is positively affected by a capacity market for new capacity only, because this scheme leads to new investments in less CO_2-intensive gas-fired generation instead of existing coal-fired generation. Furthermore, we identify

differences between the two design options of capacity markets—a capacity market for new generation only leads to a lower total bill of generation than a capacity market for new and existing generation.

In our case study we make projections of GB market prices and generation mixes that are specific to the properties of the market at hand. However, there are four findings from this study that can be generalized to foster a policy discussion on capacity markets in general.

1. Capacity markets increase generation adequacy. This is shown by a lower number of lost load occasions as well as by reduced electricity price volatility.
2. Capacity markets do not necessarily increase the total bill of generation. This is not necessarily intuitive and critics of capacity markets argue that capacity remuneration improves generation adequacy at the expense of an increase in the total bill of generation. Most studies arguing in this way neglect two important factors that we incorporate in our model: First, the interdependency of capacity and electricity markets leading to decreasing electricity wholesale prices if revenues are also obtained from a capacity market. Second, strategic behavior and above marginal cost bidding in an energy-only market resulting in wholesale electricity prices that partially reflect market power in times of shortage rather than marginal costs. While the extent of these effects is likely to differ across markets, it is important to reflect these secondary effects in capacity market discussions.
3. It is cheaper to set up a capacity market for new generation only but risky from a policy perspective. In this case, less capacity payments get disbursed in the first years since only new investments need to receive these. Despite this observation, a policy maker should bear two further factors in mind. First, by only paying new generation, investors are incentivized to retire existing generation earlier, because it is not profitable anymore and there is no access to the capacity market. This leads to an earlier need to incentivize investment in new generation through the capacity market. Hence, there is a faster capacity turnaround leading to a situation where a larger number of new generators receive high capacity payments. Second, as argued by Cramton (2013), the strategy of not paying existing generation—this unequal treatment can even be called a regulatory taking or expropriation—might work once, if investors are surprised but afterwards would lead to investors requiring additional protection from future unequal treatments and a risk premium. Apart from that, in the long-term both design options converge, because gradually there will be no generation left that existed before the introduction of the CM and all generation is covered by the capacity mechanism.

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