European security of electricity supply policy in the context of increasing volumes of intermittent generation

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Overview

Increasingly many countries in Europe are implementing some kind of policy for ensuring an adequate level of electricity generation capacity: capacity mechanisms. Scandinavian countries and Poland have some form of a strategic reserve, Ireland and several Mediterranean countries have different kinds of capacity payments, and now France and the UK are in the process of developing different types of capacity markets. In countries with energy-only markets, this raises the question what the effects will be of the implementation of a capacity mechanism by a neighboring country on their market and whether they should follow by also implementing a capacity mechanism.
In this paper, we analyze the argument for and against introducing capacity mechanisms in European electricity markets in order to maintain security of supply as the share of intermittent resources is being increased. We weigh the theoretical arguments against the practical complications that arise when different countries implement different types of capacity mechanisms. We model the effects of the implementation of a capacity mechanism in one country on a neighboring country without or with a different a capacity mechanism. We draw conclusions with respect to generation adequacy policy in Europe.

Methods

The first part of the paper covers a review of the arguments for applying a capacity mechanism in order to support a sufficient volume of back-up capacity for intermittent resources, supported by a quantitative analysis of the impact of intermittent sources on the business case of thermal plant in an energy-only market. In the second part of the paper, based on discussions with energy market analysts, strategists and policy makers in various European countries, the current debate about the implementation of capacity mechanisms in Europe is reviewed. A model is made to study the potential impacts of capacity mechanisms on neighboring countries.

Results

With increasing volumes of intermittent generation, the residual load-duration curve – the load that needs to be served by thermal plant – becomes lower on average, but continues to have about the same peak value. Fig. 1 provides an example.

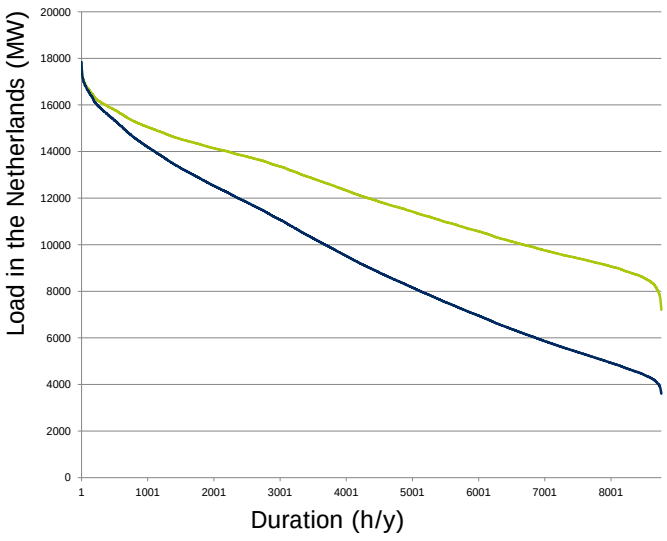

Figure 1: Example of the impact of intermittent generation on the load-duration curve of thermal plant

If the same volume of thermal plant is to be maintained, this necessarily means that peak prices will need to increase to offset the lost revenue during off-peak hours. Increased price volatility is therefore the inevitable corollary of a growth in intermittent energy sources.
In theory, this should not affect investment, but due to various causes of fundamental uncertainty and the long lead time for new power plant, there is a significant risk that investment is not optimal. For generation companies, the main risk lies in over investment, as they would not recover their costs. For consumers, the risk is opposite: if investment would be slightly less than optimal, or demand growth higher than expected, power shortages could create high costs. For consumers, and therefore also for politicians, the risk of creating excess generation capacity with the capacity mechanism can be considered as an insurance against the much higher social cost of power shortages. However, the implementation of a capacity mechanism also introduces regulatory uncertainty and a risk of regulatory failure. Moreover, the proliferation of different types of capacity mechanisms in Europe reduces the transparency of the internal market.

The arguments play out differently in the different European countries as a consequence of their generation portfolios and past market performance. In Scandinavia, concerns about years with low hydropower availability led to the implementation of strategic reserves. In southern Europe and Poland, capacity payments were implemented shortly after liberalization, apparently due to concerns about insufficient investment. In Germany, the Netherlands, Belgium Austria, the UK and France, among others, implementation of a capacity mechanism was not considered necessary.

The development of capacity mechanisms in France and the UK confronts the remaining energy-only markets with the question whether the energy-only market really no longer is adequate. And on the practical side, how will the implementation of a capacity mechanism by their neighbor affect their wholesale market?

We model the possible side-effects of this lack of harmonization. Most capacity mechanisms have negative effects on the investment climate in neighboring energy-only markets, even though they differ greatly in the ways in which they affect wholesale markets and trade between countries. Implementation of reliability options can be done in such a way that it does not impact neighboring markets with different market designs, but this is complex. Capacity subscriptions are a less invasive solution, but require smart meters in every household and have not been tried in practice.

The remaining energy-only markets in Europe may become under more pressure to implement a capacity mechanism, as the capacity mechanisms in their neighboring countries may discourage investment in their own markets. The question is how to respond to the fragmentation of European wholesale electricity markets as a result of the proliferation of capacity mechanisms.

Conclusions

As the share of intermittent resources is increasing in Europe, the case for implementing a capacity mechanism is gaining weight. The debate is complicated by the fact that a number of European countries have already implemented various kinds of capacity mechanisms. Due to the possible negative effects of capacity mechanisms in neighboring countries, caused by the presence of reserve capacity which lowers average prices but is not necessarily available to them during shortages, the remaining energy-only markets may face increasing pressure to also implement a capacity mechanism.

The key challenges are to minimize the market distortion that may arise from implementing a different mechanism in each country and to minimize regulatory risk in the implementation phase. In the long run, a system of capacity subscriptions appears more attractive than the current capacity mechanisms, as it is independent of wholesale market design, less complex and intrusive than reliability options or a capacity market and closest to an unregulated market design.

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