ELECTRICITY MARKET DESIGN FOR 100% RENEWABLE ELECTRICITY IN GERMANY

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Background

Given the German decision to phase out nuclear power and at the same time agressive carbon reduction targets, a completely renewable electricity system becomes a plausible possibility. At the same time, a discussion about integrating the rapidly rising share of renewables into the existing electricity wholesale market is ongoing at the political level. Therefore it makes sense to investigate whether the current electricity wholesale market design is suitable for a completely renewable system. A closer integration only makes sense if the current market design is valid for the future.

Methodology

The research at hand is purely qualitative. Given the huge uncertainties when assessing a completely renewable electricity sector, it was possible to develop and elaborate general arguments and mechanisms and include a broader spectrum of proposals by using a qualitative approach. The research tools included literature reviews on a number of relevant topics and semi-structured interviews with experts.

Comparison between the current and a completely renewable electricity system

When looking at different scenarios for a completely renewable electricity system for Germany, the differences in absolute and relative values for generation, consumption and contribution of different technologies are striking[2]. This makes clear that uncertainties regarding future developments are substantial indeed.

Implications for the electricity wholesale market

Despite the wide variation, several differences between the current electricity system and a completely renewable one with relevance to the electricity market can be identified. These lead to the following challenges for the current market design:

- Cost recovery will be challenging and investment incentives missing for variable plants with close to zero marginal production costs (especially wind generators). These costs are used for setting the price in the electricity spot market and the spot market price is the reference price for forward and futures trading. As a consequence, at times of high production by variable renewable sources, wholesale market prices will be low.
- The high degree of uncertainty regarding price developments in the electricity wholesale market and operation hours due to volatile und less predictable electricity generation reduces investment incentives for dispatchable plants. High price spikes due to scarcity can enable cost recovery in few operating hours but this is difficult to plan for.

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[2] The analysis is based on scenarios by SRU (2 scenarios), Greenpeace, WWF, BMU and Umweltbundesamt.

- The need for balancing or intraday adjustment is increased due to the relatively low predictability of variable sources in the day-ahead market. This raises system costs under the current regime with low liquidity in the intraday markets.
- Other challenges include grid congestion (as locations of renewable plants are different from the current ones) and the need to incorporate more diverse actors (because more diverse plant operators such as households or communities need to be included) into the market as well as the continuing possibility of market power.

The problem of insufficient investment incentives and the difficulties with cost recovery were identified as most important by the expert interviewees.

Options for making the electricity market design fit for the future

Four options exist to make the electricity market design fit for the future. The first one is to adapt the generation structure to the current one by aggregating different kinds of renewable plants ('virtual power plants'). This approach will however result in relatively high costs. The second option is to adapt the current market design in order to incorporate renewables. Adaptations include among others more flexible products in the spot, futures and balancing markets and a more liquid intraday market. The problem of cost recovery is however difficult to tackle by adapting the current market design as changing pricing mechanisms is very complicated and might not be sufficient. However, the discussion on whether the current market design can deliver adequate investment incentives is still ongoing. The third option is to add additional mechanisms to the current design, for example feed-in premiums for variable renewables and a capacity market for dispatchable units. Such a solution seems to be feasible but adds additional complexity to the system. The last option is to implement more radical changes to the market design. The pool market following the American model is ruled out as it does not bring substantial benefits but requires a big change. Promising options are long term feed-in tariffs (following the current design) for all generation assets or technology-specific auctions with long term contracts as currently in place in Brazil and suggested for the UK and Germany.

An evaluation of all proposed market designs according to their contribution to solving the above listed problems as well as degree of change, cost efficiency, simplicity and public acceptance reveals that no market design is perfect but some deserve further research. In general, simple options that require the least change, are cost efficient and accepted by the public should be preferred in order to minimize investment costs and maximize implementability.

Conclusion and policy recommendations

At this point in time it is uncertain whether the current market design can provide cost recovery and investment incentives in a completely renewable system. Other designs are successful in this but do not necessarily solve all other problems. In addition, changes in the market design lead to increased regulatory risk which raises investment risks and costs. Therefore, the main policy recommendation of the study is to take enough time to prove and test possible future market designs regarding their performance for a completely renewable electricity system. This wait-and-see approach concerning the changing of the market design was also recommended by most interviewees. The optional introduction of feed-in premiums (FIP) from 2012 on is reasonable in order to better understand the impacts of renewables actively participating in the market. Moreover, it is recommended to facilitate the integration and participation of renewables in the balancing market. In addition, a distinction between variable and dispatchable sources makes sense already now. Dispatchable renewables such as biomass need to be incentivised to become more flexible as soon as possible. Policy also needs to consider the trade-off between waiting for all necessary research to be completed and the need for action to incentivise adequate investment and ensure security of supply with an increasing share of variable generation.