

Power markets with Renewables: New perspectives for the European Target Model

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The European electricity sector was liberalized to create incentives for efficient operation and investment. Individual Member States have since developed a power market design that reflects their specific national generation mix, network topology, and industry structure. With increasing shares of intermittent renewables, however, *all* EU countries have to focus on designs that ensure an effective use of flexibility options and transmission capacity. This creates an opportunity for European policy to move beyond the traditional focus of facilitating trade between Member States and offers scope for aligning the operational and market approaches across countries. Taking account of the current diversity in national market designs, we therefore explore in this article how European electricity market design needs to evolve as the share of wind and solar power is increasing.

In detail, we first present an analysis on the specific needs of conventional and renewable (wind and solar) generation technologies and illustrate that each group warrants a different regulatory treatment. Based on the different regulatory demands for each technology group, we then explore how the design of short-term markets can address all technology-specific constraints while realizing synergies from their integration. Subsequently, we discuss potential implications for investment frameworks for conventional as well as renewable technologies. Starting at the technology level, we thereby develop a common institutional approach to operation, pricing and investment given underlying network topology.

We find that short-term power markets with large shares of intermittent renewable energy sources need revision – amongst others, guaranteeing system security in an efficient manner involves a pooling of resources over larger geographic areas; multi-part bids could resolve the perceived conflict between increasing temporal granularity of products, while at the same time respecting technical plant capacity in

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the bidding structure; and flow-based transmission allocation and smaller pricing zones can enhance efficiency in the use of transmission capacity.

With regard to investment incentives, appropriate remuneration for flexibility options within the power sector and at the interface to heat, industry and transport sectors becomes essential. In addition, market-based forward contracting provides an efficient mean of hedging fuel costs and stabilizing revenue streams. It allows to hedge against high price volatility and to protect consumers against high-price periods.

Last and regarding investment in low-carbon renewable generation, up-front investment costs of solar and wind resources have to be considered in their regulatory treatment. Stable revenue streams are required for large-scale renewable projects for a longer-term horizon in order to allow for investments by risk-averse actors that can provide capital at low cost. This suggests a continued role for renewable remuneration mechanism to reach renewable targets and reduce cost for electricity consumers.

While each of the dimensions discussed above are often considered individually, this article aims to contribute to the debate by demonstrating that a policy framework for efficient short-term operation of the overall system also strengthens the investment framework. The European Target Model has to respect that during an energy transition intermittent low-carbon generation and dispatchable fossil-fuel based generation complement each other. So far, it leaves TSO operation as a 'black box' risking secure system operation and efficient cooperation. It remains open whether common market protocols suffice to ensure secure and efficient operation of the European power system. It is likely that further refinements of market protocols and some regulatory guidance for TSOs are needed in order to avoid increasing divergence in TSO processes that already to date differ among EU power systems. Efficient and liquid short-term markets based on common auction platforms can ensure that small and large, public and private sellers obtain the same price for generated energy. It this also allows for efficient use of renewable covered by renewable remuneration mechanisms – either by public counter parties selling at these liquid market places energy contracted on feed-in type contracts or by serving as robust reference point for contracts for difference. Robust real-time and day-ahead market prices also can serve as reference for financial contracts that adequately reflect and reward the value of flexibility.