Intermittent sources, DSM and market power – Do we have to rethink the market design in electricity in Europe?

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1. Overview

The European internal market in electricity is facing major changes within the next years. The growing feed-in from intermittent sources enhances the demand for a fast-responding flexible system. Due to the lack of large-scale energy storages, technologies such as widespread demand side management, functional energy storage or decentralized feed-in into the distribution–grid from single households could be the answer.

To promote these technical developments, a beneficial market framework is needed to bring about a (near) optimal allocation of resources in such a dynamic system.

In this paper we will discuss alternative market structures and their ability to provide such a framework while keeping prices on a reasonable level. With respect to a mostly oligopolistic market structure, every market design is checked for the chance to abuse market power.

Main focus was laid on a single market system of exchange based continuous trading of 15-minute contracts.

2. Methods

This work was based on several steps to evaluate current and future market designs.

In a first step, the market designs in Europe and North America were analyzed. The European market is characterized by a variety of trading places and products: several exchanges like *Nordpool*, *EEX* or *Powernext* offer physical day-ahead auctions, continuous intraday trading and financial future contracts. In addition several *OTC*-trading places allow partly confidential bilateral trading with bilateral contracts accounting for over 80 percent of all traded energy volumes in Europe. Transmission rights for congested routes and ancillary services are marketed separately by the transmission system operator. New concepts such as market coupling or market splitting are consecutively introduced to combine energy deliveries with transmission rights.

The *PJM*-market in the U.S. is operated by an independent system operator (ISO) that handles all physical trades and centrally sets combined prices for energy generation, transport and ancillary services for every node in the system on a day-ahead and intraday basis. Long term risks are hedged by bilateral contracts for energy and by *Financial Transmission Rights* for congestion charges.

In both markets, the price levels have risen sharply within the last years and possible abuse of market power has come into the focus of antitrust agencies. Just like in the transmission system, a goal conflict emerged between low prices for customers and incomes for future investments into new infrastructure to secure the supply. In addition, another goal conflict between the idea of free price formation in a liberal market and state intervention to limit price spikes has to be solved. Different studies on the detection of market power abuse were evaluated and cross-checked for validity, the behaviour of market participants was analyzed on the basis of historical market data and empirical market simulations with students.

3. Results and Conclusions

The key requirements for a future energy market can be stated from the view of each market participant as followed with new additions are marked bold.

Generator:
- Long term price levels above each marketed unit's fixed costs
- Possibilities for long term hedging
- **Optimal allocation of transmission capacity (when on side of lower prices)**
- **Optimal choice of target market for maximized revenues**
- **Possibility to sell energy from intermittent sources on a short-term basis**

TSO:
- Maximized revenues from congestion charges and user fees
- Minimized use of reserve power (danger of system instability)

Customer:
- Fair prices with a secured supply.
- Possibilities for long term hedging
- **Optimal allocation of transmission capacity (when on side of higher prices)**
- **Requirement for renewable generators to self-market the energy to reduce socialized costs from subsidies**
- **Transparency to check price levels**
- **Ability to react to price spikes early**

Each market design contributes to a different extend to those goals. While a day-ahead market based on a closed order book maximizes market liquidity and allows the installation of integrated systems such as market coupling, it impedes a long-term anticipation of price spikes and prohibits early demand

responses. The divided market in Europe with extensive bilateral *OTC* trading, day ahead auctioning and separated marketing of ancillary services, leads to a misallocation of resources. Figure 1 shows a market situation with higher prices for not-running minute-reserve units than for energy deliveries. Due to the concept of *pay-as-bid* auctioning and a steep supply curve, the revenue for different units supplying the same product varies between 75 and 150 Euro/MWh. Those situations are caused by different market expectations of the participants and could be reproduced by our empirical market situations with students that will be discussed detailed in the paper.

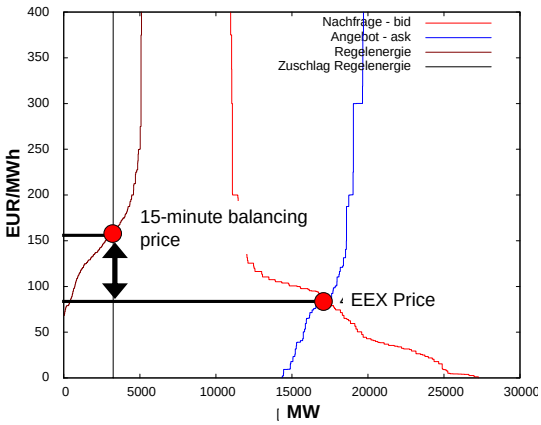

Figure 1: Misallocation between EEX and ancillary service prices (Source: EEX, Regelleistung.net)

In contrast, in the *PJM* market, energy delivery and ancillary service prices are coupled so that the price differences only reflect fixed bonuses and all units providing reserve power receive the same price.

In addition, day ahead auctioning for weekends yields time differences of up to 84 hours between trade and delivery. Figure 2 shows the decline of the prognosis error for inland wind generators in Germany.

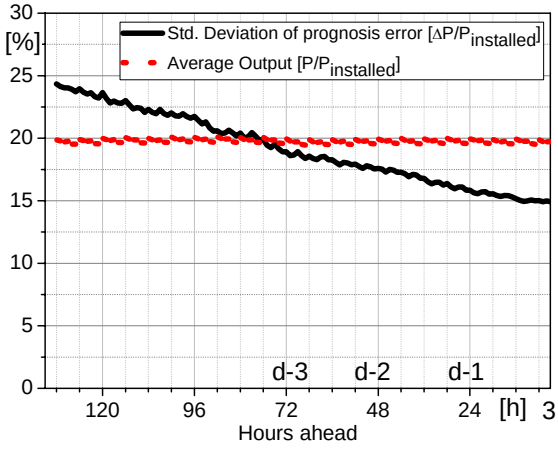

Figure 2: Decline of prognosis error for wind-turbines (Source: restricted)

The bigger the time difference between trade and delivery, the higher becomes the demand for balancing power. Our calculations showed that a self-marketing of wind energy under these conditions would require more than 30 percent of the marketed amount in reserve units controlled by the wind operator to minimize balancing costs. Such a system would lead to high misallocations of resources since the flattening and overlapping effects of systems with distributed generators would be neglected.

On the demand side, industrial or residential consumers often need early price signals to respond to price spikes. Factories receiving price spike warnings could respond several days ahead and provide functional energy storage capacity by time-shifting operations.

The alternative market design analyzed in this paper would therefore consist of only one product for each 15-minute time interval. Every quarter of an hour is continuously traded up to two years ahead. Trading ends with the beginning of the traded time interval with prices gradually converging to the real-time balancing price. Every trade is only confirmed after an automatic check for consistency by the transmission system operator.

Advantages and flaws of such a market design are discussed in the paper in detail. Although the *no-free-lunch-theorem* also applies to the question of market design, the urgent need to provide incentives for demand response will have to be met in the near future.

4. References

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