Are the European Electricity Markets Ready for More Renewables?

BY SIMON RISANGER

The last decade has witnessed a substantial increase in the share of renewable production, and even more is required in order to complete the energy transition and reach the climate targets. A growing concern in academia and industry is the intermittent nature of solar and wind production, which constitutes the two major renewable sources for new investments. The straight-forward approach to handle uncertain production is to include flexible units or storage. However, this is easier said than done. Flexible gas units carry high operational expenses and produce emissions, while the investment cost for large storage facilities is massive for the current technologies. These challenges encourage a somewhat unconventional question; could it be that we actually possess sufficient resources, but are not dispatching them efficient enough?

We will investigate the question from a European market perspective. A traditional centralized structure of dispatchable units has created a majority of trade to occur on day-ahead markets. Producers are able to plan well ahead and dispatch their most efficient units, while retailers provide accurate forecasts over a somewhat static demand side. Recent generation expansion trends, however, are contrasting to the traditional market structure. New investments are often distributed, solar and wind production are non-dispatchable, and the demand side is more active. We should therefore consider different market arenas than solely day-ahead trading, and in fact, increased activity is currently taking place at European intraday markets. EPEX SPOT announces annual increases in intraday activity. Their 71.0TWh turnover of 2017 was a 15.1% increase from 2016, and significant compared to the 6.7TWh of 2009 (EPEX SPOT, 2010, 2018). Although notably smaller in turnover, arguably due to significant flexible hydropower reserves, Nord Pool also experiences similar growth (Nord Pool, 2017). Annual turnovers are outlined in Figure 1. Intraday activity is still substantially lower than day-ahead activity, but the development is promising. Especially if we consider the newest intraday feature, the cross-border intraday project (XBID), who reported a successful go-live in June 2018 (XBID, 2018a).

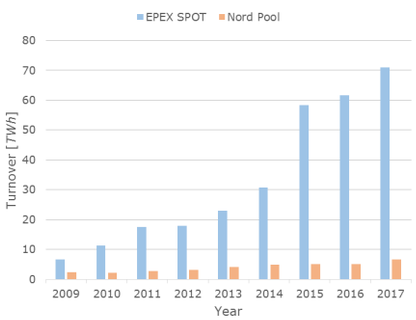

Figure 1: Turnover from EPEX SPOT and Nord Pool intraday markets, collected from their annual reports. The considerable increase in turnover of EPEX SPOT from 2014 to 2015 is partly due to the inclusion of Belgium, the Netherlands and UK through APX.

EPEX SPOT, Nord Pool, and consequently XBID allows for continual trading within the day on their intraday markets. If a producer experiences problems with committed generation, or errors occur in forecasts for renewable production, it can be adjusted by participation in the intraday market. Forecast errors have become increasingly important as the share of intermittent resources increase. In the day-ahead market, producers must estimate production for the next twelve to 36 hours. In spite of sophisticated forecasting techniques, errors are likely to occur at these time scales. Even as forecasting techniques improve, the increase in intermittent production will still create a significant imbalance volume (Borggrefe & Neuhoff, 2011). As time to delivery approaches, the accuracy of forecasts will improve (Giebel, Brownsword, Kariniotakis, Denhard, & Draxl, 2011). Producers can therefore adjust their imbalances whenever they choose in the intraday market. Because errors can be both overestimations and underestimations, a diversifying effect occurs where positive and negative errors can correct each other; an effect that increases when the trading area becomes larger. The XBID initiative will provide a significant intraday market cover, as shown in Figure 2. Additional countries will also be included in the second go-live in 2019.

Despite its existence for several years, the intraday market has been notoriously illiquid. In contrast to the periodic double auction held at day-ahead markets, where a market equilibrium between supply and demand is found through the formation of merit order curves from market offers, the intraday markets of EPEX SPOT and Nord Pool utilize a continuous double

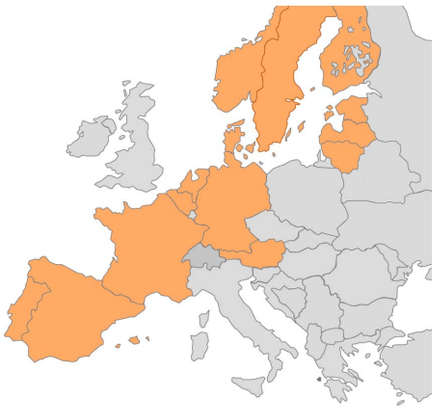

Figure 2: Countries in orange partook in the first go-live of the XBID initiative in June 2018. Snapshot from XBID (2018b).

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auction. (Notice that Spain and Portugal have a periodic double auction held six times intraday. What would be continuous trades are thus aggregated to provide sufficient liquidity at the auctions, at the expense of flexibility in timing.) In a continuous double auction scheme, limit orders form an order book of bids and asks sorted by price and time of offer, similar to equity markets. Even though the continuous double auction is a common market structure, the operation of intraday markets must comply with the power system characteristics. Most notably, system security and a constant equilibrium between consumption and production. Strategies concerning intraday operations quickly become complex; they must solve optimal bidding, dispatch, timing, unit and system constraints all combined. The opportunity for continual activity and exposure to uncertainty produce a multi-stage stochastic problem. Day-ahead operation, however, has only one decision stage for all further operations. This simplifies daily decisions significantly compared to intraday models. Still, the development of sophisticated short-term bidding models in electricity markets looks promising, as exemplified by the models of Gönsch & Hassler (2016) and Jiang & Powell (2015). Proper decision tools for participants will be an important step to reduce risks and make intraday markets more appealing.

Improved liquidity is of great importance in order to improve intraday market design (Weber, 2010). It can be debated whether illiquidity is a cause or an effect for low participation in intraday markets. Producers may conclude that the transaction cost outweighs the potential benefits, and thus their reluctance to participate causes low liquidity. The imbalances will be corrected in the balancing or regulating market operated by the transmission system operators (TSOs) regardless. However, it is a fallacy to consider balancing markets as a traditional marketplace. Its main function is to ensure system stability, not to offer an active trading strategy (Garnier & Madlener, 2015). As imbalances increase, so does the need for stability. TSOs may therefore be forced to dispatch expensive and possibly polluting flexible units, such as gas turbines. Even though positive and negative imbalance positions will cancel each other out, the responsibility is transferred unto the TSO and not the responsible party. Not only does this require extra resources and challenging real-time stability control; the costs are also incurred to society. Moreover, the main objective of the balancing market is to ensure system stability, not efficient dispatch. Operation of larger social surplus are hence likely to occur in a market based environment, such as the intraday market, where this is indeed the objective.

With respect to liquidity being the effect of low intraday activity; we may argue that producers are willing to participate intraday, but the low liquidity pose additional financial risks which they are not willing to undertake. The steady growth in intraday activity seems to demonstrate a willingness to participate. Furthermore, the XBID initiative may be the necessary trigger for intraday markets to become more prevalent. Even if the trades are still bounded by transmission constraints, it encourages intraday participation and shifts perspective towards an international market arena.

Intraday markets are in growth and represent an important market function to ease the implementation of renewable resources. Researchers, policy makers, and engineers should therefore produce appropriate policies and tools to facilitate the process. It is unreasonable to expect that intraday market can perform the integration by itself. An emission-free power system of the future is likely achieved by a combination of market design, improved forecasting techniques, transmission expansion, storage, flexible units, demand side management and so forth. Yet, intraday markets can play a significant role in the merger of the different elements and help to accelerate the process. Regardless of future developments, it will be interesting to follow the XBID initiative and its results in the following years.

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