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Report

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Beyond Gate Closure

Report on Future Power Market Workshops on short-term markets and gate closure, held in Warsaw, 28.6.2013, and in Berlin, 06.12.2013

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SUMMARY

Current EU short-term market designs for electricity face several challenges in (i) securing efficient system operation (ii) unlocking the full potential of flexible resources and (iii) fostering effective use of transmission capacity. For a gradual reform of market design and to guarantee secure operation of (cross-border) flexible resources, firm nominations for generation and load are required already at intraday, with subsequent auctions taking network constraints into account. Alternatively, gate closure can be moved several hours ahead of real-time with SO administered balancing markets starting accordingly. In both cases all auctions subsequent to day-ahead trades could be based on complex bids and hosted at a common platform at TSO, ISO or PX, where also transmission capacity and capacity allocation is jointly calculated.

Challenges with market design

We identified three major challenges in current short-term market and gate closure design in the EU.

Accurate information for secure system operation

Historically transmission system operators had a good understanding of generation schedules as production repeated in daily patterns and the rough match of generation capacity with peak demand ensured operation of large shares of generation units. The increasing share of wind and solar generation replaces some of this generation, following different spatial and temporal patterns every day. While wind- and solar forecasts allow to anticipate the scale and location of renewable generation, transmission system operators face large uncertainties over which conventional units will serve the residual demand and where these units are located on the network.

The location of residual conventional generation impacts both flow patterns within and loop-flows in neighboring countries. However, transmission system operators may only receive firm information on the nominated generation assets at the time of intraday gate closer as short as 45 min before real time. This leaves little time for the increasing scale of response that might be required with increasing uncertainty of production patterns from conventional generation assets.

Unlocking flexibility of thermal units and demand side

The profile of load and volume of system services to be served by conventional generation assets changes between and within days. Thermal generation assets and demand side have significant technical

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flexibility to match such variations. However, with energy only bids this flexibility cannot be made fully available to the market, as inter-temporal constraints like ramping and unit commitment cannot be reflected. As a result, generation is often optimized within the portfolio of utilities or aggregators at the expense of synergies across the system and with the implication that system operators have limited information on the ultimate generation pattern to be considered for flow calculations. Different types of complex bids have been implemented to allow market participants to reflect inter-temporal constraints in their offers to power exchanges or continuous trading platforms. They are necessary to unlock and reward flexibility from generation and demand.

Effective use of transmission capacity

With increasing uncertainty about final generation patterns at day-ahead and intraday timeframes, transmission system operators increase transmission reliability margins to reduce the risk of infeasible generation schedules and limit the scale of corrective measures necessary on short-notice. Thus the transmission capacity available for commercial transfers at day-ahead and intra-day stage declines, increasing price volatility and total generation costs across Europe. On the German and Czech border to Poland commercial transfer capacity has already been reduced from more than 1 GW to zero, but this still does not suffice to secure that network constraints are met at all times. Hence in addition virtual phase shifters (international re-dispatch) have been implemented.

Requirements that future power market design needs to satisfy

From the three challenges facing current power market design, we derive a set of requirements for a market design for secure and efficient system operation of low carbon power systems.

First, to allow system operators to pursue forecasts on flow patterns, they require reliable information on generation patterns including the location of generation plants already at intraday stage. Subsequent adjustments within and between countries need to respect transmission constraints of the power system. This requires that transactions are pursued through one platform that integrates a transmission model and can be hosted either by TSO, Power Exchange or an ISO.

Second, to unlock and reward flexibility, bid structures on day-ahead, intraday and balancing markets need to allow for incorporation of technical constraints of generation and demand units. Such complex bidding may range from advanced possibilities for linking energy bids, either within or between adjacent hours (Nordpool or CWE algorithm), to technically backed bids that besides energy nominate ramping and start-up costs (Spain, Poland). The different formats need to be more carefully assessed to ensure (i) full flexibility is unlocked (ii) flexibility can also be unlocked across different systems and (iii) computation for market clearing on auction platforms is feasible.

Third, to integrate the calculation of capacity made available for transfers with the market clearing process – so as to ensure that the capacity calculation is based on the location of generation units successful in the auction – transmission capacity and capacity allocation should be jointly calculated. To exploit synergies with scheduling of subsequent intraday adjustments the joint calculation could be undertaken by the same entity that hosts the auction platform described above.

Options how to address these requirements starting from Target Model

We have discussed how a gradual reform of power market design building on the current Target Model could meet the above formulated requirements. The reform could either focus initially on the intraday market design or the balancing market design.

Reform of intraday market design to address new power market requirements

Firm nominations for generation- and load schedules would be required already at intraday stage sufficiently ahead of real-time to provide time for transmission system operators to calculate implied flow patterns, coordinate with neighboring transmission system operators, and where necessary initiate adjustments also to unit commitment. After these firm nominations, an auction platform would allow market participants to place bids to offer respond to new information on their generation and demand profile and to offer flexibility to other market participants. The auction clearing algorithm incorporates network constraints and allows for bids reflecting technical constraints of market participants.

Reform of balancing market design to address new power market requirements

The gate closure time could be moved e.g. eight hours before real time. Based on the firm nominations received at gate closure time, TSOs could determine a feasible security constrained system operation schedule within two hours and with sufficient time for unit commitment decisions of most thermal units. Hourly auctions of the balancing market allow market participants to adjust their (early) nominations in the remaining hours.

Both reform options can meet the three criteria set out above. However for both reform options three additional aspects are to be considered in their potential implementation.

Drastic adjustment and potential gaming: If transmission constraints within zones are not considered in day-ahead and intraday markets prior to the firm nomination, then the system wide optimization including these constraints in the first auction after the nomination can result in significant adjustments towards a more efficient outcome. This can also create gaming opportunities between markets that clear according to different principles. Both effects are already a concern in the current arrangements in particular associated with gaming opportunities linked to re-dispatch choices like e.g. the inc-dec game. Option 1 (intraday focused) might be a preferable approach with potentially more time between the critical shift between market clearing approaches and thus less immediate threat for system security. Also, option 1 could – if needed – offer a more effective remedy with an expansion of the intraday algorithm to the day-ahead market clearing function.

Liquidity at intraday stage: For efficient intraday trades and adjustments to early nominations, liquid intraday markets are crucial. Continuous trading is based on a first-come-first-serve base and thus detrimental to market liquidity. Standardized auctions on a common platform lead to higher liquidity and are the preferred design element, especially with intraday adjustments becoming more and more important in the future. Experience from current intraday markets shows that markets with standardized auctions are among the highest in intraday liquidity throughout the EU with 52 TWh being traded in the Spanish intraday market and 15.8 TWh in the Italian market in 2012, as shown in ACER/CEERs 2012 annual market report.

Structure of complex bids: As for complex bids, the US and the Spanish market serve a good example. As in Spain, in most US systems complex bids comprise energy plus start-up and ramping nominations. In contrast, in the Central Western European (CWE) region linked energy bids dominate. However, energy bids plus nominations on unit's technical features are preferable to linked energy bids in terms of liquidity and the ease of market monitoring. First, with linked energy bids liquidity in standardized auctions might be undermined as bids only are valid conditional on being accepted for longer time durations. Second, market monitoring for linked bids is almost impossible as underlying costs structures are not defined. In contrast, complex bids with energy bids and ramping and start-up costs nominations follow observable cost structures. Due to the advantages of such bid structures, Italy and Poland are contemplating introducing several dimensions of ramping and start-up costs for nomination.

It however remains to be debated what the optimal degree of differentiation of costs structures is. While a higher differentiation in the nominations standards might allow for a more complete picture of relevant cost structures, less dimensions in complex bids foster liquidity and ease market monitoring.

Chances for a European convergence

EU countries have implemented and become accustomed to largely varying balancing mechanisms. In contrast, intraday market designs are only gradually evolving with refinements only in countries like Italy, Spain Ireland and Poland characterized by smaller systems or network constraints that did not allow for continuous intraday markets disconnected from physical reality. Hence adjustments to – and convergence of – less established intraday market design might be easier to advance than balancing markets due to three main reasons

Compatibility with emerging network codes: The emerging grid code for intraday trading allows for both continuous trading and auctions, and could thus accommodate the envisaged design. In contrast, extending the balancing period might be more difficult to align with emerging network codes and their emphasis of short gate-closure periods.

Building on experience in power markets: Spain already runs 6 intraday auctions during which the market clears for all remaining hours up to real time, and which allow for a specification of technical constraints of power stations. It could thus serve as one example for the intraday market design. Expanding the role of the balancing mechanism would put more emphasis on the real time market, and could thus more closely resemble the development in liberalized US power markets.

Catalyzing effect: With increasing penetration of renewable energy sources, and thus increasing variations of generation and flow patterns between and within days, the pressure on improvements of market design will grow. US experts argue that a functioning real-time market reflecting network constraints will spread to earlier time frames. However, it needs to be noted that US markets with nodal pricing have always combined real time pricing with day-ahead auctions that reflect the network constraints already in the market clearing process. It might be worthwhile to consider whether an effective intraday market design including appropriate auctions, could offer an alternatively effective way of encouraging a similar development in real-time and day-ahead markets adjacent to the intraday market.