Energy Policy 88 (2016) 544–557

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Trading behaviour on the continuous intraday market Elbas

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HIGHLIGHTS

- Insights into intraday trading: trading activity and price development.
- Special focus is on characteristics of continuous trading.
- Intrinsic problems in the Nordic imbalance pricing scheme are discussed.
- Implications regarding balancing of generation from vRES.

ARTICLE INFO

Article history:
Received 27 March 2015
Received in revised form
16 October 2015
Accepted 29 October 2015

Keywords:
Intraday adjustment market
Distributed balancing
Bidding strategies
Integration of renewable energy sources
Market design

ABSTRACT

Intraday markets for electricity allow for trading of energy until shortly before the period of delivery. This offers market participants a possibility to reduce their expected imbalances and to offer own unused flexibility. Because this form of distributed balancing before the period of delivery can be profitable for market participants as well as beneficial for system operations, intraday trading is expected to gain more importance in future, especially with increasing shares of variable renewable energy sources in the generation mix.

So far, intraday markets are still a research field with many open questions. This paper contributes by a first analysis of intraday trades on Elbas, one of the European intraday markets. The analysis gives a detailed picture on trading activity and price development and is intended to improve understanding of continuous intraday trading.

Findings include that trading activity differs significantly between price zones, that most trades occur in the last hours before gate closure and that market participants have to handle substantial price variations during the trading period. The paper also investigates the imbalance settlement rules in the Nordic countries and studies which effects one- and two-price imbalance settlement systems have on the market participants' profitability of intraday trading.

1. Introduction

In most European electricity markets, dispatch of power plants is not any longer decided and optimised centrally; instead, all market participants schedule their own power plants in a profit maximising manner. As each electric power system requires a continuous balance between generation and load, instruments are needed to guarantee that the schedules of all market participant converge in a both technically feasible and economically efficient solution for the whole system. Electricity markets are used as such an instrument. Usually, they are designed as a sequence of different trading opportunities; one being intraday trading which allows for trading of energy between closure of day-ahead markets and period of delivery.

There are different reasons why intraday trading can be considered profitable by market participants: first of all, it is a possibility to reduce imbalance costs to which market participants in several European electricity markets are exposed when supplying more or less energy than they planned. These imbalance costs can comprise an important incentive for all market participants to compute appropriately accurate production and consumption forecasts as well as to schedule and trade based on these forecasts. Reducing imbalance volumes is also a way to hedge against (uncertain) imbalance prices that might deviate significantly from day-ahead prices. In a survey among Swedish balance responsible parties, Pogosjan and Winberg (2013) find that the reduction of imbalance costs can currently be seen as the main motivation for intraday trading.

A second motivation is the possibility to optimise own

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http://dx.doi.org/10.1016/j.enpol.2015.10.045

production/consumption schedules, e.g. by buying energy to reduce generation in an own power plant that would be more costly to run.

Finally, intraday trading can also be used to offer flexibility in own production/consumption to other market participants who are willing to pay more for it than the respective costs of running and rescheduling the corresponding power plants and dispatchable loads. Without intraday trading, this available flexibility might not be utilised because *flexibility* on intraday and balancing markets can have different characteristics: in terms of intraday trading, flexibility consists of the possibility of increasing or decreasing own energy generation/consumption measured as MWh during the period of delivery. In contrast to that, bids to the balancing markets offer flexibility in terms of increasing/decreasing own generation/consumption levels, measured in MW. Because of higher requirements on balancing bids, e.g. minimum capacity, activation times and purely physical fulfilment, not all flexibility identified by market participants during the intraday trading period can be offered on the balancing market. Even if transmission system operators (TSOs) procure balancing services either before the intraday market opens, e.g., in Germany, or after closure of the intraday market, e.g. in the Nordic countries (Norway, Sweden, Finland, and Denmark), intraday trading is important to access this flexibility and should be regarded as a complement to balancing markets rather than a substitute.

The value of intraday markets from a system's perspective is that they can – at least on average – reduce the volume of activated balancing services; for example, if parts of the forecast errors related to variable renewable energy sources (vRES) can be handled shortly before real-time. Here, intraday trading can be advantageous because updated wind power forecasts are on average more accurate than day-ahead forecasts, which is due to reduced forecast horizons and the use of both weather prediction and recent measurements of wind power generation (Dobschinski et al., 2010; Holttinen, 2006).

In Europe, there are two predominant forms of intraday trading: discrete auctions and continuous trading, Fig. 1.

Continuous trading implies that trades can be settled whenever a market participant accepts an offer of another market participant. Therefore, prices vary from trade to trade. That is a substantial difference to auction-based intraday markets that are cleared at discrete times.

Advantages and disadvantages of intraday auctions and platforms for continuous intraday trading are manifold. The main argument in favour of continuous trading is that it allows market participants to trade whenever they can expect benefits from trading (Henriot, 2012). This can, for example, be advantageous for risk-averse market participants who want to minimise price risks related to expected imbalances as early as possible. In addition, it allows market participants who face increasing cost the later they reschedule (e.g. efficiency loss and wear-and-tear) to offer intraday flexibility at lower costs at an earlier time. For example, possibilities for rescheduling of thermal power plants are often more limited (ramping constraints, start/stop times, etc.) than for hydro units. This implies that flexibility in hydro units might be offered at comparatively low prices right before gate closure while flexibility in thermal power plants would become more expensive close to the period of delivery.

The main disadvantage of continuous trading is a lower allocative efficiency due to its inherent first-come-first-serve principle. This implies that some trades with positive welfare contribution (intra-marginal trades in discrete auctions) might not to be realised while some trades with negative welfare contribution (extra-marginal trades in discrete auctions) might be settled (Henriot, 2012; Weber and Schröder, 2011). Using a simulation model, Weber and Schröder (2011) conclude that the larger the

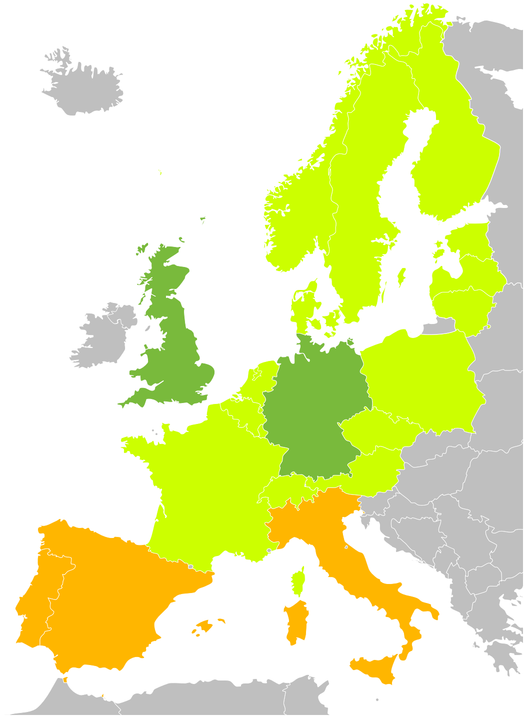

Fig. 1. Different designs of intraday markets in Europe in 2015: discrete auctions ( ), continuous trading ( ), mixture of continuous trading and discrete auctions ( ), no information ( ). Based on information from the market operators: TGE (2014) in Poland, OTE (2014) in Czech Republic, EPEX SPOT (2014b) in France, Germany/Austria and Switzerland, OMIE (2014) in Spain/Portugal, APX (2015) in the United Kingdom and GME (2014) in Italy. Political map based on Pmatulka (2015).

variations in a market participant's willingness-to-sell and willingness-to-buy during the trading period the larger the efficiency loss of continuous trading platforms compared to discrete auctions. Other commonly discussed advantages and disadvantages refer to price transparency and ease of trade.

The goal of this paper is to shed light on continuous intraday trading in order to improve understanding of its characteristics. Despite its potential to efficiently integrate vRES, intraday markets remain a research field with many open questions. For example, the majority of published models for production planning neglects intraday trading and focuses on optimising bids to day-ahead and balancing markets (Scharff et al., 2014). This has two reasons: first, computational complexity which increases the more decision steps that are included in a stochastic optimisation problem. Second, modelling of trading behaviour on continuous intraday markets is not straightforward; for example, because it might always be more profitable for a market participant to trade energy for the same period of delivery at a slightly later point in time. In addition, low liquidity – which is a common peculiarity of intraday markets (Weber, 2010) – complicates market modelling. Faria and Fleten (2011) have developed a production planning model that includes an intraday trading possibility. To represent limited liquidity in a hydro power producer's trading decisions, they manually restrict the volume that can be traded on the intraday market to a fixed level because model results will otherwise show significantly more intraday trading as what is observed in reality. As we experienced similar problems in earlier work (Scharff and Amelin, 2013), modelling continuous intraday markets and representing market liquidity in an appropriate manner are the main reasons why we analyse trading behaviour on an existing real intraday market.

Within this paper, we analyse different aspects of trading