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The Spanish intraday market design: A successful solution to balance renewable generation?

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ABSTRACT

The increasing penetration of renewable energy sources in Europe requires market mechanisms which allow an efficient balancing of these sources. This paper analyzes the participation of renewable generators in the Spanish intraday market. First, the organization of the intraday market and the short-term market mechanisms influencing intraday trading are described. After that, day-ahead and intraday market prices, as well as intraday trading volumes, are used to study the behavior of market agents in the Spanish intraday market. Regarding renewable generators, the influence of support schemes on the behavior of these agents in the intraday market is also analyzed. This paper shows that the Spanish intraday market has effectively contributed to renewable generation balancing. Despite this, market distortions have incentivized some renewable generators to arbitrate between the day-ahead and intraday markets, giving rise to higher system costs. Based on the presented analysis, it is argued that these distortions need to be removed from short-term markets to incentivize market parties, especially intermittent generators, to reduce forecast errors over time, improving economic efficiency and avoiding the use of costly balancing actions performed by the System Operator.

1. Introduction

The European Commission's 2020 targets[1] have resulted in an increasing penetration of renewable energy sources for electricity (RES-E). High shares of RES-E, especially wind and solar energy, affect power systems in several ways, for instance, by increasing network congestions, influencing market prices and creating higher balancing needs. This may require a redesign of electricity markets in order to facilitate RES-E balancing.

In this context, intraday markets play an important role to allow RES-E generators to adjust their schedules closer to real time according to updated production forecasts. Currently in Europe there are two options for intraday market designs: discrete auctions and continuous trading. The Iberian and Italian markets rely on discrete auctions, while the rest of the European countries use continuous trading. In the Iberian market, the intraday market comprises several auctions, which are held at specific times, and the market-clearing algorithm is based on the marginal pricing rule. In continuous trading, bids follow a price–time priority and matching can be based either on the pay-as-bid criterion or on the average bid price [2].

Due to its greater liquidity in relation to other European intraday markets, the Spanish intraday market design has been pointed out as a successful market design [3,4]. However, apart from the intraday market design itself (discrete auctions), this paper explores different market rules of the Spanish market that can encourage market parties to trade in this market.

This paper presents the evolution of prices and quantities of the intraday market in the last few years, and the relation with other short-term markets. Different agents can behave differently in short-term markets depending on the uncertainties faced with respect to energy forecasts and the economic incentives from the different market mechanisms. By analyzing the energy traded by technologies, we describe agents' behavior in the intraday market. We explore to what extent RES-E reduce the imbalance through the

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[1] The European Commission's Directive 2009/28/EC establishes a mandatory national target of 20% share of energy produced from renewable sources. Wind power will significantly contribute to fulfill these targets. Since 2000, 27.7% of new capacity installed has been wind power in the European Union, and already it represents a significant share of total electricity consumption in the European countries in 2012: 27% in Denmark, 17% in Portugal, 15% in Spain, 13% in Ireland and 11% in Germany [1].

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Table 1
Timing of the Spanish intraday sessions.

	1° Intraday	2° Intraday	3° Intraday	4° Intraday	5° Intraday	6° Intraday	7° Intraday
Gate-closure	18:45 (D-1)	21:45 (D-1)	1:45 (D)	4:45 (D)	8:45 (D)	12:45 (D)	18:45 (D)
Trading hours	1–24 (D)	1–24 (D)	5–24 (D)	8–24 (D)	12–24 (D)	16–24 (D)	21–24 (D)

intraday trading and what strategies are followed by these technologies in this market.

Support schemes have also an important influence on the participation of RES-E in short-term markets. In this respect, Hiroux and Saguan [5] discuss the support schemes in terms of accuracy of market signals and risks introduced by market parties. The authors conclude that the Spanish support scheme, which gave the possibility to choose between feed-in tariff and feed-in premium, is one of the best compromises between market signals, low risks and adequate sharing of wind responsibility between wind power producer and the System Operator. Batlle et al. [6] discuss the pros and cons for the different support schemes for RES-E in terms of investment incentives and dynamics, regulatory risks and the ownership structures of RES-E companies that can affect the operational decisions. Batlle et al. [6] suggest moving from price-based mechanisms to auctions, and particularly for non-dispatchable RES, to use a feed-in tariff design. This paper explores to what extent support schemes design has also an impact on RES-E bidding in the short-term markets.

The remainder of this paper is organized as follows: Section 2 briefly describes the organization of the Spanish short-term electricity market. Section 3 highlights the incentives to market parties to participate in the intraday market. Then, Section 4 studies the evolution of market prices and quantities, as well as the behavior of the different parties in this market. Section 5 discusses to what extent RES-E reduces energy imbalances through the intraday trading. Finally, Section 6 points out the main findings and presents the conclusions.

2. Overview of the Spanish electricity market

The Spanish short-term electricity markets comprise the day-ahead (DA) and intraday (ID) markets, and the balancing mechanisms which consist of the following markets for specific services: technical and security of supply constraints management, secondary reserve, tertiary reserve, deviation management, and additional upward reserve. The additional upward reserve market was recently established by the Spanish System Operator (SO) to handle situations of low online reserve margins. It is worth mentioning that in Spain the primary reserve provision is a mandatory and non-remunerated service. The Spanish market parties can also trade electricity through bilateral contracts with physical delivery. Those market parties holding bilateral contracts have to inform the SO of the electricity contracted before the DA market is held [7].

Once the DA market is cleared, agents can adjust in the ID market their schedules to compensate for equipment failures and energy forecast errors, or to apply strategic modifications. Since intermittent renewable generators cannot participate in balancing services markets, the ID market is the last option for these producers to adjust their production schedules according to updated generation profiles.

The Spanish ID market is organized as six centralized auctions (hereinafter sessions), with different gate-closure times and energy-scheduling horizons (i.e. number of hours during which energy is traded). The ID market lead-times (i.e. the difference between the last gate-closure time and the delivery hour) vary between 3.25 and 6.25 h. Table 1 presents the gate-closure and energy scheduling horizon of each intraday session[2], where 'D-1' refers to the day before operation and 'D' corresponds to the day of operation.

Although the Spanish ID market is divided into six auctions, the energy scheduling horizon of the first ID session is divided in two. The first period takes place between 21:00 and 24:00 of 'D-1' corresponding to the last ID session for the day of operation 'D-1'. A second period, comprising of all the hours of 'D', which corresponds to the first ID session for the day of operation 'D'. Hereinafter, the former will be referred as the seventh ID session of 'D'.

OMIE (the Iberian market operator) manages the DA and ID markets, without considering technical restrictions, which are handled later on through additional markets managed by each SO (i.e. the Spanish and the Portuguese). In Spain, if the market schedule does not comply with network constraints and/or reserve requirements are not enough, the SO redispatches generation through the procedure of management of technical constraints. The need to procure reserves through this procedure increased significantly in order to guarantee enough online reserve margins as a result of the growing penetration of RES-E generation and the increasingly displacing of thermal generators from the DA market. For this reason, in May 2012, the Spanish SO started procuring additional reserves through the additional upward reserve market [8]. This market is only called on when low reserve margins are detected, i.e. if the DA market schedule does not guarantee enough online reserves to balance generation and demand in real-time.

After the upward reserve market is closed, the SO procures secondary reserve capacity for each of the 24 h of the next day. Generators committed in this market receive the marginal price of the market (in €/MW) for the capacity and an energy price (in €/MWh) in case the SO activates secondary reserves. This energy price is given by the marginal price of the tertiary energy that would be required to replace the activated secondary reserve according to the tertiary energy bid ladder.

The tertiary reserve market is a market with mandatory offers, i.e. all conventional generators with available tertiary reserve capacity must bid in this market. In this market the product procured is tertiary energy (there is no payment for capacity) and it is only cleared if tertiary energy is required in real-time. The units that provide tertiary reserves receive an energy payment, corresponding to the marginal price of tertiary reserves.

Finally, if the SO predicts that generation and demand imbalance during a specific hour is greater than 300 MW and energy can no longer be traded in the ID market (i.e. deviation occurs after the gate-closure of a ID market session and before the first hour of the next session's scheduling horizon), the deviation management market is called. Available units may present energy offers and accepted bids receive the marginal market price (in €/MWh).

Fig. 1 illustrates the gate closure time of the Spanish short-term markets presented previously.

[2] The table refers to the gate-closure times and scheduling horizons valid from October 2013, the Spanish market operator delayed by 2 h the DA market gate-closure and by 1 h the first ID market session gate-closure as a result of the integration in the European Market Coupling (http://www.omie.es/files/131014_omie_press_release_gct_12.pdf).