PRICING RELIABILITY ON IMBALANCE PRICES IN ELECTRICITY MARKETS

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Overview

Based on the principle that demand and supply of electricity have to be balanced at each point in time, balancing mechanisms are introduced in the electricity markets as an essencial operation system for ensuring security of supply in real-time and stabilize system frequency. If the system is not balanced, power stability and quality of service will be compromised, leading to costly supply disruptions. Therefore, the electrical system needs to provide incentives to ensure that market participants stick to their schedules in regards to electricity production and consumption, as well as, to provide balancing services to the System Operator (TSO).

These incentives are provided by a correct settlement of imbalance prices; but, how the system should price the activation of balancing products and how to penalize supply and demand deviations, i.e., how to price caused systems imbalances? These questions become particularly relevant in the context of energy-only market. For instance, if the imbalance price is lower than the price in the electricity market, a demand party has an incentive to contract less demand that expected and buy the additional energy on the imbalance market. Additionally, imbalance pricing has become a key element in electricity markets due to the high penetration of intermittent renewable energy sources. Although electricity generation by conventional power plants can be easily controlled, this is not the case of wind and solar power plants. Electricity generation from intermittent renewable energy sources increases the need for balancing mechanisms, raising the costs of keeping the network balanced. Therefore, imbalance prices also set the incentives to make optimal use of forecast technologies in order to avoid high deviation from their scheduled production.

Following the Electricity Directive 96/92/EC, several European countries proceeded to the unbudling of their electricity markets, splitting the generation system from the transmission system and making balance management a more demanding task. Furthermore, the unbundling of the electricity system did not follow a consistent path across all Europe. In order to satisfy the characteristics of their electricity markets as well as national and individual objectives, European countries designed different balancing markets with their own particularities and rules. This is of particular relevance because different imbalance settlements might lead to different market behaviour and balancing market performance. In fact, *"the larger the impact of imbalance settlement design on balancing market performance, the more relevant careful design of imbalance settlement is, and the more important it will be to harmonize imbalance settlement if governments, energy regulators and TSOs aim to integrate the balancing markets of different countries"* (Van Der Veen, Abbasy, & Hakvoort, 2010), rising the question of which imbalance settlement design should be developed in order to cope with the current particularities and objectives of the European Electricity Market.

Methods

As mentioned by Van Der Veen & Hakvoort (2016), the topic of electricity balancing market design as well as imbalance settlement has received little attention by academic researchers. Although several studies have shown that there are many different ways to define imbalance prices (ETSO, 2003; Meibom et al., 2003; Tractebel Engineering, 2009), the imbalance settlement rules are very different. Therefore, in order to answer the research questions, this article will start with an overview over imbalance price systems in Switzerland and neighboring countries as well as other important systems such as the UK and USA imbalance mechanisms. An optimization problem will then be set up in order to evaluate different imbalance price mechanisms. In this profit maximization problem, the power plant owner decides on the quantity to sell in the day-ahead market in order to maximize the revenue in the day-ahead and imbalance market, given the realized output in different states of the world and taking into account power plant capacity as well as imbalance restrictions. This model will be then extended for a two-price and pool systems.

Results

This model aims to look at the impact of different systems on imbalance pricing on consumers and producers. We believe this framework will provide fruitful insights on new balancing market designs as well as on imbalance settlements.

Conclusions

This framework will allow us to explain the differences in performance on the basis of the imbalance settlement design differences and draw new proposals for enhancements on balancing market designs.

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