Introduction to the Special Issue on "Competition in the Electricity Sector"

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Until the last two decades or so, the electricity sector of many countries was vertically integrated and predominantly state-owned. Vertically integrated companies oversaw the generation, transmission, distribution and supply of electricity to final consumers. However, more recently, the electricity sectors for a number of countries are undergoing a process of transformative structural change, in an effort to overcome inefficiencies identified within vertically integrated structures. To address the complex economic and engineering (infrastructure) challenges inherent on promoting competition in the electricity sector, various measures have been tested. These have included for instance the introduction of wholesale electricity markets (pools), and the unbundling of the traditional vertically integrated monopolies among other things. The increasing utilization of *distributed* energy resources has also brought both benefits and challenges. The pace and extent of market reforms differ across different geographic regions, due to a combination of path-dependency/system rigidity, as well as differences in institutional and environmental contexts.

Against this backdrop of electricity market transformations occurring worldwide, there remains an imperative to question what features characterize the "optimal" pathway—or at least empirical best-practices—through to successful market transformation. Evaluating optimal development paths would need to take into consideration the range of impacts of the transformation to key economic and operational performance indices connected to the electricity market, these might include factors relating to security, reliability, economic indicators, system flexibility, and environmental sustainability. To facilitate the successful transformation of electricity markets worldwide, it is crucial also to uncover the competition distortions within electricity markets. Through this it will be possible to better understand how the mechanisms of reform and the deployment of competition policies need to be advanced, which will help to inform the changing role of competition authorities and market regulators in facilitating a sustainable system transformation.

This special issue of The Energy Journal provides a timely coverage on this important and dynamic area of research, welcoming a wide-range of empirical methodologies and applications as well as theoretical insights that contribute to our knowledge base. The applied theoretical and analytical contributions deployed provide renewed guidance to policy-makers and government officials in designing new policy scenarios for the investigation of the role of "*Competition in the Electricity Sector.*"

A brief synopsis of the contributions

- The issue begins with a broad ancillary services in electricity markets, by Pollitt and Anaya (2020). The discussion is motivated by the potentially higher future demand for ancillary services in electricity markets, which introduces the need to re-examine whether such services can continue to be procured by systems operators in the same ways they have in the past. They conclude, among other things, that while markets for ancillary

services are limited by the "overarching role of the system operator", their remains considerable scope for innovation to help develop, and bring to maturity, the market for ancillary services.

- Holmberg and Ritz (2020) turn attention towards capacity mechanisms. Seeking to add to the debate on the value and importance of capacity mechanisms, these authors introduce a "new benchmark model of a capacity mechanism", using it to help evaluate what combination of wholesale price caps and capacity payments may obtain socially optimal investment. In summary, they are able to offer a novel rationalization for capacity mechanisms, built on the tenets of internalizing the system-cost externality.
- The study by Kuosmanen and Johnson (2020) revisits the topic of yardstick competition as a tool for regulating energy markets, and focuses specifically on the application of conditional yardstick competition. The work offers an alternative approach to handle heterogeneity and allow for benchmarking in the case of multiple outputs, ensuring that regulators decisions are also informed by incentive compatible benchmarking tools.
- Heim et al (2020) review aspects of the industrial organization of electricity distribution, and the unbundling of vertically integrated utilities. The empirical work in this study focuses on a panel of data of German distribution system operators (DSOs). Their findings allude to a significant reduction in grid charges as a result of legal unbundling, ranging between 5% to 9%, however they additionally note that the extent of reductions is influenced by the type of price regulation in place.
- Keeley et al (2020) address the topic of spot market pricing in Germany. One key objective of their contribution is to illustrate how machine learning tools can be adapted and extended to economists' questions towards energy market dynamics. Their work provides an alternative lens on how renewable energy and spot market prices interact with each other, offering new empirical benchmarks on the role of renewable energy to the merit order effect at high generation volumes.
- Olmstead et al (2020) reflect upon the influence of offer price information to market competition and power in the Alberta Electricity Market. Counterfactual analysis tools are employed to illustrate that the provision of hourly trading reports facilitate learning and allowed for an increased exercise of market power.
- Darudi and Weigt (2020) develop a game theoretical framework to examine how different renewable support policies, including feed in tariff's and feed in premium's, can impact strategic actions of incumbent firms. Among other things, their paper documents how regulators choices over renewable policy support may align with a tradeoff balancing market power considerations against emission abatement.
- Giraudet et al (2020) offer an analysis on the topic of imposed energy efficiency obligations. The study alludes to the complexity of imposing such obligations, indicating that in the presence of imperfect competition, a common feature of many liberalized energy markets, introducing the ability/option to trade energy efficiency obligations "generates an equilibrium mimicking that of internal compliance."
- Ekholm and Virasjoki (2020) discuss pricing and competition in markets with 100% renewable energy and storage. This is a very timely discussion, given the rapid improvements in battery technologies in recent years. Their findings question the welfare implications of variable renewable energy (VRE), recognizing that market power and its influence to curtailed generation, has noteworthy implications to welfare, while fur-

ther acknowledging that improved monitoring by regulators could help mitigate against welfare reducing actions.

Cumulatively these studies deploy a range of techniques, theoretical and empirical orientations and international empirical analyses to provide insightful and novel contributions. They deliver an up to date evaluation of the diversity of issues being addressed in the study of competition in electricity markets. It is our opinion and belief that the contributions contained here help to advance our understanding of competition in electricity markets and will help guide the future narrative on this important and dynamic topic.

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