

electricity market

a conversation on future designs

THE FIRST EFFORTS TO RE-structure electricity markets in Europe and the United States were in the late 1990s. At that time, electricity production based on variable weather-dependent sources was virtually nonexistent. As a result, those early efforts did not take into account the properties of those resources. Today, such generators are dominant in some markets, such as in California, Texas, the Iberian Peninsula, and Denmark. The contribution of variable renewable resources in other countries and regions is increasing at a rapid pace.

On the flip side, electricity demand was largely fixed and inelastic in the 1990s, with the exception of some industrial and large commercial customers. These types of loads display more price sensitivity, especially if energy constitutes a major input to their production processes. Even though electricity demand remains primarily fixed today, new loads, such as those pertaining to electromobility, and behind-the-meter production facilities, such as rooftop solar installations, are slowly increasing demand elasticity and flexibility.

The operational and planning consequences of these major changes (such as the dramatic increase in weather-dependent electricity production and the incipient increase in demand flexibility) need to be reflected in the design of electricity markets of the future. It is crucial to spur a conversation

to scrutinize to what extent (if any) these formative market designs need to be updated or simply replaced by a new design that better incorporates weather-dependent renewable producers and increasing demand flexibility. This issue of *IEEE Power & Energy Magazine* is intended to promote such a conversation with the ultimate goal of achieving increasingly efficient and fair markets for energy.

This issue contains six articles and concludes with the “In My View” column. The first three articles describe the evolution of market designs and forthcoming challenges in Europe, the United States, and New Zealand (with the latter being a highly renewable-dominated system). The following two articles summarize market-design challenges from the perspective of regulators in the United States and Europe. The sixth article gives an in-depth analysis of current market designs from a historical perspective and suggests redesign criteria. The “In My View” column, reviews and clarifies the fundamental economic principles on which markets rely.

In the first article, “European Union Electricity Markets,” Gomez and his coauthors provide an overview of the current state of electricity markets in Europe. They emphasize policies that have been pursued by European institutions to achieve greater market integration of member states through the Electricity Target Model. The day-ahead, intraday, and real-time markets are revisited, detailing what has been

achieved in terms of integration and what lies ahead. The capacity allocation and congestion management regulation is particularly important as it allows coordination between different national and regional markets.

The second article, “Electricity Markets in the United States,” by Litvinov, Zhao, and Zheng, reviews the main features of electricity markets in the United States that resulted from Federal Energy Regulatory Commission (FERC) Order 888. The focus, in particular, is on pricing and market-coordination issues and a review of day-ahead and real-time energy, forward reserve, and forward capacity markets. A description of the market management system components is given, which is the internal architecture of the system operator that allows it to effectively function. They identify the main challenges faced by markets in the United States today, including those that pertain to the grid, and provide ideas to tackle them.

The next article, “The New Zealand Electricity Market,” by Philpott et. al describes the historical evolution, main features, and governance of the New Zealand market. New Zealand provides an interesting case study, as it is a completely isolated island system with seasonal interannual variability in the availability of (hydroelectric) renewable energy resources. The authors survey the historical market and regulatory inefficiencies, which market restructuring in New Zealand has tried to address.

“A Change Is Coming,” the fourth article, by Fulli et. al provides a vision of how the supply and use of electricity within Europe is expected to evolve over the next 30 years. They show how regulatory changes and research, demonstration, and development projects supported by European institutions will change the nature of customer interactions with electricity. In the authors’ vision of the future, customers are more engaged in making electricity supply-and-demand decisions, as opposed to leaving these to utilities and supply companies.

In the fifth article, “Wholesale Electricity Markets in the United States,” Quinn and Nicholson provide their view of the FERC in regulating and reforming competitive wholesale electricity in the United States. They discuss the means by which FERC has encouraged the development of increasingly competitive wholesale markets. The authors also outline three challenges that these markets will have to contend with in the near future: 1) the effects of declining wholesale prices on capacity invest-

ment, 2) the need for a new a fleet of flexible energy resources and the most efficient means by which to incentivize the development of such assets, and 3) coordination between electric power and natural gas systems.

In the final feature article, “The Three Waves of U.S. Electricity Market Reforms,” Hobbs and Oren provide a detailed analysis of the historical and future evolution of electricity markets. They identify this as taking place in three waves. The first, unbundling and debunking the natural monopoly myth, was the formative step in market restructuring. The second, focus on economic efficiency and incremental improvements, was the natural genesis of lessons learned from the California market crisis of 2000 and 2001. The third, making way for demand-side, renewable, and distributed resources, is the natural evolution that we are currently undergoing. They also introduce us to some of the major figures of market restructuring.

The issue concludes with an “In My View” column by Hogan. He insightfully notes that the basic premises of

supply and demand, market clearing, and pricing that applied when market restructuring took place in the 1990s will still apply to a future power system with renewable energy supply and demand flexibility. He concludes that any potential market flaws stem from implementation details, not from the underlying economic principles.

Our goal in putting together this issue is to spur a much-needed conversation on market redesign, which should involve operators, regulators, market agents, and the research community. Such a conversation will certainly produce innovative ideas that will contribute to make existing electricity markets increasingly efficient and fair for all market agents. The ultimate goal, as stated by the Electricity Authority of New Zealand, is promoting “competition in, reliable supply by, and the efficient operation of, the electricity industry for the long-term benefit of consumers.”



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