T
HE FIRST EFFORTS TO RE-
structure electricity markets in Eu-
rope and the United States were in the
late 1990s. At that time, electricity pro-
duction based on variable weather-de-
pendent sources was virtually nonexis-
tent. 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 Pen-
insula, and Denmark. The contribution
of variable renewable resources in oth-
er 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 in-
dustrial and large commercial custom-
ers. These types of loads display more
price sensitivity, especially if energy
constitutes a major input to their produc-
tion processes. Even though electricity
demand remains primarily fixed today,
new loads, such as those pertaining to
emotomobility, and behind-the-meter
production facilities, such as rooftop
solar installations, are slowly increasing
demand elasticity and flexibility.

The operational and planning con-
sequences of these major changes (such
as the dramatic increase in weather-
dependent electricity production and
the incipient increase in demand flex-
ibility) need to be reflected in the de-
sign of electricity markets of the fu-
ture. 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 produc-
ters 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” col-
umn. 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 chal-
lenges from the perspective of regula-
tors 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 fun-
damental economic principles on which
markets rely.

In the first article, “European Union
Electricity Markets,” Gomez and his
cowithors provide an overview of the
current state of electricity markets in
Europe. They emphasize policies that
have been pursued by European in-
stitutions 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 alloca-
tion and congestion management regu-
lation is particularly important as it
allows coordination between different
national and regional markets.

The second article, “Electricity
Markets in the United States,” by Lit-
vino, Zhao, and Zheng, reviews the
main features of electricity markets
in the United States that resulted from
Federal Energy Regulatory Commis-
sion (FERC) Order 888. The focus, in
particular, is on pricing and market-
coordination issues and a review of
day-ahead and real-time energy, for-
ward reserve, and forward capacity
markets. A description of the market
management system components is
given, which is the internal architec-
ture 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 pro-
vide 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 pro-
vides 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 in-
efficiencies, 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 investment, 2) the need for a new 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.”

The first efforts to restructure electricity markets in Europe and the United States were in the late 1990s.

Electricity demand was largely fixed and inelastic in the 1990s.

The capacity allocation and congestion management regulation is particularly important.