Market Evolution on High Variable Renewable Future

Panel Introduction

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ESIG
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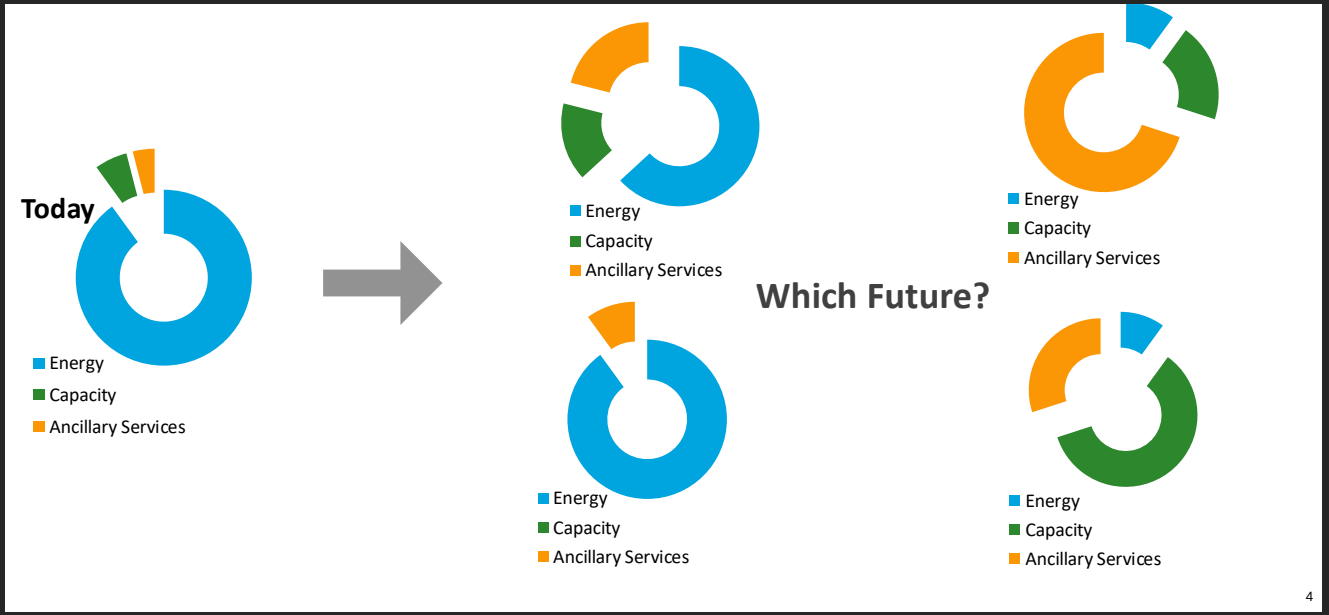
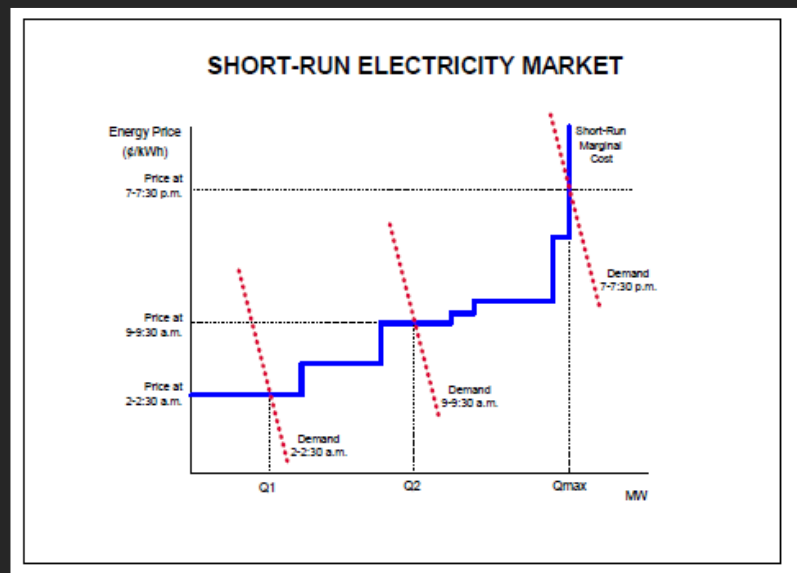
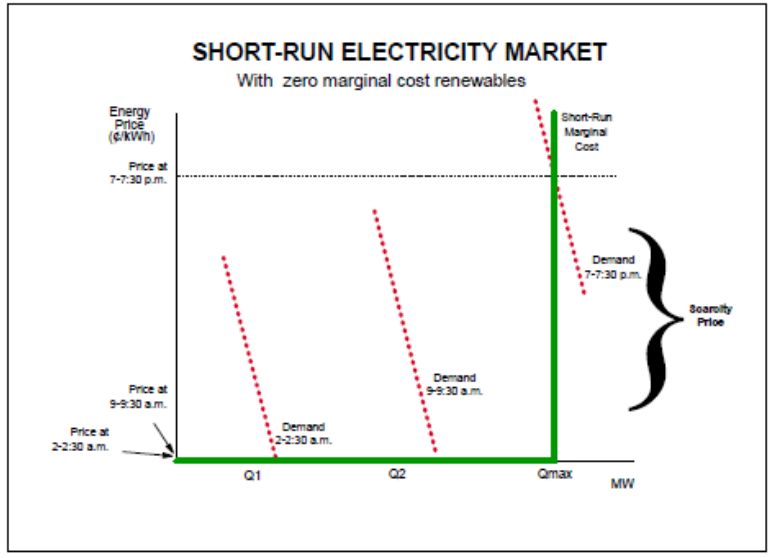
What will Energy Prices look like?



- Investment signals, environmental polices outside the energy market
- Resource adequacy structures
- Responsiveness of demand

- Shortage pricing design and allowance
- Renewable locations and correlation
- Cost-effectiveness of enabling technologies





W. Hogan, "Electricity Market Design and the Green Agenda," *IEEE PES GM*, 2020.

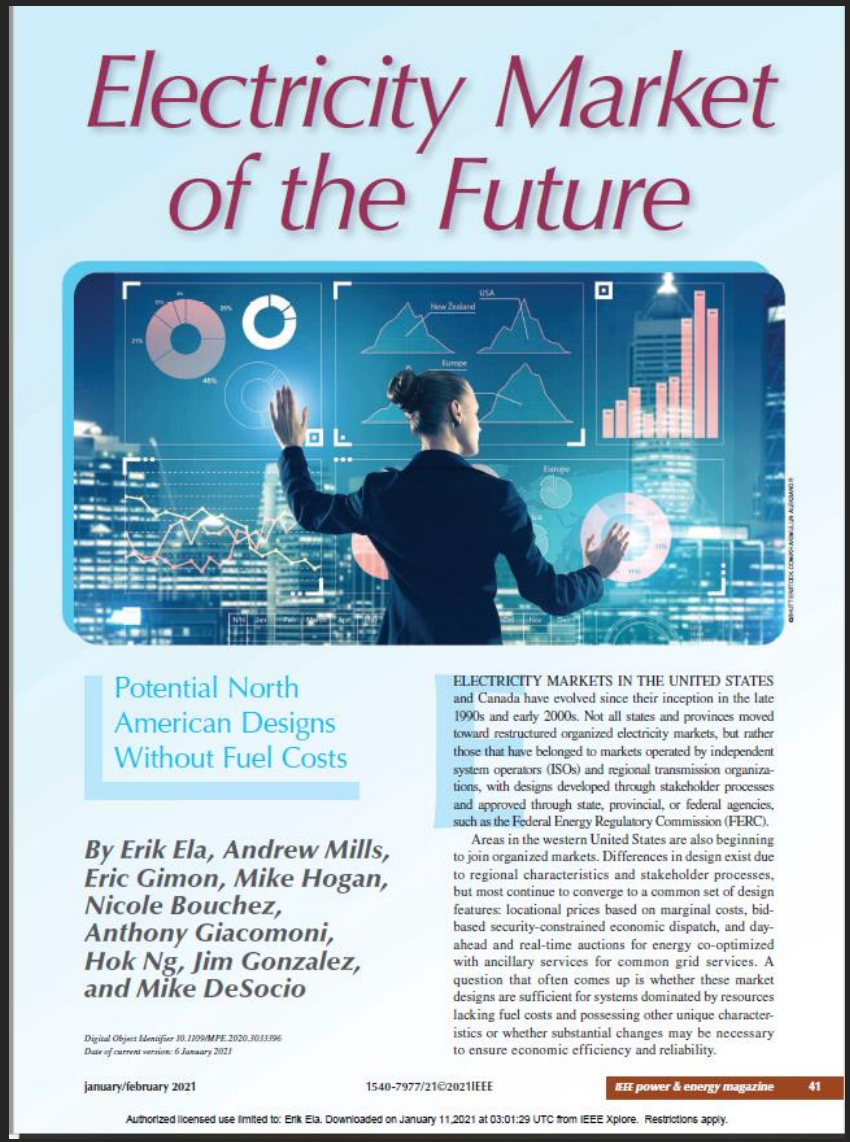
Price Formation

Key Questions

- What is the marginal cost?
- What is the value of energy?
- What is the cost / value of operational attributes?
- How do retail customers understand and react?

Panel Session

- Karen Palmer, *Resources for the Future*
- Pamela MacDougall, *Environmental Defense Fund*
- Julian Leslie, *National Grid ESO*
- Liam McManus, *Australian Energy Market Operator*



Electricity Market of the Future

Potential North American Designs Without Fuel Costs

By Erik Ela, Andrew Mills, Eric Gimon, Mike Hogan, Nicole Bouchez, Anthony Giacomoni, Hok Ng, Jim Gonzalez, and Mike DeSocio

ELECTRICITY MARKETS IN THE UNITED STATES and Canada have evolved since their inception in the late 1990s and early 2000s. Not all states and provinces moved toward restructured organized electricity markets, but rather those that have belonged to markets operated by independent system operators (ISOs) and regional transmission organizations, with designs developed through stakeholder processes and approved through state, provincial, or federal agencies, such as the Federal Energy Regulatory Commission (FERC).

Areas in the western United States are also beginning to join organized markets. Differences in design exist due to regional characteristics and stakeholder processes, but most continue to converge to a common set of design features: locational prices based on marginal costs, bid-based security-constrained economic dispatch, and day-ahead and real-time auctions for energy co-optimized with ancillary services for common grid services. A question that often comes up is whether these market designs are sufficient for systems dominated by resources lacking fuel costs and possessing other unique characteristics or whether substantial changes may be necessary to ensure economic efficiency and reliability.

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