Recent Trends and Experience in US Capacity Markets

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Solar Ontario

Canadian Solar Industries Association

PRESENTED BY

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November 14, 2018

THE Brattle GROUP

Why Capacity Markets?

Capacity markets help meet resource adequacy requirements in restructured markets, where resources are supplied by merchant investors rather than regulated entities.

- Load serving entities must buy enough capacity to meet their peak load + reserve margin (often with the RTO procuring on their behalf).
- Resources compete to provide that capacity at least cost.
- Resources that "clear" are paid the capacity clearing price.

The price needed to clear the market is positive because energy margins are typically insufficient to attract enough resources to meet the target reserve margin. This "missing money" has two causes:

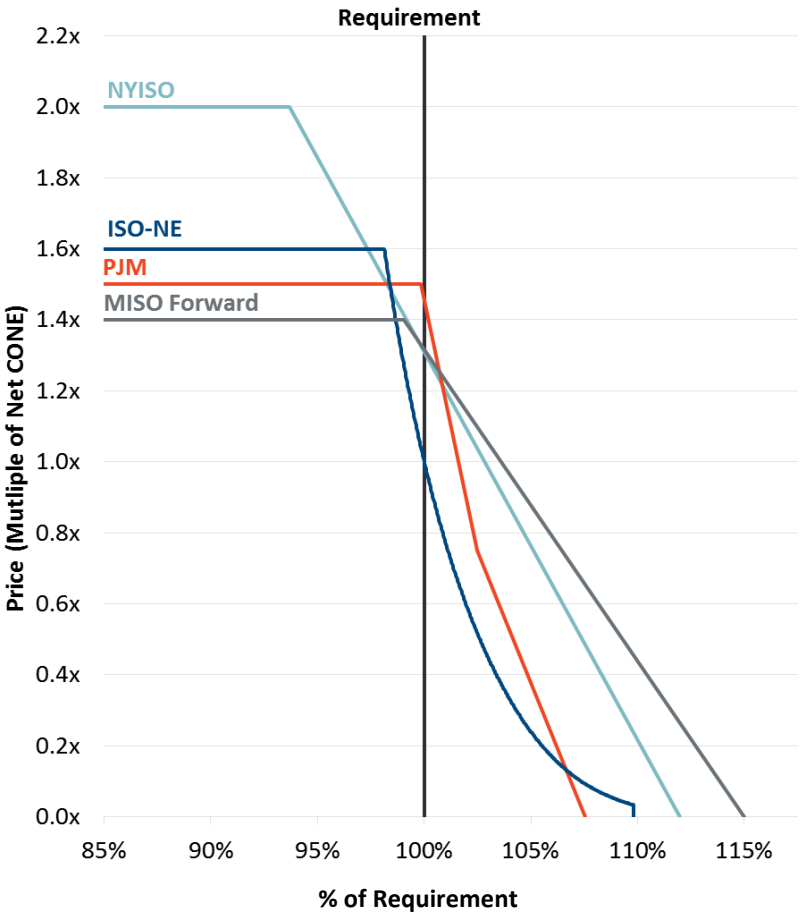
- Energy prices may be below the true marginal system cost.
- Even if prices reflected the marginal system cost, an energy-only market could provide the economically optimal reserve margin, but this would likely be below the high levels mandated based on "1-in-10"; such high reserve margins depress energy prices, so an additional payment is needed.

Traditional Capacity Market Design

Capacity market designs vary, but several elements are common:

- **Derated 'Unforced Capacity' MWs**
- **Administrative demand curves**
  - Sloped to reduce price volatility
  - Derived from administrative estimate of Net Cost of New Entry (Net CONE)
- **Forward auctions**
  - Typically 3 years forward
  - One or more "rebalancing" auctions
- **Provisions to mitigate the exercise of market power**
  - Supplier-side mitigation
  - Buyer-side mitigation

Capacity Market Demand Curves



Sources and Notes:

RTO Capacity Auction parameters for ISO-NE, PJM, and NYISO.
MISO Competitive Retail Solution Filing before FERC, Docket No. ER17-284-000.
NYISO cap expressed in terms of MISO net and gross CONE.

Summary of Successes

Meeting resource adequacy objectives

- All markets in surplus or balance (but started w/excess)
- PJM forward market cleared sufficient supply despite 10% of the fleet retiring

Competition among resource types has lowered the cost

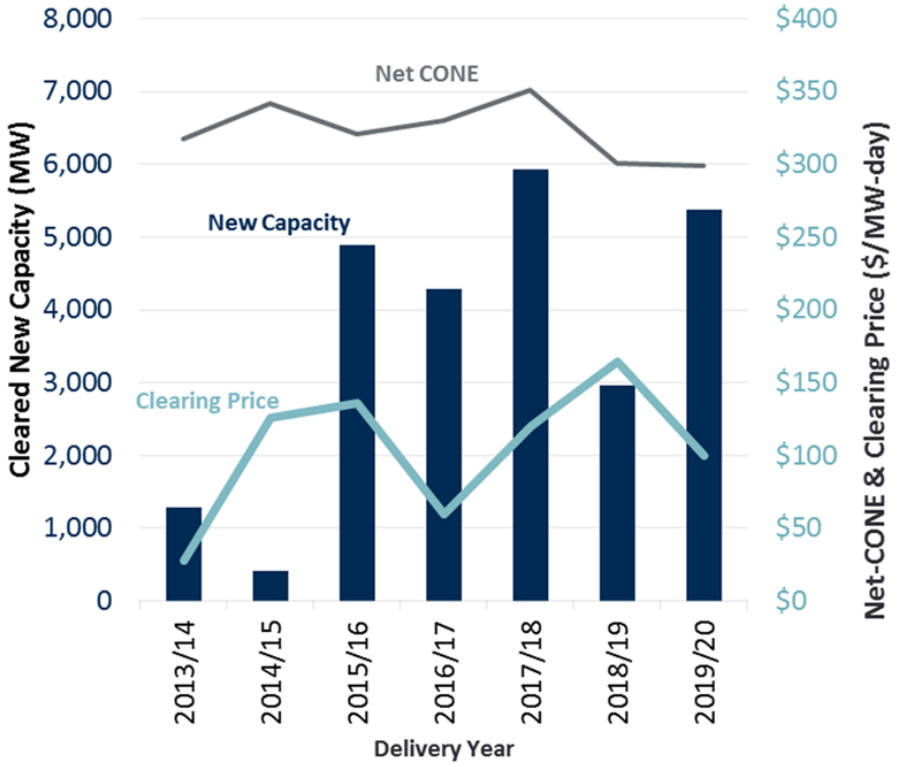
- Retention of existing capacity
- Surprising amount of entry of DR, uprates, and imports
- Need for costly new generation was deferred

Proven ability to support merchant generation entry

- Large amounts of new merchant CCs in PJM
- Some merchant entry in New York ISO and now ISO New England

PJM Cleared New Generation

Avg. 3,600 MW (mostly gas) in recent BRA auctions



Sources and Notes:
BRA clearing prices are for Annual and CP products, as applicable, in the RTO.
New Capacity data are from PJM BRA report 2019-2020.

Ongoing Design Challenges

Growth in intermittent and strongly seasonal renewables creates new challenges for electricity markets

- How to attract and retain the right resources: clean energy, flexible, etc.
- How to minimize costs with a non-traditional mix of resources
- How to incentivize performance when it is most valuable

The basic need for capacity (MW) remains. Refinements of capacity market design elements are ongoing and include:

- Refining demand curve shapes
- Sharpening performance incentives/penalties
- Accommodating large amounts of demand response

Capacity market reforms are a part of a holistic solution to these challenges

- How can existing energy and capacity markets be modified to “add in” additional variables, e.g. carbon prices and flexible capacity needs?

Flexible Resource Adequacy Products

Motivation: With more renewables, the grid must become more flexible

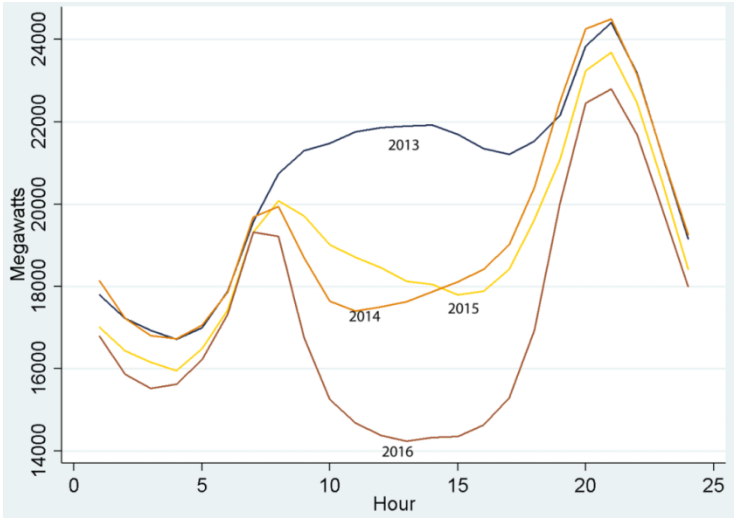
- Larger multi-hour ramps, i.e. the "duck curve"
- Capacity markets do not specify flexibility requirements

In 2014, California introduced "Flexible Resource Adequacy" requirements

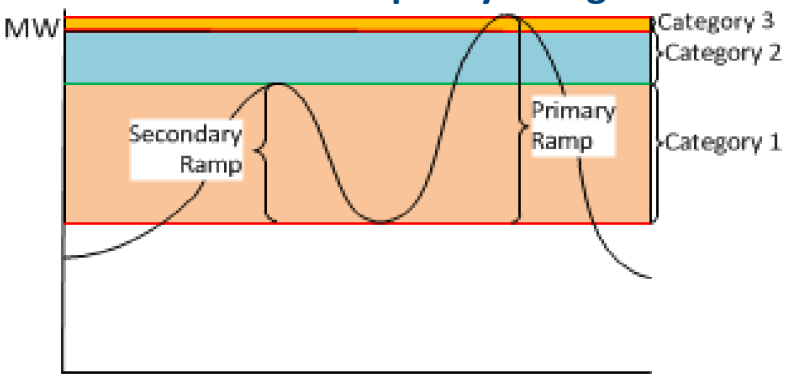
- Loads must procure sufficient resources to meet the greatest three-hour continuous ramp each month
- Flexible capacity needs range from ~7,800 MW (August) to ~11,200 MW (December)
- Will be complemented by a proposed new ramping ancillary service in the energy markets
- Similar product considered in Greece

California Hourly Net Load

March 28 – April 3, 2013 - 2016



California Flexible Capacity Categories



Sources and Notes:
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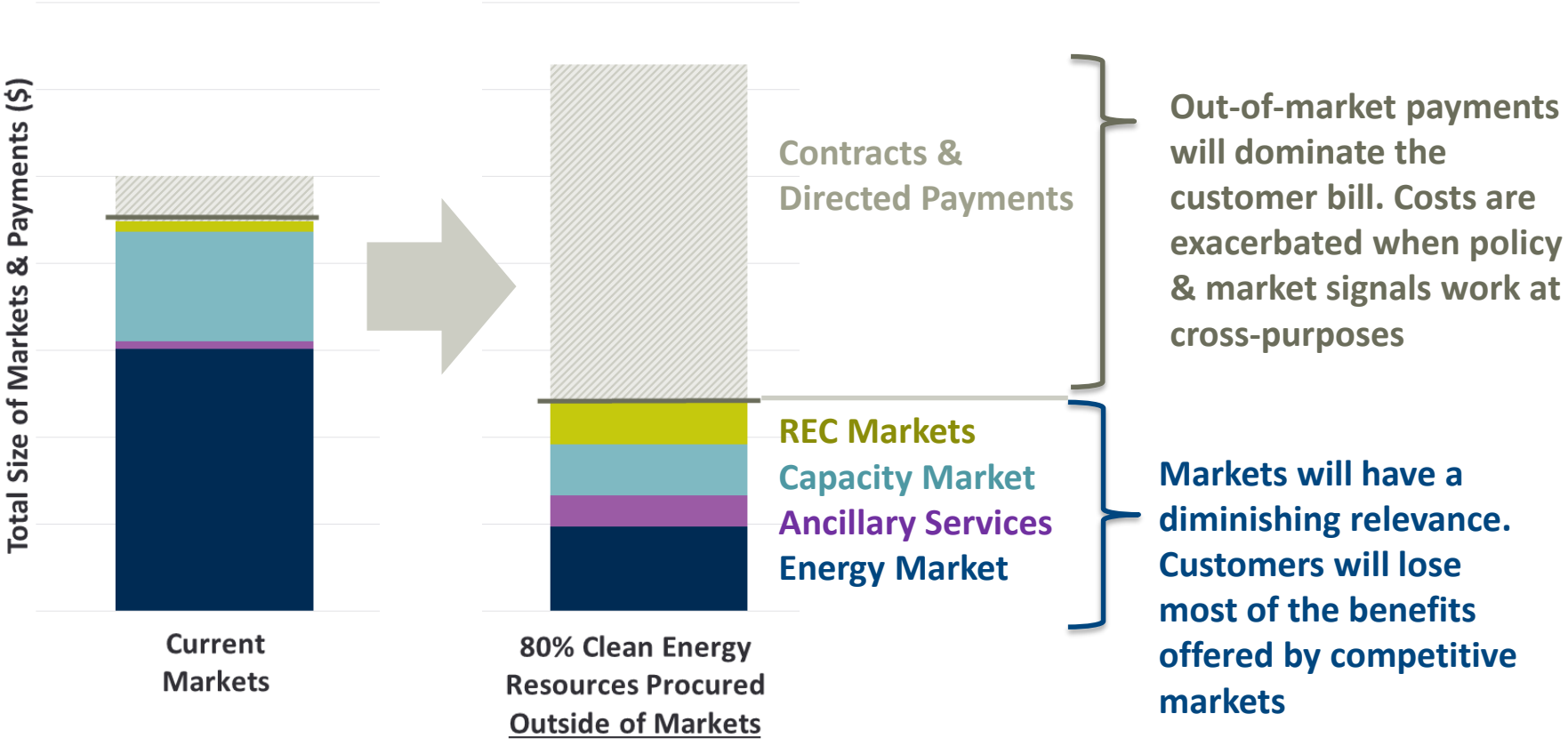
http://docketpublic.energy.ca.gov/PublicDocuments/12-AFC-02/TN202691_20140713T202749_Decision_Adopting_Local_Procurement_and_Flexible_Capacity_Oblig.PDF
Meredith Fowlie, *The Duck has Landed,* https://energyathaas.wordpress.com/2016/05/02/the-duck-has-landed/

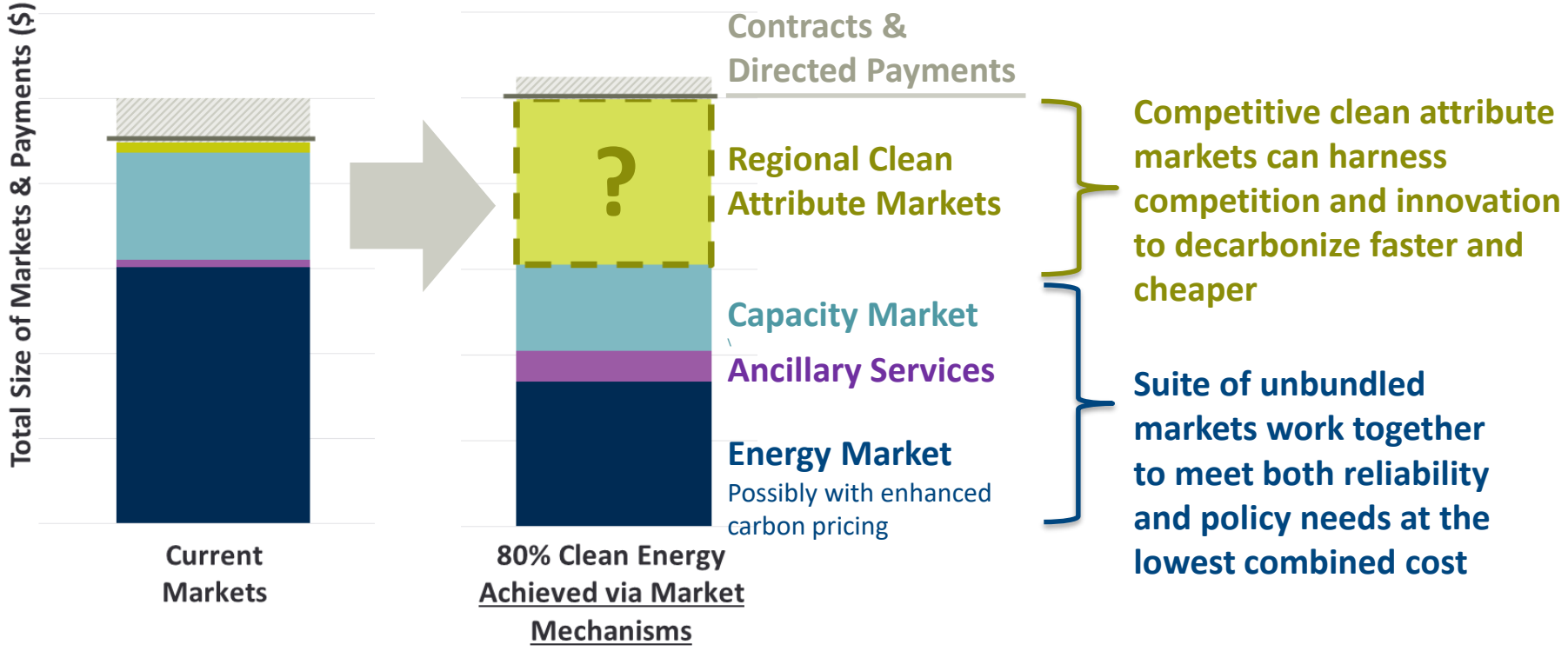
One Possible Path for Energy Markets…

The disconnect between what customers want and what the markets deliver could continue to grow…



But There's a Better Path to "Markets 3.0"

Clean energy attribute markets are the primary "missing link" needed to better align markets with customer and state demand for a cleaner grid



What Should the Clean Energy Markets Look Like?

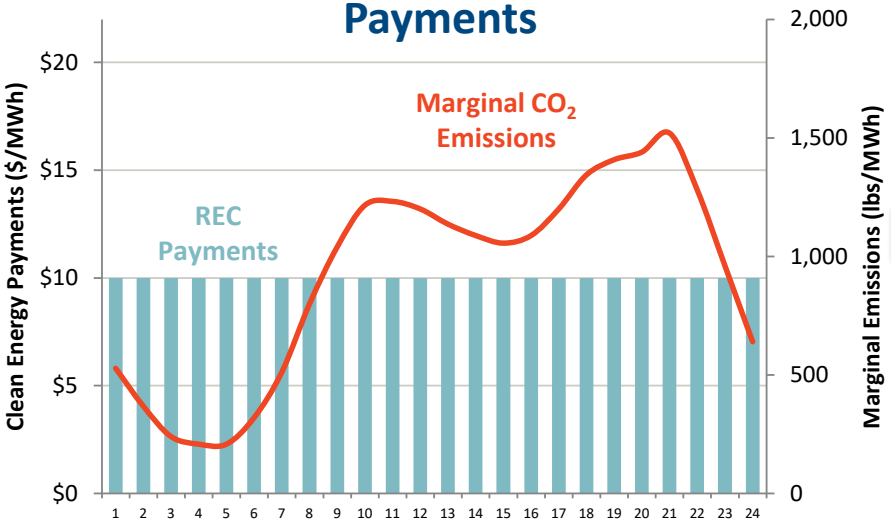
Best practices are the same, whether the leadership to develop clean energy markets comes from state/provincial policymakers, market operators, or others:

- **Product Definition** that matches the underlying objective (carbon abatement)
- **Unbundled Attributes** that maximize competition across markets and technologies
- **States and Customers Choose** their own demand quantities and willingness to pay (no costs shifted to non-participants)
- **Technology-neutral** qualification and payments
- Broad **regional competition**
- Mechanisms to **mitigate regulatory risk** and ensure financeability at competitive costs
- Care to ensure **alignment with energy, ancillary, and capacity markets**

Better Product Definition: Achieves Faster Decarbonization at a Lower Cost

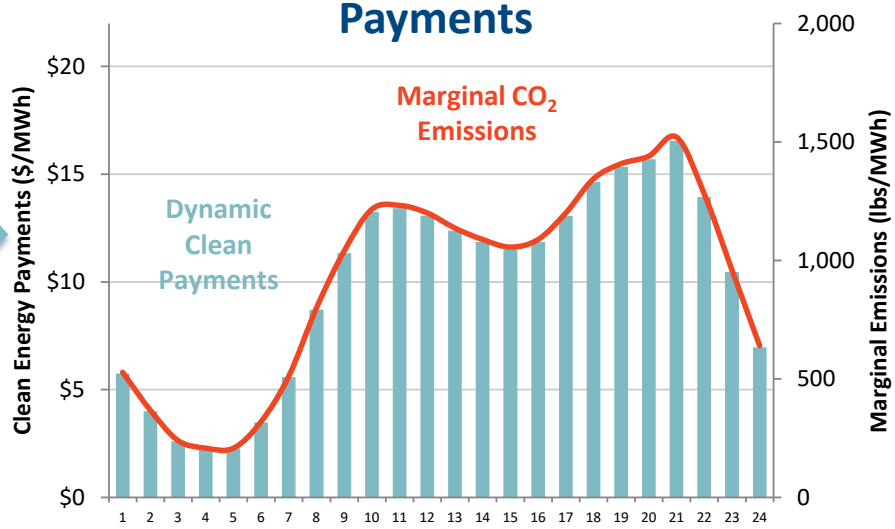
A Brattle proposal for a "Dynamic" Clean Energy Market in New England would align payments with marginal carbon abatement

Illustrative Traditional REC Payments



- Flat payments over every hour
- Incentive to offer at negative energy prices during excess energy hours

Illustrative "Dynamic" Clean Payments



- Payments scale in proportion to marginal CO_2 emissions (by time and location)
- Incentive to produce clean energy when and where it avoids the most CO_2 emissions
- No incentive to offer at negative prices

Sources and Notes:

See the full design proposal here: http://www.nepool.com/uploads/IMAPP_20170517_LT_Straw_Dynam_Clean_Energy_Market.pdf

Takeaways

Experience with capacity markets over the first decade suggests that:

- Well-designed capacity markets can attract low-cost supplies, achieve reliability targets, and even attract merchant investments
- Market design refinements will continue

Renewables growth poses a new challenges to wholesale markets.

- Attributes not directly valued by markets, e.g. flexibility and low-carbon energy, are becoming increasingly important

Capacity markets can serve as one component of holistic reforms.

- Competitive clean energy markets are a missing link in the evolution to Market Design 3.0
- Capacity market reforms can complement reforms to energy and ancillary markets

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Dr. Walter Graf is an Associate at The Brattle Group with expertise in electricity wholesale market design and analysis.

Dr. Graf's work focuses on addressing economic questions facing regulators, market operators, and market participants in the electricity industry. Recent engagements include support for the development of the Ontario Incremental Capacity Auction and work assessing the potential benefits and costs of the IESO Market Renewal Program. Dr. Graf also has experience assisting market participants assess values and risks of entering new markets, analysis of wholesale and retail electricity rate options, and long term load forecasting.

Dr. Graf holds a Ph.D. and M.S. in Agricultural and Resource Economics from the University of California, Berkeley, and a B.S. in Economics and B.S.E. in Civil and Environmental Engineering from the University of Michigan.

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