

Value of Capacity and Market Trends During Rapid Transformation To Clean Energy

PRESENTED BY
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ESIG 2019 Meteorology &
Market Design for Grid Services
Workshop (Denver, CO)

June 5, 2019

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Why Capacity Markets?

Capacity markets help meet Resource Adequacy (RA) requirements in restructured jurisdictions

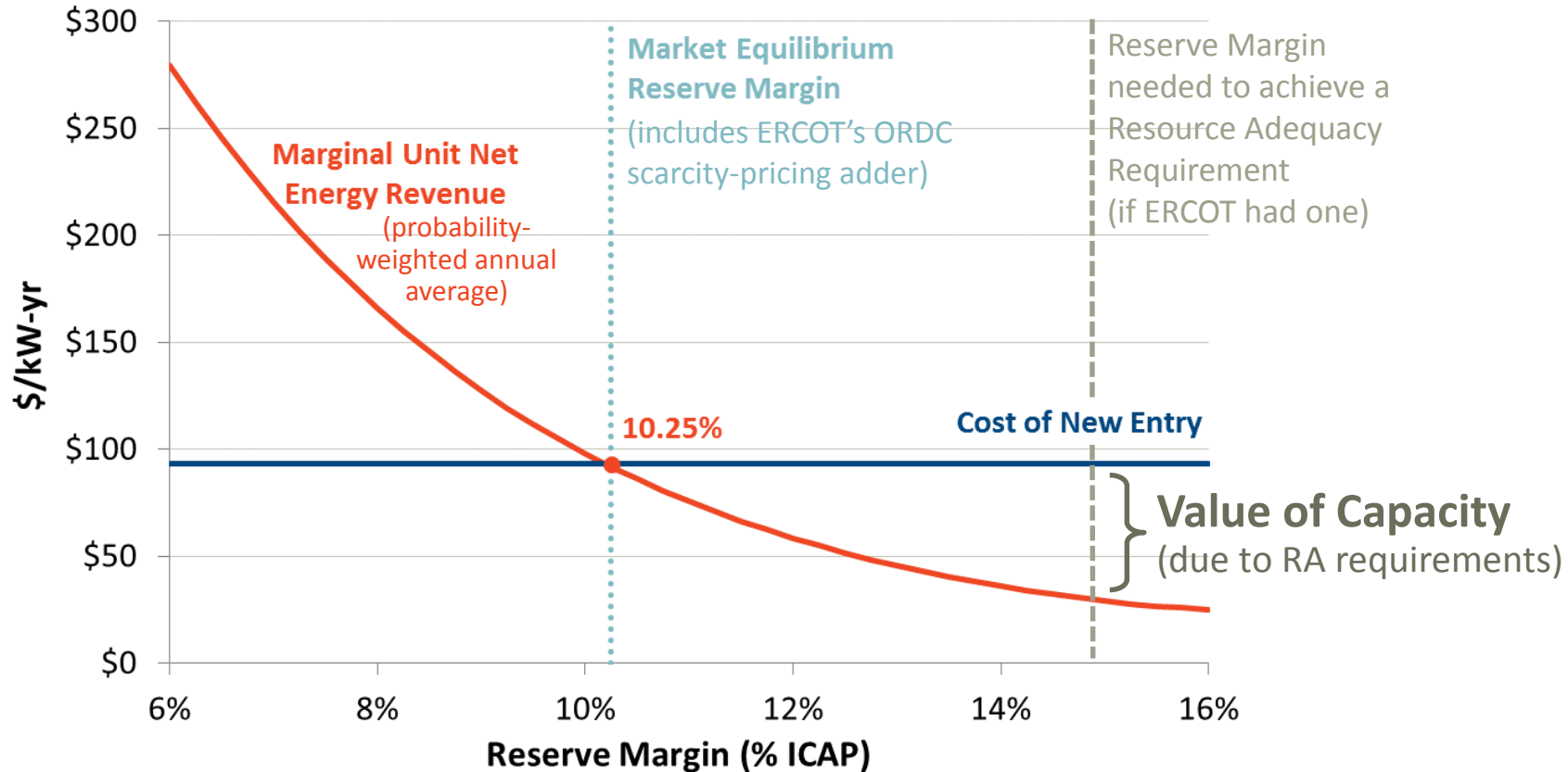
- Load serving entities must buy enough capacity to meet their peak load + reserve margin (often with the RTO procuring on their behalf)
- Resources compete to provide that capacity at least cost
- Resources that “clear” are paid the capacity clearing price
- Forward clearing moderates boom-bust

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” exists because the RA requirements are more stringent than the economic equilibrium that energy-only markets can achieve
- Widely used “1-in-10-year” standard implies a Value of Lost Load (VOLL) that is approximately 10x higher than the (risk-neutral) economic cost of outages

Capacity Value Created by Resource Adequacy Requirement

ERCOT Example: Projected 2022 Market Equilibrium Reserve Margin

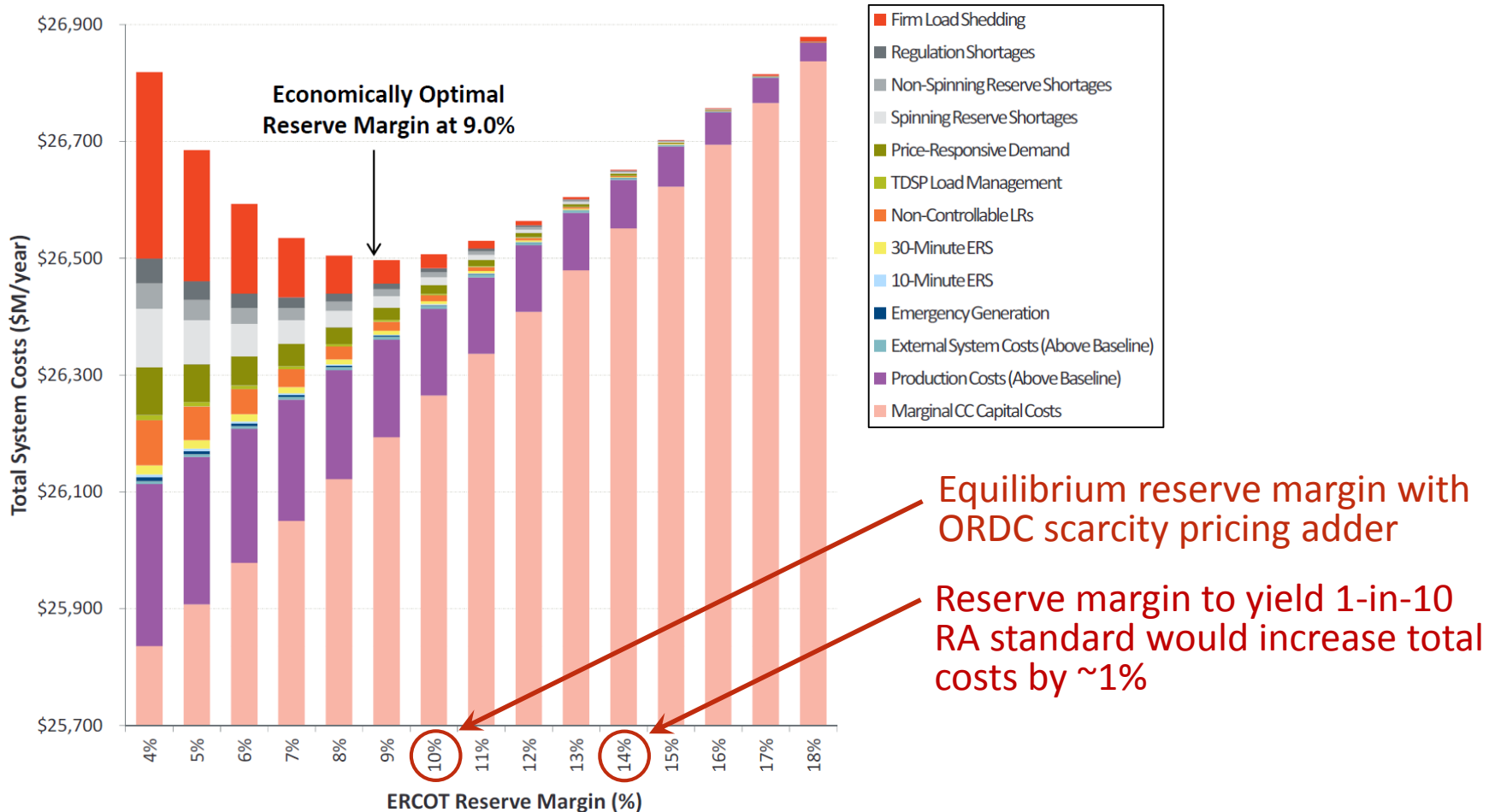


Source: Newell, Spees, et. al., [Estimation of the Market Equilibrium and Economically Optimal Reserve Margins for the ERCOT Region](#) (October 2018).

“Marginal Unit Net Energy Revenue” represents the net revenue from a mix of added CCs and CTs (77:23 ratio); the CONE shown at \$93.1/kW-yr reflects this mix as well.

Comparison of ERCOT Market Design with and without 1-in-10 RA Requirement

Total System Cost by Reserve Margin



Source: Newell, Spees, et. al., [Estimation of the Market Equilibrium and Economically Optimal Reserve Margins for the ERCOT Region](#) (October 2018).

Capacity Markets Experience to Date

Centralized capacity markets are meeting objectives:

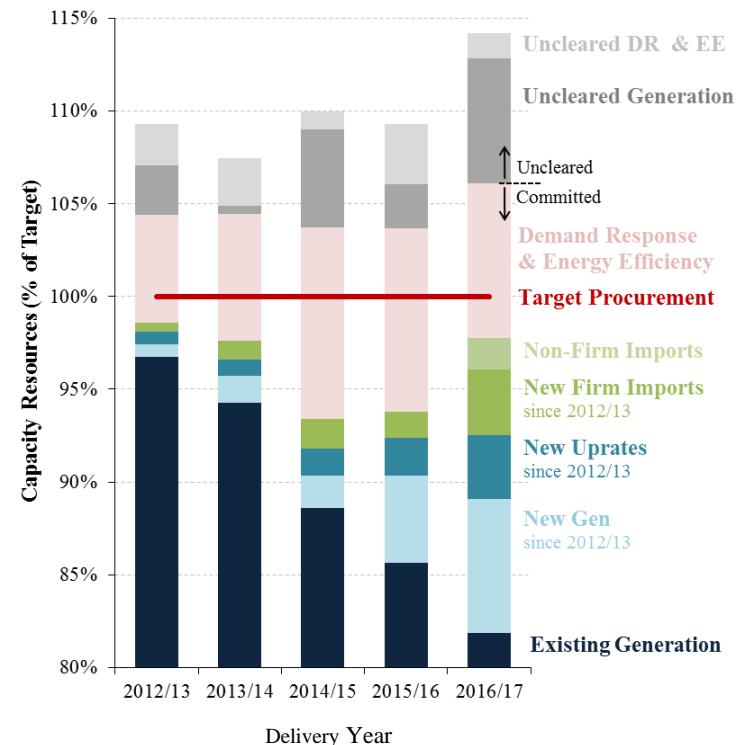
- Meeting resource adequacy objectives
 - All markets in surplus or balance
- Fostering competition to lower costs
 - Retention of existing capacity
 - Surprising amounts of new DR, uprates, and imports
 - Need for costly new generation was deferred
 - Clearing prices have generally been far below expected costs, even with new entry
- Supporting merchant generation entry
 - PJM attracted over 26 GW new generation in past 7 auctions, majority from merchants

Many ongoing refinements have been needed to ensure resources provide the reliability they advertise, to mitigate price volatility and address market power

Case Study:

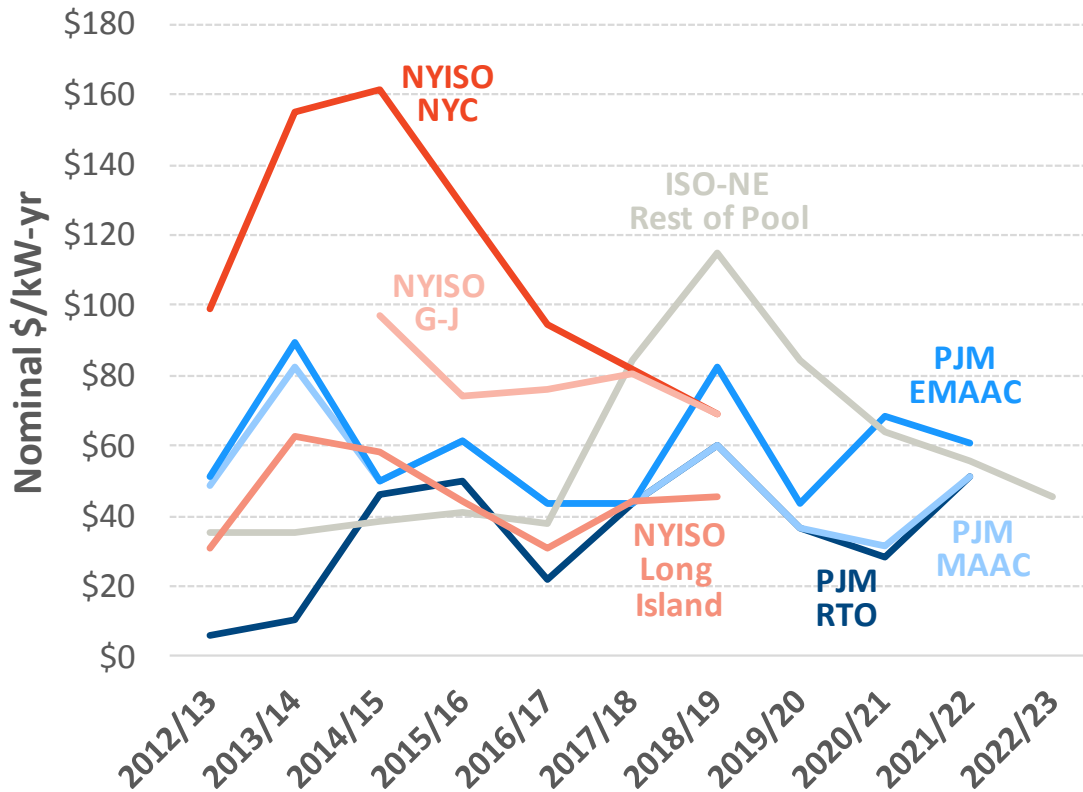
PJM Attracting New Entry

In PJM, 25 GW of coal capacity retired in only a few years due to Mercury and Air Toxics Standards; the capacity market responded with replacement capacity, incl. merchant generation

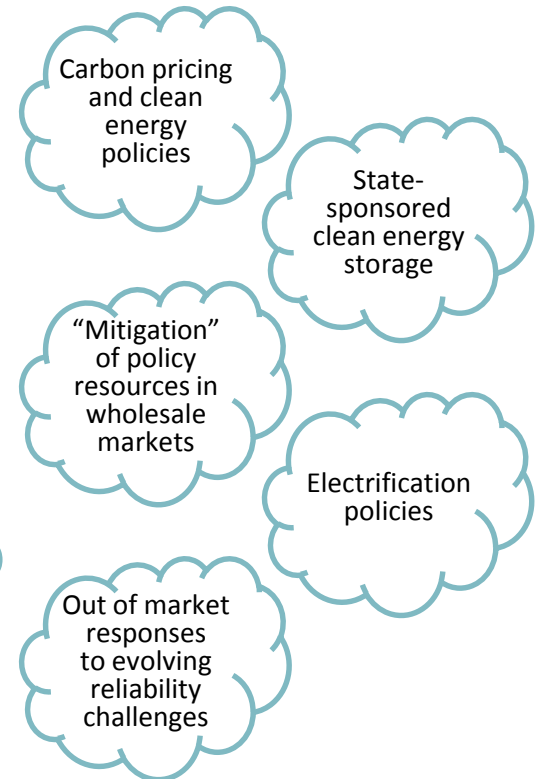


Capacity Price Levels and Trends

Capacity Prices in Selected Markets

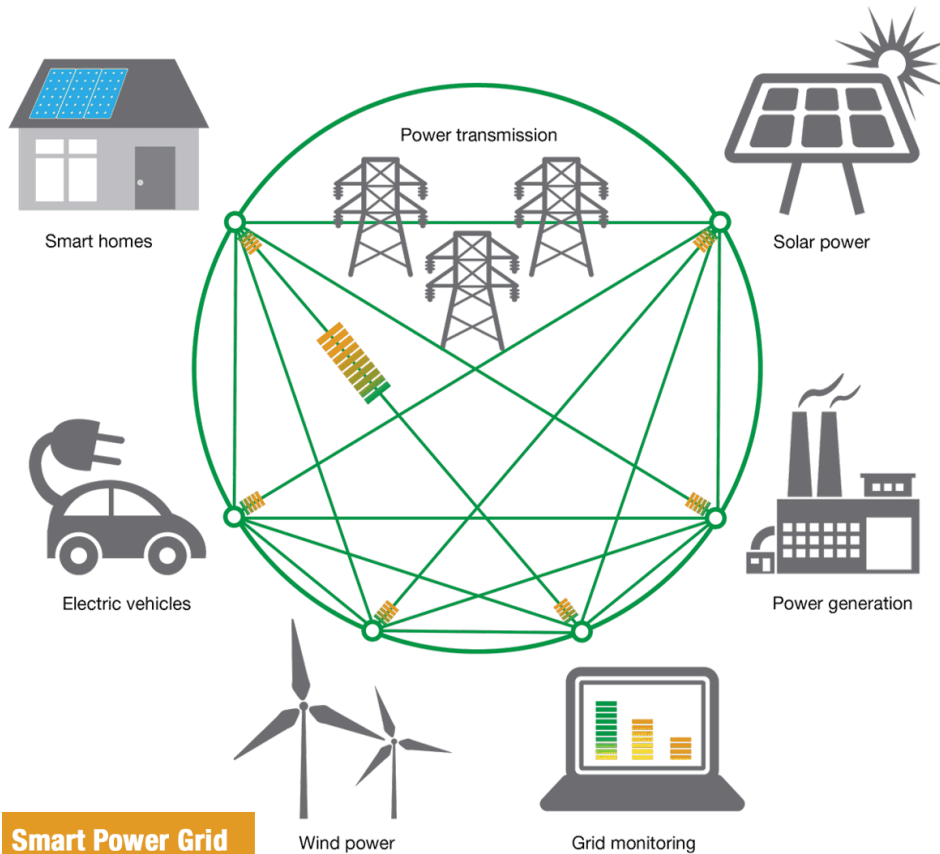


Source: RTO websites and market reports.

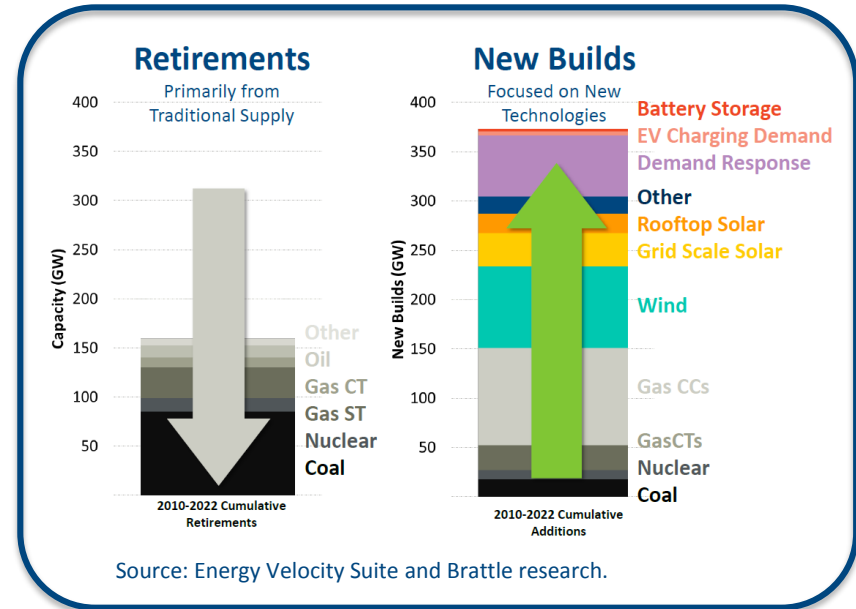


Many regulatory uncertainties will impact capacity markets & prices going forward

Evolving Landscape of the Power System



Smart Power Grid



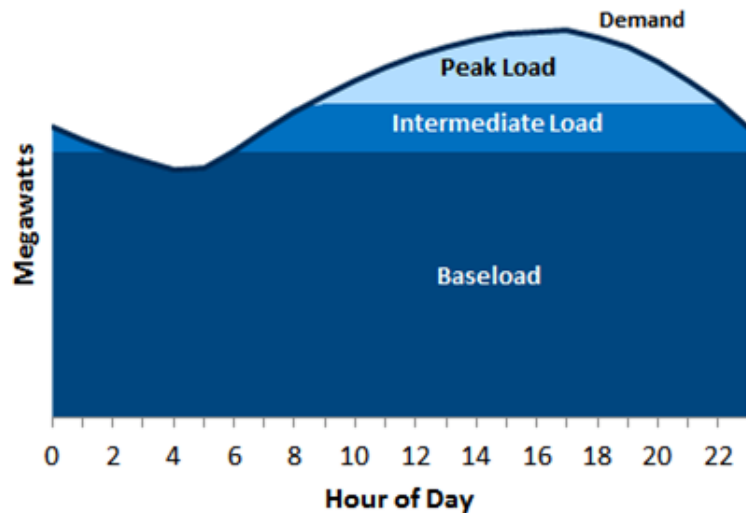
New policy- and customer-driven technologies are rapidly overtaking the traditional supply

Source: Georgia Tech, Building the Power Grid of the Future.
<https://www.news.gatech.edu/features/building-power-grid-future>

Changing Supply Mix with “New” System Needs and Challenges

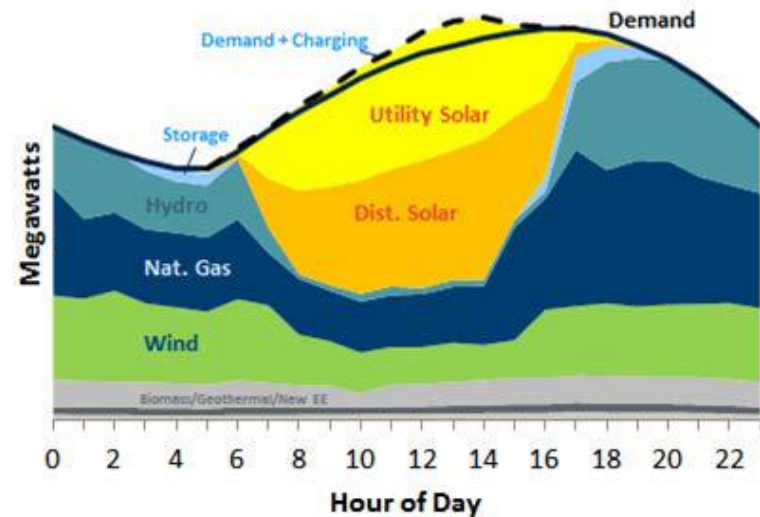
Traditional Planning

Concept: Baseload plants contributed to a cost-effective resource mix and provided many grid services “for free” as a byproduct of producing energy.



Future Supply Mix

Concept: Equation is flipped. Energy will be “free” most of the time. Flexibility and other grid services have to be defined and paid for.



Source: Chang, Geronimo Aydin, Pfeifenberger, Spees, Pedtke. [Advancing Past “Baseload” to a Flexible Grid](#) (June 2017).

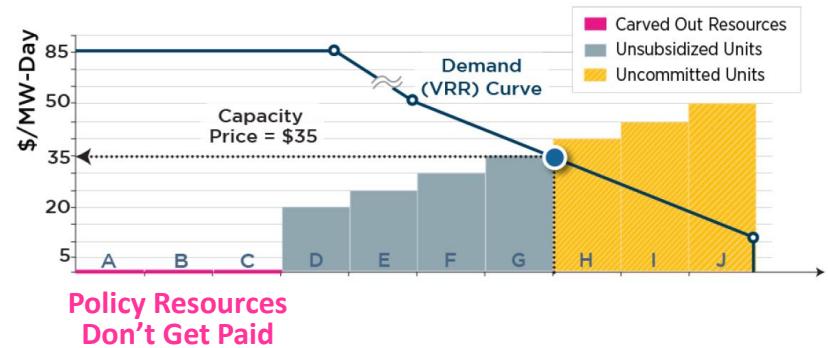
Capacity Repricing Debate: How to Adjust for the Effects of State Policies?

Some ISOs are concerned that increasing policy-supported resources undercut investment incentives. Their solution is:

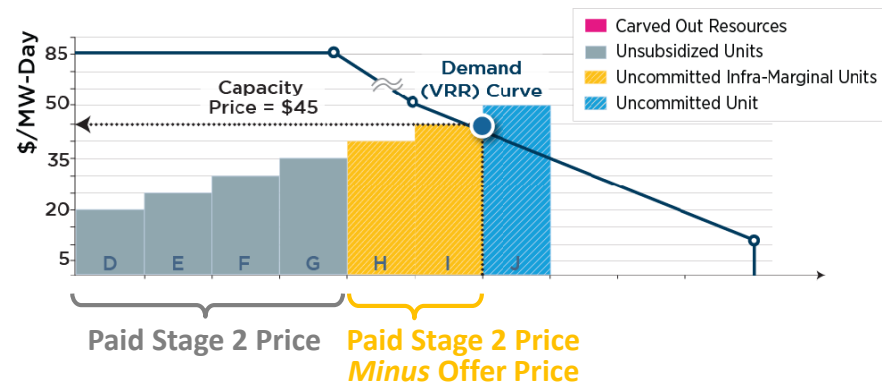
- Restore capacity prices to the higher level that would exist without subsidies
- Introduce two-stage auctions with side payments to resources that don't clear even though they offered below the clearing price

But these solutions do not address the real problem: market forces working at cross-purposes with clean energy goals

PJM Stage 1: Set Capacity Obligations



PJM Stage 2: Set Higher Capacity Prices



Source: [PJM Filing](#) before the FERC (October 2, 2018)

Crossroads for Meeting Future Carbon & Clean Energy Goals



If state policies and retail customers bypass centralized market mechanisms to meet their goals (through RPS, corporate PPAs, etc.) out-of-market payments will dominate the cost of power and markets will have a diminishing relevance

The clean energy product markets are the “missing link” to better align markets with customer and states’ needs and can harness competition and innovation to decarbonize faster and more cost effectively

Resource Adequacy and Investment

Intermittent renewables generate clean energy, but complementary resources must be attracted to provide various grid services

Challenges

- They provide little resource adequacy at high penetration
- They impose flex needs on the system and don't provide much flex themselves
- Their 0-variable costs depresses energy prices
- The major role of policy adds regulatory risk



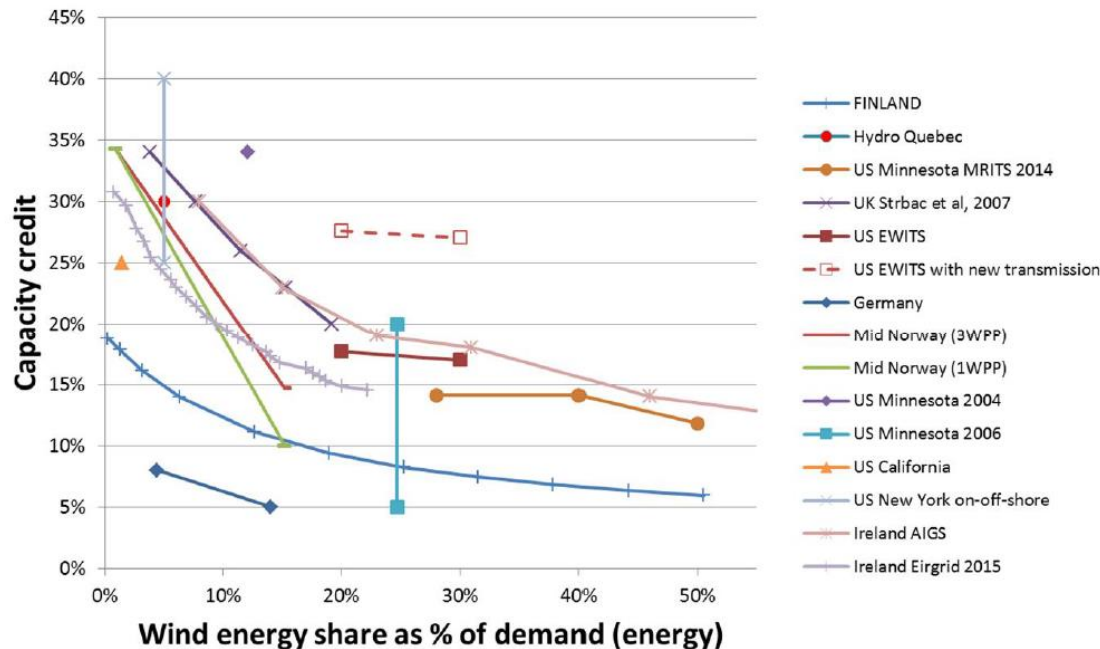
Solutions

- Discount UCAP value
- Enhance E&AS products and scarcity pricing
- Allow other value streams to increase if scarce (next slide)
- Steadily follow long-term goals

Declining Capacity Value of Renewables at High Penetration






It is important that renewables and other unconventional resources are rated at their effective load carrying capability (ELCC) for resource adequacy

Wind Capacity Credit



- Recognizes declining capacity value of wind and solar at high penetration levels
- Provides better price signals to retain dispatchable resources if needed

Revenue Sources Will Shift from Energy to Other Products and Services

Market	Value	Market Implications
Energy		<ul style="list-style-type: none"> Lower energy prices on average in most hours But higher price spikes, driven by scarcity pricing and high reservation price for demand response/storage
Flexibility & Scarcity Pricing		<ul style="list-style-type: none"> Need for greater quantities and new types of flexibility products Higher price volatility and spikes reward flexibility
Capacity		<ul style="list-style-type: none"> Value may go up or down Down if additional clean energy contributes to excess supply for a period, or if new capacity sellers are attracted by other value streams Up if new fossil plants are needed for capacity, but only a small portion of their capital costs can be recovered from other markets
Clean Energy Attributes		<ul style="list-style-type: none"> Some form of CO₂ pricing and/or clean energy payments introduced to meet policy and/or customer demand Value must be large enough to attract new clean resources
Adjacent Customer Products & Services		<ul style="list-style-type: none"> Technology and consumer-driver demand for adjacent products and services (smart home, electric vehicles) Participation may overlap with wholesale, clean, and retail/distribution markets

- Scarcity of any service should lead to high prices and attract investment
- Any resource may provide a bundle of services
- The market should identify the least cost portfolio to meet the full suite of needs

Takeaways

- Wholesale power markets will need to evolve with entry of new technologies.
- Customers and states want clean energy, with or without the help of centralized wholesale markets. If the wholesale markets do not adapt to desires of customers and policy makers, they will become less relevant in the future.
- Developing comprehensive, technology-neutral wholesale “products” markets can facilitate broad competition and innovation to decarbonize faster and more cost effectively.
- Revenues will shift from “energy” to scarcity pricing, flexibility, and clean-energy products.
- Capacity markets will continue to address “missing money” so the value of capacity will depend largely on how other value streams evolve in the future.

Speaker Bio and Contact Information



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Note:

The views expressed in this presentation are strictly those of the presenter and do not necessarily state or reflect the views of The Brattle Group, Inc.

Mr. Onur Aydin is a senior associate in Brattle's San Francisco office with more than 10 years of experience in serving clients in the power industry. He specializes in U.S. wholesale electricity markets, system planning, and economic and financial analyses of energy investments and policies. In his work, Onur employs a deep understanding of market fundamentals, market design, and technology trends to help energy companies identify and maximize value proposition associated with their strategic planning and investment decisions. He taps into a wealth of analytical tools for market forecasting and customizes them to meet client-specific needs and provide insights. Onur also collaborates closely with his clients to evaluate and manage their market risk exposure and to support their due diligence efforts.

Onur received his M.S. in Civil and Environmental Engineering from Massachusetts Institute of Technology in Cambridge, Massachusetts, and his B.S. in Civil Engineering (with high honors) from Bogazici University in Istanbul, Turkey.

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