PJM Capacity Auction Results and Market Fundamentals

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Presenter Information



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Dr. Samuel Newell, a Principal of The Brattle Group, is an economist and engineer with experience in electricity wholesale markets, the transmission system, and RTO/ISO rules. He supports clients throughout the U.S. in regulatory, litigation, and business strategy matters involving wholesale market design, generation asset valuation, transmission development, integrated resource planning, demand response programs, and contract disputes. He has provided testimony before the FERC, state regulatory commissions, and the American Arbitration Association.

Dr. Newell earned a Ph.D. in Technology Management and Policy from MIT, and a M.S. in Materials Science and Engineering from Stanford University. Prior to joining Brattle, Dr. Newell was Director of the Transmission Service at Cambridge Energy Research Associates.

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Agenda

I. Recent and Historical Capacity Auctions

- PJM Annual/Base Capacity Prices
- PJM Base, Incremental, and Transition Auctions

II. Recent Changes in PJM Market Design

- Several VRR Curve Changes
- Capacity Performance

III. Market Fundamentals

- Capacity Offer Prices with Capacity Performance
- Downward-Drifting Load Forecasts
- The Evolving Role of Demand Response
- New Generation Entry
- Why are Prices So Far Below PJM's "Net CONE"?

I. Recent and Historical Capacity Auctions PJM Annual/Base Capacity Prices



I. Recent and Historical Capacity Auctions PJM Base, Incremental, and Transition Auctions

- Incremental Auction (IA) prices used to clear systematically well below
 Base Residual Auction (BRA) prices
- Recent IA prices closer to BRA prices
- Transition Auctions (for Capacity Performance) cleared at higher prices than BRAs, esp. in RTO
 - 91 GW (16/17) and 102 GW (17/18) that was previously committed cleared the Transition Auctions
 - 4 GW (16/17) and 10 GW (17/18) that was not previously committed also cleared
- Capacity Performance prices in 2018/19 were only \$15/MW-day above Base Capacity prices



Source: PJM BRA and IA results

II. Recent Changes in PJM Market Design Several VRR Curve Changes



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II. Recent Changes in PJM Market Design Concerns About Resource Performance

PJM's experience during the 2014 Polar Vortex highlighted the importance of performance

- High load coincided with high generator unavailability
- On Jan. 7, 22% of capacity was unavailable (compared to historic average of 7%)
 - Many units not fully weatherized
 - Natural gas supplies were constrained
 - Dual-fuel units performed poorly
- PJM observed that generators faced insufficient incentives to perform during such periods



II. Recent Changes in PJM Market Design Capacity Performance Penalties and Bonuses

Hourly Penalty Charges

 $PPR \times (B - A)$

- Resources' Expected Performance is their "share" of the load + reserves during emergencies, i.e. [UCAP Committed] × B
- Charged for shortages relative to Expected
- Charged to CP and Base Resources (but Base resources pay less)

Hourly Bonus Payments

(CP or Base Resources)

 $CPBR \times (A - B)$

 Capacity resources earn a bonus payment for outputting energy + reserves in excess of Expected Performance

Hourly Bonus Payments

(Energy-Only Resources)

CPBR × **A**

- Energy-only resources w/o capacity obligation can also earn a bonus
- Same as if "Expected Performance" were zero

Definitions:

PPR = Performance Penalty Rate (\$/MWh)

<u>CP Resources</u>: Net CONE (\$/MW-yr) ÷ 30 hours

Base Resources: Capacity Price (\$/MW-yr) ÷ 30 hours

CPBR = Capacity Performance Bonus Rate (\$/MWh)

Bonus payments are less than PPR due to uncollected penalties (e.g. discounts caused by exemptions, approved outages, and stop-loss)

B = Balancing Ratio (%)

Demand in hour relative to capacity commitments

[load + reserves] ÷ [System UCAP Committed]

Maximum value of 1.0

Determines Expected Performance relative to UCAP commitment

A = Availability (%)

Actual output of energy + reserves during emergency hours Expressed as a % of UCAP Commitment

H = Hours

Hours of emergency events per year

P = Price of capacity

ACR = Avoidable Cost Rate

Net going forward costs

Investment costs minus net E&AS revenues

For a new unit, ACR = Net CONE

III. Market Fundamentals Capacity Offer Prices with Capacity Performance

New rules should flatten supply curves

- Even low-cost resources should offer at least the expected value of foregone performance payments
- Higher cost resources and new entrants should offer at least their net going-forward costs less expected net payments (or plus penalties)
- Existing resources can offer up to 85% of Net CONE w/o review

Why are capacity prices for Performance not much higher so far?

- Because roughly half of CP resources will receive net performance payments?
- Because the marginal generating capacity is new plants with good performance?
- Because providing Performance is less expensive than some thought?
- Might the premium even decrease over time as resources improve performance (weatherization, benefit from new pipelines)?

Effects of Capacity Performance On Supply Offers



Sources and Notes:

Conceptual Supply Curves illustrating potential effects of Capacity Performance

III. Market Fundamentals Downward-Drifting Load Forecasts

PJM has historically over-forecast

- Recession a factor but economic forecasts were high before/after
- Increasing efficiency gains; disconnect between load and economic growth
- PJM's forecasts are slowly incorporating historical data on low growth (2007 projected 1.5% growth rate vs. 1.0% now)
- PJM's recently proposed forecast methodology could further reduce 2018 forecast by 4 GW
- Clean Power Plan and efficiency could also reduce future loads



Sources and Notes:

Data from PJM. Forecasts shown here exclude territory expansions in order to enable comparisons across time, thus current load forecast including all current PJM zones are substantially higher.

III. Market Fundamentals The Evolving Role of Demand Response

2018/19 quantities similar to 17/18

- 17/18: 11.0 GW, 18/19: 11.1 GW
- Limited / Extended Summer eliminated and replaced by Base DR

Potential reasons for decline since 15/16

- M&V: "Firm Service Level" vs.
 "Guaranteed Load Drop"
- Capacity replacement proposal
- 30-minute lead time requirement
- 17/18: Tighter constraint on Limited

The future for DR in PJM

- Almost all 18/19 DR cleared as Base, although 4.5 GW also offered as CP
- But Base will be eliminated after 19/20
- Uncertainty re EPSA vs. FERC



DR in Base Residual Auctions

III. Market Fundamentals New Generation Entry

RPM is attracting substantial investment

- First several auctions attracted mostly lowcapital cost resources
- But new generation commitments have averaged 3,300 MW (mostly gas) for each of the last 6 BRA auctions
- Looking forward, the opportunity for new capacity may be limited
 - Continuing excess capacity
 - Low load growth
 - Retirements will be the driver

PJM Cleared New Generation



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 2018-2019.

III. Market Fundamentals Why are Prices so far Below PJM's "Net CONE"?

And yet we see new entry...

- Possibility that winning bidders project net revenues to increase over time e.g., with inflation
 - Difference between level-real and level-nominal CONE
- Possibility that they project higher E&AS revenues than PJM's estimate based on historical data
 - Difference between historical and forward looking E&AS offsets
 - Difference by location, e.g. with access to low-cost gas
- Do they enjoy uniquely low capital costs?
- Are they able to access a lower cost of capital?
- Are bidding too aggressively a winner's curse?

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About The Brattle Group

The Brattle Group provides consulting and expert testimony in economics, finance, and regulation to corporations, law firms, and governmental agencies worldwide.

We combine in-depth industry experience and rigorous analyses to help clients answer complex economic and financial questions in litigation and regulation, develop strategies for changing markets, and make critical business decisions.

Our services to the electric power industry include:

- Climate Change Policy and Planning
- Cost of Capital
- Demand Forecasting Methodology
- Demand Response and Energy Efficiency
- Electricity Market Modeling
- Energy Asset Valuation
- Energy Contract Litigation
- Environmental Compliance
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- Transmission

About The Brattle Group (cont.)

Resource Adequacy and Capacity Market Experience	
PJM	Helped review performance and improve PJM capacity market since 2007
ISO-NE	Designed ISO-NE's new demand-curve approach
MISO	Helped develop its resource adequacy framework; strategic planning of market design
NYISO	Evaluated benefits of switching to multi-year forward design
ERCOT	Analyzed ability of Texas energy-only market to assure resource adequacy; proposed and fully evaluated five market design alternatives; simulated cost/risk/reliability tradeoffs between energy-only and capacity market
CAISO	For a market participant, reviewed CA's resource adequacy construct, including inefficiencies created by of state-sponsored long-term planning and procurement; proposed options to improve market
Alberta	Analyzed ability of energy-only market to assure resource adequacy
Ontario	Assisting IESO in its design of capacity and demand response auctions
Australia	Assessed and presented capacity market design options for Western Australia
Italy, Russia	Helped Terna (Italian system operator) design its forward capacity market proposal; reviewed Russian capacity market for two clients
FERC	Analyzed resource adequacy designs and tradeoffs between costs, risks, and reliability of in energy- only and capacity markets; analyzed impacts of key market features
Various	Analyzed resource adequacy alternatives internationally and implications of transmission interconnectors (Italy, PJM, AB, ISO-NE), renewables (AB), and demand-side (PJM, MISO)

Additional Reading

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