Fundamental Capacity Market Design Choices: How Far Forward? How Locational?

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EUCI Capacity Markets Conference
Indianapolis, IN
October 2-3, 2012

Fundamental Capacity Market Design Choices

1. How *far forward* of delivery to impose mandatory obligations and hold mandatory auctions to fulfill residual obligations?
   - <= one year? Most regions with capacity constructs (NY, MISO, CA, etc.)
   - Or three years forward? PJM, New England

2. How *locational* should the capacity requirements and prices be?
   - Few, larger zones or more, smaller zones?
   - How quickly to adjust zones as conditions change?

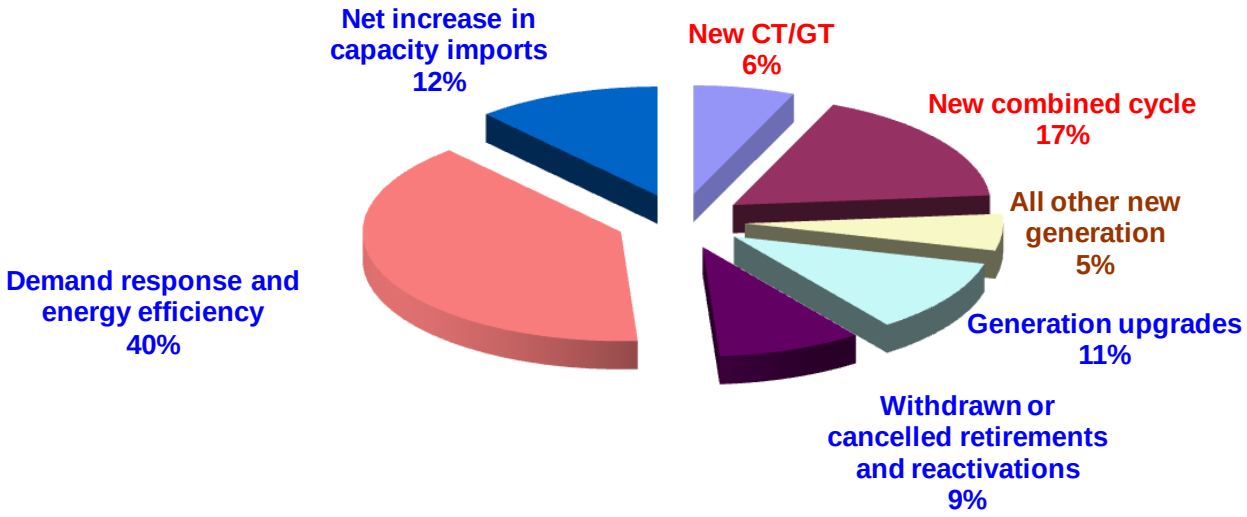
1. How Far Forward to Impose Mandatory Obligations?

- Close to delivery year (capacity spot market for residual needs):
  - Load forecast and requirements are known
  - Resources are known
  - Commit additional capacity as needed for resource adequacy
  - Leaves long-term resources choices to the market (buyers and sellers)
  - Risk that the resources may not be available and no time to build?

Over nine RPM delivery years, most incremental capacity has been short lead time, low investment resources

Incremental Capacity Resources:
First Nine PJM RPM Base Residual Auctions

Short Lead Time Resources have been 71% of the incremental resources over nine delivery years
(plant upgrades, reactivations, withdrawn or cancelled retirements, demand response, energy efficiency, net imports)

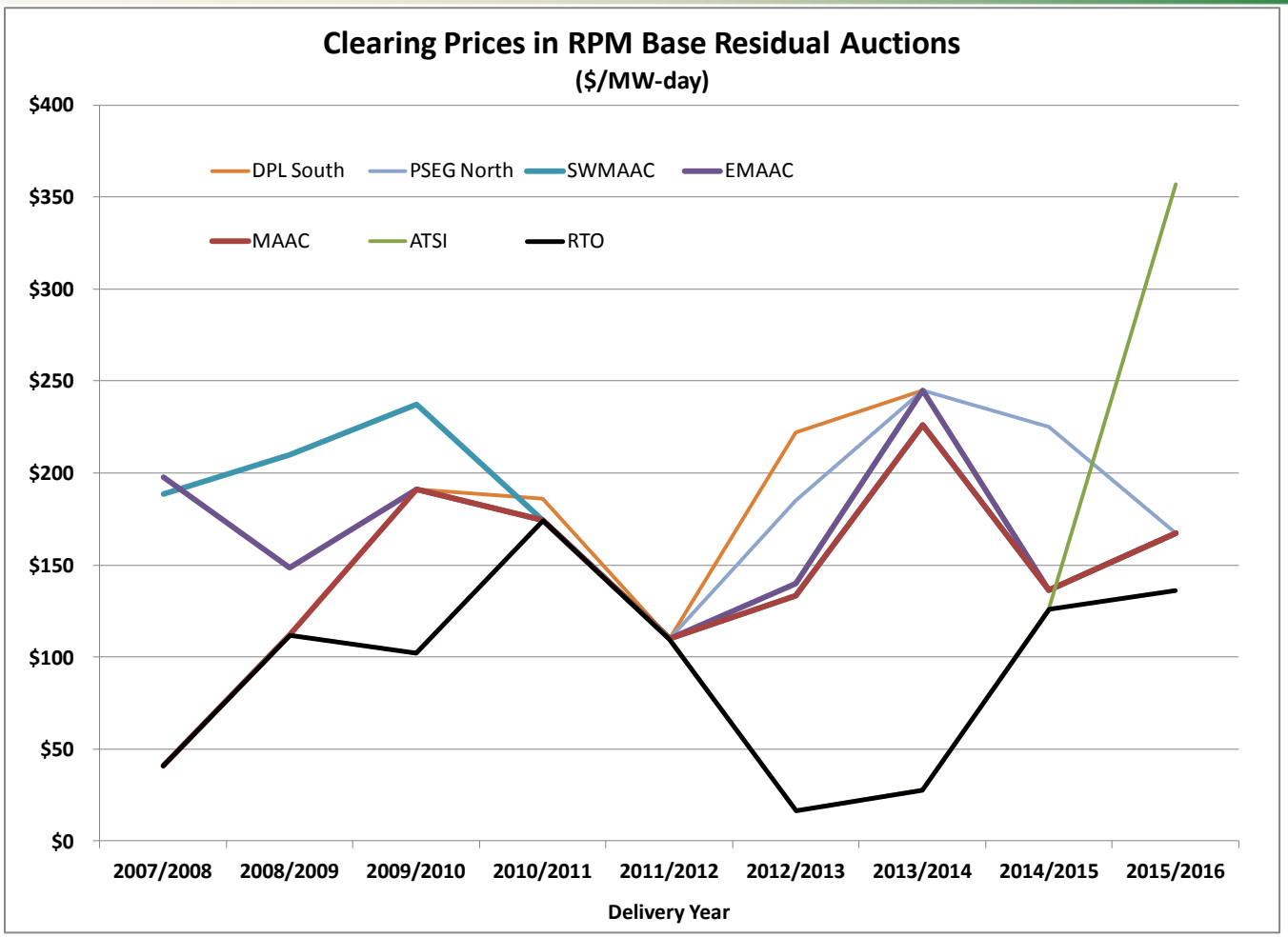


Source: PJM, *2015/2016 RPM Base Residual Auction Results*, Tables 8 and 10, which present offered capacity expressed in installed capacity terms.

Potential advantages of imposing obligations and holding mandatory auctions three (or more) years forward

- Greater confidence resources will be committed and available
- Sellers can lock in price to support investment, operation
- Transparent, three-year-forward price
- Hopes that prices will be stable, provide price signal

Zonal capacity prices for PJM's RPM capacity construct have consistently been volatile



Long-term and short-term capacity procurement approaches that make sense

Procurement approach:	LT: For long-term portfolio	ST: For residual need
Procurement goal:	Resources for long-term needs: energy, A/S, capacity	Residual capacity needs for resource adequacy
Product to purchase:	Many possibilities	Capacity to cover peak
How far forward:	Years forward (so potential new resources can offer)	Months/year forward (so residual need is clear)
Commitments sought:	Longer-term commitments (to support investment)	Coming peak season or year
Quantity sought:	High percentage of need	Residual to cover peak
Candidate resources:	Existing and potential new	Existing, short-lead time
Decision basis for selecting resources:	Multi-attribute (operational, environmental, fuel, etc.)	Lowest cost capacity
Quantity flexibility:	Yes, can try again later	Less; need is for reliability

Capacity procurement approaches: expected outcomes

Procurement approach:	LT: For long-term portfolio	ST: For residual need
Summary of procurement:	*Years forward for longer term commitments; multi-attribute decision basis*	*Months/year forward for residual capacity for peak; select based on offer price*
Anticipated offer prices:	Long-run incremental cost reflecting resource attributes	Short-run incremental cost to provide capacity only
Offer prices will include investment needs?	Yes	No; short-run incremental
Offer prices will reflect market power?	Generally not, because new resources can compete	Likely, especially when little excess capacity
Anticipated price buyer will have to pay?	Long-run incremental cost; relatively stable over time	Volatile prices, reflecting short-run conditions
Selected resources are long-term least-cost mix?	Yes, if the procurements are designed and executed well	No, the procurement only

Another procurement approach that makes less sense

Procurement approach:	PJM's RPM	LT?	ST?
How far forward:	Three years forward	✓	
Commitments sought:	One-year commitments		✓
Quantity sought:	100% of residual need		✓
Candidate resources:	Existing and potential new	✓	
Product:	Simple capacity		✓
Decision basis for selecting resources:	Lowest price		✓
Buyer quantity flexibility:	No		✓

Three-year-forward, one-year commitments (RPM): expected outcomes?

Procurement approach:	PJM's RPM	Like LT?	Like ST?
Summary of procurement:	Three years forward; one-year commitments for 100% of need; selected based on price	?	✓
Anticipated offer prices:	Short-run incremental cost due to one-year commitment (but MOPR rule forces long-run average)	✓	✓
Offer prices include investment needs?	Shouldn't if behaving competitively (but permitted - avoidable project investment, APIR)	✓	✓
Anticipated price buyer will pay?	Stable, long-run prices were expected, but instead RPM prices are volatile	✓	✓
LT least cost mix?	No; incremental resources mainly ST	✓	✓

Confusion over what RPM accomplishes

- Does RPM accomplish least cost procurement?
  - Of available incremental resources over short term – Approximately
  - Of all potential resources over long term ("IRP") – No
- Does RPM provide a "long-term price signal"? No
- Does RPM price signal whether new entry needed or not? No
- Will entrants build new plants if and only if price > Net CONE? No
- Should RPM be designed to produce a certain price outcome? No

Years-forward capacity constructs tend to overprice capacity

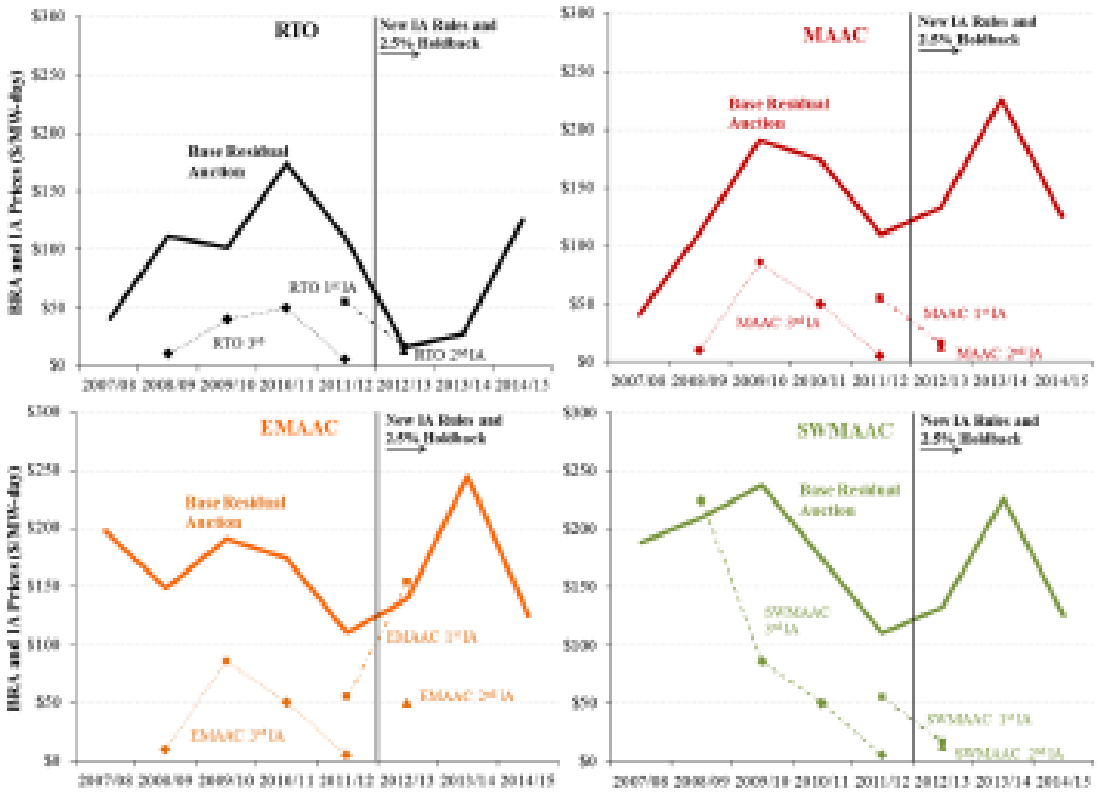
- Demand is overstated
  1. Conservative, overly-optimistic load forecasts
  2. Conservative resource adequacy targets ("1-in'10") and reserve margin planning assumptions
- Supply is understated
  1. Sellers afforded considerable flexibility to withhold given three-year-forward uncertainties (EFORd, APIR, etc.)
  2. Short-lead-time resources that will become available for delivery year are not in a position to participate in three year forward auctions

Overstated demand + understated capacity = overpriced capacity

Prices are much lower in closer-to-delivery year adjustment auctions

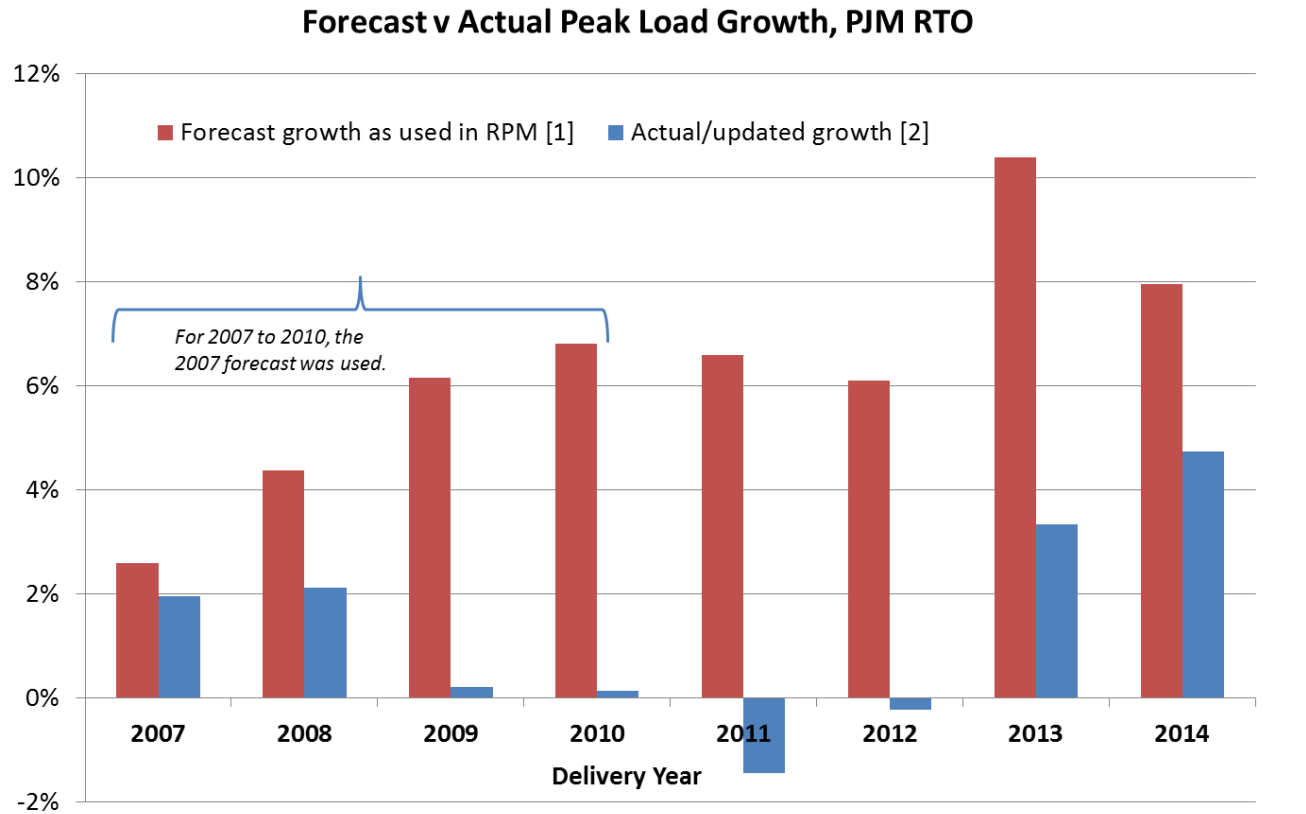
Prices have been much lower in RPM's closer-to-delivery year incremental auctions (from Brattle 2011 review of RPM)

Figure 7
Incremental Auction Clearing Prices



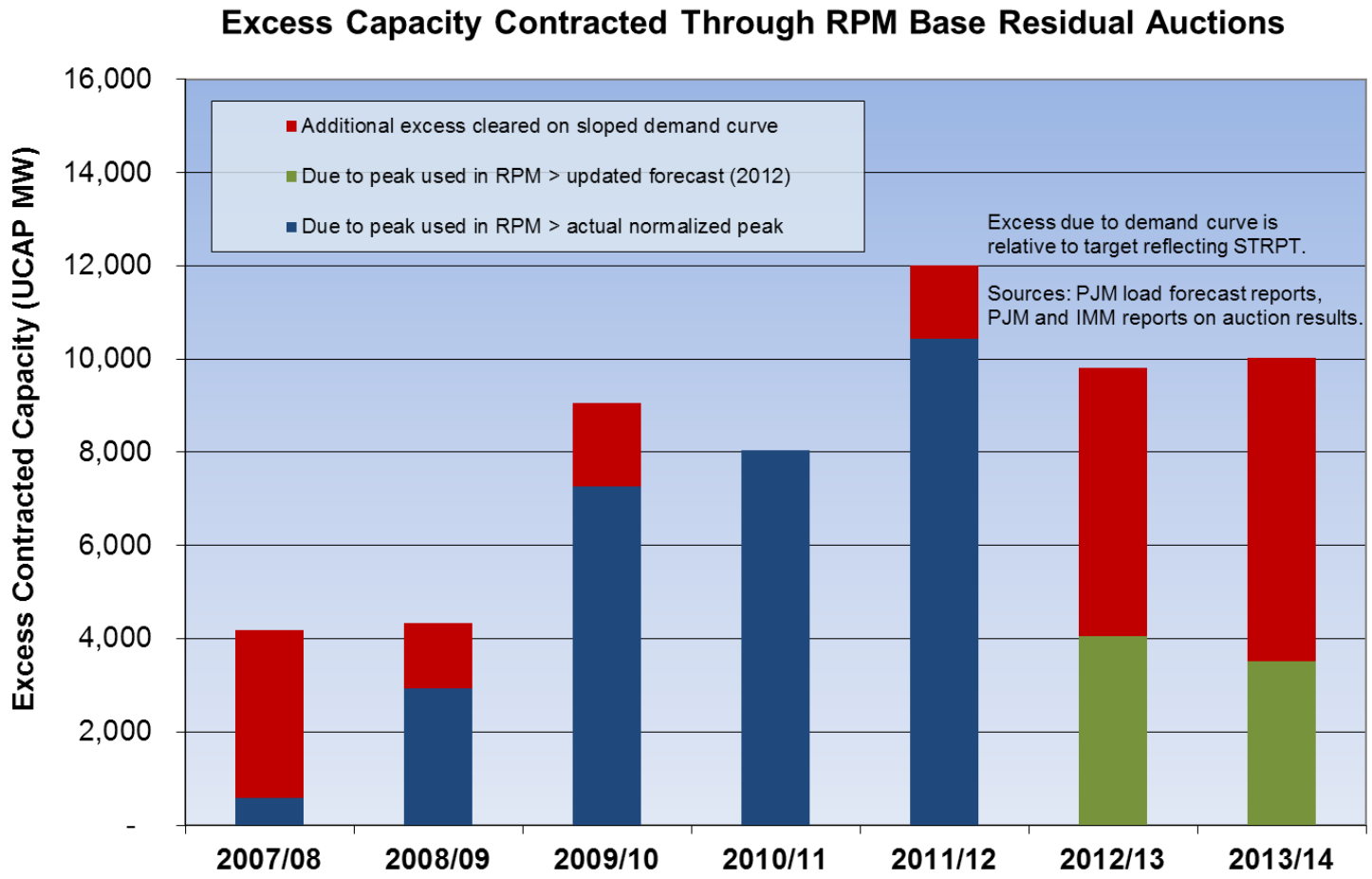
Sources and Notes:
Year 2014/15 BRA clearing prices reflect resource clearing prices without an Annual or Extended Summer price adder.
From BRA and IA results, see PJM (2007a, 2008a-c,e, 2009a,c,h-i, 2010b,f,g, 2011c,g).

PJM's three-year-forward peak load forecasts have been way too high year after year



[1] **Forecast growth as used in RPM** compares the three year forward forecast for a delivery year to the weather-normalized actual peak load for the year prior to the forecast (for example, for the 2011 delivery year, the growth from the 2007 weather-normalized peak to 2011 based on the 2008 forecast); for 2007 through 2010 delivery years, the 2007 forecast and 2006 weather-normalized actuals were used.
[2] **Actual/updated growth** compares the actual weather-normalized peak (or updated forecast, for future years) to the same weather-normalized peak load (for the 2011 delivery year, growth from the 2007 weather-normalized peak to the 2011 weather-normalized peak).

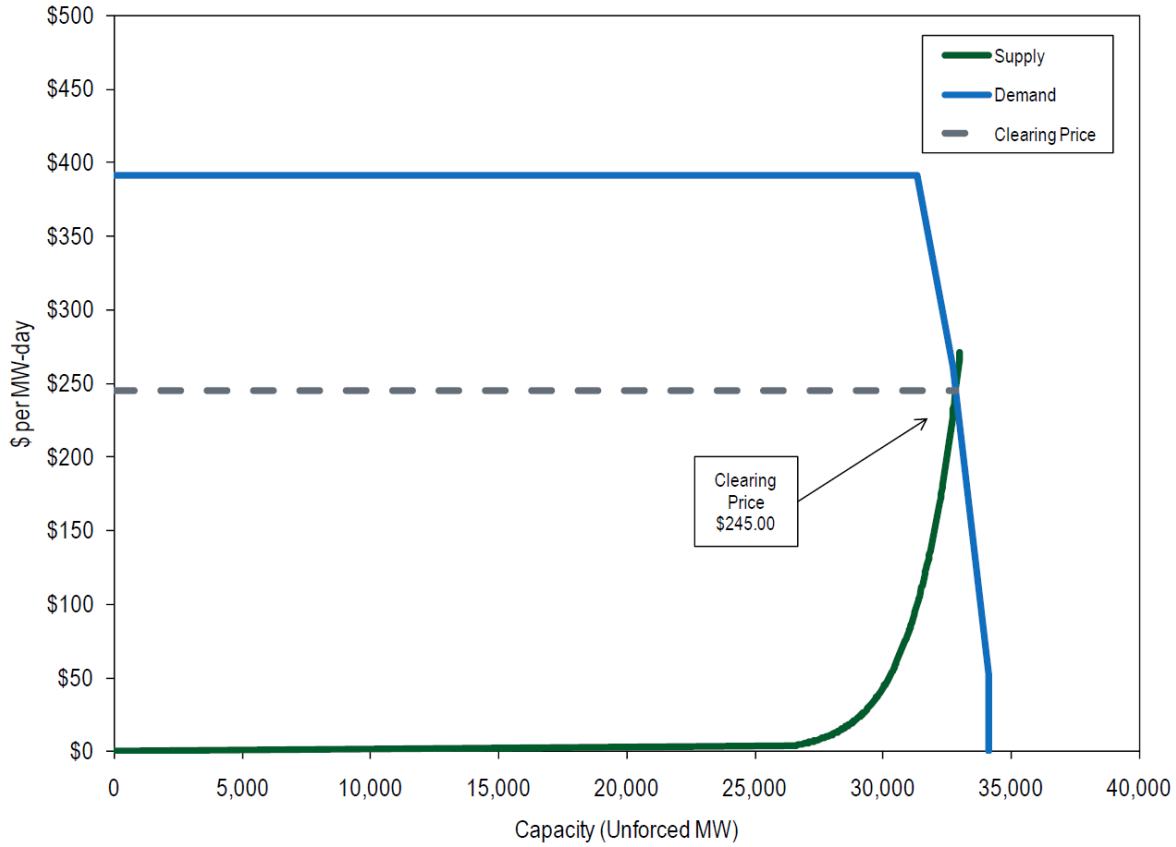
Excessive load forecasts have resulted in excessive RPM clearing prices and cleared quantities



Estimated RPM cost impact of load forecast error: $16 bil.

(assuming no change in supply curves; if supply responds, impact somewhat less)

Figure 8 EMAAC market supply/demand curves: 2013/2014 RPM Base Residual Auction[55]



Can RPM be stretched to provide longer-term price commitments?

No.

- Longer term commitments influence entry/exit decisions and must consider all resource attributes (fuel, environmental, operational, etc.); simple capacity product not appropriate for longer-term commitments
- Three (now four) rounds of stakeholder efforts to try to stretch RPM to multi-year

Market and stakeholder consensus and confidence in RPM, considered necessary for success, have not been achieved

The years-forward mandatory capacity markets (PJM, NE) were designed based on the same 2003 "CRAM Report" by NERA[1]

- Recommended three-year commitments; this was not followed
- Emphasized need for confidence and consensus to be successful:

Most importantly, however, the major hurdle facing CRAM implementation is establishing market confidence in the model and in the application of monitoring and mitigation… The most difficult step will be the transition to the CRAM and the largest challenge will be to gain confidence of all parties in the workability of the model and the willingness to accept transitional results that may be less than ideal. In this regard the most important next step is to develop a consensus of market participants willing to move forward and make the model work.

[1] NERA Economic Consulting, *Central Resource Adequacy Markets for PJM, NY-ISO and NE-ISO*, Final Report, February 2003 (CRAM Report)

In evaluations for RTOs, consultants consistently do not recommend a years-forward mandatory capacity market

- The Brattle Group, NYISO, 2009
- The Brattle Group, MISO, 2010
- The Brattle Group, Alberta ESO, 2011
- [The Brattle Group's 2011 review of RPM for PJM did not evaluate the years-forward characteristic, or RPM cost-effectiveness]
- The Brattle Group, ERCOT, 2012
- FTI, NYISO, 2012

Capacity construct forward period: recommendations

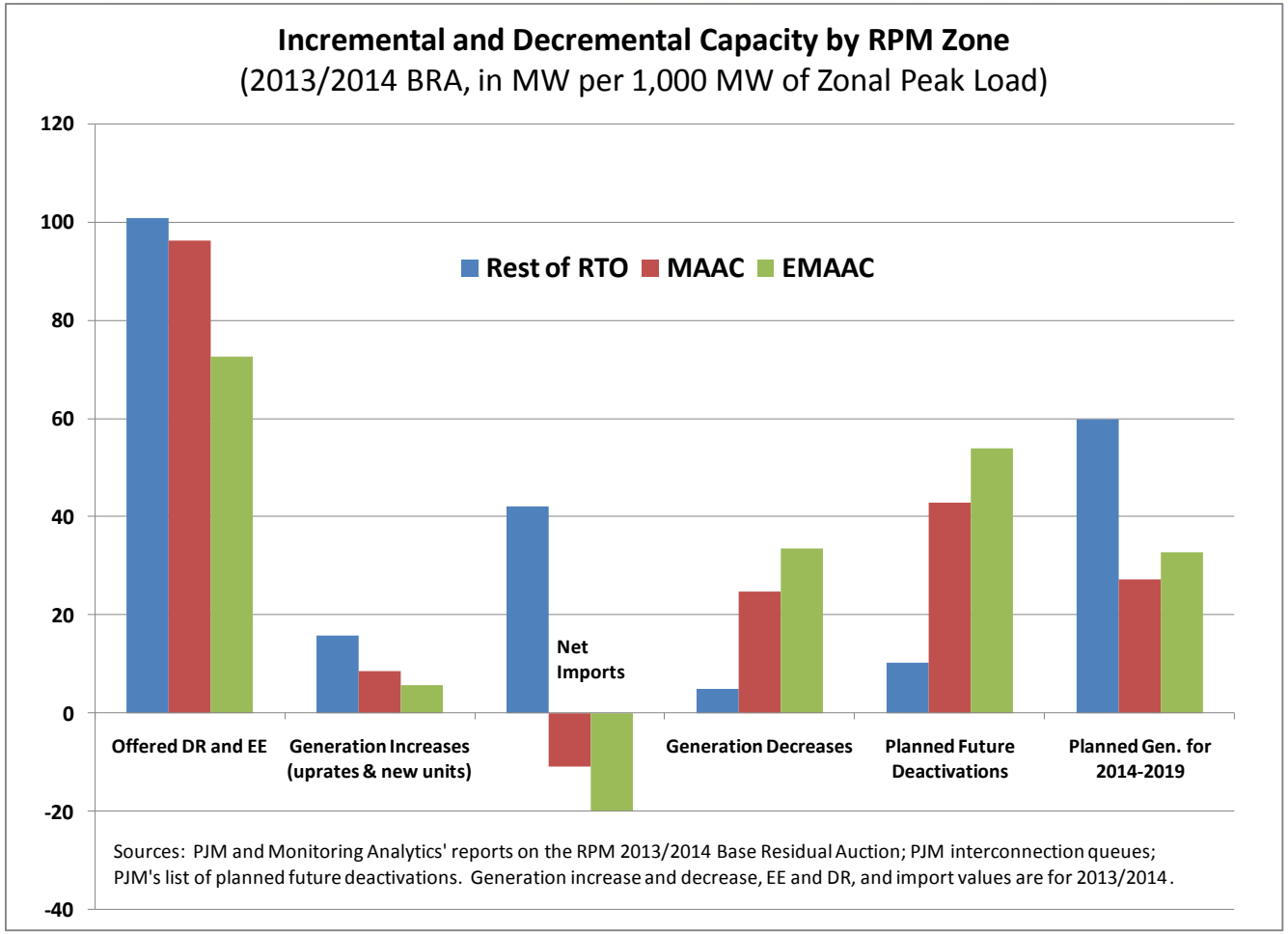
- Close-to-delivery year constructs make the most sense (months to year in advance)
  - Simple capacity product
  - Leave long-term procurement to bilateral markets
- Where years-forward constructs are in place and entrenched, better arbitrage between years-forward and later auctions would improve efficiency
- Strive to focus revenue recovery on the real markets (E&AS) not capacity
  - *RPM parameters assume 86% of revenue through capacity, 14% E&AS*
- Resource adequacy targets should be reconsidered ("1-in-10")
  - Telson 1975, … Wilson 2009, Centolella 2011, Brattle for ERCOT 2012
- Longer term, capacity constructs should be phased out as price-responsive demand develops, E&AS pricing reflects value under all circumstances including shortage

2. Capacity Pricing – How Locational?

Locational capacity pricing:

- Right In Principle
  - Ensure capacity is acquired where needed
  - Send locational price signals
- Problematic In Practice, especially years-forward, for smaller zones
  - Price "signals" often short-lived, do not influence decision-making
  - Smaller zones result in much stronger incentives for incumbents to offer less rather than more capacity into the auctions, to raise clearing prices
  - Especially problematic for smaller zones, and if obligations are years-forward

In PJM, high-priced capacity zones have not attracted relatively more capacity (2010 analysis)



Why higher zonal capacity prices in PJM do not lead to relatively more new capacity in the high-priced zones

1. The zonal prices are volatile – its too late to get the price you see, and it generally won't be repeated
2. The market knows PJM will plan transmission upgrades to resolve constraints and this will moderate or eliminate zonal prices; and its generally easier to built outside of constrained areas
3. The market knows PJM's three-year-forward administrative determinations of locational requirements overstate needs and result in prices that overstate needs
4. While most market participants largely ignore the zonal prices, for incumbent capacity owners there is a strong incentive to offer less rather than more capacity and at the highest allowed prices, to raise the RPM clearing price earned by the rest of the owner's portfolio

Capacity zones – how quickly to redefine as conditions change?

- Likely constrained zones/zone boundaries change as generation or transmission or demand response is added, generation retires, etc.
- Defining new or changing existing zones ensures constraints are accurately represented but results in unpredictable prices
- Defining a new nested zone likely lowers prices in surrounding zone

Case study in locational capacity pricing: PJM's new ATSI zone

June 2011	FirstEnergy's ATSI subsidiary (N. Ohio) joins PJM ATSI zone is part of large, competitive, low-priced "Rest of RTO" area)
Dec. 2012	PJM defines new ATSI capacity price zone for upcoming RPM auction
Jan. 2012	FirstEnergy affiliate announces ATSI zone retirements; GenOn also announces retirements (total is roughly 20% of ATSI generation)
April 2012	PJM identifies $195 mil. in ATSI zone transmission upgrades for 2015
May 2012	Unprecedented RPM price spike in ATSI zone for 2015 (no new gen.)
Aug. 2012	PJM identifies additional $450 mil. in ATSI transmission upgrades for 2015, determines the ATSI zone is no longer constrained (PJM will define a new, smaller Cleveland zone for the next RPM auction)

PJM's ATSI capacity pricing zone: main outcomes

1. The last-minute zone definition and last-minute retirements caught the market by surprise with no significant new generation in the pipeline for the zone; so despite the price spike no new generating capacity cleared the auction (some new DR cleared).
2. The ATSI zone price spike raised the cost of capacity to Northern Ohio consumers by over $800 million. The retirements raised FirstEnergy's total ATSI capacity revenues by roughly $600 million.
3. Due to transmission upgrades, the zone is no longer expected to be constrained, so the ATSI price spike was a one-time "price signal".

A voluntary capacity buyer would never have held such an auction under the extraordinary circumstances of last-minute retirements with no time for the market to respond.

Locational Capacity Pricing: Conclusions

Locational capacity pricing is a good idea in theory, but….

- Locational capacity pricing in PJM has generally not resulted in relatively more capacity where prices are higher
- The "price signals" are volatile and temporary, and often ignored
- Locational pricing creates strong incentives for incumbents to physically/economically withhold; offer prices are more competitive in larger zones
- Especially doubtful that creating smaller zones (< 20,000 MW) has an overall positive impact on economic efficiency in a years-forward construct (will depend upon concentration of ownership, vertical integration/contract coverage, forward period, availability of good sites to build)

Capacity Markets – Final Words

1. Reevaluate resource adequacy targets
   - "1-in-10" is uneconomic, two orders of magnitude more reliability than distribution systems provide
   - Requires substantial intervention to achieve
2. Increase demand response participation in E&AS markets
3. Get the prices right, focus revenue recovery on E&AS markets
4. Over time, resource adequacy is achieved without administrative capacity constructs

Speaker Information

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James Wilson is an economist with over 25 years of consulting experience in the electric power and natural gas industries. His work has pertained to the economic and policy issues arising from the interplay of competition and regulation in these industries, including restructuring policies, market design, market analysis and market power. Other engagements have involved resource adequacy and capacity markets, contract litigation and pipeline rate cases. Prior to founding Wilson Energy Economics, Mr. Wilson was a Principal at LECG, LLC. He holds a B.A. in Mathematics from Oberlin College and an M.S. in Engineering-Economic Systems from Stanford University.