Reliability and Economics: Separate Realities?

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"Reliability" – Three Broad Categories

1. Transmission system
2. Distribution system
3. Resource adequacy (generation, transmission, demand response)

Our focus today: #3, resource adequacy

Panel Q: Should We Inject Economics Into Reliability?

1. Transmission system operation – reliability/cost tradeoffs?
2. Distribution system – we already do (tree trimming, etc.)
3. Resource adequacy – we inject reliability into economics…

Resource Adequacy Planning – Over/Under Study (1978)

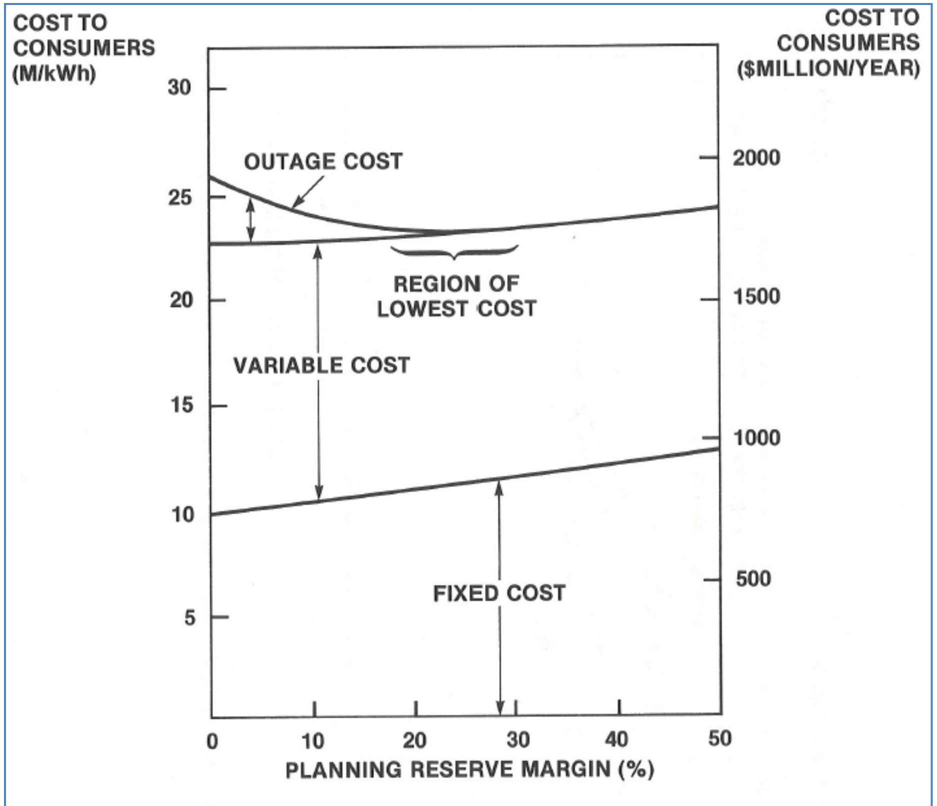


FIGURE 6-12. BASE CASE RESULTS FOR WISCONSIN ELECTRIC POWER COMPANY

Source: Decision Focus, Inc. *Costs and Benefits of Over/Under Capacity in Electric Power System Planning*, EPRI Report EA-927, Oct. 1978

Insights from Over/Under study:

- Flat curve: Cost is minimized over a wide range of PRMs
- Asymmetry: "Under" capacity risk greater than "Over" risk
- Important drivers of PRM:
  - Demand growth, uncertainty (big)
  - New plant lead times (long)
  - Planning flexibility (valuable)
  - Value of Lost Load (same as today)

Common Industry Practice: "One Day in Ten Years"

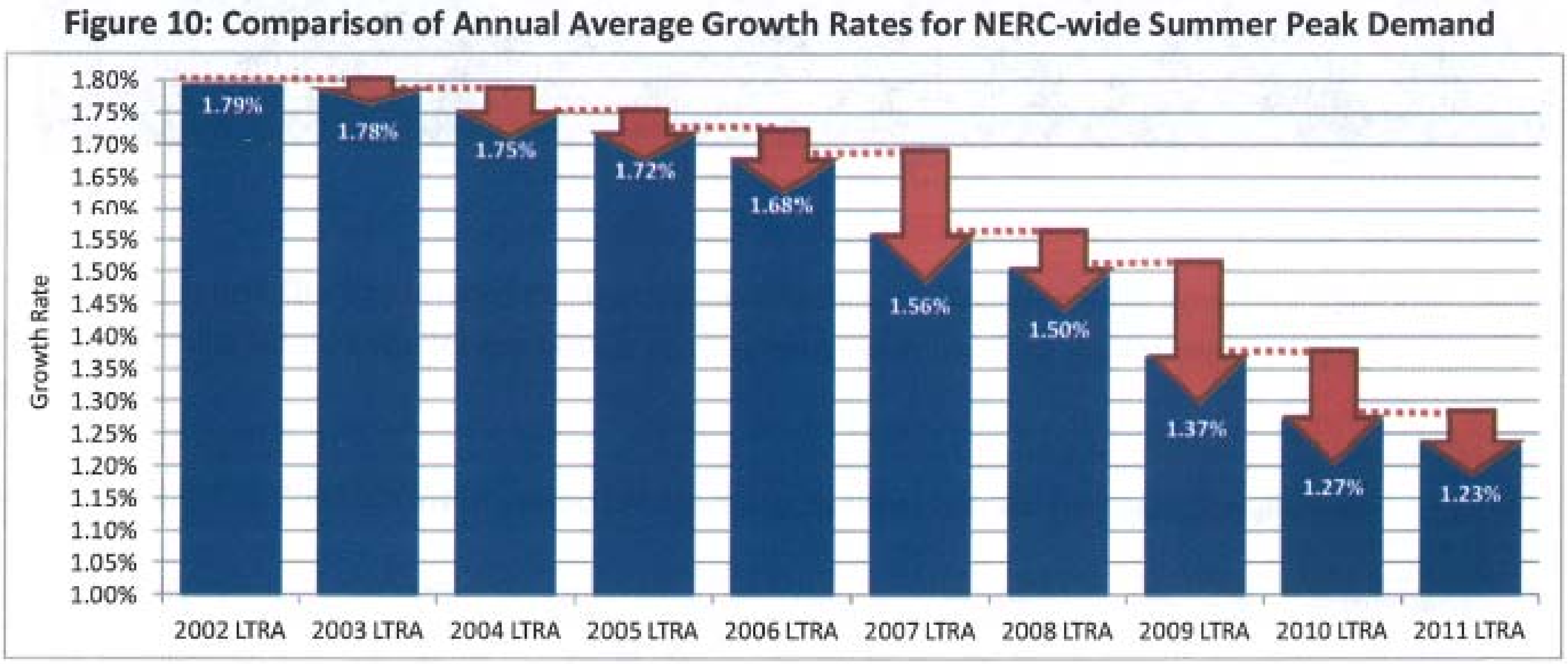
- 1-in-10 is a very conservative criterion that does not balance the marginal cost of the last incremental of capacity against its benefit (primarily, avoiding outages)
- 1-in-10 provides roughly two orders of magnitude more delivered reliability than provided by distributions systems
- In addition, approaches to calculating 1-in-10 PRMs generally make very conservative assumptions (so its not really 1-in-10)
- Highly conservative PRMs make more sense for utility planners and regulators than for consumers

Wilson, James F., *Reconsidering Resource Adequacy Part 1: Has the one-day-in-ten-years criterion outlived its usefulness*? Public Utilities Fortnightly, April 2010.

Resource Adequacy Over/Under: Then, Now and Future

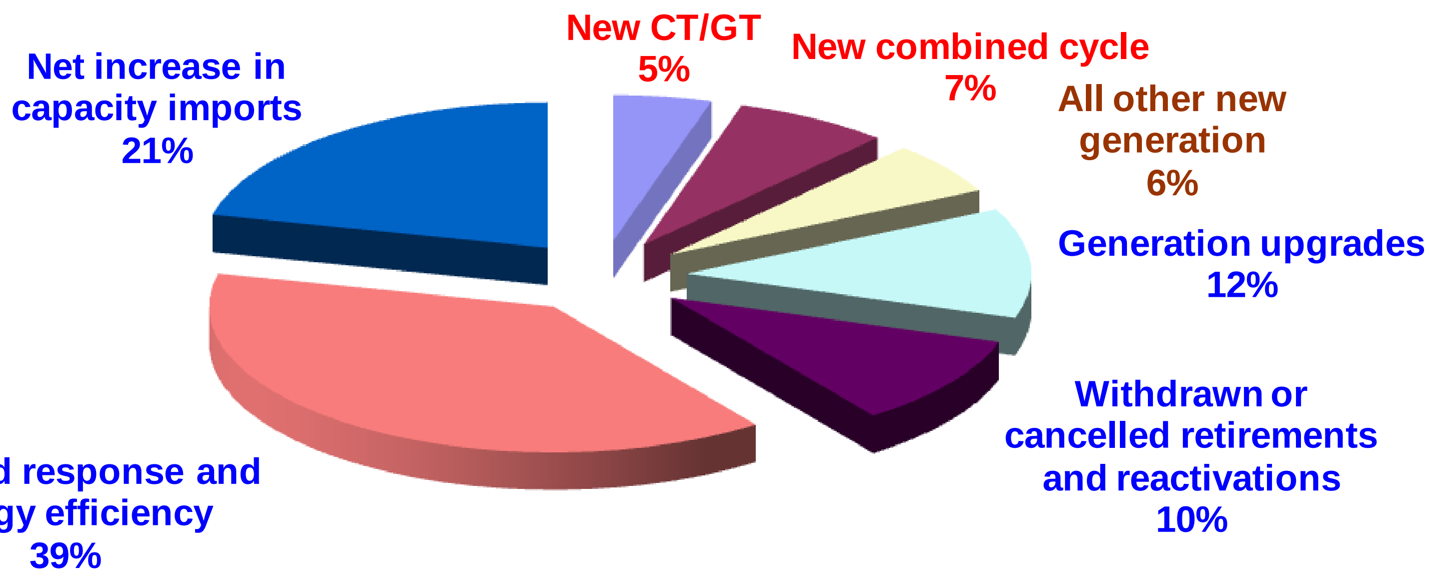
	Then	Now	Future
Load growth	2% to 7%/year, highly uncertain	1.2%/year, much narrower range	Still falling?
Incremental capacity	Large nuclear, coal, natural gas	Uprates, extensions, gas, DR, renewables…	Increasingly diverse
Lead times	>> 3 years	Most <= 3 years	Various
"Over" risk	Small – load growth quickly absorbs excess capacity	Larger – load growth slow, capacity may be excess for years	Larger – load growth uncertain
"Under" risk	Large – inelastic, rapidly growing demand, long lead times to catch up	Smaller – peak grows slower and is more manageable, many short lead time resources	Demand increasing price-responsive; better shortage pricing to activate

Peak Load Growth Is Slowing



Source: NERC Long Term Reliability Assessment 2011

Short Lead Time, Low Investment Resources: 82% of PJM Incremental Capacity Over 8 Delivery Years



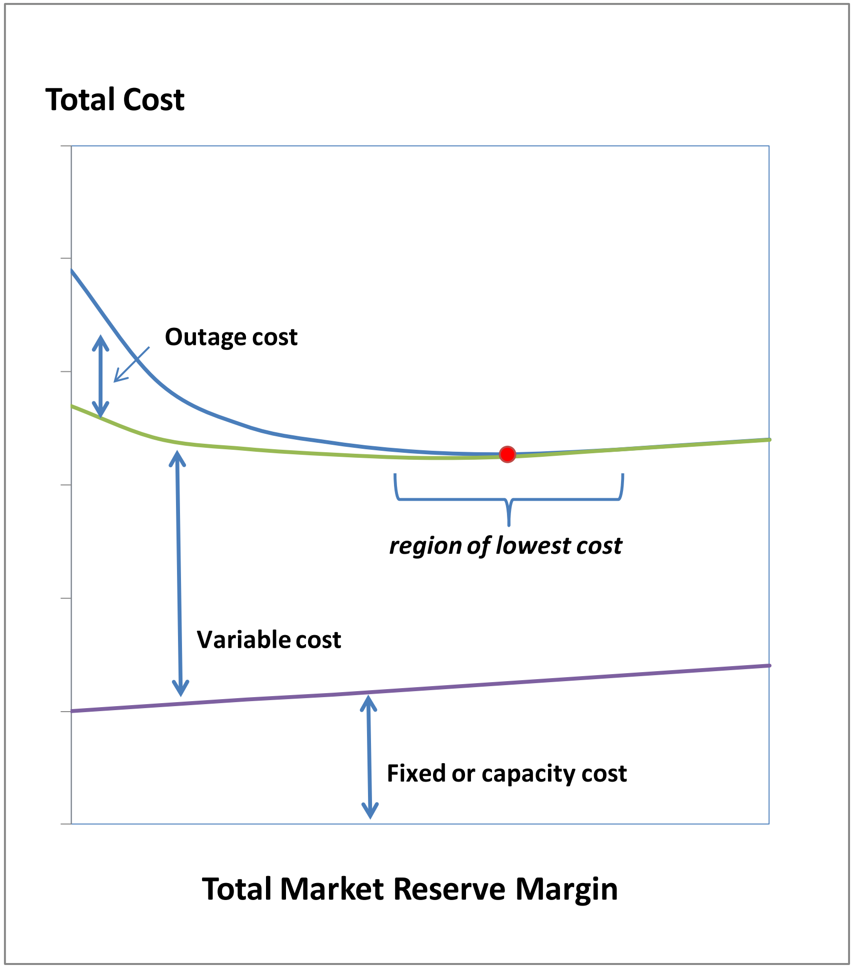
Source: PJM, *2014/2015 RPM Base Residual Auction Results*, Tables 7 and 9, which present offered capacity expressed in installed capacity terms.

Injecting Reliability Into Economics:
PRMS in Competitive Wholesale Power Markets

Why are administrative PRMs imposed on some restructured, competitive wholesale markets?

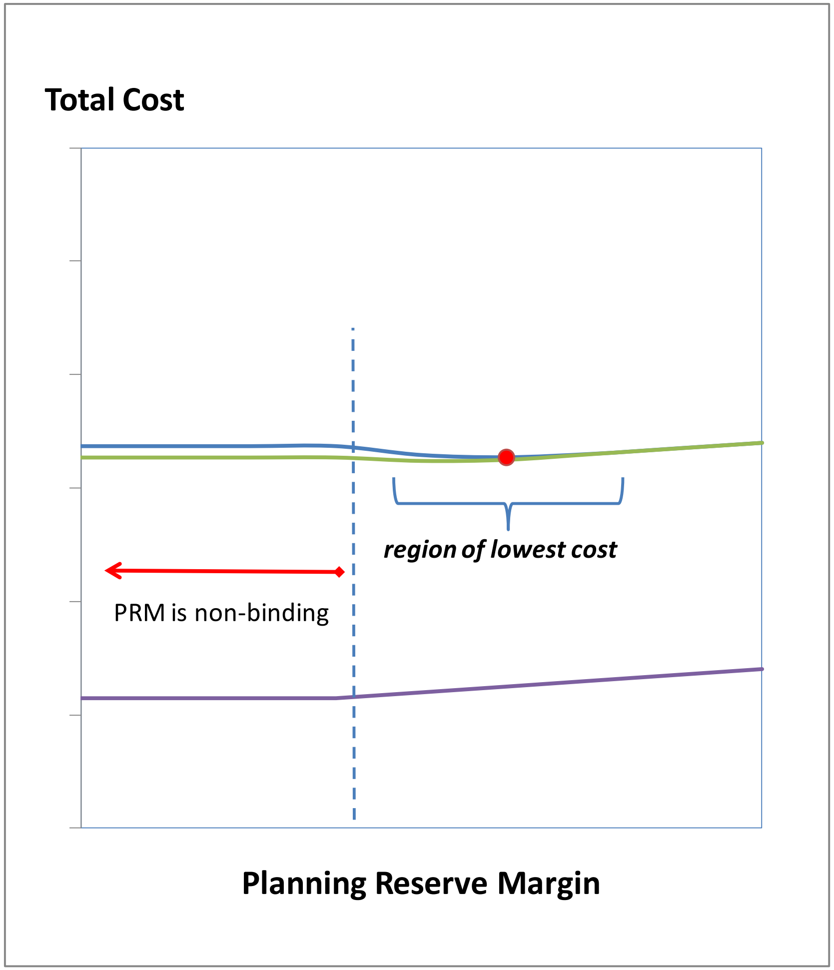
- Sanctity of the "one day in ten years" criterion
- Concern that market participants may not act to provide "enough" total capacity
  - Is "adequacy" a common good?
  - Inadequate ncentives for merchant capacity construction under current wholesale market rules with limited demand elasticity

Over/Under Revisited: Wholesale Markets



- Market participants (buyers and sellers) make their own decisions to contract or build capacity, or hedge energy, ancillary services and capacity costs, based on their private assessments of load growth, capacity needs, prices, etc
- However, in aggregate, the relationship between total market cost and the *actual* reserve capacity may be similar to the regulated utility case.

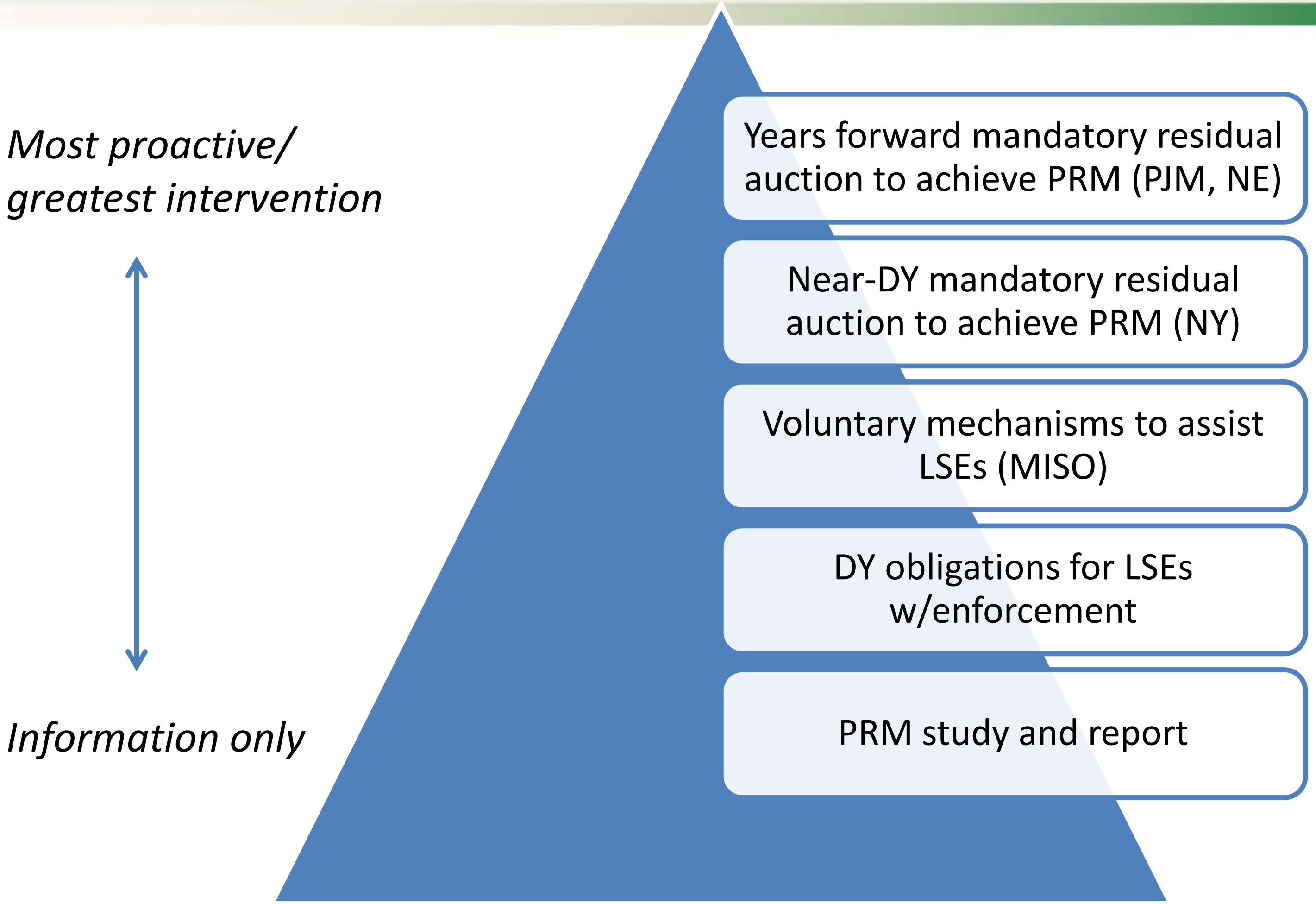
PRM in a Restructured Power Market: Total Market Cost



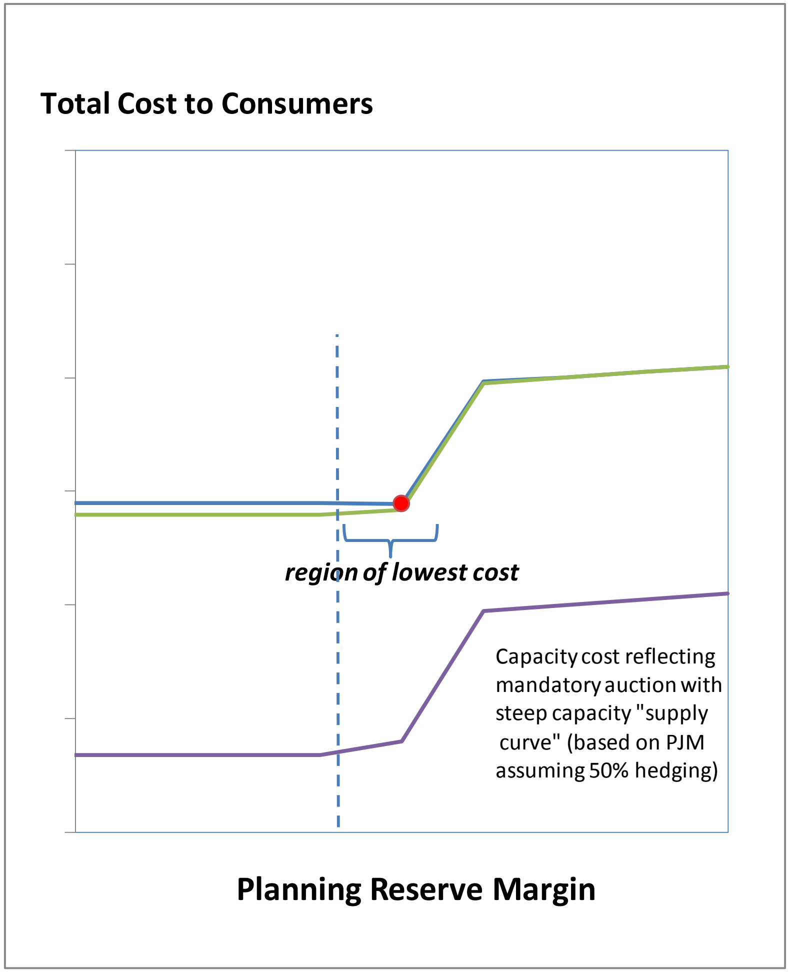
- With a relatively low PRM, market participants (buyers and sellers) cause more capacity to be built than the PRM; it is a non-binding constraint and has no effect.

- To realize a larger PRM, a mechanism is needed to override the aggregate result of market participants' assessments of capacity needs and capacity and hedging decisions (carrots or sticks)

RTO Actions and Interventions for Resource Adequacy

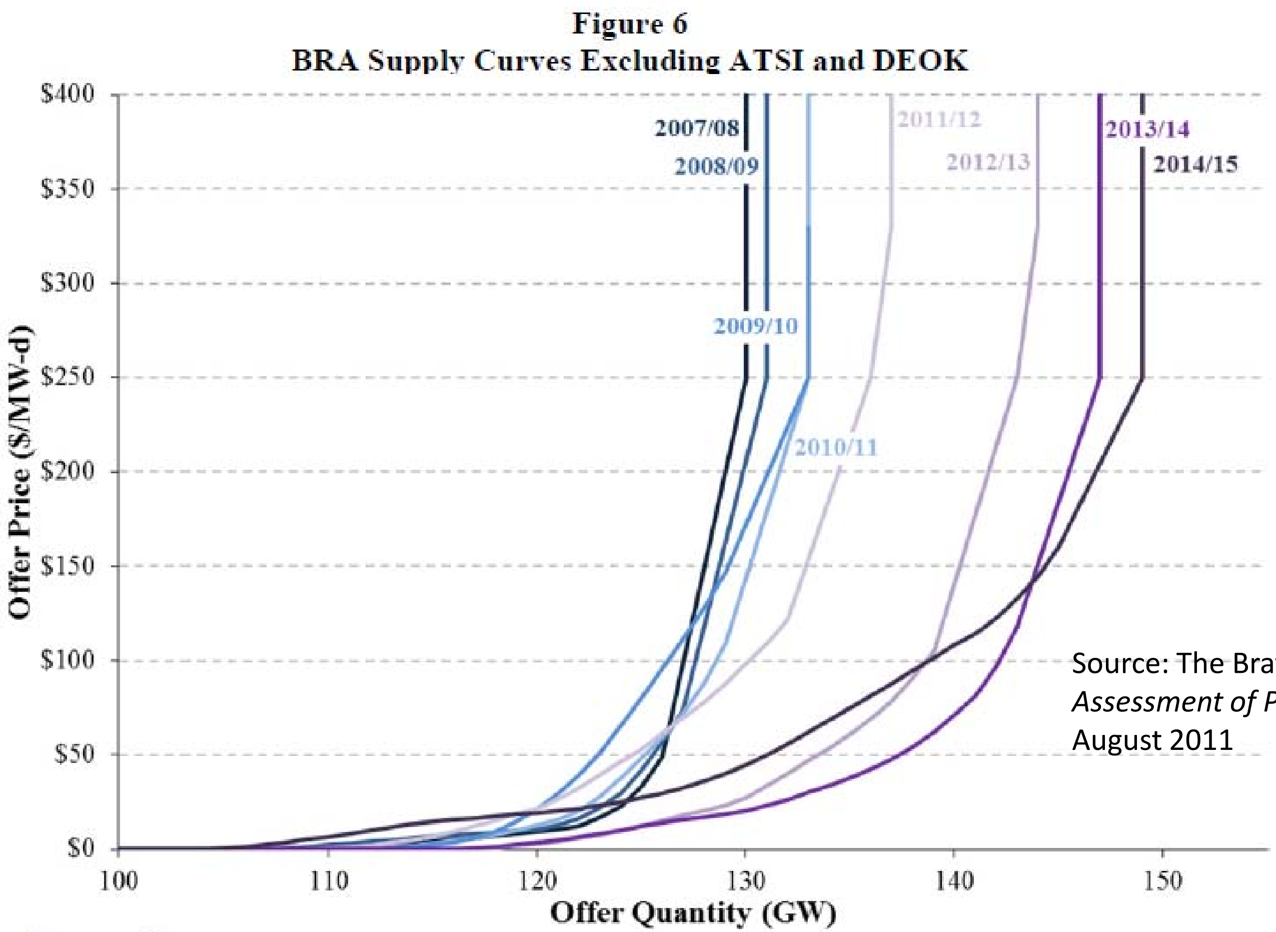


Cost to Consumers With Mandatory Forward Capacity Obligations



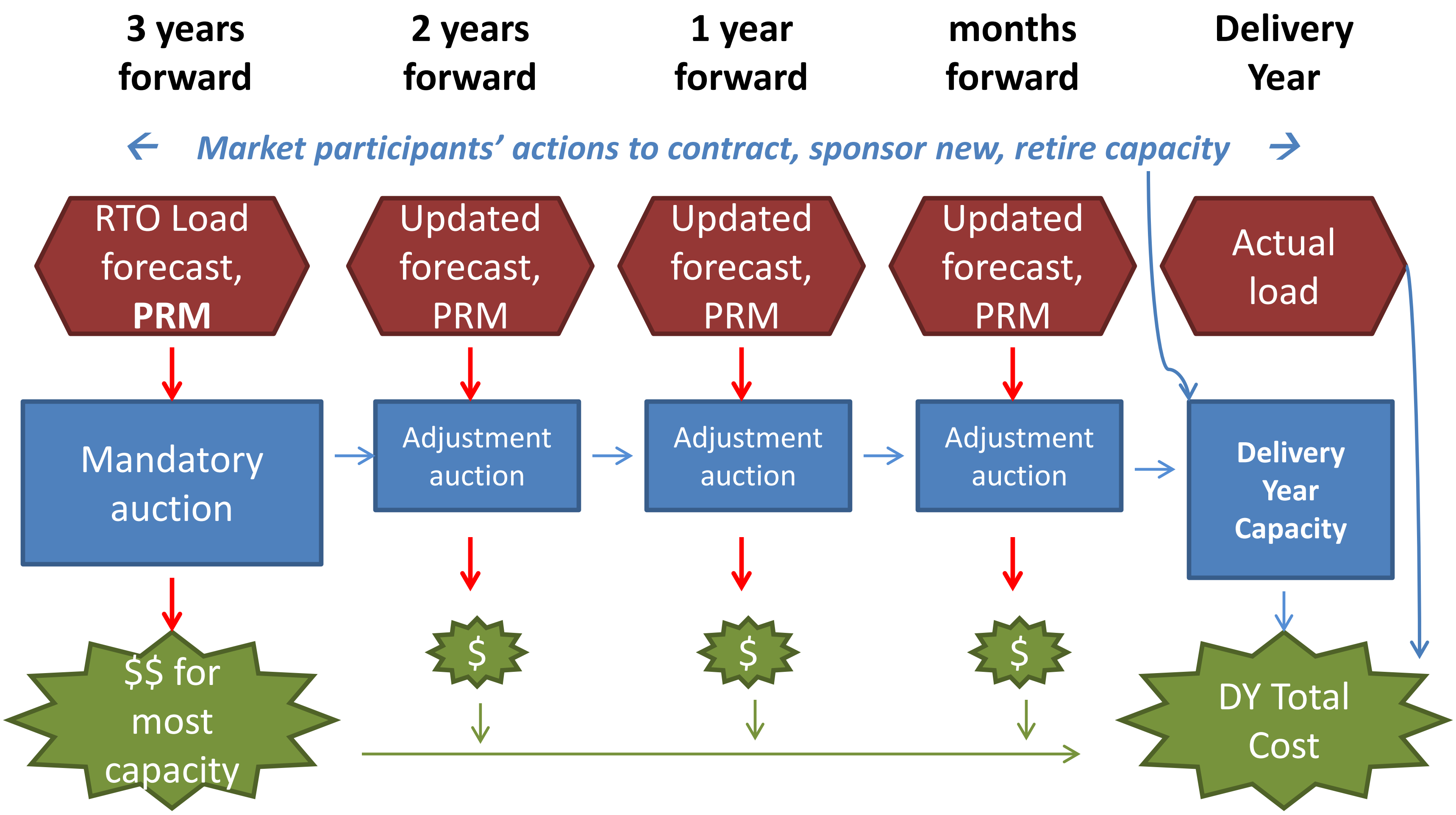
- Higher PRMs, through a mandatory auction, can cause large transfers of wealth from consumers to capacity sellers
  - Supply curves for incremental capacity are very steep and do not include all capacity that can be available for the delivery year
- The transfers of wealth are hoped to incent future capacity construction, however, the evidence to date is not supportive.

Capacity Auction Supply Curves Remain Steep (PJM example)

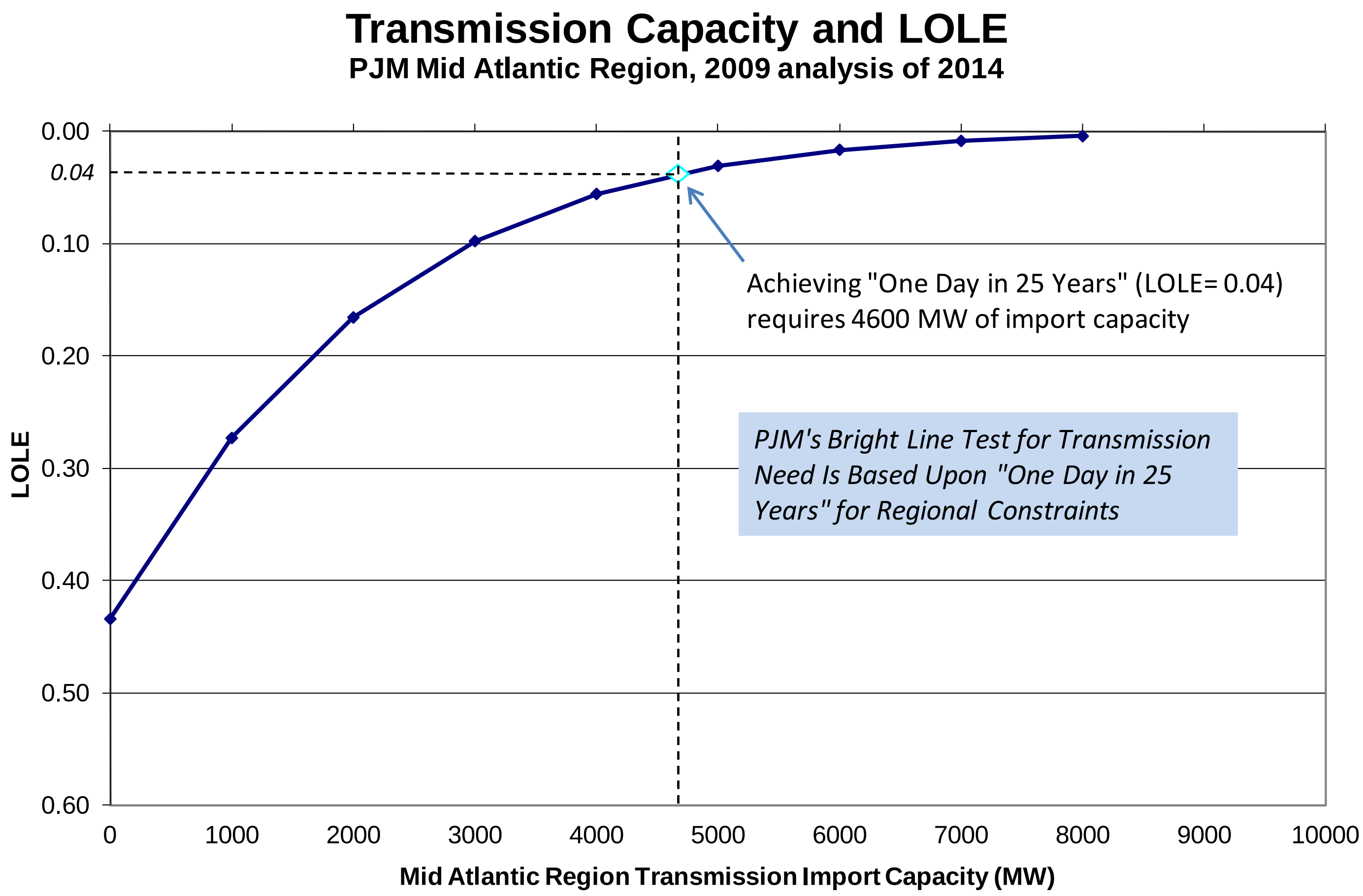


Source: The Brattle Group, *Second Performance Assessment of PJM's Reliability Pricing Model*, August 2011

The Impact of an Administrative Years-Forward PRM on Actual Delivery Year Capacity, Total Cost Is Complex *(PJM Example)*



Transmission Planning "Bright Line Tests" Also Ignore Economics (PJM Example)



Conclusions: Resource adequacy under "1-in-10"

1. "One Day in Ten Years" ignores economics, is too conservative
   a. Fails to balance cost of capacity and probability, cost of outages; and conservative assumptions often used in determining 1-in-10 PRMs
   b. Capacity "Over/Under" risks have changed significantly in recent years, (slower load growth, short-lead-time resources, more manageable peaks)
   c. With substantial PRD, modeling 1-in-10 becomes arbitrary, meaningless
2. Traditional, conservative PRMs based on 1-in-10 harm consumers and markets
   a. Pre-empts market decision-making, stunting market development
   b. The resulting excess capacity depresses E&AS prices and discourages DR and PRD, which hold the potential to make markets more efficient
   c. Large PRMs can result in large transfers of wealth from consumers to capacity sellers without commensurate short-term or long-term benefit
   d. Forward capacity markets become entrenched and create a constituency in favor of conservative PRMs that raise capacity prices

Conclusions: Economic evaluation of PRMs

3. Modeling the economic impacts of resource adequacy criteria and resulting PRMs in a market context is complex and the results will necessarily depend on many questionable model structure choices and assumptions
   a. Connection between administrative PRM and delivery year actual RM
   b. Connection between actual RM and energy, A/S, capacity prices
   c. Connection between all prices and market participants' future capacity decisions (multi-year dynamics)
   d. Theory v. actual impact of forward capacity markets
4. The structure and focus of the Over/Under approach is not well suited for modeling the dynamics of power markets
5. Communicating probabilistic resource adequacy analyses is also challenging ; simplified presentation can provide a highly inaccurate impressions of risks (example: transmission bright line test)

Conclusions: Resource adequacy for restructured markets

6. For restructured markets under RTOs, PRMs are a market intervention that should remain focused on resource adequacy
   a. Purpose: To protect against unacceptably low RM leading to unacceptable risk of frequent curtailment of firm load (guard rails)
   b. Not to optimize the economics – not appropriate in a market context
   c. Not to try to send "price signals" – evidence (and theory) do not support effectiveness of spot capacity market prices in incenting new capacity
7. The goal should be to phase out administrative PRMs (or see them become non-binding) through further development of demand-side price responsiveness and better pricing when reserves are low
8. Attitudes that "reliability is paramount" applied to resource adequacy (as opposed to grid operation) are outdated and must change with the times

Related Work (available at www.wilsonenec.com)

Wilson, James F., *Reconsidering Resource Adequacy, Part 1: Has the one-day-in-10-years criterion outlived its usefulness*? Public Utilities Fortnightly, April 2010 Link

Wilson, James F., *Reconsidering Resource Adequacy, Part 2: Capacity planning for the smart grid,* Public Utilities Fortnightly, May 2010 Link

Wilson, James F., *One Day in Ten Years? Resource Adequacy for the Smart Grid*, revised draft, November 2009 Link

Wilson, James F., *Comments on Proposed Reliability Standard BAL-502-RFC-02: Planning Resource Adequacy Analysis, Assessment And Documentation,* FERC Docket No. RM10-10, Dec. 27, 2010 Link

Wilson, James F., *Forward Capacity Market CONEfusion,* Electricity Journal, November, 2010 Link

Wilson, James F., *Direct Testimony on Behalf of Virginia State Corporation Commission Staff,* Application of PATH Allegheny Virginia Transmission, Virginia State Corporation Commission Case No. PUE-2009-00043, December 8, 2009 Link

Wilson, James F., Affidavit in Support of Comments and Protest of the Pennsylvania Public Utility Commission, FERC Docket No. ER09-1063-004 (shortage pricing), July 30, 2010 Link