

Resource Adequacy

Current Issues in North American Power Markets

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Resource Adequacy Constructs in North America

◆ Regulated Planning

- Utility or administrative entity conducts integrated resource planning (IRP) for resource adequacy
- Cost recovery through regulated approval
- Risk of uneconomic investment decisions borne by customers

◆ Market-Based

- Focus of this presentation
- Market design challenge
 - Sufficient market-based revenues to attract and retain supply when and where needed for resource adequacy
 - Prices low enough to discourage new investments during surplus
- Risk of uneconomic investment decisions borne by suppliers (increases investment and financing costs)
- Price volatility and uncertainty are a key concern

Introduction

Resource Adequacy Constructs in North America

	Regulated Planning (Customers Bear Risk)		Market Mechanisms (Suppliers Bear Risk)		
	Regulated Utilities	Administrative Contracting	LSE RA Requirement	RTO Capacity Markets	Energy-Only Markets
Examples	BC Hydro, SaskPower, most of WECC, Southeast U.S.	Ontario	California, MISO	PJM, NYISO, ISO-NE	Alberta, Texas
Resource Adequacy Requirement?	Yes (Utility IRP)	Yes (Administrative IRP)	Yes (Creates Bilateral Capacity Market)	Yes (Mandatory Capacity Auction)	No (RA Not Assured)
How are Capital Costs Recovered?	Rate Recovery	Long-Term Contracts	Bilateral Capacity Payments and Energy Market	Capacity and Energy Markets	Energy Market

See Also: Pfeifenberger & Spees (2009). Review of Alternative Market Designs for Resource Adequacy.

Appropriate Investment Signals in Alberta

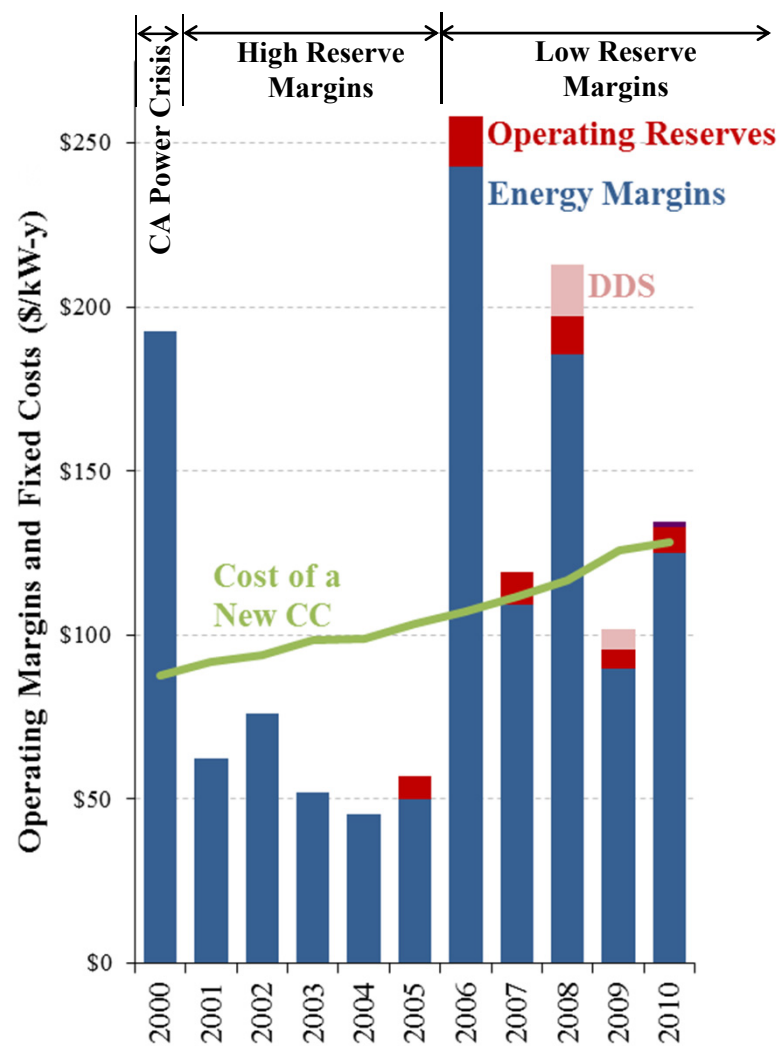
Alberta Energy-Only Market Review

- ◆ We studied challenges to resource adequacy and market sustainability
- ◆ Found that net revenues were consistent with market conditions:
 - Sufficient to attract investment when reserve margins were low
 - Below new plant costs when reserve margins were high
- ◆ Economic outlook favors gas over coal

Recommendations

- ◆ Need phased approach to environmental regs to prevent large simultaneous retirements
- ◆ Consider raising price cap to Value of Lost Load (VOLL) and refining administrative scarcity pricing

Combined Cycle Net Revenues

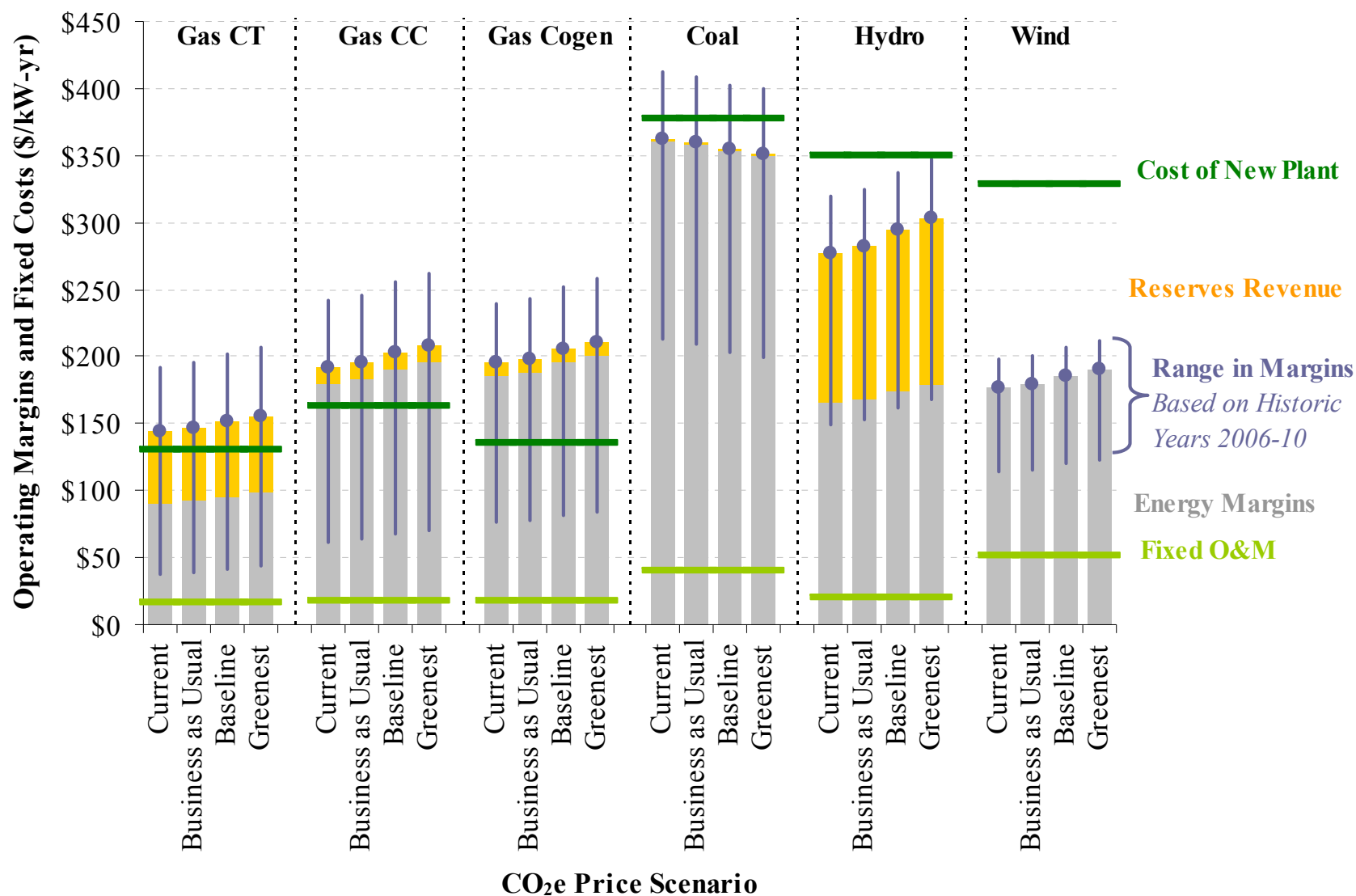


Source: Pfeifenberger & Spees (2010).

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Energy-Only Markets: Alberta

Alberta Projected 2020 Returns by Technology



Source: Pfeifenberger & Spees (2010).

Texas Effort to Refine Shortage Pricing

Substantial RA Challenges

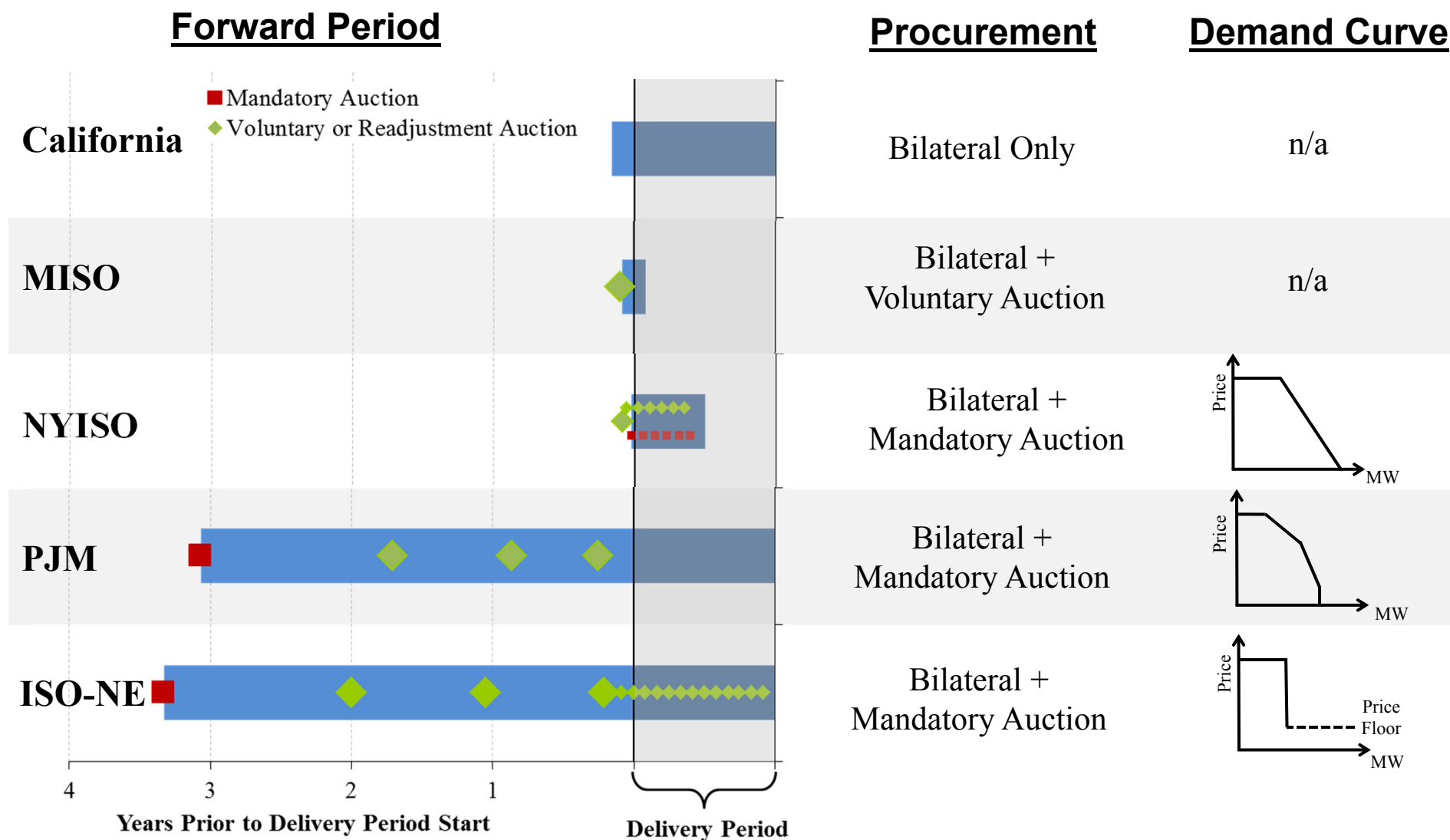
- ◆ Low gas prices and high wind penetration (12% of ICAP) have suppressed ERCOT prices
- ◆ IMM estimated returns to generators were sufficient to attract new plants only one in the past four years (over 2006-10)
- ◆ Shortages during a February cold snap and summer heat wave required ERCOT to sign out-of-market contracts to bring mothballed units back online
- ◆ Upcoming environmental regs (HAP, CSAPR, CWA 316(b)) expected to induce retirements

Effort to Refine Scarcity Pricing

- ◆ Price floors (\$120-180/MWh) when reserves are dispatched for reliability (to prevent suppressed prices during these reliability-dispatch events)
- ◆ “Power Balance Penalty Curve”
 - Administrative price adder when ERCOT is deficient of reserves
 - Prices rise to \$3,000/MWh price cap with severity of shortage

Sources: EPA CWA 316(b) Info; ERCOT May 2011 retirement risk study; Ventyx; November news coverage from SNL, MW Daily, RT, and Energy Choice Matters; PUCT project 37897 materials; ERCOT stakeholder materials.

Summary of RA and Capacity Market Constructs



California's Local RA Requirement

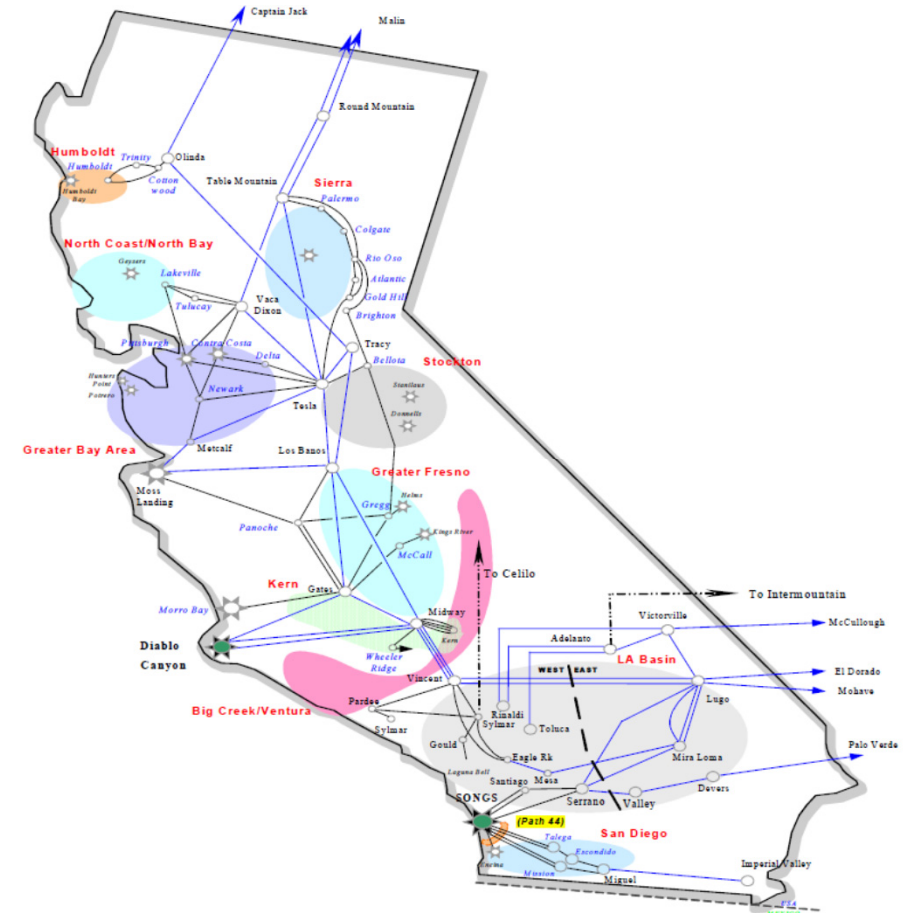
California

- ◆ California PUC imposes a RA requirement on LSEs (their customers' peak load plus reserve margin)
- ◆ LSEs can self-supply capacity or procure it bilaterally
- ◆ CAISO administers a "Standard Capacity Product" mechanism to enable the bilateral market

Local RA Requirements

- ◆ LSEs in load pockets must purchase a fraction of their capacity locally
- ◆ Local requirement is assigned proportionally to the LSE's contribution to local peak load

California's Locally Constrained Areas



Sources: <http://www.caiso.com/2060/2060dbea28470.pdf>; “California Regulators: Jury is out on Capacity Markets,” *MW Daily*. 6-14-2010; CPUC Decision 06-06-064. June 29, 2006; CPUC 2010 Filing Guide for System and Local Resource Adequacy (RA) Compliance Filings; <http://www.caiso.com/1c44/1c44b2dd750.html>.

MISO's RA Enhancement Proposal

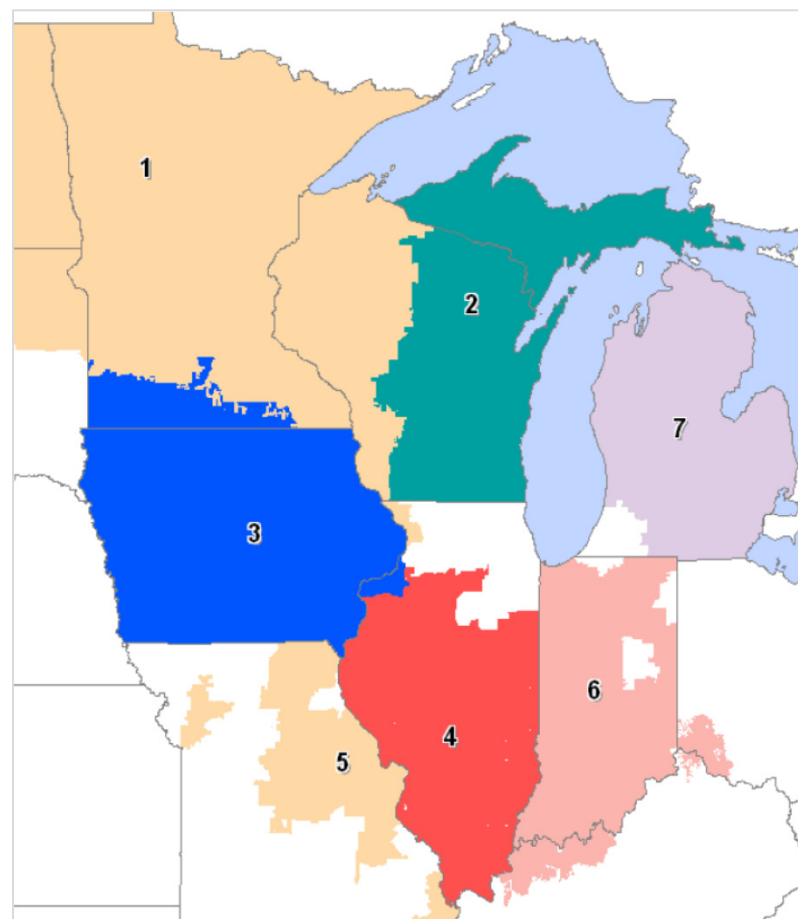
Current Mechanism

- ◆ Monthly LSE RA requirement
- ◆ Bilaterally tradable capacity product
- ◆ Voluntary Capacity Auction (VCA) a few days before the monthly planning deadline
- ◆ Most states also oversee utility IRP for major investments

Proposed Enhanced Mechanism

- ◆ Locational mechanism (imposed by FERC)
- ◆ Annual construct with a mandatory auction
- ◆ Opt-out provisions:
 - Self-suppliers may opt out of the auction
 - Self-suppliers may be subject to locational deliverability charges if they procure too little capacity locally

MISO's Proposed Capacity Zones



Sources: MISO FERC RA Enhancements Filing, July 20, 2011;
<https://www.midwestiso.org/Events/Pages/SAWG20110317.aspx>

Capacity Markets

Price Volatility and Uncertainty are a Concern

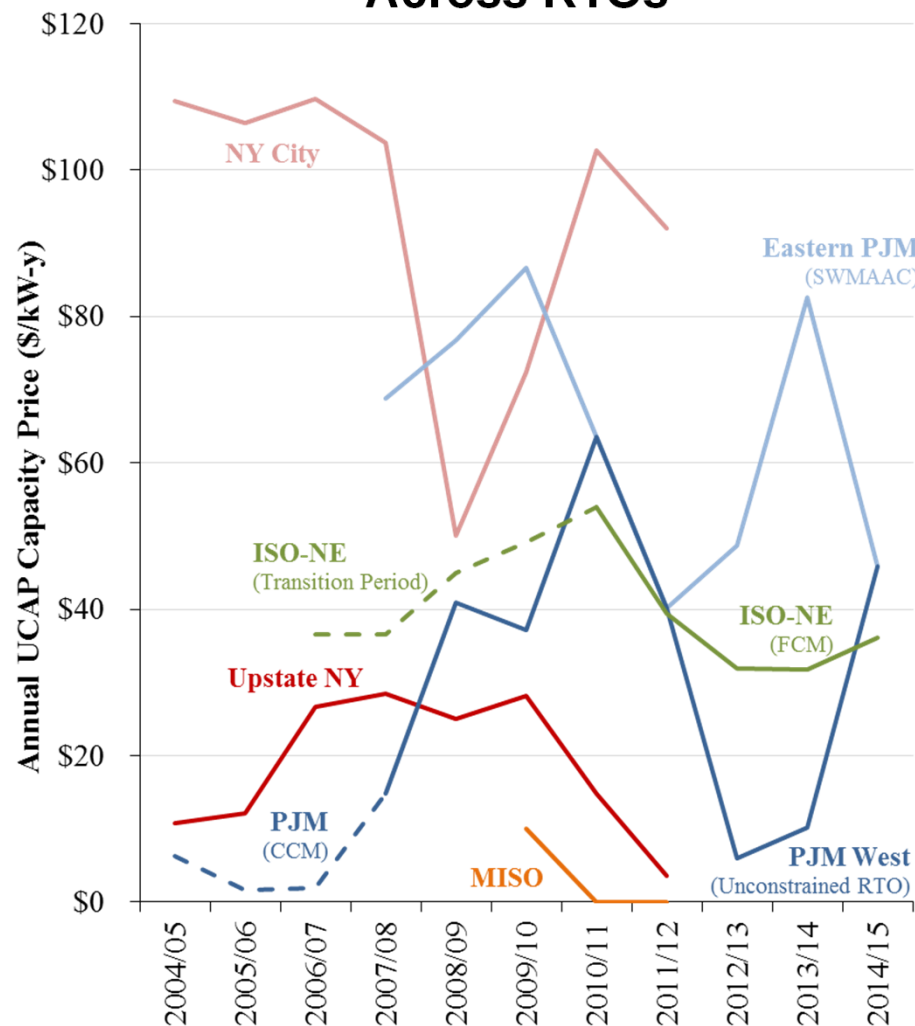
◆ Example from our PJM review:

- Single biggest concern for all stakeholder sectors was price volatility and uncertainty
- Related concerns about the lack of long-term hedging options

◆ Several contributing factors:

- **Market Fundamentals** – not a concern, prices should move with market fundamentals
- **Previous Design Changes** – one-time design changes contribute to volatility, but not a persistent concern
- **Ongoing Administrative Uncertainties** – importance of uncertain administrative parameters is an ongoing concern

Capacity Price Comparison Across RTOs



Sources: PJM, ISO-NE, MISO, and NYISO Capacity Market Results.

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...but Not All Concerns Are Supported by the Facts

Concern

Reality

- | | |
|---|--|
| <ul style="list-style-type: none">◆ “Capacity prices are too high (or too low)”

◆ “Capacity markets have not attracted new generation”

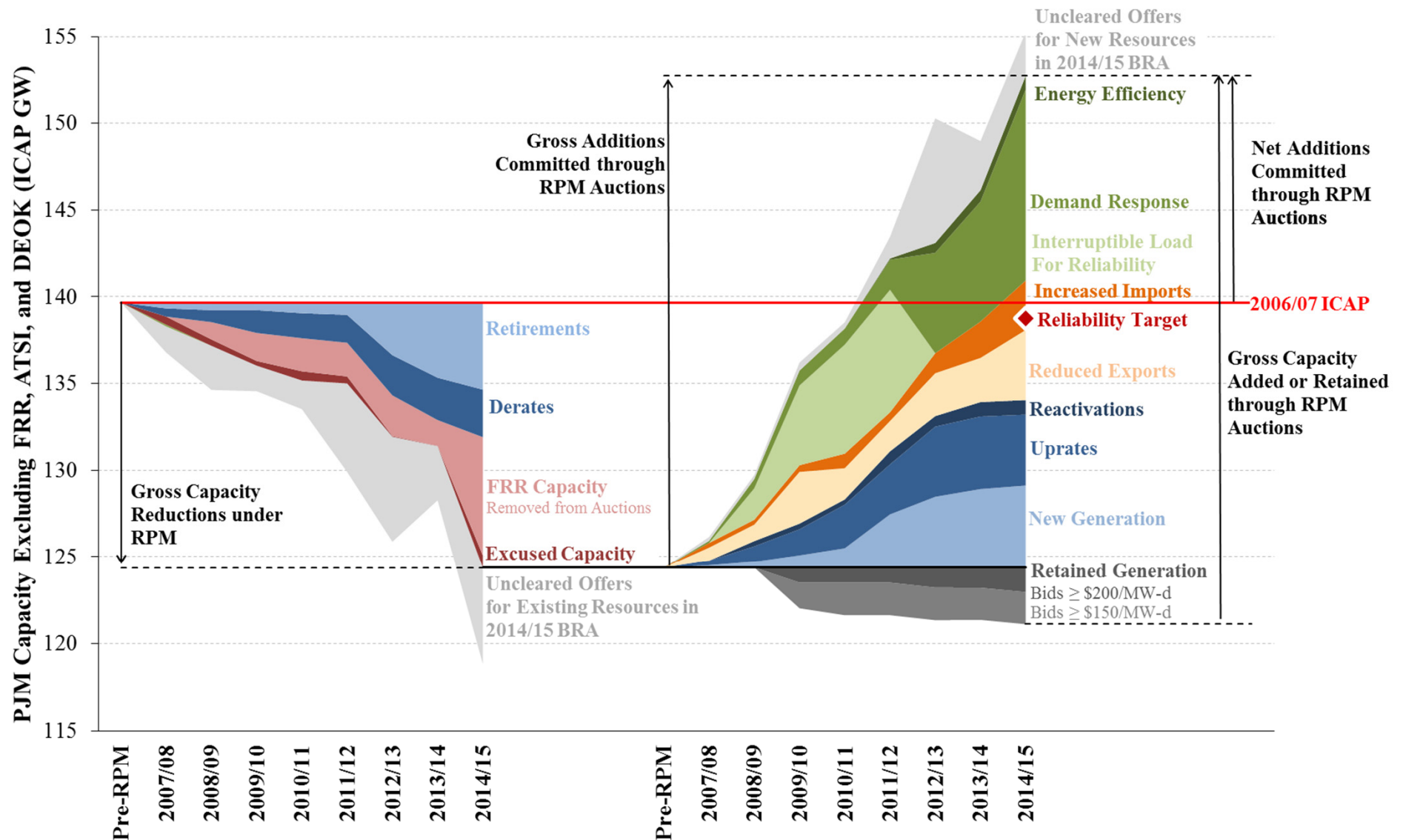
◆ “Capacity markets cannot maintain reliability under environmental regulations” | <ul style="list-style-type: none">◆ Prices have been consistent with the fundamentals, mostly below Net CONE (reflecting surplus)◆ ISO-NE exception, with price floor contributing to supply excess

◆ New generation has not been needed in most places, and cheaper alternatives have been available (DR, uprates, reinvestment)◆ 4.8 GW of new gen added in RPM

◆ PJM and ISO-NE 2014/15 auctions cleared excesses despite NESHAP◆ Some new safeguards needed (e.g. for co-located retirements) |
|---|--|

Capacity Markets

Substantial Capacity Additions Committed in PJM



Source: Pfeifenberger, Newell, Spees, et al. (2011).

Rapid Demand Response Growth

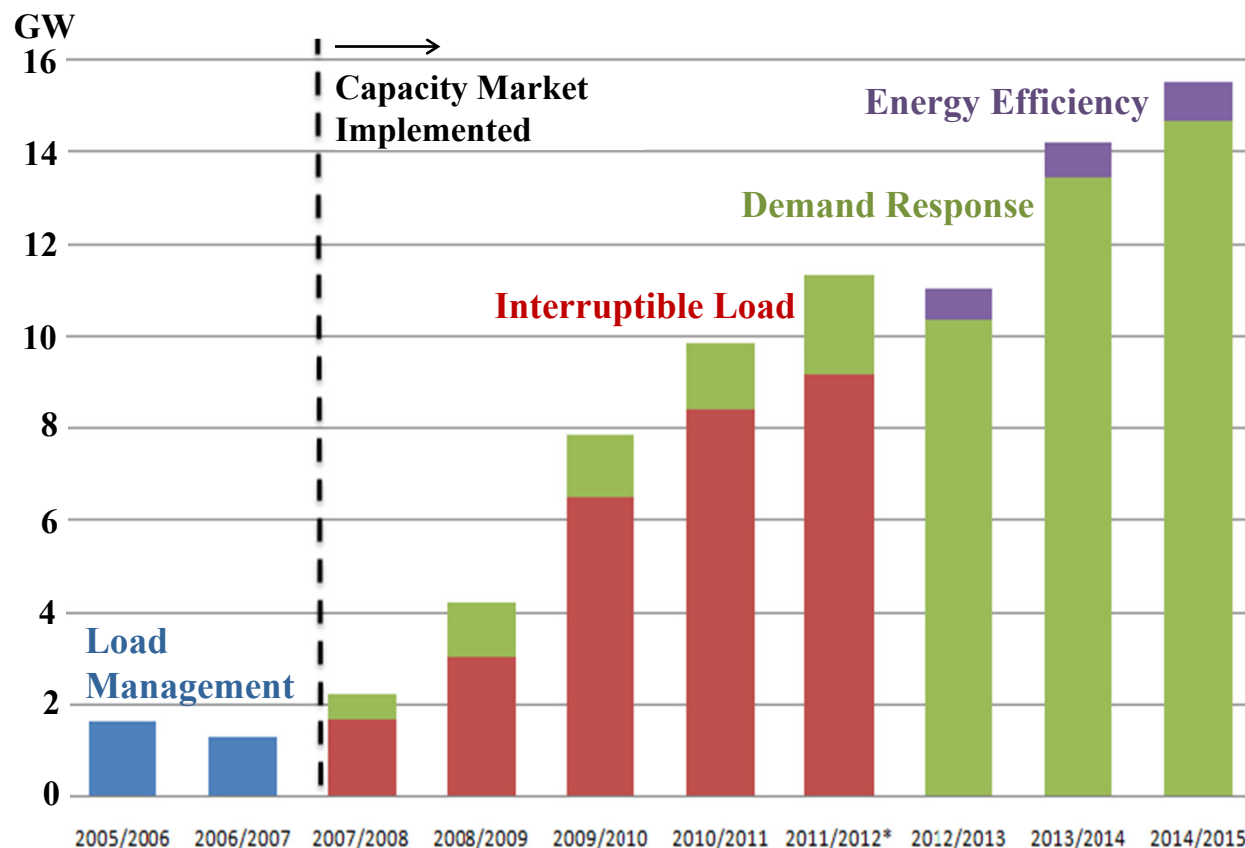
Surprising Growth

- ◆ Major success of capacity markets is large influx of DR
- ◆ Lower-cost supplies than traditional gen

Future of DR

- ◆ Will eventually reach saturation and stabilize
 - More calls on DR customers will be required, increasing interruption costs
 - May top out at 12-15% of peak load
- ◆ High DR means lower gen reserve margin (i.e. higher energy prices)

DR Growth in PJM Capacity Market



Source: PJM 2014/15 BRA Results (2011).

U.S. Environmental Regulations

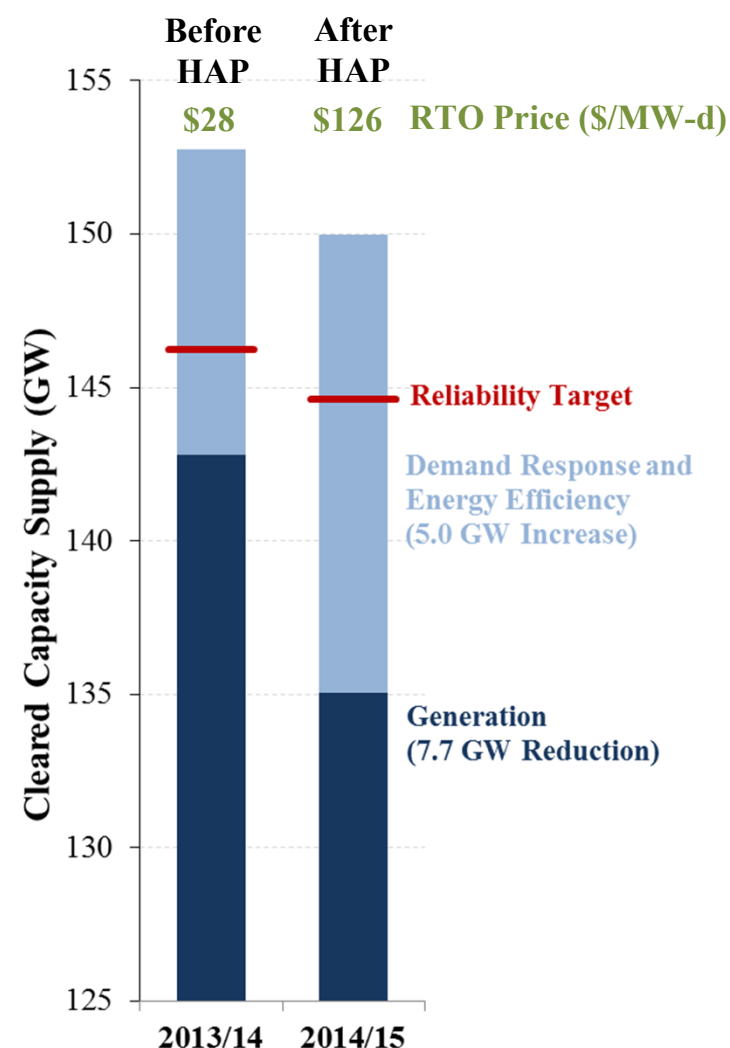
HAP and CSAPR

- ◆ 2012: Cross-state air pollution rule (CSAPR) will increase NO_x and SO₂ costs
- ◆ 2015: Hazardous air pollutant (HAP) regulation for air toxics including Hg and acid gases will force retire/reinvest decisions on much of the U.S. coal fleet

PJM & ISO-NE 2014/15 Auctions

- ◆ HAP rule was an important “stress test”
 - Both procured sufficient capacity
 - PJM prices increased substantially (still below Net CONE); ISO-NE prices remained at the floor
 - Some uncleared gen (from coal likely to retire), partly offset by DR increases
- ◆ Remaining concern that retirements may be co-located in unmodeled subzones
- ◆ Shorter-term markets yet to pass test

PJM Cleared Capacity



Source: PJM 2014/15 BRA Results.

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Minimum Offer Price Rules

Minimum Offer Price Rules (MOPR)

- ◆ MOPRs introduced to prevent artificial price suppression
 - Net short buyers and/or states may have incentive to suppress prices
 - In some cases a single new plant can suppress capacity prices for years
- ◆ MOPR prevents new supply offers at uncompetitive low levels
- ◆ “Incentive test” was targeted only net buyers w/ incentive to crash price
 - Failed to account for states or other contractual counterparties’ incentives
 - NJ (and possibly MD) above-market contracts would have been exempt

Concerns

- ◆ Move to eliminate “incentive tests” will apply MOPR to all suppliers (including merchant plants or integrated planning entities that have no incentive to suppress prices)
- ◆ Unclear whether MOPR application will be strict enough to prevent price suppression when needed in all places (current issue in PJM, ISO-NE, NYISO, and MISO)

Take Aways

- ◆ Key challenge for both energy-only and capacity markets is to create appropriate investment signals:
 - Total returns to suppliers should be high enough to attract new investment during shortages; below investment costs during surplus
 - Scarcity prices that reflect the marginal cost of emergency actions
 - Price cap at the VOLL (especially in energy-only markets)
- ◆ Price volatility and uncertainty increase investment costs and may postpone investments until prices are higher (but volatility should not be artificially muted if it reflects underlying fundamentals)
- ◆ Avoid administrative uncertainties to the extent possible
 - Political interventions in response to price spikes
 - Out-of-market capacity procurement
 - Impact of administrative parameters
- ◆ Careful introduction of environmental regulations
 - Forward capacity markets seem robust; remaining risk of co-located retirements
 - Short-term capacity markets not yet tested
 - Energy-only markets at risk to all-at-once environmental mandates

Additional Reading

- Pfeifenberger, Newell, Spees, Hajos, Madjarov, "Second Performance Assessment of PJM's Reliability Pricing Model: Market Results 2007/08 through 2014/15," August 26, 2011.
- Spees, Newell, Carlton, Zhou, Pfeifenberger, "Cost of New Entry Estimates for Combustion Turbine and Combined-Cycle Plants in PJM," August 24, 2011.
- Pfeifenberger, Spees. "Evaluation of Market Fundamentals and Challenges to Long-Term System Adequacy in Alberta's Electricity Market," April 2011.
- Newell, Spees, Hajos, "The Midwest ISO's Resource Adequacy Construct: An Evaluation of Market Design Elements," *The Brattle Group*, January 19, 2010.
- Hesmondalgh, Pfeifenberger, Robinson, "Resource Adequacy and Renewable Energy in Competitive Wholesale Electricity Markets," BIEE, September 2010.
- Pfeifenberger, Spees, "Best Practices in Resource Adequacy," PJM Long Term Capacity Issues Symposium, January 27, 2009.
- LaPlante, Chao, Newell, Celebi, Hajos, "Internal Market Monitoring Unit Review of the Forward Capacity Market Auction Results and Design Elements," ISO New England and *The Brattle Group*, June 5, 2009.
- Newell, Bhattacharyya, Madjarov, "Cost-Benefit Analysis of Replacing the NYISO's Existing ICAP Market with a Forward Capacity Market," *The Brattle Group*, June 15, 2009.
- Pfeifenberger, Spees, Schumacher, "A Comparison of PJM's RPM with Alternative Energy and Capacity Market Designs," *The Brattle Group*, September 2009.
- Pfeifenberger, Newell, Earle, Hajos, Geronimo, "Review of PJM's Reliability Pricing Model (RPM)," *The Brattle Group*, June 30, 2008.
- Reitzes, Pfeifenberger, Fox-Penner, Basheda, Garcia, Newell, Schumacher, "Review of PJM's Market Power Mitigation Practices in Comparison to Other Organized Electricity Markets," *The Brattle Group*, September 2007.

About *The Brattle Group*

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

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

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On behalf of his clients—which include ISOs, transmission owners, utilities, generators, and regulators—he has addressed RTO market designs, the economic benefits and cost allocation of transmission projects, the reasons behind rate increases, implications of restructuring policies, competitive conduct in electric power markets, and the effects of proposed mergers.