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# Resource Adequacy

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# Resource Adequacy vs. Reliability

**For end users, "reliability" is a combination of three distinct components:**

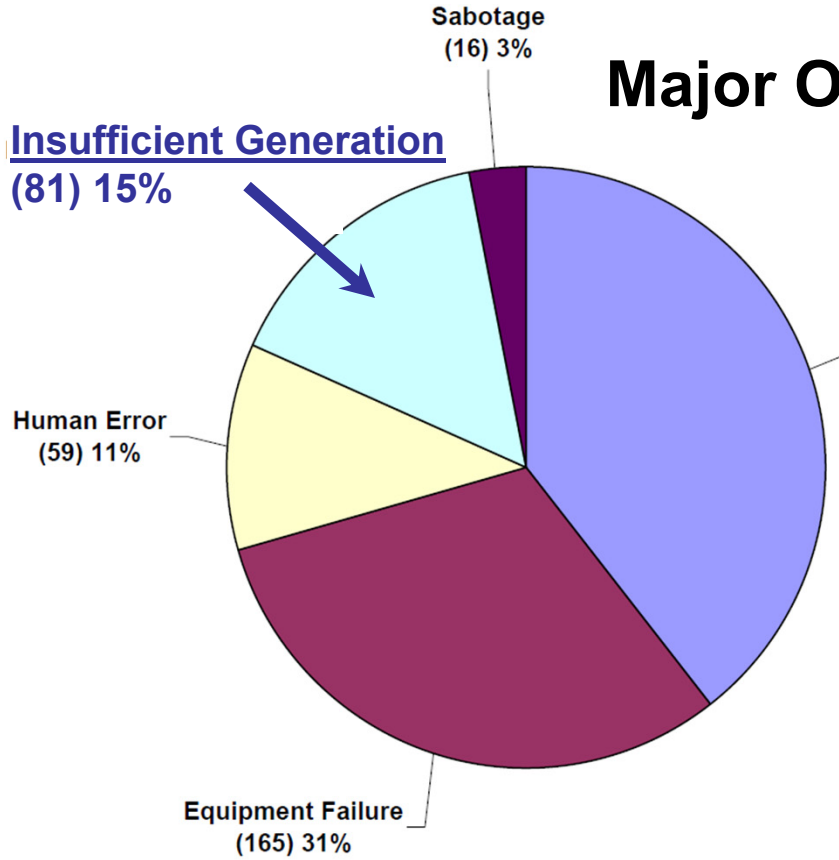
- Distribution system reliability
- Transmission system reliability
- Resource adequacy (bulk power supply vs. load)

**Estimates for U.S.-wide customer cost of power outages range from $20 billion to $150 billion per year:**

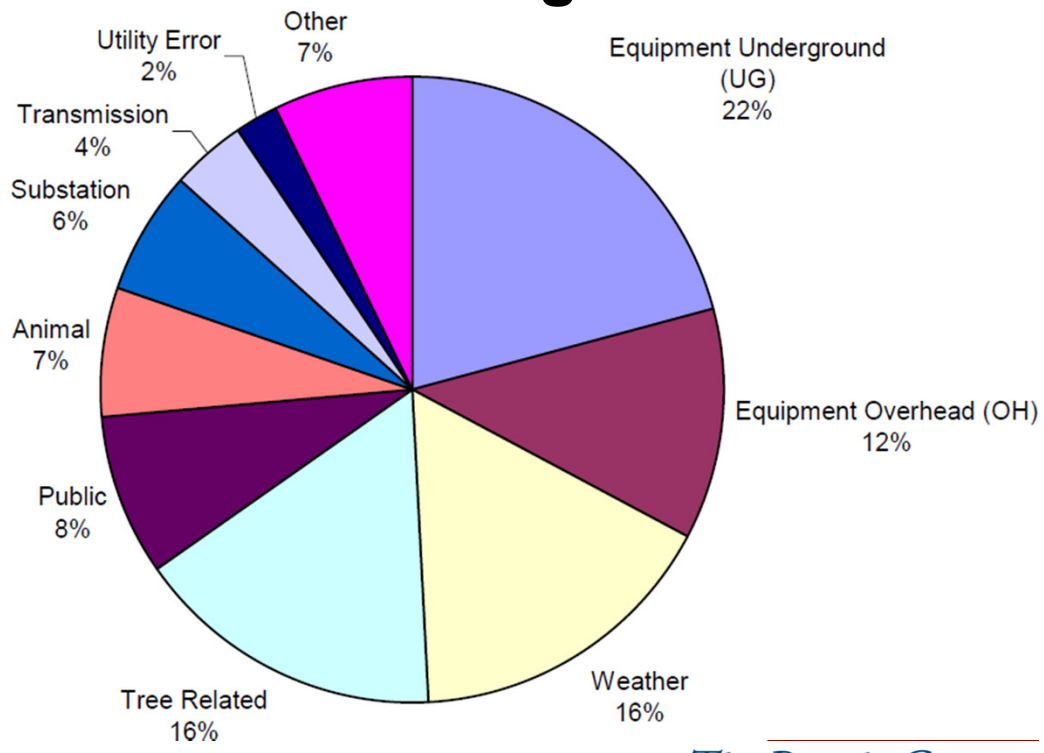
| | |
|---|---|
| ♦ EPRI (1993): | $26 billion/yr |
| ♦ Swaminathan and Sen (Sandia 1998): | $150 billion/yr |
| ♦ Primen (EPRI 2001): | $119 billion/yr |
| ♦ LaCommare and Eto (LNBL 2004): | $80 billion/yr (ranging from $22-135 billion) |

# Resource Adequacy's Share of Power Outages

## Major Outage Events




## All Retail Service Outages




Source: Lave, Apt and Morgan, *Worst Case Electricity Scenarios: The Benefits & Costs of Prevention*, CREATE Symposium, University of Southern California, August 2005.

# Why Resource Adequacy Standards?

## RAS offer several attractive benefits

- Ensure adequate supply, prevent high levels of curtailments
- Address common-good/free-ridership problem
- Reduce price volatility and investment risk premiums
- Mitigate market power in spot energy markets

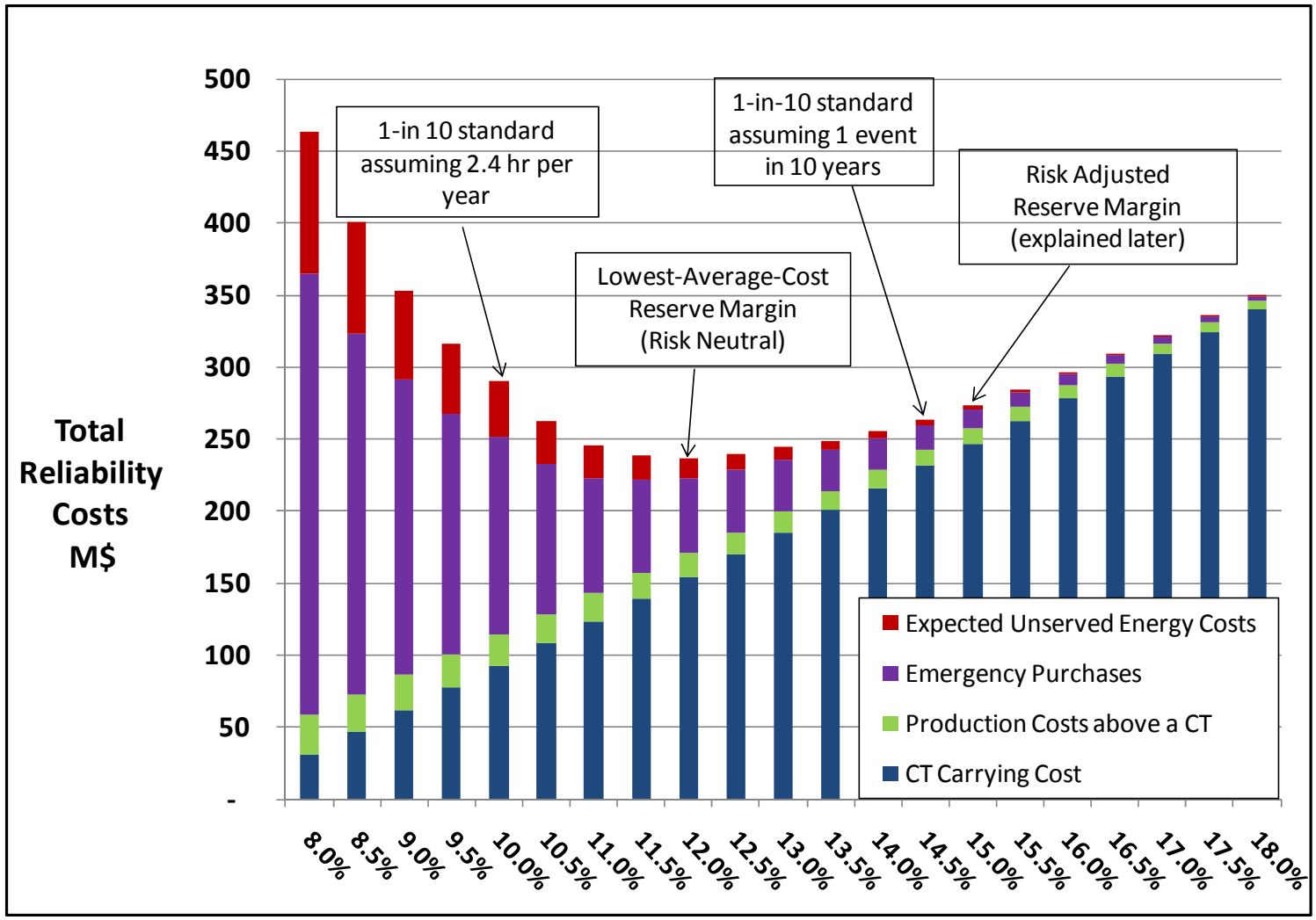
## Do RAS distort energy markets?

- Yes, but similar to requirements imposed in other markets
- Examples: environmental rules, vehicle safety standards, building codes, appliance efficiency requirements

## Will RAS be able to fully "fade away" as DR grows?

- Not likely: creating additional "non-firm" service (DR) does not eliminate the need for reliability of serving the residual "firm" load
- Only if (1) customers can choose to purchase higher reliability for their firm residual load and (2) the ISO can curtail others

# What is the "Right" Level of Resource Adequacy?




Source: Carden, Pfeifenberger and Wintermantel, *The Economics of Resource Adequacy Planning: Why Reserve Margins Are Not Just About Keeping the Lights On*, NRRI Report 11-09, April 2011.

# Resource Adequacy Constructs

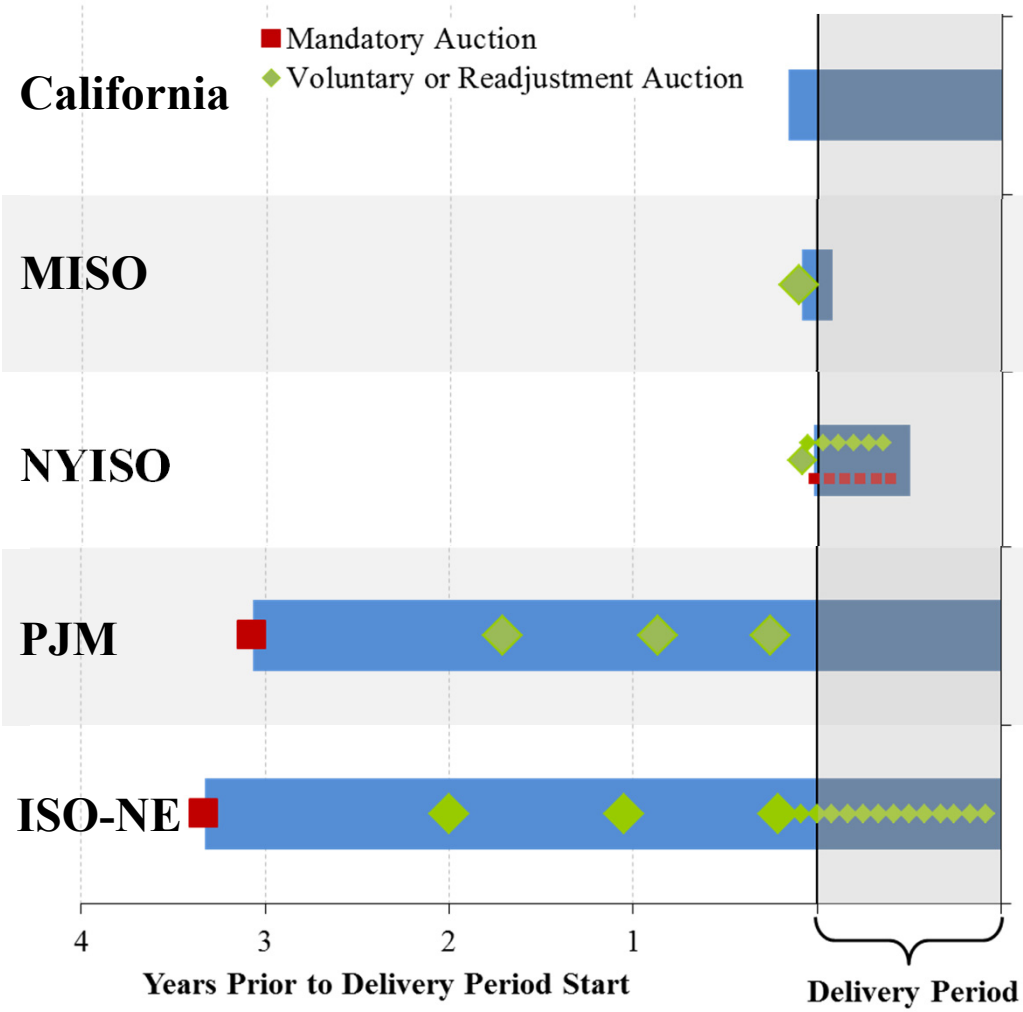
- **Administrative Mechanisms**
  - Resource adequacy achieved through administrative means
  - Examples: Regulated utility planning, administrative PPAs, administratively-determined capacity payments
  - Cost recovery through regulated approval or contract payments
  - Risk of uneconomic investment decisions borne by customers
- **Market-Based Mechanisms**
  - Utilize market forces to achieve resource adequacy
  - Examples: Energy-only markets, RA requirements for LSEs, near-term or forward capacity markets
  - Challenge: achieve revenues to attract and retain supply when/where needed for resource adequacy; discourage investments during surplus
  - Risk of uneconomic investment decisions borne by suppliers (but increases investment and financing costs)
  - Price volatility and uncertainty are a key concern

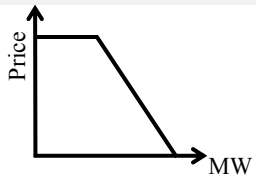
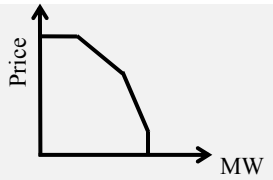
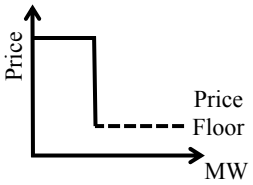
# Resource Adequacy Constructs

| | Administrative Mechanisms (Customers Bear Risk) | | Market-based Mechanisms (Suppliers Bear Risk) | | |
|---|---|---|---|---|---|
| | **Regulated Utilities** | **PPAs or Capacity Payments** | **LSE RA Requirement** | **Capacity Markets** | **Energy-Only Markets** |
| **Examples** | SPP, BC Hydro, SaskPower, most of WECC, Southeast U.S. | Ontario, Argentina, Chile, Colombia, Peru, Spain, South Korea | California, MISO | PJM, NYISO, ISO-NE, Brazil, Australia's SWIS, Italy, Russia | Texas, Alberta, Australia's NEM, NordPool, Great Britain (current) |
| **Resource Adequacy Requirement?** | Yes (Utility IRP) | Yes/No (Yes through PPAs; No if relying on capacity payments) | Yes (Creates bilateral capacity market) | Yes (Mandatory near-term or forward capacity auction) | No (RA not assured) |
| **How are Capital Costs Recovered?** | Regulated retail rate recovery | Long-term PPAs or capacity payment plus energy market | Bilateral capacity payments and energy market | Capacity and energy markets | Energy market only |

*See also:* Pfeifenberger & Spees (2009, 2010). Review of Alternative Market Designs for Resource Adequacy.

# Summary of RA and Capacity Market Constructs




| Forward Period | Procurement | Demand Curve |
|---|---|---|
| California | Bilateral Only | n/a |
| MISO | Bilateral + Voluntary Auction | n/a |
| NYISO | Bilateral + Mandatory Auction |  |
| PJM | Bilateral + Mandatory Auction |  |
| ISO-NE | Bilateral + Mandatory Auction |  |







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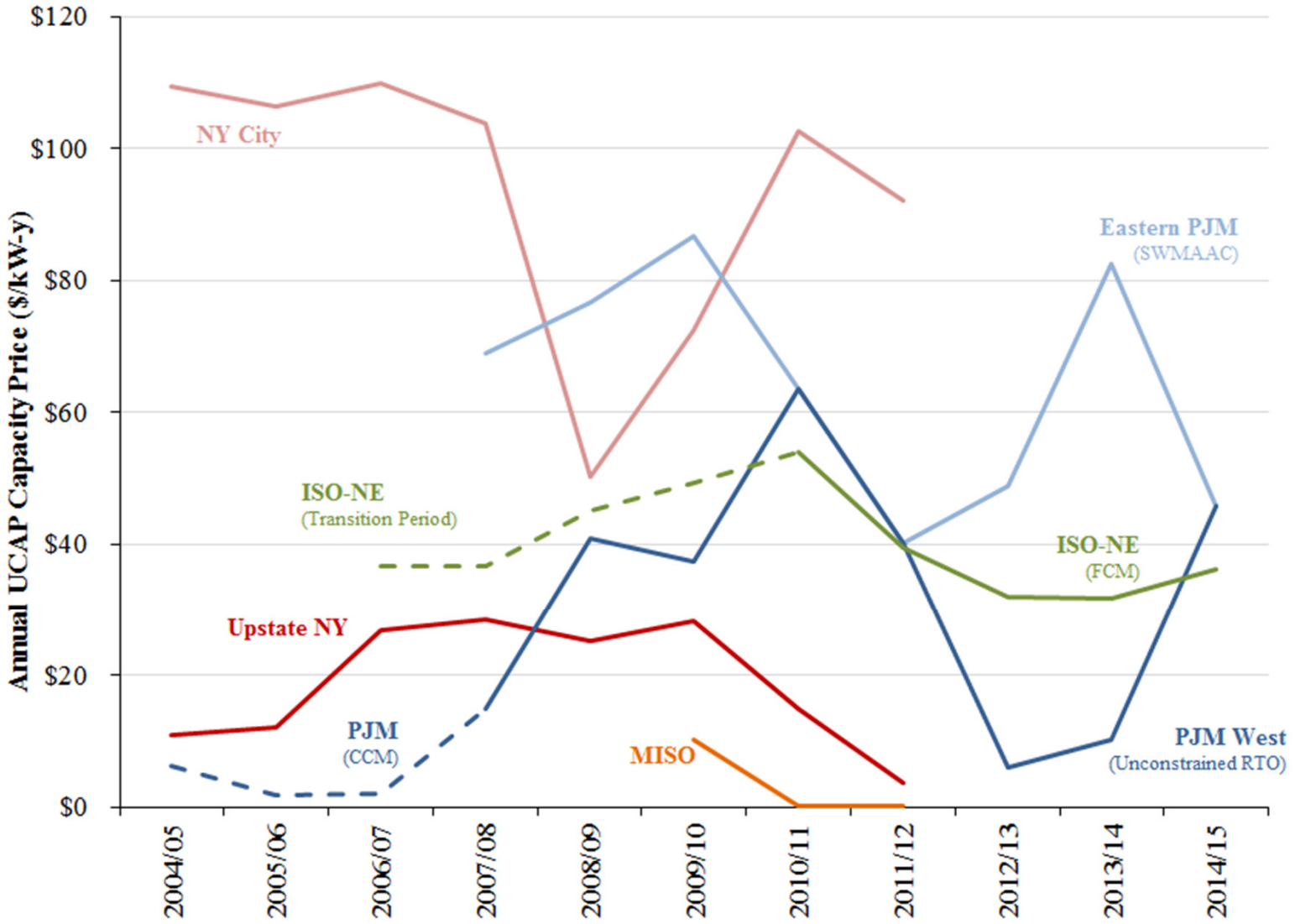
# Capacity Price Comparison Across RTOs



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# 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.

Carden, Pfeifenberger and Wintermantel, *The Economics of Resource Adequacy Planning: Why Reserve Margins Are Not Just About Keeping the Lights On*, NRRI Report 11-09, April 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, 2010.

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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- Demand Response and Energy Efficiency
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- Energy Contract Litigation
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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.***

Johannes (Hannes) Pfeifenberger is an economist with a background in power engineering and over 20 years of experience in the areas of public utility economics and finance. He has published widely, assisted clients and stakeholder groups in the formulation of business and regulatory strategy, and submitted expert testimony to the U.S. Congress, courts, state and federal regulatory agencies, and in arbitration proceedings.

Hannes has extensive experience in the economic analyses of electricity wholesale markets and transmission systems. His recent experience includes reviews of RTO capacity market and resource adequacy designs, testimony in contract disputes, and the analysis of transmission benefits, cost allocation, and rate design. He has performed market assessments, market design reviews, asset valuations, and cost-benefit studies for investor-owned utilities, independent system operators, transmission companies, regulatory agencies, public power companies, and generators across North America.

Hannes received an M.A. in Economics and Finance from Brandeis University and an M.S. in Power Engineering and Energy Economics from the University of Technology in Vienna, Austria

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