E-CONTROL

PROFITIEREN. WO IMMER SIE ENERGIE BRAUCHEN.

The Brattle Group

„Benötigen Energiemärkte Kapazitätsmechanismen? Was können wir von den Erfahrungen in den USA lernen?“

Prepared for:
E-Control

Presented by:
Jurgen Weiss
Principal, The Brattle Group

February 14, 2013

Copyright © 2012 *The Brattle Group, Inc.*

Agenda

Historical Recap

US Experiences

What can we learn from the US experience

Going Forward: Key Questions

About the presenter

- Principal, The Brattle Group
- Energy Economist with emphasis on issues motivated by climate change
- PhD Business Economics, Harvard and MBA, Columbia
- German native
- The Brattle Group is an economic consulting firm with 200 professionals in the USA and Europe.

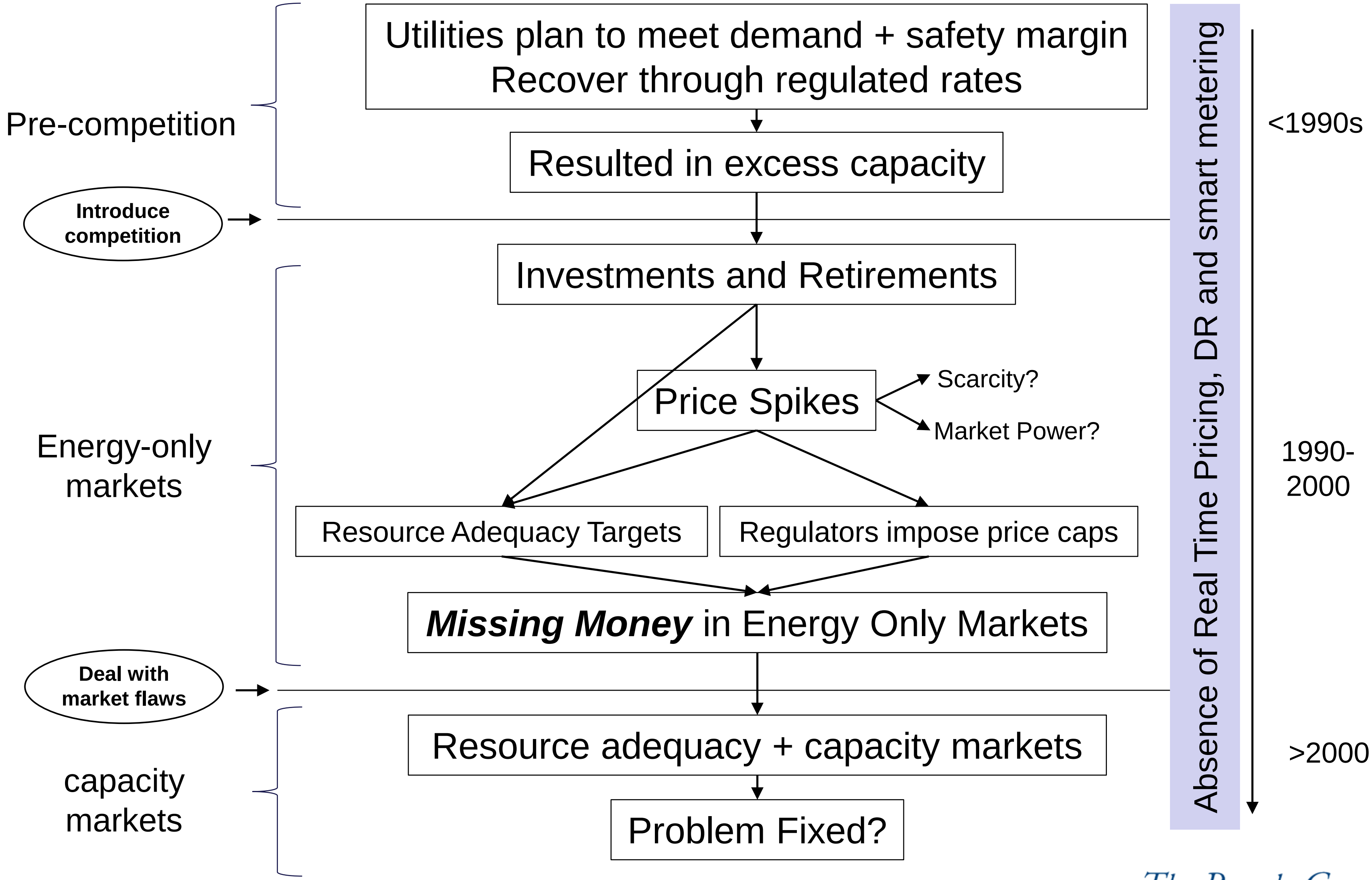
Note:

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*.

Historic Recap:

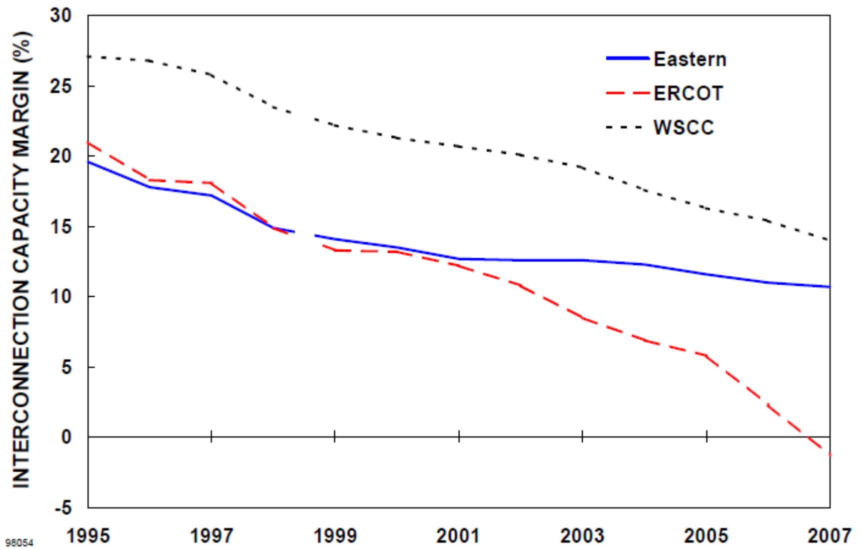
Why are we talking about capacity markets?

The evolution of the electricity sector in the United States proceeded in three phases



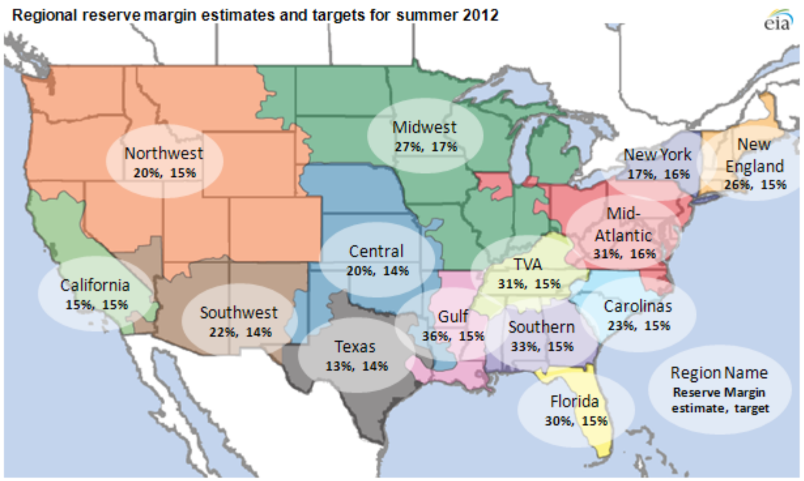
Pre-restructuring reserve margins of 20+%, fell to approx. 15% today (relatively stable)

- Reports in the late 90s showed a trend of reduced reserve margins throughout the US since the beginning of restructuring.
- Projections in that time were that ERCOT supply would not even meet demand.
- In 2000 the reported reserve margins line up with 1999's predictions.
- Over the past few years, reserve margins seem to have stabilized around 15%
- Some regions project shortfalls in the coming years (relative to targets) – but shortfalls have consistently been projected in the past



Interconnection capacity margins from 1995 through 2007

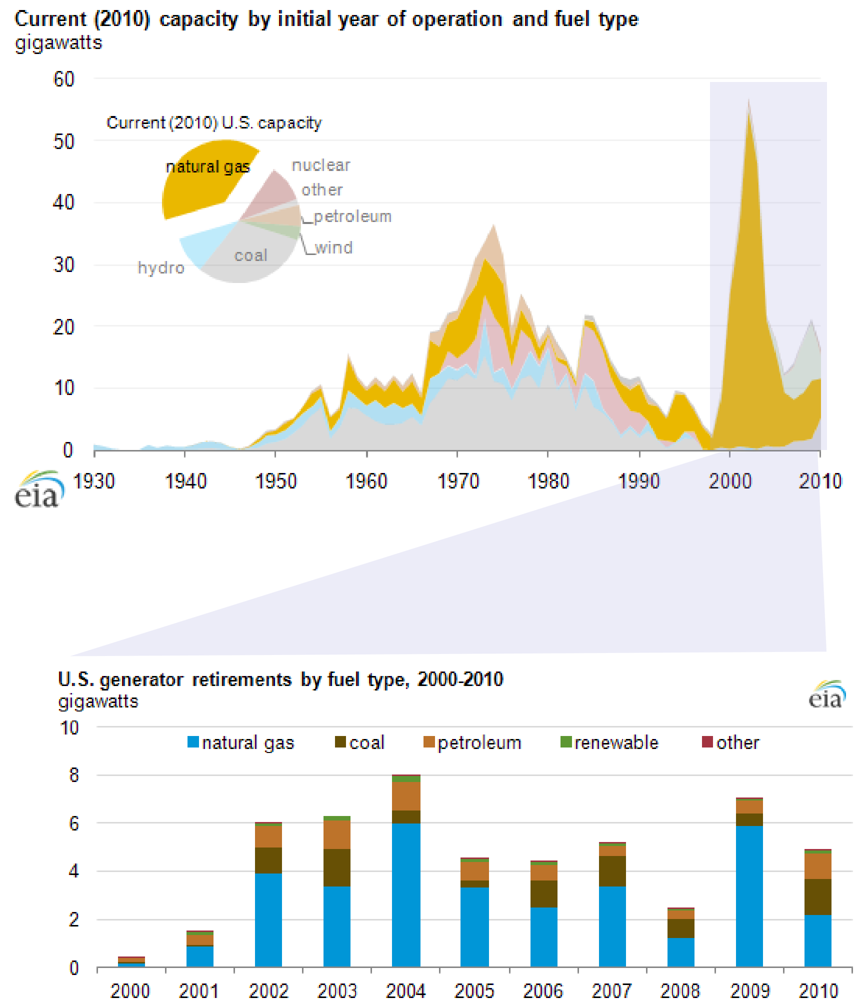
Source: Oak Ridge National Labortories (1999)



A large expansion of generation capacity occurred after restructuring.

- Most markets restructured around 1998/1999
- Very large capacity additions (almost all natural gas) in early 2000s
- Only partially offset by subsequent retirements

- Answer as to whether or not price-caps would prevent sufficient entry postponed until reserve margins come back into balance postponed…
- Existing generators may be "missing" money, but ultimate test is whether there is enough net-entry to maintain reliability targets.
- Nonetheless, several US markets have implemented capacity mechanisms.



Source: EIA.

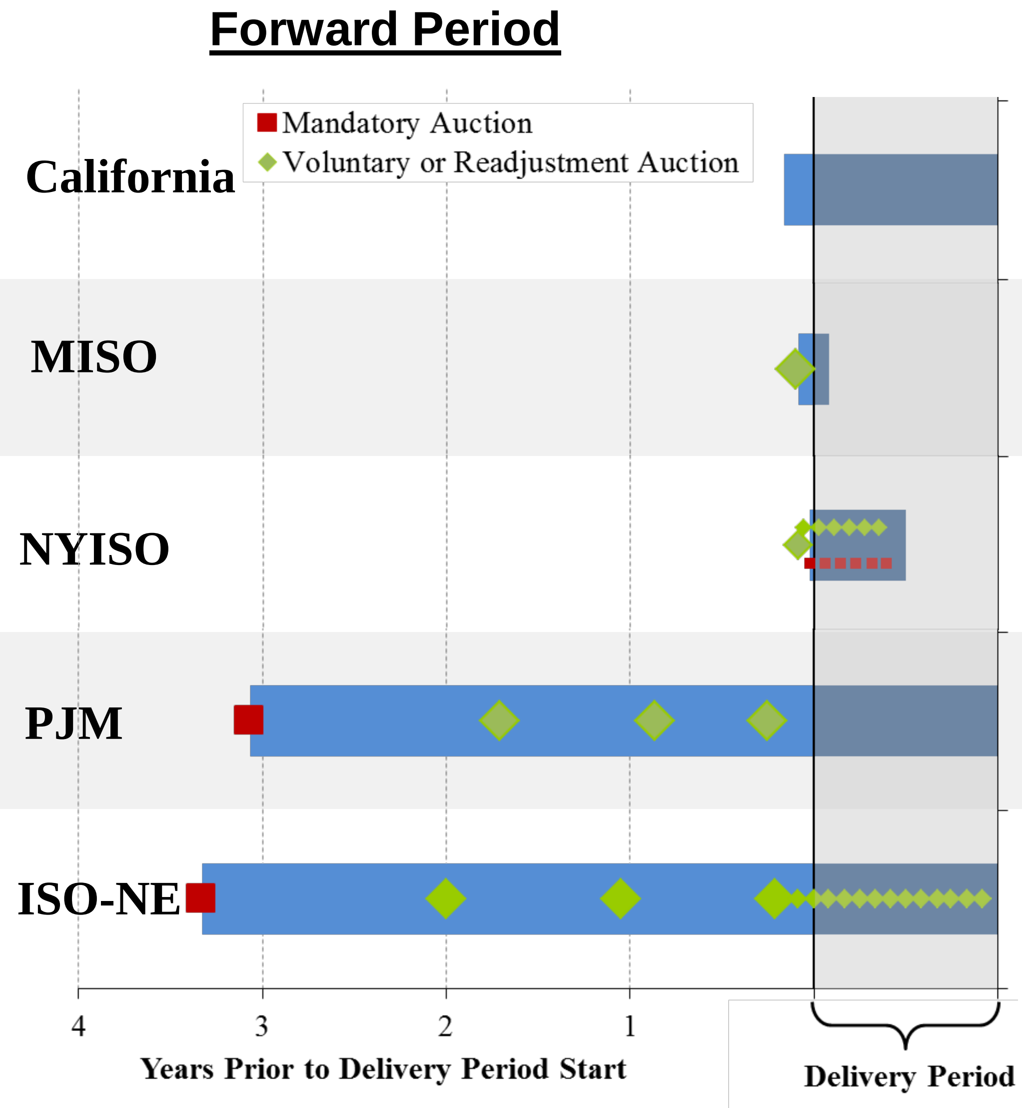
US Experience with Capacity Mechanisms

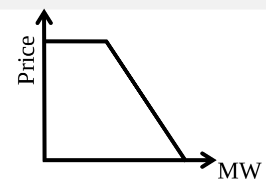
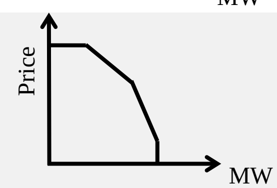
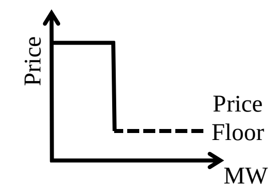
Several US markets have some form of Resource Adequacy standard

	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 US Resource Adequacy and Capacity Market Constructs



	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	

The Brattle Group

PJM – RPM

An in-depth example of a US capacity market

Objectives of PJM's Capacity Market

PJM and stakeholders developed PJM's capacity market (the "Reliability Pricing Model" or RPM) to:

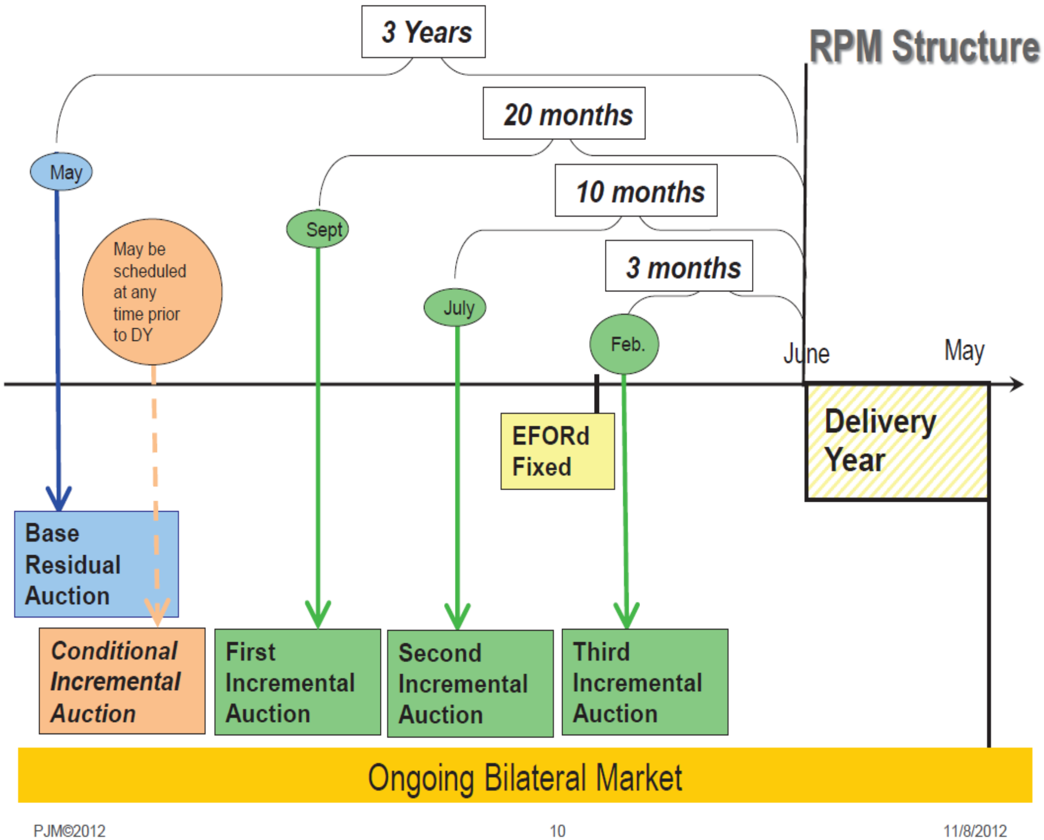
- Replace its daily "Capacity Credit Market" that failed to ensure resource adequacy, particularly in import constrained zones
- Obtain sufficient resources to meet reliability targets for PJM as a whole and import-constrained (LDAs) on a multi-year forward basis
- Improve price stability and force existing resources to compete with a potentially large supply of new resources
- Accommodate LSEs' self-supply of their capacity obligations
- Utilize a competitive auction to secure the residual capacity needs that are not satisfied through self-supply

FERC approved RPM in 2006. Since then, nine "Base Residual Auctions" (BRAs) have been conducted for the 2007/08 through 2015/16 delivery years

The Brattle Group

In PJM, formal 3-year forward capacity market (RPM) coexists with bilateral markets

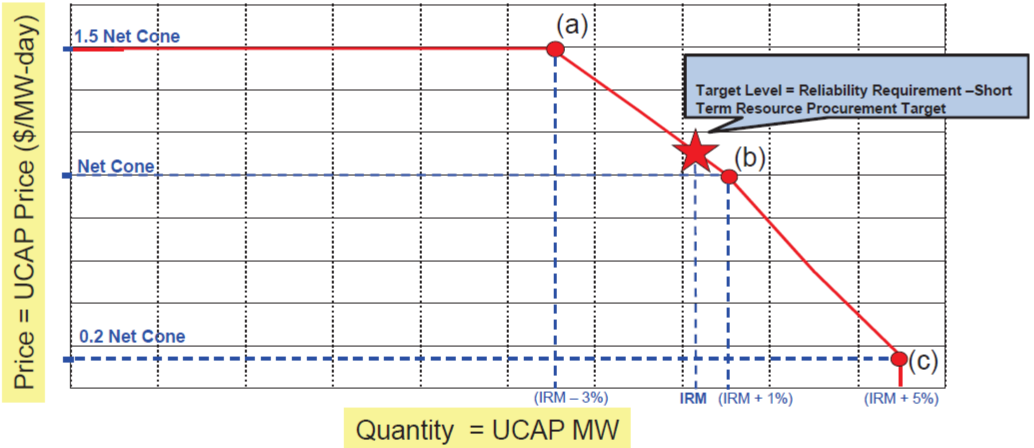
- PJM sets reliability criteria for each auction
- Currently about 15.6% (Unforced Capacity Margin above expected peak load)
- LSEs can meet this requirement through bilateral contracting or through PJM's centralized procurement
- Various incremental auctions to the extent actual conditions change relative to expectations
- All LSEs must procure, all suppliers CAN participate.
- Supplies include generation (dispatchable, renewable, DR and EE, transmission upgrades
- Planned and existing resources



Source: PJM

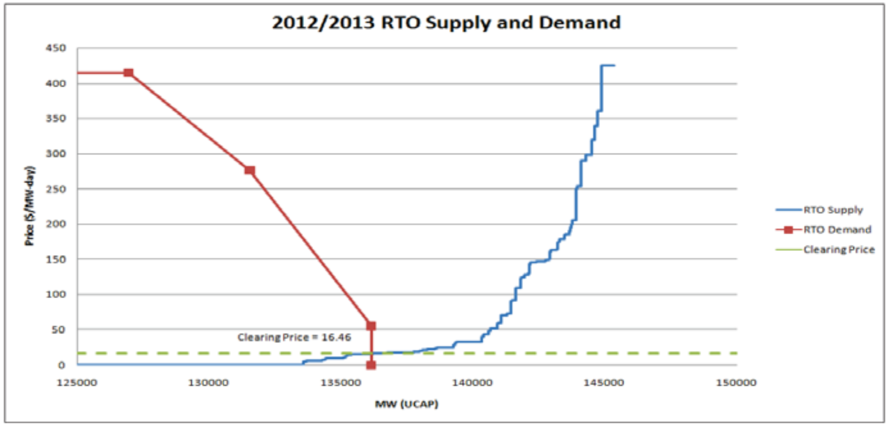
PJM's RPM uses a downward sloping, administratively determined demand curve.

- Target level in any auction is reduced somewhat relative to Reliability Requirement to allow for shorter term procurement
- Administrative Price at target level = Net Cone (**N**et **C**ost **o**f **N**ew **E**ntry)
- Downward sloping demand through target level, with prices between 0.2 and 1.5 * CONE



A VRR Curve is defined for the PJM Region.

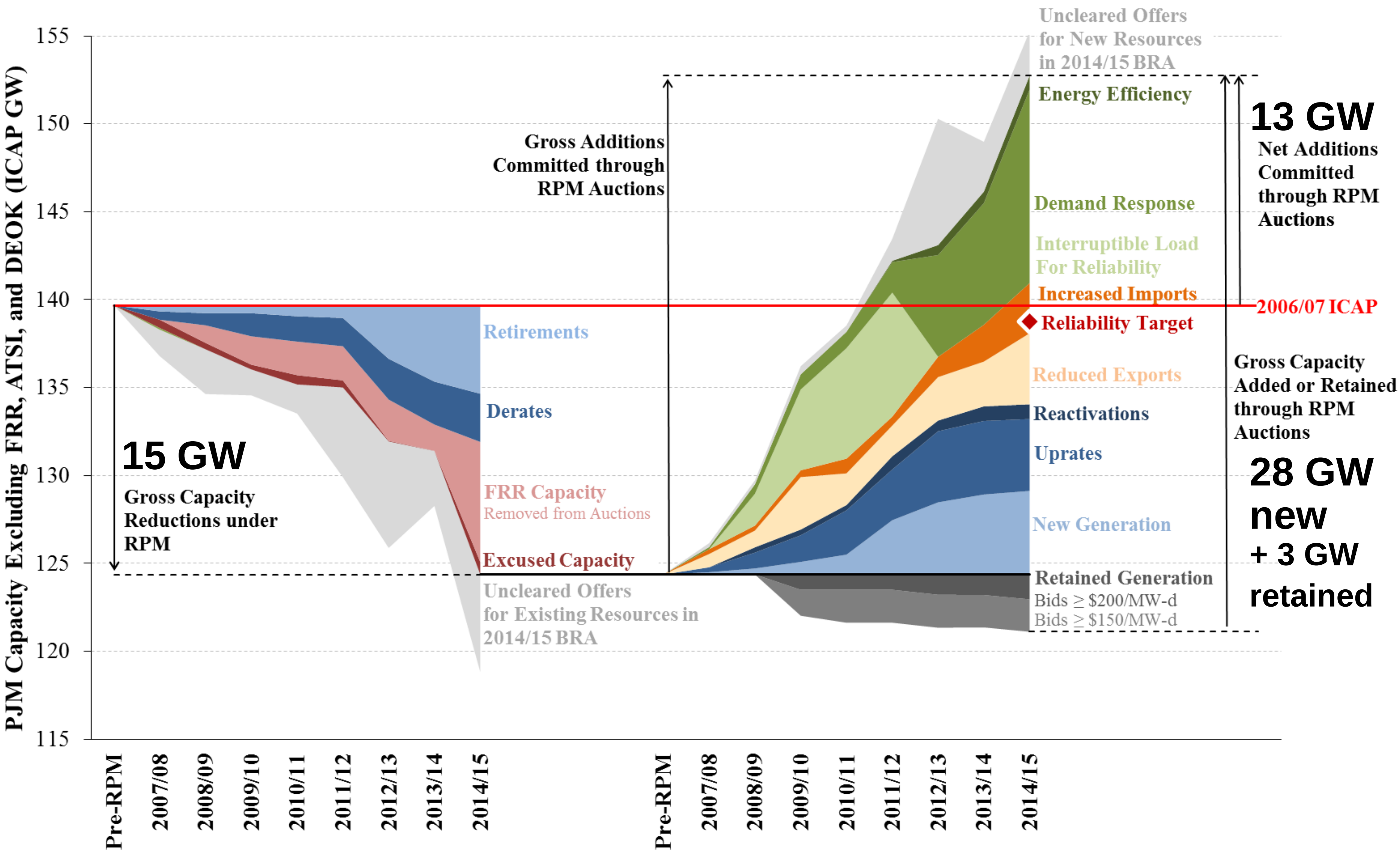
Individual VRR Curves are defined for each Constrained LDA.



Sources: PJM

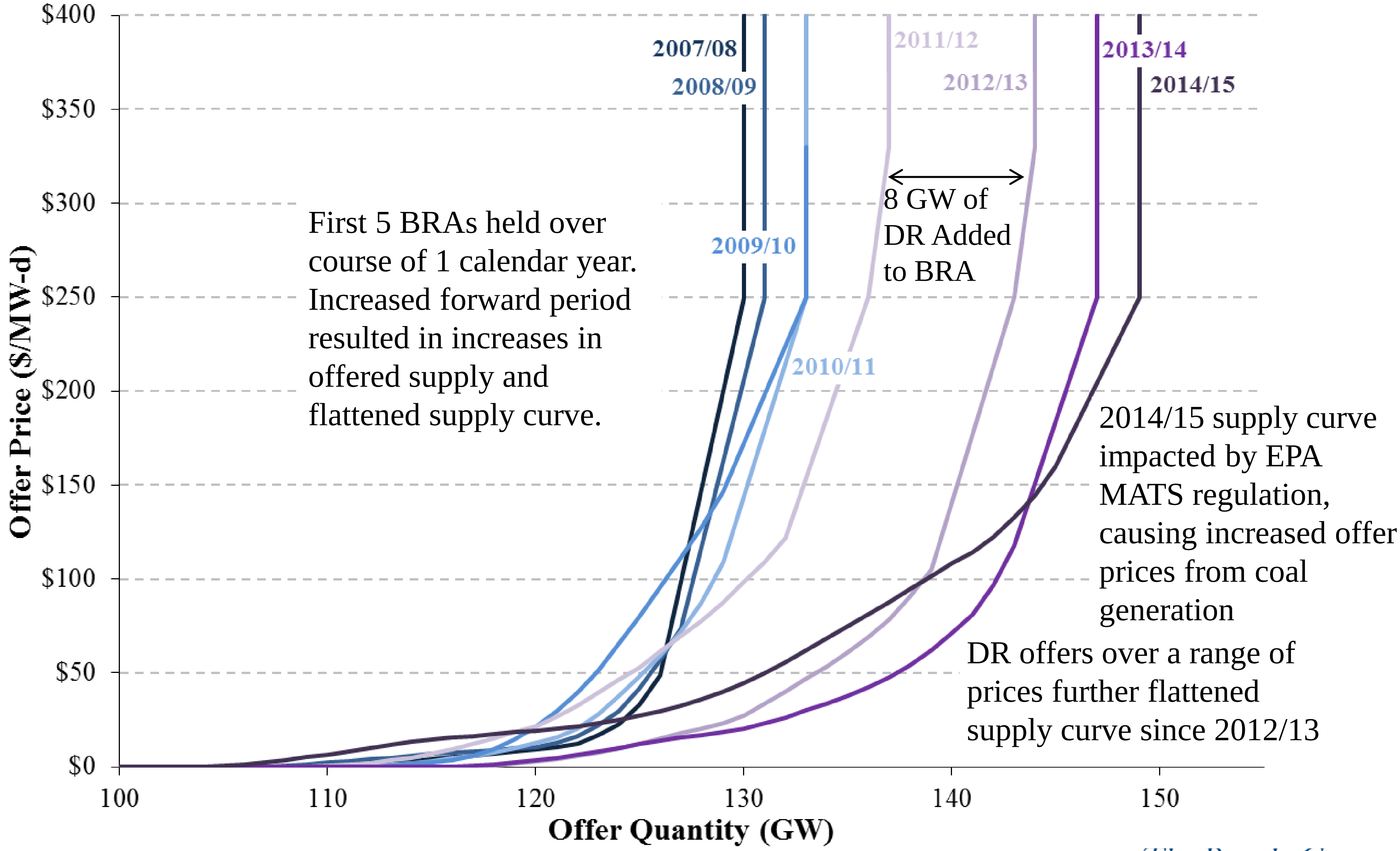
The Brattle Group

Overall, the PJM market has been successful in attracting new resources



The Brattle Group

Change to 3-year forward market and inclusion of DR have let to deeper and more elastic supply.



The Brattle Group

Many aspects of the PJM-RPM are “working”.

RPM achieved resource adequacy

- Attracted/ retained sufficient capacity to meet or exceed reliability requirements in the RTO and every LDA
- Moderate capacity deficits occurred in some LDAs in early years due to pre-RPM conditions, but no shortages anywhere in the last 4 BRAs

Prices volatile, but consistent with market conditions

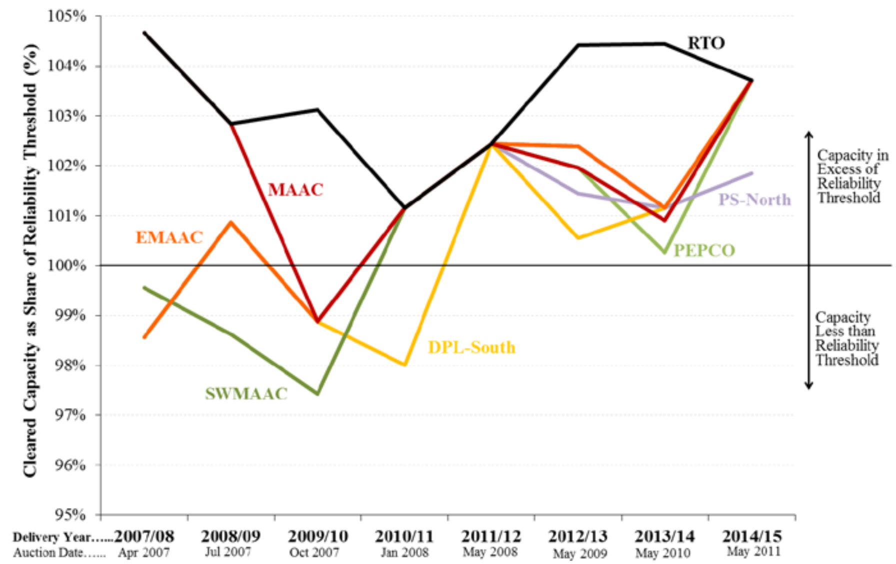
- Lower prices (below Net CONE) under excess supply conditions
- Higher prices in E-PJM due to tighter supply (but still below Net CONE)
- Price changes reflected (1) market fundamentals, (2) one-time market design changes, and (3) changes in administrative parameters

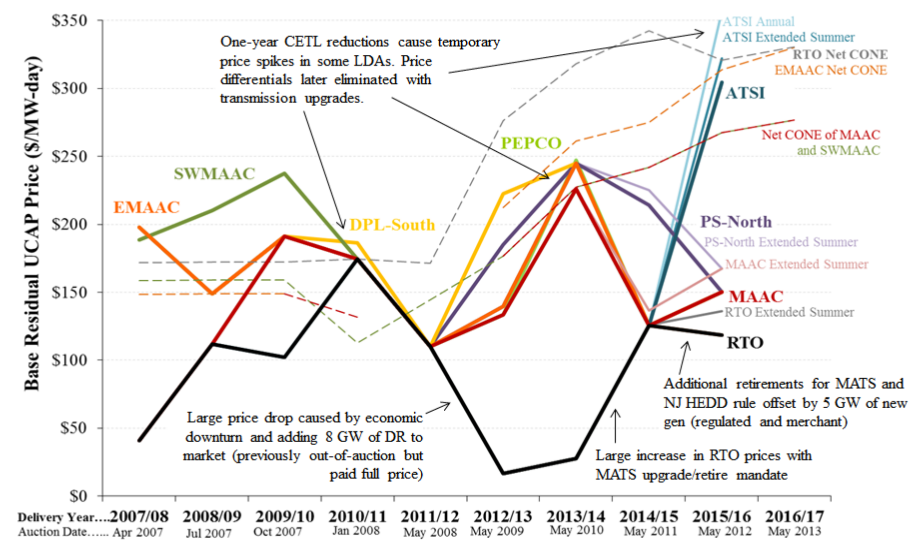
Reduced costs by fostering competition

- Attracted lower-cost supply: DR, EE, uprates, imports, deferred retirement
- Supply curves increasingly “flatter” (due to DR and forward period)

Enabled cost-effective response to environmental rules

- Cleared retrofits; uncleared coal replaced with DR commitments





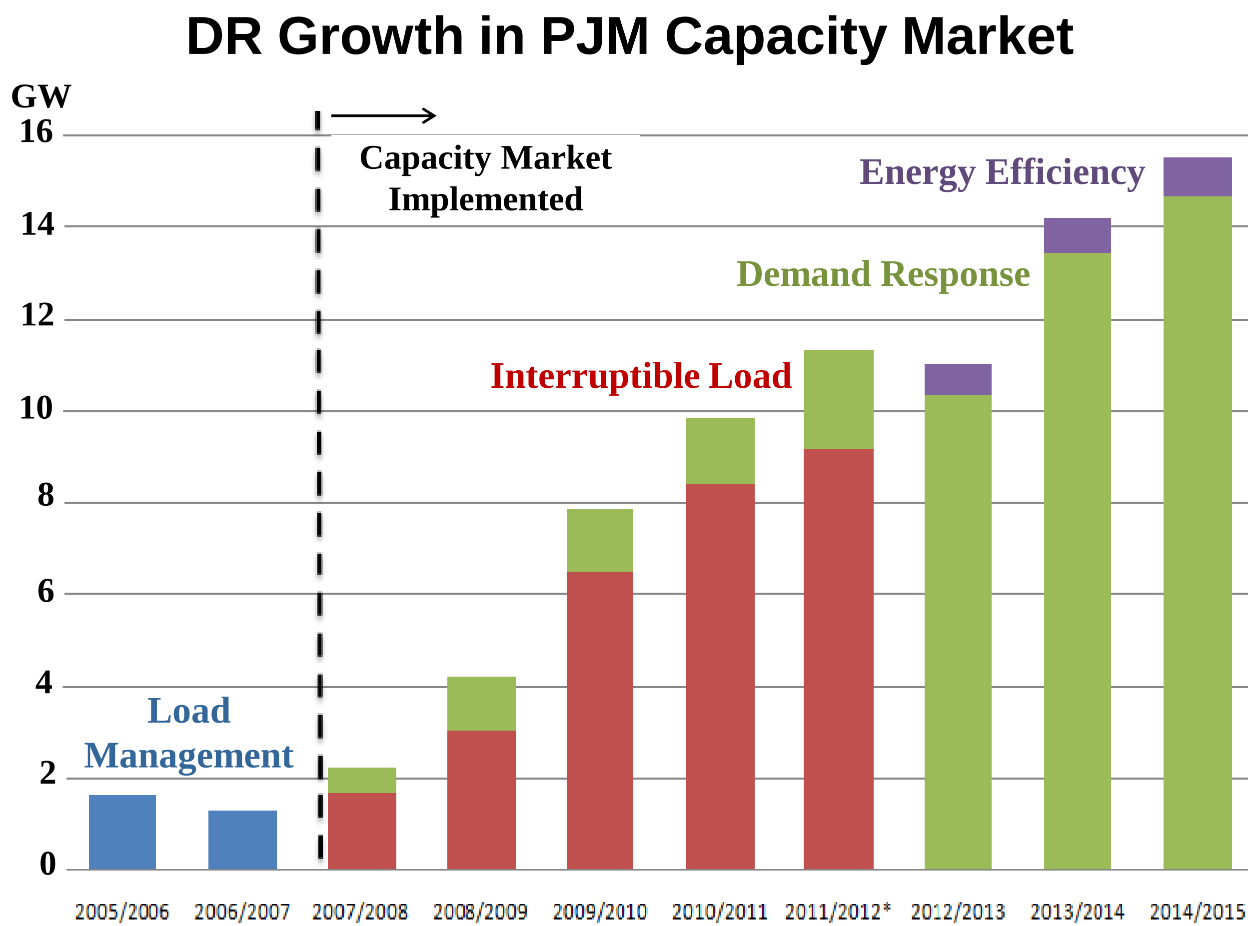
A large amount of demand response resources has participated in the market

Large DR influx is major success of capacity markets

- Major success of capacity markets is large influx of DR
- Lower-cost than new plants

Future of DR

- Reaching saturation (12-15% of peak load)
- Increasing number of DR calls will limit participation
- High DR means lower gen reserve margin and higher energy margins



As a consequence, the dependability of DR has emerged as a concern.

PJM used to treat DR interchangeably with generation even though it was not required to respond more than 10 times for no more than 6 hours at a time

- But PJM analysis showed it was approaching “saturation” where the 1-in-10 reliability target could not be maintained without calling the DR more often

Starting with the auction for 2014/15, PJM defined three products and determined minimum amounts of the higher quality ones

- Annual, Extended Summer, and Limited Summer
- To maintain reliability, at least a minimum quantity of annual and annual + extended summer must be procured
  - Higher-value products may price-separate and receive a premium
- DR suppliers can submit linked bids for multiple products
  - The asset will clear as the most profitable product

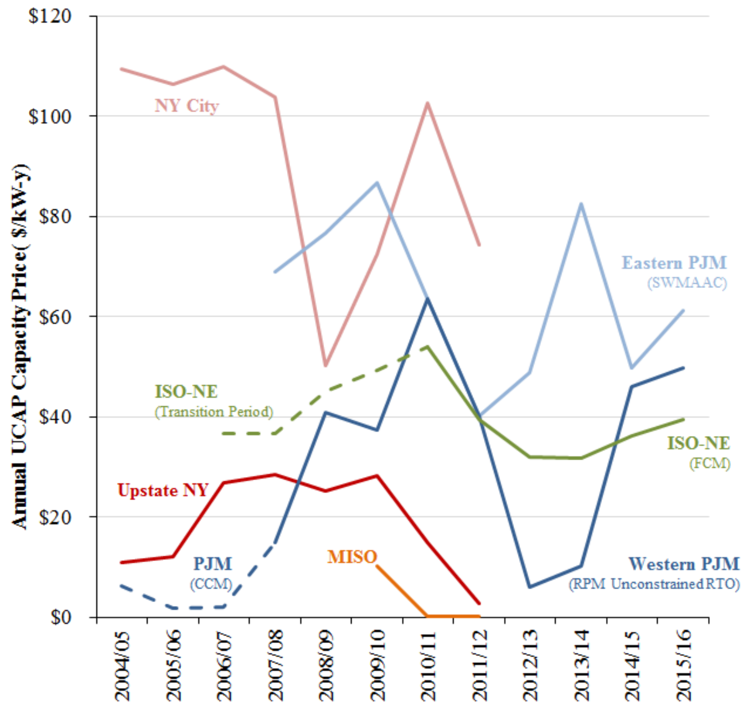
Volatility of capacity prices raises questions about overall efficiency of market mechanism.

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

Potential Causes of price uncertainty:

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

Capacity Price Comparison Across RTOs



Potential problem only if centralized market is the only revenue mechanism.

The Brattle Group

Price volatility and unpredictability issue can be mitigated through improved market design.

Does the volatility prevent investment in new generation when needed (or make this investment much more expensive than necessary)?

- So far, experience is encouraging
  - Several examples of merchant entry
  - Plenty of un-cleared capacity that could have been committed if needed
- Next, existing market "flaws" should be addressed:
  - Increase transparency and stability of administrative parameters
    - Local/zonal capacity price uncertainty driven by changing/unpredictable parameters such as import limits
      - Transmission transparency – provide longer term outlook of transmission planning.
      - Load forecasting – make process and uncertainty range more transparent.
- Also, facilitate long-term price transparency and contracting by developing **voluntary centralized auctions** for long-term capacity products
  - Centralized capacity market is not the only mechanism for revenue generation

The ultimate question is whether the mechanism attracts new investment in time to avoid serious reliability issues.

Old and dirty generating plants receive the same compensation as new generation.

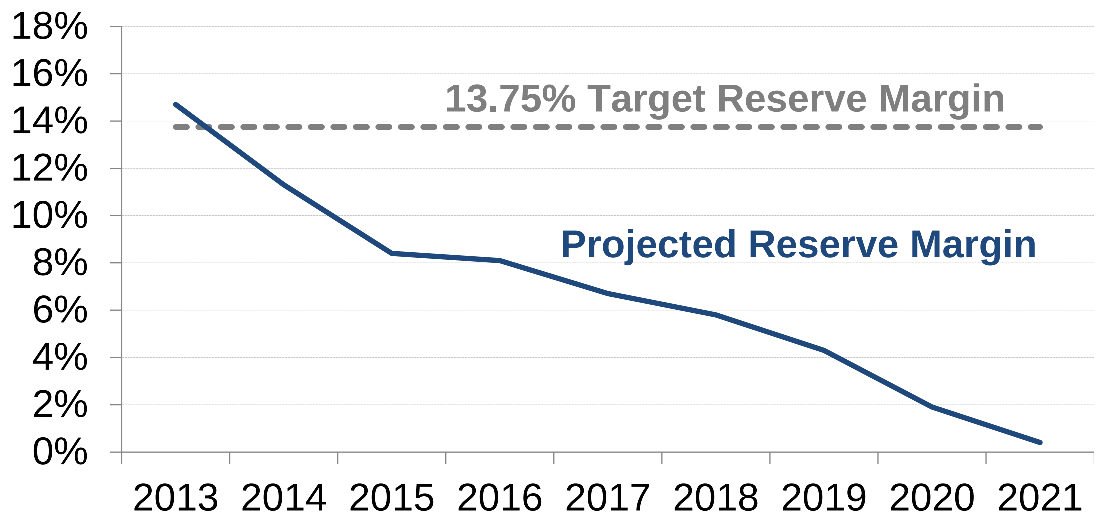
- Environmental issues
  - RPM is well-designed to internalize the fixed and variable costs of complying with environmental regulations
  - RPM should not be expected to impose tighter environmental standards than state and federal governments have currently defined
- Price discrimination
  - Restructured-market prices do not follow the trajectory of regulated markets in which cost recovery begins above the “levelized” level and declines as the plant depreciates
  - Trying to differentiate payments based on age would be inconsistent with a market approach in which all resources are sell the same capacity product
  - Ignores that keeping existing plants operational can be as or more costly as adding new plants (otherwise there would be no retirements)
  - Would lead to inefficiency and higher costs in the long-term

ERCOT - Texas

In Texas, reserve margins in the energy only market are projected to fall below target.

- Energy-only market has a 13.75% target reserve margin, but energy prices are capped at $4,500/MWh, recently increased from $3,000/MWh.
- There is little new investment in the face of high load growth
- There is no mechanism to enforce meeting the resource adequacy “target” in ERCOT
- The Texas PUC has already acted to increase administrative scarcity prices to incent investment, but will it be enough to meet the target? If not, what are the PUC’s options?

Installed Reserve Margins



Sources: 2013-2017, ERCOT September 2012 Reserve Margin Analysis; 2017-2021, May 2012 CDR

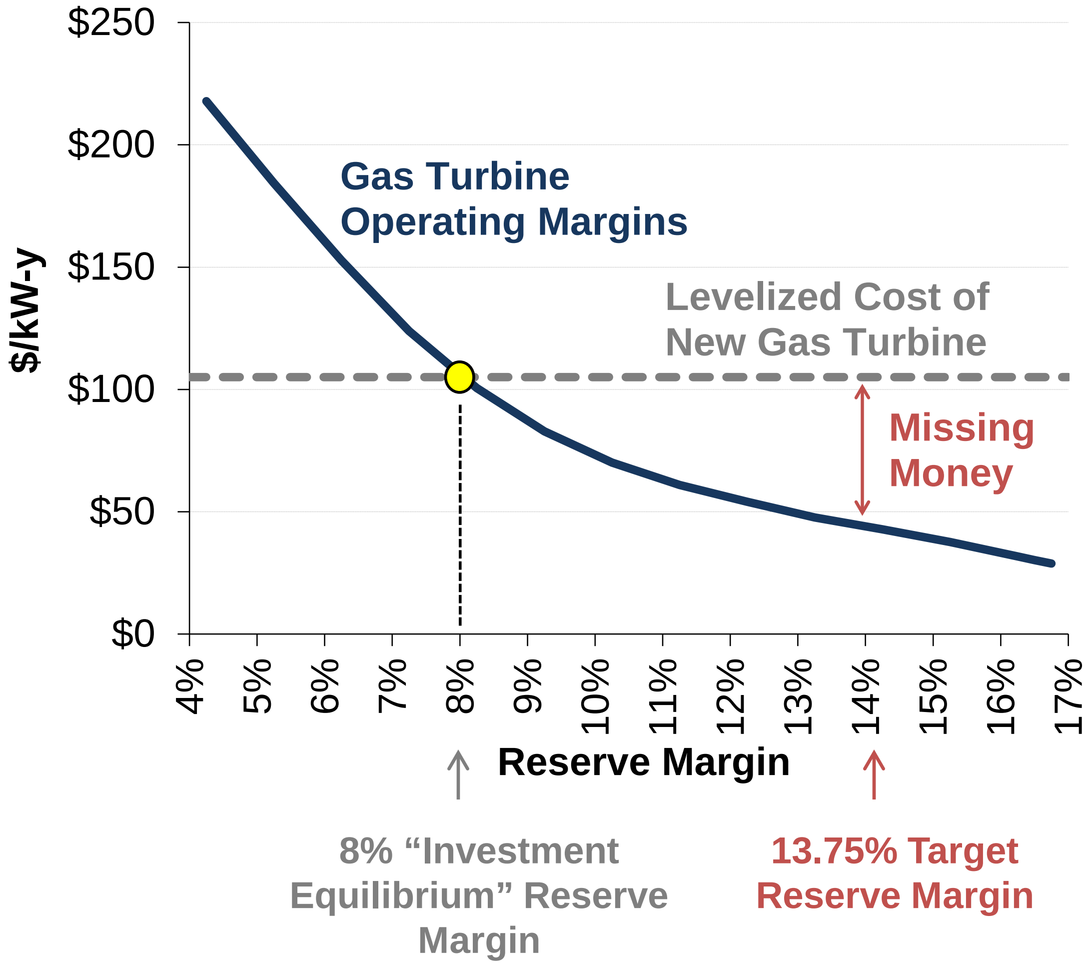
Note: ERCOT has recently indicated that they will likely revised the load forecast downward, and other changes to the CDR

The Brattle Group

In ERCOT there is "Missing Money" at the target reserve margin.

- Generators cannot earn enough with low gas prices and low market heat rates
- At high reserve margins, there is almost always more than enough supply, so scarcity-driven high prices are rare, hence "missing money"
- Reliability could improve if large amounts of DR develop (unlikely to happen quickly)

Generators Earn Less at High Reserve Margins



Note: based on a $4,500 price cap and gradual scarcity pricing

Texas is exploring how to achieve acceptable minimum reserve margin

- Energy-Only Market
  - Under current market structure and fundamentals, the reserve margin is likely to drift below 10% on average (but variable and uncertain)
  - Could be economically optimal but may dip below the minimum acceptable level
- Energy-Only with Support
  - Subsidizing reasonable-cost DR and possibly withholding generation administratively through higher operating reserves could increase achieved reserve margins by several percentage points while mostly maintaining the current market design
  - But much higher min. reserve margin goals would stretch the viability of this approach, as economic inefficiencies and/or regulatory instability increase, and meeting reliability goals becomes less certain, as described in our October 25 workshop presentation (which assumed the current target was the min. acceptable)
- A "Texas Capacity Market"
  - Adding a resource adequacy requirement facilitated by a centralized forward capacity market could achieve high minimum reserve margins more dependably than other approaches while pitting all resources to compete to meet the need at least cost
  - But taking on the implementation complexity, administrative intensity, and contentiousness of this approach may be unnecessary if the minimum acceptable reserve margin is lower

California

California: Evolving Resource Adequacy Challenges

Resource adequacy in CA

- Assuring sufficient supply for system and local reliability needs has been a policy priority since the Western power crisis of 2000-01
- California's current RA framework relies primarily on regulated planning and partly on market-based mechanisms
- Current mechanisms are disconnected, resulting in a number of inefficiencies not anticipated at the time they were implemented

New Challenges since RA design was last evaluated

- Once through cooling mandate will require approximately 16,000 MW of existing generation to retire or reinvest over the coming decade
- 33% renewables standard by 2020 will introduce a need for additional flexible resources that can compensate for intermittent resources
  - This is the closest a US market comes to the perceived EU challenges
- Low natural gas and declining market heat rates prices reduce margins

California uses a mix of approaches to meet Resource Adequacy targets.

Long-Term Procurement Plans (LTPP)

- Utilities develop LTPPs for customers' energy, capacity, and ancillary service needs
- System-needs portion of LTPP determines whether and when a utility will procure new generation under long-term contracts 3-7 years out
- However, utility procurements only consider new generation even though lower-cost alternatives may be available

Resource Adequacy Requirements (RAR)

- On an annual and monthly basis, all LSEs must demonstrate that they have contracted for sufficient capacity to meet customers' needs
- Total system requirement is peak load plus 15%, local requirement in load pockets depends on local import capability
- Creates a bilateral market for capacity prior to the annual and monthly compliance deadlines

California uses a mix of approaches to meet Resource Adequacy targets. (continued)

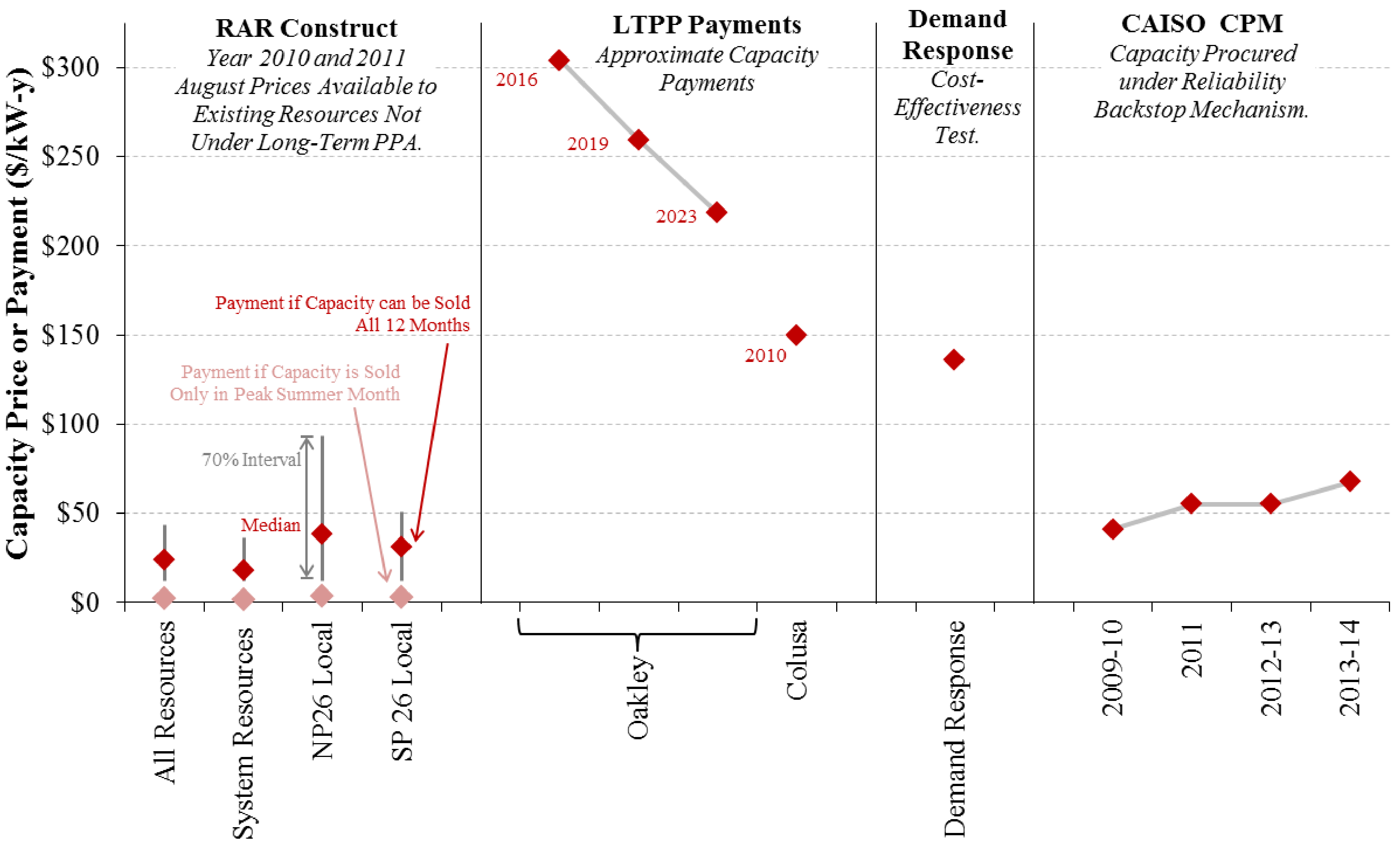
Demand Response Programs

- LSE’s are engaged in many efforts to implement DR.
- Costs of implementing DR are recoverable through rates if they meet cost-effectiveness thresholds.
- CPUC has issued protocols for assessing cost-effectiveness, but these are not coordinated with LTPP and RAR

Capacity Procurement mechanism (CPM)

- CPM enables the ISO to acquire generation capacity to (1) maintain grid reliability if load serving entities fail to meet resource adequacy requirements; (2) procured resource adequacy resources are insufficient or (3) unexpected conditions, i.e., "Significant Events“
- Compensation based on going-forward costs
- Only for existing generators
- Used rarely and only for short periods of time

There are important price discrepancies among capacity resources procured through these programs

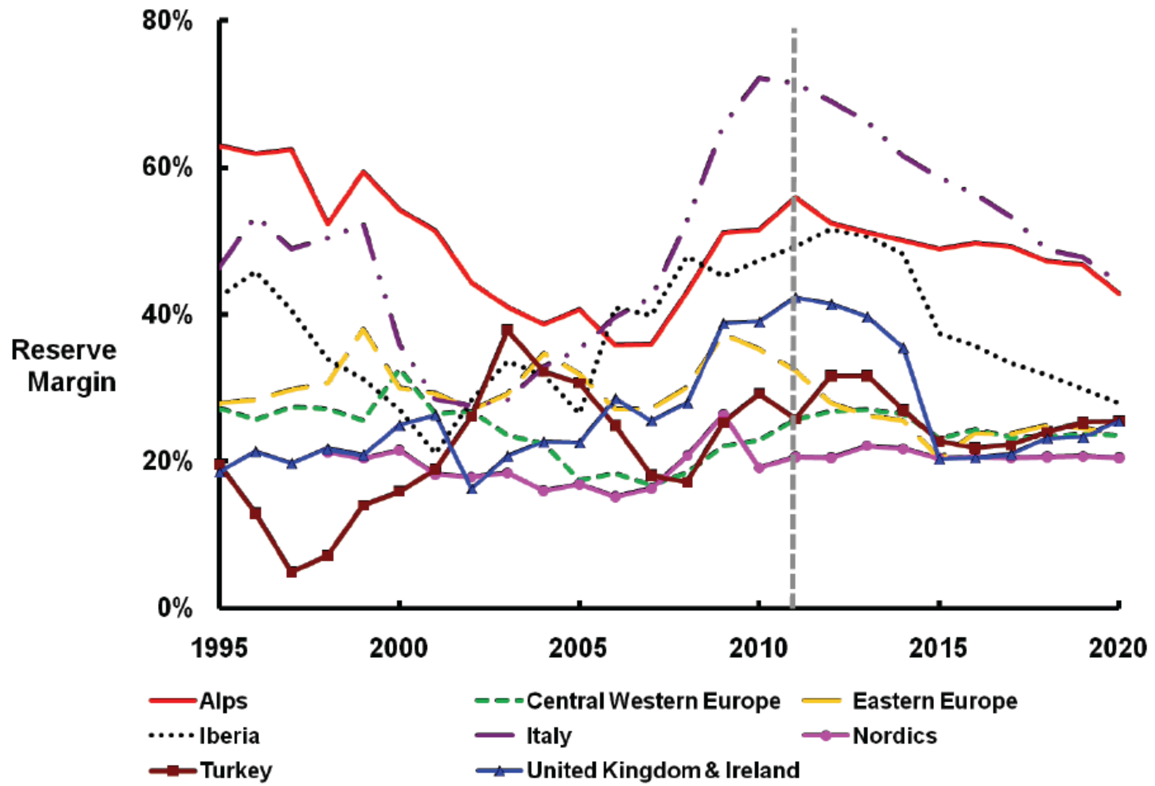


The Brattle Group

Putting the US Experience into the European Context

In general, European reserve margins seem to be stabilizing at 20%

- Historically European capacity reserve margins varied wildly, but were quite high.
- Current projections see convergence at reserves between 20-30%
- These reserves are still much higher than target US reserves.



Source: IHS CERA.
Reserve Margin = (Effective installed capacity – peak demand)/peak demand.

General perception that energy-only market has worked well, at least until the advent of RE.

- Very few concerns about lack of resources
- Quick penetration of renewable energy is squeezing the margins of existing generation
  - Question of how much retirement will result.
- Quick penetration of renewables also leads to demand for new flexible generation resources
  - Question of whether energy-only market provides sufficient incentives.
    - In light of decreasing average EEX prices
    - In light of collapsing on-peak prices, primarily due to PV
- The whole discussion has received more urgency as a result of the phase-out of German nuclear capacity after Fukushima.

Several countries are implementing capacity mechanisms or thinking about it.

- Active discussion of whether or not Germany needs a formal capacity market or a “strategic reserve”
  - Basic issues
    - Is the missing money problem permanent or temporary?
    - Should resource adequacy be looked at nationally or at the EU level?
    - How likely is it that a capacity market can be designed so it works properly?

- Italy is in the process of implementing a capacity mechanism, as is the UK
- France is thinking about one.

US experience only relevant to Europe to some extent.

- With the exception of CA, capacity markets in the US have not been driven by the same issues that drive EU debate
  - Reduced margins for existing generators due to increasing feed-in from RE through FITs
  - Collapsing on-peak prices and hence disappearing price spikes due to more PV
  - Complex “seams” issues related to market differences across national boundaries.
- CA is more motivated by similar concerns, but remains mostly a “regulated” market and hence many of the approaches are driven by that model
  - Rate recovery of new generation units and DR efforts.

Key Lessons/Questions from US for EU going forward

Are energy markets working well enough so that the energy-only market approach can work?

- In the US, price caps lead to missing money problem – is there a similar problem with EEX and related price caps in Europe?
  - Texas is increasing price caps to see whether this helps while exploring capacity markets
- The energy-only approach assumes some form of "complete markets", i.e. parties can hedge their risk as desired.
  - There is probably some hedging by private parties that is possible (bilateral contracts)
  - But private parties may not hedge against systematic risks
  - Also markets are certainly incomplete or at least very thin with respect to some risks
    - Longer term secondary markets for many products either thin or non-existent. (ancillary services markets, emissions, etc.)

If they don't work well, can they be improved before moving towards capacity markets?

- There are some things that should be done anyway
  - Perhaps rethink levels of price caps.
  - Aggressively pursue leveling the playing field for demand response
  - Create functioning markets for ancillary services where none exist today (or where the wrong ones exist)
  - Finish harmonization of rules and markets across the EU
- Is this a temporary or permanent problem?
  - Phase out of German nuclear plants may be a unique situation
    - Can this period be "survived" without fundamental changes?
  - Common market for electricity should help alleviate some of the resource adequacy concerns
    - Will remove current barriers to efficient transnational trade
    - Local reliability issues will likely emerge
  - Smart metering infrastructure DR, batteries and other technological innovation begins to tilt the demand curve – timing?

Creating capacity markets before EU-wide harmonization is in place might create bad incentives

- National capacity markets with EU free trade rules may create strange incentives
  - Build in one country to get capacity revenues, sell power into another.
- If the need is quicker than EU harmonization, is there a EU-wide mechanism that might work but respects somewhat different national regulatory frameworks?
  - Could you develop a system of tradable capacity rights, which respect the differences across borders (and take account of congestion issues?)
- Would national strategic reserves not create at least some similar problems?
  - How would one country procure resources for SR without discrimination?

It is tempting to provide enough revenue certainty in the long run to attract new generators to meet reliability targets

- But committing now (sinking investment) is foregoing the benefit of new information between now and the future
  - We don't know what demand will be in 20 years
  - We don't know what the cost of generation will be in 20 years
    - Or even what technologies exist
  - We don't know how flexible the demand side will be
- It is probably unwise to commit to solving the entire problem of reliability far in advance
  - Sensible to commit to some portion of supply far out
  - But allow for some shorter term responses as well
    - Evidence in the US shows that there is a lot of shorter term supply available
      - DR does not take a long time to "build"
      - Delayed retirement, changes to existing units, also are shorter term decisions

Thank you!

Jurgen Weiss

Jurgen.weiss@brattle.com

www.brattle.com

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
- Fuel and Power Procurement
- Incentive Regulation
- Rate Design and Cost Allocation
- Regulatory Strategy and Litigation Support
- Renewables
- Resource Planning
- Retail Access and Restructuring
- Risk Management
- Market-Based Rates
- Market Design and Competitive Analysis
- Mergers and Acquisitions
- Transmission


E-CONTROL
PROFITIEREN. WO IMMER SIE ENERGIE BRAUCHEN.