



Resource Adequacy in Wholesale Electricity Markets: Principles and Lessons Learned

Presented to:

Federal Energy Regulatory Commission
Technical Conference

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September 25, 2013



Introduction

- Market-based investment in wholesale electricity markets is ultimately facilitated by the markets economic signals, including:
 - ✓ Energy and ancillary service net revenues during non-shortages;
 - ✓ Energy and ancillary service net revenues during shortages; and
 - ✓ Capacity market net revenues;
- Long-run equilibrium is achieved when the combination of these expected revenues cover entry costs of the marginal resource.
- While theoretically sufficient, energy-only markets will generally not satisfy RTOs' planning reserve needs.
 - ✓ In other words, there is “missing money”.
 - ✓ Capacity markets exist primarily to provide the missing money.
 - ✓ The only alternative to a capacity market is to artificially inflate shortage pricing, which raises a variety of concerns.



Why is There Missing Money in Electricity Markets?

Missing money exists for three reasons:

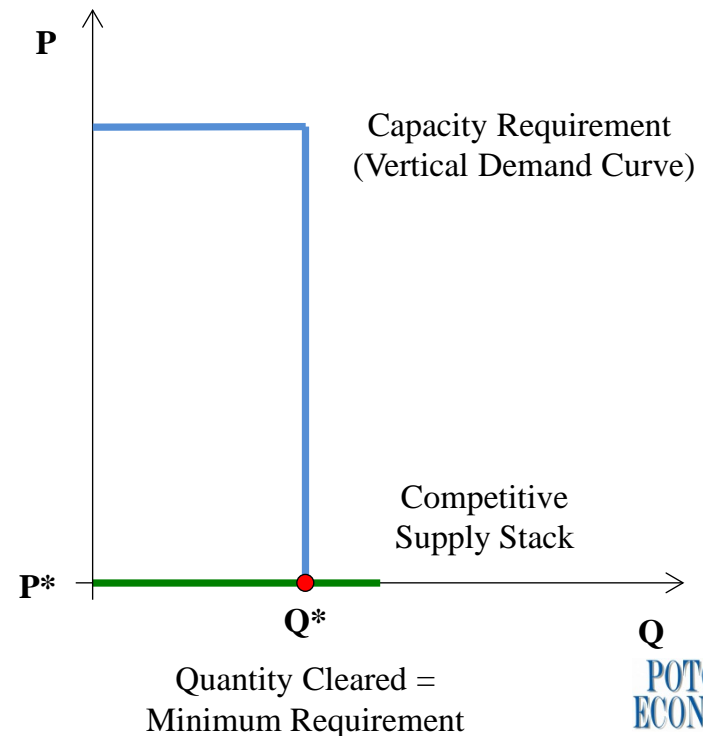
- Planning reserve requirements exceed levels that an energy-only market would provide, assuming the energy market prices shortages efficiently.
 - ✓ Therefore, additional revenues are needed to prompt the higher level of investment needed to satisfy these targets.
- The higher planning margins result in more supply, which reduces the frequency of shortages (and associated shortage revenues).
- Real-time prices may not always fully reflect the value of energy because of the effects of the ISO's reliability actions:
 - ✓ Committing peaking resources or other generating resources;
 - ✓ Curtailing load; and
 - ✓ Curtailing exports;

Necessary Attributes of Efficient Capacity Markets

Market Attribute	New York ISO	ISO New England	PJM
Essential Attributes			
Sloped Demand Curve	✓		✓
Locational Market Structure	1/2 ✓	✓	✓
Supply-side and Demand-Side Mitigation	1/2 ✓	1/2 ✓	1/2 ✓
Optional/Undetermined Attribute			
Forward Procurement		✓	✓

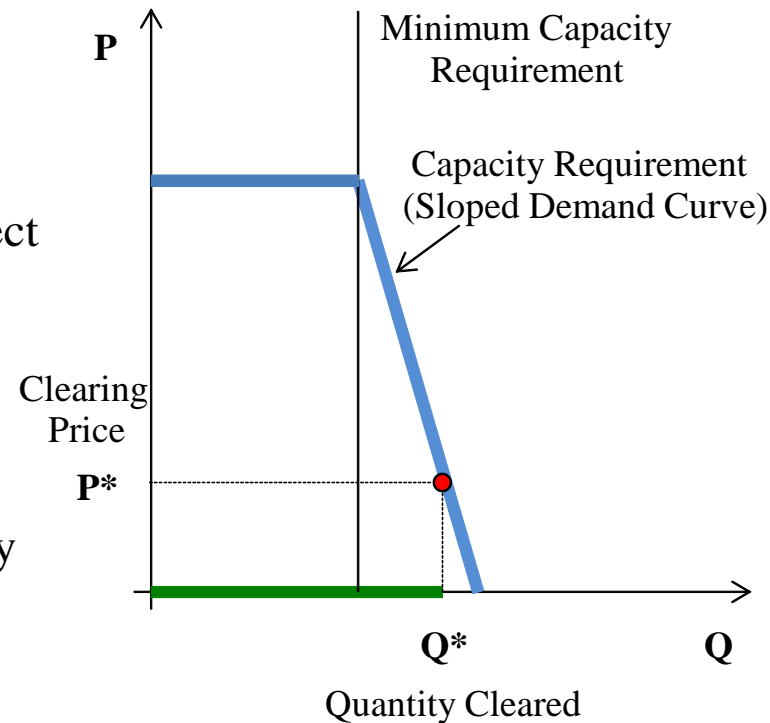
Essential Attribute #1: Capacity Demand Curve

- Demand for Capacity. Based on the reliability value provided by the capacity.
 - ✓ Vertical demand curve indicates that the last MW needed to meet the capacity requirement has extreme value and the first MW of surplus has no value.
 - ✓ In reality, each MW of surplus capacity increases reliability, although these reliability increases diminish as the surplus grows.
- Supply of Capacity. The competitive offer for capacity (i.e., the marginal cost of selling capacity) is generally close to zero because the costs of satisfying the capacity obligations are usually very low.
- **These characteristics cause:**
 - ✓ Clearing prices to almost always be close to zero.
 - ✓ Investment signals only from shortages that are unpredictable and unstable.



Essential Attribute #1: Capacity Demand Curve

- A sloped demand curve reflects that additional capacity above the minimum does have reliability value (which decreases as the excess increases).
 - ✓ The price (P^*) would be determined by the marginal value of additional capacity as represented by the sloped demand curve, rather than by a supply offer.
- A sloped demand curve:
 - ✓ Provides more efficient prices that reflect the prevailing surplus.
 - ✓ Improves price stability, which should facilitate investment by reducing price risk.
 - ✓ Reduces incentives to withhold capacity by raising the opportunity costs of withholding (foregone revenues) and decreasing its price effects.





Other Essential Attributes

- Essential Attribute #2: Locational Requirements and Zones
 - ✓ Transmission constraints cause RTOs' planning needs to vary locationally.
 - ✓ In order to efficiently facilitate investment (and retirement) decisions, these local needs must be accurately reflected in the capacity market such that:
 - Prices will dynamically adjust based on the supply and demand that exists in local areas.
- Essential Attribute #3: Market Power Mitigation Measures (particularly in local zones)
 - ✓ Supply-side: to prevent withholding of capacity that would increase prices.
 - ✓ Buyer-side: to prevent subsidized uneconomic investment to lower prices.



Optional Attribute: Forward Procurement

- Capacity markets vary regarding when capacity must be procured:
 - ✓ NYISO (and MISO): Shortly before the operating year or month.
 - ✓ New England and PJM: Roughly 3 years in advance.
- Primary role for the capacity markets, regardless of the procurement timeframe, is to establish a transparent, efficient price for capacity.
 - ✓ Such prices facilitate efficient forward contracting and long-term decisions (investment, retirement, and maintenance).
- Many in the industry confuse RTOs' mandatory forward procurement with longer-term forward contracting.
 - ✓ *They are not substitutes;*
 - ✓ Bilateral forward contracting remains key under any market design for locking in revenues and facilitating financing of new resources.
- Mandatory forward procurement has potential benefits and drawbacks.
 - ✓ It is premature to determine whether this is an improvement.



Optional Attribute: Resource Characteristics

- Some have argued that capacity markets should be used to favor certain operating characteristics, such as:
 - ✓ Flexibility
 - ✓ Dual-fueled or specific fuel (e.g., non-gas)
- The energy market should play a primary role in rewarding good operating characteristics. Efficient shortage pricing greatly rewards:
 - ✓ Non-gas units when shortages occur due to gas system contingencies;
 - ✓ Flexible resources that can start quickly and provide energy when unexpected conditions lead to a shortage;
 - ✓ Resources with back-up or firm fuel supplies;
- Hence, RTOs should ensure real-time market efficiently rewards such characteristics before modifying the capacity markets to do so.



Final Thoughts

- The NYISO market design has been very effective in facilitating investment and maintaining adequacy.
 - ✓ Buyer-side mitigation has been controversial.
 - ✓ Its “deliverability” framework and locational market design needs significant improvement.
 - ✓ We have not recommended NYISO consider mandatory forward procurement.
- Stability in the design and operation of the capacity market is critical.
 - ✓ Investors must be able to project capacity revenue over the life of their resources.
 - ✓ Instability raises investment risk that will cause investors to require higher prices to enter.