ERCOT Market Design, Capacity Markets, and Resource Adequacy

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Resource Adequacy in ERCOT
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Topics

• Is a capacity market the best design to support resource adequacy in ERCOT?

• Are there changes in elements of the current ERCOT energy market design that would better support resource adequacy?
Potential Advantages of Capacity Market Based Resource Adequacy Designs

- Avoids the need for high spot energy prices during shortage conditions;
- Capacity cost recovery is potentially spread out more evenly in time, rather than concentrated in years with higher than expected load; leading to more stable consumer costs, less regulatory risk;
- The resource adequacy capacity target is explicitly defined and enforced by regulators or the relevant reliability organization.
Limitations of Capacity Market Based Resource Adequacy Designs

- Supplier performance incentives must be provided through capacity market rules rather than energy prices;
- Capacity market obligations are hard to accommodate with retail access;
- A goal of stable recovery of fixed costs is hard to achieve through capacity market design and requiring consumers to pay a lot for capacity when there is a surplus, has its own regulatory risk;
- Identifying the exercise of buyer or seller market power is more complex than in the energy market;
- Consumer conservation incentives must be provided through capacity market rules (demand response) rather than through consumer response to high energy prices.
Capacity Market Rules

Overview

Reliance on a capacity market system to maintain reliability requires complex rules regarding:

- The location of resources that count as capacity (i.e. deliverability);
- The availability of resources that count as capacity (accounting for planned, forced and “economic” outages);
- The capacity market value of intermittent and energy limited resources.
- The capacity market value of merchant transmission facilities and allocation of the value of rate based transmission upgrades among power consumers;
Capacity Market Rules

All three Northeast ISO’s have struggled with how to apply some form of deliverability test to resource suppliers in the capacity market. Such a test would ideally meet three objectives.

- **No barriers to entry**: The deliverability test should preserve the condition for efficient entry that the entrant’s full generating costs need only be less than the avoidable generating costs of the incumbent.

- **Permit long-term capacity contracts**: The deliverability test should permit long-term bilateral contracts for capacity. This requires a mechanism that permits capacity sellers to enter into long-term capacity contracts and hedge themselves against the impact of entry on deliverability.

- **Reflect reliability criteria**: The deliverability test needs to ensure that resources eligible for capacity payments make an appropriate contribution to reliability under stressed system conditions.
Capacity Market Rules

A capacity based resource adequacy system requires deliverability analysis of interconnecting generators, contributing to the complexity and length of the interconnection study process.

• Almost all of the complexity in analyzing and allocating “deliverability” for new generation is a result of analyzing deliverability from the standpoint of capacity requirements.
• This is true even in regions which do not currently have formal capacity markets such as California.
• Most of these rules in practice grandfather incumbents, violating the goal of not creating barriers to entry.
Because spot energy prices are generally capped at relatively low levels under capacity market systems, generating resources typically recover only a small portion of their fixed operating costs and return on investment through energy market revenues during shortage conditions.

- Energy market revenues therefore do not provide capacity market resources with appropriate incentives to be available and online during reserve shortages when their availability is important to maintaining reliability.
- Capacity market systems therefore need to impose rules that provide incentives for supply resources to take extraordinary measures to keep their resources on-line during reserve shortage conditions.

Capacity Market Rules

Outage Performance
Another problem with generator availability in capacity market systems is that reliability does not depend solely on generator capacity and forced outage rates. Other important characteristics affecting the energy output of capacity resources during stressed system conditions are:

- Fuel availability
- Energy limits
- Startup costs and conditions
- Availability constraints
- Intermittency

All of these characteristics need to be addressed through market rules in a capacity market design.
The reliability analyses from which capacity requirements are derived are probabilistic assessments of available generation, transmission and load.

- Generation forced outages are treated as independent events in assessing loss of load probabilities.
- These probabilities will not be accurate for fuel-driven outages because these outages will be highly correlated across gas-fired generation as well as correlated with high electric load.

This was not a problem initially because in areas prone to winter gas curtailments, the existing utility generation had dual fuel capability or sometimes firm gas supply. That generation is retiring and now capacity market designs have to provide appropriate incentives for winter availability.
A variety of generating units are subject to limits on their energy output over the day, year or other period. These limits can have a variety of sources:

- Environmental requirements.
- Water flow and pondage (hydro).

Energy-limited units are useful in providing reserves and meeting peak load but too much capacity supplied by energy-limited resources could lead to reliability problems.

Capacity market designs need rules governing the capacity value of energy limited resources.
Generating units are permitted under most capacity market systems to submit unit startup times that exceed 24 hours.

- These long startup times reduce manning costs as rarely used generation can be left unmanned during low demand periods.
- This capacity is not available, however, when weather conditions change rapidly (e.g., PJM winter 1993-1994; ERCOT, February 24-25, 2003; New York and NEPOOL, May 7-8, 2000).

Units dependent on high energy market prices during shortage conditions for revenues would take steps to ensure their availability during such surprises. Capacity markets must provide similar incentives through their rules.
Capacity Market Rules  Intermittent Resources

Resources such as solar and wind generation and run-of river hydro give rise to additional issues in assessing reliability.

- Treating reductions in wind output like forced outages does not accurately account for the reliability impact of these output reductions because unlike the forced outages of thermal units, the availability of output from wind generation may be highly correlated across units and may be correlated with demand (still air and high A/C load).
- New York currently values wind and solar resource capacity based on an average historical capacity factor during hours beginning 14 through 18 during the months of June, July and August, and hours beginning 16 through 20 during the months of December through January.
- Other capacity markets have their own arbitrary rules governing the capacity value of intermittent resources.
Capacity Market Rules  Intermittent Resources

It is also difficult for market participants and regulators to accurately assess the contributions of intermittent resources to reliability in an energy only market.

- Market participants in an energy only market may keep too little thermal generation in operation because they overestimate the energy output of intermittent resources under stressed system conditions.
- In a capacity market system, however, intermittent resources will potentially earn capacity payments based on their assumed performance rather than their actual performance.
- As wind generation becomes more significant, it will be more important for capacity markets to accurately account for its contribution to reliability.
Capped energy and ancillary service prices in capacity market systems may fail to elicit the proper mix of generation capability, potentially requiring that these attributes be procured in the capacity market.

- PJM’s initial RPM design envisioned such procurement;
- The California CPUC and ISO are currently looking at the need for forward procurement of “flexible” capacity through resource adequacy requirements.
- This will not be a good path to have to move down, but may be necessary in capacity market designs as intermittent resource output rises, if energy and ancillary service prices fail to provide appropriate incentives.
Reliance on capacity markets to sustain resource adequacy requires rules to account for the impact of transmission upgrades on resource adequacy locational capacity requirements.

- Non-locational capacity markets generally account for the impact of transmission upgrades through deliverability requirements.
- Locational capacity markets generally award transmission upgrades some form of capacity deliverability right to the extent that an upgrade increases transfer capability into a local capacity market.
Retail Access

In a market environment with retail choice, capacity markets must incorporate mechanisms to accommodate load switching. In PJM, load serving entities initially were not required to procure capacity to cover the loads they served until the day before the operating day.

• There was no central mechanism to credit load serving entities that lost loads or to charge load serving entities that gained load from day to day.
• If load serving entities needed to purchase additional capacity or dispose of excess capacity due to load shifts, they could do so in the daily auction.
• If an load serving entity was short of capacity due to a load shift, it was assessed a deficiency penalty, prorated on a daily basis.

This led to very volatile and on average very low capacity prices in the daily market.
PJM UCAP Market Prices

$ /MW-Day

First Monthly Auction Price
Last Monthly Auction Price
Average Daily Auction Price
Retail Access

Deficiency Charges

On high load days in PJM and adjacent regions, the ability to export energy and capacity from PJM was often worth far more than the daily deficiency charge (1/365 times the annual capacity charge).

• Consequently, PJM began to be capacity short on the hottest days of the year.

• The switch to forward capacity markets design in PJM and New England largely eliminated these issues because the RTO, not the load serving entity makes the procurement decision, and capacity costs are simply allocated to the load serving entities.

• Today there is no direct option for a load serving entity to not procure capacity and instead pay deficiency charges in these designs.
Stability of Capital Cost Recovery

The presumed stability of capital cost recovery in capacity market designs proved to be a fiction in the initial capacity markets of PJM, ISO-New England and to a degree the New York ISO.

• With an absolute capacity requirement there was either too little capacity and the price rose to the deficiency level, or too much capacity and the price fell close to zero.

• The New York ISO and PJM subsequently introduced a “demand curve” for capacity which recognizes that a small capacity deficit does not cause the value of incremental capacity to rise to the deficiency level, nor does a small surplus cause the value of incremental capacity to fall to zero.
NYISO Summer 2003 UCAP Demand Curve

- New York City
- Long Island
- NYCA

- $251,640
- $217,440
- $134,880
- $108,840
- $59,040

- 82%
- 84.2%
- 84.8%
- 100%
- 112%
- 118%
Stability of Capital Cost Recovery

The way to achieve stability of capital cost recovery is through long-term contracts, which do not require a capacity market.

- It may in fact be easier to structure long-term energy contracts than long-term capacity contracts because electric energy is a well defined product.
- Capacity is an artificial product that is defined by market rules that will inevitably change over time.
- The core problem is forward contracting in retail access markets, not energy only vs capacity market designs.

If consumers do not contract forward, does that mean someone should enter into a long-term contract in their behalf, or are they sending a message. Generation can be built based on spot energy prices, margins will be higher, because the generator is bearing the risk.
Capacity Market Rules

With an energy only resource adequacy design, it is straightforward for price responsive load to contribute to reliability, and avoid capacity costs, by reducing consumption when prices are high during reserve shortage conditions.

- These price incentives for demand response do not work in regions using capacity markets for resource adequacy because prices do not get high enough during capacity shortages to incent the efficient level of conservation.
- The ability for price responsive demand to avoid capacity costs must therefore be built into capacity market rules.
Capacity market systems in PJM, New York, and ISO New England allow demand response resources having the ability to reduce load and making the commitment to do so when needed to substitute for generating capacity in the capacity market.

- SCR (New York ISO)
- Energy Efficiency, Interruptible Load for Reliability (ILR) until 2012-2013 RPM year, PJM demand response, FRR demand response (PJM)
- Real-time demand response, real-time emergency generation, on-peak demand response, seasonal peak demand response (ISO-New England)
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<th>PJM Demand Response</th>
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Because prices do not get high enough to provide efficient incentives for demand response to perform during reserve shortage conditions, capacity market systems need detailed rules for demand response, like for generators.

- How to measure capacity.
- How to measure performance.
- How often it must perform.
Limits on demand response activations such as those in PJM have the potential to become more problematic as demand responses displace more and more generation in the capacity market as the displaced generation will have been needed during more and more hours.

Figure 4-4: Load-duration curves for the 500 highest-demand hours in 2007, 2008, and 2009.

Market Power

There is a potential for the exercise of short-run market power in energy markets that can be exacerbated by the high price caps necessary in markets relying on energy prices to support resource adequacy.

- There is also, however, a potential for the exercise of short-run market power in capacity markets.
- The exercise of market power can sometimes be hard to clearly identify in energy markets, but it is even more difficult to clearly identify in capacity markets.

PJM, New York ISO and ISO New England have very complex rules applying to existing generation (seller market power) and to new generation (buyer market power).
A fundamental characteristic of capacity market systems is that there is a predefined capacity requirement, typically set by the ISO or an ISO related reliability organization such as the New York State Reliability Council.

- Northeastern ISOs define nominal capacity requirements whose level depends on projected generation outage and availability rates, the nominal capacity requirement depends on which resources provide capacity.
- The more high outage rate or low availability resources provide capacity, the higher the nominal capacity requirement needs to be.
- Capacity markets therefore do not necessarily provide the target level of reliability when they provide the target level of nominal capacity.
Capacity Requirements

Defining capacity requirements becomes more complex as the procurement process moves forward in time.

- Conservative reliability criteria can lead to extreme capacity requirements when combined with uncertainty regarding future load, load patterns, resource mix and transmission.
- Contracting forward on behalf of consumers for capacity based on absolute reliability criteria, rather than market based valuations, may provide uncertain reliability at high cost.
Hockey stick bids are an imperfect mechanism for implementing shortage pricing.

- Operator reserve scheduling and activation practices (e.g. activating non-spin) will often make it impossible for hockey stick bids to set prices even during sustained shortage conditions.
- If supplier expectations are incorrect, high offer prices intended to set prices during shortage conditions could reduce the efficiency of the real-time economic dispatch.
Shortage Pricing

Rather than relying on high energy offer prices to set market prices during shortage conditions, an alternative is to let the reserve shortage condition itself determine energy prices.

- A penalty cost can be attached to violating RTO reserve targets (i.e., capacity needed to satisfy the reserve target is dispatched to meet load) and this penalty cost can be reflected in real-time energy prices.

- With such an approach, all market participants could submit cost-based energy offers, yet prices could reach appropriately high levels during shortage conditions.

- New York ISO, ISO-New England, and Midwest ISO have implemented real-time reserve shortage pricing as part of their ancillary service and energy market design.
Shortage Pricing

Reserve Shortage Prices

NEW YORK ISO RESERVE SHORTAGE VALUES
MARCH 2011 to date

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