PJM ICAP MARKET DESIGN: SOME BASIC CONSIDERATIONS

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PJM July 12, 2001

DISCLAIMER

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- THE MARKET DESIGN (ISO/RTO) PROCESS IS A VERY COMPLEX UNDERTAKING:
  - IT REQUIRES THE **CONSISTENT** BALANCING OF:
    - HARD PHYSICS-ELECTRICAL ENGINEERING
    - ECONOMIC THEORY
    - STAKEHOLDER INTERESTS
    - REGULATORY/LEGAL/POLITICAL REQUIREMENTS

- THE PROCESS TENDS TO "COME OFF THE RAILS" IF ANY OF SEVERAL GENERIC MISTAKES ARE MADE:
  - WE OVERLOOK OR OMIT BASIC ELEMENTS OR FACTS **AND HOW THEY INTERACT**
  - WE IGNORE THE PHYSICAL REALITY OF ELECTRIC SYSTEMS
  - WE ATTEMPT TO REACH COMPROMISE IN AREAS THAT BASICALLY CAN'T BE COMPROMISED
  - WE IGNORE POLITICAL REALITIES

- When we “come off the rails” the resulting prices tend to get characterized as Unfair, or “ Unjust and Unreasonable” if they result in increased prices regardless of why they occurred
- An important distinction may be Unanticipated versus Unjust

Why Capacity Adequacy Markets?

- Energy Only Markets Work In Theory
- Basic Assumptions
  - Competitive market
    - Atomistic buyers and sellers
    - Rational buyers and sellers with knowledge
    - Elastic demand
    - Elastic supply, no barriers to entry
  - Functional market design
  - Absence of market power

Why Capacity Adequacy Markets/Requirements

- In theory, in a market system, when demand exceeds supply the market price would be set by the scarcity costs represented by load bidding in its willingness to be interrupted
- The system would clear at prices representing scarcity
- Suppliers over time would capture scarcity rents sufficient to attract new capital
- There would be no need for capacity requirements
- This would be the resolution both short and long term

- We never meet the assumptions of a fully competitive market in electricity—more "workably competitive"
  - Reasonably concentrated buyers/sellers
  - Reasonable short term (long term?) barriers to entry
  - No short term demand elasticity at retail/limited real time information
  - Limited long term demand elasticity

How to Deal with these Limitations

- THE KEY IS HOW WE DESIGN AROUND THESE LIMITATIONS
- Two basic errors in approaching this problem
- Most of the problems being experienced today with "unjust or unexpected" are a result of failing to recognize **basic** market failings and address them from day one
- The other basic problem is **failing to understand** the properties of what has been designed

- These limitations aren't necessarily a barrier to going to a market based pricing system
- They are however a limitation to going to an energy only market system
- These limitations provide specific areas of caution in market design
  - You have to get the prices right
  - You have to protect against market power
  - You have to recognize the implications of inelastic (uninformed) demand and scarcity in the setting of prices

Two Basic Problem Areas

- Focus today on two related/integrated and very important areas where we are seeing problems based on a failure to both address a basic problem and a failure to understand what has been designed
  - Short term/real time scarcity
  - Long term adequacy

Short Term-Real Time Scarcity

- Historically, in "equilibrium" regulated electric supply systems were designed to be "short"
- The typical design standard was loss of load probability (LOLP) of "one day in ten years"
- This means with normal weather, no unusual conditions we planned systems for demand to exceed supply 2.4 hours a year
- With unusual weather, transmission outages this would result in ????? hours

Short Term-Real Time Scarcity

- In theory, in a market system, **in real time** when demand exceeds supply the market price would be set by the **scarcity costs** represented by load bidding in its willingness to be interrupted
- The system would clear
- Suppliers over time would capture scarcity rents sufficient to attract new capital

Short Term-Real Time Scarcity

- However, currently real time demand is effectively totally inelastic
- Retail markets don't see any of the wholesale price signals
- There is currently no practical way to set clearing prices by scarcity
- There is no "correct" clearing price between marginal production cost with adequate supply, and interruption with shortage

Short Term-Real Time Scarcity

- The periods of highest demand are easily predictable
  - Extreme weather
  - Multiple days in a row
  - Afternoon to early evening
  - Most of the information is on the web or available from the ISO

Short Term-Real Time Scarcity

- **Shortage+Inelastic Demand+Known Occurrence= Suppliers can set any price they want**
- We know this is unacceptable, it typically leads to price caps
- Price caps are "ok" if we agree in **advance** to what the price will be during shortage
- **AND** we establish alternative ways to collect market **clearing** revenues-E.g. capacity payments or other ancillary service payments

Short Term-Real Time Scarcity

- With the possible exception of PJM all of the ISO's have failed to answer this very basic question:
- "WHAT WILL BE THE MARKET PRICE OF ENERGY WHEN DEMAND EXCEEDS SUPPLY"
- It appears some refuse to answer this

Short Term-Real Time Scarcity

- Because of market realities the price can be set at whatever we want it to be in this situation
- As a result, you have to answer this question first, and design the markets back from the answer
- This is the only way to get a consistent and workable market design

Short Term-Real Time Scarcity

- Possible solutions
- Design the market (IN ADVANCE) to allow "politically acceptable" energy prices (caps) plus clearing revenues from other sources in an acceptable fashion
  - Ancillary services
  - ICAP, ACAP, operating reserves

Short Term-Real Time Scarcity

- This means at times of scarcity the price will rise to the cap
- What does this mean in terms of pricing:
  - The "spread" between marginal production costs and the energy price cap is a **LEGITIMATE** revenue for generation—it reflects a proxy for a **portion** of shortage costs or scarcity rents
  - Suppliers have to be able to bid to the cap in scarcity situations regardless of marginal production costs
  - The use of caps **has to be coupled in advance** with other clearing revenue sources

Long Term Adequacy

- Again, theory suggests that an energy only market is all that is needed
- Participants responding to short term price signals will build new generation and transmission in response to market needs
- Scarcity rents in energy prices only, over the business cycle, are sufficient to attract new capital
- Get the energy prices right and the rest (e.g. new entry) follows

Long Term Adequacy

- This is the pricing/market structure for other capital intensive commodities-aluminum, paper etc.
- Characteristics of these other capital intensive commodity markets:
  - Undifferentiated commodity
  - Single commodity price
  - Multiple year business cycle as supply and demand oscillate and adjust-multiple years of scarcity
  - High Price volatility over cycle, factors or 3-5 variation not unusual

Long Term Adequacy

- Implications for single commodity price-energy only-electric markets:
  - High price volatility
  - Scarcity for number of years—business cycle
  - Coupled with demand inelasticity no rational "cap" for price
- This is exactly the "unexpected" result of a design like California, the results are consistent with design
- **We know this is not politically acceptable-no market design rhetoric is going to change this reality**

Long Term Adequacy

- Potential Long Term Solution
- Administratively set reserves; Installed Capacity Requirements and Market or Equivalent (e.g. mandatory call contracts backed by hard assets)
- These designs don't necessarily encourage reliable performance (DMNC versus Calls)
- Typically criticized as inefficient, e.g. a tax of participants to maintain excess/inefficient resources

Long Term Adequacy

- **THAT IS EXACTLY THE POINT**
- THE "TAX" COMPELS SURPLUS CAPACITY
- THE SURPLUS "DAMPENS" VOLATILITY IN THE ENERGY MARKETS
- THE "LONG" SYSTEM NEVER GOES THROUGH THE BUSINESS CYCLE OR HAS A SHORTER PERIOD OF SCARCITY
- DIRECTLY COMPLEMENTS THE SOLUTION TO THE SHORT TERM SCARCITY PROBLEM
- **REALITY IS THAT THIS IS POLITICALLY CORRECT AND ACCEPTABLE**

Long Term Adequacy

- What might this "tax" of excess capacity cost?
- For PJM, assume that the tax was to have excess 4% of peaker reserves above the "market solution", e.g. ~2,000 MW
- Using Joe Bowring's ~$50 per kW-year this is $100,000,000 or less than peak "premiums" for a few hours under current conditions (e.g. 50,000 MW for two hours at $1000)
- In theory this "tax" plus ICAP and energy payments should approximate the same "energy only" total revenues over time,

Long Term Adequacy

- This is a small price to pay to avoid persistent scarcity for multiple years coupled with regulatory and political intervention
- "Smart" market participants recognize this:
  - "ICAP is the price I am willing to pay to have access to a liquid and competitive energy market" (Manager of large trading operation.)
  - Sufficient inherent volatility to keep marketers happy

Long Term Adequacy

- This is exactly what California is proposing too late
  - Mandatory call rights plus RMR
  - RMR payments effectively are capacity payments
- The problem is they are starting during shortage, and the basic premise of the "Tax" wont work to maintain surplus if you start short

Long Term Adequacy

- What does this mean in terms of Market Design
  - Mandatory capacity markets and administratively set levels of reserves
  - Need to recognize pricing implications of a tax in terms of market design
  - Need to couple with short term solution, recognizing entitlement to payments in excess of marginal production costs during scarcity

Additional Observations

- These types of solutions only work if you start from a system in surplus
- Nothing helps once the system goes "short", you have to solve the physical supply issue before you can "dampen" energy prices
- With "bad" design, it will be almost impossible to differentiate or partition between the impacts of scarcity and market power
- **This ICAP process is not likely reversible once associated property rights are awarded**

IMPLEMENTATION

- Given the above, what are some of the basic functions and problems that have to be addressed with the design of an adequacy market.

Basic Functions of An Adequacy Market

- Establish Reliability/Adequacy Target
- Establish Reserve/Installed Requirement
- Assign Requirement to Participants
- Establish Eligibility/Obligation of Generation to Participate
- Measure Capacity Provided
- Match Supply and Demand
- Penalties for Failure to Meet Requirements

Some Alternative Implementations

- California-none E.g. a boom/bust cycle
- New York
  - NYSRC sets LOLP, ISO Reserve
  - DMNC, limited performance moving to unforced capacity
  - 6 month period, now monthly market
  - ISO auction, bi lateral
  - Locational requirement, no deliverability or associated property rights, minimum interconnect standard
  - Monthly pro-rata deficiency
  - Allocated by peak ratio share

Alternative Implementations

- PJM
  - RAA/ISO sets reserve requirement
  - Unforced capacity for performance
  - Annual requirement but daily obligation, just shifted to seasonal periods
  - ISO auction, bi lateral
  - Clear deliverability rights, and associated FTR creation
    - Question on treatment of excess injection rights
  - Daily pro-rata deficiency going to seasonal
  - Peak load ratio share

Alternative Implementations

- GridFlorida (Proposed)
  - Proposed ICE, energy call options
  - Monthly requirement
  - No reserve requirement value over 100%
  - Auction and bilateral
- Other
  - Central Procurement, long term (not implemented)
  - Call option with reserve level iron in ground requirements/reserves (not implemented)

Alternative Implementations

- From my perspective no one has got this "right". There are missing or inconsistent elements in each of the proposals.
- The following discusses a few of these problems.
- This is a partial agenda for considering new alternatives for PJM

Important Issues

- In this context look at four areas important to capacity market design
  - Time step/obligation period
  - Generator performance/evaluation
  - Deliverability/property rights
  - Level of deficiency penalties

Time Step

- One of the most important elements and least understood is the time step-obligation period-performance period of the capacity adequacy markets
- The time step is a key driver in actually achieving reliability and attracting new entrants in the long run

Time Step--Continued

- To meet reliability objective the time step of the market
  - Must match the underlying reliability assumptions
  - Currently this only appears as annual evaluations (e.g. LOLP analysis assumes that a central planner "consumes" annual maintenance coordination and LOLP is calculated over the year, similarly you see seasonal energy patterns etc.)
  - This means the only "right" time step for current market reliability standards is annual

Time Step -- Continued

- Pattern appears to be to go to shorter obligation period
- This reflects:
  - Desire of marketers for more liquid market
  - Desire to mesh more easily with retail
- Shorter obligation period means that physical reliability is reduced
  - LOLP actually higher
  - Generation can typical migrate more easily
  - Load can avoid meeting requirements when actual need exists

Time Step --Continued

- Obligation period is also a major driver for new entry
- Shorter obligation period typically "dilutes" deficiency penalty, e.g. payments are only a (small) share of annual charge
  - This diminishes incentive for long term transactions,
  - This in turn may discourage new entry
  - This also encourages migration of capacity out of system when prices higher elsewhere

Time Step --Continued

- Shorter time step may also make capacity pricing more volatile (tend towards zero-one)
  - When markets are long, this tends to penalize generators by encouraging short purchases/obligations, in turn this may result in very low ICAP prices as most of the short run "to go" costs are sunk after decision to stay in operation.
  - When market is close to being short, prices will likely rise to deficiency rather than marginal "to go" costs

Time Step – Continued

- PJM has recognized some of these limitations from a shorter time step and has moved to extend the obligation period to a seasonal basis. This is still too short
- NY is actually making matters worse by shortening its period

Time Step --Continued

Basic Tension-liquidity and retail access flexibility versus physical adequacy

- The time step interacts with the relationship between markets and reliability. The more you assure long term physical adequacy/"iron in the ground" through strong long term obligations (likely encouraging new entry), the less likely you are to get a market design that meets the flexibility requirements of open retail access and the liquidity desires of traders.

Time Step --Continued

- This isn't a bad result, it is just the reality of administratively imposed physical adequacy. It is at odds with a liquid market
- Indeed, this type of observation may argue for some sort of central imposed ICAP structure.

Time Step --Continued

- Possible improvement-Actions to further extend the time step and promote new entry
  - Go to at least a one year step
  - Central procurement of XX% on a long term basis e.g. if reserve requirement is 118%, 110% could be annual and 8% on a rolling basis for up to 5 years
  - This could be bi lateral and part of LSE requirements as an alternative
  - Offers a long term entry stimulus that is competitively driven

Generator Performance-Evaluation

- There has to be a way to measure a generator's relative contribution to meeting installed capacity requirements
- Ideally there would be a direct link between system demand and performance, e.g. energy at times of highest demand

Generator Performance-Evaluation

- There are a range of alternatives
  - Single measure DMNC (NY)
  - Unforced Capacity (PJM)
  - Performance versus price, call options
  - Performance versus LOLP
- The closer you come to performance tracking actual system reliability needs the better
- Coarse measures like DMNC don’t relate to performance and may actually encourage lower reliability

Generator Performance-Evaluation

- The best solutions should emphasize actual performance, e.g. UCAP or calls or peak related (as long as rules are known at the start of the market)
  - Is more fair in terms compensation
  - Rewards the “good” players/performers
  - Encourages new entry
  - Encourages retirement of “bad” performers

Deliverability/Property Rights

- Key element to supporting new entry is clearly defined property rights
  - What is required to be recognized as eligible to sell installed capacity or be a capacity resource?
  - Who pays for these requirements?
  - Who owns the rights to recognition after these payments are made?
  - How long do these rights exist?
  - Who owns any related rights created in the energy markets, E.g. FTR's / TCC's
    - Direct use, future overhead created

Deliverability/Property Rights

- Ambiguity with respect to these rights creates uncertainty for investment
- Clarity for the rights, regardless of "correctness" creates a business environment people can deal with
- I.E. you can have weak or strong rights, with the associated change in risk or incentives so long as you don't have ambiguous rights

Deliverability/Property Rights

- PJM has a clear process for rights:
  - Formal process for deliverability and cost allocation for Capacity Resources v. Energy Only
  - Clear long term Capacity Injection rights for facilities that choose to pay for upgrades to be Capacity Resource
  - These rights are saleable
  - Clear ownership of any incremental FTR's created by upgrades
  - The treatment of excess deliverability is incorrect and should parallel FTR's
  - There is no analogous transmission only process

Deliverability/Property Rights

- New York has failed to clarify rights, or even the lack of rights, business rules are ambiguous
  - No deliverability concept
  - Unclear business rules for existing system
  - Minimum/energy only interconnection only
  - No formal property rights to ICAP deliverability for new entrants (or old??)
  - Most participants aren't aware or still don't understand this after years of warning
  - Major problem for new entrants and long term agreements
  - NY does get transmission only property rights

Deliverability/Property Rights

- Major Hidden Problem-Who Owns the Existing Rights on Day One
  - PJM finessed this by just giving them away to incumbents
  - Better result for customer may have been auction of existing deliverability and FTR's with revenues going to reduce access charges
  - Another area where consistency is important in any new approach
  - It probably is too late to fix the injection rights piece of this in PJM due to generator sales
  - It is still feasible to move to a full FTR auction

Deficiency Payments

- Key "enforcement" element in ANY ICAP system is the structure and level of deficiency payments
- This is the engine that drives "proper" behavior-higher is better
- The "right" level is consistent with a premium over the costs of new entry- reflecting the all the costs and risks associated with new entry
- Right level also has to reflect opportunity costs if there are adjacent markets without similar market structures

Deficiency Payments

- PJM has set this too low
- New York is more consistent with function of deficiency payment
- Current rate is a vestige of old environment where participants had mandatory obligations under state jurisdiction
  - The rate was more of a "capacity equalization payment" than deficiency or penalty rate

Deficiency Payments

- PJM needs to recognize the "enforcement" aspect of deficiency charges and move to rates reflecting significant premiums over new entry

STRAWMAN

- Any straw has to recognize the seven basic functions and address them consistently
- There are several different approaches we could try, e.g.:
  - Current form with annual time step, higher deficiency rate, better performance measure, modified allocation of deliverability and new rights etc.
  - Call option structure with "iron in the ground provisions
  - Others?