

PJM ICAP MARKET DESIGN: SOME BASIC CONSIDERATIONS

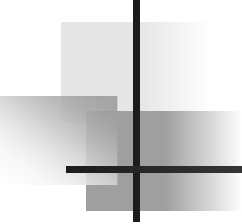


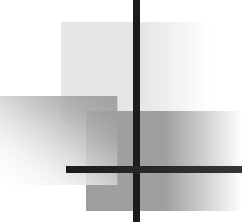
Roy J. Shanker
PJM July 12, 2001

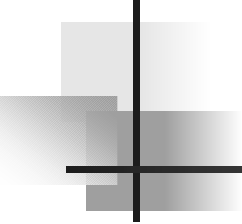


DISCLAIMER

- The following presentation is a personal work product and does not necessarily represent the position of any of my clients.

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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/LLEGAL/POLITICAL REQUIREMENTS

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- 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

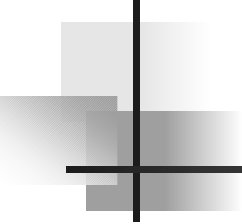
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- When we “come off the rails” the resulting prices tend to get characterized as Unfair, or “ Unjust and Unreasonable” if they result in increased prices regardless of why they occurred
 - An important distinction may be Unanticipated versus Unjust

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

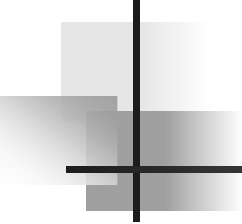
Why Capacity Adequacy Markets/Requirements

- 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

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- 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

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- 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



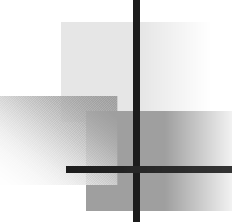
Important Issues

- 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



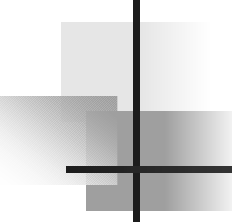
Time Step--Continued

- 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



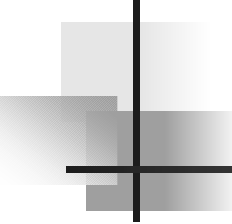
Time Step -- Continued

- 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 typically 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



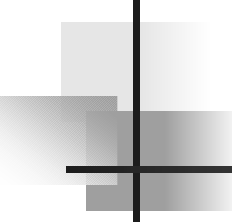
Time Step --Continued

- 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

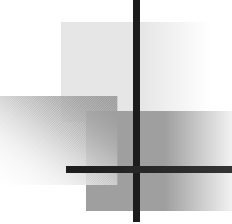
- PJM has recognized some of these limitations from a shorter time step and has moved to extend the obligation period to a seasonal basis. This is still too short
- NY is actually making matters worse by shortening its period



Time Step --Continued

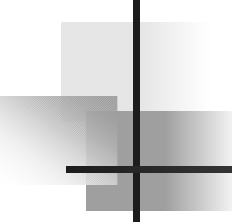
Basic Tension-liquidity and retail access flexibility versus physical adequacy

- 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



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?