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Eliminating the Flaws
in New England's Reserve Markets

Peter Cramton and Jeffrey Lien

University of Maryland

peter@cramton.umd.edu

lien@econ.umd.edu

www.cramton.umd.edu

Markets run by ISO New England

- Energy
- Automatic Generation Control (AGC)
- Ten-minute Spinning Reserve (TMSR)
- Ten-minute Non-spinning Reserve (TMNSR)
- Thirty-minute Operating Reserve (TMOR)
- Operable Capability (OpCap)
- Installed Capability

Focus on Reserve Markets

- Examine reserves and operable capability markets
 - TMSR: ten-minute spinning reserve
 - TMNSR: ten-minute non-spinning reserve
 - TMOR: thirty-minute operating reserve
 - OpCap: operable capability
- Data analysis covers May 1 to August 31, 1999
- All seven NEPOOL markets examined, since interrelated
- All bid, pricing, and settlement data examined

Purpose

- Identify potential market flaws
- Look at performance of markets to see if potential problems materialized
- Propose alternative solutions to identified problems

Objective used in evaluating markets

Efficiency

- Do the rules send the right price signals?
- Do the rules minimize opportunities for gaming?
- Do the rules encourage system reliability?

Recommendations

- Eliminate OpCap market
- Adopt smart buyer model for the reserve markets
- Restructure the reserve markets
- Create a day-ahead reserve market

Purpose of OpCap and reserves

Provide dispatch flexibility so that ISO can balance uncertain supply and demand in real time

Markets should be designed to set marginal cost equal to marginal benefit

- Costs of reserves
 - Long run - Fixed cost of capacity investment
 - Day-ahead - Costs of making capacity available
 - The plant needs to be staffed
 - Export sales are foregone
 - Real-time - Lost revenue in the energy market
- Benefits from reserves
 - Keep production and consumption in balance
 - Protect against
 - Generation outages
 - Transmission line outages
 - Unanticipated load levels
 - Prevent
 - cascading failure of the interconnected transmission grid
 - NERC and MPCC penalties
 - Avoid having to take corrective actions
 - Brownouts
 - Load-Shedding

New England's Reserve Market Structure

- No reserves scheduled in advance
- All units capable of supplying reserves submit bids day-ahead
- Bid stack (aggregate supply curve) is formed from reserve bids of units that are not accepted in the real-time energy market
- Bid stack clears against vertical “demand curve” and a uniform real-time clearing price is determined for each hour of the day for each reserve market
- Prices capped at the energy price
- Low bidders are paid the uniform price
- High bidders receive nothing but are still required to respond to the ISO's dispatch instructions
- Markets clear sequentially - superior services first. Capacity not accepted in one market is available for the next
- If capacity available for reserves is less than the requirement, OP-4 is implemented
 - ISO searches for imports and ways to reduce load
 - Reserve levels are dropped if necessary

California's Reserve Market Structure

- Markets clear and reserves are scheduled one day in advance
- Bid stack clears against vertical demand and a uniform price is determined for each hour of the day for each market
- Markets clear sequentially
- If needed, reserves may be included in the schedules for energy at any point in the day
 - If called for energy reserves receive the energy price in addition to the reserve capacity payment
 - Can think of reserves as a call option
 - Replacement reserves are found so that a minimum reserve requirement is maintained in real-time

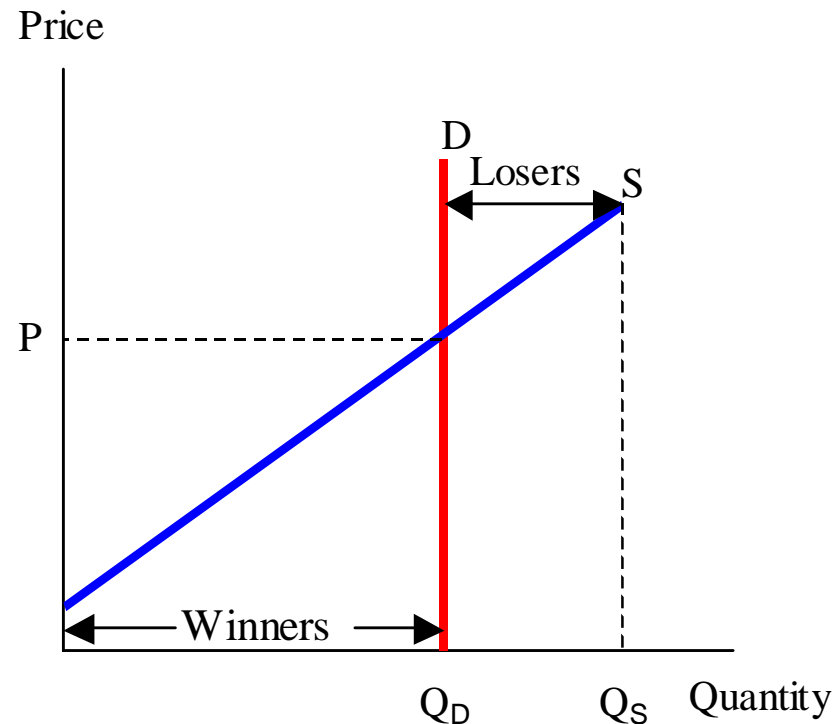
Are Costs Sunk before the markets clear?

- New England
 - Long run investment costs – YES
 - Day-ahead availability costs – YES
 - Real-time opportunity costs – YES
- California
 - Long run investment costs – YES
 - Day-ahead availability costs – NO
 - Real-time opportunity costs - NO

Basic flaws in the design of New England's reserve markets

- Losing bidders face the same obligations as winning bidders
- Reserve prices are arbitrarily high in times of scarcity
- The ISO is not a “smart” buyer
 - Sequential clearing of markets does not ensure overall cost minimization
 - Price inversions are possible

Losing bidders face the same obligation as winning bidders



(a) Current Market Structure for Reserves

There is no difference in the costs or risks incurred by those participants who receive payment in the market and those who do not

Incentive for bids of 0 (better to be paid than not)

In times of scarcity, prices in these markets are arbitrarily high

- In Operating Procedure 4 conditions, there is a shortage of reserves (or OpCap)
- ISO must accept all bids, regardless of price
- Prices may be arbitrarily high with no basis in cost and no economic constraint on behavior
Incentive for arbitrarily high bids
- “Ask and it shall be given” game
 - Each bidder names a price
 - All bidders are paid the highest bid

Two flaws lead to severe gaming in OpCap

Consider 1000 MW unit:

- Bid \$0 on first 999 MWs, so get paid clearing price on entire capability (less 1 MW) during normal times
- Bid \$999 on last 1 MW, so get at least \$999 on entire capability in times of scarcity

Best of both worlds: get the clearing price on the largest possible quantity absent scarcity, and then in times of scarcity set an extremely high clearing price and receive it on the entire quantity!

Gaming in reserve markets also

- Only bid a single price in each market, not a schedule, so cannot do extreme gaming (except those with many units)
- Bid \$0 if think that it is sufficiently unlikely that you will set the clearing price
- Bid a modest amount if you think that you have a reasonable chance of setting the clearing price, but you think that the clearing price will be low
- Bid \$999 in times of scarcity
- If you have many units, you can bid all but the smallest at \$0 and then bid \$999 on the last unit (hence, get paid for as large a quantity as possible, and set a high price in times of scarcity)

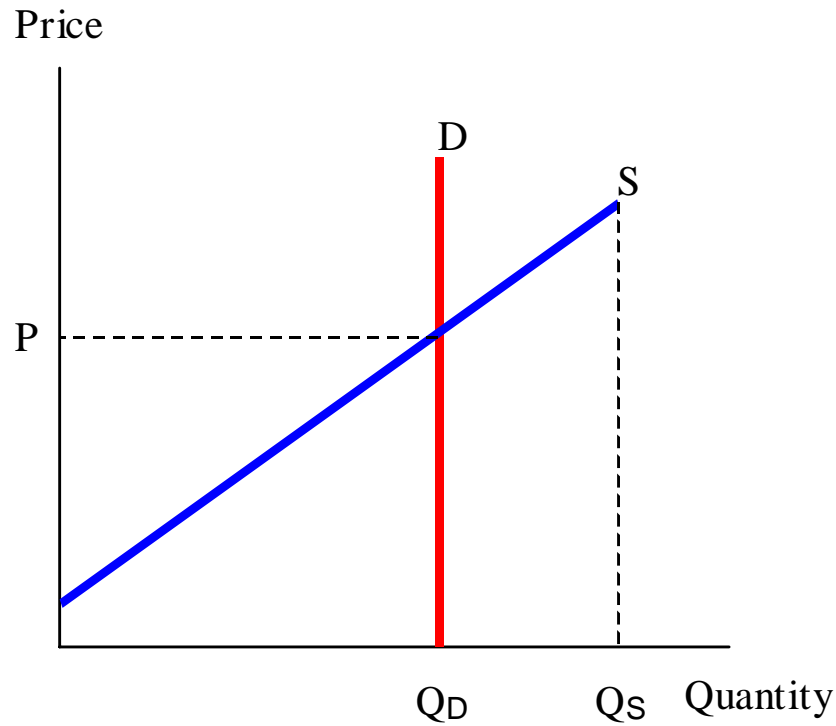
Eliminate OpCap market

- Severe market flaws
 - Winning and losing bidders face same obligations
 - Arbitrarily high prices in times of scarcity
- Market serves no purpose
 - ISO needs dispatch flexibility; market does not provide dispatch flexibility
 - Can bid 1000 MW unit with a ramp rate of 1 MW/hr
 - Unit is worthless for dispatch flexibility yet it gets full 1000 MW credit as operable capability
 - Reserve markets are better able to reward dispatch flexibility
 - With well-run energy and reserve markets, OpCap is totally redundant, even if redesigned to address market flaws
 - OpCap is an option with an unspecified strike price; such an option is worthless

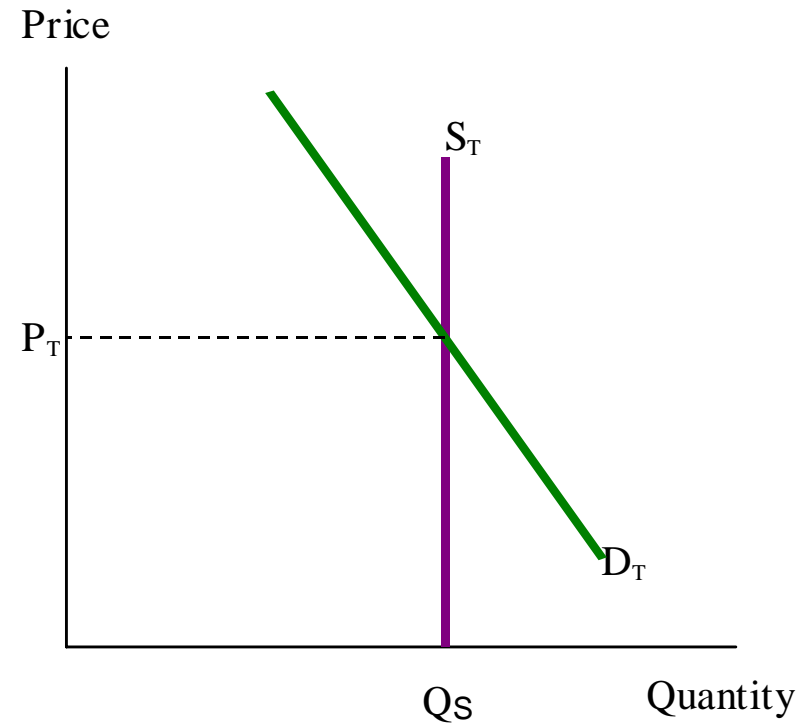
Policy suggestions

- Create a day-ahead market for scheduled reserves
- If an ex-post clearing real-time market is maintained, let price be determined by the marginal value of reserves and pay this uniform price to all units supplying reserves and
 - No bids need to be submitted
 - The supply curve is vertical and the demand curve is downward sloping
 - The marginal value of reserves can be calculated using probabilistic techniques taking system conditions into account.

Real-time Reserve Market



(a) Current Market Structure for Reserves



(b) Revised Market Structure for Reserves

Why should units be paid the marginal value of reserves?

- Promote efficient availability decisions
- Promote efficient investment decisions
- Assuming no market power the ISO will be able to use energy bids to create an efficient dispatch

Conclusions

- Energy market is working reasonably well
 - But much debate about unit commitment and operator decisions
- Reserves and OpCap markets are seriously flawed
 - Losing bidders face the same obligations as winning bidders
 - In times of scarcity, prices are arbitrarily high
- New England's markets continue to suffer from lack of
 - Multi-settlement for energy and reserves
 - Congestion management for energy
- Progress is being made...but slowly