*Presented at POWER*
*March 17, 2000*

# Eliminating the Flaws in New England's Reserve Markets

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# 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?

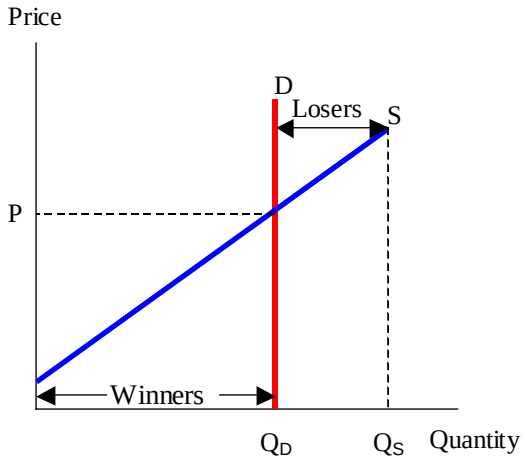
- New England
  - Long run investment costs – YES
  - Day-ahead availability costs – YES
  - Real-time opportunity costs – YES
- California
  - Long run investment costs – YES
  - Day-ahead availability costs – NO
  - Real-time opportunity costs - NO



## 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

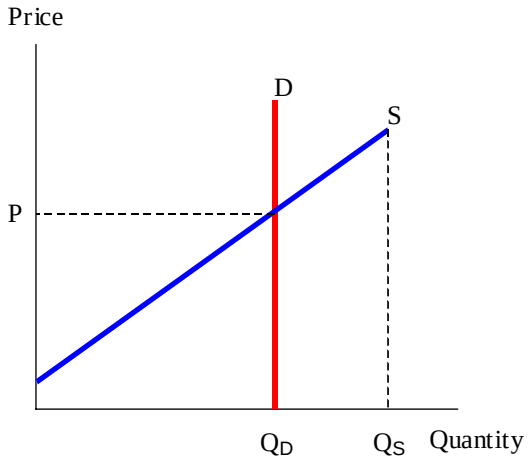
- Severe market flaws
  - Winning and losing bidders face same obligations
  - Arbitrarily high prices in times of scarcity
- Market serves no purpose
  - ISO needs dispatch flexibility; market does not provide dispatch flexibility
    - Can bid 1000 MW unit with a ramp rate of 1 MW/hr
    - Unit is 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



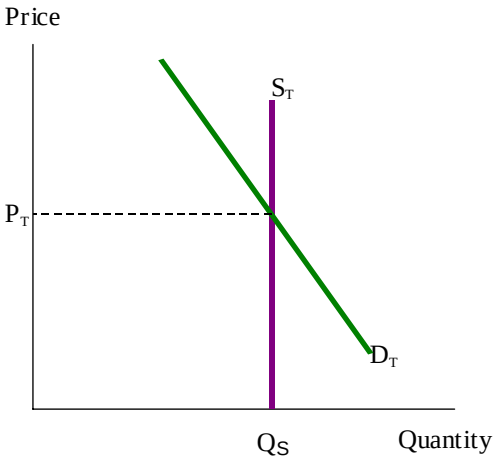
# Policy suggestions

- 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