



CALIFORNIA ISO

California Independent
System Operator

Empirical Evidence of Strategic Bidding in CA ISO Real Time Market

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<http://www.caiso.com/docs/2001/04/27/2001042710305919478.pdf>

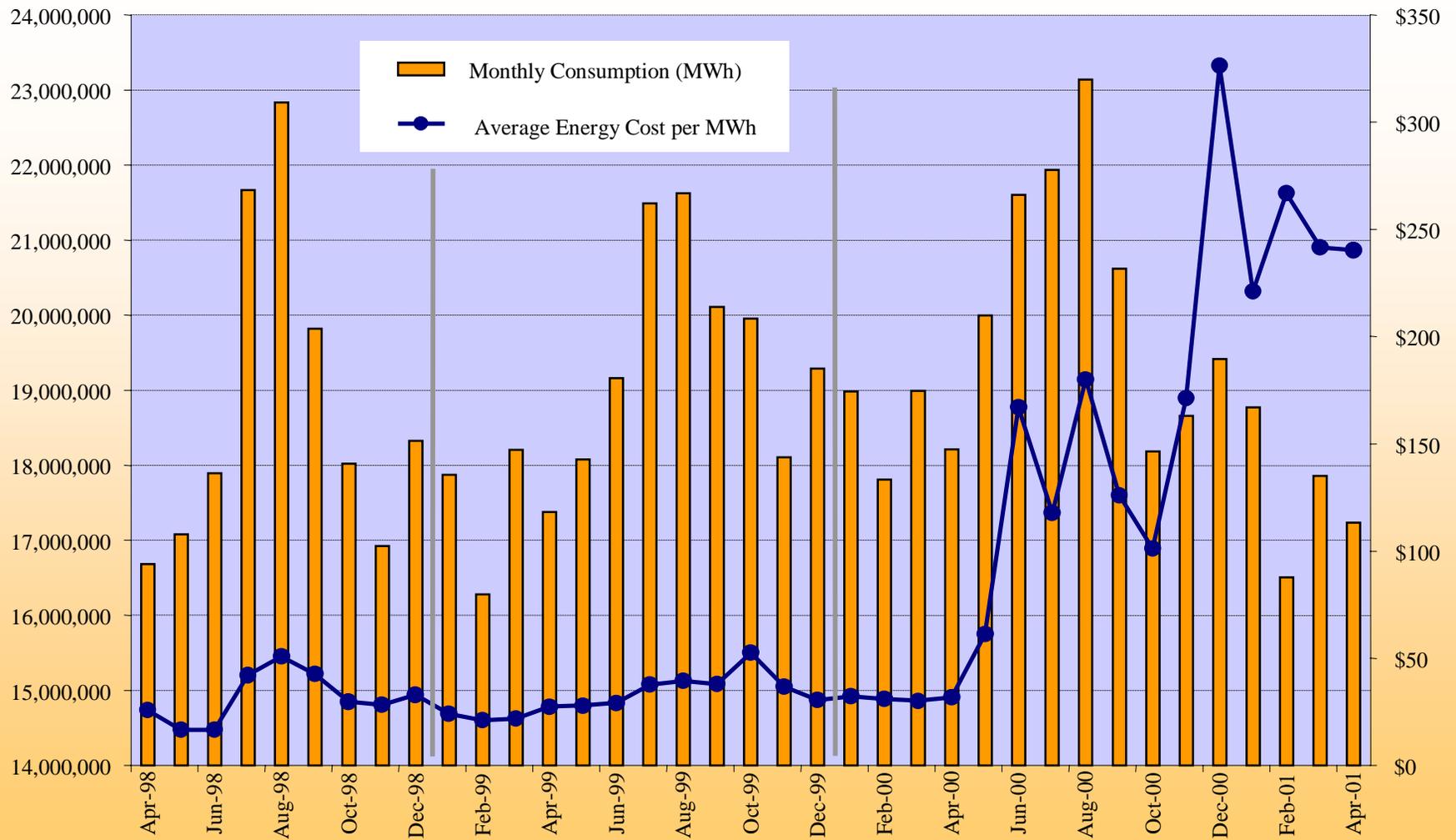


Overview of Presentation

- I. Starting point was observed level of high prices and high system price-cost mark-up.
- II. What was the underlying bidding behavior which caused prices to be so high?
 - I. Methodology for studying strategic bidding and withholding
 - II. Results:
 - I. Frequent withholding
 - II. High bid prices and mark-up above suppliers own portfolio costs
 - III. Able to extract large monopoly rents



Why Did Prices Jump After Two Years of Moderate Prices?





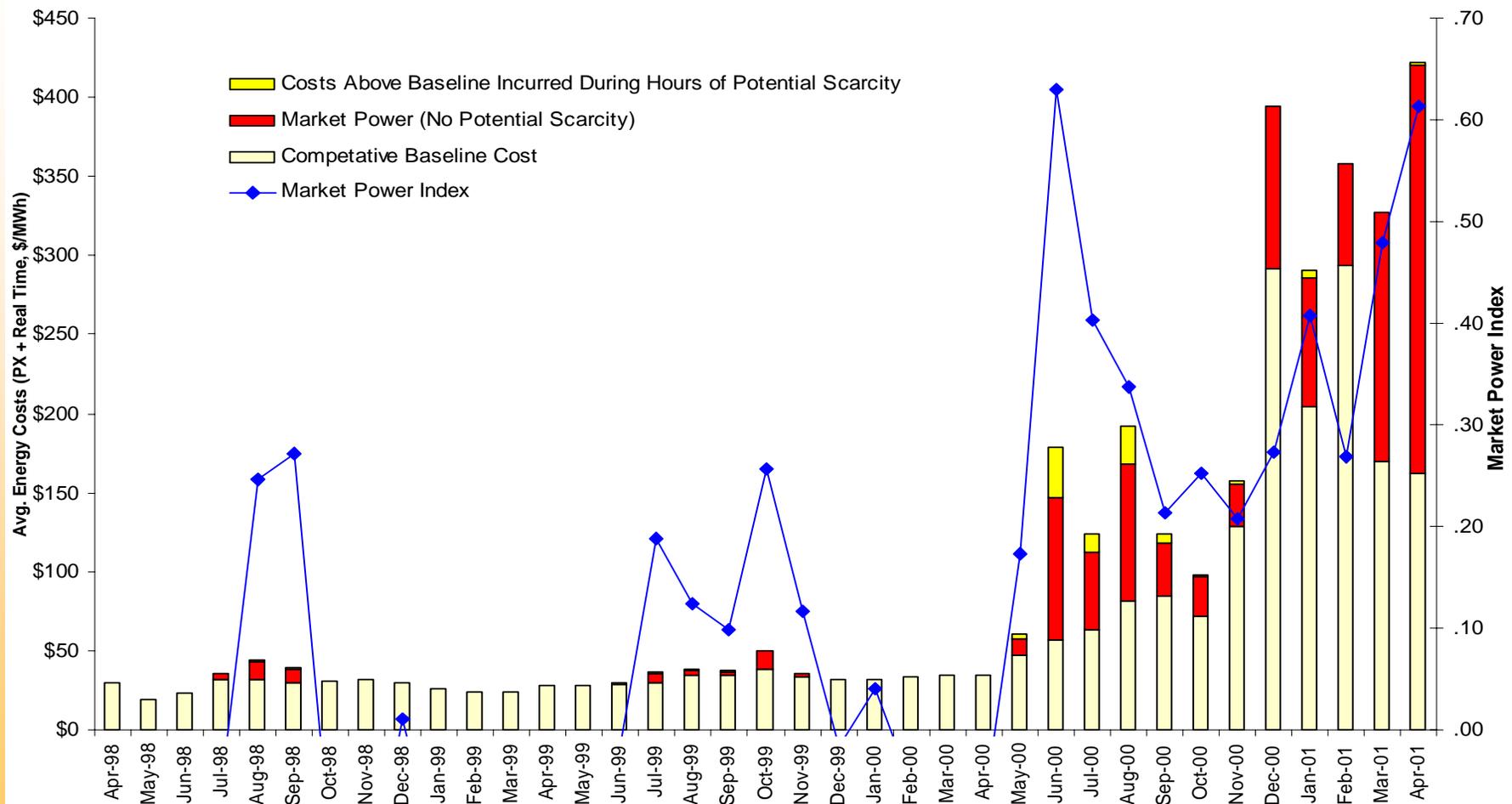
What Were the Key Factors Causing Price Spikes?

- 1 Limited Demand Response - Rate freeze meant no price signal to load to conserve
- 2 Lower Supplies Available and at Higher Cost
 - Lack of New Generation for Last 10 Years
 - Numerous Outages of Generation and Transmission
 - Reduced Hydro Generation and Imports, Increased Gas Prices, High Cost of Emissions
- 3 Unrestrained Exercise of Market Power by Suppliers



What Explains the High Prices?

Prices above competitive levels were due to both higher production cost and higher mark-up from market power



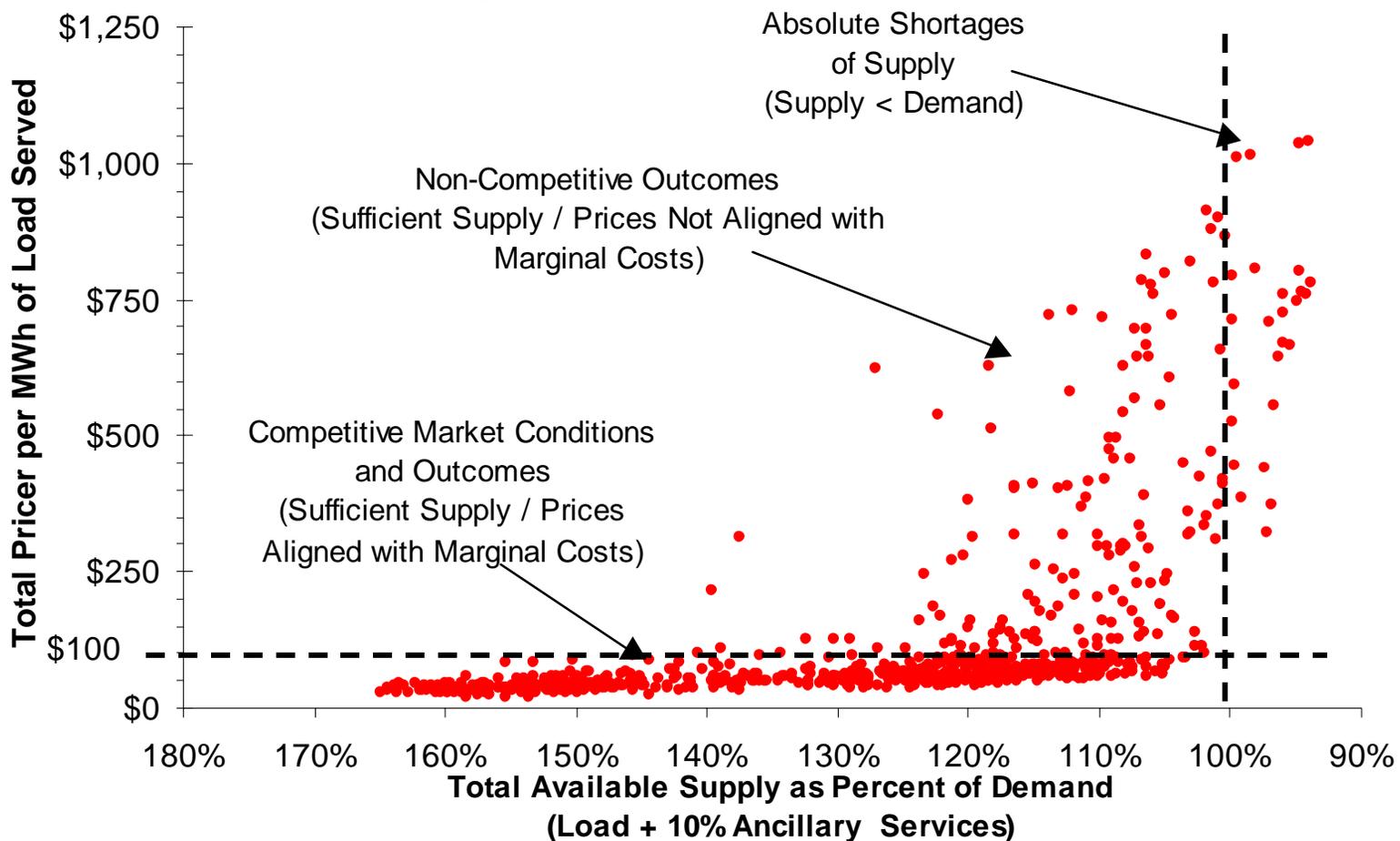


How Do We Evaluate Market Power?

- Market power is generally defined as a firm's capability to profitably raise the price above competitive levels for a significant period of time.
- Practical monitoring index: Price-cost mark-up — market clearing price above system marginal cost.
- Two ways to exercise market power: economic withholding and physical withholding. All market power bidding strategies will be carried out in one of these forms.
- Economic withholding
 - Submit bids at prices above producer's marginal cost
 - Most often observed in CA ISO real time market
- Physical withholding
 - Restrict output or withhold capacity from bidding into market



Scarcity or Market Power?



* Source: *Report on California Energy Market Issues and Performance: May-June, 2000*, Prepared by the Department of Market Analysis, August 10, 2000

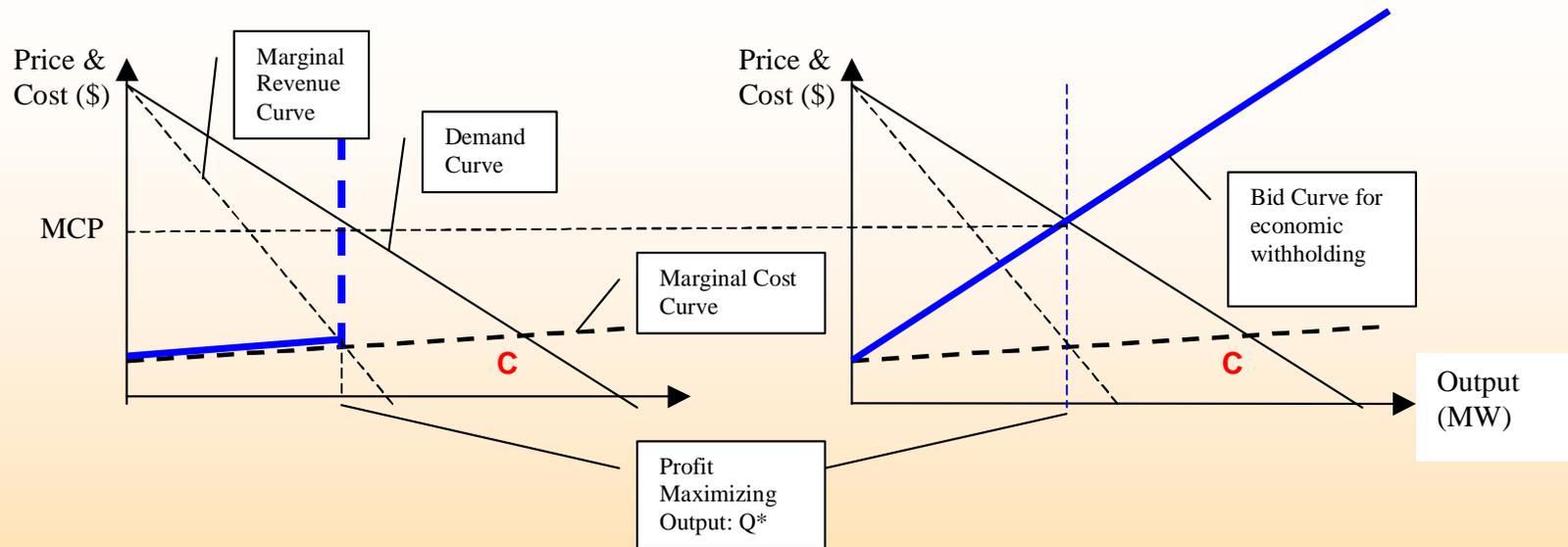


Methodology of Bid-cost Mark-up Study

- DMA examined bids from 5 large in-state non-utility suppliers and 16 importers in real time market for each hour of summer 2000
 - Identified common bidding patterns
 - Checked for evidence of physical withholding and economic withholding
 - Developed Bid-cost mark-up Indices
 - Established the contribution to system price hikes by individual bid-cost mark-up and calculated monopoly rent received by each supplier
 - Compared observed bidding strategy with oligopoly price models to confirm market power outcome



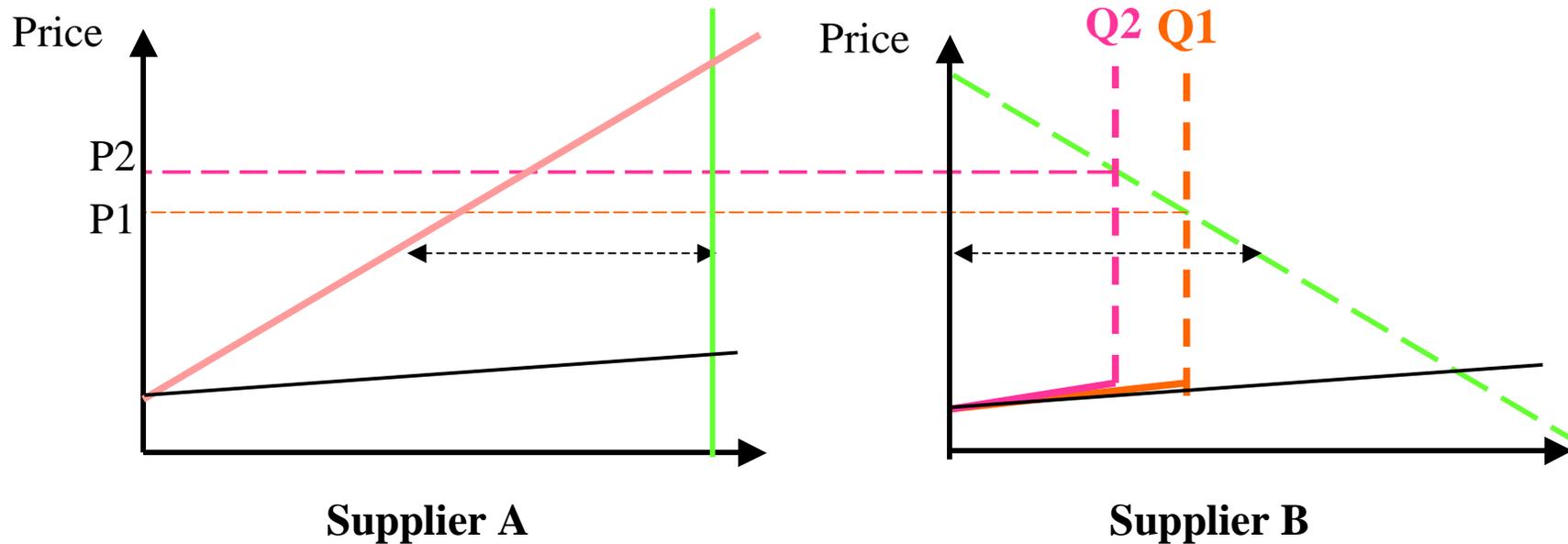
What Bidding Strategies Can be Used to Set Market Prices and Maximize Profits?



For an oligopolist in the market facing a residual demand curve, it has two bidding strategies available: physical withholding (left panel) and economic withholding (right panel). Both strategies result in the same reduced output available to the market and at prices inflated above competitive levels. The expected competitive production and price levels are at the point marked "C".

Both strategies result in reduced output and inflated price.

Who is setting the MCP?



- **Indirect Price Setting** (by withholding capacity like supplier B) is as effective in setting the market clearing price as **Direct Price Setting** (by having a bid price equal to the market clearing price like supplier A).
- They jointly set the MCP, and they both effectively bidding at MCP at the dispatched output.



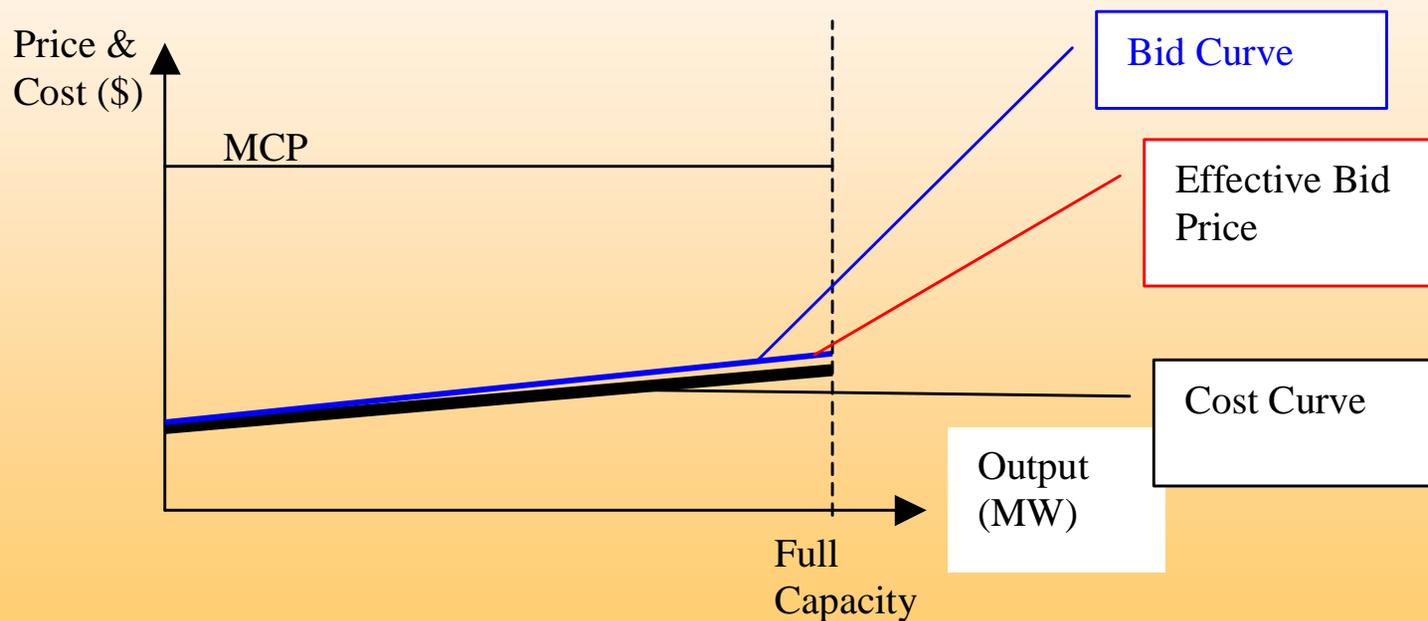
Steps of Bid Mark up Study

- Estimate variable cost of each generation unit
 - Heat rate data and spot market fuel prices are used to estimate unit marginal cost
 - NOx cost are included when applicable
- Determine available capacity for each supplier's portfolio
 - Scheduled outages are deducted from rated capacity
 - A EFOR are applied to each unit to allow for normal forced outages. A conservative value of 10% was used in the study to reduce false positive.
 - A units owned by the same supplier are combined into a single portfolio. All cost and capacity are considered together.
- Determine effective bid price and withholding pattern
 - The study focus on the measures around the total dispatch quantity in a suppliers portfolio. The dispatch quantity and price are the only point that determines a suppliers profit and best reflect a suppliers intent and impact of market power.



Effective Bid Price and Bid-cost Mark-up -- (a) Price Taking Supplier

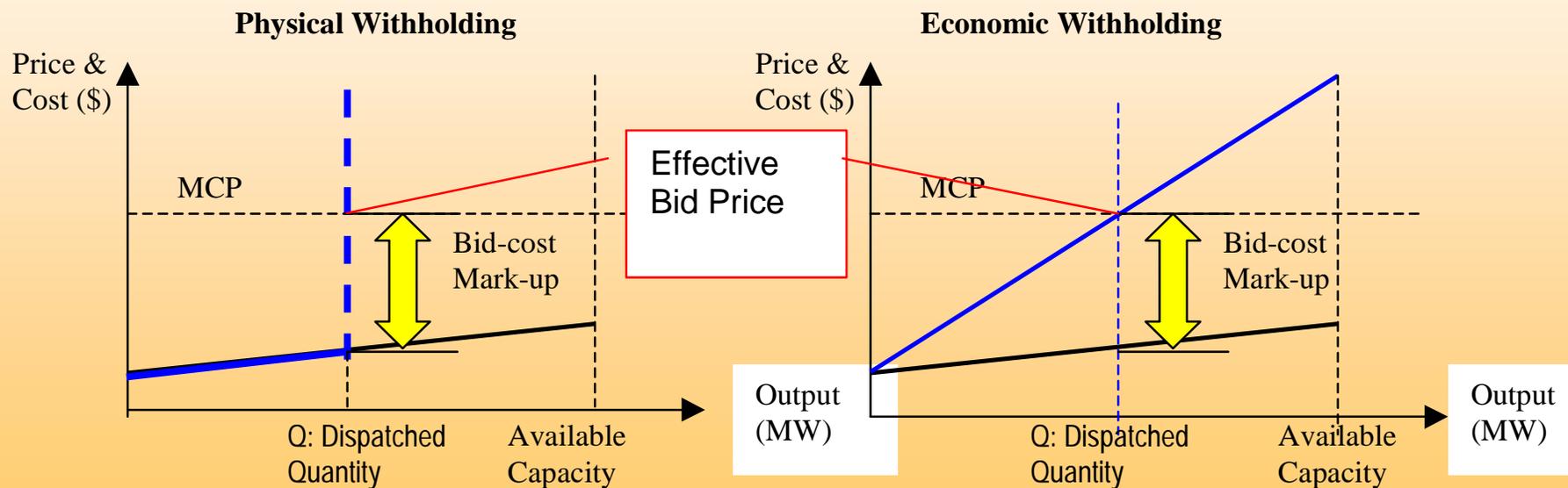
- Effective bid price equals to bid price at dispatch quantity, which can be less than MCP(as in chart) or equal to MCP(when MCP line intersect the bid curve and cost curve).





Effective Bid Price and Bid-cost Mark-up -- (b) Strategic Supplier

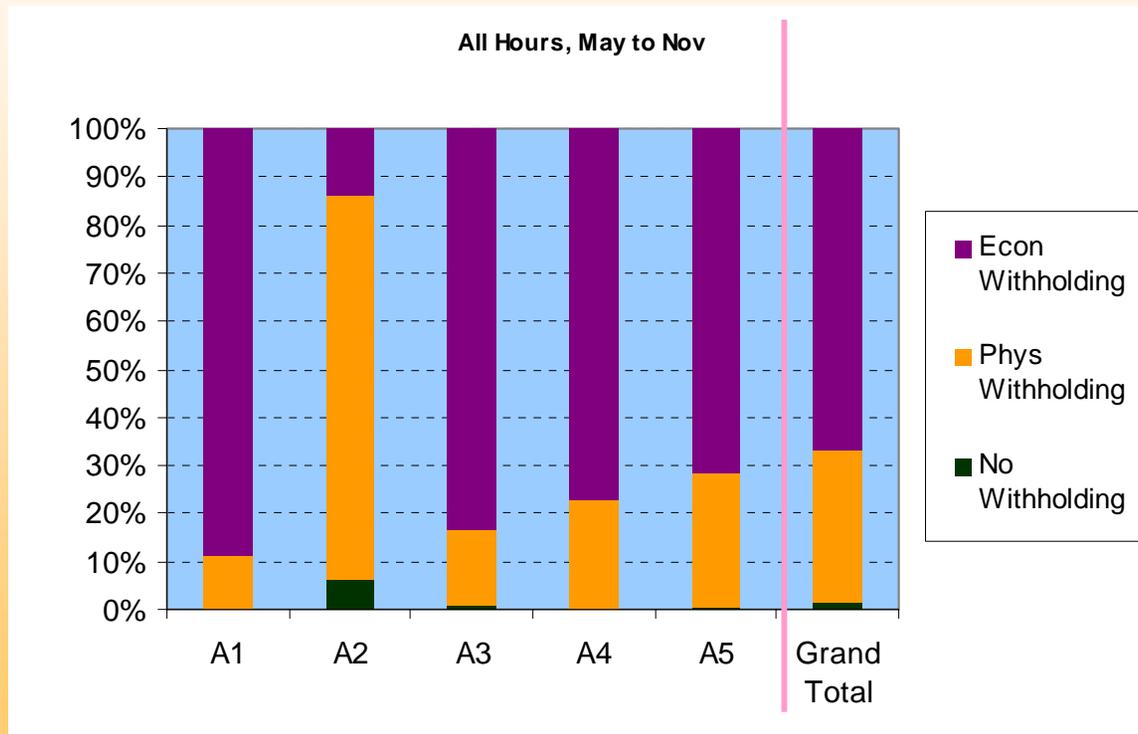
- Strategic Suppliers use physical withholding and economic withholding. Effective bid price is calculated to be equal to the Market Clearing Price in both cases shown below. Both strategies allow the supplier to set the MCP. The calculated bid-cost mark-ups are significant as shown in the figure.





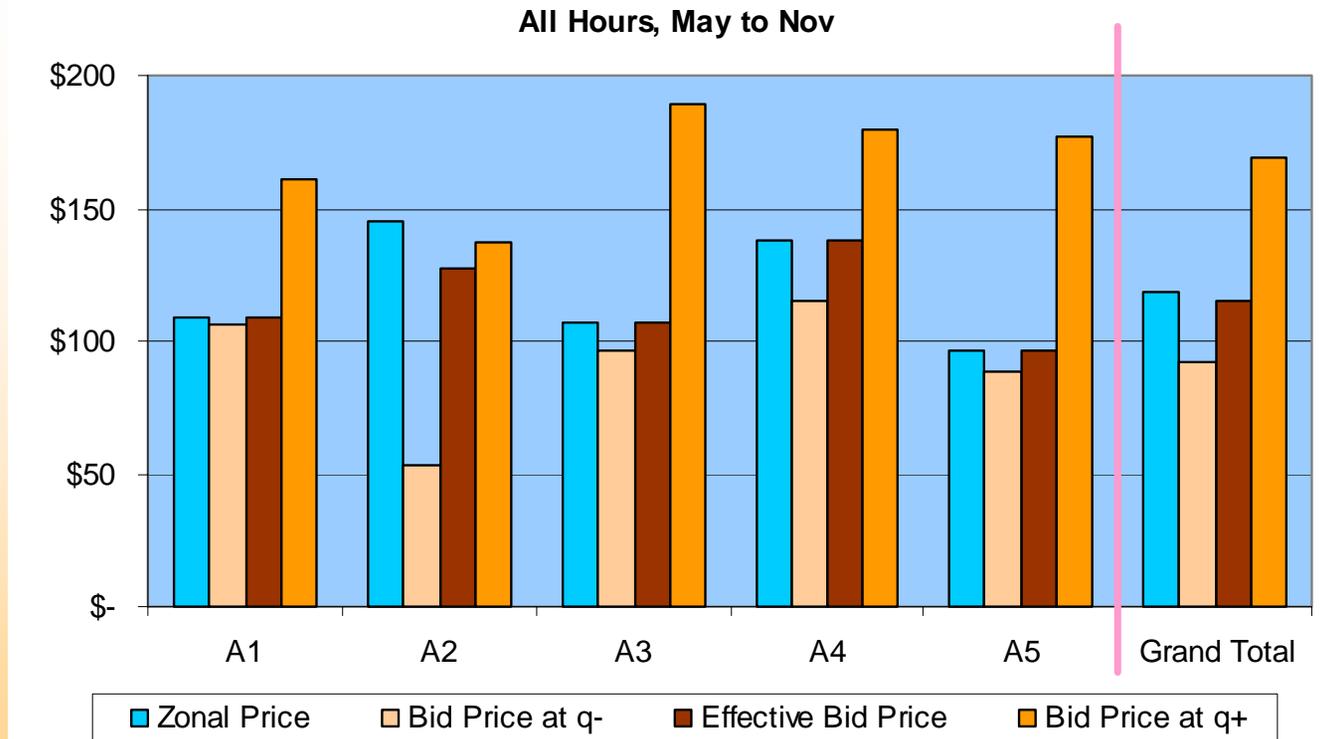
Frequent Withholding Utilized By Suppliers in Summer 2000

- Physical withholding was not the dominant strategy for most suppliers in summer 2000 (though this may change when studying Dec 2000).
- 4 out of 5 large in-state suppliers used economic withholding strategy more than 70% of the time. One supplier used physical withholding nearly 90% of the time.





High Withholding Translates into High Bid Price – Five Large in-state Suppliers Set the MCP Most of the Time



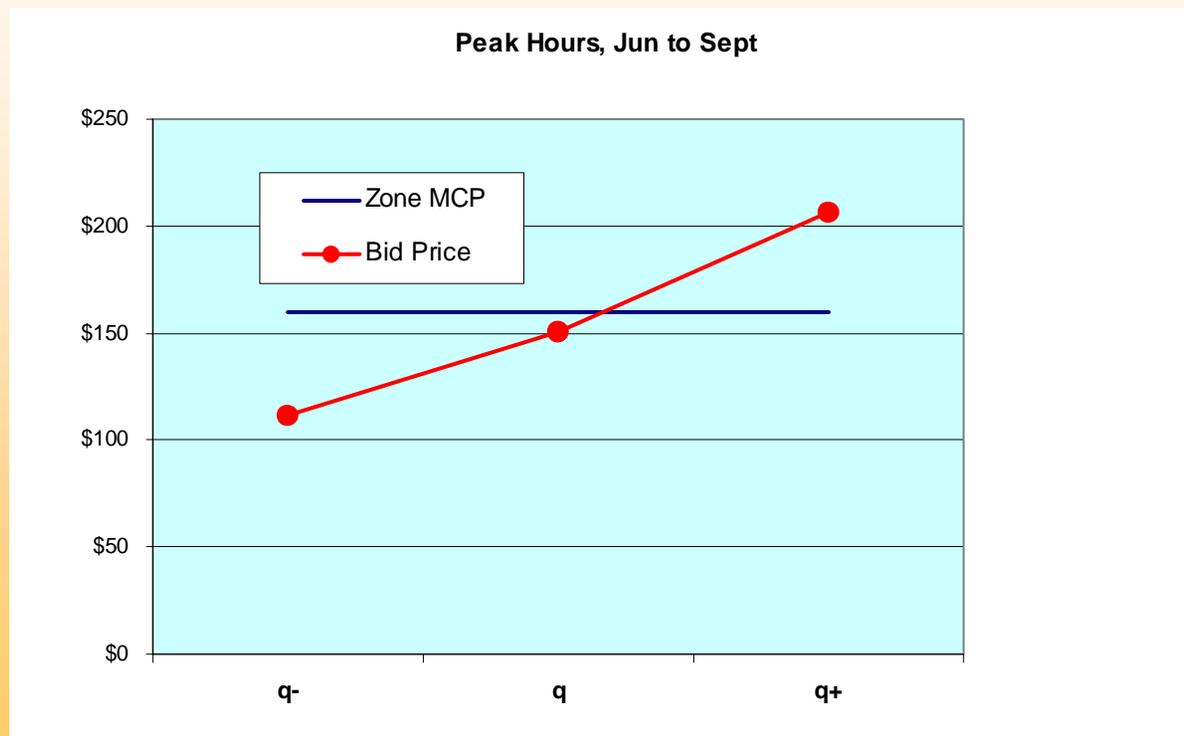
This chart compares the zonal market clearing price with the effective bid price for each supplier at their dispatched output level. This chart also reports the bid prices for a 50 MW change in the dispatch quantity($q+$). This shows that if the system demand were somewhat higher, the suppliers would have been successful at setting even higher prices with bids in the market at much higher prices. If system demand were somewhat lower, the suppliers had high bids standing to support high prices and keep them from falling lower.



Another View of Bid Prices: Well Planned Strategy to Ensure Maximum Prices at all Load Conditions

Average Bid Prices for all 5 large in-state suppliers:

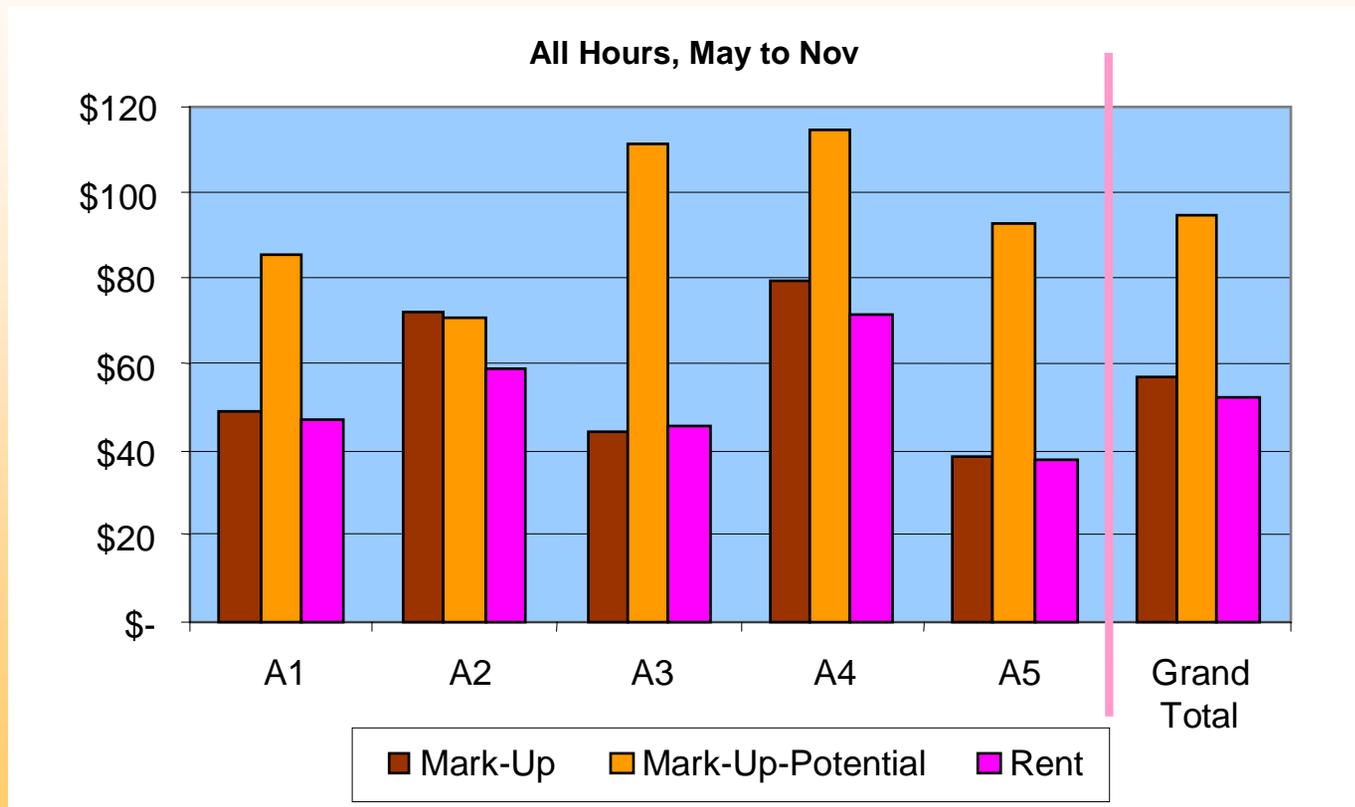
- At q , most suppliers bid MCP most of the time. On average, it is almost equal.
- If the demand were higher ($q+$), they have much higher bid price ready to push the price.
- If the demand were lower, they still have fairly high bids in waiting to support high prices.





Behind High Bid Prices Are Significant Bid-cost Mark-ups

During Peak Hours and High Load Hours, Similar Patterns are observed with much higher \$ amount of mark-up.





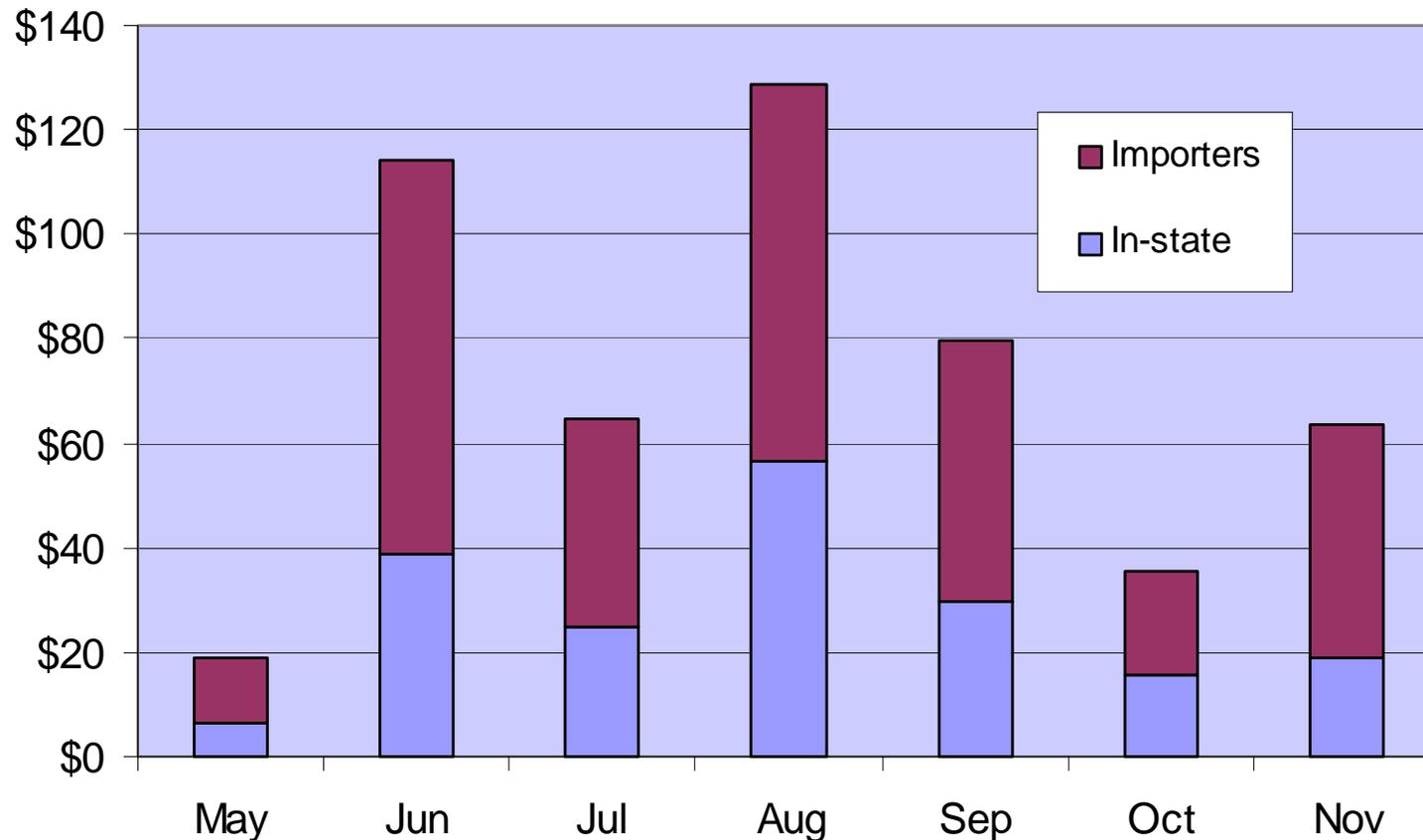
A Measure of Market Power Impact: Monopoly Rent

- Monopoly Rent measure the impact to the market price and cost due to the exercise of market power by large suppliers
- Monopoly Rent = Eff. Bid Price – System MC. (if a supplier's cost is higher then it is used instead of system MC)
- Cumulative Rent = Monopoly Rent x (RT output MW) accumulated over each month



Large Amount of Monopoly Rent Extracted

Total In-state: \$190; Total Importer: \$315;
Grand Total: \$505 (\$millions)





Conclusion

- Results are based on best data available on outages, emissions costs and spot natural gas costs
- Developed indices to measure strategic bidding or the exercise of market power by large strategic suppliers.
- Found evidence of strategic bidding activity by most of the large suppliers and demonstrated how they successfully inflated market prices in summer 2000.