

Evaluating the Potential Impact of Transmission Constraints on the Operation of a Competitive Electricity Market in Illinois

prepared for

Illinois Commerce Commission

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The Study Was a Joint Effort: Argonne National Laboratory University of Illinois at Urbana-Champaign

- Work commenced July 2002
- Initial draft report submitted December 2003
- Revised draft report with additional analysis September 2004
- Briefing to Transmission Advisory Group May 2005
- Final TAG comments received January 2006
- Letter response to TAG comments sent March 2006
- Final report with editorial changes April 2006



The Study Was Commissioned to Address Some Important Questions Regarding the Electricity Market in Illinois

- Is the transmission system adequate to support market operation?
- Can competition keep prices in check?
- Is there the potential for market power to be exerted?
 - *Market power: The ability to raise prices and increase profitability by unilateral action*

The Study Was Designed to Be:

- *Exploratory, not predictive of specific outcomes*
- *Initial investigation*
- *Issue-oriented, not regulatory-oriented*



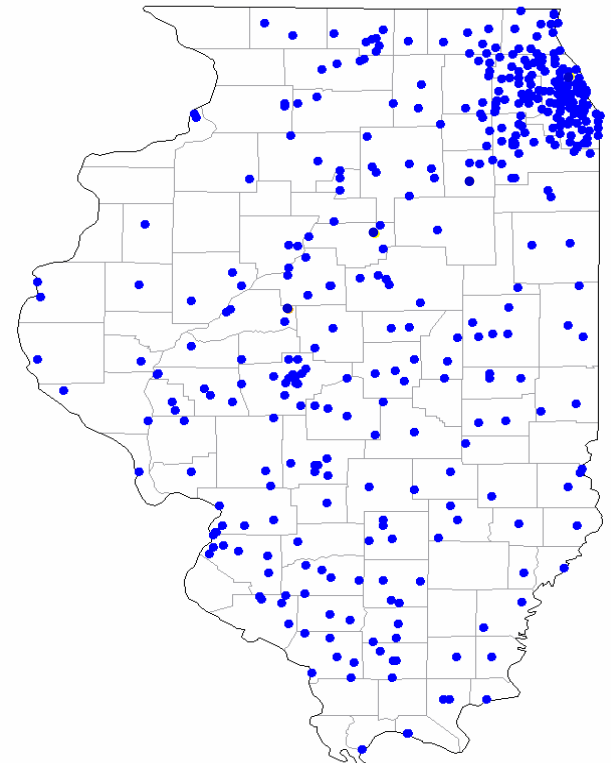
Basic Assumptions Used in the Study

- Analysis year : 2007
- Projections for 2007 based on data from NERC, FERC, EIA, IEPA
- A single day-ahead pool market operating in the State
 - *All buyers and sellers of electricity bid into a common market every day*
- No bilateral contracts
- Out-of-state generation and load participate in the market
- Groups of cases
 - *Case Study Assumptions – with generator forced outages*
 - *Conservative Assumptions – no forced outages*



In the Pool Market, a Locational Marginal Price (LMP) Settlement Process Was Assumed to Be Operative

- The cost of providing the next MW of power at each point in the network (i.e., the LMP) is calculated
- In the absence of transmission limitations:
 - The lowest cost generators are used first
 - Higher cost generators are used only as needed
 - The LMP at every point in the network is the same
- With transmission limitations:
 - It is not always possible to use the lowest cost generators
 - The LMPs vary, sometimes considerably, across the network



**Transmission
Nodes**



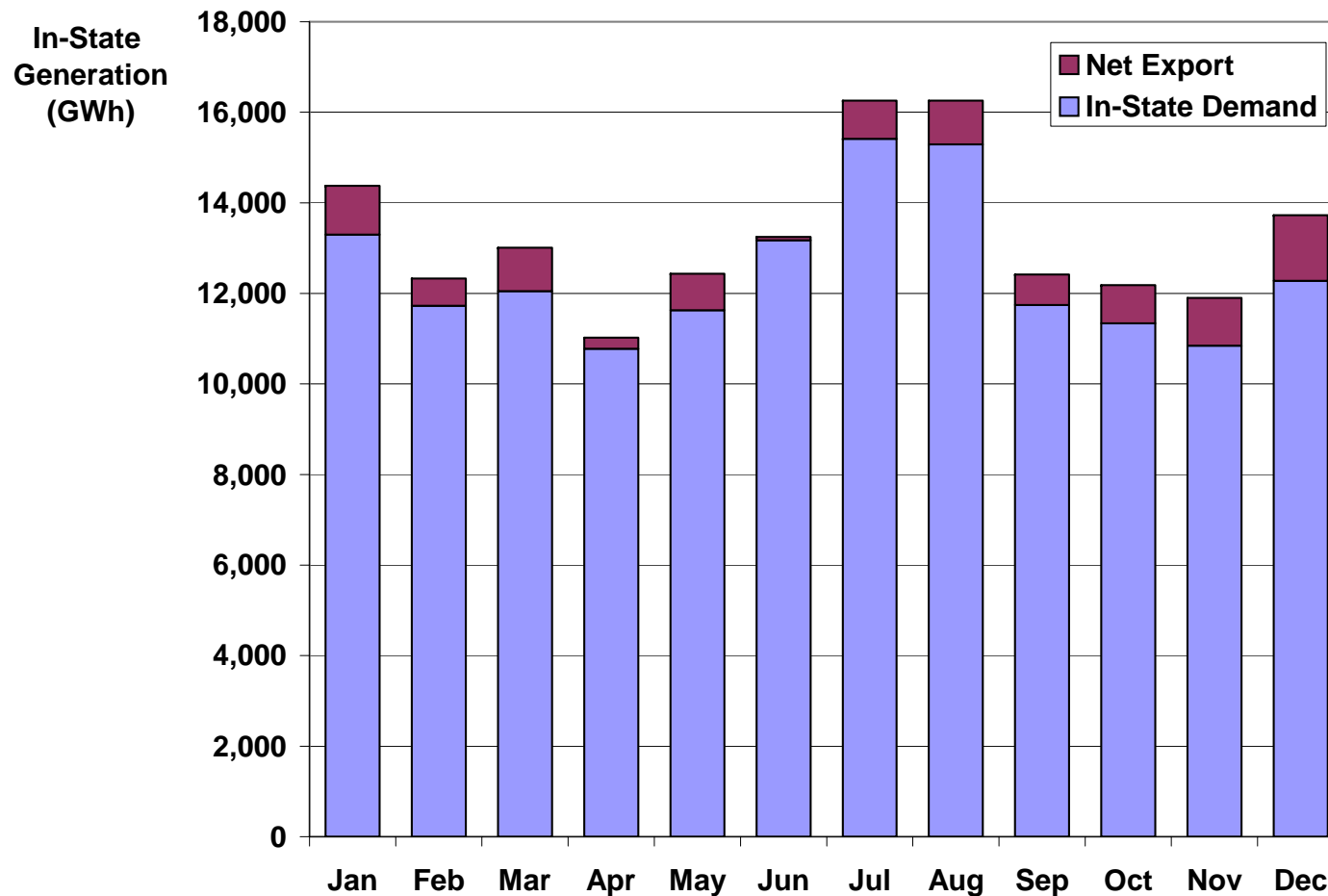
Cases Were Constructed as “Electronic Experiments” to Study Market Behavior

Production Cost	<ul style="list-style-type: none">•Generation companies bid production cost•Gives the lowest system cost
Physical Withholding	<ul style="list-style-type: none">•Intentionally take generators out of service•Prices rise
Economic Withholding	<ul style="list-style-type: none">•Generation companies bid above production cost•Prices rise

- Experiments moved from very simple to more complex strategies*
- Production Cost Case used as a benchmark*
- Not intended to imply that any company would attempt to exercise market power*
- Only an initial mapping of possible market bidding*



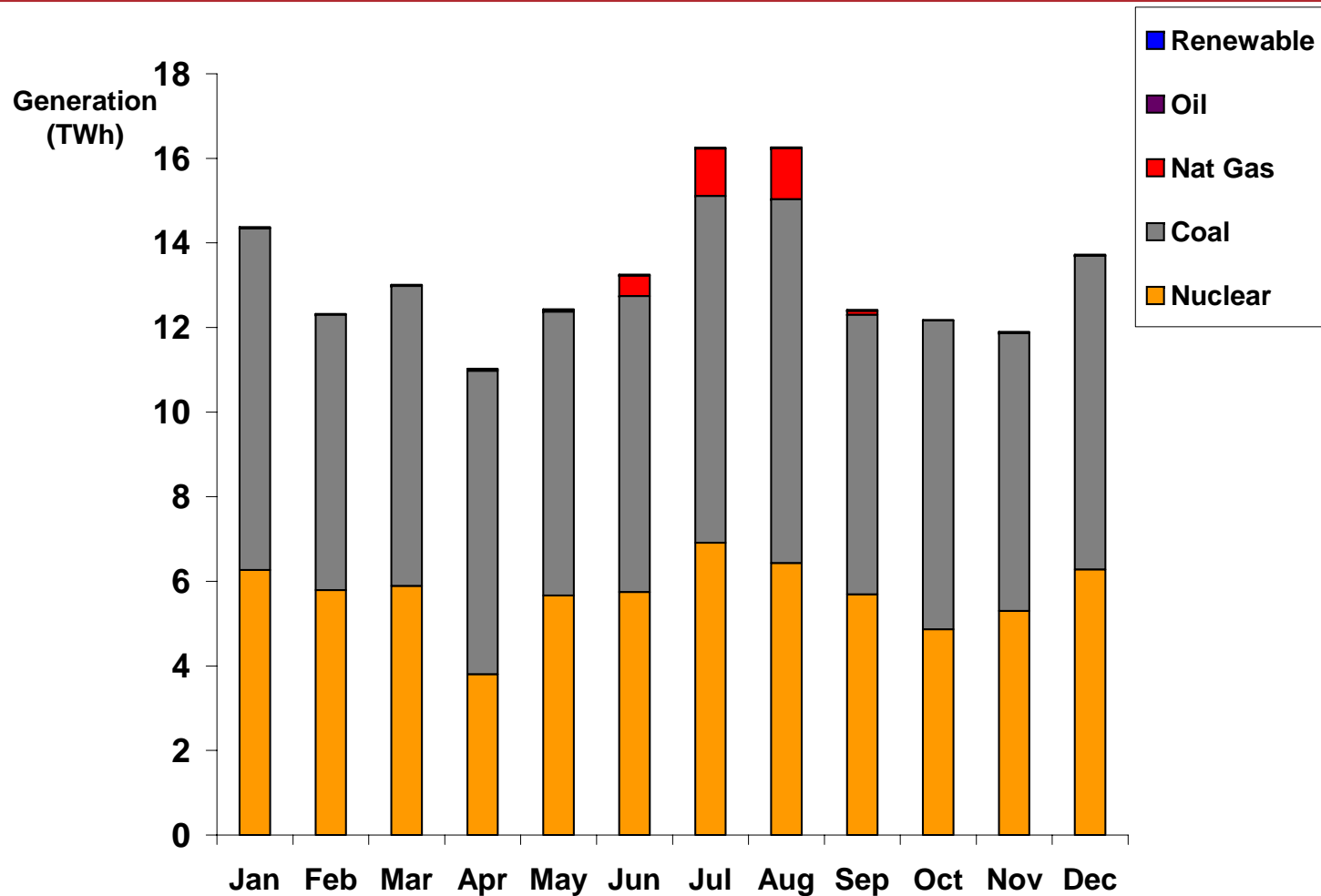
In the Production Cost Case for the Analysis Year 2007, the State Is a Net Exporter of Electricity



Approximately 6% of the electricity generated is exported



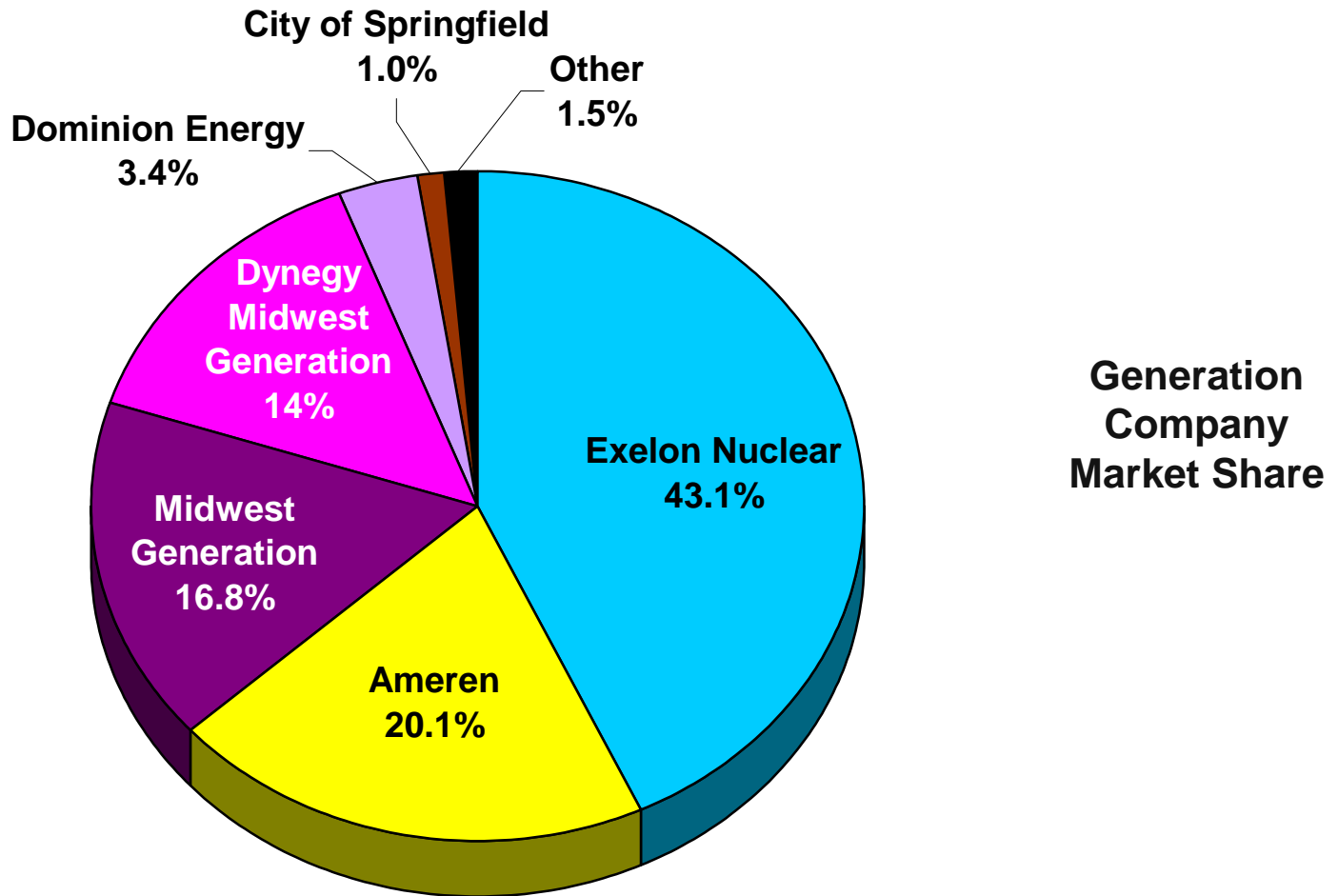
Coal and Nuclear Capture the Largest Market Share



Approximately 2% of the electricity is from natural gas and other sources



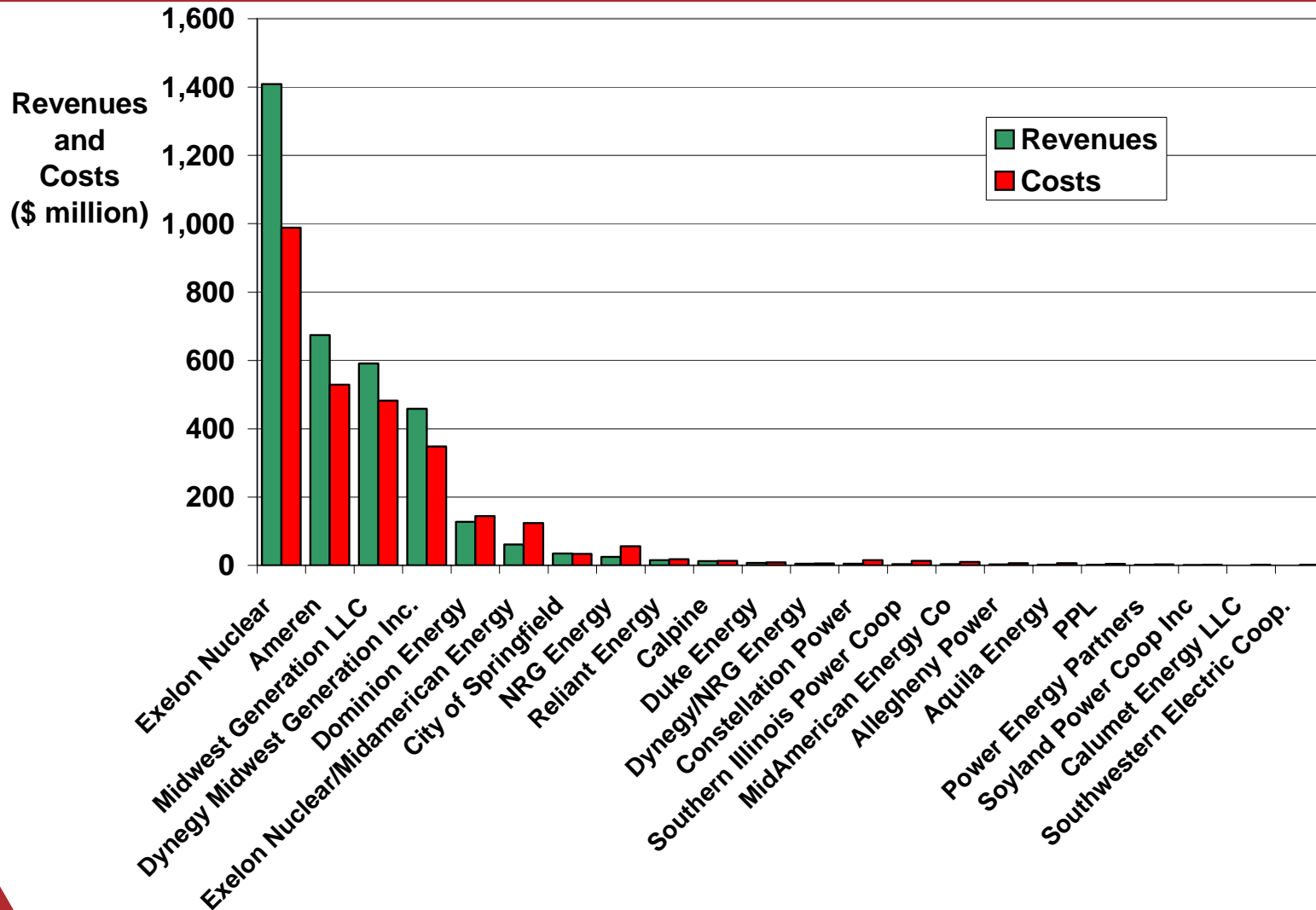
In the Production Cost Case, 4 out of 22 Companies Account for About 95% of the Market



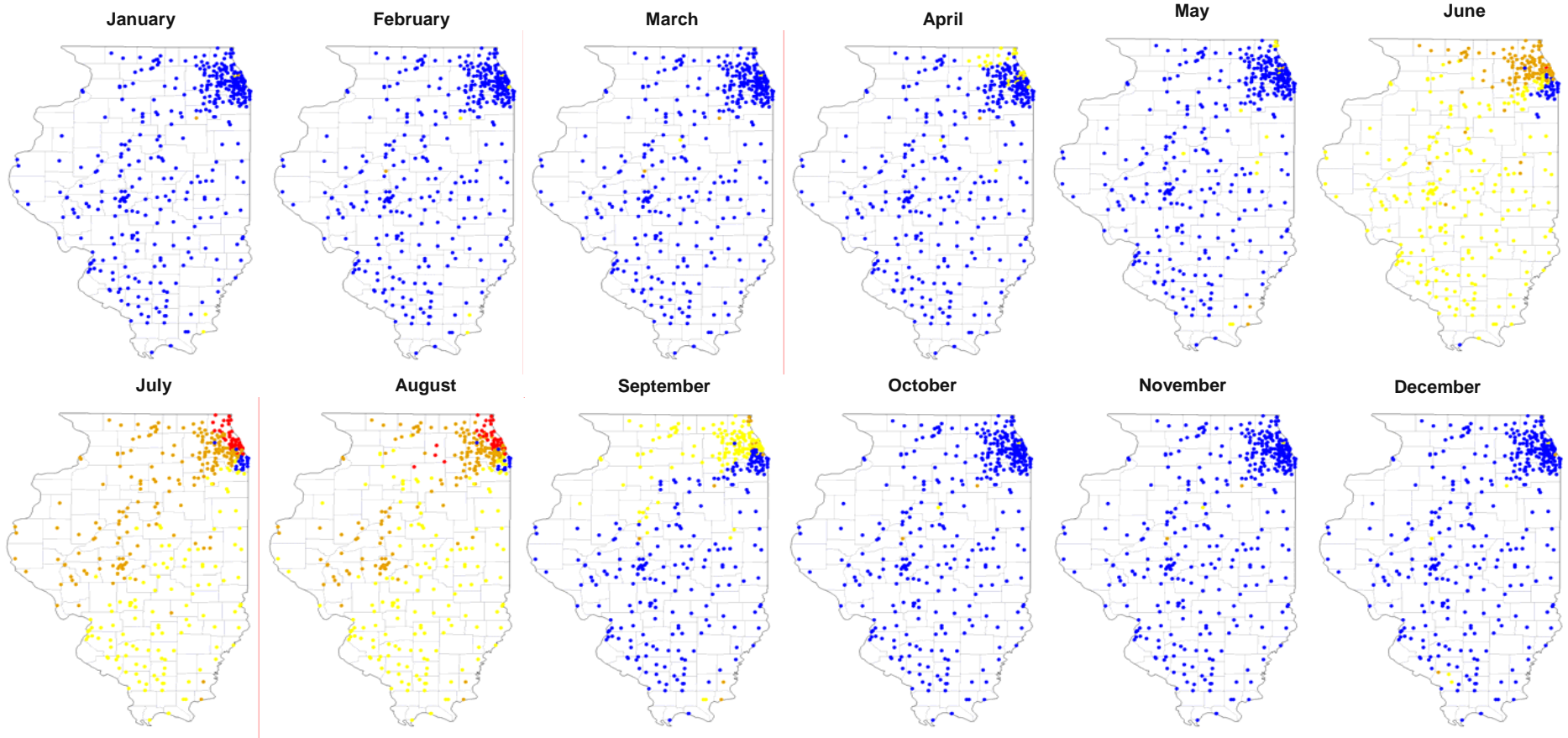
Out-of-state suppliers do not gain significant market share



Only 5 of 22 Generation Companies Show an Operating Profit In the Production Cost Case. Others Are Not Dispatched Enough to Recover Fixed Operating Costs.



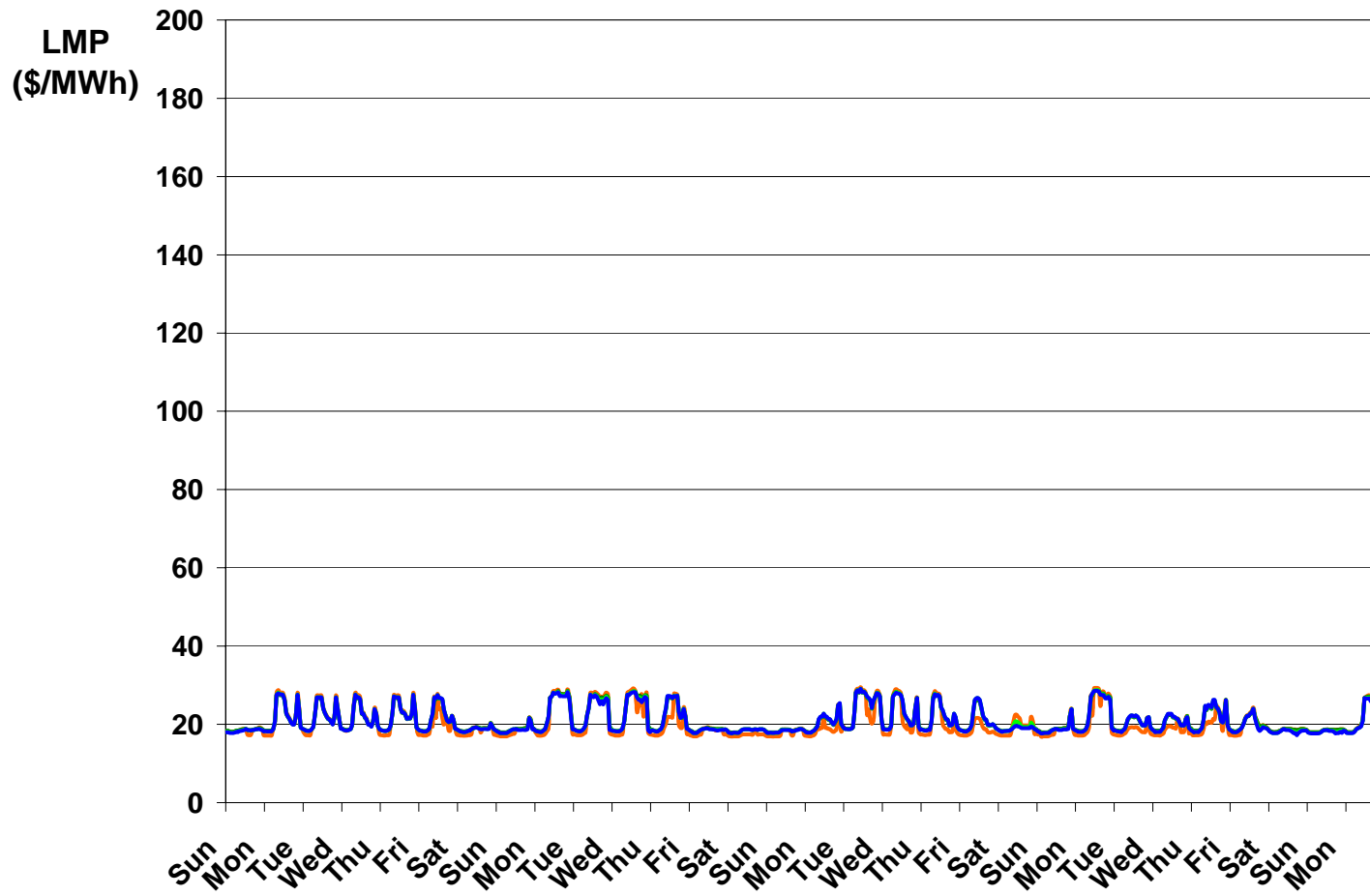
LMPs at Transmission Nodes Increase In the Peak Load Summer Months and Vary Across the State, Even Under Production Cost Conditions



LMP Price and Duration: Lower  Higher



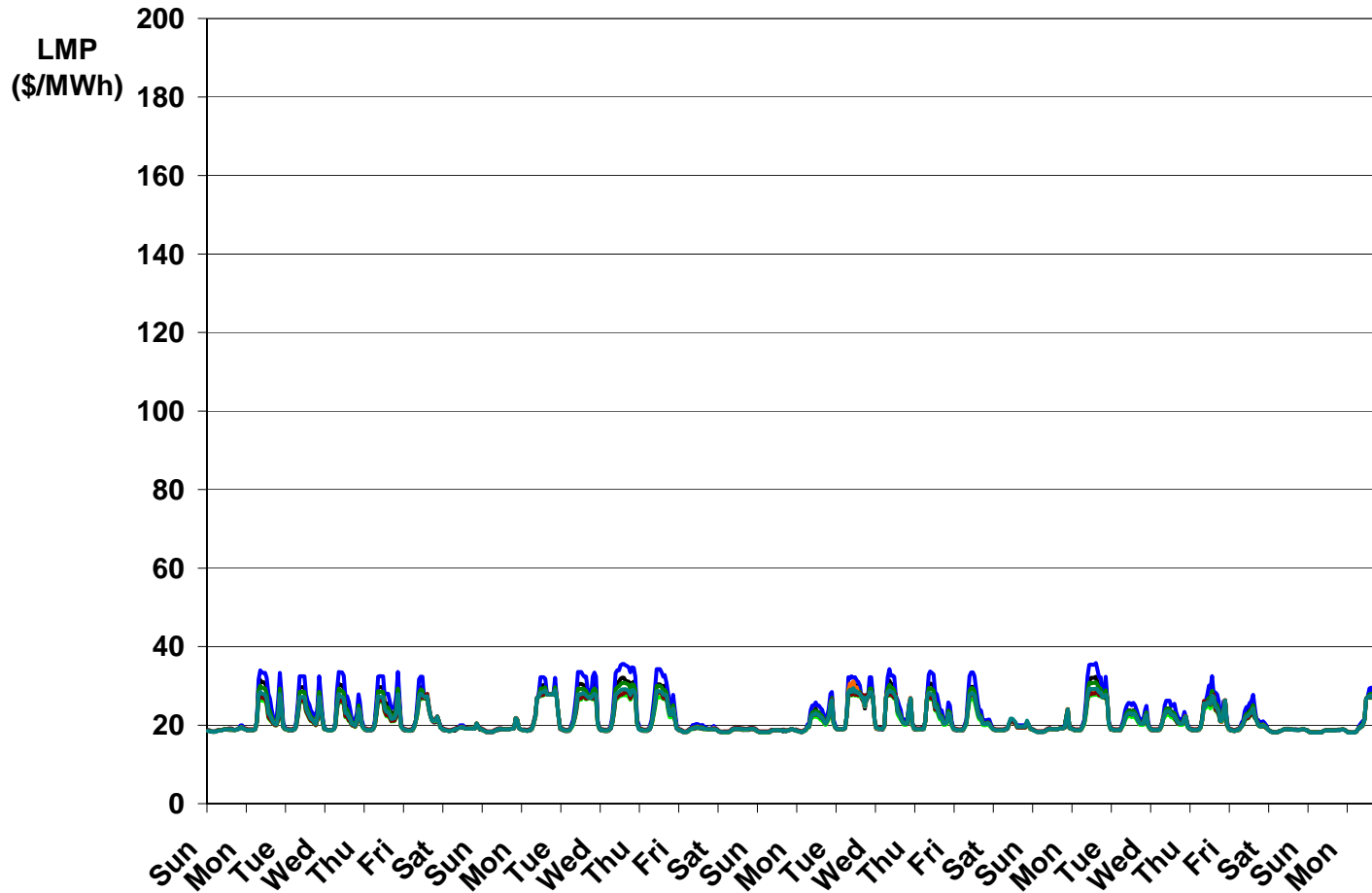
Four Downstate Zones in April (Low Load Month) LMPs Are Low and Close Together



Little Transmission Congestion



Four Downstate Zones in July (High Load Month) LMPs Are a Little Higher But Still Close Together

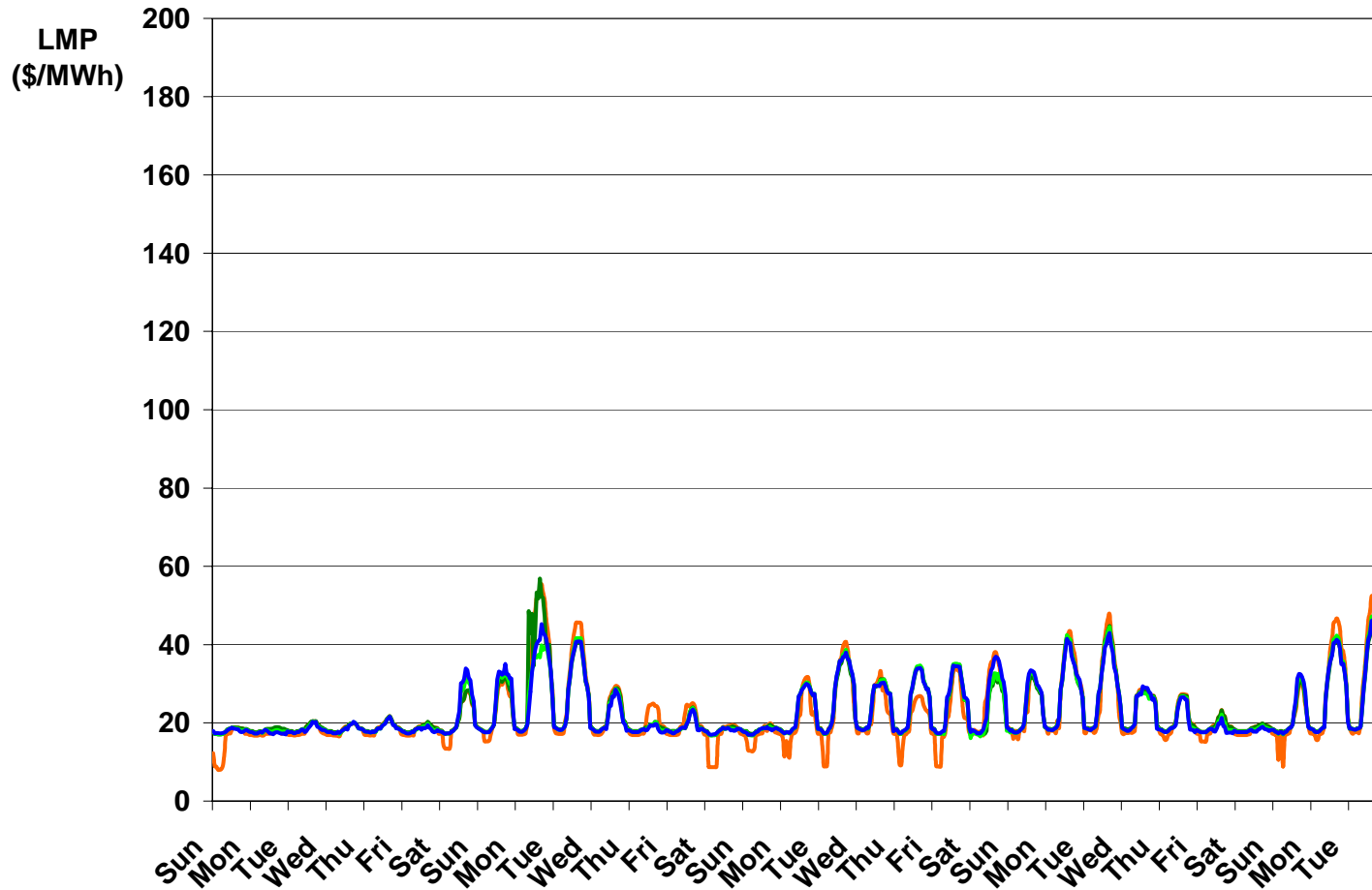


Little Transmission Congestion



Six Northern Zones in April (Low Load Month)

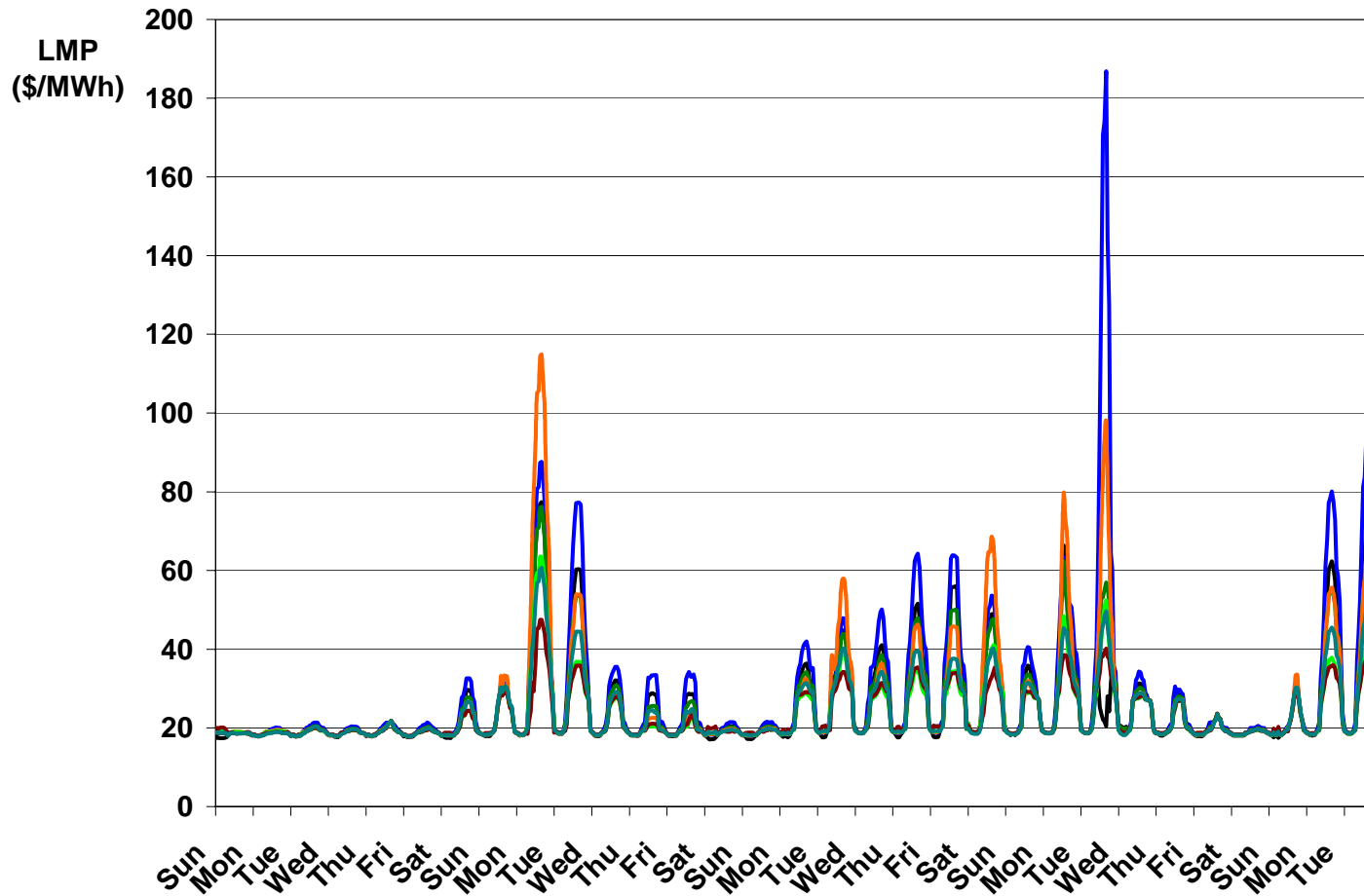
LMPs Are a Little Higher than Downstate But Close Together



Little Transmission Congestion



Six Northern Zones in July (High Load Month) LMPs Are High and with a Significant Spread



Noticeable Transmission Congestion

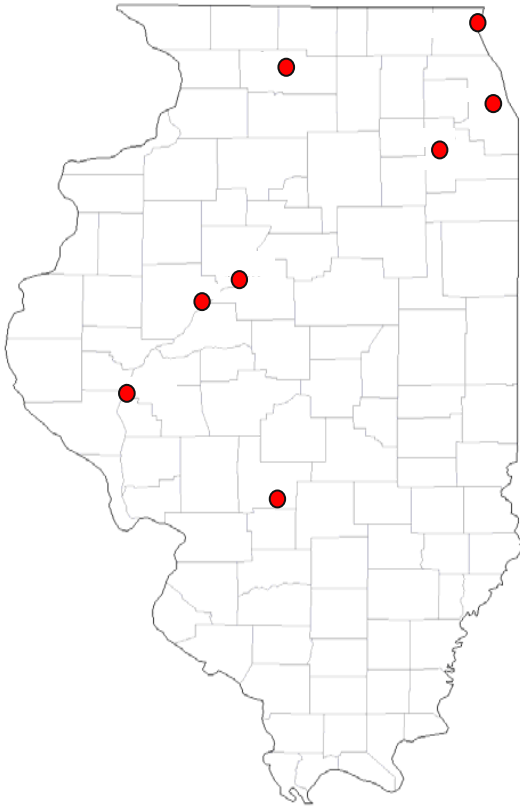


Physical Withholding Cases Were Studied

- Withhold generator units from the market
 - Reduce supply to cause prices to rise
 - Increase profitability of other units owned by the company
- Cases studied:
 - Withhold one unit at a time: *Does not increase profitability*
 - Use a profitability screen: *Does not significantly increase profitability*
 - System reserve screen: *Can increase profitability*



Units Withheld Using the System Reserve Screen Could Potentially Increase Prices and Profitability



- **Impact of physical withholding depends on:**
 - *Capacity withheld*
 - *Location on the network*
 - *Availability of replacement capacity*
- **Increase in company peak day operating profit:
\$2-14 million**
- **Increase in peak day consumer costs:
\$45-230 million**
- **Conservative assumptions do not change the
basic result**

- ***This assumes there is no market oversight or prohibition on withholding***
- ***There are some physical constraints on the ability to withhold large units***
- ***There is no implication that any company would do this***

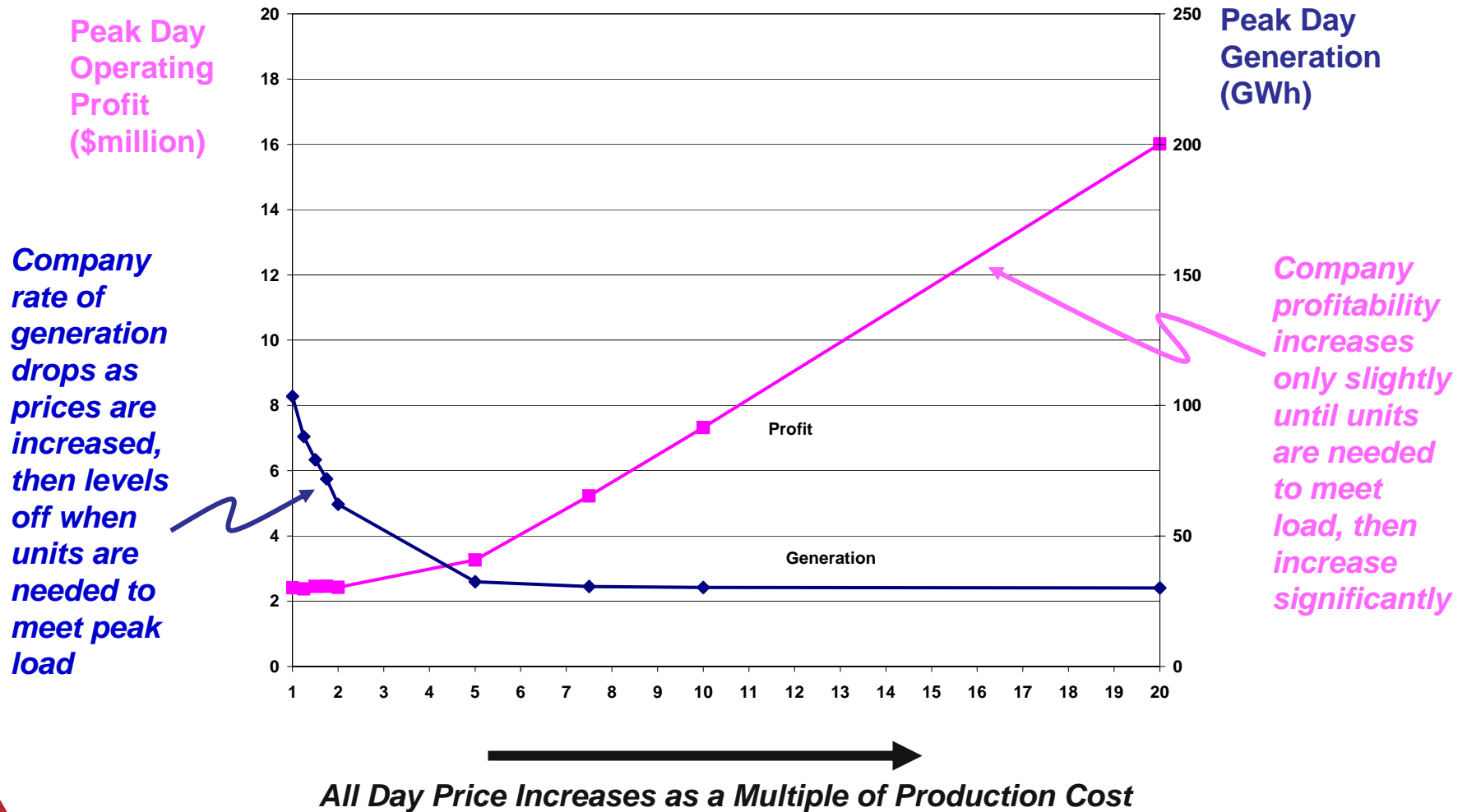


Economic Withholding Cases Were Studied

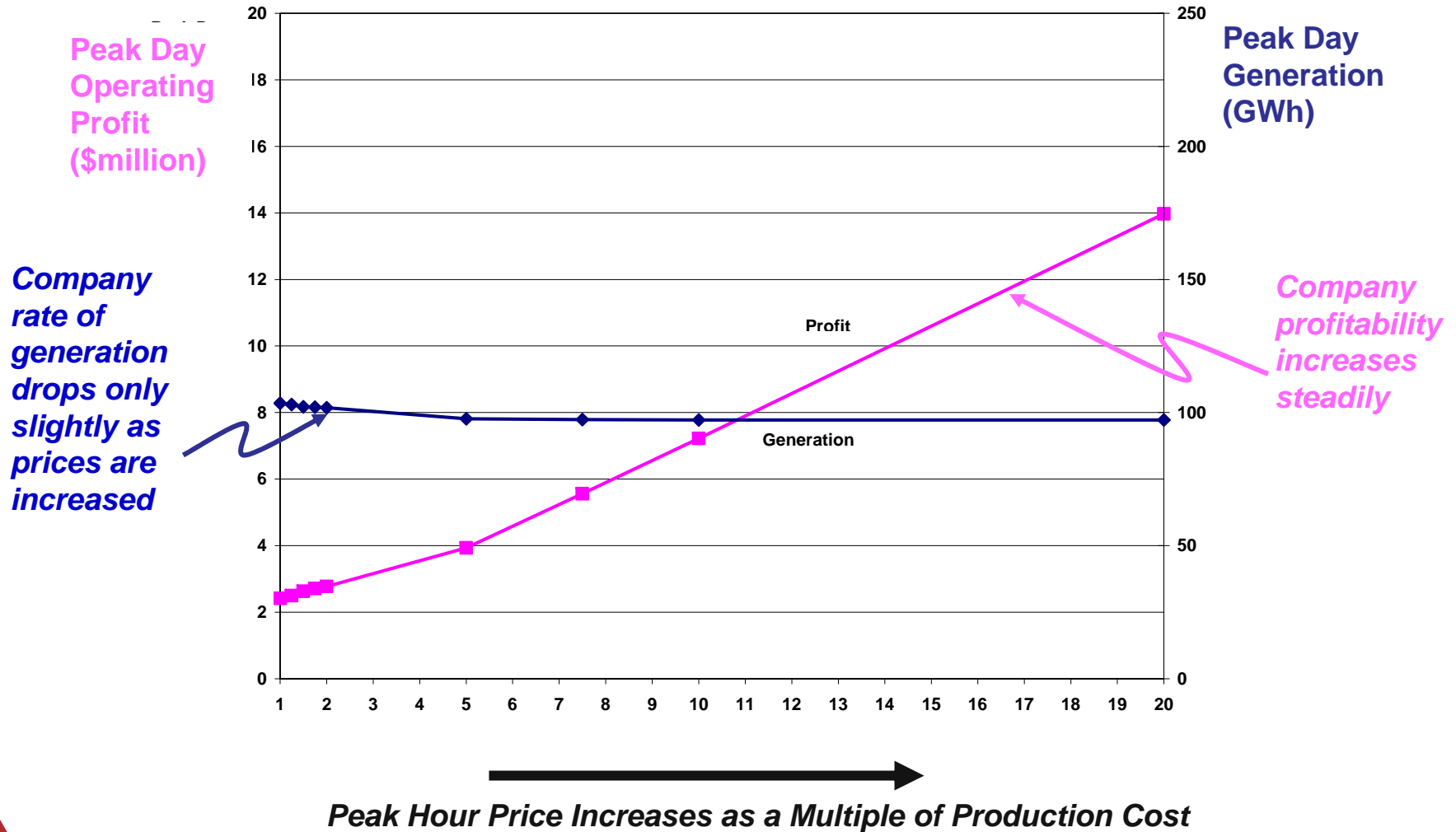
- Generator unit prices are increased
 - Units are not taken out of service
 - Prices increased relative to production cost
- Cases studied
 - Single unit price increases: *Does not increase profitability*
 - Companywide price increases in all hours: *Profitability increase but loss of market share*
 - Companywide price increases in peak hours: *Profitability increase with little loss of market share*



For Some Companies, Increasing Prices All Day Leads to a Loss of Generation Market Share But Can Increase Profitability



For Some Companies, Increasing Prices Only During Peak Hours Minimizes the Loss of Market Share



Overall Observations Under the Assumed Conditions

- The State has an abundance of generation capacity. The State is a net exporter of electricity. Virtually all the generation is supplied by coal and nuclear; only a small amount by natural gas.
- Using several indices, the generation market in the State is highly concentrated.
- The transmission system is adequate for most hours but will show signs of congestion about 5% of the time. During high load periods, transmission congestion causes prices to rise at different rates across the State, even with no exerting of market power.
- There is the potential for some companies to exercise market power (i.e., raise prices and increase profitability by unilateral action) and raise consumer costs under selected conditions, particularly when there is transmission congestion.
- The Conservative Assumptions (no forced outages) do not change the basic results.



Additional Work Is Needed to Expand the Understanding of the Electricity Market

- Improved representation of out-of-state generation and load
- Sensitivity analyses
- Effect of bilateral contracts
- Effect of consumer price responsiveness
- Addition of generation and transmission resources in key places
- Effect of market rules



Comments Received on the Study Made Several Major Points

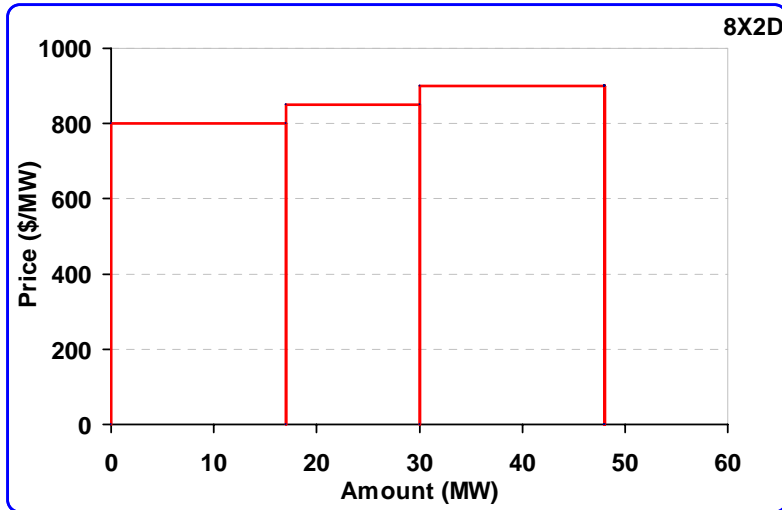
- The study does not reflect the current operating practices of the PJM/MISO markets
 - *Agree*
 - *Modeling of alternative market rules was originally proposed as a later phase of the study.*

- The data and information used in the report have been superseded
 - *Agree*
 - *The study was not intended to be a one-time effort. The plan was to have ICC staff use the model and data in-house for updating and further analysis.*

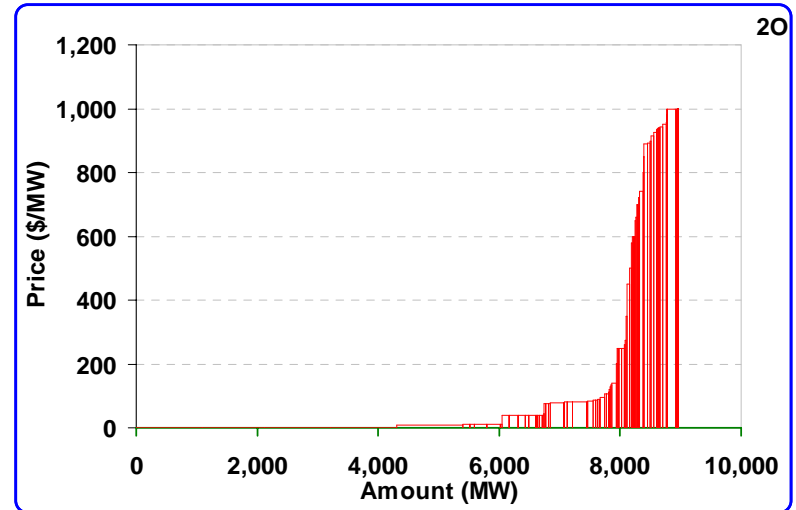
- The results have no relevance to the current situation
 - *Strongly disagree*



Examples of Generator Bids in PJM for July 26, 2005 Illustrate Bidding That Goes Beyond Production Cost



GenCo 90 bid unit 8X2D of 48 MW
at 800-900 \$/MWh

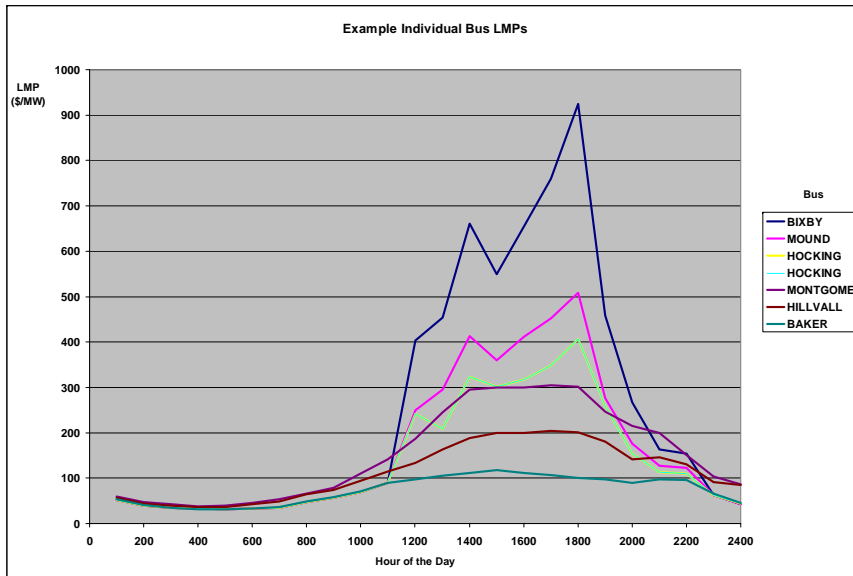


On a companywide basis, GenCo 20 bid almost 9,000 MW into the market. Approximately the last 1,000 MW of the company's capacity were bid at prices greater than 600 \$/MWh.

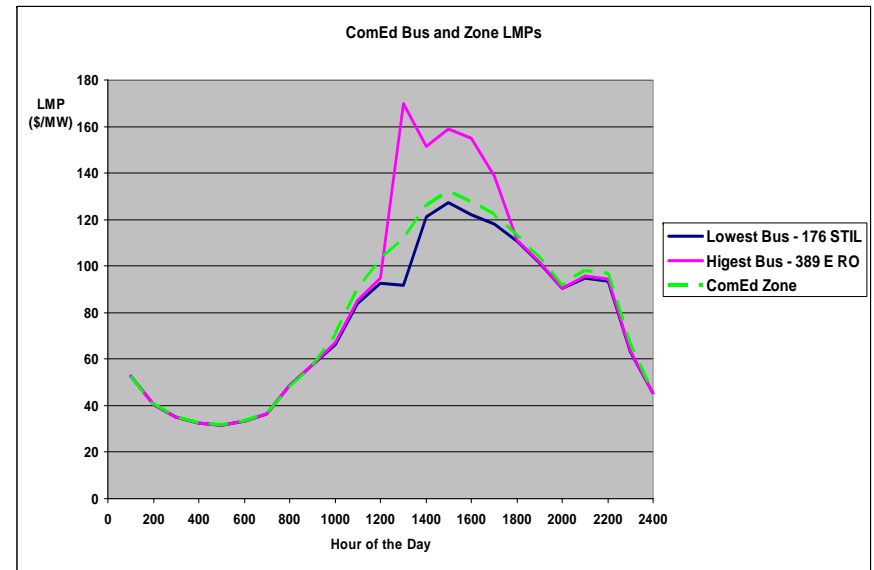
- ***These are actual bids, not model results***
- ***It is not possible to determine if the bids were accepted***
- ***Market monitor actions in response to the bids are unknown***



PJM Data on LMPs for July 26, 2005 Show the Effects of Generator Bids and Transmission Congestion



Selected PJM LMPs



Selected ComEd LMPs



There Is Strong Agreement with Several Comments

- “The most important finding of the study is the rigorous demonstration that the transmission system is a vital part of an energy market.”

- Ameren Electric

- “...the necessity for RTOs to continue to refine the independence of their transmission system operations, market designs, market rules and oversight of the RTO market by market monitors.”

- PJM

