



# Transmission Constraints and Electric Generation Market Power: Some Trends in Regulation and Research Topics

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# Some Acronyms

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AMP	Automated Mitigation Procedure
CT	Combustion Turbine
DAM	Day-Ahead Market
HHI	Herfindahl-Hirschmann Index
ISO	Independent System Operator
LMP	Locational Marginal Price
MCP	Market Clearing Price
RMR	Reliability Must Run
RP	Reference Price
RTM	Real-Time Market
RTO	Regional Transmission Organization



# Outline

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- **Background**
- **Transmission Constraints in Long-Term Generation Market Power Analysis**
- **Transmission Constraints in Short-Term (Spot) Generation Market Power Screening and Mitigation**
- **Load Pocket Market Power Mitigation, Fixed Cost Recovery and Investment: A New England Case**
- **Market Design Options**

# Definition of Market Power

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- Basic economic definition: “ability to alter prices from competitive levels” by physically or economically withholding a product or service
  - Transmission constraints (physical limits; reliability limits or requirements) subdivide the geographic market in a dynamic fashion
- Regulatory definition: when is market power of concern?
  - Needs appropriate time-frame, e.g., 5 minutes, 1 hour, “sustained”
  - Needs upper and lower bound around competitive level, e.g., 5%, 10%, 100%, etc.

# Regulatory Applications of Market Power Screening and Mitigation

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	<i>Ex Ante</i>	<i>Ex Post</i>
<b>Long-term</b>	<ul style="list-style-type: none"><li>- mergers</li><li>- market-based rates</li><li>- RMR rules</li></ul>	<ul style="list-style-type: none"><li>- California refund case</li></ul>
<b>Short-term</b>	<ul style="list-style-type: none"><li>- spot market mitigation</li></ul>	<ul style="list-style-type: none"><li>- short-term market price re-calculations</li><li>- penalties for withholding</li></ul>

# Current Analytical Methods for Market Power Screening

	<i>Ex Ante</i>	<i>Ex Post</i>
<b>Long-term</b>	<ul style="list-style-type: none"><li>- largely structural analysis, e.g., HHIs, pivotal supplier</li></ul>	<ul style="list-style-type: none"><li>- Simulation of historical market prices</li><li>- econometric and statistical analysis</li></ul>
<b>Short-term</b>	<ul style="list-style-type: none"><li>- Bid screening with mitigation rules</li><li>- Some use of structural metrics to trigger screening, such as pivotal supplier test</li></ul>	

# Network Representation in Regional Market Modeling

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- “Transportation” Models
  - High level of aggregation
  - Transmission rates/hurdle rates determine flows between regions
  - Quick solution time useful for long-term planning and/or market modeling
- AC power flow
  - Nonlinear equations that govern power flow
  - Used in shorter-term planning, reliability analysis and system operations
- DC power flow
  - Linearization of the AC model; used in planning, system operations and adaptable for both short-term and long-term market modeling
  - Level of network aggregation can be adjusted
  - Quick solution time for market modeling

# Analytical Methods: Ex Ante, Long-Term

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- **Horizontal Merger Screening**
  - 1996 FERC Delivered Price Test (DPT)
- **Market-Based Rates Screening**
  - 2003 FERC Supply Margin Assessment (SMA)
- These are model-based screens with “transportation” network representation used to calculate measures of market share.
  - The DPT solves how much power can be delivered to a pre-defined geographical market up to a 5% increase in price. The resulting HHI is the screen.
  - The SMA (evolving) is a network model that solves for pivotal suppliers under various system conditions



# Analytical Methods: Ex Ante, Long-Term (*cont.*)

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- Modifications to Existing Ex Ante, Long-Term methods
  - Refinements current under consideration in structural tests, e.g., from simple concentration indices to pivotal supplier
  - Refinements in network representation; can more realistic network models be applied?
    - Market share metrics, such as HHIs, can be problematic on electrical networks
    - How “granular” should the network model be?
- Alternative Ex Ante, Long-Term Methods
  - Oligopoly equilibrium modeling with detailed transmission constraints (e.g., Hobbs presentation)
    - Under some assumptions, can consider detailed transmission networks

# Analytical Methods: Ex Ante, Short-Term

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- **Spot market mitigation based on transmission constrained market outcomes**
  - Variety of methods currently in use or proposed in ISO/RTOs in PJM, New York, New England, California. Each has one or more of the following:
    - Triggering conditions for invoking bid screening, such as prices above a pre-defined level or the presence of binding transmission constraints;
    - Screening methods, such as a pivotal supplier test or bid thresholds, typically differentiated between inside load pockets and outside;
    - Market impact test, to determine whether to mitigate a particular bid.

# Analytical Methods: Ex Ante, Short-Term (*cont.*)

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## ○ **Spot Market Mitigation**

- ISO methods following mitigation trigger:
  - New York, New England, MISO (proposed): each bidder has a reference price based on an average of accepted offers; bid thresholds determine whether the bidder's conduct is subject to scrutiny; a market impact test determines whether the bid is mitigated to the reference level.
  - PJM: accepted offers that are "out of merit" are automatically mitigated to marginal cost + 10%.
  - California: offers by pivotal suppliers are mitigated to reference price.

# System-Wide Spot Market “Safety Net” Bid Caps

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<b>NYISO</b>	\$1,000/MWh
<b>ISO-NE</b>	\$1,000/MWh
<b>MISO</b> <i>(proposed)</i>	\$1,000/MWh
<b>Cal-ISO</b> <i>(proposed)</i>	\$250/MWh
<b>PJM</b>	\$1,000/MWh

# Bid Thresholds/Caps inside Load Pockets

<b>NYISO</b> <b>(bid threshold)</b>	$RP + 8760 \times \text{average price in RTM over prior 12 months} \times (2\% \div \text{total constrained hours over prior 12 months})$
<b>ISO-NE (temporary)</b> <b>(bid threshold)</b>	Net Annual Fixed Cost/ Expected Run Hours
<b>MISO (<i>proposed</i>)</b> <b>(bid threshold)</b>	Net annual fixed cost of a new peaker $\div$ total constrained hours over prior 12 months
<b>Cal-ISO</b> <b>(bid threshold)</b>	Lower of \$50 or 200 % greater than the MCP
<b>PJM</b> <b>(bid cap)</b>	Same for all areas (see next table)

# Bid Thresholds/Caps outside Load Pockets (compared to reference price)

<b>NYISO</b> (bid threshold)	lower of 300% increase or an increase of \$100/MWh
<b>ISO-NE</b> (bid threshold)	lower of 50% increase or an increase of \$25/MWh
<b>MISO</b> ( <i>proposed</i> ) (bid threshold)	lower of 300% increase or an increase of \$100/MWh
<b>Cal-ISO</b> (*bid threshold for all areas)	lower of 200% increase or an increase of \$100/MWh
<b>PJM</b> (bid cap)	Out of merit generators mitigated to marginal cost plus 10%

# Bid Thresholds/Caps outside Load Pockets: Triggering Conditions and Identification of Suppliers Subject to Mitigation

<b>NYISO</b> (bid threshold)	LMPs $\geq$ \$150 to trigger AMP
<b>ISO-NE</b> ( <i>proposed</i> ) (bid threshold)	Identification of pivotal supplier to trigger AMP
<b>MISO</b> ( <i>proposed</i> ) (bid threshold)	Binding transmission constraint and threshold generator shift factor on that constraint to trigger AMP
<b>Cal-ISO</b> (bid threshold)	MCP must be $\geq$ \$91.87 to trigger AMP
<b>PJM</b> (bid cap)	Out-of-merit generation

# Market Impact Tests outside Load Pockets

<b>NYISO</b>	LMP increases by 200% or \$100/MWh
<b>ISO-NE</b>	LMP increases by 200% or \$100/MWh
<b>MISO (<i>proposed</i>)</b>	LMP increases by 200% or \$100/MWh
<b>Cal-ISO</b>	The lower of a \$50 or 200% increase in the MCP compared with a reference MCP in which all bids failing the conduct test are replaced.
<b>PJM</b>	none



# Market Power Mitigation, Fixed Cost Recovery and Investment: A New England Case

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- **Setting:** A “load pocket” in Connecticut
- **Issue:** Certain peaking generators claimed that they were not recovering sufficient revenue to cover annual operating fixed costs from the energy market under bid mitigation and sought to be operated under cost-of-service regulation
- **Regulatory Objective:** ISO New England wants these units operable (RMR). Provide market mechanisms to allow for fixed cost recovery and provide price signals for investment

## New England Case (*cont.*)

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- Prior rules: Certain RMR peaking units are allowed to offer up to incremental proxy Combustion Turbine operating cost
- New rules (2003): Peaking Unit Safe Harbor (PUSH) allows peaking units with low capacity factors to offer up to their marginal energy costs plus levelized fixed costs

# New England Case (*cont.*)

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- PUSH results, summer 2003
  - Rules fail to allow sufficient fixed cost recovery by PUSH eligible units
    - Cool summer, so lower capacity factors than expected
    - Units bid at PUSH cap may have bid themselves out of market on occasion
  - Rules fail to provide sufficient locational price signal
    - Many PUSH eligible units are run at low operating level for reserves, hence not eligible to set the LMP

# New England Case (*cont.*)

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- ISO recommendations:
  - PUSH rules did not yield appropriate price signals for investment and should be replaced
  - Locational capacity markets
  - Consider locational reserve markets to supplement reserve payments and induce entry of new generation with desirable operating characteristics

# New England Case: More Reading

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- FERC Order:

<http://www.iso-ne.com/FERC/orders/er03-563-000a.pdf>

- Summer 2003 results:

[http://www.iso-ne.com/smd/market\\_monitoring\\_and\\_mitigation/PUSH\\_Implementation/PUSH%20Report.pdf](http://www.iso-ne.com/smd/market_monitoring_and_mitigation/PUSH_Implementation/PUSH%20Report.pdf)

# Analytical Methods: Ex Ante, Short-Term (*cont.*)

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- Modifications to Existing Ex Ante, Short-term methods
  - Are existing market power metrics (e.g., pivotal supplier or out-of-merit) appropriate triggers for screening of bids?
  - Or are the more important questions related to market design? (next slide)



# Market Design Alternatives

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- Market mechanisms that provide appropriate scarcity price signals in mitigated ISO spot markets
  - Price adders or administrative demand curves during periods of shortage
- Market mechanisms that provide additional payments in mitigated ISO spot markets
  - Locational capacity and reserve payments