Some issues on Scarcity Pricing*

FERC Research in Market Oversight (RIMO) Program
CPUC Project

Bishu Chatterjee (CPUC) / Keith Collins (FERC)
In collaboration with FERC Division of Energy Market Oversight

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*** The views expressed in this project are solely those of the researchers and not necessarily those of the California Public Utilities Commission nor the Federal Energy Regulatory Commission**

Overview

- FERC RIMO Program
- Scarcity Pricing context in CAISO
- Review of Scarcity Pricing in RTO/ISO
- Examine scarcity conditions based on predefined Heat Rates
- Examine Off-peak hour shortage conditions
- Role of Scarcity Pricing in energy only market versus capacity market
- Conclusion

The Scarcity Pricing context

In MRTU Release 1 the CAISO will have a limited scarcity pricing mechanism where bids will be raised to bid cap when there are insufficient energy bids

In September 2006 MRTU Order, FERC ordered a more comprehensive reserve shortage scarcity pricing to be implemented within 12 months of the MRTU Release 1

In April 2007 MRTU Order FERC further emphasized that 1) Prices should rise when energy and reserves are short in Day Ahead and Real Time 2) Reserve shortage scarcity pricing that applies administratively-determined graduated prices to various levels of reserve shortage

Scarcity Pricing (SP)

SP is based on the idea that under scarcity conditions generating units will receive higher compensation. This additional revenue stream helps to incentivize investment in new generation and promotes overall system reliability. When supply conditions are tight and drop below a pre-determined threshold level, the price for additional MW significantly rises.

Scarcity Pricing (SP) Program and Scarcity Pricing

The SP exists in various ISO /RTOs can be grouped as follows:

SP Program: SP Program has pre-specified prices/rules so when scarcity conditions (a tight supply situation due to pre-specified shortage) are triggered, such pre-administratively determined prices set SP. SP Programs exist in PJM, MISO, NYISO, ISONE, CAISO (MRTU Release 1A).

SP Programs

- Reserve demand Curve for shortage pricing uses pre-defined shadow prices for reserves under scarcity conditions and energy prices automatically reflect cost of reserves under scarcity conditions. Example, NYISO and ISONE.
- SP Program also determines SP via the co-optimization of energy and ancillary services. The locational and temporal constraints for ancillary services given congestion and scarcity determine SP. Under the co-optimization, energy and reserves are priced simultaneously to reflect the opportunity cost of not providing the product. Example, NYISO and ISONE. PJM optimizes energy and reserves sequentially.

SP via demand/supply conditions that are outside the SP Program

SP can also be set outside the SP program by demand and supply conditions due to tight supply conditions. Such SP do not have pre-specified prices but are based on willingness of load to curtail load at such price. These concepts are similar to Value of Lost Load w/ an Offer Cap. Example: ERCOT ($1500/MWh), PJM, MISO, NYISO, ISONE ($1000/MWh),CAISO($500/MWh).

SP in PJM

SP Trigger (SP region is incapable of meeting demand under normal economic dispatch conditions) and PJM performs any of the following:

1. Distribution Level Voltage reduction action by 5 percent to provide load relief

2. Dispatch of online generators partially designated as Maximum Emergency into emergency output levels, entirely designated as Maximum Emergency above their minimum load points, and offline generators designated to run only in emergency conditions.

3. Manual Load Dump – to disconnect firm customer load

SP in PJM…(2)

SP = Highest Offer Price to supply either energy or reserves in Real-Time subject to the overall offer cap of **$1000/MWh**

In the State of the Market Report 2006 the PJM Market Monitor recommends

- Stages of SP – based on system conditions with progressive impacts on prices
- Locational Price Signals

SP in MISO

SP Trigger

1. Day Ahead Maximum Generation Emergency conditions (event steps 1 to 5) – shortage when the sum of demand bids (including price sensitive demand), exports, and virtual bids cannot be satisfied from generation, imports, and virtual supply. [market demand ≥ market supply].

2. Real Time shortage when real Time demand forecast ≥ Available generation + Self Schedules + Demand Response Resources.

SP = The higher of the Market Participant submitted Resource Offer/ARC in step 1 or $1000/MWh in step 2

Step 1 SP in MISO…(2)

Step 1 uses up to 50% of the emergency range of online generators to handle load change less than 1 hour in duration (addresses temporary supply and demand)

Adequate Ramp Capability (ARC): ARC captures the value of operational flexibility and electricity price fluctuation. ARC allows an incremental procedure to release operating reserves for energy dispatch.

The ARC price is set by the higher of offered price or a Peaker Proxy Offer (Daily Peaker Proxy is calculated from monthly Peaker Proxy Heat Rate based on average CT offers in Real Time market during previous month) and Daily Spot Price (Chicago spot gas) index.

SP in MISO…(3)

Adequate Ramp Capability Pricing example:
Start-up = $3,000 per start
No-load = $750 per hour, Incremental energy = $100/MWh
Capacity = 50 MW
Total Single Hour Offer = ($3000/50) + ($750/50) + $100 = $175/MWh
Total offer = $175/MWh
Spot Gas = $7.44/MMBtu
Peaker Proxy heat Rate = $175/$7.44 = 23.5 MMBtu /MWh

The Proxy Peaker Price is determined as follow:
On 6/1/2005 gas price = $6.32
Proxy Peaker Heat Rate = 23.5
Proxy Peaker Price = $6.32 * 23.5 = $148.5

Shortage Price is set higher of the offer or proxy peaker price.

Step 2 uses additional capacity needed or longer period, 100% of the dispatch range.
In step 2, the offer price released capacity segments is set to $1,000/MWh
Interruptible generation is called on when MISO calls a Max Generation Emergency - Event Step 1 (NERC Engineering Emergency Alert 2) to Firm load shedding - Event Step 5 (NERC EEA 3).

SP in NYISO

SP Trigger

Reserves (10-min spinning, 10-min non-synchronized, 30-min) by location shortage

SP =

	NYCA	Eastern NY	Long Island
10 m Spinning	$500	$25	$25
10 m Total Reserve	$150	$500	$25
30 m Reserve	200 MW @ $50 200 MW @ $100 200 MW @ $200	$25	$300

SP in NYISO…(2)

	NYCA	Eastern NY	Long Island
10 m Spinning	**$850** **= $500+$150+$200**	**$1400** =$500 + $25 + $$150 + $500 + $200+ $25	**$1750** = $500 +$25+$25 + $150 + $500 + $25 +$200 + $25 + $300
10 m Total Reserve	**$350** = $150 + $200	**$875** = $150 + $500 + $200 +$25	**$1200** =$150 + $500 +$25 + $200 +$25 + $300
30 m Reserve	**$200**	**$225** = $200 + $25	**$525** = $300 + $200 + $25

SP in NYISO…(3)

System Wide Regulation Demand Curve

Regulation	Demand Curve Value
Need > 25 MW to meet Target	$300/MW
Need < 25 MW to meet Target	$250/MW

2. Energy Reserve co-optimization in Real Time

Guarantees that the clearing prices of energy, reserves, and regulation fully reflect opportunity cost

Example: LMP = $120/MWh Offer Price = $50/MWh

SP for LI = $70 + $1750/MWh

SP in ISONE

SP Trigger via Locational Forward and Real Time Reserve Market that co-optimize Energy and Reserve

Physical Reserve Shortage = System not having enough capacity to meet the total energy and reserve requirement

LMP = Marginal Unit's Offer Price + Reserve Market Clearing Price

Economic Reserve Shortage = System re-dispatch cost to procure reserve exceeds the value of Reserve Constraint Penalty Factors (System 10 Min spin - $50/MWh, System Total 10 Min Reserves $850/MWh, System 30 Min - $100/MWh, Local 30 Min - $50/MWh)

LMP = Marginal Unit's Offer Price + Re-dispatch cost to produce additional 1 MW of reserve

SP in ERCOT

SP Trigger: Based on the supply demand conditions

SP is based on the Australian model. At the beginning of the Resource Adequacy Cycle the offer cap is set to $1500/MWh (High Cap) but if the Peaker Net Margin [the sum of all positive differences between the clearing price and estimated marginal cost of a hypothetical peaker with 10 Heat Rate] exceeds $175,000 per MW then the offer cap is reset to a lower level (Low Cap) to $500/MWh or $500 per MW per hr. for the remainder of that annual resource adequacy cycle.

2005-6 Instances of SP Trigger

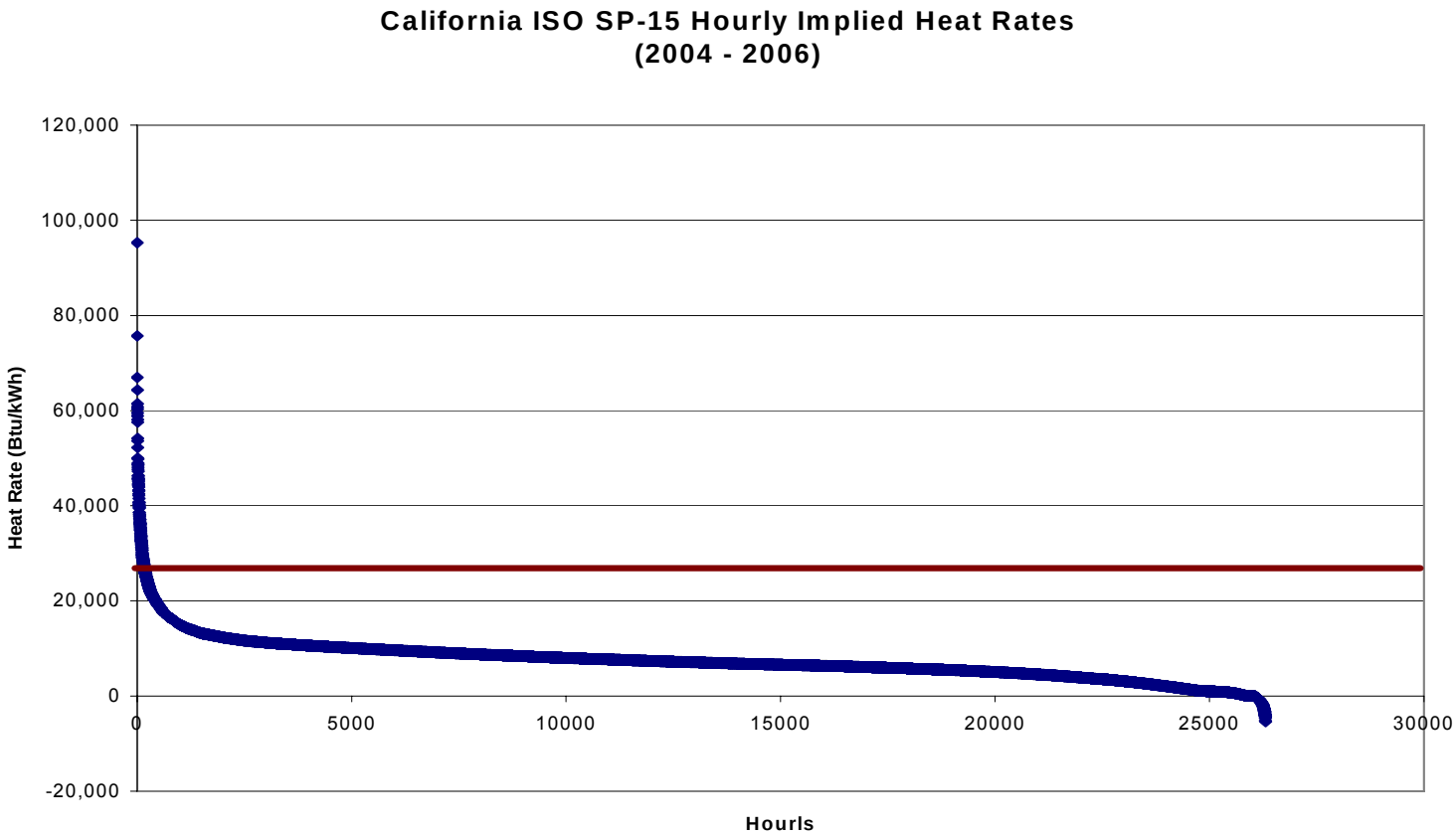
Year	PJM	MISO	NYISO	ISONE	CAISO	ERCOT
2005	July 26 – 5 h July 27 – 4.5 h	None	Aug 27 – 4 h	None	NA	
2006	None	In 2007 ARC June 15-15m June 20 – 30 m	July 18 – 9h July 19 – 9h Aug 1 – 5h Aug 2 – 11h Aug 3 – 6h	Aug 1 – 40 m Aug 2 – 4 h 45 m	NA	In 2007 on April 3 – 7 fifteen minute intervals

Methodology

- Scarcity pricing defined as heat rates over 25,000 Btu/kWh. Only the most inefficient gas plants run at this level.
  - For example, AES Redondo Beach in California is rated at or above 25,000 Btu/kWh in 2006.
  - This is not a magical heat rate, but just one that attempts to capture just the scarcity periods.

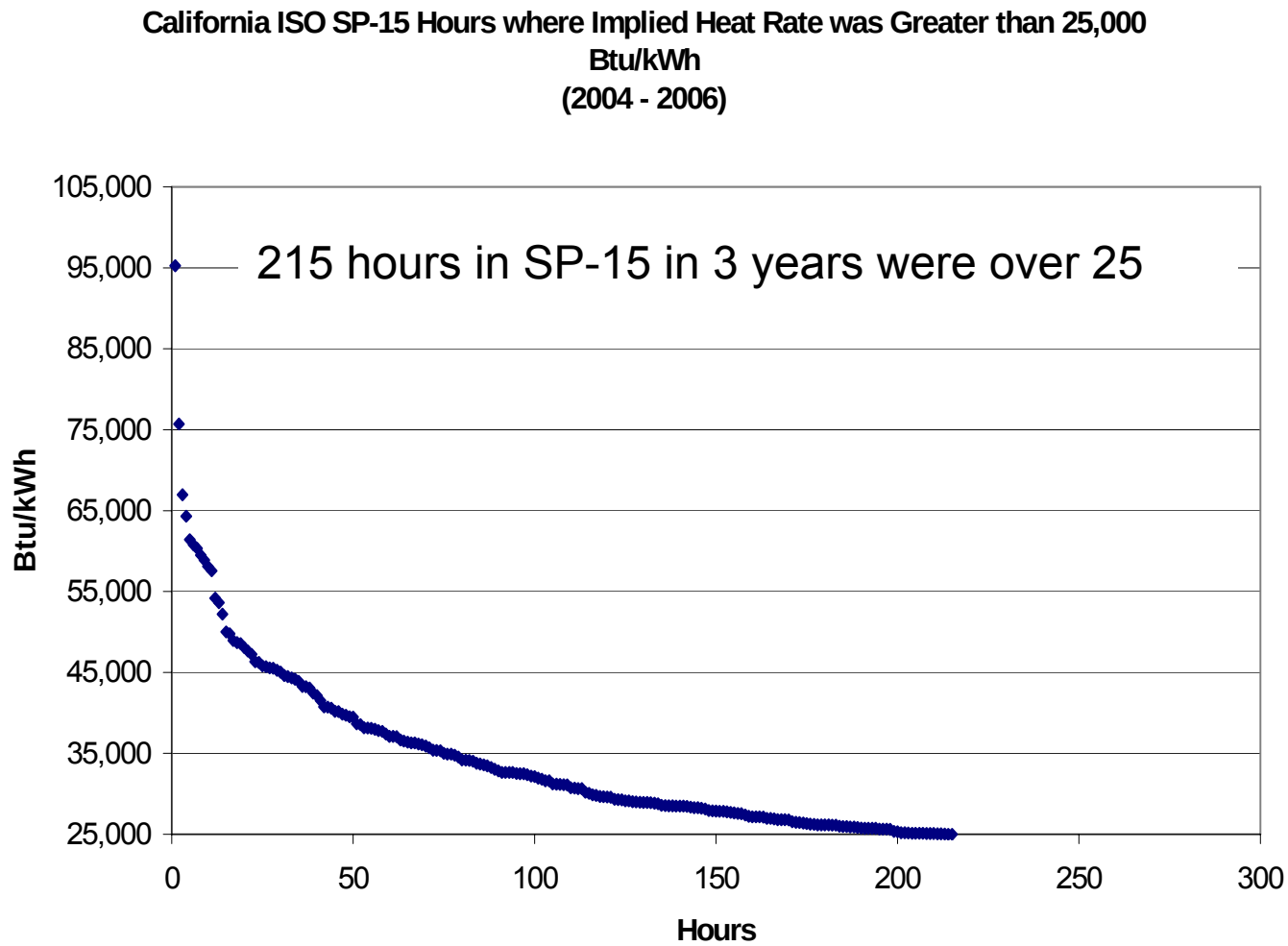
- Hourly real time electricity prices from the RTO/ISOs were compared to the daily day-ahead Gas Daily price.
  - While scarcity can be approximated in day-ahead markets, the system events occur in real time.
  - Though gas prices may vary during the day, the daily price is a reasonable approximation of average variable fuel costs.
  - O&M costs were not factored into this analysis.

Implied heat rates were calculated for every hour from 2004 to 2006



Hours

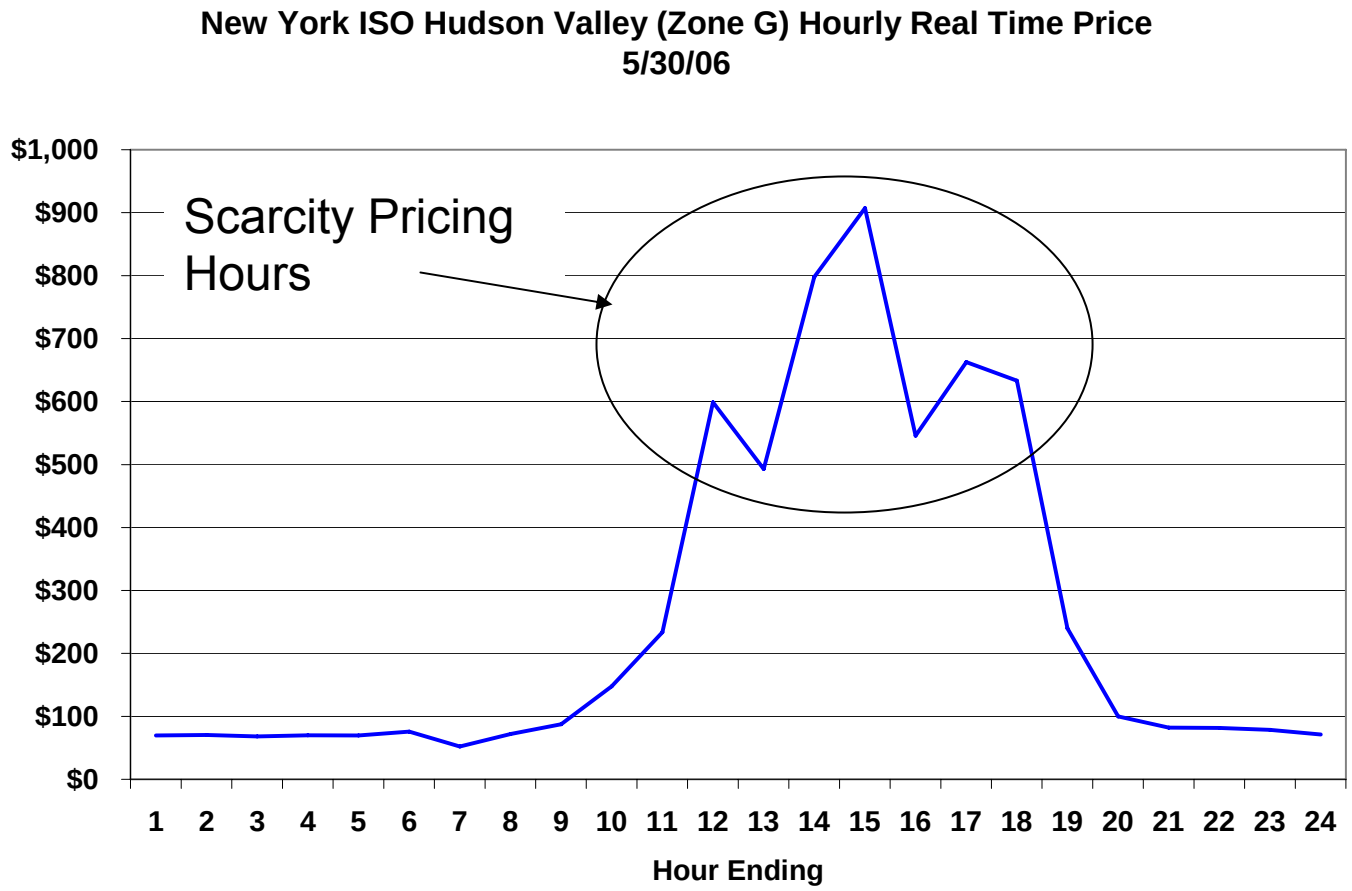
Implied heat rates over 25,000 Btu/kWh were considered scarcity



Off-peak shortage conditions

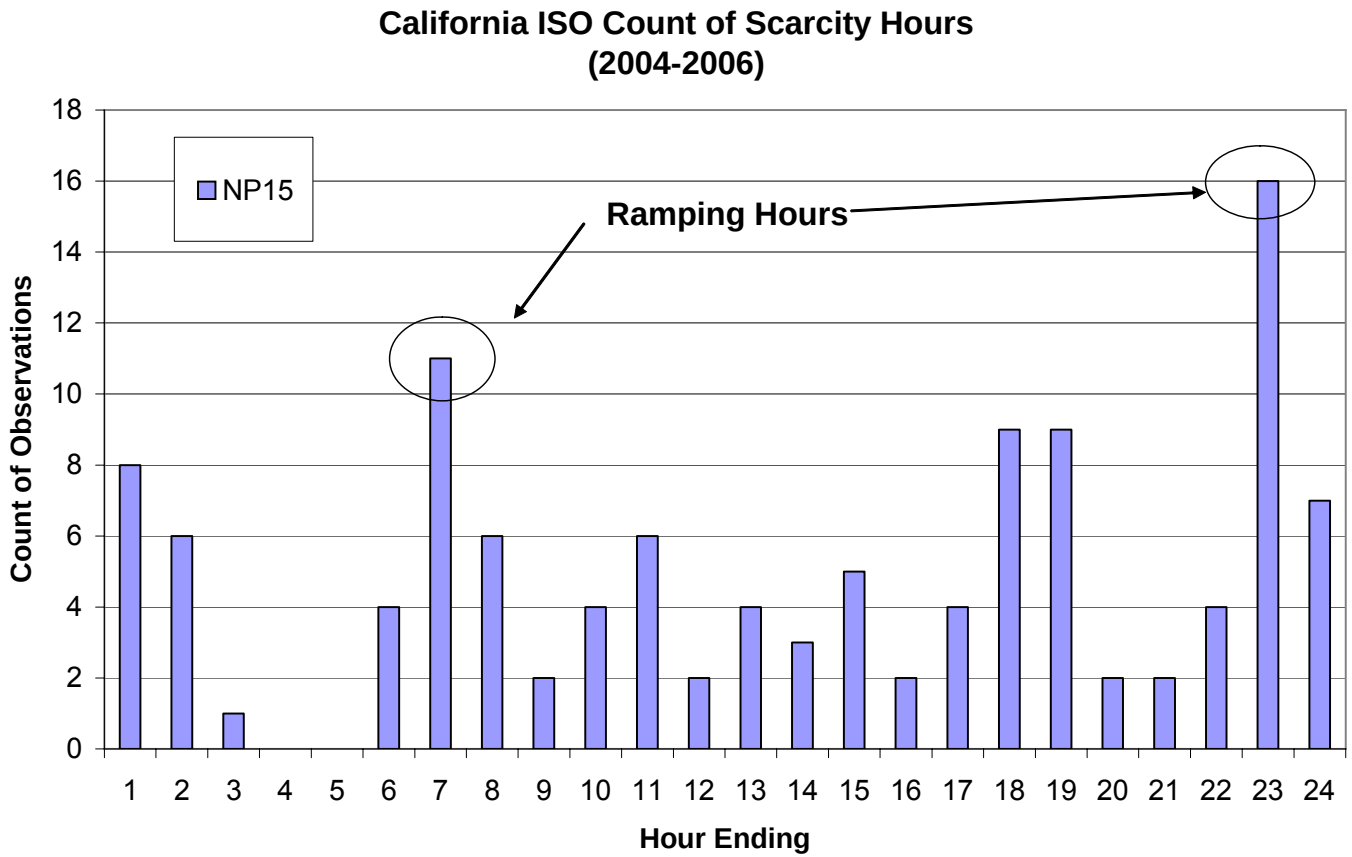
- Off-peak shortage can be related to issues with ramping, scheduling (i.e. day-ahead forecast accuracy) and system events (e.g. outages) but not system capacity scarcity.
- Off-peak shortage as a percentage of total observed scarcity ranged as follows for zones and hubs covered in this analysis:
  - ISONE: No instances
  - NYISO: 1% to 4%
  - PJM: 0% to 4%
  - MISO: 3% to 25%
  - CAISO: 25% to 36%
  - ERCOT: 4% to 6%

Scarcity prices a function of missed load forecast



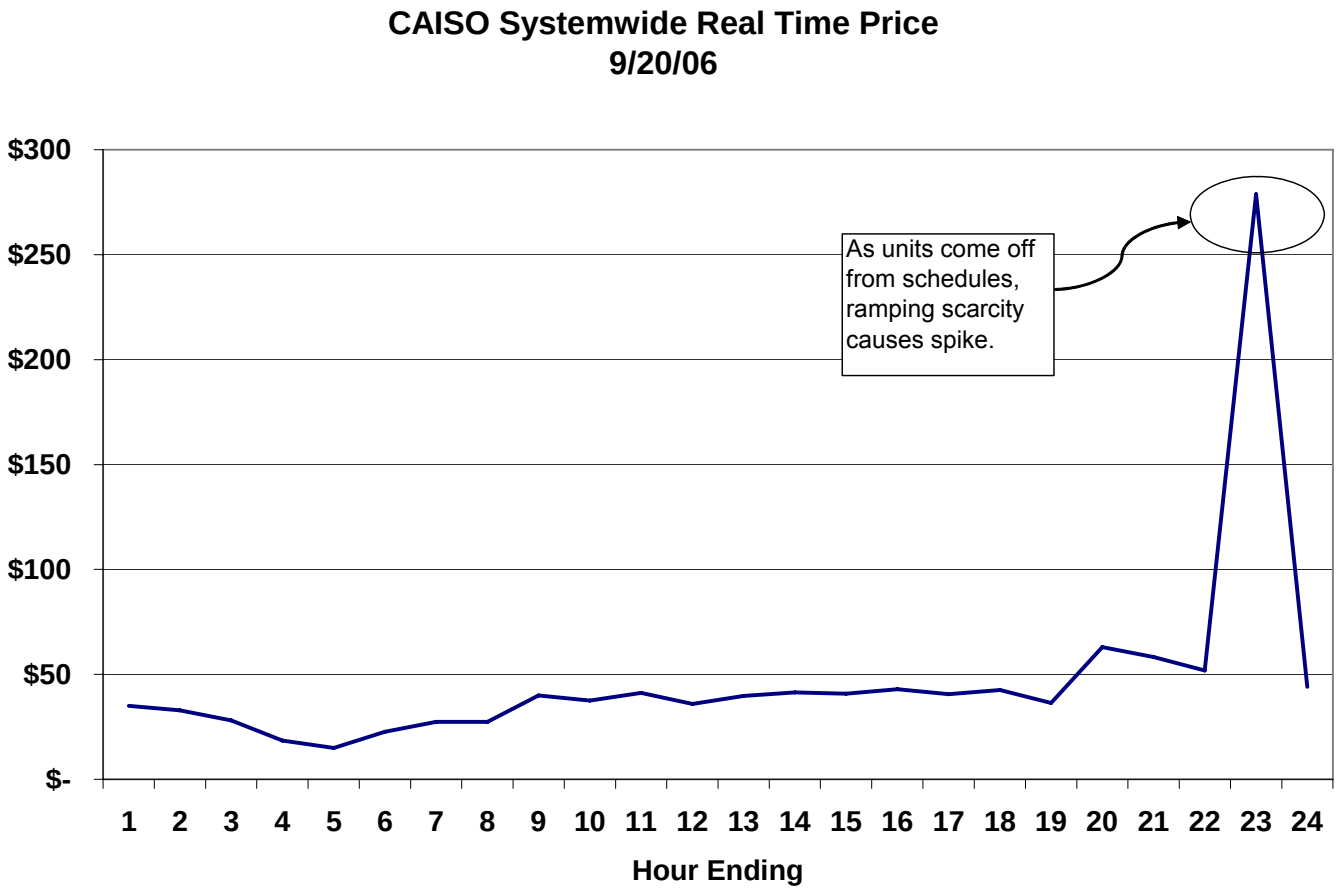
Data source: Derived from NYISO real time hourly prices.
http://www.nyiso.com/public/market_data/pricing_data.jsp

Ramping can cause scarcity conditions



Data source: Derived from CAISO prices and Platts Gas Daily prices.
http://oasis.caiso.com

As load and units come off in the evening, ramping scarcity exists



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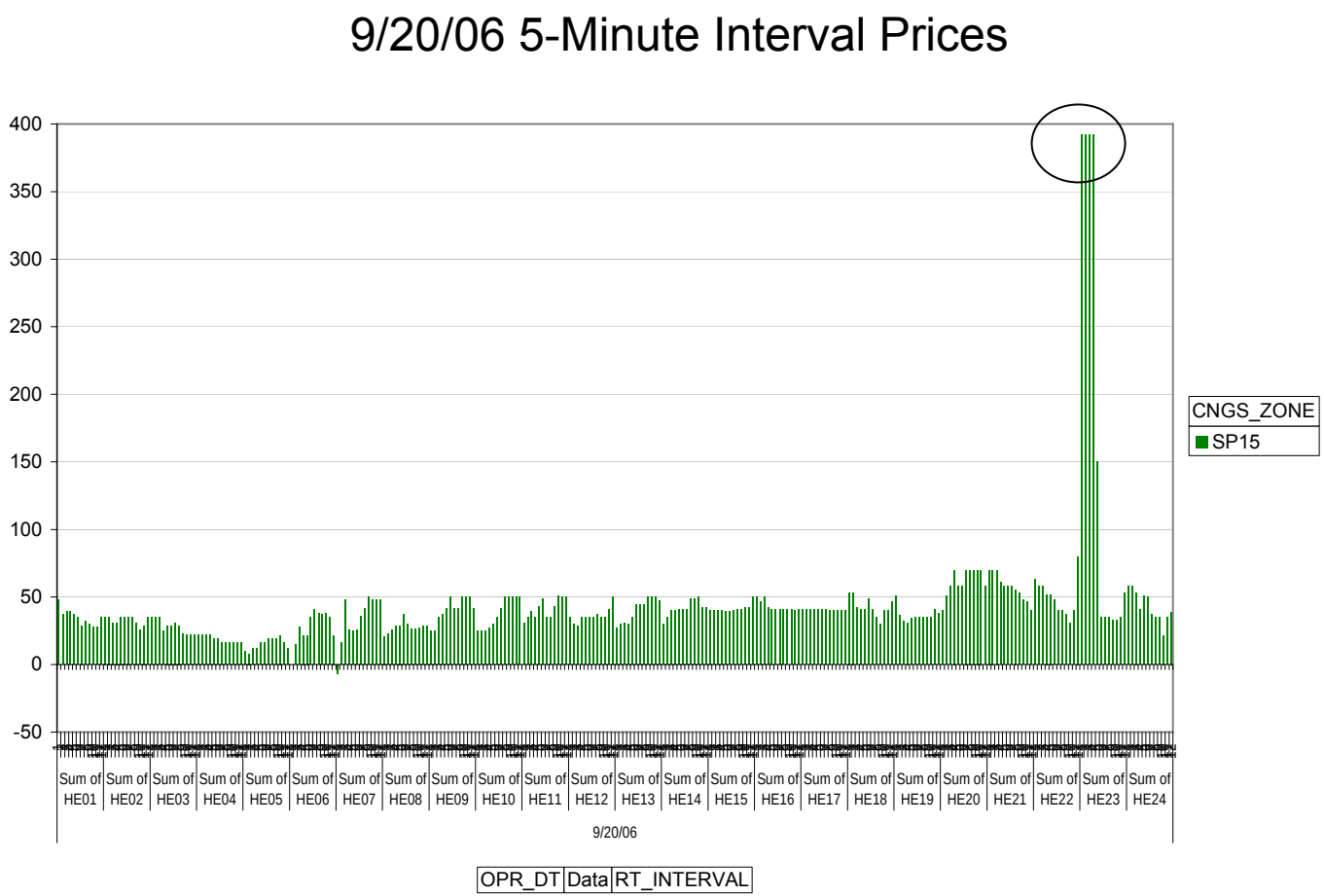

Data source: Derived from CAISO prices.
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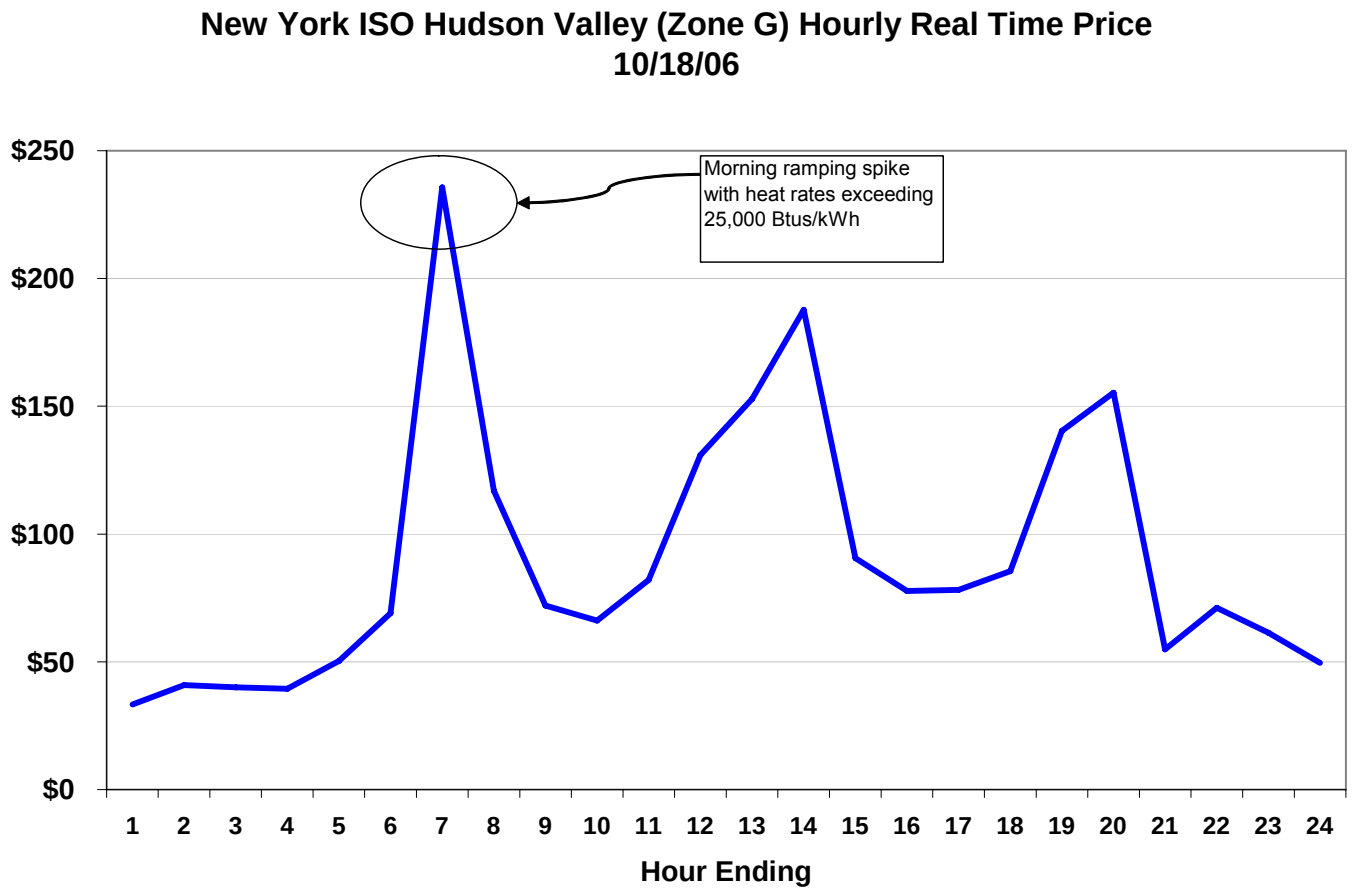
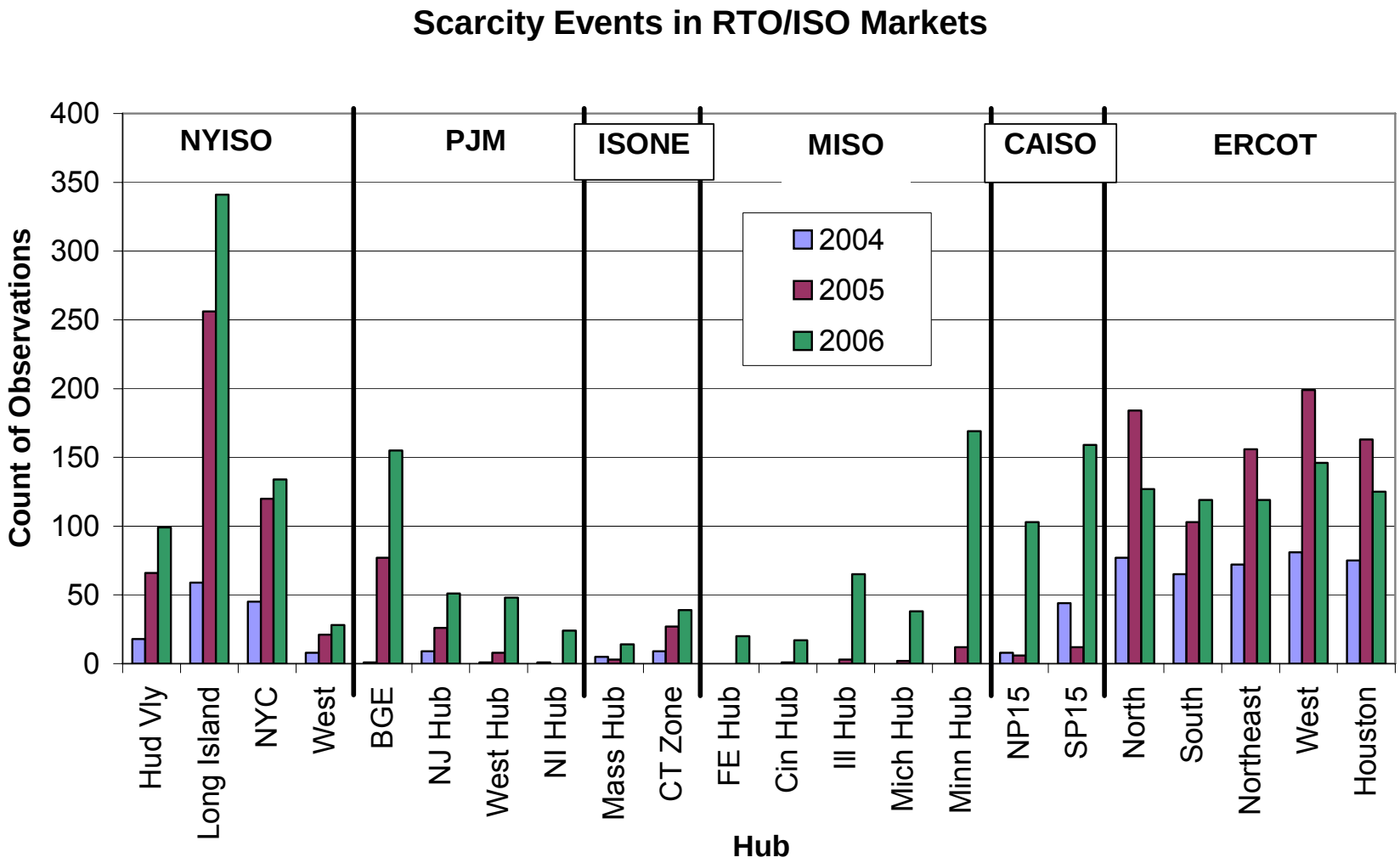
Ramping causes scarcity prices to trigger in New York ISO



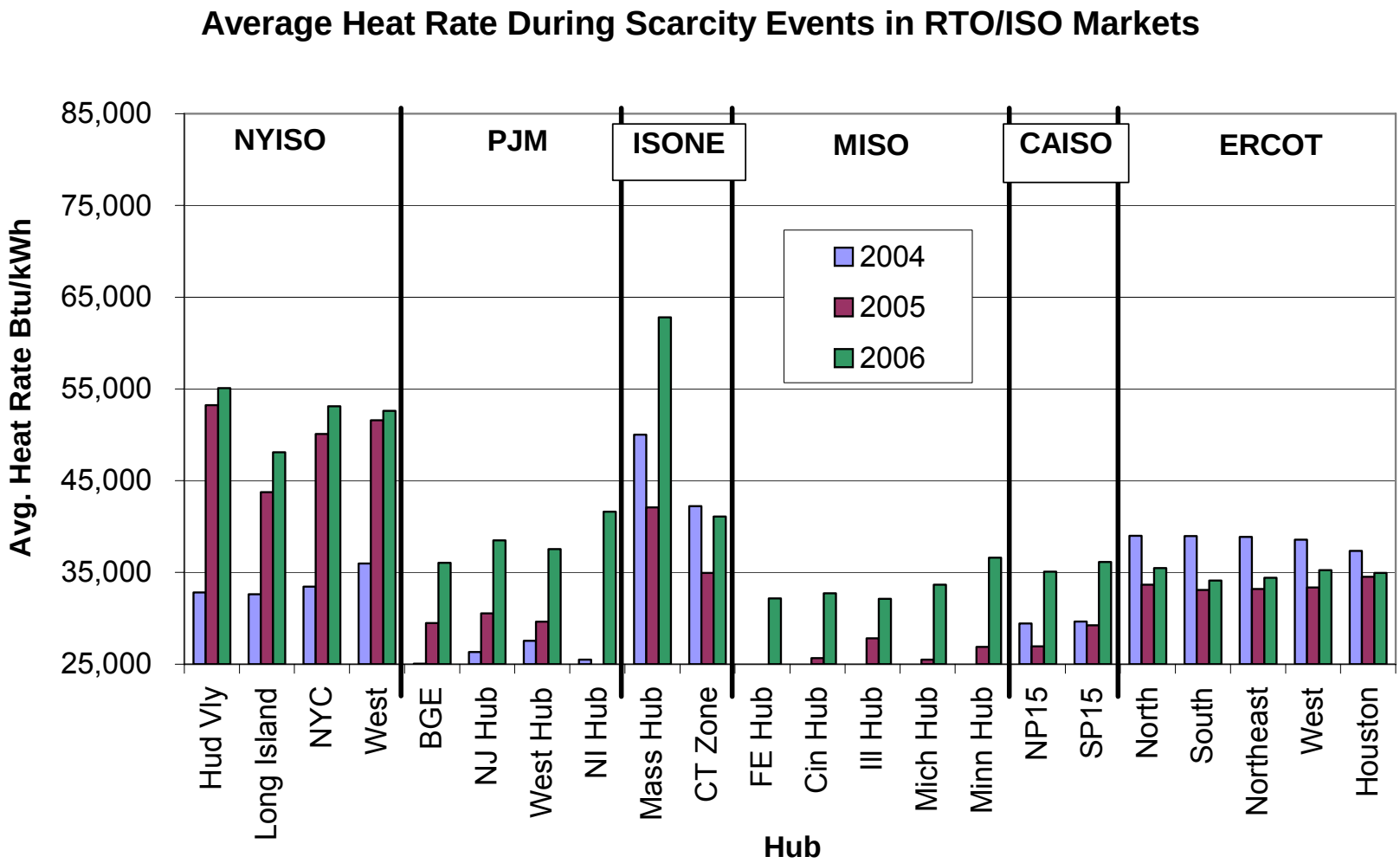
Data source: Derived from NYISO real time hourly prices.
http://www.nyiso.com/public/market_data/pricing_data.jsp

Scarcity pricing events in RTO/ISO markets from 2004 - 2006



Note: All electricity prices are from real time markets. PJM NI Hub did not start till May 2004. NYISO SMD2 market redesign occurred in Feb. 2005. MISO started market operation on April 2005. First Energy Hub (FE) did not start till Sep. 2005. CAISO software changes were implemented in 2006.

Average heat rates during scarcity events differ by region



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Conclusion

- Scarcity Pricing plays a different role based on whether it is implemented in an energy only market or a capacity market
- There can be shortage conditions even when there is no “scarcity” in a traditional sense
- Increased prices under scarcity conditions send the right price signals to active Demand Response programs
- Market manipulation under SP and Performance metrics for generation investment should be addressed
- Next step is to isolate off-peak hour shortage conditions by shortage types