Value of Flexibility in the Markets
June 2015

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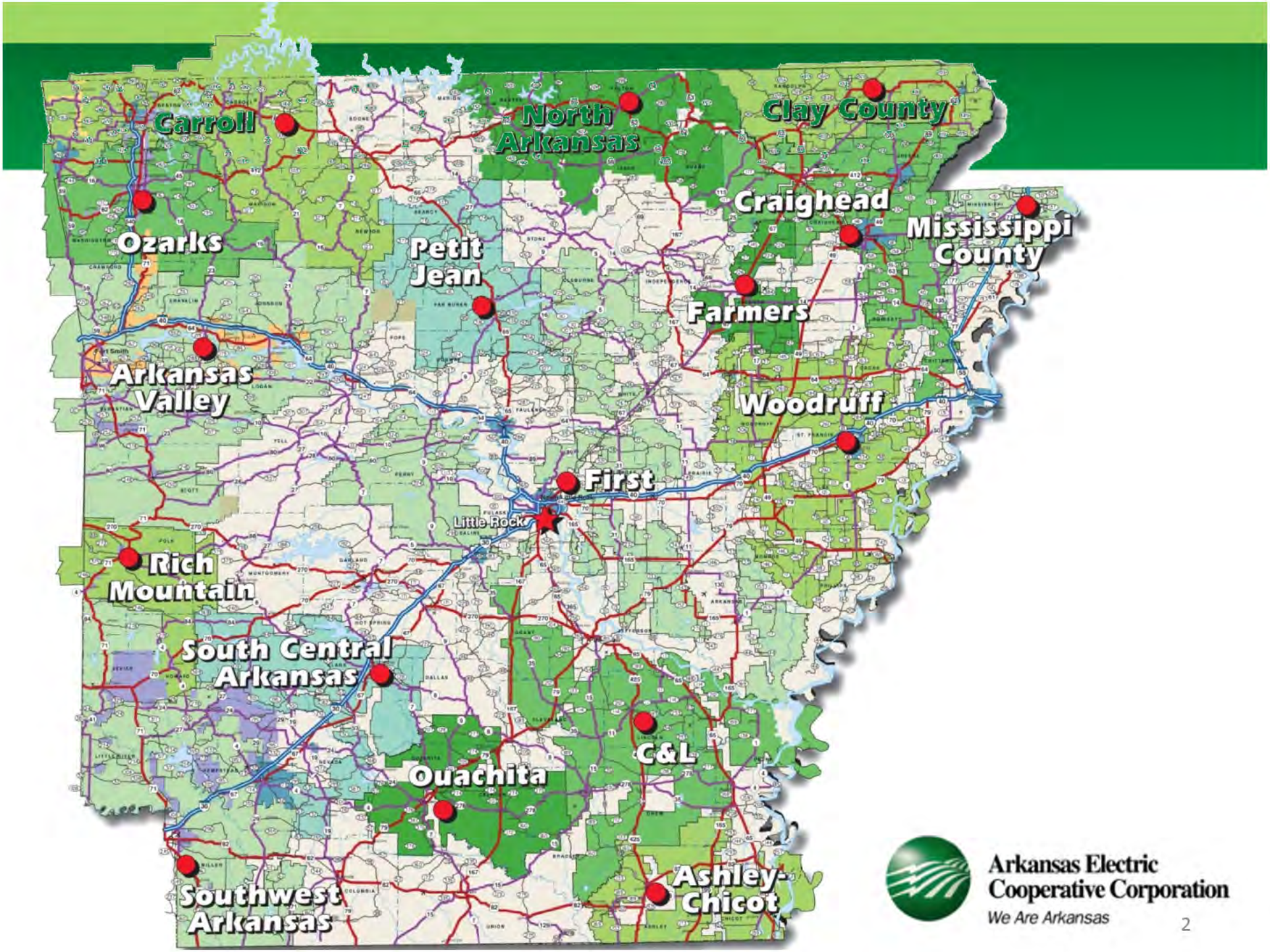

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Value of Flexibility in the Markets

- Basic overview of the SPP and MISO markets
- Potential benefit to some SPA customers of using markets to schedule energy
- Increasing need for ancillary services, and the value of ancillary services in the markets

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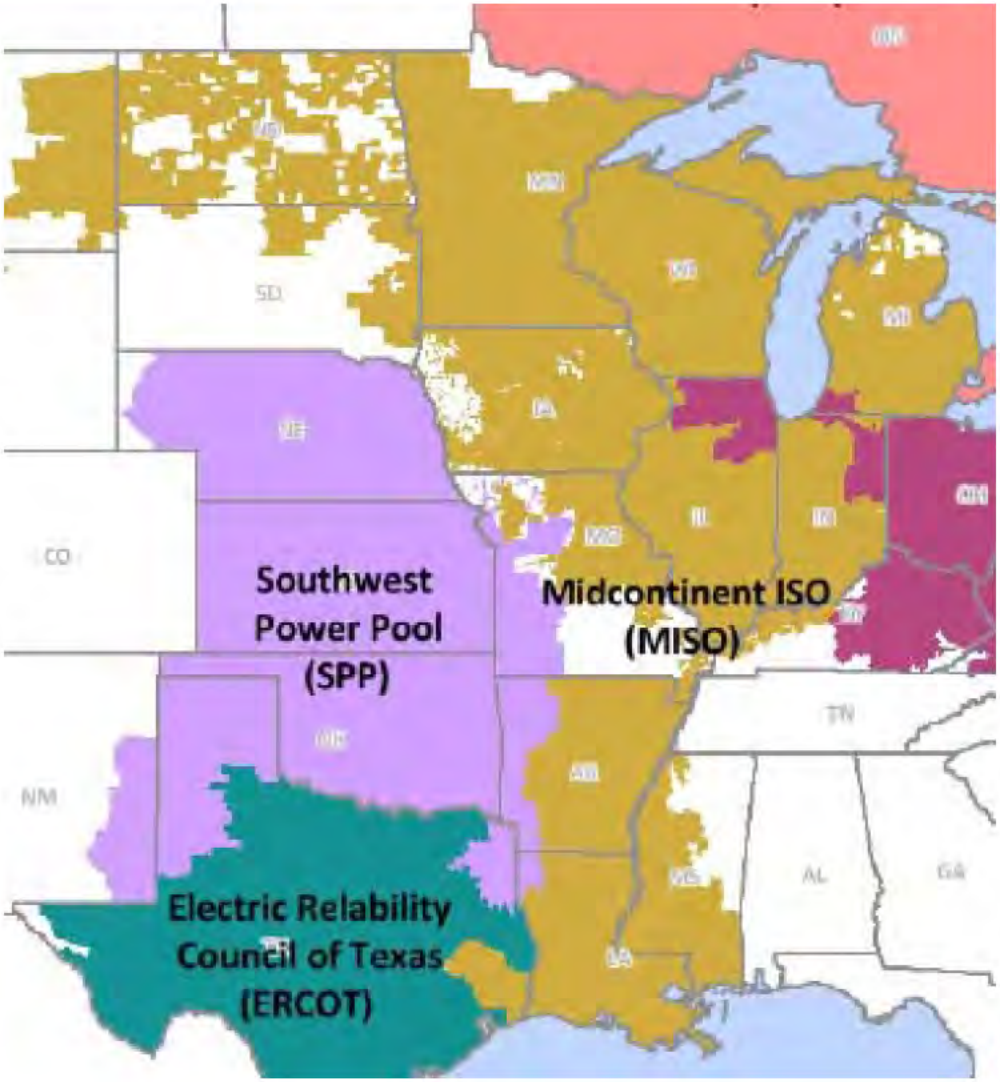
MISO/SPP



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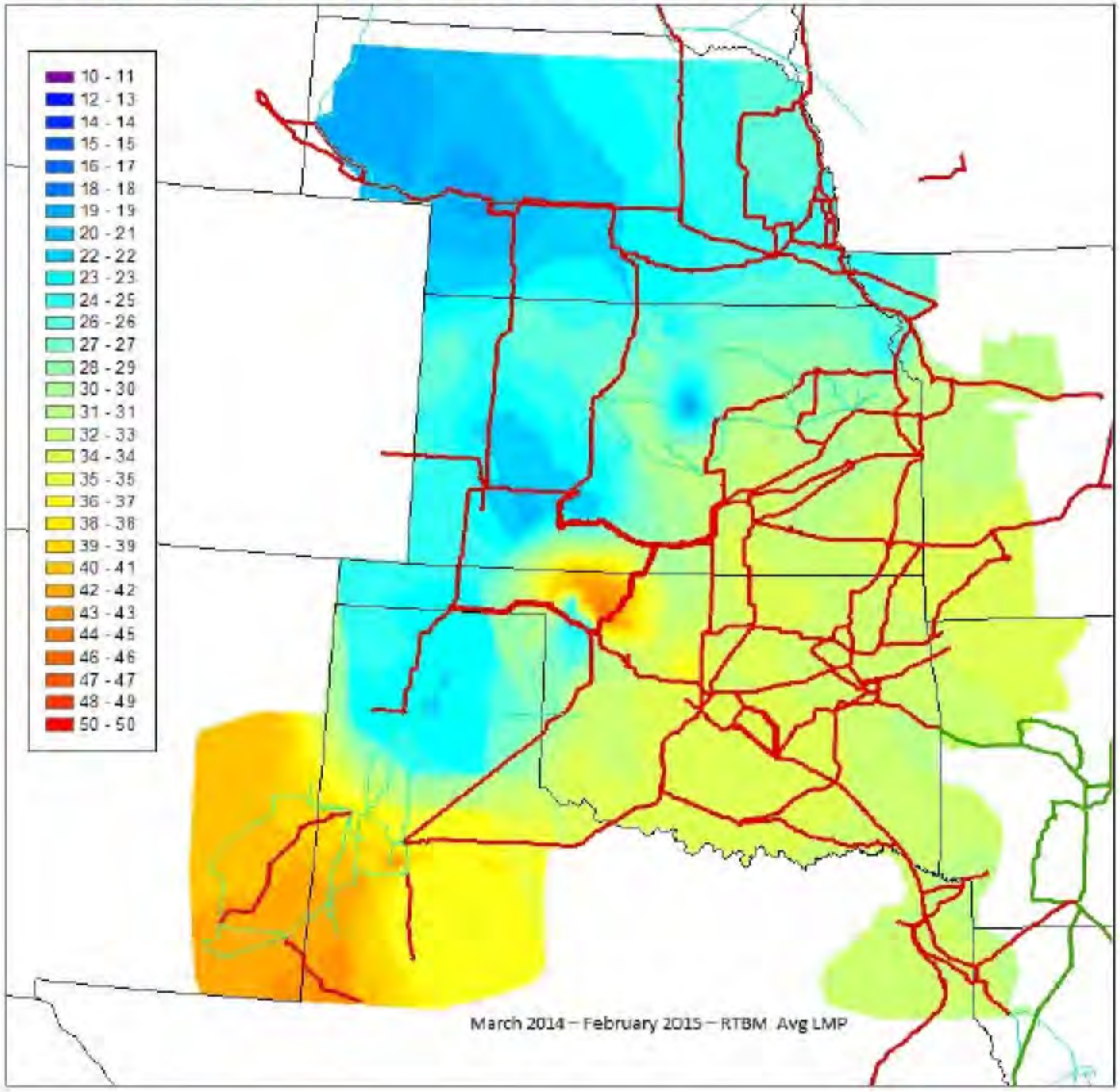
SPP Locational Marginal Prices

Real-Time (average March 2014 - February 2015)



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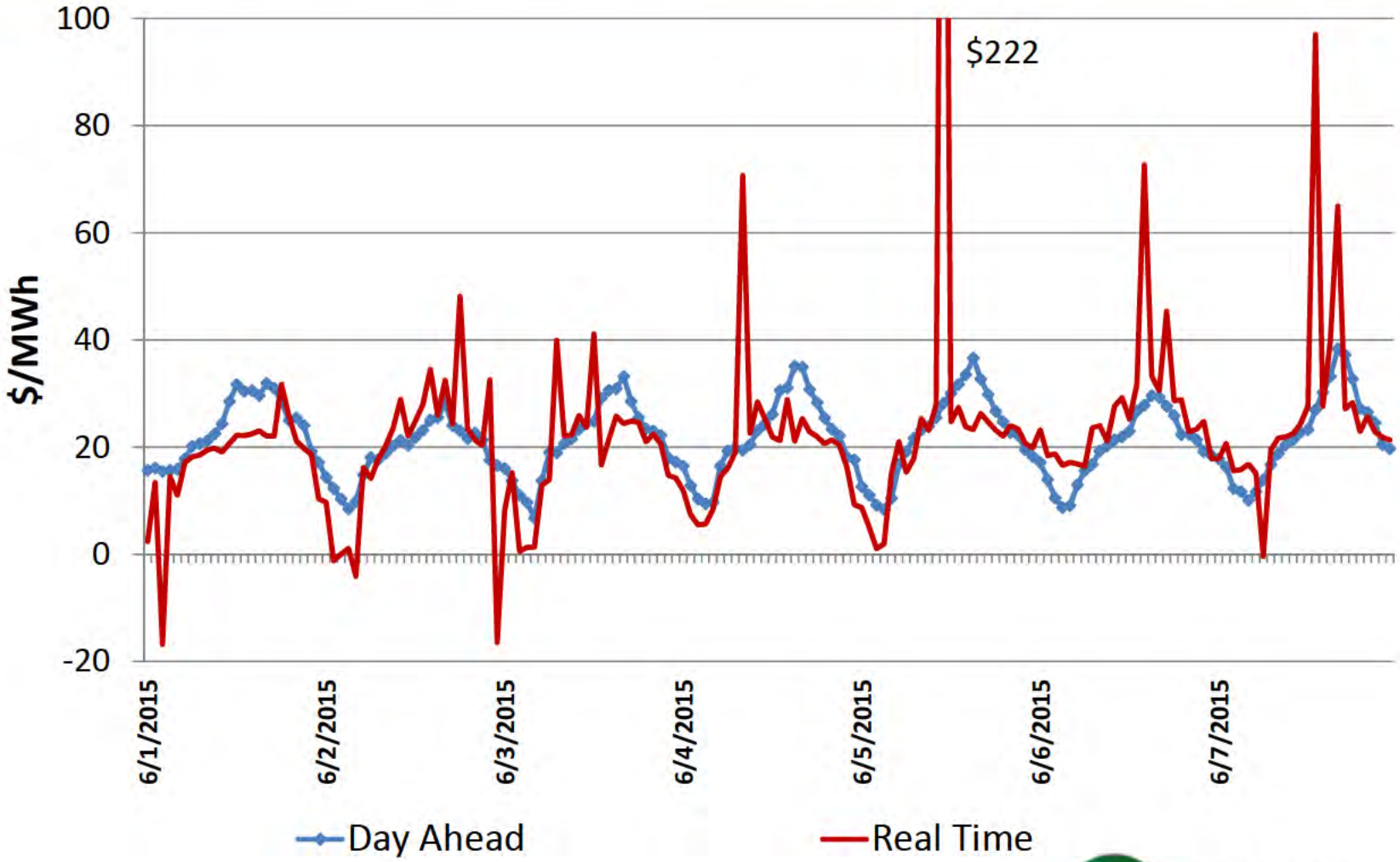
SPA - SPP Prices
June 1 – June 7, 2015



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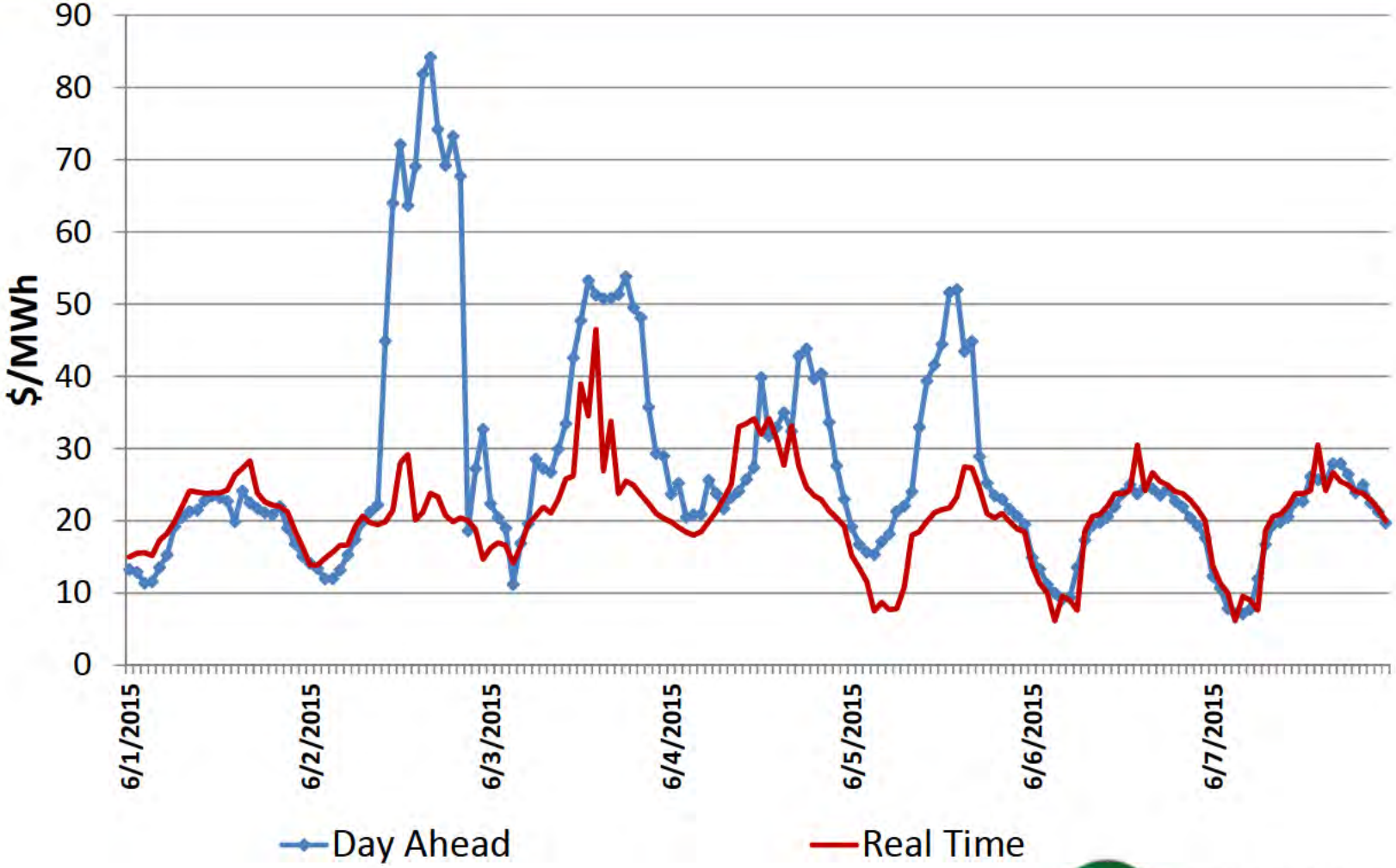
SPA - MISO Prices
June 1 – June 7, 2015



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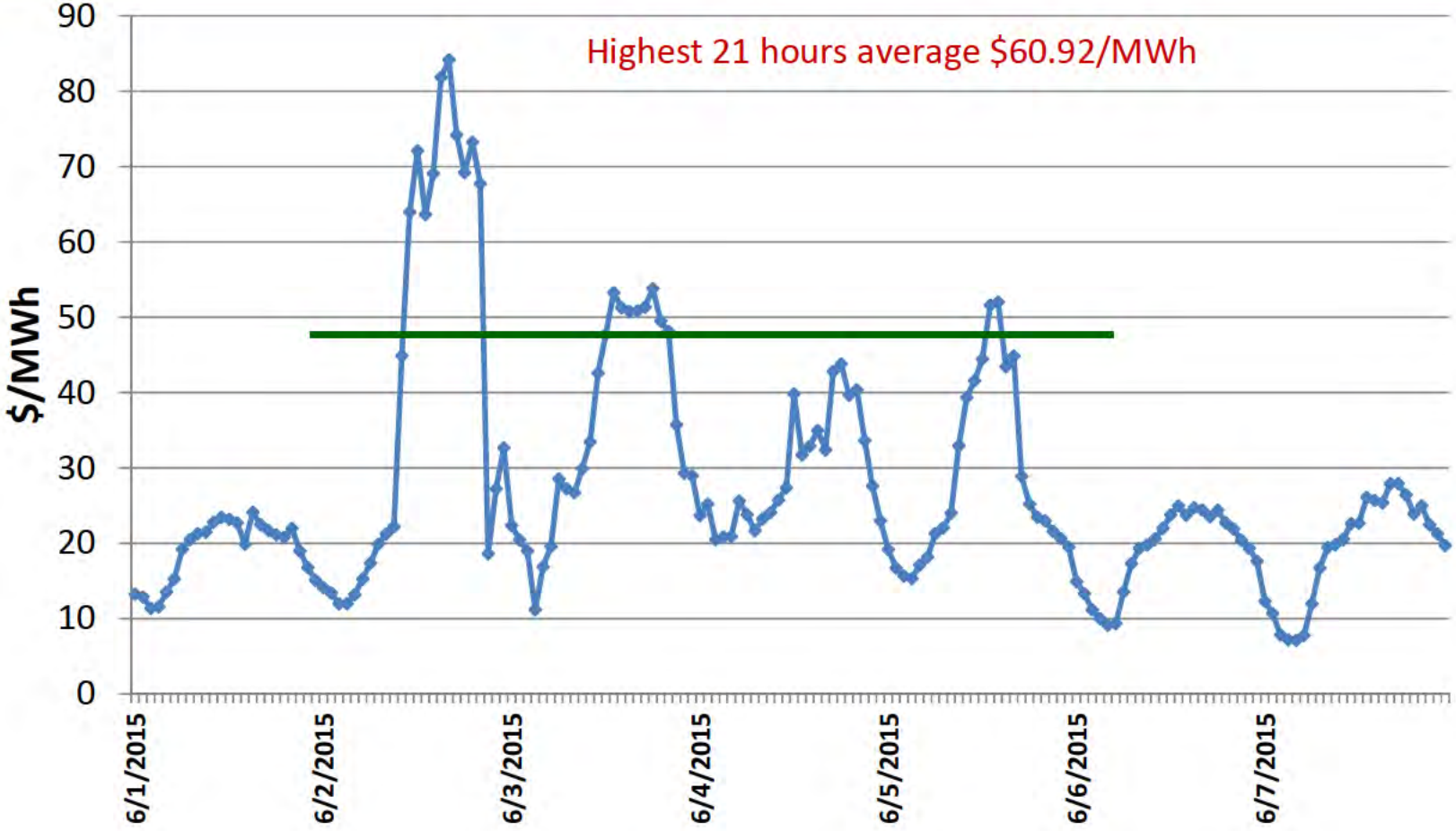
SPA - MISO Day Ahead Prices
June 1 – June 7, 2015



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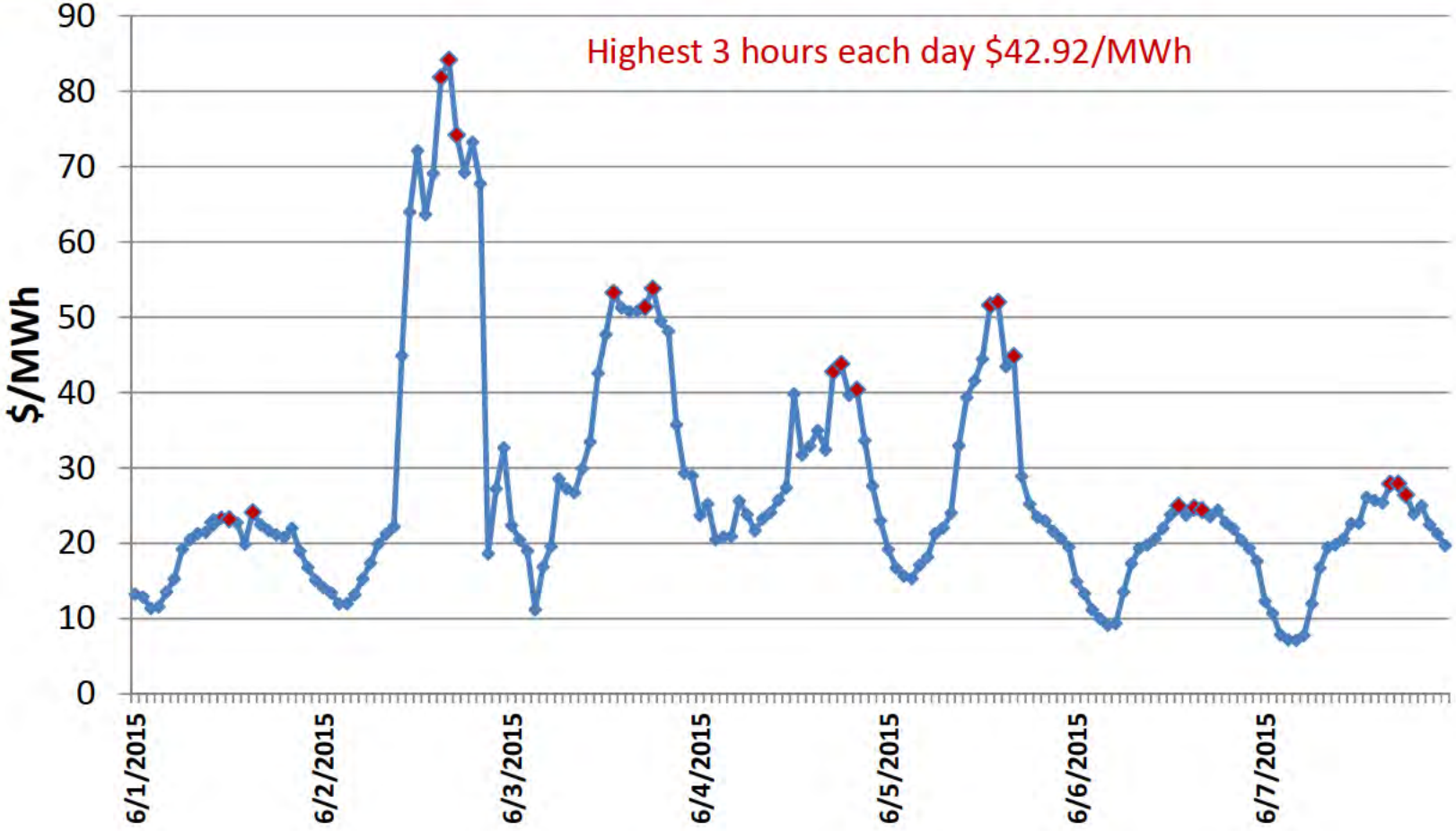
SPA - MISO Day Ahead Prices
June 1 – June 7, 2015



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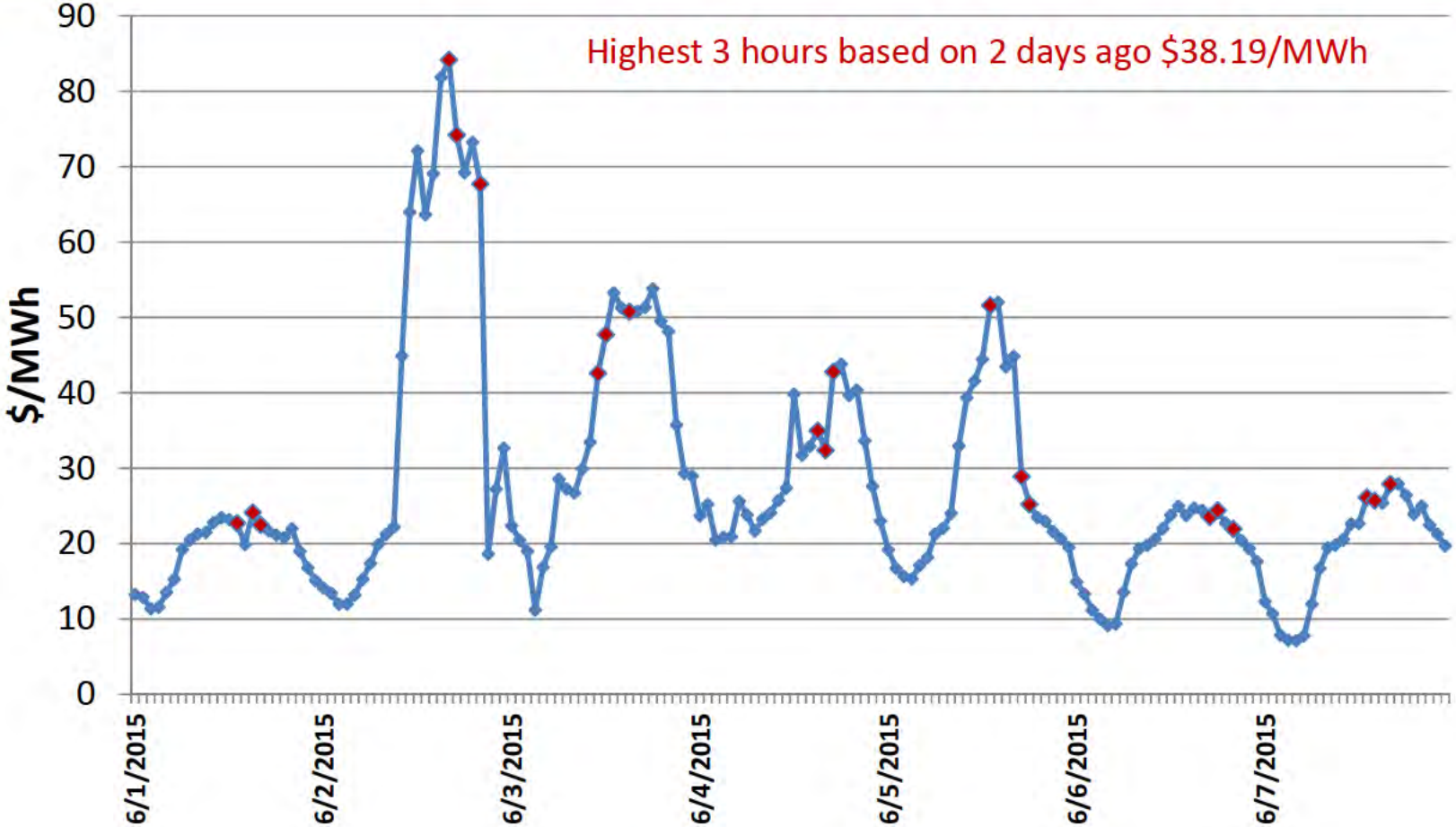
SPA - MISO Day Ahead Prices
June 1 – June 7, 2015



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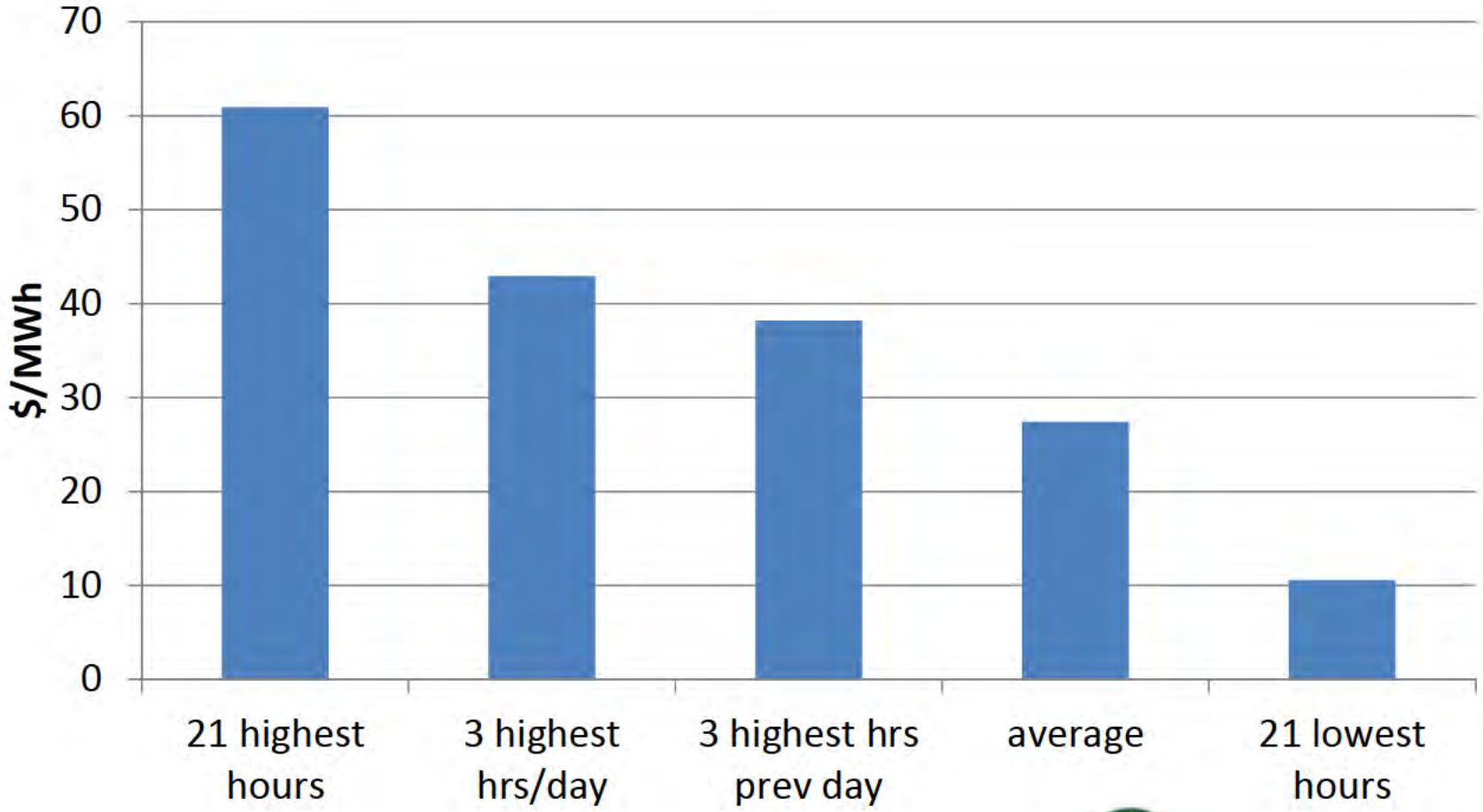
Value of Flexibility for a Limited Energy Resource



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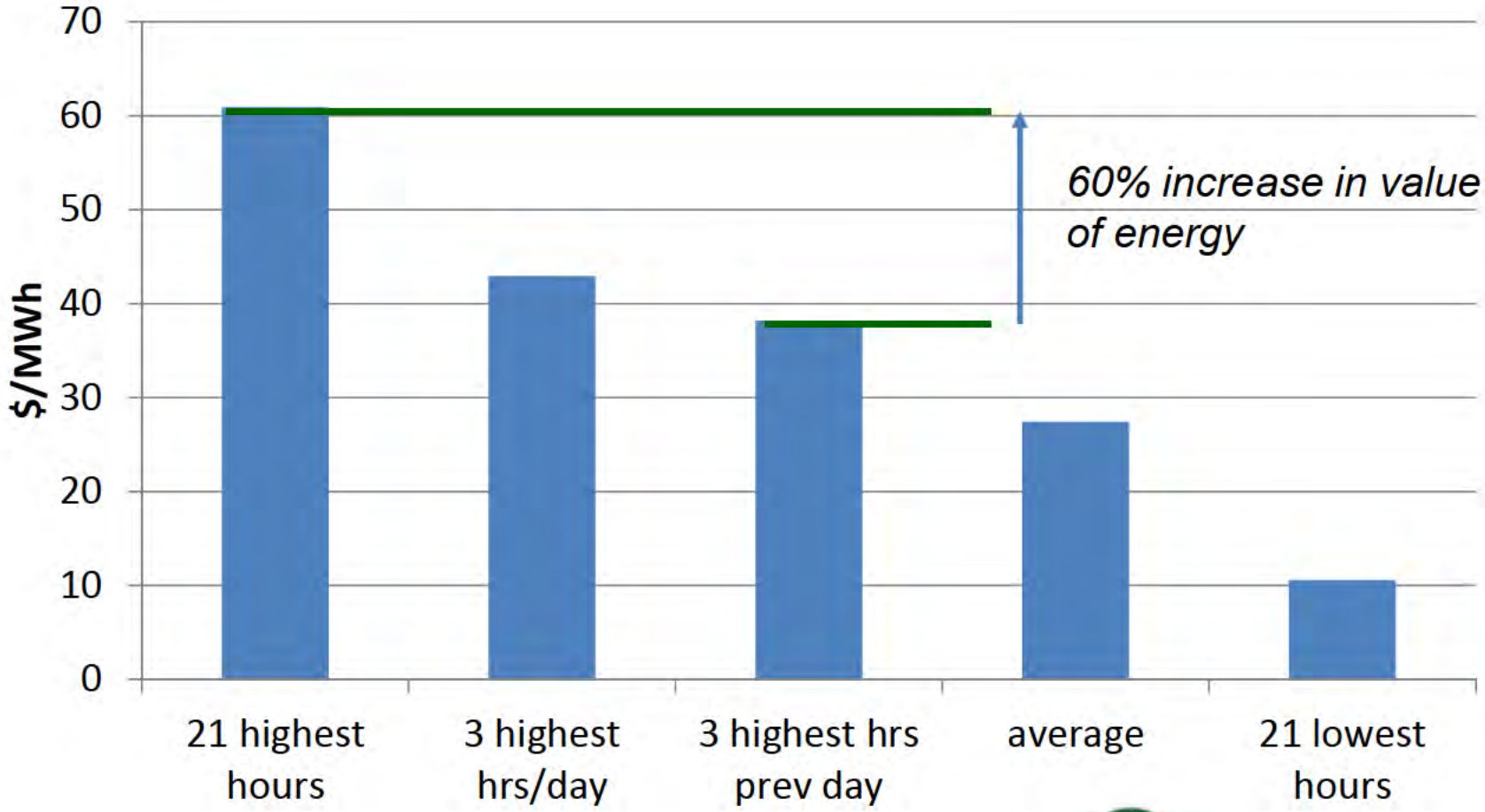
Value of Flexibility for a Limited Energy Resource



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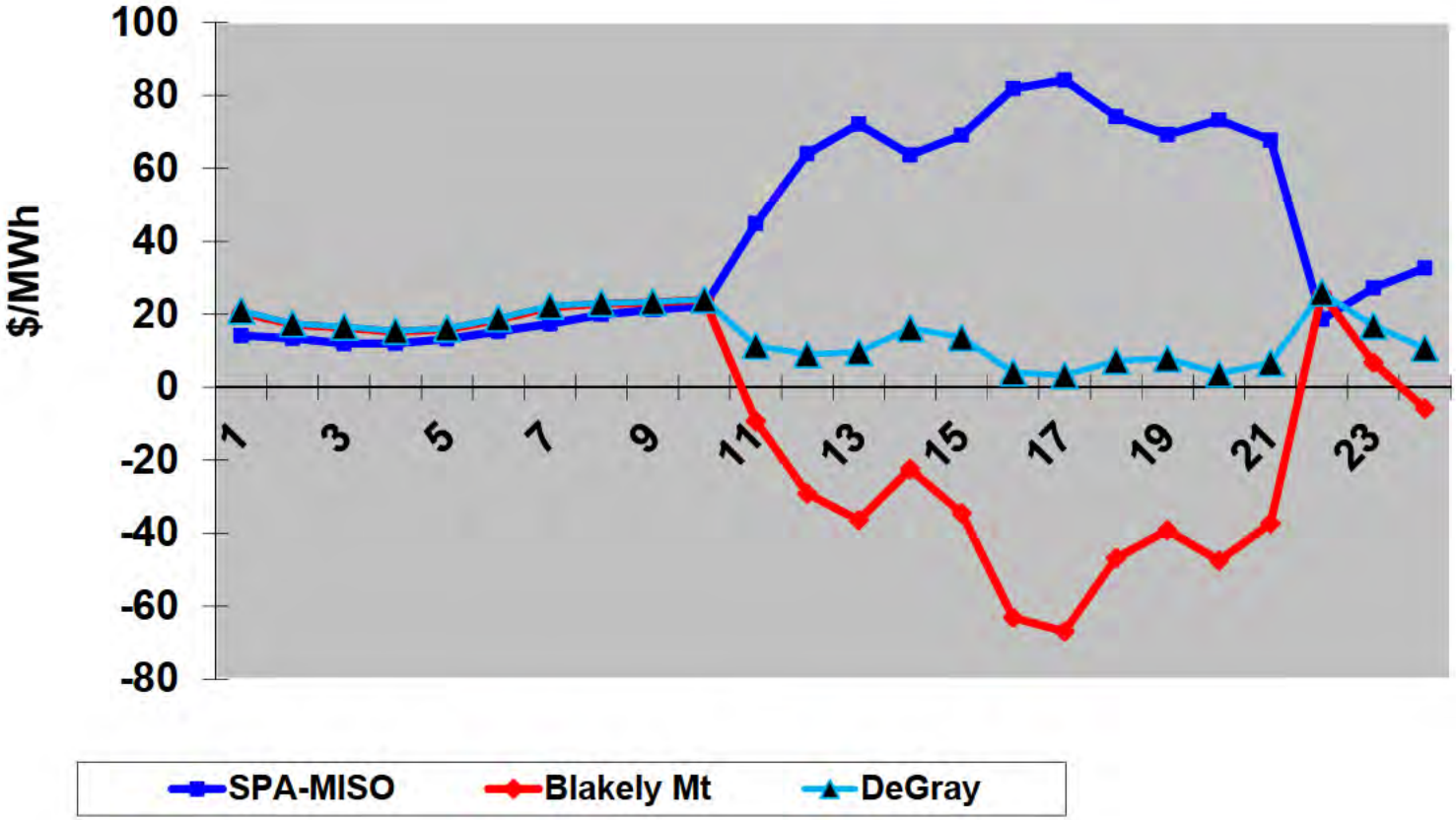
Day-Ahead Prices, June 2, 2015



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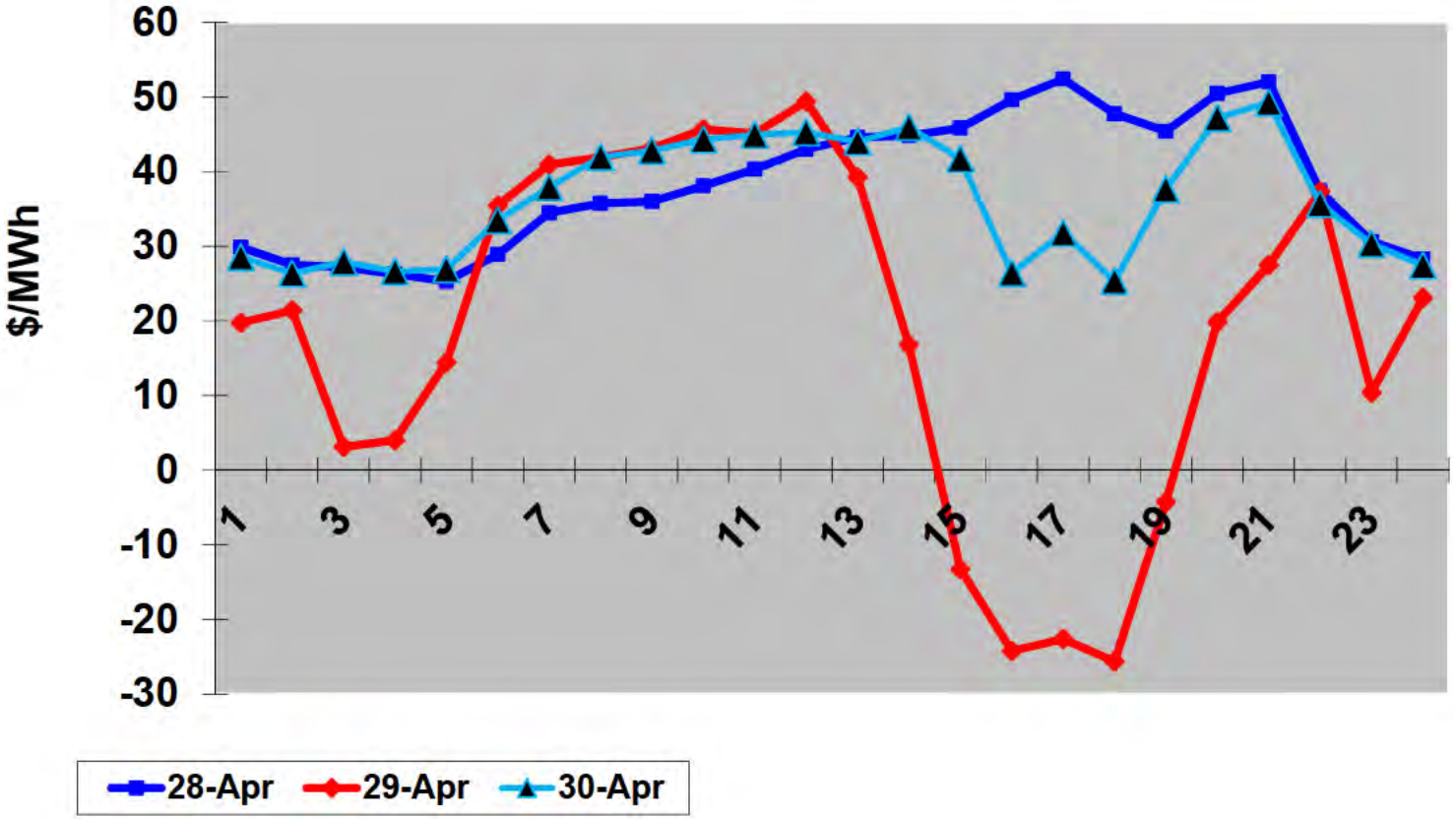
MISO-SPA Interface
Day-Ahead Prices, April 28-30, 2014



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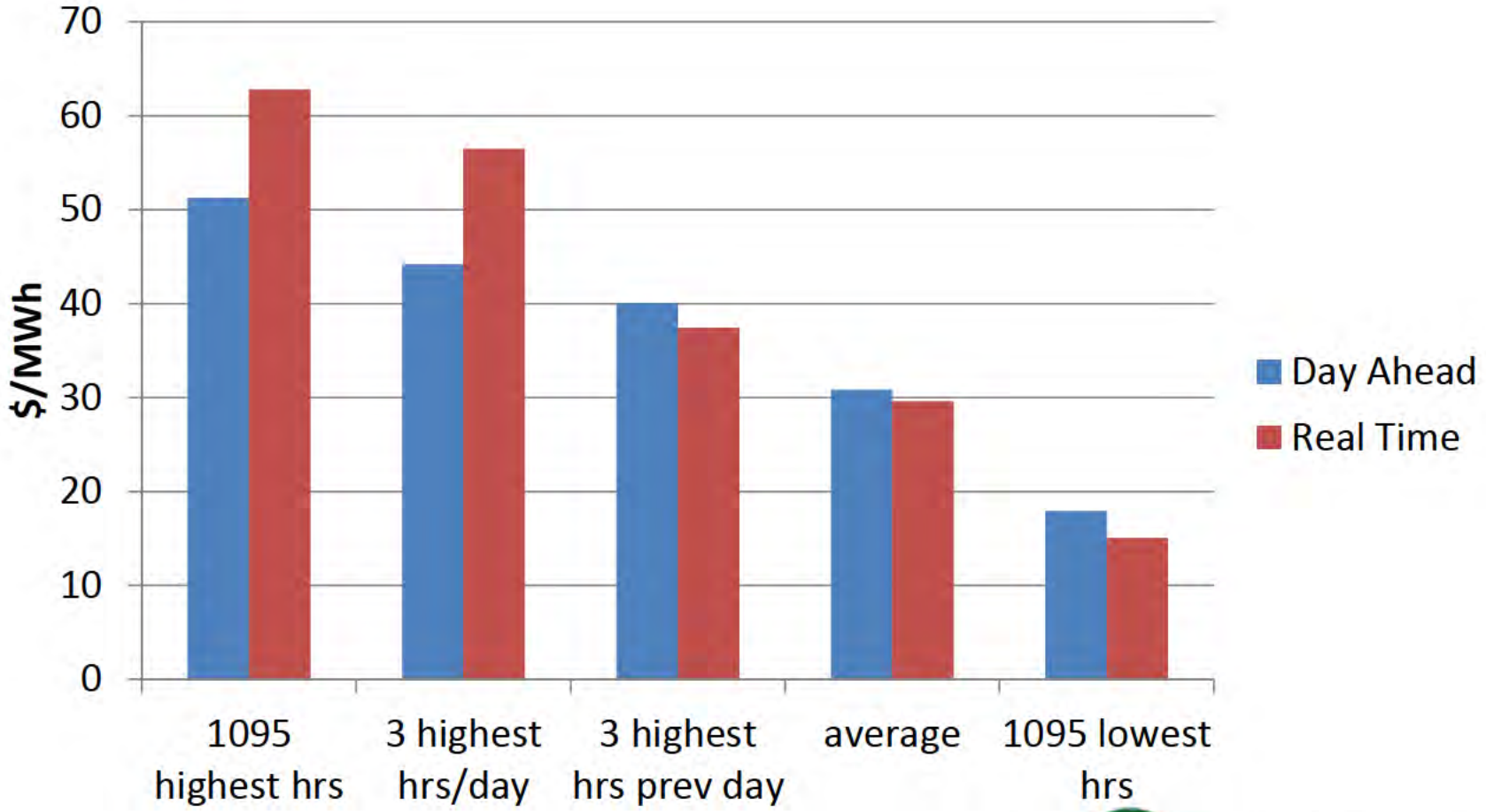
SPA-SPP, 5/1/2014 thru 4/30/2015



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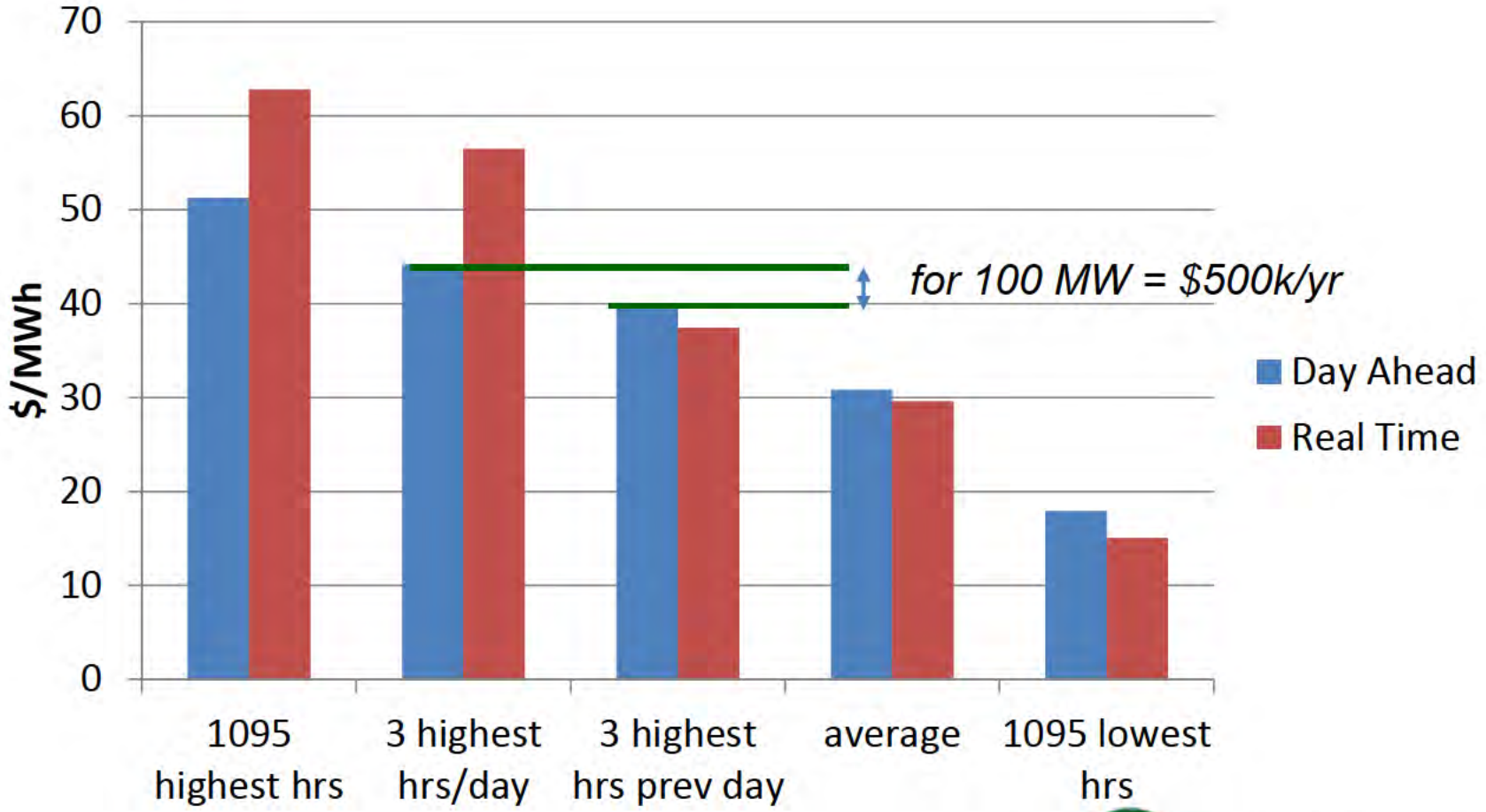
SPA-SPP, 5/1/2014 thru 4/30/2015



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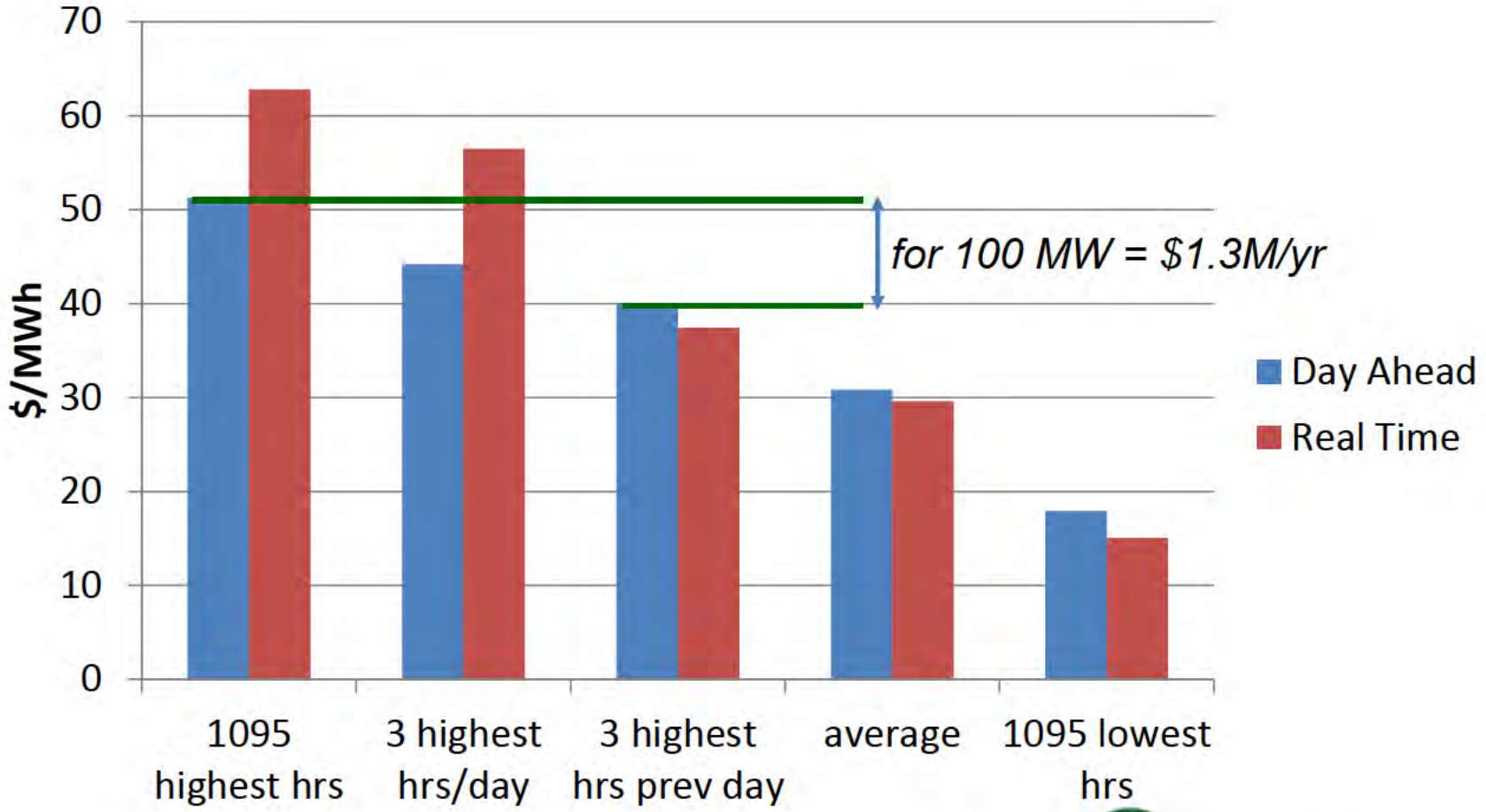
SPA-SPP, 5/1/2014 thru 4/30/2015



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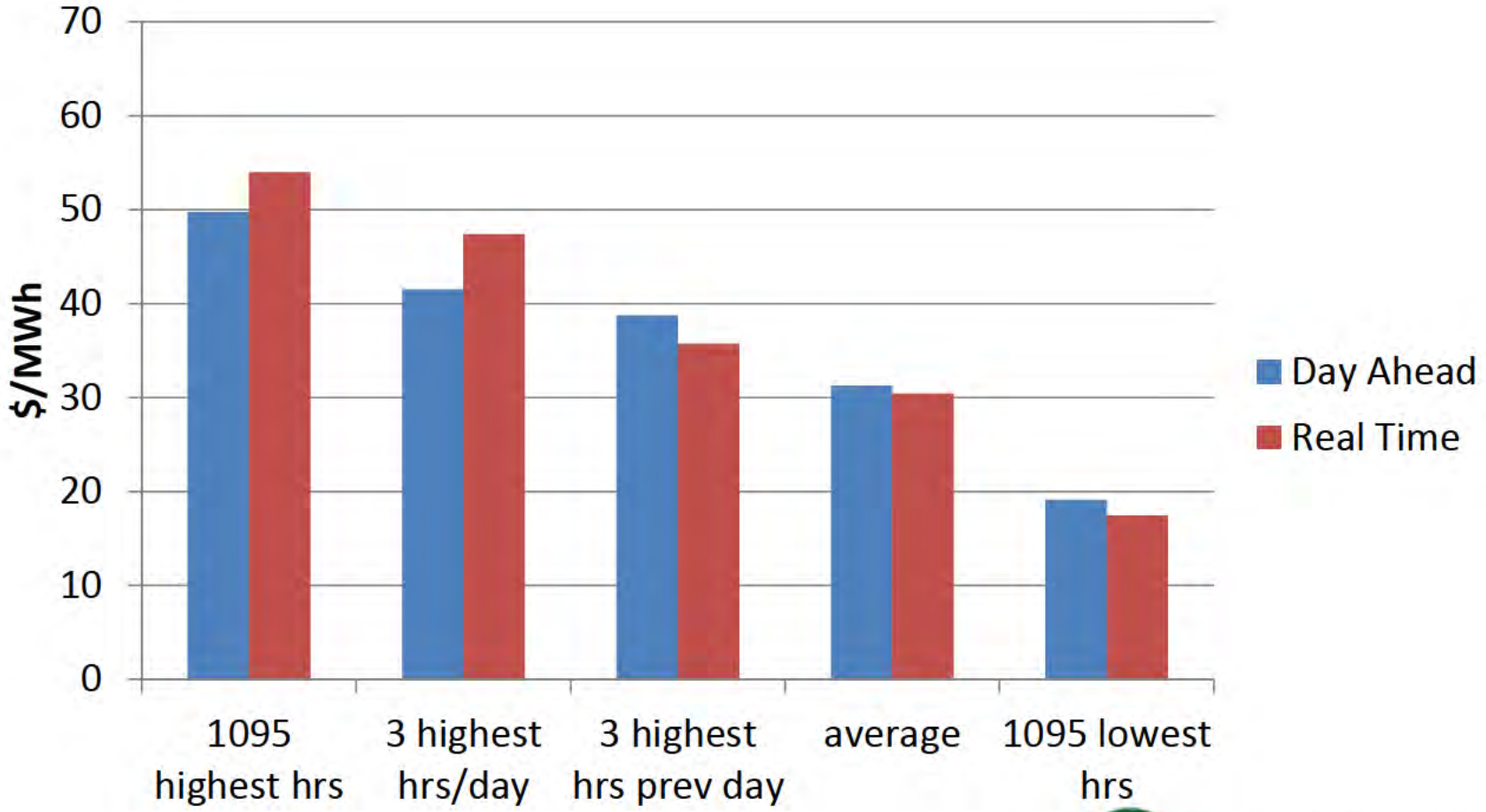
SPA-MISO, 5/1/2014 thru 4/30/2015



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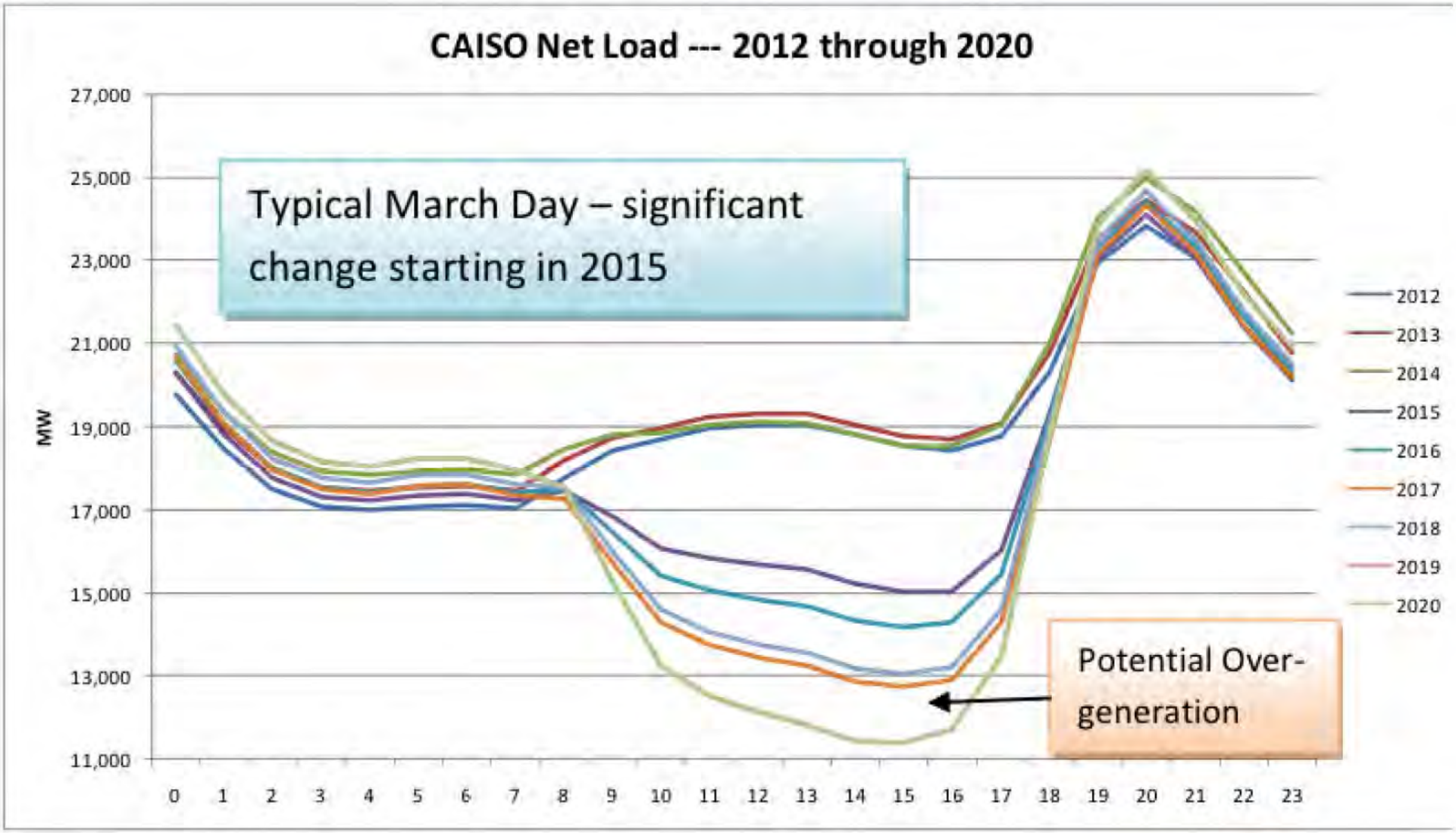
California "Duck Curve"



From presentation by ERCOT:

Operational Challenges due to High Wind

- Higher frequency deviations due to large system excursions
- Inadequate transmission for projected wind growth
- Constraint management under high and low wind
- Difficulty in managing transient stability due to reduced inertial response
- Increased variability of net load
- **Higher Ancillary Service Requirement**
  - **Increased Non-Spin for forecast error of net load (roughly 20%)**
  - **Increased Regulation due to increased net load variability (roughly 10%)**
- Increased volatility in prices
  - Lower average system wide energy prices
  - Lower average Real Time prices in West Zone
  - Higher Day-Ahead premium in West Zone

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From presentation by CAISO: Summary of future grid operations to manage a more complex grid

- **Increased requirements for regulation up and down**
- **Need to manage increased intra-hour flexibility and multiple hour daily ramps**
  - **Approx. 3,000 MW of intra-hour load-following**
  - **Approx. 13,000 MW of continuous up-ramp within a 3 hour time period (almost double current up-ramps)**
- Non-dispatchable resources serving load varies between 10,000 MW to 12,000 MW based on maximum capability of resources
- Increased instances of over-generation conditions
- Need to comply with a frequency response obligation following a disturbance (Compliance with BAL-003-1)
- Impact of distributed energy resources on the bulk electric system is still not fully understood

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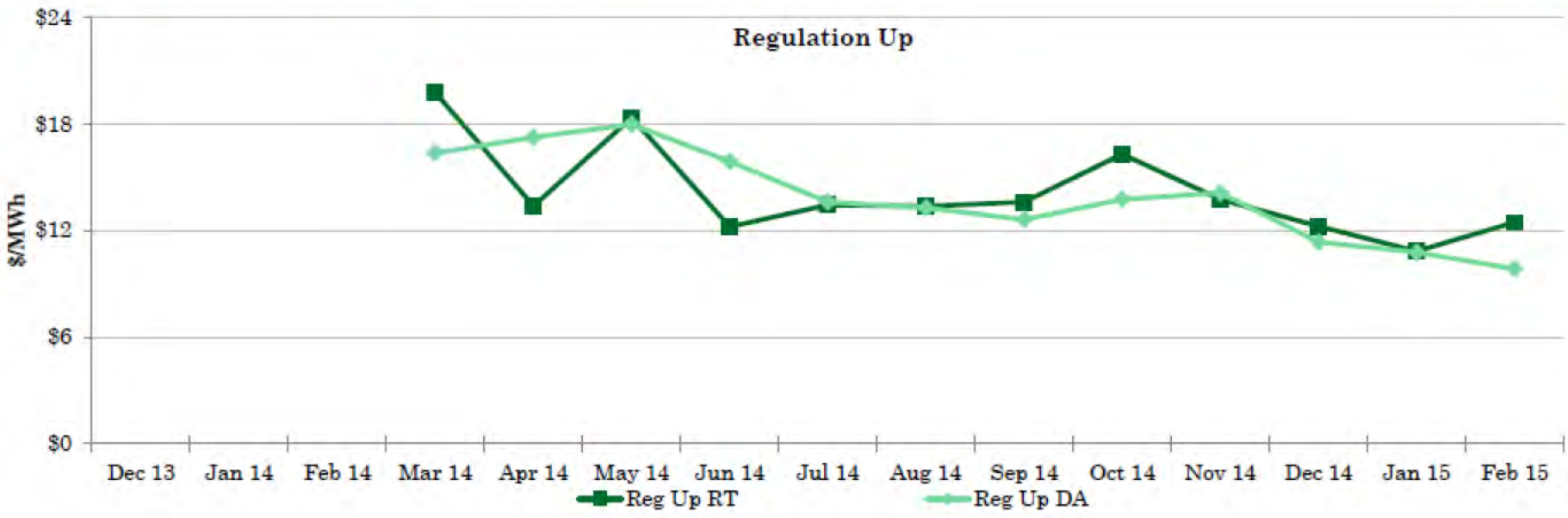
WARNING: Relative rankings in table based on specific assumptions and disclaimers documented in white paper—do not use in isolation.
Relative scores are based on "typical" capabilities of resources presently being installed.

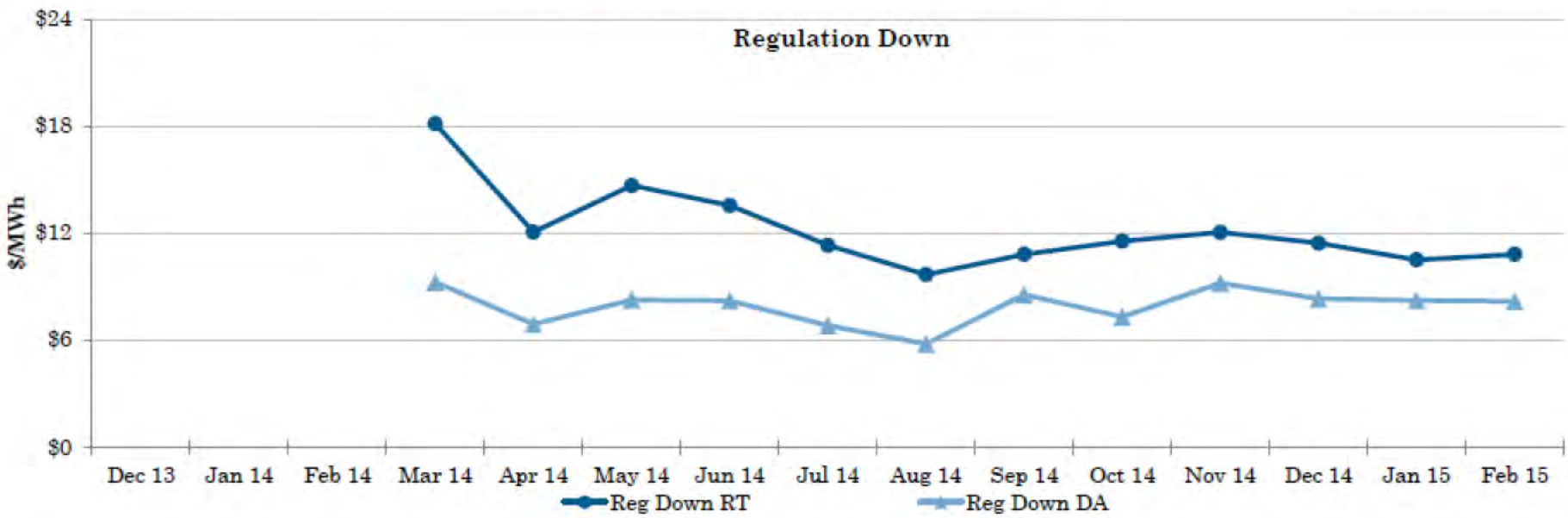
		SYNCHRONOUS INTERCONNECTION					INVERTER-BASED INTERCONNECTION				DEMAND RESPONSE	
		Coal	Natural Gas Simple Cycle	Natural Gas Combined Cycle	Nuclear	Hydro	Grid Scale Wind	Grid Scale PV	Distributed PV	Distributed Battery Storage	Large (Industrial/ Commercial)	Small (Aggregated)
Volt/Var Control		5	5	5	5	5	5	5	2	2	0	0
Short Circuit Contribution		5	5	5	5	5	2	2	2	2	0	0
Frequency Control	Inertial Response	5	3	5	5	5	3	0	0	0	2	0
	Primary Frequency Response (droop)	3	3	3	0	5	3	2	0	2	3	0
	Regulation	3	5	5	0	5	3	3	0	3	3	3
	Load Following/ Ramping	2	5	5	0	3	3	3	0	3	2	2
	Spinning Reserve	3	5	5	0	5	3	2	2	3	5	5
Short-term Availability (fuel)		5	3	3	5	3	3	3	2	3	3	3
Long-term Availability (plant)		3	3	3	5	5	3	3	3	3	3	3
Black Start		2	3	3	0	5	0	0	0	0	0	0

Reliable system operation requires online resources aggregately capable of providing the full range of required reliability services.
Synchronous Interconnection resources provide the highest contribution across the broadest range of reliability services.

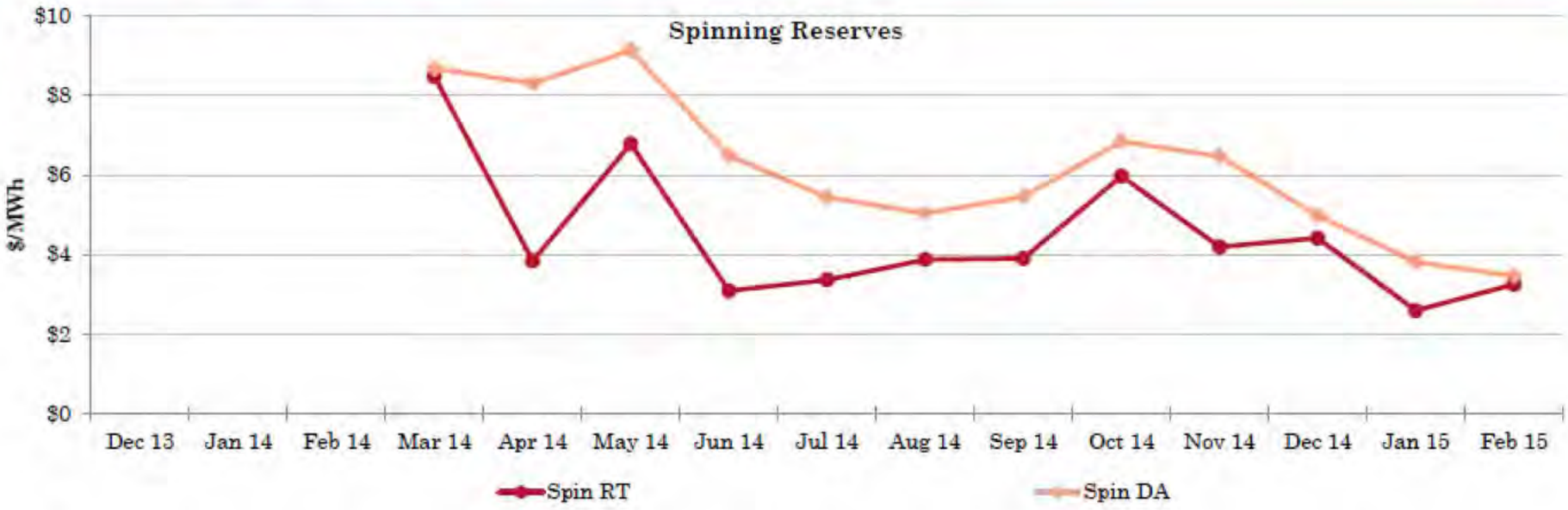
Electric Power Research Institute

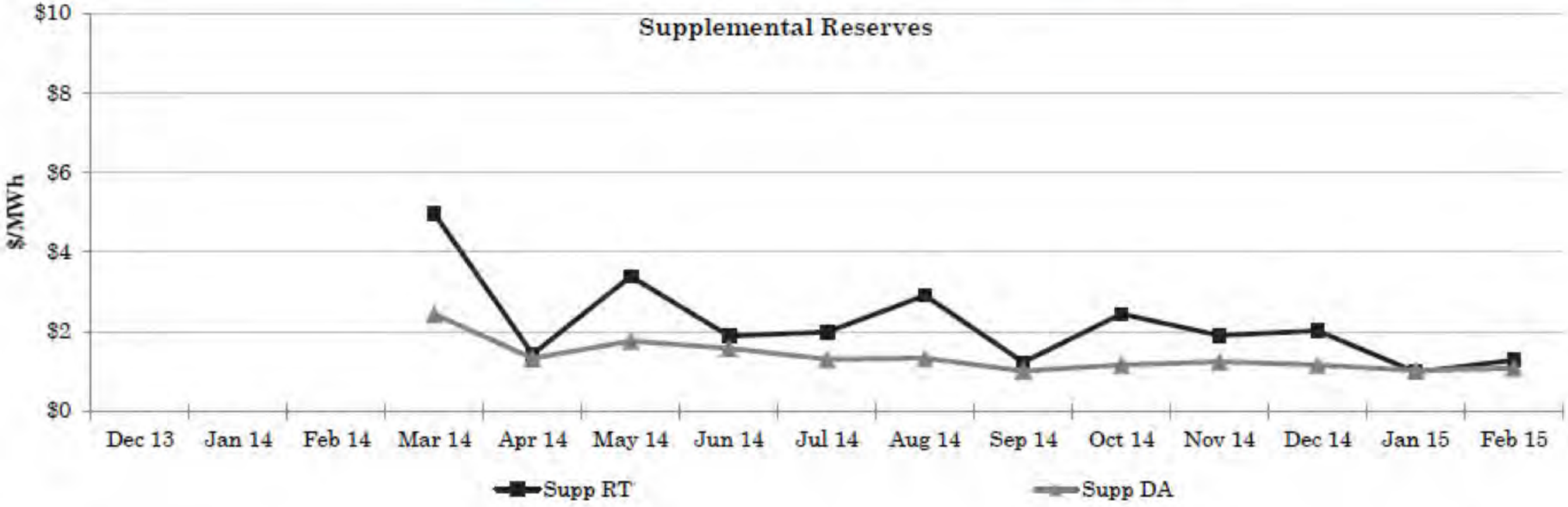
1.8 Ancillary Service Prices - Regulation





1.8 Ancillary Service Prices - Reserves





Value of Flexibility in the Markets

Thank you!

"Historical LMP" and other MISO data found here:
https://www.misoenergy.org/Library/MarketReports/Pages/MarketReports.aspx
Current Real Time Prices:
https://www.misoenergy.org/LMPContourMap/MISO_All.html
https://pricecontourmap.spp.org/pricecontourmap/
EPRI report, *Contributions of Supply and Demand Resources to Required Power System Reliability Services*:
http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000003002006400

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