California Independent
System Operator Corporation

Analysis of Depressed Real-Time Prices in the CAISO Real-Time Energy Market

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Market Surveillance Committee Meeting

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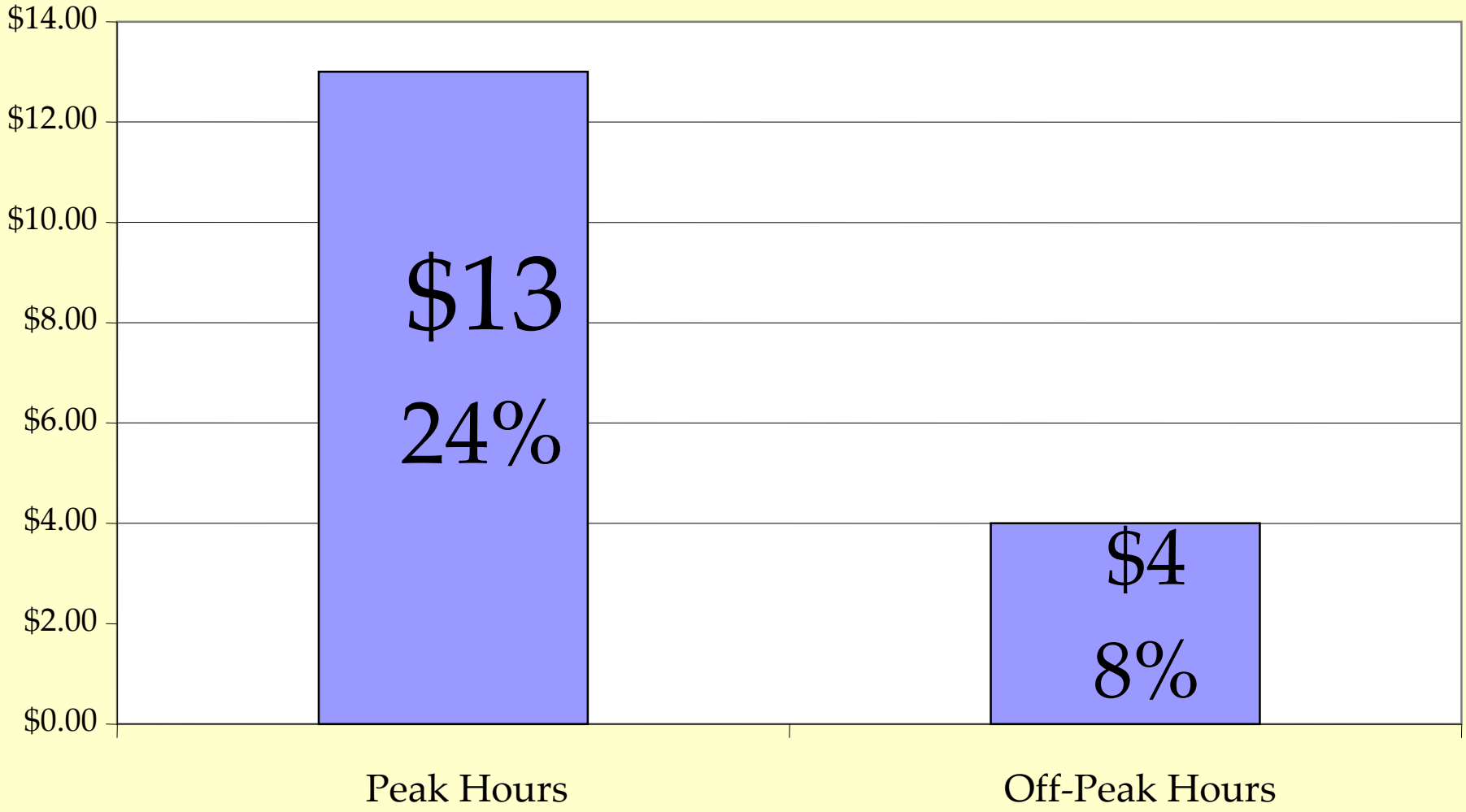
Issue and Purpose

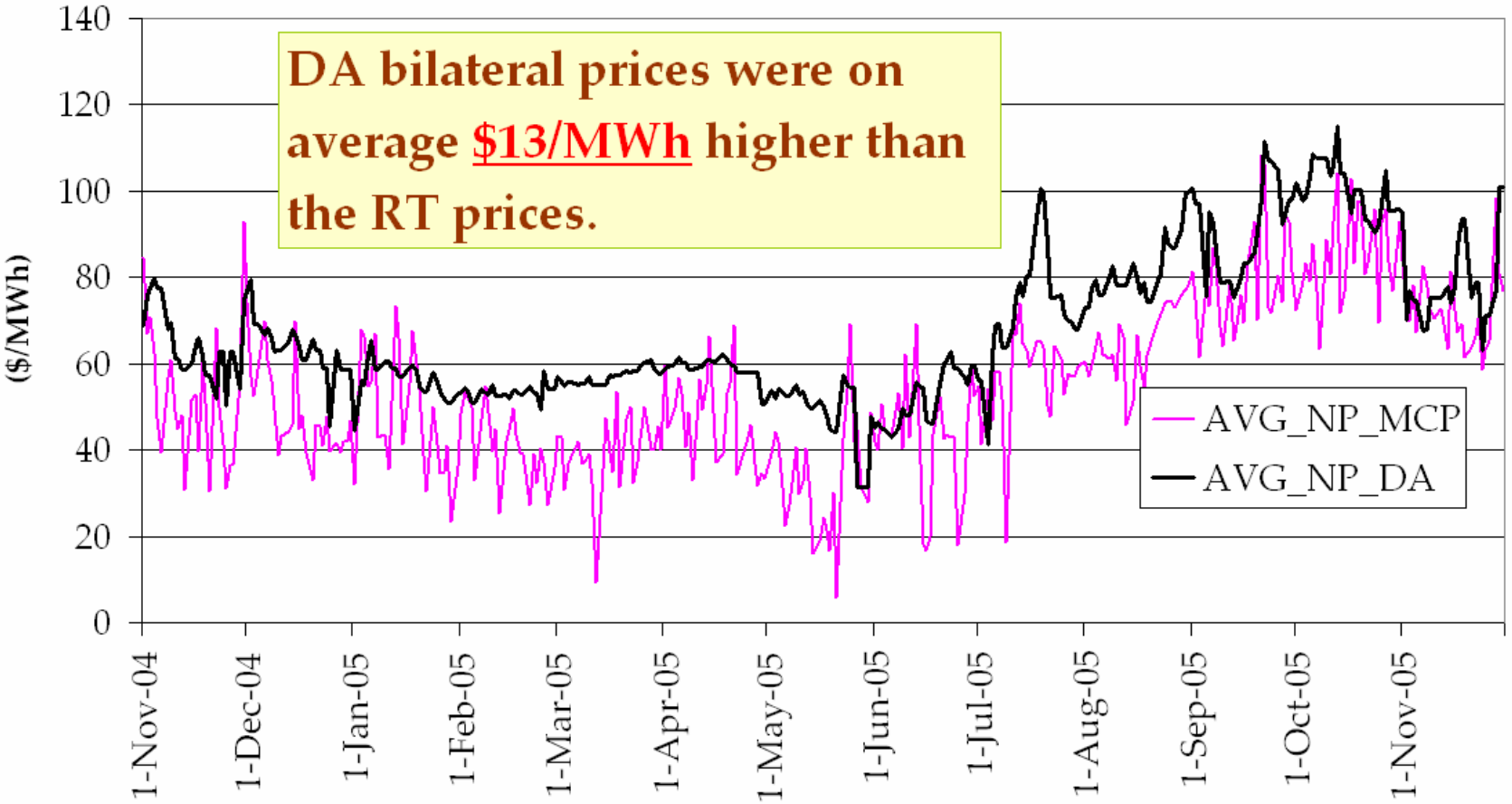
- **Issue**
  - RT prices in the CAISO RT Energy Market have been consistently lower than DA bilateral contract prices since 2003.
- **Purpose of this study**
  - To understand the magnitude of price difference and the main driving factors.

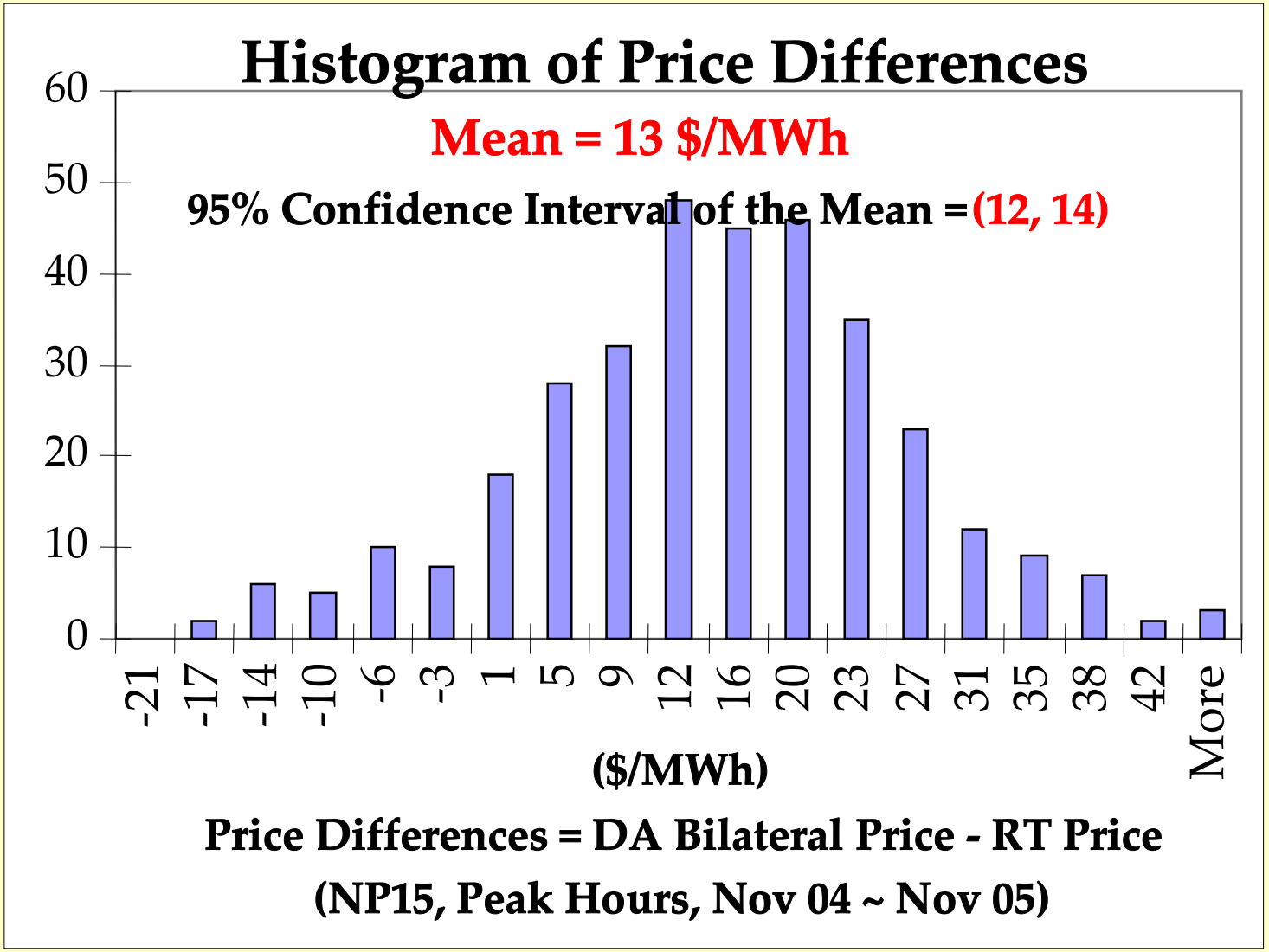
Price Difference = DA Bilateral Price - RT Price

NP15 (Nov 04 ~ Nov 05)



Daily Averages of 16-hr Block Bilateral Prices and Real Time Prices -- NP15, Peak Hours (Nov 04 ~ Nov 05)




Histogram of Price Differences
Mean = 13 $/MWh
95% Confidence Interval of the Mean = (12, 14)
60
50
40
30
20
10
0
-21
-17
-14
-10
-6
-3
1
5
9
12
16
20
23
27
31
35
38
42
More
($/MWh)
Price Differences = DA Bilateral Price - RT Price
(NP15, Peak Hours, Nov 04 ~ Nov 05)

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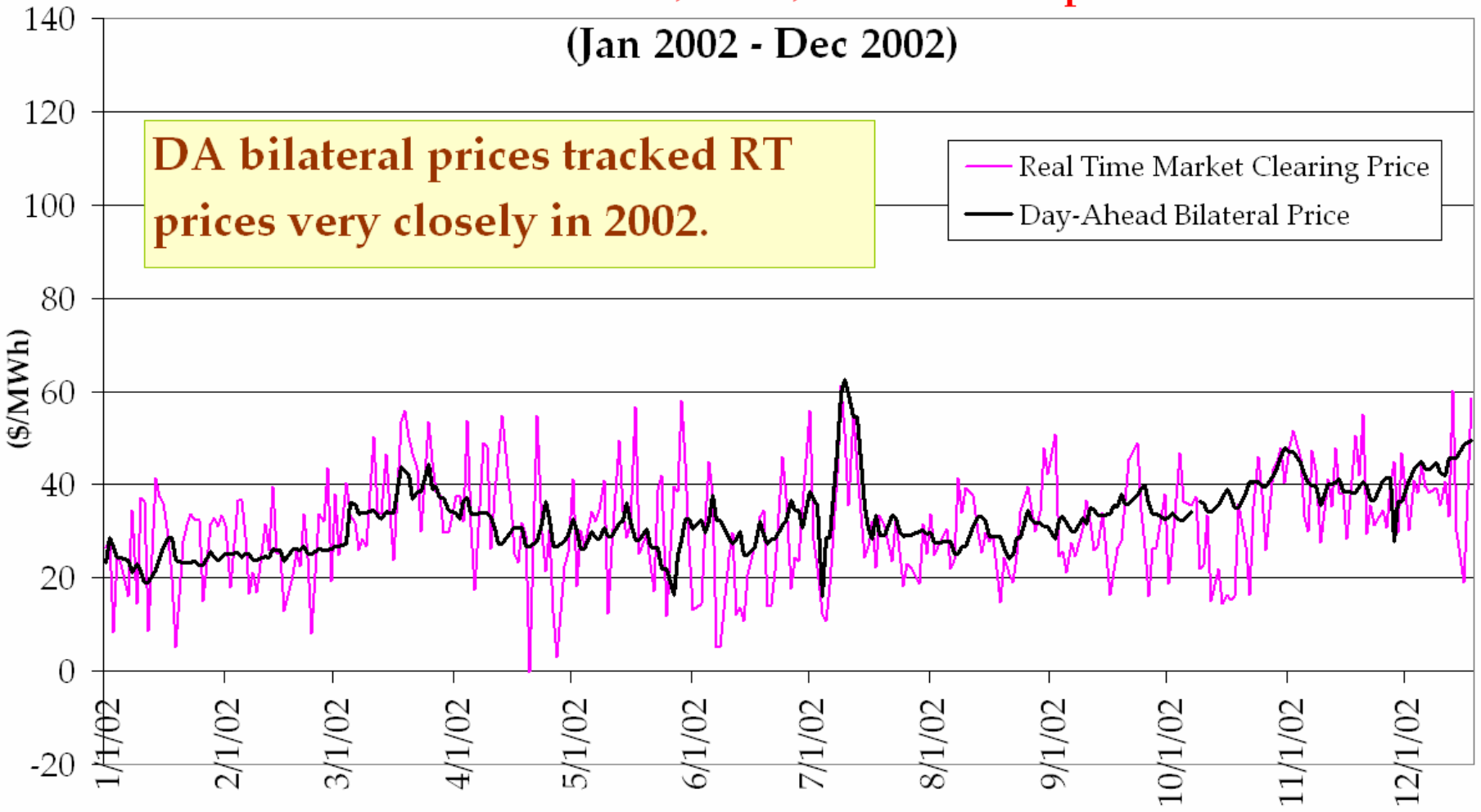
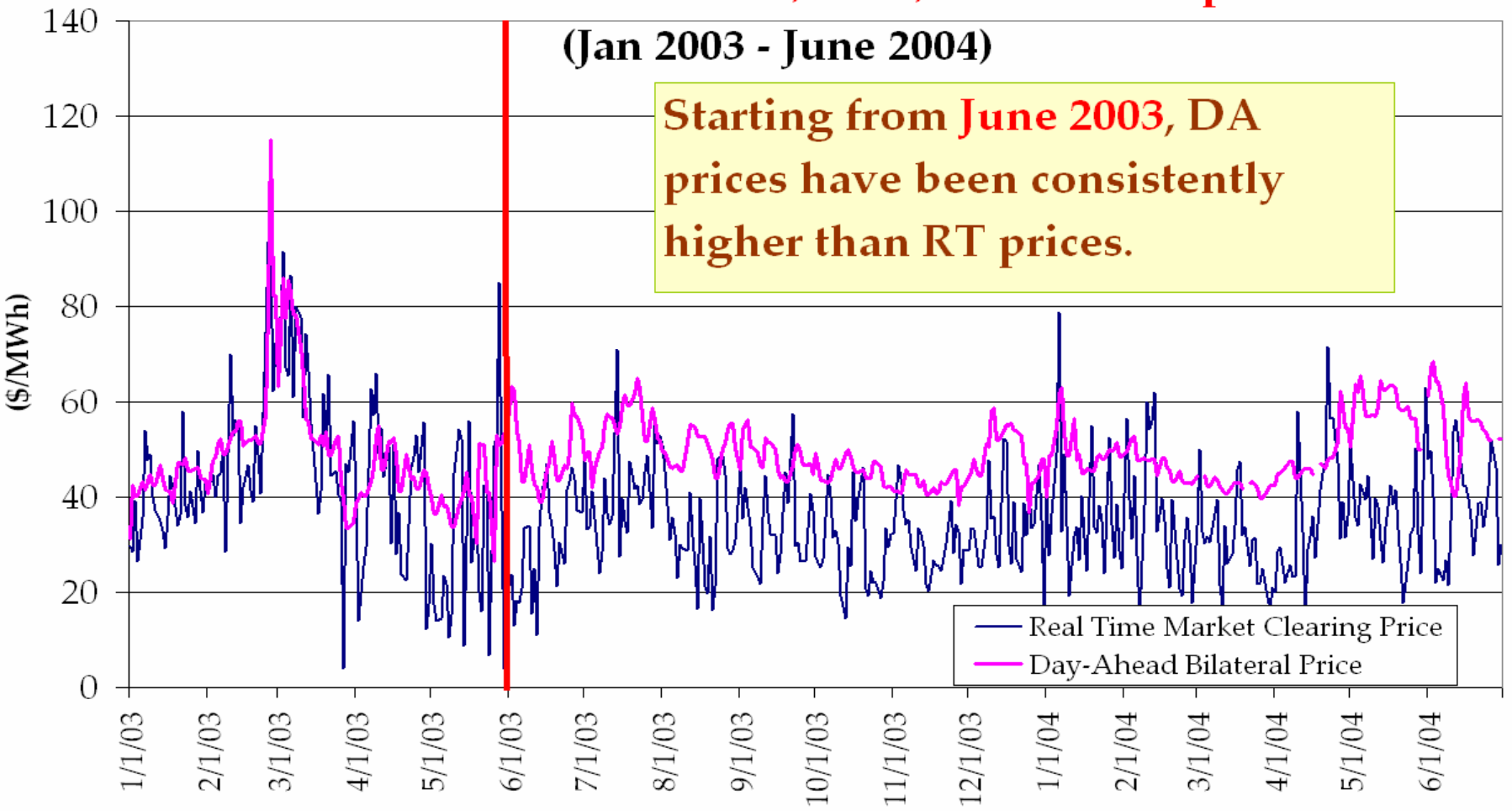
When did it start?

Real Time Prices v.s. Day-Ahead 16-Hour Block Bilateral Prices -- NP15, Peak, No Market Split



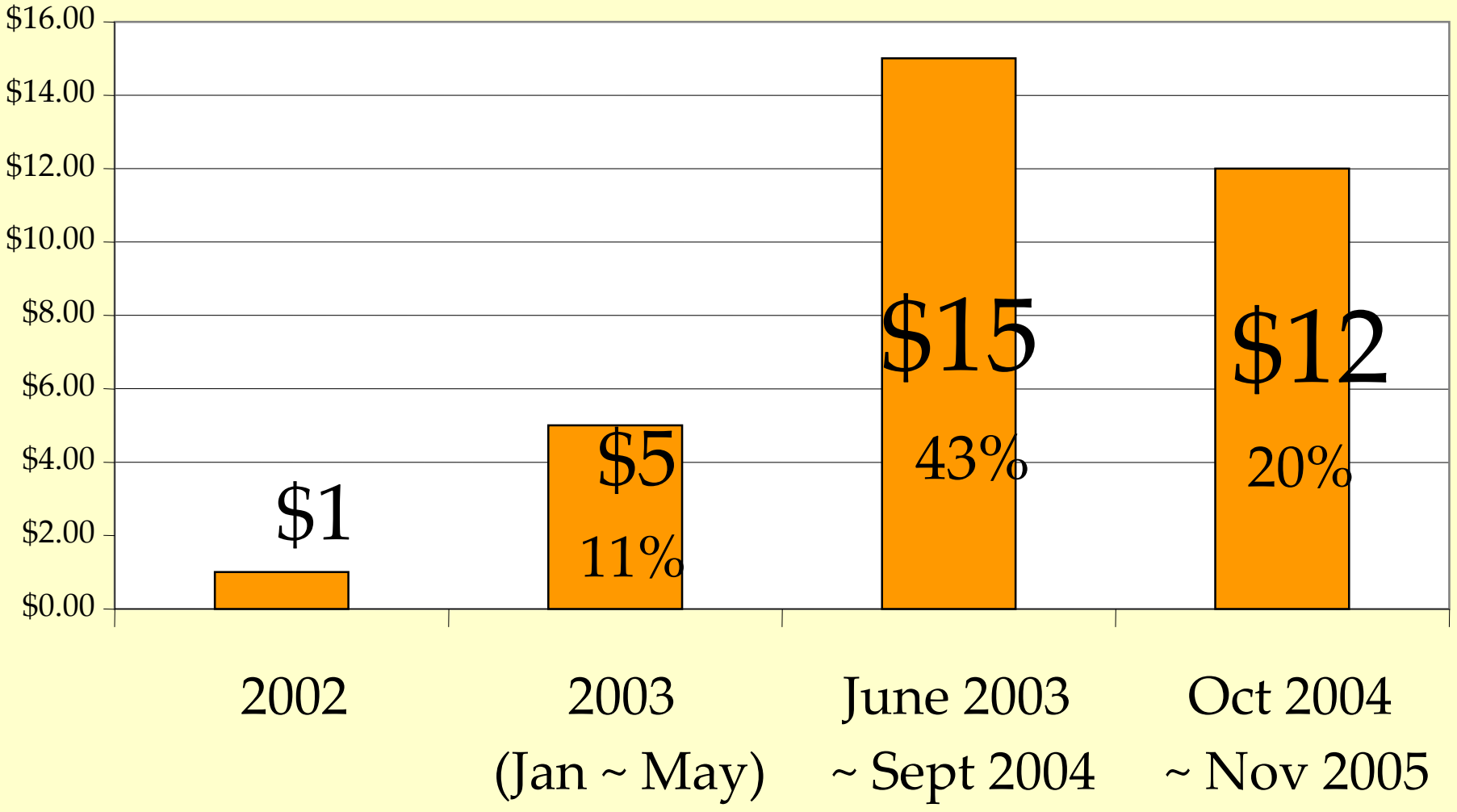
Real Time Prices v.s. Day-Ahead 16-Hour Block

Bilateral Prices -- NP15, Peak, No Market Split



Price Difference = DA Bilateral Price - RT Price

Peak Hours, No Market Split



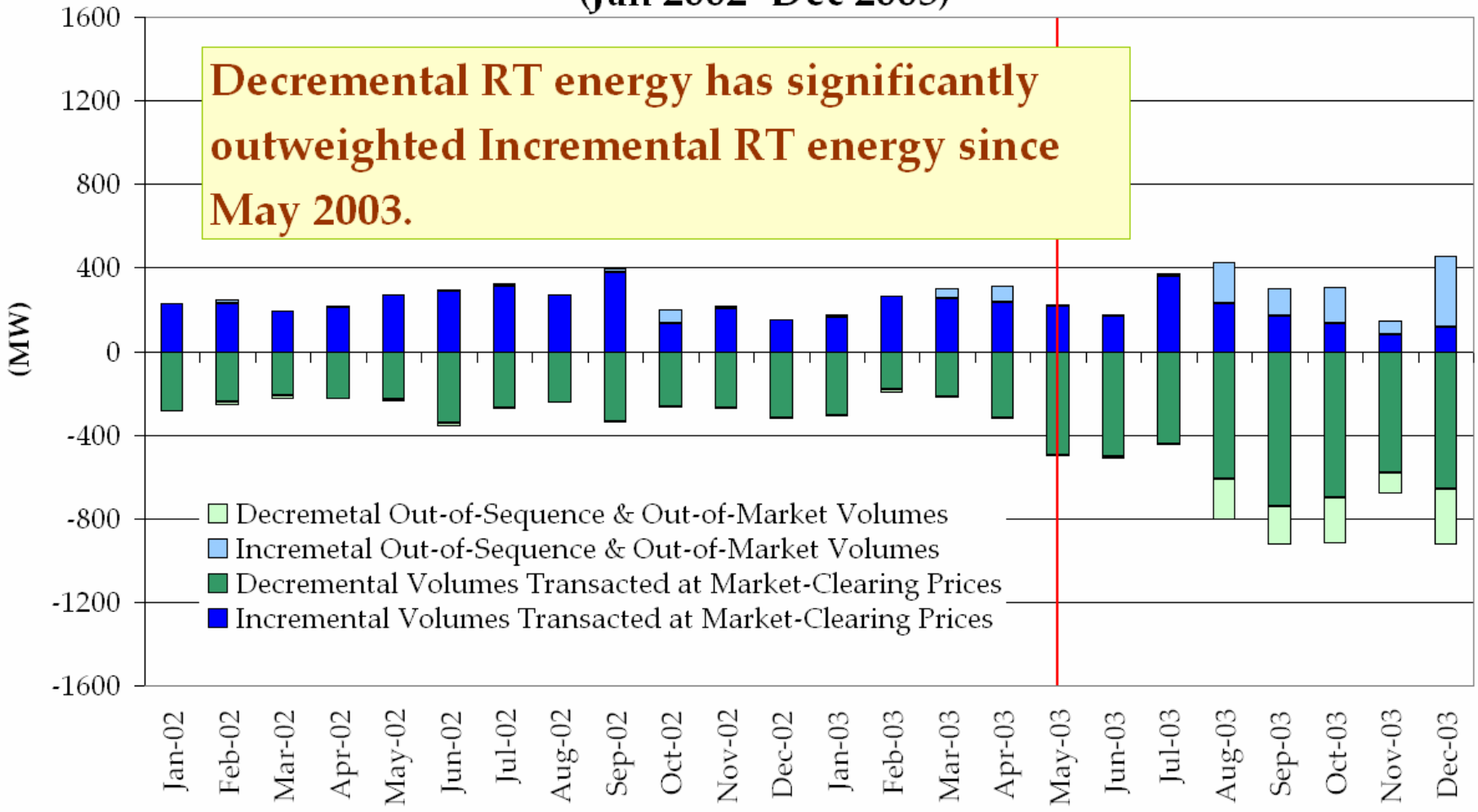
What causes RT prices to be lower?

Potential Causes of Price Difference

- **Risk Aversion**
- **Transaction Cost**
- **Regulatory Policy**
- **Fundamental Demand and Supply Factors in the Real-Time Energy Market**

Monthly Average CAISO Real Time Dispatch Volumes

(Jan 2002- Dec 2003)



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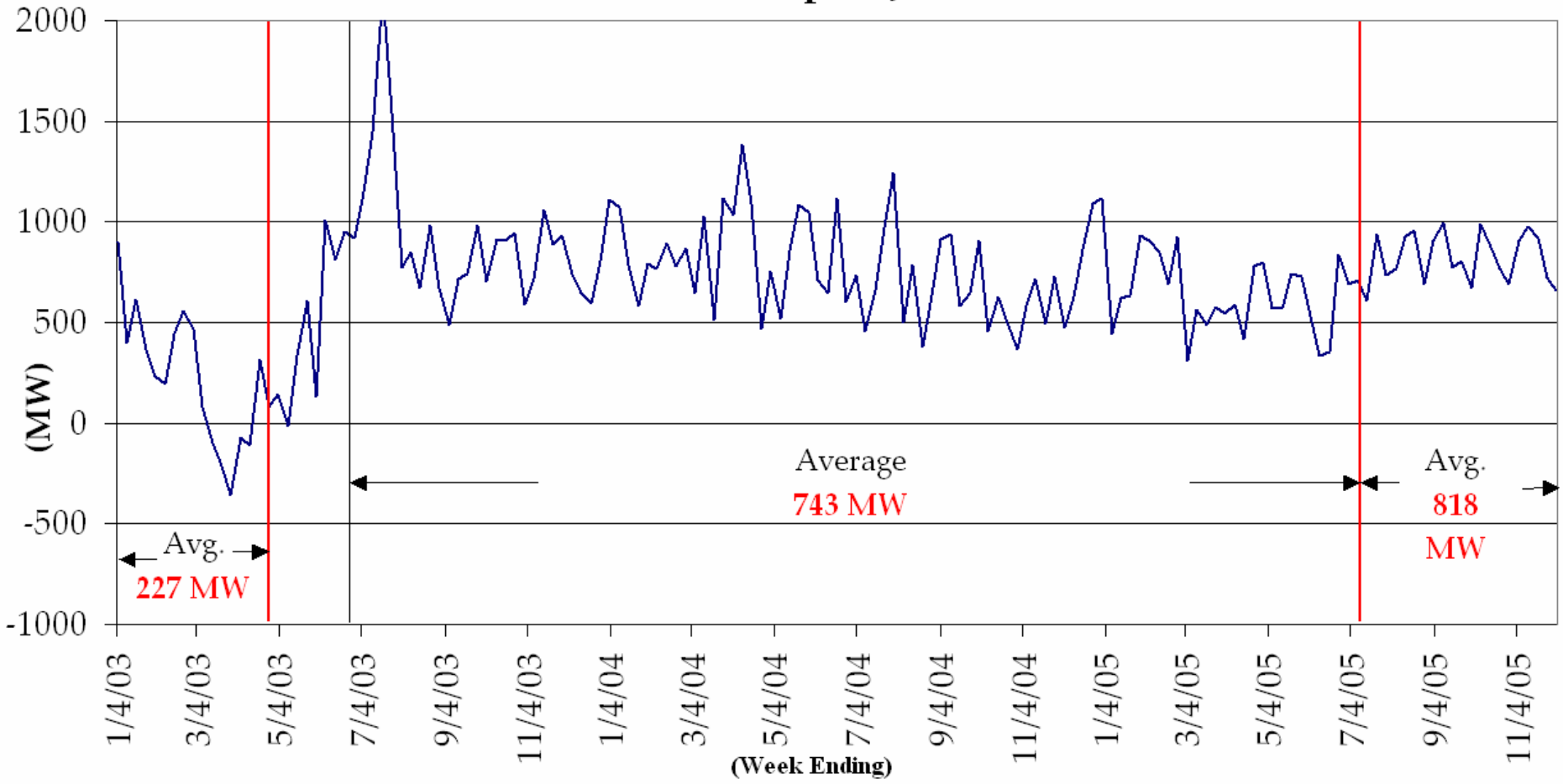
The RT Energy Market has been predominantly decremental since summer 2003. Why?

Factors Shifting the Real-Time Imbalance Demand Curve

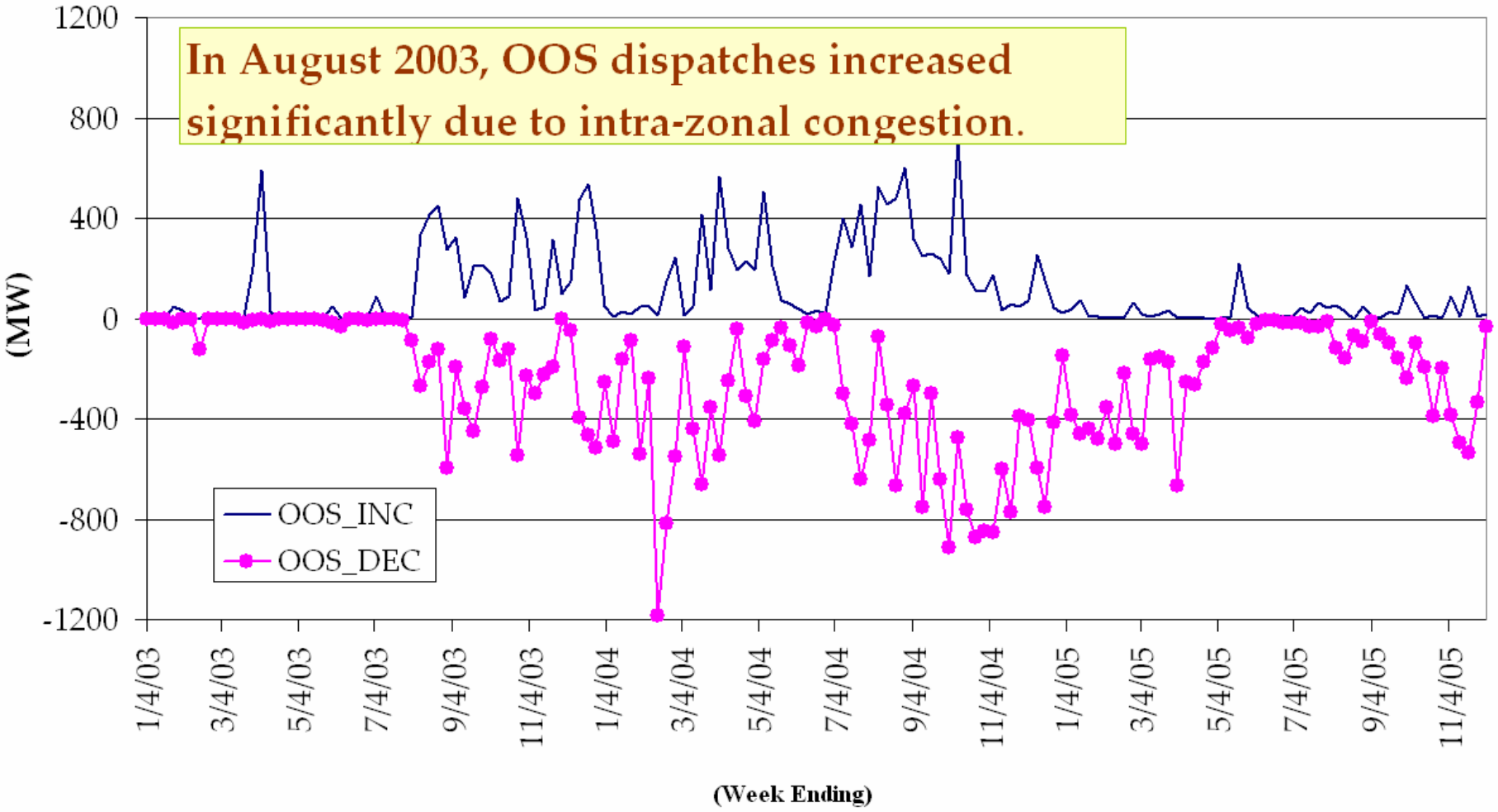
- Load Schedule Deviations
- Uninstructed Energy
- Out-of-Sequence (Out-of-Market) Dispatches
- Must Offer Minimum Load Energy
- RMR
- Hourly Inter-tie Pre-Dispatches (Import & Export)

Load Schedule Deviation
(Hour-Ahead Load Schedule - Metered Load)
Peak Hours, No Market Split (Jan 2003 - Nov 2005)



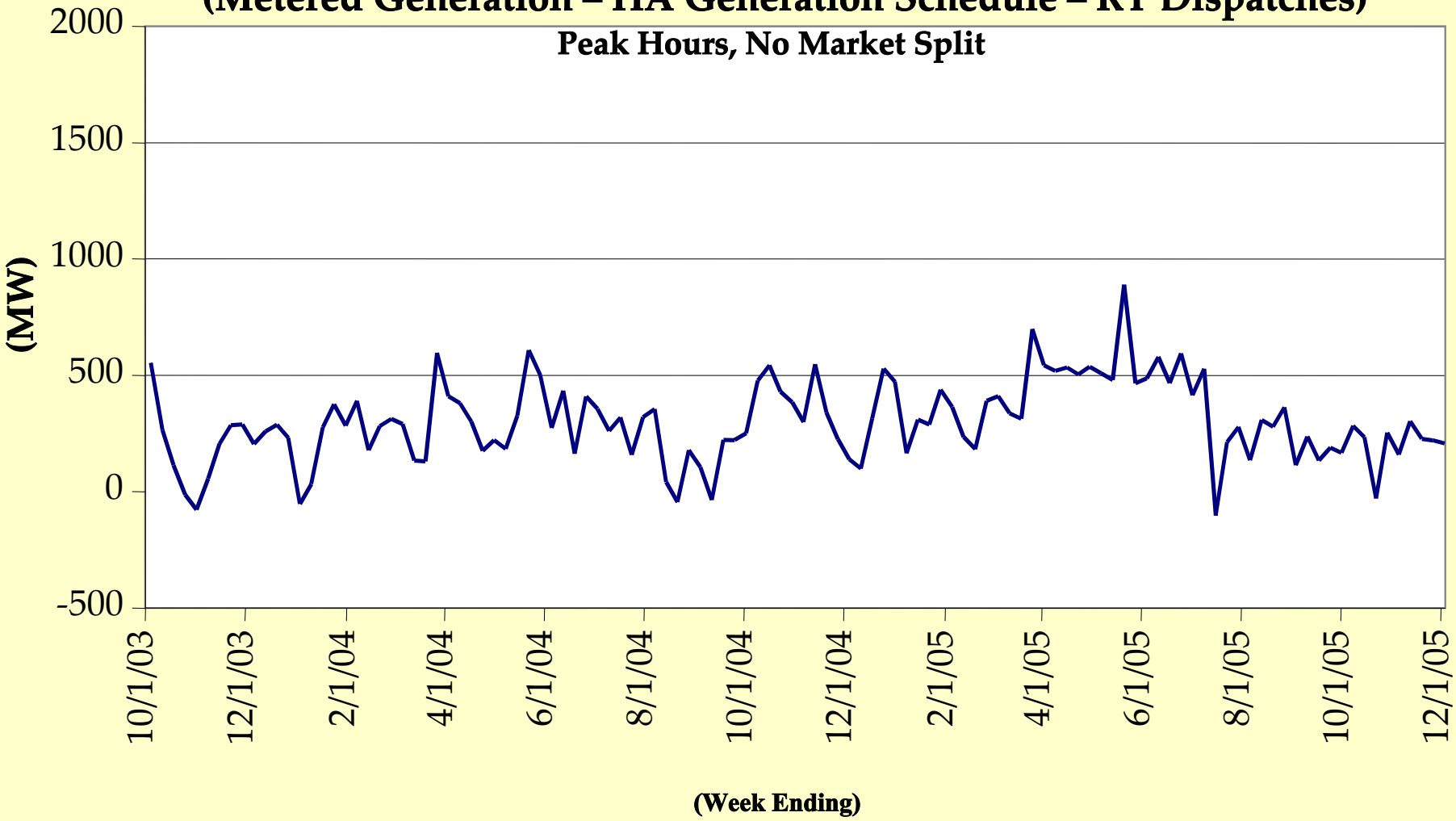
Out-of-Sequence Dispatches

Peak Hours, No Market Split (Jan 2003 - Nov 2005)

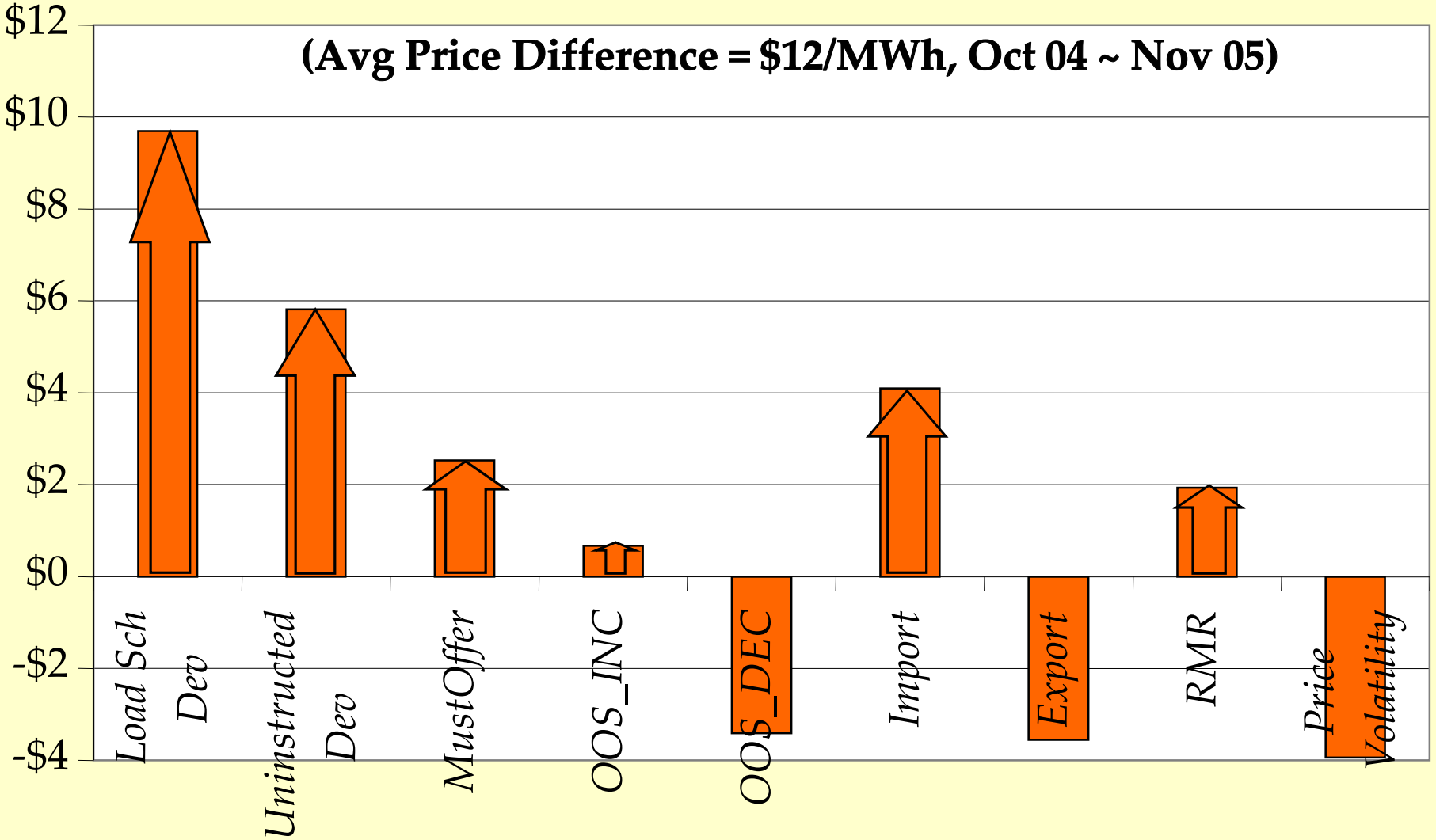


Uninstructed Deviations

(Metered Generation – HA Generation Schedule – RT Dispatches)



Estimated Contribution to Price Difference



Contribution is estimated at the mean of each factor. "Import" measures the incremental RT hourly pre-dispatches, and "Export" measures the decremental RT hourly pre-dispatches.

Results
Price Impact of Load Over-Scheduling and Uninstructed Energy

- **Average RT prices have been lower than DA prices due to a mix of factors.**

- **Load over-scheduling and positive uninstructed deviations were the most significant factors depressing RT prices.**

MRTU Market Design Should Mitigate Factors Causing DA & RT Price Differences

- RT congestion management under current zonal market design created some unscheduled/uninstructed (e.g., OOS & Must Offer) energy. Nodal pricing should solve the problem and provide more accurate locational price signals.
- MRTU is ready to incorporate the capability to implement UDP.
- The CAISO is also investigating further market design enhancements such as convergence bidding which could further reduce price discrepancies between DA & RT prices.