Market Performance during MISO Heat Wave: June/July 2012

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July 31, 2012

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MISO Heat Wave: Late June/July 2012

- This presentation reviews the performance of the MISO market during the very hot weather than occurred in the region in early to mid July.
  - ✓ In late June and extending through the first week of July, MISO experienced record temperatures. MISO also experienced hot weather on the July 17 and 23.
- As shown on the following slide, all the major MISO load centers experienced temperatures at or above 99 degrees during this heat wave with most areas experiencing several days above 100 degrees.
- Due to the July 4 holiday, load was likely lower than it otherwise would have been. Despite this, MISO set a record market peak load of 96.7 GW.
  - ✓ On July 17, MISO set another record peak load of 97.7 GW, which was recently exceeded on July 23 at 98.5 GW.
- MISO's reserve margin was reduced during the peak load periods due to several long-term forced outages and low wind generation levels.
- MISO LSEs invoked voluntary load curtailments on most of the peak load days:
  - ✓ MISO does not invoke or call upon these curtailments nor do they include them in their reliability commitment process.
  - ✓ The curtailments were roughly 500 MW on most of the highest-load days.

2012 Heat Wave, June 27 – Jul 8

- A heat wave lasting nearly two weeks and spanning the entire MISO reliability and market footprint exceeded many temperature records.
- The table below shows the high temperatures on each day of the heat wave compared to the average high temperature historically for these days and locations.
  - ✓ Several locations at times exceeded their historical average by 20 degrees or more.
  - ✓ MISO issued a MaxGen Alert on June 28th and 29th (shown in yellow) and a MaxGen Warning on July 5th and 6th (orange).
  - ✓ We evaluate these four days more closely in the following slides.

	Historical Average	June 27	28	29	30	July 1	2	3	4	5	6	7	8
Cincinnati	85	89	102	100	102	98	95	95	99	99	102	104	100
Detroit	82	89	98	93	93	93	91	84	100	88	99	96	86
Indianapolis	85	91	104	103	97	95	98	98	102	103	105	105	96
Milwaukee	80	93	96	86	92	84	87	97	102	103	94	86	81
St. Louis	89	99	108	106	105	102	100	101	105	105	106	107	98
Minneapolis	79	91	87	89	89	93	98	93	98	91	99	84	87

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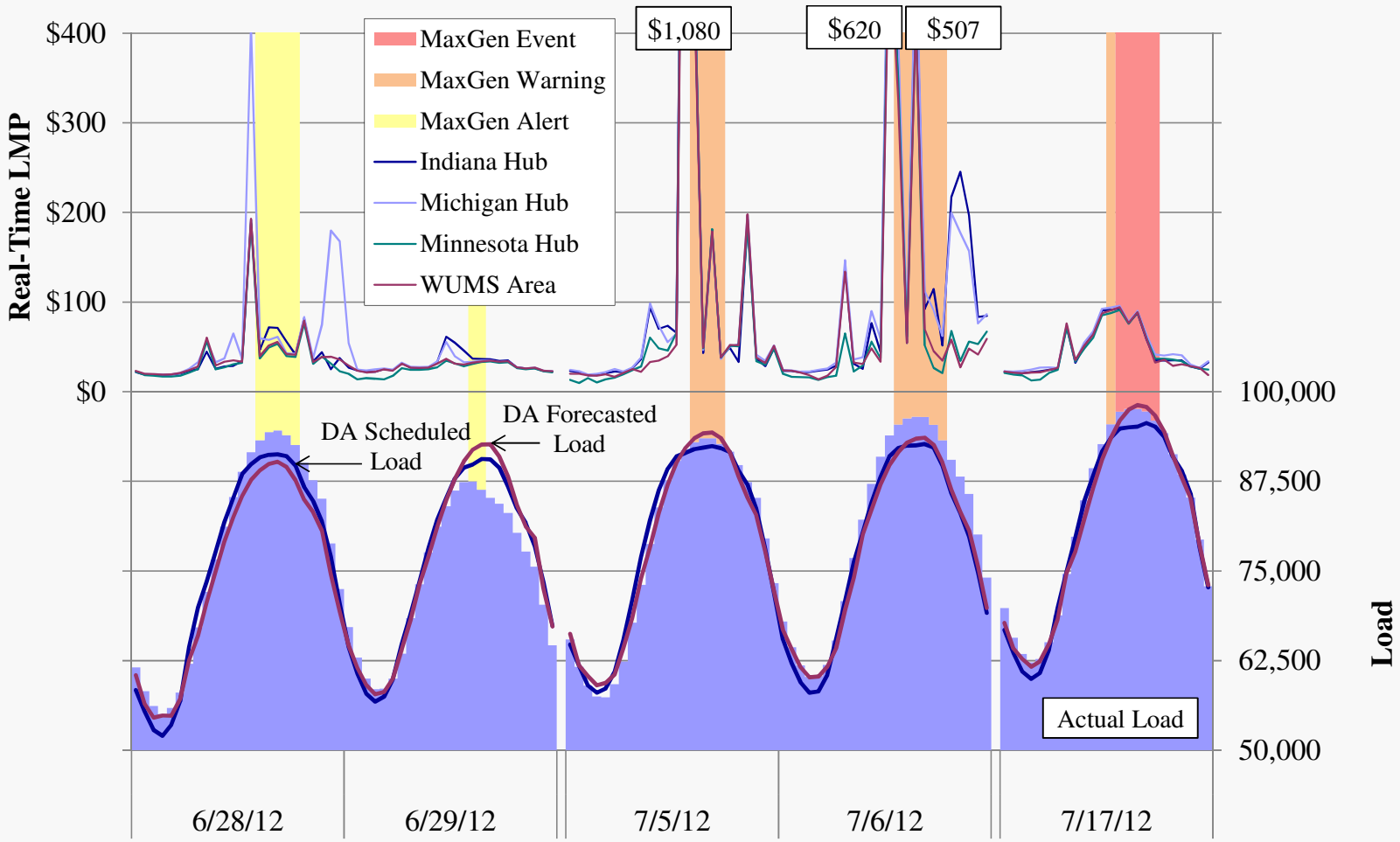
2012 Heat Wave
June 28–July 6 and July 17

- The following chart shows a summary of real-time hub prices during the heat wave and the corresponding day-ahead load scheduling, day-ahead forecast and real-time load.
- The chart also shows in shading the periods when MISO declared emergencies: alerts, warnings, or events. MISO declared conservative operations for the entire time period.
- The chart shows that:
  - ✓ Load was significantly under-scheduled on all but one of the heat wave days (June 29). It was overscheduled on June 29 because thunderstorms reduced load unexpectedly.
  - ✓ Load was only significantly under-forecast on two of these days (June 28 and July 6);
- Prices were volatile on most of these days, but this chart only shows some of the factors that influence. Other factors that impact price include:
  - ✓ RT forced outages and derates (generation and transmission);
  - ✓ RT wind generation and net imports;
  - ✓ Operator actions (RT commitments, load offsets);
- In the subsequent charts we show details of several price spike events that occurred during heat wave that show the impacts of these factors.

DA Load Scheduling and RT Energy Prices
Late June and Early July 2012



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Real-Time Factors Impacting Energy Prices

- The next several charts show the real-time factors that directly impact capacity levels and energy prices.
  - ✓ Factors which contribute to higher prices ("harmful") are shown as positive MWs and those that reduce load and prices ("helpful") are shown as negative MWs.
  - ✓ The charts show the cumulative impact of supply and demand factors that affect the net capacity balance from the start of the pricing events;
- The factors shown in the charts include the changes in:
  - ✓ Real-time market load (prior to the application of any operator offset);
  - ✓ Operator load offset;
  - ✓ Real-time Net Scheduled Interchange (changes in net imports);
  - ✓ Real-time wind output;
  - ✓ MISO commitments (for capacity or congestion);
  - ✓ Other Supply (e.g. additional ramping capability from resources dispatched up in the prior interval, increased output from non-dispatchable resources, or self-commitments).
  - ✓ Significant outages (real-time forced unit outages greater than 60 MW).

Events on July 5
12:40 – 16:50

- The was short of reserves twice during the peak hours on July 5, which led to transitory price spikes.
- 12:40 - 13:25: Net demand (net of supply changes) rose roughly 600 MW leading to an operating reserve shortage.
  - ✓ Load was rising rapidly, increasing by over 1100 MW in this period.
  - ✓ A forced outage of a 560 MW unit occurred at 13:12 (reflected in the 13:25 interval).
  - ✓ Imports decreased by more than 500 MW (as prices in PJM rose to over $100/MWh) and wind declined by 200 MW in this period and contributed to the shortage.
  - ✓ The net demands were not fully offset– MISO committed roughly 750 MW by this time and other supply rose 800 MW as output rose on ramp-constrained units.
- 13:30 - 14:25: MISO is in an operating reserve shortage.
  - ✓ MISO's commits more than an additional 1100 MWs and other supply rises another 200 MW, but load increases by another 1300 MWs.
  - ✓ Imports do not begin responding materially to the price spike until 14:15 due to the 30 minute scheduling window. By 14:25, net imports have increased by more than 1 GW from before the event and the shortage is over.
- 14:25 - 16:50: Load continues to rise but the net imports continue to surge to more than 3 GW, producing very low prices. When imports fall, a second brief shortage occurs.

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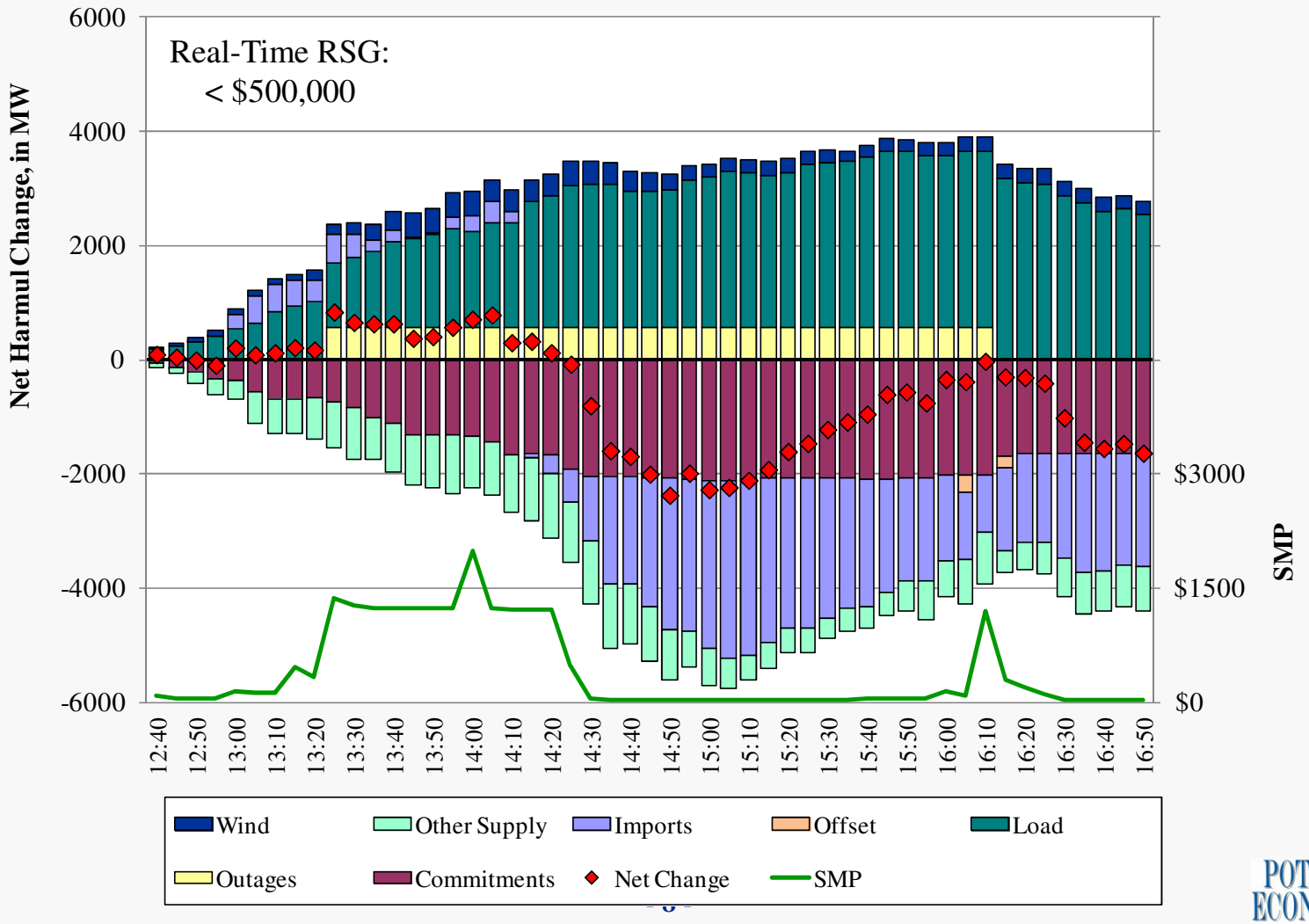
July 5
12:40 – 16:50



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Events on July 6
12:00 – 16:00

- 12:00 – 12:50: Net demand increased nearly 1.3 GWs due to rapid increases in load and declining imports leading to an operating reserve shortage.
  - ✓ Load increased 1.7 GWs during this time period and imports declined by 800 MW.
  - ✓ In addition a 580 MW unit tripped at 12:20.
  - ✓ Net imports fall by 530 MW by 12:50 as prices in PJM average $160 per MWh.
  - ✓ The increased net demand is not fully offset- MISO commits 1 GW and other supply rises 670 MW, increasing wind output adds 100 MW during this time period.
- 12:55 – 13:20: Reserve shortage produces prices peaking at almost $2400 per MWh.
  - ✓ Load increases 1 GW during this period, but shortage ends due to the following.
  - ✓ MISO commits additional 540 MWs, other supply change grows another 430 MW, and wind output increases another 200 MW.
  - ✓ Net imports begin to respond, increasing by 600 MW.
- 13:20 – 15:10: Imports surge more than 2.9 GW in response to the shortage pricing.
  - ✓ The excess response leads to energy prices averaging $40/MWh, causing net imports to fall rapidly as load continues rising (almost another 1 GW by 15:10).
- 15:15 – 15:35: Load is growing slowly, but other factors lead to a second shortage.
  - ✓ Falling net imports and additional forced outages of 650 MW produce another reserve shortage and peak prices of $1350. Shortage ends as net imports increase.

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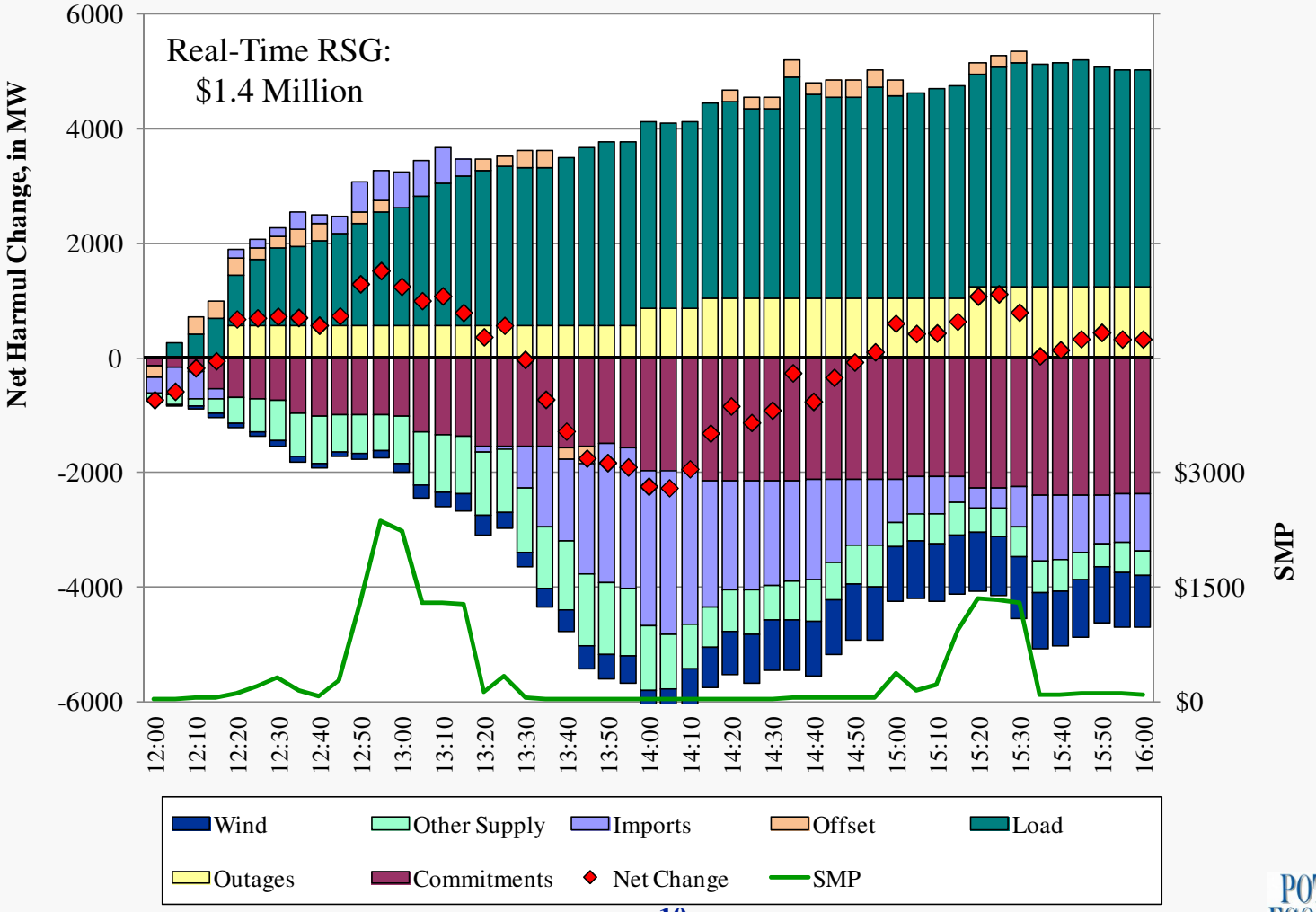
July 6
12:00 – 16:00



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Events on July 17
11:30 – 18:00

- On July 17, record load is forecast and an operating reserve shortage is expected. MISO declares a Max Gen Event Step 1A from 1 PM to 7 PM.
- 10:00 – 13:00: MISO begins preparing for forecasted loads and sharp load increases by committing CTs and shifting operating reserves from offline to on-line resources.
  - ✓ At 10:00, MISO begins committing quick start CTs;
  - ✓ 11:30 – 13:00 Load ramps steeply increasing nearly 4 GWs.
  - ✓ When MISO declares the Gen Event at 1 PM, it has committed more than 800 MWs of fast start CTs, carrying only 300 MWs of contingency reserves on off-line units.
- 13:00 – 18:00: MISO declares an emergency and commits all available resources and prepares for the forecasted peak load.
  - ✓ At 13:07, MISO declares a Max Gen Event Step 1A, curtailing 200 MW of exports.
  - ✓ By 14:00 MISO voluntary load curtailments of 400 MWs has occurred.
  - ✓ By 16:30 MISO completes the commitment of all available resources is meeting operating reserve requirements entirely with spinning reserves.
  - ✓ In the late afternoon, storms in Wisconsin reduce load and wind output increases resulting in substantial surplus capacity. Decommitment occurs slowly.
- Because much of the committed capacity was not needed in retrospect, prices were low, imports did not increase, and RSG costs were very high (almost $3 million).

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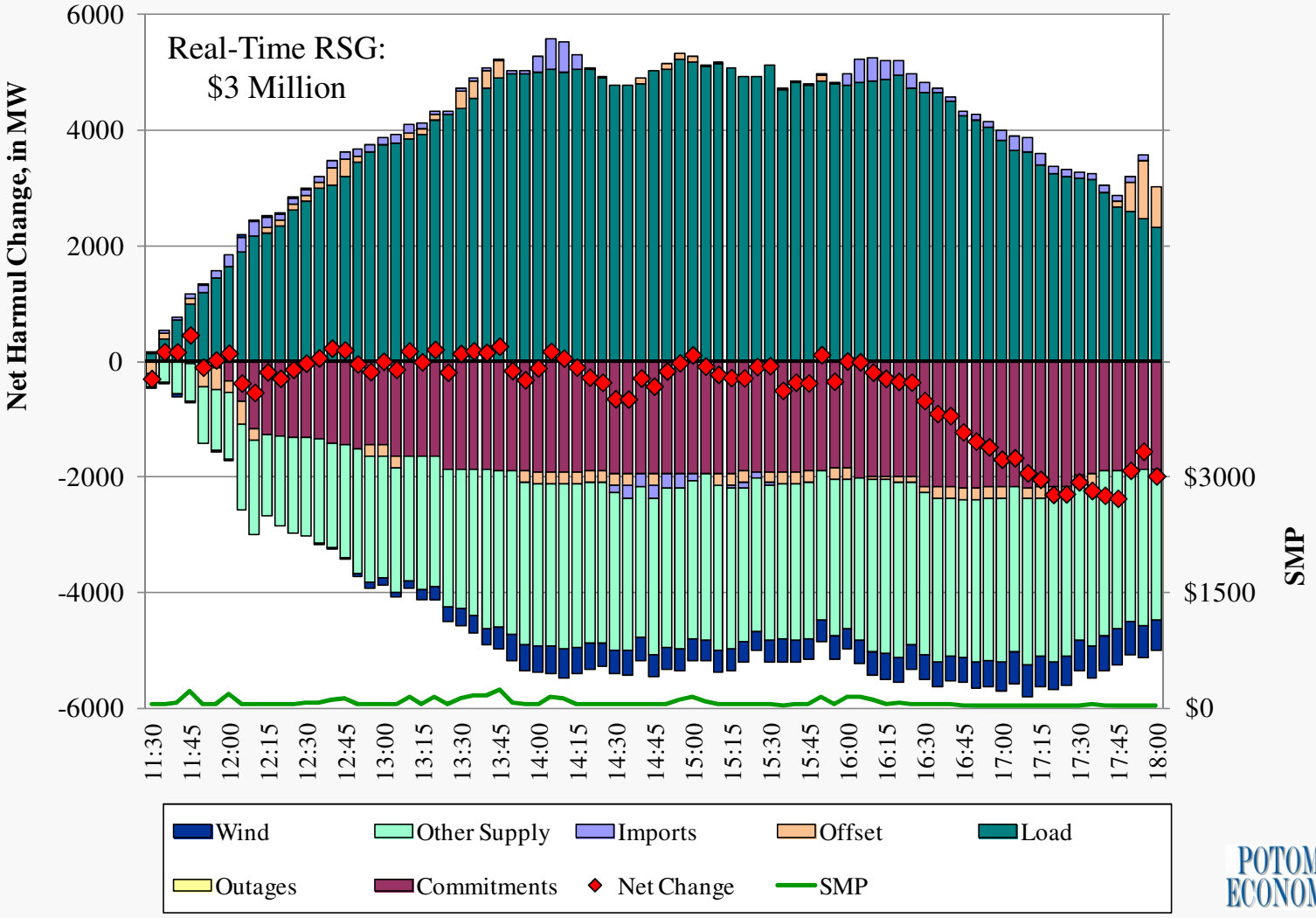
July 17
11:30 – 18:00



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Conclusions

- Tight conditions test the performance of the market and the RTO, and highlight opportunities for improvement.
- Overall, reliability was maintained and the markets accurately signaled the actual shortages that occurred.
- However, these events indicate the high degree of interdependence between the market and the MISO's actions.
- The interfaces with other areas provide significant reliability to MISO, but cannot be relied upon by MISO operators because:
  - ✓ They are not directly coordinated.
  - ✓ The response is lagged.
- By responding preemptively, prices may not materialize to prompt increased net imports or other market responses.
- Both reliability actions and the lagged market response can result in substantial RSG by rendering reliability commitments uneconomic.
  - ✓ Improved interchange coordination with PJM and improved real-time pricing will both help address these issues.