

# Memorandum

**To:** ISO Board of Governors  
**From:** Eric Hildebrandt, Director, Market Monitoring  
**Date:** July 5, 2012  
**Re:** **Market Monitoring Report**

---

*This memorandum does not require Board action.*

## EXECUTIVE SUMMARY

This memo provides an update on market performance over the first half of 2012.

- **Price divergence between the ISO markets has reemerged.** The convergence of average prices in the day-ahead, hour-ahead and real-time market improved in the later months of 2011 and the first few months of 2012. However, starting in March the divergence of average prices has gradually increased, particularly between the hour-ahead and real-time markets. The divergence of average prices in these markets has been driven largely by an increase in real-time price spikes. As discussed below, many of these real-time price spikes have been due to short-term ramping limitations and congestion. Although price spikes due to these limitations are brief and occur in a relatively small number of intervals, the extremely high prices that result have driven the average real-time price well-above day-ahead and hour-ahead prices in recent months. The price divergences have increased revenues paid to virtual bidders and increased the real-time imbalance offset costs allocated to load-serving entities.
- **Congestion has increased due to outages.** Congestion increased in the first half of this year relative to previous years. This increase is related to a combination of generation and transmission outages. While the outage of the San Onofre Nuclear Generating Station (SONGS) accounted for 2,200 MW of generation on outage, the ISO averaged over 14,000 MW of generation on outage in the first quarter. In addition, there have been outages of several key transmission paths – including one of the main transmission paths connecting southern California from the northern portion of the ISO (Path 26). Together, the transmission and generation outages have increased the frequency of congestion and price spikes, particularly in southern California.

- **Real-time price volatility increased.** Real-time price volatility has increased due to the combination of extreme price spikes in a small percentage of intervals and very low prices in many other intervals. A number of factors have contributed to extreme price spikes, including short-term ramping limitations, transmission de-rates, mitigation of unscheduled flows and load forecasting. Short-term ramping limitations account for over half of prices at or above the \$1,000 bid cap from May to June 2012. Unscheduled flows (or loop flow) are often common during the spring as hydro-electric and wind generation move out of the Northwest. These unscheduled flows require operators to take action to manage their impact, with price volatility sometimes occurring as a result. Finally, when the weather is volatile, this increases the discrepancy between day-ahead and hour-ahead load and wind forecasts relative to actual real-time conditions.

### Price Divergence

Price divergence, particularly between the hour-ahead and real-time markets, has represented a reoccurring problem in the ISO markets.<sup>1</sup> Price divergence was particularly problematic in spring 2011 when convergence bidding in inter-ties allowed participants to take advantage of systematic price differences between hour-ahead and real-time prices without providing any market efficiency benefits. The ISO took several steps, including making changes to operational procedures and software, which ultimately helped improve convergence of average prices in the second half of 2011.

Prices in different markets continued to converge well in the first few months of 2012. However, starting in March the divergence of average prices has gradually increased, particularly between the hour-ahead and real-time markets (see Figure 1). The divergence of average prices in these markets has been driven largely by an increase in real-time price spikes (see Figure 2).

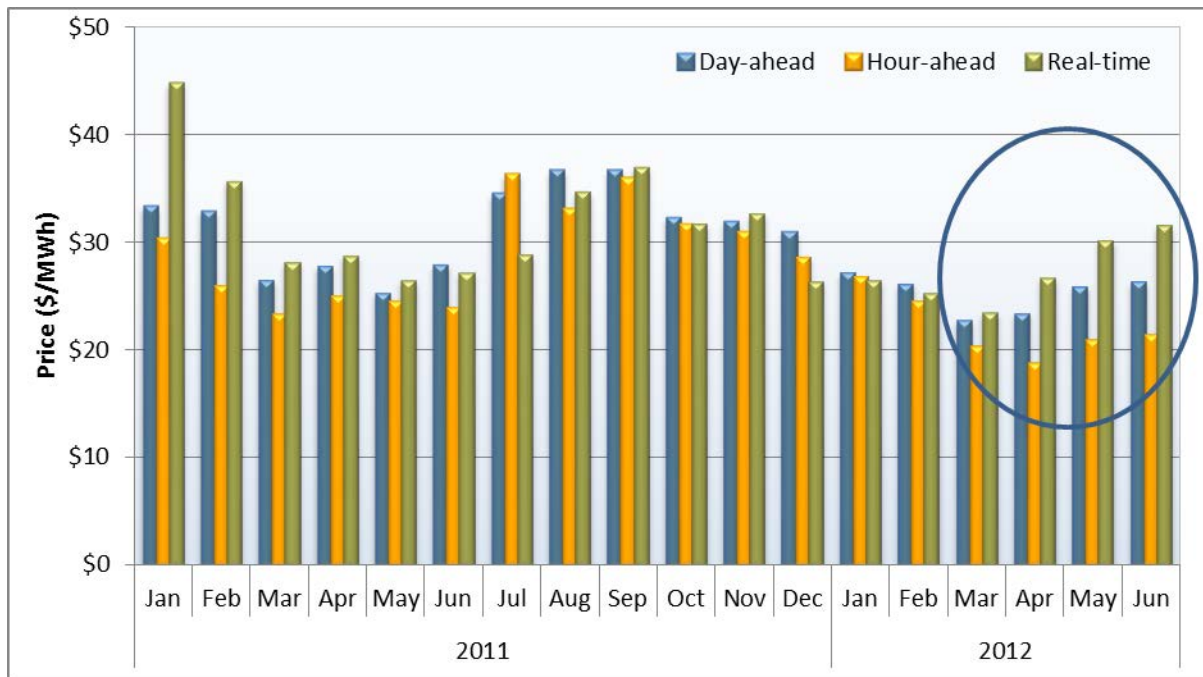
Many of these real-time price spikes have been due to short-term ramping limitations and congestion. Prices are set by penalty parameters at \$1,000/MWh when the system runs out of available ramping capability. Although price spikes due to these limitations are brief and occur in a relatively small number of intervals, the extremely high prices that result have driven the average real-time price well-above day-ahead and hour-ahead prices in recent months.

In the month of February, shortages of capacity occurred in only 0.1 percent of all real-time intervals. However, by the month of June, such shortages increased to over 1 percent of real-time intervals. During intervals when these short-term ramping limitations did not occur, average day-ahead and real-time prices converged well.

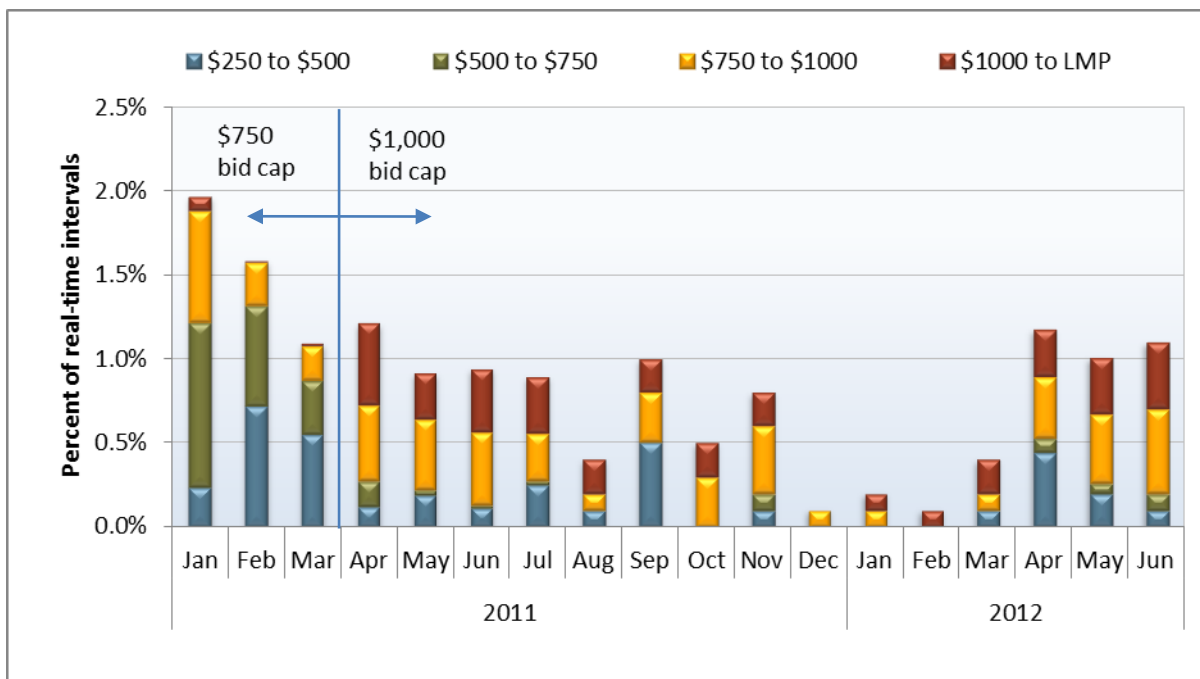
---

<sup>1</sup> Further discussion can be found in DMM's September 2010 and May 2011 board memos. Memorandum to ISO Board of Governors from Eric Hildebrandt, Director, Market Monitoring, September 11, 2010, <http://www.caiso.com/Documents/100909InformationalReport-Department-MarketMonitoringReport.pdf>, and Memorandum to ISO Board of Governors from Eric Hildebrandt, Director, Market Monitoring, May 11, 2011, <http://www.caiso.com/Documents/110518DepartmentMarketMonitoringUpdate-Memo.pdf>.

**Figure 1 Average monthly prices - system marginal energy price (all hours)**



**Figure 2 Frequency of real-time price spikes (all LAP areas)**



Convergence bidders profited from the predictable differences in average day-ahead and real-time prices. Net profits from convergence bidding from April through June totaled over \$10 million. This was roughly the same as the revenues they earned in the previous eight months combined.

Hour-ahead prices continued to remain low relative to day-ahead and real-time prices during these periods. Beginning in April, net imports after the hour-ahead market relative to the day-ahead market have dropped significantly. These reductions in net imports have contributed to real-time imbalance offset costs by creating hours when the ISO “sells low” in the hour-ahead market and then buys additional energy in the 5-minute real-time market at a higher price. Reductions in net imports accounted for an estimated \$8.4 million in real-time imbalance offset costs paid by load-servicing entities in April and May. This is more than what occurred in the previous 10 months.

### **Congestion**

In addition to systematic system-wide price differences, prices in the first half of 2012 have also been influenced by transmission congestion. Congestion increased in the first half of this year relative to previous years. This increase is related to a combination of generation and transmission outages. The outage of SONGS accounted for 2,200 MW of generation on outage.

In addition there have been outages of several key transmission paths. Together, the transmission and generation outages have combined to increase the frequency of congestion, particularly in southern California. Day-ahead market congestion accounted for about 2 percent of the price in SCE and over 5 percent of the price in San Diego in the first half of 2012. In 2011, congestion accounted for less than 1 percent of the price in SCE and about 4 percent of the price in San Diego in the first six months.

### **Real-time price volatility**

Real-time prices in spring have been highly volatile, with very high prices some hours and low prices during many other hours. Both the frequency and the price levels associated with real-time price spikes are higher than they have been for over the last year. Causes of these real-time price spikes include:

- **Short-term ramping limitations.** The ISO historically faces short-term ramping limitations in the spring as loads are often low and as hydro-electric generation increases. As a result, the overall availability of flexible ramping capacity is often reduced. While the flexible ramping constraint, which was added in December, helps to address many short-term ramping limitations, the benefits of the flexible ramping constraint can be limited in the presence of congestion. This is because the flexible ramping constraint is a system-wide constraint. In the event that inter-zonal congestion, such as congestion on Path 26, occurs, flexible generation on the low priced side of the constraint may not be deliverable. When this occurs, congestion spikes may result.

- **Transmission de-rates.** As a result of various key generation and transmission outages, transmission paths are often de-rated in order to protect for contingences. For instance, the capacity of Path 26 was reduced at times from a maximum rating of 4,000 MW, to around 500 MW. In addition, operators will often de-rate transmission limits in real-time to create reliability margins on various paths. At times, this can create extreme congestion as the system adjusts to account for the new limits. DMM has recommended in the past that the operators gradually adjust limits in order to smooth out the market effects. This can remain a challenge, particularly with large transmission groups such as the SCE Import Branch group limit which is around 6,000 MW. A small adjustment in this limit can require relatively large movements in generation to resolve the constraint in a short period of time.
- **Mitigation of unscheduled flows.** In spring, it is common for unscheduled flows (also known as loop flows) to occur along the inter-ties with the Northwest. This poses operational challenges, which necessitates that operators take actions to manage the reliability of the system by adjusting transmission constraint limits. These actions can cause price spikes to occur in the real-time market.
- **Load forecasting.** The weather this spring has been variable with some weeks warm and others cool. This variability has been difficult to predict and has caused the load forecasting software to be off at times. This caused the day-ahead forecast to be below real-time actual loads on a handful of days. When the day-ahead forecast does not accurately reflect the real-time conditions, there are fewer resources available to meet real-time demand. Prices levels and volatility can increase in real-time as a result.

### **DMM Recommendations**

DMM recommends that the ISO continue to pursue ways to address the problem of price divergence between the hour-ahead and real-time markets through software, operational and market design improvements. Even though convergence bidding was temporarily suspended on the inter-ties, physical resources can contribute to real-time imbalance offset costs by being sold off in the hour-ahead market at low prices and replaced in the real-time market at higher prices. This pattern has returned and highlights the need to continue to improve price convergence between the hour-ahead and real-time markets.

DMM also recommends that the ISO continue to fine tune the flexible ramping constraint to increase its effectiveness. The flexible ramping constraint has been less effective over the last few months in addressing ramping limitations. This may in part be attributable to the increase in internal congestion, which can limit the amount of flexible capacity that has been procured that is actually available for dispatch. The ISO also decreased the amount of the flexible ramping constraint in some hours, which may also limit the effectiveness of this constraint.