Memorandum

To: ISO Board of Governors

From: Eric Hildebrandt, Director, Market Monitoring

Date: October 25, 2012

Re: **Market Monitoring Report**

This memorandum does not require Board action.

EXECUTIVE SUMMARY

This memo provides comments by the Department of Market Monitoring (DMM) on one item being presented to the Board by Management.

- **Price and dispatch consistency enhancements.** DMM supports Management's proposed changes to enhance price and dispatch consistency. Under this proposal, prices for each aggregated pricing point will be based directly on the price for the constraint representing each aggregation, rather than on the weighted average or the prices and quantities clearing at each of the nodes that comprise the aggregation point. DMM has worked with ISO staff to review a stakeholder concern about how some participants might seek to employ virtual bidding to take advantage of this new pricing rule, without providing any efficiency benefits. DMM and the ISO staff have both concluded that the conditions needed to create this scenario are very unlikely to occur. DMM has also worked with ISO staff to identify specific metrics that will be developed and employed by the ISO to quickly identify if this scenario did occur.

The memo also provides an update on market performance over the summer months.

- **Real-time price divergence.** Average prices in the real-time market continued to be significantly higher than hour-ahead prices in the summer months. This trend has been driven largely by an increase in real-time price spikes. Many of these price spikes were due to short-term ramping limitations and congestion. Although price spikes due to these limitations are often 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 hour-ahead prices in recent months.
- **Uplift costs due to congestion.** Congestion increased in the summer months relative to previous periods. This increase is related to a combination of factors

including new model constraints added for reliability purposes, unscheduled flows, fires and outages. When transmission conditions change in real-time, which are not reflected in the day-ahead market, operators often reduce real-time constraint limits to manage reliability. This can create uplifts that are recovered from load serving entities through real-time congestion offset charges. These congestion offset charges totaled over $97 million in the third quarter. This amount is more than the congestion uplifts in the last two and a half years combined. The ISO is taking a number of steps to reduce these charges by reducing real-time congestion and by making constraints and congestion more consistent between the day-ahead and real-time markets.

PRICE AND DISPATCH CONSISTENCY ENHANCMENTS

One component of Management's proposed enhancements to improve price and dispatch consistency relates to how aggregate prices for default aggregate load points and trading hubs are determined. Under Management's proposal, prices for each aggregated pricing point will be based directly on the price for the constraint representing each aggregation, rather than on the weighted average or the prices and quantities clearing at each of the nodes that comprise the aggregation point. The goal of this change is to make prices for bids clearing at these aggregations more consistent with accepted bid prices. As noted in Management's memo to the Board on these enhancements, some concern was raised that this modification could theoretically create opportunities for exploitive market behavior. Specifically, these concerns centered on how virtual bidding might be employed to take advantage of potential differences in congestion prices created by the new pricing rules, without providing any efficiency benefits.

DMM and the ISO staff carefully considered this concern, and both concluded the congestion, network and market conditions needed to create this scenario are very unlikely to occur. This is largely due primarily to the difficulty in effectively predicting when such a strategy would be profitable to engage in given congestion patterns in both the day-ahead and real-time markets. The ISO has also reduced the possibility of this scenario proposing to apply same aggregate pricing methodology in real-time and in day-ahead market. In addition, this strategy would likely involve substantial financial risk. DMM has also worked with ISO staff to identify specific metrics that will be developed and employed by the ISO to quickly identify this scenario if it did occur.

MARKET PERFORMANCE

Price Divergence

Price divergence, particularly between the hour-ahead and real-time markets, has represented a reoccurring problem in the ISO market.[1] Price divergence was particularly problematic in spring 2011 when convergence bidding in inter-ties allowed participants to take advantage of systematic 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.

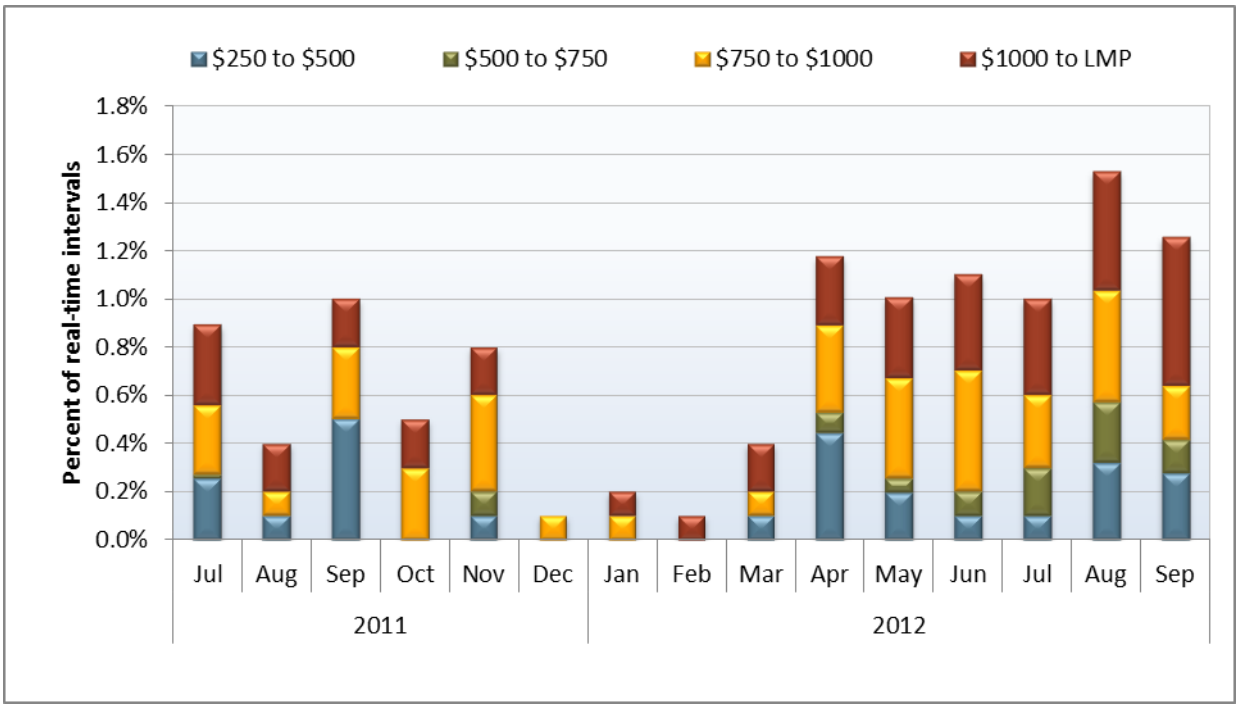
Prices in the different energy markets continued to converge well in the first few months of 2012. However, starting in March the difference in average prices in these markets has gradually increased, particularly between the hour-ahead and real-time markets (see Figure 1).

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

[1] Further discussion can be found in DMM's September 2010, May 2011, and July 2012 board memos.

Hour-ahead prices continued to remain low relative to day-ahead and real-time prices during these periods. Higher average real-time prices have been driven largely by the frequency of real-time price spikes (see Figure 2).

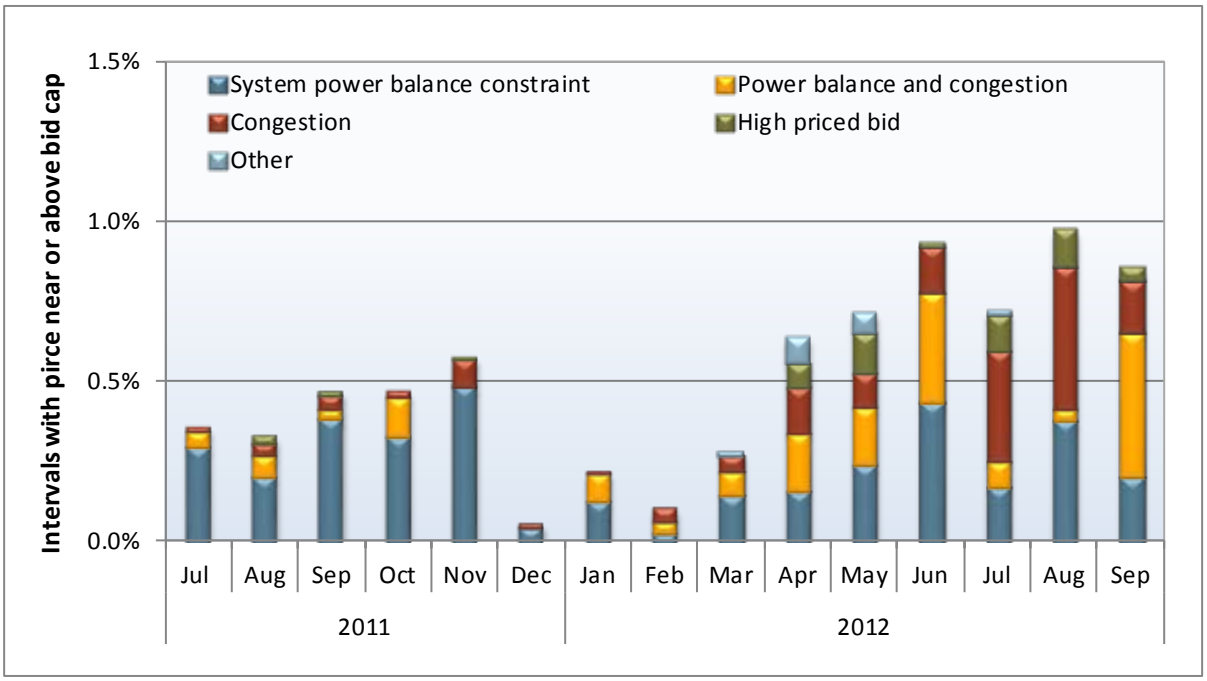
Figure 2 Frequency of real-time price spikes (all LAP areas)



Both the frequency and price levels of real-time price spikes remain high. Ramping limitations play a role in most price spikes. As shown in Figure 3, real-time price spikes were driven primarily by congestion, the system power balance constraint, and dispatch of high bids during ramping and tight supply demand conditions. In recent months, high prices have often occurred as a result of congestion and high priced bids, which sometimes set high prices before the system power balance is reached.

When hour-ahead prices are lower than real-time prices, this can lead to reductions in net hour-ahead imports. 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, this results in real-time imbalance offset costs that are paid by load-servicing entities. Reductions in net imports at relatively low prices accounted for an estimated $19 million in real-time energy imbalance offset costs in the third quarter. This is approximately equal to the amount of real-time energy imbalance offset costs incurred from reductions of net imports in the hour-ahead market over the previous 12 months combined.

Figure 3. Estimated factors causing high real-time prices[2]



In response to the systematic differences between hour-ahead and real-time prices, the ISO began to adjust the load forecast in the hour-ahead model upward in August. This tends to result in fewer reductions of net imports in the hour-ahead market. The ISO utilized this approach last year in helping to improve price convergence. The difference between average hour-ahead and real-time prices improved somewhat in August and September compared to July. This can partially be attributed to the change in use of load adjustments in the hour-ahead process.

In the third quarter, average day-ahead and real-time prices have been more consistent (see Figure 1). However, real-time price spikes have driven average real-time prices above day-ahead prices during the highest load hours (hours ending 15 to 18). Convergence bidders profited from the predictable differences in average day-ahead and real-time prices, particularly during periods of congestion. Net profits from convergence bidding in July through September totaled over $30 million. This is roughly the same as the net convergence bidding revenues earned in the previous 15 months combined.

[2] This figure reviews price spikes above $700/MWh. For further description of the methodology used to develop this graphic, please see section 3.2.1 of DMM's *2011 Annual Report on Market Issues and Performance*, April 2012, p. 67, http://www.caiso.com/Documents/2011AnnualReport-MarketIssues-Performance.pdf.

Congestion

Transmission congestion increased in the summer months relative to previous periods and had a major influence on prices. This increase is related to a combination of factors. The ISO recently added and modified a variety of transmission constraints to the market model to improve system reliability. During the summer, unscheduled flows, fires and outages also contributed to an increase in congestion.

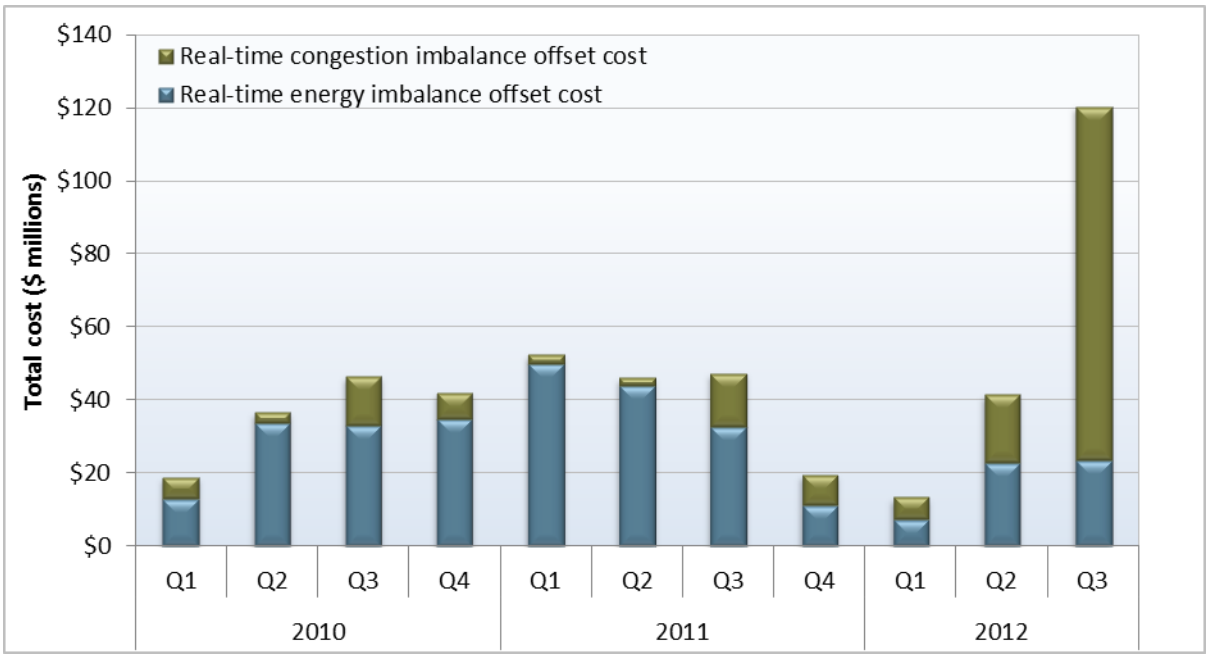
Congestion had the greatest upward impact on prices in southern California. Day-ahead market congestion accounted for about 3 percent of the price in the SCE areas and almost 10 percent of the price in the San Diego areas in the third quarter. Congestion was higher in the real-time market, accounting for almost 5 percent of the real-time price in the SCE area and 22 percent of the price in the San Diego area. Congestion in the PG&E area was mixed in both the day-ahead and real-time markets, as congestion on some constraints caused the PG&E price to fall, while congestion on other constraints caused the congestion to rise.

Much of the congestion driving real-time prices higher was associated with three constraints that were recently added or modified to the market model to improve system reliability.[3] These constraints have frequently not been binding in the day-ahead market. However, operators would adjust the line limits in response to observed differences in scheduled and actual flows to manage reliability. Changing the line limits frequently caused market congestion to occur in real-time, with relatively high congestion prices. Congestion prices in real-time are typically higher than in day-ahead since there are more limited ramping and re-dispatch options in real-time. For example, interties that are not available in the 5-minute real-time dispatch.

The combination of de-rating constraint limits and high congestion prices in real-time can cause real-time uplift costs. These are recovered from load serving entities through real-time congestion offset charges. These charges totaled about $97 million in the third quarter --- or more than occurred in the previous two and a half years combined (see Figure 4).

[3] Three constraints in particular had the greatest impact on the overall system and system uplifts: the Hoodoo Wash to North Gila 500 kV line, the Sycamore Canyon to Carlton Hills nomogram and the Table Mountain bank nomogram.

Figure 4. Real-time energy and congestion imbalance uplifts



The ISO has taken steps to reduce these high congestion offset costs. For example:

- The ISO has improved the consistency of the automated mechanism (known as compensating injections) used to account for unscheduled energy flows in the hour-ahead and real-time markets. This should reduce fluctuations between modeled and actual flows that must be managed manually by gird operators. However, DMM continues to recommend that the ISO perform systematic analysis of the impact of compensating injections in terms of increasing the accuracy of modeled flows on individual constraints, including those inside the ISO system on which congestion occurs.
- The ISO is taking steps to better reflect the congestion in the day-ahead model by modifying day-ahead transmission limits to better reflect expected conditions in real-time. DMM is supportive of these steps, but cautions that this can create differences between the day-ahead and congestion revenue rights models. Thus, DMM recommends that the ISO keep detailed procedures and logs to outline under what circumstances and conditions the day-ahead limits will be and were adjusted to better reflect real-time conditions. Ideally, these procedures would provide for adjustments made based on statistical analysis of actual unscheduled flows in real-time

DMM Recommendations

- DMM continues to recommend that the ISO pursue ways to address the problem of price divergence between the hour-ahead and real-time markets through software, operational and market design improvements. DMM is supportive of the ISO adjusting the hour-ahead load to better improve convergence as it appeared to have success last year. However, DMM stresses that the ISO should continue to look for other methods to address the systematic problem of price divergence.
- DMM supports the ISO's attempts to better model transmission in the day-ahead market, but cautions that this can create differences between the day-ahead and congestion revenue rights models. Thus, DMM recommends that the ISO develop detailed procedures to outline the circumstances and conditions under which day-ahead limits will be adjusted to better reflect real-time conditions. Ideally, these procedures would provide for adjustments made based on statistical analysis of actual unscheduled flows in real-time.
- The ISO has improved the consistency of the automated mechanism (known as compensating injections) used to account for unscheduled energy flows in the hour-ahead and real-time markets. However, DMM continues to recommend that the ISO perform systematic analysis of the impact of compensating injections in terms of increasing the accuracy of modeled flows on individual constraints, including those inside the ISO system on which congestion occurs.