

# Memorandum

**To:** ISO Board of Governors  
**From:** Eric Hildebrandt, Interim Director, Market Monitoring  
**Date:** December 9, 2009  
**Re:** **Market Monitoring Report**

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*This memorandum does not require Board action.*

## EXECUTIVE SUMMARY

This report provides a brief update from the Department of Market Monitoring (DMM) on the following two topics:

- Comments and recommendations on the California Independent System Operator Corporation's (ISO) proposal for reserve scarcity pricing
- A summary and update on DMM's *Quarterly Report on Market Issues and Performance*, completed on October 30, 2009

DMM supports the ISO's reserve shortage scarcity pricing proposal as a step toward improving short term pricing signals during operating reserve shortages that may occur under extremely high load or low supply conditions. The ISO's proposal builds upon the experience of other ISOs, while taking into account specific features of the ISO's new market design. Once implemented, the framework established through the reserve shortage scarcity pricing proposal can be further refined by implementing co-optimization of energy and ancillary services in the 5-minute real-time energy market and modifying specific values such as the reserve scarcity pricing demand curve based on analysis of actual operating experience.

The second section of this report provides a summary and update of DMM's *Quarterly Report on Market Issues and Performance* completed on October 30, 2009. The performance of the ISO's energy markets has improved substantially since the first quarter of the operation of this new nodal market. However, prices used to settle import and exports in the hour ahead scheduling process (HASP) continue to be systematically lower than prices in the day-ahead market or the 5-minute real-time market. DMM believes that the price divergence between the HASP and these other markets represents one of the most critical areas for further improvement in the ISO's new market software and processes.

## RESERVE SHORTAGE SCARCITY PRICING

Scarcity pricing for ancillary services – or reserve shortage scarcity pricing – is a key component of the Federal Energy Regulatory Commission’s (FERC) Standard Market Design for markets based on locational marginal pricing (LMP). Scarcity pricing can provide improved short term price signals during periods of operating reserve shortages that may occur under extremely high load conditions or under unusual supply conditions. Other potential benefits of scarcity pricing include stimulating demand response, encouraging long-term contracting for energy and ancillary services, and promoting investment in new supply resources.<sup>1</sup>

The ISO’s proposal for reserve shortage scarcity pricing is based on a thorough review of scarcity pricing designs in other ISOs and careful consideration of how reserve shortage scarcity pricing may be designed given the unique characteristics of the ISO’s new nodal market design. The proposal has been developed through an extensive stakeholder process, in which recommendations provided by DMM were considered along with input provided by stakeholders. The following sections provide DMM’s perspective on key aspects of the ISO’s proposal and some of the key concerns raised by some stakeholders.

### *Potential for Artificial Scarcity*

Early in the stakeholder process on this issue, one of DMM’s initial recommendations was that provisions should be included to ensure that reserve shortage scarcity pricing would not be triggered due to “artificial scarcity” caused by a failure of suppliers to bid all available operating reserves into the ISO markets. This concern has been addressed through the ISO’s recent standard capacity product tariff filing, which extends the *must-offer* requirement for resource adequacy (RA) units to include all available ancillary services (as well as energy). DMM has been engaged in reviewing the detailed software design specifications for reserve shortage scarcity pricing to ensure that ancillary service bids are automatically generated for capacity known to be available from RA units.<sup>2</sup>

The performance of the ancillary services market under the ISO’s new nodal market – in terms of the sufficiency and competitiveness of supply bids – has been very good, without any scarcity conditions occurring to date. When reserve shortage scarcity pricing is implemented and is triggered, DMM will monitor the availability of resources for indications of any potential withholding of energy or ancillary service supply during these critical periods.

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<sup>1</sup> In a well-functioning market with a sufficient capacity obligation for load-serving entities, the frequency that reserve shortage scarcity pricing is triggered and the amount of capacity procured during periods of reserve scarcity should be very limited and/or very sporadic. Thus, DMM does not expect that the overall revenue provided by reserve scarcity pricing should be viewed as a major source of potential revenue that would drive investment in new supply or demand side resources or contracting.

<sup>2</sup> As noted in DMM’s comments on the ISO’s standard capacity product provisions, one refinement suggested by DMM is to further refine bidding requirements for the approximately 900 MW of use-limited peaking units that are exempt from the must-offer requirement to ensure that this capacity is available for energy or operating reserve during critical periods. See *Comments on Updated Straw Proposal for Standard Resource Adequacy Capacity Product*, Department of Market Monitoring, December 18, 2008, pp.4-6, <http://www.aiso.com/20a2/20a2e7b12ae60.pdf>

From a longer term market design perspective, DMM notes that the overall supply of available ancillary services from RA resources relative to the ISO's market requirements should be periodically assessed to ensure that the portfolio of resources being used to meet RA requirements can provide sufficient ancillary services to meet the ISO's needs, or if more specific RA requirements may be necessary to ensure that a sufficient overall level and type of ancillary service capacity is provided to the ISO markets from the overall mix of RA resources.

### ***Co-optimization of Ancillary Services and Energy***

A second issue noted by DMM is that under the ISO's current market design, reserve shortage scarcity pricing will not be directly reflected in the 5-minute real time dispatch (RTD) market prices. This result stems from the fact that under the ISO's current market design, any incremental procurement of ancillary services after the day-ahead market is performed is procured on a 15 minute basis in the real-time unit commitment (RTUC) process, rather than in the RTD process which is performed every five minutes. Energy prices produced in the RTUC process are only financially binding for imports and exports that are pre-dispatched in the HASP, while all real-time energy from resources within the ISO are settled based on LMPs from the 5-minute RTD process. This creates a situation where, for example, relatively high ancillary service prices may occur in this 15-minute RTUC process reflecting scarcity in ancillary services and not have an impact on the RTD energy prices which could be much lower.

As discussed in DMM's recent *Quarterly Report on Market Issues and Performance*, the potential discrepancy between real-time ancillary services and energy prices could be eliminated by modifying the ISO's market design so that ancillary services are co-optimized on a 5-minute basis in RTD, rather than in the 15-minute RTUC process. DMM notes that co-optimization of ancillary services in the 5-minute RTD process may represent a relatively significant software design change – while the frequency and volume of real time ancillary service procurement and shortages may be relatively low. Thus, the ISO may need to weigh costs and benefits of placing a very high priority on this market improvement relative to other potential enhancements and initiatives.

### ***Scarcity Pricing for Sub-Regions***

Another concern expressed by some stakeholders and the Market Surveillance Committee (MSC) involves the ISO's proposal to apply a lower priced demand curve for shortages on ancillary services on a sub-regional level than for shortages on a region-wide basis. The ISO's rationale for this approach is that these two types of shortage have different reliability implications. Region-wide ancillary service requirements are based on specific mandatory NERC/WECC requirements tied to overall system reliability. If a shortage occurs on a regional level, this is a violation of NERC/WECC reliability standards and there is a relatively high likelihood that load may need to be curtailed. Meanwhile, requirements for sub-regions are not mandatory and are set by the ISO at a level that is designed to help ensure that the ISO could respond to a variety of potential transmission outages. When a shortage of any of these sub-regional requirements for 10-minute operating reserve set by the ISO occurs – coupled with a transmission contingency – any affected transmission lines can be overloaded for more than a 10 minute time horizon (e.g., 15 minutes to one hour for Emergency Rating, and 15 minutes to 24 hours for normal rating). In this circumstance, any type of capacity that can mitigate the

overloading within this longer time frame (except firm load and N-1 substitution) can be used to respond to such a contingency. Thus, according to the ISO, this type of sub-regional shortage is much less likely to cause curtailment of load.

Given the ISO's assessment of the difference in reliability implications of scarcity on a regional versus sub-regional level, DMM believes the ISO's proposal to use lower demand curve prices for shortages of ancillary services that occur only on a sub-regional level appears appropriate. In addition, throughout the stakeholder process on this issue, DMM has expressed three major concerns about the application of scarcity pricing on a sub-regional level.

- First, DMM has expressed concern that the criteria for setting sub-regional requirements were not sufficiently well-defined or objectively determinable for use as a "hard trigger" for scarcity pricing.
- Second, DMM has noted that sub-regional requirements may be used by the ISO to help ensure that the ISO procures enough 10-minute reserve to mitigate transmission contingencies that may actually be mitigated over a longer time frame (e.g. 30 minutes) and through a broader range of options than can be procured in the ISO's current ancillary services markets. DMM has recommended that if the ISO determines that specific sub-regional reliability requirements may be met by a new ancillary services product, a market for this product should be developed, rather than seeking to meet demand for a 30-minute reserve requirement by relying on the ISO's existing markets for 10-minute operating reserves.
- Finally, DMM has noted that if the ISO develops a specific new requirement or market for reserves on a sub-regional level, it may then be appropriate to assess the need for new locational market power mitigation provisions. However, the need for local market power mitigation can only be assessed once the demand and eligible supply from any new reserve product is more clearly defined.

For these reasons, DMM has been cautious about the appropriateness of applying scarcity pricing in the ISO's ancillary services market on a sub-regional level in the same manner that scarcity pricing is applied on a regional level. Since implementation of the ISO's new market design, sub-regional requirements for 10-minute ancillary services set by the ISO have been set at a sufficiently low level that has not created significant concerns about local market power or inappropriate triggering of reserve shortage scarcity pricing for transmission contingencies. Going forward, DMM continues to recommend that the ISO seek to more clearly define criteria for setting any sub-regional requirements (particularly if these requirements are increased substantially over current levels) and explore a market for new ancillary services that might better meet these reliability needs (e.g. a 30-minute operating reserve product).

### ***Comprehensive Reliability-based Approach to Scarcity Pricing***

The main concern with the ISO's proposal expressed by the MSC is that the proposal does not include a comprehensive initiative to set all parameters in the ISO software so that that all energy and ancillary services prices reflect the relative reliability cost of violating or relaxing different requirement or constraints incorporated in the market model. DMM agrees with the theoretical premise underlying this recommendation – i.e. that the ISO should seek to set the various penalty

prices incorporated in the ISO market model at levels that reflect the relative reliability impacts of violating or relaxing these constraints. In addition, DMM notes that – as described in the previous section – the different prices for shortages of 10-minute reserves on a regional versus sub-regional level incorporated in the ISO’s proposal do reflect the ISO’s assessment that any shortages of sub-regional requirements would result in a significantly lower impact on the probability of an outage than would result from any shortage of mandatory regional requirements.

In practice, the approach advocated by the MSC requires a quantitative assessment of the loss of load probability (LOLP) and the value of lost load (VOLL) of each increment that a software constraint (such as a transmission limit or sub-regional ancillary service requirement) is relaxed or violated. Both the LOLP and VOLL are highly dependent on a wide range of highly dynamic factors which can vary for each different constraint and time or day or year. As noted by the MSC, the analytical challenges of doing this in a meaningful manner are significant and no other ISO has sought to implement this approach to date. While parameter setting may be improved by more quantitative analysis of the LOLP of each increment that a software constraint is relaxed or violated, this represents an extremely complex analytical undertaking, given that results are highly dependent on system conditions and the nature and location of the specific constraint in question. Meanwhile, the VOLL is another factor that is extremely difficult to quantify in a manner that would be applicable in the way suggested by the MSC.<sup>3</sup>

Given the complexity of implementing this approach in a robust meaningful quantitative manner, DMM believes that this approach should be viewed as a longer term goal or framework for refining parameter settings, rather than an approach that the ISO should seek to apply in conjunction with implementation of reserve shortage scarcity pricing in Spring 2010. Moreover, the priority placed on this in terms of resources and timing should be considered along with other important potential initiatives that may be undertaken to improve the ISO’s market design, software, and operational tools and practices. The ISO’s existing market initiatives roadmap process provides an appropriate forum for discussing and prioritizing this potential initiative alongside other initiatives under consideration based on a variety of criteria.

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<sup>3</sup> For example, research typically shows that VOLL ranges widely for different customer segments and can depend largely on the nature and timing of any outage or energy limit. In practice, however, load curtailments that are made due to transmission system conditions are generally made for large aggregated groups of customers within a geographic area, rather than based on the VOLL of each customer.

## UPDATE ON MARKET ISSUES AND PERFORMANCE

### *Overview*

This section provides a summary and update of DMM's *Quarterly Report on Market Issues and Performance* completed on October 30, 2009, which covered the second three months of the ISO's new nodal market (July – September, 2009), corresponding to the third quarter of 2009 (Q3).<sup>4</sup> DMM's Q3 report provides an overview of general market performance, as well as more detailed analysis of a variety of special market issues or areas for market improvements. As discussed in our Q3 report, the new ISO markets are continuing to perform well and have improved in Q3. Most notably:

- The day-ahead integrated forward market (IFM) has been very stable and extremely competitive.
- Market activity in the residual unit commitment (RUC) market has been minimal due to high levels of load scheduling in the IFM and sufficient resource adequacy (RA) capacity in RUC.
- The five-minute real time dispatch (RTD) market has improved as a result of several software and operational changes implemented by the ISO to reduce the frequency and magnitude of extremely high or low prices that are not reflective of actual real-time supply and demand conditions. While extreme RTD prices continue to occur in some intervals, these prices tend to reflect short-term supply and demand conditions, such as ramping constraints and sudden unit outages.

Despite these improvements, significant systematic price divergence has continued to occur at times, particularly between RTD prices and prices in the hour ahead scheduling process (HASP) used to settle additional imports and exports that are “pre-dispatched” prior to the 5-minute RTD market. This price divergence has been coupled with a trend for the ISO to export relatively large quantities of additional energy in the HASP (at low prices), and then dispatch additional energy within the ISO in RTD (at significantly higher prices). This pattern of “selling low” in HASP and “buying high” in RTD has continued to create substantial revenue imbalances that are recovered based on each participant's metered loads through real time energy imbalance energy offset charges. DMM believes that the price divergence between HASP and RTD represents one of the most critical areas for further improvement in the ISO's new market software and processes.

### *Metrics on Market Performance*

As described in our Q3 Report, DMM utilizes a variety of metrics to assess the performance of the ISO's energy markets. Provided below is a summary and update of these key metrics of the ISO's energy market performance:

- ***IFM Prices Compared to Competitive Baseline.*** The competitiveness of overall market prices and outcomes is assessed by comparing prices in the day-ahead IFM to *competitive baseline* prices that are calculated by re-running the actual IFM software with default energy bids (DEBs) that are used in bid mitigation. Since DEBs are designed to be reflective of each

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<sup>4</sup> <http://www.caiso.com/2457/2457987152ab0.pdf>

unit's marginal costs (including any opportunity costs), this produces a measure of prices that would be expected under perfectly competitive conditions. As shown in Figure 1, IFM prices have generally been just slightly above or below this competitive baseline price, indicating that prices in the IFM have been highly competitive. The *price-cost markup* shown in the right axis of Figure 1 represents the percentage difference in IFM prices compared to this *competitive baseline* price. The slightly negative price-cost mark-ups for some months reflect the fact that cost-based DEBs used in this analysis include a 10 percent adder above calculated marginal costs, and that many units bid somewhat lower than their DEB.

- ***RTM Prices Compared to Competitive Baseline.*** Prices in the 5-minute RTD can also be compared to the competitive *baseline* prices to provide an indication of the competitiveness and efficiency of the RTD. As shown in Figure 2, average RTD prices were significantly higher than this competitive baseline during the first two months of the ISO's new LMP market, but were just slightly above this competitive baseline when extremely high and low prices (outside of the \$500 and -\$30 bid caps) were excluded from the analysis. However, since June, average monthly RTD prices have been just above or below this competitive baseline. This improvement can be attributed to a variety of software and operational changes implemented by the ISO to reduce the frequency and magnitude of extremely high or low prices that are not reflective of actual real-time supply and demand conditions
- ***Volatility of RTM Prices.*** Another measure of performance of the RTD market is the *volatility* of RTD prices. In DMM's first *Quarterly Report on Market Issues and Performance*, we provided a comparison of the volatility of RTD prices with the volatility of prices in other ISO markets using standard metrics used by market monitors for these other markets.<sup>5</sup> Figure 3 provides an updated comparison of the volatility of RTD prices during Q3 and the first half of Q4 2009 with the volatility of real-time prices in these other ISO markets. As shown in Figure 3, the volatility of RTD prices in the second half of 2009 has been within the same range of the volatility of real-time prices in these other ISO markets.
- ***Price Convergence Across Energy Markets.*** Another key measure of the overall performance of the ISO's various sequential energy markets is the convergence of prices in these markets (IFM, HASP and RTD). To the extent that prices do not converge in these three markets, this may indicate that efficiency could be increased and costs could be reduced by increasing the demand met in lower priced markets and decreasing the demand met in the higher priced markets. As illustrated in Figure 4, the convergence of average monthly prices in the day-ahead IFM and 5-minute RTM has improved significantly since the first few months of the ISO's new nodal markets. However, prices in the HASP have continued to be significantly lower than prices in RTD. As noted above, this price divergence has been coupled with a trend for the ISO to export relatively large quantities of additional energy in the HASP (at low prices), and then dispatch additional energy within the ISO in RTD (at significantly higher prices). DMM believes that the price divergence between HASP and RTD represents one of the most critical areas for further improvement in the ISO's new market software and processes.

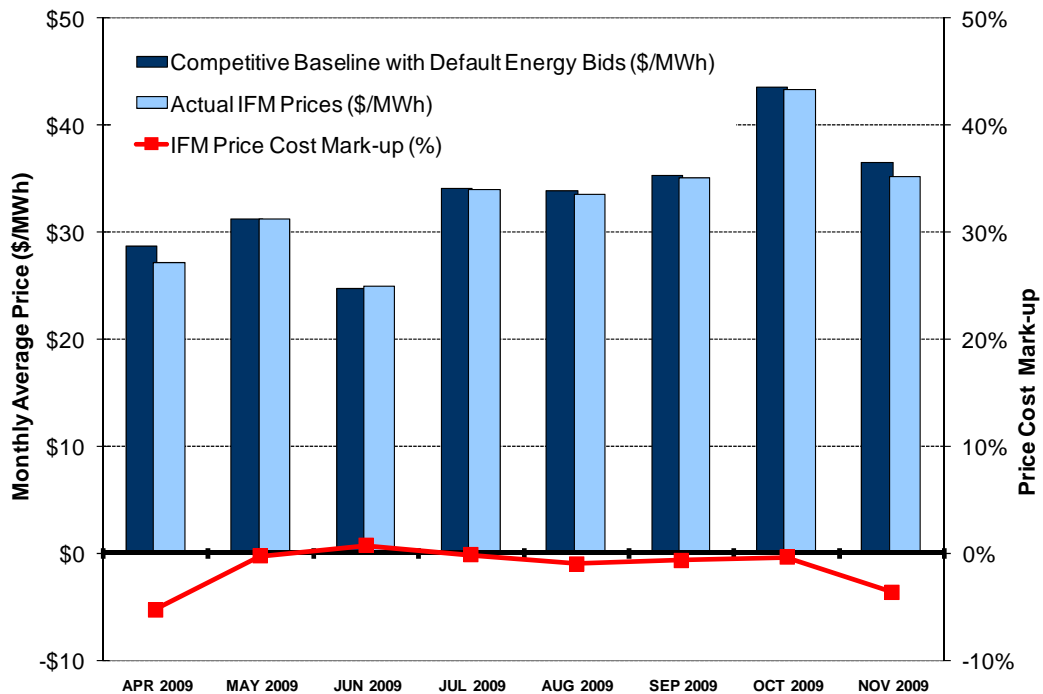
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<sup>5</sup> *Quarterly Report on Market Issues and Performance*, Department of Market Monitoring, July 30, 2009, pp. 20-22, <http://www.caiso.com/23fb/23fbbed164b6b0.pdf>

As noted in our Q3 report, the ISO is currently taking steps to mitigate two of the key root causes of the systematic divergence in HASP and RTM prices:

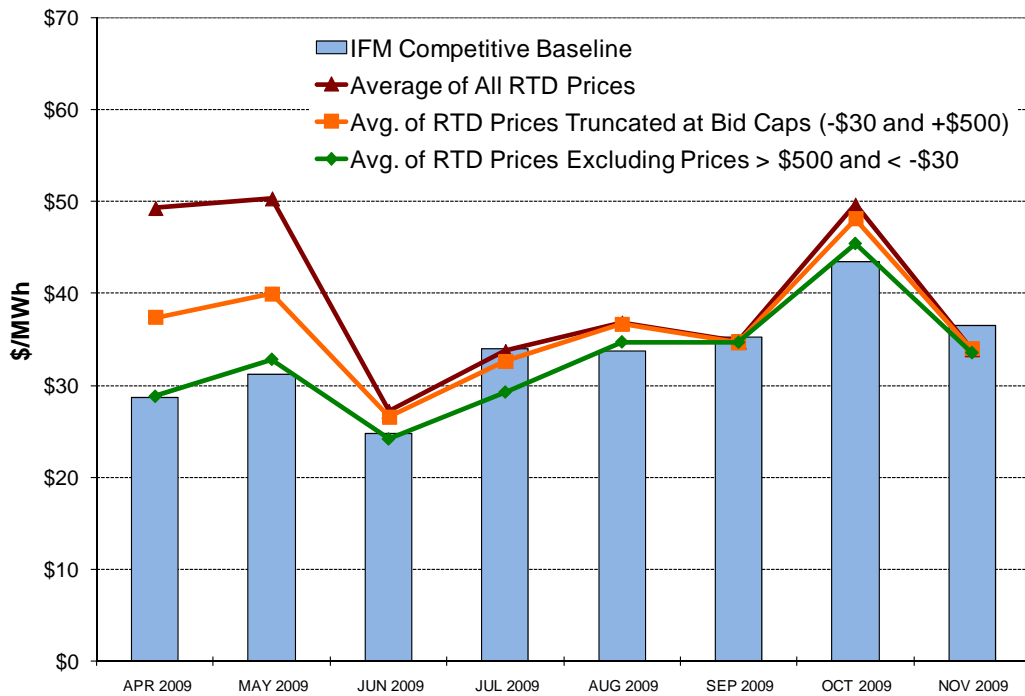
- The ISO currently has a new short-term forecasting tool under development that is designed to provide a more accurate and consistent forecast for both HASP and RTM. Implementation of this new forecasting tool is anticipated in early 2010.
- The ISO is also developing enhancements that would modify HASP to account for the imbalance energy difference that arises due to the fact that HASP does not model how changes in net hourly inter-tie schedules are ramped in over a 20-minute period each operating hour. The HASP ramping modification has been delivered for testing, and may be implemented by the end of year.

**Figure 1. Day Ahead Market Prices and Competitive Baseline Price (SCE LAP)**

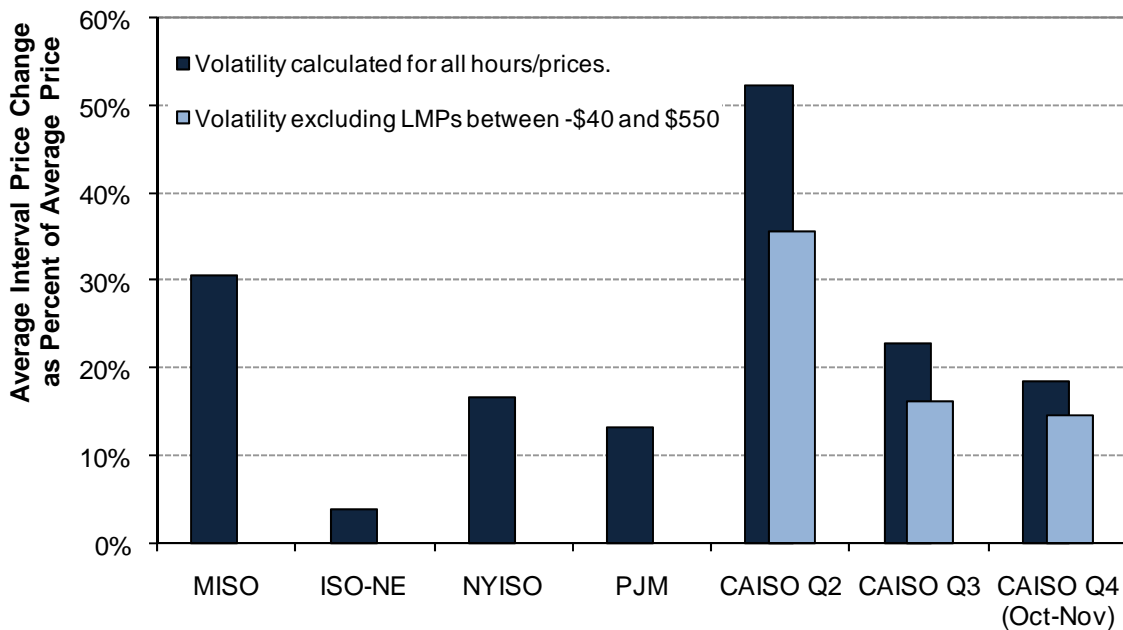




**Figure 2. Real Time Market Prices and Competitive Baseline Price (SCE LAP)**



**Figure 3. Volatility of Real Time Market Prices Compared to Other ISOs**



**Figure 4. Comparison of IFM, HASP and RTM Prices (SCE LAP)  
Monthly Average Prices (Peak Hours 7-22)**

