

## MEMO

### Analysis of Selected Effects of Load Bias Limiter on CAISO and EIM prices, Oct.-Dec. 2016

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#### 1. Introduction

The purpose of this memo is to provide background and documentation of the price analysis I summarized orally during the May 5, 2017 CAISO Market Surveillance Committee in Folsom, CA.

All ISOs allow operators to use “load bias”-type adjustments to load in market models to better reflect actual conditions. As explained in Section 4.2 of the 2016 Market Issues and Performance report by the CAISO Department of Market Monitoring (DMM)<sup>1</sup> and in Dr. Scott Harvey’s presentation at the May 5, 2017 Market Surveillance Committee,<sup>2</sup> the load bias limiter procedure was implemented in 2012 to assess whether the adjustment caused relaxation of the power balance. If so, the procedure adjusts the bias in the pricing run so that the power balance would no longer be violated. As a result, the price will no longer reflect the penalty parameter, but will instead be based on the marginal bid of a dispatched resource. The motivation of the limiter is to lessen the impact that possible overadjustments might have on prices, but there are also concerns that the use of the limiter might at other times suppress valid scarcity price signals. Both DMM and Dr. Harvey discussed these issues, and the CAISO has been considering changes in the limiter process.

Information on the frequency of application and potential price impact of the load bias limiter on the CAISO markets is useful in this consideration. The DMM report quantifies the potential impact in Q4 of 2016 upon average prices in the fifteen minute market (FMM) and real time dispatch (RTD) for the non-CAISO balancing authorities participating in the Energy Imbalance Market. The purpose of this memo is to complement DMM’s analysis. Based on data developed by the CAISO Department of Market Monitoring (DMM), I address two questions in this memo:

- (1) What was the average potential effect of the Load Bias Limiter on average FMM and RTD prices in Oct-Dec 2016 for the CAISO? The same information was presented by DMM for the non-CAISO Balancing Authorities (BAs) in “Q4 2016 Report on Market Issues and Performance,” Table 3.2 p. 58.
- (2) What was the average potential effect of the Load Bias Limiter on average FMM and RTD prices in Oct.-Dec. 2016 for the CAISO and EIM BAs, given that price before application of the limiter (i.e., the unadjusted price) would have been above \$30/MWh? This focuses on the impact

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<sup>1</sup>Available from [www.caiso.com/market/Pages/MarketMonitoring/MarketIssuesPerformanceReports/Default.aspx](http://www.caiso.com/market/Pages/MarketMonitoring/MarketIssuesPerformanceReports/Default.aspx)

<sup>2</sup> S. Harvey, “The Load Bias Limiter, Price Formation, and the Need for Flexible Capacity”, Presentation, May 5 2017, [www.caiso.com/Documents/LoadBiasLimiterandFlexibleCapacityFTIConsulting.pdf](http://www.caiso.com/Documents/LoadBiasLimiterandFlexibleCapacityFTIConsulting.pdf)

when the load exceeds supply, as opposed to over-supply situations when the load bias limiter might increase prices.

In summary, the answer to the first question indicates that the limiter had a substantial negative impact on CAISO RTD prices, but not CAISO FMM prices. The second question is of interest because that is the impact that is of most interest to flexible generation, in that it is likely to be producing in intervals when prices are positive but not when they are negative. If there are substantial positive price increases during times of negative prices, those would offset negative price impacts at other times in the calculation of the overall average, which would understate the impact of the limiter on flexible generation resources. In summary, the answer to the second question indicates that the average impact of the limiter over all intervals is actually a reasonable indication of the effect on potential flexible generation revenues in all cases except Arizona Public Service because in the other areas positive price adjustments are relatively infrequent and small in magnitude relative to negative price adjustments during times of positive prices.

## **2. Effect of Load Bias Limiter on CAISO FMM and RTD Prices in Oct.-Dec. 2016**

The averages of DMM's estimates of the CAISO FMM and RTD prices after application of the limiter over all intervals were as follows:<sup>3</sup>

Average Estimated FMM price after adjustment for load bias limiter = \$32.40/MWh

Average Estimated RTD price after adjustment for the limiter = \$35.24/MWh

These are the averages over the three DLAPs (SDGE, SCE, and PG&E); the differences among them were very small. Then the average of DMM's interval-by-interval estimates of the potential effect of the limiter on CAISO prices is as follows (averaged over all 26,500 intervals during those three months):

Average estimated potential impact on FMM price = \$0.00/MWh (averaged over all 8800 FMM intervals in those three months)

Average estimated potential impact on RTD price = -\$5.03/MWh (averaged over all 26,500 RTD intervals in those three months)

That is, the limiter had no impact on CAISO FMM prices (unlike the small but nonzero impacts noted for the non-CAISO BAs in DMM's table). However, there was a large potential impact on RTD prices, changing them by an average of -\$5.03/MWh (about a 15% change). Thus, without the load bias limiter,

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<sup>3</sup>In particular, this is referred to by DMM as the "Price without Price Discovery or Load Bias Limiter" in DMM's database. These are broadly consistent with the DMM reported system prices for Q4, with slight discrepancies because I am averaging SDGE, SCE, and PGE LAPs without weighting by consumption rather than using a system price. DMM reports a system FMM price of about \$32 for Q4, and a system average RTD price of \$34.5 for the same quarter, based on my interpretation of the graphs in the report. See the CAISO DMM's Q4 report and 2017 Annual Market Performance Report for a discussion of how the data for the analysis of the potential impact of the load bias limiter was developed.

the average RTD price for the CAISO would have been \$5 higher, or about \$40.30/MWh.<sup>4</sup> (The estimated impacts of the limiter for each of the LAPS—SCE, SDGE, PGE—were all of the same magnitude, about -\$5/MWh.) This is a much larger impact than occurred in the non-CAISO BA's, where the largest impact (in Nevada) was approximately an order of magnitude smaller (-\$0.56/MWh).<sup>5</sup>

The distribution of these impacts were as follows:

*Fraction of intervals in which the CAISO RTD price adjustment due to the limiter was:*<sup>6</sup>

below -\$900/MWh: 0.19%

below -\$700/MWh: 0.49%

< -\$500/MWh: 0.58%

< \$0/MWh: 0.82%

Thus, CAISO RTD prices were adjusted downwards in less than 1% (0.82%, to be precise) of the intervals in October-December as a result of adjustments for the load bias limiter, but in more than half of those intervals, the potential price adjustment was greater than -\$700/MWh in magnitude (i.e., 0.49% out of the total of 0.82% in which negative adjustments occurred). Meanwhile, the results of the DMM analysis indicates that in only 0.05% of the intervals were RTD prices increased, and then usually by much more modest amounts (in most cases by less than \$5/MWh).

In interpreting this -\$5/MWh impact, it should be kept in mind that: (1) the RTD market clears only a small percentage of total energy in the market, and presently no resource commitments are based on RTD prices; (2) anticipated changes in the application of the limiter in the future may lessen this impact; and (3) the Oct-Dec. period may be unrepresentative. Nevertheless, this indicates that any flexible generation that obtains a significant portion of its revenue in the RTD markets in the CAISO footprint may have its annual gross margin significantly impacted. (Extrapolated to 8760 hours/yr, this \$5/MWh figure could be as large as \$40,000/MW/yr, which is large relative to the gross margins that DMM has calculated in its annual market reports for new gas-fired generation in the CAISO.)

Thus, the role of load biasing in scheduling runs and the limiter adjustment in pricing runs deserves further consideration and perhaps adjustment.

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<sup>4</sup>This price is referred to as "Price without Price Discovery" in DMM's database.

<sup>5</sup>The values in DMM's table in its Q4 report for the non-CAISO BAs were checked and confirmed by me.

<sup>6</sup>Note that these are cumulative values. E.g., the below -\$500 value also includes the intervals for which prices were below -\$700 or -\$900.

### **3. Effect of Load Bias Limiter on CAISO and Non-CAISO BA FMM and RTD Prices in Oct.-Dec. 2016 during Periods of Positive Prices**

It is price adjustments during times when flexible generation is most likely to be operating that matter, in terms of effects on flexible generation gross margins and, ultimately, incentives for investment.

Therefore, I looked at the interval-by-interval price adjustments that DMM calculated but focusing just on intervals when the prices (prior to adjustment for the load bias) would have been \$30/MWh or more. (Moving this threshold up or down did not appreciably change the below conclusions).

In the California ISO footprint, the price adjustments occurring when RTD prices (calculated with the limiter) were above \$30/MWh resulted in no change in the average impact (-\$5.03/MWh) (averaged over all 26,500 intervals during the three months). This is because nearly all price adjustments occurred when prices were above \$60/MWh. (Thus, the average impact of the limiter can be used as an index for the impact on flexible generation that operates only during higher price hours.)

For Puget Sound (PSE), Pacific Corp (PAC), and Nevada (NV Energy), the average potential RTD impact over all intervals amounted to -\$0.29/MWh, while in Arizona Public Service it was +\$0.27/MWh (the latter number was also reported in DMM's table, cited above). Considering only intervals when prices (including the effect of the limiter) were above \$30/MWh, the average price changed in the former BAs by -\$0.23/MWh, while the average price in APS changed by -\$0.14/MWh (averaged over all 212,000 5 minute intervals in the 3 month period). So the average potential impact over all intervals does not distort the estimated impact on flexible generators (who operate mainly during positive period intervals) in the case of PS, PAC, and NV. But for APS, there is a slight negative impact on prices in higher price periods as opposed to the overall positive impact on prices when all intervals are considered.

For the FMM, APS prices changed on average by -\$0.10/MWh when prices (including the effect of the limiter) were above \$30/MWh (averaged over all 8836 intervals in the 3 month period), while for PSE, PAC, and NV Energy, the change was -\$0.15/MWh. (In contrast, the price change in all intervals for APS was +\$0.04/MWh, a slight change from DMM's number, probably due to rounding.)