

January 28, 2016

The Honorable Kimberly D. Bose  
Secretary  
Federal Energy Regulatory Commission  
888 First Street, NE  
Washington, DC 20426

**Re: California Independent System Operator Corporation  
Docket No. ER15-402\_\_\_\_  
Independent Assessment – Department of Market Monitoring  
Report on Energy Imbalance Market Issues and Performance**

Dear Secretary Bose:

The Department of Market Monitoring hereby submits its independent assessment on the causes and solutions identified by the California Independent System Operator Corporation in its report on the performance of the Energy Imbalance Market for November 1, 2015 through November 30, 2015.<sup>1</sup>

Please contact the undersigned with any questions.

Respectfully submitted,

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<sup>1</sup> The CAISO submits this report pursuant to *California Independent System Operator Corp.*, 149 FERC ¶ 61,194 (2014).

## California ISO

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# Report on energy imbalance market issues and performance

January 28, 2016

Prepared by: Department of Market Monitoring



## Executive summary

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Pursuant to the Commission's March 16, 2015 Order on the ISO's Energy Imbalance Market (EIM), the ISO filed a report on January 21, 2016 covering the period from November 1 through November 30, 2015 (November Report).<sup>1</sup> This report provides a review by the Department of Market Monitoring (DMM) of EIM performance during the period covered in the ISO's November report. The redline portion of the ISO's November report, shows that the ISO's November report contains updated graphs and figures from the ISO's October report.

Key findings of DMM's review of EIM performance in November 2015 include the following:

- During November, the percentage of intervals when the flexible ramping constraint was relaxed in the 15-minute market – but price discovery provisions were not triggered due to relaxation of the energy power balance constraint – continued to increase sharply for the fourth consecutive month. During these intervals, the energy price in the 15-minute market is increased by the \$60/MWh penalty price for relaxation of the flexible ramping constraint.<sup>2</sup> In PacifiCorp East, this occurred during almost 18 percent of intervals in November compared to less than 2 percent in July.
- The increased frequency of flexible ramping constraint shortages has driven the monthly average 15-minute price up significantly in in PacifiCorp East. During November, flexible ramping constraint shortages drove 15-minute prices higher by about \$9.50/MWh in PacifiCorp East. In PacifiCorp West, 15-minute prices were driven up by about \$2.50/MWh.
- The increased impact of the flexible ramping constraint on prices appears to be attributable to a number of factors. DMM concludes that this trend has been driven in large part by the continued high levels of flexible ramping requirements and a reduction of available ramping capacity due to generation outages. According to the ISO, other factors contributing to this trend include a software defect impacting the multi-stage generation unit logic, as well as data alignment issues that can contribute to flexible ramping constraint infeasibilities, in similar ways that such issues contribute to power balance infeasibilities.
- DMM worked with the ISO and PacifiCorp to mitigate these flexible ramping constraint issues and a noticeable decrease in these relaxations began in late November and continued through December. The decrease in flexible ramping constraint relaxations in PacifiCorp East beginning in late November coincided with the return of a significant amount of generating capacity from outages in that area. This reduction continued in December and was likely driven in part by the addition of NV Energy to the EIM beginning in December. This trend will be highlighted in the next report covering December 2015.
- The percentage of intervals when the energy power balance constraint was relaxed to allow the market software to balance modeled supply and demand remained at low to moderate levels during

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<sup>1</sup> The ISO's November Report was filed at FERC on January 21 and posted in the ISO website on January 22, 2016, [http://www.caiso.com/Documents/Jan21\\_2016\\_November2015EIMPriceWaiverReport\\_ER15-402.pdf](http://www.caiso.com/Documents/Jan21_2016_November2015EIMPriceWaiverReport_ER15-402.pdf).

<sup>2</sup> When price discovery provisions are triggered by relaxation of the energy power balance constraint, the penalty price for the flexible ramping constraint is changed from \$60/MWh to \$0/MWh in the pricing run, so that the shadow price of this constraint is \$0.

November for all EIM areas and markets. Prices during these intervals continue to be mitigated by special price discovery provisions that prevent prices from being set by the \$1,000/MWh penalty price for energy power balance shortages that would otherwise be utilized to set final market prices.

- During November, the load bias limiter feature would have been triggered during over half of the 15-minute intervals in PacifiCorp East when the power balance constraint was relaxed. These results are similar to results from prior months. In the 5-minute market, the load bias limiter would have been triggered during a majority of intervals with power balance constraint shortages in both PacifiCorp areas.
- When triggered, the load bias limiter would have the same effect as the price discovery feature triggered by power balance constraint shortages, and would cause prices to be set by the last economic bid dispatched rather than the \$1,000/MWh penalty price for energy power balance shortages. Without the price discovery provisions, the load bias limiter would have reduced average 15-minute prices by about 20 percent in PacifiCorp East. The load bias limiter would have decreased prices by only about 1 percent in PacifiCorp West due to the low frequency of times this feature would have been triggered in that area in November. The load bias limiter would have lowered 5-minute prices in PacifiCorp East by about 32 percent and lowered prices by about 13 percent in PacifiCorp West during November.

This report is organized as follows. This summary section highlights key findings and trends occurring in November 2015. Sections 1 through 4 provide updated charts and tables which have been included in prior reports.

## 1 Energy imbalance market prices

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Figure 1.1 and Figure 1.3 show the average daily frequency of constraint relaxations in the 15-minute market by month in PacifiCorp East and PacifiCorp West, respectively. Figure 1.5 and Figure 1.7 provide a similar summary for the 5-minute market in these two areas. A detailed description of various types of constraint relaxation in these figures has been provided in prior reports.<sup>3</sup>

Figure 1.2 and Figure 1.4 show average monthly prices in the 15-minute market *with* and *without* the special price discovery mechanism being applied to mitigate prices in PacifiCorp East and PacifiCorp West, respectively. Figure 1.6 and Figure 1.8 provide the same monthly price summary for the 5-minute market. These four figures also include monthly average ranges of firm bilateral trading hub market prices for comparison to EIM market prices, represented by the grey shaded regions.<sup>4</sup>

Table 1.1 shows that without price discovery, prices in PacifiCorp East during November would have been roughly 60 to 90 percent higher than representative bilateral trading hub prices in the 15-minute market and 20 to 30 percent lower than the representative bilateral trading hub prices in the 5-minute market. In PacifiCorp West both 15-minute and 5-minute prices without price discovery would have been roughly 20 to 30 percent lower than the representative bilateral market prices. This is the third consecutive month where large deviations from representative bilateral prices occurred in PacifiCorp East, which has been mainly driven by flexible ramping constraint shortages. Furthermore, Table 1.1 shows that prices with price discovery, or prices not impacted by price discovery, were roughly 30 to 50 percent higher than bilateral prices in PacifiCorp East.<sup>5</sup>

As shown in these figures, the price discovery mechanism approved under the Commission's December 1, 2014 Order has mitigated the impact of constraint relaxation on market prices in prior months. In November, the price discovery mechanism was not triggered frequently relative to prior months and prices with and without this mechanism were relatively converged in the 15-minute market in both PacifiCorp East and PacifiCorp West. The most notable divergence was in PacifiCorp East where an increase in the number of power balance shortages caused divergence between prices with and without price discovery in the 15-minute market by 22 percent and in the 5-minute market by 14 percent.

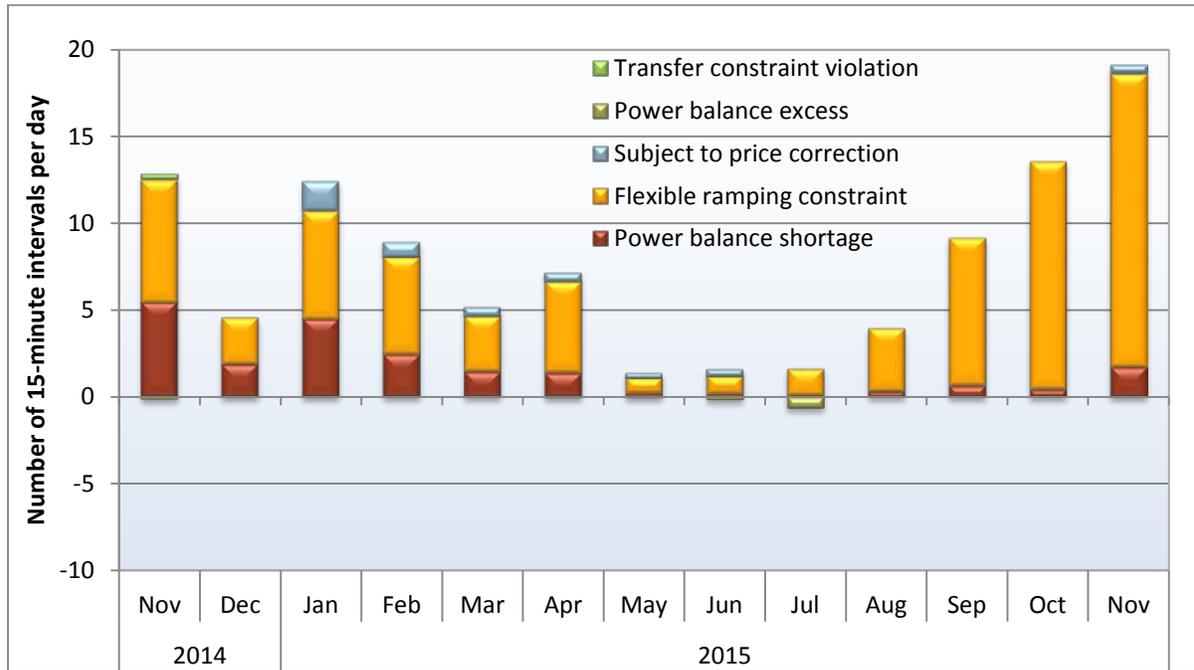
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<sup>3</sup> *Report on Energy Imbalance Market Issues and Performance*, Department of Market Monitoring, April 2, 2015, p.5. [http://www.caiso.com/Documents/Apr2\\_2015\\_DMM\\_AssessmentPerformance\\_EIM-Feb13-Mar16\\_2015\\_ER15-402.pdf](http://www.caiso.com/Documents/Apr2_2015_DMM_AssessmentPerformance_EIM-Feb13-Mar16_2015_ER15-402.pdf).

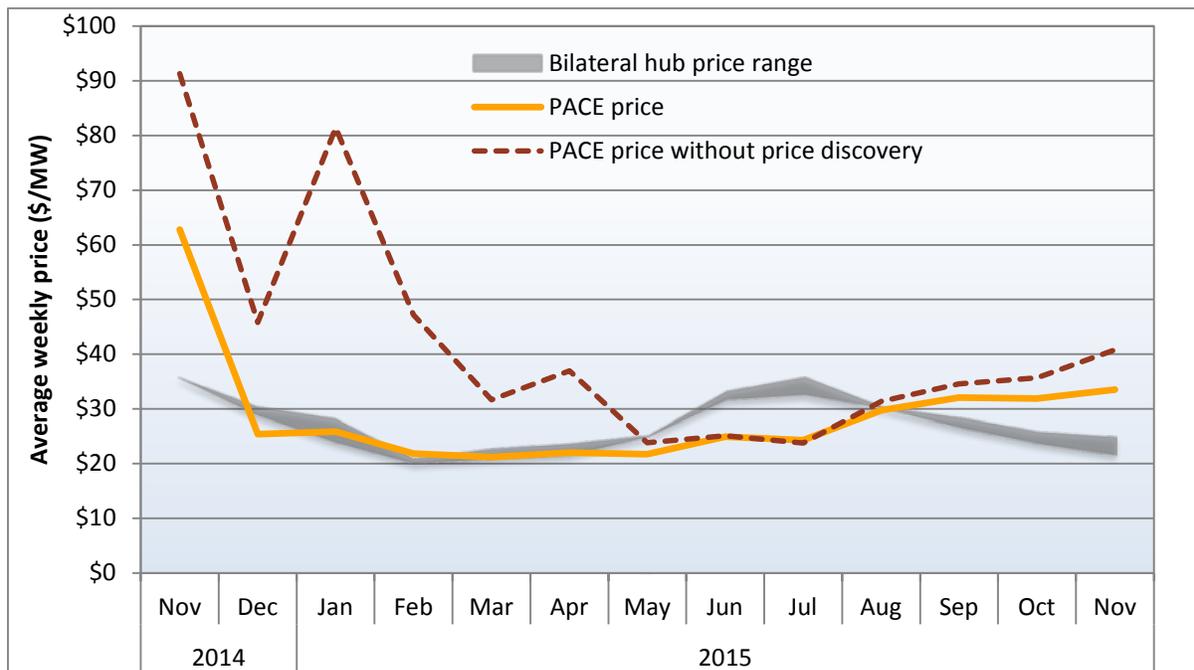
<sup>4</sup> The bilateral trading hub price range is calculated using the range between the ICE and Powerdex indices. Price calculations are performed using daily averages of four major western trading hubs (California Oregon Border, Mid-Columbia, Palo Verde and Four Corners) including peak and on-peak prices.

<sup>5</sup> A detailed description of the methodology used to calculate these counterfactual prices that would result without price discovery was provided on p. 6 of the April 2 report from DMM (link below). The ISO's June 3 Report notes that the ISO implemented the load bias limiter feature for EIM on March 20, so that data in the ISO's report now excludes intervals since March 20 when the power balance constraint was relaxed in the scheduling run, but this software feature would have been triggered if price discovery was not in effect. Also, when estimating prices without price discovery, it is assumed that when the load bias limited would have been triggered, the resulting price would have been equal to the actual price that resulted with price discovery in effect. DMM has also adjusted its analysis to be consistent with the data in the ISO report. [http://www.caiso.com/Documents/Apr2\\_2015\\_DMM\\_AssessmentPerformance\\_EIM-Feb13-Mar16\\_2015\\_ER15-402.pdf](http://www.caiso.com/Documents/Apr2_2015_DMM_AssessmentPerformance_EIM-Feb13-Mar16_2015_ER15-402.pdf).

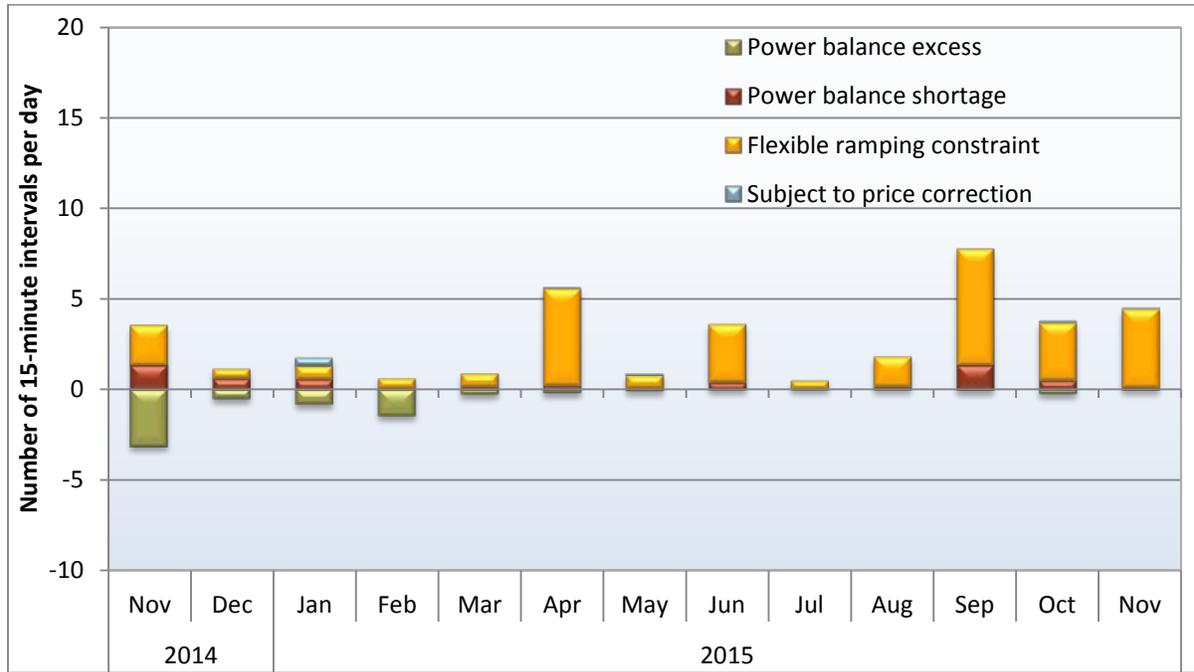
**Figure 1.1 Frequency of constraint relaxation  
PacifiCorp East - 15-minute market**



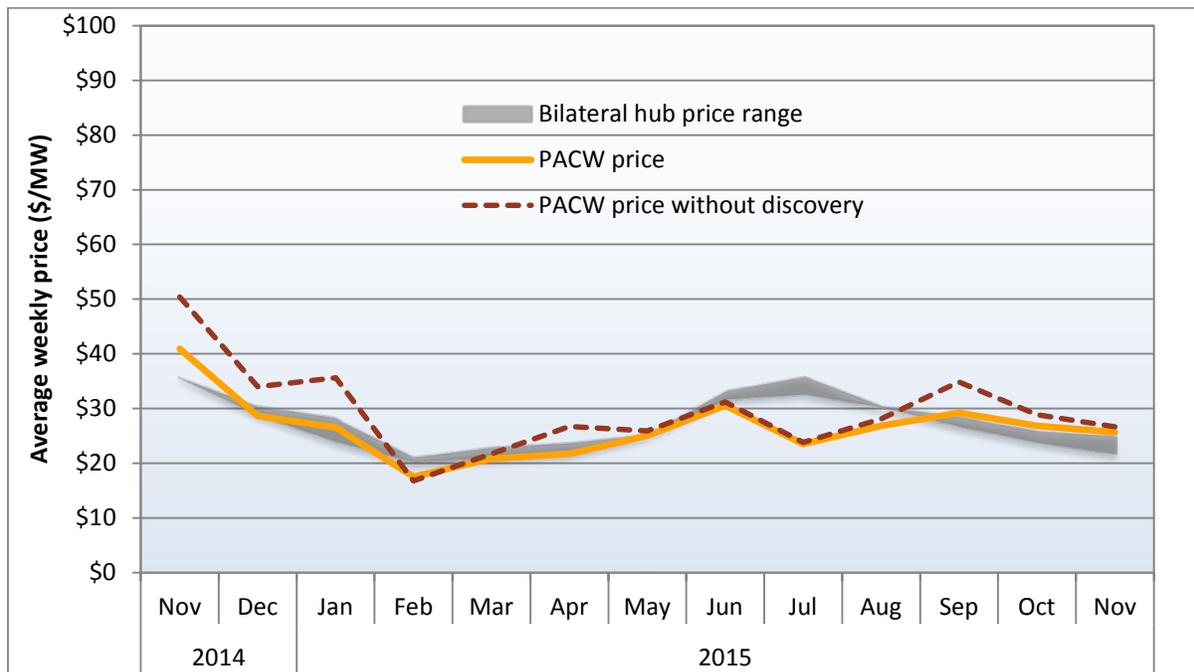
**Figure 1.2 Average daily prices with and without price discovery  
PacifiCorp East - 15-minute market**



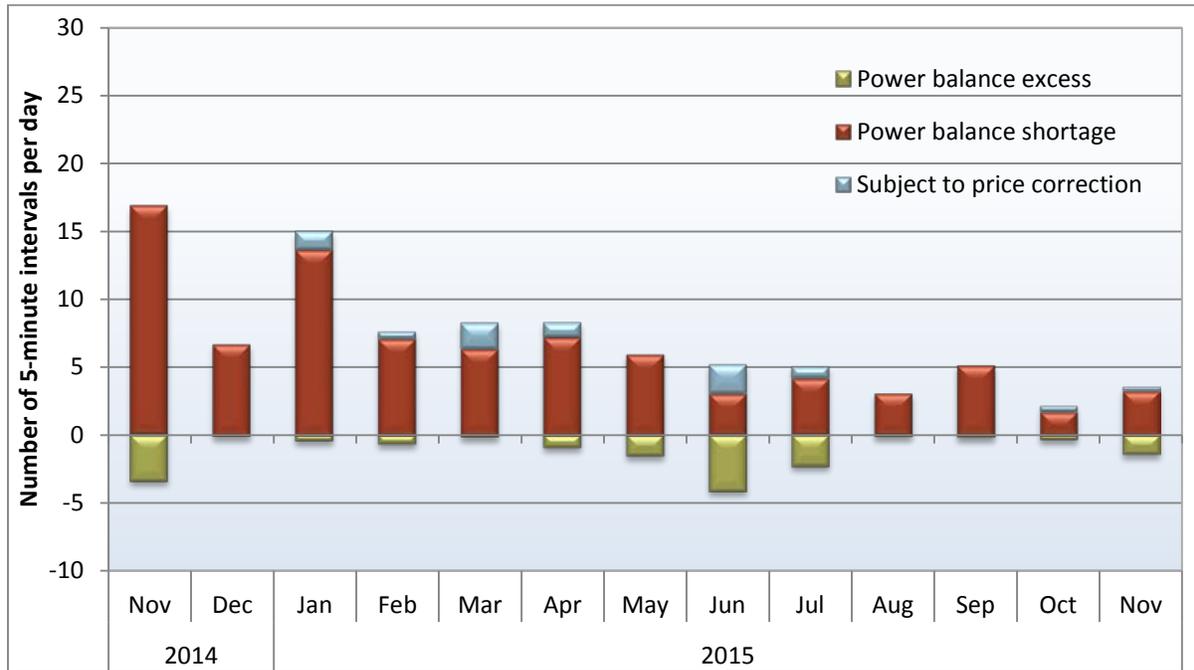
**Figure 1.3 Frequency of constraint relaxation  
PacifiCorp West - 15-minute market**



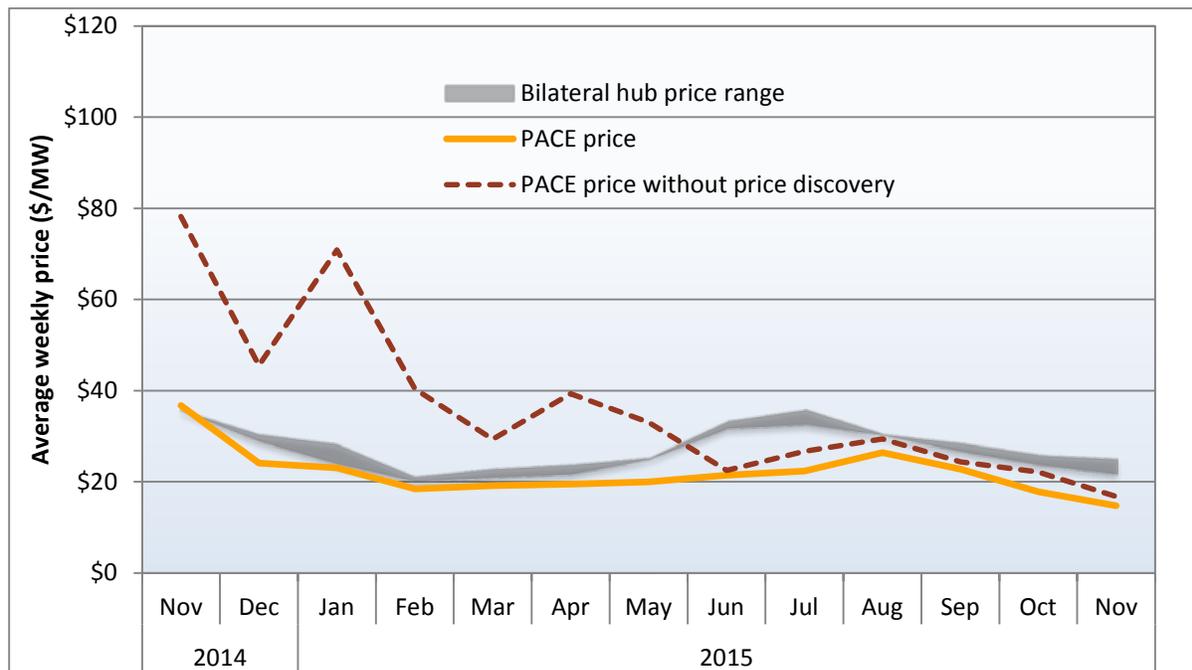
**Figure 1.4 Average daily prices with and without price discovery  
PacifiCorp West - 15-minute market**



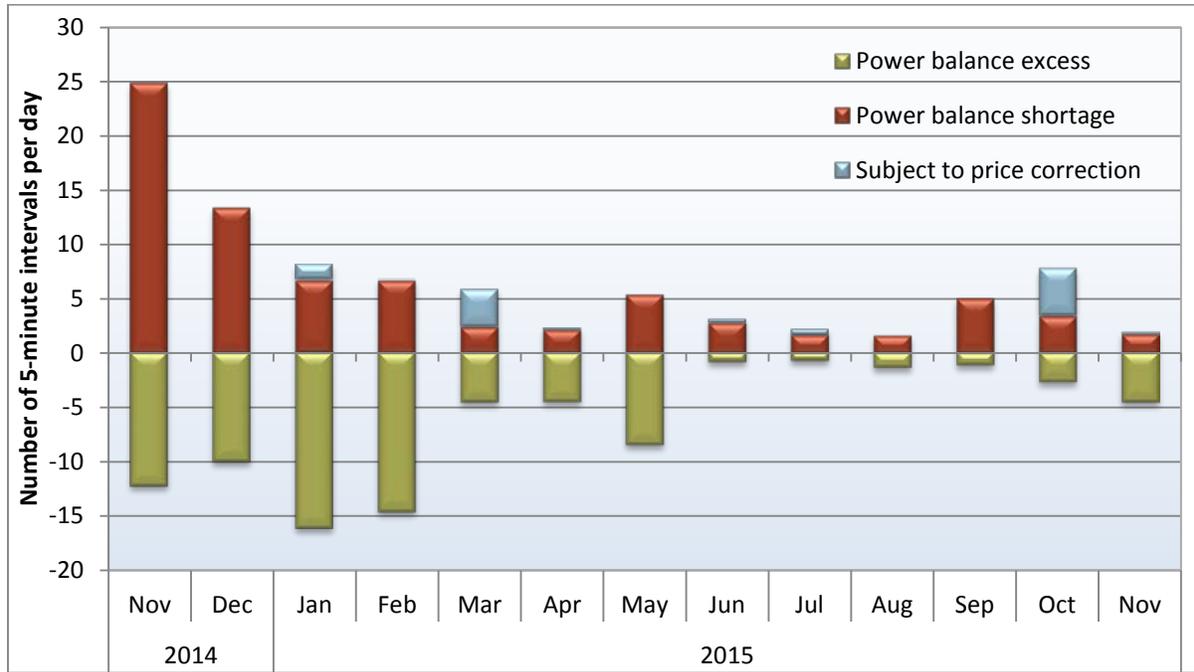
**Figure 1.5 Frequency of constraint relaxation  
PacifiCorp East – 5-minute market**



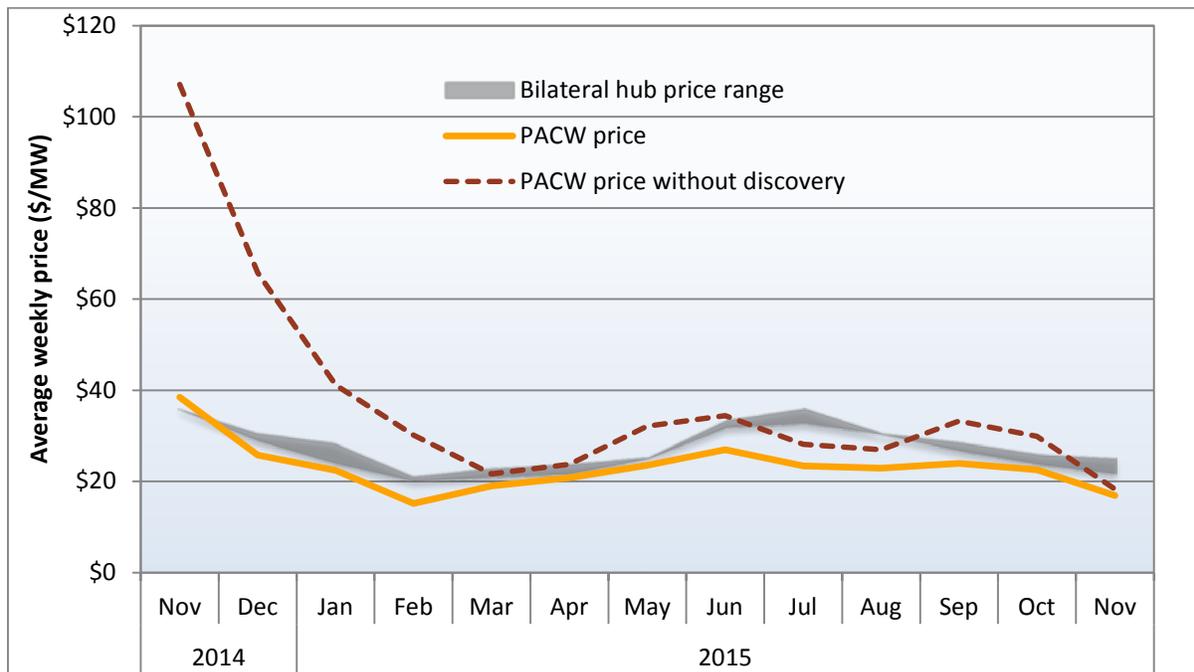
**Figure 1.6 Average daily prices with and without price discovery  
PacifiCorp East – 5-minute market**



**Figure 1.7 Frequency of constraint relaxation  
PacifiCorp West 5-minute market**



**Figure 1.8 Average daily prices with and without price discovery  
PacifiCorp West – 5-minute market**



**Table 1.1 Average prices in EIM and bilateral markets (November 2015)**

	Representative bilateral trading hub price - low	Representative bilateral trading hub price - high	Average EIM price	EIM price without price discovery
<b><i>PacifiCorp East</i></b>				
15-minute market (FMM)	\$21.73	\$25.03	\$33.52	\$40.81
5-minute market (RTD)	\$21.73	\$25.03	\$14.76	\$16.79
<b><i>PacifiCorp West</i></b>				
15-minute market (FMM)	\$21.73	\$25.03	\$25.68	\$26.64
5-minute market (RTD)	\$21.73	\$25.03	\$16.88	\$18.27

## 2 Market software constraint relaxation

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EIM performance was driven primarily by the need to periodically relax several key constraints in the EIM market model. This section provides summary information on the frequency of the constraint violations in the EIM by calendar month for each market. Figure 2.1 and Figure 2.2 summarize the percent of intervals in which the power balance and flexible ramping constraints have been relaxed by month in PacifiCorp East and PacifiCorp West, respectively.

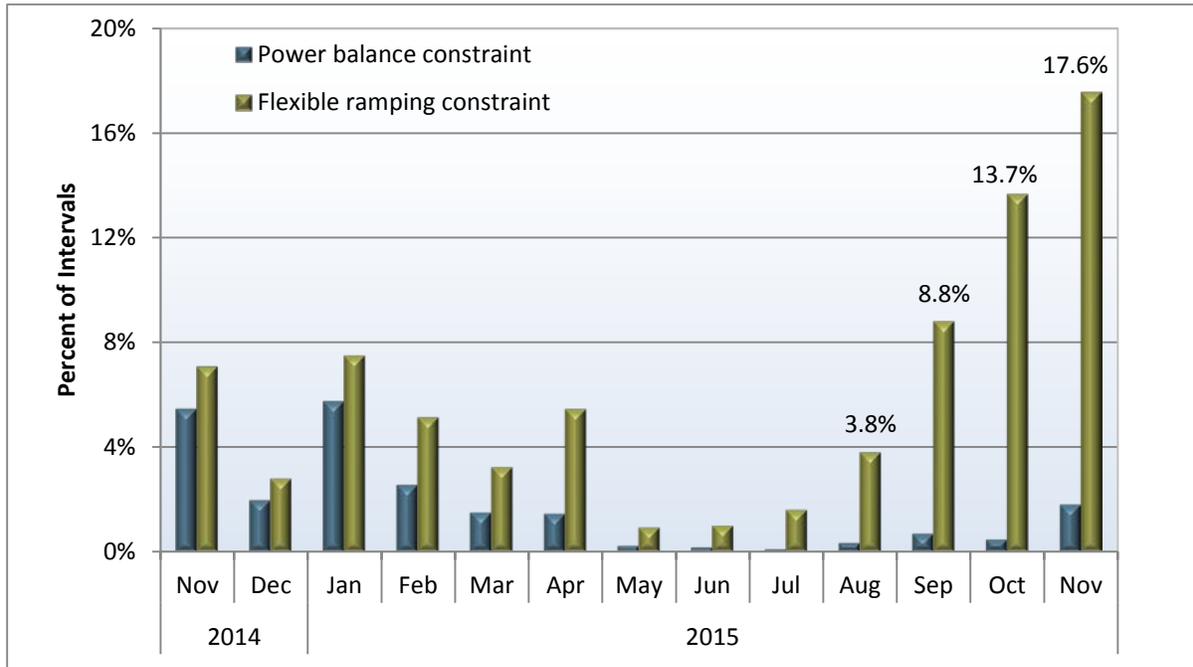
Figure 2.1, Figure 2.2, Figure 2.3 and Figure 2.4 show that the frequency of intervals when the power balance constraint was relaxed to allow the market software to balance modeled supply and demand remained at low to moderate levels during November for all four markets. The highest of these frequencies was observed in the 15-minute in PacifiCorp East where it rose from 0.5 percent in October to 1.8 percent of all intervals in November. The increase in power balance relaxations contributed to an increase in the divergence between the prices with and without price discovery, discussed above. This frequency is relatively moderate compared to historical rates in PacifiCorp East. Relaxation rates for the power balance constraint in the 15-minute market in PacifiCorp West and both 5-minute markets were relatively low during November compared to prior months.

Figure 2.1 shows a continued trend of record levels of flexible ramping constraint relaxations in the 15-minute market in PacifiCorp East. In November, flexible ramping relaxation rates rose to 17.6 percent of all intervals in that market. The increased frequency of intervals when the flexible ramping constraint is relaxed, at the \$60/MWh penalty price, has driven the overall average price in the 15-minute market up significantly in PacifiCorp East beginning in September and continuing through November. As discussed above, flexible ramping constraint relaxations in the 15-minute market have been the primary driver for prices ranging of roughly 60 to 90 percent above representative bilateral trading hub prices in PacifiCorp East.

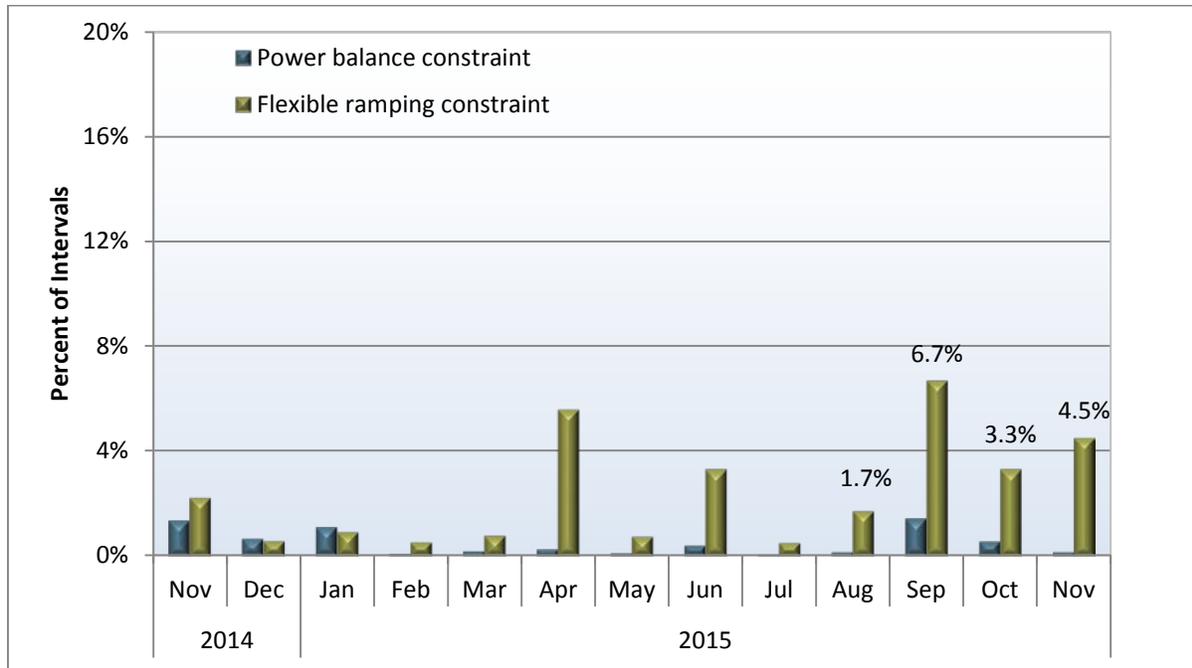
Figure 2.2 shows that the flexible ramping constraint relaxations in the 15-minute PacifiCorp West market declined in November, for the second consecutive month, to 0.6 percent, which matches historic lows for the market.

The increase in flexible ramping constraint activity is likely to have occurred as a result of higher flexible ramping requirements and a reduction of available ramping capacity due to generation outages, compounded with a software defect that affected the flexible ramping constraint.

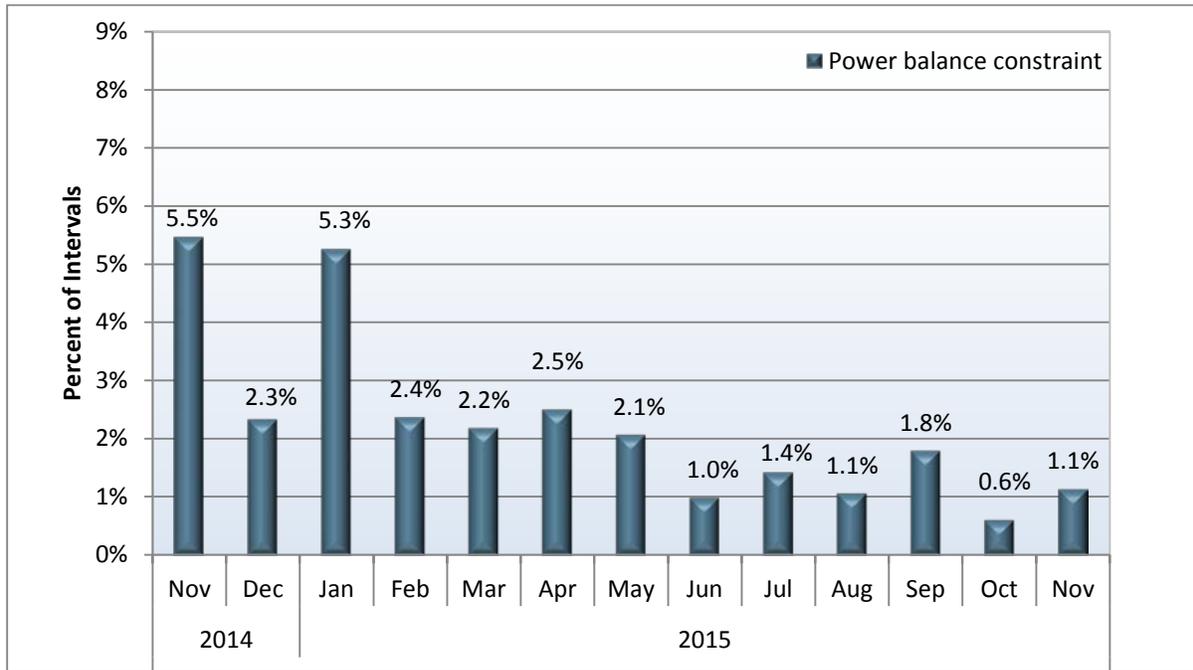
**Figure 2.1 Frequency of constraint relaxation by month – PacifiCorp East (PACE)**



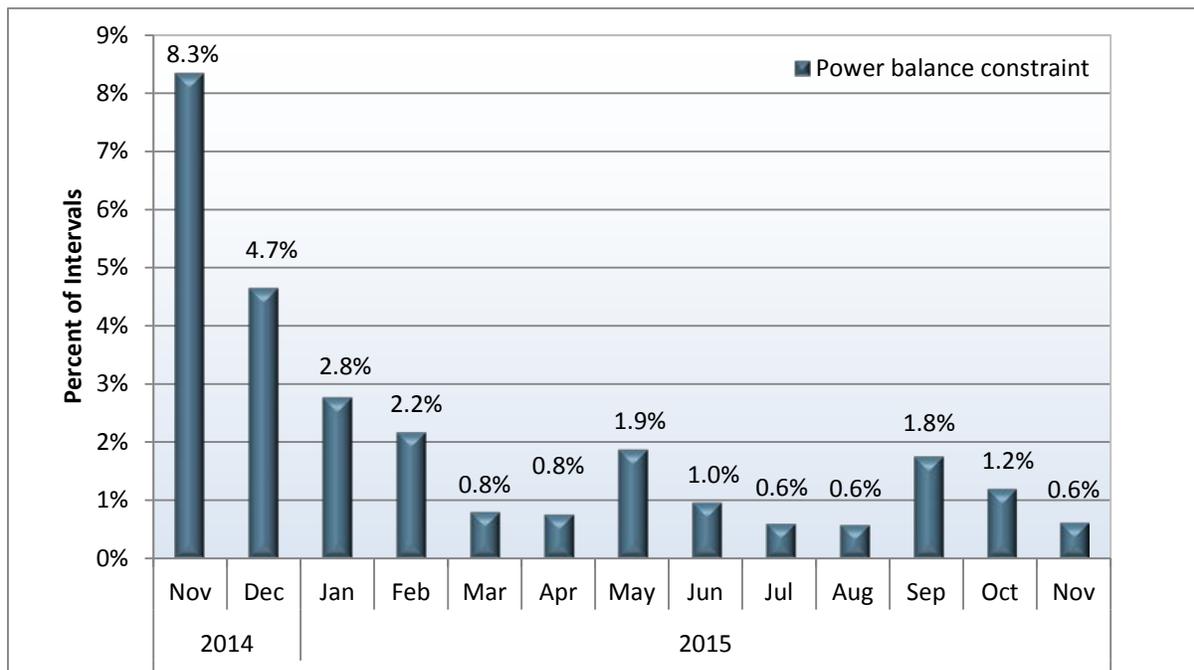
**Figure 2.2 Frequency of constraint relaxation by month – PacifiCorp West (PACW)**



**Figure 2.3 Frequency of 5-minute market constraint relaxation by month PacifiCorp East (PACE)**



**Figure 2.4 Frequency of 5-minute market constraint relaxation by month PacifiCorp West (PACW)**





### 3 Flexible ramping capacity

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The ISO market includes two features designed to ensure sufficient flexible capacity is available to meet dispatch needs in EIM areas: the flexible ramping sufficiency test and the flexible ramping capacity constraint.

#### Flexible ramping sufficiency test

The flexible ramping sufficiency test is designed to ensure an EIM entity has sufficient ramping capacity to meet real-time market requirements without relying on transfers from other EIM balancing areas. This test is performed prior to each operating hour. If an EIM area fails the test, EIM transfers into that area cannot be increased. In addition, if an EIM area fails the test and a power balance constraint shortage occurs during that hour the price discovery mechanism is triggered during that interval, pursuant to special provisions in the EIM Business Practice Manual.<sup>6</sup> The area will also fail the flexible ramping sufficiency test for any hour when the capacity test fails.<sup>7</sup>

Prior to June, the flexible ramping sufficiency test requirement was calculated as the cumulative sum of the flexible ramping requirement for each of the 15-minute intervals during each operating hour. This method was recognized to significantly overestimate the ramping requirements for an EIM entity because the total flexible ramping requirements for the 15-minute intervals within each operating hour are not additive. Therefore, in June the ISO modified the test to eliminate this cumulative summation and be based directly on the requirement for each 15-minute interval.

The ISO has further modified the flexible ramping sufficiency test in early November. These changes included implementing a static floor and ceiling for the flexible ramping constraint, used for each interval in calculating the flexible ramping constraint. There were additional small changes implemented to ensure that the process was functioning as described in the EIM Business Process Manual.<sup>8</sup>

As shown in Table 3.1, following the modification to the flexible ramping sufficiency test in June, the ISO increased the average requirement for flexible ramping capacity constraint significantly between that time and November. In PacifiCorp East, the average requirement increased from 39 MW in May to 139 MW in September, and in PacifiCorp West the average requirement increased from 32 MW in May to 99 MW in October. These requirements have remained at elevated levels since the increase.

As shown in Figure 3.1 and Figure 3.2, the percentage of intervals that the flexible ramping sufficiency test failed in both PacifiCorp regions drops dramatically coinciding with the modification to the flexible ramping sufficiency test in June, despite the fact that the flexible ramping requirement used in the 15-minute market increased significantly. This reflects the fact that the test was modified to eliminate the cumulative summation and was based directly on the requirement for each 15-minute interval. Figure

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<sup>6</sup> Business Practice Manual for the Energy Imbalance Market, July 6, 2015, p. 27:  
[http://bpmcm.caiso.com/BPM%20Document%20Library/Energy%20Imbalance%20Market/BPM\\_for\\_Energy%20Imbalance%20Market\\_V3\\_clean.docx](http://bpmcm.caiso.com/BPM%20Document%20Library/Energy%20Imbalance%20Market/BPM_for_Energy%20Imbalance%20Market_V3_clean.docx).

<sup>7</sup> Details for this test are also outlined in the EIM Business Practice Manual (Ibid p. 34).

<sup>8</sup> Business Practice Manual for the Energy Imbalance Market, July 6, 2015, pp. 35-37:  
[http://bpmcm.caiso.com/BPM%20Document%20Library/Energy%20Imbalance%20Market/BPM\\_for\\_Energy%20Imbalance%20Market\\_V3\\_clean.docx](http://bpmcm.caiso.com/BPM%20Document%20Library/Energy%20Imbalance%20Market/BPM_for_Energy%20Imbalance%20Market_V3_clean.docx).

3.1 also shows that in November levels of flexible ramping sufficiency test failures in PacifiCorp East area were at historic highs, where over 20 percent of hours failed the test during the month.

### Flexible ramping capacity constraint

Table 3.1 shows that as the requirement for flexible ramping capacity in the 15-minute market increased, starting in June, the portion of 15-minute intervals when the flexible ramping constraint bound or was relaxed, also increased significantly. When the flexible ramping constraint cannot be met and must be relaxed, during intervals in which price discovery is not triggered by a relaxation of the power balance constraint, energy prices across the balancing area are increased by the \$60/MW shadow price that results for this constraint.

Figure 3.1 also shows that during hours when the flexible ramping sufficiency test failed, the percentage of intervals when a shortage of flexible ramping capacity occurs has steadily grown since August in PacifiCorp East. In November, during more than one-third of the hours when the flexible ramping sufficiency test failed there were coinciding shortages in the flexible ramping constraint in PacifiCorp East.

Figure 3.3 shows that when there was a flexible ramping constraint relaxation in November in PacifiCorp East, there was also ramping sufficiency test failures roughly half of the time, while during the remaining half there was not. Figure 3.4 show the same breakdown for November for PacifiCorp West.

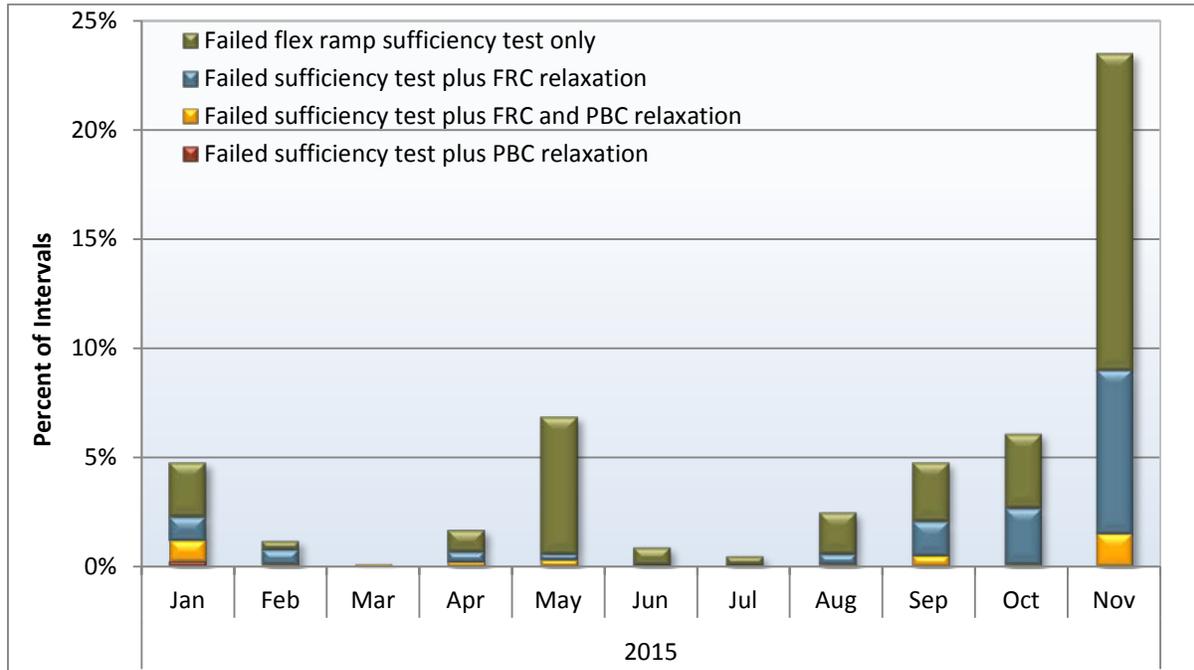
Analysis by DMM indicates that two major factors contributing to the increase in flexible ramping constraint relaxations include (1) an increase in the level of flexible ramping requirements and (2) a reduction of available ramping capacity due to generation outages.

The ISO indicated that a software defect with the multi-stage generation logic increased the frequency of flexible ramp constraint infeasibilities. The ISO indicated that price corrections were being applied to mitigate for this defect since early November, and that the fix for the defect was implemented on November 24. The ISO also notes that data alignment issues affect the flexible ramp constraint in a similar way and that such issues can contribute to power balance infeasibilities.

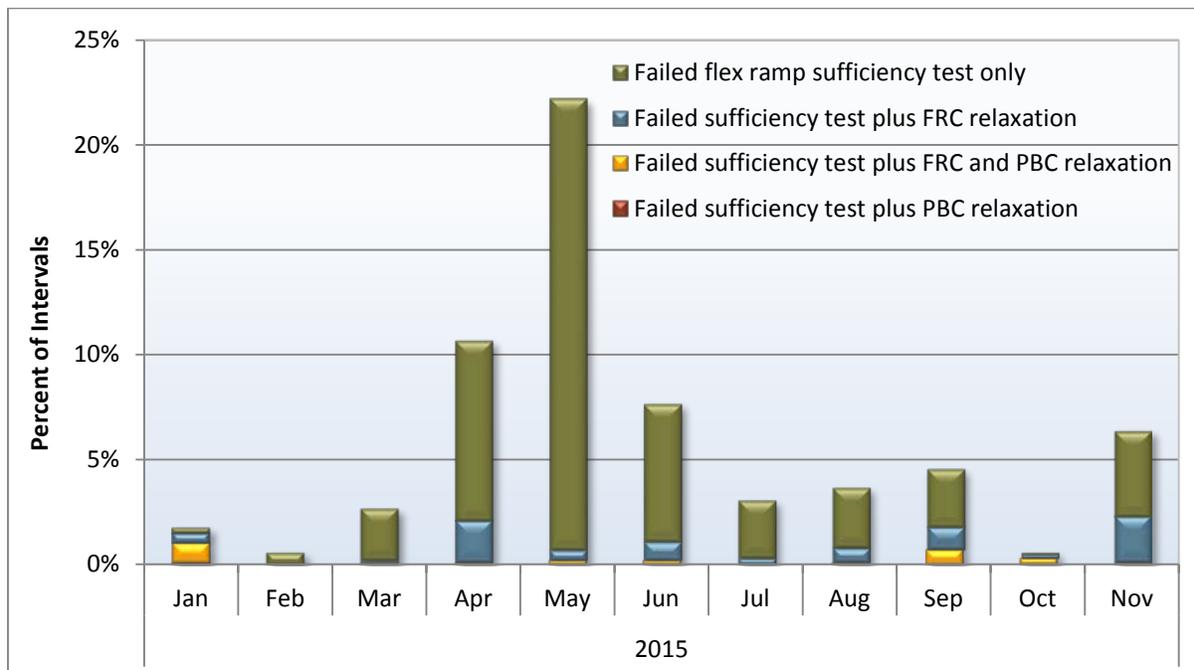
The increased frequency of intervals when the flexible ramping constraint is relaxed at the \$60/MWh penalty price has driven the overall average price in the 15-minute market up significantly in both PacifiCorp areas. Figure 3.5 and Figure 3.6 show the incremental impact from shortages of flexible ramping capacity on average prices in the 15-minute market. During November, flexible ramping constraint shortages continued to have a greater impact on prices and drove 15-minute prices higher by more than \$9/MWh in PacifiCorp East, compared to an already high impact of around \$8/MWh during October.

This resulted in prices in PacifiCorp East being higher than the range of representative bilateral prices by 30 to 50 percent during November. However, if the impact from flexible ramping shortages was excluded from the 15-minute PacifiCorp East prices, they have been within the range of representative bilateral prices during the month. DMM worked with the ISO and PacifiCorp to mitigate these flexible ramping constraint issues and a noticeable decrease in these relaxations began in late November and continued through December.

**Figure 3.1 Flexible ramping sufficiency test results – PacifiCorp East**



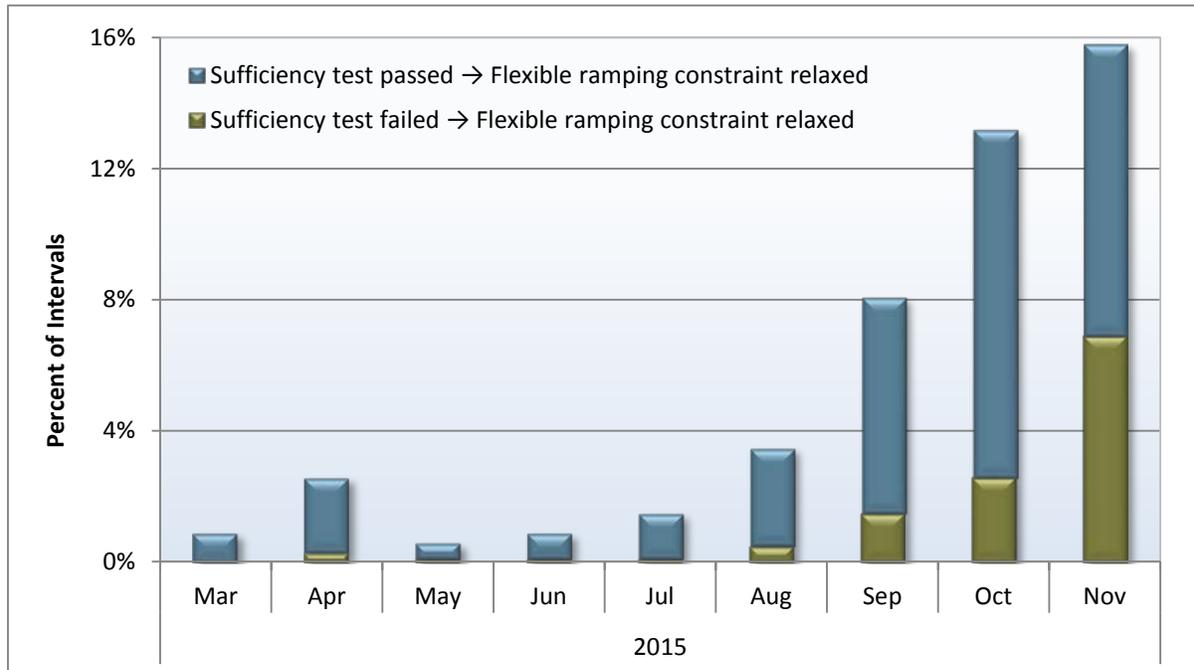
**Figure 3.2 Flexible ramping sufficiency test results – PacifiCorp West**



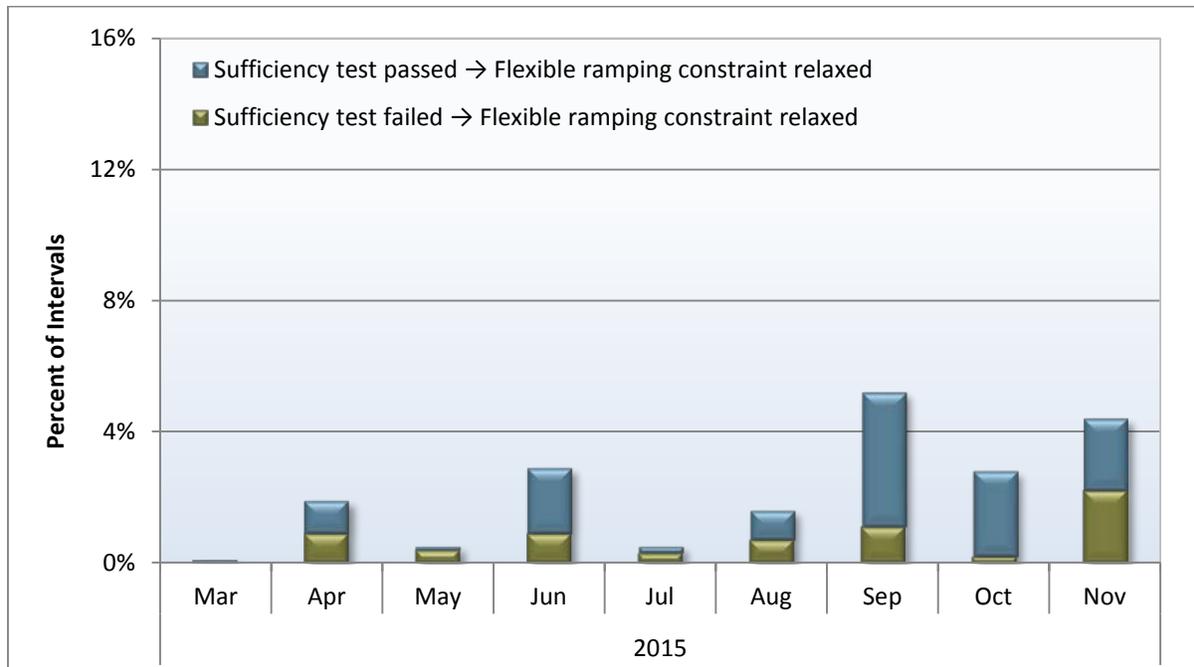
**Table 3.1 Flexible ramping constraint requirements and market impacts**

	Average flex ramp requirement (MW)	Binding flexible ramping constraint (no shortage)		Relaxed flexible ramping constraint (shortage)	
		% of intervals	Average shadow price	% of intervals	Average shadow price
<b><i>PacifiCorp East</i></b>					
March	33	6.4%	\$8.92	0.9%	\$21.17
April	44	8.0%	\$7.57	2.6%	\$27.67
May	39	7.7%	\$7.68	0.6%	\$47.86
June	63	15.1%	\$9.28	0.9%	\$60.00
July	87	15.7%	\$8.91	1.5%	\$60.00
August	112	30.8%	\$11.75	3.5%	\$60.81
September	139	29.5%	\$16.20	8.2%	\$60.31
October	139	28.0%	\$16.28	13.2%	\$60.11
November	134	41.7%	\$9.17	15.8%	\$60.00
<b><i>PacifiCorp West</i></b>					
March	27	12.9%	\$6.09	0.2%	\$9.54
April	47	17.2%	\$8.00	2.0%	\$9.75
May	32	15.4%	\$6.95	0.5%	\$41.02
June	54	26.1%	\$10.65	2.9%	\$60.85
July	69	20.0%	\$8.78	0.5%	\$60.00
August	86	37.6%	\$9.19	1.6%	\$60.14
September	97	36.2%	\$8.22	5.3%	\$60.00
October	99	49.7%	\$10.05	2.8%	\$60.00
November	99	48.0%	\$8.30	4.3%	\$60.00

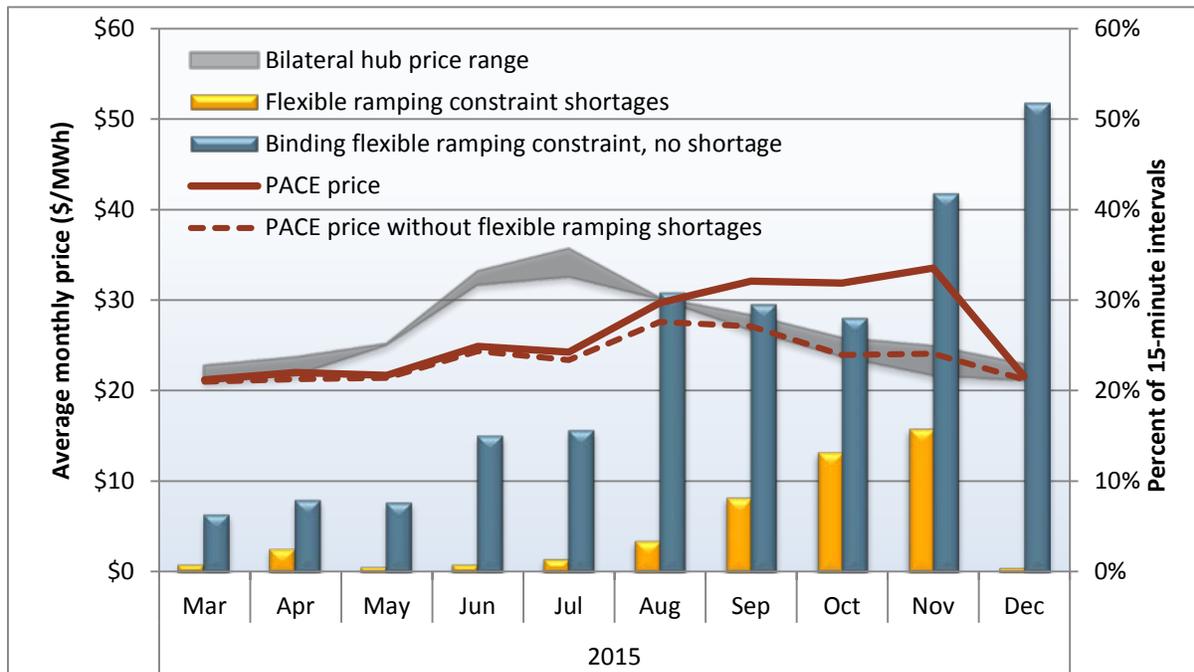
**Figure 3.3 Flexible ramping constraint relaxation and sufficiency test results – PacifiCorp East**



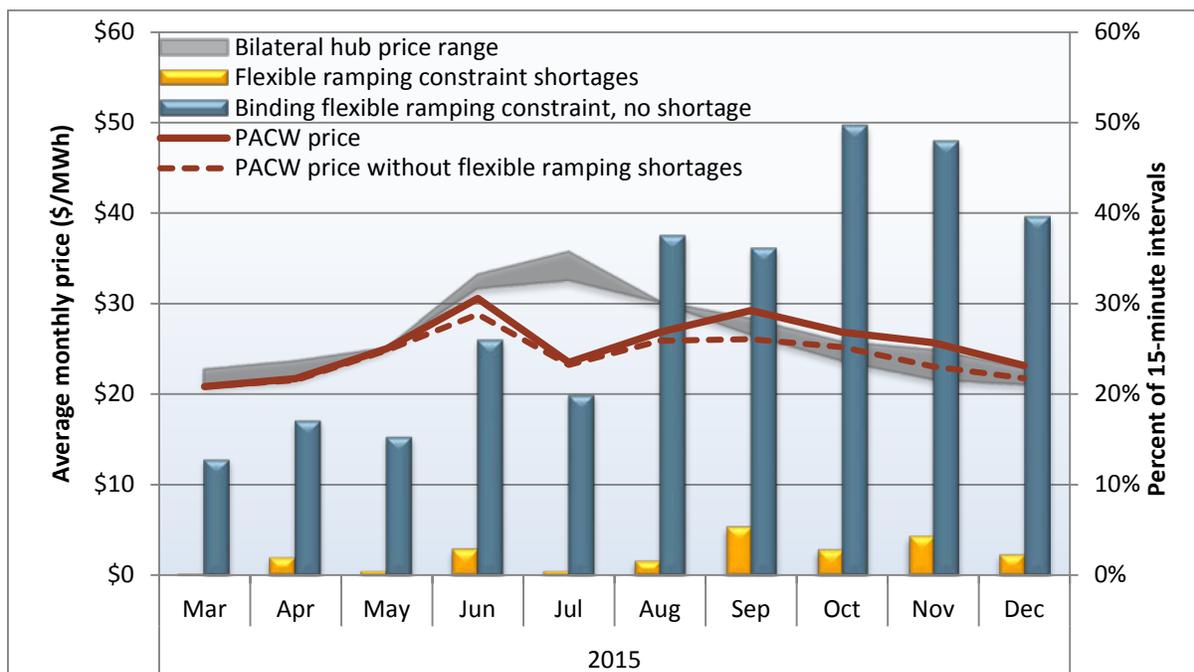
**Figure 3.4 Flexible ramping constraint relaxation and sufficiency test results – PacifiCorp West**



**Figure 3.5 Impact of flexible ramping constraint relaxation  
PacifiCorp East – 15-minute market**



**Figure 3.6 Impact of flexible ramping constraint relaxation  
PacifiCorp West – 15-minute market**



The frequency of flexible ramping constraint relaxations in PacifiCorp East dropped significantly beginning in late November. This decline coincided with the return of a significant amount of generating capacity from outages in PacifiCorp East.

This trend continued throughout December and is likely to have also been driven in large part by the addition of NV Energy to the EIM beginning in December. This provides a significant increase in the amount of additional energy scheduled in the 15-minute market into the PacifiCorp areas. Although flexible ramping capacity cannot be directly imported from other EIM areas, additional energy imports can allow more ramping capacity from resources within an EIM area to remain unloaded and available to meet flexible ramping constraint requirements. The impact of the expansion of the EIM to include the NV Energy area will be highlighted in the next report covering December 2015.

### Flexible ramping requirements

DMM believes one factor that could be contributing to flexible ramping constraint shortages may be the volatility of flexible ramping requirements from one 15-minute interval to the next that occurs under the current method used to set flexible ramping requirements. As discussed in DMM's last two quarterly reports, on March 30 the ISO implemented an automated procedure to set the flexible ramping requirement in both the ISO and PacifiCorp balancing areas.<sup>9</sup> This procedure is called the balancing area ramp requirement (BARR) tool.

Because the BARR tool calculates flexible ramping requirements based on a very limited set of historical observations, the tool results in a very high variability in the flexible ramping requirements from one 15-minute interval to the next in both the ISO and EIM areas. Both DMM and other ISO staff are concerned that this high volatility reflects requirements that are unnecessarily high in some intervals and too low compared to the actual potential demand for ramping capacity in other intervals.

The ISO has sought to decrease this volatility by increasing the number of observations used to calculate the requirement and by placing minimum and maximum bounds of the output of the BARR tool. While these changes helped reduce the volatility of flexible ramping requirements, the overall volatility of requirements remains higher than prior to implementation of the BARR tool. As noted in our second quarter report, DMM has recommended increasing the set of observations used to calculate the requirement – preferably by grouping surrounding intervals together – to increase the accuracy of the calculation and reduce the high level of variability due to random variations in historical data. The ISO has indicated it will seek to implement this enhancement.

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<sup>9</sup> *Report on Market Issues and Performance, Q2 2015*, Department of Market Monitoring, August 17, 2015, pp. 43-46.  
[http://www.caiso.com/Documents/2015\\_SecondQuarterReport-MarketIssues\\_Performance-August2015.pdf](http://www.caiso.com/Documents/2015_SecondQuarterReport-MarketIssues_Performance-August2015.pdf).

*Report on Market Issues and Performance, Q3 2015*, Department of Market Monitoring, November 16, 2015, pp. 33-36.  
<http://www.caiso.com/Documents/2015ThirdQuarterReport-MarketIssuesandPerformance-November2015.pdf>.



## 4 Load bias limiter

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The percentage of intervals when the energy power balance constraint was relaxed to allow the market software to balance modeled supply and demand remained relatively low during November. Without special price discovery provisions in effect, the load bias limiter feature would have been triggered during a high portion of the power balance shortages observed in November. When triggered, the load bias limiter would have the same effect as the price discovery feature by causing prices to be set by the last economic bid dispatched rather than the \$1,000/MWh penalty price for energy power balance shortages.

A more detailed description of the load bias limiter was included in the DMM's April 2 report.<sup>10</sup> The ISO included discussion of the load bias limiter in its recent answer to the comments regarding the ISO's response to the Commission's September 24, 2015 letter requesting additional information on the ISO's August 19, 2015 filing to implement its available balancing capacity proposal in the EIM.<sup>11</sup>

As shown in Figure 4.1, the load bias limiter would have been triggered during over half of the 15-minute intervals in PacifiCorp East.

Figure 4.2 shows that the percentage of intervals with power balance shortages in PacifiCorp West was relatively low and that the load bias limiter would not have been triggered during most of these shortages. These overall results are in line with prior months, where the load bias limiter would have been triggered during about half of the intervals with power balance shortages in the 15-minute markets.

Figure 4.3 and Figure 4.4 show that during 5-minute intervals when power balance constraint shortages existed in November, a majority would have also triggered the load bias limiter in both PacifiCorp areas.

The estimates of EIM prices without price discovery in Section 1 of this report assume that price discovery provisions are not in place, but energy prices would not be set by the \$1,000/MWh penalty price when the power balance constraint was relaxed and the criteria for triggering the load bias limiter were met.<sup>12</sup> This reflects that on March 20 the ISO indicated that the load bias limiter would have been triggered under these criteria, if price discovery provisions were no longer in effect.

Table 4.1 shows estimated EIM prices if prices were set at the \$1,000/MWh penalty price during intervals when the load bias limiter would have been triggered and the price discovery provisions approved pursuant to FERC's December 2014 Order were not in effect. As shown in these tables, without existing price discovery provisions, the load bias limiter would have reduced average 15-minute prices by about 20 percent in PacifiCorp East. The load bias limiter would have decreased prices in PacifiCorp West by only about 1 percent due to the low frequency of times this feature would have been triggered. The load bias limiter would have lowered 5-minute prices in PacifiCorp East by over 30 percent and lowered prices by over 10 percent in PacifiCorp West during November.

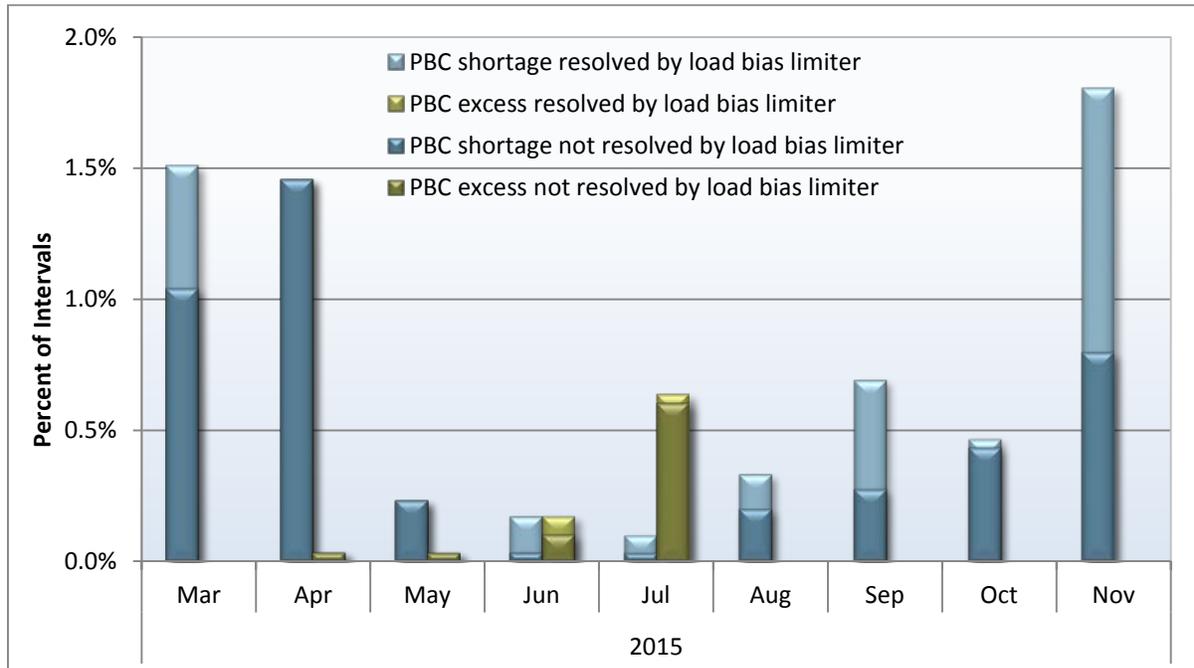
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<sup>10</sup> *Report on Energy Imbalance Market Issues and Performance*, Department of Market Monitoring, April 2, 2015, pp.34-35. [http://www.caiso.com/Documents/Apr2\\_2015\\_DMM\\_AssessmentPerformance\\_EIM-Feb13-Mar16\\_2015\\_ER15-402.pdf](http://www.caiso.com/Documents/Apr2_2015_DMM_AssessmentPerformance_EIM-Feb13-Mar16_2015_ER15-402.pdf).

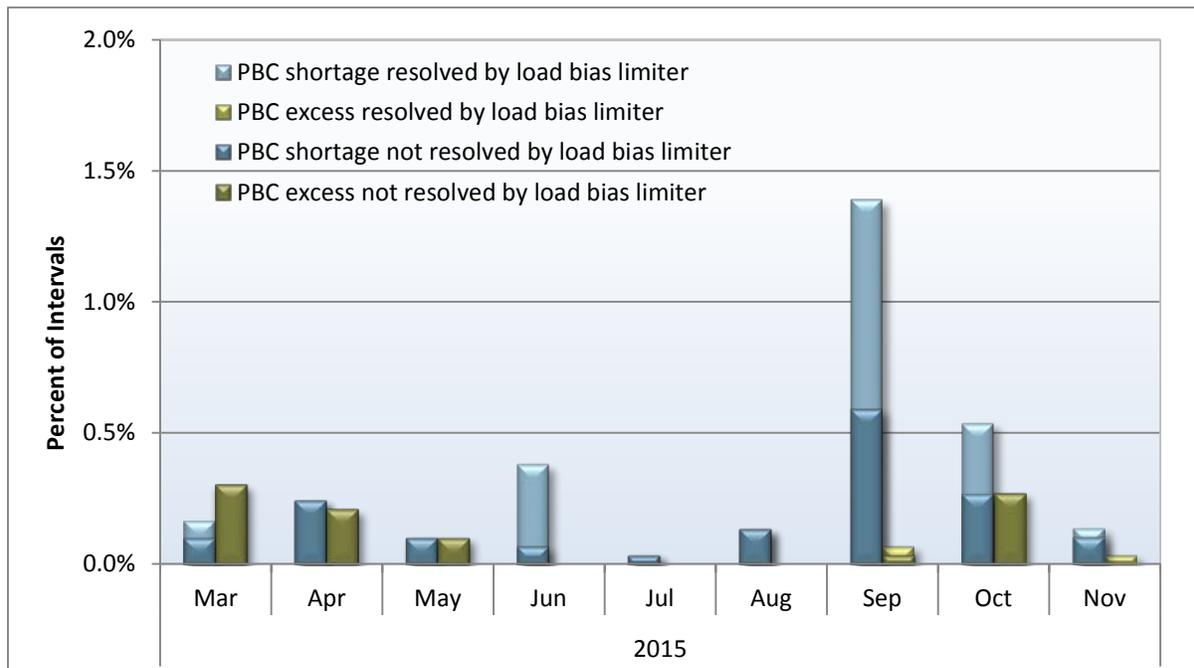
<sup>11</sup> Answer of the California Independent systems Operator Corporation to Comments, November 24, 2015, pp. 13-21. [http://www.caiso.com/Documents/Nov24\\_2015\\_Answer\\_Comments\\_AvailableBalancingCapacity\\_ER15-861-006.pdf](http://www.caiso.com/Documents/Nov24_2015_Answer_Comments_AvailableBalancingCapacity_ER15-861-006.pdf).

<sup>12</sup> See discussion on in Section 1, page 5.

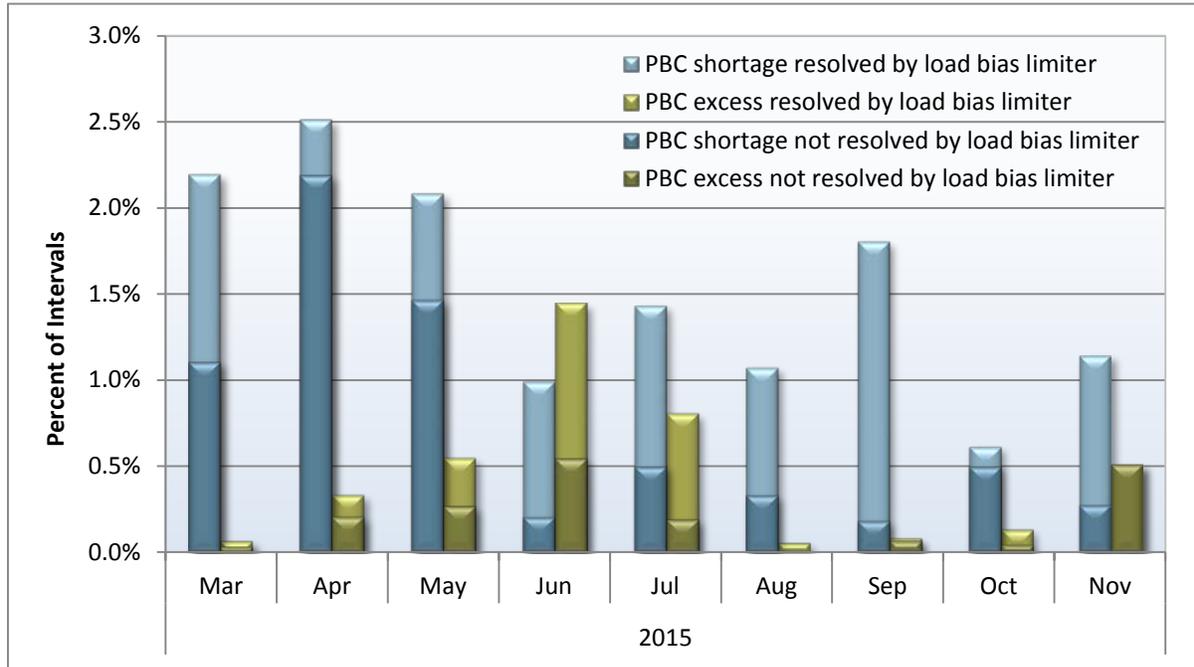
**Figure 4.1 Mitigation of power balance relaxation by load bias limiter  
PacifiCorp East – 15-minute market**



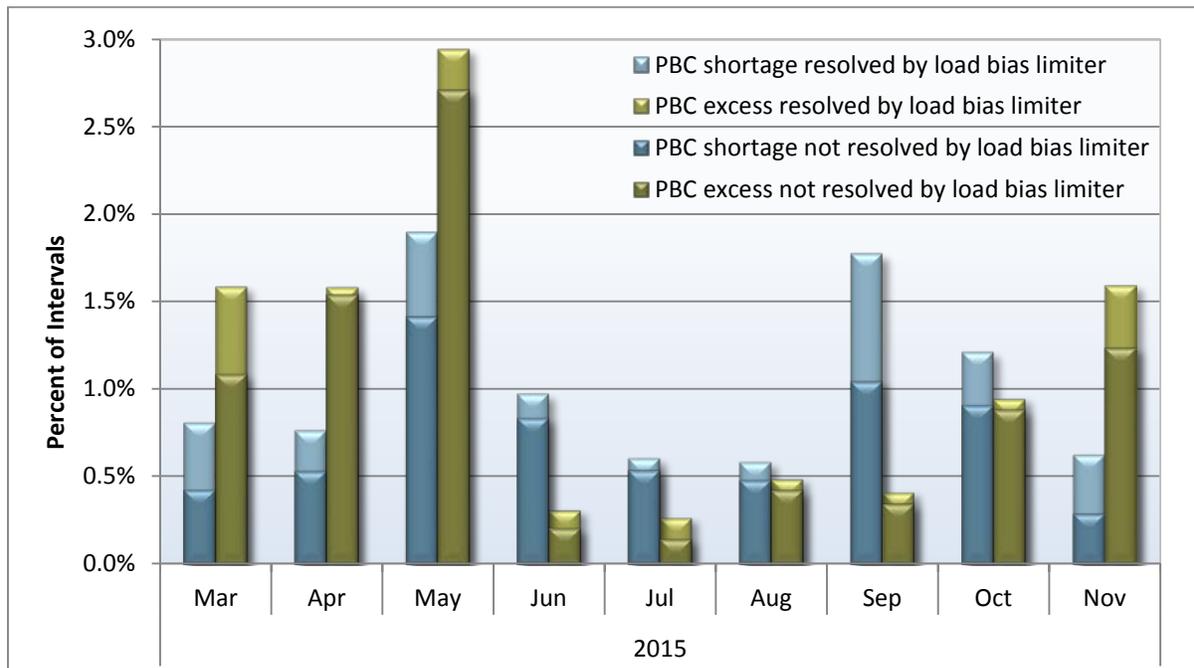
**Figure 4.2 Mitigation of power balance relaxation by load bias limiter  
PacifiCorp West – 15-minute market**



**Figure 4.3 Mitigation of power balance relaxation by load bias limiter  
PacifiCorp East – 5-minute market**



**Figure 4.4 Mitigation of power balance relaxation by load bias limiter  
PacifiCorp West – 5-minute market**



**Table 4.1 Impact of load bias limiter on EIM prices (November 2015)**

	Representative bilateral trading hub price range		Average EIM price	EIM price without price discovery	EIM price without price discovery or load bias limiter	Potential impact of load bias limiter	
	Low	High				Dollars	Percent
<b><i>PacifiCorp East</i></b>							
15-minute market (FMM)	\$21.73	\$25.03	\$33.52	\$40.81	\$50.07	-\$9.25	-19%
5-minute market (RTD)	\$21.73	\$25.03	\$14.76	\$16.79	\$24.67	-\$7.88	-32%
<b><i>PacifiCorp West</i></b>							
15-minute market (FMM)	\$21.73	\$25.03	\$25.68	\$26.64	\$26.91	-\$0.28	-1%
5-minute market (RTD)	\$21.73	\$25.03	\$16.88	\$18.27	\$20.98	-\$2.70	-13%

## CERTIFICATE OF SERVICE

I certify that I have served the foregoing document upon the parties listed on the official service list in the captioned proceedings, in accordance with the requirements of Rule 2010 of the Commission's Rules of Practice and Procedure (18 C.F.R. § 385.2010).

Dated at Folsom, California this 28<sup>th</sup> day of January, 2016.

*Is/ Anna Pascuzzo*  
Anna Pascuzzo