

December 1, 2015

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 August 1, 2015 through and September 30, 2015.¹

Please contact the undersigned with any questions.

Respectfully submitted,

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

California ISO

Report on energy imbalance market issues and performance

December 1, 2015

Prepared by: Department of Market Monitoring

Executive summary

Pursuant to the Commission's March 16, 2015, Order on the ISO's Energy Imbalance Market (EIM), the ISO filed a report on November 13, 2015 covering the period from August 1 through September 30, 2015 (November Report).¹ 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. Key findings include the following:

- During most intervals, EIM prices continue to be set by bids closely reflective of the marginal operating cost of the highest cost resource dispatched to balance loads and generation. Bids for most capacity continue to be slightly below or slightly above default energy bids used for market power mitigation. When bids are mitigated due to market power mitigation provisions, these procedures generally result in modest reductions in bid prices.
- 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 – increased significantly from July to August and August to September. During these intervals, when there is a shortage of flexible ramping capacity, the energy price in the 15-minute market includes the \$60/MWh penalty price for the flexible ramping constraint.²
- The increased frequency of flexible ramping constraint shortages has driven the overall average price in the 15-minute market up significantly in both PacifiCorp areas. During September, flexible ramping constraint shortages drove 15-minute prices higher by about \$5/MWh in PacifiCorp East and over \$3/MWh in PacifiCorp West. This resulted in average 15-minute prices being higher than average bilateral prices by about 20 percent and 10 percent in each of these EIM areas, respectively, during September.
- The increased impact of the flexible ramping constraint on prices appears to be attributable to a number of factors. Analysis by DMM indicates that this trend has been driven in large part by an increase in the level 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 flex ramp constraint infeasibilities in similar way that such issues contribute to power balance infeasibilities. DMM is working with the ISO and PacifiCorp to further assess and mitigate these flexible ramping constraint issues.
- This trend continues in October and November, with prices in the 15-minute market continuing to exceed bilateral prices due to the impact of the flexible ramping constraint. This trend may be mitigated with the addition of NV Energy to the EIM, since this may significantly increase the amount of additional energy that can be scheduled in the 15-minute market into the PacifiCorp areas. Although flexible ramping capacity cannot be directly imported from other EIM areas,

¹ The ISO's November Report was filed at FERC on November 13 and posted in the ISO website on November 17, 2015, http://www.caiso.com/Documents/Nov13_2015_Aug2015throughSep2015EIMPriceWaiverReport_ER15-402.pdf.

² 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.

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 percentage of intervals when the energy power balance constraint was relaxed to allow the market software to balance modeled supply and demand also increased notably. During September, the power balance constraint was relaxed 0.7 percent of 15-minute intervals in PacifiCorp East and 1.4 percent of 15-minute intervals in PacifiCorp West. The percentage of 5-minute intervals that the power balance constraint was relaxed increased to 1.8 percent in both PacifiCorp areas in September. 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.
- Without special price discovery provisions in effect, the load bias limiter feature would have been triggered during about half of the 15-minute intervals in both PacifiCorp areas when the power balance constraint was relaxed during August and September. In the 5-minute market, the load bias limiter would have been triggered during over 80 percent of intervals with power balance constraint shortages in PacifiCorp East and about one-third of intervals with power balance shortages in PacifiCorp West. This represents a significant increase from prior months.
- 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 in PacifiCorp East by about 4 percent in August and about 10 percent in September. Most notably, it would have lowered 5-minute prices in PacifiCorp East by about 18 percent in August and 37 percent in September. In PacifiCorp West, it would have lowered 15-minute and 5-minute prices by about 17 percent in September.

Because the ISO's monthly reports are composed primarily of information included in prior reports, since June DMM has been recommending that the ISO provide a summary of key additional information in each report or and/or a redlined version of each report so that this new information is more readily apparent.³ The ISO included a redlined version of its report for the first time as part of its November 13 report filed with the Commission.⁴ This redlined version highlights several actions that have been completed to improve EIM performance.

This report is organized as follows: This summary section highlights key findings and trends occurring in August and September 2015. Section 1 through 3 provide updated charts and tables which have been included in prior reports. Section 4 provides a special update on the increased impact that the flexible ramping constraint and load bias limiter have had on EIM prices.

³ *Report on Energy Imbalance Market Issues and Performance*, Department of Market Monitoring, June 12, 2015, p.2, footnote 2: http://www.caiso.com/Documents/Jun12_2015_DMM_Report_Performance_Issues_EIM_April2015_ER15-402.pdf, and *Report on Energy Imbalance Market Issues and Performance*, Department of Market Monitoring, August 21, 2015, p.3: http://www.caiso.com/Documents/Aug21_2015_DMMReport_Performance_Issues_EIM_June2015_ER15-402.pdf.

⁴ *Energy Imbalance Market Pricing Waiver Report*, August 1 – September 31, 2015, November 13, 2015 http://www.caiso.com/Documents/Nov13_2015_Aug2015throughSep2015EIMPriceWaiverReport_ER15-402.pdf.

1 Energy imbalance market prices

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.⁵

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. All four figures also include monthly average bilateral market prices for trading points that were used to determine balancing energy charges prior to EIM implementation in PacifiCorp East and PacifiCorp West.

Table 1.1 shows that without price discovery, prices in PacifiCorp East during August would have been 4 percent higher in the 15-minute market and 2 percent lower in the 5-minute market than bilateral prices. In PacifiCorp West, prices in August would have been 7 percent lower than bilateral market prices in the 15-minute market and 11 percent lower in the 5-minute market.

Table 1.2 shows that without price discovery, prices in PacifiCorp East during September would have been 30 percent higher in the 15-minute market and 8 percent lower in the 5-minute market than bilateral prices. In PacifiCorp West, prices in September would have been 31 percent higher than bilateral market prices in the 15-minute market and 25 percent higher in the 5-minute market.

A detailed description of the methodology used to calculate these counterfactual prices that would result without price discovery has been provided in prior reports.⁶ 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. DMM has also adjusted its analysis to be consistent with the data in the ISO report.⁷

As discussed in Section 4 of this report, the percentage of intervals when the power balance constraint was relaxed and the load bias limiter would have been triggered increased notably during in August and September. An analysis of the impact of the load bias limiter on EIM prices during these months is provided in Section 4.

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 August, the price discovery mechanism was not triggered frequently and prices with and without this mechanism were nearly converged in the 15-minute market in both PacifiCorp East and PacifiCorp West. With the increase in frequency of intervals when the power balance constraint was relaxed in PacifiCorp

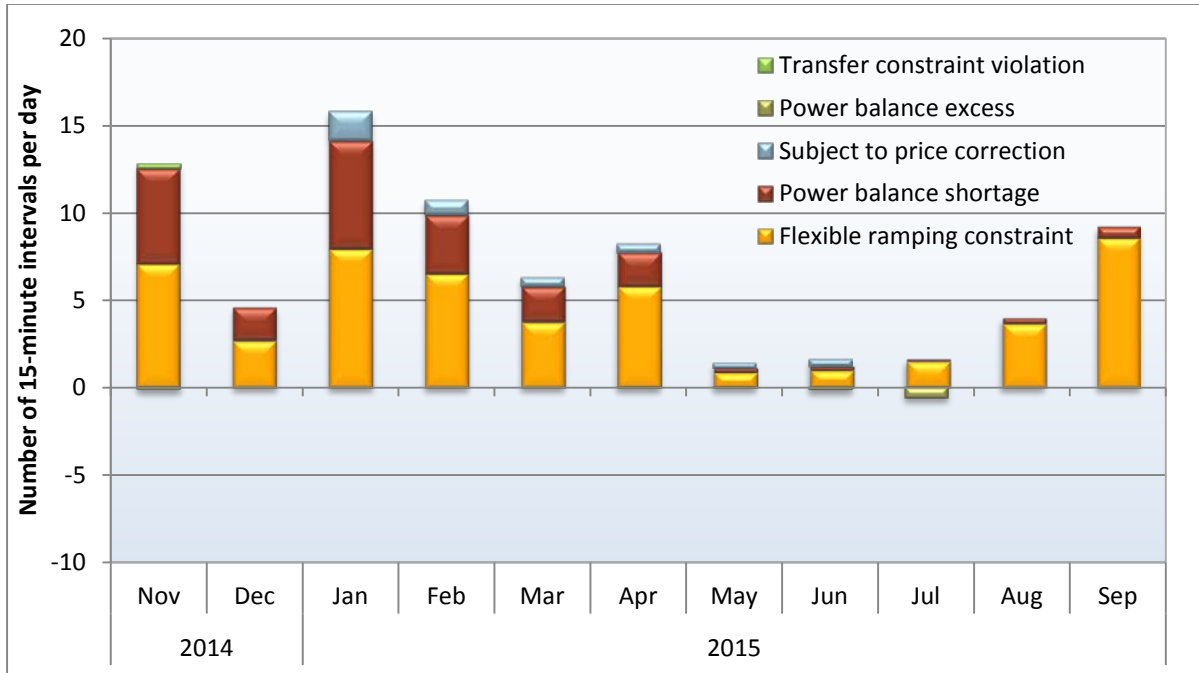
⁵ *Report on Energy Imbalance Market Issues and Performance*, Department of Market Monitoring, April 2, 2015, p.5. http://www.caiso.com/Documents/Apr2_2015_DMM_AssessmentPerformance_EIM-Feb13-Mar16_2015_ER15-402.pdf.

⁶ *Report on Energy Imbalance Market Issues and Performance*, Department of Market Monitoring, April 2, 2015, p.6. http://www.caiso.com/Documents/Apr2_2015_DMM_AssessmentPerformance_EIM-Feb13-Mar16_2015_ER15-402.pdf.

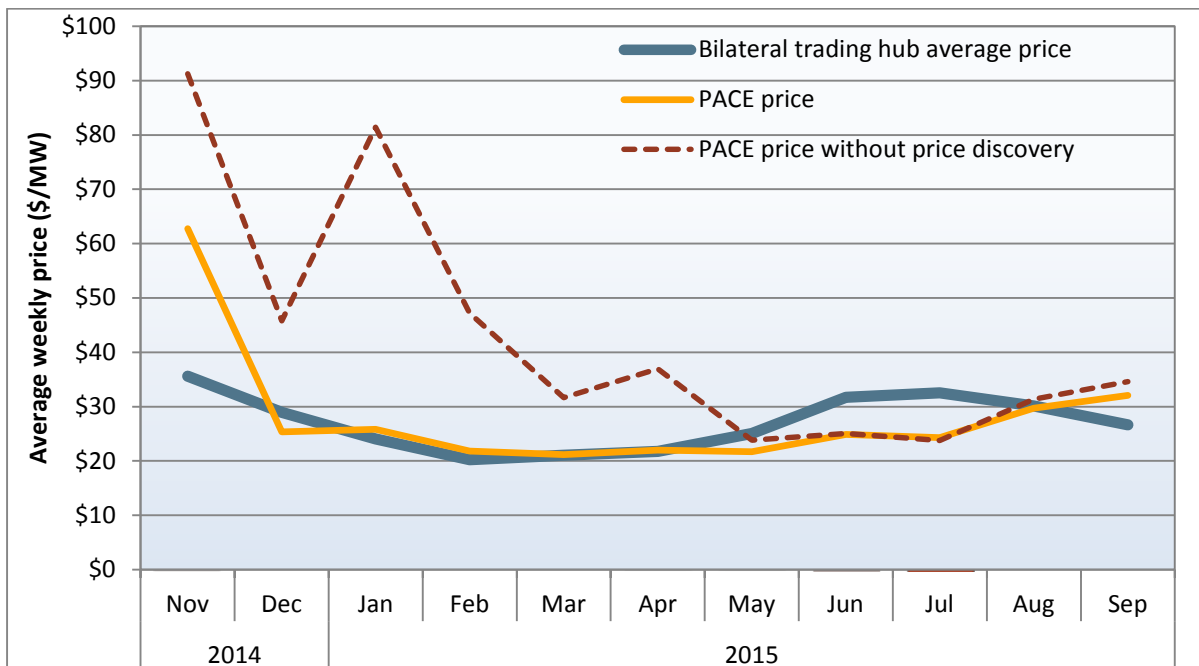
⁷ As in the ISO report, data on the frequency of constraint relaxation exclude intervals since March 20 when the power balance constraint was relaxed in the scheduling run, but this software feature would have been triggered if price discovery was not in effect. Also, when estimating prices without price 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.

West, there was an accompanying increase in divergence between the regional price with the price discovery mechanism and without the price discovery mechanism in September in the 5-minute and 15-minute markets. This divergence was not observed to the same degree in either PacifiCorp East market.

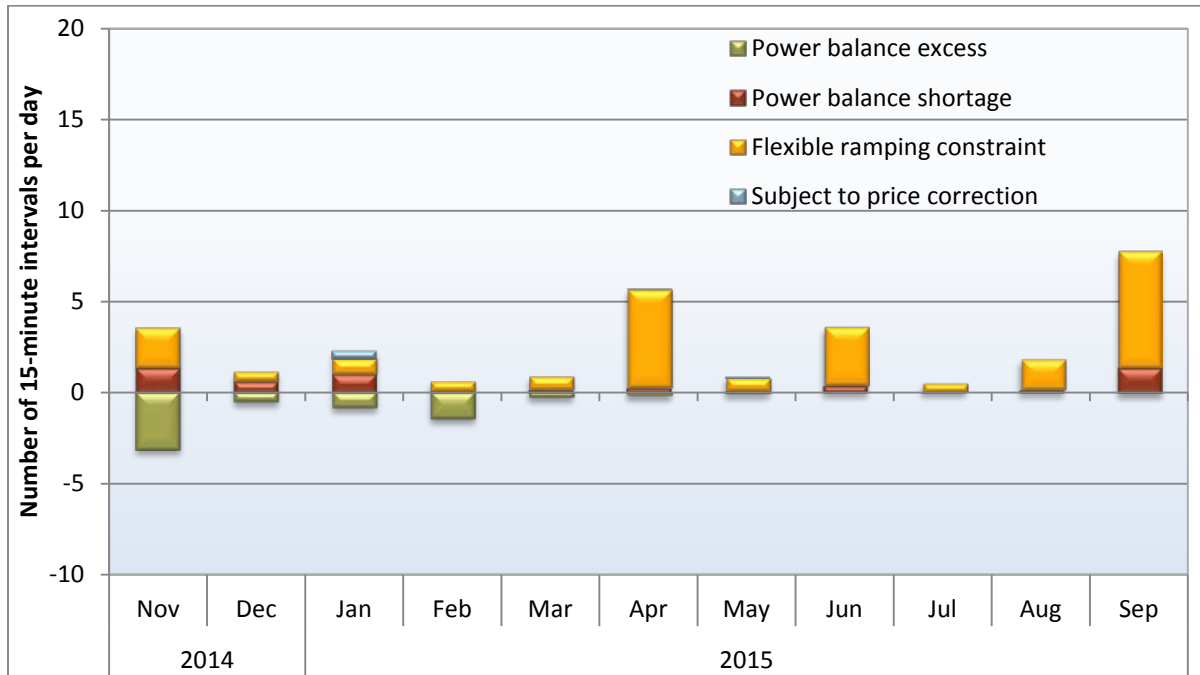
**Figure 1.1 Frequency of constraint relaxation
PacifiCorp East - 15-minute market**



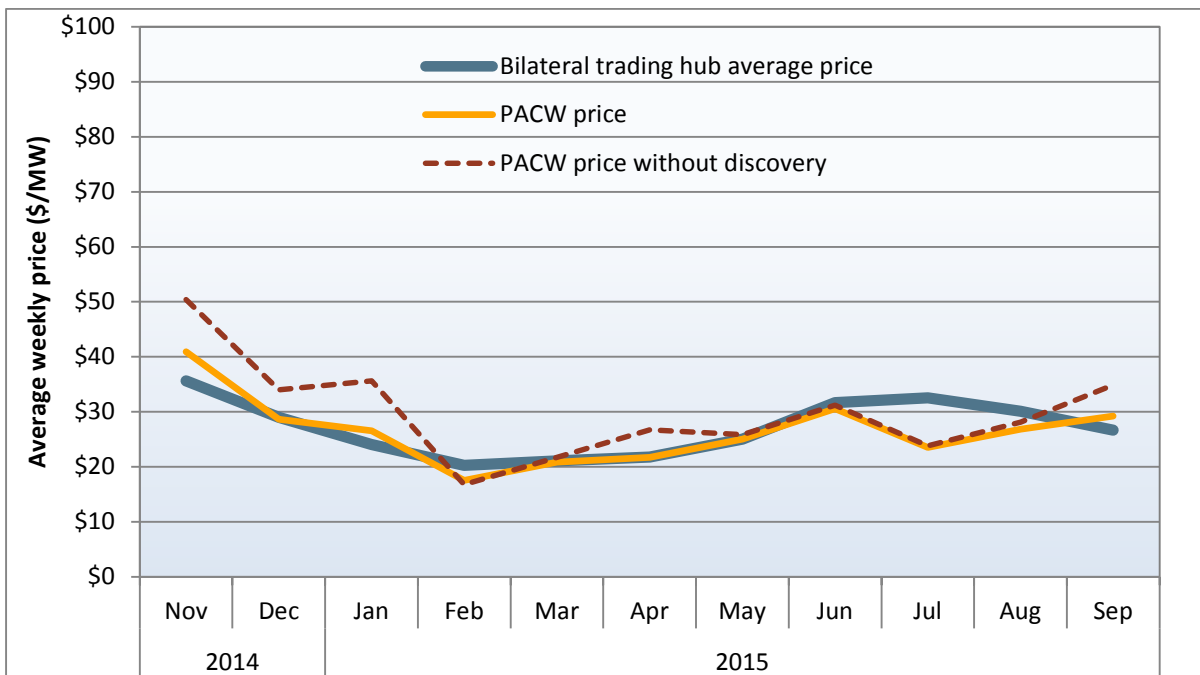
**Figure 1.2 Average daily prices with and without price discovery
PacifiCorp East - 15-minute market**



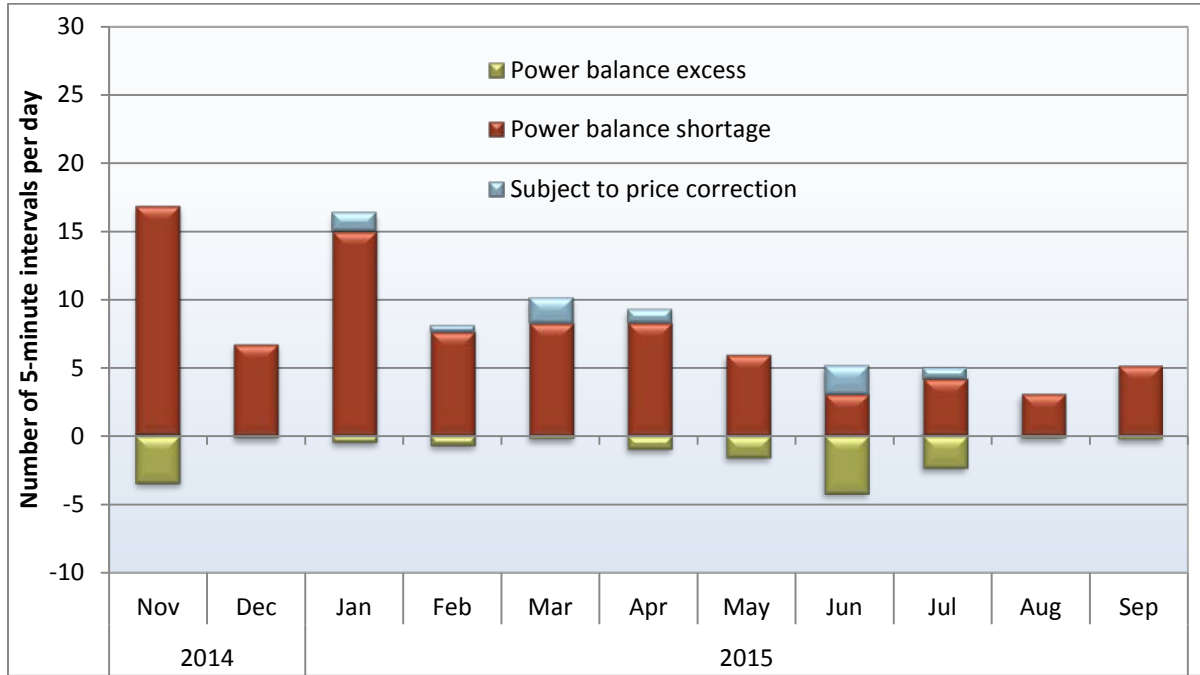
**Figure 1.3 Frequency of constraint relaxation
PacifiCorp West - 15-minute market**



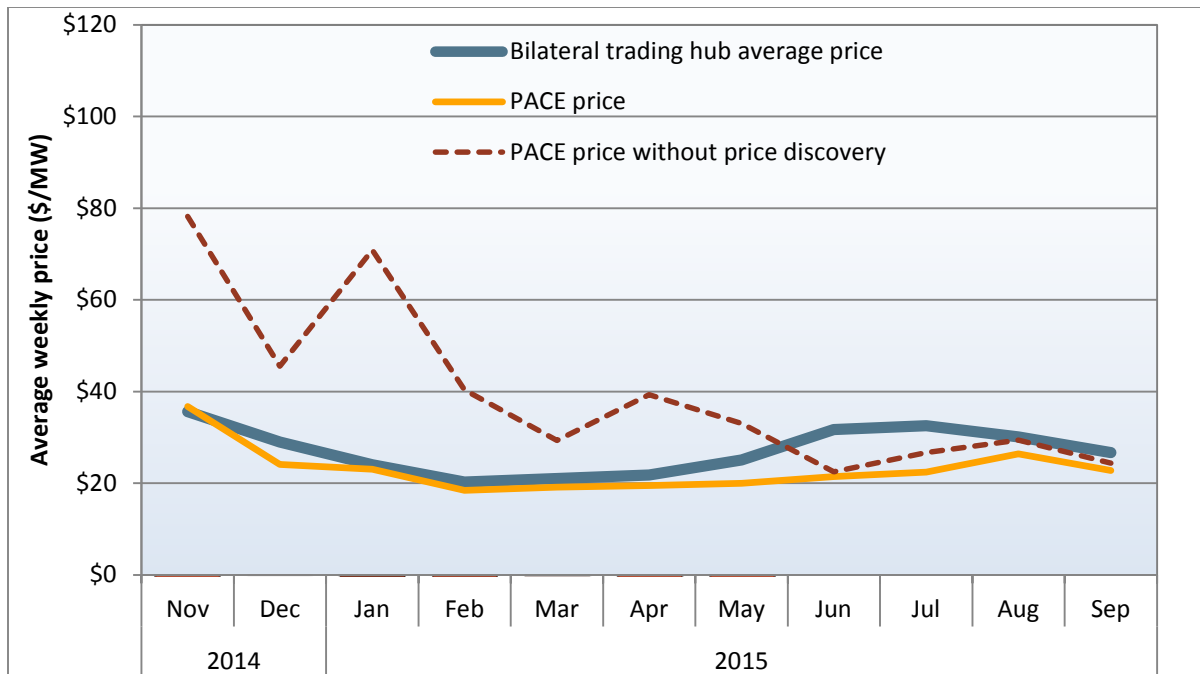
**Figure 1.4 Average daily prices with and without price discovery
PacifiCorp West - 15-minute market**



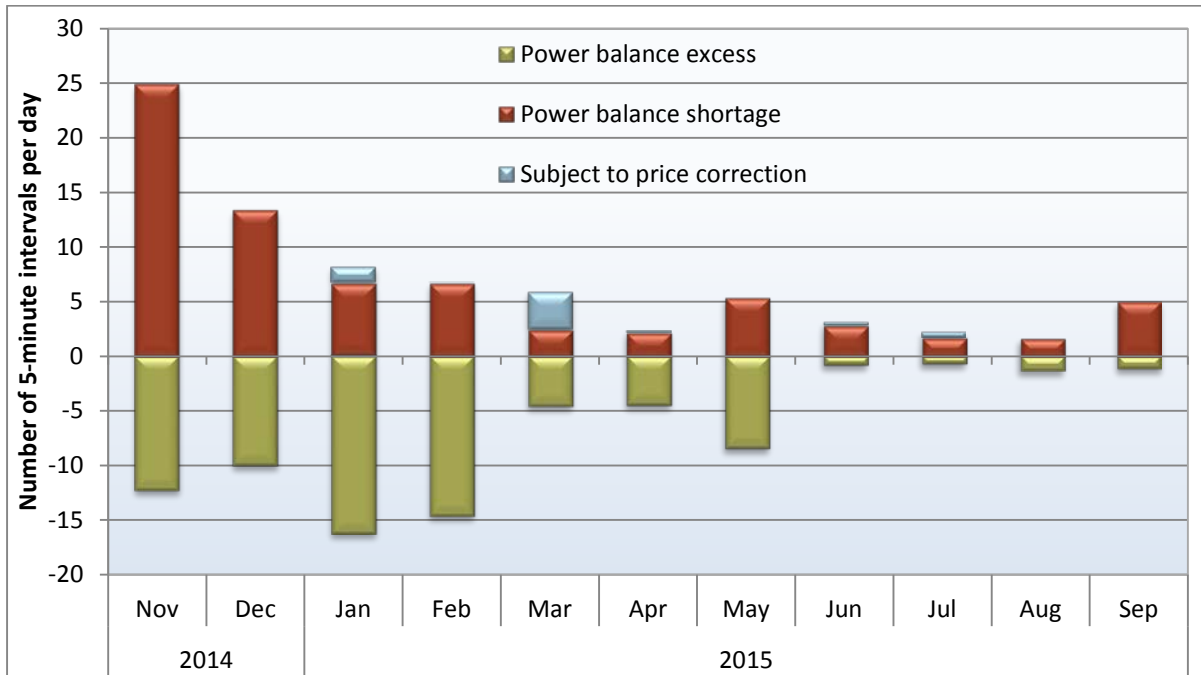
**Figure 1.5 Frequency of constraint relaxation
PacifiCorp East – 5-minute market**



**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**

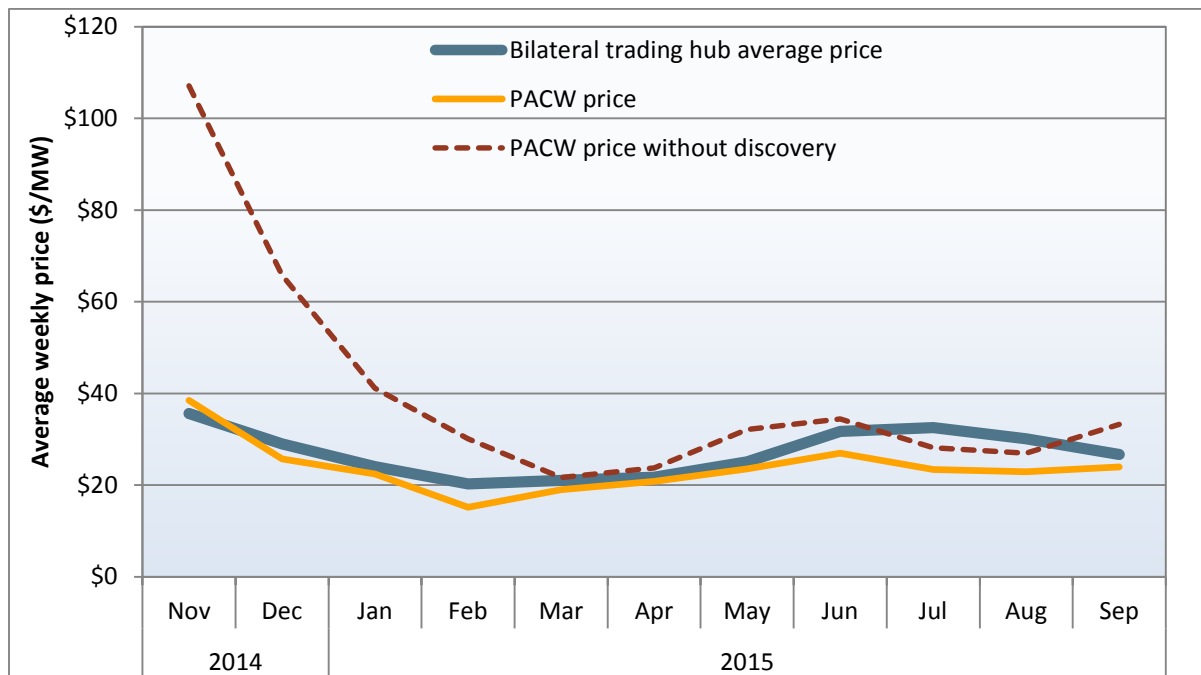


Table 1.1 Average prices in EIM and bilateral markets (August 2015)

	Bilateral trading hub average price	Average EIM price	EIM price without price discovery
<i>PacifiCorp East</i>			
15-minute market (FMM)	\$30.12	\$29.72	\$31.36
5-minute market (RTD)	\$30.12	\$26.43	\$29.40
<i>PacifiCorp West</i>			
15-minute market (FMM)	\$30.12	\$26.83	\$28.09
5-minute market (RTD)	\$30.12	\$22.89	\$26.94

Table 1.2 Average prices in EIM and bilateral markets (September 2015)

	Bilateral trading hub average price	Average EIM price	EIM price without price discovery
<i>PacifiCorp East</i>			
15-minute market (FMM)	\$26.66	\$32.08	\$34.58
5-minute market (RTD)	\$26.66	\$22.78	\$24.40
<i>PacifiCorp West</i>			
15-minute market (FMM)	\$26.66	\$29.23	\$34.84
5-minute market (RTD)	\$26.66	\$23.96	\$33.22

2 Market software constraint relaxation

EIM performance has been 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 and Figure 2.2 show that the frequency of intervals when the power balance constraint was relaxed in the 15-minute market increased in August and September in the 15-minute market in both PacifiCorp East and PacifiCorp West. In PacifiCorp East relaxations increased to 0.3 percent of intervals in August, then increased again in September to 0.7 percent. Similarly, relaxation rates increased in PacifiCorp West to 0.1 percent in August, then to 1.4 percent in September.

The frequency of power balance constraint relaxation in both markets for August were low compared to previous periods. In PacifiCorp East, the frequency of power balance constraint relaxations during September were significantly lower than rates observed close to the beginning of the energy imbalance market. Relaxation rates increased in PacifiCorp West during September and caused a divergence between the PacifiCorp West price with price discovery and the price without price discovery, as discussed above. Although this divergence was notable, it was relatively small compared to the beginning of the energy imbalance market. These elevated power balance relaxations in September were driven by an outage that prevented flows from PacifiCorp East to PacifiCorp West. This outage continued through October.

Figure 2.1 and Figure 2.2 also show a substantial increase in flexible ramping constraint relaxations in the 15-minute market from July to August and again from August to September in both PacifiCorp East and PacifiCorp West markets. Rates of relaxation for the flexible ramping constraint in September were the highest since the inception of both markets. 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 impacting the flexible ramp constraint.

Figure 2.3 and Figure 2.4 show increases from low levels of power balance constraint relaxation in August to moderate levels in the 5-minute markets in September for both PacifiCorp East and PacifiCorp West. The percentage of intervals when the power balance constraint was relaxed in September in PacifiCorp East and PacifiCorp West was 1.8 percent. This level of constraint relaxation in September is significantly less than levels observed closer to the beginning of the market. These increases in constraint relaxation were also related to the outages that removed transfer capacity between PacifiCorp East and West.

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

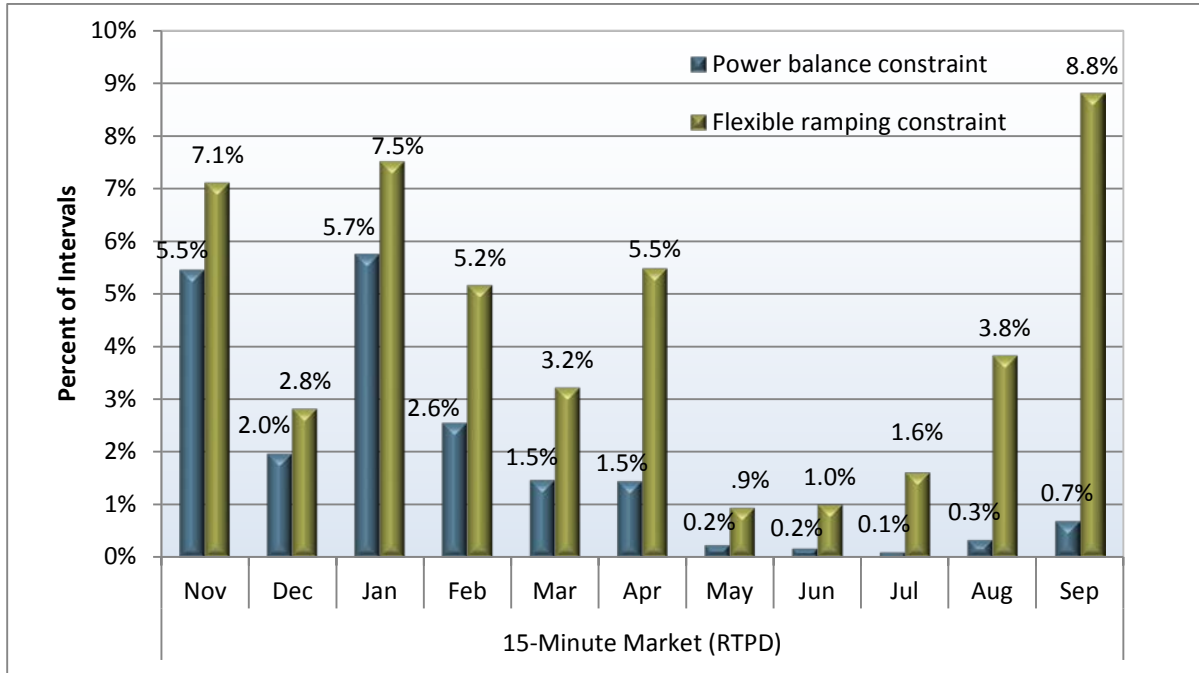


Figure 2.2 Frequency of constraint relaxation by month – PacifiCorp West (PACW)

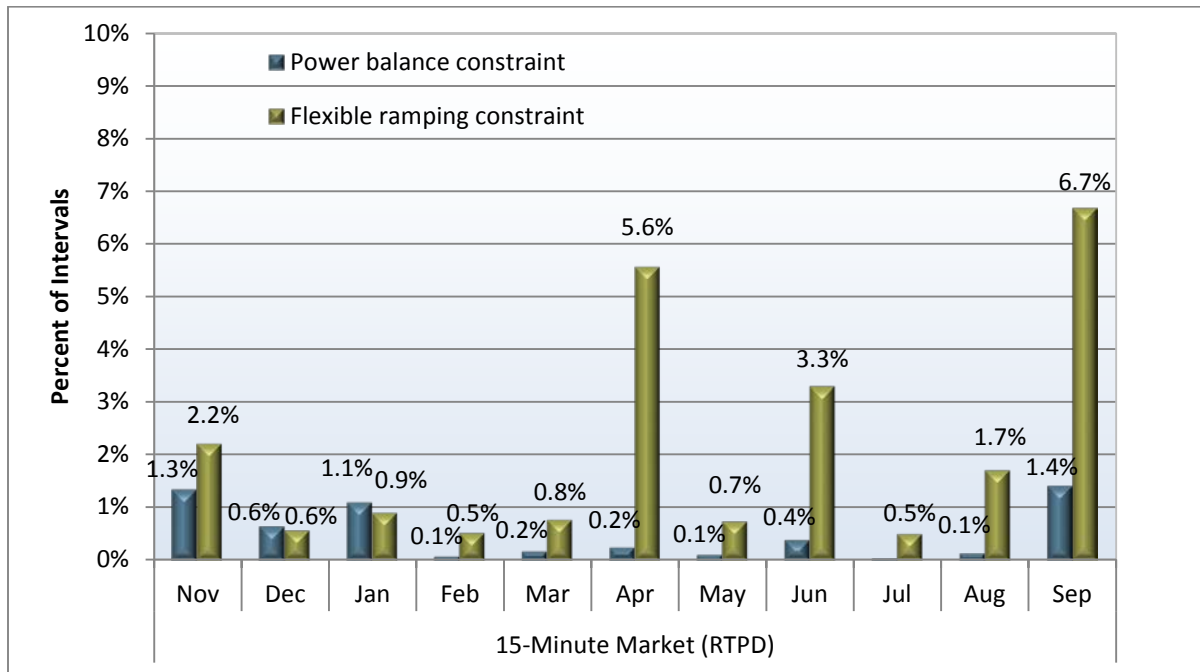


Figure 2.3 Frequency of 5-minute market constraint relaxation by month PacifiCorp East (PACE)

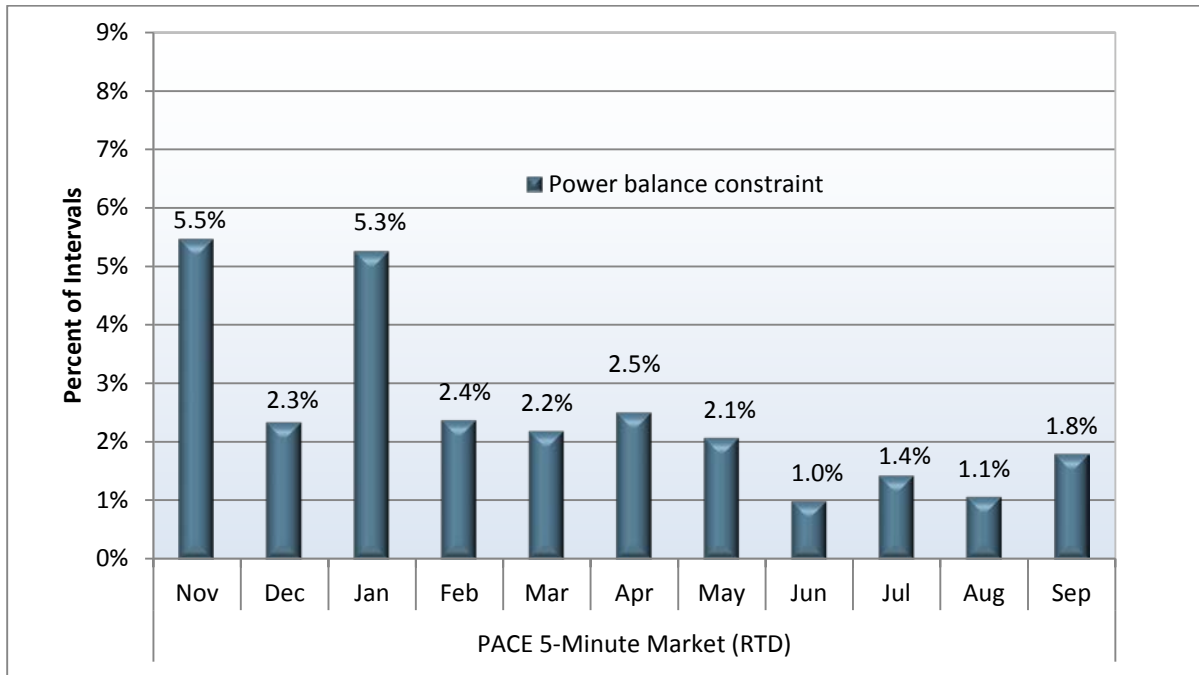
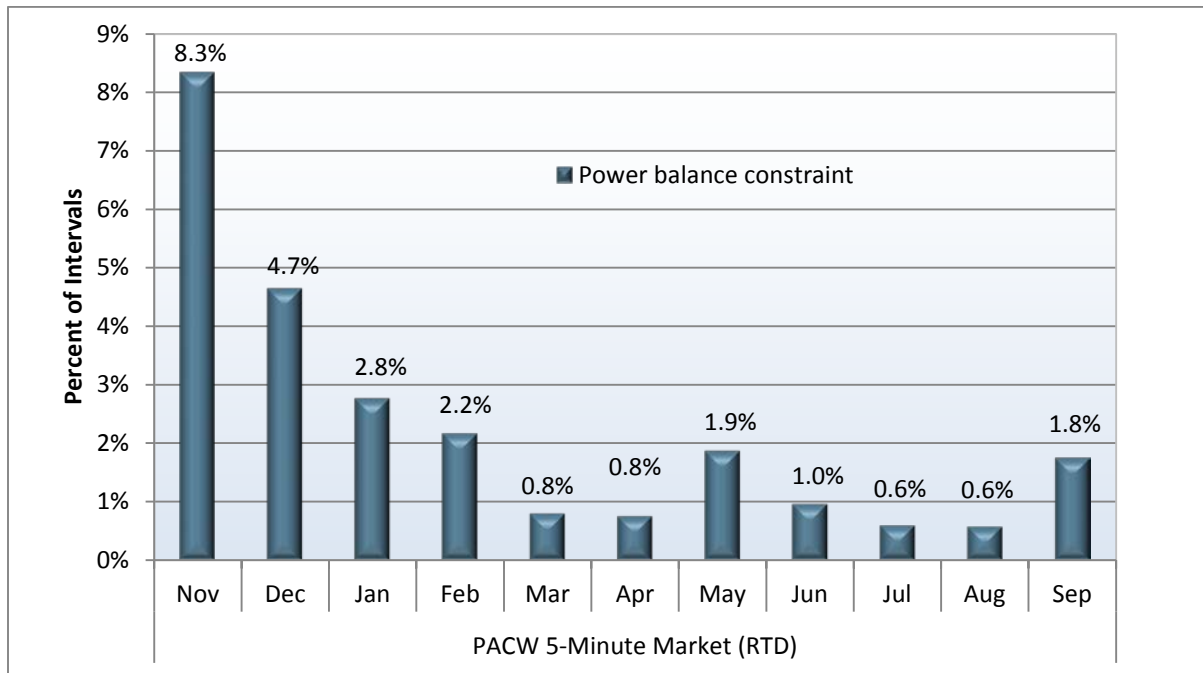


Figure 2.4 Frequency of 5-minute market constraint relaxation by month PacifiCorp West (PACW)



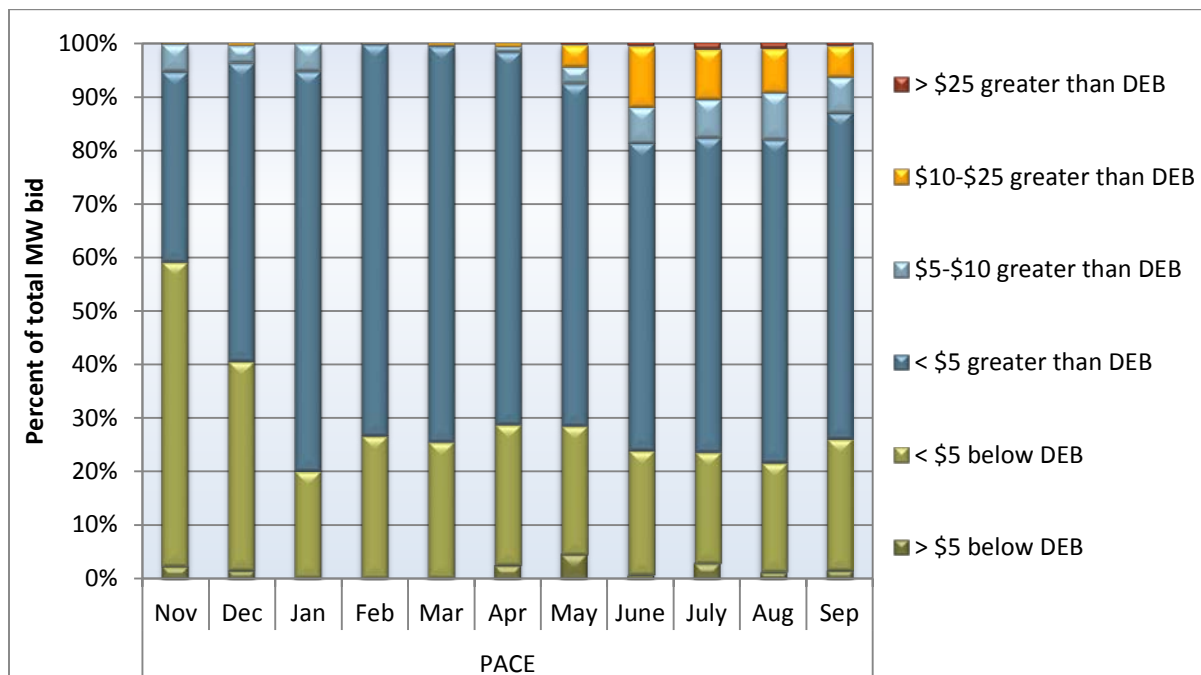
3 Market bidding and mitigation

Most of the bids for capacity are below or slightly above default energy bids (DEBs) used for market power mitigation. In addition, when bids are mitigated due to market power mitigation provisions, these procedures generally result in modest reductions in bid prices.

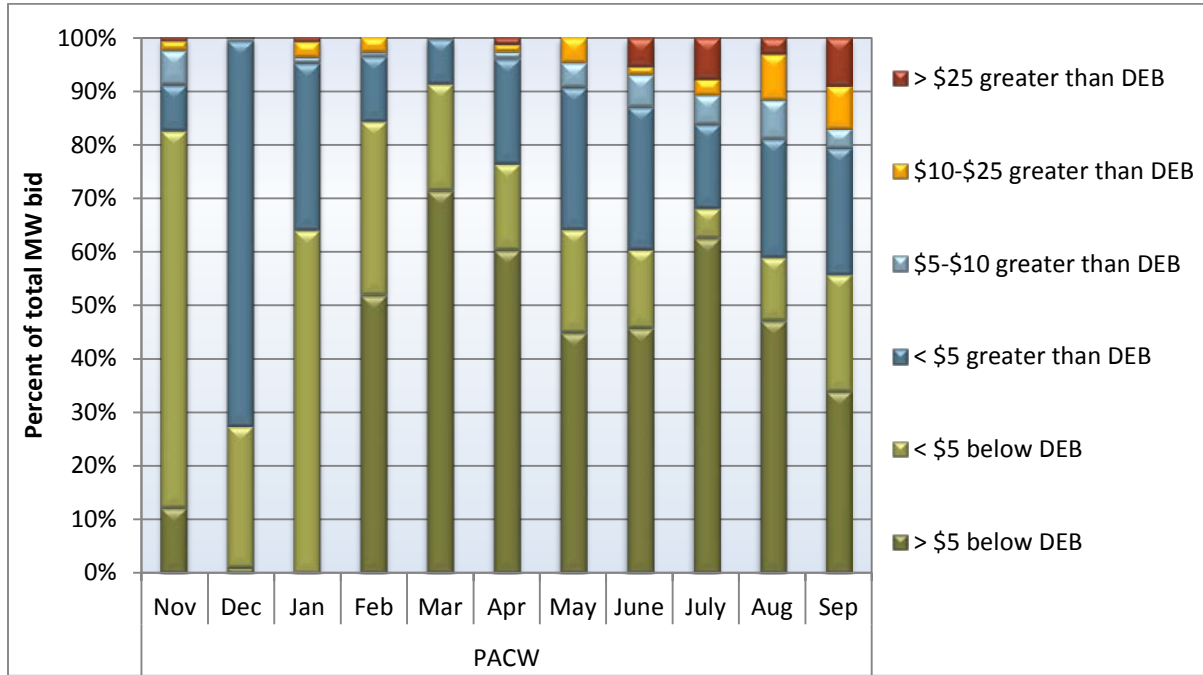
Figure 3.1 summarizes a comparison of bid prices in PacifiCorp East for thermal and hydro units compared to DEBs used in market power mitigation. Figure 3.2 shows the same information for PacifiCorp West. These DEBs are based on the marginal operating costs of thermal resources or opportunity cost for hydro resources with limited energy and energy storage capabilities.

Figure 3.1 shows that the bidding pattern in PacifiCorp East in September and August was similar to prior months. In PacifiCorp East, there was a continued small volume of bids more than \$5/MWh above the default energy bid and a continued volume of bids below the default energy bid. Figure 3.2 shows that in PacifiCorp West there was an increase in the volume of bids more than \$25/MWh above the default energy bid from August to September and a continued reduction, during both months, of offers greater than \$5/MWh below the default energy bid. Most of the bids more than \$5/MWh below the default energy bid in PacifiCorp West were between \$5 and \$10/MWh below the default energy bid. Bids more than \$25/MWh above the default energy bid during September resembled the pattern observed in July.

**Figure 3.1 Comparison of market bids to default energy bids
PacifiCorp East**



**Figure 3.2 Comparison of market bids to default energy bids
PacifiCorp West**



4 Special issues

This section provides a special update on the impact that the flexible ramping constraint and load bias limiter have had on EIM prices.

Flexible ramping sufficiency test and constraint

The ISO has two processes for ensuring flexible capacity is available to meet dispatch needs. The first process is the flexible ramping sufficiency test that, on an hourly basis before the 15-minute market runs, ensures that each balancing area has enough ramping resources over an hour to meet expected ramping needs. This test keeps balancing areas from leaning on ramp from other balancing areas. The flexible ramping constraint, which is enforced in the 15-minute market, ensures that there is sufficient capacity in the 15-minute market to meet required ramping needs for the interval. This constraint can directly affect 15-minute market prices when binding.

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.⁸ The area will also fail the flexible ramping sufficiency test for any hour when the capacity test fails. The capacity test is a test designed to ensure that there is sufficient resource capacity available to meet forecasts and net exports for any given hour.⁹

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, as described in the EIM Business Practice Manual.¹⁰ 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. DMM will address this change in future reports. DMM has also recommended that the ISO continually update its Business Practice Manual to accurately reflect how the flexible ramping sufficiency test is being performed.

As shown in Table 4.1, following the modification to the flexible ramping sufficiency test in June, the ISO increased the average requirement for flexible ramping capacity significantly through September. In

⁸ 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.

⁹ Details for this test are also outlined in the EIM Business Practice Manual (Ibid p. 34). DMM has not performed any analysis on cases where capacity test failures resulted in flexible ramping sufficiency test failures for specific hours, but may perform such analysis and include results in future reports.

¹⁰ 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.

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 to 97 MW during the same interval.

As shown in Figure 4.1 and Figure 4.2, the percentage of intervals that the flexible ramping sufficiency test failed in both PacifiCorp regions drops dramatically immediately following 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 this cumulative summation and was based directly on the requirement for each 15-minute interval.

However, as shown in Table 4.1, as the requirement for flexible ramping capacity in the 15-minute market increased, the portion of 15-minute intervals when this constraint bound or was relaxed, due to a shortage of 15-minute ramping capacity, has also increased significantly. As shown in Figure 4.1, the frequency of hours when the flexible ramping sufficiency test failed in PacifiCorp East also increased significantly in August and September.

As shown in Figure 4.1 and Figure 4.2, during hours when the flexible ramping sufficiency test failed, the frequency of 15-minute intervals when a shortage of flexible ramping capacity occurs is higher. In PacifiCorp East, during August and September, the flexible ramping constraint was relaxed in 36.8 percent of intervals when the flexible ramping test failed, while this constraint was relaxed 6.7 percent during all intervals over this time period. In PacifiCorp West, the flexible ramping constraint was relaxed in 31.2 percent of intervals when the flexible ramping test failed, compared to 4.1 percent during all intervals during August and September. As shown in Figure 4.1 and Figure 4.2, during hours when the flexible ramping sufficiency test failed, the frequency of 15-minute intervals when a shortage of flexible ramping capacity occurs is higher. In PacifiCorp East, during August and September, the flexible ramping constraint was relaxed in 36.8 percent of intervals when the flexible ramping test failed, while this constraint was relaxed 6.7 percent during all intervals over this time period. In PacifiCorp West, the flexible ramping constraint was relaxed in 31.2 percent of intervals when the flexible ramping test failed, compared to 4.1 percent during all intervals during August and September.

However, as shown in Figure 4.3 and Figure 4.4, most 15-minute intervals in which the flexible ramping constraint is relaxed occur during hours when the flexible ramping sufficiency test was passed. During August and September, only about 22 percent of 15-minute intervals in which the flexible ramping constraint was relaxed occurred during hours when the PacifiCorp areas failed the flexible ramping sufficiency test. Thus, the increase in flexible ramping capacity shortages in both PacifiCorp areas during August and September was driven by other factors.

Analysis by DMM indicates that two major factors contributing to the increase in flexible ramping constraint relaxations include an increase in the level of flexible ramping requirements and 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 in recent weeks. 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 ISO has indicated it will provide a more detailed explanation of these issues in its next report covering the month of October.

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 4.5 and Figure 4.6 show the incremental impact from shortages of flexible ramping capacity on average prices in the 15-minute market.

During September, flexible ramping constraint shortages had a greater impact on prices and drove 15-minute prices higher by \$4.97/MWh in PacifiCorp East and \$3.16/MWh in PacifiCorp West. This resulted in prices being higher than bilateral prices by about 20 percent and 10 percent in each of these markets respectively. DMM is working with the ISO and PacifiCorp to further assess and mitigate these flexible ramping constraint issues.

This trend continues in October and November with prices in the 15-minute market continuing to exceed bilateral prices due to the impact of the flexible ramping constraint. This trend may be mitigated with the addition of NV Energy to the EIM, since this may significantly increase the amount of additional energy that can be 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.

Figure 4.1 Flexible ramping sufficiency test results (PacifiCorp East)

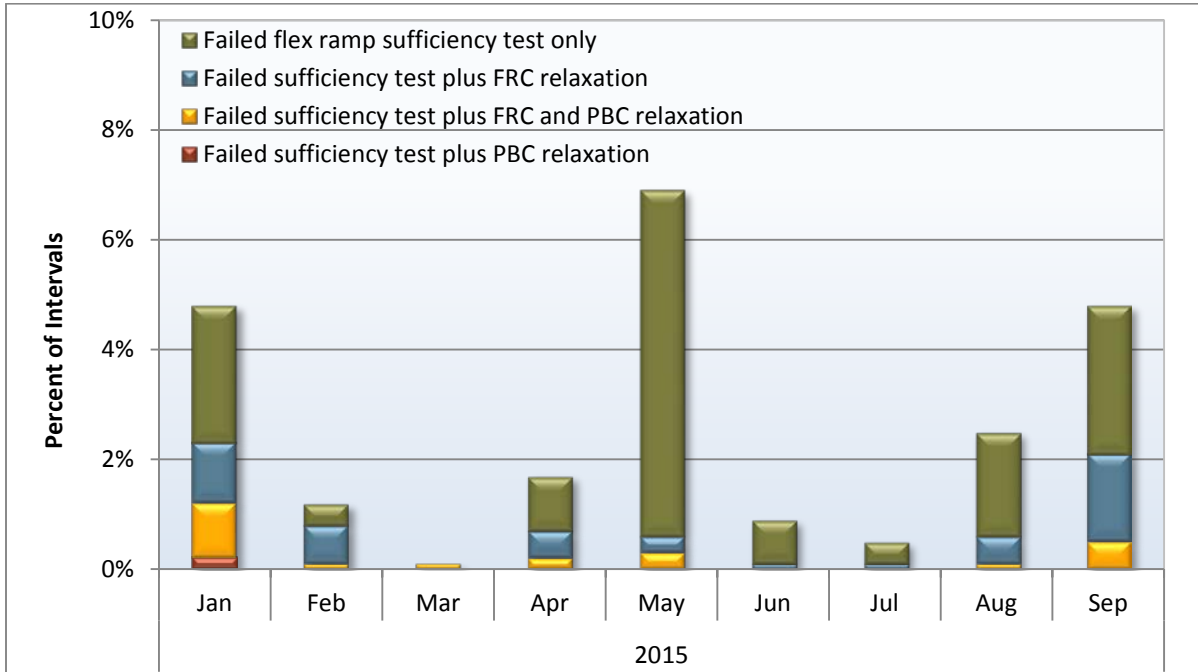


Figure 4.2 Flexible ramping sufficiency test results (PacifiCorp West)

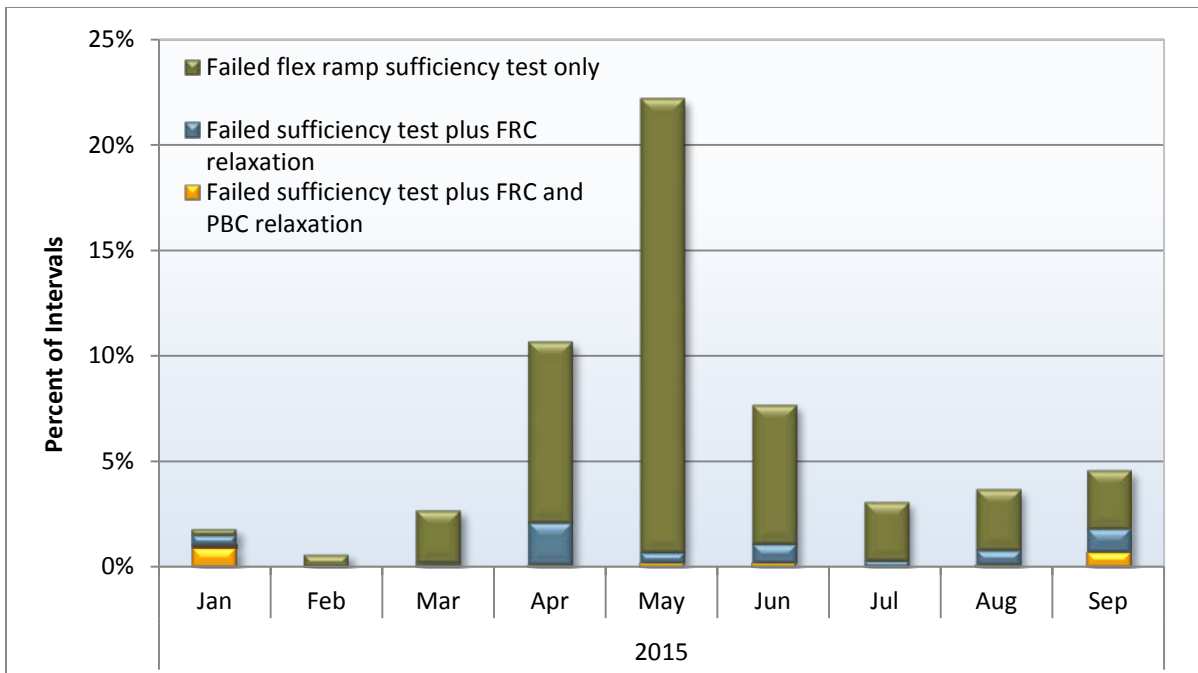


Table 4.1 Flexible ramping constraint requirements and market impacts

	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
<i>PacifiCorp East</i>					
March	33	6%	\$8.92	0.9%	\$21.17
April	44	8%	\$7.57	2.6%	\$27.67
May	39	8%	\$7.68	0.6%	\$47.86
June	63	15%	\$9.28	0.9%	\$60.00
July	87	16%	\$8.91	1.5%	\$60.00
August	112	31%	\$11.75	3.5%	\$60.81
September	139	30%	\$16.20	8.2%	\$60.31
<i>PacifiCorp West</i>					
March	27	13%	\$6.09	0.2%	\$9.54
April	47	17%	\$8.00	2.0%	\$9.75
May	32	15%	\$6.95	0.5%	\$41.02
June	54	26%	\$10.65	2.9%	\$60.85
July	69	20%	\$8.78	0.5%	\$60.00
August	86	38%	\$9.19	1.6%	\$60.14
September	97	36%	\$8.22	5.3%	\$60.00

Figure 4.3 Flexible ramping constraint relaxation and sufficiency test results (PacifiCorp East)

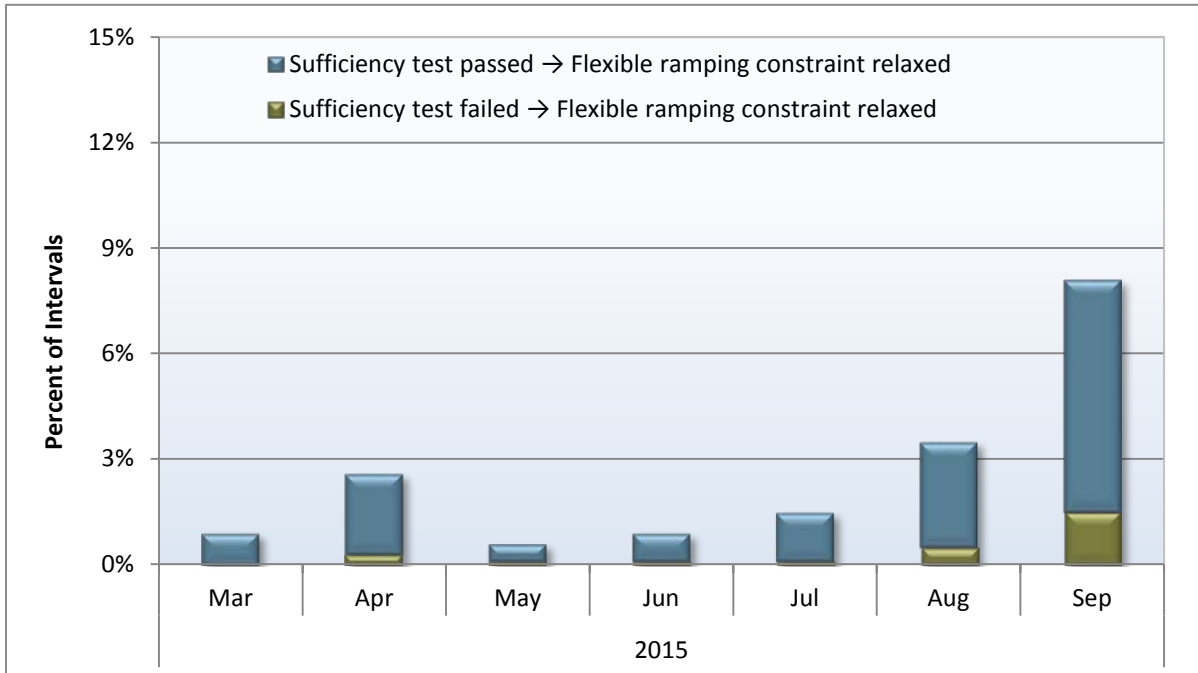


Figure 4.4 Flexible ramping constraint relaxation and sufficiency test results (PacifiCorp West)

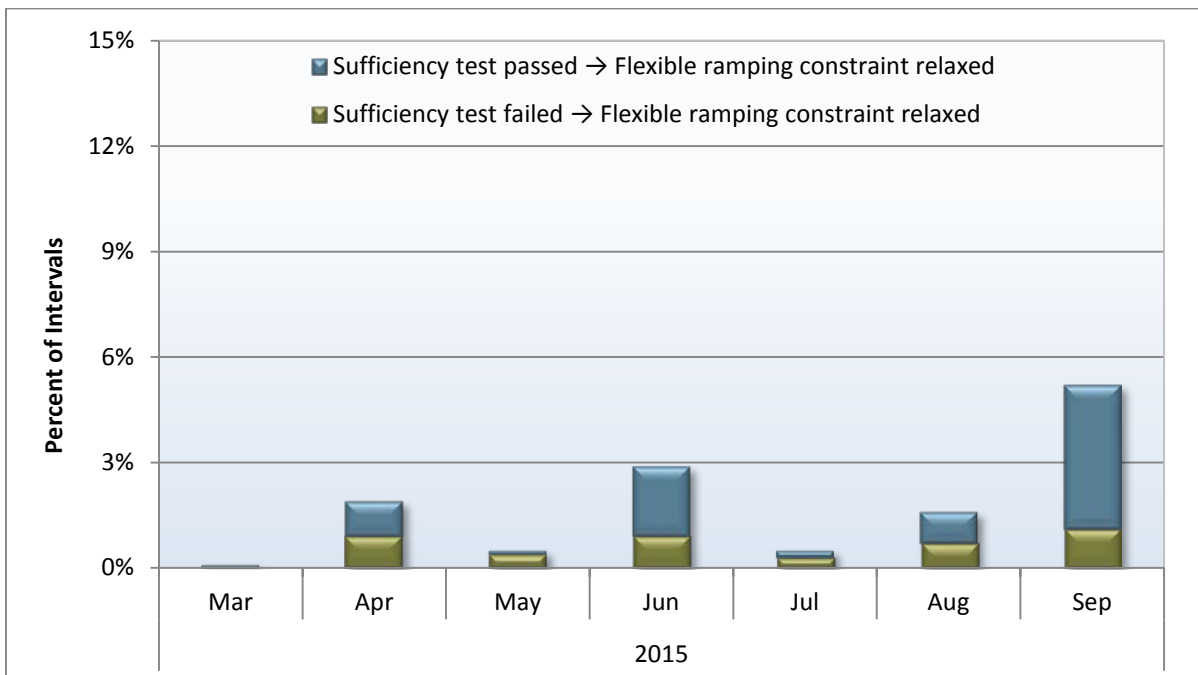


Figure 4.5 Impact of flexible ramping constraint relaxation on 15-minute market price (PacifiCorp East)

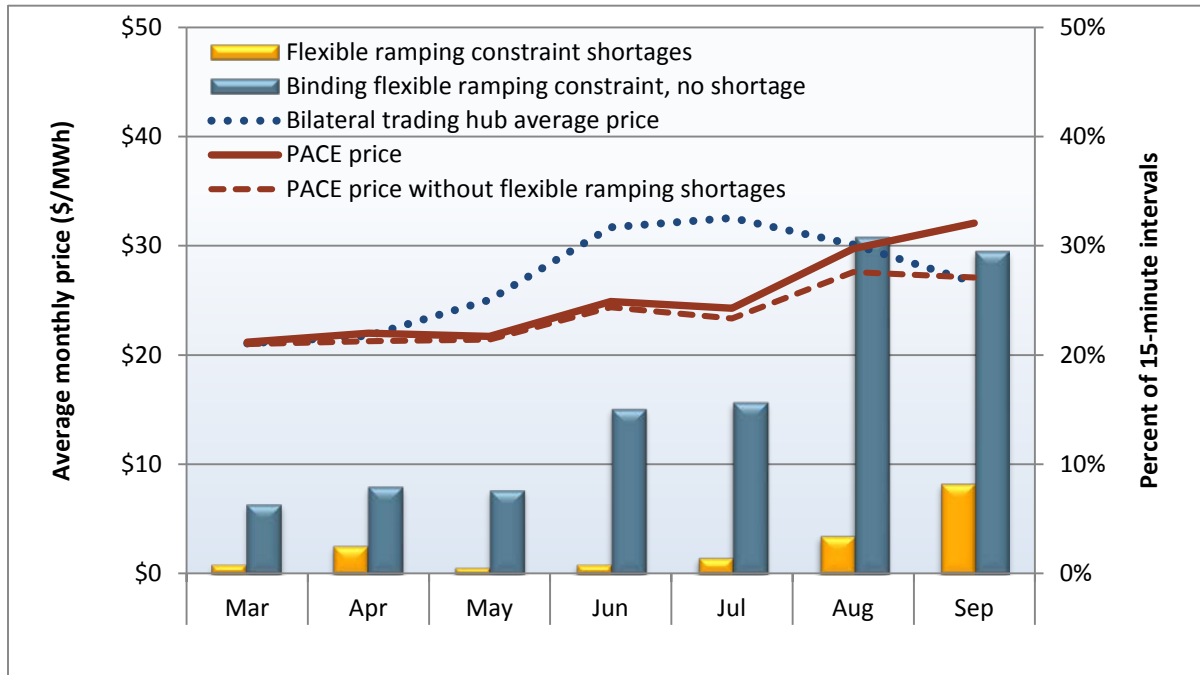
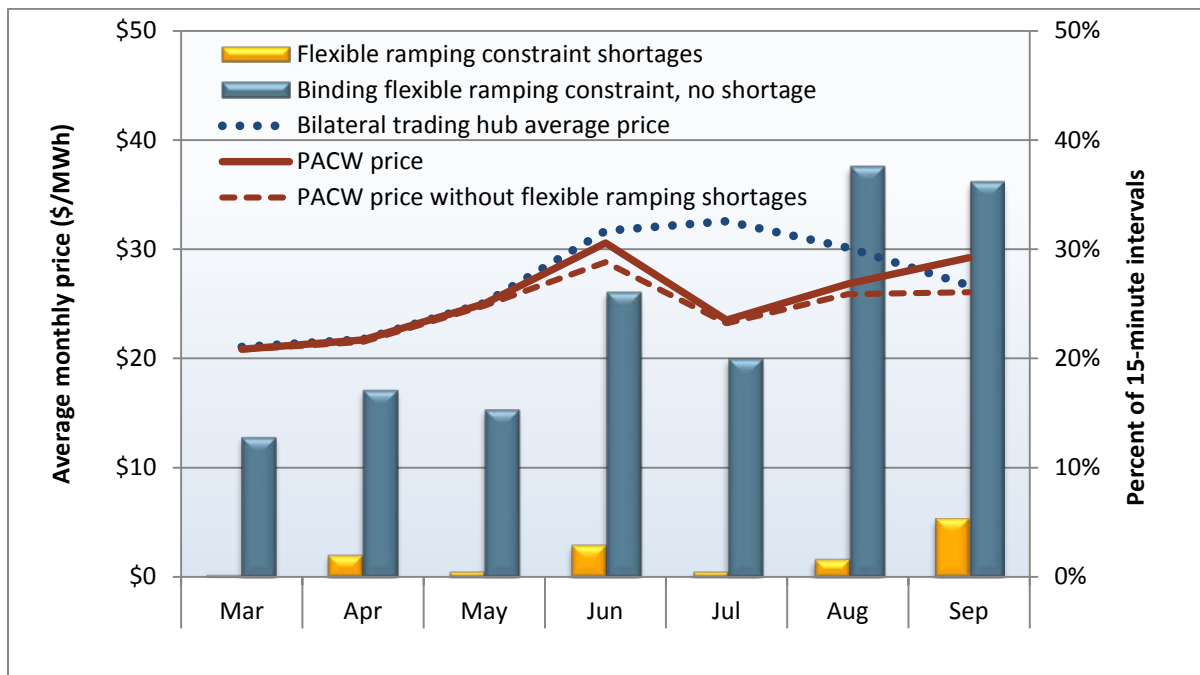


Figure 4.6 Impact of flexible ramping constraint relaxation on 15-minute market price (PacifiCorp West)



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.¹¹ 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 when resources permit.

Load bias limiter

The percentage of intervals when the energy power balance constraint was relaxed to allow the market software to balance modeled supply and demand increased notably during August and September. However, without special price discovery provisions in effect, the load bias limiter feature would have been triggered during a high portion of these intervals. 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.¹²

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.¹³ As noted in that filing, the ISO has explained in its monthly reports to the Commission that the ISO is currently exploring enhancements to the load bias limiter to address the potential for the limiter, as currently configured, to be under-applied, in cases of sudden changes in load bias, or triggered

¹¹ *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.

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>.

¹² *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.

¹³ 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.

unnecessarily, in intervals where a persistent bias is unintentionally applied. The ISOs' filing also indicates that it will soon commence a stakeholder effort to consider these enhancements, and will determine, as part of that effort, the appropriate means of documenting the application of the load-bias limiter, such as through business practice manual and/or tariff revisions.

As shown in Figure 4.7 and Figure 4.8, the load bias limiter would have been triggered during about half of the 15-minute intervals in both PacifiCorp areas when the power balance constraint was relaxed during August and September. During this two month period, the load bias limiter would have been triggered during over 80 percent of 5-minute intervals with power balance constraint shortages in PacifiCorp East (see Figure 4.9) and about one-third of 5-minute intervals with power balance shortages in PacifiCorp West (see Figure 4.10). This represents a significant increase from prior months for both the 15-minute and 5-minute markets.

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.¹⁴ 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 4.2 and Table 4.3 show 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 these other price discovery provisions, the load bias limiter would have reduced average 15-minute prices in PacifiCorp East by about 4 percent in August and about 10 percent in September. Most notably, it would have lowered 5-minute prices in PacifiCorp East by about 18 percent in August and 37 percent in September. In PacifiCorp West, it would have lowered 15-minute and 5-minute prices by about 17 percent in September.

¹⁴ See discussion on in Section 1, page 5.

Figure 4.7 Mitigation of power balance relaxation by load bias limiter (PacifiCorp East, 15-minute market)

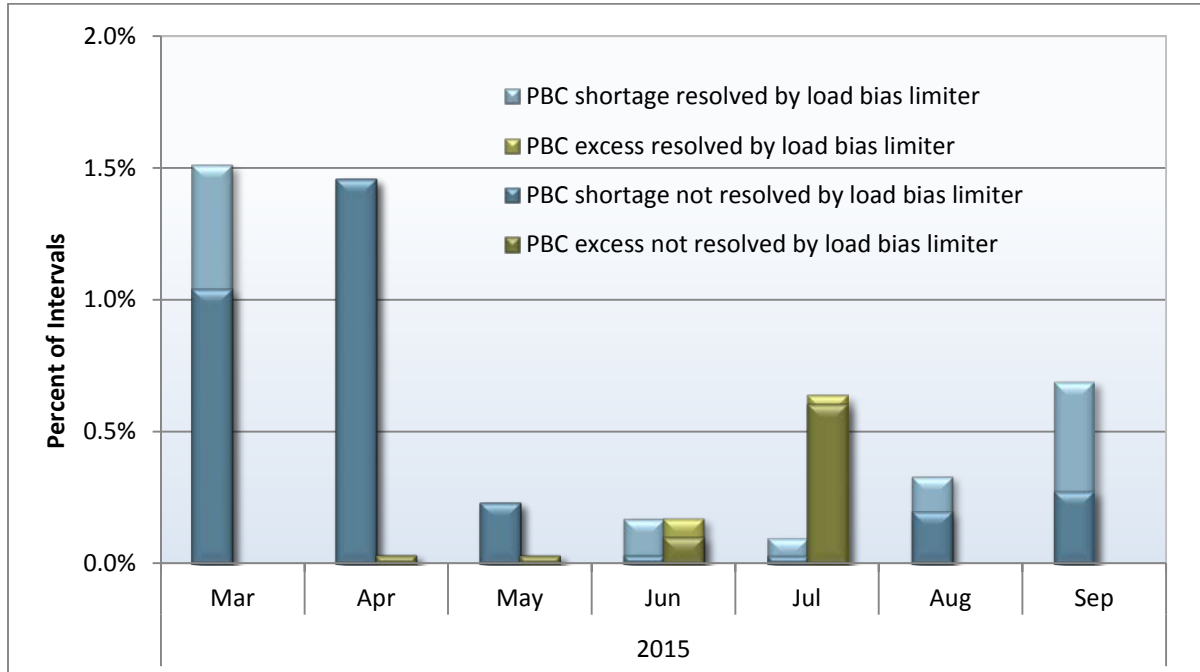


Figure 4.8 Mitigation of power balance relaxation by load bias limiter (PacifiCorp West, 15-minute market)

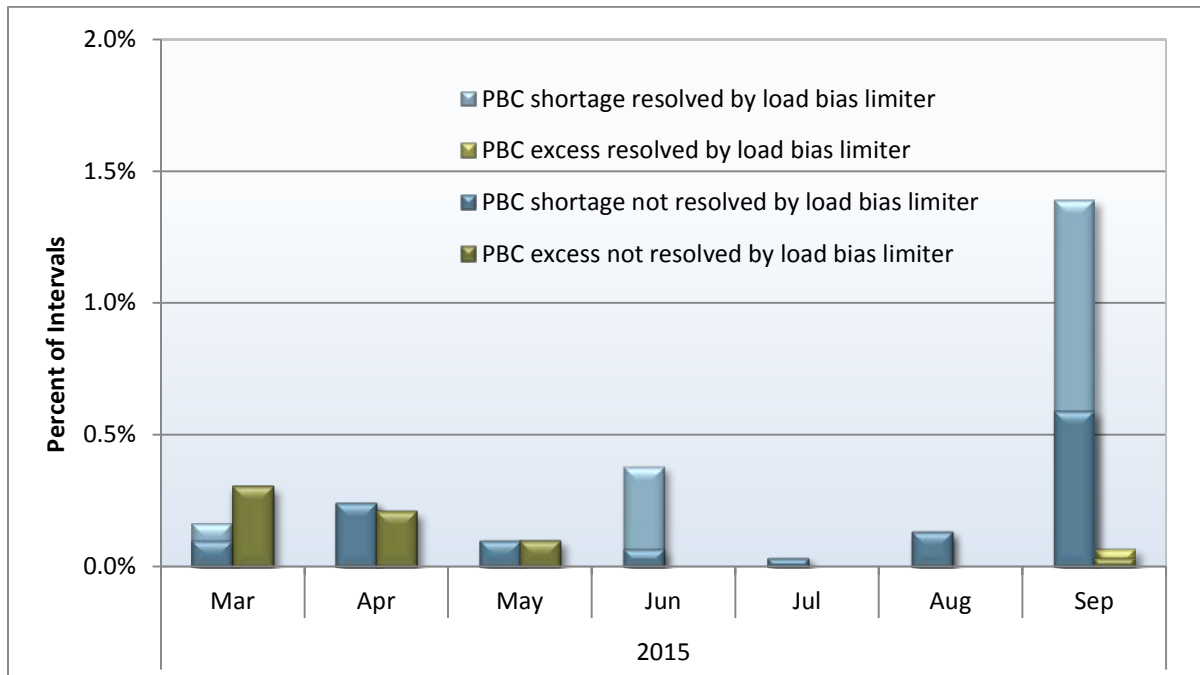


Figure 4.9 Mitigation of power balance relaxation by load bias limiter (PacifiCorp East, 5-minute market)

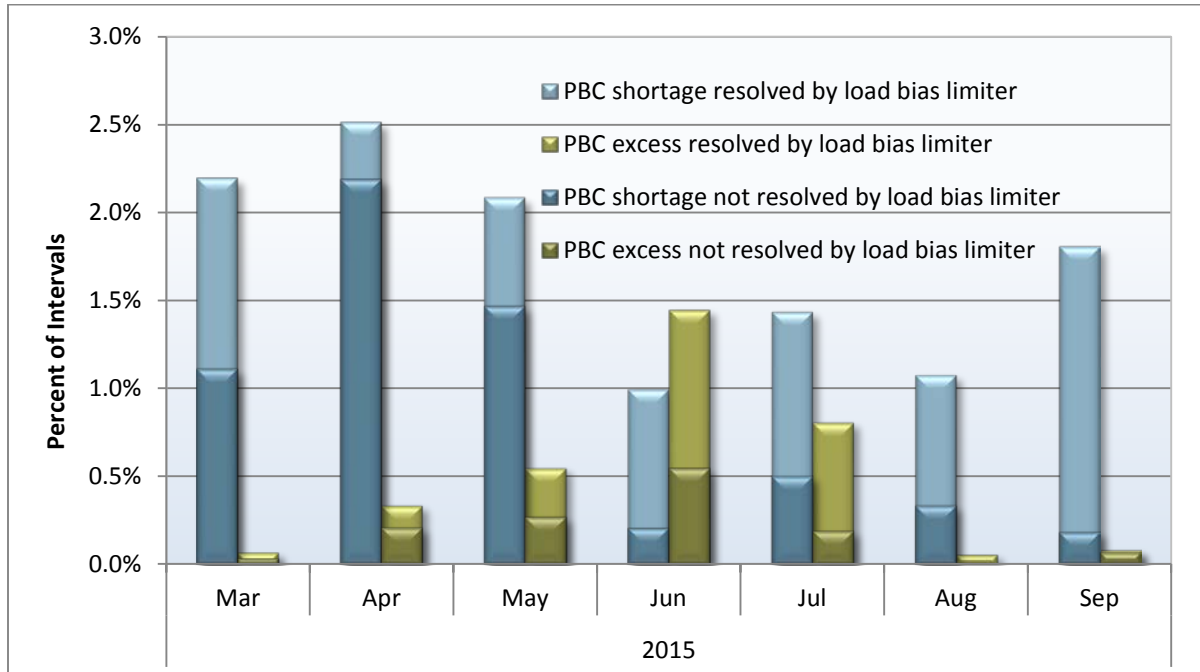


Figure 4.10 Mitigation of power balance relaxation by load bias limiter (PacifiCorp West, 5-minute market)

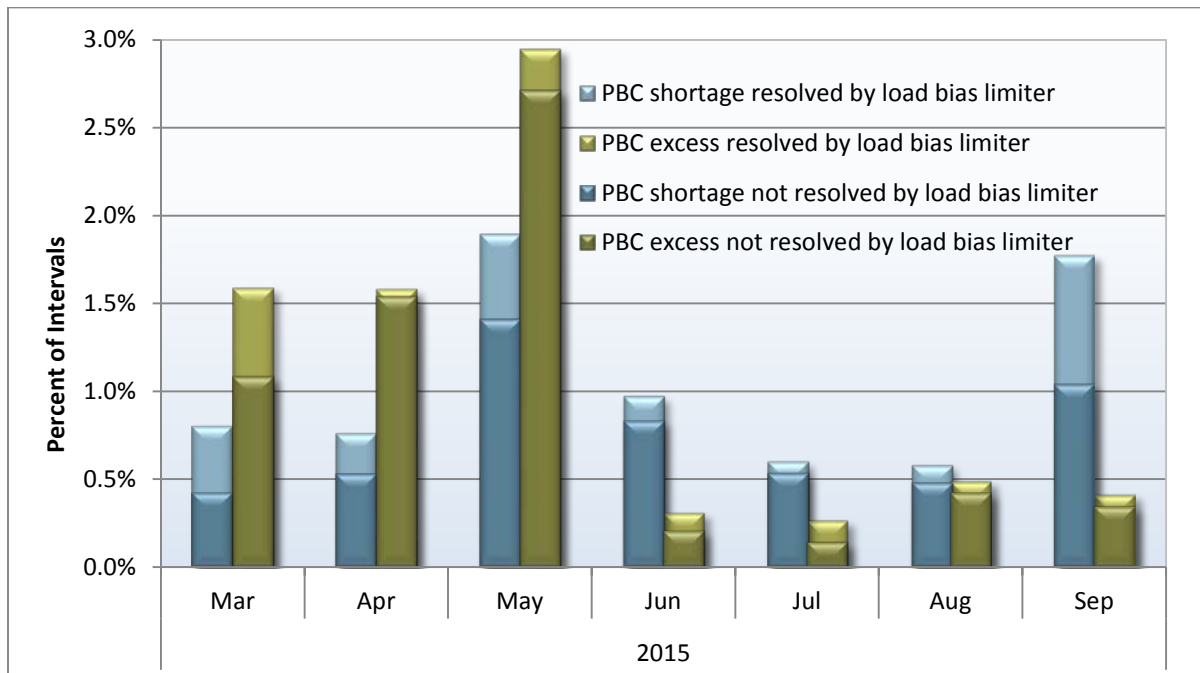


Table 4.2 Impact of load bias limiter on EIM prices (August 2015)

	Western trading hub average price	Average EIM price	EIM price without price discovery	EIM price without price discovery or load bias limiter	Impact of load bias limiter	
					Dollars	Percent
<i>PacifiCorp East</i>						
15-minute market (FMM)	\$30.12	\$29.72	\$31.36	\$32.56	-\$1.20	-3.7%
5-minute market (RTD)	\$30.12	\$26.43	\$29.40	\$35.86	-\$6.46	-18.0%
<i>PacifiCorp West</i>						
15-minute market (FMM)	\$30.12	\$26.83	\$28.09	\$28.09	\$0.00	0.0%
5-minute market (RTD)	\$30.12	\$22.89	\$26.94	\$27.80	-\$0.86	-3.1%

Table 4.3 Impact of load bias limiter on EIM prices (September 2015)

	Western trading hub average price	Average EIM price	EIM price without price discovery	EIM price without price discovery or load bias limiter	Impact of load bias limiter	
					Dollars	Percent
<i>PacifiCorp East</i>						
15-minute market (FMM)	\$26.66	\$32.08	\$34.58	\$38.29	-\$3.71	-9.7%
5-minute market (RTD)	\$26.66	\$22.78	\$24.40	\$38.86	-\$14.46	-37.2%
<i>PacifiCorp West</i>						
15-minute market (FMM)	\$26.66	\$29.23	\$34.84	\$42.34	-\$7.50	-17.7%
5-minute market (RTD)	\$26.66	\$23.96	\$33.22	\$39.97	-\$6.75	-16.9%

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 1st day of December, 2015.

1st Anna Pascuzzo
Anna Pascuzzo