

March 4, 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 Performance of Energy Imbalance Market**

Dear Secretary Bose:

The Department of Market Monitoring hereby submits its third 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.<sup>1</sup>

On March 3, 2015 the CAISO erroneously submitted last month's informational report. Consequently, the CAISO is submitting the current DMM report dated March 3, 2015 for the period of January 1 – February 12, 2015. We apologize for any inconvenience this may have caused.

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 Independent  
System Operator Corporation

California ISO

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# Report on Energy Imbalance Market Issues and Performance

March 3, 2015

Prepared by: Department of Market Monitoring



## Executive Summary

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This report represents the third report by the Department of Market Monitoring (DMM) pursuant to the Commission's December 1, 2014, Order on the ISO's Energy Imbalance Market (EIM). The report covers the same period as the ISO's third report issued pursuant to the Commission's December 1 Order (November 2014 through February 12, 2015). Key findings include the following:

- During most intervals, prices in the EIM have been highly competitive and have been set by bids closely reflective of the marginal operating cost of the highest cost resource dispatched to balance loads and generation. However, during a relatively small portion of intervals, energy or flexible ramping constraints have had to be relaxed for the market software to balance modeled supply and demand.
- In PacifiCorp East, the frequency of constraint relaxations in the 15-minute market increased significantly in mid-January, and then declined in mid-February.
- In PacifiCorp West, the frequency of upward constraint relaxations in the 15-minute market increased in mid-January and remained relatively low through mid-February. The frequency of downward constraint relaxations increased in the second half of January and remained into February.
- In the 5-minute market, the need to relax the power balance constraint has also remained relatively high in PacifiCorp East, peaking in mid-January and then declining afterwards. In PacifiCorp West, constraint relaxations in the 5-minute market have generally declined since November.
- The impact of constraint relaxation on market prices has been effectively mitigated by the price discovery mechanism approved under the Commission's December 1 Order. Average EIM prices in January and into February were similar to bilateral market price indices that were used to set prices in the PacifiCorp areas prior to EIM implementation. Without these provisions, EIM prices would have been significantly higher than these bilateral market price indices.
- The amount of capacity participating in the EIM remained consistent with no significant changes, with most of the available capacity from EIM participating resources offered into the market. On average, about 75 percent of the nameplate gas and coal capacity registered to participate in EIM has been bid into the market during peak hours. The majority of the capacity that is not bid into the market appears to be unavailable due to outages and other unit limitations.
- The total capacity offered into the EIM appears to be more than sufficient to meet demand during most hours. However, the portion of this supply available for dispatch on a 15-minute and 5-minute basis is still sometimes insufficient to meet the demand for imbalance energy as projected by the market software. In many cases, these insufficiencies appear to be largely attributable to the various factors cited in the ISO's three reports rather than more fundamental market or system conditions.
- Bidding in the EIM has been highly competitive, with bids for most capacity slightly below or above default energy bids used in market power mitigation. When bids are mitigated due to market power mitigation provisions, these procedures generally result in modest reductions in bid prices.



## 1 Background

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On November 13, 2014, the ISO requested a 90-day waiver of two tariff provisions for establishing the price of energy in the Energy Imbalance Market (EIM) during intervals when, due to a lack of sufficient supply from capacity bid into the market, the ISO's market software must resort to relaxing transmission or system energy balance constraints in order to reach a market solution.<sup>1</sup>

Under these conditions, the waiver would allow prices to be set by a special *price discovery* process designed to let prices reflect the last market bids dispatched, rather than based on penalty pricing parameters such as the \$1,000/MW price otherwise applied to the amount by which the power balance constraint relaxed. The ISO has also applied this price discovery feature when the flexible ramping constraint must be relaxed in the market software. In these cases, this price discovery mechanism allows prices to reflect the highest priced market bid dispatched rather than the \$247/MW penalty price otherwise assigned to flexible ramping constraint relaxation.<sup>2</sup>

The ISO's November 13 waiver request was submitted as a means of mitigating high prices that the ISO believes resulted from a variety of factors which prevented the market software from producing prices reflective of actual supply and demand conditions. The ISO explained that these high prices are not always indicative of actual physical conditions on the system, and instead reflect factors such as (1) challenges in providing timely and complete data to ensure system visibility under the new procedures, (2) limitations on the resources available to PacifiCorp for use in the EIM, and (3) several forced outages of large EIM participating resources.

On December 1, the Federal Energy Regulatory Commission (FERC) issued an order granting the ISO's petition for waiver of these provisions for 90 days, effective November 14, 2014, as requested.<sup>3</sup> The Commission also directed the ISO to file detailed informational reports at 30-day intervals during the 90-day waiver period, providing detailed supporting data demonstrating progress towards identifying and eliminating the problems giving rise to the waiver petition. FERC indicated that these reports should include independent assessments from the Department of Market Monitoring on the causes and the solutions identified by the ISO. The Commission indicated that the first report be filed 30 days from the effective date of the tariff waiver, December 15, 2014.

This represents DMM's third report pursuant to the Commission's December 1 Order. The ISO filed its third report pursuant to the December 1 Order on February 19.<sup>4</sup> The ISO's report covered market performance through February 12, 2015.

The ISO's reports identified a wide range of factors contributing to the need to relax software constraints and trigger the special price discovery features, along with steps to be taken by the ISO and PacifiCorp to address these issues. These steps include a range of software improvements and tools, enhanced processes and procedures, and increased operational training and experience. DMM does not have the resources to monitor or assess the progress or impact of these specific steps. However, DMM

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<sup>1</sup> [http://www.caiso.com/Documents/Nov13\\_2014\\_PetitionWaiver\\_EIM\\_ER15-402.pdf](http://www.caiso.com/Documents/Nov13_2014_PetitionWaiver_EIM_ER15-402.pdf)

<sup>2</sup> As of January 15, 2015, the ISO tariff specifies that the parameter for the flexible ramping constraint will be set to \$60.

<sup>3</sup> [http://www.caiso.com/Documents/Dec1\\_2014\\_OrderGrantingWaiver\\_EIM PricingParameters\\_ER15-402.pdf](http://www.caiso.com/Documents/Dec1_2014_OrderGrantingWaiver_EIM PricingParameters_ER15-402.pdf)

<sup>4</sup> [http://www.caiso.com/Documents/Feb19\\_2015\\_EIM\\_Informational\\_Report\\_ER15-402.pdf](http://www.caiso.com/Documents/Feb19_2015_EIM_Informational_Report_ER15-402.pdf)

has developed a range of metrics and analysis to provide insights into the ultimate effectiveness of these efforts on EIM market performance.

This report provides estimates of average prices in the PacifiCorp West and PacifiCorp East areas after November 14 if the same pricing parameters used in the ISO real-time market were used for all constraints relaxed in the EIM. As noted in our first and second reports, DMM believes this will provide a valuable quantitative measure of EIM market performance and progress made as the result of various steps being taken by the ISO and PacifiCorp to improve market performance.

This report also provides a comparison of EIM prices to bilateral market price indices that were used to set prices in the PacifiCorp areas prior to EIM implementation. Prior to EIM implementation, DMM identified this bilateral price index to stakeholders and regulators as a benchmark DMM would use to assess the competitiveness and overall performance of the EIM.

## 2 Energy imbalance market prices

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During most intervals, prices in the EIM have been highly competitive and have been set by bids closely reflective of the marginal operating cost of the highest cost resource dispatched to balance loads and generation. However, during a relatively small portion of intervals, energy or flexible ramping constraints have had to be relaxed for the market software to balance modeled supply and demand.

Figure 2.1 and Figure 2.3 show the frequency of constraint relaxations in the 15-minute market by day in PacifiCorp East and PacifiCorp West, respectively, from January 1, 2015 through February 12, 2015. As shown in these figures, four different constraints have been relaxed in the 15-minute market:

- The flexible ramping constraint shortages (yellow) occur when there is insufficient ramping capacity in the 15-minute market to meet the capacity requirement. During this period, this requirement has been set at about 25 to 40 MW. The penalty price for shortages of the flexible ramping constraint was set at \$500/MW in the scheduling run and was normally set at \$247/MW in the pricing run prior to January 15. Beginning on January 15, the penalty price for shortages of the flexible ramping constraint was set to \$60/MW in both the scheduling and pricing runs. This constraint is enforced in the binding 15-minute market but not in the binding 5-minute market.
- Power balance constraint shortages (red bar) occur when the power balance constraint that matches generation and load is relaxed when load exceeds the available generation. The penalty price for power balance relaxation due to energy shortage within EIM balancing authority areas is set at \$1,100/MW in the scheduling run. In the pricing run, the penalty price normally assigned to relaxations of this constraint would be consistent with the offer cap of \$1,000/MW. The pricing parameter when this constraint is relaxed has been set to \$0 in the EIM when the price discovery mechanism has been implemented.
- Power balance constraint excess (green bar) occurs when the power balance constraint that matches generation and load is relaxed because generation exceeds load. The penalty price for excess generation related to the power balance constraint is set at -\$155/MW in the scheduling run and is normally set at the offer floor of -\$150/MW in the pricing run. The pricing parameter when this constraint is relaxed has been set to \$0 in the EIM when the price discovery mechanism has been implemented. The figures show the count of intervals where power balance excess occurred in terms of a negative number, since these violations reduce overall prices.
- The light blue bars in Figure 2.1 and Figure 2.3 show the number of intervals when power balance constraint shortages occurred due to reasons that the ISO determined would have triggered price correction even if price discovery provisions were not in place.<sup>5</sup>

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<sup>5</sup> Section 35.4 of the ISO tariff provides the CAISO authority to correct prices if it detects an invalid market solution or prices due to issues such as data input failure, occurrence of hardware or software failure, or a result that is inconsistent with the ISO tariff.

As shown in Figure 2.1, the frequency of constraint relaxations in the 15-minute market in PacifiCorp East was relatively high during the middle of January, and then declined afterwards. As shown in Figure 2.3, the frequency of constraint relaxations in the 15-minute market in PacifiCorp West was also most frequent in mid-January and was not significant afterwards. Both of these increases in relaxations represent an increase from December.

Figure 2.2 and Figure 2.4 show average daily 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. These figures also provide a comparison of EIM prices to bilateral market price indices that were used to set prices in the PacifiCorp areas prior to EIM implementation.<sup>6</sup> For this analysis, the estimated EIM price without price discovery is calculated as follows:

- When the power balance constraint was relaxed for a shortage of energy, it is assumed prices would be \$1,000/MW minus estimated losses of about 3 percent on average.
- When the EIM transfer constraint was relaxed for a shortage of energy, it is assumed prices would be \$1,000/MW minus estimated losses of about 3 percent on average.
- When only the flexible ramping constraint was relaxed due to a shortage of 15-minute ramping, it is assumed shadow prices for this constraint would be \$247/MW before January 15 and \$60 after, which would be incorporated in the locational price.
- When the power balance constraint needed to be relaxed in market software for an excess of energy, it is assumed prices would be -\$150/MW plus estimated losses of about 1 percent.
- When relaxations of penalty parameters occurred due to conditions that would trigger price correction, prices were not adjusted. This is because there was an underlying error that caused the price discovery provisions to be triggered. The ISO determined that prices resulting under price discovery during these intervals were equivalent to prices that would result from price correction, so that no further price adjustment was appropriate.

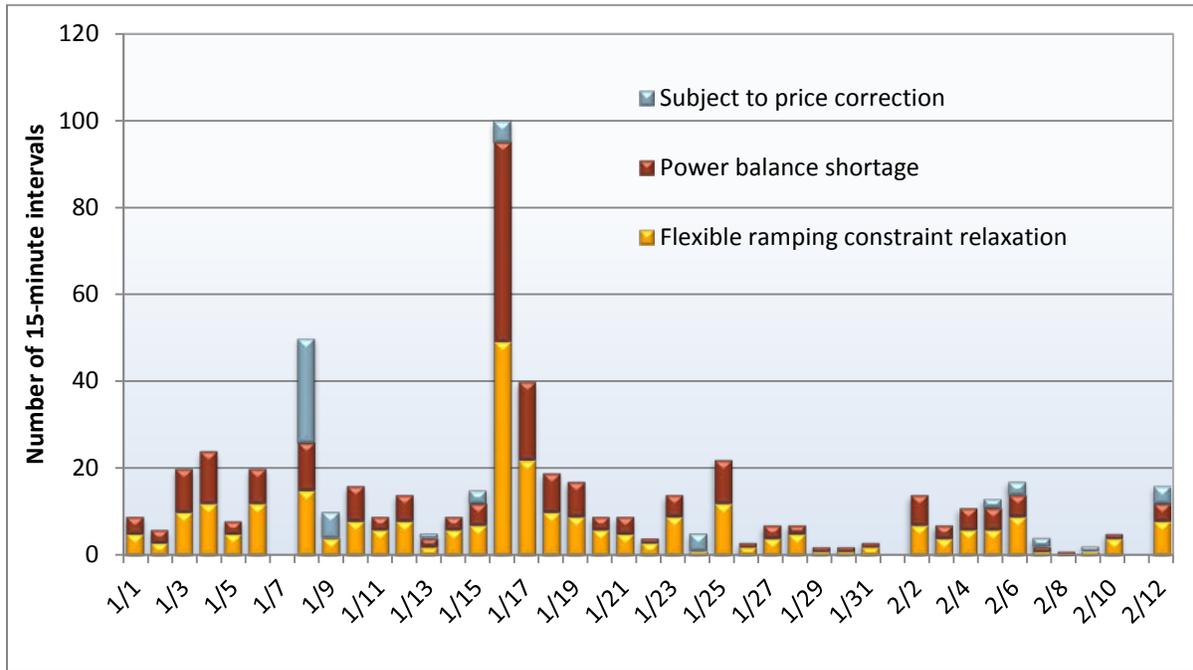
This methodology differs for the estimates of counterfactual price in the ISO's February 19 report in one key respect. DMM's analysis estimates prices without application of any special price discovery provisions in EIM. The ISO's analysis only incorporates the effects of price discovery provisions implemented by the ISO following approval of the ISO's November 13 waiver request.

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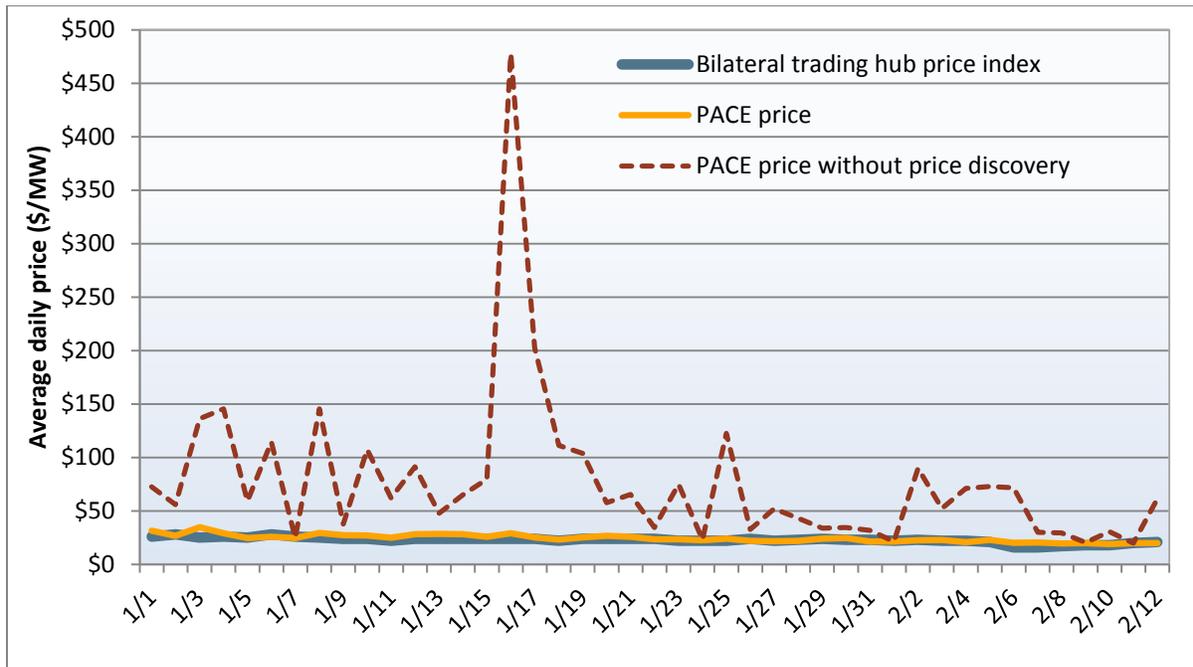
As noted in the ISO's February 19 report, Figure 16 through Figure 23 of the ISO's report exclude intervals in which power balance constraint was relaxed due to factors that would have been subject to price correction if price discovery provisions had not been applied (p.44). The ISO determined that prices resulting under price discovery during these intervals were equivalent to prices that would result from price correction, so that no further price adjustment was appropriate. DMM has included data on the frequency of these intervals to provide market transparency.

<sup>6</sup> The bilateral market index represents a daily average of peak and off-peak prices for four major Western trading hubs representative of the PacifiCorp East and West areas (California Oregon Border, Mid-Columbia, Palo Verde and Four Corners). Prior to EIM implementation, DMM identified this bilateral price index to stakeholders and regulators as a benchmark DMM would use to assess the competitiveness and overall performance of the EIM.

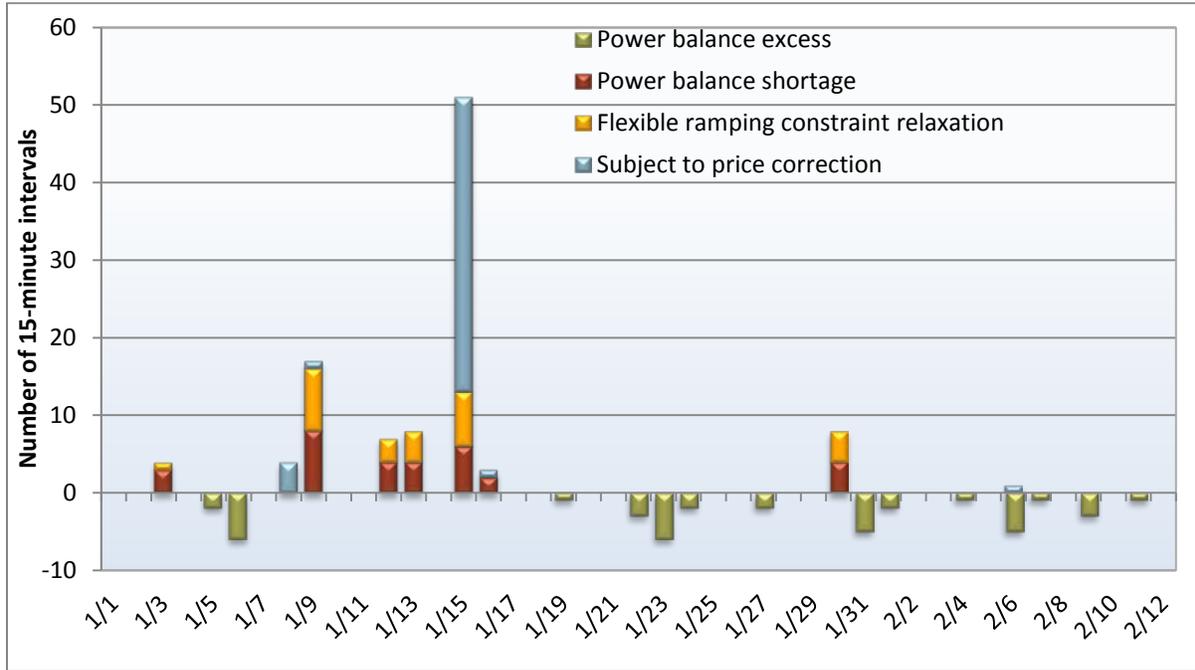
**Figure 2.1 Frequency of constraint relaxation  
PacifiCorp East - 15-minute market**



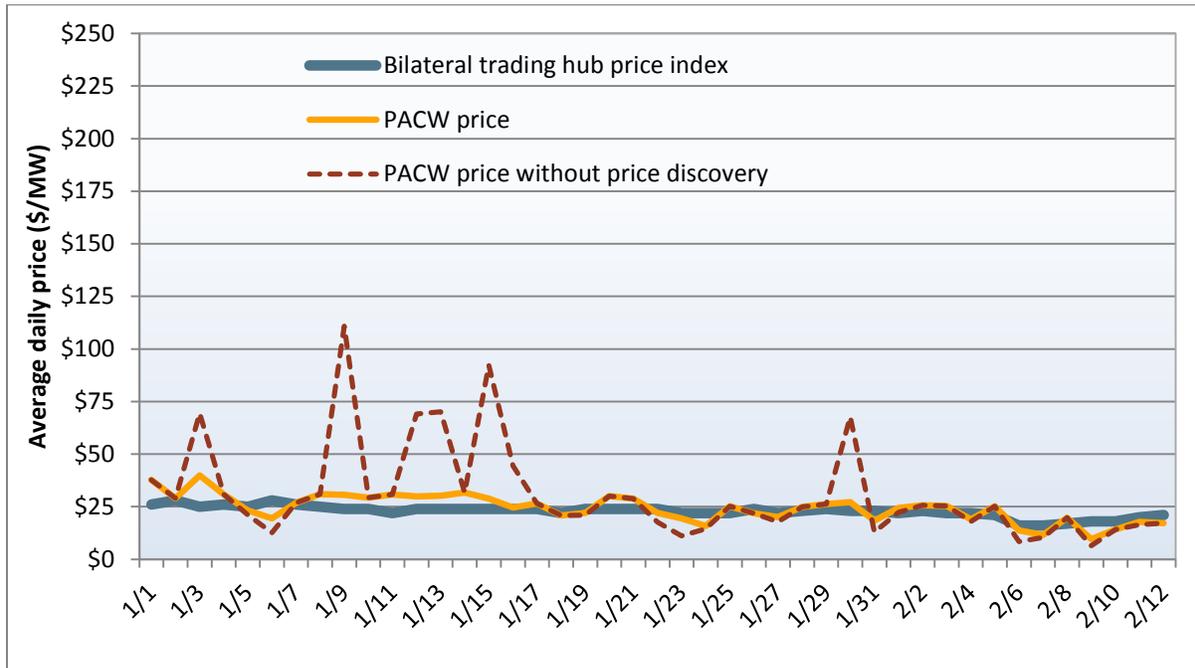
**Figure 2.2 Average daily prices with and without price discovery  
PacifiCorp East - 15-minute market**



**Figure 2.3 Frequency of constraint relaxation  
PacifiCorp West - 15-minute market**



**Figure 2.4 Average daily prices with and without price discovery  
PacifiCorp West - 15-minute market**



Specifically, the ISO analysis reflects the fact that shortly prior to EIM go-live, the ISO amended the EIM business practice manual (BPM) so that price discovery was triggered if a constraint was relaxed during an interval when the EIM balancing area had failed to pass the flexible ramping requirement test.<sup>7</sup>

As shown in Figure 2.2 and Figure 2.4, without the price discovery provisions being applied in EIM, on days when the power balance or flexible ramping constraints need to be relaxed in more than a few intervals of the 15-minute market, average daily prices would consistently exceed the bilateral market price index reflective of prices for imbalance energy in the PacifiCorp areas prior to EIM. However, with price discovery, EIM prices track very closely with this bilateral price index.

Figure 2.5 and Figure 2.6 provide a weekly summary from the beginning of November 2014 to mid-February 2015 of the frequency of constraint relaxation, average prices with and without price discovery, and bilateral market prices for PacifiCorp East and PacifiCorp West, respectively.

Figure 2.7 and Figure 2.8 provide the same weekly summary for the 5-minute market. As shown in these figures, the need to relax the power balance constraint in the 5-minute market has also remained relatively high in both PacifiCorp East and PacifiCorp West since EIM implementation. This reflects the fact that in the 5-minute market the supply of ramping capacity within PacifiCorp is more constrained than in the 15-minute market.

The higher frequency of power balance constraint relaxations in the 5-minute market also reflects the fact that incremental transfers into PacifiCorp from the ISO in the 5-minute market have been essentially prevented during almost all intervals until the first week of February. The dynamic transfer constraint (DTC), which constrains the extent to which transfers between PacifiCorp and the ISO scheduled in the 15-minute market can change in the 5-minute market, was set to a limit of less than 0.003 MW during most 5-minute market intervals until early February. Starting on February 5, the limit was increased to about 20 MW in peak hours and around 38 MW during off-peak hours. Since February 12, the limit has been set to about 350 MW during most off-peak hours. This may help significantly reduce the frequency of power balance relaxations in the 5-minute market.

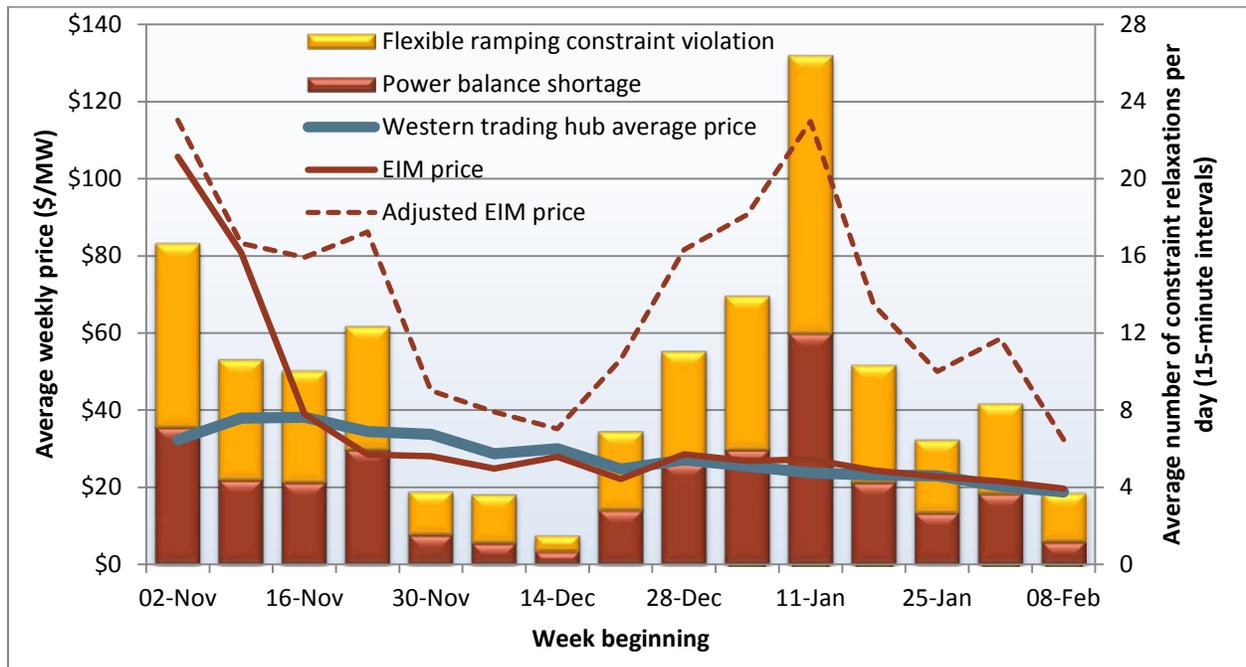
As shown in Figure 2.5 through Figure 2.8, the price discovery mechanism approved under the Commission's December 1 Order has effectively mitigated the impact of constraint relaxation on market prices. Table 2.1 shows average EIM prices in the 15-minute and 5-minute markets with and without application of price discovery, along with average bilateral market prices, from November 14, 2014 through February 12, 2015. As shown in Table 2.1:

- Application of the price discovery mechanism has kept average EIM prices in the 15-minute market lower than bilateral market price indices that were used to set rates in the PacifiCorp area prior to EIM by about 3.5 percent in PacifiCorp East. Prices in PacifiCorp West with price discovery have been about equal to these bilateral prices.
- Prices in the 5-minute market since the price discovery mechanism has been in effect have been lower than these bilateral market price indices by about 13 percent in PacifiCorp East and about 11 percent in PacifiCorp West.

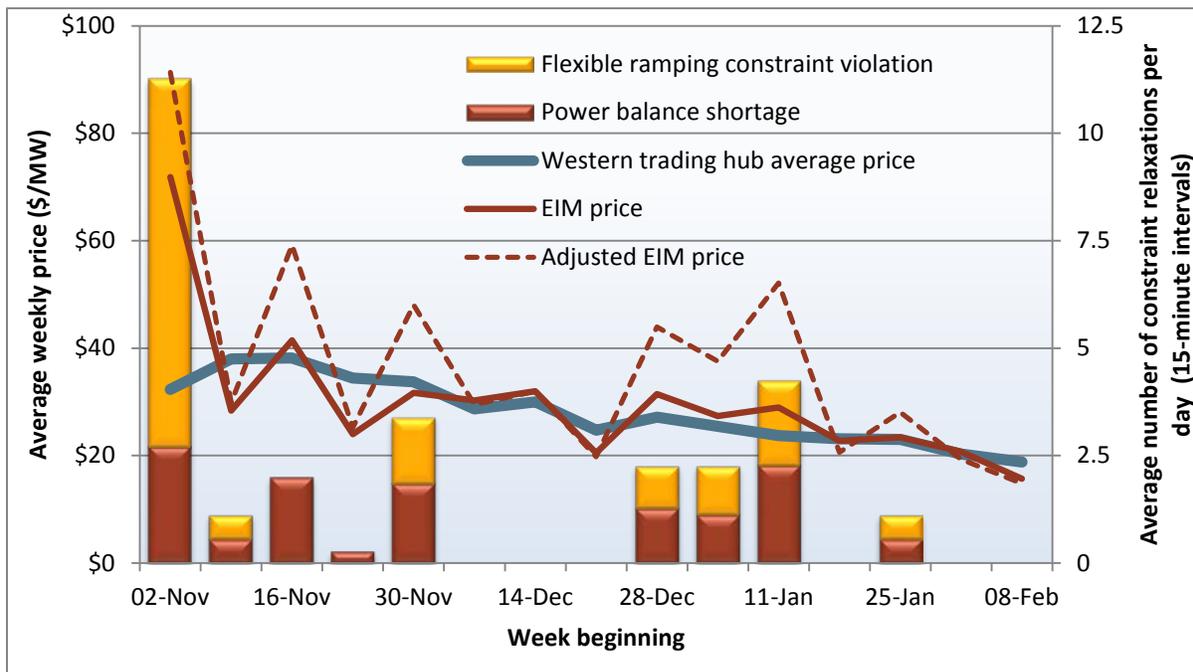
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<sup>7</sup> See pp. 10-11 of *Energy Imbalance Market Pricing Waiver Report*, December 1 - 31, 2014, January 15, 2015, [http://www.caiso.com/Documents/Jan15\\_2015\\_EnergyImbalanceMarket\\_REPORT\\_ER15-402.pdf](http://www.caiso.com/Documents/Jan15_2015_EnergyImbalanceMarket_REPORT_ER15-402.pdf).

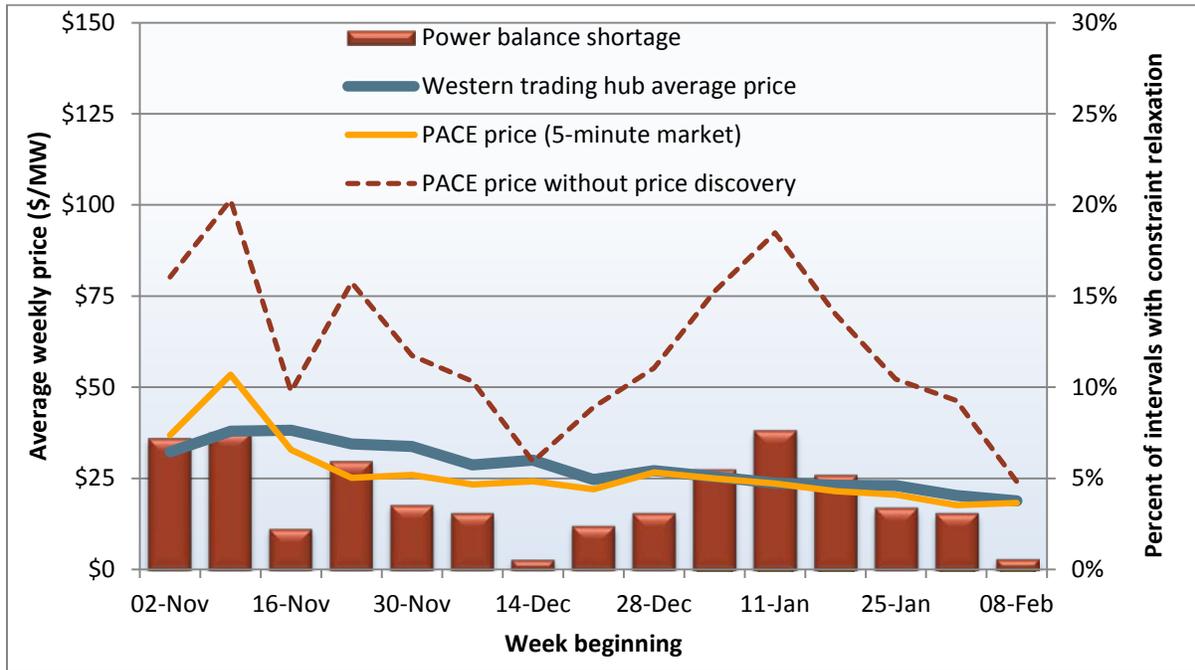
**Figure 2.5 Frequency of constraint relaxation and average prices by week  
PacifiCorp East - 15-minute market**



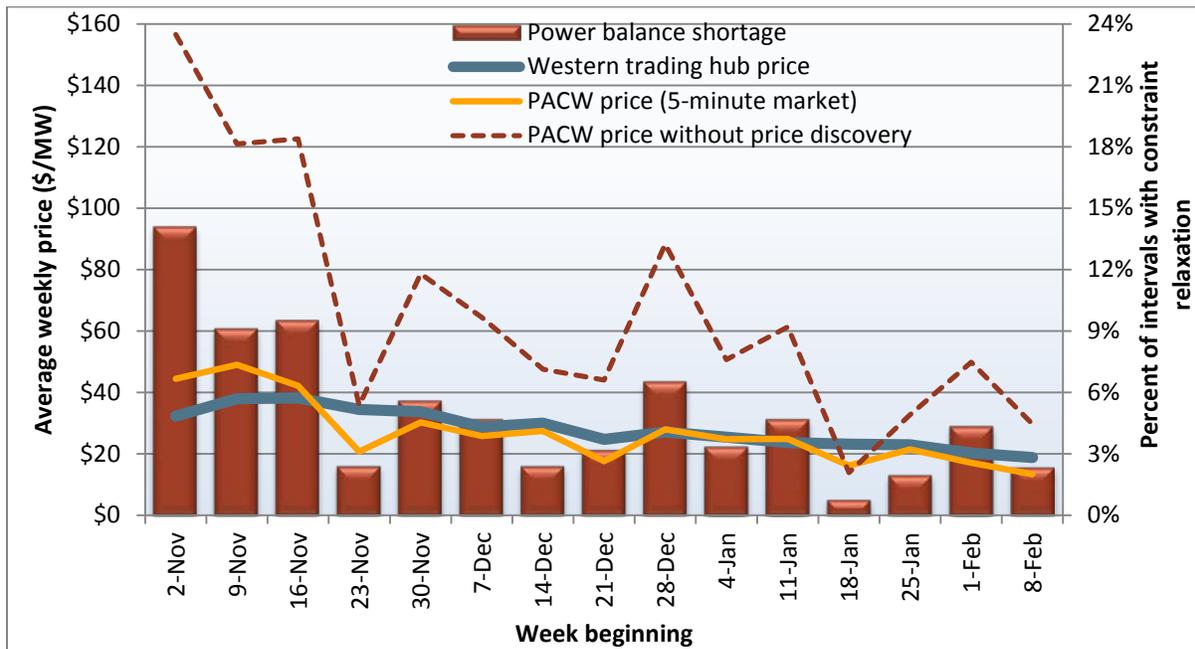
**Figure 2.6 Frequency of constraint relaxation and average prices by week  
PacifiCorp West - 15-minute market**



**Figure 2.7 Frequency of constraint relaxation and average prices by week PacifiCorp East - 5-minute market**



**Figure 2.8 Frequency of constraint relaxation and average prices by week PacifiCorp West - 5-minute market**



- Without price discovery, prices in PacifiCorp East would be about 2.3 times higher than bilateral market price indices in the 15-minute and about twice as high in the 5-minute market relative to these bilateral market prices.
- In PacifiCorp West, prices without price discovery would be about 23 percent higher than bilateral market prices in the 15-minute market and about twice as high in the 5-minute market compared to these bilateral prices.

**Table 2.1 Average prices in EIM and bilateral markets (November 14, 2014 – February 12, 2015)**

	Western trading hub average price	Average EIM price	EIM price without price discovery
<b><i>PacifiCorp East</i></b>			
15-minute market (FMM)	\$27.47	\$26.48	\$60.09
5-minute market (RTD)	\$27.47	\$23.97	\$56.58
<b><i>PacifiCorp West</i></b>			
15-minute market (FMM)	\$27.47	\$27.37	\$33.73
5-minute market (RTD)	\$27.47	\$24.38	\$56.36

### Flexible ramping sufficiency test

As previously noted, DMM’s estimates of EIM prices that would result without price discovery include price discovery that would be triggered when the EIM balancing area had failed to pass the flexible ramping requirement test under a business practice manual modification made shortly prior to EIM go-live.

The ISO tariff specifies that when an EIM area fails to pass the flexible ramping sufficiency test, transfers of energy into that EIM area may not increase. As noted in the ISO report:

As specified in section 29.34(n) of the CAISO tariff and section 10.3.2.1 of the Business Practice Manual for the Energy Imbalance Market, if the EIM Entity balancing authority area fails the sufficient ramp test, or is deemed to have failed the test because it failed the capacity (resource plan) test, CAISO will restrict additional EIM Transfer imports into that EIM Entity balancing authority area during the hour starting at T beyond the optimal solution for T-7.5 minutes. The CAISO will enforce the individual EIM Entity balancing authority area flexible ramp requirement in the isolated EIM Entity balancing authority area and will not include that balancing authority area in area group constraints.<sup>8</sup>

This provision was included in the EIM design to deter “capacity leaning” and provide a strong incentive for each EIM area to ensure it has enough ramping capacity available to meet its own needs. In

<sup>8</sup> See pp. 10-11 (ii) in *Energy Imbalance Market Pricing Waiver Report*, December 1 - 31, 2014, January 15, 2015, [http://www.caiso.com/Documents/Jan15\\_2015\\_EnergyImbalanceMarket\\_REPORT\\_ER15-402.pdf](http://www.caiso.com/Documents/Jan15_2015_EnergyImbalanceMarket_REPORT_ER15-402.pdf)

practice, this provision means that if an EIM area fails the sufficiency test, transfers of energy into that EIM area in the 15-minute market may not increase. For instance, if 100 MW is being transferred into the EIM area, transfers are constrained not to exceed 100 MW. If 100 MW is being exported from an EIM area when the area fails the ramping sufficiency test, the transfer out of that EIM area may be reduced to 0 MW, but the constraint on imports into that area is set to 0 MW.

Shortly prior to EIM go-live, the EIM Business Practice Manual for the Energy Imbalance Market was changed so that when an EIM area failed the ramping sufficiency test, the price discovery mechanism would be applied in the event any constraint such as the power balance or flexible ramping constraint was relaxed in the 15-minute or 5-minute market.<sup>9</sup>

To provide market transparency on the impact of this BPM change, DMM has included information on the frequency with which constraint relaxation occurred during hours when the flexible ramping sufficiency test failed prior to application of price discovery provisions on November 14 pursuant to FERC's December 1 Order. DMM continues to provide information on this issue to provide market transparency on the potential impact of this BPM change if price discovery provisions approved in the December 1 Order were not in effect.

Figure 2.9 through Figure 2.12 show the frequency of failures of the ramping sufficiency test, along with the portion of these events during which the power balance or flexible ramping constraint was subsequently relaxed in the 15-minute or 5-minute market in the PacifiCorp areas.

As shown in Figure 2.9 through Figure 2.12:

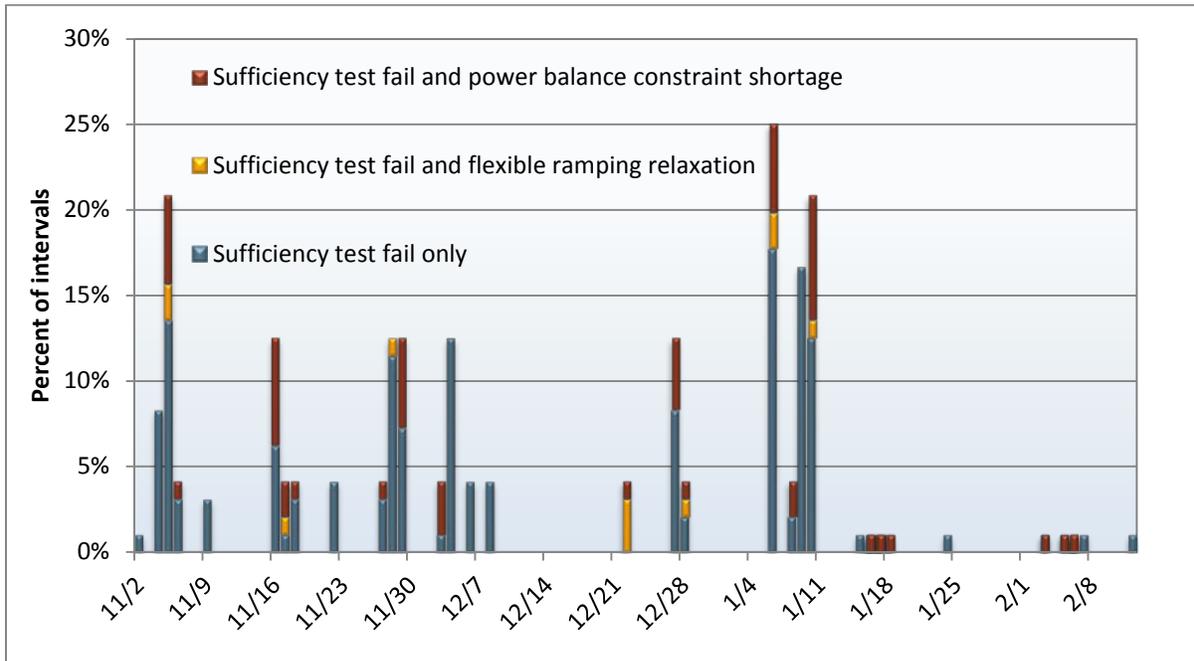
- Failures of the ramping sufficiency test are relatively frequent in the PacifiCorp East area, but much less frequent in PacifiCorp West.
- In the 15-minute market, while the power balance or flexible ramping constraints occasionally need to be relaxed when an area fails to meet the ramping sufficiency test, during many intervals this is not the case.
- When an area fails to meet the ramping sufficiency test, chances are increased that the power balance constraint will need to be relaxed in the 5-minute market.

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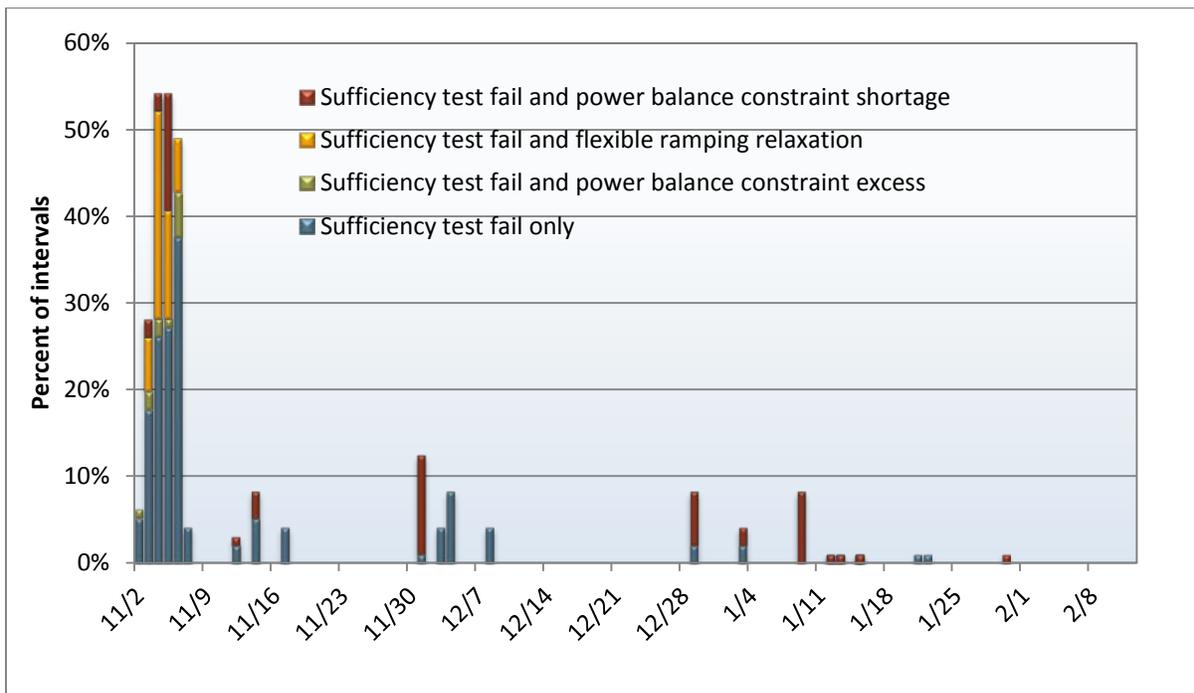
<sup>9</sup> See p. 35, *Business Practice Manual for The Energy Imbalance Market*, as revised 10/30/2014.

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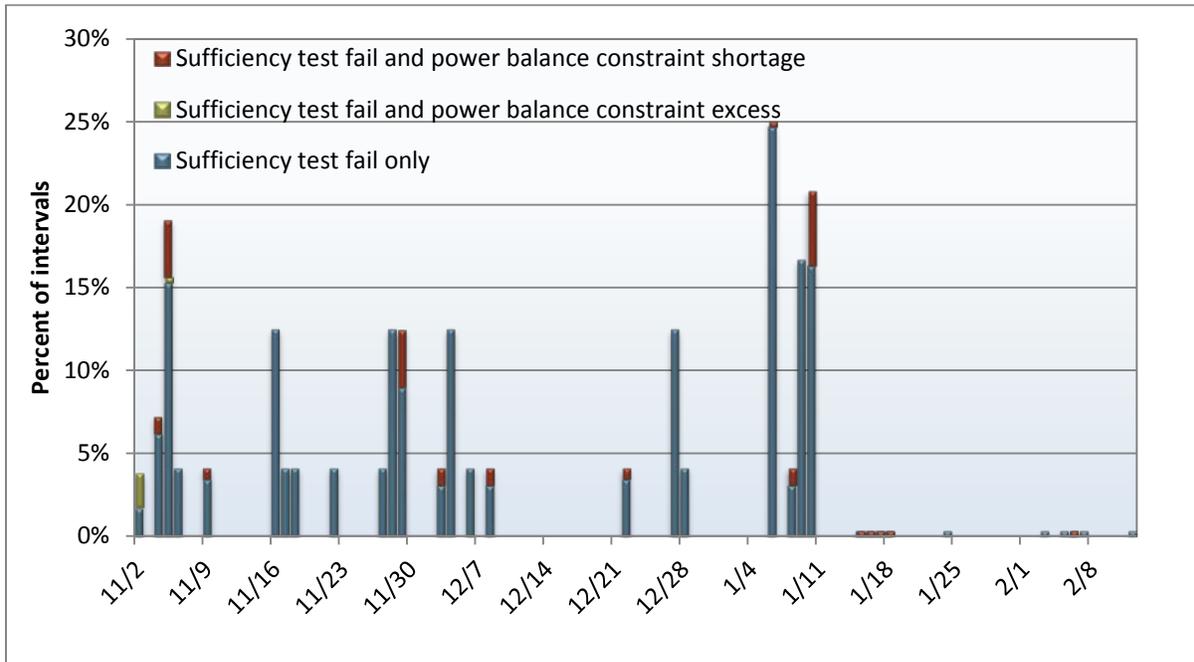
**Figure 2.9 Frequency of constraint relaxation when flexible ramping sufficiency test failed  
PacifiCorp East - 15-minute market**



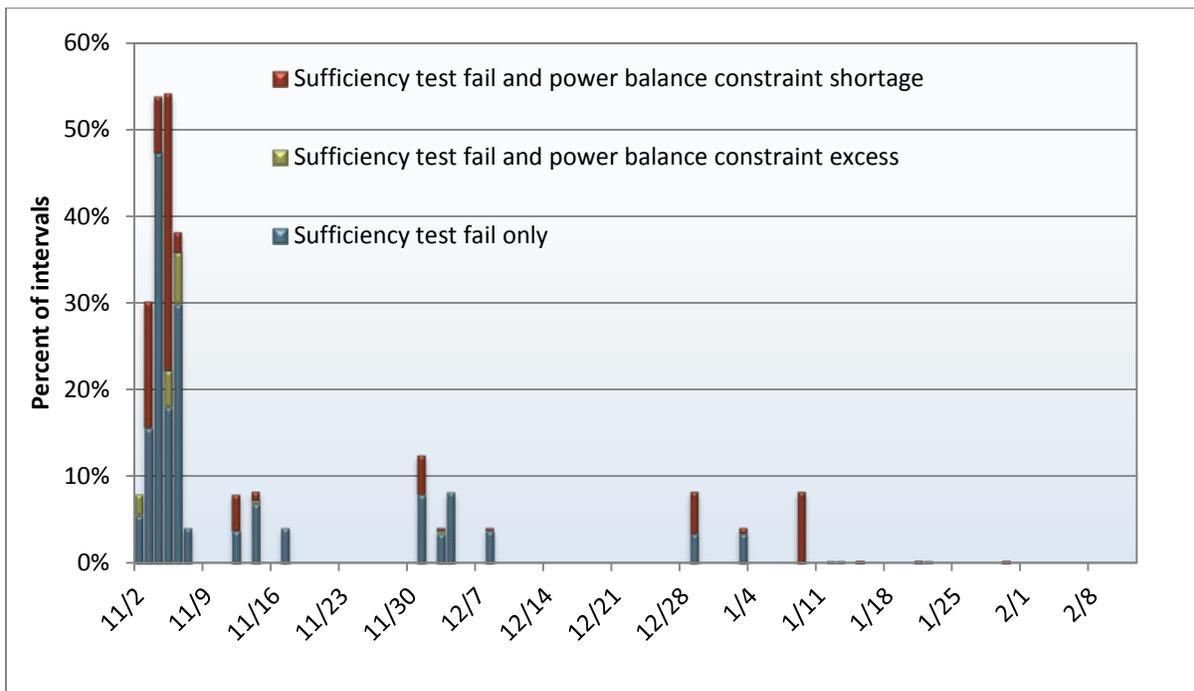
**Figure 2.10 Frequency of constraint relaxation when flexible ramping sufficiency test failed  
PacifiCorp West - 15-minute market**



**Figure 2.11 Frequency of constraint relaxation when flexible ramping sufficiency test failed  
PacifiCorp East - 5-minute market**



**Figure 2.12 Frequency of constraint relaxation when flexible ramping sufficiency test failed  
PacifiCorp West - 5-minute market**



### 3 Market software constraint relaxation

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EIM performance has been driven primarily by the need to periodically relax several key constraints in the EIM market model. This section provides additional information on the frequency and causes of various constraint violations in the EIM during January and February 2015.

Figure 3.1 and Figure 3.2 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.

As shown in Figure 3.1, in PacifiCorp East the frequency of constraint relaxation increased in January for power balance shortages to about 5.5 percent in both the 15-minute and 5-minute markets. The flexible ramping constraint relaxations decreased to about 2.5 percent in the 15-minute market.

As shown in Figure 3.2, in PacifiCorp West the frequency of constraint relaxation increased slightly in January in the 15-minute markets to about 1 percent. The power balance constraint was still relaxed in about 3 percent of intervals in the 5-minute market in January compared to about 5 percent of 5-minute intervals in December.

As described in the ISO's February 19 report, the ISO has reviewed each interval in which the power balance constraint was relaxed due to supply insufficiency in January and the beginning of February and categorized each of these in terms of a primary cause of this supply insufficiency.<sup>10</sup> DMM has aggregated data underlying the Figures 10 and 12 of the ISO's February 19 report to highlight the relative magnitude of the different factors driving supply insufficiency events from December to mid-February. The data covering January 1 through February 12 are provided in Figure 3.3 through Figure 3.6.

Provided below is a summary of the primary cause of EIM supply insufficiencies in the approximate order of the frequency of which these issues caused supply insufficiencies in January to mid-February based on data underlying the ISO report.

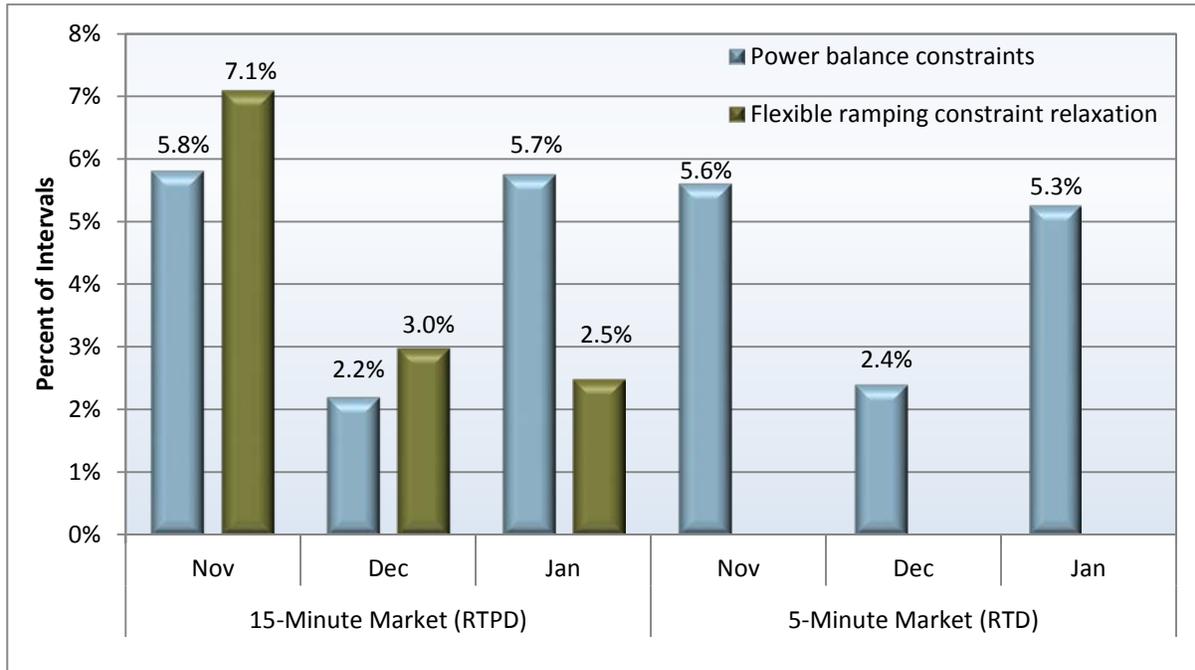
- **Resource data alignment.** As shown in Figure 3.3, this category is cited as the primary cause of 12 percent of supply insufficiencies in PacifiCorp East in the 15-minute market and about 16 percent in the 5-minute market as examined by the ISO. This category is cited as the primary cause of almost 29 percent of insufficiencies in PacifiCorp West in the 15-minute market and 22 percent in the 5-minute market. The ISO report explains that "this group accounts for resource deviating from their dispatch, differences between base schedules and bids or dispatches, and changes between markets."<sup>11</sup> Based on DMM's review of the ISO's analysis and discussions with the ISO, many of these events appear to be related to issues related to how multi-stage generating units are scheduled, bid and dispatched in the market. The ISO and PacifiCorp have indicated they are working to improve how this software functionality is utilized to reduce this type of issue.

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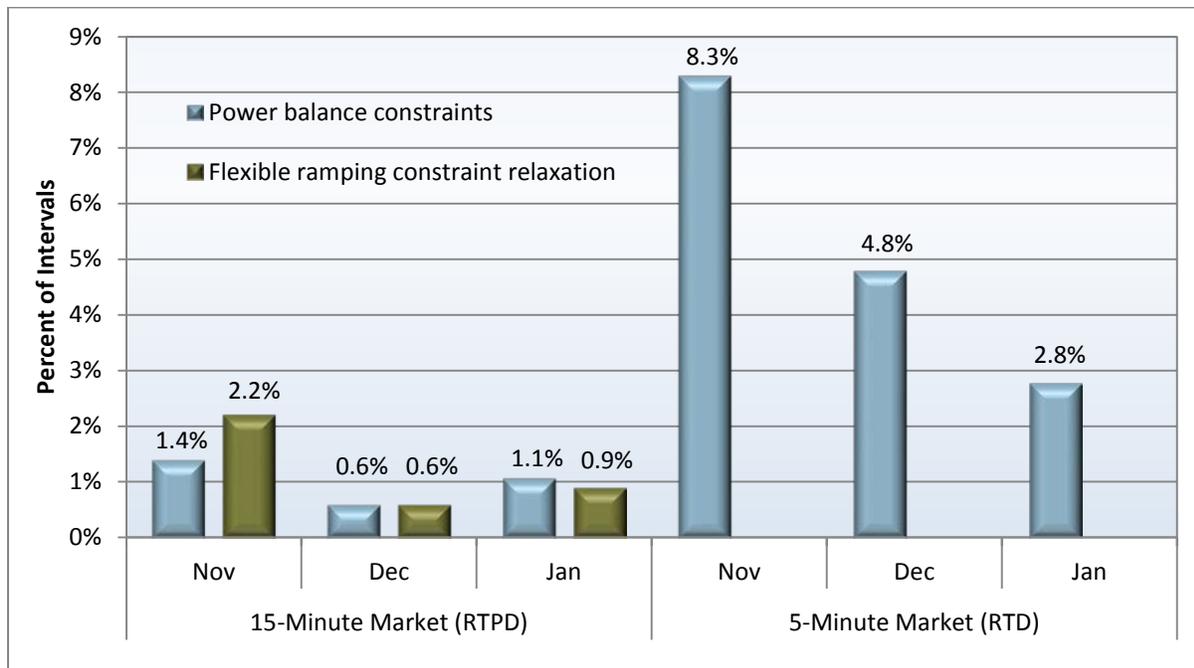
<sup>10</sup> See Figures 10 and 12, pp. 16-18, in *Energy Imbalance Market Pricing Waiver Report*, January 1 – February 12, 2015, February 19, 2015:  
[http://www.caiso.com/Documents/Feb19\\_2015\\_EIM\\_Informational\\_Report\\_ER15-402.pdf](http://www.caiso.com/Documents/Feb19_2015_EIM_Informational_Report_ER15-402.pdf).

<sup>11</sup> See page 15, in *Energy Imbalance Market Pricing Waiver Report*, January 1 – February 12, 2015, February 19, 2015:  
[http://www.caiso.com/Documents/Feb19\\_2015\\_EIM\\_Informational\\_Report\\_ER15-402.pdf](http://www.caiso.com/Documents/Feb19_2015_EIM_Informational_Report_ER15-402.pdf).

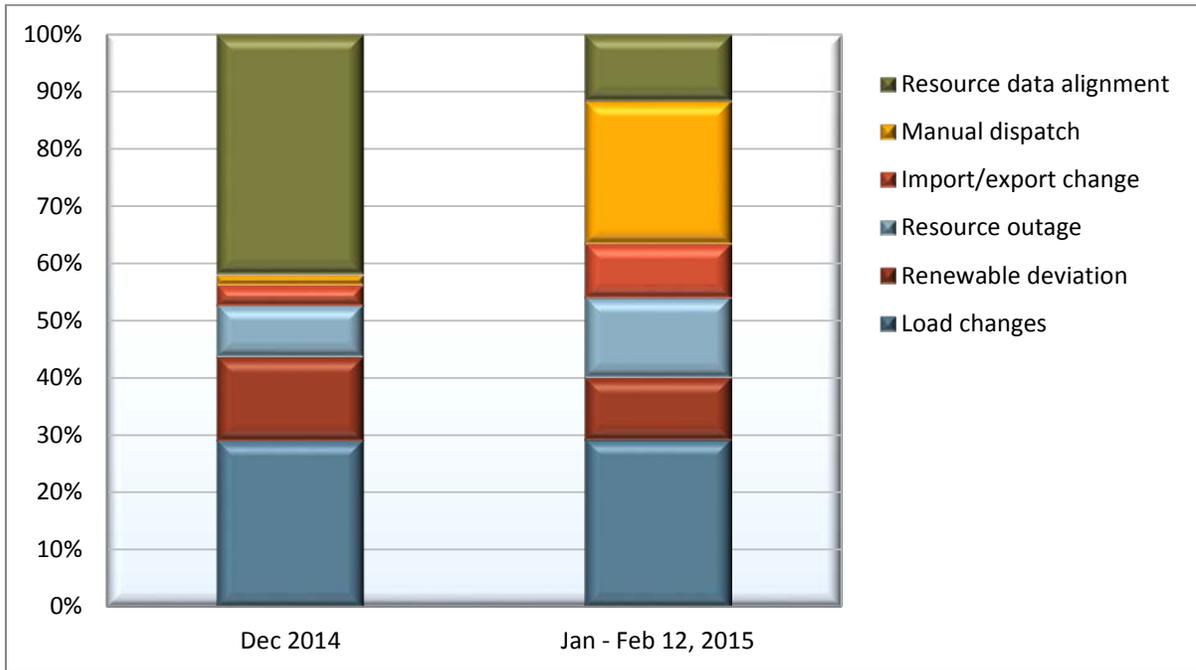
**Figure 3.1 Frequency of constraint relaxation by month – PacifiCorp East (PACE)**



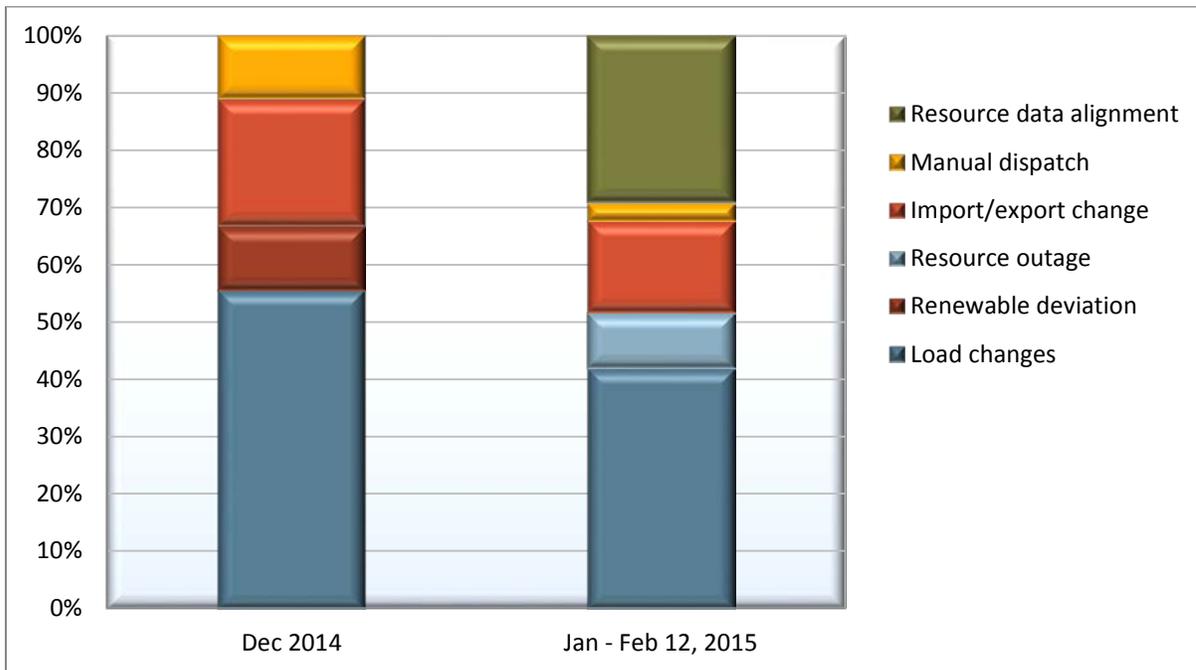
**Figure 3.2 Frequency of constraint relaxation by month – PacifiCorp West (PACW)**



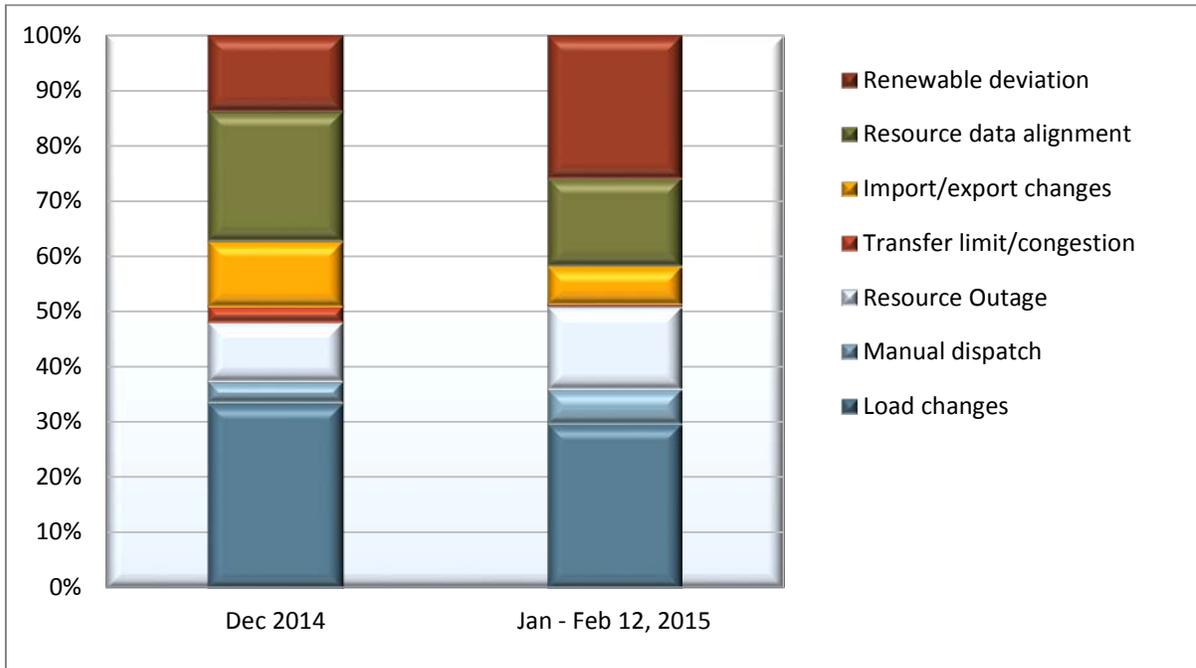
**Figure 3.3 Major causes of power balance constraint relaxation  
PacifiCorp East - 15-minute market (January/February 2015)**



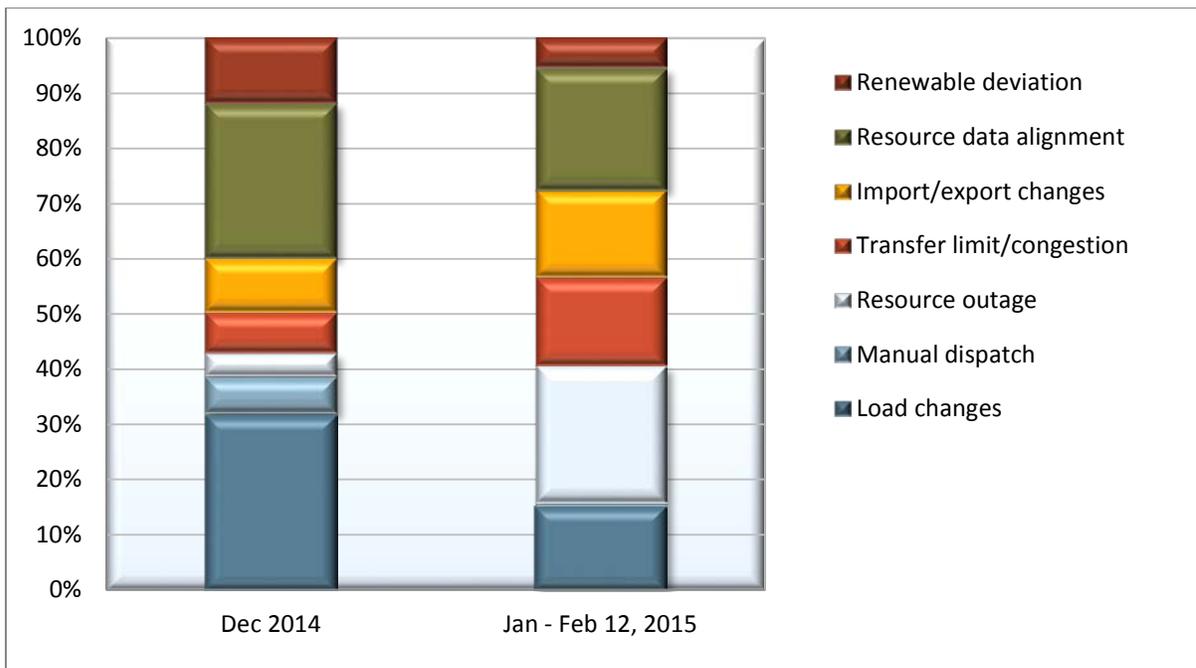
**Figure 3.4 Major causes of power balance constraint relaxation  
PacifiCorp West - 15-minute market (January/February 2015)**



**Figure 3.5 Major causes of power balance constraint relaxation  
PacifiCorp East - 5-minute market (January/February 2015)**



**Figure 3.6 Major causes of power balance constraint relaxation  
PacifiCorp West - 5-minute market (January/February 2015)**



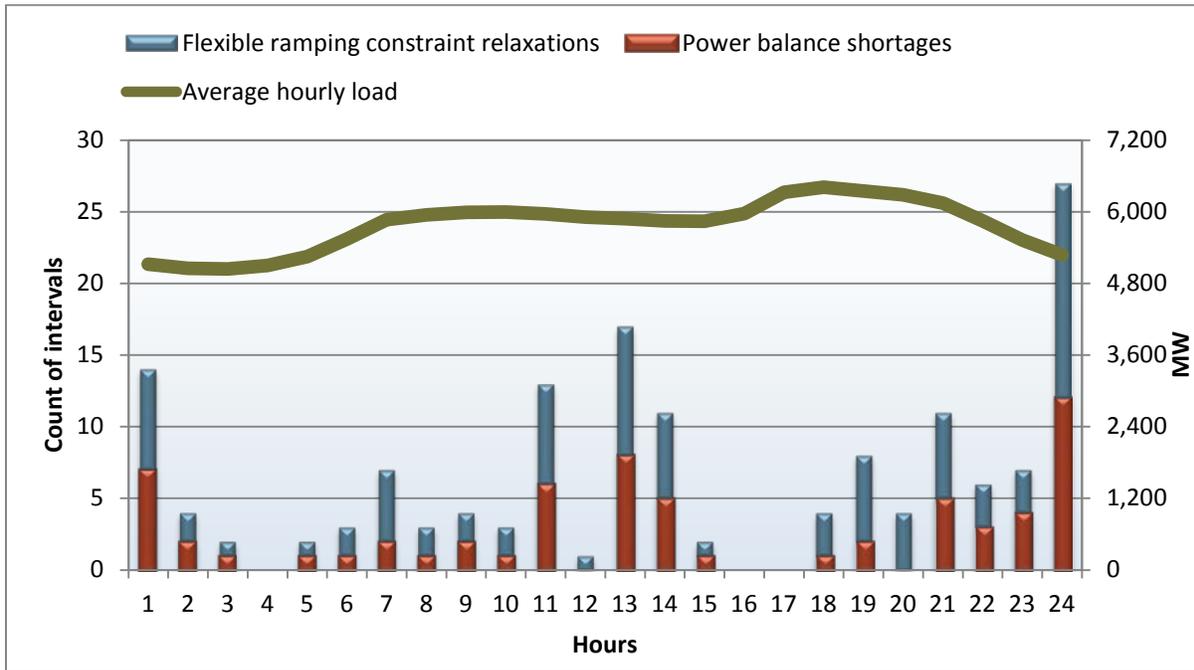
- **Load changes.** This category is cited as the primary cause of 30 percent of supply insufficiencies in the 15-minute market in the PacifiCorp areas from January to mid-February. In the 5-minute market, this category represented about 42 percent of the supply insufficiencies in PacifiCorp East and 15 percent in PacifiCorp West for the same period. The ISO report indicates that this category includes conditions where either the load forecast is adjusted or there is a change in the load bias. In practice, it should be noted that load forecast adjustments or biasing is often the tool by which the EIM operator may seek to account for many sources of modeling discrepancies besides actual fluctuation in loads versus forecasts. For instance, if the EIM operator overestimates the amount of load adjustment or bias actually needed, this may create a supply insufficiency that does not reflect actual system conditions. DMM notes that the need to rely on load adjustments may be reduced by modeling improvements, and that use of adjustments may improve as EIM operators gain additional experience, as occurred in the ISO over time.
- **Renewable deviation.** This category is cited as the primary cause of 11 to 26 percent of supply insufficiencies in the 15-minute and 5-minute markets in PacifiCorp East and 0 to 5 percent of the insufficiencies in the 15-minute and 5-minute markets in PacifiCorp West. This category represents cases in which changes in wind generation lead to the loss of capacity and for the need to increase generation from other resources. DMM notes that wind deviations appear to represent a higher portion of total load in PacifiCorp than the ISO. As noted in the ISO report, PacifiCorp is working to improve the forecast of wind generation in its area.
- **Resource outages.** This category is cited as the primary cause of about 15 to 25 percent of supply insufficiencies in the 15-minute markets in PacifiCorp East and West, respectively, during January and early February. When a generating resource outage occurs, the market software needs to increase generation from other resources. When a resource is no longer on outage and is scheduled by an EIM entity, it is also important that the outage cancellation be reported in a timely manner so that the market software represents that this capacity is available. Otherwise, the market software perceives that there is capacity shortage to meet the load. As noted in the ISO report, PacifiCorp is working to improve the timeliness with which outages are reported and outages are cancelled for units no longer on outage.
- **Manual dispatch.** This category is cited as the primary cause of about 25 percent of supply insufficiencies in the 15-minute market and 6 percent of supply insufficiencies in the 5-minute market in PacifiCorp East. Manual dispatches are issued to dispatch additional generation when outages or other issues occur causing a sudden need for additional generation. However, if these out-of-market dispatches are not entered into the market software, this generation is not reflected in the available supply modeled in the market software, which can cause a supply insufficiency in the market software. As indicated in the ISO report, the ISO and PacifiCorp have discussed the need for improvement in the timeliness of manual dispatch logging processes.
- **Import/export changes.** This category is cited as the primary cause of about 16 percent of supply insufficiencies in PacifiCorp West in the 15-minute and 5-minute markets, and about 8 percent of supply insufficiencies in the PacifiCorp East area in both markets. This category involves delays in making adjustments and updates to import and export schedules in the market software during resource outage times or steep load ramping conditions. Although additional energy may be procured for import in the bilateral market, e-tags are not due until 20 minutes prior to the operating hour. If this energy is not e-tagged before the 15-minute market is run 37.5 minutes prior to the operating hour, this energy is not available to meet supply in the EIM 15-minute market.

- **Transfer constraints/congestion.** This category is cited as the primary cause of about 16 percent of supply insufficiencies in the 5-minute market in PacifiCorp West and 1 percent of supply insufficiencies in the 5-minute market in PacifiCorp East. This category appears to include cases where energy was transferred out of an EIM area in the 15-minute market, and then was needed to meet demand within that area, but was not available since transfers out of the EIM area could not be reduced to the limits placed on EIM transfers in the 5-minute market. In practice, the amount of changes made to 15-minute schedules in the 5-minute market in the EIM was set to not more than 0.003 MW during most intervals until early February, so that no significant changes can be made to net EIM transfers in the 5-minute market. DMM identified this as a major contributing factor to supply insufficiencies in the EIM during many intervals.

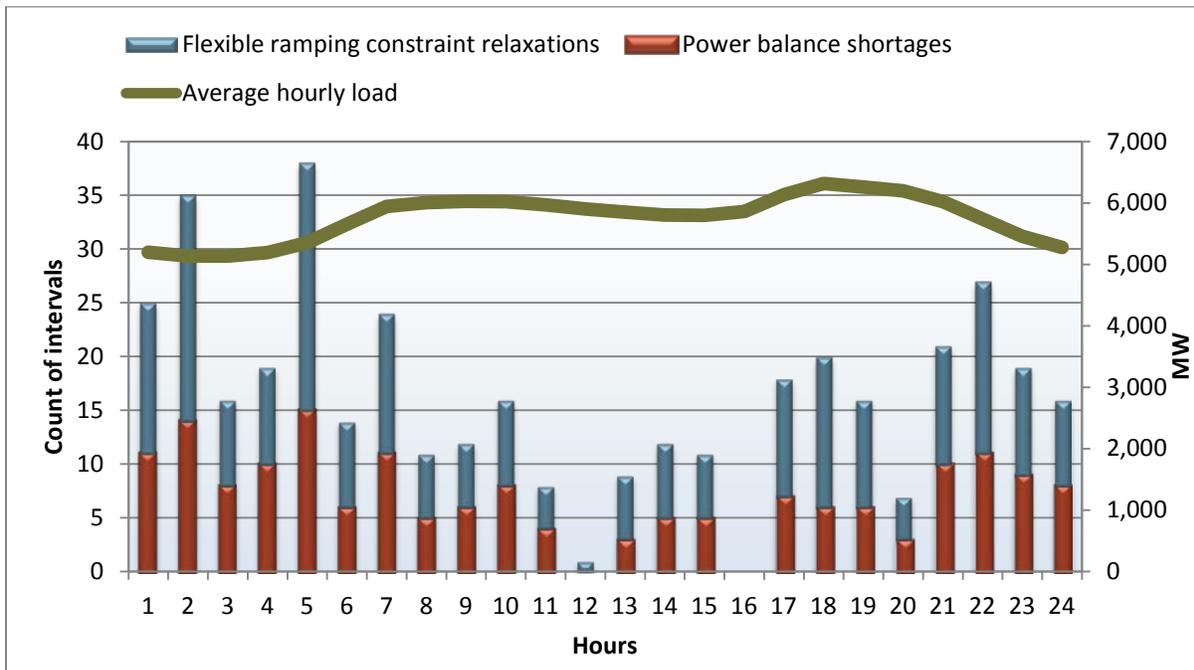
Figure 3.7 through Figure 3.10 show the frequency of various constraint relaxations by operating hour in PacifiCorp East and PacifiCorp West in the 15-minute market during December 2014 and January 2015. These charts also include the average total load (green line) in the PacifiCorp areas in each hour.

As shown in Figure 3.7 through Figure 3.10, the overall frequency of constraint relaxations increased in January in PacifiCorp East and decreased in PacifiCorp West for the same period. The pattern of constraint relaxation does not appear to be highly correlated with hours of high ramping requirements or loads, particularly in PacifiCorp East. In PacifiCorp West, there appears to be a better correlation with the overall frequency of constraint relaxations and the morning and evening high load periods.

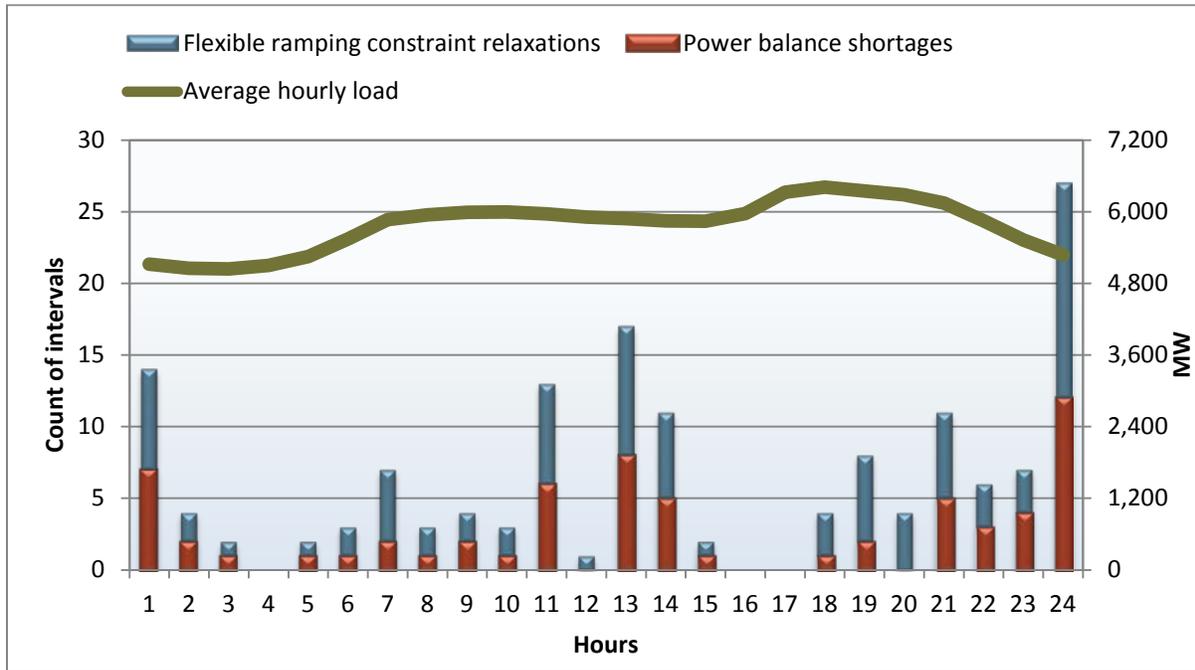
**Figure 3.7 Constraint relaxation by operating hour (December 2014)  
PacifiCorp East - 15-minute market**



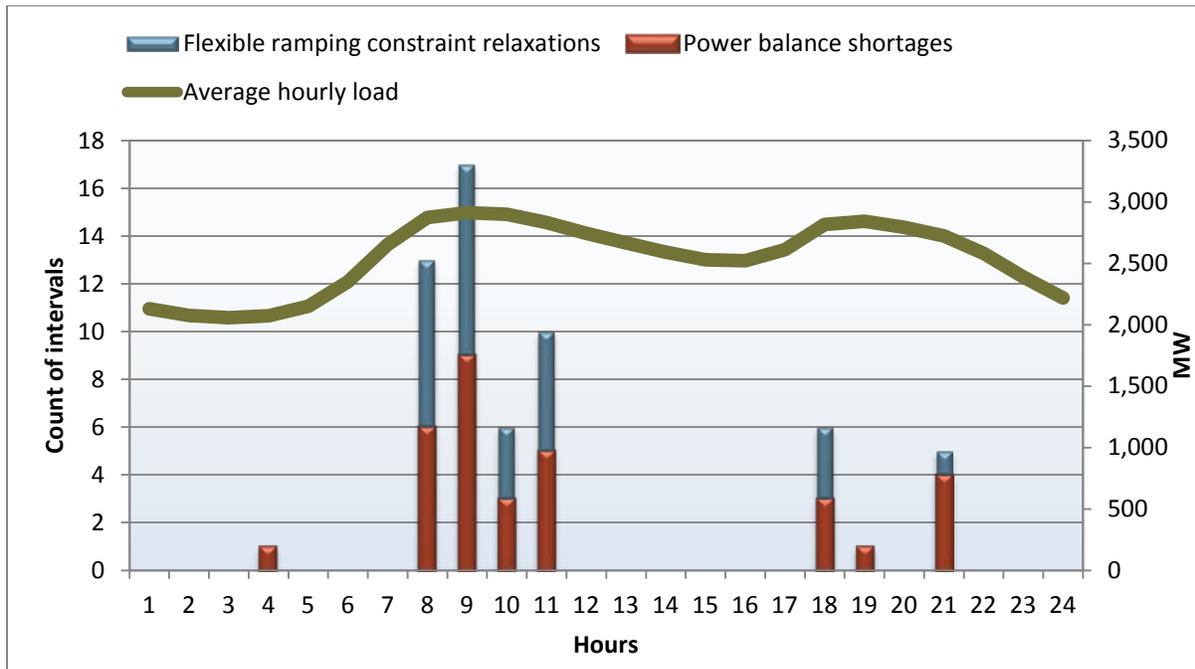
**Figure 3.8 Constraint relaxation by operating hour (January 2015)  
PacifiCorp East - 15-minute market**



**Figure 3.9 Constraint relaxation by operating hour (December 2014)  
PacifiCorp West - 15-minute market**



**Figure 3.10 Constraint violations by operating hour (January 2015)  
PacifiCorp West - 15-minute market**



## 4 Resource schedules, bids and dispatches

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This section provides a summary of the amount of capacity being scheduled, bid and dispatched in the EIM. As noted in DMM's first and second reports, the amount of capacity bid into the EIM continues to generally exceed the amount of energy dispatched from EIM resources by a substantial margin. The charts below have been modified from similar charts in prior DMM reports to only include gas and coal resources, and to correct several other data issues, as described below.<sup>12</sup>

Figure 4.1 and Figure 4.2 show the total amount of gas and coal capacity participating in EIM from January through mid-February 2015, along with the portion of this capacity reported on outage. Outage rates vary widely from day to day, but have averaged just under 15 percent in PacifiCorp East and 10 percent in PacifiCorp West.

Figure 4.3 and Figure 4.4 show the average amount of gas and coal capacity scheduled, bid and dispatched in PacifiCorp East and PacifiCorp West in the 15-minute market during January 2015 by operating hour.

- The red lines represent the average of total gas and coal capacity participating in EIM over the month of January in PacifiCorp East (4,729 MW) and PacifiCorp West (3,171 MW).<sup>13</sup>
- The black lines represent the average amount of this capacity that was available after accounting for outages and de-rates reported in the ISO outage system. DMM's review of reasons codes recorded in outage logs suggests that some of the outages may be due to generator restrictions, such as minimum off-line times and other operating limitations, rather than operational problems.
- The darker blue area represents the average base schedules for all gas and coal capacity from participating EIM resources by operating hour during January.
- The lighter blue line shows the average amount of gas and coal capacity bid-in and dispatched in the EIM 15-minute market.
- The green area shows DMM's estimate of the amount of undispached bids available within a 15-minute ramp beyond the level at which units were actually dispatched in the 15-minute market.
- The yellow area shows DMM's estimate of the additional amount of undispached bids available beyond a 15-minute ramping horizon.

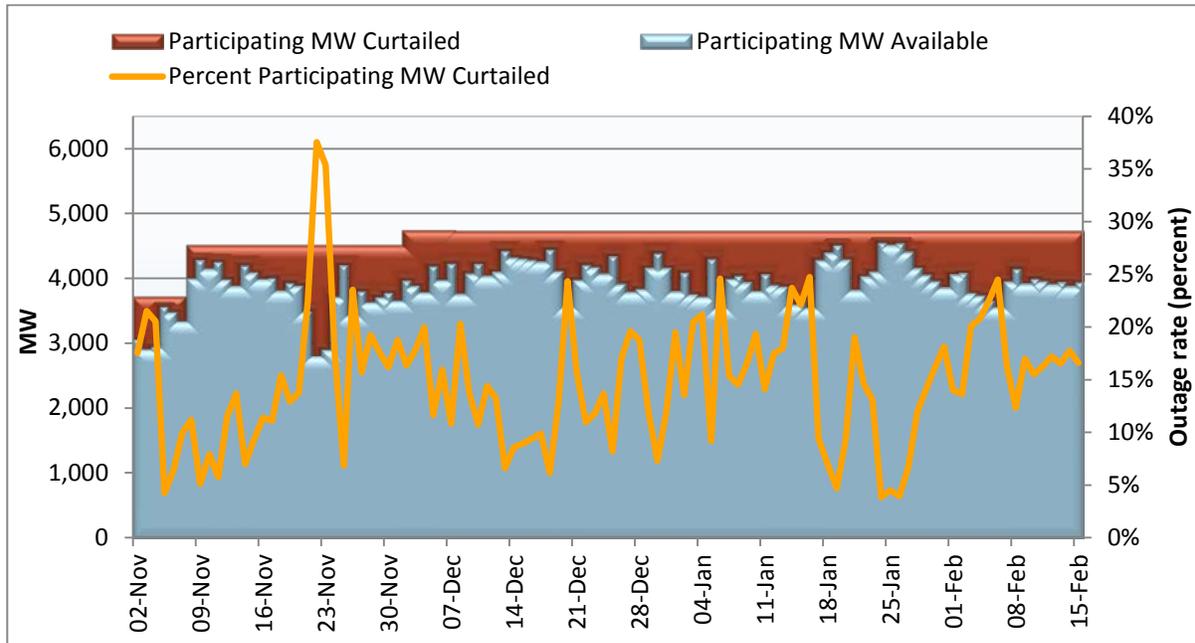
This analysis differentiates the estimated level of bid-in capacity available on a 15-minute horizon (shown in green) from capacity that is bid-in but only available on a longer time-frame (shown in yellow), since much of the capacity shown in yellow may not be available for dispatch in response to many of the factors driving constraint violations in the EIM.

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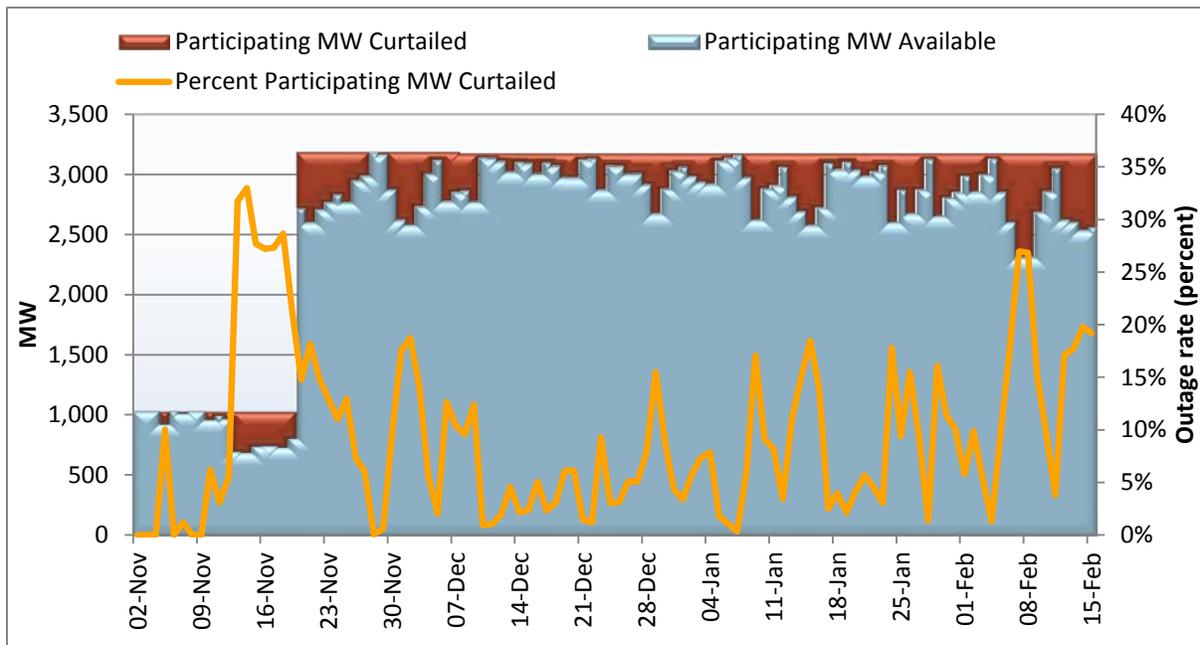
<sup>12</sup> In DMM's prior reports, Figures 4.3 and 4.4 had incorrectly reported that the generation was for gas and coal units when they actually showed data for all participating units including wind and hydro.

<sup>13</sup> The total capacity participating in EIM in PacifiCorp East and PacifiCorp West during each day in January 2015 is provided in Figure 4.1 and Figure 4.2, respectively.

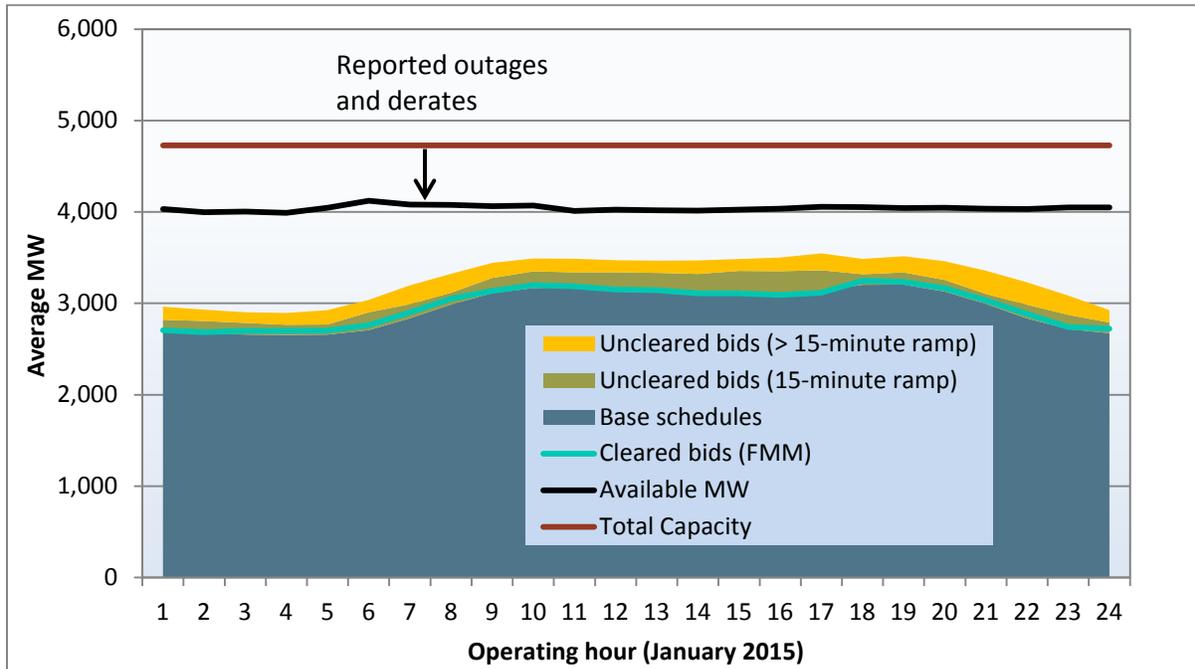
**Figure 4.1 Participating capacity and outages (gas and coal)  
PacifiCorp East**



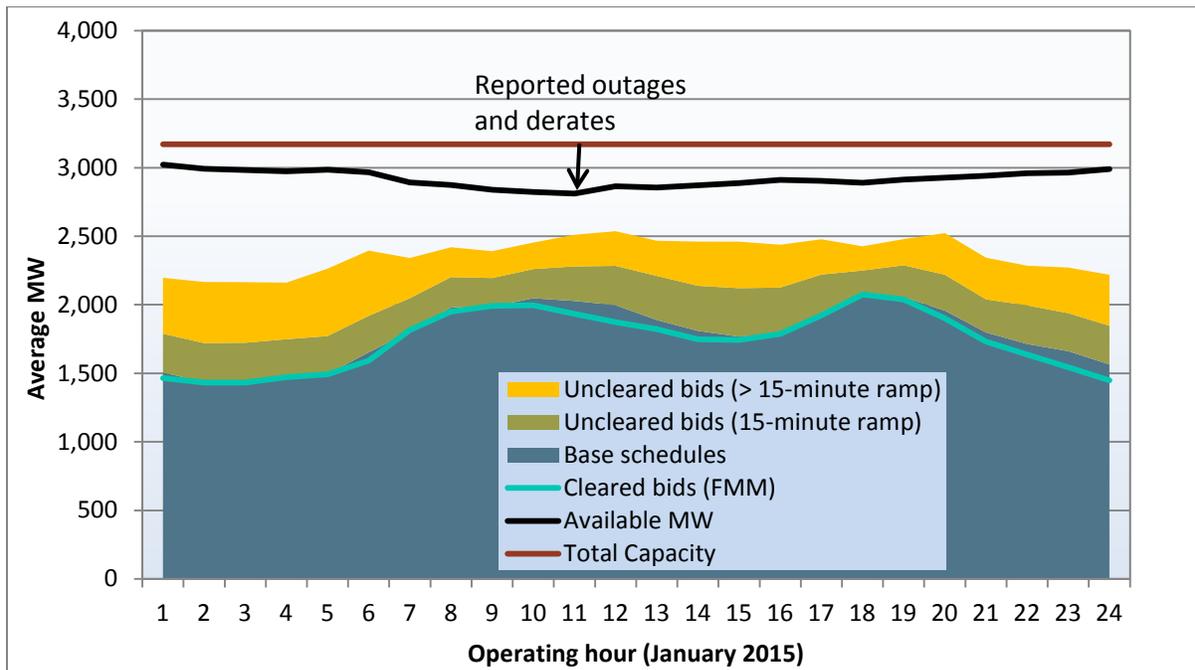
**Figure 4.2 Participating capacity and outages (gas and coal)  
PacifiCorp West**



**Figure 4.3 Average schedules, bids and dispatches by operating hour – January 2015  
PacifiCorp East - 15-minute market (gas and coal units)**



**Figure 4.4 Average schedules, bids and dispatches by operating hour – January 2015  
PacifiCorp West - 15-minute market (gas and coal units)**



For example, the yellow area in Figure 4.3 and Figure 4.4 includes capacity that is bid into the EIM from multi-stage generating units that would only be available if the resource is transitioned to another configuration. The availability of this capacity can often be significantly restricted due to minimum operating times, minimum down times and transition times for different configurations.

Data in this report incorporate outages and de-rates reported to the ISO. DMM has modified its accounting of available MW that were not on outage, but were not bid in. When accounting for this difference, the black line is higher than the yellow area by several hundred MW in both PacifiCorp East and West for much of the day. The larger differences in the off-peak hours can represent gas units that are unavailable as these units cycle off and are then unavailable due to minimum downtime requirements.

Even when accounting for unit cycling, there still tends to be differences between the available capacity and the bid-in capacity. DMM has determined that much of this capacity is related to commitment decisions made in the day-ahead timeframe. Just as the ISO software schedules resources in the day-ahead market, PacifiCorp must also make decisions about day-ahead scheduling. Not all resources are scheduled to meet load. Thus, in addition to outages and de-rates, day-ahead commitment decisions can also limit the availability of longer start resources. However, even with these scheduling decisions, there still appears to be significant capacity available, on average, to meet capacity and ramping needs.

Table 4.1 provides a numerical summary of several metrics derived from the data underlying Figure 4.3 and Figure 4.4. As shown by this analysis, the amount of capacity bid into the EIM continued to generally exceed the amount of energy dispatched in most hours in January.

Since DMM has modified its analysis to include only gas and coal capacity, comparisons with prior reports would not be direct. Overall, however, the following table shows that generally more capacity is scheduled during peak periods compared to off-peak periods. Also, there is more unscheduled capacity in PacifiCorp West compared to PacifiCorp East. This is consistent with DMM's prior findings.

**Table 4.1 Summary of average schedules, bids and dispatches for gas and coal capacity in EIM (January 2015)**

	Percent of nameplate capacity scheduled	Percent of nameplate capacity scheduled+bid	Undispatched bids for incremental energy as percent of base schedules	Undispatched bids as percent of final 15-minute schedules	Undispatched bids as percent of total balancing area load
PacifiCorp East					
Peak	66%	73%	12%	11%	5.8%
Off-peak	57%	63%	12%	10%	5.3%
PacifiCorp West					
Peak	61%	76%	25%	28%	20%
Off-peak	48%	69%	43%	47%	32%

As shown in Figure 4.1 and Table 4.1, in PacifiCorp East:

- An average of about 65 percent of the nameplate rating of participating gas and coal capacity is scheduled to operate to meet base schedules during peak hours and just over 55 percent of capacity is used during off-peak hours.
- During peak hours, a total of about 73 percent of nameplate participating capacity was scheduled or bid into the EIM.
- A majority of the remaining 27 percent of participating nameplate capacity from gas and coal units not bid into EIM during these peak hours represents capacity that was on outage or de-rates. About 55 percent of participating capacity that is available after accounting for outages and de-rates is scheduled or bid into EIM.
- During off-peak hours, the total amount of gas and coal capacity above base schedules bid into the EIM is somewhat lower, so that an average of about 63 percent of participating capacity in PacifiCorp East was scheduled or bid into the EIM. During these off-peak hours, some units are cycled off-line during off-peak hours, and are not bid into the market since they are unavailable due to minimum down times.
- The amount of undispached bids for incremental energy averaged 11 percent of the total amount of energy scheduled and dispatched in the EIM from participating capacity during peak hours and 10 percent in off-peak hours. This is slightly lower than the amount of undispached bids compared to base schedules (12 percent) in the peak and off-peak hours. This reflects the fact that the 15-minute market increased dispatches slightly above base schedules, on average, in January in PacifiCorp East.
- Undispached bids for incremental energy averaged about 5.6 percent of the total load in the PacifiCorp balancing area. This represents additional energy beyond operating reserves and upward regulation capacity. Under the EIM design, the EIM balancing area entity arranges for the capacity needed to meet these requirements but does not schedule this capacity in the EIM.

As shown in Table 4.1, in PacifiCorp West:

- An average of about 61 percent of participating gas and coal capacity is scheduled to operate to meet base schedules during peak and about 48 percent is scheduled during off-peak hours.
- An average of about 76 percent of participating gas and coal capacity was scheduled or bid into the EIM during peak hours, while about 69 percent was scheduled or bid during off-peak hours.
- Undispached bids for incremental energy offered in PacifiCorp West averaged 28 percent and 47 percent of the total amount of energy scheduled and dispatched from gas and coal capacity participating in EIM during peak and off-peak hours, respectively. This is slightly higher than the amount of undispached capacity above base schedules in the peak (25 percent) and off-peak (43 percent) hours. This reflects the fact that the 15-minute market decreased dispatches slightly below base schedules, on average, in January in PacifiCorp West.
- Undispached bids for incremental energy averaged about 20 percent of the total load in the PacifiCorp balancing area during peak hours and 32 percent in off-peak hours. This represents additional energy beyond operating reserves and upward regulation capacity.

## 5 Market bidding and mitigation

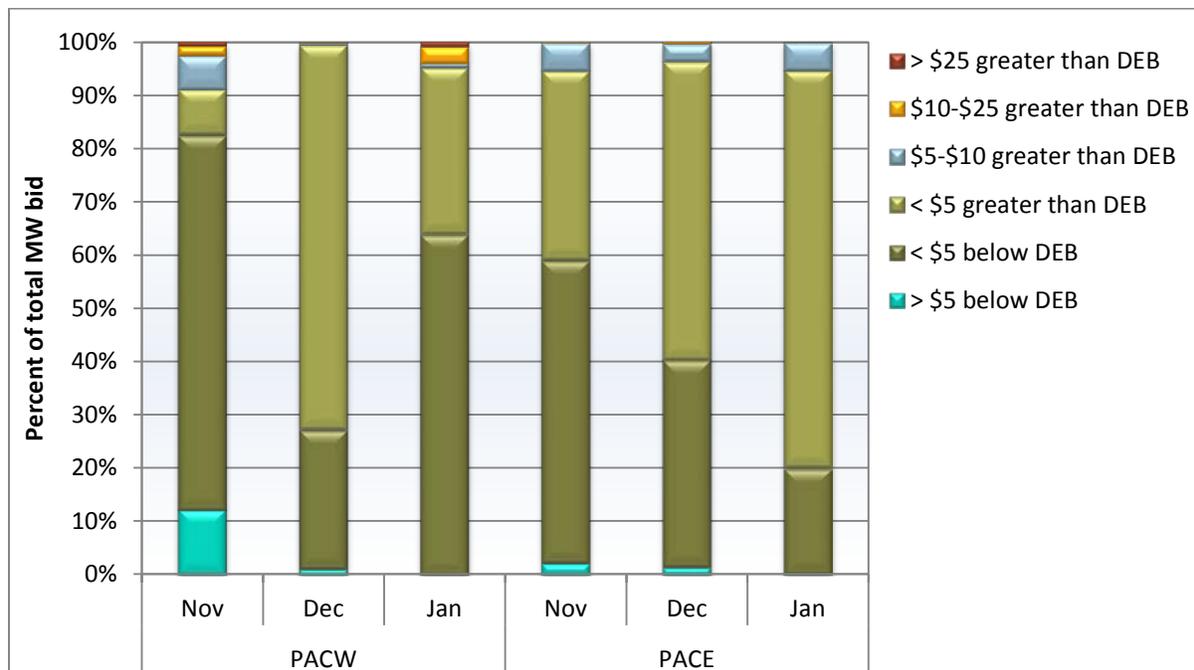
Bidding in the EIM has been highly competitive, with bids for most capacity slightly below or above default energy bids (DEBs) used in market power mitigation. Thus, when relatively high EIM prices have occurred, these prices reflect penalty prices for software constraints rather than bid prices. In addition, when bids are mitigated due to market power mitigation provisions, these procedures generally result in modest reductions in bid prices.

Figure 5.1 summarizes a comparison of bid prices in PacifiCorp East and PacifiCorp West for thermal and hydro units compared to default energy bids used in market power mitigation. These default energy bids are based on the marginal operating costs of thermal resources or opportunity cost for hydro resources with limited energy and energy storage capabilities.

In PacifiCorp East, during January about 20 percent of bids have been less than \$5/MW lower than the default energy bids, with another 75 percent of bids being not more than \$5/MW above default energy bids. Almost all the remaining 5 percent of bids have been no more than \$10/MW above default energy bids.

In PacifiCorp West, during December, about 65 percent of bids have been less than \$5/MW lower than the default energy bids, with another 30 percent of bids being not more than \$5/MW above default energy bids. The remaining bids were typically less than \$25/MW above default energy bids.

**Figure 5.1 Comparison of market bids to default energy bids**



## CERTIFICATE OF SERVICE

I hereby 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 4<sup>th</sup> day of March, 2015.

*/s/ Anna Pascuzzo*  
Anna Pascuzzo