

July 21, 2015

VIA ELECTRONIC FILING

Steven V. King
Executive Director and Secretary
Washington Utilities and Transportation Commission
1300 S. Evergreen Park Drive SW
PO Box 47250
Olympia, WA 98504-7250

RE: Docket UE-151273—Pacific Power & Light Company Comments

Pacific Power & Light Company, a division of PacifiCorp (PacifiCorp or Company), submits the following comments in response to the Washington Utilities and Transportation Commission's (Commission) Notice of Opportunity to File Written Comments and Notice of Workshop (Notice) issued July 10, 2015, in Docket UE-151273.

Benefits to the Company and Customers

Enclosed as Attachment 1 is a copy of the Energy and Environmental Economics (E3) study estimating the PacifiCorp-ISO energy imbalance market (EIM) benefits. Washington customers receive a share of the benefits associated with the PacifiCorp West (PACW) balancing authority area (BAA) participation; however, results were only presented on a PacifiCorp system basis.

Attachment 2 provides the California Independent System Operator's (CAISO) reports of estimated actual benefits from EIM for the fourth quarter of 2014 and the fifth quarter of 2015. These results include separate breakouts for the Company's east and west BAAs.

Market Performance

Root Causes and Actions Taken to Reduce Market Infeasibilities

Attachment 3 contains the following informational reports filed with the Federal Energy Regulatory Commission (FERC) in Docket No. ER15-402.

Dated	Period of EIM Operations	Beginning Page
12/15/14	11/1/14 – 11/30/14	12
01/15/15	12/1/14 – 12/31/14	19
02/19/15	01/01/15 – 02/12/15	21
03/26/15	02/13/15 – 03/16/15	23
04/24/15	03/01/15 – 03/31/15	15
06/03/15	04/01/15 – 04/30/15	15
07/14/15	05/01/15 – 05/31/15	15

These reports identify the root causes and describe the actions the CAISO or PacifiCorp are taking with respect to each root cause to reduce the frequency and severity of market infeasibilities. In reports dated December 15, 2014, through March 26, 2015, please refer to Attachment A for descriptions of issues prompting the pricing waiver, remedial actions taken, status and outstanding items, and Attachment B for descriptions of market performance related to the issues that prompted the CAISO's waiver request. Beginning in the report dated April 24, 2015, and forward, please refer to Attachment B for remedial actions taken and planned by the CAISO and PacifiCorp, and Attachment C for a discussion of whether the cause was due to transitional issues or insufficient supply of resources bid into the EIM, including the time of the instance, the duration, the cause, and the affected node(s) and load. The document was reorganized and refined beginning with the April 24, 2015 report in compliance with FERC's March 16, 2015 order in Docket Nos. ER15-861 and EL15-53.

Reduction in Market Infeasibilities

Enclosed as Attachment 4 is CAISO's comments regarding a proposed operational solution to reduce market infeasibilities, which was filed with FERC on April 23, 2015, in Docket No. EL15-53.

PacifiCorp is confident that the operational solution proposed by the CAISO will substantially reduce the remaining price infeasibilities from the already low levels that occurred at initial go-live. There is always the possibility of limited pricing infeasibilities due to true scarcity, which could occur, for example, if a participating resource failed to respond to a dispatch operating target.

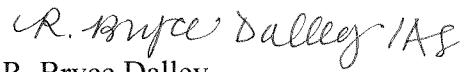
Company Actions to Further Reduce Market Infeasibilities

Actions that the Company is undertaking to reduce infeasibilities are increasing the number of participating resources to increase market depth, improving data transfers and interface of information between systems to reduce discrepancies in data, and improving display of information for better system awareness.

When known issues are resolved, planned enhancements are implemented, and the EIM footprint is expanded, it is reasonable to expect sustained infeasibilities to disappear. Momentary infeasibilities will likely continue due to variability of real-time system conditions and the reliance of the market on accurate and timely data as these conditions change. The Company continues to work with the CAISO on improving the management of data and the tools for operators to respond to changing conditions.

PacifiCorp appreciates the opportunity to provide these comments and looks forward to the workshop scheduled for July 30, 2015. If you have any questions regarding these comments, please contact Ariel Son, Manager, Regulatory Projects, at (503) 813-5410.

Sincerely,

A handwritten signature in cursive script that reads "R. Bryce Dalley" followed by a stylized flourish.

R. Bryce Dalley
Vice President, Regulation

Enclosures

Attachment 1: E3 Study—PacifiCorp-ISO Energy Imbalance Market Benefits

Attachment 2: CAISO Reports—Benefits for Participating in EIM (February 11, 2015 report and April 30, 2015 report)

Attachment 3: Informational reports filed with FERC in Docket No. ER15-402.

Attachment 4: April 23, 2015 CAISO Comments

Attachment 1

PacifiCorp-ISO Energy Imbalance Market Benefits

March 13, 2013



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Attachment: Technical Appendix

Executive Summary

This report examines the benefits of an energy imbalance market (EIM) between PacifiCorp and the California Independent System Operator (ISO). This report focuses on estimated potential EIM benefits with the low range reflecting a scenario in which assumptions were chosen to be conservative. The full range of estimated EIM benefits in this report for the year 2017 is \$21 million to \$129 million (2012\$). Preliminary cost estimates (based on previous studies) of setting up the EIM range from \$3 million to \$6 million, with an estimated annual cost of \$2 million to \$5 million.

The report supports the conclusion that the two-party EIM provides a low-cost, low-risk means of achieving operational savings for both PacifiCorp and ISO and enabling greater penetration of variable energy resources. The report further supports that the benefits of the EIM would increase to the extent that: (1) operational changes can be made to support the EIM, such as increased transmission transfer capabilities between PacifiCorp and ISO; and (2) additional entities join the EIM, thus bringing incremental load and resource diversity, transfer capability, and flexible generation resources that would further reduce costs for customers.



Changes in the electricity industry in the Western U.S. are making the need for greater coordination among balancing authorities (BAs),¹ such as through an EIM, increasingly apparent. Renewable portfolio standards already enacted in Western states are expected to result in some 60,000 MW of wind, solar, geothermal, and other renewable generation in the Western Interconnection by 2022, comprising approximately 15% of total electric energy.²

Recent studies have suggested that it will be possible to reliably operate the current western electric grid with high levels of variable generation, but doing so may require supplementing the hourly bilateral markets used in the West toward shorter scheduling timescales and greater coordination among western BAs. Greater coordination would allow BAs to pool load, wind, and solar variability and reduce flexibility reserve requirements, and would increase flexibility and reduce renewable curtailment.

In response, several regional initiatives, studies, and groups have emerged to explore innovations for scheduling and coordination. These include reforms being assessed as part of the Western Electric Coordinating Council's Efficient Dispatch Toolkit (EDT) initiative, an effort by a group of public utility commissions to explore an EIM for the West, and an ongoing Northwest Power Pool initiative to analyze the benefits of an EIM or other forms of regional coordination for the Pacific Northwest region.

As an extension of these efforts, in February 2013 PacifiCorp and ISO signed a memorandum of understanding to pursue an EIM. Energy and Environmental Economics,

¹ A balancing authority (BA) is a responsible entity that integrates resource plans ahead of time, maintains load-interchange-generation balance within a balancing authority area, and supports Interconnection frequency in real time. A balancing authority area (BAA) is the collection of generation, transmission, and loads within the metered boundaries of a balancing authority, which maintains load-resource balance within this area.

² These renewable capacity and energy projections are from the Western Electricity Coordinating Council's Transmission Expansion Planning Policy Committee (TEPPC) 2022 Common Case; see <http://www.wecc.biz/Lists/Calendar/Attachments/4057/2022%20Common%20Case%20-%20Webinar%205.pdf>.

Inc. (E3), a consulting firm, was retained by ISO to assess the EIM's potential benefits. This report documents E3's findings.

The EIM under consideration is a balancing market that optimizes generator dispatch within and between balance authority areas (BAA)³ every five minutes by leveraging the existing ISO real-time dispatch market functionality. It does not replace the day-ahead or hourly markets and scheduling procedures that exist today. The ISO outlined the structure of such an EIM in a recent proposal to the Western Governors Association and the Public Utilities Commissions Energy Imbalance Market (PUC-EIM) Task Force.⁴

An EIM covering PacifiCorp and ISO would allow both parties to improve dispatch efficiency and take advantage of the diversity in loads and generation resources between the two systems, reducing production costs, operating reserve requirements, and renewable generation curtailment. Specifically, the creation of a PacifiCorp-ISO EIM would yield the following four principal benefits:

- + *Interregional dispatch savings*, by realizing the efficiency of combined 5-minute dispatch, which would reduce “transactional friction” (e.g., transmission charges) and alleviate structural impediments currently preventing trade between the two systems;
- + *Intraregional dispatch savings*, by enabling PacifiCorp generators to be dispatched more efficiently through the ISO's automated system (nodal dispatch software), including benefits from more efficient transmission utilization;

³ See footnote #1

⁴ See CAISO, “CAISO Response to Request from PUC-EIM Task Force,” March 29, 2012, <http://www.westgov.org/PUCEim/documents/CAISOcewa.pdf>; CAISO, “Energy Imbalance Protocols (Revised to Support CAISO Cost Estimate for PUC-EIM)”, January 24, 2013, <http://www.westgov.org/PUCEim/documents/CAISOrcp.pdf>.

- 
- + *Reduced flexibility reserves*, by aggregating the two systems' load, wind, and solar variability and forecast errors; and
 - + *Reduced renewable energy curtailment*, by allowing BAs to export or reduce imports of renewable generation when it would otherwise need to be curtailed.

These benefits are indicative but not exhaustive. A recent report by staff to the Federal Energy Regulatory Commission identifies non-quantified reliability benefits that will also arise. These include enhanced situational awareness, security constrained dispatch, faster delivery of replacement generation after the end of contingency reserve sharing assistance, and enhanced integration of renewable resources.⁵

E3 estimated benefits from a PacifiCorp-ISO EIM using the GridView⁶ production simulation software to simulate operations of the Western Interconnection with and without the EIM in the year 2017. This year was selected to represent likely system conditions within the first several years after the EIM becomes operational. E3's analysis incorporated California's greenhouse gas regulations, and the associated dispatch costs.

The GridView results are sensitive to several key assumptions and modeling parameters. These include: limits on the transmission transfer capabilities between PacifiCorp and ISO, and the extent to which unloaded hydroelectric capacity is allowed to contribute toward contingency and flexibility reserve requirements. E3's analysis of EIM benefits is also sensitive to the assumed level of savings from moving to nodal dispatch in PacifiCorp and the amount of renewable energy curtailment that could be reduced through the EIM.

⁵ Staff of the Federal Energy Regulatory Commission, 2013, "Qualitative Assessment of Potential Reliability Benefits from a Western Energy Imbalance Market," February 26.

⁶ GridView is ABB's production simulation software.

E3 developed several scenarios to address key uncertainties in the modeling of EIM benefits. These scenarios explore a wide range of potential benefit levels to reflect both the limitations of existing tools to characterize all of the changes to system operations that would occur under an EIM, particularly in the modeling of hydropower, reserves, and renewable curtailment, greenhouse gas regulation, and uncertainties about the extent to which future industry developments would allow cost savings to occur both with and without an EIM. The scenarios were developed around three assumptions of transfer capability between PacifiCorp and ISO: low (100 MW), medium (400 MW), and high (800 MW). Within each scenario, E3 modeled a low and high range of benefits. The assumptions for the low and high range estimates are shown in Table 1.

Table 1. Low and high range assumptions under low (100 MW), medium (400 MW), and high (800 MW) PacifiCorp-ISO transfer capability scenarios

Assumption	Low transfer capability		Medium transfer capability		High transfer capability	
	Low range	High range	Low range	High range	Low range	High range
Maximum hydropower contribution to contingency and flexibility reserves*	25%	12%	25%	12%	25%	12%
Share of intraregional dispatch savings achieved	10%	100%	10%	100%	10%	100%
Share of identified renewable energy curtailment avoided	10%	100%	10%	100%	10%	100%

* Percent of nameplate capacity for each project

Across these scenarios, E3 estimated that a PacifiCorp-ISO EIM would generate total annual cost savings (in 2012 \$) of \$21-129 million in 2017, with PacifiCorp and ISO both benefitting. Table 2 shows the range of benefits by category for each scenario.

Table 2. Low and high range annual benefits under low (100 MW), medium (400 MW), and high (800 MW) PacifiCorp-ISO transfer capability scenarios (million 2012\$)

Benefit Category	Low transfer capability		Medium transfer capability		High transfer capability	
	Low range	High range	Low range	High range	Low range	High range
Interregional dispatch	\$14.1	\$11.0	\$22.3	\$17.7	\$22.4	\$17.8
Intraregional dispatch	\$2.3	\$23.0	\$2.3	\$23.0	\$2.3	\$23.0
Flexibility reserves	\$4.0	\$20.8	\$11.0	\$51.3	\$13.4	\$77.1
Renewable curtailment	\$1.1	\$10.8	\$1.1	\$10.8	\$1.1	\$10.8
Total benefits	\$21.4	\$65.6	\$36.7	\$102.8	\$39.2	\$128.7

Notes: Individual estimates may not sum to total benefits due to rounding. Section 2.4 describes why interregional dispatch savings are lower in the high range than the low range.

The benefit estimates described in this report are gross benefits and are not net of estimated costs. Because the EIM would make use of ISO's existing dispatch software, the initial cost is expected to be low when compared to these benefits. E3 did not conduct an independent analysis of the cost of establishing and operating an EIM. Based on ISO's estimates of market operator costs, PacifiCorp would incur a one-time fixed charge of approximately \$2.1 million.⁷ A separate study of a WECC-wide EIM estimated that each EIM market participant would also incur one-time capital costs of \$1-4 million for software, hardware, and other related investments.⁸ Annual costs to operate the PacifiCorp-ISO EIM are estimated to be on the order of \$2-5 million.⁹

⁷ Based on estimates from CAISO staff.

⁸ WECC, 2011, "WECC Efficient Dispatch Toolkit Cost-Benefit Analysis (Revised)," WECC White Paper, p. 62, <http://www.wecc.biz/committees/EDT/EDT%20Results/EDT%20Cost%20Benefit%20Analysis%20Report%20-%20REVISED.pdf>.

⁹ This estimate is comprised of CAISO estimate of \$1.35 million per year in administrative charges to PacifiCorp plus additional PacifiCorp costs of \$1-4 million per year in staffing and other operating costs for an EIM market participant.

1 Introduction

1.1 Background and Goals

PacifiCorp and ISO have been active participants in an ongoing regional effort to enhance bulk power operations to achieve cost savings for customers and facilitate the integration of higher levels of renewable generation. In response, PacifiCorp and ISO have been funding, participating in, and observing a number of regional and national initiatives, studies, and groups aimed at enhancing access to needed flexible resources, application of automated tools to manage resources and products that balance variable generation, and more effective utilization of existing and new transmission facilities. These efforts include:

- + The 2008 Western Executive Industry Leaders (WEIL) study, which identified economic opportunities to lower renewable procurement costs across the Western Interconnection;¹⁰
- + Two recent (2011 and 2012) studies of an EIM covering all of the Western Interconnection except for ISO and the Alberta Electric System Operator, one coordinated by WECC and another by the PUC-EIM Group (see Section 3.2);
- + Two studies examining intra-hour scheduling in the Western Interconnection, one for the WECC's Variable Generation Subcommittee and another for the Northwest Power Pool (see Section 3.2);

¹⁰ See http://www.weilgroup.org/E3_WEIL_Complete_Study_2008_082508.pdf for the full report.

- + A Joint Initiative among Columbia Grid, Northern Tier Transmission Group, and WestConnect on a dynamic scheduling system, an intra-hour transaction accelerator platform, and intra-hour transmission scheduling;¹¹ and
- + The North American Electric Reliability Corporation's (NERC's) ongoing Integration of Variable Generation Task Force (IVGTF).¹²

Building on their involvement in these efforts, PacifiCorp and ISO undertook a joint study to evaluate the potential benefits of an EIM covering their service areas. E3 was retained to identify and quantify the benefits of this potential EIM, and to examine the allocation of benefits between PacifiCorp and ISO.

This report describes E3's methods and findings. Throughout the study process, E3 worked closely with both PacifiCorp and ISO to develop scenario assumptions, validate the approach, and estimate benefits consistent with how each party believes its system operates today and would operate in the future under each of the defined scenarios.

1.2 Structure of this Report

The remainder of the report is organized as follows. Section 2 identifies key assumptions (2.1), specifies methods (2.2) and scenarios (2.3), and presents benefits (2.4) and benefit attribution (2.5) for the analysis. Section 3 provides context for interpreting the results, describing where the assumptions lie along a conservative-moderate-aggressive spectrum (3.1) and how the results compare against other EIM studies (3.2). The report also contains a technical appendix that describes modeling assumptions and methods in more detail.

¹¹ For documents related to this process, see <http://www.columbiagrid.org/ji-nttg-wc-documents.cfm>.

¹² For task force materials, see <http://www.nerc.com/filez/ivgtf.html>.

2 EIM Analysis

2.1 Key Assumptions

2.1.1 WHAT IS AN EIM AND WHAT WOULD IT DO?

The EIM considered in this study would consist of a voluntary, sub-hourly market covering the PacifiCorp West, PacifiCorp East, and ISO BAAs. EIM software would automatically dispatch imbalance energy from generators voluntarily offering their resource for dispatch across these BAAs every five minutes using a security-constrained least-cost dispatch algorithm. By providing an interregional market for intra-hour imbalance energy, the EIM would complement PacifiCorp's existing procedures for transacting in the ISO's hour-ahead and day-ahead markets. This study assumes that the ISO hour-ahead and day-ahead markets will remain unchanged and that PacifiCorp will continue its existing operational plans to serve its load, arrangements for unit commitment, contingency reserves, regulation, regional reserve sharing agreements, and other BA responsibilities.

The EIM is expected to lead to four principal changes in system operations for PacifiCorp and ISO:

- + **More efficient interregional dispatch.** The EIM would allow more efficient use of generators and the transmission systems in PacifiCorp and ISO by removing transmission rate and structural impediments between BAAs, eliminating



within-hour limitations, and enabling more efficient dispatch between the two systems relative to hourly scheduling.

- + **More efficient intraregional dispatch in PacifiCorp.** The EIM's nodal dispatch software would improve the efficiency of PacifiCorp's system dispatch by better reflecting transmission constraints and congestion within PacifiCorp.
- + **Reduced flexibility reserve requirements in PacifiCorp and ISO.** By pooling variability in load and wind and solar output, PacifiCorp and ISO would each reduce the quantity of reserves required to meet flexibility needs.
- + **Reduced renewable energy curtailment in ISO.** By allowing generators in PacifiCorp's BAAs to reduce output when ISO faces an "over-generation" situation, an EIM would reduce the amount of renewable energy ISO would otherwise need to curtail.

This study calculates the benefits associated with these changes by comparing the total cost of operating the combined ISO and PacifiCorp systems under two cases: (1) a Benchmark Case, representing continuation of current scheduling and operating practices under "business-as-usual," and (2) an EIM Case, in which an EIM is established encompassing the PacifiCorp and ISO BAAs. The cost difference between the Benchmark Case and the EIM Case represents the total benefits of an EIM. The study also provides a high-level estimate of how these benefits might be apportioned among the ISO and PacifiCorp systems.

2.1.2 EIM COSTS

The costs of an EIM include those borne by the market operator to set up and operate the EIM, and those borne by market participants to participate in the EIM. The EIM requires some expansion of ISO's modeling and software capabilities, but by using ISO's

existing software, initial costs are significantly reduced relative to what they would be if new software development were needed.

Additional hardware and organizational costs may also be required. For instance, PacifiCorp may need to purchase some new metering or communications hardware to enable effective communication between parties. PacifiCorp may also seek some amount of staff training and organizational development to more fully take advantage of the market opportunities offered by the EIM.

ISO has estimated the costs of setting up and operating an EIM, as part of its engagement with ongoing regional EIM initiatives. ISO's proposed operator charges for the EIM use a "pay-as-you-go" approach, which allows the EIM to expand as new market participants join. The one-time upfront charge covers the cost of making the modeling, systems, and other preparations to include an entity in the EIM, and depends on the size of the BAA. Ongoing administrative charges cover costs to operate the EIM, and are based on the same cost structure as ISO's existing grid management charge and the EIM participant's level of usage. For a PacifiCorp-ISO EIM, ISO estimates that PacifiCorp would incur a one-time fixed charge of approximately \$2.1 million and \$1.35 million per year in administrative charges.¹³

Independent estimates of market participant costs were not developed for this study. A WECC-sponsored study of EIM costs estimated that each market participant would incur total capital startup costs of \$1-4 million and operating costs of \$1-4 million per year.¹⁴

¹³ Based on estimates from CAISO staff. Administrative charges per participant will likely fall as the number of participants grows. Other cost and risk allocation issues associated with the EIM, and the rules to address these issues, will be considered in a 2013 stakeholder process.

¹⁴ WECC, 2011, "WECC Efficient Dispatch Toolkit Cost-Benefit Analysis (Revised)," WECC White Paper, p. 62, <http://www.wecc.biz/committees/EDT/EDT%20Results/EDT%20Cost%20Benefit%20Analysis%20Report%20-%20REVISED.pdf>.



In this case, PacifiCorp is assumed to be the only incremental market participant and no incremental costs would be required for existing ISO market participants.

Using these preliminary estimates of market operator and market participant costs, total fixed and operating costs for the PacifiCorp-ISO EIM would be on the order of \$3-6 million (one-time startup costs) and \$2-5 million per year (annual operating costs), respectively. PacifiCorp and ISO are actively working to develop specific start up and operating costs as part of initial efforts under the memorandum of understanding.

2.1.3 KEY MODELING ASSUMPTIONS

Five key modeling assumptions are important for understanding the results in this study: 1) the use of hurdle rates, (2) hourly dispatch, (3) the treatment of flexibility reserves, (4) transfer capability limits between PacifiCorp and ISO, and (5) limits on hydropower contributions to reserves. This section provides a brief overview of the rationale for these assumptions.

2.1.3.1 Hurdle rates

Within the Western Interconnection's bilateral markets, there are a number of impediments to efficient trade of energy across BAA boundaries. These include:

- + The need, in some cases, for market participants to acquire point-to-point transmission service in order to schedule transactions from one BAA to another;
- + The current practice of some transmission providers requiring short-term transactions to provide real power losses for each transmission provider system that is utilized, resulting, in some cases, in multiple or “pancaked” losses requirements; and

- + Inefficiencies due to illiquid markets and imperfect information, such as the standard 16-hour “Heavy-Load Hour” and 8-hour “Light-Load Hour” day-ahead trading products defined by the Western Systems Power Pool, minimum transaction quantities of 25 MW, and the bilateral nature of transaction origination and clearing, among others.

In production simulation modeling, these impediments to trade are typically represented by “hurdle rates,” \$/MWh price adders that inhibit power flow over transmission paths that cross BAA boundaries. In this analysis, E3 used hurdle rates that were benchmarked to historical data, so that hourly power flows on major WECC paths in the simulation approximate the historical flow levels on those paths during a historical test year.¹⁵

An EIM would perform a security-constrained, least-cost dispatch across the entire EIM footprint for each 5-minute settlement period, eliminating the barriers listed above at the 5-minute timestep. This is represented in production simulation modeling by the removal of hurdle rates, which allows for more efficient (i.e., lower cost) dispatch.

2.1.3.2 Hourly dispatch

While a PacifiCorp-ISO EIM would likely operate on a 5-minute timestep, E3 used GridView simulation runs with an hourly timestep to estimate the change in operating costs associated with an EIM. This was done in order to simplify the computational process and reduce model runtime, and because of the limited quantity of high-temporal resolution data available for the Western Interconnection.

¹⁵ This analysis used benchmarked hurdle rates from the WECC EIM study. See [http://www.wecc.biz/committees/EDT/Documents/E3_EIM_Benefits_Study-Phase_2_Report_RevisedOct2011_CLEAN2\[1\].pdf](http://www.wecc.biz/committees/EDT/Documents/E3_EIM_Benefits_Study-Phase_2_Report_RevisedOct2011_CLEAN2[1].pdf), pp 41-43.



This assumption introduces two potentially offsetting modeling inaccuracies. On the one hand, since hourly operations would continue to be performed using today's operating practices, the use of an hourly timestep might overestimate the potential benefits of an EIM, because changes in dispatch that are feasible on an hourly timestep might not be feasible on a 5-minute timestep due to ramping limitations. On the other hand, this method excludes: (1) savings due to more efficient dispatch of resources to meet net load variations inside the operating hour; and (2) savings from reductions in costs to meet potential intra-hour ramping shortages. Other studies have indicated that sub-hourly dispatch benefits may be substantial. Those benefits would be additive to the benefits reported here.

2.1.3.3 Flexibility reserves

BAs hold reserves to balance discrepancies between forecasted and actual load within the operating hour. These “flexibility” reserves are in addition to the spinning and supplemental reserves carried against generation or transmission system contingencies.¹⁶ Flexibility reserves generally fall into two categories: *regulation* reserves automatically respond to control signals or changes in system frequency on a time scale of a few cycles up to five minutes, while *load following* reserves provide ramping capability to meet changes in net loads between a 5-minute and hourly timescale.

Higher penetration of wind and solar energy increases the amount of both regulation and load following reserves needed to accommodate the uncertainty and variability inherent in these resources while maintaining acceptable balancing area control

¹⁶ This study assumes that contingency reserves would be unaffected by an EIM and that PacifiCorp would continue to participate in its existing regional reserve sharing agreement for contingency reserves in all scenarios.

performance. By pooling load and resource variability across space and time, total variability can be reduced, decreasing the amount of flexibility reserves required to ensure reliable operations. This reduces operating costs by requiring fewer thermal generators to be committed and operated at less efficient set points.

For this study, E3 performed statistical calculations of the quantity of flexibility reserves that would be required in both the Benchmark Case and the EIM Case. The reserve quantities are a function of the variability and uncertainty of the within-hour net load signal. These requirements decline when the calculations are performed for a larger geographic area and a more diverse portfolio of wind and solar resources. In keeping with the 5-minute operational timestep of a potential EIM, E3 assumed that the diversity benefit from an EIM results in savings from reduced load following reserves, but not regulation reserves. Other contingency reserves (spin and non-spinning reserves) were assumed not to change under the EIM operation.

There are two implicit assumptions embedded in this approach: (1) that PacifiCorp and ISO would carry the calculated levels of flexibility reserves in the Benchmark Case, and (2) the EIM would include a mechanism to take advantage of increased net load diversity by reducing the quantities of flexibility reserves that would need to be carried. With regard to the first assumption, while there is currently no defined requirement for BAs to carry load following reserves, all BAs must carry load following reserves in order to maintain control performance standards within acceptable bounds, and reserve requirements will grow under higher renewable penetration scenarios. ISO is in the process of introducing a “flexi-ramp” product for this purpose.

With regard to the second assumption, while the specific design of a potential PacifiCorp-ISO EIM has not been finalized, it is logical to assume that ISO’s flexi-ramp



requirements would be calculated in such a way as to maximize diversity benefits across the entire EIM footprint, within the context of its 5-minute operational timestep. However, it should be noted that this mechanism may not be in place at the time EIM becomes operational, and the ISO and PacifiCorp may require a period of operational experience before the full benefits of flexibility reserve savings can be achieved.

2.1.3.4 Transmission transfer capability

PacifiCorp has several interconnections and contract transmission rights between the ISO and both the PacifiCorp East and PacifiCorp West BAAs that can potentially be utilized for EIM activity. Each interconnection has unique capabilities to facilitate beneficial interchange based upon existing facilities, path operators, legacy agreements, and incremental costs. Initiatives are underway to maximize the potential at each interconnection for the EIM.

Transmission transfer capability limits between PacifiCorp and ISO will constrain EIM benefits. These limits can be physical or contractual. If the transmission paths connecting PacifiCorp and ISO are congested, generators in PacifiCorp will not be able to provide additional imbalance energy to ISO, and vice versa. PacifiCorp and ISO anticipate initially relying on PacifiCorp transmission contract rights to the ISO to facilitate EIM transactions, as opposed to a “flow-based” transmission optimization, similar to those in use in the ISO and other organized markets, that would be unconstrained by contract limitations.

While reliance on existing contract path scheduling mechanisms will prevent achievement of full benefits at EIM startup, transmission transfer capability and associated EIM benefits would increase through potential contractual changes, new transmission construction, operational changes such as WECC-wide 15-minute

scheduling, and the addition of other EIM participants. In particular, as additional market participants join the EIM and a larger contiguous EIM area is formed, flow-based transmission usage will be explored, along with methods to limit impact to non-participating transmission systems. Flow-based transmission usage is expected to increase benefits to EIM market participants. In addition, a mechanism to increase the flexibility of existing transmission for intra-hour use could be pursued to increase the transfer capabilities and increase the value of EIM.

This report provides a range of benefits based, in part, on three different potential interchange capabilities between PacifiCorp and ISO, specifically 100, 400, and 800 MW.¹⁷ The two parties have agreed in the memorandum of understanding to conduct an initial review of contracts. The findings from the ongoing review, collaboration with neighboring transmission path operators, and additional certainty on market design will inform total interconnection capabilities in the short-term as well as specific opportunities to add to those capabilities over time. The model also incorporates a 200 MW limit on east to west transfers between the PacifiCorp East and PacifiCorp West BAAs. For reduced renewable curtailment, E3 assumed that this transfer capability would not pose a constraint, given the relatively small quantity of curtailed energy in question.

¹⁷ For simplicity of modeling, transmission transfer capabilities are modeled at the California-Oregon Intertie (COI). This is a proxy used to demonstrate a general level of increased benefit with increasing interconnection capabilities, which may occur on other paths.

2.1.3.5 Limits on hydropower contributions to flexibility reserves

Cost savings from reduced flexibility reserves are sensitive to assumptions about the availability of hydropower to provide reserves. Dispatchable hydroelectric resources only rarely generate at levels that approach maximum nameplate capacity due to limitations on water available for power generation. On many facilities, a portion of the “unloaded” capacity — the difference between the nameplate capacity and the actual generation — can be used to provide contingency and flexibility reserves. However, this unloaded capacity varies by facility and with continually-fluctuating river conditions, making it challenging to generalize for modeling purposes. This leads to uncertainty in the calculation of operating costs using production simulation models.

In order to address this uncertainty, E3 developed a range regarding the ability of hydro to provide flexibility reserves, which affect a significant component of potential EIM savings. In the high range, E3 assumed that up to 12% of the total nameplate capacity of hydropower generation is available to provide flexibility reserves, while in the low range, E3 assumed that up to 25% of hydropower nameplate capacity is available to provide flexibility reserves.¹⁸ EIM benefits are higher in the case where hydro’s ability to provide flexibility reserves is restricted, because a higher proportion of reserves are being provided by thermal resources that can be optimized using the EIM dispatch software. Conversely, there are fewer cost savings available in the case where hydro provides a larger quantity of flexibility reserves with little, if any, variable cost.

¹⁸ The two scenarios used here reflect the low and high ends of a plausible range of values based on CAISO and PacifiCorp experience.

2.2 Methods

2.2.1 INTERREGIONAL DISPATCH SAVINGS

An EIM would reduce transactional friction between PacifiCorp and ISO and thus enable improved resource dispatch efficiency and reduced cost to serve load in both systems. E3 estimated these interregional dispatch savings by running parallel production cost simulations using GridView: one with a PacifiCorp-ISO EIM (EIM Dispatch Case) and one without the EIM (Benchmark Case).

The Benchmark Case simulates status quo operational arrangements, and includes hurdle rates to represent economic and non-economic barriers to trade, such as transmission tariff rates, losses, and lack of market liquidity. The EIM Dispatch Case simulates operations with an EIM in place by eliminating these hurdle rates between PacifiCorp and ISO, resulting in more efficient energy dispatch and lower production costs.¹⁹ Interregional dispatch savings from an EIM are measured as the difference in production costs between the Benchmark and EIM Dispatch Cases. In eliminating hurdle rates, E3 implicitly assumed that no variable transmission costs are incurred for EIM transactions.

To calculate the interregional dispatch savings, E3 developed GridView production cost estimates for two cases. The first, a Benchmark Case, assumes hurdle rates are in place. The second, an EIM Dispatch Case, assumes alternately that there is 100, 400, and 800 MW of transmission transfer capability between the PacifiCorp and ISO systems, and that EIM transactions using this capability pay no hurdle rates. E3 scaled the

¹⁹ Only hurdle rates between PacifiCorp –West and ISO have been adjusted from the benchmark case. Hurdle rates were also used to simulate the need for market participants to acquire CO₂ allowances when delivering “unspecified” electric energy into California. These CO₂-related hurdle rates were kept in place for both the Benchmark and the EIM Dispatch Cases.



interregional dispatch savings for lower levels of transmission transfer capability (100 MW and 400 MW) by assuming that the benefits are proportional to the change in intertie flows resulting from the EIM at each level of transfer capability.²⁰

2.2.2 INTRAREGIONAL DISPATCH SAVINGS

In bilateral markets, load serving entities (LSEs) like PacifiCorp seek to minimize the cost of serving their loads through a combination of dispatching their own resources and trading energy subject to the physical limitations of the transmission system. This can result in significant additional dispatch costs to manage transmission congestion within the LSE's own service territories. In a nodal market, all transmission constraints are considered when determining optimal commitment²¹ and dispatch of generators, and the efficient use of the transmission system.

While ISO currently uses nodal dispatch, PacifiCorp's unit commitment and dispatch do not take full advantage of all sub-hourly cost saving opportunities. A PacifiCorp-ISO EIM would provide 5-minute nodal price signals to generation resources throughout the EIM area, thus enabling more optimal generation and transmission dispatch in the PacifiCorp area. These efficiency improvements cannot be captured using the GridView software, which assumes perfectly efficient operations within each area.

To quantify the cost savings from using ISO's nodal dispatch software within PacifiCorp's BAAs, E3 assumed these savings would be proportional to the estimated savings from

²⁰ Scaling factors of 0.617 (12% hydropower reserve cap) and 0.628 (25% hydropower reserve cap), applied to the 800 MW results, were used for the 100 MW transfer capability scenario, based on estimated changes in intertie flows. A 0.997 scaling factor, applied to the 800 MW results, was used in the 400 MW case for both hydropower assumptions.

²¹ Under an EIM, commitment would remain the responsibility of the BA. An EIM would provide optimal real-time dispatch, but would not address commitment.

ISO's own transition to nodal pricing that occurred in 2009.²² By assuming estimated cost savings scale with peak load, the benefits from nodal dispatch in PacifiCorp for 2017 would be:

$$\text{PacifiCorp 2017 savings} = \text{CAISO 2009 savings} * \frac{\text{PAC 2017 peak load}}{\text{CAISO 2009 peak load}}$$

or

$$\text{PacifiCorp 2017 savings} = \frac{\$105 \text{ MM}}{\text{yr}} * \frac{10,079 \text{ MW}}{45,486 \text{ MW}} = \frac{\$23 \text{ MM}}{\text{yr}}$$

Because there is some uncertainty about the extent to which ISO's nodal dispatch software will produce dispatch cost savings from PacifiCorp's generation, this study examines alternative low and high scenarios. In the low range scenario, the EIM is assumed to achieve 10% of the total \$23 million of available cost savings, which were calculated based on an hourly analysis. This assumption stems from the ISO's experience that its balancing market clears transactions totaling approximately 10% of total load. In the high range scenario, the EIM is assumed to achieve 100% of the total \$23 million of available cost savings. This scenario implicitly assumes that 5-minute EIM prices will inform market transactions that occur on an hourly basis, allowing more savings than would occur based only on the amount of imbalance energy clearing in the 5-minute market. As the non-EIM forward market becomes better informed by the EIM market, E3 would expect that the real-time nodal market applied to PacifiCorp would result in more than 10% savings.

²² See Frank A. Wolak, 2011, "Measuring the Benefits of Greater Spatial Granularity in Short-Term Pricing in Wholesale Electricity Markets, *American Economic Review* 101: 247-252. The estimates in this study are estimated annual cost reductions that resulted from the introduction of nodal pricing in California.

2.2.3 REDUCED FLEXIBILITY RESERVES

Currently, PacifiCorp and ISO meet their operating reserve requirements by procuring and utilizing existing generating capacity within their respective BAAs. An EIM would lower the total cost of procuring and utilizing flexibility reserves for both entities in two ways: (1) reducing flexibility reserve requirement quantities by combining PacifiCorp and ISO's forecast error for load and variable generation; and (2) enabling flexibility reserves to be procured from thermal or hydro resources anywhere in the EIM footprint, subject to transmission constraints. The result is that the combined cost of procuring flexibility reserves with an EIM is less than it would be if each entity procured them independently.

E3 estimated the cost savings from reduced flexibility reserves using the following three steps. First, flexibility reserve requirements were calculated for PacifiCorp and ISO as separate areas (Benchmark Case) and then again as a combined area (EIM Flexibility Reserve Case).²³ Flexibility reserve requirements were calculated separately for each hour using three years of 10-minute load, wind, and solar data for PacifiCorp and ISO. Calculations in the EIM Flexibility Reserve Case were constrained so that reductions in flexibility reserve requirements were less than or equal to the assumed transfer capability between PacifiCorp and ISO.

Next, E3 applied the flexibility reserve requirement calculations from above to production cost simulation runs for each case, using GridView. In the Benchmark Case and EIM Dispatch Cases, PacifiCorp and ISO must procure flexibility reserves from capacity located in their respective BAs to meet the requirements calculated for each

²³ These results, when scaled back from 2017, are similar in size to the levels of reserves procured in each jurisdiction today for regulation and load following.

entity. In the EIM Flexibility Reserve Case, all PacifiCorp and ISO generation is eligible to meet the single flexibility reserve requirement for the EIM footprint, subject to transfer constraints.

Table 3 shows E3's estimates of the combined minimum reserve requirements for PacifiCorp and ISO under the EIM. The standalone case represents no transfer capability between PacifiCorp and ISO, and is comprised of 608 MW of required reserves in PacifiCorp and 1,403 MW in ISO. As the Table shows, increasing transfer capability allows for greater diversity benefits, reducing minimum reserve holdings.

Table 3. Estimated Total Minimum Reserve Holdings under the EIM in 2017

PacifiCorp-ISO Transfer Capability	Minimum Reserve Holdings (MW)
Standalone (no EIM)	2,011
100 MW	1,932
400 MW	1,687
800 MW	1,583

As a final step, E3 calculated the difference in production costs between the EIM Dispatch Case and EIM Flexibility Reserve Case to estimate the annual benefit of reduced flexibility reserves, over and above the dispatch benefits. This yields the incremental savings associated with flexibility reserve reductions between the two cases. E3 benchmarked the cost savings using market prices for ancillary services in ISO, to ensure that these estimates were reasonable (See Technical Appendix).

Since the PacifiCorp-ISO EIM would be a 5-minute energy market, only the portion of savings associated with reductions in load following reserves (5-minute to hourly timescale) would accrue under an EIM. Each area would continue to procure and deploy regulation reserves independently. Since load following accounts for approximately 80%



of total flexibility reserve needs (load following plus regulation) in E3's calculations, E3 assumed that a PacifiCorp-ISO EIM could achieve 80% of total savings from reduced flexibility reserve requirements.

2.2.4 REDUCED RENEWABLE ENERGY CURTAILMENT

High penetrations of variable generation increase the likelihood of over-generation conditions. In these situations, curtailment of variable generation may be necessary since the system is not flexible enough to reduce the output from other resources located exclusively within the same BAA. Based on discussions with ISO, over-generation conditions and the curtailment of renewable generation are likely to be a long-term issue as additional wind and solar resources come online.

As a standalone BA, ISO schedules imports on an hour-ahead basis and may find it difficult to back down imports on shorter timescales if local renewable generation is higher or if load is lower than expected. An EIM could potentially avoid over-generation situations since it could enable ISO to reduce imports in real time from PacifiCorp rather than curtail renewables during minimum generation or ramp-constrained intervals.

E3 calculated the benefits of reduced energy curtailment in ISO by multiplying estimates of: (1) the annual amount of renewable energy curtailed when simulating ISO operations as a standalone entity without an EIM, and (2) the value of curtailed renewable energy (in \$/MWh). The result represents the cost of renewable energy curtailment that an EIM could help to avoid, assuming that PacifiCorp has generation available to back down during these situations.

To estimate the level of renewable energy curtailment in ISO, E3 developed a methodology that uses outputs from two sequential GridView model runs. In the first

run (representing unit commitment based on forecasted needs), projected solar, wind, and load profiles were used to estimate economic imports into ISO. In the second run (representing real-time dispatch), actual solar, wind, and load profiles were used along with minimum import limits set to the level of economic imports from the first simulation. This limit prevented the model from lowering the interchange below the level determined by the unit commitment process. This reduction in system flexibility resulted in approximately 120 GWh of renewable energy curtailed by ISO in 2022.

This is likely a conservative estimate of the level of renewable energy curtailment. Production simulation models are designed to utilize normative assumptions regarding load, hydro conditions, thermal resource outages, and other variables in order to produce reasonable, mid-range estimates of resource dispatch and prevailing power flows. However, renewable curtailment occurs during extreme events such as very high output of wind, solar and hydro resources combined with very low load conditions. These conditions are not well-represented in production simulation modeling inputs. Hence, renewable curtailment is likely to be understated in production simulation model outputs.

E3 used a \$90/MWh value of avoided renewable energy curtailment as the sum of three components: (1) renewable energy certificate (REC) value, assumed to be \$50/MWh; (2) production tax credit (PTC) value of \$20/MWh; and (3) the avoided production cost of the thermal unit that an EIM enables to dispatch down, estimated to be \$20/MWh.

E3 used the simulated renewable curtailment results to develop two scenarios for renewable energy curtailment in 2017. As a lower end estimate, E3 assumed that ISO renewable energy curtailment is 10% of the simulated value, or 12 GWh. As a higher end estimate, E3 assumed that renewable curtailment is 100% of the simulated value, or 120



GWh. This range of curtailment estimates was then multiplied by the value of avoided renewable energy curtailment to calculate lower end and higher end estimates of \$1.1 million ($= 12 \text{ GWh} * 90/\text{MWh}$) to \$10.8 million ($= 120 \text{ GWh} * \$90/\text{MWh}$) in benefits for reduced renewable energy curtailment in 2017.

2.3 EIM Scenarios

E3 estimated EIM benefits based on study year 2017. E3 chose this year, in consultation with ISO and PacifiCorp, to represent a period after the EIM was already operational but prior to any significant changes in load, generation, and transmission. In particular, E3's modeling analysis excludes: (1) a portion of the full build out of renewable resources necessary to meet California's 33% RPS; (2) expected retirements and replacements of ISO thermal generating capacity due to once-through-cooling (OTC) regulations; and (3) a number of planned and proposed transmission projects, such as Gateway West that have the potential to provide a substantial expansion of the quantity of flexible resources that would be able to participate in a 5-minute market.

E3 used scenario assumptions to inform how sensitive benefits are to: (1) the transmission transfer capability between ISO and PacifiCorp, which limits savings both from interregional dispatch and reduced flexibility reserves; (2) the amount of hydropower capacity that can provide flexibility reserves; (3) the extent to which nodal prices from an EIM would change PacifiCorp's dispatch and produce associated efficiency improvements; and (4) the extent of renewable energy curtailment that can be avoided through an EIM. These scenarios are designed to explore a wide range of potential benefit levels to reflect the limitations of existing tools to characterize all of the changes to system operations that would occur under an EIM, particularly the modeling of hydropower, reserves, and renewable curtailment. In addition, the

scenarios capture a range of uncertainties about the extent to which future industry developments would allow cost savings to occur both with and without an EIM.

Table 4. Low and high range assumptions under low (100 MW), medium (400 MW), and high (800 MW) PacifiCorp-ISO transfer capability scenarios

Assumption	Low transfer capability		Medium transfer capability		High transfer capability	
	Low range	High range	Low range	High range	Low range	High range
Maximum hydropower contribution to contingency and flexibility reserves*	25%	12%	25%	12%	25%	12%
Share of intraregional dispatch savings achieved	10%	100%	10%	100%	10%	100%
Share of identified renewable energy curtailment avoided	10%	100%	10%	100%	10%	100%

* Percent of nameplate capacity for each project

The scenarios are organized around low, medium, and high scenarios for transmission transfer capability between PacifiCorp and ISO, with 100, 400, and 800 MW, respectively, in each case. Within each scenario, E3 calculated a low and high range of benefits (Table 4). The low range assumes: hydropower can contribute up to 25% of nameplate capacity toward flexibility reserves; PacifiCorp achieves 10% of estimated nodal dispatch savings; and the value of renewable energy curtailment is 10% of the full estimated value. The high range assumes: hydropower can contribute up to 12% of nameplate capacity toward contingency and flexibility reserves; PacifiCorp achieves 100% of estimated nodal dispatch savings; and the value of renewable energy curtailment is 100% of the full estimated value.

2.4 EIM Benefits

Figure 1 and Table 5 show the low and high range of EIM benefits for the low (100 MW), medium (400 MW), and high (800 MW) transfer scenarios, and the amount attributed to each component. Total annual benefits in 2017 range from \$21 million in the low range of the 100 MW transfer capability scenario, to \$129 million in the high range of the 800 MW transfer capability scenario (2012\$).

Figure 1. Low and high range benefits under low (100 MW), medium (400 MW), and high (800 MW) PacifiCorp-ISO transfer capability scenarios (2012\$)

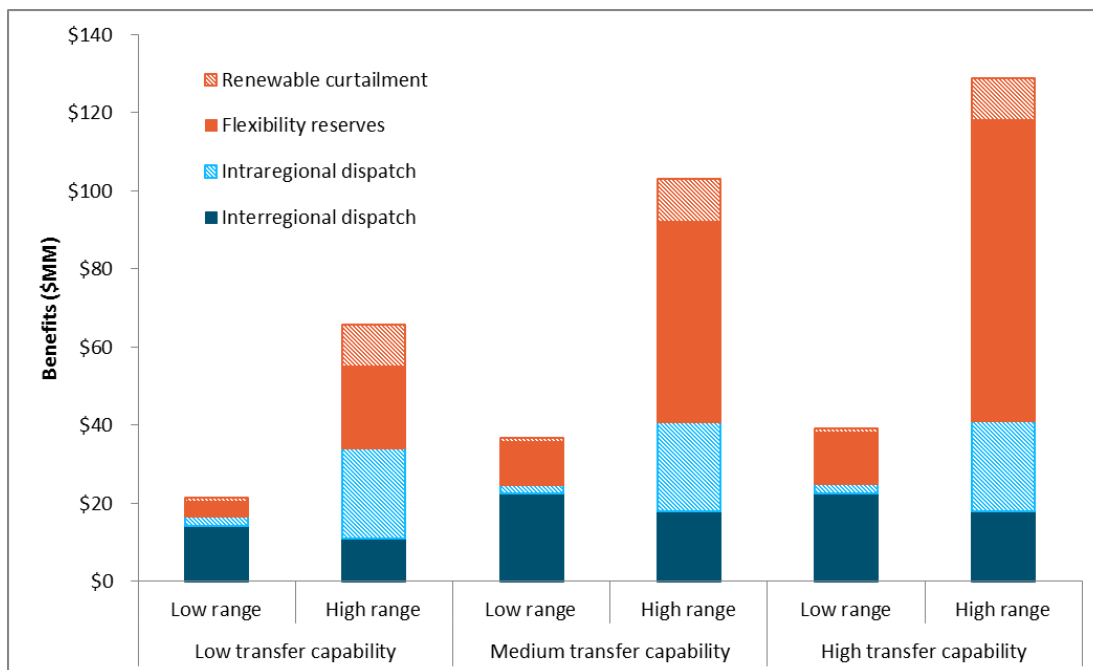


Table 5. Low and high range annual benefits in 2017 under low, medium, and high PacifiCorp-ISO transfer capability scenarios (million 2012\$)

Benefit Category	Low transfer capability		Medium transfer capability		High transfer capability	
	Low range	High range	Low range	High range	Low range	High range
Interregional dispatch	\$14.1	\$11.0	\$22.3	\$17.7	\$22.4	\$17.8
Intraregional dispatch	\$2.3	\$23.0	\$2.3	\$23.0	\$2.3	\$23.0
Flexibility reserves	\$4.0	\$20.8	\$11.0	\$51.3	\$13.4	\$77.1
Renewable curtailment	\$1.1	\$10.8	\$1.1	\$10.8	\$1.1	\$10.8
Total benefits	\$21.4	\$65.6	\$36.7	\$102.8	\$39.2	\$128.7

Notes: Individual estimates may not sum to total benefits due to rounding.

Differences in individual benefit categories provide important insights into the impact of scenario assumptions on the results.

- + Interregional dispatch savings range from \$14 million to \$22 million per year. Increasing PacifiCorp-ISO transfer capability from 100 MW in to 400 MW drives significant additional cost savings. However, the marginal benefit of additional transfer capability beyond 400 MW appears to be small.
- + Interregional dispatch savings are somewhat lower under the high range scenarios than under the low range scenarios because of interactions that occur between the hurdle rate and operating reserve aspects of the modeling. When the ability of hydropower to provide reserves is restricted, total production costs increase because more thermal generators are committed to provide reserves. These additional thermal generators tend to be higher-cost units, which may be operated at or near their minimum operating levels. This restricts the dispatch efficiency gains that are available due to the elimination of hurdle rates, because these higher-cost generators are less able to reduce their output when a lower-cost unit is available in a neighboring system.
- + Annual cost savings from reduced flexibility reserves range from \$4 million to \$77 million. These are driven largely by constraints on the ability of hydropower to provide contingency and flexibility reserves. This is a source of considerable



uncertainty, and more research is needed to understand hydro's ability to contribute toward flexibility reserve requirements under high penetrations of wind and solar. Transfer capability is also an important constraint, as benefits increase from \$4 million per year with 100 MW to \$13 million per year with 800 MW of transfer capability in the scenario where hydropower can contribute to up to 25% of flexibility reserves.

- + Annual cost savings from intraregional dispatch savings and reduced renewable energy curtailment range from \$3 million to \$34 million, suggesting that, although they are uncertain, both categories could be important contributors to EIM benefits. Because an EIM would provide an automated mechanism for facilitating wind curtailment solutions, as well as clearing any payment required in the event of curtailment, this is likely to be an important and growing EIM benefit going forward.

The results described here confirm that, even under conservative assumptions regarding the use of hydro for imbalance energy and the availability of transmission transfer capability, the incremental benefits of an EIM between PacifiCorp and ISO are likely to be larger than the preliminary estimates of the costs to implement and operate this market. The results also confirm that the benefits of an EIM can be quite substantial as participation grows, allowing more resources to participate and lowering the costs of both imbalance energy and the costs of providing adequate dynamic reserves.

2.5 Attribution of EIM Benefits

E3 assumed that the benefits of an EIM would be attributed to PacifiCorp and ISO as follows:

- + **Interregional dispatch savings.** Savings were split evenly between PacifiCorp and ISO to reflect: (1) the reduced cost to serve ISO load, since expensive internal generation is displaced by low-cost imports from PacifiCorp; and (2) additional revenues for PacifiCorp, since it exports additional power to ISO.
- + **Intraregional dispatch savings.** The savings were scaled to the PacifiCorp service area from a study of the ISO's nodal market, thus all benefits were attributed to PacifiCorp.
- + **Reduced flexibility reserves.** Benefits were allocated to PacifiCorp and ISO in proportion to their standalone need, resulting in a roughly 30/70 split, respectively.
- + **Reduced renewable energy curtailment.** All benefits of reduced curtailment were attributed to ISO, because the reduced curtailment would take place within the ISO footprint.

This simple approach allocates the total cost savings between the two parties and does not attempt to account for changes in market revenues relative to today's bilateral system. It is not intended to be a methodology for allocating costs and benefits. The actual net costs and benefits that would flow to the PacifiCorp and ISO systems might be different from the assumptions used here.

The attribution of benefits from a PacifiCorp-ISO EIM in 2017 is summarized in Tables 6 and 7. PacifiCorp achieves annual cost savings of \$10-54 million, with the range dependent on the extent to which PacifiCorp generators participate in the EIM and its nodal market, transfer limits, and the extent to which hydropower can provide flexibility reserves. Annual cost savings to ISO are \$11-74 million by 2017, with the range dependent on transfer limits, the extent to which hydropower can provide flexibility reserves, and the extent of renewable curtailment.

Table 6. Attribution of EIM benefits to PacifiCorp in 2017 (million 2012\$)

Benefit Category	Low transfer capability		Medium transfer capability		High transfer capability	
	Low	High	Low	High	Low	High
	Range	Range	Range	Range	Range	Range
Interregional dispatch	\$7.0	\$5.5	\$11.2	\$8.9	\$11.2	\$8.9
Intraregional dispatch	\$2.3	\$23.0	\$2.3	\$23.0	\$2.3	\$23.0
Flexibility reserves	\$1.2	\$6.1	\$3.2	\$14.9	\$3.9	\$22.5
Renewable curtailment	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0
Total benefits	\$10.5	\$34.6	\$16.7	\$46.8	\$17.4	\$54.4

Note: Attributed values may not match totals due to independent rounding.

Table 7. Attribution of EIM benefits to ISO in 2017 (million 2012\$)

Benefit Category	Low transfer capability		Medium transfer capability		High transfer capability	
	Low	High	Low	High	Low	High
	Range	Range	Range	Range	Range	Range
Interregional dispatch	\$7.0	\$5.5	\$11.2	\$8.9	\$11.2	\$8.9
Intraregional dispatch	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0
Flexibility reserves	\$2.8	\$14.7	\$7.8	\$36.4	\$9.5	\$54.6
Renewable curtailment	\$1.1	\$10.8	\$1.1	\$10.8	\$1.1	\$10.8
Total benefits	\$10.9	\$31.0	\$20.0	\$56.0	\$21.8	\$74.3

Note: Attributed values may not match totals due to independent rounding.

3 Interpreting the Results

3.1 Conservative Nature of the Results

Because of the difficulties in modeling the operational complexities of an EIM, E3's approach was intended to use conservative to moderate assumptions to generate credible results, both as a standalone analysis and relative to other studies. Table 8 provides a high-level overview of the nature of assumptions (conservative, moderate, aggressive) used for each of the five identified categories of benefits, and an explanation of why the assumptions were considered to be conservative or moderate.

Table 8. Categorization of assumptions used in this study

Benefit Category	Assumptions (conservative, moderate, aggressive)	Rationale
Interregional dispatch	Conservative-Moderate	- E3 limited PacifiCorp-ISO transmission transfer capability in the low transfer capability scenario to 100 MW, which limited EIM benefits - E3 used hurdle rates to inhibit interregional trade in Benchmark Case (moderate assumption) - Hourly cost differences between natural gas-fired generators are understated in production simulation models due to the use of uniform heat rates assumptions and normalized system conditions; these models understated EIM benefits
Intraregional dispatch	Conservative-Moderate	E3 calculated nodal dispatch savings by scaling estimated ISO peak load-normalized savings by PacifiCorp peak load (moderate assumption); E3 assumed only 10% of these savings materialize for low range (conservative assumption)
Flexibility reserves	Conservative	- E3 limited PacifiCorp-ISO transmission transfer capability in the low transfer capability scenario to 100 MW, which limited EIM benefits - E3 included operating cost only; no capacity cost savings are included, which limited EIM benefits - E3 allowed 25% of total hydropower capacity to contribute to flexibility reserves in the low range estimates, which limited EIM benefits - E3 did not require lock-down of dispatch 45 minutes prior to the operating hour, as done in other studies, which would have raised the quantity of reserves required and increased EIM benefits
Renewable curtailment	Conservative	- E3 did not evaluate renewable curtailment for PacifiCorp, which limited EIM benefits - In low range estimate, E3 assumed wind and solar not producing significant over-generation (conservative assumption) - Production simulation models understate the frequency with which low net load/high generation events occur due to their use of idealized operating assumptions; these models limit EIM benefits
Within-hour dispatch	Conservative	Production simulation analysis modeled at hourly level, omitting potential benefits of sub-hourly dispatch (other studies indicate that these benefits could be substantial)

3.2 Comparison to other Studies

Several recent studies have examined the potential benefits of greater balancing area coordination in the Western Interconnection. These include:

- + **WECC EIM Analysis (completed in 2011)** — examined the benefits of an hourly EIM in parts of the WI region; undertaken by E3 for WECC;²⁴
- + **PUC EIM Group Analysis (completed in 2012)** — examined the benefits of a 10-minute EIM in parts of the WI region; undertaken by the National Renewable Energy Laboratory (NREL) for the PUC-EIM Group;²⁵
- + **WECC VGS (draft completed in 2012)** — examined the benefits of 10-minute bilateral scheduling for the entire WECC region; undertaken by the Pacific Northwest National Laboratory (PNNL) for WECC as part of the WECC Variable Generation Subcommittee (VGS);²⁶
- + **NWPP EIM (ongoing)** — examining the benefits of 5-minute security constrained economic dispatch for the Northwest Power Pool (NWPP) footprint, undertaken by PNNL for the NWPP Market Assessment and Coordination (MC) Initiative using a 10-minute dispatch model.

The above studies can be broadly categorized into two different approaches. The first two studies, the WECC EIM and PUC Group EIM analyses, use hurdle rates to capture transactional friction between BAAs in the base case, which are removed in the EIM case. They also assume that an EIM will enable BAs to reduce the quantity of flexibility reserves that they would need to carry for wind and solar integration. The last two

²⁴ See http://www.wecc.biz/committees/EDT/EDT%20Results/E3_EIM_Benefits_Study-Phase_2_Report_RevisedOct2011_CLEAN2%5B1%5D.pdf for the final report.

²⁵ See <http://www.westgov.org/PUCEim/> for the PUC EIM website and link to the NREL final report.

²⁶ The draft final report, “Balancing Authority Cooperation Concepts to Reduce Variable Generation Integration Costs in the Western Interconnection,” is not yet publicly available.



studies assume transactional friction between balancing areas is not alleviated by an EIM on an hourly timestep, and that an EIM will not reduce the quantity of regulation and flexibility reserves required for wind and solar integration. Instead, they conduct detailed analysis of dispatch changes that would occur on a 10-minute timestep compared to a fixed hourly interchange schedule between BAAs.

The approach used in this study is consistent with the WECC EIM and PUC Group EIM analyses. It does benefit, however, from the NWPP EIM study assumption used to limit the amount of hydropower that would qualify and be available to provide contingency and flexible reserves. Table 9 (next page) provides a high-level comparison between the benefit estimates in this study and the four aforementioned studies, describing key drivers of differences.

The estimated annual benefits in this study are smaller than in other studies because of:

- + The smaller geographic footprint of this study, which covered only the PacifiCorp and ISO areas and not the larger Western Interconnection region;
- + The modeling scope in this study, which did not include sub-hourly dispatch; and
- + The modeling assumptions used in this study, which resulted in a smaller base case operating reserve requirement, and hence a smaller change in reserves in the EIM case, than the PUC EIM Group analysis.

The results in this study should thus be viewed as conservative relative to other studies.

Table 9. Comparison of annual benefits and geographic scope between this study and other EIM studies

Study (Organization)	Annual Benefits (\$MM)	Geographic Scope	Key Drivers of Differences with this Study
PacifiCorp-ISO EIM study	\$21-\$129 in 2017	PacifiCorp and ISO	
WECC EIM (E3)	\$141 in 2020	WECC excluding ISO and AESO	• WECC EIM study had similar approach to this study • WECC EIM study had larger EIM footprint than this study • WECC study excluded intraregional dispatch savings; this study includes intraregional dispatch savings • No assessment of renewable curtailment reduction in WECC study; this study includes benefits of renewable curtailment reduction
PUC EIM Group (NREL)	\$349 in 2020	WECC excluding ISO and AESO	• PUC EIM study had larger EIM footprint than this study • PUC EIM study modeled 10-minute dispatch; this study models hourly dispatch • PUC EIM study required more reserve in base case due to earlier schedule lockdown, increasing EIM benefits; this study assumed later lockdown • PUC EIM study included regulation reserve savings for EIM; this study assumes no regulation reserve savings
WECC VGS (PNNL)	Pending	Entire WECC	• WECC VGS study had larger EIM footprint than this study • VGS study modeled 10-minute bilateral scheduling, not EIM • In VGS study, no savings due to reduced reserves or reduced transactional friction, which means all savings due to within-hour efficiency gains; this study includes savings from reduced reserves or transactional friction
NWPP EIM (PNNL)	Pending	NWPP	• Similar approach to WECC VGS study • Detailed results pending



Technical Appendix

Technical Appendix

Overview

This technical appendix provides a detailed description of the methods and assumptions used in calculating the benefits of more efficient interregional dispatch and reduced flexibility reserves from a PacifiCorp-ISO EIM. Following this overview, this appendix includes three sections. The first describes methods for calculating inputs to the Benchmark Case, including hurdle rates and statistical calculations used to estimate flexibility reserve requirements in the Benchmark Case. The second section describes the change in hurdle rates used in an EIM Dispatch Case. The third section describes the statistical calculations used to estimate a comparative benchmark for reserves in an EIM Flexibility Reserves Case and how transmission constraints were addressed in these calculations.

E3 estimated the benefits of more efficient interregional dispatch and reduced flexibility reserves using a combination of statistical analysis and production simulation modeling. All production simulation modeling was conducted using ABB's GridView model.¹

E3 modeled three cases:

- **Benchmark Case**, reflecting a business as usual scenario that includes continued obstacles to interregional dispatch between PacifiCorp and ISO and separate procurement of flexibility reserves;
- **EIM Dispatch Case**, in which obstacles to more efficient interregional dispatch are removed but flexibility reserves are still procured separately; and
- **EIM Flexibility Reserve Case**, in which obstacles to more efficient interregional dispatch are removed and PacifiCorp and ISO pool flexibility reserves.

The Benchmark Case was developed using the Western Electricity Coordinating Council's (WECC's) Transmission Expansion Planning Policy Committee (TEPPC) 2022 Common Case as a starting point, with updates developed for ISO's Transmission Planning Process (TPP) GridView simulation to improve accuracy inside of California. Load forecasts, fuel price forecasts, generators, and transmission were also adjusted to reflect anticipated values and availability in 2017. The EIM Dispatch Case and EIM Flexibility Reserve Case were used to isolate the benefits of more efficient interregional dispatch and reduced flexibility reserves, respectively, relative to the Benchmark Case.

In the EIM Dispatch Case, E3 modeled the incremental benefits of more efficient interregional dispatch by eliminating the hurdle rates between PacifiCorp and ISO that are used to reflect impediments to regional electricity trades in the Benchmark Case.² In the EIM Flexibility Reserve Case, E3 modeled the

¹ For more on GridView, see

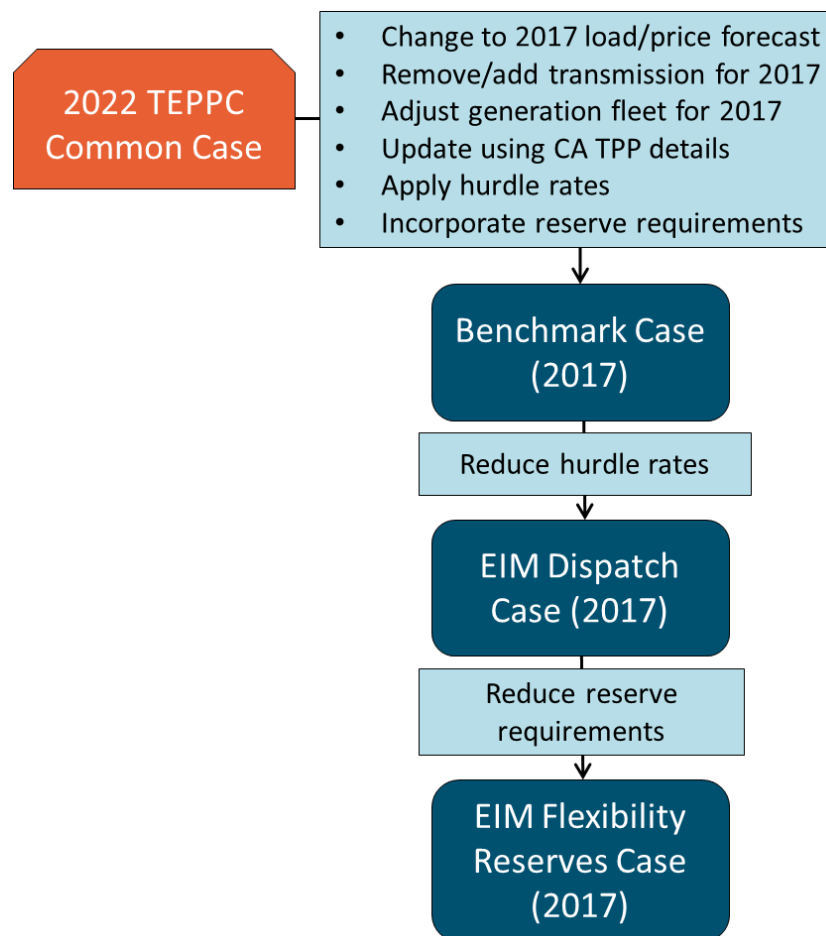
<http://www.abb.com/industries/db0003db004333/c12573e7003305cbc12570060069fe77.aspx>.

² A component of hurdle rates that reflects the need to acquire CO₂ allowances when delivering electricity from neighboring states into California, as required by California's greenhouse gas "cap-and-trade" program developed in compliance with AB32, was retained in all cases.

incremental benefits of reduced flexibility reserves by calculating the reduction in flexibility reserves that results from pooling load, wind, and solar variability between PacifiCorp and ISO, and then by reducing the amount of required reserves in GridView runs.

As described in the main report, within the EIM Dispatch Case and EIM Flexibility Reserve Case, E3 modeled the year 2017, to provide an estimate of near-term benefits from an EIM. Figure 1A illustrates E3's modeling approach.

Figure 1A. Modeling approach for calculating interregional dispatch and reduced flexibility reserve benefits



The modeling was organized around three scenarios of interchange transfer capability between PacifiCorp and ISO: 100, 400, and 800 MW. Within each transfer capability scenario, E3 modeled low and high benefit ranges. In the low range scenario, E3 limited hydropower's ability to contribute to contingency and flexibility reserves to 25% of nameplate capacity. In the high range scenario, E3 assumed that 12% of hydropower nameplate capacity can contribute to contingency and flexibility reserves. Production cost results for the interaction of all of these scenarios are described in this Appendix.

Benchmark Case

The Benchmark Case used WECC's TEPPC 2022 Common Case as a starting database. Inputs to the TEPPC database are developed from a collaborative stakeholder process, and are used in studies to assess regional economic transmission in the Western Interconnection. In addition, the TEPPC database has been used in ISO's TPP, and in other studies of the benefits of an EIM throughout the Western Interconnection.³

Adjustments to the TEPPC Common Case

In developing its 2017 TPP Case, ISO staff made adjustments to the TEPPC 2022 Common Case to improve transmission and generation modeling accuracy within California. E3 incorporated those adjustments and made further modifications to the TEPPC 2022 Common Case in three primary areas: (1) fuel price forecast, (2) load forecast, and (3) generation and transmission.

Fuel price forecast

Natural gas prices were based on the ISO's long-term procurement plan (LTPP), adjusted to match annual average Henry Hub fuel prices from NYMEX.⁴ Table 1A shows fuel prices by region, for the TEPPC regions within the ISO and PacifiCorp BAAs.

Table 1A. Average annual burnertip gas price (2012\$/MMBtu)

Area	2017
PACE_ID	\$ 3.99
PACE_UT	\$ 3.81
PACE_WY	\$ 3.95
PACW	\$ 3.91
PG&E_BAY	\$ 4.09
PG&E_VLY	\$ 4.09
SCE	\$ 4.18
SDGE	\$ 3.86

Load forecast

A load forecast for 2017 was provided directly by PacifiCorp for the PacifiCorp East and PacifiCorp West BAAs. For all other load areas, monthly peak and energy values were interpolated between 2006 historical data (provided by TEPPC by BA) and the 2022 forecasted value from TEPPC's Data Working Group (DWG) based on the most recently available WECC Load-Resource Subcommittee (LRS) data submittals.

³ ISO, 2013, *Draft 2012-2013 Transmission Plan*, <http://www.caiso.com/Documents/Draft2012-2013TransmissionPlan.pdf>; E3, 2011, *WECC EDT Phase 2 EIM Benefits Analysis & Results (October 2011 Revision)*, http://www.wecc.biz/committees/EDT/EDT%20Results/E3_EIM_Benefits_Study-Phase_2_Report_RevisedOct2011_CLEAN2%5B1%5D.pdf.

⁴ A small adjustment was also implemented to use the same fuel prices for PG&E Bay and PG&E Valley load areas.

Generation and transmission

Some generation and transmission projects were removed from the TEPPC 2022 Common Case, because they were not expected to be online by 2017, based on input from ISO and PacifiCorp. For modeling purposes, generation in 2017 was assumed to precede the majority of expected OTC-related retirements and replacements in California.

Hurdle rates

The Benchmark Case utilized hurdle rates from the WECC EDT Phase 2 EIM Benefits Analysis, which were developed by calibrating simulation output to historical flow levels on WECC paths.⁵ These historically-calibrated hurdle rates are adjusted to reflect the impact of anticipated CO₂ allowance cost on unspecified power imports into California in 2017. For power flows from PacifiCorp-West (PACW) to ISO, E3 used a value of \$21.07/MWh, which included a \$10.76/MWh cost for CO₂ allowances on PacifiCorp exports to ISO (Table 2A). This \$10.76/MWh adder was based on a default CO₂ emissions factor for a CCGT from the California Air Resources Board and a CO₂ price of \$24.66 (2012\$) per short ton of CO₂. For power flows from ISO to PACW, E3 used a hurdle rate of \$3.97/MWh. E3 assumed no direct interties between ISO and PACE.

Table 2A. Hurdle rates used in the Benchmark Case

Case	Hurdle Rate (\$/MWh)			
	PACW → ISO			ISO → PACW
	CO ₂ -related	Non-CO ₂ related	Total	
Benchmark Case	\$10.76	\$10.31	\$21.07	\$3.97*

**No CO₂-related hurdle rate is applied to ISO exports to PACW because CO₂ permit cost under AB32 is directly modeled in the dispatch for generators located inside California.*

Flexibility reserves

To determine the production costs associated with flexibility reserve levels in the Benchmark Case, E3 calculated load following and regulation reserve requirements, summed the two, and then set the total as a constraint in GridView. Load following here is defined as the capacity needed to manage the difference between the hourly unit commitment schedule and 10-minute forecasted net load. Regulation is defined as the capacity needed to manage the difference between 10-minute forecasted net load and 10-minute actual net load.

Load following and regulation reserves were calculated using a common methodology based on the North American Electricity Reliability Corporation (NERC) Control Performance Standard 2 (CPS2).⁶ CPS2 is designed to ensure that a BA maintains its area control error (ACE) – the difference between actual and scheduled power flows across interties to neighboring BAs – within reasonable bounds. Spinning

⁵ See http://www.wecc.biz/committees/EDT/EDT%20Results/E3_EIM_Benefits_Study-Phase_2_Report_RevisedOct2011_CLEAN2%5B1%5D.pdf. The WECC Analysis reported hurdle rates in 2010\$, and those rates were adjusted to 2012\$ for this analysis.

⁶ For more on NERC CPS, see <http://www.nerc.com/docs/oc/ps/tutorcps.pdf>.

reserve requirements) were set to equal 3% of load, which represents one-half of total operating reserves requirements (spinning plus non-spinning). Non-spinning reserve needs were not explicitly modeled because the simulation addresses reserve needs by increasing the level of generator commitment required, but is assumed for modeling that non-spinning reserve needs would typically be met with resources that do not require day-ahead unit commitment.

By benchmarking against ISO's current regulation procurement, wind integration studies performed by PacifiCorp, and in consultation with ISO and PacifiCorp, E3 chose to model a CPS2 compliance target which requires BAAs to secure load following reserves to meet 97% of forecasted load following demand, equivalent to 1.5% of the left-hand and right-hand tails of a distribution of load following needs (i.e., 10-minute forecasted net load minus hourly unit commitment). For regulation under this target, BAAs also secure regulation reserves to meet 94% of forecasted regulation demand, equivalent to 3% of the left-hand and right-hand tails of a distribution of regulation needs (i.e., 10-minute actual load minus 10-minute forecasted net load). This approach allows regulation reserves to meet load following needs, but not vice versa.

The regulation requirement percentage is lower than load following because regulation can be used to meet load following requirements. In the 3% of time periods with an unmet load following requirement, the residual load following error is added to the time-series regulation requirement. During these hours, if the system had unutilized regulation capacity or if regulation needs were in the opposite direction of the load following residual error, generator flexibility procured for regulation may be able to still satisfy the CPS2 requirement for that time period even though the system were short on load following resources.

Key steps in this analysis are shown graphically in Figure 2A.

- Step 1: Calculate a distribution of load following requirements. E3 used historical 10-minute wind, solar, and load data to forecast 10-minute net load and hourly unit commitment based on hourly net load. Forecasted hourly net load was then calculated for each 10-minute time period, using a linear 20-minute ramp across the top of the hour (see upper rightmost part of Figure 2A). A distribution of load following requirements was calculated as the difference between the 10-minute and hourly net load forecasts in each 10-minute period.
- Step 2: Calculate load following up and down needs. These were calculated using the 1.5 and 98.5 percentiles of these distributions, respectively, consistent with the chosen CPS2 compliance target. Figure 3A shows an example of the distribution for load following requirements and the points associated with the 1.5 and 98.5 percentiles.
- Step 3: Calculate a distribution of regulation requirements. A distribution of regulation requirements was calculated as the difference between the 10-minute net load forecast and 10-minute actual net load values. Residual load following errors were added to the regulation distributions to allow for the fact that regulation reserves can also be used for load following.
- Step 4: Calculate final regulation requirements as the 3rd and 97th percentiles of this distribution, representing regulation down and up needs, respectively.

Figure 2A. Flexibility reserve calculation steps

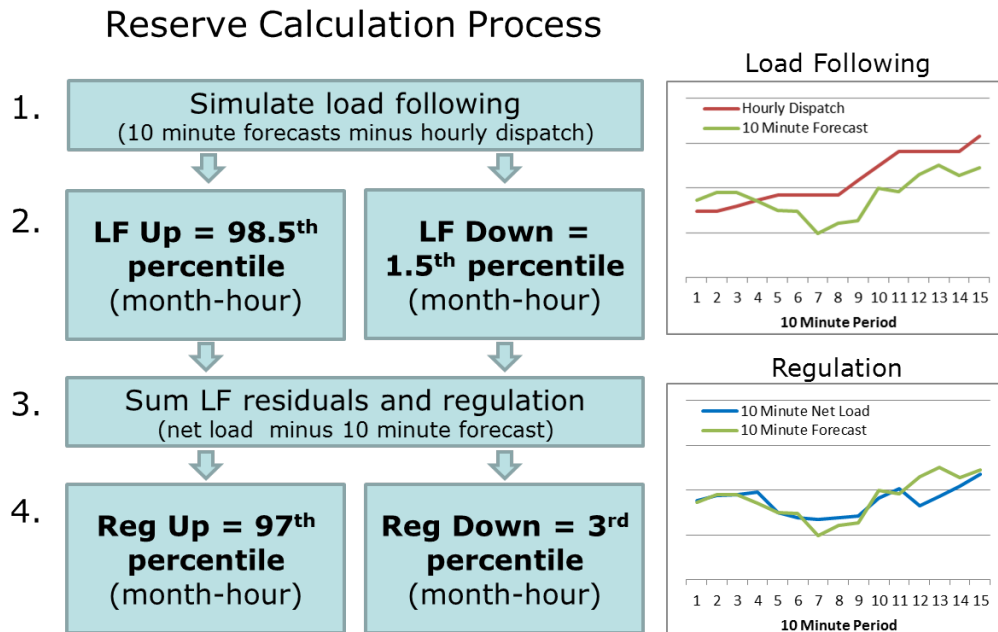
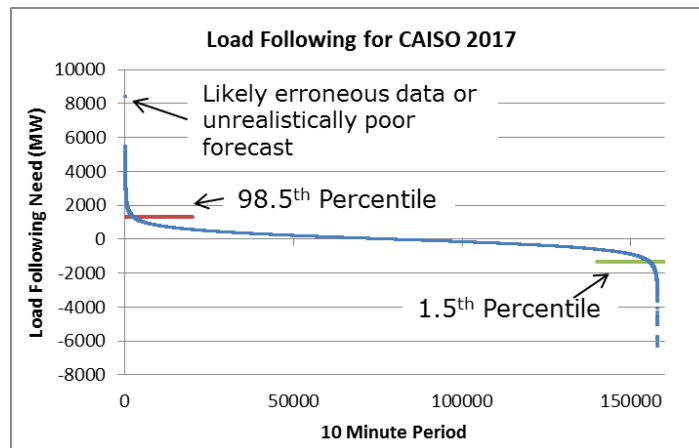


Figure 3A. Load following needs associated with the 1.5 and 98.5 percentiles



To calculate net load, E3 used three years of 10-minute load and modeled renewable production data. Years 2004 to 2006 were used in the analysis because of data availability in the Western Wind Integration Dataset. Solar PV was modeled using data from Solar Anywhere and 10-minute load data was provided by PacifiCorp and ISO. The load data provided was scaled to 2017 by both annual energy and peak load to account for load growth. Forecasts for 10-minute wind, solar, and load were created using linear regression and were extensively benchmarked. The following table shows renewable assumptions used for 2017.

Table 3A. Renewable assumptions for 2017 reserve calculations⁷

Area	Wind Installed (MW)	Solar Installed (MW)
PacifiCorp East	1,638	-
PacifiCorp West	635	-
PacifiCorp Combined	2,272	-
ISO	6,228	5,483
PacifiCorp and ISO (pooled)	8,501	5,483

In the Benchmark Case, regulation and load following were calculated separately for PacifiCorp East, PacifiCorp West, and ISO, and were implemented in GridView as separate constraints for each BAA. Table 4A shows the resulting load following up and regulation up reserve requirements for PacifiCorp East, PacifiCorp West, and ISO. The GridView modeling configuration used does not have the ability to model load following down and regulation down.

Table 4A. Estimated load following up and regulation up reserve requirements for PacifiCorp East, PacifiCorp West, and ISO in 2017

Area	Average Regulation Up (MW)	Average Load Following Up (MW)
PacifiCorp East	103	313
PacifiCorp West ⁸	45	146
PacifiCorp Combined	115	357
ISO ⁹	276	1,128

⁷ The study did not incorporate the most current renewable resource capacity in PacifiCorp, which results in understating total installed wind capacity in PacifiCorp's BAAs by 280 MW. As of 2013 PacifiCorp will have 1,758 MW of installed wind capacity in PacifiCorp East and 795 MW of installed wind capacity in PacifiCorp West.

⁸ In the Benchmark and EIM Cases, E3 assumed that PacifiCorp East is able to transfer 200 MW to PacifiCorp West within the hour but with no transfer capability in the reverse direction for EIM transactions. The hourly load following requirement applied to PacifiCorp West is reduced for this transfer capability, and a separate reserve requirement is applied to the Combined PacifiCorp area which reflects diversity of wind and load variability across the two PacifiCorp BAAs.

⁹ The applied common methodology for determining regulation and load following results in conservative lower amount of regulation requirements used in ISO production and lower regulation and load following 20 minute requirements than has been calculated using other methodologies.

EIM Dispatch Case

In the EIM Dispatch Case, E3 modeled reduced transactional friction between PacifiCorp and ISO from the EIM by removing the non-CO₂ hurdle rates in the Benchmark Case. In this case, the PACW → ISO hurdle rate still includes the \$10.76/MWh cost for CO₂ allowances on PacifiCorp flows to ISO (Table 5A).

Table 5A. Hurdle rates for the Benchmark and EIM Dispatch Cases

Case	Hurdle Rate (\$/MWh)			
	PACW → ISO			ISO → PACW
	CO ₂ -related	Non-CO ₂ related	Total	
Benchmark Case	\$10.76	\$10.31	\$21.07	\$3.97
EIM Dispatch Case	\$10.76	\$0.00	\$10.76	\$0.00*

**No CO₂-related hurdle rate is applied to ISO exports to PACW because CO₂ permit cost under AB32 is directly modeled in the dispatch for generators located inside California.*

Eliminating hurdle rates enables GridView to dispatch more generation in the PacifiCorp BAAs to serve needs in the ISO BAA when more efficient units are available, and vice-versa. Reduced transactional friction lowers total production costs. As described in the main text, for the EIM Dispatch Case E3 used an 800 MW static transfer limit on the California-Oregon Intertie (COI) as a proxy for transfer capability between the PacifiCorp and ISO systems.

Table 6A shows production costs in the Benchmark Case, the EIM Dispatch Case, and cost savings (Benchmark Case – EIM Dispatch Case production costs), for the 100, 400, and 800 MW transfer capability scenarios under both hydro assumptions. As described in the main body, production cost savings from the 800 MW scenario were scaled to 100 and 400 MW based on relative changes in intertie flows. Most of the savings stemming from increased flows between the Benchmark Case and the EIM Dispatch Case were captured with 400 MW of transfer capability.

Table 6A. Production cost savings in the EIM Dispatch Case for different hydropower flexibility scenarios and assumptions about transfer capability between PacifiCorp and ISO (Million 2012\$)

	25% Hydro Reserve Cap			12% Hydro Reserve Cap		
	100	400	800	100	400	800
EIM Dispatch Case	\$14.1	\$22.3	\$22.4	\$11.0	\$17.7	\$17.8

As described in this report, GridView assumes perfect, security-constrained, least-cost dispatch within both the ISO and PacifiCorp footprints. The EIM Dispatch Case thus captures the incremental benefits from more efficient dispatch between PacifiCorp and ISO assuming that PacifiCorp already uses nodal dispatch. The savings from moving to nodal dispatch in PacifiCorp are estimated separately under “intraregional dispatch savings” and described in Section 2.2.2 of this report.

EIM Flexibility Reserves Case

E3 calculated within-hour regulation and load following reserves for the EIM Flexibility Reserves Case using the same approach as in the Benchmark and EIM Dispatch Cases, except that net load profiles for each BA were summed before the calculation and transmission constraints were enforced to ensure realistic reserve sharing. By summing the net load profiles for PacifiCorp and ISO, diversity in forecast errors and net load ramps reduces the reserves that each BAA is required to hold, relative to the Benchmark Case.

Table 7A shows the pooled load following up and regulation up reserve requirements for PacifiCorp and ISO in 2017, prior to enforcing transmission constraints between BAs.

Table 7A. Pooled load following and regulation up reserve requirements for PacifiCorp and ISO in 2017

Area	Average Regulation Up (MW) ¹⁰	Average Load Following Up (MW)
PacifiCorp and ISO (pooled)	310	1,255

Transmission limits were enforced on the results in the above table as a set of five separate constraints in the GridView cases, shown below for the scenario where 100 MW of transfer capability exists between PacifiCorp and ISO. These five constraints ensure that each BA holds the necessary reserves given transfer limits. The constraints also reflect the assumption that PacifiCorp East is able to transfer 200 MW to PacifiCorp West within the hour but with no transfer capability in the reverse direction.

1. $PACW_{pooled\ reserves} \geq \max(PACW_{benchmark\ case} - 200\ MW, 0)$
2. $PACE_{pooled\ reserves} \geq PACE_{benchmark\ case}$
3. $CAISO_{pooled\ reserves} \geq \max(CAISO_{benchmark\ case} - 100\ MW, 0)$
4. $PacifiCorp_{pooled\ reserves} \geq \max(x - 100\ MW, 0)$
5. $PAC\&CAISO_{pooled\ reserves} \geq \max(x + CAISO_{benchmark\ case} - 100\ MW, PAC\&CAISO_{no\ transfer\ limit})$

where: $x = \max(PACW_{benchmark\ case} + PACE_{benchmark\ case}, PacifiCorp_{benchmark\ case})$

¹⁰ Reductions to both regulation and load following requirements were modeled in the EIM Flexibility Reserves Case, but resulting cost savings were multiplied by the share that load following reserves (80%) represent relative to total flexibility reserves (load following plus regulation), to account for the fact that the EIM will only affect reserves above a 5-minute timestep.

Table 8A shows production cost savings for the four transfer capability scenarios and two hydropower flexibility scenarios. As described in the main text, cost savings were multiplied by the share that load following reserves (80%) represent relative to total flexibility reserves (load following plus regulation), to account for the fact that the EIM will only affect reserves above a 5-minute timestep.

Table 8A. Production cost savings in the EIM Dispatch and EIM Flexibility Reserve Cases for different hydropower flexibility scenarios and assumptions about transfer capability between PacifiCorp and ISO (Million 2012\$)

Transfer Capability (MW)	25% Hydro Reserve Cap			12% Hydro Reserve Cap		
	100	400	800	100	400	800
EIM Dispatch Case	\$14.1	\$22.3	\$22.4	\$11.0	\$17.7	\$17.8
EIM Flexibility Reserve Case	\$4.0	\$11.0	\$13.4	\$20.8	\$51.3	\$77.1
Total Both Cases	\$18.1	\$33.3	\$35.8	\$31.8	\$69.0	\$94.9

E3 benchmarked the results from the EIM Flexibility Reserve Case by multiplying reductions in hourly load following component of flexibility reserve quantities by ISO regulation prices. Annual savings from reduced flexibility reserves were calculated as the difference between reserve costs with no transfer capability (i.e., 0 MW) and reserve costs with transfer capability (i.e., 100, 400, or 800 MW) between PacifiCorp and ISO. Consistent with the approach taken for the GridView modeling, only savings in load following up reserve costs were assumed to be achievable through an EIM.

The results of this benchmarking exercise (AS price-based results) are shown in Table 9A, using ISO AS market prices from 2010, 2011, and an average of the two years. Given that PacifiCorp is more dependent than ISO on thermal resources to provide flexibility reserves, the benchmarking results in the below table are conservatively low (i.e., ISO AS prices are likely to be lower than implied AS prices in PacifiCorp because hydropower provides a significant amount of AS in ISO). With this in mind, the EIM Flexibility Reserve Case results (Table 8A) appear reasonable compared to the benchmarking results below.

Table 9A. Results from flexibility reserve benefits benchmarking analysis (Million 2012\$)

Transfer Capability	2010 AS Prices	2011 AS Prices	Average 2010/2011 AS Prices	EIM Flex. Reserve Case (25% Hydro Reserve Cap)	EIM Flex. Reserve Case (12% Hydro Reserve Cap)
100 MW	\$7.3	\$4.5	\$5.7	\$4.0	\$20.8
400 MW	\$24.3	\$14.8	\$18.8	\$11.0	\$51.3
800 MW	\$29.6	\$17.6	\$22.7	\$13.4	\$77.1

Attachment 2

Benefits for Participating in EIM

February 11, 2015

Revision History

Date	Version	Description	Author
2/10/2015	1.0		Lin Xu

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Executive Summary

The Energy Imbalance Market (EIM) began financially-binding operation on November 1, 2014 by optimizing resources across the California Independent System Operator (ISO) and PacifiCorp balancing authority areas (BAAs).

This first report quantifies the estimated gross benefits from the first two months of EIM operation to be \$5.97 million, which is in line with pre-launch projections. This benefit report reflects EIM's ability to select the lowest cost resource across the PacifiCorp and ISO BAAs to serve demand and accounts for the following categories as described in an earlier study conducted by Energy + Environmental Economics (E3)¹ for PacifiCorp and the ISO:

- **More efficient dispatch, both inter- and intra-regional**, by automating dispatch every five minutes within PacifiCorp's two BAAs and between the PacifiCorp and California ISO BAAs; and
- **Reduced renewable energy curtailment** by allowing BAAs to export or reduce imports of renewable generation when it would otherwise need to be economically dispatched down or manually curtailed.

This report does not calculate the **reduced flexibility reserves** needed by the ISO and PacifiCorp BAAs, which provides additional savings by aggregating the load, wind, and solar variability and forecast errors of the combined EIM footprint. It also does not calculate the benefits in the 5-minute market. The ISO plans to add this component to future benefits reports.

The table below shows the estimated benefits summary for November and December 2014 in millions of dollars per BAA. The EIM benefit is calculated based on the methodology discussed in an earlier ISO [Technical Bulletin](#) with some practical simplifications described later in this report.

BAA	November	December	Total
ISO	\$0.65	\$0.59	\$1.24
PACE	\$1.05	\$1.26	\$2.31
PACW	\$1.39	\$1.03	\$2.42
Total	\$3.09	\$2.88	\$5.97

Table 1: Estimated benefits shown are in the millions and accrued for the last two months in 2014.

The EIM dispatched energy transfers up to 421 megawatts (MW) in a 15-minute interval between the PacifiCorp West BAA (PACW) and ISO, up to 220 MW from ISO to PACW, and up to 200 MW from PAC East BAA (PACE) to PACW, which were consistent with economic pricing between the regions.

¹ PacifiCorp, Energy Imbalance Markets Summary, <http://www.caiso.com/Documents/PacifiCorp-ISOEnergyImbalanceMarketBenefits.pdf>

PacifiCorp consistently exercised its Interchange Rights Holder mechanism for EIM transfers to use a large percentage of its transfer rights between PACW and the ISO. Congestion within the ISO-controlled grid also factored into the amount of capacity available for EIM transfers.

This report does not consider PacifiCorp's opportunity cost that the utility considered when deciding to use its transfer rights. Although subject to continuously varying market conditions, the benefits are expected to increase as system operations continue to improve with new resources participating and as transfer capability increases or is available during 5-minute intervals. Preliminary estimates for November and December 2014 reflect approximately 180,786 megawatt hours (MWh) transferred to ISO from PacifiCorp and 27,361 MWh transferred to PacifiCorp from the ISO (Figure 1).

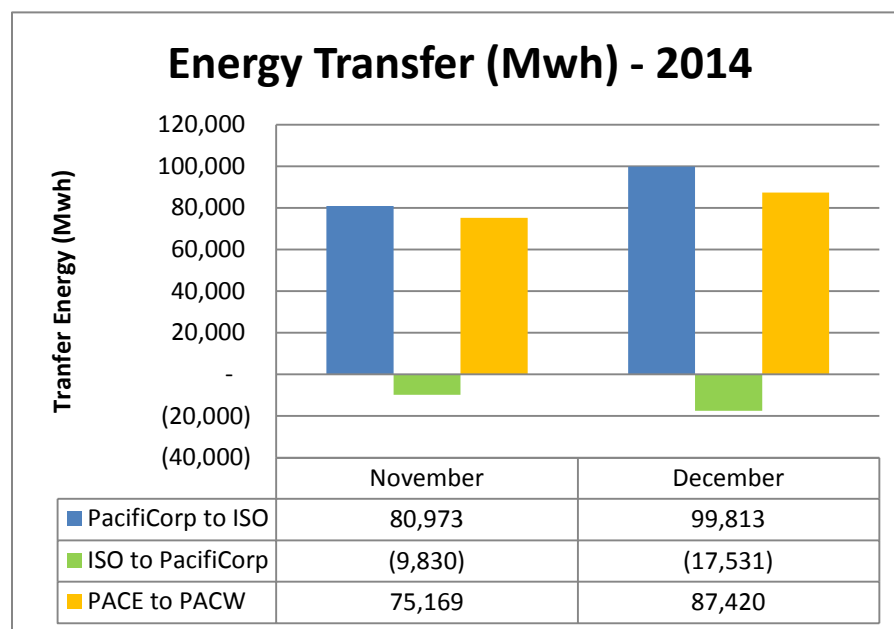


Figure 1: Energy Transfer

The estimated benefits in the first two months of operation are consistent with the March 2013 study conducted by E3² for PacifiCorp and the ISO that projected annual savings in 2017 in the range of \$21 million to \$129 million.

While market conditions will vary, the benefits demonstrated in EIM's first two months indicate that EIM has the potential to provide benefits to participating entities and their customers for the long term.

² PacifiCorp, Energy Imbalance Markets Summary, <http://www.caiso.com/Documents/PacifiCorp-ISOEnergyImbalanceMarketBenefits.pdf>

Background

The EIM began financially binding operation on November 1, 2014 by optimizing resources across the ISO and PacifiCorp BAAs, which includes California, Oregon, Washington, Utah, Idaho and Wyoming. The EIM improves the integration of renewable resources and increases reliability by sharing information between balancing authorities on electricity delivery conditions across the entire EIM region. This first quarterly report outlines the estimated benefits from the first two months of EIM operation. Future reports will examine EIM customer savings and benefits on a three month quarterly basis. As other entities such as NV Energy begin participating in the EIM, future reports will assess those additional balancing authorities and associated benefits.

During the design, development, and implementation over the last two years, EIM has been supported by a broad range of stakeholders, government officials and energy policy organizations. EIM participants expect to benefit from more efficient dispatch of resources both within and between BAAs, and the ability to share flexible resources to accommodate variable energy resources. A joint PacifiCorp and ISO study performed by E3 predicted the EIM's annual benefit in the range of \$21 million to \$129 million in 2017.³ Likewise, a study conducted for NV Energy showed incremental benefits to all EIM participants from \$9 million to \$29 million.⁴ In addition, the ISO built the EIM model on an existing, proven market platform that gives EIM entities a low-cost, low-risk option to participate in EIM.

In a [Technical Bulletin](#) provided to stakeholders on August 28, 2014,⁵ the ISO proposed a systematic way to quantify benefits for each region served by EIM. In both the Technical Bulletin and in this report, the ISO refers to EIM benefits compared to a “counterfactual” or “business without EIM” approach. Cost savings are calculated by comparing the cost of the EIM optimized dispatch to the counterfactual cost of dispatch without EIM optimization and without intra-hour transfers between PacifiCorp and ISO that would not occur but for the EIM.

Simplified Method of Calculating Benefits

This report quantifies the estimated benefit of participating in the EIM for November and December 2014. Because of the complexity in automating the counterfactual reruns and validating the results, the ISO was unable to complete the counterfactual reruns for fourth quarter of 2014 by the publication date of this first report. However, the ISO has developed a simplified process to produce the optimized counterfactual dispatch. This method only quantifies benefits from the 15-minute market and does not attempt to quantify additional benefits from 5-minute market or diversification affecting flexible ramping requirements. The ISO will explore quantifying these benefits in future reports.

³ PacifiCorp, Energy Imbalance Markets Summary, <http://www.caiso.com/Documents/PacifiCorp-ISOEnergyImbalanceMarketBenefits.pdf>

⁴ NV Energy-ISO Energy Imbalance Market Economic Assessment http://www.caiso.com/Documents/NV_Energy-ISO-EnergyImbalanceMarketEconomicAssessment.pdf

⁵ Quantifying the Benefits for Participating in EIM, published August 28, 2014 posted at http://www.caiso.com/Documents/TechnicalBulletin_EnergyImbalanceMarket-Benefits.pdf

The major difference from the approach discussed in the Technical Bulletin is that the counterfactual dispatches without EIM are based on the off line optimization of production data rather than re-running the EIM market clearing engine with modifications to simulate pre-EIM practice. The simplified approach provides reasonable counterfactual dispatches when no transmission constraints are binding in the PacifiCorp regions.

Counterfactual dispatch

The counterfactual dispatch for the ISO mimics ISO market operations without importing from or exporting to PacifiCorp through EIM transfers. The counterfactual dispatch for PacifiCorp mimics PacifiCorp's pre-EIM manual dispatch to meet demand with limited ability for intra-hour transfers between PacifiCorp and the ISO prior to EIM.

In cases where a counterfactual dispatch could not be produced for a balancing area using available bids, a conservative assumption was made by extending the highest bid dispatched.

ISO counterfactual dispatch

The ISO would need to meet demand without EIM transfers between PacifiCorp and the ISO. The ISO counterfactual dispatch will be constructed in the following ways.

Scenario 1: ISO counterfactual dispatch without EIM transfer from PacifiCorp to the ISO

1. Find ISO's undischpatched supply (not including supply from PacifiCorp) with bids greater than or equal to the transfer point price (MALIN 500 KV);
2. Sort and stack them from low to high bid; and
3. Clear the supply stack from low to high bid up to the transfer megawatts.

The supply resources that are dispatched up to the volume of transferred megawatts are the counterfactual dispatches that the ISO would have to dispatch without importing through the EIM transfer. The counterfactual dispatch cost represents the cost of meeting demand in the ISO without economic EIM transfers from PacifiCorp.

Scenario 2: ISO counterfactual dispatch without EIM transfer from the ISO to PacifiCorp

1. Find ISO's dispatched supply with bids less than or equal to the transfer point price (MALIN 500 KV);
2. Sort and stack them from high to low bid; and
3. Clear the supply stack from high to low bid up to the transfer megawatts.

The supply resources that are dispatched down to the volume of transferred megawatts are the counterfactual dispatches that the ISO would have realized but for the EIM export transfer.

PacifiCorp counterfactual dispatch

PacifiCorp East and PacifiCorp West BAAs would need to meet demand without EIM optimization and without intra-hour transfers between PacifiCorp and the ISO. The PacifiCorp counterfactual dispatch will be constructed in the following way:

1. Calculate the demand change for each BAA;
2. If the demand change results in violations of the transfer limitations between PACE and PACW, then adjust base schedules from the limited pool in each BAA to resolve the overloads in the right economic order; and
3. Economically dispatch resources from the limited pool on top of the changed base schedules from step 2 to meet PacifiCorp demand without violating the transfer limitations between PACE and PACW.

The economic clearing in step 2 and step 3 are performed the same way as in the ISO's counterfactual dispatch by going through the sorted supply stacks. The limited pool of resources reasonably approximates PacifiCorp's manual resource dispatch prior to EIM to meet intra-hour system imbalances.

This process is expected to result in the following:

- No intra-hour transfers between the ISO and PacifiCorp;
- The allowance of intra-hour transfer changes between PACE and PACW subject to directional transfer capability limitations;
- Meeting PacifiCorp's total demand (PACE and PACW) change from base schedule from a limited pool of resources; and
- The disallowance of intra-hour dispatch instructions to economically clear against each other unless it is for congestion management purposes.

EIM benefit calculation steps

For each interval and each BAA, the EIM benefit is calculated in the following way:

1. Use the simplified method to determine the optimized counterfactual dispatches would be without EIM;
2. For each region, calculate the total EIM dispatch cost as the sum of bid cost associated with the dispatch difference between the EIM dispatch and the base schedule, the EIM transfer cost (volume and price), and the greenhouse gas (GHG) cost;
3. For each region, calculate the total counterfactual dispatch cost as the sum of bid cost associated with the dispatch difference between the counterfactual dispatch and the base schedule, and the counterfactual transfer cost between PACE and PACW; and
4. Calculate each region's cost saving as the difference between the total counterfactual dispatch cost and the total EIM dispatch cost.

EIM benefits in Q4 2014

The total estimated EIM benefit is about \$3.09 million for November and \$2.88 million for December for a total of \$5.97 million with details provided in Table 2. These numbers represent benefits from 79 percent of all the intervals where the largest absolute price difference between the Malin500 and PACE or between the Malin500 and PACW is less than \$50/MWh. The intervals with price differences larger than \$50/MWh are excluded to reasonably represent, but not overstate, the benefits from after-the-fact price corrections or changes as a result of the pricing waiver⁶.

BAA	November	December	Total
ISO	\$0.65	\$0.59	\$1.24
PACE	\$1.05	\$1.26	\$2.31
PACW	\$1.39	\$1.03	\$2.42
Total	\$3.09	\$2.88	\$5.97

Table 2: Estimated benefits shown are in the millions and accrued for the last two months in 2014.

Conclusion

The estimated benefits calculation was developed through a thorough analysis and is a reasonable representation of the benefits accrued by both balancing authorities. Results are in line with expectations given market conditions and the first two months of operating the new market. Future reports will include assessing flexibility reserve benefits and 5-minute dispatch benefits that were not included in this report. Prospects for increases in customer benefits remain bright with improvements to market operations, expanding of the market with more participants, and expanding of renewables and transmission within the EIM footprint.

⁶ Dec 1, 2014 Order Granting Waiver - EIM Pricing Parameters (ER15-402)
http://www.caiso.com/Documents/Dec1_2014_OrderGrantingWaiver_EIMPricingParameters_ER15-402.pdf

Benefits for Participating in EIM

April 30, 2015



Revision History

Date	Version	Description	Author
4/30/2015	1.0		Lin Xu

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Executive Summary

The Energy Imbalance Market (EIM) began financially-binding operation on November 1, 2014 by optimizing resources across the California Independent System Operator (ISO) and PacifiCorp balancing authority areas (BAAs). The ISO published the first EIM benefit report for November and December 2014 in February 2015.¹

This second report quantifies the estimated gross benefits for January, February, and March 2015 to be \$5.26 million, which remains in line with pre-launch projections. The benefit report reflects the EIM's ability to select the lowest cost resource across the PacifiCorp and ISO BAAs to serve demand. The report analysis considers the following categories as described in an earlier study conducted by Energy + Environmental Economics (E3)² for PacifiCorp and the ISO.

- **More efficient dispatch, both inter- and intra-regional**, by automating dispatch every five minutes within PacifiCorp's two BAAs and between the PacifiCorp and California ISO BAAs.
- **Reduced renewable energy curtailment** by allowing BAAs to export or reduce imports of renewable generation when it would otherwise need to be economically curtailed.
- **Reduced flexibility reserves needed in PacifiCorp BAAs**, which saves cost by aggregating the load, wind and solar variability and forecast errors of the combined EIM footprint. This report introduces the flexibility reserve benefits for PacifiCorp but defers measurement of reduced flexibility reserve benefits for the ISO to future reports due to the need to develop additional measurement techniques.

The ISO made the following enhancements in this report from the 2014 Q4 report.

- **Benefit calculations this report included all fifteen minute market intervals.** In the previous report, the intervals with price differences larger than \$50/MWh were excluded to reasonably represent, but not overstate, the benefits from after-the-fact price corrections or changes as a result of the pricing waiver.³
- **Calculations for this quarter used relevant prices including any corrections, rather than raw market prices.** This not only allows the benefit to be calculated with better accuracy, but also eliminated the need to exclude intervals that may be corrected for prices after the fact.
- **2015 Q1 calculations included avoided renewable curtailments (in MWh) in the ISO BAA, which contributed to the total EIM benefit.** This is when a renewable resource is supporting the

¹ California ISO, http://www.caiso.com/Documents/PacifiCorp_ISO_EIMBenefitsReportQ4_2014.pdf

² PacifiCorp, Energy Imbalance Markets Summary, <http://www.caiso.com/Documents/PacifiCorp-ISOEnergyImbalanceMarketBenefits.pdf>

³ Dec 1, 2014 Order Granting Waiver - EIM Pricing Parameters (ER15-402)
http://www.caiso.com/Documents/Dec1_2014_OrderGrantingWaiver_EIMPricingParameters_ER15-402.pdf

transfer from the ISO to PacifiCorp such that without the EIM the renewable generation in the ISO has to be curtailed.

These enhancements improved the accuracy of the benefit calculation. This report, though, has not quantified the benefits in the 5-minute market because the simplified benefit methodology has not been expanded to quantify 5-minute and 5-minute transfers between PacifiCorp and ISO started on February 4, 2015., The ISO plans to add the 5-minute components to future benefits reports

The table below shows the estimated benefits summary for the first quarter of 2015 in millions of dollars per BAA. The EIM benefit is calculated based on the methodology discussed in an earlier ISO [technical bulletin](#) with the simplifications described in the [2014 Q4 report](#).

BAA	January	February	March	Total
ISO	\$0.48	\$0.49	\$0.48	\$1.44
PACE	\$0.88	\$0.83	\$0.91	\$2.63
PACW	\$0.42	\$0.49	\$0.28	\$1.19
Total	\$1.78	\$1.81	\$1.67	\$5.26

Table 1: Estimated benefits shown are in millions and accrued in the first quarter of 2015.

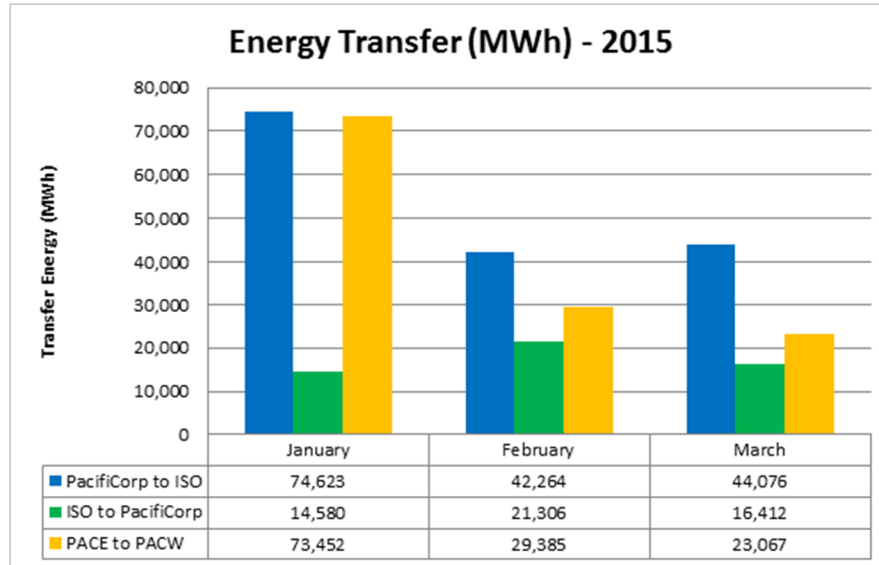
One of the most important contributions to the EIM benefit is the EIM transfer, which allows lower cost supply from one BAA to meet demand in another BAA. As such, the transfer volume is a good indicator of the EIM benefit. The highest level of energy transfers dispatched by the EIM in the 15-minute intervals for this quarter were 421 megawatts (MW) between the PacifiCorp West BAA (PACW) and the ISO, 321 MW from the ISO to PACW, and 200 MW from PacifiCorp East BAA (PACE) to PACW. The level of transfers reflect the economic opportunity between the regions.

PacifiCorp used a large portion of its Interchange Rights Holder mechanism for EIM transfers between PACW and the ISO. This report does not consider PacifiCorp's opportunity cost that the utility considered when using its transfer rights for the EIM.

Total 15-minute market transfers for January through March 2015 are approximately 160,963 megawatt hours (MWh) from PacifiCorp to the ISO and 52,297 MWh from the ISO to PacifiCorp (Figure 1). For the same period, average monthly transfers from PacifiCorp to the ISO and PACE to PACW decreased when compared to November and December 2014. Average monthly transfers from PacifiCorp to the ISO increased for the period January through March 2015 when compared to November and December 2014.

Five-minute incremental transfers were introduced between PacifiCorp and ISO starting on February 4, 2015. Since then, about 6,000 MWh in February and 13,000 MWh in March of incremental energy was transferred above that which was transferred in the 15-minute transfer reflected in Figure 1. This implies that there may be additional benefits in the 5-minute market, which the ISO has planned to quantify in future reports.

Figure 1: Energy transfers in the 15-minute market



While market conditions vary, the EIM continues to provide benefits to participating entities and their customers as demonstrated in this report.

Background

The EIM began financially-binding operation on November 1, 2014 by optimizing resources across the ISO and PacifiCorp BAAs, which includes California, Oregon, Washington, Utah, Idaho and Wyoming. The EIM improves the integration of renewable resources and increases reliability by sharing information between balancing authorities on electricity delivery conditions across the entire EIM region. The ISO published the first EIM benefits report for November and December 2014 in February 2015.⁴ This 2015 Q1 report is the second quarterly EIM benefits. As other entities such as NV Energy begin participating in the EIM, future reports will assess those additional balancing authorities and associated benefits.

Enhancements

The ISO continues to use the simplified method discussed in the 2014 Q4 report, but has implemented several enhancements to improve the accuracy of calculation.

Flexibility reserve procurement benefit

The net uncertainty from aggregating the load, wind and solar variability and forecast errors of the combined EIM footprint is typically smaller than the sum of each BAA's individual uncertainty in supply and demand. This is because the one BAA's uncertainty may offset another BAA's uncertainty, so that

⁴ California ISO Q4 2014 EIM Benefits Report,
http://www.caiso.com/Documents/PacifiCorp_ISO_EIMBenefitsReportQ4_2014.pdf

the net uncertainty is reduced. The reduction of uncertainty in the EIM means less flexibility reserve would be needed to maintain the same level of operational standard. The EIM flexibility reserve reduction is calculated as the sum of each EIM participating BAA's flexibility reserve requirement minus the net total flexibility reserve requirement for the whole EIM footprint.

The EIM co-optimizes the flexibility reserve with energy. Providing flexibility reserve may result in opportunity cost from not being able to provide energy, and the flexibility reserve is priced at the marginal opportunity cost in the EIM. The cost savings from the reduced flexibility reserve requirement, which is part of the total EIM benefit, is estimated to be \$74,000 for Q1 2015. The calculation methodology is described below.

In the counterfactual dispatch for PacifiCorp BAAs, its flexible ramp requirement is reset to the standalone BAA's flexible ramping requirement, which does not reflect the diversity benefit. The available supply will be first used to meet the energy demand.

After the BAA's energy demand is met, the remaining unloaded capacity will be used to meet the flexible ramping. If the BAA does not have enough capacity to meet the flexible ramp requirement on top of its energy demand, then it implies that getting additional flexibility reserve capacity will incur an opportunity cost.

The ISO estimated the per MW opportunity cost by the corresponding flexible ramping price in the EIM. Then the flexibility reserve cost, which equals the extra flexibility reserve needed multiplied by the EIM flexible ramping price, is added to the counterfactual dispatch cost for each BAA.

The added flexible ramping cost will increase the EIM benefit by the same amount because the EIM benefit is calculated as the total counterfactual dispatch cost minus the total EIM cost.

In summary, by aggregating the load, wind and solar variability and the forecast errors of the combined EIM footprint, PacifiCorp can reduce its procurement of flexibility reserves. This reduction was calculated and averaged as high as 13.8 MW per hour in Q1 2015 at a savings of \$74,000. The ISO may also benefit in a similar way, but the dollar savings were not quantified due to the complexity of binding transmission constraints and co-optimization in the ISO's market. The simplified calculation does not support considering these binding constraints.

The flexibility reserve benefit calculated as above represents only the cost savings due to reduced procurement in the EIM. There may be additional benefits when the flexibility reserve is deployed in the five-minute market. The deployment benefit will be included in future reports.

Reduced Renewable Curtailment

Included in the EIM benefit is the avoided renewable curtailment in the ISO. This occurs when a renewable resource is supporting the transfer from the ISO to PacifiCorp such that without the EIM the

renewable generation in the ISO would need to be curtailed. In addition to the cost saving benefit that is quantified in the report, avoided renewable curtailment may have additional benefit in reducing greenhouse gas emissions and renewable credits. The the avoided renewable curtailment volume for Q1 2015 was 8,860 MWh .

Other enhancements

The ISO made the following enhancements in the 2015 Q1 report. First, the ISO used relevant prices that included corrections in the benefit calculation rather than the raw market output prices. Second, all intervals have been included in the benefit calculation. In the 2014 Q4 report, the EIM benefits were calculated from the intervals where the absolute price difference between MALIN 500 KV bus and PacifiCorp was below \$50/MWh. That was to avoid misrepresenting the benefit stemming from after-the-fact price corrections as under the existing pricing waiver⁵. No exclusion was applied in the 2015 Q1 report because the ISO moved to using relevant prices that corrections. These enhancements are expected to improve the benefit calculation accuracy and quality.

EIM Benefits in Q1 2015

The gross estimated EIM benefit is about \$1.78 million for January, \$1.81 million for February and \$1.67 million for March for a total of \$5.26 million. The details are provided in Table 3. These numbers represent benefits from all the intervals and include the flexibility reserve benefits discussed above.

BAA	January	February	March	Total
ISO	\$0.48	\$0.49	\$0.48	\$1.44
PACE	\$0.88	\$0.83	\$0.91	\$2.63
PACW	\$0.42	\$0.49	\$0.28	\$1.19
Total	\$1.78	\$1.81	\$1.67	\$5.26

Table 3: Estimated benefits shown are in millions and accrued for the first quarter of 2015.

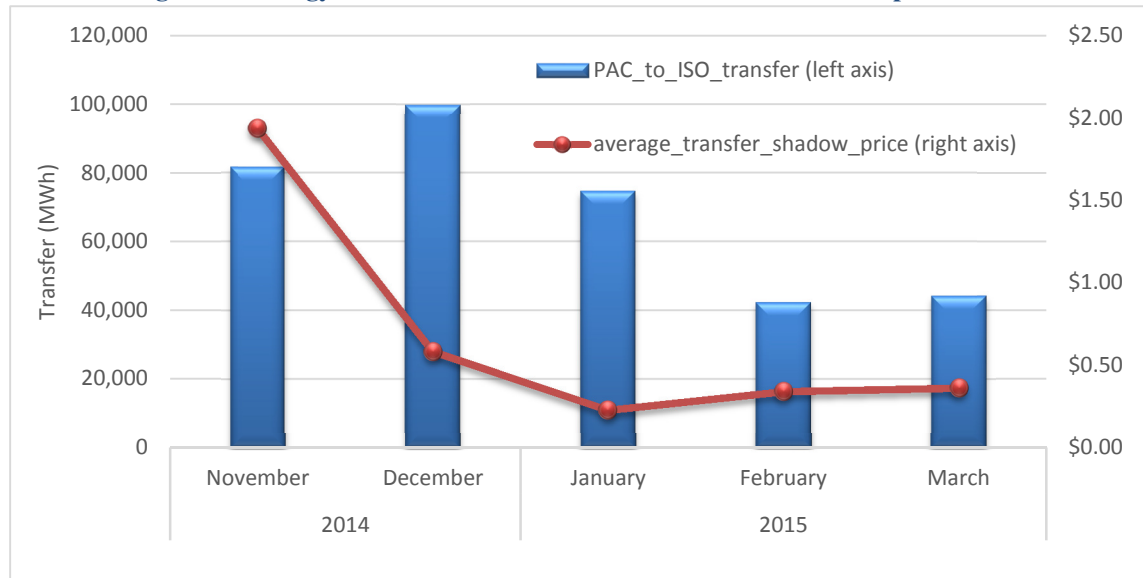
Compared with 2014 Q4, the monthly average EIM benefit was reduced by about \$1.23 million. This may be due to the following reasons.

First, the volume of EIM transfers from PacifiCorp to the ISO were less than November and December 2014. As shown in Figure 2, the monthly average transfer volume from PacifiCorp to the ISO decreased by approximately 40 percent from 2014 Q4 to 2015 Q1. Coincidentally, the monthly average transfer shadow price also dropped from \$0.60/MW-\$1.90/MW range in 2014 Q4 to \$0.20/MW-\$0.40/MW range in 2015 Q1. The transfer shadow price is the marginal cost difference between the supply in PacifiCorp and the supply in the ISO deliverable to the MALIN 500 KV bus. PacifiCorp's marginal supply cost was lower than that of the ISO when EIM transferred energy from PacifiCorp to the ISO, however,

⁵ Dec 1, 2014 Order Granting Waiver - EIM Pricing Parameters (ER15-402)
http://www.caiso.com/Documents/Dec1_2014_OrderGrantingWaiver_EIMPricingParameters_ER15-402.pdf

the marginal cost difference between PacifiCorp and the ISO tightened in 2015 Q1. Note that the EIM transfer benefit captures the total cost difference between PacifiCorp's supply and the ISO's supply for the transferred energy, but not the marginal cost difference. Yet empirically, marginal cost and total cost usually trend the same way. The downward trend of EIM benefit from 2014 Q4 to 2015 Q1 correlated well with decrease in marginal cost difference, which may be related to changes in supply and demand conditions in both the ISO and PacifiCorp.

Figure 2: Energy transfer in the 15-minute market from PacifiCorp to the ISO



Second, as the EIM stabilizes with less price excursions, the benefit resulting from extreme market conditions may reduce. We expect these extreme market outcomes to decrease over time as offers submitted into the EIM increase, and with improvements in the market clearing engine.

Third, improved scheduling practices may also lead to less EIM benefit being quantifiable under the current approach. As EIM BAAs gain more experience with the market, they may start to improve their base scheduling practices. More optimized base schedules will leave less room for the EIM to optimize, and thus less EIM benefit being calculated. However, these improvements would not materialize but for the EIM. We just cannot quantify such benefits through the current calculations.

Conclusion

The benefit continued to accrue in the EIM for the first quarter of 2015 at about \$1.75 million per month, which is in line with pre-launch projections. Comparing with 2014 Q4, there was a reduction in the monthly average benefit. This can be attributable to multiple reasons that includes seasonal transfer reductions, a more stable market and improved scheduling practices. The ISO made several enhancements in this report to improve the benefit accuracy and quality including quantifying the flexibility reserve benefit.

Attachment 3

December 15, 2014

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____
Informational Report – Performance of Energy Imbalance Market**

Dear Secretary Bose:

The California Independent System Operator Corporation (CAISO) hereby submits its December 15 report on the performance of the Energy Imbalance Market for November 1 – November 30, 2014.¹

The CAISO also respectfully requests a modest extension of no more than seven days after the date of this submission to allow the Department of Market Monitoring additional time to review the CAISO's report and provide its independent assessment. The Commission directed the Department of Market Monitoring to submit independent assessments on the causes and solutions identified by CAISO. Because this first reporting requirement came so quickly after the issuance of the Commission's order, the Department of Market Monitoring requires some additional days to fully review and evaluate the CAISO's report and provide an independent assessment.

Please contact the undersigned with any questions.

Respectfully submitted,

By: /s/ Anna A. McKenna

Roger E. Collanton
General Counsel
Anna A. McKenna
Assistant General Counsel
John Anders
Lead Counsel
California Independent System

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

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Energy Imbalance Market Pricing Waiver Report November 1 - 30, 2014

December 15, 2014

I. Introduction

On December 1, 2014, FERC granted the California Independent System Operator Corporation's (CAISO) petition for limited waiver of the pricing parameters in sections 27.4.3.2 and 27.4.3.4 of its tariff for 90 days, as they pertain to the Energy Imbalance Market, effective November 14, 2014, as requested.¹ In addition, FERC directed CAISO to submit informational reports as further described herein. The CAISO will be submitting on a monthly basis the requested reports in Attachments A through E, including reports provided by the CAISO's Department of Market Monitoring and PacifiCorp. This report covers the CAISO's reporting requirements for the time period covering November 1 through November 30, 2014.

For this first report, the CAISO is requesting a modest extension to allow it to submit the Department of Market Monitoring's report within seven days of December 15, 2014. The Commission directed the Department of Market Monitoring to submit independent assessments on the causes and solutions identified by CAISO. Because this first reporting requirement came so quickly after the issuance of the Commission's order, the Department of Market Monitoring requires some additional days to fully review and evaluate the CAISO's report and provide an independent assessment.

II. Background

On November 1, 2014, the CAISO fully activated the Energy Imbalance Market (EIM). The Energy Imbalance Market allows balancing authorities outside of the CAISO balancing authority area to voluntarily take part in the imbalance energy portion of the CAISO locational marginal price-based real-time market. PacifiCorp, the CAISO, and market participants participated in market simulations prior to the start of the Energy Imbalance Market on November 1, including parallel production from October 1 to November 1. However, shortly after go live the CAISO began observing challenges that led to artificially high prices in cases where the market application had to resort to the relaxation of transmission constraints or the power balance constraint in order to clear the market.

On November 13, 2014, the CAISO sought a 90-day waiver of the applicability of section 27.4.3.3 and the second sentence of section 27.4.3.4 of its tariff to permit CAISO to address, without suspending the Energy Imbalance Market, those circumstances produced atypically high prices. Those two sections of the tariff provide that when there is a lack of economic bids to clear the fifteen-minute and five-minute markets, the

¹ *California Indep. Sys. Operator Corp.*, 149 FERC ¶ 61,194 (2014) (December 1 Order).

CAISO's market application will price the shortages (and therefore set locational marginal prices) according to the pricing parameters specified in those sections. Specifically, for the purpose of determining how a transmission constraint or system-energy balance constraint will affect the determination of prices in the market, the pricing parameter for the relaxation of the constraint is \$1,000/MWh (the maximum energy bid price specified in tariff section 39.6.1.1).

The waiver addresses three sets of transitional conditions in the Energy Imbalance Market that together have caused the transmission and system energy-balance constraints described in tariff sections 27.4.3.2 and 27.4.3.4 to bind more frequently than expected in the weeks since the Energy Imbalance Market began operation on November 1, causing prices in these intervals to be set by the \$1,000/MWh bid cap. Because of these transitional conditions, the high prices are not always indicative of actual physical conditions on the system, and reflect challenges in providing timely and complete data to ensure system visibility under the new procedures, exacerbated by limitations on the resources available to PacifiCorp for use in the Energy Imbalance Market and several forced outages of large Energy Imbalance Market participating resources. The CAISO described² the transitional conditions that led to the waiver in its petition filed on November 13, 2014, as follows:

- 1) All possible operational conditions, including interactions between disturbance events and other conditions on the system, were not fully represented, simulated and tested during these earlier market simulations. It was not until actual operations that these circumstances were experienced and the resulting price excursions became apparent. In some cases data issues arise because of errors made in processing such information, and in such intervals the CAISO will have authority to correct prices. But in some cases, the pricing excursions may be due to the need to adopt better practices generally and not because of an erroneous data processing issue.
- 2) Limitations on the resources available to PacifiCorp for use in the Energy Imbalance Market. Several resources had not yet received the necessary metering upgrades due to various outage schedule limitations, which has prevented PacifiCorp from making these resources available in the initial pool of resources participating in the Energy Imbalance Market. The CAISO is processing temporary metering exemptions in accordance with its requirements and participation by some additional resources has improved conditions, but other considerations remain. For instance, some resources are subject to multiple ownership rights and have contractual issues that

² See *Petition For Limited Tariff Waiver And Request For Expedited Consideration*, California Independent System Operator Corp., filed November 13, 2014, FERC Docket No. ER15-402.

must be resolved to enable their participation in the Energy Imbalance Market. Additionally, third-party resources in PacifiCorp's balancing authority areas have not yet begun participating in the Energy Imbalance Market, which further limits the pool of available resources.

- 3) The PacifiCorp East and PacifiCorp West balancing authority areas experienced several forced outages of large Energy Imbalance Market participating resources, which led to short term supply deficiencies in the market. While outages are not necessarily uncommon, these outages quickly exacerbated an already tight supply and contributed to price increases in the associated intervals. In addition, while PacifiCorp operations accounted for the outages by responding to system conditions, these actions have not always been communicated in a timely manner to the market. Without such information, the market results would not necessarily reflect physical conditions on PacifiCorp's system. The addition of more participating resources and enhanced operational procedures should mitigate the impact of such outages.

On December 1, 2014, FERC granted the CAISO its waiver request and also directed monthly reports to FERC on the progress of the issues that led to the need for the waiver. The CAISO provides its reports consistent with the order below and in the attachments to this report.

III. Reports

In the December 1 Order, the Commission directed the CAISO to file detailed informational reports on the performance of Energy Imbalance Market at 30-day intervals during the 90-day waiver period. Consistent with the order, this first of such reports is filed 30 days from the effective date of the tariff waiver, December 15, 2014. The Commission stated that these reports should provide detailed supporting data demonstrating progress towards identifying and eliminating the problems giving rise to the waiver petition. Consistent with the December 1 order, the following reports are included in Attachments A through E as follows:

Attachment A: A quantitative and qualitative description of the market performance (covering both progress and remaining concerns) related to the issues that prompted the CAISO's waiver request that are within the CAISO's control. Includes a description of, and status update regarding, measures being taken or planned to be taken to identify and address the market performance problems related to the issues that prompted the CAISO's waiver request. Identifies any remaining deficiencies in CAISO and PacifiCorp processes, procedures, and tools and any additional market issues

related to these pricing concerns that the CAISO considers necessary to sustain stable market operations, along with the CAISO's plan to address such issues.

Attachment B: A quantitative and qualitative description of the market performance (covering both progress and remaining concerns) related to the issues that prompted the CAISO's waiver request that are within PacifiCorp's control. This section includes a description of, and status update regarding, measures being taken or planned to be taken to identify and address the market performance problems related to the issues that prompted the CAISO's waiver request.

Attachment C: Independent assessments from the Department of Market Monitoring on the causes and solutions identified by the CAISO. For this first report, this will be submitted within seven days of the CAISO's first submission.

Attachment D: An exploration of impacts, if any, on non-EIM pricing nodes, including the Mona trading node. Report on whether EIM pricing is adversely impacting non-EIM pricing nodes. The extent to which non-EIM pricing nodes such as the Mona trading node are impacted by EIM pricing within the PacifiCorp Balancing Authority Areas. Identify any such impacts and describe any actions the CAISO is taking or plans to take to address such impacts.

Attachment E: Description of each relaxation event, and a summary of the magnitude and frequency of such events overall. Data on instances where the \$1,000/MWh price would have occurred but for this waiver, including the time of the instance, the duration, the cause, and the affected node(s) and load aggregation points.

ATTACHMENT A

Quantitative and qualitative descriptions of market performance related to the issues that prompted the CAISO's waiver request - CAISO.

This attachment includes quantitative and qualitative information for three reporting requirements specified in the Commission's December 1 order. First, section 1 and section 2 provide a quantitative and qualitative description of the market performance (covering both progress and remaining concerns) related to the issues that prompted the CAISO's waiver request that are within the CAISO's control. Second, the tables in section 2 of this attachment provide a descriptions of, and status update regarding, measures being taken or planned to be taken to identify and address the market performance related to the issues that prompted the CAISO's waiver request. Finally, the tables in section 2 of this attachment also report on the measures taken and planned to address the market performance problems, which also identify any remaining deficiencies in processes, procedures, and tools and any additional market issues related to these pricing concerns that the CAISO considers necessary to sustain stable market operations, along with the CAISO's plan to address such issues.³

1. Analysis of Impact on Market Performance

In this section the CAISO provides a quantitative and qualitative analysis of the market performance impact of the issues that prompted the CAISO's request for a waiver. Figure 3 and Figure 4 provide daily average price trends in the Energy Imbalance Market organized by market and area. These daily averages reflect all prices in the real-time market, including the price corrected through the price correction process. From November 14 through November 30 the price adjustments pursuant to the waiver are implemented retroactively after the December 1 order was issued. The CAISO has commenced but not completed these retroactive adjustments, which means that prices for this time period may change.

³ *December 1 Order* at P 25.

Figure 1: Daily average of fifteen-minute market prices in PAC West and PAC East.

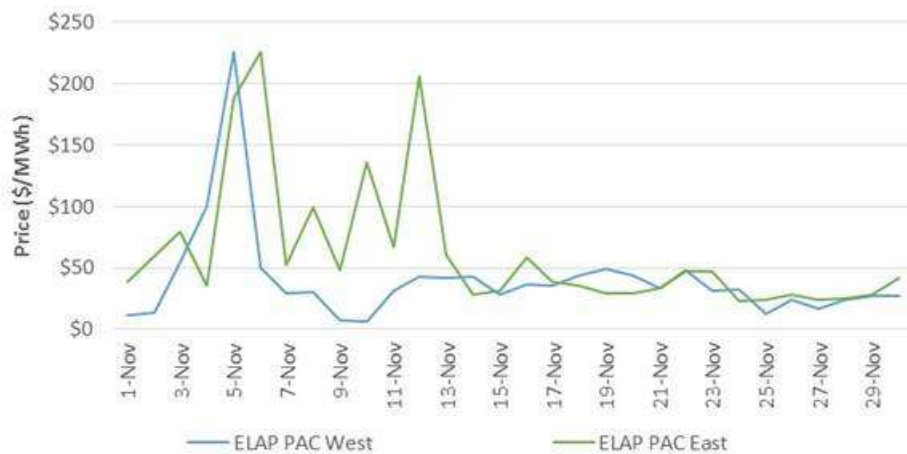


Figure 2: Daily average of five-minute market prices in PAC West and PAC East.

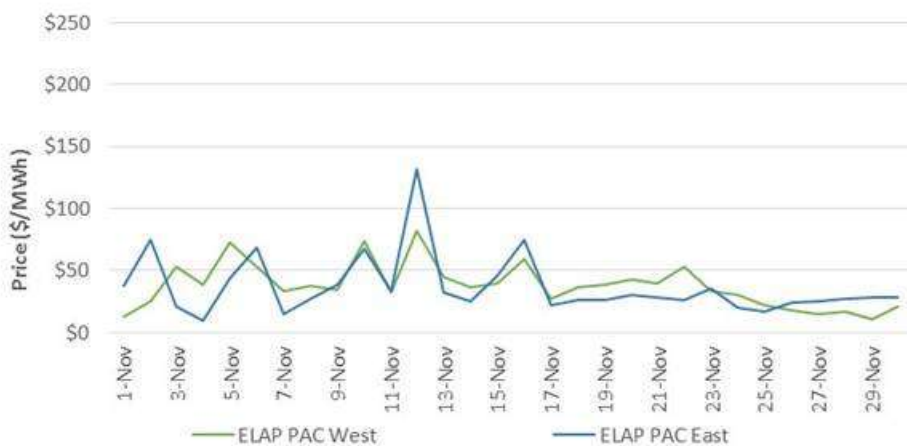


Figure 3 thru 6 report on all market intervals in which the CAISO experienced price excursions, counted by fifteen or five minute market intervals. The data includes pricing for both the PacifiCorp (PAC) West and PacifiCorp East load aggregation points (ELAPs). A fifteen or five minute market interval is counted once if the ELAP price of PAC West area or PAC East area, or both areas exceed \$500. The data excludes any price excursions that were already subject to price corrections. Section 35.4 of the CAISO tariff already 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 CAISO tariff. The CAISO has now completed all the price corrections authorized under its existing tariff authority for the month of November. As described above, the factors that led to the need of the waiver fall outside of the scope of this authority and therefore, this report

only focuses on those intervals that would have been left unadjusted but for the waiver. The report focuses on the ELAP prices because these aggregate prices are representative of pricing in each area -- PAC West and PAC East-- and would reflect short-term imbalance shortage for the aggregate area.

Figures 3 and 4 provide the daily frequency of price excursions in the fifteen- and five-minute markets. For the period of November 1 through November 13, prices were validated through the CAISO’s tariff price validation and correction process authority and stand final. For the period of November 14 through November 30 prices are being adjusted per the tariff waiver of this report. This provides a perspective of the final prices that stand unchanged and the volume of prices that may be still adjusted after the December 1 tariff waiver.

Figure 3: Frequency of intervals with ELAP prices exceeding \$500 in the fifteen-minute market. PAC West and PAC East.

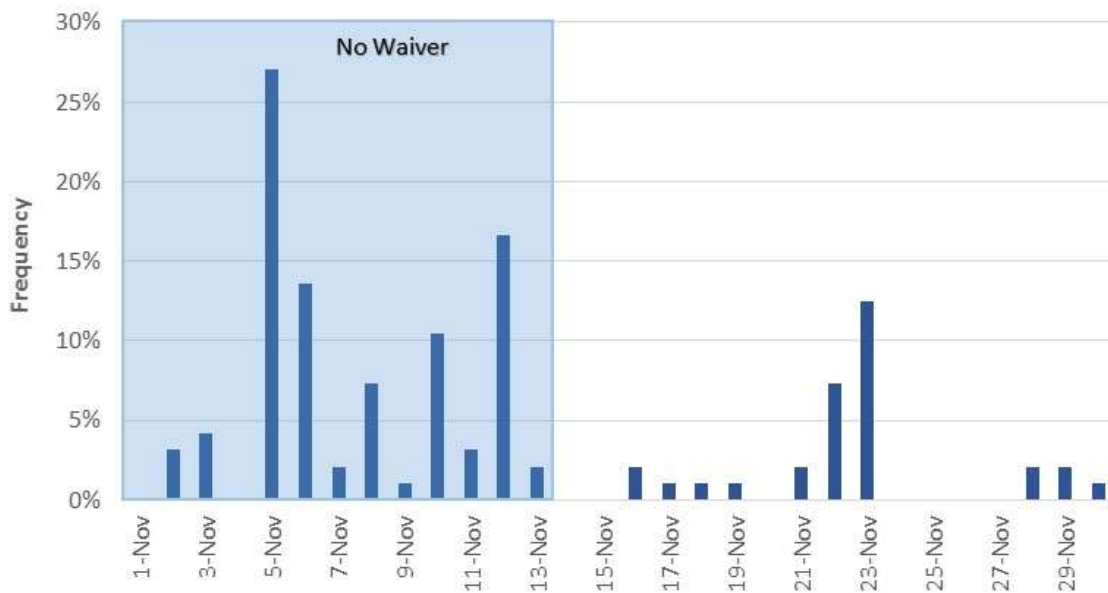


Figure 4: Frequency of intervals with ELAP prices exceeding \$500 in the five-minute market. PAC West and PAC East.

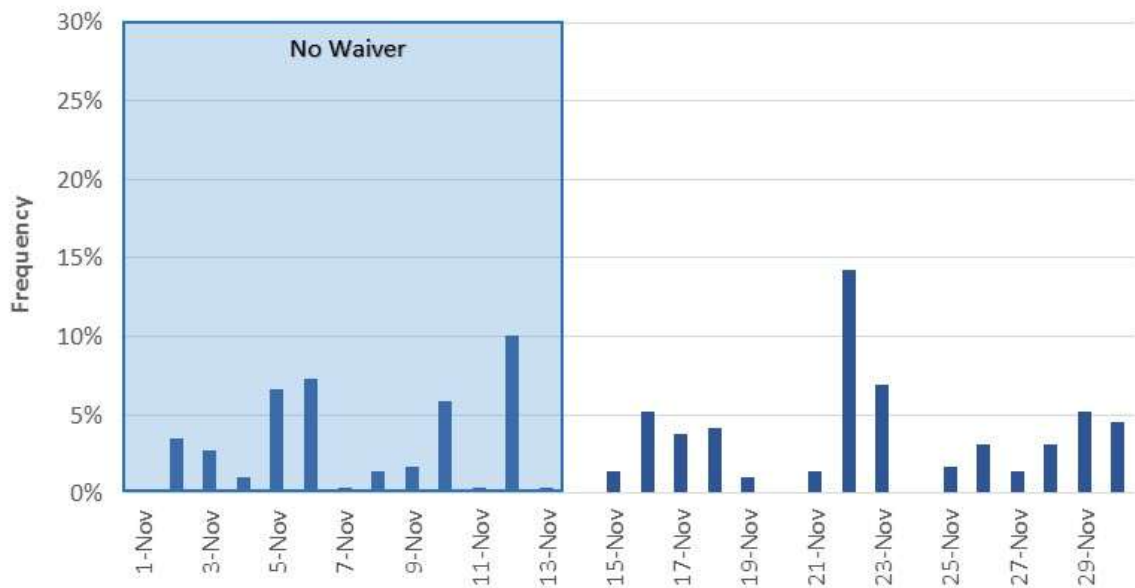


Figure 5 and Figure 6 show the frequency of price excursions for both the fifteen and five-minute market, including the cause for the excursions. In any given market interval, more than one of the illustrated reason may have contributed to the price excursion because there are numerous elements that can impact the market outcome. For example, a given market interval may experience a price excursion due to data alignment, manual dispatches and load changes. For the purpose this report, the CAISO has reviewed each affected market interval and has assigned the interval to a reason category that most afflicted the interval. The categories used in the figures in this section 1, include:

1. *Renewable deviations* for conditions in which wind changes lead to the loss of capacity and for the need to increase generation from other resources.
2. *Load changes* refer to conditions where either the load forecast is adjusted or there is a change in the load bias.
3. *Import/Export changes* is for adjustments and updates to imports and exports as seen by the market.
4. *Resource outage* is for conditions in which an outage results in the loss of capacity available to the market, and for which the market needs to increase generation from other resources. Similar conditions apply for manual dispatches leading to a reduction of available capacity to the market.
5. *Resource data alignment* is for any other condition not captured in the previous five categories. This group accounts for resource deviating from

their dispatch, differences between base schedules and bids or dispatches, and changes between markets.

Figure 5: Reasons for intervals with ELAP prices exceeding \$500 in the fifteen-minute market. PAC West and PAC East.

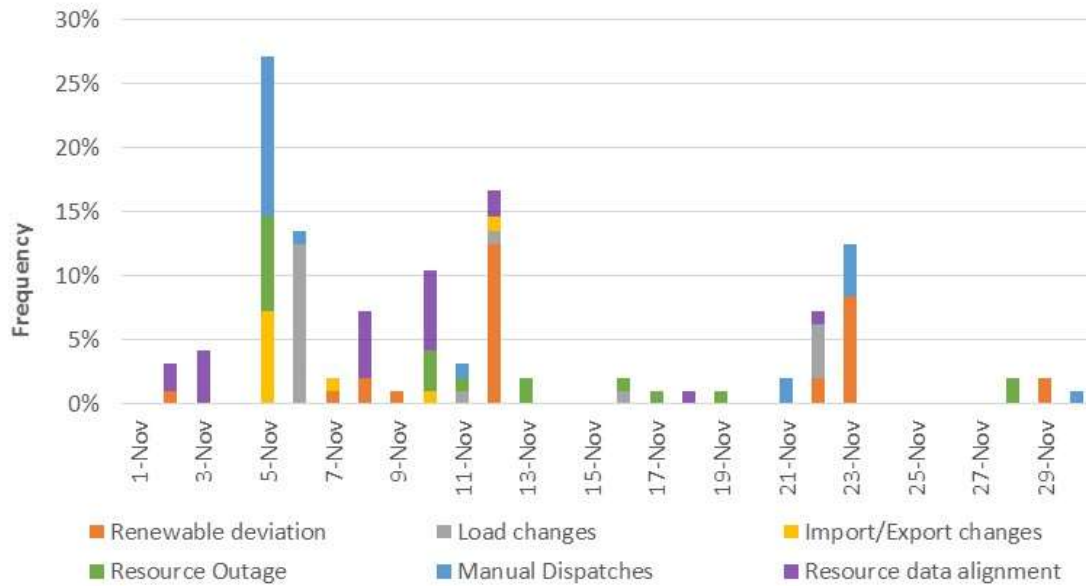
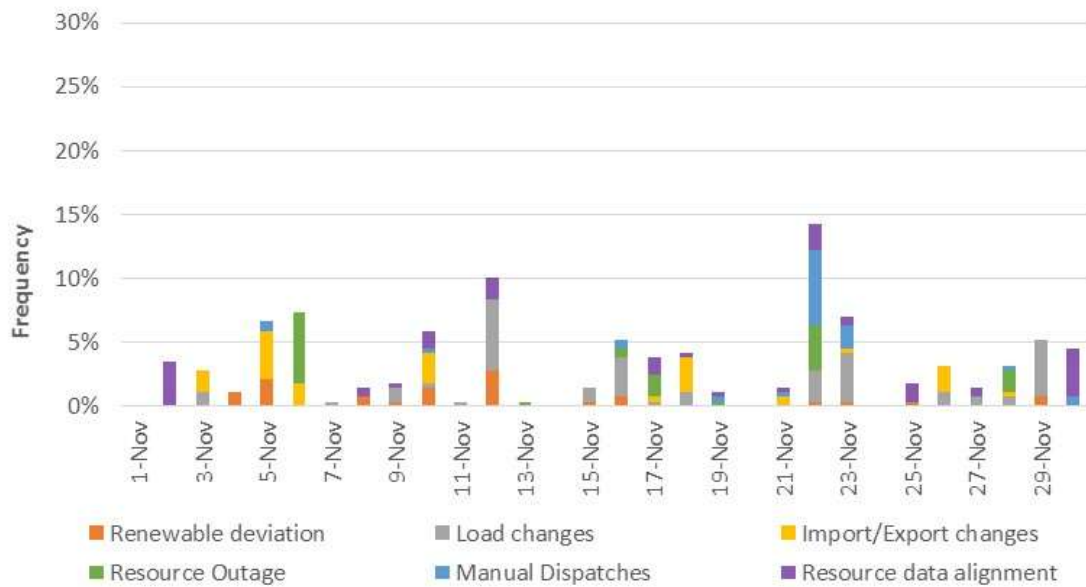


Figure 6: Reasons of ELAP Prices exceeding \$500 in the five-minute market. PAC West and PAC East.



The categories used in Figures 5 and 6 are related but not exactly the same as the broader descriptions provided in the tables in section 2 below. In some cases, the descriptions provided in the tables below will create conditions leading to the manifestation of price excursions. For example, in category 1 below includes the issue of timely manner of entering and cancelling outages. This issue also falls in the category of resource data alignment shown in Figure 5 and Figure 6. The descriptions in the tables below link each issue to the relevant category of reasons above to more specifically define the categories of reasons that prompted the need for the December 1 Order tariff waiver.

2. Issues prompting waiver, remedial actions taken, status and outstanding items

Category 1: Outages, derates/rerates management

Issue	Description	Remedial Action and Status	Frequency and Market Impact
1. Timely entering and cancelling of outages in the market	When resources experience full or partial forced outages, the market must be informed in a timely manner of the outage event and the corresponding measures taken to compensate for the lost megawatt capacity. Delay in informing the market application causes the market application to detect capacity shortages not covered by the unloaded capacity from participating resources. Under such conditions, prompt EIM Entity manual dispatch instructions are needed to increase the generation of available non-participating resources to create room for participating resources to be marginal and to economically set price. When the EIM Entity cancels an outage in a timely manner, it is also important to inform the market that the capacity is available and can be used to clear the Energy Imbalance Market, otherwise the market will perceive that there is capacity shortage to meet the load.	The CAISO provided additional training to the EIM Entity to correct processes and procedures for understanding when and what information is to be correctly entered and canceled in the Outage Management System. The training was provided through verbal and written instructions and guidelines, and clarifications to procedures. Significant progress has been made in the last 30 days. The CAISO continues to monitor and analyze for the timeliness of response to inform the market about any out-of-market manual actions that are taken or are planned to be taken.	This issue may result in instances counted in Figure 5 and 6 as Resource data alignment and Resource outages. As illustrated in those figures, these causal categories have decreased in frequency over time.

2. Base schedule and Bid submission for resources undergoing outages	The timing in which the EIM Entity reports the outage is very important. If the outage occurred before T-75 (<i>i.e.</i>, seventy five minutes before the operating hour) and is expected to last during the operating hour T, then both the economic bid and base schedule submission should be adjusted to account for the outage. Otherwise, the assumptions and data used by the market application for the balance test and look-ahead fifteen-minute market are not consistent with real system conditions, which results in less capacity available to the Energy Imbalance Market than what was computed before the start of the operating hour, and high prices are imminent due to limited unloaded economic capacity that is offered in the market.	The CAISO provided the EIM Entity additional market operator training, discussions, clarifications to guide the EIM Entity to follow best practices, and procedures for actions that must be taken depending on the timeframe of the outage: before T-75', before T-40', and after T-40'. The CAISO has provided more information about derates and outages and by enhancing the EIM Entity user interface displays to include greater awareness of the effective resource limits and any disqualified capacity due to derates or full outages. Significant progress has been made in the last 30 days. The CAISO continues to monitor and analyze for timely responses to inform the market about any out-of-market manual actions that are taken or are planned to be taken by the EIM Entity.	This issue may result in instances counted in Figure 5 and 6 as Resource data alignment and Resource outages.
3. Outages of partial or full multi-stage generating resource configurations	Multi-stage generating resources have multiple configurations that must be carefully managed in the real-time market. The configuration characteristics are registered in the master file and are	The CAISO provided the EIM Entity additional training on data modeling and base scheduling and definition of multi-stage generating resource parameters.	This issue may result in instances counted in Figure 5 and 6 as Resource data alignment and Resource outages

	observed and honored by the market application. These include physical registered characteristics such as transition time, minimum up time, and minimum down time and minimum load (Pmin) and maximum output (Pmax) megawatts (MWs) as well as any overlapping MW regions between configurations. If a configuration is out of service, a timely input of the outage is needed to inform the market that the corresponding economic bid or base schedule is not available and another configuration should be used. If the information is not promptly entered or bids don't exist on other configurations then the market has no way to move the resource to other configurations and the whole MW of the plant is lost in the market and price excursions will occur.	The CAISO has seen a lot of improvement in this area but due to the complexity of multi-stage generating resource data modeling there is still room for improvement.	

Category 2: Manual Dispatch

Issue	Description	Remedial Action and Status	Frequency and Market Impact
1. Timely input of manual dispatch	Since many units are not participating in the market, manual dispatch and other out-of-market actions taken on these units must be recorded by the EIM Entity in the market to inform the market about the availability of these resources and their	The manual dispatch is entered directly in the market tool by the EIM Entity and any software limitations were discussed and explained in detail by the market operator. A review of the process	This issue may result in instances counted in Figure 5 and 6 as Resource data alignment and Manual Dispatches

	movements to respond to events like contingency or outages of other units. Without this timely information, the market can only assume that the participating resources will respond to these various events, which will result in depleting the unloaded capacity of the participating resources and their capability to set economic prices.	and the interaction between the EIM Entity and the EIM Participating Resource Scheduling Coordinator that represents PacifiCorp Energy was conducted to explain and clarify the role of each group in this process and how to achieve a coordinated and timely response.	
2. Flexible ramping sufficiency test	The CAISO performs the flexible ramping sufficiency test on the base schedules, the last test being at 40 minutes before the start of each operating hour. When the EIM Entity fails the test based on the economic bid-in capacity that is being offered to the market, the market application will constrain the failed balancing area and limit it from increasing its import from other balancing areas to prevent the leaning concern. This means that the failed balancing area enters the operating hour depending on its resources and any additional manual changes to available non-participating resources set points or purchases of interchanges within the hour. Any delay in performing the manual dispatches or the additional interchange purchases leaves the market exposed for price excursions due to insufficient bid-in flex capacity.	The CAISO has discussed this issue with the EIM Entity and has clarified the market impact. The CAISO also is considering whether it is necessary to make available a user interface display of the results of the flexible ramping sufficiency test to the balancing group of PacifiCorp similar to the display/report available to grid operation.	This issue may reduce the flexibility of the market to absorb system condition changes and data updates and, consequently, leave the market more susceptible to price excursions by any of the reasons provided in Figures 5 and 6.

Category 3: Wind forecast accuracy

Issue	Description	Remedial Action and Status	Frequency and Market Impact
1. Accuracy of PacifiCorp wind resources forecast	The variable energy resource (VER) forecast, which is mainly wind forecast for the PacifiCorp balancing authority areas, is crucial because it sets the maximum economic megawatt range that the market is allowed to dispatch these resources. The accuracy of the short term VER forecast benefits immensely from the accurate telemetry of the output of the VER resources. The forecast of the wind resources was deviating significantly from the output of the resources even for the next 5-min forecast over a period of many days. This resulted in significant deviations in calculated energy imbalance and sometimes resulted in overgeneration, or undergeneration conditions compared to the hourly base schedule values of these wind resources for the corresponding operating hour. Lastly, in cases where wind resources are participating and being dispatched, the short-term forecast, which is a persistent forecast, may not be accounting for the dispatch instruction.	The CAISO provided an additional unit deviation display as part of the EIM Entity user interface. This display provides the grid operator information in a fast and flexible manner with respect to any differences between any combination of telemetry, state estimation, base schedule, and cleared target operating points. This display helped not only to quickly identify which wind resource is deviating but also the amount of deviation per resource and on aggregate basis per balancing area. PacifiCorp is diligently working with its wind forecast service provider to enhance the forecast quality of the wind resources megawatt output and accounting for participating wind resources that are dispatched based on submitted bids.	This issue may result in instances counted in Figure 5 and 6 as Renewable deviation

Category 4: Interchange schedule variation

Issue	Description	Remedial Action and Status	Frequency and Market Impact
1. Interchange information within the hour	Interchange information is an essential part of meeting energy imbalance for each balancing authority area. Considering the forward look-ahead time horizon of the fifteen-minute market for almost two hours, and one hour for the five-minute real-time dispatch market, timely information about the interchange schedules is essential. The delay to inform the market application about these interchanges during resources outage times or steep load ramping conditions tightens the market conditions, leading to fake price excursions that sometimes show in the financially binding fifteen-min market interval which is calculated 37.5 minutes ahead of time before the T-20 minutes cut off time for the tags to be submitted and approved for any extra or within the hour interchanges.	Review of the fifteen-minute and five-minute market timelines, and impact of lack of market information about any planned purchase or sale of interchanges before or within the hour was discussed with the EIM Entity, and the pricing impact was clarified. Information was incorporated in business procedures that are used to train PacifiCorp personnel. The CAISO also discussed with the EIM Entity the need to submit planned interchange base schedules for multiple hours in the horizon to provide the short term unit commitment, which has a four and half hours look-ahead horizon, with good projection of the forward hours to enable good market decisions.	This issue may result in instances counted in Figure 5 and 6 as Import/Export changes

Category 5: Load forecast variation

Issue	Description	Remedial Action and Status	Frequency and Market Impact
1. Load forecast biasing	EIM Entity grid operators have the capability to bias the load forecast for reliability purposes to account for any non-modeled issues causing discrepancy between forecast load and actual load. The setting of the bias is somewhat subjective based on the grid operator's judgment of system operational and reliability needs. This biasing if not done in a coordinated fashion with market operations can create price excursions especially when there is limited flexible ramp capacity available to accommodate small marginal overshoot or undershoot of the bias values. Due to the limited pool of participating resources, the PacifiCorp grid operator will necessarily need to pay extra attention to the bias values to prevent unintended overshoot or undershoot.	The logic for the load bias to maintain reliability was extensively discussed, documented, and used during PacifiCorp grid operator training. The impact of these actions on prices was also discussed and, as explained, the price is a situational awareness signal to indicate the issue of meeting load or balancing the system. The issue of grid operator adjustment for correcting the area control error (ACE) was also discussed in detail and the challenges of operating under market structure and non-market structure was clarified and included in the training material.	This issue may result in instances counted in Figure 5 and 6 as Load changes

Category 6: Resources not following dispatch

Issue	Description	Remedial Action and Status	Frequency and Market Impact
1. Resources not following dispatch signal	On occasion resources were not closely following the market dispatch signal. This was either because the plant was unavailable and an outage ticket was not	The CAISO provided an additional unit deviation display as part of the EIM Entity grid operator user interface. This display provides the	This issue may result in instances counted in Figure 5 and 6 as Resource data alignment

	entered on-time for the market to consider the outage, or because of some lag time when the plant was not set on automatic generator control to be dispatched directly from market signal. In any of these cases, the deviation from the market dispatch and the lack of the manual instructions to inform the market application when the resource cannot operate to the target operating point, resulted in market conditions that are not reflective of actual system conditions, causing price excursions. In some cases when the plant is dragging its response to the market signal it was necessary for the EIM Entity to make direct phone calls to the plant to start moving up or down to the plant's designated market dispatch signal.	operator, with a fast and flexible depiction of any differences between any combination of telemetry, state estimation, base schedule, and cleared target operating point. This display helped to quickly identify which wind resource is deviating and the amount of deviation per resource and on aggregate basis per balancing authority area. When a resource was observed to be dragging its dispatch, a direct call to the plant was enough to expedite the response if the plant was available or resulted in submission of outage ticket or manual dispatch instruction if the plant had any temporary physical limitations.	

Category 7: Network Model discrepancy

Issue	Description	Remedial Action and Status	Frequency and Market Impact
1. Industrial load base schedules	PacifiCorp has industrial load as part of the conforming load and market load forecast. This created a discrepancy whenever these industrial loads are operating or called upon to curtail. The market is not aware of these non-participating	CAISO and PacifiCorp went through a series of meetings and identified these resources. An action plan was developed to add these non-participating resources to the network model used in the market	This issue may result in instances counted in Figure 5 and 6 as load changes and resource data alignment

	resources that exist in the PacifiCorp energy management system, but not in the market, creating the need to manually bias load to maintain consistency between market model and PacifiCorp's energy management system (EMS) model.	application. These resources are also taken out of the conforming load calculations and PacifiCorp will be submitting average hourly base schedules for these resources like any other non-participating resources.	
2. Distributed energy resources modeling	Distributed energy resources are currently included in the market load forecast as conforming load. These resources have both load and generation components, which net to positive or negative net injection at the load bus. When generating the market sees more load than what the PacifiCorp's EMS is seeing and price excursions occur because of the lack of base schedules for these resources.	CAISO and PacifiCorp went through series of meetings and identified the gross impact of these resources. Action plan was developed to add them to the market network model. These resources are also taken out of the conforming load calculations and PacifiCorp will be submitting average hourly base schedule for them like any other non-participating resources.	This issue may result in instances counted in Figure 5 and 6 as load changes and resource data alignment
3. Telemetry quality issues (net versus gross accounting)	The EIM Entity is sending telemetry values for all PacifiCorp registered resources in the master file. When the quality of the telemetry values is not good, the state estimator solution quality is negatively impacted, which in turn affects the quality of the market solution and the dispatch operating targets of these resources. During the first few weeks of operation the CAISO found that some resources have telemetry measurement that is net of its	The CAISO and PacifiCorp identified all these resources and telemetry issues. Some workarounds are now in place to adjust or correct the sign of the measurement or resolve the gross versus net telemetry measurement, as well as to resolve the zero telemetry for some of the non-participating resources. Much progress was achieved in this area	This issue may result in instances counted in Figure 5 and 6 resource data alignment

	auxiliary loads and others have gross telemetry measurements that do not include the auxiliary load. In addition, certain wind resources and other small non-participating resources did not have telemetry. When these discrepancies are combined together they tend to impact the market solution and prices.	and improvements are underway.	

Category 8: Market model discrepancy

Issue	Description	Remedial Action and Status	Frequency and Market Impact
1. Energy during startup and shutdown	For multi-stage generating resources, the energy of these resources during the startup and shutdown periods when their output is below the PMin is accounted for in energy management system and automatic generation control (AGC). But the market does not account for this energy because it is below the PMin of the resource. This created discrepancy in the base schedule balance test, and the imbalance calculations between market and actual conditions as seen by AGC, which led to performing some load bias during the startup and shutdown of these resources subjecting the market to price excursions.	CAISO is working with PacifiCorp on defining some parameters to best model the startup and shutdown profile of multi-stage generating resources and their ramping time. The CAISO is also looking into adding startup and shutdown profile features to the fifteen-minute market to help model the impact of the energy from such resources during startup and shutdown.	This issue may result in instances counted in Figure 5 and 6 resource data alignment

Category 9: EIM Transfer Limits

Issue	Description	Remedial Action and Status	Frequency and Market Impact
1. Static and dynamic transfer limit restrictions on California-Oregon Intertie (COI)	The Energy Imbalance Market is designed to have the EIM transfer capacity fully re-optimized in both the fifteen-minute and five-minute market. With respect to the COI, the added restriction of the dynamic five-minute limit which is an incremental limit around the fifteen-minute solution creates at times price excursions. The five-minute dynamic limit constrains the market application from re-optimizing the fifteen-minute EIM transfers decisions between PacifiCorp and CAISO beyond the amount allowed by the five-minute incremental dynamic limit, which can be restrictive especially during the on-peak hours.	PacifiCorp is engaged in ongoing discussions with the Bonneville Power Administration (BPA) to understand the nature and allocation of the dynamic transfer capability on COI. BPA is in the process of conducting a detailed dynamic transfer capability study, which is ongoing work. Any additional five-minute capability will help the five-minute market re-optimize the fifteen-minute decisions that are based on system conditions and information available at approximately 30 minutes prior to the five-minute market.	
2. Five-minute rate-of-change constraints	The rate-of-change constraints are five-minute flow limit constraints that limit the amount of five-minute movement of PAC West balancing authority area participating resources around the corresponding resources' fifteen-minute schedules due to their flow impact on certain paths and flowgates internal to BPA's balancing authority area. This	PacifiCorp is engaged in discussions with BPA to understand the nature and basis behind the five-minute flowgate limits. BPA is reviewing the five-minute limits which are based on historical movement of PacifiCorp West resources before EIM. Any additional five-minute capability	

	restriction on the resources' five-minute movements or the corresponding rate-of-change constraint has created at times price excursions on the impacted resources when the corresponding path or flowgate five-minute limit constraint is binding.	will help the five-minute market re-optimize the fifteen-minute market decisions that are based on system conditions and information available approximately 30 minutes prior to the five-minute market. The CAISO is considering discussing the modeling of these constraints to determine if the current model matches the BPA study assumptions that resulted in setting up the five-minute rate-of-change constraint limits.	

ATTACHMENT B

Quantitative and qualitative descriptions of market performance related to the issues that prompted the CAISO's waiver request - PacifiCorp.

REPORT PROVIDED BY PACIFICORP

Description of, and status update regarding, measures being taken or planned to be taken to identify and address the market performance problems related to the issues that prompted CAISO's waiver request.

In addition to the measures undertaken by the CAISO to address the identified market performance issues described in Attachment A, PacifiCorp has implemented additional measures to address performance of the EIM appropriate for it to undertake as an EIM Entity.

First, PacifiCorp led efforts to coordinate with the CAISO to significantly increase the pool of resources available to participate in the EIM since November 1, 2014. PacifiCorp Energy has received certification, and addressed outstanding metering and contractual issues, for the following PacifiCorp EIM Participating Resources: Huntington Unit 2 (450 MW), Naughton Unit 3 (330 MW), Jim Bridger Units 1-4 (2,147 MW), Gadsby Unit 3 (105 MW), and Gadsby Units 4-6 (120 MW). In the aggregate, PacifiCorp has recently enabled EIM participation for over 3,150 MW of additional resources. PacifiCorp anticipates continuing to add participating resources by addressing remaining metering and contractual issues (the latter due to shared facilities), as scheduled generator outages permit. In addition, PacifiCorp continues to work with other transmission customers who may be interested in participating in the EIM with resources. This effort includes responding to information requests, providing customers with appropriate contacts or resources at the CAISO, and processing applications and certifications pursuant to PacifiCorp's OATT processes, if requested. At this time, PacifiCorp has not certified any third-party transmission customers for participation in the EIM and is not at liberty to disclose the identity of any transmission customers that have made inquiries related to EIM participation, but is nevertheless hopeful that these efforts will result in additional EIM participation.

Second, PacifiCorp has developed and implemented additional tools and displays to provide its Grid Operations personnel with increased visibility and situational awareness

regarding available regulation on a 5- and 15-minute basis which are the critical time intervals for the EIM. Grid Operations' "BAA Ops Tool" features the following new displays which allow grid operators to monitor generator availability, capacity, and ramp capacity: Bid Overview – Generators Price and Ramps, Bid Overview – Generators Start-ups, and Bid Overview – Generators Self Schedules. Further, the display in PacifiCorp's Base Schedule Aggregation Portal ("BSAP") BAA Balance Viewer now features "generation only" and "interchange only" values – in addition to the Aggregated Base Schedule, Demand Forecast, and the difference between the two items – and specifically identifies CRAG and Mona schedules (to address the two interties between PacifiCorp and the CAISO). PacifiCorp's Grid Operations and Commercial and Trading business units also developed additional generation displays that show available generation capacity for all PacifiCorp EIM Participating Resources, and continues to develop similar tools to display aggregated and disaggregated generation values, generation deviations, and interchange deviations, which are expected to be deployed by the end of the first quarter in 2015.

Third, PacifiCorp has (i) provided training on outage entry, including training provided by CAISO personnel, and (ii) required the provision of daily spreadsheets from PacifiCorp EIM Participating Resources that describe any operational issues and the resources' ambient conditions. PacifiCorp continues to coordinate with its outage vendor and the CAISO to improve functionality between its COMPASS outage management system and WebOMS, and also continues to develop a reference guide for outage management as part of this effort, which is expected to be completed by December 31, 2014.

Finally, to ensure that PacifiCorp EIM Participating Resources are following their respective Dispatch Instructions, PacifiCorp has configured real-time generation deviation displays to monitor any deviations between plant output and Dispatch Operating Points issued by the Market Operator. PacifiCorp continues to develop a display to incorporate Fifteen Minute Market and Real-Time Dispatch prices in addition to Transmission Customer Base Schedules, Dispatch Operating Points, and plant output, to track primary settlement statement components and to display for Grid Operations' situational awareness overview, which is expected to be completed by December 31, 2014.

Identification of any remaining deficiencies in CAISO and PacifiCorp processes, procedures, and tools and any additional market issues related to these pricing concerns that CAISO considers necessary to sustain stable market operations, along with CAISO's plan to address such issues.

In addition to the continued work of PacifiCorp described above, PacifiCorp has taken (and continues to take) additional steps to improve its processes and tools to address

identified market performance issues. PacifiCorp Grid Operations has drafted and posted “best practices” procedure documents – and continues to update such documents in real-time as needed (including to reflect additional PacifiCorp EIM Participating Resources) – to aid in personnel’s implementation of critical EIM Entity tasks. In addition to the activities described above, PacifiCorp and the CAISO have developed a series of training modules for PacifiCorp generation and grid operators, which are anticipated to be delivered by the end of January 2015. Such trainings are designed to enhance operator actions, decision making, and understanding of market operations on an ongoing basis.

ATTACHMENT C

Independent assessments from the Department of Market Monitoring on the causes and solutions identified by the CAISO.

This report part of the report will be submitted to the Commission within seven days of December 15, 2014.

ATTACHMENT D:

This attachment provides an exploration of impacts, if any, on non-Energy Imbalance Market pricing nodes, including the Mona trading node.⁴ This attachment identifies any such impacts and describes any actions the CAISO is taking or plans to take to address such impacts.

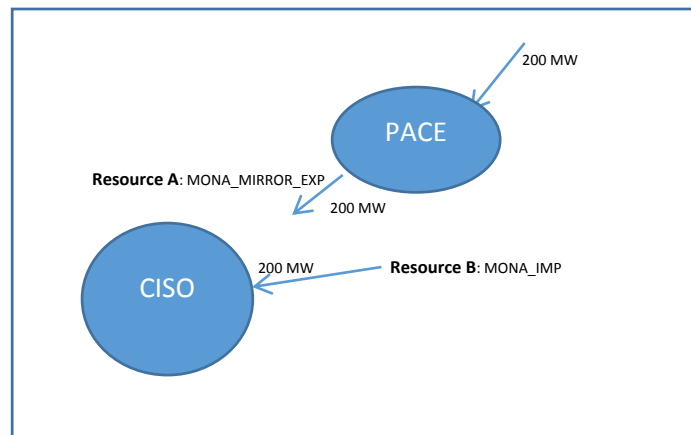
The implementation of the Full Network Model Expansion on October 15 increased the accuracy of the transmission grid modeling from neighboring balancing authority areas, and also allowed for better representation of unscheduled flows effects into the CAISO system. In addition, the implementation of the Energy imbalance Market on November 1, 2014, further enables the CAISO to co-optimize resources across the various areas of the Energy Imbalance Market. Both of these initiatives required that the CAISO also change the way in which the scheduling points are defined so that it can associate the scheduling points with external interties.

With regards to the CRAG and Mona scheduling points, the CAISO had to account for the fact that schedules can be submitted at the locations for purposes of CAISO only transactions or Energy Imbalance Market only transactions. The Crag location is the scheduling point for the Cascade intertie; the Mona location serves as a scheduling point for various southern interties, such as IPPUTAH and Adelanto interties. Prior to the implementation of the full network model, these two scheduling points were modeled with the standard radial link and were considered part of the CAISO balancing authority area. With the implementation of the full network model expansion, this definition changed and with the implementation of the Energy Imbalance Market, the prices at these locations changed notably as the CAISO began accounting for Energy Imbalance Market related congestion.

CRAG and Mona scheduling points are physically located inside PacifiCorp Balancing Authority Areas instead of the CAISO Balancing Authority Area. Mona is located inside PAC East, and CRAG is located inside PAC West. However, these locations continue to serve as scheduling points for imports and exports transacted with the CAISO balancing authority area. This situation requires special treatment for balancing and pricing calculations and leads to a special prices posted on OASIS. The pricing at these locations is based on the following rules to implement the special treatment of CAISO scheduling points CRAG/Mona Interchanges into the balance and price calculations of CAISO and PAC East/PAC West balancing authority areas.

⁴ See December 1 Order at P 25.

Figure 7: Illustration of Mona Pricing



Assume that Resource A is Mona_Mirror_Exp, Resource B is Mona_IMP. Both of these resources are defined in Master file to have the same scheduling point and intertie definitions (ISO-PACE). The following rules apply:

Resource A,		
BAA	Balance	Price
CISO	Don't include MW	Not applicable
PACE	Include MW	Resource LMP= Price@SP
Resource B,		
CISO	Include MW	Adj_Price@SP= Price@SP – EIM_PACE – EIM_PACE_PACW – GHG + $\sum$ MONA ITCs Resource LMP= Adj_Price@SP
		SP-TIE Price shall use the Adj_Price@SP for the SP price calculations.
PACE	Don't include MW	Not applicable

The same above treatment shall be applied to CRAG scheduling point and mirror resource. The Figure above illustrates how an import at Mona scheduling point is mirrored by an export from the PACE balancing authority area with equal megawatt value. The reason for this mirroring is to allow the accounting for the import and associated offsetting export for each balancing authority area separately while the supporting resource(s) for the transaction is modeled at the physical location within PACE balancing authority area or as a separate import to PACE balancing authority area from another balancing authority area.

The table above illustrates that the pricing at Mona for CAISO balancing authority area is adjusted to not include effects of Energy Imbalance Market transfer constraints, GHG pricing, and other constraints pertaining to the EIM area.

The CAISO detected that the pricing at CRAG and Mona over the first few days of implementation were subject to a software defect that resulted in the CAISO pricing to include some of the LMP components pertaining to the mirror resource. The CAISO fixed this issue on November 5, 2014 and has not detected it since.

Currently, the prices at these scheduling points, as posted on OASIS, reflect all the congestion effects from either CAISO or PAC balancing authority areas. However, for CAISO imports and exports, the actual price used for settling the respective schedules at each of these locations as scheduling points for imports and export to and from CAISO balancing authority area, only accounts for the congestion arising from CAISO balancing authority area. The prices posted on OASIS do not reflect that, but the prices provided through the California Market Results Interface (CMRI) application and used for settlements for resources transacting at these scheduling points will reflect only the applicable CAISO BAA congestion.

For example, consider the case of a sample market interval, November 26, hour ending 11 interval 4 for the fifteen-minute market. The shadow price of the IPPUTAH ITC is -\$183.29, the Energy Imbalance Market transfer for PAC East is \$6.8 and the Energy Imbalance Market transfer for PAC East and PAC West is -\$11.88. The system energy price is \$35.38 and the greenhouse gas price is \$0. The price posted on OASIS for the marginal congestion component at MONA_3_N501 is -\$188.37. The congestion component posted on OASIS accounts for all the congestion associated with this location, both from the CAISO and PAC balancing authority areas. This published congestion component is thus calculated as $-\$183.29 \text{ (IPPUTAH ITC)} - \$11.88 \text{ (PACW\_PACE)} + \$6.8 \text{ (PACE)} = -\$188.37$.

On the other hand, for intertie awards using the Mona point as a scheduling point to transact in the CAISO Balancing Authority Area, the prices posted in CMRI and used for settlements reflect accordingly only the congestion share of -\$183.29 arising from IPPUTAH ITC. This price still adheres to the typical congestion calculation used prior to the implementation of the full network expansion and Energy Imbalance Market.

The current data structure used in the OASIS application only supports the display of one entry for the marginal congestion component, and given the nature of the congestion associated with these two scheduling points, either marginal congestion component combination will reflect partial information. Currently the display of the full congestion components -- CAISO and PAC -- does not apply to CAISO schedules. If the entry displayed only the CAISO congestion share, it will still be partial because it will be missing now the congestion portion associated with PAC. The CAISO is working on an enhanced OASIS display that will publish the congestion component breakdown. In this case there will be an entry for the congestion share associated with PAC of $-\$11.88 + \$6.8$ and another entry with the congestion share associated with CAISO tie of -

\$183.29. The CAISO expect that this display will be available in January 2015 and will provide the clarity and minimize the concerns about the pricing for these two locations.

ATTACHMENT E

In this attachment, the CAISO reports on each relaxation event, and a summary of the magnitude and frequency of such events overall.⁵ This report provides data on instances where the \$1,000/MWh price would have occurred but for the Commission's December 1 Order waiver, including the time of the instance, the duration, the cause, and the affected node(s) and load aggregation points.

The relaxation events affect numerous market intervals as the CAISO real-time markets contain many fifteen and five minute intervals. The information is provided in summary level because the data is significant and detail specific reporting of such events would not be as meaningful. The report focuses on the ELAP prices because these aggregate prices are representative of pricing in each area --West and East-- and would reflect short-term imbalance shortage for the aggregate area.

The information provided in Figures 8-11 is for instances of relaxation that resulted in prices in the neighborhood of the penalty-based price \$1000/MWh. However, there are two cases in which there maybe the need to relax certain constraints but prices attained under such events were not based on the \$1000/MWh penalty prices. On Case One, the EIM Entity fails the flexible ramping sufficiency test. 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 to area group constraints. Also, for the duration of the restricted interval, the market clearing price in the affected EIM Entity balancing authority area will be based on the last economic bid cleared in the applicable fifteen-minute or five-minute interval in the EIM Entity balancing authority area. Therefore, for some intervals, there may be a need to relax the power balance constraint, for example, but the pricing is set pursuant to the procedure described above and not pursuant to the December 1 Order waiver pricing.⁶

⁵ *December 1 Order*, at P 26.

⁶ The price discovery mechanism under the procedure described in Section 10.3.2.1 of the BPM for Energy Imbalance Market is, however, essentially the same price discovery procedure used under the December 1 Order waiver.

In Case Two, the CAISO has identified intervals that although there was constraint relaxation, for whatever reason, the price was not determined by the penalty prices for relaxation. The CAISO is still investigating those unusual market outcomes.

Figures 8 through 11 do not reflect the intervals affected by the issues in Case One and Two described above and instead only focus on the intervals that are the subject of the waiver provided in the December 1 Order. Figures 12 through 15 below, however, provide all of the instances in which there was infeasibility observed, distinguished by the various categories discussed above.

The data in this report does not include those cases in which there was infeasibility for over supply conditions as these cases are not reflected in the waiver requested in this proceeding. The penalty prices specified in sections 27.4.3.2 and 27.4.3.4 only pertain to infeasibility cases in which there is under-supply. The penalty prices for the over-supply conditions are specified in section 6.6.5 of the BPM for Market Operations.

Figure 8 and Figure 9 show the summary of instances where power balance constraint relaxations occurred in the fifteen- and five-minute market in the PAC West and East area, respectively. The reported events are also aggregated on a daily basis and depicted with an infeasibility range with the vertical line in blue. The end of the vertical blue line represents the minimum and maximum value of power balance relaxation in each day. The average magnitude of the infeasibility is shown by the red marker on the blue vertical lines. Figure 10 and

Figure 11 provide similar information but for the five-minute market.

Figure 8: Magnitude of power infeasibility in PAC West. Fifteen-minute market.

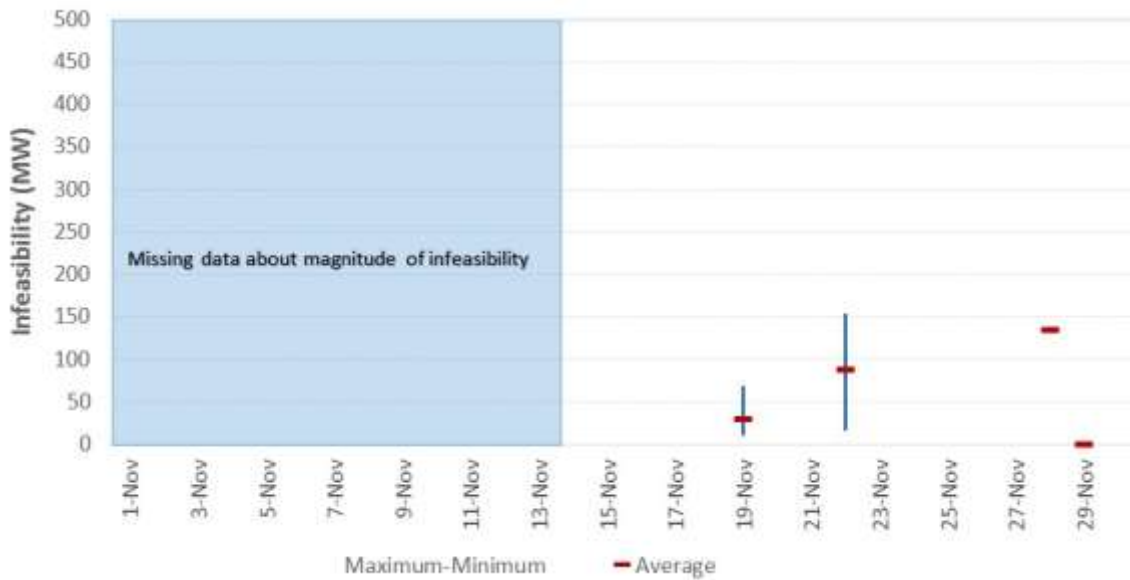


Figure 9: Magnitude of power infeasibility in PAC East. Fifteen-minute market.

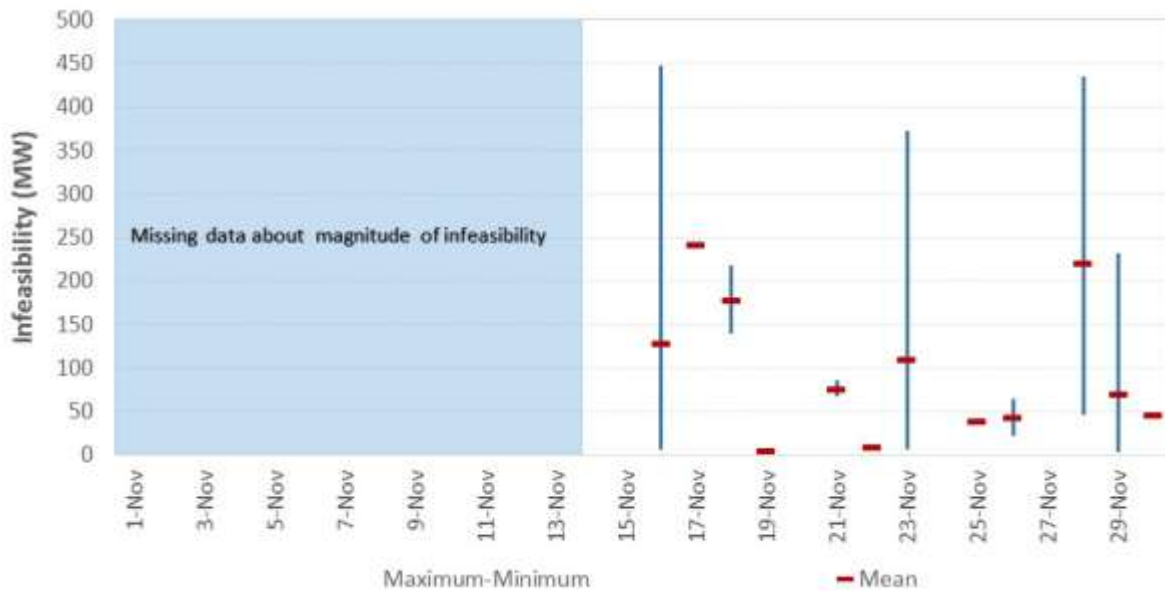


Figure 10: Magnitude of power infeasibility in PAC West. Five-minute market.

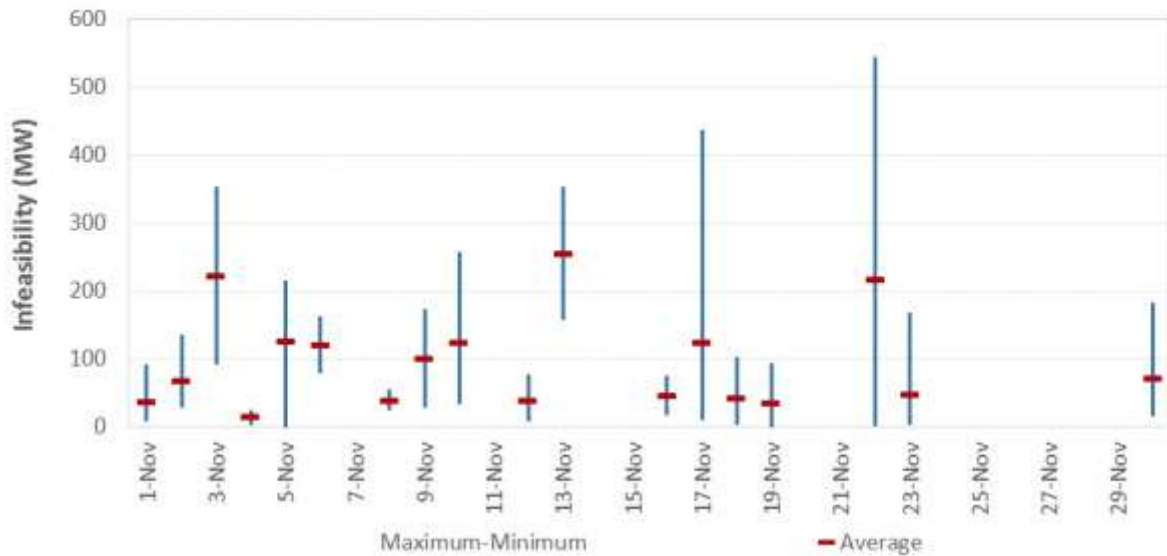
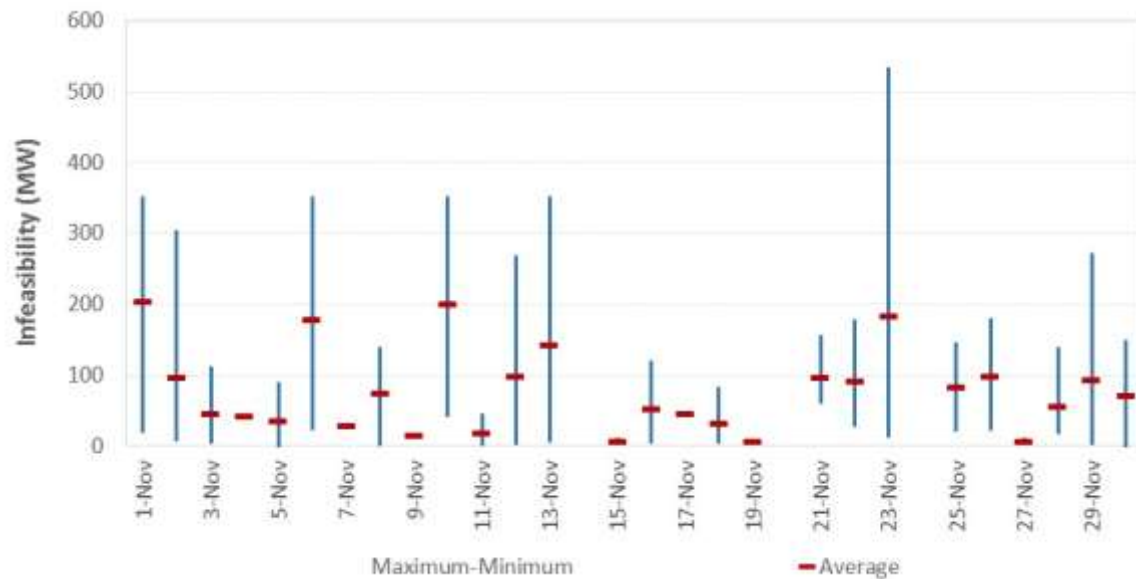


Figure 11: Magnitude of power infeasibility in PAC East. Five-minute market.



For the fifteen-minute market, the magnitude of infeasibility was not preserved in the data system for the period of November 1 through November 13, which impedes to identify the cases with infeasibility and quantify their magnitude. However, such instances are identified by analyzing the cases where prices reached the relaxation-based levels of \$1000. Figure 12 through Figure 15 show the frequency of the fifteen- and five-minute markets with infeasibilities, grouped by PAC West and East.

Figure 12: Frequency of fifteen-minute intervals with power infeasibility in PAC West.

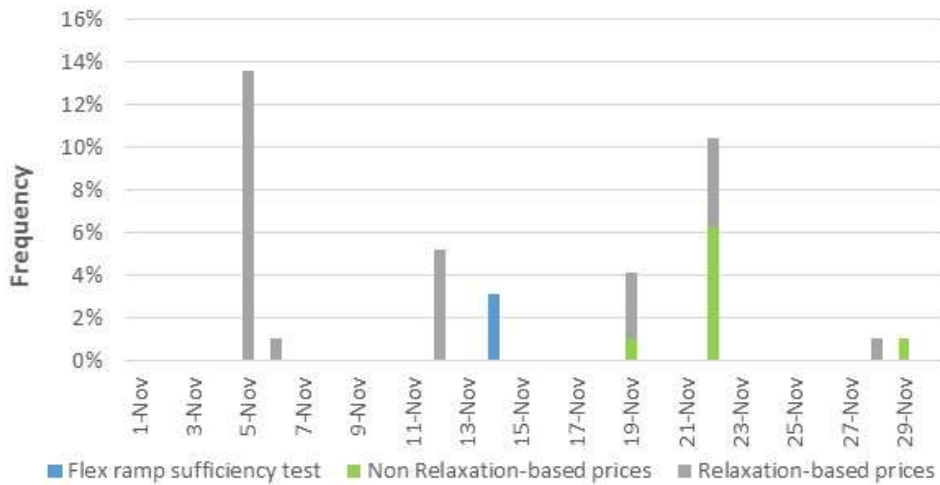


Figure 13: Frequency of fifteen-minute intervals with power infeasibility in PAC East.

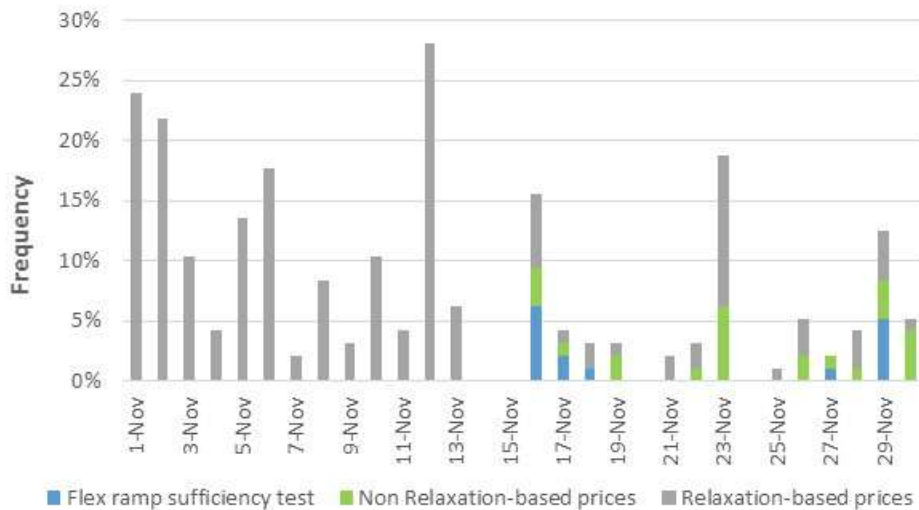
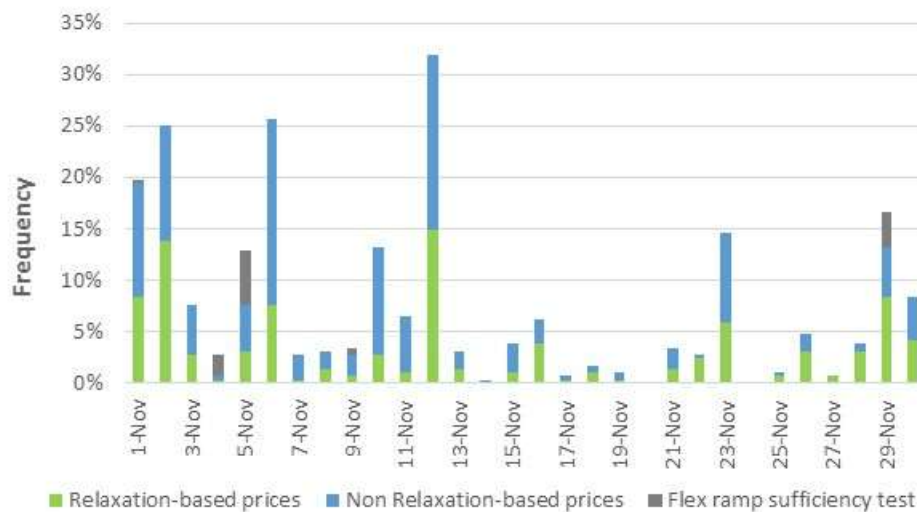


Figure 14: Frequency of five-minute intervals with power balance infeasibility in PAC West.



Figure 15: Frequency of five-minute intervals with power balance infeasibility in PAC East.



The imbalance energy transfers may also be subject to relaxation to address infeasibilities; there were few instances only in the PAC East transfer that resulted in relaxation; there were no instances of relaxation of EIM transfers between PAC and CAISO. The summary of these instance are listed in Table 1 and Table 2. All these instances occurred before the period applicable for the waiver associated with this report.

**Table 1: Statistics of EIM transfer infeasibilities for PAC East.
Fifteen-minute market.**

Date	Maximum	Minimum	Average	Count
6-Nov-14	51.4	1.1	26.2	2
10-Nov-14	121.0	121.0	121.0	1
12-Nov-14	126.7	72.0	99.3	2
13-Nov-14	130.9	16.9	76.2	3

**Table 2: Statistics of EIM transfer infeasibilities for PAC East.
Five-minute market.**

Date	Maximum	Minimum	Average	Count
6-Nov-14	65.2	65.2	65.2	1
10-Nov-14	114.3	97.9	106.1	2

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 15th day of December, 2014.

/s/ Sarah Garcia

Sarah Garcia

January 15, 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____
Informational Report – Performance of Energy Imbalance Market**

Dear Secretary Bose:

The California Independent System Operator Corporation (CAISO) hereby submits its January 15 report on the performance of the Energy Imbalance Market for December 1 – December 31, 2014.¹

The CAISO also respectfully requests a modest extension to allow the Department of Market Monitoring additional time to review the CAISO's report and provide its independent assessment. The CAISO intends to submit this additional report in about eight days. The Commission directed the Department of Market Monitoring to submit independent assessments on the causes and solutions identified by CAISO.

Please contact the undersigned with any questions.

Respectfully submitted,

By: /s/ Anna A. McKenna

Roger E. Collanton
General Counsel
Anna A. McKenna
Assistant General Counsel
John Anders
Lead Counsel
California Independent System
Operator Corporation
250 Outcropping Way
Folsom, CA 95630

¹ The CAISO submits this report pursuant to *California Independent System Operator Corp.*, 149 FERC ¶ 61,194 (2014). Thirty days from the time the CAISO filed its last report is January 14, 2015. The CAISO respectfully requests that the Commission accept this report only one day after date. The additional day was needed to finalize the CAISO analysis.

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Energy Imbalance Market Pricing Waiver Report December 1 - 31, 2014

January 15, 2015

I. Introduction

On December 1, 2014, the Federal Energy Regulatory Commission (FERC) granted the California Independent System Operator Corporation's (CAISO) petition for limited waiver of the pricing parameters in sections 27.4.3.2 and 27.4.3.4 of its tariff for 90 days, as they pertain to the Energy Imbalance Market, effective November 14, 2014, as requested.¹ In addition, FERC directed CAISO to submit informational reports as further described herein. The CAISO will be submitting on a monthly basis the requested reports in Attachments A through E, including reports provided by the CAISO's Department of Market Monitoring and PacifiCorp. This report covers the CAISO's reporting requirements for the time period covering December 1 through December 31, 2014.

For this second report, the CAISO is requesting a modest extension to allow it to submit the Department of Market Monitoring's report within approximately eight days of January 15, 2015. The Commission directed the Department of Market Monitoring to submit independent assessments on the causes and solutions identified by CAISO. The Department of Market Monitoring requires some additional days to fully review and evaluate the CAISO's report and provide an independent assessment.

II. Background

On November 1, 2014, the CAISO fully activated the Energy Imbalance Market (EIM). The Energy Imbalance Market allows balancing authorities outside of the CAISO balancing authority area to voluntarily take part in the imbalance energy portion of the CAISO locational marginal price-based real-time market. PacifiCorp, the CAISO, and market participants participated in market simulations prior to the start of the Energy Imbalance Market on November 1, including parallel production from October 1 to November 1. However, shortly after go live the CAISO began observing challenges that led to artificially high prices in cases where the market application had to resort to the relaxation of transmission constraints or the power balance constraint in order to clear the market.

On November 13, 2014, the CAISO sought a 90-day waiver of the applicability of section 27.4.3.3 and the second sentence of section 27.4.3.4 of its tariff to permit CAISO to address, without suspending the Energy Imbalance Market, those circumstances produced atypically high prices. Those two sections of the tariff provide that when there is a lack of economic bids to clear the fifteen-minute and five-minute markets, the

¹ *California Indep. Sys. Operator Corp.*, 149 FERC ¶ 61,194 (2014) (December 1 Order).

CAISO's market application will price the shortages (and therefore set locational marginal prices) according to the pricing parameters specified in those sections. Specifically, for the purpose of determining how a transmission constraint or system-energy balance constraint will affect the determination of prices in the market, the pricing parameter for the relaxation of the constraint is \$1,000/MWh (the maximum energy bid price specified in tariff section 39.6.1.1).

The waiver addresses three sets of transitional conditions in the Energy Imbalance Market that together have caused the transmission and system energy-balance constraints described in tariff sections 27.4.3.2 and 27.4.3.4 to bind more frequently than expected in the weeks since the Energy Imbalance Market began operation on November 1, causing prices in these intervals to be set by the \$1,000/MWh relaxation parameter. Because of these transitional conditions, the high prices are not always indicative of actual physical conditions on the system, and reflect challenges in providing timely and complete data to ensure system visibility under the new procedures, exacerbated by limitations on the resources available to PacifiCorp for use in the Energy Imbalance Market and several forced outages of large Energy Imbalance Market participating resources. The CAISO described² the transitional conditions that led to the waiver in its petition filed on November 13, 2014, as follows:

- 1) All possible operational conditions, including interactions between disturbance events and other conditions on the system, were not fully represented, simulated and tested during these earlier market simulations. It was not until actual operations that these circumstances were experienced and the resulting price excursions became apparent. In some cases data issues arise because of errors made in processing such information, and in such intervals the CAISO will have authority to correct prices. But in some cases, the pricing excursions may be due to the need to adopt better practices generally and not because of an erroneous data processing issue.
- 2) Limitations on the resources available to PacifiCorp for use in the Energy Imbalance Market. Several resources had not yet received the necessary metering upgrades due to various outage schedule limitations, which has prevented PacifiCorp from making these resources available in the initial pool of resources participating in the Energy Imbalance Market. The CAISO is processing temporary metering exemptions in accordance with its requirements and participation by some additional resources has improved conditions, but other considerations remain. For instance, some resources are subject to multiple ownership rights and have contractual issues that

² See *Petition For Limited Tariff Waiver And Request For Expedited Consideration*, California Independent System Operator Corp., filed November 13, 2014, FERC Docket No. ER15-402.

must be resolved to enable their participation in the Energy Imbalance Market. Additionally, third-party resources in PacifiCorp's balancing authority areas have not yet begun participating in the Energy Imbalance Market, which further limits the pool of available resources.

- 3) The PacifiCorp East (PAC East) and PacifiCorp West (PAC West) balancing authority areas experienced several forced outages of large Energy Imbalance Market participating resources, which led to short term supply deficiencies in the market. While outages are not necessarily uncommon, these outages quickly exacerbated an already tight supply and contributed to price increases in the associated intervals. In addition, while PacifiCorp operations accounted for the outages by responding to system conditions, these actions have not always been communicated in a timely manner to the market. Without such information, the market results would not necessarily reflect physical conditions on PacifiCorp's system. The addition of more participating resources and enhanced operational procedures should mitigate the impact of such outages.

On December 1, 2014, FERC granted the CAISO its waiver request and also directed monthly reports to FERC on the progress of the issues that led to the need for the waiver. The CAISO provides its reports consistent with the order below and in the attachments to this report.

III. Reports

In the December 1 Order, the Commission directed the CAISO to file detailed informational reports on the performance of Energy Imbalance Market at 30-day intervals during the 90-day waiver period. Consistent with the order, this second report is filed 30 days from the last report filed on December 15, 2014. The Commission stated that these reports should provide detailed supporting data demonstrating progress towards identifying and eliminating the problems giving rise to the waiver petition. Consistent with the December 1 order, the following reports are included in Attachments A through E as follows:

Attachment A: A quantitative and qualitative description of the market performance (covering both progress and remaining concerns) related to the issues that prompted the CAISO's waiver request that are within the CAISO's control. Includes a description of, and status update regarding, measures being taken or planned to be taken to identify and address the market performance problems related to the issues that prompted the CAISO's waiver request. Identifies any remaining deficiencies in CAISO and PacifiCorp processes, procedures, and tools and any additional market issues

related to these pricing concerns that the CAISO considers necessary to sustain stable market operations, along with the CAISO's plan to address such issues.

Attachment B: A quantitative and qualitative description of the market performance (covering both progress and remaining concerns) related to the issues that prompted the CAISO's waiver request that are within PacifiCorp's control. This section includes a description of, and status update regarding, measures being taken or planned to be taken to identify and address the market performance problems related to the issues that prompted the CAISO's waiver request.

Attachment C: Independent assessments from the Department of Market Monitoring on the causes and solutions identified by the CAISO. For this first report, this will be submitted within seven days of the CAISO's first submission.

Attachment D: An exploration of impacts, if any, on non-EIM pricing nodes, including the Mona trading node. Report on whether EIM pricing is adversely impacting non-EIM pricing nodes. The extent to which non-EIM pricing nodes such as the Mona trading node are impacted by EIM pricing within the PacifiCorp Balancing Authority Areas. Identify any such impacts and describe any actions the CAISO is taking or plans to take to address such impacts.

Attachment E: Description of each relaxation event, and a summary of the magnitude and frequency of such events overall. Data on instances where the \$1,000/MWh price would have occurred but for this waiver, including the time of the instance, the duration, the cause, and the affected node(s) and load aggregation points.

ATTACHMENT A

Quantitative and qualitative descriptions of market performance related to the issues that prompted the CAISO's waiver request - CAISO.

This attachment includes quantitative and qualitative information for three reporting requirements specified in the Commission's December 1 order. First, section 1 and section 2 provide a quantitative and qualitative description of the market performance (covering both progress and remaining concerns) related to the issues that prompted the CAISO's waiver request that are within the CAISO's control. Second, the tables in section 2 of this attachment provide a descriptions of, and status update regarding, measures being taken or planned to be taken to identify and address the market performance related to the issues that prompted the CAISO's waiver request. Finally, the tables in section 2 of this attachment also report on the measures taken and planned to address the market performance problems, which also identify any remaining deficiencies in processes, procedures, and tools and any additional market issues related to these pricing concerns that the CAISO considers necessary to sustain stable market operations, along with the CAISO's plan to address such issues.³

1. Analysis of Impact on Market Performance

In this section the CAISO provides a quantitative and qualitative analysis of the market performance impact of the issues that prompted the CAISO's request for a waiver.

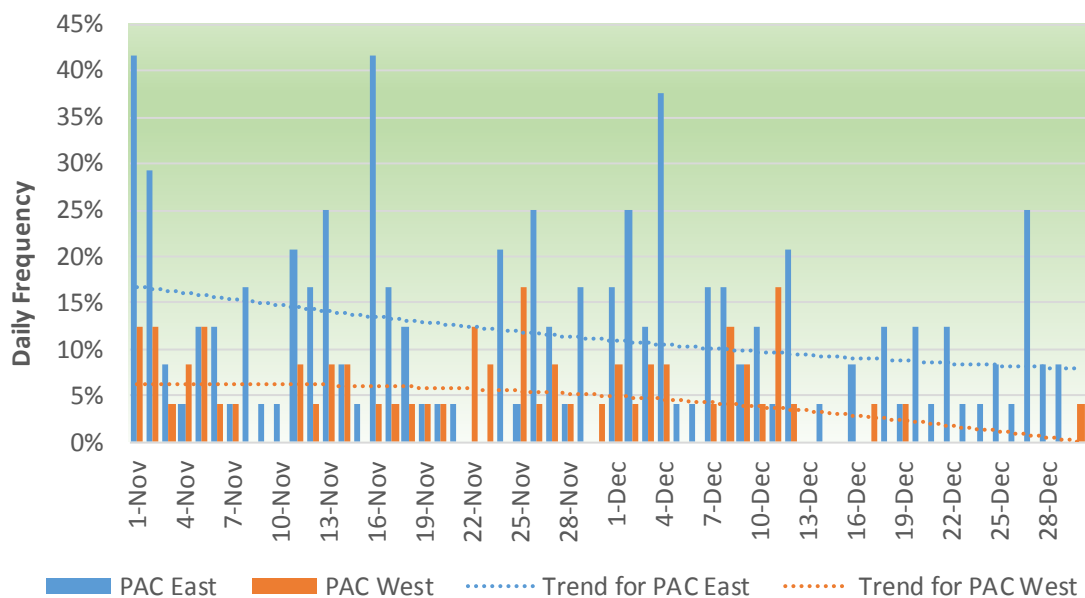
The Energy Imbalance Market is only a part of the real-time market and is not part of the day-ahead market. The CAISO uses the day-ahead market as a reference point for the real-time market. In lieu of the day-ahead market solution, the Energy Imbalance Market the CAISO uses EIM balanced base schedules, which are used to model hourly Balancing Authority Area generation and load before the Energy Imbalance Market runs. The base schedule can be adjusted by seventy five minutes before the applicable hour, (T-75), fifty five minutes before (T-55) and forty minutes before (T-40). The last cycle at T-40 minute will determine the base schedules actually used for the Energy Imbalance Market. The base schedules also serve as a reference for imbalance energy settlements. When the EIM entity opts to use the ISO demand forecasts, the CAISO compares the base schedules –generation and net interchange- with hourly demand forecast and performs a balancing test by EIM Balancing Authority Area and if the EIM entity Balancing Authority Area imbalance is within 1 percent of the forecast, it passes the balancing test. The balancing test is important because it is the

³ *December 1 Order at P 25.*

starting point from which the Energy Imbalance Market is run. Therefore, if the energy market starts with a significant imbalance, such that even the bid-in capacity is not enough to cover the imbalance, there is the potential for infeasibilities in the fifteen- and five-minute markets for either over- or under-supply. It is important to note that the base schedules are set at one level for the entire hour, while load actually varies within the hour.

Figure 1 shows the trend of balancing test failures for the first two months of operation of the Energy Imbalance Market by area, PAC West and East. There is a downward trend in the frequency of failures from a frequency of failures of 9.2 percent in November to 6.45 percent in December. The average amount of imbalance has been 188 MW and 165 MW in PAC East and West, respectively.

Figure 1: Frequency of balancing test failures in PAC West and East.



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 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 to area group constraints. This sufficiency test applies to each PAC West and East area on an hourly basis. Figure 2 shows the trend of test failures for flexible ramping for the first two months of operation of the energy imbalance market. The frequency is obtained by dividing the number of hours failed by 24 hours of a day. Figure 2 shows that there was

a continued reduction in the frequency of failures of the sufficiency test over November and December, from an average of 20 percent to an average of 1.5 percent in the combined PAC West and East areas. However, more recently in late December, there was an increase in failures of the test.

Figure 2: Frequency of flexible ramp sufficiency test failures in PAC West and East.

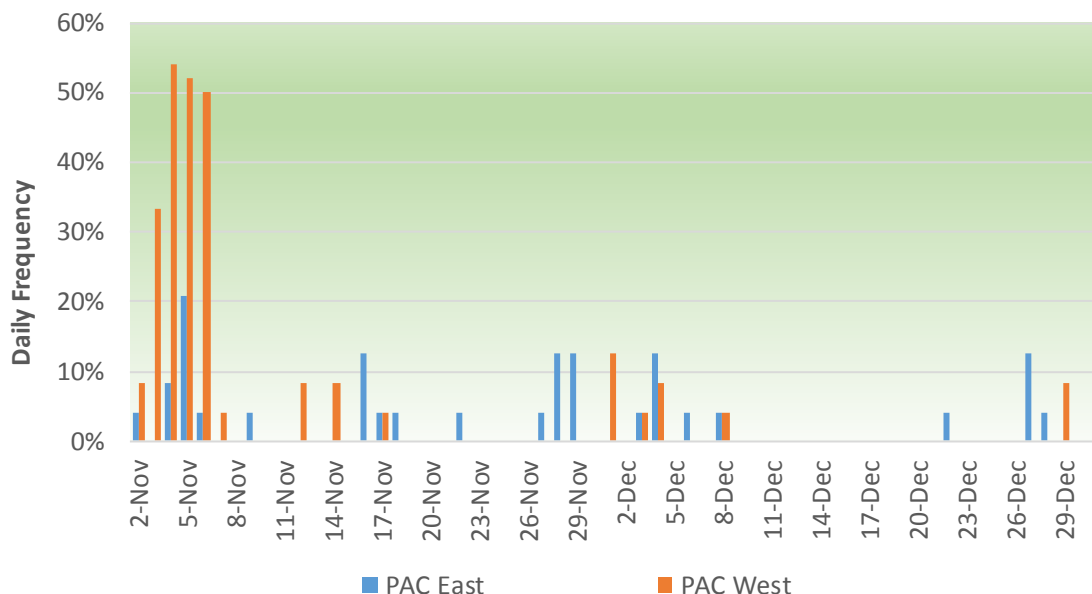


Figure 3 through Figure 6 provide daily average price trends in the Energy Imbalance Market organized by market and area. These trends include pricing for both the PAC West and PAC East external load aggregation points (ELAPs). The report focuses on the ELAP prices because these aggregate prices are representative of pricing in each area -- PAC West and PAC East-- and would reflect short-term imbalance shortage for the aggregate area. These daily averages reflect all prices of the real-time market, including the price corrected through the price correction process and the price adjustments pursuant to the waiver associated with this report⁴. From November 14 through November 30 the CAISO implemented the price adjustments pursuant to the waiver retroactively and is making the relevant adjustments in settlement statements after the December 1 order was issued. After December 1, there are no retroactive adjustments since the logic of the price discovery feature implemented pursuant to the waiver is implemented through the market clearing solution process. These prices, like any other prices, are still subject to the price validation and correction process. Section 35.4 of the CAISO tariff already provides the CAISO authority to correct prices if it detects an invalid market solution or prices due to issues such as data input failure,

⁴ Note a separate waiver has been submitted requested relief for period of November 1-November 13. These reports do not reflect any adjustments for this separate waiver request which has not yet ruled on as of the date of this report.

occurrence of hardware or software failure, or a result that is inconsistent with the CAISO tariff. The CAISO has now completed all the price corrections authorized under its existing tariff authority for the month of November and December.

Figure 3: Daily average of fifteen-minute market prices in PAC West.

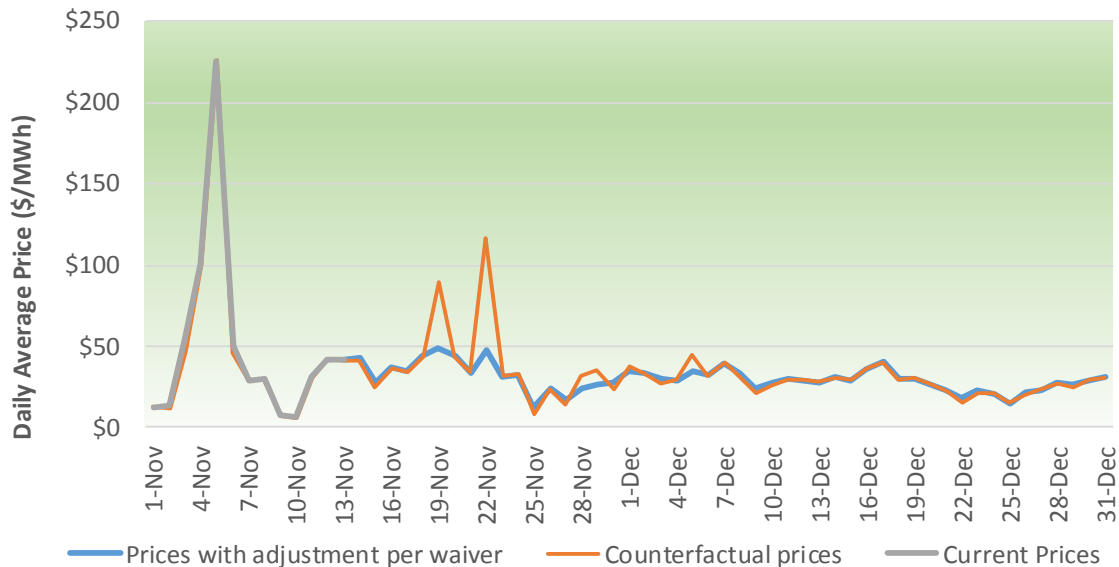


Figure 4: Daily average of fifteen-minute market prices in PAC East.

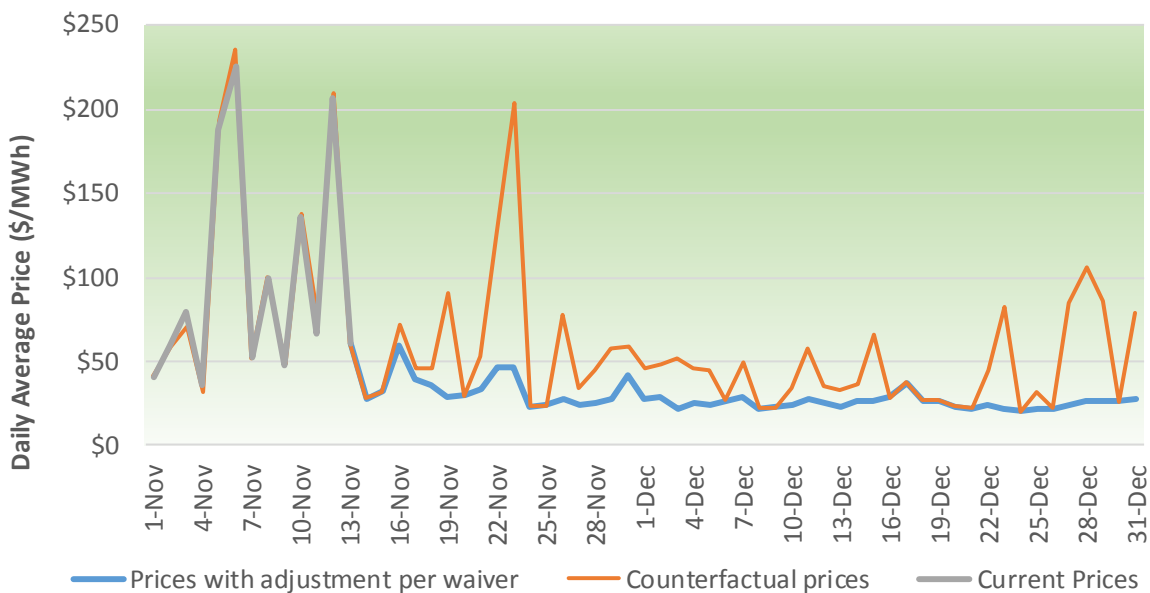


Figure 4 and Figure 5 each compare two trends for the same market and same area, PAC East and West respectively. The line in blue line illustrates daily average prices from November 14 on and represents the actual and final prices after any price corrections or price adjustments pursuant to the December 1 Waiver, which is the subject of this report. After November 14,

even when there were power supply infeasibilities, per the December 1 Waiver, this trend reflects prices that are set based on the the marginal economic signal in the market and are not based on constraint relaxation pricing parameters. The price trends for November 1 through November 13 is represented in a different color than the the prices after November 14 because those represent the final prices as of this date, after all price corrections have been made. The prices for the November 1-13 include prices based on the constraint relaxation pricing parameters.

The orange line was constructed to estimate the counterfactual case of what prices would have been if they were based on the constraint relaxation pricing parameters, pegged to the \$1000/MWh bid cap. As of December 1, the CAISO adopted the waiver-based pricing in its systems, which means that the market systems produced prices consistent with the pricing mechanism under the waiver and not based on the constraint relaxation pricing parameters. Therefore, the CAISO had to find a way to reconstruct those cases, which it is referring to as the counterfactual case. In other words, the prices represented by the orange line represent the CAISO's estimate of what prices would have been absent the December 1 Waiver. These two lines compare together prices under the December 1 Wavier to what they would have been without that waiver.

The orange line is more volatile and spiky because those prices are calculated based on the \$1000/MWh any time there is an observed undersupply infeasibility. Whereas the blue line shows a more stable pricing trend reflecting dispatched economic bids. For the first 13 days of November, the lines in grey and orange track closely to each other but not exactly. The prices represented by the grey line are final as of now and include prices that even though there was infeasibility, for other reasons the prices were not based on the constraint relaxation pricing paramters. In contrast, in the counterfactual case, the CAISO estimated that any interval with infeasibility would produce a price based on the constraint relaxation pricing parameter.

In addition, the prices for the counterfactual case in Figure 4 and Figure 5 were constructed based on the following two factors. First, because the goal of this report is to quantify and explain the price changes associated with the the implementation of the December 1 Waiver, these trends do not include the reconstruction of prices related to price corrections and flexible ramping constraint infeasibility for the following reasons:

- i) Price corretions. If there was a price associated with a power balance infeasibility, but the interval was rendered to have an invalid price and was subject to price corrections for other reasons, the CAISO did not estimate the counterfactual price and instead the estimated and counterfactual price is equal to the final and current price. This is based on the premise that had the CAISO not experienced the issue that supported the price correction in the first place, the power balance infeasibility would not have triggered in the first instance. Therefore, the market price would have been based on the tariff-based rules that consider the submitted economic bid prices rather than the penalty prices specified in the tariff; and
- ii) Flexible ramp sufficiency test. 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. For the duration of the restricted interval, the market clearing price in the affected EIM Entity balancing authority area will also be based the tariff-based rules that look at the last economic bid cleared in the applicable fifteen-minute or five-minute interval in the EIM Entity balancing authority area. This logic is outside the scope of the waiver of this report and consequently, with or without the waiver, the pricing mechanism will be in place. Therefore, the original price for market intervals that had power balance infeasibilities and that failed the flexible ramp test will remain unchanged as they will not be set by relaxation parameter prices.

Second, the prices reflecting the tariff-based relaxation parameters were reconstructed for both under-supply and over-supply infeasibilities. This means that when an instance of undersupply was reconstructed, the price was set to the bid cap plus/minus marginal loss component. Similarly, when an oversupply instance was reconstructed, the prices in the counterfactual case were set to the bid floor relaxation parameter plus/minus marginal loss prices.

An important characteristic of pricing in the CAISO real-time markets during this time period that became more apparent through further investigation after the last report was filed on December 15, 2014, is that in some intervals the market clearing process experienced what is referred to as “degenerate cases” during which the market may be able to clear at multiple pricing run solutions that are equally valid from an economic perspective.

Mitigating price multiplicity has been recently explored and discussed with stakeholders, and the CAISO board has approved market rule changes that eliminate the multiplicity of pricing issue and produce one price that reflects the lack of congestion at the appropriate locations. During such cases, even if the market systems had observed an infeasibility that would have led to the relaxation of a constraint and triggered the penalty pricing parameters, the pricing run could have landed at a price that was based on the marginal resource economic bid price, which could be different than the price had it been based on the \$1000/MWh parameter. The CAISO observed many intervals in which this phenomena occurred, in particular in the five minute real-time dispatch. The CAISO does not correct for these cases and believes these to be optimal from the perspective of the energy market alone. But because of issues this may cause in associated markets such as the congestion revenue rights, the CAISO will be modifying its market rules prospectively to eliminate such occurrences.⁵

The counterfactual case represented by the orange line cannot account for the degeneracy and simply represents what prices would have been for those intervals based on the tariff-based constraint relaxation pricing parameters because there was an infeasibility. This has implications regarding the trends presented in the figures below. For the first 13 days, as

⁵ Additional information regarding the stakeholder process and the resulting policy changes is available at: <http://www.caiso.com/informed/Pages/StakeholderProcesses/PricingEnhancements.aspx>. This will be the subject of an upcoming tariff amendment with the Commission.

discussed above, the CAISO has not yet modified posted prices based on the waiver-type pricing. The CAISO filed for an additional waiver to conduct this pricing adjustment and it is pending before the Commission in FERC Docket No. ER15-817. Without the waiver, the prices as posted would remain as they are. One would expect the counterfactual case represented by the orange line to be close to the posted prices represented by the blue line. This is the case for the fifteen minute markets. However, for the real-time dispatch, the lines diverge because in a number of the intervals posted prices appear to have not been determined based on the \$1000/MWh parameter even if there was infeasibility. At this time, the CAISO believes that this was due to the fact that many of the affected intervals were subject to degeneracy. After November 13, however, whether or not there would have been degeneracy in the pricing run, is immaterial, because pricing under the December 1 waiver or degeneracy is based on the last economic bid price signal.

Figure 5: Daily average of five-minute market prices in PAC West.

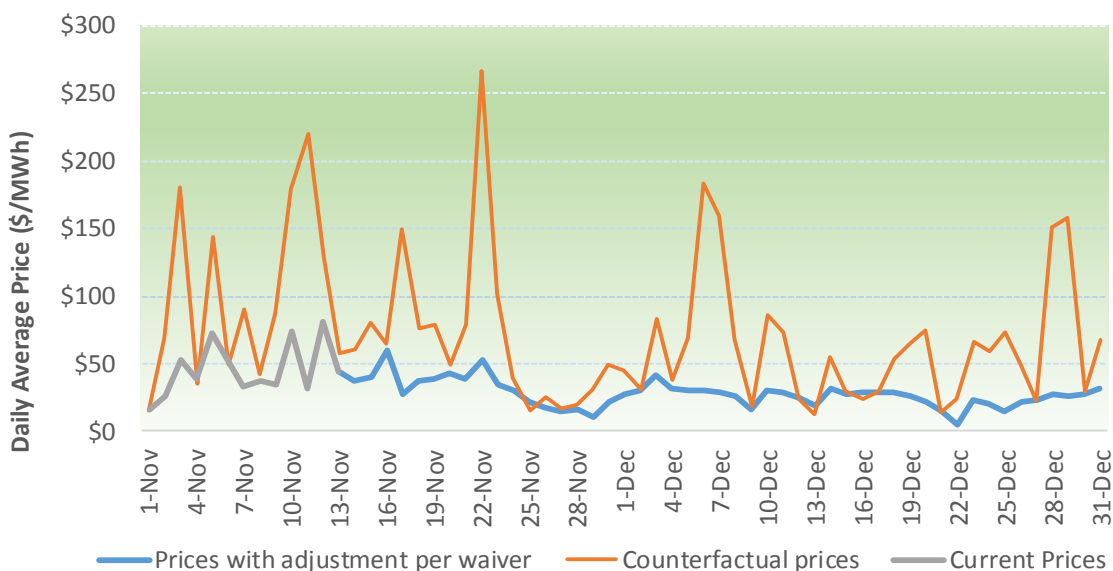
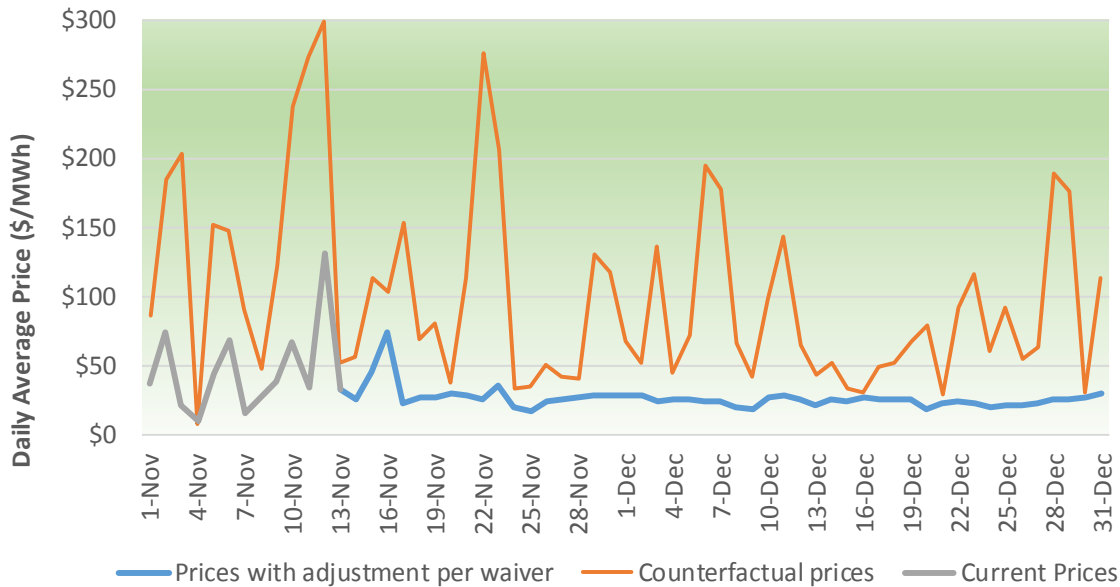


Figure 6: Daily average of five-minute market prices in PAC East.



Overall, PAC East tends to be more volatile and subject to more frequent price excursions than PAC West. This may be due to limited transfers into the PAC East area. In contrast, PAC West does not share such limitations which enable more transfers in and out of the CAISO balancing authority areas to PAC West.

In both PAC East and PAC West, the five-minute real-time dispatch is notably more volatile than the fifteen minute market. This is due to the fact that the fifteen minute market embodies more flexibility as it is further in time than the applicable intervals whereas the five minute real-time dispatch is closer to real-time. In the five minute dispatch, ramping capability is more limited. Figure 7 and Figure 8 provide bi-weekly averages of the prices as modified under the December 1 Waiver and are final as of now. These include price corrections and price adjustments pursuant to waiver of this report. These figures show that the average price for energy in both the PAC East and West areas stabilize around \$25/MWh with the December 1 waiver in place.

Figure 7: Bi-weekly average of fifteen-minute market prices in PAC West and East.

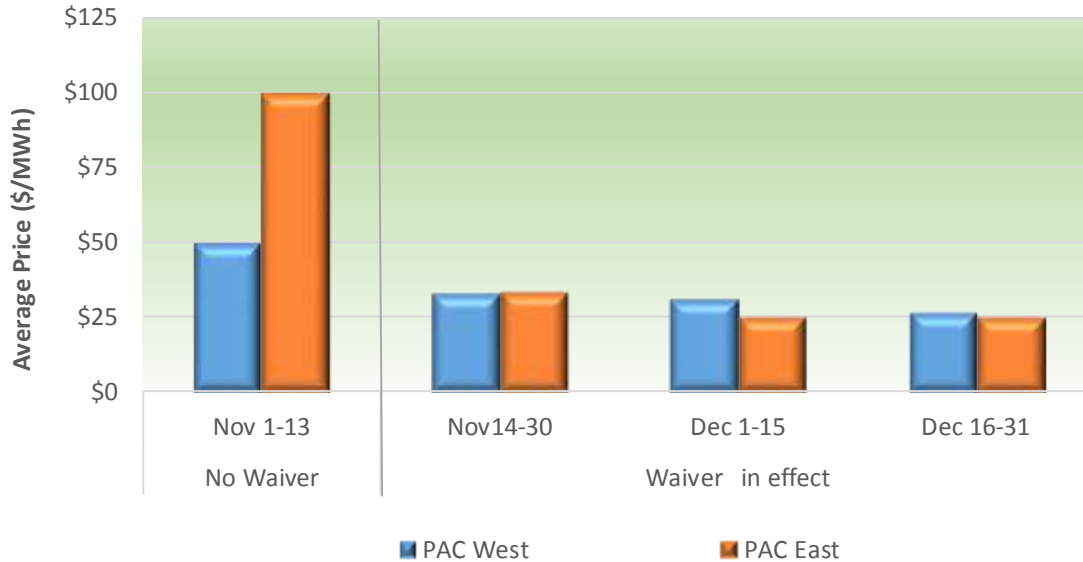


Figure 8: Bi-weekly average of five-minute market prices in PAC West and East.

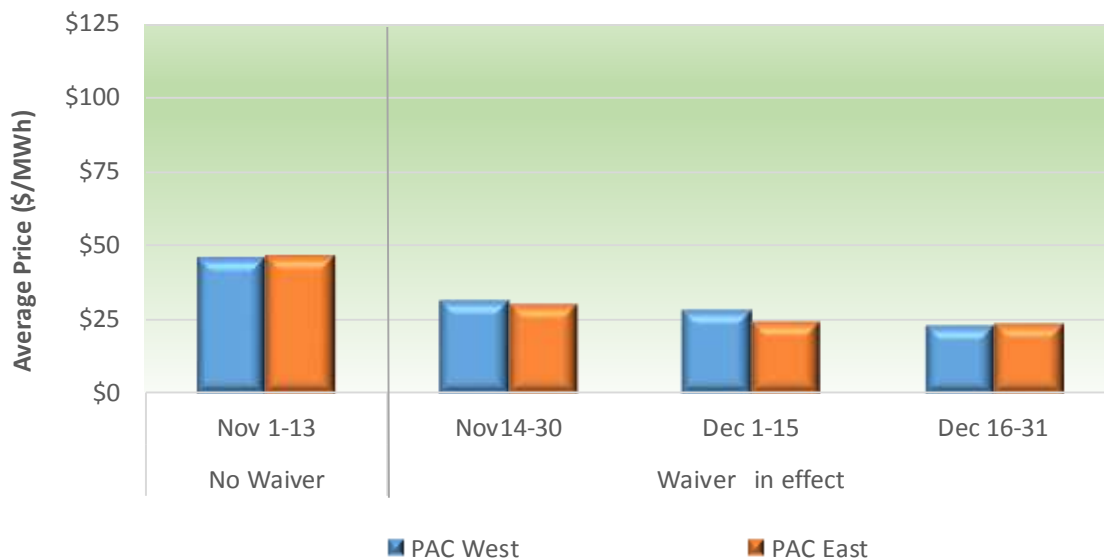


Figure 9 through Figure 12 show the frequency of price excursions for both the fifteen and five-minute market, organized by the reason for the power balance infeasibility. In any given market interval, more than one of the illustrated reason may have contributed to the price excursion because there are numerous elements that can impact the market outcome. For example, a given market interval may experience a price excursion due to data alignment, manual dispatches and load changes. For the purpose this report, the CAISO has reviewed each affected market interval and has assigned the interval to a reason category that most afflicted the interval. The categories used in the figures in this section 1, include:

1. *Renewable deviations* for conditions in which wind or solar changes lead to the loss of capacity and for the need to increase generation from other resources.
2. *Load changes* refer to conditions where either the load forecast is adjusted or there is a change in the load bias.
3. *Import/Export changes* is for adjustments and updates to imports and exports as seen by the market.
4. *Resource outage* is for conditions in which an outage results in the loss of capacity available to the market, and for which the market needs to increase generation from other resources. Similar conditions apply for manual dispatches leading to a reduction of available capacity to the market.
5. *Manual dispatches* is for instances where the introduction of a manual dispatch may cause imbalances, such as max go to manual dispatch may limit the unit up to certain capacity, resulting in the loss of capacity for the market.
6. *Resource data alignment* is for any other condition not captured in the previous five categories. This group accounts for resource deviating from their dispatch, differences between base schedules and bids or dispatches, and changes between markets.
7. *Transfer/Congestion constraints* is for instances where the interplay of EIM transfer constraints or congestion in either PAC or CA balancing authority area may restrict the incremental generation of resources leading to infeasibilities.

Figure 9: Reasons for intervals with ELAP prices exceeding \$500 in the fifteen-minute market in November. PAC West and PAC East combined.

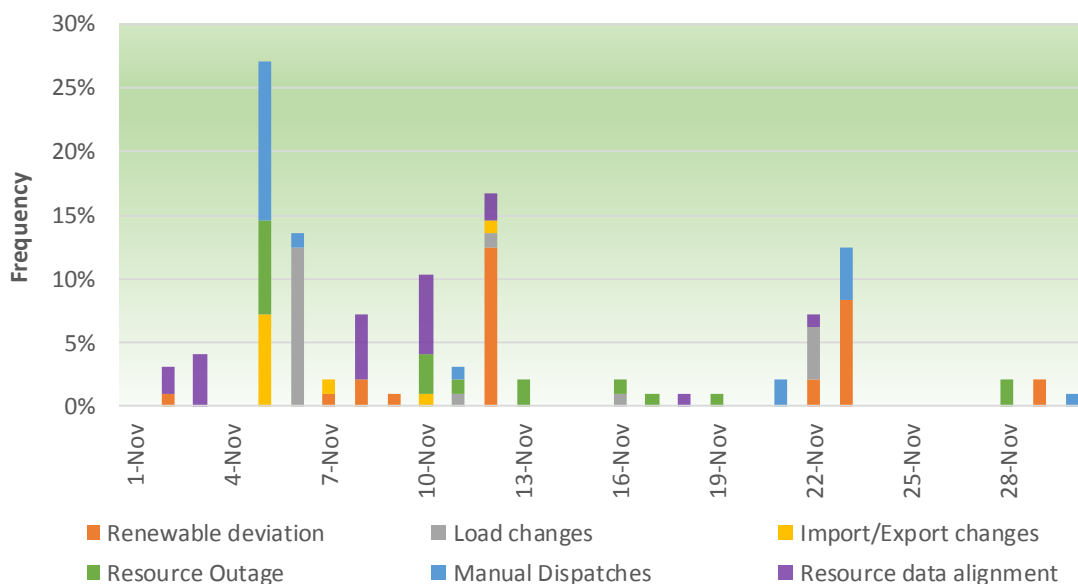
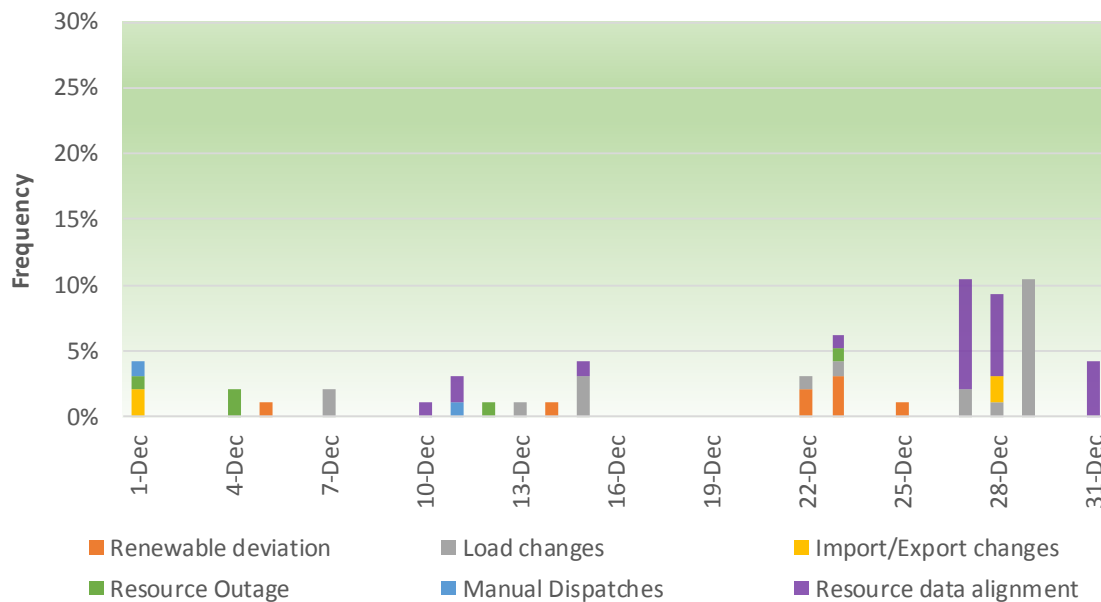


Figure 10: Reasons for intervals with undersupply infeasibility in the fifteen-minute market in December. PAC West and PAC East combined.



For the month of November, as previously reported in the December 15 report, the metrics represent all intervals where there were price excursions above \$500/MWh in either PAC West or PAC East, or both, whether or not there were power balance constraint infeasibilities. The sample was chosen as such, because the CAISO presumed that prices exceeding \$500 were suspect and possibly in need of price corrections due to some form of an error, or they were due to the relaxation of a constraint and were based on the \$1000/MWh pricing parameter. For the month of December and onwards, because the CAISO started employing the December 1 Waiver, prices simply were rarely above \$500. Following that same approach would have yielded a very small set of intervals. Therefore, for the December time period it is more appropriate to report the frequency of issues that led to the request for a waiver based on the intervals in which there were power balance infeasibilities (undersupply conditions) as observed through the relaxation of a constraint (power balance or transmission). While these differences present a difference in the type of intervals from which the frequency data was drawn, the data for the two months is still instructive in terms of which of the types of issues that led to the need for the waiver were observed most frequently in each month. The CAISO further reports on the frequency and magnitude of power balance infeasibilities in greater detail in both months in Attachment E of this report in Figure 14 through Figure 21. Those later figures better represent the trends for magnitude of the infeasibilities observed in the markets overall.

Figure 11: Reasons for intervals with ELAP prices exceeding \$500 in the five-minute market in November. PAC West and PAC East combined.

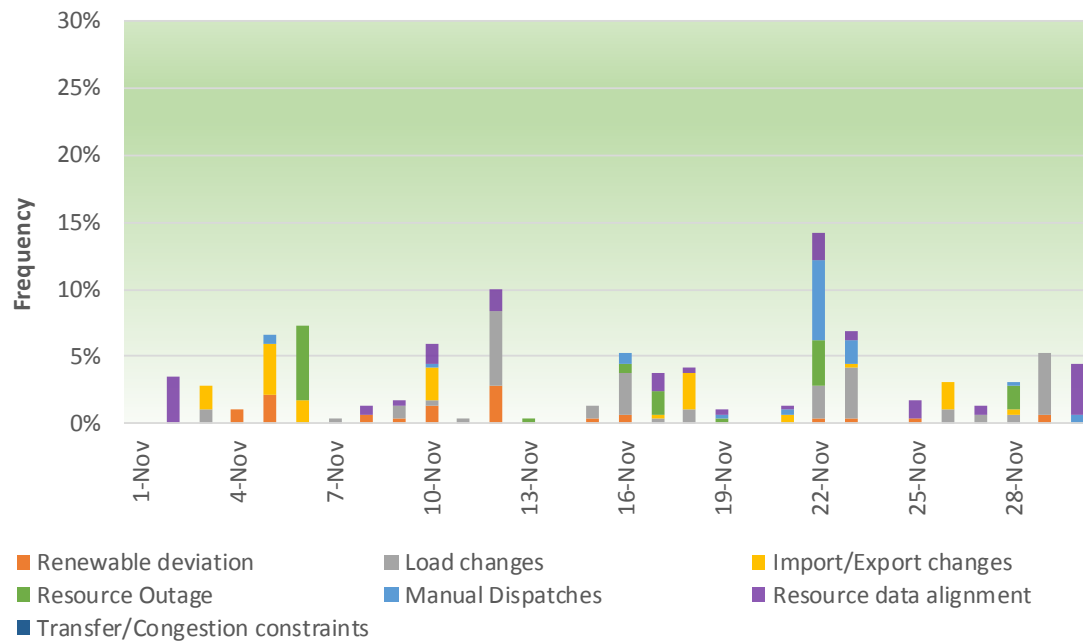
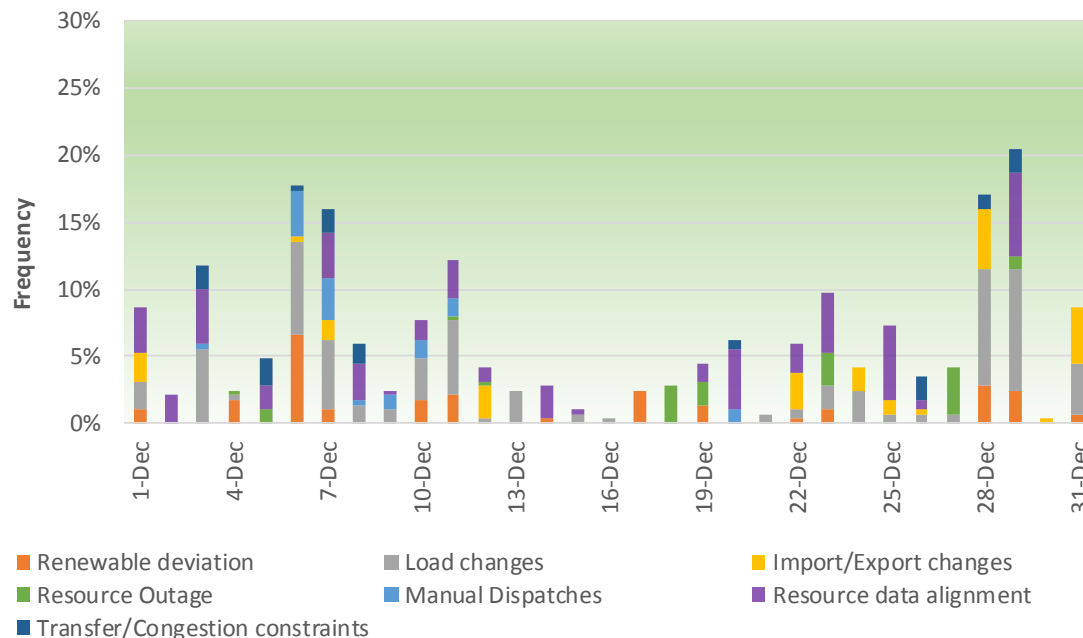


Figure 12: Reasons for intervals with undersupply infeasibility in the fifteen-minute market in December. PAC West and PAC East combined.



The categories used in Figure 9 through Figure 12 are related but not exactly the same as the broader descriptions provided in the tables in section 2 below. In some cases, the descriptions provided in the tables below will create conditions leading to the manifestation of power balance infeasibilities. For example, in category 1 below

includes the issue of timely manner of entering and cancelling outages. This issue also falls in the category of resource data alignment. The descriptions in the tables below link each issue to the relevant category of reasons above to more specifically define the categories of reasons that prompted the need for the December 1 Order tariff waiver.

2. Issues prompting waiver, remedial actions taken, status and outstanding items

Category 1: Outages, derates/rerates management

Issue	Description	Remedial Action and Status	Frequency and Market Impact
1. Timely entering and cancelling of outages in the market	When resources experience full or partial forced outages, the market must be informed in a timely manner of the outage event and the corresponding measures taken to compensate for the lost megawatt capacity. Delay in informing the market application causes the market application to detect capacity shortages not covered by the unloaded capacity from participating resources. Under such conditions, prompt EIM Entity manual dispatch instructions are needed to increase the generation of available non-participating resources to create room for participating resources to be marginal and to economically set price. When the EIM Entity cancels an outage in a timely manner, it is also important to inform the market that the capacity is available and can be used to clear the Energy Imbalance Market, otherwise the market will perceive that there is capacity shortage to meet the load.	CAISO and PacifiCorp participated in several discussion sessions to clarify the process of entering or cancelling outages including maximum capacity derates, and minimum capacity re-rates. More emphasis was given to multi-stage generating resources due to the complexity of their multiple configurations and additional needed coordination between them. CAISO formalized a production system support plan for Outage Management System to respond quickly to questions or situations encountered by PacifiCorp operator when entering outage tickets. Many issues related to interfaces and timely communication of the outages has been resolved. However, we still see many instances were invalid or un-cancelled outages are behind excessive loss of capacity in the market causing supply shortage	This issue may result in instances counted in Figure 9 through Figure 12 as Resource data alignment and Resource outages. As illustrated in those figures, these causal categories have increased the last week of December where excessive number of planned maintenance was scheduled after the Christmas Holiday.

		and price excursions. These instances are identified and root-cause analysis was conducted. Improvements were made to the process of entering outages in the local PacifiCorp system and the interface to the CAISO outage management system. The CAISO continues to monitor, analyze, and provide feedback to PacifiCorp for continuous improvements.	
2. Base schedule and Bid submission for resources undergoing outages	The timing in which the EIM Entity reports the outage is very important. If the outage occurred before T-75 (<i>i.e.</i> , seventy five minutes before the operating hour) and is expected to last during the operating hour T, then both the economic bid and base schedule submission should be adjusted to account for the outage. Otherwise, the assumptions and data used by the market application for the balance test and look-ahead fifteen-minute market are not consistent with real system conditions, which results in less capacity available to the Energy Imbalance Market than what was computed before the start of the operating hour, and high prices are imminent due to limited unloaded economic capacity that is offered in the market.	PacifiCorp has utilized the CAISO new displays to quickly identify discrepancies between base schedules and derated maximum capacity of resources. PacifiCorp has acted on these discrepancies and adjusted the base schedules accordingly. Other than a couple of days in December 4, and 10, a decrease in discrepancy occurrences has been noted. The CAISO continues to monitor and analyze for timely responses to inform the market about any out-of-market manual actions that are taken or are planned to be taken by the EIM Entity.	This issue may result in instances counted in Figure 9 through Figure 12 as Resource data alignment and Resource outages.

3. Outages of partial or full multi-stage generating resource configurations	Multi-stage generating resources have multiple configurations that must be carefully managed in the real-time market. The configuration characteristics are registered in the master file and are observed and honored by the market application. These include physical registered characteristics such as transition time, minimum up time, and minimum down time and minimum capacity (Pmin) and maximum capacity output (Pmax) megawatts (MWs) as well as any overlapping MW regions between configurations. If a configuration is out of service, a timely input of the outage is needed to inform the market that the corresponding economic bid or base schedule is not available and another configuration should be used. If the information is not promptly entered or bids don't exist on other configurations then the market has no way to move the resource to other configurations and the whole MW of the plant is not accounted for in the market and price excursions will occur.	The CAISO provided additional clarification and review of base schedules and coordination with resource parameters. Due to the complexity of multi-stage generating resource data modeling there, this constitutes the majority of outage/derates/re-rates issues causing price excursions. More substantial improvements are yet to be seen in this area. The CAISO continues to monitor, analyze, and provide feedback to PacifiCorp for continuous improvements.	This issue may result in instances counted in Figure 9 through Figure 12 as Resource data alignment and Resource outages

Category 2: Manual Dispatch

Issue	Description	Remedial Action and Status	Frequency and Market Impact
1. Timely input of manual dispatch	Since many units are not participating in the market, manual dispatch and other out-of-market actions taken on these units must be recorded by the EIM Entity in the market to inform the market about the availability of these resources and their movements to respond to events like contingency or outages of other units. Without this timely information, the market can only assume that the participating resources will respond to these various events, which will result in depleting the flexible unloaded capacity of the participating resources and their capability to set economic prices causing price excursions.	The manual dispatch is entered directly in the market tool by the EIM Entity. There were several occasions reported where manual dispatches are not entered promptly due to outage of resources or fail to startup on time to be consisted with base schedule submission. These instances were identified and discussed with PacifiCorp for continuous improvement and enforcement of this process.	This issue may result in instances counted in Figure 9 through Figure 12 as Resource data alignment and Manual Dispatches
2. Flexible ramping sufficiency test	The CAISO performs the flexible ramping sufficiency test on the base schedules, the last test being at 40 minutes before the start of each operating hour. When the EIM Entity fails the test based on the economic bid-in capacity that is being offered to the market, the market application will constrain PacifiCorp from increasing its import from CAISO to prevent the leaning concern. This means that PacifiCorp enters the operating hour depending on its resources and any	The CAISO has discussed this issue with the PacifiCorp and has clarified the market impact. The CAISO is also collecting and analyzing both wind and load variability in PacifiCorp's two balancing areas. After the resolution of some wind forecasting issues that PacifiCorp is addressing, it will be appropriate for CAISO to assess the flexible ramp requirement for PacifiCorp's two balancing areas based on the collected data for the actual real-time imbalance conditions.	This issue may reduce the flexibility of the market to absorb system condition changes and data updates and, consequently, leave the market more susceptible to price excursions by any of the reasons provided in Figure 9 through Figure 12

	additional manual changes to available non-participating resources set points or purchases of interchanges within the hour. Any delay in performing the manual dispatches or the additional interchange purchases leaves the market exposed to price excursions due to insufficient bid-in flexible capacity.		

Category 3: Wind forecast accuracy

Issue	Description	Remedial Action and Status	Frequency and Market Impact
1. Accuracy of PacifiCorp wind resources forecast	The variable energy resource (VER) forecast, which is mainly wind forecast for the PacifiCorp balancing authority areas, is crucial because it sets the maximum economic megawatt range that the market is allowed to dispatch these resources. The accuracy of the short term VER forecast benefits immensely from the accurate telemetry of the output of the VER resources. The forecast of the wind resources was deviating significantly from the output of the resources even for the next 5-min forecast over a period of many days. This resulted in significant deviations in calculated energy imbalance and sometimes resulted in over-generation, or under-generation conditions compared to the hourly base	PacifiCorp continues to utilize the new unit deviation display that CAISO added to the EIM Entity user interface. This display provides the grid operator information related to differences between any combination of telemetry, state estimation, base schedule, and cleared target operating points for all resources. This display is used by PacifiCorp to quickly identify which wind resource is deviating and the amount of deviation per resource and on aggregate basis per balancing area. PacifiCorp has identified some areas of improvement related to its wind forecast quality and has worked	This issue may result in instances counted in Figure 9 through Figure 12 as Renewable deviation

	schedule values of these wind resources for the corresponding operating hour. Lastly, in cases where wind resources are participating and being dispatched, the short-term forecast, which is a persistent forecast, may not be accounting for the dispatch instruction.	diligently with its wind forecast service provider to implement these changes. Not all changes were implemented to see their impact in December. The CAISO anticipates the next report will show more progress in this area as these changes are to be activated in early January 2015.	

Category 4: Interchange schedule variation

Issue	Description	Remedial Action and Status	Frequency and Market Impact
1. Interchange information within the hour	Interchange information is essential part of meeting energy imbalance for each balancing authority area. Considering the forward look-ahead time horizon of the fifteen-minute market for almost two hours, and one hour for the five-minute real-time dispatch market, timely information about the interchange schedules is essential. The delay to inform the market application about these interchanges during resources outage times or steep load ramping conditions tightens the market conditions, leading to fake price excursions that sometimes show in the financially binding fifteen-min market interval which is calculated 37.5 minutes ahead of time before the T-20 minutes cut off time for the tags to be	CAISO has re-emphasized the importance of informing the market about any planned purchase or sale of interchanges before the balancing test or within the hour to respond to changing imbalance conditions. The CAISO also re-emphasized the need to submit planned interchange base schedules for multiple hours in the horizon to provide the short term unit commitment, which has a four and half hours look-ahead horizon, with good projection of the forward hours to enable optimal market decisions related to multi-stage generating resources transitions from one configuration	This issue may result in instances counted in Figure 9 through Figure 12 as Import/Export changes

	submitted and approved for any extra or within the hour interchanges.	to another, and startup of fast start resources.	

Category 5: Load forecast variation

Issue	Description	Remedial Action and Status	Frequency and Market Impact
1. Load forecast biasing	EIM Entity grid operators have the capability to bias the load forecast for reliability purposes to account for any non-modeled issues causing discrepancy between forecast load and actual load. The setting of the bias is somewhat subjective based on the grid operator's judgment of system operational and reliability needs. This biasing if not done in a coordinated fashion with market operations can create price excursions especially when there is limited flexible ramp capacity available to accommodate small marginal overshoot or undershoot of the bias values. Due to the limited pool of participating resources, the PacifiCorp grid operator will necessarily need to pay extra attention to the bias values to prevent unintended overshoot or undershoot.	The logic for the load bias to maintain reliability was extensively discussed, documented, and used during PacifiCorp grid operator training including the impact on prices as a situational awareness signal to indicate an issue in meeting load or balancing the system. There were several instances reported in December when excessive amount of load bias was used to dispatch more capacity when the system is out of flexible ramping capacity. The CAISO has identified these instances and discussed with PacifiCorp that the bias can only cause price excursions without helping system reliability and re-emphasized in the on-going operator training sessions this phenomena.	This issue may result in instances counted in Figure 9 through Figure 12 as Load changes

Category 6: Resources not following dispatch

Issue	Description	Remedial Action and Status	Frequency and Market Impact
1. Resources not following dispatch signal	On occasions resources were not closely following the market dispatch signal. This was either because the plant was unavailable and an outage ticket was not entered on-time for the market to consider the outage, or because of some lag time when the plant was not set on automatic generator control to be dispatched directly from market signal. In any of these cases, the deviation from the market dispatch and the lack of the manual instructions to inform the market application when the resource cannot operate to the target operating point, resulted in market conditions that are not reflective of actual system conditions, causing price excursions. In some cases when the plant is dragging its response to the market signal, it was necessary for the EIM Entity to make direct phone calls to the plant to start moving up or down to the plant's designated market dispatch signal.	PacifiCorp continues to utilize the new unit deviation display that CAISO added to the EIM Entity user interface. This display is used by PacifiCorp to quickly identify which resource is deviating and the amount of deviation per resource and on aggregate basis per balancing area. When a resource was observed to be dragging its dispatch, a direct call to the plant was enough to expedite the response if the plant was available or resulted in submission of outage ticket or manual dispatch instruction if the plant had any temporary physical limitations. Unit deviations have decreased compared to previous month but they are still present and among the reasons for price excursions, especially when they are combined with a manual dispatch that fixes the resource megawatts in the market but the resource is not following the dispatch.	This issue may result in instances counted Figure 9 through Figure 12 as Resource data alignment

Category 7: Network Model discrepancy

Issue	Description	Remedial Action and Status	Frequency and Market Impact
1. Industrial load base schedules	PacifiCorp has industrial load as part of the conforming load and market load forecast. This created a discrepancy whenever these industrial loads are operating or called upon to curtail. The market is not aware of these non-participating resources that exist in the PacifiCorp energy management system, but not in the market, creating the need to manually bias load to maintain consistency between market model and PacifiCorp's energy management system (EMS) model.	CAISO and PacifiCorp went through a series of meetings and identified these resources. An action plan was developed to add these non-participating resources to the network model used in the market application. PacifiCorp is diligently working on providing telemetry, and register these resource with CAISO so they can be treated as separate resources with the capability to submit base schedules reflecting their actual real-time operation. The issue has impacted the quality of load forecast for several days in December and called for manual load biasing after resulting in some price excursions.	This issue may result in instances counted in Figure 9 through Figure 12 as load changes and resource data alignment
2. Distributed energy resources modeling	Distributed energy resources are currently included in the market load forecast as conforming load. These resources have both load and generation components, which nets to positive or negative net injection at the load bus. When generating the market does not visibility of them and effectively considers more load than what the PacifiCorp's EMS is observing and price excursions occur	CAISO and PacifiCorp went through series of meetings and identified the gross impact of these resources. Action plan was developed to add them to the market network model. Many resources are adjusted already but there are few that awaiting the next network model deployment cycle.	This issue may result in instances counted Figure 9 through Figure 12 as load changes and resource data alignment

	because of the lack of base schedules for these resources.		
3. Telemetry quality issues (net versus gross accounting)	The EIM Entity is sending telemetry values for all PacifiCorp registered resources in the master file. When the quality of the telemetry values is not good, the state estimator solution quality is negatively impacted, which in turn affects the quality of the market solution and the dispatch operating targets of these resources. During the first few weeks of operation the CAISO found that some resources have telemetry measurement that is net of its auxiliary loads and others have gross telemetry measurements that do not include the auxiliary load. In addition, certain wind resources and other small non-participating resources did not have telemetry. When these discrepancies are combined together they tend to impact the market solution and cause price excursions.	The CAISO and PacifiCorp identified all these resources and telemetry issues. Most of the workarounds that were put in place last month are now removed and replaced with the permanent fixes in telemetry or network model updates. There were reported 5-min market cases on December 5 on some telemetry issues corresponding to wind resources but those were resolved.	This issue may result in instances counted in Figure 9 through Figure 12 resource data alignment

Category 8: Market model discrepancy

Issue	Description	Remedial Action and Status	Frequency and Market Impact
1. Energy during startup and shutdown	For multi-stage generating resources, the energy of these resources during the startup and shutdown periods when their	CAISO is working with PacifiCorp on defining some parameters to best model the startup and	This issue may result in instances counted in Figure 9 through Figure 12 as part of the resource data

	output is below the PMin is accounted for in energy management system and automatic generation control (AGC). But the market does not account for this energy because it is below the PMin of the resource. This created discrepancy in the base schedule balance test, and the imbalance calculations between market and actual conditions as seen by AGC, which led to performing some load bias during the startup and shutdown of these resources subjecting the market to price excursions.	shutdown profile of multi-stage generating resources and their ramping time. The CAISO is modeling the transition ramping for multi-stage generating resources and has scoped the requirements to add startup and shutdown profile to the 15-minute market since these features are already in the 5-min market. PacifiCorp is in the process of collecting data to define the startup and shutdown profiles for many of the resources with high PMin values.	alignment
2. Inconsistent base schedule and bid submission for multi-stage generating resources	For multi-stage generating resources, it is important that the base schedules, self-schedule, and economic price curve submission are consistent. If a resource is scheduled to be OFF at a particular hour, then it is expected that the submitted base schedule to be zero, it is not expected, however, for this resource to have a self-schedule at higher configuration for the same hour. Another bid submission inconsistency occurs when the resource's higher configuration bid ends or not submitted for a particular hour forcing the resource to transition to lower configuration with lower PMax value than its submitted base schedule for	CAISO has identified, and analyzed these instances and discussed them in detail with PacifiCorp. PacifiCorp has identified changes to its internal processes and interfaces to mitigate those inconsistencies in the automated bid submission.	This issue may result in instances counted in Figure 10 and 11 as part of the resource data alignment

	that hour, which was used in the balance test calculation. These inconsistencies results in market supply shortages that cause price excursions.		

Category 9: EIM Transfer Limits

Issue	Description	Remedial Action and Status	Frequency and Market Impact
1. Static and dynamic transfer limit restrictions on California-Oregon Intertie (COI)	The Energy Imbalance Market is designed to have the EIM transfer capacity fully re-optimized in both the fifteen-minute and five-minute market. With respect to the COI, the added restriction of the dynamic five-minute limit which is an incremental limit around the fifteen-minute solution creates at times price excursions. The five-minute dynamic limit constrains the market application from re-optimizing the fifteen-minute EIM transfers decisions between PacifiCorp and CAISO beyond the amount allowed by the five-minute incremental dynamic limit, which can be restrictive especially during the on-peak hours.	PacifiCorp is engaged in ongoing discussions with the Bonneville Power Administration (BPA) to understand the nature and allocation of the dynamic transfer capability on COI. BPA is in the process of conducting a detailed dynamic transfer capability study, which is ongoing work. Any additional five-minute capability will help the five-minute market re-optimize the fifteen-minute decisions that are based on system conditions and information available at approximately 30 minutes prior to the five-minute market.	This restriction on the 5-min dynamic limit on COI issue is counted in Figure 9 through Figure 12 as part of transfer/congestion constraints
2. Five-minute rate-of-change constraints	The rate-of-change constraints are five-minute flow limit constraints that limit the amount of five-minute movement of PAC West balancing authority area	PacifiCorp is engaged in discussions with BPA to understand the nature and basis behind the five-minute flowgate	

	participating resources around the corresponding resources' fifteen-minute schedules due to their flow impact on certain paths and flowgates internal to BPA's balancing authority area. This restriction on the resources' five-minute movements or the corresponding rate-of-change constraint has created at times price excursions on the impacted resources when the corresponding path or flowgate five-minute limit constraint is binding.	limits and possible change in the calculation of those limits... BPA is reviewing the five-minute limits which are based on historical movement of PacifiCorp West resources before EIM. BPA has also asked for more data points to perform a review of the current rate-of-change limits based on actual EIM market data. Any additional five-minute capability will help the five-minute market re-optimize the fifteen-minute market decisions that are based on system conditions and information available approximately 30 minutes prior to the five-minute market. The CAISO is engaged with BPA to provide the requested data points and answer any relevant questions. CAISO is also engaged with both BPA and PacifiCorp to model and implement any limit changes that may result from BPA's limit calculation review effort.	

ATTACHMENT B

Quantitative and qualitative descriptions of market performance related to the issues that prompted the CAISO's waiver request – PacifiCorp

REPORT PROVIDED BY PACIFICORP

Issue	Description	Remedial Actions Taken	Remaining Steps
1. Increase Pool of EIM Participating Resources	PacifiCorp continues to coordinate with the CAISO to increase the pool of owned and third-party resources available to participate in the EIM.	As described in the December 15, 2014 report ("First EIM Report"), PacifiCorp received certification and addressed remaining metering and contractual issues to enable EIM participation for the following additional PacifiCorp EIM participating resources following EIM go-live: Huntington Unit 2 (450 MW), Naughton Unit 3 (330 MW), Jim Bridger Units 1-4 (2,147 MW), Gadsby Unit 3 (105 MW), and Gadsby Units 4-6 (120 MW). No additional EIM Participating Resources have been added since the First EIM Report.	As indicated in the First EIM Report, PacifiCorp anticipates continuing to add participating resources by addressing remaining metering and contractual issues (the latter due to shared facilities), as scheduled generator outages permit. PacifiCorp is currently working on adding its Swift 2 resource, which is a 72 MW hydro resource downstream from Swift 1, an existing participating resource. Adding this resource requires making software adjustments so that the resource is accurately integrated into the network model along with Swift 1. In addition, PacifiCorp continues to work with other transmission customers who may be interested in participating in the EIM with resources. Consistent with the

Issue	Description	Remedial Actions Taken	Remaining Steps
			First EIM Report, at this time, PacifiCorp has not certified any third-party transmission customers for participation in the EIM and is not at liberty to disclose the identity of any transmission customers that have made inquiries related to EIM participation, but is nevertheless hopeful that these efforts will result in additional EIM participation. PacifiCorp continues efforts to model certain of its industrial customer interruptible loads as participating resources. This is necessary because some of PacifiCorp's industrial customer loads have on-site generation and, as a result, this present additional complexity for accurate forecasting and balancing. Adding these elements as participating resources will provide improved operational visibility and will also add approximately 200MW of flex capacity in PACE.
2. Increase System Visibility and	PacifiCorp continues to develop and implement additional tools	As described in the First EIM Report, PacifiCorp created and/or improved certain	As indicated in the First EIM Report, PacifiCorp's Grid

Issue	Description	Remedial Actions Taken	Remaining Steps
Situational Awareness	and displays to provide its Grid Operations personnel with increased visibility and situational awareness regarding available regulation on a 5- and 15-minute basis.	Grid Operations displays to monitor generator availability, capacity, and ramp capacity. PacifiCorp has finalized enhancements to its generator database (Pi) displays to provide Grid Operations with situational awareness when there is a deviation between the Dispatch Operating Target (DOT) and the actual dispatch. Since go-live, PacifiCorp has been participating in reoccurring discussions with the CAISO to evaluate the root cause of remaining infeasible schedules. PacifiCorp has made improvements to its systems that interface with the CAISO's BSAP and SIBR, as well as systems designed for bidding resources in the start-up and shutdown hours for multi-stage resources.	Operations and its balancing agent continue to develop similar tools to display aggregated and disaggregated generation values, generation deviations, and interchange deviations, which are expected to be deployed by the end of the first quarter in 2015. PacifiCorp has analyzed wind forecasting data submitted to the CAISO and DOTs issued by the Market Operator and determined software adjustments can be made that would improve DOTs for wind participating resources. PacifiCorp anticipates completing this software adjustment by January 31, 2015, and will coordinate with CAISO on any identified potential improvements.
3. Improve Training and Systems	PacifiCorp continues to focus on opportunities to provide additional training to personnel and improve systems with increased EIM operational experience.	As described in the First EIM Report, PacifiCorp provided personnel with training on outage entry and requires the provision of daily spreadsheets from PacifiCorp EIM Participating Resources that describe any operational issues and the resources' ambient conditions. PacifiCorp and the CAISO developed a series	PacifiCorp anticipates completing modifications to its COMPASS outage management system by January 31, 2015, and will thereafter provide training to appropriate personnel. PacifiCorp and the CAISO will conduct a "Session B" training

Issue	Description	Remedial Actions Taken	Remaining Steps
		of training modules for PacifiCorp generation and grid operators. PacifiCorp and the CAISO held “Session A” Operator Training December 9-10, 2014, which included modules covering a range of issues relevant to EIM balancing and operations. PacifiCorp continues to coordinate with its outage vendor and the CAISO to improve functionality between its COMPASS outage management system and WebOMS, and developed a reference guide for outage management as part of this effort December 2014.	February 3-4, 2015. Session B will include modules on Master File, infeasibility causes, load conforming, transaction identification numbers, multi-stage generation re-qualifications, and DOT deviations.
4. Improve Internal Processes and Tools	PacifiCorp continues to take additional steps to improve its processes and tools to address identified market performance issues.	As described in the First EIM Report, PacifiCorp’s Grid Operations drafted and posted “best practices” procedure documents to aid in personnel’s implementation of critical EIM Entity tasks.	PacifiCorp will continue to update these procedure documents in real-time as needed.

ATTACHMENT C

Independent assessments from the Department of Market Monitoring on the causes and solutions identified by the CAISO.

This report part of the report will be submitted to the Commission within seven days of January 15, 2015.

ATTACHMENT D:

This attachment provides an exploration of impacts, if any, on non-Energy Imbalance Market pricing nodes, including the Mona trading node.⁶ This attachment identifies any such impacts and describes any actions the CAISO is taking or plans to take to address such impacts.

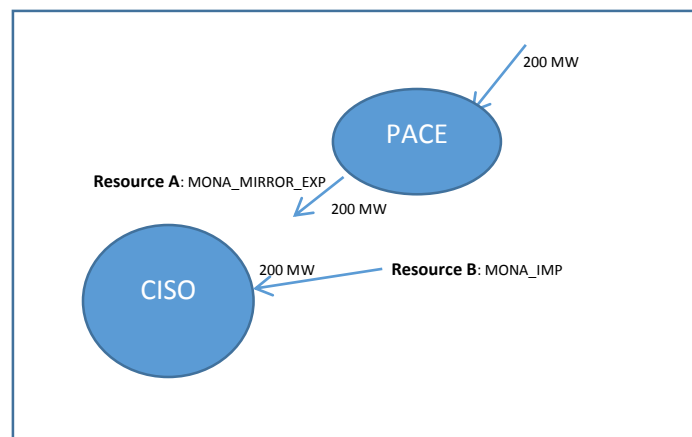
The implementation of the Full Network Model Expansion on October 15 increased the accuracy of the transmission grid modeling from neighboring balancing authority areas, and also allowed for better representation of unscheduled flows effects into the CAISO system. In addition, the implementation of the Energy imbalance Market on November 1, 2014, further enables the CAISO to co-optimize resources across the various areas of the Energy Imbalance Market. Both of these initiatives required that the CAISO also change the way in which the scheduling points are defined so that it can associate the scheduling points with external interties.

With regards to the CRAG and Mona scheduling points, the CAISO had to account for the fact that schedules can be submitted at the locations for purposes of CAISO only transactions or Energy Imbalance Market only transactions. The Crag location is the scheduling point for the Cascade intertie; the Mona location serves as a scheduling point for various southern interties, such as IPPUTAH and Adelanto interties. Prior to the implementation of the full network model, these two scheduling points were modeled with the standard radial link and were considered part of the CAISO balancing authority area. With the implementation of the full network model expansion, this definition changed and with the implementation of the Energy Imbalance Market, the prices at these locations changed notably as the CAISO began accounting for Energy Imbalance Market related congestion.

CRAG and Mona scheduling points are physically located inside PacifiCorp Balancing Authority Areas instead of the CAISO Balancing Authority Area. Mona is located inside PAC East, and CRAG is located inside PAC West. However, these locations continue to serve as scheduling points for imports and exports transacted with the CAISO balancing authority area. This situation requires special treatment for balancing and pricing calculations and leads to a special prices posted on OASIS. The pricing at these locations is based on the following rules to implement the special treatment of CAISO scheduling points CRAG/Mona Interchanges into the balance and price calculations of CAISO and PAC East/PAC West balancing authority areas.

⁶ See December 1 Order at P 25.

Figure 13: Illustration of Mona Pricing



Assume that Resource A is Mona_Mirror_Exp, Resource B is Mona_IMP. Both of these resources are defined in Master file to have the same scheduling point and intertie definitions (ISO-PACE). The following rules apply:

Resource A,		
BAA	Balance	Price
CISO	Don't include MW	Not applicable
PACE	Include MW	Resource LMP= Price@SP
Resource B,		
CISO	Include MW	Adj_Price@SP= Price@SP – EIM_PACE – EIM_PACE_PACW – GHG + $\sum$ MONA ITCs Resource LMP= Adj_Price@SP
		SP-TIE Price shall use the Adj_Price@SP for the SP price calculations.
PACE	Don't include MW	Not applicable

The same above treatment shall be applied to CRAG scheduling point and mirror resource. The Figure above illustrates how an import at Mona scheduling point is mirrored by an export from the PACE balancing authority area with equal megawatt value. The reason for this mirroring is to allow the accounting for the import and associated offsetting export for each balancing authority area separately while the supporting resource(s) for the transaction is modeled at the physical location within PACE balancing authority area or as a separate import to PACE balancing authority area from another balancing authority area.

The table above illustrates that the pricing at Mona for CAISO balancing authority area is adjusted to not include effects of Energy Imbalance Market transfer constraints, GHG pricing, and other constraints pertaining to the EIM area.

The CAISO detected that the pricing at CRAG and Mona over the first few days of implementation were subject to a software defect that resulted in the CAISO pricing to include some of the LMP components pertaining to the mirror resource. The CAISO fixed this issue on November 5, 2014 and has not detected it since.

Currently, the prices at these scheduling points, as posted on OASIS, reflect all the congestion effects from either CAISO or PAC balancing authority areas. However, for CAISO imports and exports, the actual price used for settling the respective schedules at each of these locations as scheduling points for imports and export to and from CAISO balancing authority area, only accounts for the congestion arising from CAISO balancing authority area. The prices posted on OASIS do not reflect that, but the prices provided through the California Market Results Interface (CMRI) application and used for settlements for resources transacting at these scheduling points will reflect only the applicable CAISO balancing authority area congestion.

For example, consider the case of a sample market interval, November 26, hour ending 11 interval 4 for the fifteen-minute market. The shadow price of the IPPUTAH ITC is -\$183.29, the Energy Imbalance Market transfer for PAC East is \$6.8 and the Energy Imbalance Market transfer for PAC East and PAC West is -\$11.88. The system energy price is \$35.38 and the greenhouse gas price is \$0. The price posted on OASIS for the marginal congestion component at MONA_3_N501 is -\$188.37. The congestion component posted on OASIS accounts for all the congestion associated with this location, both from the CAISO and PacifiCorp balancing authority areas. This published congestion component is thus calculated as $-\$183.29 \text{ (IPPUTAH ITC)} - \$11.88 \text{ (PACW\_PACE)} + \$6.8 \text{ (PACE)} = -\$188.37$.

On the other hand, for intertie awards using the Mona point as a scheduling point to transact in the CAISO Balancing Authority Area, the prices posted in CMRI and used for settlements reflect accordingly only the congestion share of -\$183.29 arising from IPPUTAH ITC. This price still adheres to the typical congestion calculation used prior to the implementation of the full network expansion and Energy Imbalance Market.

The current data structure used in the OASIS application only supports the display of one entry for the marginal congestion component, and given the nature of the congestion associated with these two scheduling points, either marginal congestion component combination will reflect partial information. Currently the display of the full congestion components -- CAISO and PAC -- does not apply to CAISO schedules. If the entry displayed only the CAISO congestion share, it will still be partial because it will be missing now the congestion portion associated with PAC. The CAISO is working on an enhanced OASIS display that will publish the congestion component breakdown. In this case there will be an entry for the congestion share associated with PAC of $-\$11.88 + \$6.8$ and another entry with the congestion share associated with CAISO tie of -

\$183.29. The CAISO expect that this display will be available in January 2015 and will provide the clarity and minimize the concerns about the pricing for these two locations.

Updated report:

The CAISO upgraded its OASIS to provide the more granular displays for the Mona and Crag locations on January 8, 2015. However, it is continuing to evaluate the performance of that display and continues to make changes to ensure the greater granularity is provided accurately. The CAISO also is also working towards posting the greater granularity of prices going back to the start of the Energy Imbalance Market later in February 2015.

ATTACHMENT E

In this attachment, the CAISO reports on each relaxation event, and a summary of the magnitude and frequency of such events overall.⁷ This report provides data on instances where the \$1,000/MWh price would have occurred but for the Commission's December 1 Order waiver, including the time of the instance, the duration, the cause, and the affected node(s) and load aggregation points.

The relaxation events affect numerous market intervals as the CAISO real-time markets contain many fifteen and five minute intervals. The information is provided at summary level because the data is significant and detail specific reporting of such events would not be meaningful. The report focuses on the external load aggregation points (ELAP) prices because these aggregate prices are representative of pricing in each area -- West and East-- and would reflect short-term imbalance shortage for the aggregate area.

Figure 14 through Figure 21 provide summary information on the instances of power balance relaxation for undersupply (shortage) in the fifteen- and five-minute market in the PAC West and East area. Normally, when there are such infeasibilities, it is expected that prices will be based on the constraint relaxation pricing parameter, and prices will be near or at \$1000/MWh. However, there are three cases where this would not occur and is reflected in the data supporting the figures in this report. First, as of December 1st consistent with the December 1 tariff waiver, the price is based on the last economic signal consistent with the pricing principles contained in the tariff. Second, as described in more detail in Attachment A, when the EIM Entity fails the flexible ramping sufficiency test prices are calculated using the same approach based on the last economic signal for the duration of the restricted interval. Therefore, it is important to keep in mind that in these intervals, even if there are infeasibilities the market price in the affected EIM Entity balancing authority area will be based on the last economic bid cleared in the applicable fifteen-minute or five-minute interval in the EIM Entity balancing authority area as opposed to the \$1000/MWh bid cap.⁸ In the last report filed on December 15, 2014, the CAISO noted that there was a third case in which it had observed the power balance constraint was relaxed in the scheduling run, but prices did not reflect the \$1000/MWh. The CAISO has since evaluated these cases more closely and as discussed in Attachment A, in some instances the market is in a degeneracy case, and the market clears based on the last economic signal. The CAISO is continuing to

⁷ *December 1 Order*, at P 26.

⁸ The price discovery mechanism under the procedure described in Section 10.3.2.1 of the BPM for Energy Imbalance Market is, however, essentially the same price discovery procedure used under the December 1 Order waiver.

investigate these intervals to ensure these events are not due to other abnormalities and are in fact due to degeneracy. As explained in Attachment A, after the implementation of the pricing procedure under the December 1 waiver there is no pricing based on the degenerate cases because the pricing procedure under the December 1 waiver governs over the pricing.

Figure 14 through Figure 21 exclude the intervals that were subject to price corrections because they were invalid. These figures show the frequency of infeasibilities organized by instances in which the prices were set based on 1) the last economic bid price signal as per the tariff waiver, referred to in the figures as “Tariff waiver,” 2) the \$1000/MWh penalty price parameter, referred to in the figures as “Penalty-based prices” 3) last economical signal from degeneracy referred as “Last economical signal” and 4) the last economic signal but because for those intervals the EIM entity failed the flexible ramping sufficient test, referred to as the “Flex-ramp sufficient test.” Each figure of the frequency of infeasibilities is accompanied with a figure the magnitude of infeasibilities. The reported events are also aggregated on a daily basis and depicted with an infeasibility range shown by the vertical line in blue. The ends of the vertical blue lines represent the minimum and maximum values of power balance relaxation in each day. The average magnitude of the infeasibility is shown by the red marker on the blue vertical lines.

Figure 14: Frequency of under-supply infeasibility in PAC West. Fifteen-minute market.



For the period of November 1 through November 13, the data on the magnitude of infeasibility in the fifteen minute market was not preserved in the data system. This impedes the CAISO’s ability to identify the cases with infeasibility and quantify their magnitude. However, such instances were conservatively estimated by analyzing the cases where prices reached the relaxation-based levels of \$1000.

Figure 15: Magnitude of undersupply infeasibility in PAC West. Fifteen-minute market.

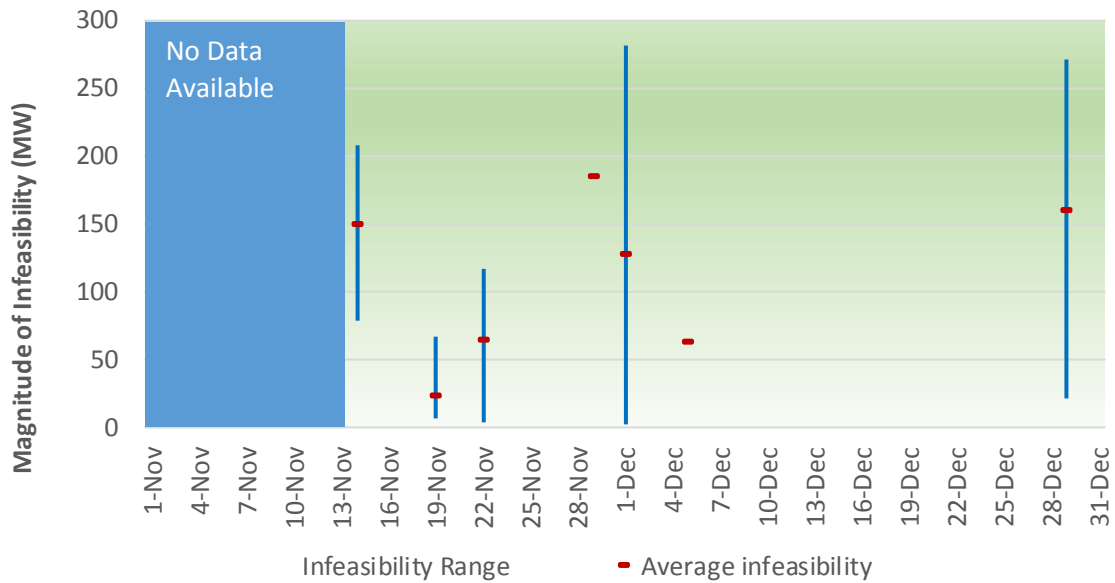


Figure 16: Frequency of undersupply infeasibility PAC East. Fifteen-minute market.

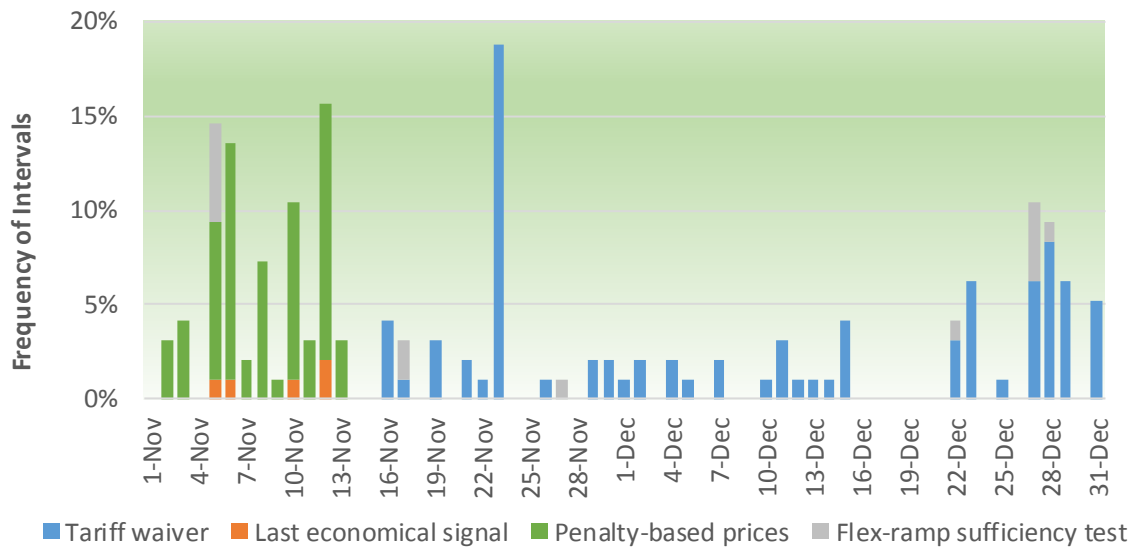


Figure 17: Magnitude of undersupply infeasibility PAC West. Fifteen-minute market.

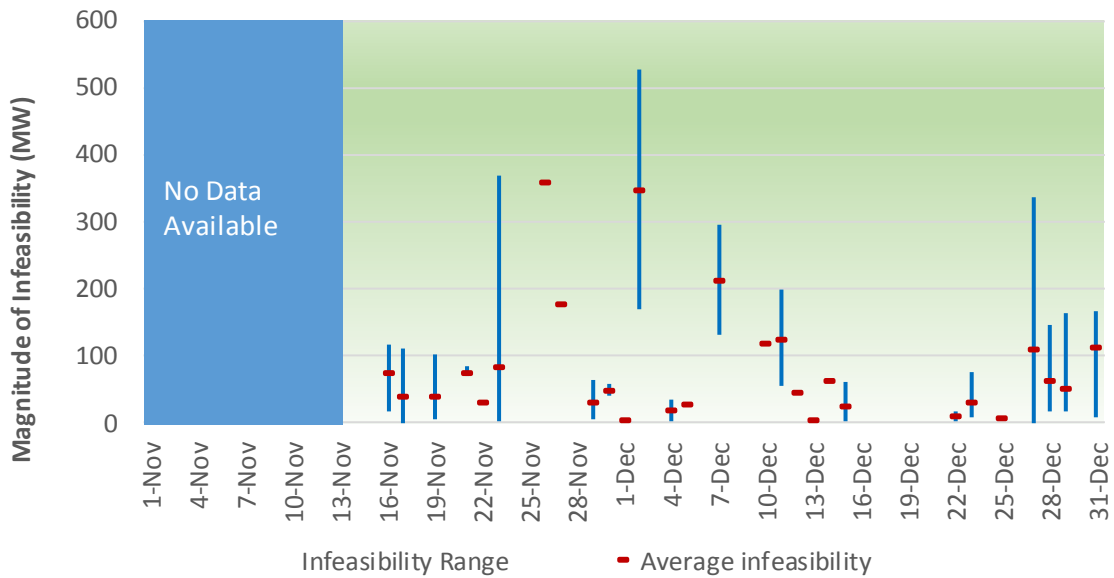


Figure 18: Frequency of undersupply infeasibility PAC West. Five-minute market.

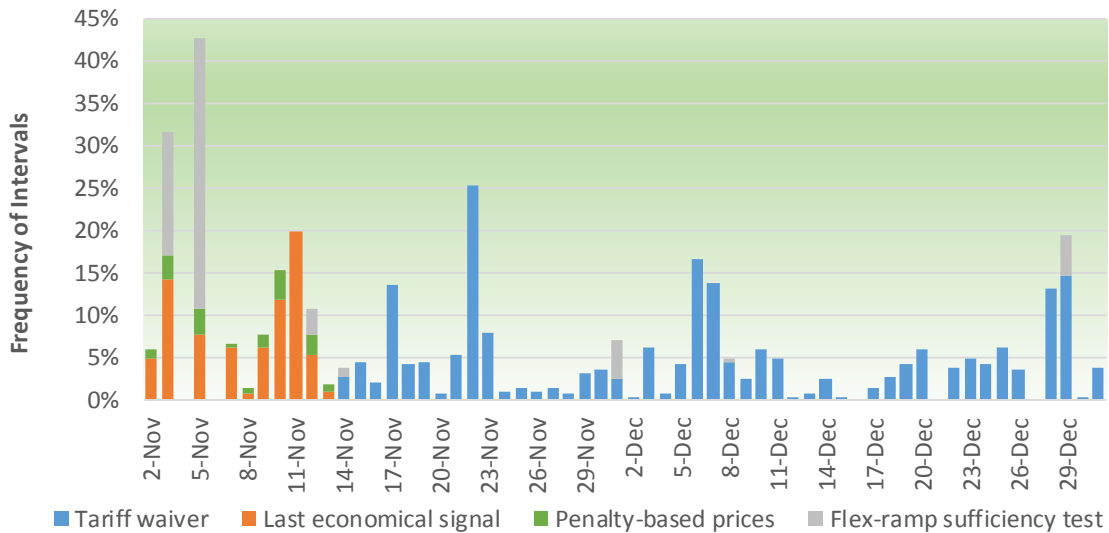


Figure 19: Magnitude of undersupply infeasibility PAC West. Five-minute market.

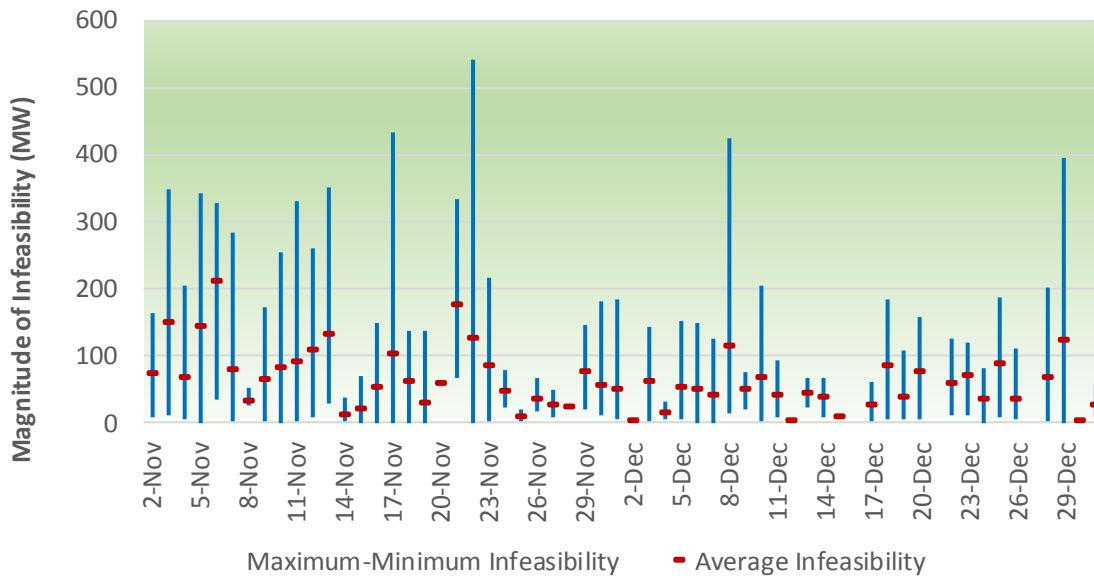


Figure 20: Frequency of undersupply infeasibility PAC East. Five-minute market.

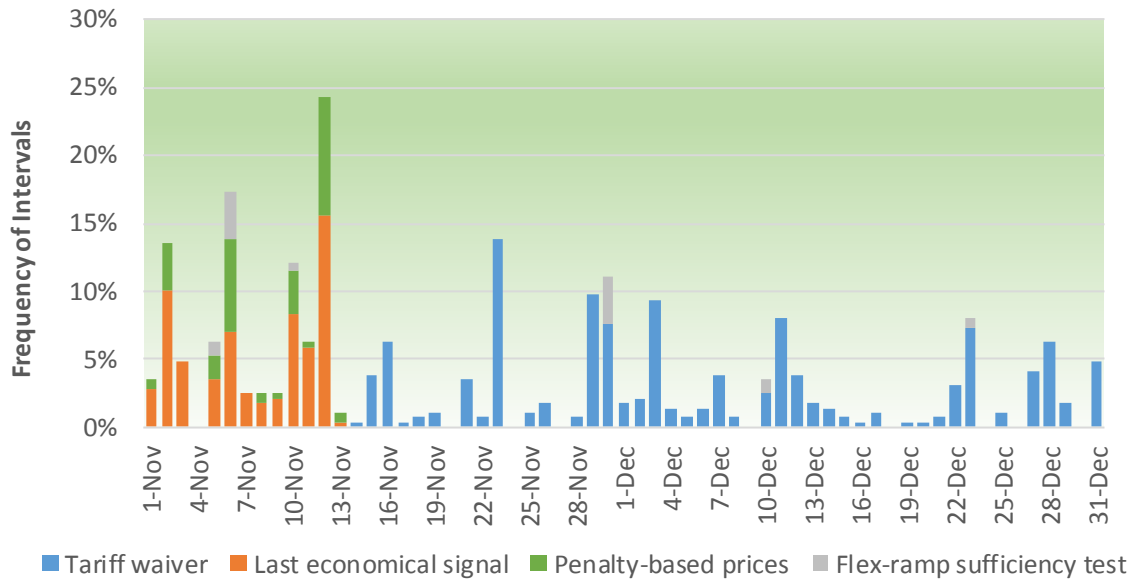


Figure 21: Magnitude of undersupply infeasibility PAC East. Five-minute market.

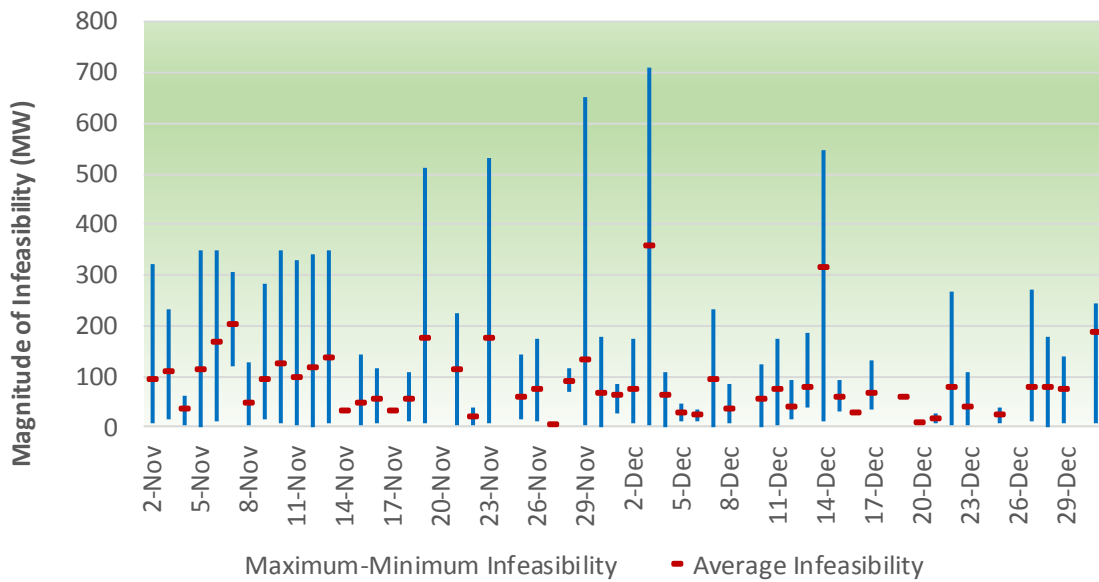


Figure 22 through Figure 25 show the hourly profile of the undersupply infeasibilities for both PAC West and East by market. This profile is provided to identify any patterns during the day where infeasibilities may be more prone to occur, such as the pull-up periods of load. The first two months of operational data, however, show no marked pattern of the frequency of infeasibilities with the time of day. This may be an indication that the drivers of infeasibilities are not system condition related.

Figure 22: Hourly undersupply infeasibilities for PAC West. Fifteen-minute market.

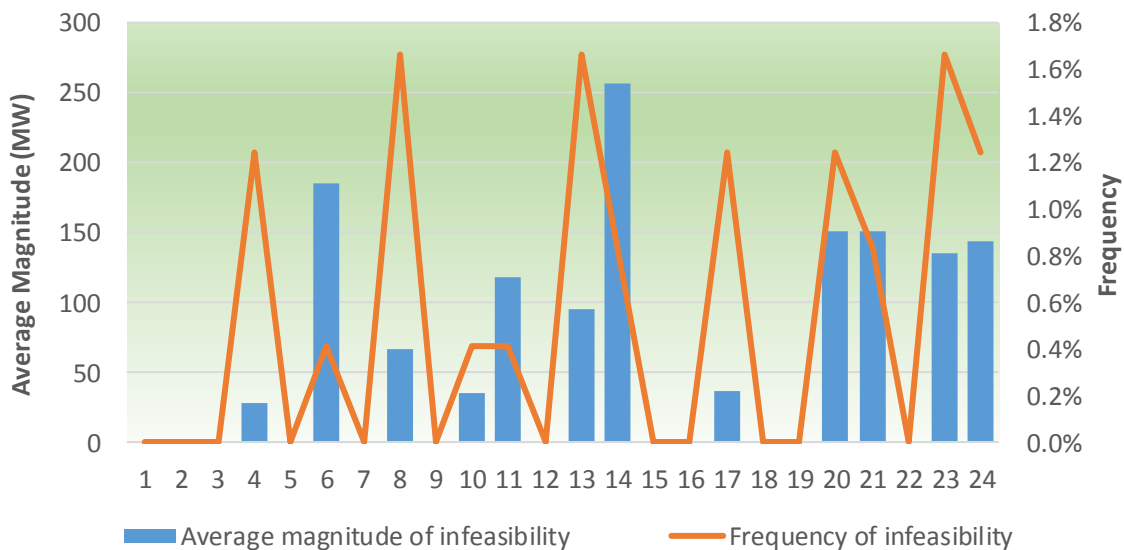


Figure 23: Hourly undersupply infeasibilities for PAC East. Fifteen-minute market.

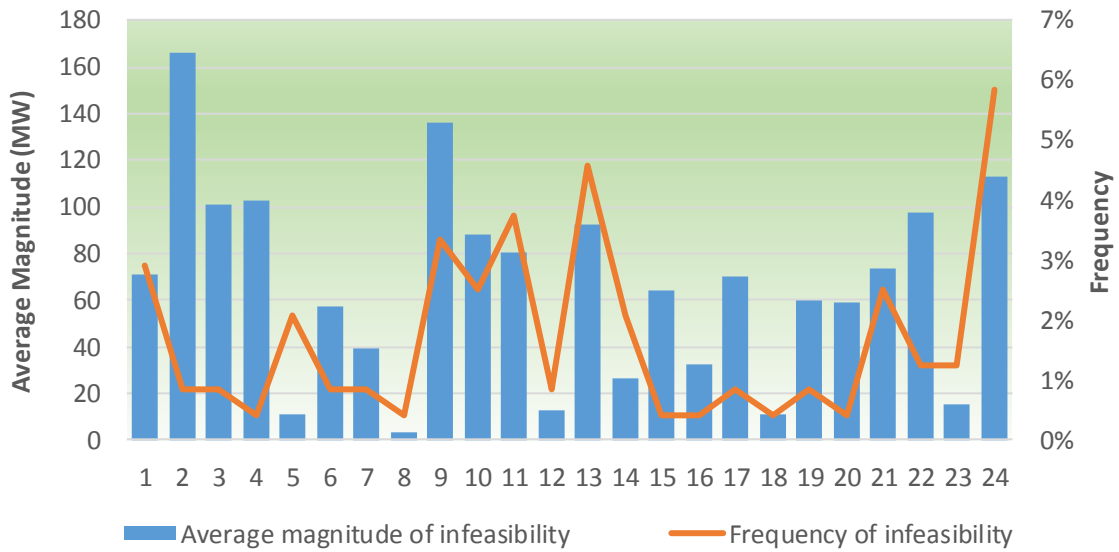


Figure 24: Hourly undersupply infeasibilities for PAC West. Five-minute market.

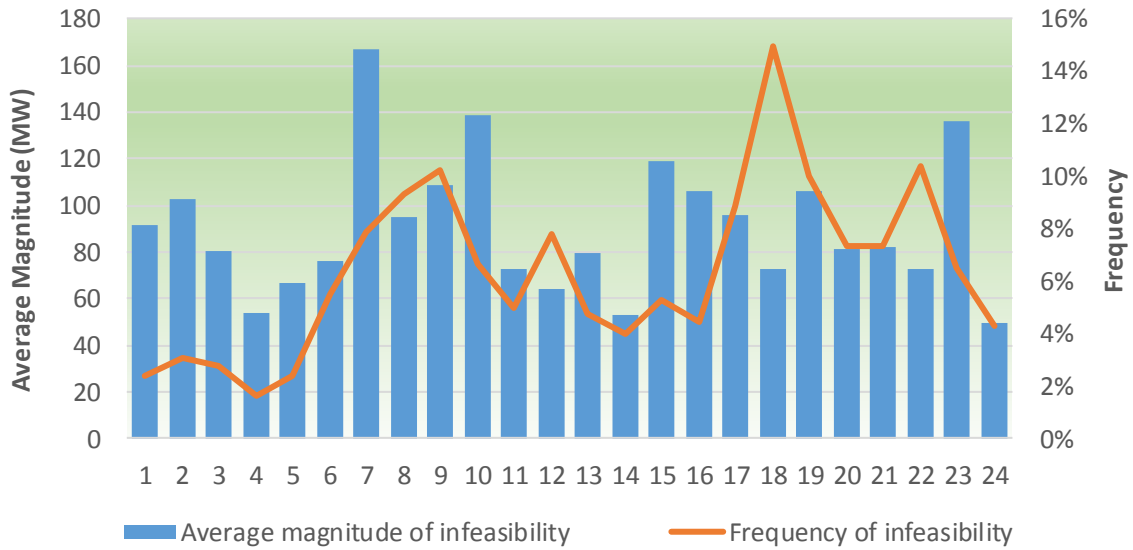
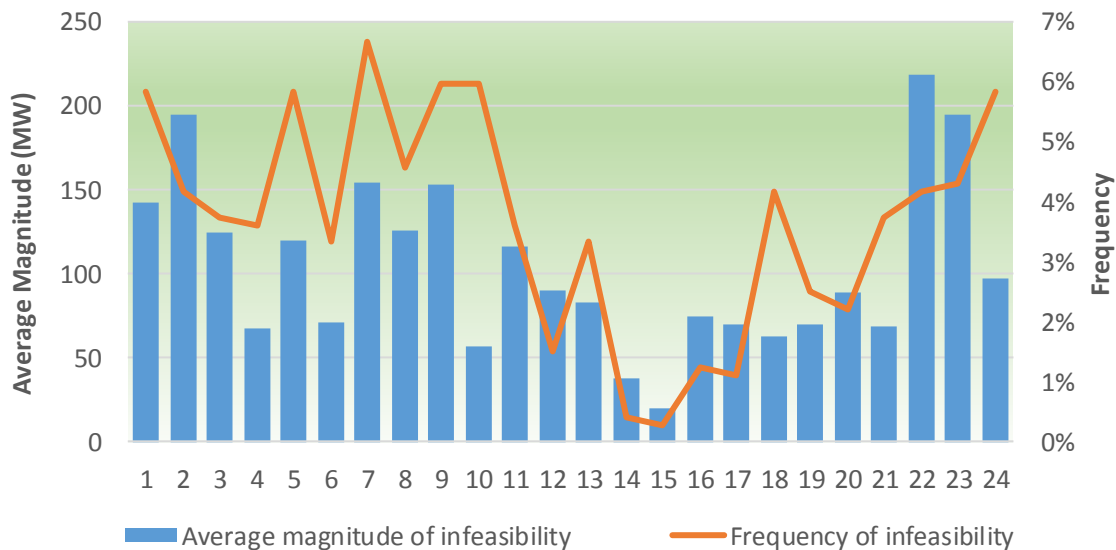


Figure 25: Hourly undersupply infeasibilities for PAC East. Five-minute market.

The imbalance energy transfers may also be subject to relaxation to address infeasibilities; there were few instances only in the PAC East transfer that resulted in relaxation; there were no instances of relaxation of EIM transfers between PAC and CAISO. The summary of these instance are listed in Table 1

Table 2. All these instances occurred before the period applicable for the waiver associated with this report; there were no EIM transfer infeasibilities observed in December.

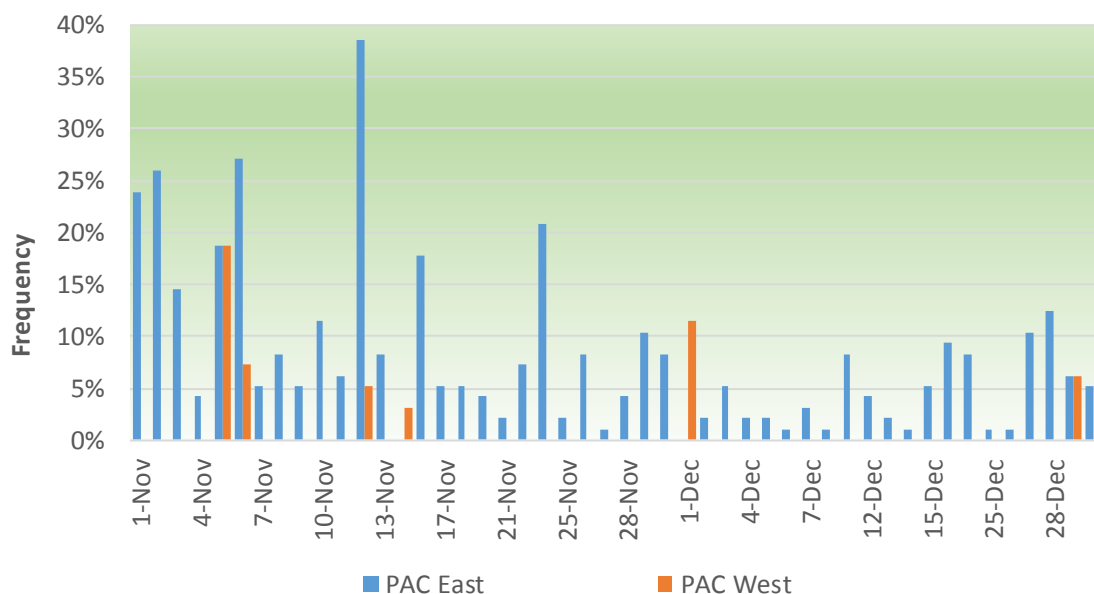
Table 1: Statistics of EIM transfer infeasibilities for PAC East.
Fifteen-minute market.

Date	Maximum	Minimum	Average	Count
6-Nov-14	51.4	1.1	26.2	2
10-Nov-14	121.0	121.0	121.0	1
12-Nov-14	126.7	72.0	99.3	2
13-Nov-14	130.9	16.9	76.2	3

Table 2: Statistics of EIM transfer infeasibilities for PAC East.**Five-minute market.**

Date	Maximum	Minimum	Average	Count
6-Nov-14	65.2	65.2	65.2	1
10-Nov-14	114.3	97.9	106.1	2

For completeness, the data in this report also includes those cases in which there was a relaxation of flexible ramp constraint; the data is organized by PAC West and East in Figure 26. The average frequency of infeasibility went down from 6 percent in November to 2.6 percent in December.

Figure 26: Frequency of flexible ramp constraint infeasibility PAC West

Finally, this report also includes information about infeasibility for over supply conditions even though these cases are not reflected in the waiver requested in this proceeding. The penalty prices specified in sections 27.4.3.2 and 27.4.3.4 only pertain to infeasibility cases in which there is under-supply. The penalty prices for the over-

supply conditions are specified in section 6.6.5 of the BPM for Market Operations. The over-supply metrics are provided in Figure 27 through Figure 34.

Figure 27: Frequency of oversupply infeasibility PAC West. Fifteen-minute market.

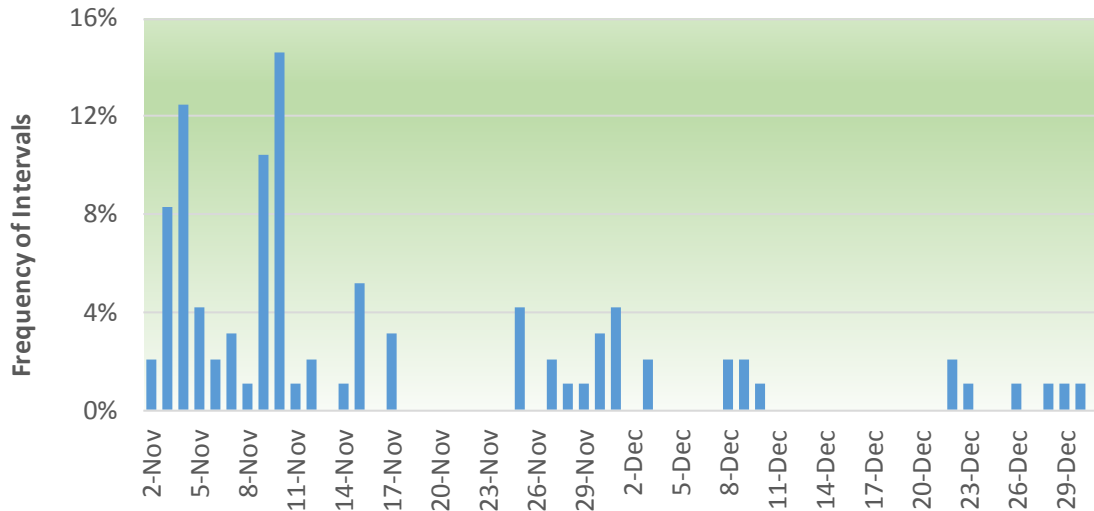


Figure 28: Magnitude of oversupply infeasibility PAC West. Fifteen-minute market.

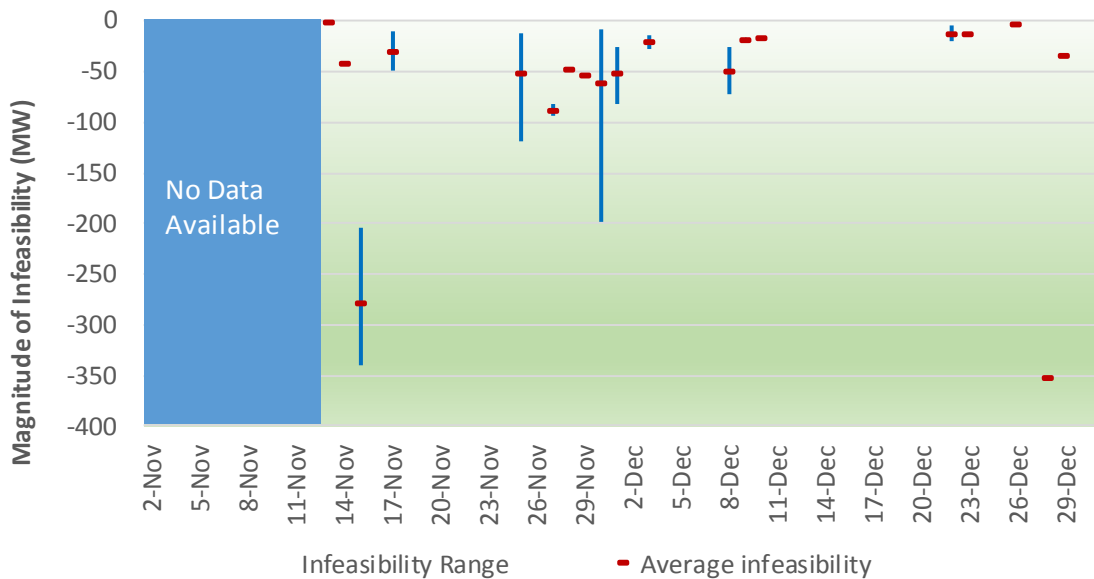


Figure 29: Frequency of oversupply infeasibility PAC East. Fifteen-minute market.

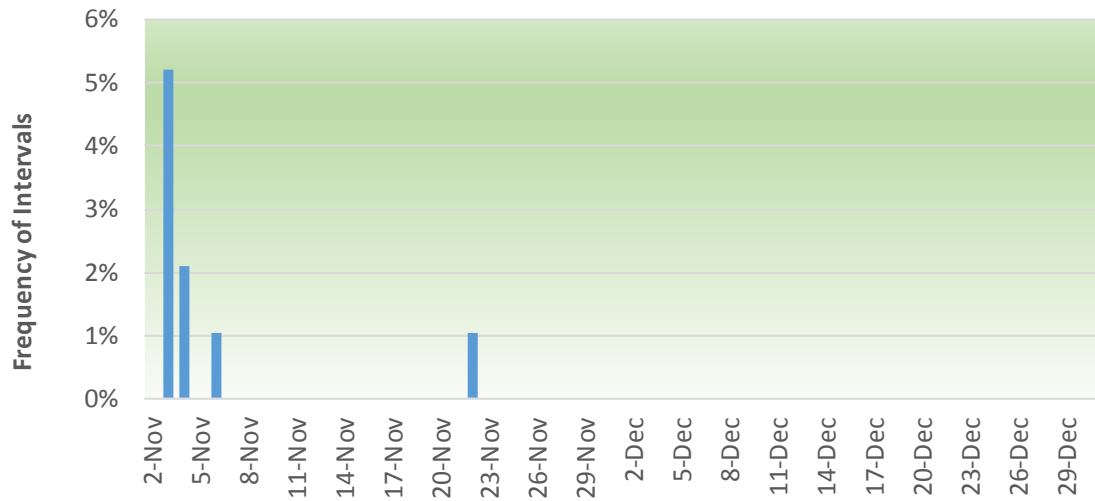


Figure 30: Magnitude of oversupply infeasibility PAC East. Fifteen-minute market.

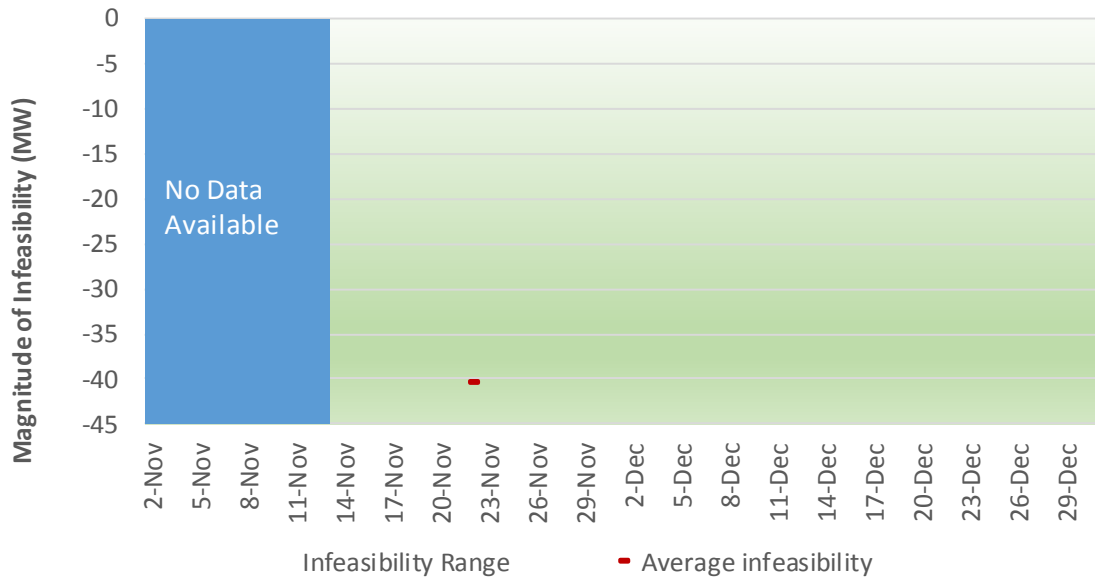


Figure 31: Frequency of oversupply infeasibility PAC West. Five-minute market.

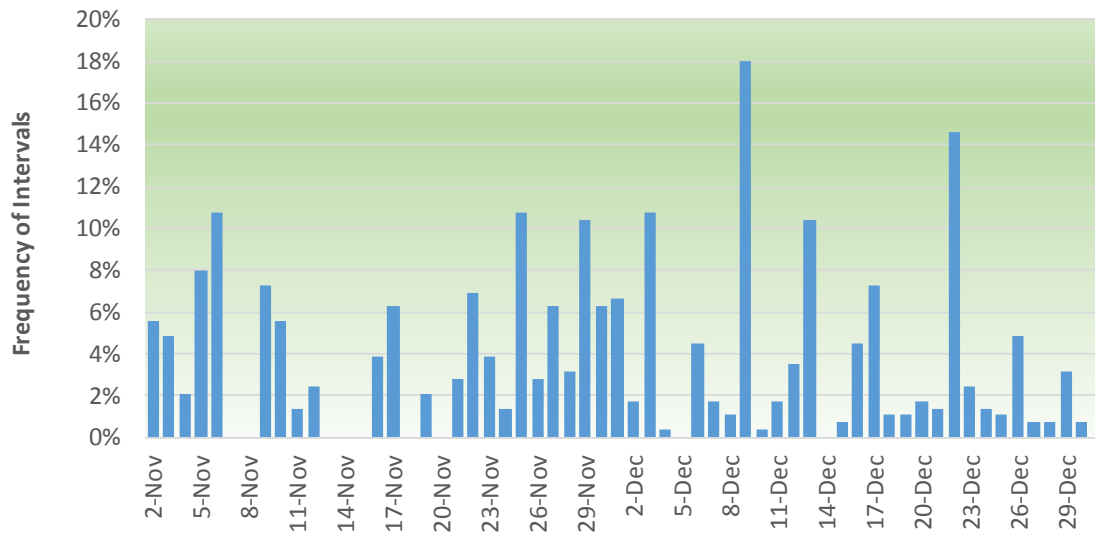


Figure 32: Magnitude of oversupply infeasibility PAC West. Five-minute market.

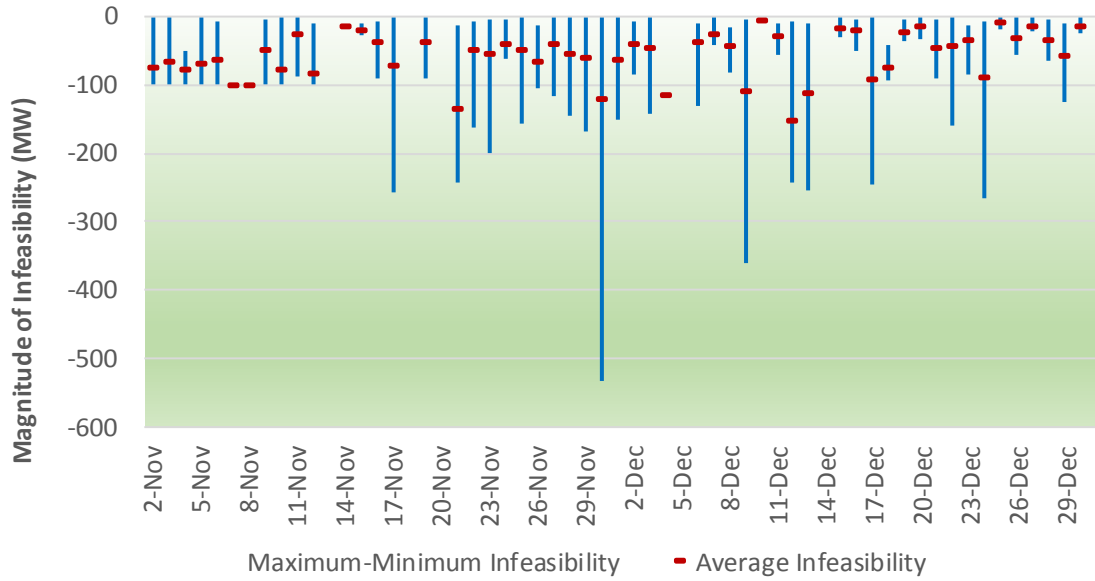


Figure 33: Frequency of oversupply infeasibility PAC East. Five-minute market.

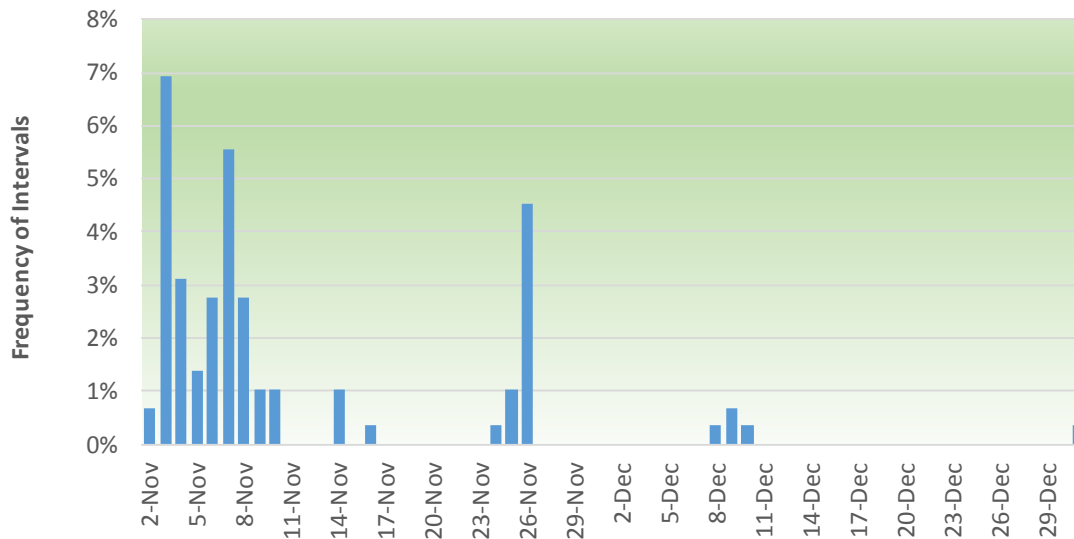
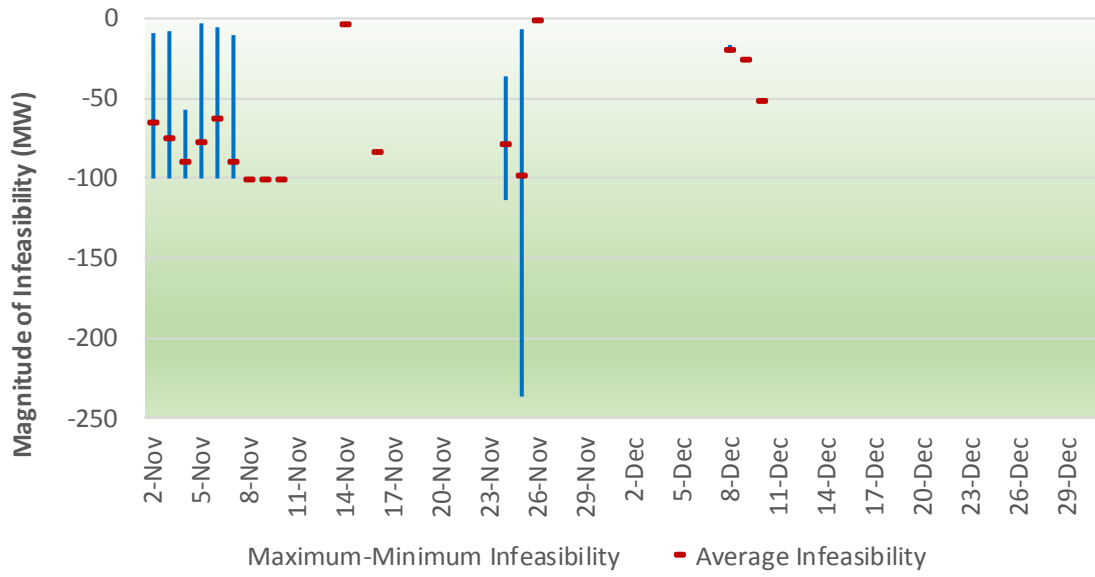


Figure 34: Magnitude of oversupply infeasibility PAC East. Five-minute market.



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 15th day of January, 2015.

/s/ Sarah Garcia
Sarah Garcia

February 19, 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____
Informational Report – Performance of Energy Imbalance Market**

Dear Secretary Bose:

The California Independent System Operator Corporation (CAISO) hereby submits its February 19 report on the performance of the Energy Imbalance Market for January 1 – February 12, 2015.¹

The Commission also directed the Department of Market Monitoring to submit independent assessments on the causes and solutions identified by CAISO. The CAISO intends to submit the independent assessment of the Department of Market Monitoring in about eight days.

Please contact the undersigned with any questions.

¹ The CAISO submits this report pursuant to *California Independent System Operator Corp.*, 149 FERC ¶ 61,194 (2014). On February 12, 2015 the CAISO submitted an informational letter notifying the Commission of its intent to file a final, comprehensive report on February 17, 2015. Also on February 12, the Commission extended the waiver period; the CAISO will submit its report covering the remaining days in the waiver period, February 13 – March 16, 2015 on or about March 23, 2015. The CAISO respectfully requests that the Commission accept this report only one day after date. The additional day was needed to finalize the CAISO analysis.

Respectfully submitted

By: /s/ Anna A. McKenna

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California ISO
Shaping a Renewed Future

Energy Imbalance Market Pricing Waiver Report January 1 – February 12, 2015

February 19, 2015

I. Introduction

On December 1, 2014, the Federal Energy Regulatory Commission (FERC) granted the California Independent System Operator Corporation's (CAISO) petition for limited waiver of the pricing parameters in sections 27.4.3.2 and 27.4.3.4 of its tariff for 90 days, as they pertain to the Energy Imbalance Market, effective November 14, 2014, as requested.¹ In addition, FERC directed CAISO to submit informational reports as further described herein. The CAISO will be submitting on a monthly basis the requested reports in Attachments A through E, including reports provided by the CAISO's Department of Market Monitoring and PacifiCorp. This report covers the CAISO's reporting requirements for the time period covering January 1 through February 12, 2015.

The Department of Market Monitoring will file its report within approximately eight days of February 18, 2015. The Commission directed the Department of Market Monitoring to submit independent assessments on the causes and solutions identified by CAISO. The Department of Market Monitoring requires some additional days to fully review and evaluate the CAISO's report and provide an independent assessment.

II. Background

On November 1, 2014, the CAISO fully activated the Energy Imbalance Market (EIM). The Energy Imbalance Market allows balancing authorities outside of the CAISO balancing authority area to voluntarily take part in the imbalance energy portion of the CAISO locational marginal price-based real-time market. PacifiCorp, the CAISO, and market participants participated in market simulations prior to the start of the Energy Imbalance Market on November 1, including parallel production from October 1 to November 1. However, shortly after go live the CAISO began observing challenges that led to artificially high prices in cases where the market application had to resort to the relaxation of transmission constraints or the power balance constraint in order to clear the market.

On November 13, 2014, the CAISO sought a 90-day waiver of the applicability of section 27.4.3.3 and the second sentence of section 27.4.3.4 of its tariff to permit CAISO to address, without suspending the Energy Imbalance Market, those circumstances which produced atypically high prices. Those two sections of the tariff provide that when there is a lack of economic bids to clear the fifteen-minute and five-minute markets, the CAISO's market application will price the shortages (and therefore set

¹ *California Indep. Sys. Operator Corp.*, 149 FERC ¶ 61,194 (2014) (December 1 Order).

locational marginal prices) according to the pricing parameters specified in those sections. Specifically, for the purpose of determining how a transmission constraint or system-energy balance constraint will affect the determination of prices in the market, the pricing parameter for the relaxation of the constraint is \$1,000/MWh (the maximum energy bid price specified in tariff section 39.6.1.1).

The waiver addresses three sets of transitional conditions in the Energy Imbalance Market that together have caused the transmission and system energy-balance constraints described in tariff sections 27.4.3.2 and 27.4.3.4 to bind more frequently than expected in the weeks since the Energy Imbalance Market began operation on November 1, causing prices in these intervals to be set by the \$1,000/MWh relaxation parameter. Because of these transitional conditions, the high prices are not always indicative of actual physical conditions on the system, and reflect challenges in providing timely and complete data to ensure system visibility under the new procedures, exacerbated by limitations on the resources available to PacifiCorp for use in the Energy Imbalance Market and several forced outages of large Energy Imbalance Market participating resources. The CAISO described² the transitional conditions that led to the waiver in its petition filed on November 13, 2014, as follows:

- 1) All possible operational conditions, including interactions between disturbance events and other conditions on the system, were not fully represented, simulated and tested during these earlier market simulations. It was not until actual operations that these circumstances were experienced and the resulting price excursions became apparent. In some cases data issues arise because of errors made in processing such information, and in such intervals the CAISO will have authority to correct prices. But in some cases, the pricing excursions may be due to the need to adopt better practices generally and not because of an erroneous data processing issue.
- 2) Limitations on the resources available to PacifiCorp for use in the Energy Imbalance Market. Several resources had not yet received the necessary metering upgrades due to various outage schedule limitations, which has prevented PacifiCorp from making these resources available in the initial pool of resources participating in the Energy Imbalance Market. The CAISO is processing temporary metering exemptions in accordance with its requirements and participation by some additional resources has improved conditions, but other considerations remain. For instance, some resources are subject to multiple ownership rights and have contractual issues that must be resolved to enable their participation in the Energy Imbalance

² See *Petition For Limited Tariff Waiver And Request For Expedited Consideration*, California Independent System Operator Corp., filed November 13, 2014, FERC Docket No. ER15-402.

Market. Additionally, third-party resources in PacifiCorp's balancing authority areas have not yet begun participating in the Energy Imbalance Market, which further limits the pool of available resources.

- 3) The PacifiCorp East (PAC East) and PacifiCorp West (PAC West) balancing authority areas experienced several forced outages of large Energy Imbalance Market participating resources, which led to short term supply deficiencies in the market. While outages are not necessarily uncommon, these outages quickly exacerbated an already tight supply and contributed to price increases in the associated intervals. In addition, while PacifiCorp operations accounted for the outages by responding to system conditions, these actions have not always been communicated in a timely manner to the market. Without such information, the market results would not necessarily reflect physical conditions on PacifiCorp's system. The addition of more participating resources and enhanced operational procedures should mitigate the impact of such outages.

On December 1, 2014, FERC granted the CAISO its waiver request and also directed monthly reports to FERC on the progress of the issues that led to the need for the waiver. The CAISO provides its reports consistent with the order below and in the attachments to this report. On February 12, 2015, the Commission extended the term of this waiver to March 15, 2015, in its order issued in FERC Docket ER15-861 (*California Indep. Sys. Operator Corp.*, 150 FERC ¶ 61,086 (2015)). Consistent with that extension, the CAISO intends to file an additional report after March 16, 2015.

III. Reports

In the December 1 Order, the Commission directed the CAISO to file detailed informational reports on the performance of Energy Imbalance Market at 30-day intervals during the 90-day waiver period. Consistent with the order, this third report is filed approximately 30 days from the last report filed on January 15, 2015. The Commission stated that these reports should provide detailed supporting data demonstrating progress towards identifying and eliminating the problems giving rise to the waiver petition. Consistent with the December 1 order, the following reports are included in Attachments A through E as follows:

Attachment A: A quantitative and qualitative description of the market performance (covering both progress and remaining concerns) related to the issues that prompted the CAISO's waiver request that are within the CAISO's control. Includes a description of, and status update regarding, measures being taken or planned to be taken to identify and address the market performance problems related to the issues that prompted the CAISO's waiver request. Identifies any remaining deficiencies in

CAISO and PacifiCorp processes, procedures, and tools and any additional market issues related to these pricing concerns that the CAISO considers necessary to sustain stable market operations, along with the CAISO's plan to address such issues.

Attachment B: A quantitative and qualitative description of the market performance (covering both progress and remaining concerns) related to the issues that prompted the CAISO's waiver request that are within PacifiCorp's control. This section includes a description of, and status update regarding, measures being taken or planned to be taken to identify and address the market performance problems related to the issues that prompted the CAISO's waiver request.

Attachment C: Independent assessments from the Department of Market Monitoring on the causes and solutions identified by the CAISO. For this first report, this will be submitted within seven days of the CAISO's first submission.

Attachment D: An exploration of impacts, if any, on non-EIM pricing nodes, including the Mona trading node. Report on whether EIM pricing is adversely impacting non-EIM pricing nodes. The extent to which non-EIM pricing nodes such as the Mona trading node are impacted by EIM pricing within the PacifiCorp Balancing Authority Areas. Identify any such impacts and describe any actions the CAISO is taking or plans to take to address such impacts.

Attachment E: Description of each relaxation event, and a summary of the magnitude and frequency of such events overall. Data on instances where the \$1,000/MWh price would have occurred but for this waiver, including the time of the instance, the duration, the cause, and the affected node(s) and load aggregation points.

ATTACHMENT A

Quantitative and qualitative descriptions of market performance related to the issues that prompted the CAISO's waiver request - CAISO.

This attachment includes quantitative and qualitative information for three reporting requirements specified in the Commission's December 1 order. First, section 1 and section 2 provide a quantitative and qualitative description of the market performance (covering both progress and remaining concerns) related to the issues that prompted the CAISO's waiver request that are within the CAISO's control. Second, the tables in section 2 of this attachment provide a descriptions of, and status update regarding, measures being taken or planned to be taken to identify and address the market performance related to the issues that prompted the CAISO's waiver request. Finally, the tables in section 2 of this attachment also report on the measures taken and planned to address the market performance problems, which also identify any remaining deficiencies in processes, procedures, and tools and any additional market issues related to these pricing concerns that the CAISO considers necessary to sustain stable market operations, along with the CAISO's plan to address such issues.³

1. Analysis of Impact on Market Performance

In this section the CAISO provides a quantitative and qualitative analysis of the market performance impact of the issues that prompted the CAISO's request for a waiver.

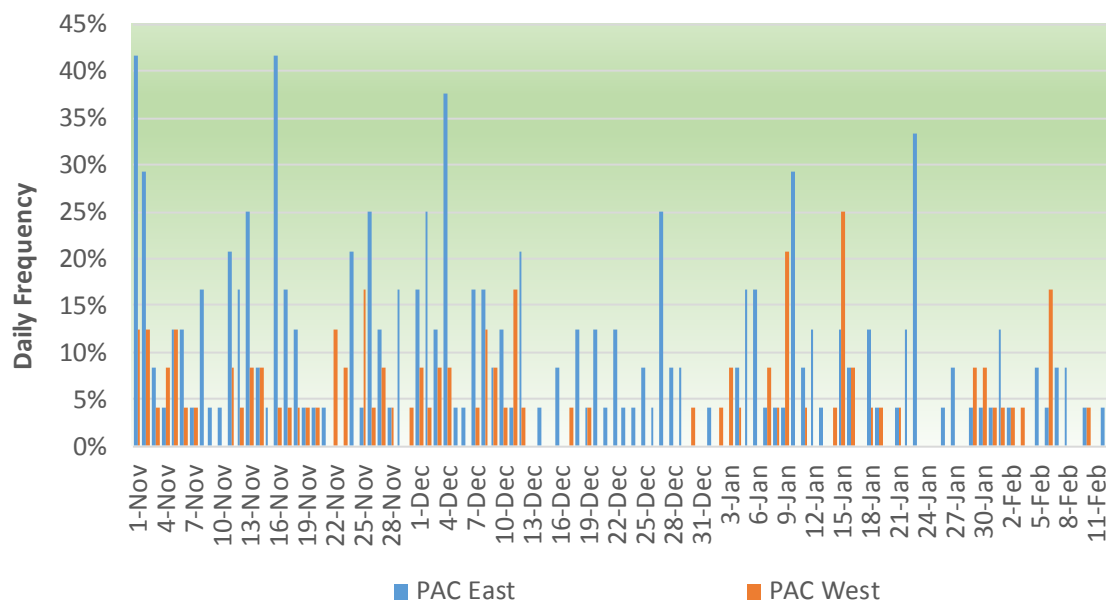
The Energy Imbalance Market is only a part of the real-time market and is not part of the day-ahead market. The CAISO uses the day-ahead market as a reference point for the real-time market. In lieu of the day-ahead market solution, the Energy Imbalance Market the CAISO uses EIM balanced base schedules, which are used to model hourly Balancing Authority Area generation and load before the Energy Imbalance Market runs. The base schedule can be adjusted by seventy five minutes before the applicable hour, (T-75), fifty five minutes before (T-55) and forty minutes before (T-40). The last cycle at T-40 minute will determine the base schedules actually used for the Energy Imbalance Market. The base schedules also serve as a reference for imbalance energy settlements. When the EIM entity opts to use the ISO demand forecasts, the CAISO compares the base schedules –generation and net interchange- with hourly demand forecast and performs a balancing test by EIM Balancing Authority Area and if the EIM entity Balancing Authority Area imbalance is within 1 percent of the forecast, it passes the balancing test. The balancing test is important because it is the

³ *December 1 Order at P 25.*

starting point from which the Energy Imbalance Market is run. Therefore, if the energy market starts with a significant imbalance, such that even the bid-in capacity is not enough to cover the imbalance, there is the potential for infeasibilities in the fifteen- and five-minute markets for either over- or under-supply. It is important to note that the base schedules are set at one level for the entire hour, while load actually varies within the hour.

Figure 1 shows the trend of balancing test failures for the period of November 1, 2014, through February 12, 2015 of operation of the Energy Imbalance Market by area, PAC West and East. There is a downward trend in the frequency of failures from a frequency of failures of 9.2 percent in November to 6.45 percent in December to 5 percent in January and February. The average amount of imbalance has been 166 MW and 148 MW in PAC East and West, respectively.

Figure 1: Frequency of balancing test failures in PAC West and East.



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 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 to area group constraints. This sufficiency test applies to each PAC West and East area on an hourly basis. Figure 2 shows the trend of test failures for flexible ramping for the first two months of operation of the energy imbalance market. The frequency is obtained by

dividing the number of hours failed by 24 hours of a day.⁴ Figure 2 shows that there was a continued reduction in the frequency of failures of the sufficiency test over November and December, from an average of 20 percent to an average of 1.5 percent in the combined PAC West and East areas. In January, there was an increase in failures of the test, which trended down again in February.

Figure 2: Frequency of flexible ramp sufficiency test failures in PAC West and East.

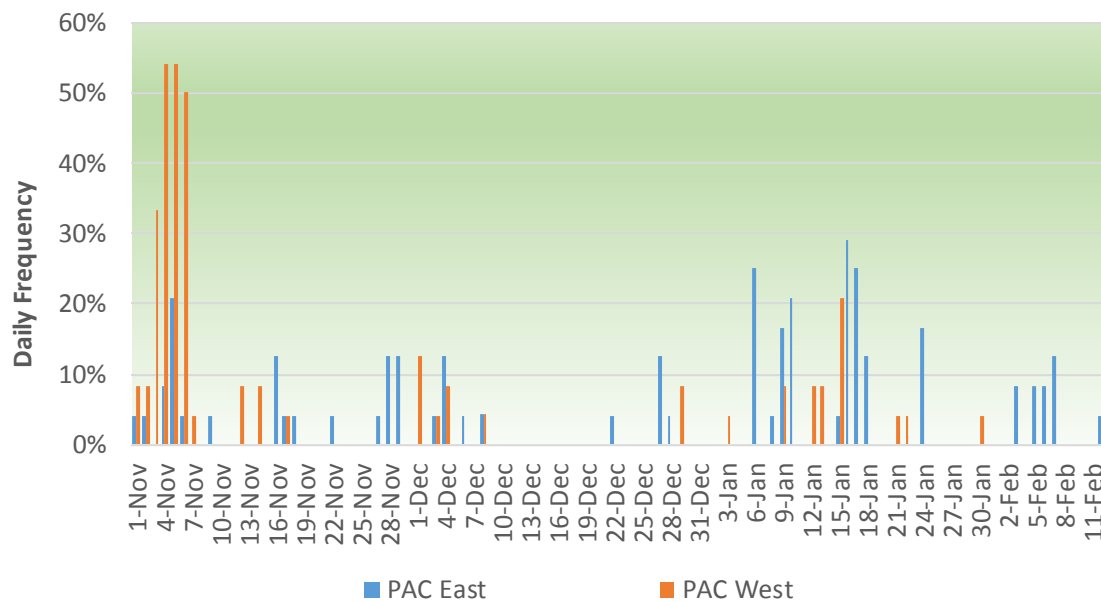


Figure 3 through Figure 6 provide daily average price trends in the Energy Imbalance Market organized by market and area. These trends include pricing for both the PAC West and PAC East external load aggregation points (ELAPs). The report focuses on the ELAP prices because these aggregate prices are representative of pricing in each area -- PAC West and PAC East-- and would reflect short-term imbalance shortage for the aggregate area. These daily averages reflect all prices of the real-time market, including the price corrected through the price correction process and the price adjustments pursuant to the waiver associated with this report.⁵ From November 14 through November 30 the CAISO implemented the price adjustments pursuant to the waiver retroactively and is making the relevant adjustments in settlement statements after the December 1 order was issued. After December 1, there are no retroactive adjustments since the logic of the price discovery feature implemented pursuant to the

⁴ During the term of the waiver, the procedure described in Section 10.3.2.1 of the Business Practice Manual is made ineffective under the pricing procedure under the waiver.

⁵ Note a separate waiver has been submitted requested relief for period of November 1- November 13. These reports do not reflect any adjustments for this separate waiver request which has not yet ruled on as of the date of this report.

waiver is implemented through the market clearing solution process. These prices, like any other prices, are still subject to the price validation and correction process. Section 35.4 of the CAISO tariff already 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 CAISO tariff.

Figure 3: Daily average of fifteen-minute market prices in PAC West.

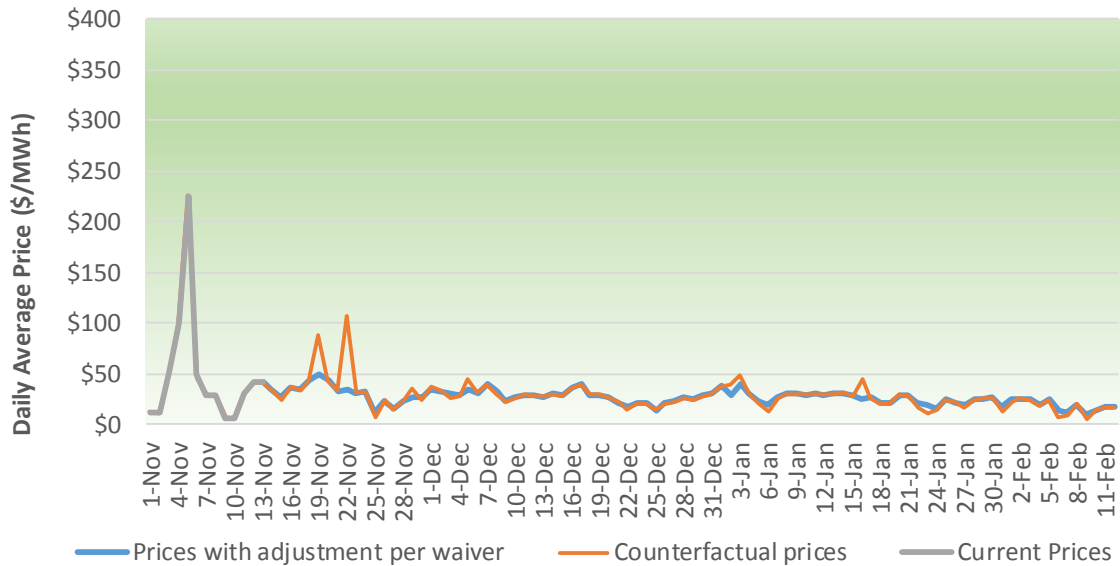


Figure 4: Daily average of fifteen-minute market prices in PAC East.

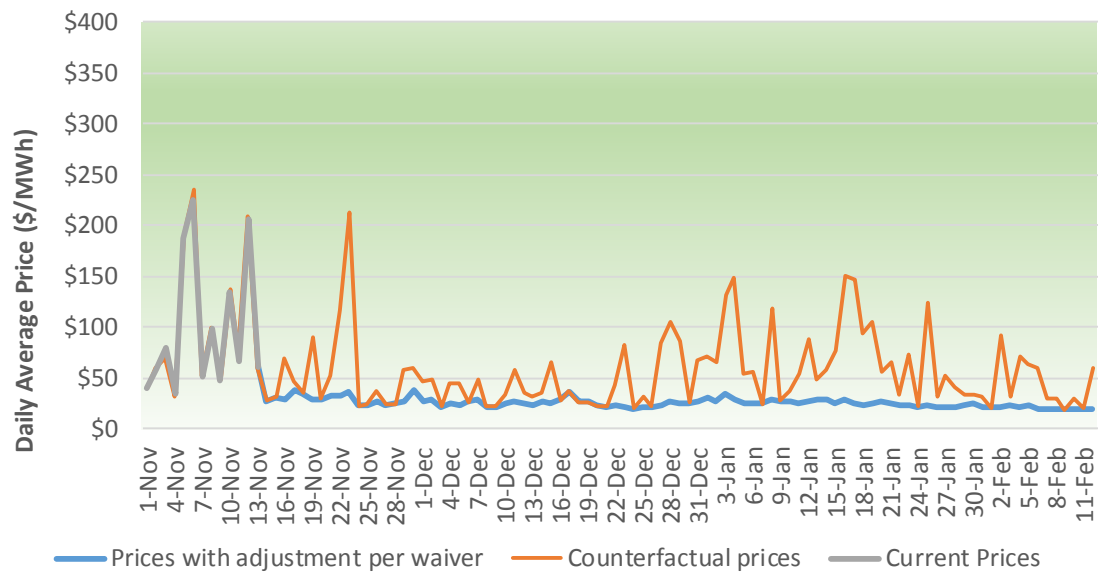


Figure 4 and Figure 5 each compare two trends for the same market and same area, PAC East and West respectively. The line in blue line illustrates daily average prices from November 14 on and represents the actual and final prices after any price corrections or price adjustments pursuant to the December 1 Waiver, which is the subject of this report. After November 14, even when there were power supply infeasibilities, per the December 1 Waiver, this trend reflects prices that are set based on the the marginal economic signal in the market and are not based on constraint relaxation pricing parameters. The price trends for November 1 through November 13 is represented in a different color than the the prices after November 14 because those represent the final prices as of this date, after all price corrections have been made. The prices for the November 1-13 include prices based on the constraint relaxation pricing parameters.

The orange line was constructed to estimate the counterfactual case of what prices would have been if they were based on the constraint relaxation pricing parameters, pegged to the \$1000/MWh bid cap. As of December 1, the CAISO adopted the waiver-based pricing in its systems, which means that the market systems produced prices consistent with the pricing mechanism under the waiver and not based on the constraint relaxation pricing parameters. Therefore, the CAISO had to find a way to reconstruct those cases, which it is referring to as the counterfactual case. In other words, the prices represented by the orange line represent the CAISO's estimate of what prices would have been absent the December 1 Waiver. These two lines compare together prices under the December 1 Wavier to what they would have been without that waiver.

The orange line is more volatile and spiky because those prices are calculated based on the \$1000/MWh any time there is an observed undersupply infeasibility. Whereas the blue line shows a more stable pricing trend reflecting dispatched economic bids. For the first 13 days of November, the lines in grey and orange track closely to each other but not exactly. The prices represented by the grey line are final as of now and include prices that even though there was infeasibility, for other reasons the prices were not based on the constraint relaxation pricing parameters. In contrast, in the counterfactual case, the CAISO estimated that any interval with infeasibility would produce a price based on the constraint relaxation pricing parameter.

In addition, the prices for the counterfactual case in Figure 4 and Figure 5 were constructed based on the following two factors. First, because the goal of this report is to quantify and explain the price changes associated with the the implementation of the December 1 Waiver, these trends do not include the reconstruction of prices related to price corrections and flexible ramping constraint infeasibility for the following reasons:

- i) Price corrections. If there was a price associated with a power balance infeasibility, but the interval was rendered to have an invalid price and was subject to price corrections for other reasons, the CAISO did not estimate the counterfactual price and instead the estimated and counterfactual price is equal to the final and current price. This is based on the premise that had the CAISO not experienced the issue that supported the price correction in the first place, the power balance infeasibility would not have triggered in the first instance. Therefore, the market price would

have been based on the tariff-based rules that consider the submitted economic bid prices rather than the penalty prices specified in the tariff; and

- ii) Flexible ramp sufficiency test. 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. For the duration of the restricted interval, the market clearing price in the affected EIM Entity balancing authority area will also be based the tariff-based rules that look at the last economic bid cleared in the applicable fifteen-minute or five-minute interval in the EIM Entity balancing authority area. This logic is outside the scope of the waiver of this report and consequently, with or without the waiver, the pricing mechanism will be in place. Therefore, the original price for market intervals that had power balance infeasibilities and that failed the flexible ramp test would have remain unchanged absent the waiver as they will not be set by relaxation parameter prices pursuant to Section 10.3.2.1 of the BPM for the Energy Imbalance Market.

Second, the prices reflecting the tariff-based relaxation parameters were reconstructed for both under-supply and over-supply infeasibilitites. This means that when an instance of undersupply was reconstructed, the price was set to the bid cap plus/minus marginal loss component. Similarly, when an oversupply instance was reconstructed, the prices in the counterfactual casewere set to the bid floor relaxation parameter plus/minus marginal loss prices.

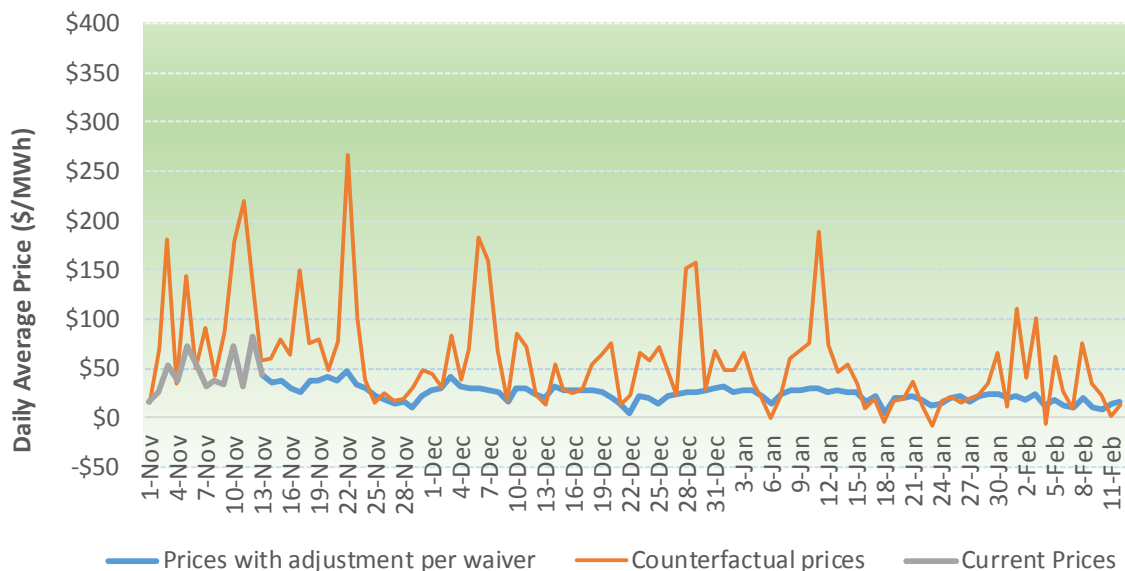
An important characteristic of pricing in the CAISO real-time markets during this time period that became more apparent through further investigation after the last report was filed on December 15, 2014, is that in some intervals the market clearing process experienced what is referred to as “degenerate cases” during which the market may be able to clear at multiple pricing run solutions that are equally valid from an economic perspective.

Mitigating price multiplicity has been recently explored and discussed with stakeholders, and the CAISO board has approved market rule changes that eliminate the multiplicity of pricing issue and produce one price that reflects the lack of congestion at the appropriate locations. During such cases, even if the market systems had observed an infeasibilty that would have led to the relaxation of a constraint and triggered the penalty pricing parameters, the pricing run could have landed at a price that was based on the marginal resource economic bid price, which could be different than the price had it been based on the \$1000/MWh parameter. The CAISO observed many intervals in which this phenomena occurred, in particular in the five minute real-time dispatch. The CAISO does not correct for these cases and believes these to be optimal from the perspective of the energy market alone.

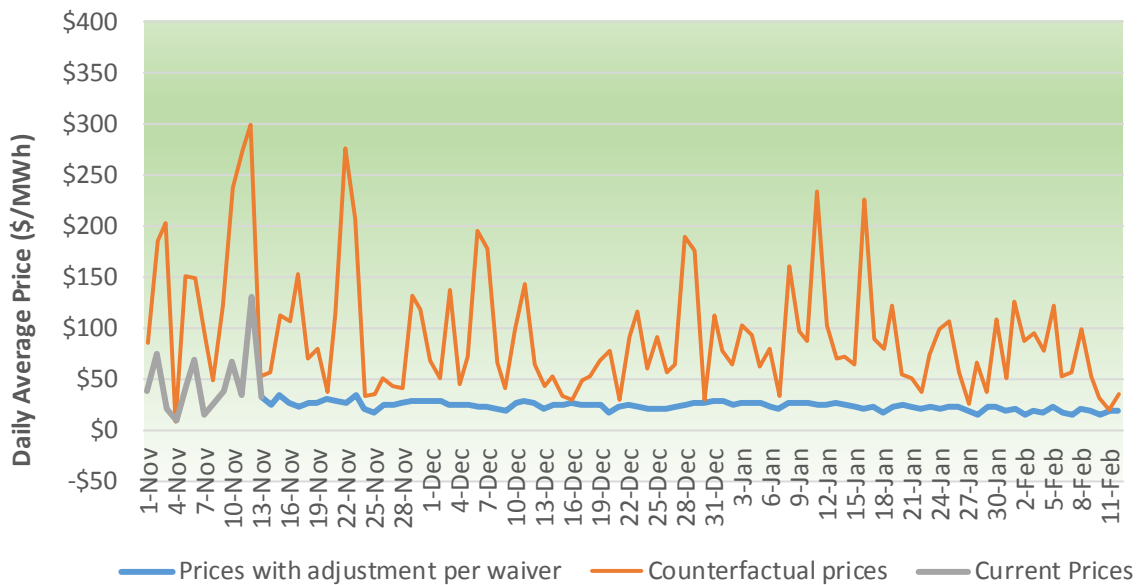
But because of issues this may cause in associated markets such as the congestion revenue rights, the CAISO will be modifying its market rules prospectively to eliminate such occurrences.⁶

The counterfactual case represented by the orange line cannot account for the degeneracy and simply represents what prices would have been for those intervals based on the tariff-based constraint relaxation pricing parameters because there was an infeasibility. This has implications regarding the trends presented in the figures below. For the first 13 days, as discussed above, the CAISO has not yet modified posted prices based on the waiver-type pricing. The CAISO filed for an additional waiver to conduct this pricing adjustment and it is pending before the Commission in FERC Docket No. ER15-817. Without the waiver, the prices as posted would remain as they are. One would expect the counterfactual case represented by the orange line to be close to the posted prices represented by the blue line. This is the case for the fifteen minute markets. However, for the real-time dispatch, the lines diverge because in a number of the intervals posted prices appear to have not been determined based on the \$1000/MWh parameter even if there was infeasibility. At this time, the CAISO believes that this was due to the fact that many of the affected intervals were subject to degeneracy. After November 13, however, whether or not there would have been degeneracy in the pricing run, is immaterial, because pricing under the December 1 waiver or degeneracy is based on the last economic bid price signal.

Figure 5: Daily average of five-minute market prices in PAC West.



⁶ Additional information regarding the stakeholder process and the resulting policy changes is available at: <http://www.caiso.com/informed/Pages/StakeholderProcesses/PricingEnhancements.aspx>. This will be the subject of an upcoming tariff amendment with the Commission.

Figure 6: Daily average of five-minute market prices in PAC East.

Overall, PAC East tends to be more volatile and subject to more frequent price excursions than PAC West. This may be due to limited transfers into the PAC East area. In contrast, PAC West does not share such limitations which enable more transfers in and out of the CAISO balancing authority areas to PAC West.

In both PAC East and PAC West, the five-minute real-time dispatch is notably more volatile than the fifteen minute market. This is due to the fact that the fifteen minute market embodies more flexibility as it is further in time than the applicable intervals whereas the five minute real-time dispatch is closer to real-time. In the five minute dispatch, ramping capability is more limited. Figure 7 and Figure 8 provide bi-weekly averages of the prices as modified under the December 1 Waiver and are final as of now. These include price corrections and price adjustments pursuant to waiver of this report. These figures show that the average price for energy in both the PAC East and West have a downward trend around \$25/MWh with the December 1 waiver in place.

Figure 7: Bi-weekly average of fifteen-minute market prices in PAC West and East.

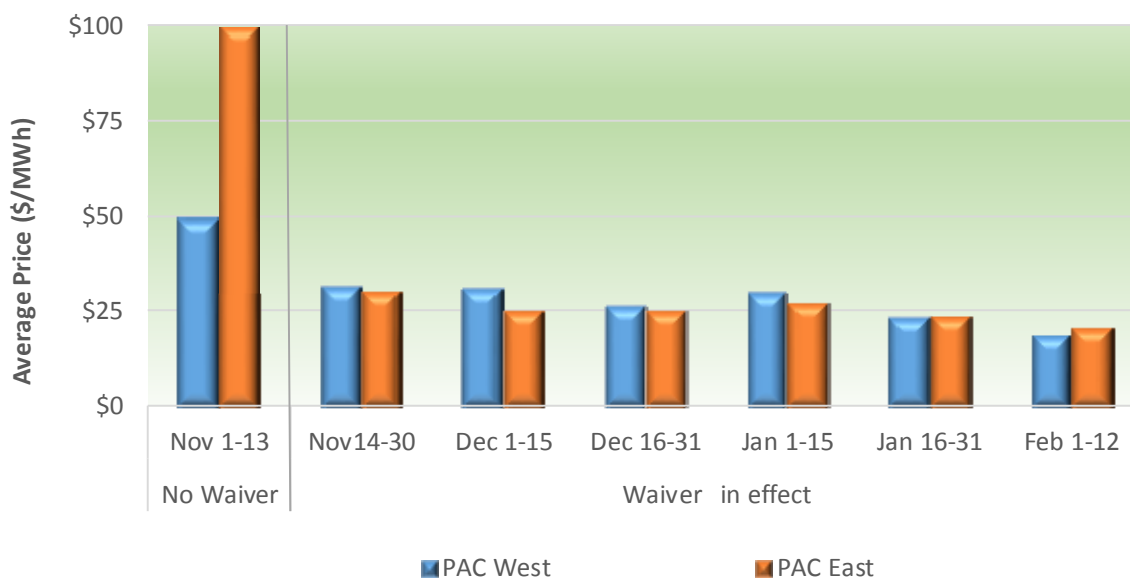


Figure 8: Bi-weekly average of five-minute market prices in PAC West and East.

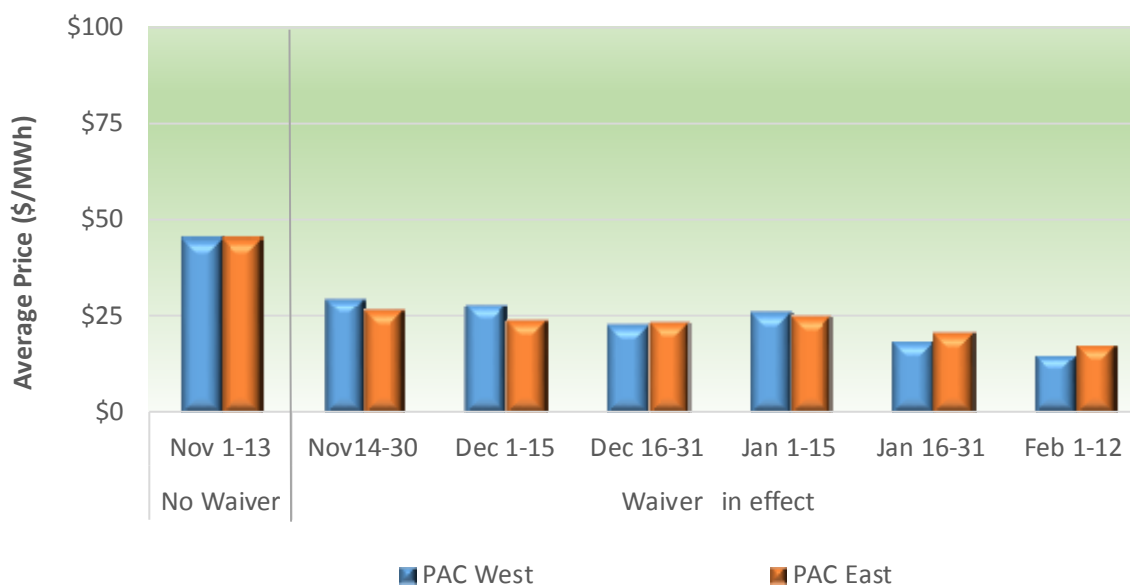


Figure 9 through Figure 12 show the frequency of price excursions for both the fifteen and five-minute market, organized by the reason for the power balance infeasibility. In any given market interval, more than one of the illustrated reason may have contributed to the price excursion because there are numerous elements that can impact the market outcome. For example, a given market interval may experience a price excursion due to data alignment, manual dispatches and load changes. For the

purpose this report, the CAISO has reviewed each affected market interval and has assigned the interval to a reason category that most afflicted the interval. The categories used in the figures in this section 1, include:

1. *Renewable deviations* for conditions in which wind or solar changes lead to the loss of capacity and for the need to increase generation from other resources.
2. *Load changes* refer to conditions where either the load forecast is adjusted or there is a change in the load bias.
3. *Import/Export changes* is for adjustments and updates to imports and exports as seen by the market.
4. *Resource outage* is for conditions in which an outage results in the loss of capacity available to the market, and for which the market needs to increase generation from other resources. Similar conditions apply for manual dispatches leading to a reduction of available capacity to the market.
5. *Manual dispatches* is for instances where the introduction of a manual dispatch may cause imbalances, such as max go to manual dispatch may limit the unit up to certain capacity, resulting in the loss of capacity for the market.
6. *Resource data alignment* is for any other condition not captured in the previous five categories. This group accounts for resource deviating from their dispatch, differences between base schedules and bids or dispatches, and changes between markets.
7. *Transfer/Congestion constraints* is for instances where the interplay of EIM transfer constraints or congestion in either PAC or CA balancing authority area may restrict the incremental generation of resources leading to infeasibilities.

Figure 9: Reasons for intervals with ELAP prices exceeding \$500 in the fifteen-minute market in November. PAC West and PAC East combined.

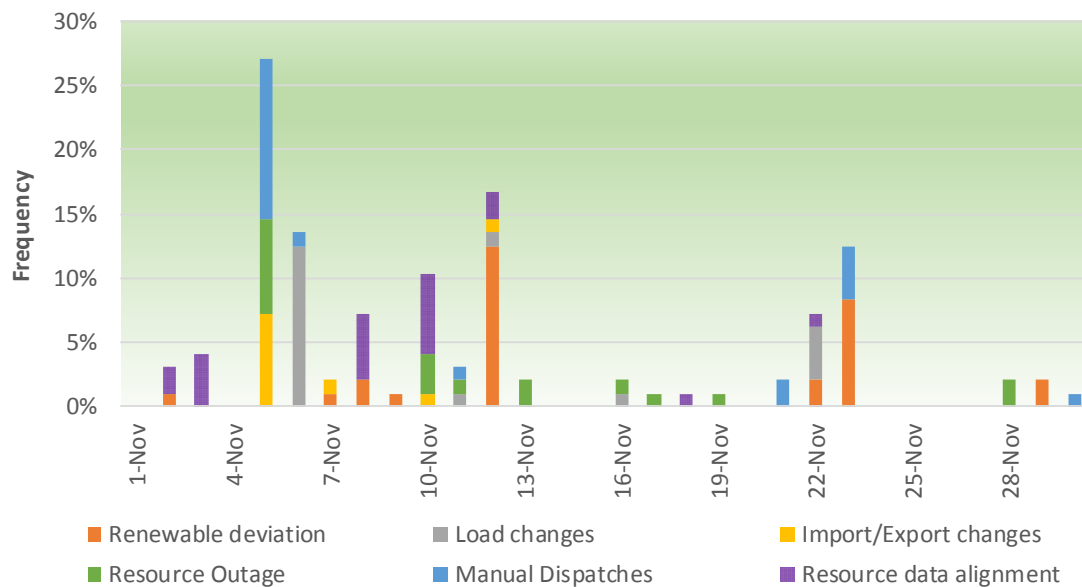
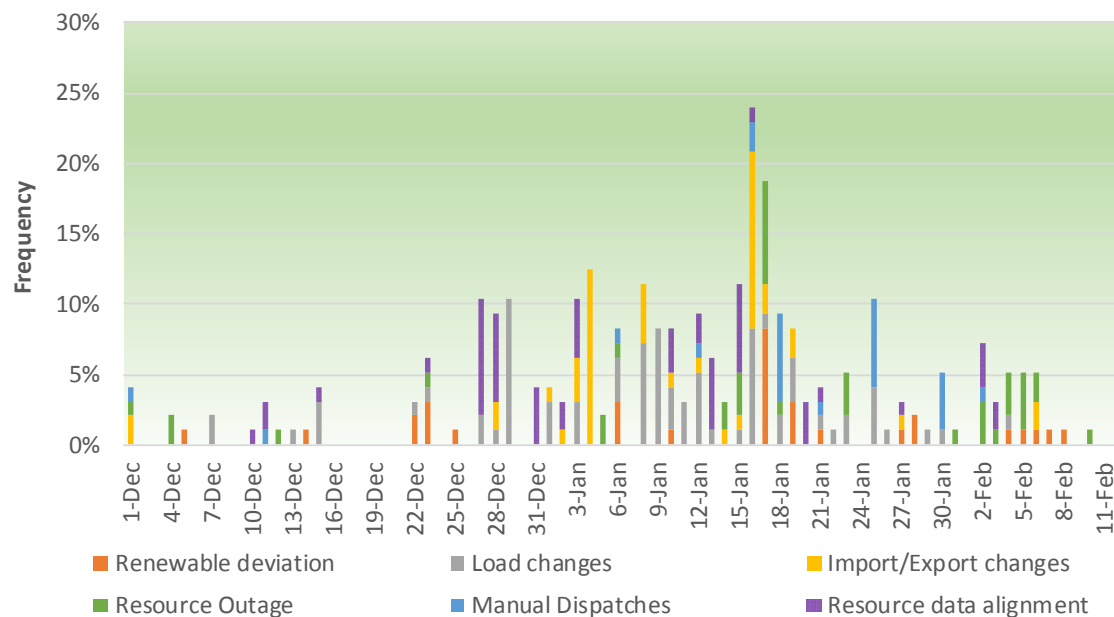


Figure 10: Reasons for intervals with undersupply infeasibility in the fifteen-minute market in December to February. PAC West and PAC East combined.



For the month of November, as previously reported in the December 15 report, the metrics represent all intervals where there were price excursions above \$500/MWh in either PAC West or PAC East, or both, whether or not there were power balance

constraint infeasibilities. The sample was chosen as such, because the CAISO presumed that prices exceeding \$500 were suspect and possibly in need of price corrections due to some form of an error, or they were due to the relaxation of a constraint and were based on the \$1000/MWh pricing parameter. For the month of December and onwards, because the CAISO started employing the December 1 Waiver, prices simply were rarely above \$500. Following that same approach would have yielded a very small set of intervals. Therefore, for the December time period it is more appropriate to report the frequency of issues that led to the request for a waiver based on the intervals in which there were power balance infeasibilities (undersupply conditions) as observed through the relaxation of a constraint (power balance or transmission). While these differences present a difference in the type of intervals from which the frequency data was drawn, the data for the two months is still instructive in terms of which of the types of issues that led to the need for the waiver were observed most frequently in each month. The CAISO further reports on the frequency and magnitude of power balance infeasibilities in greater detail in both months in Attachment E of this report in Figure 16 through Figure 23. Those later figures better represent the trends for magnitude of the infeasibilities observed in the markets overall.

Figure 11: Reasons for intervals with ELAP prices exceeding \$500 in the five-minute market in November. PAC West and PAC East combined.

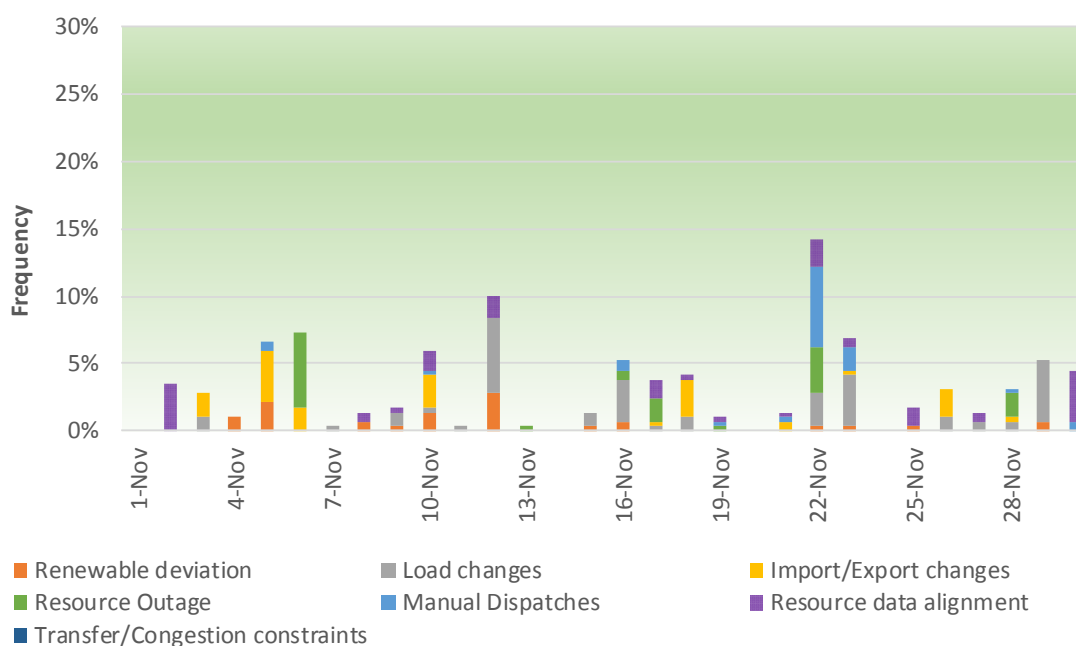
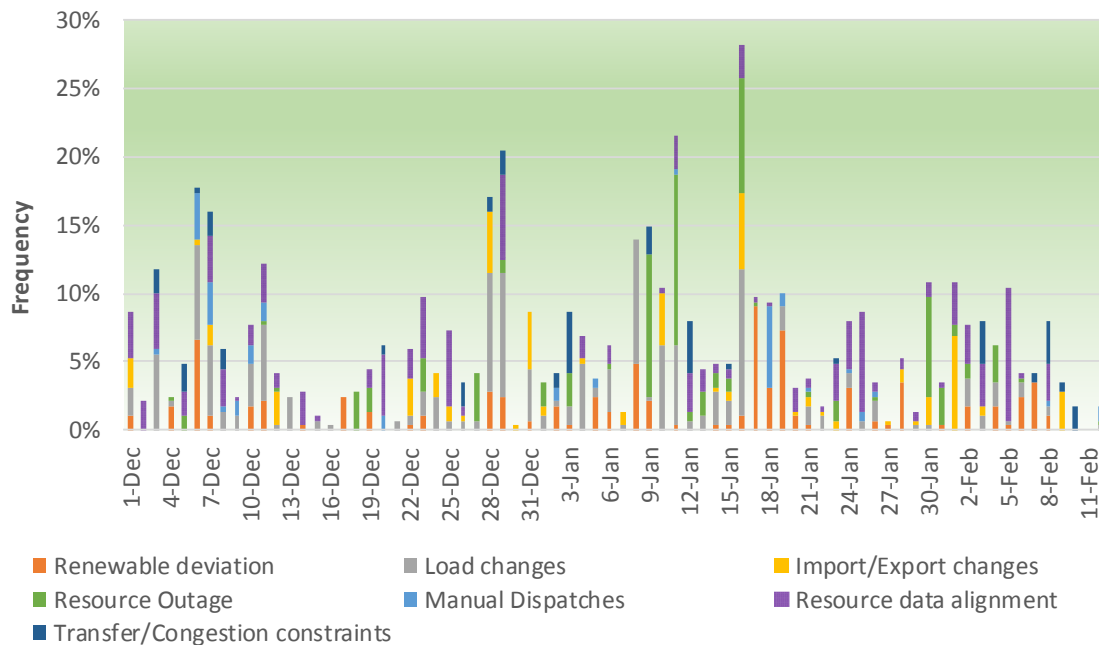


Figure 12: Reasons for intervals with undersupply infeasibility in the five-minute market in December to February. PAC West and PAC East combined.



The categories used in Figure 9 through Figure 12 are related but not exactly the same as the broader descriptions provided in the tables in section 2 below. In some cases, the descriptions provided in the tables below will create conditions leading to the manifestation of power balance infeasibilities. For example, in category 1 below includes the issue of timely manner of entering and cancelling outages. This issue also falls in the category of resource data alignment. The descriptions in the tables below link each issue to the relevant category of reasons above to more specifically define the categories of reasons that prompted the need for the December 1 Order tariff waiver.

Also, as indicated above, this classification of reasons for power balance infeasibilities is a relative classification. The reasons described in this section are not mutually exclusive, and the ISO has identified that at times multiple factors lead to power infeasibilities; therefore, assigning only one reason to an infeasibility is relative and does not capture the nature of various factors interplaying. In some cases a single reason may be sufficient to drive an infeasibility but in others it is the combination of more than one condition that lead to the infeasibilities. To illustrate this concept, consider the following figure where the relative frequency of reasons leading to power infeasibility is provided for the period of January 1 to February 2014. If there was a certain number of infeasibilities in a given day (in percent of the total number of intervals in FMM per day), this figure shows how frequently each reason was present in a day with power balance infeasibilities. The frequencies are not cumulative and are not mutually exclusive; they

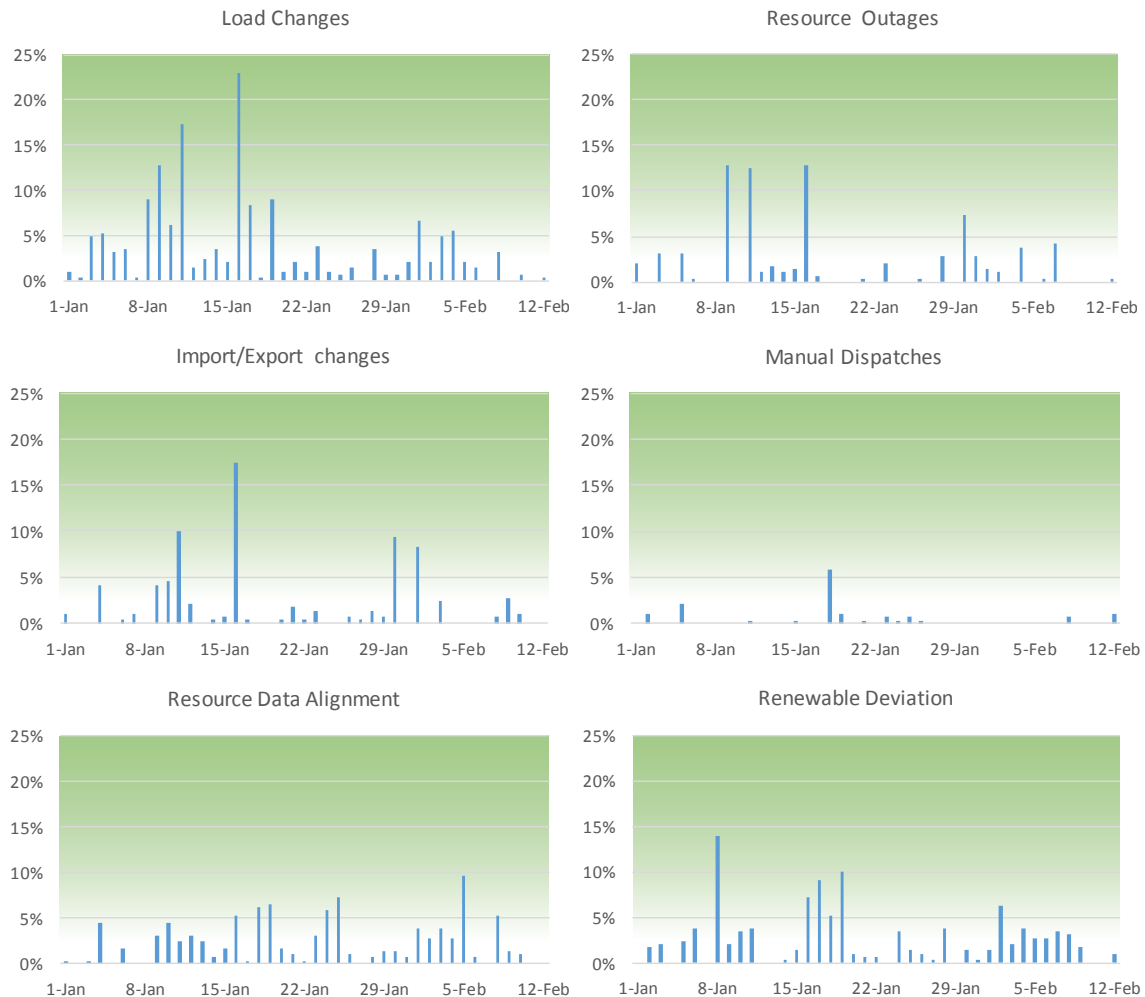
rather show the frequency of each reason with respect to the total intervals in a day for intervals where a power balance infeasibility occurred.

Figure 13: Frequency of reasons leading to power balance infeasibilities in the fifteen-minute market. Both PAC West and PAC East combined.



Similarly, the reasons for power balance infeasibilities in the five-minute market are organized by groups in the following figure.

Figure 14: Frequency of reasons leading to power balance infeasibilities in the five-minute market. Both PAC West and PAC East combined.



2. Issues prompting waiver, remedial actions taken, status and outstanding items

Category 1: Outages, derates/rerates management

Issue	Description	Remedial Action and Status	Frequency and Market Impact
1. Timely entering and cancelling of outages in the market	When resources experience full or partial forced outages, the market must be informed in a timely manner of the outage event and the corresponding measures taken to compensate for the lost megawatt capacity. Delay in informing the market application causes the market application to detect capacity shortages not covered by the unloaded capacity from participating resources. Under such conditions, prompt EIM Entity manual dispatch instructions are needed to increase the generation of available non-participating resources to create room for participating resources to be marginal and to economically set price. When the EIM Entity cancels an outage in a timely manner, it is also important to inform the market that the capacity is available and can be used to clear the Energy Imbalance Market, otherwise the market will perceive that there is capacity shortage to meet the load.	CAISO and PacifiCorp participated in several discussion sessions to clarify the process of entering or cancelling outages including maximum capacity derates, and minimum capacity re-rates. More emphasis was given to multi-stage generating resources due to the complexity of their multiple configurations and additional needed coordination between them. CAISO formalized a production system support plan for Outage Management System to respond quickly to questions or situations encountered by PacifiCorp operator when entering outage tickets. We observe downward trend of price excursions caused by incorrect outages or timing of outages due to resolving many issues related to processes, training, and software glitches. Many issues related to interfaces and timely communication of the	This issue may result in instances counted in Figure 9 through Figure 12 as Resource data alignment and Resource outages.

Issue	Description	Remedial Action and Status	Frequency and Market Impact
		outages have also been resolved.	
2. Base schedule and Bid submission for resources undergoing outages	The timing in which the EIM Entity reports the outage is very important. If the outage occurred before T-75 (<i>i.e.</i> , seventy five minutes before the operating hour) and is expected to last during the operating hour T, then both the economic bid and base schedule submission should be adjusted to account for the outage. Otherwise, the assumptions and data used by the market application for the balance test and look-ahead fifteen-minute market are not consistent with real system conditions, which results in less capacity available to the Energy Imbalance Market than what was computed before the start of the operating hour, and high prices are imminent due to limited unloaded economic capacity that is offered in the market.	PacifiCorp has utilized the CAISO new displays to quickly identify discrepancies between base schedules and derated maximum capacity of resources. PacifiCorp has acted on these discrepancies and adjusted the base schedules accordingly. A decrease in discrepancy occurrences has been noted. Additional information related to re-rated minimum capacity has been added to existing displays to help PacifiCorp identify and fix discrepancies between base schedules and re-rated minimum capacity that caused many noted over-generation conditions in PACW. The CAISO continues to monitor and analyze for timely responses to inform the market about any out-of-market manual actions that are taken or are planned to be taken by the EIM Entity.	This issue may result in instances counted in Figure 9 through Figure 12 as Resource data alignment and Resource outages.
3. Outages of partial or full multi-stage generating resource configurations	Multi-stage generating resources have multiple configurations that must be carefully managed in the real-time market. The configuration characteristics are	The CAISO provided additional clarification and review of base schedules and coordination with resource parameters. Due to the	This issue may result in instances counted in Figure 9 through Figure 12 as Resource data alignment and Resource outages

Issue	Description	Remedial Action and Status	Frequency and Market Impact
	registered in the master file and are observed and honored by the market application. These include physical registered characteristics such as transition time, minimum up time, and minimum down time and minimum capacity (Pmin) and maximum capacity output (Pmax) megawatts (MWs) as well as any overlapping MW regions between configurations. If a configuration is out of service, a timely input of the outage is needed to inform the market that the corresponding economic bid or base schedule is not available and another configuration should be used. If the information is not promptly entered or bids don't exist on other configurations then the market has no way to move the resource to other configurations and the whole MW of the plant is not accounted for in the market and price excursions will occur.	complexity of multi-stage generating resource data modeling there, this constitutes the majority of outage/derates/re-rates issues causing price excursions. A lot of improvement has been noted in entering MSG outages, but this area continues to introduce major risk when outages are not entered correctly. The CAISO continues to monitor, analyze, and provide feedback to PacifiCorp for continuous improvements.	

Category 2: Manual Dispatch

Issue	Description	Remedial Action and Status	Frequency and Market Impact
1. Timely input of manual dispatch	Since many units are not participating in the market, manual dispatch and other out-of-market actions taken on these units must be recorded by the EIM Entity in the market to inform the market about the availability of these resources and their movements to respond to events like contingency or outages of other units. Without this timely information, the market can only assume that the participating resources will respond to these various events, which will result in depleting the flexible unloaded capacity of the participating resources and their capability to set economic prices causing price excursions.	The manual dispatch is entered directly in the market tool by the EIM Entity. There were several occasions reported where manual dispatches are not entered promptly due to outage of resources or fail to startup on time to be consisted with base schedule submission. During the month of January, there were several incidents where a manual “FixedGotoMW” was entered on a unit below its base schedule and caused under-supply or positive MW infeasibility to meet load. There were also a few but substantial instances including January 16, when “SWICHCONF” manual dispatch was entered on MSG units and caused periods of persistent infeasibilities. Despite PacifiCorp being aware that this features was not supported, to avoid any future confusion the ISO removed this this unsupported manual dispatch feature..	This issue may result in instances counted in Figure 9 through Figure 12 as Resource data alignment and Manual Dispatches
2. Flexible ramping sufficiency test	The CAISO performs the flexible ramping sufficiency test on the base schedules, the last test being at 40 minutes before the start of each operating hour. When the EIM Entity fails the test based on the economic bid-in capacity that is being	The CAISO has discussed this issue with the PacifiCorp and has clarified the market impact. The CAISO is also collecting and analyzing both wind and load variability in PacifiCorp’s two balancing areas. Several wind forecasting issues were addressed	This issue may reduce the flexibility of the market to absorb system condition changes and data updates and, consequently, leave the market more

Issue	Description	Remedial Action and Status	Frequency and Market Impact
	offered to the market, the market application will constrain PacifiCorp from increasing its import from CAISO to prevent the leaning concern. This means that PacifiCorp enters the operating hour depending on its resources and any additional manual changes to available non-participating resources set points or purchases of interchanges within the hour. Any delay in performing the manual dispatches or the additional interchange purchases leaves the market exposed to price excursions due to insufficient bid-in flexible capacity.	last month, but wind forecast deviations from base schedules continues to be among the main reasons for price excursions and infeasibilities. The CAISO is in the process of assessing the flexible ramp requirement for PacifiCorp's two balancing areas based on the collected data for the actual real-time imbalance conditions. The CAISO is also revisiting and reviewing the flexible ramp constraint and associated credit accounting in the flexibility sufficiency test and towards satisfying the flexible ramp requirements in the market optimization.	susceptible to price excursions by any of the reasons provided in Figure 9 through Figure 12

Category 3: Wind forecast accuracy

Issue	Description	Remedial Action and Status	Frequency and Market Impact
1. Accuracy of PacifiCorp wind resources forecast	The variable energy resource (VER) forecast, which is mainly wind forecast for the PacifiCorp balancing authority areas, is crucial because it sets the maximum economic megawatt range that the market is allowed to dispatch these resources. The accuracy of the short term VER forecast benefits immensely from the accurate telemetry of the output of the VER resources. The forecast of the wind	PacifiCorp continues to utilize the new unit deviation display that CAISO added to the EIM Entity user interface. This display provides the grid operator information related to differences between any combination of telemetry, state estimation, base schedule, and cleared target operating points for all resources. This display is used	This issue may result in instances counted in Figure 9 through Figure 12 as Renewable deviation

Issue	Description	Remedial Action and Status	Frequency and Market Impact
	resources was deviating significantly from the output of the resources even for the next 5-min forecast over a period of many days. This resulted in significant deviations in calculated energy imbalance and sometimes resulted in over-generation, or under-generation conditions compared to the hourly base schedule values of these wind resources for the corresponding operating hour. Lastly, in cases where wind resources are participating and being dispatched, the short-term forecast, which is a persistent forecast, may not be accounting for the dispatch instruction.	by PacifiCorp to quickly identify which wind resource is deviating and the amount of deviation per resource and on aggregate basis per balancing area. PacifiCorp has identified some areas of improvement related to its wind forecast quality and has worked diligently with its wind forecast service provider to fix those issues. However, there have been several reported volatile cases when the wind drops more than 150MW from its base schedules causing potential price excursions had the waiver is not currently in place.	

Category 4: Interchange schedule variation

Issue	Description	Remedial Action and Status	Frequency and Market Impact
1. Interchange information within the hour	Interchange information is essential part of meeting energy imbalance for each balancing authority area. Considering the forward look-ahead time horizon of the fifteen-minute market for almost two hours, and one hour for the five-minute real-time dispatch market, timely information about the interchange schedules is essential. The delay to inform the market application about these	CAISO has re-emphasized the importance of informing the market application about any planned purchase or sale of interchanges before the balancing test or within the hour to respond to changing imbalance conditions. The CAISO also re-emphasized the need to submit planned interchange base schedules for	This issue may result in instances counted in Figure 9 through Figure 12 as Import/Export changes

Issue	Description	Remedial Action and Status	Frequency and Market Impact
	interchanges during resources outage times or steep load ramping conditions tightens the market conditions, leading to fake price excursions that sometimes show in the financially binding fifteen-min market interval which is calculated 37.5 minutes ahead of time before the T-20 minutes cut off time for the tags to be submitted and approved for any extra or within the hour interchanges.	multiple hours in the horizon to provide the short term unit commitment, which has a four and half hours look-ahead horizon, with good projection of the forward hours to enable optimal market decisions related to multi-stage generating resources transitions from one configuration to another, and startup of fast start resources. There were several cases noted in January and first two weeks of Feb when changes in interchanges within the hour compared to the bases schedule values caused infeasibilities. PacifiCorp is aware of these cases and reacted quickly to fix this issue via moving internal resources to support such change within the hour.	

Category 5: Load forecast variation

Issue	Description	Remedial Action and Status	Frequency and Market Impact
1. Load forecast biasing	EIM Entity grid operators have the capability to bias the load forecast for reliability purposes to account for any non-modeled issues causing discrepancy between forecast load and actual load. The setting of the bias is somewhat subjective based on the grid operator's judgment of system operational and reliability needs. This biasing if not done in a coordinated fashion with market operations can create price excursions especially when there is limited flexible ramp capacity available to accommodate small marginal overshoot or undershoot of the bias values. Due to the limited pool of participating resources, the PacifiCorp grid operator will necessarily need to pay extra attention to the bias values to prevent unintended overshoot or undershoot.	The logic for the load bias to maintain reliability was extensively discussed, documented, and used during PacifiCorp grid operator training including the impact on prices as a situational awareness signal to indicate an issue in meeting load or balancing the system. There were several instances reported in January when excessive amount of load bias was used to dispatch more capacity when the system is out of flexible ramping capacity. The CAISO has identified these instances and discussed with PacifiCorp that the bias in such cases can only cause price excursions without helping system reliability and re-emphasized the importance of the on-going operator training sessions on this issue.	This issue may result in instances counted in Figure 9 through Figure 12 as Load changes

Category 6: Resources not following dispatch

Issue	Description	Remedial Action and Status	Frequency and Market Impact
1. Resources not following dispatch signal	On occasions resources were not closely following the market dispatch signal. This was either because the plant was unavailable or an outage ticket was not entered on-time for the market to consider the outage, or because of some lag time when the plant was not set on automatic generator control to be dispatched directly from market signal. In any of these cases, the deviation from the market dispatch and the lack of the manual instructions to inform the market application when the resource cannot operate to the target operating point, resulted in market conditions that are not reflective of actual system conditions, causing price excursions. In some cases when the plant is dragging its response to the market signal, it was necessary for the EIM Entity to make direct phone calls to the plant to start moving up or down to the plant's designated market dispatch signal.	PacifiCorp continues to utilize the new unit deviation display that CAISO added to the EIM Entity user interface. This display is used by PacifiCorp to quickly identify which resource is deviating and the amount of deviation per resource and on aggregate basis per balancing area. When a resource was observed to be dragging its dispatch, a direct call to the plant was enough to expedite the response if the plant was available or resulted in submission of outage ticket or manual dispatch instruction if the plant had any temporary physical limitations. Unit deviations in January have maintained their levels in December but they are still present and among the reasons for price excursions, especially when they are combined with a manual dispatch that fixes the resource megawatts in the market but the resource is not following the dispatch.	This issue may result in instances counted Figure 9 through Figure 12 as Resource data alignment

Category 7: Network Model discrepancy

Issue	Description	Remedial Action and Status	Frequency and Market Impact
1. Industrial load base schedules	PacifiCorp has industrial load as part of the conforming load and market load forecast. This created a discrepancy whenever these industrial loads are operating or called upon to curtail. The market is not aware of these non-participating resources that exist in the PacifiCorp energy management system, but not in the market, creating the need to manually bias load to maintain consistency between market model and PacifiCorp's energy management system (EMS) model.	CAISO and PacifiCorp went through a series of meetings and identified these resources. An action plan was developed to add these non-participating resources to the network model used in the market application. PacifiCorp is diligently working on providing telemetry, and register these resource with CAISO so they can be treated as separate resources with the capability to submit base schedules reflecting their actual real-time operation. The issue has impacted the quality of load forecast and called for manual load biasing after resulting in some MW infeasibilities and potential price excursions had the waiver is not currently in effect.	This issue may result in instances counted in Figure 9 through Figure 12 as load changes and resource data alignment
2. Distributed energy resources modeling	Distributed energy resources are currently included in the market load forecast as conforming load. These resources have both load and generation components, which nets to positive or negative net injection at the load bus. When generating the market does not visibility of them and effectively considers more	CAISO and PacifiCorp went through series of meetings and identified the gross impact of these resources. Action plan was developed to add them to the market network model. The non-generation resource market model is used to model one of these	This issue may result in instances counted Figure 9 through Figure 12 as load changes and resource data alignment

Issue	Description	Remedial Action and Status	Frequency and Market Impact
	load than what the PacifiCorp's EMS is observing and price excursions occur because of the lack of base schedules for these resources.	resources, and others are coming with this coming month. Load biasing is being used in the meantime to compensate for the MW changes of these resources.	
3. Telemetry quality issues (net versus gross accounting)	The EIM Entity is sending telemetry values for all PacifiCorp registered resources in the master file. When the quality of the telemetry values is not good, the state estimator solution quality is negatively impacted, which in turn affects the quality of the market solution and the dispatch operating targets of these resources. During the first few weeks of operation the CAISO found that some resources have telemetry measurement that is net of its auxiliary loads and others have gross telemetry measurements that do not include the auxiliary load. In addition, certain wind resources and other small non-participating resources did not have telemetry. When these discrepancies are combined together they tend to impact the market solution and cause price excursions.	The CAISO and PacifiCorp identified all these resources and telemetry issues and permanent fixes were put in place.	This issue may result in instances counted in Figure 9 through Figure 12 resource data alignment

Category 8: Market model discrepancy

Issue	Description	Remedial Action and Status	Frequency and Market Impact
1. Energy during startup and shutdown	For multi-stage generating resources, the energy of these resources during the startup and shutdown periods when their output is below the PMin is accounted for in energy management system and automatic generation control (AGC). But the market does not account for this energy because it is below the PMin of the resource. This created discrepancy in the base schedule balance test, and the imbalance calculations between market and actual conditions as seen by AGC, which led to performing some load bias during the startup and shutdown of these resources subjecting the market to price excursions.	The CAISO is modeling the transition ramping for multi-stage generating resources and has scoped the requirements to add startup and shutdown profile to the 15-minute market since these features are already in the 5-min market. PacifiCorp is in the process of collecting data to define the startup and shutdown profiles for many of the resources with high PMin values.	This issue may result in instances counted in Figure 9 through Figure 12 as part of the resource data alignment
2. Inconsistent base schedule and bid submission	It is important that the base schedules, self-schedule, and economic price curve submission are consistent. If a resource is scheduled to be OFF at a particular hour, then it is expected that the submitted base schedule to be zero, it is not expected, however, for this resource to have a self-schedule at higher configuration for the same hour. Another bid submission inconsistency occurs when the resource's higher configuration bid ends or not submitted for a particular	This issue continues to exist. There were several reported cases where base schedule value is above the maximum economic bid range causing MW infeasibility. The CAISO has identified, and analyzed these instances and discussed them in detail with PacifiCorp. PacifiCorp has identified changes to its internal processes and interfaces to mitigate those inconsistencies in the automated	This issue may result in instances counted in Figure 10 and 11 as part of the resource data alignment

Issue	Description	Remedial Action and Status	Frequency and Market Impact
	hour forcing the resource to transition to lower configuration with lower PMax value than its submitted base schedule for that hour, which was used in the balance test calculation. These inconsistencies results in market supply shortages that cause price excursions.	bid submission.	

Category 9: EIM Transfer Limits

Issue	Description	Remedial Action and Status	Frequency and Market Impact
1. Static and dynamic transfer limit restrictions on California-Oregon Intertie (COI)	The Energy Imbalance Market is designed to have the EIM transfer capacity fully re-optimized in both the fifteen-minute and five-minute market. With respect to the COI, the added restriction of the dynamic five-minute limit which is an incremental limit around the fifteen-minute solution creates at times price excursions. The five-minute dynamic limit constrains the market application from re-optimizing the fifteen-minute EIM transfers decisions between PacifiCorp and CAISO beyond the amount allowed by the five-minute incremental dynamic limit, which can be restrictive especially during the on-peak hours.	PacifiCorp is engaged in ongoing discussions with the Bonneville Power Administration (BPA) to understand the nature and allocation of the dynamic transfer capability on COI. BPA is in the process of conducting a detailed dynamic transfer capability study, which is ongoing work. Any additional five-minute capability will help the five-minute market re-optimize the fifteen-minute decisions that are based on system conditions and information available at approximately 30 minutes prior to the five-minute market. The five-minute dynamic COI limits were recently increased for the off-peak hours but still very	This restriction on the 5-min dynamic limit on COI issue is counted in Figure 9 through Figure 12 as part of transfer/congestion constraints

Issue	Description	Remedial Action and Status	Frequency and Market Impact
2. Five-minute rate-of-change constraints	The rate-of-change constraints are five-minute flow limit constraints that limit the amount of five-minute movement of PAC West balancing authority area participating resources around the corresponding resources' fifteen-minute schedules due to their flow impact on certain paths and flowgates internal to BPA's balancing authority area. This restriction on the resources' five-minute movements or the corresponding rate-of-change constraint has created at times price excursions on the impacted resources when the corresponding path or flowgate five-minute limit constraint is binding.	limited in the on-peak hours. PacifiCorp is engaged in discussions with BPA to understand the nature and basis behind the five-minute flowgate limits and possible change in the calculation of those limits. BPA is reviewing the five-minute limits which are based on historical movement of PacifiCorp West resources before EIM. BPA has also asked for more data points to perform a review of the current rate-of-change limits based on actual EIM market data. Any additional five-minute capability will help the five-minute market re-optimize the fifteen-minute market decisions that are based on system conditions and information available approximately 30 minutes prior to the five-minute market. The CAISO had provided BPA the requested data points and answered any relevant questions. CAISO is also engaged with both BPA and PacifiCorp to revise the implementation model for the rate of change constraint to reflect ramping 15-min schedule values.	

ATTACHMENT B

**Quantitative and qualitative descriptions of market performance related to the issues that prompted the CAISO’s waiver request – PacifiCorp
REPORT PROVIDED BY PACIFICORP**

Issue	Description	Remedial Actions Taken During Waiver Period and Ongoing Activity
1. Increase Pool of EIM Participating Resources	PacifiCorp coordinated with the CAISO to increase the pool of owned and third-party resources available to participate in the EIM.	PacifiCorp received certification and addressed remaining metering and contractual issues to enable EIM participation for the following additional PacifiCorp EIM participating resources following EIM go-live: Huntington Unit 2 (450 MW), Naughton Unit 3 (330 MW), Jim Bridger Units 1-4 (2,147 MW), Gadsby Unit 3 (105 MW), and Gadsby Units 4-6 (120 MW). PacifiCorp anticipates continuing to add participating resources by addressing remaining metering and contractual issues (the latter due to shared facilities), as scheduled generator outages permit. PacifiCorp has progressed into the final stages of modeling the addition of its Swift 2 resource as a participating resource. Adding this resource requires making software adjustments so that the resource is accurately integrated into the network model along with its Swift 1 resource. PacifiCorp has modeled one of its non-participating resources as a Non-Generator Resource (“NGR”), which will allow the resource to more adequately reflect operating conditions during both generation and consumption periods. In addition, PacifiCorp continues to work with other transmission customers who may be interested in participating in the EIM with resources. At this time, PacifiCorp has not certified any third-party transmission customers for participation in the EIM and is not at liberty to disclose the identity of any transmission customers that have made inquiries related to EIM participation, but is nevertheless hopeful that these efforts will result in additional EIM participation.

Issue	Description	Remedial Actions Taken During Waiver Period and Ongoing Activity
		Finally, PacifiCorp continues efforts to model certain of its industrial customer interruptible loads as participating resources. This is necessary because some of PacifiCorp's industrial customer loads have on-site generation and, as a result, this presents additional complexity for accurate forecasting and balancing. Adding these elements as participating resources will provide improved operational visibility and will also add approximately 200 MW of flex capacity in its PACE BAA.
2. Increase System Visibility and Situational Awareness	PacifiCorp developed and implemented additional tools and displays to provide its Grid Operations personnel with increased visibility and situational awareness regarding available regulation on a 5- and 15-minute basis.	PacifiCorp created and/or improved certain Grid Operations displays to monitor generator availability, capacity, and ramp capacity. PacifiCorp has finalized enhancements to its generator database (Pi) displays to provide Grid Operations with situational awareness when there is a deviation between the Dispatch Operating Target (DOT) and the actual dispatch. Since go-live, PacifiCorp has been participating in recurring discussions with the CAISO to evaluate the root cause of remaining infeasible schedules. PacifiCorp has made improvements to its systems that interface with the CAISO's BSAP and SIBR, as well as systems designed for bidding resources in the start-up and shutdown hours for multi-stage resources. PacifiCorp analyzed wind forecasting data submitted to the CAISO and DOTs issued by the Market Operator and determined that software adjustments would improve DOTs for participating wind resources. PacifiCorp completed these software adjustments January 31, 2015, and will coordinate with the CAISO on any identified potential improvements. PacifiCorp's Grid Operations and its balancing agent continue to develop similar tools to display aggregated and disaggregated generation values, generation deviations, and interchange deviations, which are expected to be deployed by the end of the first quarter 2015.
3. Improve Training	PacifiCorp identified opportunities to provide additional training to	PacifiCorp provided personnel with training on outage entry and required the provision of daily spreadsheets from PacifiCorp EIM Participating Resources

Issue	Description	Remedial Actions Taken During Waiver Period and Ongoing Activity
and Systems	personnel and improve systems with increased EIM operational experience.	that describe any operational issues and the resources' ambient conditions. PacifiCorp and the CAISO developed a series of training modules for PacifiCorp generation and grid operators. PacifiCorp and the CAISO conducted "Session A" Operator Training December 9-10, 2014, which included modules covering a range of issues relevant to EIM balancing and operations. PacifiCorp and the CAISO conducted "Session B" Operator Training February 5-6, 2015, which included modules on Master File, causes of infeasibility, load conforming, transaction identification numbers, multi-stage generation re-qualifications, and DOT deviations. PacifiCorp continues to coordinate with its outage vendor and the CAISO to improve functionality between its COMPASS outage management system and WebOMS, and developed a reference guide for outage management as part of this effort December 2014. PacifiCorp completed modifications to its COMPASS outage management system that are expected to be uploaded into the production environment February 17, 2015. These improvements were discussed in a recent training session, with additional training sessions scheduled for late February 2015. PacifiCorp's Grid Operations provided its balancing agent real-time continued training on CAISO EIM tools during the first two weeks of February.
4. Improve Internal Processes and Tools	PacifiCorp improved its processes and tools to address identified market performance issues.	PacifiCorp's Grid Operations drafted and posted "best practices" procedure documents to aid in personnel's implementation of critical EIM Entity tasks. PacifiCorp will continue to update these procedure documents in real-time as needed. PacifiCorp also developed a Desk Guide for the new 24/7 Grid Operations desk and an EIM Division of Responsibilities document.

ATTACHMENT C

Independent assessments from the Department of Market Monitoring on the causes and solutions identified by the CAISO.

This part of the report will be submitted to the Commission within seven days of February 18, 2015.

ATTACHMENT D:

This attachment provides an exploration of impacts, if any, on non-Energy Imbalance Market pricing nodes, including the Mona trading node.⁷ This attachment identifies any such impacts and describes any actions the CAISO is taking or plans to take to address such impacts.

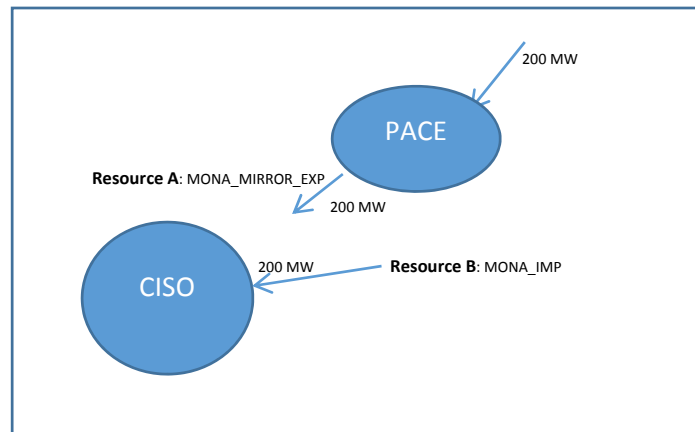
The implementation of the Full Network Model Expansion on October 15 increased the accuracy of the transmission grid modeling from neighboring balancing authority areas, and also allowed for better representation of unscheduled flows effects into the CAISO system. In addition, the implementation of the Energy imbalance Market on November 1, 2014, further enables the CAISO to co-optimize resources across the various areas of the Energy Imbalance Market. Both of these initiatives required that the CAISO also change the way in which the scheduling points are defined so that it can associate the scheduling points with external interties.

With regards to the CRAG and Mona scheduling points, the CAISO had to account for the fact that schedules can be submitted at the locations for purposes of CAISO only transactions or Energy Imbalance Market only transactions. The Crag location is the scheduling point for the Cascade intertie; the Mona location serves as a scheduling point for various southern interties, such as IPPUTAH and Adelanto interties. Prior to the implementation of the full network model, these two scheduling points were modeled with the standard radial link and were considered part of the CAISO balancing authority area. With the implementation of the full network model expansion, this definition changed and with the implementation of the Energy Imbalance Market, the prices at these locations changed notably as the CAISO began accounting for Energy Imbalance Market related congestion.

CRAG and Mona scheduling points are physically located inside PacifiCorp Balancing Authority Areas instead of the CAISO Balancing Authority Area. Mona is located inside PAC East, and CRAG is located inside PAC West. However, these locations continue to serve as scheduling points for imports and exports transacted with the CAISO balancing authority area. This situation requires special treatment for balancing and pricing calculations and leads to a special prices posted on OASIS. The pricing at these locations is based on the following rules to implement the special treatment of CAISO scheduling points CRAG/Mona Interchanges into the balance and price calculations of CAISO and PAC East/PAC West balancing authority areas.

⁷ See December 1 Order at P 25.

Figure 15: Illustration of Mona Pricing



Assume that Resource A is Mona_Mirror_Exp, Resource B is Mona_IMP. Both of these resources are defined in Master file to have the same scheduling point and intertie definitions (ISO-PACE). The following rules apply:

Resource A,		
BAA	Balance	Price
CISO	Don't include MW	Not applicable
PACE	Include MW	Resource LMP= Price@SP
Resource B,		
CISO	Include MW	Adj_Price@SP= Price@SP – EIM_PACE – EIM_PACE_PACW – GHG + $\sum$ MONA ITCs Resource LMP= Adj_Price@SP SP-TIE Price shall use the Adj_Price@SP for the SP price calculations.
PACE	Don't include MW	Not applicable

The same above treatment shall be applied to CRAG scheduling point and mirror resource. The Figure above illustrates how an import at Mona scheduling point is mirrored by an export from the PACE balancing authority area with equal megawatt value. The reason for this mirroring is to allow the accounting for the import and associated offsetting export for each balancing authority area separately while the supporting resource(s) for the transaction is modeled at the physical location within PACE balancing authority area or as a separate import to PACE balancing authority area from another balancing authority area.

The table above illustrates that the pricing at Mona for CAISO balancing authority area is adjusted to not include effects of Energy Imbalance Market transfer constraints, GHG pricing, and other constraints pertaining to the EIM area.

The CAISO detected that the pricing at CRAG and Mona over the first few days of implementation were subject to a software defect that resulted in the CAISO pricing to include some of the LMP components pertaining to the mirror resource. The CAISO fixed this issue on November 5, 2014 and has not detected it since.

Currently, the prices at these scheduling points, as posted on OASIS, reflect all the congestion effects from either CAISO or PAC balancing authority areas. However, for CAISO imports and exports, the actual price used for settling the respective schedules at each of these locations as scheduling points for imports and export to and from CAISO balancing authority area, only accounts for the congestion arising from CAISO balancing authority area. The prices posted on OASIS do not reflect that, but the prices provided through the California Market Results Interface (CMRI) application and used for settlements for resources transacting at these scheduling points will reflect only the applicable CAISO balancing authority area congestion.

For example, consider the case of a sample market interval, November 26, hour ending 11 interval 4 for the fifteen-minute market. The shadow price of the IPPUTAH ITC is -\$183.29, the Energy Imbalance Market transfer price for PAC East is \$6.8 and the Energy Imbalance Market transfer for PAC East and PAC West is -\$11.88. The system energy price is \$35.38 and the greenhouse gas price is \$0. The price posted on OASIS for the marginal congestion component at MONA_3_N501 is -\$188.37. The congestion component posted on OASIS accounts for all the congestion associated with this location, both from the CAISO and PacifiCorp balancing authority areas. This published congestion component is thus calculated as $-\$183.29 \text{ (IPPUTAH ITC)} - \$11.88 \text{ (PACW\_PACE)} + \$6.8 \text{ (PACE)} = -\$188.37$.

On the other hand, for intertie awards using the Mona point as a scheduling point to transact in the CAISO Balancing Authority Area, the prices posted in CMRI and used for settlements reflect accordingly only the congestion share of -\$183.29 arising from IPPUTAH ITC. This price still adheres to the typical congestion calculation used prior to the implementation of the full network expansion and Energy Imbalance Market.

The current data structure used in the OASIS application only supports the display of one entry for the marginal congestion component, and given the nature of the congestion associated with these two scheduling points, either marginal congestion component combination will reflect partial information. Currently the display of the full congestion components -- CAISO and PAC -- does not apply to CAISO schedules. If the entry displayed only the CAISO congestion share, it will still be partial because it will be missing now the congestion portion associated with PAC. The CAISO is working on an enhanced OASIS display that will publish the congestion component breakdown. In this case there will be an entry for the congestion share associated with PAC of $-\$11.88 + \$6.8$ and another entry with the congestion share associated with CAISO tie of -

\$183.29. The CAISO expect that this display will be available in January 2015 and will provide the clarity and minimize the concerns about the pricing for these two locations.

Updated report:

The CAISO upgraded its OASIS to provide the more granular displays for the Mona and Crag locations on January 8, 2015. However, it is continuing to evaluate the performance of that display and continues to make changes to ensure the greater granularity is provided accurately. The CAISO has been also working towards posting the greater granularity of prices going back to October 15 and is expected to have this part completed by February 18.

ATTACHMENT E

In this attachment, the CAISO reports on each relaxation event, and a summary of the magnitude and frequency of such events overall.⁸ This report provides data on instances where the \$1,000/MWh price would have occurred but for the Commission's December 1 Order waiver, including the time of the instance, the duration, the cause, and the affected node(s) and load aggregation points.

The relaxation events affect numerous market intervals as the CAISO real-time markets contain many fifteen and five minute intervals. The information is provided at summary level because the data is significant and detail specific reporting of such events would not be meaningful. The report focuses on the external load aggregation points (ELAP) prices because these aggregate prices are representative of pricing in each area -- West and East-- and would reflect short-term imbalance shortage for the aggregate area.

Figure 16 through Figure 23 provide summary information on the instances of power balance relaxation for undersupply (shortage) in the fifteen- and five-minute market in the PAC West and East area. Normally, when there are such infeasibilities, it is expected that prices will be based on the constraint relaxation pricing parameter, and prices will be near or at \$1000/MWh. However, there are three cases where this would not occur and is reflected in the data supporting the figures in this report. First, as of December 1st consistent with the December 1 tariff waiver, the price is based on the last economic signal consistent with the pricing principles contained in the tariff. Second, as described in more detail in Attachment A, when the EIM Entity fails the flexible ramping sufficiency test prices are calculated using the same approach based on the last economic signal for the duration of the restricted interval. Therefore, it is important to keep in mind that in these intervals, even if there CAISO have not received the waiver, the CAISO would have implemented the procedure described in Section 10.3.2.1 of the Business Practice Manual, and prices would have still been based on the last economic bid cleared in the applicable fifteen-minute or five-minute interval in the EIM Entity balancing authority area as opposed to the \$1000/MWh bid cap.⁹ In the December 15, 2014 report the CAISO noted that there was a third case in which it had observed the power balance constraint was relaxed in the scheduling run, but prices did not reflect the \$1000/MWh. The CAISO has since evaluated these cases more closely and as discussed in Attachment A, in some instances the market is in a degeneracy case, and

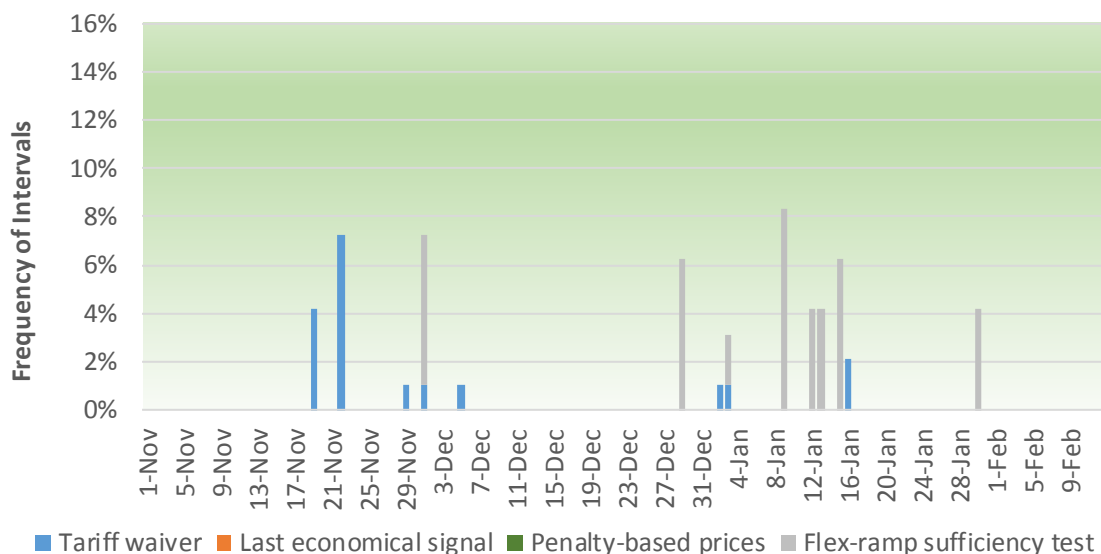
⁸ *December 1 Order*, at P 26.

⁹ The price discovery mechanism under the procedure described in Section 10.3.2.1 of the BPM for Energy Imbalance Market is, however, essentially the same price discovery procedure used under the December 1 Order waiver.

the market clears based on the last economic signal. The CAISO is continuing to investigate these intervals to ensure these events are not due to other abnormalities and are in fact due to degeneracy. As explained in Attachment A, after the implementation of the pricing procedure under the December 1 waiver there is no pricing based on the degenerate cases because the pricing procedure under the December 1 waiver governs over the pricing.

Figure 16 through Figure 23 exclude the intervals that were subject to price corrections because they were invalid. These figures show the frequency of infeasibilities organized by instances in which the prices were set based on 1) the last economic bid price signal as per the tariff waiver, referred to in the figures as “Tariff waiver,” 2) the \$1000/MWh penalty price parameter, referred to in the figures as “Penalty-based prices” 3) last economical signal from degeneracy referred as “Last economical signal” and 4) the last economic signal but because for those intervals the EIM entity failed the flexible ramping sufficient test, referred to as the “Flex-ramp sufficient test.” Each figure of the frequency of infeasibilities is accompanied with a figure the magnitude of infeasibilities. The reported events are also aggregated on a daily basis and depicted with an infeasibility range shown by the vertical line in blue. The ends of the vertical blue lines represent the minimum and maximum values of power balance relaxation in each day. The average magnitude of the infeasibility is shown by the red marker on the blue vertical lines.

Figure 16: Frequency of under-supply infeasibility in PAC West. Fifteen-minute market.



For the period of November 1 through November 13, the data on the magnitude of infeasibility in the fifteen minute market was not preserved in the data system. This impedes the CAISO’s ability to identify the cases with infeasibility and quantify their

magnitude. However, such instances were conservatively estimated by analyzing the cases where prices reached the relaxation-based levels of \$1000.

Figure 17: Magnitude of undersupply infeasibility in PAC West. Fifteen-minute market.

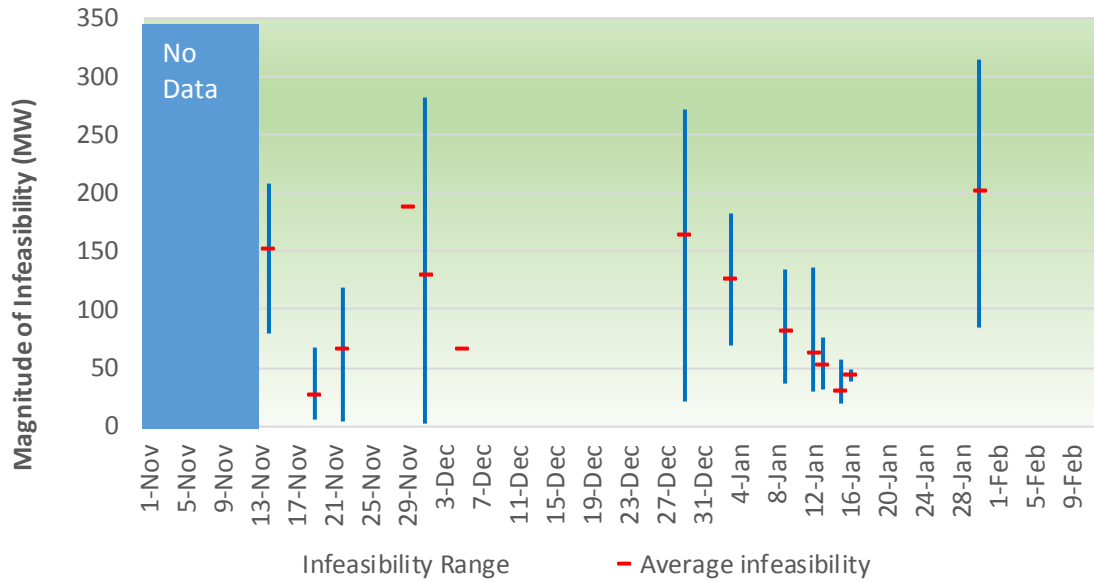


Figure 18: Frequency of undersupply infeasibility PAC East. Fifteen-minute market.

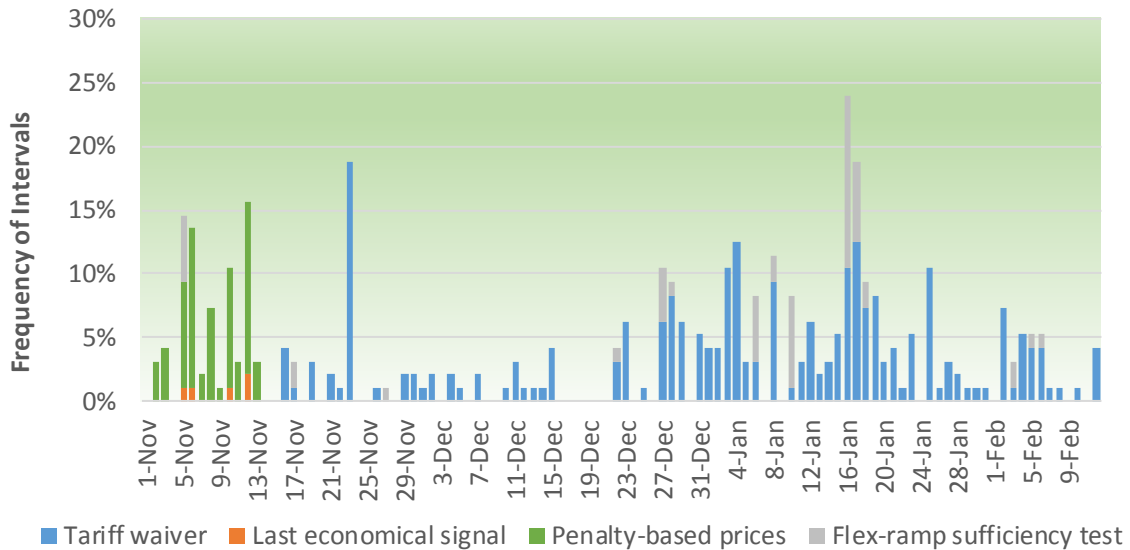


Figure 19: Magnitude of undersupply infeasibility PAC East. Fifteen-minute market.

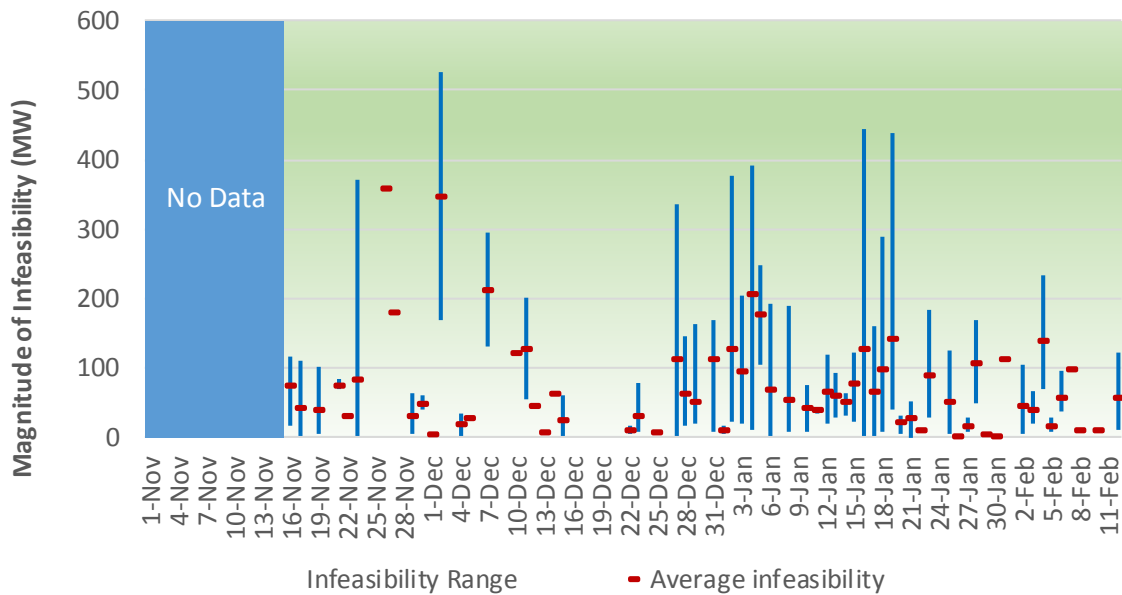


Figure 20: Frequency of undersupply infeasibility PAC West. Five-minute market.

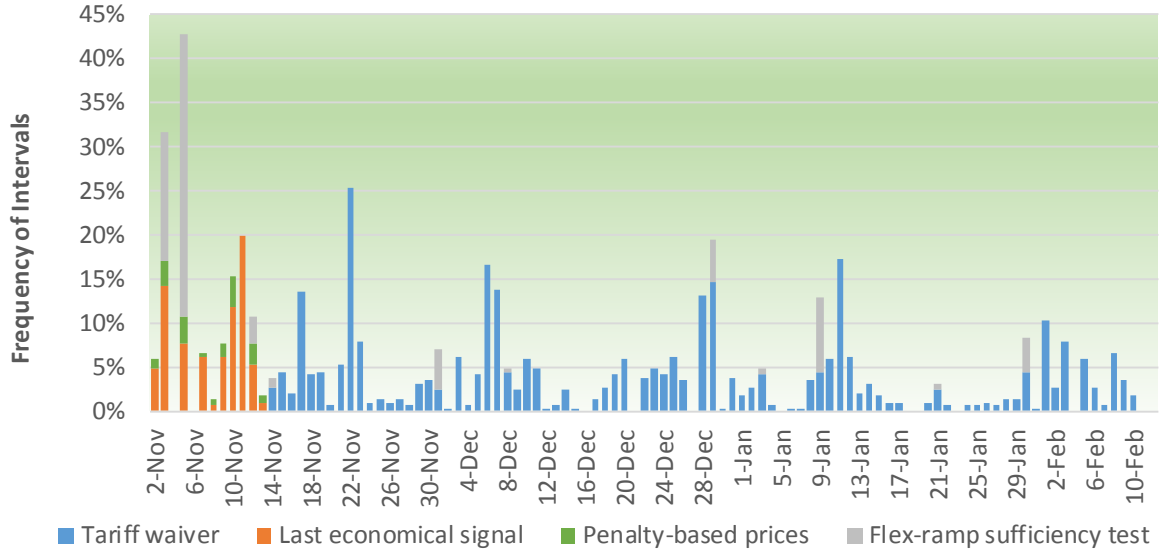


Figure 21: Magnitude of undersupply infeasibility PAC West. Five-minute market.

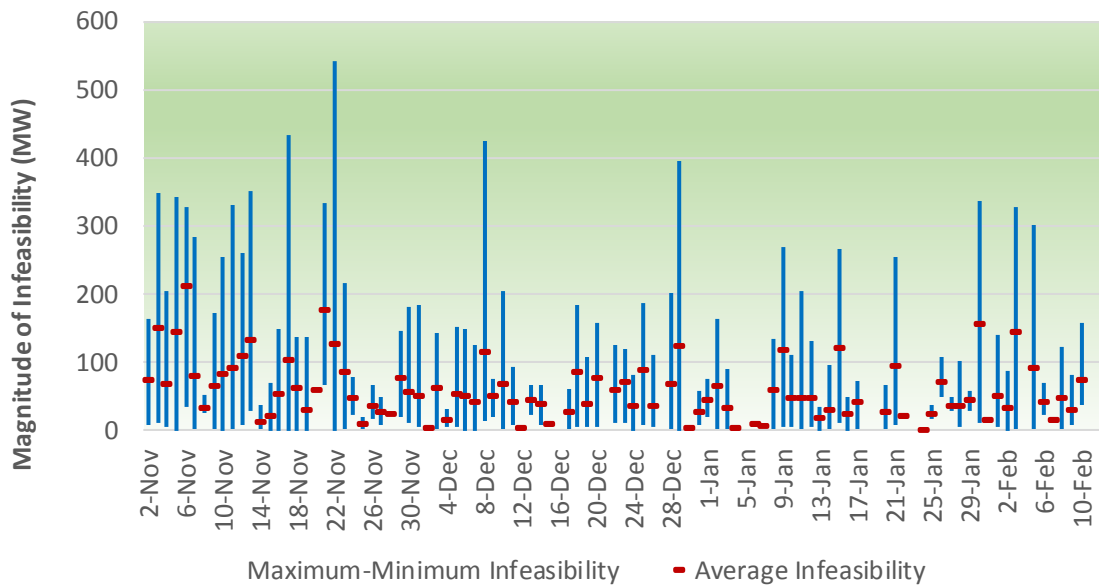


Figure 22: Frequency of undersupply infeasibility PAC East. Five-minute market.

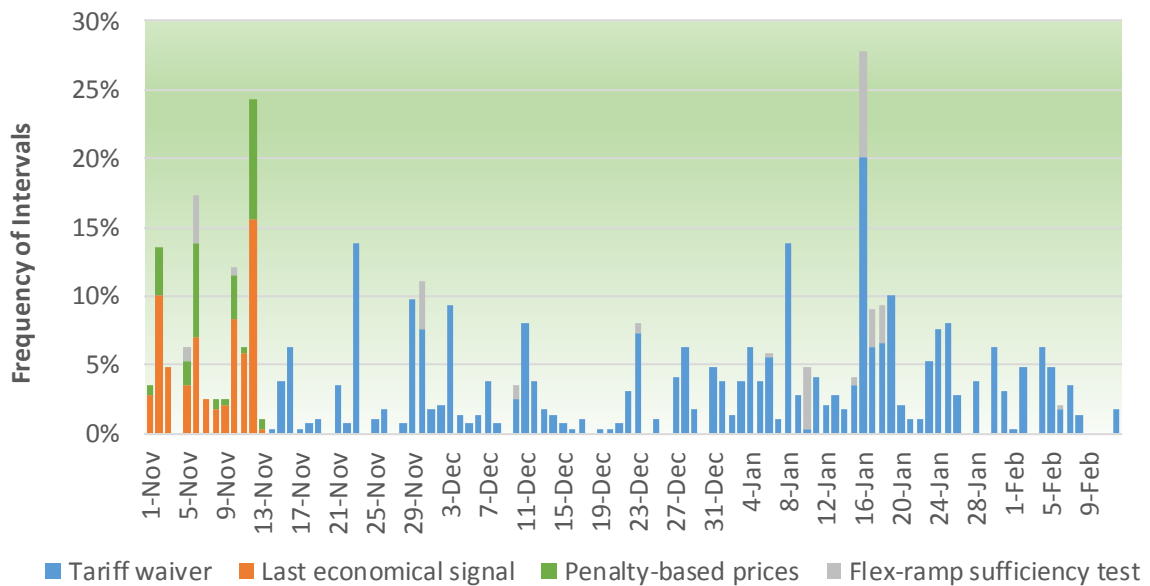


Figure 23: Magnitude of undersupply infeasibility PAC East. Five-minute market.

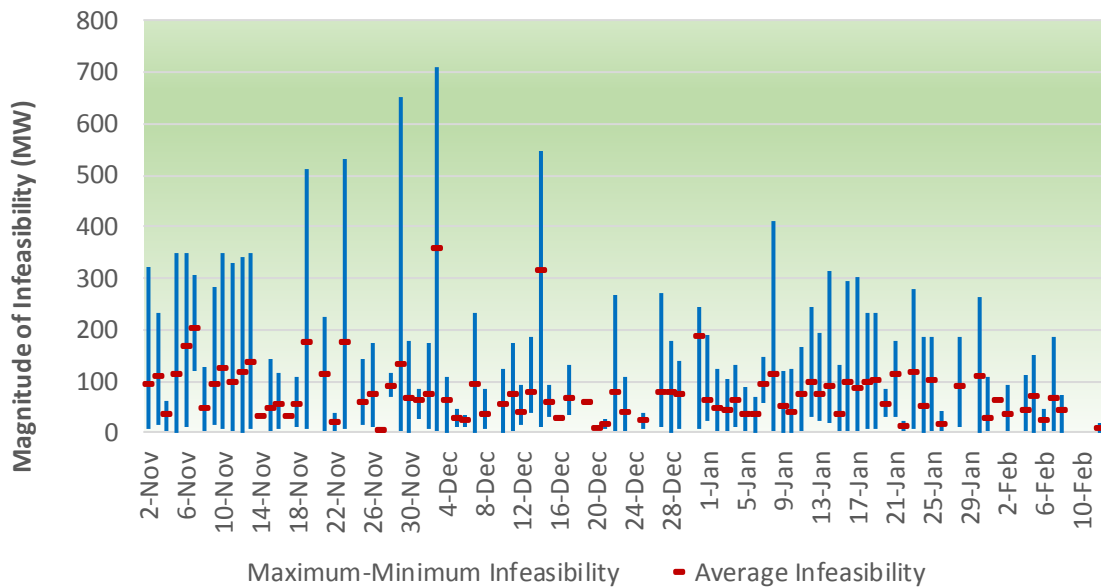


Figure 24 through Figure 27 show the hourly profile of the undersupply infeasibilities for both PAC West and East by market. This profile is provided to identify any patterns during the day where infeasibilities may be more prone to occur, such as the pull-up periods of load, for the period of January 1 through February 12. This operational data, however, shows no marked pattern of the frequency of infeasibilities with the time of day. This may be an indication that the drivers of infeasibilities are not system condition related.

Figure 24: Hourly undersupply infeasibilities for PAC West. Fifteen-minute market.

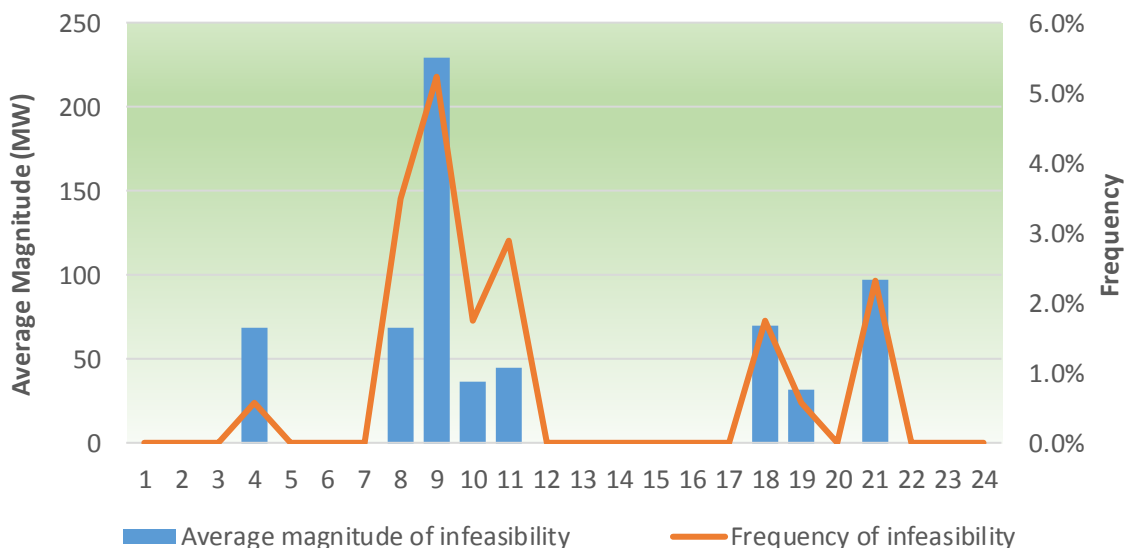


Figure 25: Hourly undersupply infeasibilities for PAC East. Fifteen-minute market.

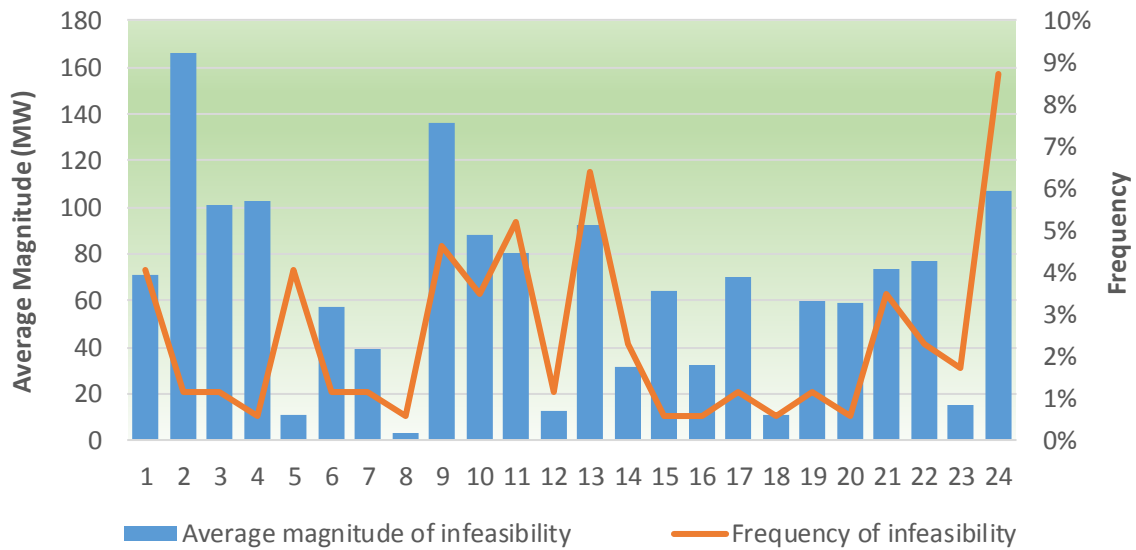


Figure 26: Hourly undersupply infeasibilities for PAC West. Five-minute market.

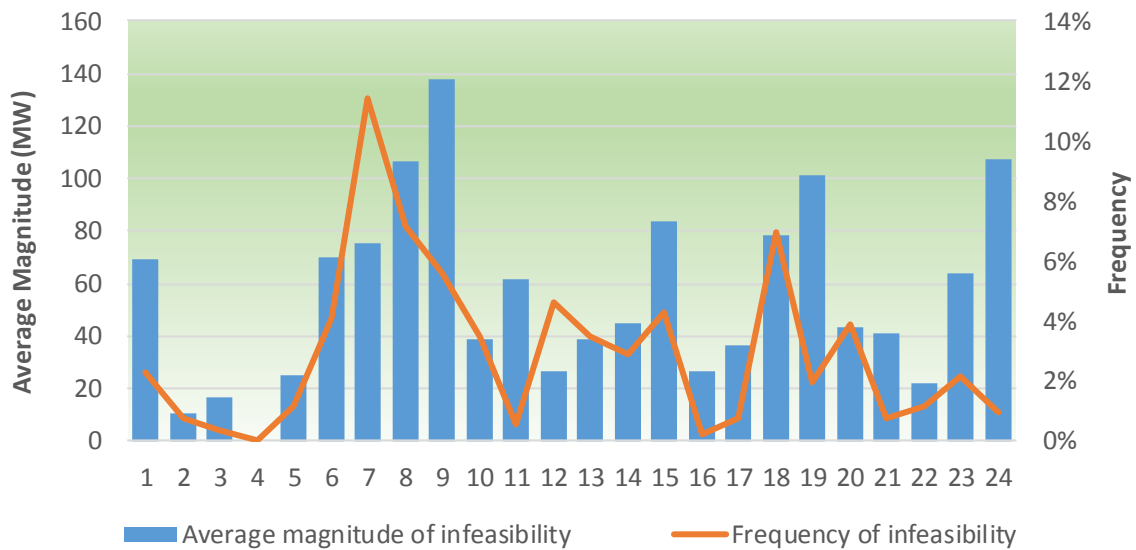
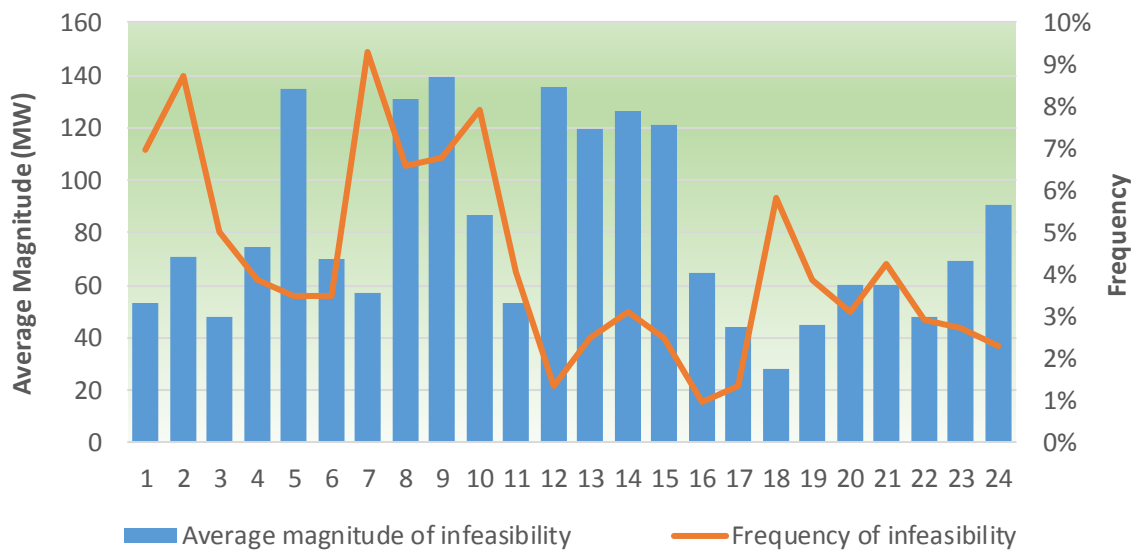


Figure 27: Hourly undersupply infeasibilities for PAC East. Five-minute market.

The imbalance energy transfers may also be subject to relaxation to address infeasibilities; there were few instances only in the PAC East transfer that resulted in relaxation; there were no instances of relaxation of EIM transfers between PAC and CAISO. The summary of these instance are listed in Table 1

Table 2. All these instances occurred before the period applicable for the waiver associated with this report; there were no valid EIM transfer infeasibilities observed in January and February. There were three invalid infeasibilities on PAC East on January 15 due to a software issue that were addressed through the standard process of price corrections.

Table 1: Statistics of EIM transfer infeasibilities for PAC East. Fifteen-minute market.

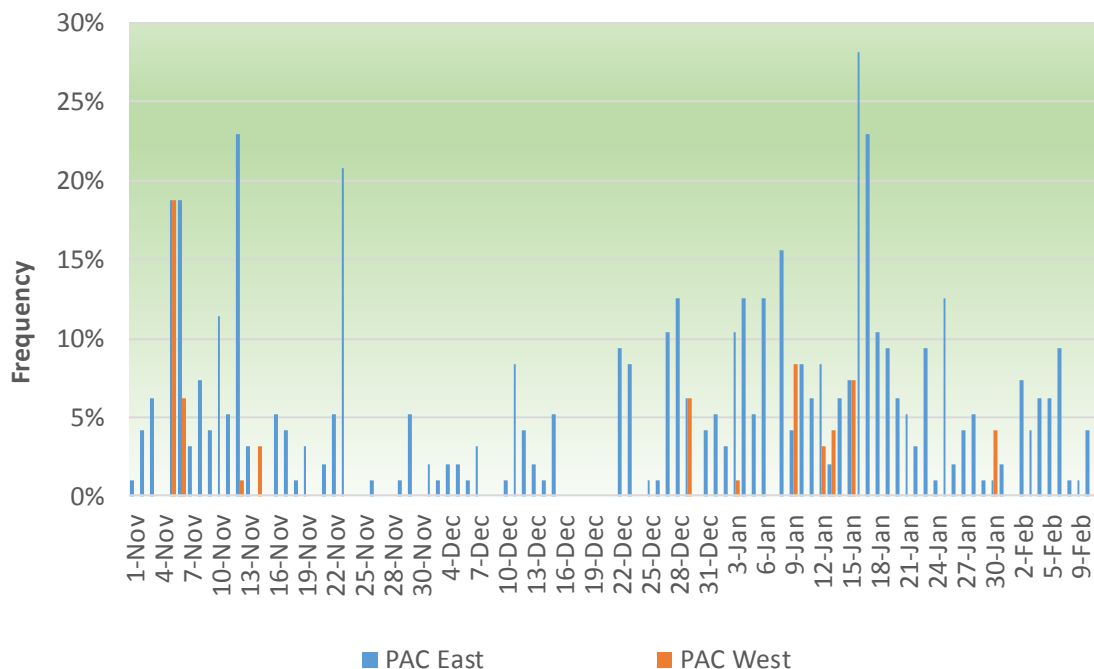
Date	Maximum	Minimum	Average	Count
6-Nov-14	51.4	1.1	26.2	2
10-Nov-14	121.0	121.0	121.0	1
12-Nov-14	126.7	72.0	99.3	2
13-Nov-14	130.9	16.9	76.2	3

**Table 2: Statistics of EIM transfer infeasibilities for PAC East.
Five-minute market.**

Date	Maximum	Minimum	Average	Count
6-Nov-14	65.2	65.2	65.2	1
10-Nov-14	114.3	97.9	106.1	2

For completeness, the data in this report also includes those cases in which there was a relaxation of flexible ramp constraint; the data is organized by PAC West and East in Figure 28. This metric does not include intervals that were subject to price corrections.

Figure 28: Frequency of flexible ramp constraint infeasibility in PAC



Finally, this report also includes information about infeasibility for over supply conditions even though these cases are not reflected in the waiver requested in this proceeding. The penalty prices specified in sections 27.4.3.2 and 27.4.3.4 only pertain to infeasibility cases in which there is under-supply. The penalty prices for the over-supply conditions are specified in section 6.6.5 of the BPM for Market Operations. The over-supply metrics are provided in Figure 29 through Figure 36.

Figure 29: Frequency of oversupply infeasibility PAC West. Fifteen-minute market.

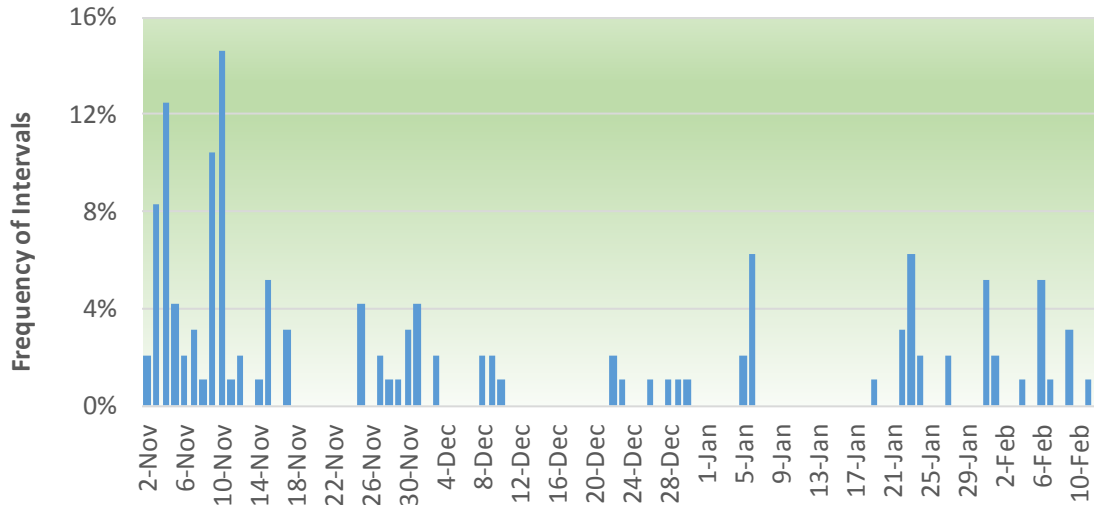


Figure 30: Magnitude of oversupply infeasibility PAC West. Fifteen-minute market.

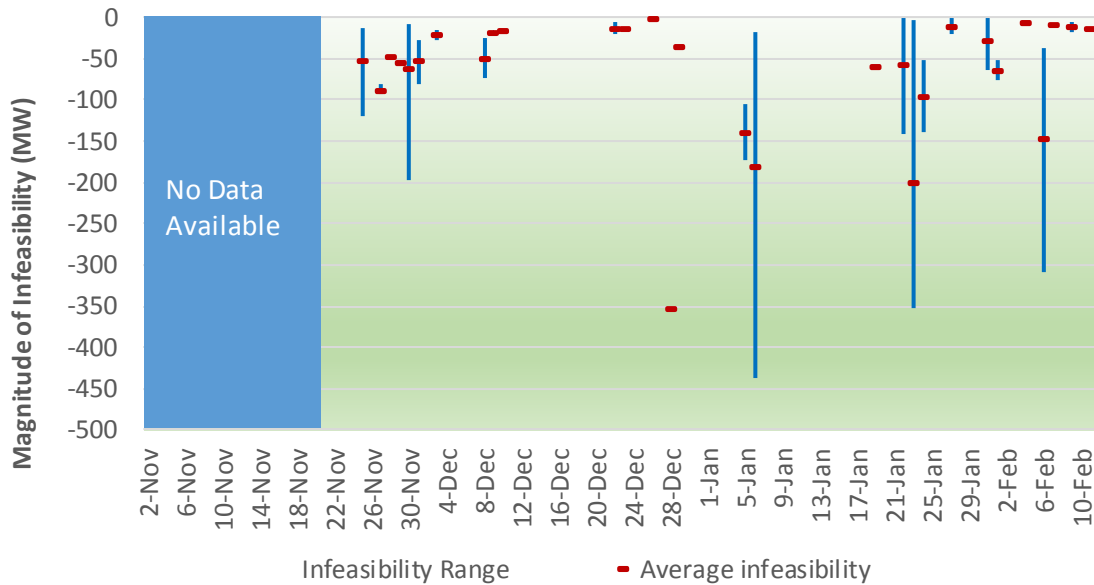


Figure 31: Frequency of oversupply infeasibility PAC East. Fifteen-minute market.

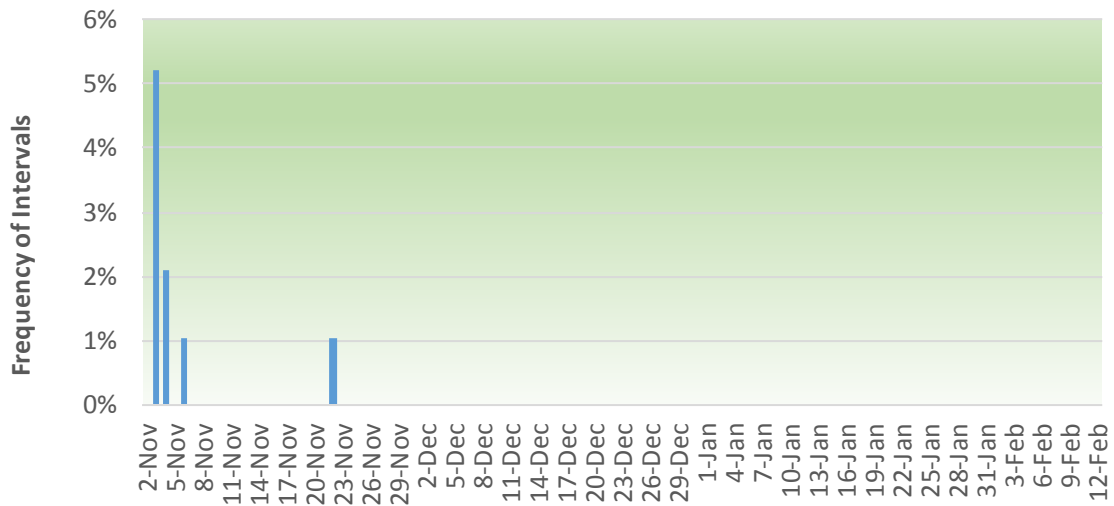


Figure 32: Magnitude of oversupply infeasibility PAC East. Fifteen-minute market.

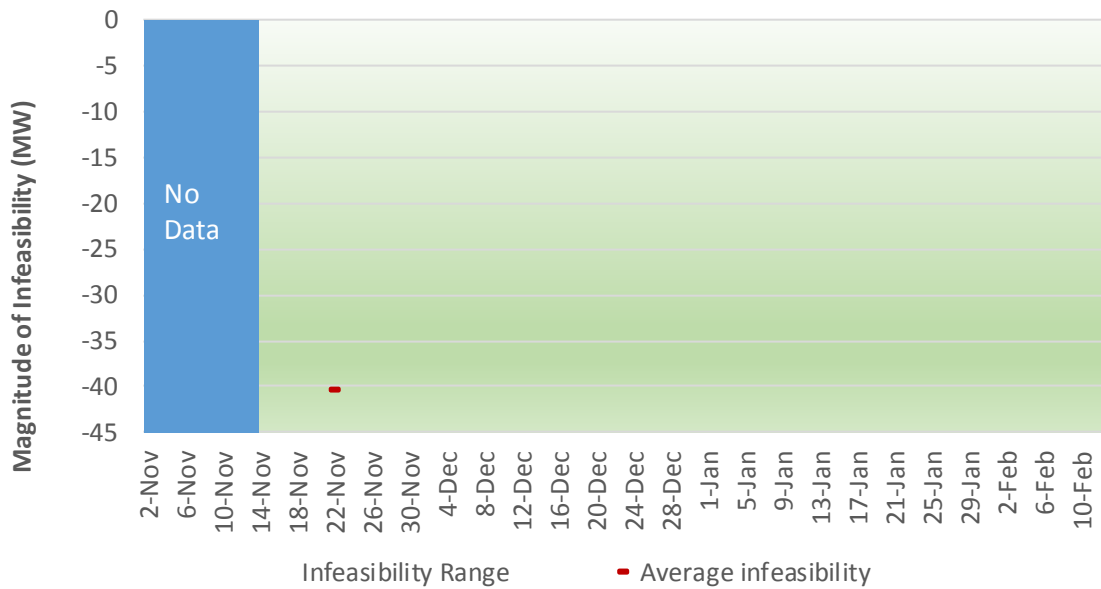


Figure 33: Frequency of oversupply infeasibility PAC West. Five-minute market.

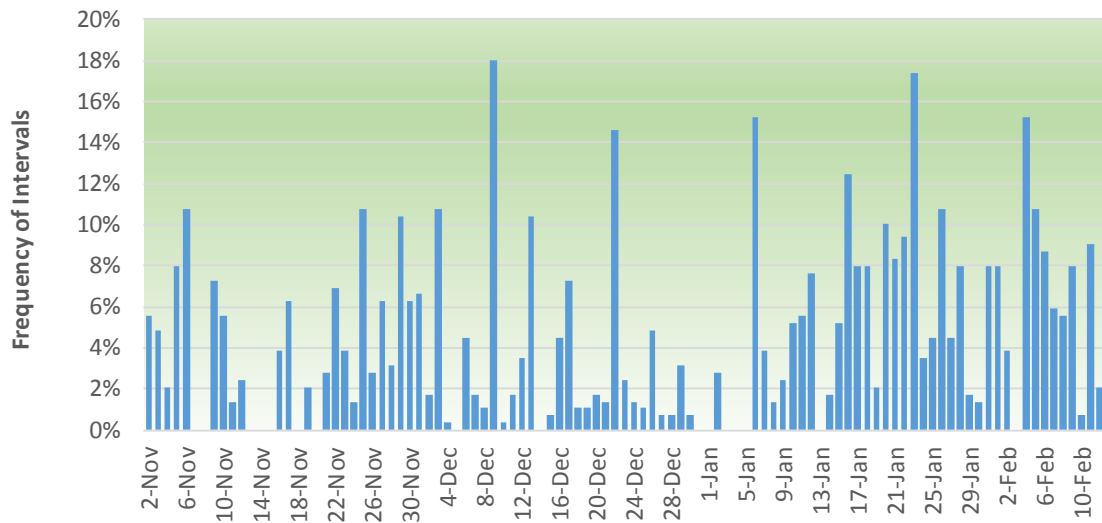


Figure 34: Magnitude of oversupply infeasibility PAC West. Five-minute market.

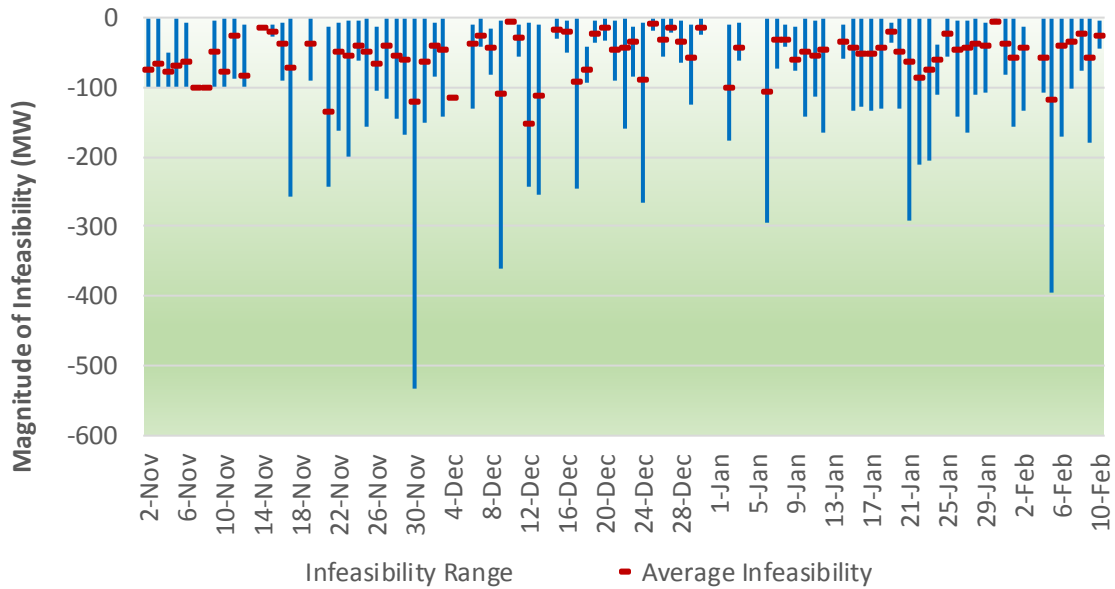


Figure 35: Frequency of oversupply infeasibility PAC East. Five-minute market.

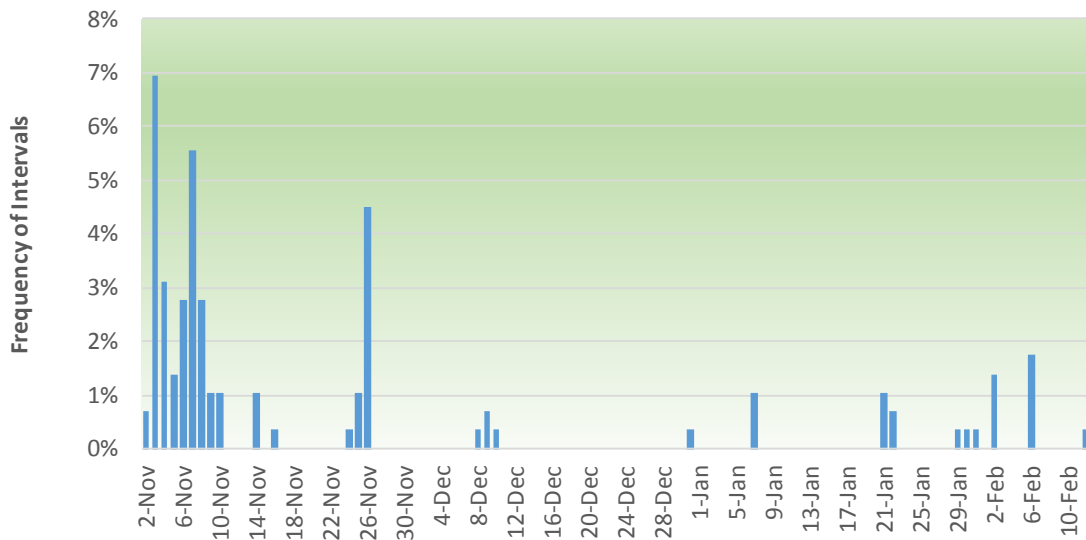
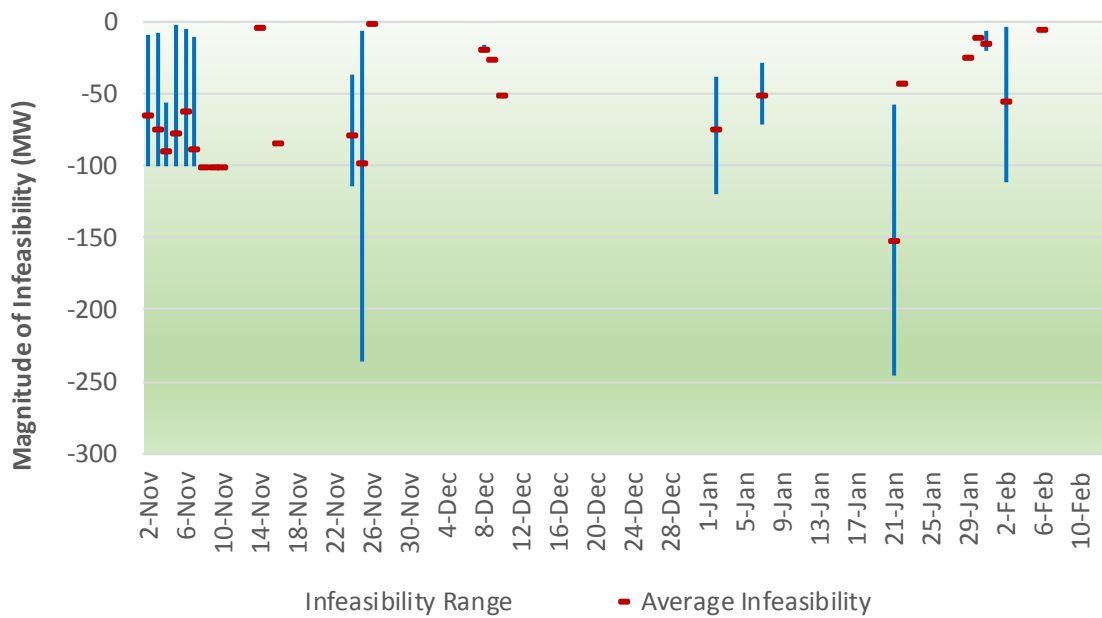


Figure 36: Magnitude of oversupply infeasibility PAC East. Five-minute market.



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 19th day of February, 2015.

/s/ Anna Pascuzzo
Anna Pascuzzo

March 26, 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____
Informational Report – Performance of Energy Imbalance Market**

Dear Secretary Bose:

The California Independent System Operator Corporation (CAISO) hereby submits its March report on the performance of the Energy Imbalance Market for February 13 – March 16, 2015.¹

The Commission also directed the Department of Market Monitoring to submit independent assessments on the causes and solutions identified by CAISO. The CAISO intends to submit the independent assessment of the Department of Market Monitoring in about eight days.

On March 16, 2015, the Commission directed the CAISO to refine the monthly reports to “assist the Commission and the parties in determining the extent to which the price spikes continue to be caused by transitional issues, and the extent to which they may be triggered by lack of adequate supply in the EIM.”² While the CAISO started to change its reporting procedures to comply with the Commission’s directives shortly after the order was issued, the CAISO was not able to modify this report with those changes in time for this submission. Therefore, the CAISO is filing this report with the same type of information provided in prior reports. However, the CAISO will file in mid-April a

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

² *California Indep. Sys. Operator Corp. Inc.*, 150 FERC ¶ 61,191 (2015).

report that complies with the Commission's directives and covers the full month of March. Thereafter, the CAISO will continue filing such reports monthly consistent with the Commission's order to continue submitting reports on a 30 day interval until the 206 investigation is concluded or the Commission issues a directive, whichever is earlier.

Please contact the undersigned with any questions.

Respectfully submitted

By: /s/ Anna A. McKenna

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California ISO
Shaping a Renewed Future

Energy Imbalance Market Pricing Waiver Report February 13 – March 16, 2015

March 26, 2015

I. Introduction

On December 1, 2014, the Federal Energy Regulatory Commission (FERC) granted the California Independent System Operator Corporation's (CAISO) petition for limited waiver of the pricing parameters in sections 27.4.3.2 and 27.4.3.4 of its tariff for 90 days, as they pertain to the Energy Imbalance Market, effective November 14, 2014, as requested.¹ In addition, FERC directed CAISO to submit informational reports as further described herein. The CAISO will be submitting on a monthly basis the requested reports in Attachments A through E, including reports provided by the CAISO's Department of Market Monitoring and PacifiCorp. This report covers the CAISO's reporting requirements for the time period covering February 13 through March 16, 2015.

The Department of Market Monitoring will file its report within approximately eight days of March 26, 2015. The Commission directed the Department of Market Monitoring to submit independent assessments on the causes and solutions identified by CAISO. The Department of Market Monitoring requires some additional days to fully review and evaluate the CAISO's report and provide an independent assessment.

II. Background

On November 1, 2014, the CAISO fully activated the Energy Imbalance Market (EIM). The Energy Imbalance Market allows balancing authorities outside of the CAISO balancing authority area to voluntarily take part in the imbalance energy portion of the CAISO locational marginal price-based real-time market. PacifiCorp, the CAISO, and market participants participated in market simulations prior to the start of the Energy Imbalance Market on November 1, including parallel production from October 1 to November 1. However, shortly after go live the CAISO began observing challenges that led to artificially high prices in cases where the market application had to resort to the relaxation of transmission constraints or the power balance constraint in order to clear the market.

On November 13, 2014, the CAISO sought a 90-day waiver of the applicability of section 27.4.3.3 and the second sentence of section 27.4.3.4 of its tariff to permit CAISO to address, without suspending the Energy Imbalance Market, those circumstances which produced atypically high prices. Those two sections of the tariff provide that when there is a lack of economic bids to clear the fifteen-minute and five-minute markets, the CAISO's market application will price the shortages (and therefore set

¹ *California Indep. Sys. Operator Corp.*, 149 FERC ¶ 61,194 (2014) (December 1 Order).

locational marginal prices) according to the pricing parameters specified in those sections. Specifically, for the purpose of determining how a transmission constraint or system-energy balance constraint will affect the determination of prices in the market, the pricing parameter for the relaxation of the constraint is \$1,000/MWh (the maximum energy bid price specified in tariff section 39.6.1.1).

The waiver addresses three sets of transitional conditions in the Energy Imbalance Market that together have caused the transmission and system energy-balance constraints described in tariff sections 27.4.3.2 and 27.4.3.4 to bind more frequently than expected in the weeks since the Energy Imbalance Market began operation on November 1, causing prices in these intervals to be set by the \$1,000/MWh relaxation parameter. Because of these transitional conditions, the high prices are not always indicative of actual physical conditions on the system, and reflect challenges in providing timely and complete data to ensure system visibility under the new procedures, exacerbated by limitations on the resources available to PacifiCorp for use in the Energy Imbalance Market and several forced outages of large Energy Imbalance Market participating resources. The CAISO described² the transitional conditions that led to the waiver in its petition filed on November 13, 2014, as follows:

- 1) All possible operational conditions, including interactions between disturbance events and other conditions on the system, were not fully represented, simulated and tested during these earlier market simulations. It was not until actual operations that these circumstances were experienced and the resulting price excursions became apparent. In some cases data issues arise because of errors made in processing such information, and in such intervals the CAISO will have authority to correct prices. But in some cases, the pricing excursions may be due to the need to adopt better practices generally and not because of an erroneous data processing issue.
- 2) Limitations on the resources available to PacifiCorp for use in the Energy Imbalance Market. Several resources had not yet received the necessary metering upgrades due to various outage schedule limitations, which has prevented PacifiCorp from making these resources available in the initial pool of resources participating in the Energy Imbalance Market. The CAISO is processing temporary metering exemptions in accordance with its requirements and participation by some additional resources has improved conditions, but other considerations remain. For instance, some resources are subject to multiple ownership rights and have contractual issues that must be resolved to enable their participation in the Energy Imbalance

² See *Petition For Limited Tariff Waiver And Request For Expedited Consideration*, California Independent System Operator Corp., filed November 13, 2014, FERC Docket No. ER15-402.

Market. Additionally, third-party resources in PacifiCorp's balancing authority areas have not yet begun participating in the Energy Imbalance Market, which further limits the pool of available resources.

- 3) The PacifiCorp East (PAC East) and PacifiCorp West (PAC West) balancing authority areas experienced several forced outages of large Energy Imbalance Market participating resources, which led to short term supply deficiencies in the market. While outages are not necessarily uncommon, these outages quickly exacerbated an already tight supply and contributed to price increases in the associated intervals. In addition, while PacifiCorp operations accounted for the outages by responding to system conditions, these actions have not always been communicated in a timely manner to the market. Without such information, the market results would not necessarily reflect physical conditions on PacifiCorp's system. The addition of more participating resources and enhanced operational procedures should mitigate the impact of such outages.

On December 1, 2014, FERC granted the CAISO its waiver request and also directed monthly reports to FERC on the progress of the issues that led to the need for the waiver. The CAISO provides its reports consistent with the order below and in the attachments to this report. On February 12, 2015, the Commission extended the term of this waiver to March 15, 2015, in its order issued in FERC Docket ER15-861 (*California Indep. Sys. Operator Corp.*, 150 FERC ¶ 61,086 (2015)). Consistent with that extension, the CAISO intends to file an additional report after March 16, 2015.

On March 16, 2015, the Commission again extended the waiver to 90 days after the date on which the Commission's order issued on March 16, 2015, in FERC Docket No. ER15-861 (150 FERC ¶ 61,191) is registered in the Federal Register (June 22, 2015). In the March 16, 2015, order the Commission also directed the CAISO to refine the monthly reports to "assist the Commission and the parties in determining the extent to which the price spikes continue to be caused by transitional issues, and the extent to which they may be triggered by lack of adequate supply in the EIM."³ While the CAISO started to change its reporting procedures to comply with the Commission's directives, the CAISO was not able to modify its report with those changes in time for its submission of the March monthly report. Therefore, the CAISO files this report with the same type of information provided in prior reports. However, the CAISO will file in mid-April a report that complies with the Commission's directives and covers the full month of March. The CAISO will continue filing such reports monthly consistent with the

³ See 150 FERC ¶ 61,191 at P 38.

Commission's order to continue submitting reports on a 30 day interval until the 206 investigation is concluded or the Commission issues a directive, whichever is earlier.

III. Reports

In the December 1 Order, the Commission directed the CAISO to file detailed informational reports on the performance of Energy Imbalance Market at 30-day intervals during the 90-day waiver period. Consistent with the order, this fourth report is filed approximately 30 days from the last report filed on February 19, 2015. The Commission stated that these reports should provide detailed supporting data demonstrating progress towards identifying and eliminating the problems giving rise to the waiver petition. Consistent with the December 1 order, the following reports are included in Attachments A through E as follows:

Attachment A: A quantitative and qualitative description of the market performance (covering both progress and remaining concerns) related to the issues that prompted the CAISO's waiver request that are within the CAISO's control. Includes a description of, and status update regarding, measures being taken or planned to be taken to identify and address the market performance problems related to the issues that prompted the CAISO's waiver request. Identifies any remaining deficiencies in CAISO and PacifiCorp processes, procedures, and tools and any additional market issues related to these pricing concerns that the CAISO considers necessary to sustain stable market operations, along with the CAISO's plan to address such issues.

Attachment B: A quantitative and qualitative description of the market performance (covering both progress and remaining concerns) related to the issues that prompted the CAISO's waiver request that are within PacifiCorp's control. This section includes a description of, and status update regarding, measures being taken or planned to be taken to identify and address the market performance problems related to the issues that prompted the CAISO's waiver request.

Attachment C: Independent assessments from the Department of Market Monitoring on the causes and solutions identified by the CAISO. For this first report, this will be submitted within seven days of the CAISO's first submission.

Attachment D: An exploration of impacts, if any, on non-EIM pricing nodes, including the Mona trading node. Report on whether EIM pricing is adversely impacting non-EIM pricing nodes. The extent to which non-EIM pricing nodes such as the Mona trading node are impacted by EIM pricing within the PacifiCorp Balancing Authority Areas. Identify any such impacts and describe any actions the CAISO is taking or plans to take to address such impacts.

Attachment E: Description of each relaxation event, and a summary of the magnitude and frequency of such events overall. Data on instances where the \$1,000/MWh price would have occurred but for this waiver, including the time of the instance, the duration, the cause, and the affected node(s) and load aggregation points.

ATTACHMENT A

Quantitative and qualitative descriptions of market performance related to the issues that prompted the CAISO's waiver request - CAISO.

This attachment includes quantitative and qualitative information for three reporting requirements specified in the Commission's December 1 order. First, section 1 and section 2 provide a quantitative and qualitative description of the market performance (covering both progress and remaining concerns) related to the issues that prompted the CAISO's waiver request that are within the CAISO's control. Second, the tables in section 2 of this attachment provide a descriptions of, and status update regarding, measures being taken or planned to be taken to identify and address the market performance related to the issues that prompted the CAISO's waiver request. Finally, the tables in section 2 of this attachment also report on the measures taken and planned to address the market performance problems, which also identify any remaining deficiencies in processes, procedures, and tools and any additional market issues related to these pricing concerns that the CAISO considers necessary to sustain stable market operations, along with the CAISO's plan to address such issues.⁴

1. Analysis of Impact on Market Performance

In this section the CAISO provides a quantitative and qualitative analysis of the market performance impact of the issues that prompted the CAISO's request for a waiver.

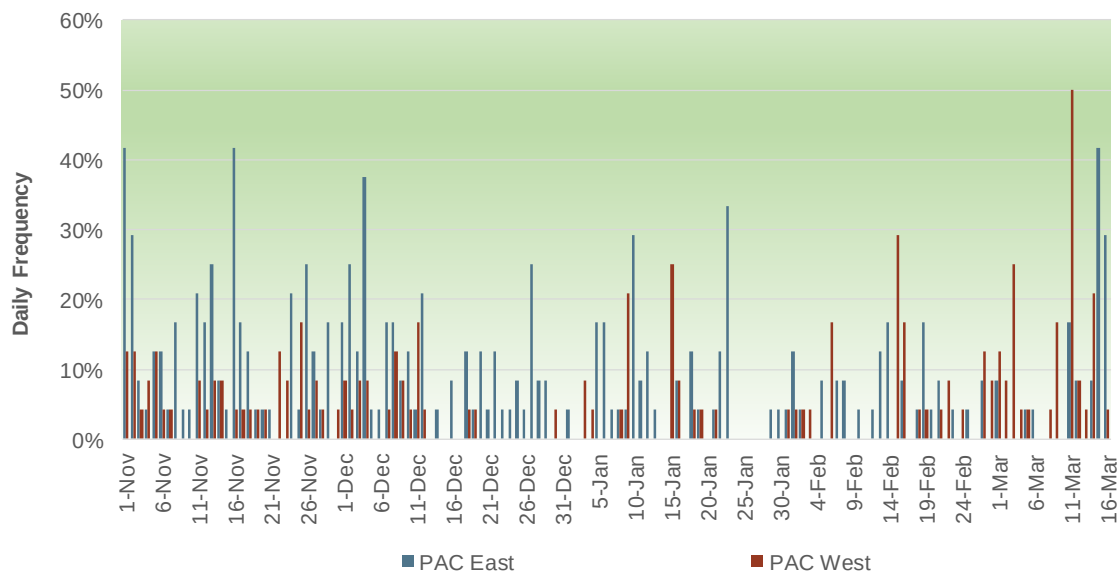
The Energy Imbalance Market is only a part of the real-time market and is not part of the day-ahead market. The CAISO uses the day-ahead market as a reference point for the real-time market. In lieu of the day-ahead market solution, for the Energy Imbalance Market the CAISO uses EIM balanced base schedules, which are used to model hourly Balancing Authority Area generation and load before the Energy Imbalance Market runs. The base schedule can be adjusted by seventy five minutes before the applicable hour, (T-75), fifty five minutes before (T-55) and forty minutes before (T-40). The last cycle at T-40 minute will determine the base schedules actually used for the Energy Imbalance Market. The base schedules also serve as a reference for imbalance energy settlements. When the EIM entity opts to use the ISO demand forecasts, the CAISO compares the base schedules –generation and net interchange- with hourly demand forecast and performs a balancing test by EIM Balancing Authority Area and if the EIM entity Balancing Authority Area imbalance is within 1 percent of the forecast, it passes the balancing test. The balancing test is important because it is the

⁴ December 1 Order at P 25.

starting point from which the Energy Imbalance Market is run. Therefore, if the energy market starts with a significant imbalance, such that even the bid-in capacity is not enough to cover the imbalance, there is the potential for infeasibilities in the fifteen- and five-minute markets for either over- or under-supply. It is important to note that the base schedules are set at one level for the entire hour, while load actually varies within the hour.

Figure 1 shows the trend of balancing test failures for the period of November 1, 2014, through March 16, 2015 of operation of the Energy Imbalance Market by area, PAC West and East. There is a downward trend in the frequency of failures from a frequency of failures of 9.2 percent in November to 6.45 percent in December to 5 percent in January and February. The average amount of imbalance has been 166 MW and 148 MW in PAC East and West, respectively. The frequency of balancing test failures increased to a daily average of 8 percent for the period of March 1 through March 16. During this time, the average imbalance was 222 MW and 72 MW in PAC East and West, respectively. The increase in frequency of balancing test failure appears to be driven by two issues: 1) an error in the net schedule interchange for both PACE and PACW reported for the balancing test compared to the net schedule interchange supplied for the fifteen and five minute markets; and 2) incorrect disqualification of base schedules from certain multi-stage generating units. These issues did not appear to influence imbalance infeasibilities.

Figure 1: Frequency of balancing test failures in PAC West and East.



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 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 to area group constraints. This sufficiency test applies to each PAC West and East area on an hourly basis. Figure 2 shows the trend of test failures for flexible ramping for the first two months of operation of the energy imbalance market. The frequency is obtained by dividing the number of hours failed by 24 hours of a day.⁵ Figure 2 shows that there was a continued reduction in the frequency of failures of the sufficiency test over November and December, from an average of 20 percent to an average of 1.5 percent in the combined PAC West and East areas. In January, there was an increase in failures of the test, which trended down again in February. The downward trend continued in March in PAC East and PAC West, except for one day.

Figure 2: Frequency of flexible ramp sufficiency test failures in PAC West and East.

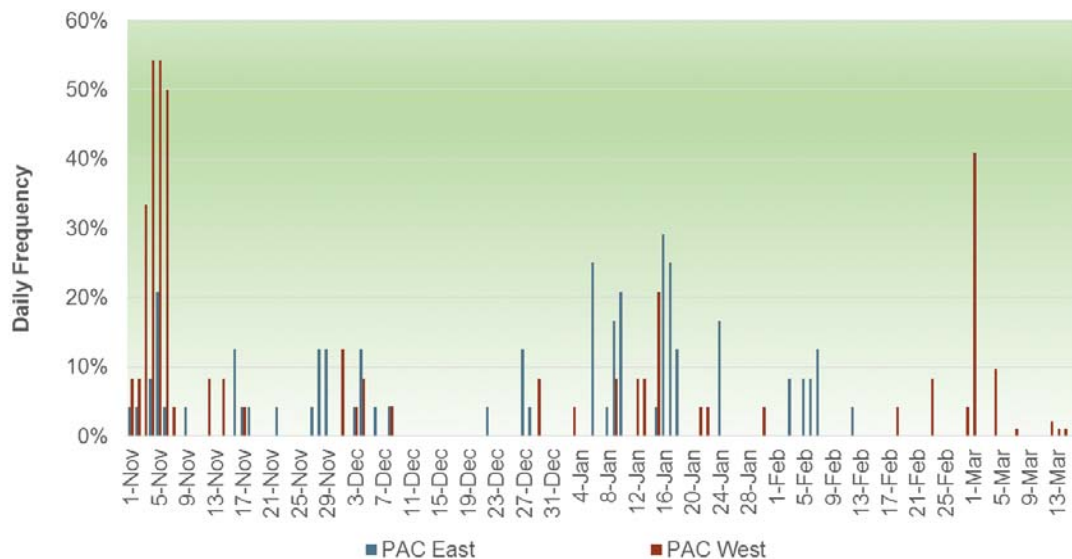
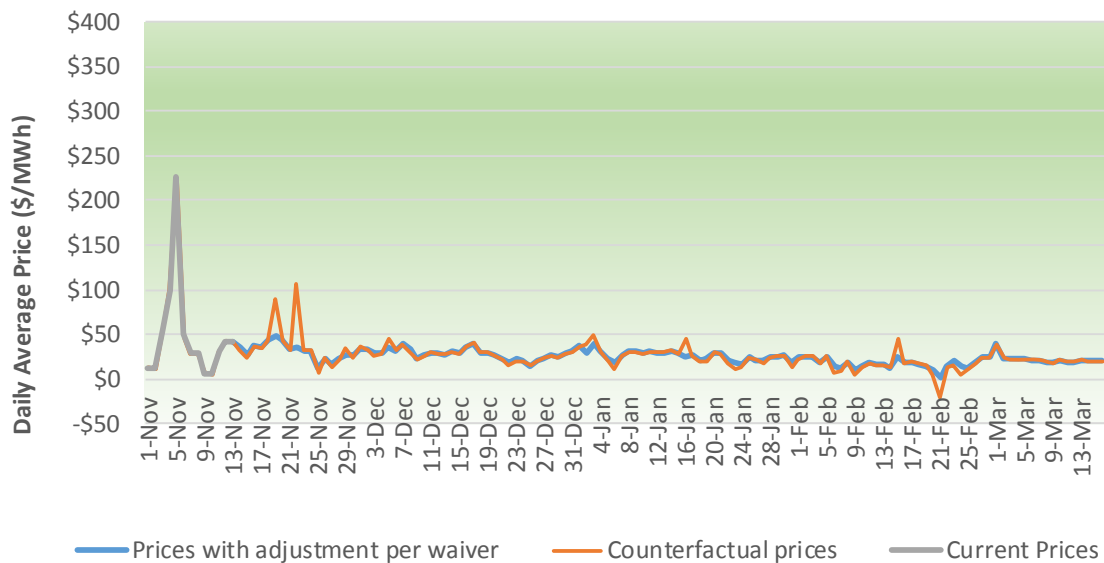


Figure 3 through Figure 6 provide daily average price trends in the Energy Imbalance Market organized by market and area. These trends include pricing for both the PAC West and PAC East external load aggregation points (ELAPs). The report focuses on the ELAP prices because these aggregate prices are representative of pricing in each area -- PAC West and PAC East-- and would reflect short-term imbalance shortage for

⁵ During the term of the waiver, the procedure described in Section 10.3.2.1 of the Business Practice Manual is made ineffective under the pricing procedure under the waiver.

the aggregate area. These daily averages reflect all prices of the real-time market, including the price corrected through the price correction process and the price adjustments pursuant to the waiver associated with this report.⁶ From November 14 through November 30 the CAISO implemented the price adjustments pursuant to the waiver retroactively and is making the relevant adjustments in settlement statements after the December 1 order was issued. After December 1, there are no retroactive adjustments since the logic of the price discovery feature implemented pursuant to the waiver is implemented through the market clearing solution process. These prices, like any other prices, are still subject to the price validation and correction process. Section 35.4 of the CAISO tariff already 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 CAISO tariff.

Figure 3: Daily average of fifteen-minute market prices in PAC West.



⁶ Note a separate waiver has been submitted requesting relief for period of November 1- November 13. These reports do not reflect any adjustments for this separate waiver request which has not yet ruled on as of the date of this report.

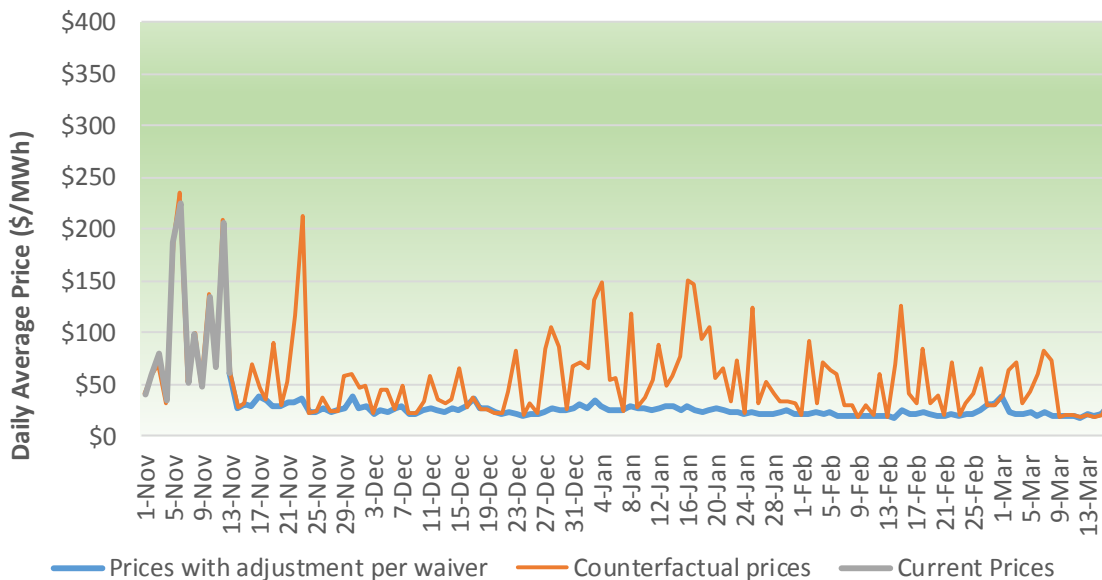
Figure 4: Daily average of fifteen-minute market prices in PAC East.

Figure 4 and Figure 5 each compare two trends for the same market and same area, PAC East and West respectively. The blue line illustrates daily average prices from November 14 on and represents the actual and final prices after any price corrections or price adjustments pursuant to the December 1 Waiver, which is the subject of this report. After November 14, even when there were power supply infeasibilities, per the December 1 Waiver, this trend reflects prices that are set based on the the marginal economic signal in the market and are not based on constraint relaxation pricing parameters. The price trends for November 1 through November 13 are represented in a different color than the the prices after November 14 because those represent the final prices as of this date, after all price corrections have been made. The prices for the November 1-13 include prices based on the constraint relaxation pricing parameters.

The orange line was constructed to estimate the counterfactual case of what prices would have been if they were based on the constraint relaxation pricing parameters, pegged to the \$1000/MWh bid cap. As of December 1, the CAISO adopted the waiver-based pricing in its systems, which means that the market systems produced prices consistent with the pricing mechanism under the waiver and not based on the constraint relaxation pricing parameters. Therefore, the CAISO had to find a way to reconstruct those cases, which it is referring to as the counterfactual case. In other words, the prices represented by the orange line represent the CAISO's estimate of what prices would have been absent the December 1 Waiver. These two lines compare

together prices under the December 1 Waiver to what they would have been without that waiver.

The orange line is more volatile and spiky because those prices are calculated based on the \$1000/MWh any time there is an observed undersupply infeasibility. Whereas the blue line shows a more stable pricing trend reflecting dispatched economic bids. For the first 13 days of November, the lines in grey and orange track closely to each other but not exactly. The prices represented by the grey line are final as of now and include prices that even though there was infeasibility, for other reasons the prices were not based on the constraint relaxation pricing parameters. In contrast, in the counterfactual case, the CAISO estimated that any interval with infeasibility would produce a price based on the constraint relaxation pricing parameter.

In addition, the prices for the counterfactual case in Figure 4 and Figure 5 were constructed based on the following two factors. First, because the goal of this report is to quantify and explain the price changes associated with the the implementation of the December 1 Waiver, these trends do not include the reconstruction of prices related to price corrections and flexible ramping constraint infeasibility for the following reasons:

- i) Price corrections. If there was a price associated with a power balance infeasibility, but the interval was rendered to have an invalid price and was subject to price corrections for other reasons, the CAISO did not estimate the counterfactual price and instead the estimated and counterfactual price is equal to the final and current price. This is based on the premise that had the CAISO not experienced the issue that supported the price correction in the first place, the power balance infeasibility would not have triggered in the first instance. Therefore, the market price would have been based on the tariff-based rules that consider the submitted economic bid prices rather than the penalty prices specified in the tariff; and
- ii) Flexible ramp sufficiency test. 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. For the duration of the restricted interval, the market clearing price in the affected EIM Entity balancing authority area will also be based the tariff-based rules that look at the last economic bid cleared in the applicable fifteen-minute or five-minute interval in the EIM Entity balancing authority area. This logic is outside the scope of the waiver of this report and consequently, with or without the waiver, the pricing mechanism will be in place. Therefore, the original price for market intervals that had power balance infeasibilities and that failed the

flexible ramp test would have remain unchanged absent the waiver as they will not be set by relaxation parameter prices pursuant to Section 10.3.2.1 of the BPM for the Energy Imbalance Market.

Second, the prices reflecting the tariff-based relaxation parameters were reconstructed for both under-supply and over-supply infeasibilities. This means that when an instance of undersupply was reconstructed, the price was set to the bid cap plus/minus marginal loss component. Similarly, when an oversupply instance was reconstructed, the prices in the counterfactual case were set to the bid floor relaxation parameter plus/minus marginal loss prices.

During the term of these reports, in some intervals the market clearing process experienced what is referred to as “degenerate cases” during which the market may be able to clear at multiple pricing run solutions that are equally valid from an economic perspective. The CAISO has recently stakeholdered and the CAISO board of governors has approved a solution to this phenomena and intends to file a tariff amendment to implement this change. These upcoming market rule changes eliminate the multiplicity of pricing issue and produce one price that reflects the lack of congestion at the appropriate locations. During such cases, even if the market systems had observed an infeasibility that would have led to the relaxation of a constraint and triggered the penalty pricing parameters, the pricing run could have landed at a price that was based on the marginal resource economic bid price, which could be different than the price had it been based on the \$1000/MWh parameter. The CAISO observed many intervals in which this phenomena occurred, in particular in the five minute real-time dispatch. The CAISO does not correct for these cases and believes these to be optimal from the perspective of the energy market alone. But because of issues this may cause in associated markets such as the congestion revenue rights, the CAISO will be modifying its market rules prospectively to eliminate such occurrences.⁷

The counterfactual case represented by the orange line cannot account for the degeneracy and simply represents what prices would have been for those intervals based on the tariff-based constraint relaxation pricing parameters because there was an infeasibility. This has implications regarding the trends presented in the figures below. For the first 13 days, as discussed above, the CAISO has not yet modified posted prices based on the waiver-type pricing. The CAISO filed for an additional waiver to conduct this pricing adjustment and it is pending before the Commission in FERC Docket No. ER15-817. Without the waiver, the prices as posted would remain as they are. One would expect the counterfactual case represented by the orange line to be close to the

⁷ Additional information regarding the stakeholder process and the resulting policy changes is available at: <http://www.caiso.com/informed/Pages/StakeholderProcesses/PricingEnhancements.aspx>. This will be the subject of an upcoming tariff amendment with the Commission.

posted prices represented by the blue line. This is the case for the fifteen minute markets. However, for the real-time dispatch, the lines diverge because in a number of the intervals posted prices appear to have not been determined based on the \$1000/MWh parameter even if there was infeasibility. At this time, the CAISO believes that this was due to the fact that many of the affected intervals were subject to degeneracy. After November 13, however, whether or not there would have been degeneracy in the pricing run, is immaterial, because pricing under the December 1 waiver or degeneracy is based on the last economic bid price signal.

Figure 5: Daily average of five-minute market prices in PAC West.

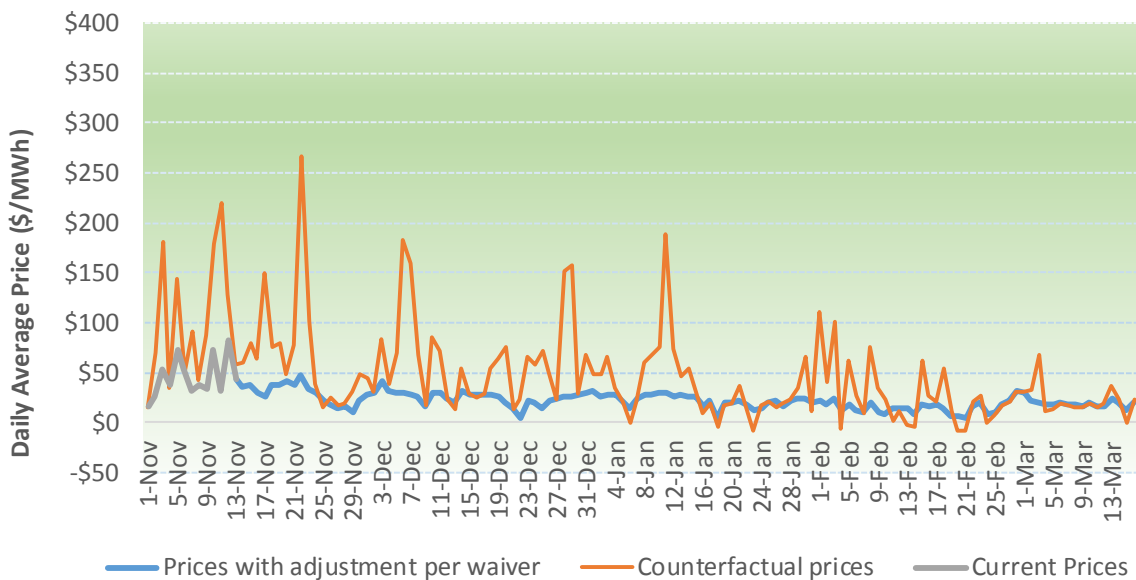
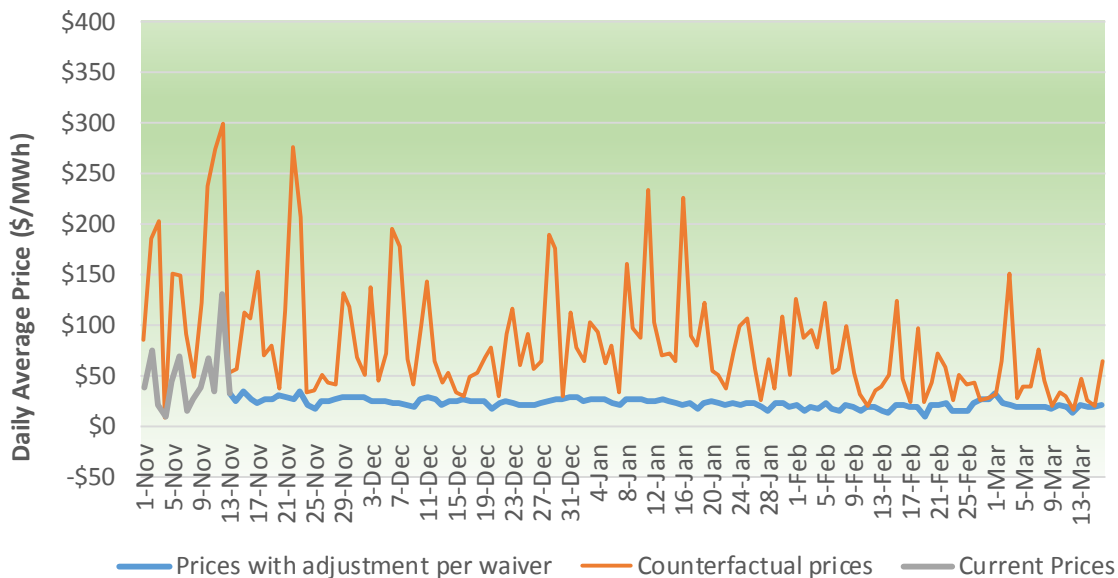


Figure 6: Daily average of five-minute market prices in PAC East.

Overall, PAC East tends to be more volatile and subject to more frequent price excursions than PAC West. This may be due to limited transfers into the PAC East area. In contrast, PAC West does not share such limitations which enable more transfers in and out of the CAISO balancing authority areas to PAC West.

In both PAC East and PAC West, the five-minute real-time dispatch is notably more volatile than the fifteen minute market. This is due to the fact that the fifteen minute market embodies more flexibility as it is further in time than the applicable intervals whereas the five minute real-time dispatch is closer to real-time. In the five minute dispatch, ramping capability is more limited. Figure 7 and Figure 8 provide bi-weekly averages of the prices as modified under the December 1 Waiver and are final as of now. These include price corrections and price adjustments pursuant to waiver of this report. These figures show that the average price for energy in both the PAC East and West have increased slightly in March 2015, around \$22/MWh in the fifteen minute market and around \$19/MWh in the five minute market.

Figure 7: Bi-weekly average of fifteen-minute market prices in PAC West and East.

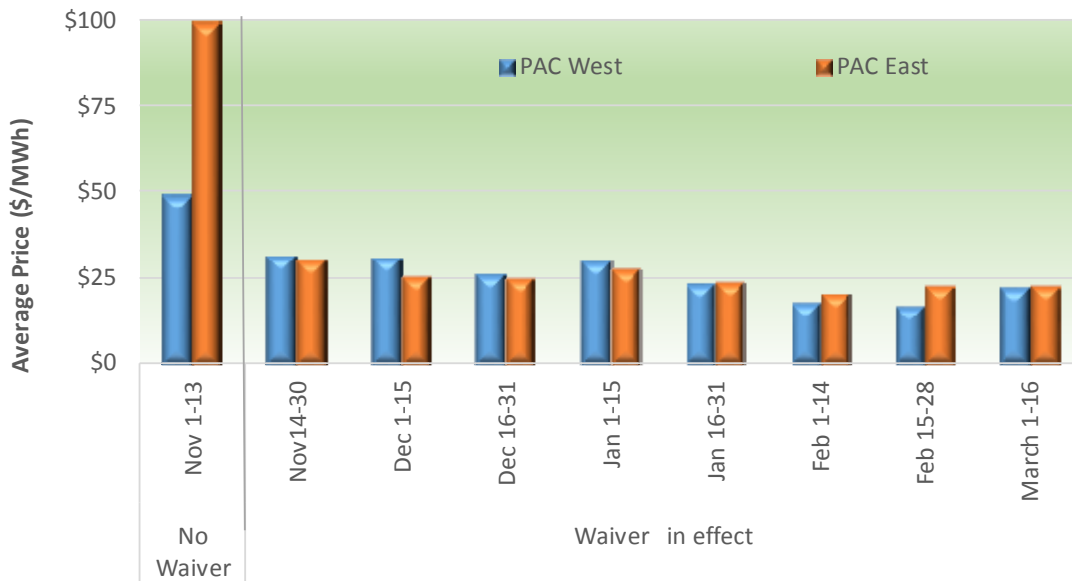


Figure 8: Bi-weekly average of five-minute market prices in PAC West and East.

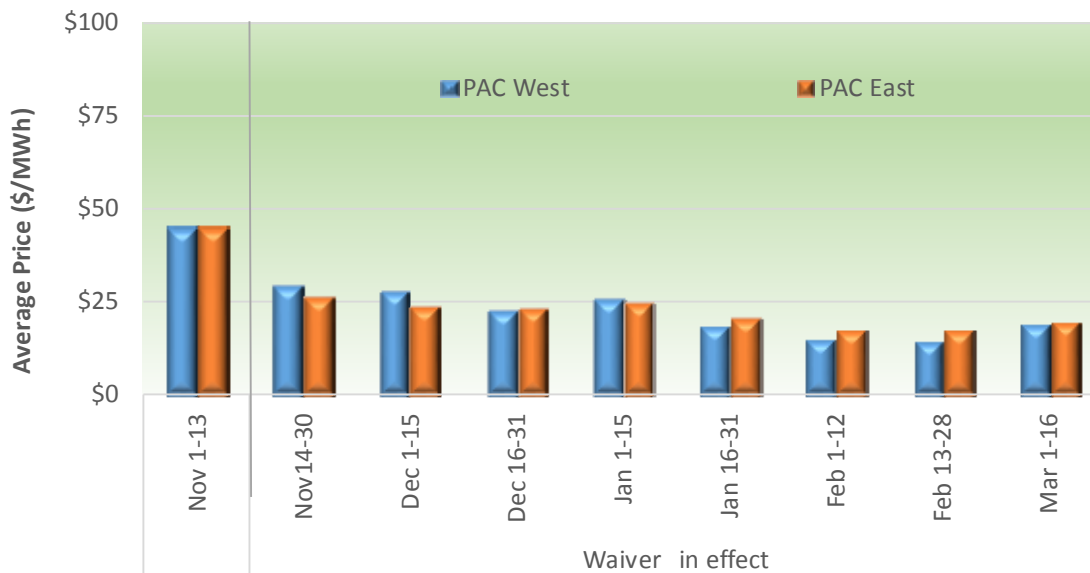


Figure 9 through Figure 12 show the frequency of price excursions for both the fifteen and five-minute market, organized by the reason for the power balance infeasibility. In any given market interval, more than one of the illustrated reason may have contributed to the price excursion because there are numerous elements that can impact the market outcome. For example, a given market interval may experience a

price excursion due to data alignment, manual dispatches and load changes. For the purpose this report, the CAISO has reviewed each affected market interval and has assigned the interval to a reason category that most afflicted the interval. The categories used in the figures in this section 1, include:

1. *Renewable deviations* for conditions in which wind or solar changes lead to the loss of capacity and for the need to increase generation from other resources.
2. *Load changes* refer to conditions where either the load forecast is adjusted or there is a change in the load bias.
3. *Import/Export changes* is for adjustments and updates to imports and exports as seen by the market.
4. *Resource outage* is for conditions in which an outage results in the loss of capacity available to the market, and for which the market needs to increase generation from other resources. Similar conditions apply for manual dispatches leading to a reduction of available capacity to the market.
5. *Manual dispatches* is for instances where the introduction of a manual dispatch may cause imbalances, such as max go to manual dispatch may limit the unit up to certain capacity, resulting in the loss of capacity for the market.
6. *Resource data alignment* is for any other condition not captured in the previous five categories. This group accounts for resource deviating from their dispatch, differences between base schedules and bids or dispatches, and changes between markets.
7. *Transfer/Congestion constraints* is for instances where the interplay of EIM transfer constraints or congestion in either PAC or CA balancing authority area may restrict the incremental generation of resources leading to infeasibilities.

Figure 9: Reasons for intervals with ELAP prices exceeding \$500 in the fifteen-minute market in November. PAC West and PAC East combined.

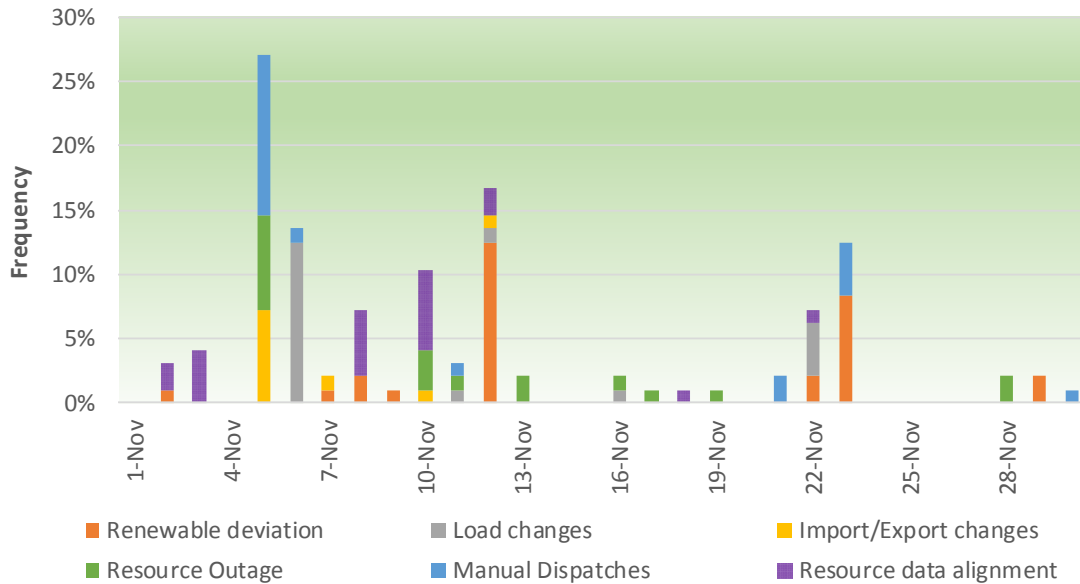
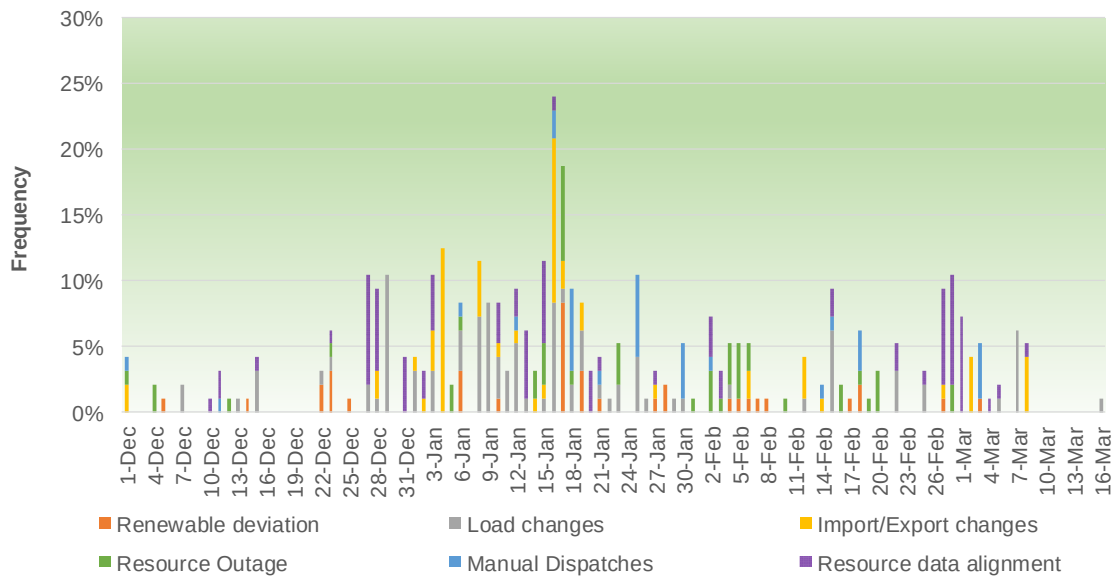


Figure 10: Reasons for intervals with undersupply infeasibility in the fifteen-minute market in December to March 16. PAC West and PAC East combined.



For the month of November, as previously reported in the December 15 report, the metrics represent all intervals where there were price excursions above \$500/MWh

in either PAC West or PAC East, or both, whether or not there were power balance constraint infeasibilities. The sample was chosen as such, because the CAISO presumed that prices exceeding \$500 were suspect and possibly in need of price corrections due to some form of an error, or they were due to the relaxation of a constraint and were based on the \$1000/MWh pricing parameter. For the month of December and onwards, because the CAISO started employing the December 1 Waiver, prices simply were rarely above \$500. Following that same approach would have yielded a very small set of intervals. Therefore, for the December time period it is more appropriate to report the frequency of issues that led to the request for a waiver based on the intervals in which there were power balance infeasibilities (undersupply conditions) as observed through the relaxation of a constraint (power balance or transmission). While these differences present a difference in the type of intervals from which the frequency data was drawn, the data for the two months is still instructive in terms of which of the types of issues that led to the need for the waiver were observed most frequently in each month. The CAISO further reports on the frequency and magnitude of power balance infeasibilities in greater detail in both months in Attachment E of this report in Figure 16 through Figure 23. Those later figures better represent the trends for magnitude of the infeasibilities observed in the markets overall.

Figure 11: Reasons for intervals with ELAP prices exceeding \$500 in the five-minute market in November. PAC West and PAC East combined.

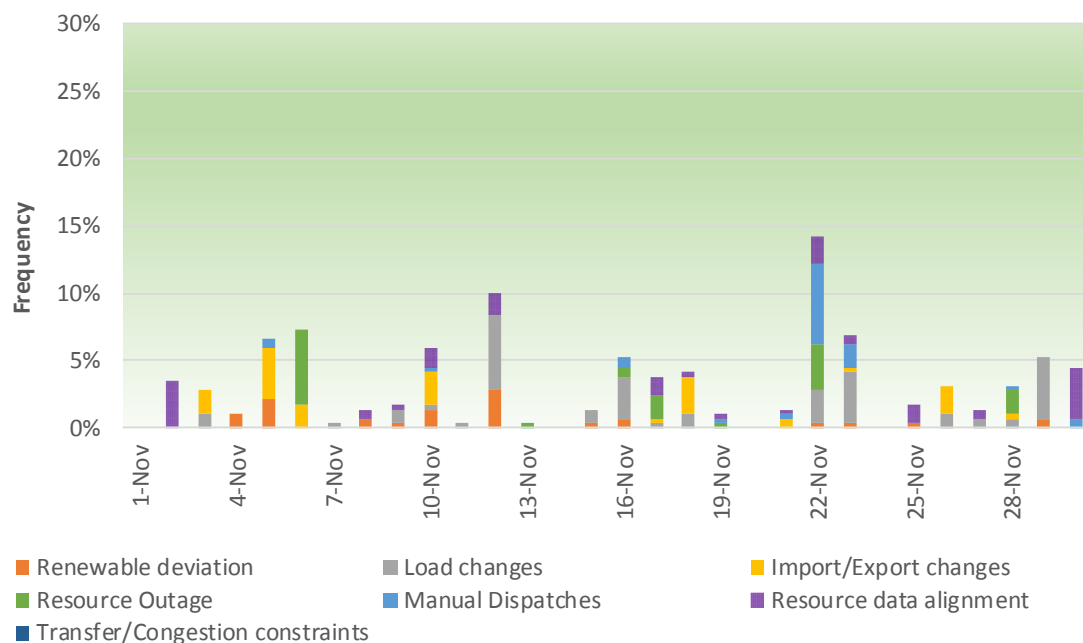
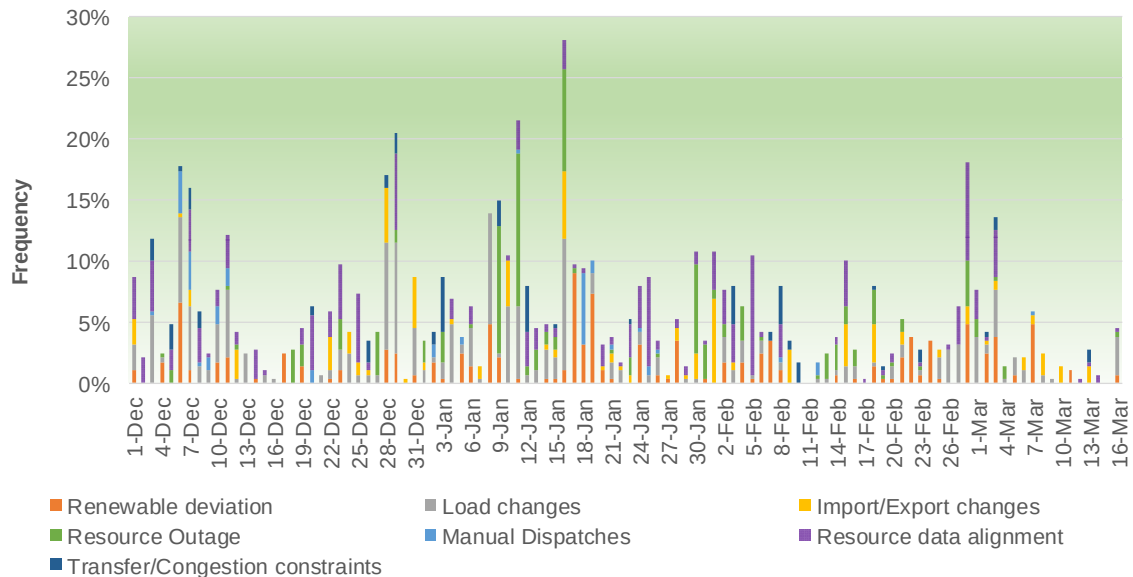


Figure 12: Reasons for intervals with undersupply infeasibility in the five-minute market in December 1 to March 16. PAC West and PAC East combined.

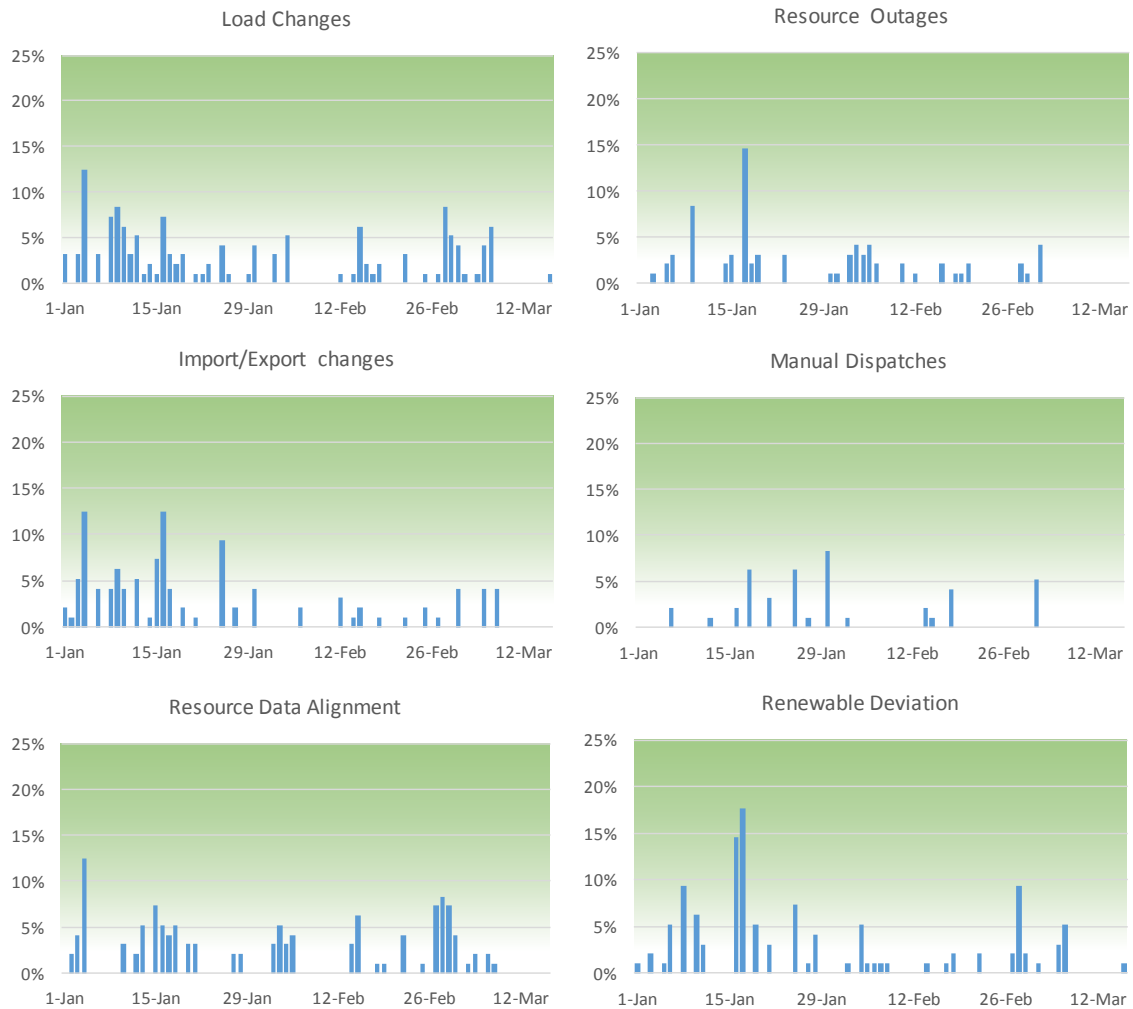


The categories used in Figure 9 through Figure 12 are related but not exactly the same as the broader descriptions provided in the tables in section 2 below. In some cases, the descriptions provided in the tables below will create conditions leading to the manifestation of power balance infeasibilities. For example, category 1 below includes the issue of timely manner of entering and cancelling outages. This issue also falls in the category of resource data alignment. The descriptions in the tables below link each issue to the relevant category of reasons above to more specifically define the categories of reasons that prompted the need for the December 1 Order tariff waiver.

Also, as indicated above, this classification of reasons for power balance infeasibilities is a relative classification. The reasons described in this section are not mutually exclusive, and the ISO has identified that at times multiple factors lead to power infeasibilities; therefore, assigning only one reason to an infeasibility is relative and does not capture the nature of various factors interplaying. In some cases a single reason may be sufficient to drive an infeasibility but in others it is the combination of more than one condition that lead to the infeasibilities. To illustrate this concept, consider the following figure where the relative frequency of reasons leading to power infeasibility is provided for the period of January 1 to March 16, 2015. If there was a certain number of infeasibilities in a given day (in percent of the total number of intervals in FMM per day), this figure shows how frequently each reason was present in a day with power balance infeasibilities. The frequencies are not cumulative and are not

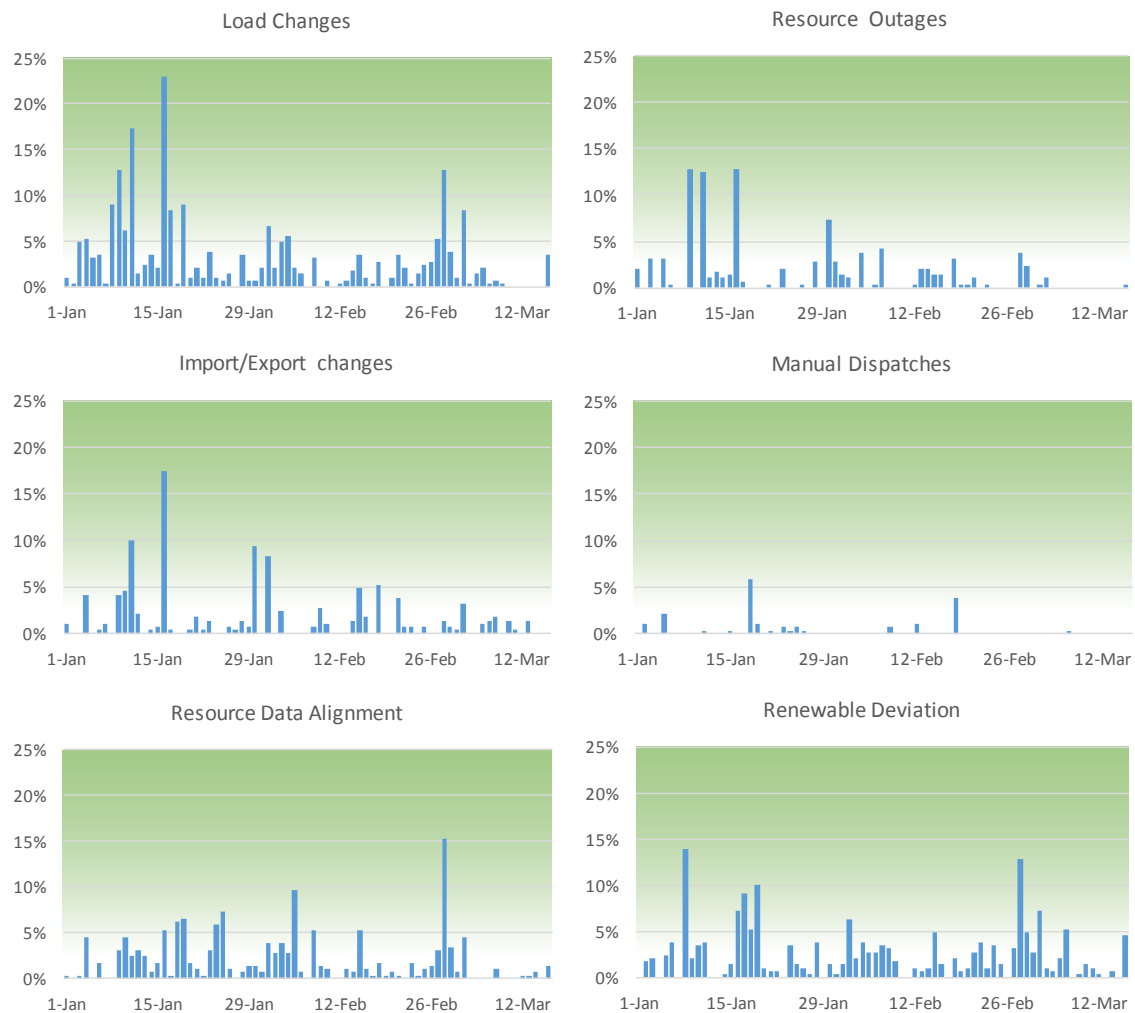
mutually exclusive; they rather show the frequency of each reason with respect to the total intervals in a day for intervals where a power balance infeasibility occurred.

Figure 13: Frequency of reasons leading to power balance infeasibilities in the fifteen-minute market. Both PAC West and PAC East combined.



Similarly, the reasons for power balance infeasibilities in the five-minute market are organized by groups in the following figure.

Figure 14: Frequency of reasons leading to power balance infeasibilities in the five-minute market. Both PAC West and PAC East combined



2. Issues prompting waiver, remedial actions taken, status and outstanding items

Category 1: Outages, derates/rerates management

Issue	Description	Remedial Action and Status	Frequency and Market Impact
1. Timely entering and cancelling of outages in the market	When resources experience full or partial forced outages, the market must be informed in a timely manner of the outage event and the corresponding measures taken to compensate for the lost megawatt capacity. Delay in informing the market application causes the market application to detect capacity shortages not covered by the unloaded capacity from participating resources. Under such conditions, prompt EIM Entity manual dispatch instructions are needed to increase the generation of available non-participating resources to create room for participating resources to be marginal and to economically set price. When the EIM Entity cancels an outage in a timely manner, it is also important to inform the market that the capacity is available and can be used to clear the Energy Imbalance Market, otherwise the market will perceive that there is capacity shortage to meet the load.	CAISO and PacifiCorp participated in several discussion sessions to clarify the process of entering or cancelling outages including maximum capacity derates, and minimum capacity re-rates. More emphasis was given to multi-stage generating resources due to the complexity of their multiple configurations and additional needed coordination between them. CAISO formalized a production system support plan for Outage Management System to respond quickly to questions or situations encountered by PacifiCorp operator when entering outage tickets. We observe downward trend of price excursions caused by incorrect outages or timing of outages due to resolving many issues related to processes, training, and software glitches. PacifiCorp's practices of managing	This issue may result in instances counted in Figure 910 and Figure 12 as Resource data alignment and Resource outages.

Issue	Description	Remedial Action and Status	Frequency and Market Impact
		their reserves in the EIM described in Attachment B allows the market to see the deployment of reserves more quickly and recognizes that load is actually covered by generation.	
2. Base schedule and Bid submission for resources undergoing outages	The timing in which the EIM Entity reports the outage is very important. If the outage occurred before T-75 (<i>i.e.</i>, seventy five minutes before the operating hour) and is expected to last during the operating hour T, then both the economic bid and base schedule submission should be adjusted to account for the outage. Otherwise, the assumptions and data used by the market application for the balance test and look-ahead fifteen-minute market are not consistent with real system conditions, which results in less capacity available to the Energy Imbalance Market than what was computed before the start of the operating hour, and high prices are imminent due to limited unloaded economic capacity that is offered in the market.	PacifiCorp has utilized the CAISO new displays to quickly identify discrepancies between base schedules and derated maximum capacity of resources. PacifiCorp has acted on these discrepancies and adjusted the base schedules accordingly. A decrease in discrepancy occurrences has been noted. Additional information related to re-rated minimum capacity has been added to existing displays to help PacifiCorp identify and fix discrepancies between base schedules and re-rated minimum capacity that caused many noted over-generation conditions in PACW. The CAISO enhanced situational awareness screens to report on un-qualified MWh when base schedules were submitted for the	This issue may result in instances counted in Figure 9 and Figure 12 as Resource data alignment and Resource outages.

Issue	Description	Remedial Action and Status	Frequency and Market Impact
		outaged resource to inform the EIM entity of inconsistencies between base schedules and outages earlier. The CAISO continues to monitor and analyze for timely responses to inform the market about any out-of-market manual actions that are taken or are planned to be taken by the EIM Entity.	
3. Outages of partial or full multi-stage generating resource configurations	Multi-stage generating resources have multiple configurations that must be carefully managed in the real-time market. The configuration characteristics are registered in the master file and are observed and honored by the market application. These include physical registered characteristics such as transition time, minimum up time, and minimum down time and minimum capacity (Pmin) and maximum capacity output (Pmax) megawatts (MWs) as well as any overlapping MW regions between configurations. If a configuration is out of service, a timely input of the outage is needed to inform the market that the corresponding economic bid or base schedule is not available and another configuration should be used. If the	The CAISO provided additional clarification and review of base schedules and coordination with resource parameters. Due to the complexity of multi-stage generating resource data modeling there, this constitutes the majority of outage/derates/re-rates issues causing price excursions. PacifiCorp's practices of managing their reserves in the EIM described in Attachment B allows the market to see the deployment of reserves more quickly and recognizes that load is actually covered by generation. The CAISO continues to monitor, analyze, and provide feedback to	This issue may result in instances counted in Figure 910 and Figure 12 as Resource data alignment and Resource outages

Issue	Description	Remedial Action and Status	Frequency and Market Impact
	information is not promptly entered or bids don't exist on other configurations then the market has no way to move the resource to other configurations and the whole MW of the plant is not accounted for in the market and price excursions will occur.	PacifiCorp for continuous improvements.	
4. Availability of Upward/Downward Capacity	Upward and downward capacity is needed to cover system uncertainty besides serving EIM transfers. Typical system uncertainties include: a. Load deviation during an hour b. Load forecast error c. Wind deviation d. Resource outage e. Net Schedule Interchange deviation	PacifiCorp has reviewed all their MSG parameters and modified transition times.	
5. T-75' balance test	T-75' balance test is the first balance test of the three balances tests ran. The accuracy of the base schedules submitted for the test impacts prices as well. For example, if the EIM entity under schedules at T-75', HASP would have EIM transfer import from the CAISO. This EIM transfer import could counter flow on Malin 500 such that the ISO could import more than the Malin 500 limit. Later, even if the EIM entity balances the schedules, it is still necessary to import from the CAISO causing over generation.	PacifiCorp is working on a process to improve T-75' balance test.	

Category 2: Manual Dispatch

Issue	Description	Remedial Action and Status	Frequency and Market Impact
1. Timely input of manual dispatch	Since many units are not participating in the market, manual dispatch and other out-of-market actions taken on these units must be recorded by the EIM Entity in the market to inform the market about the availability of these resources and their movements to respond to events like contingency or outages of other units. Without this timely information, the market can only assume that the participating resources will respond to these various events, which will result in depleting the flexible unloaded capacity of the participating resources and their capability to set economic prices causing price excursions.	The manual dispatch is entered directly in the market tool by the EIM Entity. PacifiCorp's practices of managing their reserves in the EIM described in Attachment B allows the market to see the deployment of reserves more quickly and recognizes that load is actually covered by generation.	This issue may result in instances counted in Figure 910 and Figure 12 as Resource data alignment and Manual Dispatches
2. Flexible ramping sufficiency test	The CAISO performs the flexible ramping sufficiency test on the base schedules, the last test being at 40 minutes before the start of each operating hour. When the EIM Entity fails the test based on the economic bid-in capacity that is being offered to the market, the market application will constrain PacifiCorp from increasing its import from CAISO to prevent the leaning concern. This means	The CAISO has discussed this issue with the PacifiCorp and has clarified the market impact. The CAISO is also collecting and analyzing both wind and load variability in PacifiCorp's two balancing areas. Several wind forecasting issues were addressed last month, but wind forecast deviations from base schedules continues to be among the main reasons for price excursions and infeasibilities. The CAISO is	This issue may reduce the flexibility of the market to absorb system condition changes and data updates and, consequently, leave the market more susceptible to price excursions by any of the reasons provided in Figure 910 and Figure 12

Issue	Description	Remedial Action and Status	Frequency and Market Impact
	that PacifiCorp enters the operating hour depending on its resources and any additional manual changes to available non-participating resources set points or purchases of interchanges within the hour. Any delay in performing the manual dispatches or the additional interchange purchases leaves the market exposed to price excursions due to insufficient bid-in flexible capacity.	in the process of assessing the flexible ramp requirement for PacifiCorp's two balancing areas based on the collected data for the actual real-time imbalance conditions. The CAISO is also revisiting and reviewing the flexible ramp constraint and associated credit accounting in the flexibility sufficiency test and towards satisfying the flexible ramp requirements in the market optimization.	

Category 3: Wind forecast accuracy

Issue	Description	Remedial Action and Status	Frequency and Market Impact
1. Accuracy of PacifiCorp wind resources forecast	The variable energy resource (VER) forecast, which is mainly wind forecast for the PacifiCorp balancing authority areas, is crucial because it sets the maximum economic megawatt range that the market is allowed to dispatch these resources. The accuracy of the short term VER forecast benefits immensely from the accurate telemetry of the output of the VER resources. The forecast of the wind resources was deviating significantly from the output of the resources even for the next 5-min forecast over a period of many days. This resulted in significant	PacifiCorp continues to utilize the new unit deviation display that CAISO added to the EIM Entity user interface. This display provides the grid operator information related to differences between any combination of telemetry, state estimation, base schedule, and cleared target operating points for all resources. This display is used by PacifiCorp to quickly identify which wind resource is deviating and the amount of deviation per resource and on aggregate basis	This issue may result in instances counted in Figure 9 and Figure 12 as Renewable deviation

Issue	Description	Remedial Action and Status	Frequency and Market Impact
	deviations in calculated energy imbalance and sometimes resulted in over-generation, or under-generation conditions compared to the hourly base schedule values of these wind resources for the corresponding operating hour. Lastly, in cases where wind resources are participating and being dispatched, the short-term forecast, which is a persistent forecast, may not be accounting for the dispatch instruction.	per balancing area. PacifiCorp has identified some areas of improvement related to its wind forecast quality and has worked diligently with its wind forecast service provider to fix those issues. However, there have been several reported volatile cases when the wind drops more than 150MW from its base schedules causing potential price excursions had the waiver is not currently in place.	

Category 4: Interchange schedule variation

Issue	Description	Remedial Action and Status	Frequency and Market Impact
1. Interchange information within the hour	Interchange information is essential part of meeting energy imbalance for each balancing authority area. Considering the forward look-ahead time horizon of the fifteen-minute market for almost two hours, and one hour for the five-minute real-time dispatch market, timely information about the interchange schedules is essential. The delay to inform the market application about these interchanges during resources outage times or steep load ramping conditions tightens the market conditions, leading to fake price excursions that sometimes	CAISO has re-emphasized the importance of informing the market application about any planned purchase or sale of interchanges before the balancing test or within the hour to respond to changing imbalance conditions. The CAISO also re-emphasized the need to submit planned interchange base schedules for multiple hours in the horizon to provide the short term unit commitment, which has a four and half hours look-ahead horizon,	This issue may result in instances counted in Figure 9 and Figure 12 as Import/Export changes

Issue	Description	Remedial Action and Status	Frequency and Market Impact
	show in the financially binding fifteen-min market interval which is calculated 37.5 minutes ahead of time before the T-20 minutes cut off time for the tags to be submitted and approved for any extra or within the hour interchanges.	with good projection of the forward hours to enable optimal market decisions related to multi-stage generating resources transitions from one configuration to another, and startup of fast start resources. In the first part of March, system issues affecting interchange schedules and balancing occurred. PacifiCorp is aware of these cases and is reviewing to avoid repeat of such issues.	

Category 5: Load forecast variation

Issue	Description	Remedial Action and Status	Frequency and Market Impact
1. Load forecast biasing	EIM Entity grid operators have the capability to bias the load forecast for reliability purposes to account for any non-modeled issues causing discrepancy between forecast load and actual load. The setting of the bias is somewhat subjective based on the grid operator's judgment of system operational and reliability needs. This biasing if not done in a coordinated fashion with market operations can create price excursions especially when there is limited flexible ramp capacity available to accommodate small marginal overshoot or undershoot of the bias values. Due to the limited pool of participating resources, the PacifiCorp grid operator will necessarily need to pay extra attention to the bias values to prevent unintended overshoot or undershoot.	The logic for the load bias to maintain reliability was extensively discussed, documented, and used during PacifiCorp grid operator training including the impact on prices as a situational awareness signal to indicate an issue in meeting load or balancing the system. There were several instances reported in January when excessive amount of load bias was used to dispatch more capacity when the system is out of CAISO will be implementing software functionality to limit erroneous excessive load bias, similar to the logic currently used for the CAISO operator bias of load. This feature corrects operator bias of load forecast that exceed available ramp.	This issue may result in instances counted in Figure 910 and Figure 12 as Load changes

Category 6: Resources not following dispatch

Issue	Description	Remedial Action and Status	Frequency and Market Impact
1. Resources not following dispatch signal	On occasions resources were not closely following the market dispatch signal. This was either because the plant was unavailable or an outage ticket was not entered on-time for the market to consider the outage, or because of some lag time when the plant was not set on automatic generator control to be dispatched directly from market signal. In any of these cases, the deviation from the market dispatch and the lack of the manual instructions to inform the market application when the resource cannot operate to the target operating point, resulted in market conditions that are not reflective of actual system conditions, causing price excursions. In some cases when the plant is dragging its response to the market signal, it was necessary for the EIM Entity to make direct phone calls to the plant to start moving up or down to the plant's designated market dispatch signal.	PacifiCorp continues to utilize the new unit deviation display that CAISO added to the EIM Entity user interface. This display is used by PacifiCorp to quickly identify which resource is deviating and the amount of deviation per resource and on aggregate basis per balancing area. When a resource was observed to be dragging its dispatch, a direct call to the plant was enough to expedite the response if the plant was available or resulted in submission of outage ticket or manual dispatch instruction if the plant had any temporary physical limitations. Unit deviations in January have maintained their levels in December but they are still present and among the reasons for price excursions, especially when they are combined with a manual dispatch that fixes the resource megawatts in the market but the resource is not following the dispatch.	This issue may result in instances counted Figure 9 and Figure 12 as Resource data alignment

Category 7: Network Model discrepancy

Issue	Description	Remedial Action and Status	Frequency and Market Impact
1. Industrial load base schedules	PacifiCorp has industrial load as part of the conforming load and market load forecast. This created a discrepancy whenever these industrial loads are operating or called upon to curtail. The market is not aware of these non-participating resources that exist in the PacifiCorp energy management system, but not in the market, creating the need to manually bias load to maintain consistency between market model and PacifiCorp's energy management system (EMS) model.	CAISO and PacifiCorp went through a series of meetings and identified these resources. An action plan was developed to add these non-participating resources to the network model used in the market application. PacifiCorp is diligently working on providing telemetry, and register these resource with CAISO so they can be treated as separate resources with the capability to submit base schedules reflecting their actual real-time operation. The issue has impacted the quality of load forecast and called for manual load biasing after resulting in some MW infeasibilities and potential price excursions had the waiver is not currently in effect.	This issue may result in instances counted in Figure 910 and Figure 12 as load changes and resource data alignment
2. Distributed energy resources modeling	Distributed energy resources are currently included in the market load forecast as conforming load. These resources have both load and generation components, which nets to positive or negative net injection at the load bus. When generating the market does not visibility of them and effectively considers more	CAISO and PacifiCorp went through series of meetings and identified the gross impact of these resources. Action plan was developed to add them to the market network model. The non-generation resource market model is used to model one of these	This issue may result in instances counted Figure 9 and Figure 12 as load changes and resource data alignment

Issue	Description	Remedial Action and Status	Frequency and Market Impact
	load than what the PacifiCorp's EMS is observing and price excursions occur because of the lack of base schedules for these resources.	resources, and others are coming with this coming month. Load biasing is being used in the meantime to compensate for the MW changes of these resources.	
3. Telemetry quality issues (net versus gross accounting)	The EIM Entity is sending telemetry values for all PacifiCorp registered resources in the master file. When the quality of the telemetry values is not good, the state estimator solution quality is negatively impacted, which in turn affects the quality of the market solution and the dispatch operating targets of these resources. During the first few weeks of operation the CAISO found that some resources have telemetry measurement that is net of its auxiliary loads and others have gross telemetry measurements that do not include the auxiliary load. In addition, certain wind resources and other small non-participating resources did not have telemetry. When these discrepancies are combined together they tend to impact the market solution and cause price excursions.	The CAISO and PacifiCorp identified all these resources and telemetry issues and permanent fixes were put in place.	This issue may result in instances counted in Figure 910 and Figure 12 resource data alignment

Category 8: Market model discrepancy

Issue	Description	Remedial Action and Status	Frequency and Market Impact
1. Energy during startup and shutdown	For multi-stage generating resources, the energy of these resources during the startup and shutdown periods when their output is below the PMin is accounted for in energy management system and automatic generation control (AGC). But the market does not account for this energy because it is below the PMin of the resource. This created discrepancy in the base schedule balance test, and the imbalance calculations between market and actual conditions as seen by AGC, which led to performing some load bias during the startup and shutdown of these resources subjecting the market to price excursions.	The CAISO is modeling the transition ramping for multi-stage generating resources and has scoped the requirements to add startup and shutdown profile to the 15-minute market since these features are already in the 5-min market. PacifiCorp is in the process of collecting data to define the startup and shutdown profiles for many of the resources with high PMin values.	This issue may result in instances counted in Figure 910 and Figure 12 as part of the resource data alignment
2. Inconsistent base schedule and bid submission	It is important that the base schedules, self-schedule, and economic price curve submission are consistent. If a resource is scheduled to be OFF at a particular hour, then it is expected that the submitted base schedule to be zero, it is not expected, however, for this resource to have a self-schedule at higher configuration for the same hour. Another bid submission inconsistency occurs when the resource's higher configuration bid ends or not submitted for a particular	This issue continues to exist. There were several reported cases where base schedule value is above the maximum economic bid range causing MW infeasibility. The CAISO has identified, and analyzed these instances and discussed them in detail with PacifiCorp. PacifiCorp has identified changes to its internal processes and interfaces to mitigate those inconsistencies in the automated	This issue may result in instances counted in Figure 10 and 12 as part of the resource data alignment

Issue	Description	Remedial Action and Status	Frequency and Market Impact
	hour forcing the resource to transition to lower configuration with lower PMax value than its submitted base schedule for that hour, which was used in the balance test calculation. These inconsistencies results in market supply shortages that cause price excursions.	bid submission.	

Category 9: EIM Transfer Limits

Issue	Description	Remedial Action and Status	Frequency and Market Impact
1. Static and dynamic transfer limit restrictions on California-Oregon Intertie (COI)	The Energy Imbalance Market is designed to have the EIM transfer capacity fully re-optimized in both the fifteen-minute and five-minute market. With respect to the COI, the added restriction of the dynamic five-minute limit which is an incremental limit around the fifteen-minute solution creates at times price excursions. The five-minute dynamic limit constrains the market application from re-optimizing the fifteen-minute EIM transfers decisions between PacifiCorp and CAISO beyond the amount allowed by the five-minute incremental dynamic limit, which can be restrictive especially during the on-peak hours.	PacifiCorp is engaged in ongoing discussions with the Bonneville Power Administration (BPA) to understand the nature and allocation of the dynamic transfer capability on COI. BPA is in the process of conducting a detailed dynamic transfer capability study, which is ongoing work. Any additional five-minute capability will help the five-minute market re-optimize the fifteen-minute decisions that are based on system conditions and information available at approximately 30 minutes prior to the five-minute market. The five-minute dynamic COI limits were recently increased for the off-peak hours but still very	This restriction on the 5-min dynamic limit on COI issue is counted in Figure 910 and Figure 12 as part of transfer/congestion constraints

Issue	Description	Remedial Action and Status	Frequency and Market Impact
2. Five-minute rate-of-change constraints	The rate-of-change constraints are five-minute flow limit constraints that limit the amount of five-minute movement of PAC West balancing authority area participating resources around the corresponding resources' fifteen-minute schedules due to their flow impact on certain paths and flowgates internal to BPA's balancing authority area. This restriction on the resources' five-minute movements or the corresponding rate-of-change constraint has created at times price excursions on the impacted resources when the corresponding path or flowgate five-minute limit constraint is binding.	limited in the on-peak hours. PacifiCorp is engaged in discussions with BPA to understand the nature and basis behind the five-minute flowgate limits and possible change in the calculation of those limits. BPA is reviewing the five-minute limits which are based on historical movement of PacifiCorp West resources before EIM. BPA has also asked for more data points to perform a review of the current rate-of-change limits based on actual EIM market data. Any additional five-minute capability will help the five-minute market re-optimize the fifteen-minute market decisions that are based on system conditions and information available approximately 30 minutes prior to the five-minute market. The CAISO had provided BPA the requested data points and answered any relevant questions. CAISO is also engaged with both BPA and PacifiCorp to revise the implementation model for the rate of change constraint to reflect ramping 15-min schedule values.	

ATTACHMENT B

Quantitative and qualitative descriptions of market performance related to the issues that prompted the CAISO's waiver request – PacifiCorp

REPORT PROVIDED BY PACIFICORP

Issue	Description	Remedial Actions Taken During Waiver Period and Ongoing Activity
1. Increase Pool of EIM Participating Resources	PacifiCorp coordinated with the CAISO to increase the pool of owned and third-party resources available to participate in the EIM.	PacifiCorp has completed testing of the Swift 1&2 aggregation project and is planning on making these changes effective in the Master File by March 27, 2015. This will result in the Swift 1&2 units becoming a single aggregated PacifiCorp EIM Participating Resource and will add approximately 68 MWs of upper bid range capability. In addition, PacifiCorp continues to work with other transmission customers who may be interested in participating in the EIM with resources, including the recent filing of a construction agreement at FERC to enable resource metering upgrades, which would facilitate further steps towards participation of the resource in the EIM (FERC Docket No. ER15-711). At this time, PacifiCorp has not certified any third-party transmission customers for participation in the EIM, but is nevertheless hopeful that these efforts will result in additional EIM participation. PacifiCorp continues efforts to model certain of its industrial customer interruptible loads as participating resources. This is necessary because some of PacifiCorp's industrial customer loads have on-site generation and, as a result, this presents additional complexity for accurate forecasting and balancing. These changes are expected April 8, 2015, because they need to be aligned with changes to the ISO network model. Adding these elements as participating resources will provide improved operational visibility and will

Issue	Description	Remedial Actions Taken During Waiver Period and Ongoing Activity
		also add approximately 200 MW of flex capacity in its PACE Balancing Authority Area (“BAA”). PacifiCorp is also improving modeling of its jointly owned generating resources. Such improvements will further minimize imbalance issues and improve forecast accuracy. PacifiCorp has also made improvements to the bid configurations of PacifiCorp EIM Participating Resources in order to fully maximize the bid range available to the market. This includes recognizing start-up hours for CCGT plants, working to bid in all possible plant operating configurations and accounting for reserves to fully reflect the operational capability to respond to real-time market conditions. These modifications became effective in the Master File March 24, 2015. PacifiCorp has experienced challenges conveying information to the EIM models relating to PacifiCorp’s contingency reserve management in its BAAs. As with other operational improvements identified and realized since EIM go live, PacifiCorp has been working in coordination with the ISO to improve the accuracy of how the EIM understands PacifiCorp’s balancing authority operations by using the information communication tools available in the EIM, including outage cards, to ensure that the EIM is accurately understanding the real time system conditions and unit capacity available in PacifiCorp’s BAAs. Leading to and through initial go-live, PacifiCorp designed the bid range of units to separate capacity associated with units holding contingency reserves from the bid range. This was based upon an assumption that contingency reserve obligation should be separately accounted for and that capacity associated with contingency reserves could not be made available. This had the unintentional consequence of overly restricting the capacity of these units when the market models assess potential infeasible market solutions

Issue	Description	Remedial Actions Taken During Waiver Period and Ongoing Activity
		and PacifiCorp's ability to make operational adjustments to units required by real time system conditions. The result of this approach was that the bid range and operational capacity of these units were essentially fixed for 75 minutes prior to the operating hour when EIM bids are due and during the operating hour (or approximately 135 minutes), even when system conditions changed. Without such restrictions (similar to PacifiCorp's pre-EIM operations), PacifiCorp would have been able to respond to real time system conditions, such as a precipitous drop on variable energy resource output, by making operational adjustments to its units, including deploying contingency reserves as needed and adjusting which units are carrying sufficient reserves to meet PacifiCorp's contingency reserve obligation. As explained above, an unintended consequence of PacifiCorp's initial bid range configuration design was reduced ability to make such changes without triggering additional market infeasibilities. To overcome this issue, in coordination with the ISO, PacifiCorp has implemented a solution which better approximates its actual contingency reserve management through the use of outage cards. The solution allows PacifiCorp to bid full unit capacity into the market and control the dispatch of contingency reserves with outage cards (as well as through PacifiCorp's EMS system). PacifiCorp continues to meet its contingency reserve obligation by holding sufficient contingency reserves on its units, but is able to convey adjustments that it makes to which units are carrying the reserves in real time also through outage cards. For example, when reserves are deployed or shifted to other units, the associated outage card can be adjusted for the amount of reserves being deployed or transferred to other units. This allows for a more transparent, efficient and timely market awareness of contingency reserve management and the ability to increase the amount of capacity available to the EIM, without affecting PacifiCorp's contingency

Issue	Description	Remedial Actions Taken During Waiver Period and Ongoing Activity
		reserve obligations. Use of outage cards ensures that PacifiCorp is able to represent actual operating conditions and offer the maximum possible capacity from its units to address market infeasibilities, but can also better approximate how PacifiCorp holds contingency reserves on its units during real time to meet its contingency reserve obligation and how PacifiCorp deploys reserves when necessary. This solution was deployed and working effective as of March 9, 2015, in the PACW BAA and implementation is still in progress in the PACE BAA, expected to be completed April 3, 2015.
2. Increase System Visibility and Situational Awareness	PacifiCorp developed and implemented additional tools and displays to provide its Grid Operations personnel with increased visibility and situational awareness regarding available regulation on a 5- and 15-minute basis.	PacifiCorp created and/or improved certain Grid Operations displays to monitor generator availability, capacity, and ramp capacity. PacifiCorp has finalized enhancements to its generator database (Pi) displays to provide Grid Operations with situational awareness when there is a deviation between the Dispatch Operating Target (DOT) and the actual dispatch. Since go-live, PacifiCorp has been participating in recurring discussions with the CAISO to evaluate the root cause of remaining infeasible schedules. PacifiCorp has made improvements to its systems that interface with the CAISO's BSAP and SIBR, as well as systems designed for bidding resources in the start-up and shutdown hours for multi-stage resources. PacifiCorp further narrowed the gap between the persistence forecast methods it uses for VER forecasting and the submission of those forecasts to the market. This ensures the market has a more current view of wind conditions and results in an improved market solution. Additionally, PacifiCorp has worked with CAISO to improve the load forecast during ramping hours. This has resulted in an even more accurate load

Issue	Description	Remedial Actions Taken During Waiver Period and Ongoing Activity
		forecast during these hours and improved the flex available to the market as less resource is needed to cover forecast error. For troubleshooting purposes, PacifiCorp continues to work with CAISO on tools and displays that can compare interchange deviations between EIM Entity submissions and confirmation of interchange data used by the Market Operator. PacifiCorp Grid Operations also continues to work with neighboring BAAs to improve visibility and tools.
3. Improve Training and Systems	PacifiCorp identified opportunities to provide additional training to personnel and improve systems with increased EIM operational experience.	PacifiCorp provided personnel with training on outage entry and required the provision of daily spreadsheets from PacifiCorp EIM Participating Resources that describe any operational issues and the resources' ambient conditions. PacifiCorp's Grid Operations provided its balancing agent real-time continued training on CAISO EIM tools during the first two weeks of February. Finally, PacifiCorp has worked with CAISO to improve load conforming errors. Software enhancements have been introduced that help protect against over-conforming that can exacerbate issues when capacity in the market is near its limit.
4. Improve Internal Processes and Tools	PacifiCorp improved its processes and tools to address identified market performance issues.	PacifiCorp's Grid Operations drafted and made available to operations personnel, "best practices" procedure documents to aid in personnel's implementation of critical EIM Entity tasks. PacifiCorp will continue to update these procedure documents in real-time as needed. PacifiCorp also developed a Desk Guide for the 24/7 Grid Operations desk and an EIM Division of Responsibilities document.

In addition to the operational updates provided above, PacifiCorp provides the following update relating to the implementation of emergency e-tags in PacifiCorp's BAAs. During the month of February 2015, there was a material decrease in emergency e-tags in PacifiCorp's BAAs. There were 10 emergency e-tags total during February 2015, which is an approximate 400% decrease from the average amount of emergency e-tags in November 2014-January 2015. The 10 e-tags implemented during February 2015 represent 984 MW across both BAAs (271 MW in PACW and 713 MW in PACE), or only 0.0175% of PACW BAA load and 0.021% of PACE BAA load during this period. This marked decrease is primarily due to not having a Colorado River Supply Project resupply issue at Vernal for all of February, which was the primary non-EIM related cause of emergency e-tags for prior months. Notably, emergency e-Tags for December 2014 (16 e-tags) and January 2015 (19 e-tags) were non-EIM related and were primarily due to an existing potential overload condition for the Vernal transmission lines which manifests during specific line outages in PacifiCorp's PACE BAA. The occurrence of outage event condition during December 2014 and January 2015 resulted in an influx of re-supply Western Area Power Administration ("WAPA") load e-Tags initiated by PacifiCorp's curtailment of existing WAPA load e-Tags.

ATTACHMENT C

Independent assessments from the Department of Market Monitoring on the causes and solutions identified by the CAISO.

This part of the report will be submitted to the Commission within eight days of March 26, 2015.

ATTACHMENT D:

This attachment provides an exploration of impacts, if any, on non-Energy Imbalance Market pricing nodes, including the Mona trading node.⁸ This attachment identifies any such impacts and describes any actions the CAISO is taking or plans to take to address such impacts.

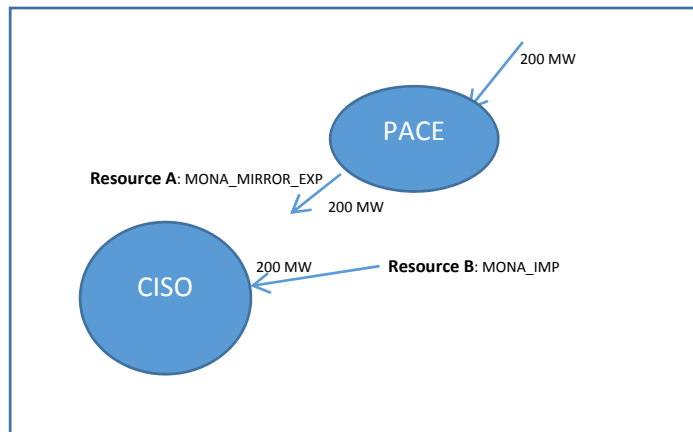
The implementation of the Full Network Model Expansion on October 15 increased the accuracy of the transmission grid modeling from neighboring balancing authority areas, and also allowed for better representation of unscheduled flow effects into the CAISO system. In addition, the implementation of the Energy Imbalance Market on November 1, 2014, further enables the CAISO to co-optimize resources across the various areas of the Energy Imbalance Market. Both of these initiatives required that the CAISO also change the way in which the scheduling points are defined so that it can associate the scheduling points with external interties.

With regards to the CRAG and Mona scheduling points, the CAISO had to account for the fact that schedules can be submitted at the locations for purposes of CAISO only transactions or Energy Imbalance Market only transactions. The Crag location is the scheduling point for the Cascade intertie; the Mona location serves as a scheduling point for various southern interties, such as IPPUTAH and Adelanto interties. Prior to the implementation of the full network model, these two scheduling points were modeled with the standard radial link and were considered part of the CAISO balancing authority area. With the implementation of the full network model expansion, this definition changed and with the implementation of the Energy Imbalance Market, the prices at these locations changed notably as the CAISO began accounting for Energy Imbalance Market related congestion.

CRAG and Mona scheduling points are physically located inside PacifiCorp Balancing Authority Areas instead of the CAISO Balancing Authority Area. Mona is located inside PAC East, and CRAG is located inside PAC West. However, these locations continue to serve as scheduling points for imports and exports transacted with the CAISO balancing authority area. This situation requires special treatment for balancing and pricing calculations and leads to a special prices posted on OASIS. The pricing at these locations is based on the following rules to implement the special treatment of CAISO scheduling points CRAG/Mona Interchanges into the balance and price calculations of CAISO and PAC East/PAC West balancing authority areas.

⁸ See December 1 Order at P 25.

Figure 15: Illustration of Mona Pricing



Assume that Resource A is Mona_Mirror_Exp, Resource B is Mona_IMP. Both of these resources are defined in Master file to have the same scheduling point and intertie definitions (ISO-PACE). The following rules apply:

Resource A,		
BAA	Balance	Price
CISO	Don't include MW	Not applicable
PACE	Include MW	Resource LMP= Price@SP
Resource B,		
CISO	Include MW	Adj_Price@SP= Price@SP – EIM_PACE – EIM_PACE_PACW – GHG + $\sum$ MONA ITCs Resource LMP= Adj_Price@SP SP-TIE Price shall use the Adj_Price@SP for the SP price calculations.
PACE	Don't include MW	Not applicable

The same above treatment shall be applied to CRAG scheduling point and mirror resource. The Figure above illustrates how an import at Mona scheduling point is mirrored by an export from the PACE balancing authority area with equal megawatt value. The reason for this mirroring is to allow the accounting for the import and associated offsetting export for each balancing authority area separately while the supporting resource(s) for the transaction is modeled at the physical location within PACE balancing authority area or as a separate import to PACE balancing authority area from another balancing authority area.

The table above illustrates that the pricing at Mona for CAISO balancing authority area is adjusted to not include effects of Energy Imbalance Market transfer constraints, GHG pricing, and other constraints pertaining to the EIM area.

The CAISO detected that the pricing at CRAG and Mona over the first few days of implementation were subject to a software defect that resulted in the CAISO pricing to include some of the LMP components pertaining to the mirror resource. The CAISO fixed this issue on November 5, 2014 and has not detected it since.

Currently, the prices at these scheduling points, as posted on OASIS, reflect all the congestion effects from either CAISO or PAC balancing authority areas. However, for CAISO imports and exports, the actual price used for settling the respective schedules at each of these locations as scheduling points for imports and export to and from CAISO balancing authority area, only accounts for the congestion arising from CAISO balancing authority area. The prices posted on OASIS do not reflect that, but the prices provided through the California Market Results Interface (CMRI) application and used for settlements for resources transacting at these scheduling points will reflect only the applicable CAISO balancing authority area congestion.

For example, consider the case of a sample market interval, November 26, hour ending 11 interval 4 for the fifteen-minute market. The shadow price of the IPPUTAH ITC is -\$183.29, the Energy Imbalance Market transfer price for PAC East is \$6.80 and the Energy Imbalance Market transfer for PAC East and PAC West is -\$11.88. The system energy price is \$35.38 and the greenhouse gas price is \$0. The price posted on OASIS for the marginal congestion component at MONA_3_N501 is -\$188.37. The congestion component posted on OASIS accounts for all the congestion associated with this location, both from the CAISO and PacifiCorp balancing authority areas. This published congestion component is thus calculated as $-\$183.29 \text{ (IPPUTAH ITC)} - \$11.88 \text{ (PACW\_PACE)} + \$6.80 \text{ (PACE)} = -\$188.37$.

On the other hand, for intertie awards using the Mona point as a scheduling point to transact in the CAISO Balancing Authority Area, the prices posted in CMRI and used for settlements reflect accordingly only the congestion share of -\$183.29 arising from IPPUTAH ITC. This price still adheres to the typical congestion calculation used prior to the implementation of the full network expansion and Energy Imbalance Market.

The current data structure used in the OASIS application only supports the display of one entry for the marginal congestion component, and given the nature of the congestion associated with these two scheduling points, either marginal congestion component combination will reflect partial information. Currently the display of the full congestion components -- CAISO and PAC -- does not apply to CAISO schedules. If the entry displayed only the CAISO congestion share, it will still be partial because it will be missing now the congestion portion associated with PAC. The CAISO is working on an enhanced OASIS display that will publish the congestion component breakdown. In this case there will be an entry for the congestion share associated with PAC of $-\$11.88 + \$6.80$ and another entry with the congestion share associated with CAISO tie of

-\$183.29. The CAISO expect that this display will be available in January 2015 and will provide the clarity and minimize the concerns about the pricing for these two locations.

The CAISO upgraded its OASIS to provide the more granular displays for the Mona and Crag locations on January 8, 2015. However, it is continuing to evaluate the performance of that display and continues to make changes to ensure the greater granularity is provided accurately. The CAISO has been also working towards posting the greater granularity of prices going back to October 15 and is expected to have this part completed by February 18.

While the CAISO has resolved the pricing displays, the CAISO identified other technical issues that might have rendered prices as posted on OASIS or CMRI incorrect. The CAISO posted a market issue bulletin to describe these issues and is investigating the financial impact of these errors.⁹

⁹ The market issue bulletin is available at:
http://www.caiso.com/Documents/TechnicalBulletin_PricingLogicforSchedulingPoint-TieCombination.pdf,

ATTACHMENT E

In this attachment, the CAISO reports on each relaxation event, and a summary of the magnitude and frequency of such events overall.¹⁰ This report provides data on instances where the \$1,000/MWh price would have occurred but for the Commission's December 1 Order waiver, including the time of the instance, the duration, the cause, and the affected node(s) and load aggregation points.

The relaxation events affect numerous market intervals as the CAISO real-time markets contain many fifteen and five minute intervals. The information is provided at summary level because the data is significant and detail specific reporting of such events would not be meaningful. The report focuses on the external load aggregation points (ELAP) prices because these aggregate prices are representative of pricing in each area -- West and East-- and would reflect short-term imbalance shortage for the aggregate area.

Figure 16 through Figure 23 provide summary information on the instances of power balance relaxation for undersupply (shortage) in the fifteen- and five-minute market in the PAC West and East area. Normally, when there are such infeasibilities, it is expected that prices will be based on the constraint relaxation pricing parameter, and prices will be near or at \$1000/MWh. However, there are three cases where this would not occur and is reflected in the data supporting the figures in this report. First, as of December 1st consistent with the December 1 tariff waiver, the price is based on the last economic signal consistent with the pricing principles contained in the tariff. Second, as described in more detail in Attachment A, when the EIM Entity fails the flexible ramping sufficiency test prices are calculated using the same approach based on the last economic signal for the duration of the restricted interval. Therefore, it is important to keep in mind that in these intervals, even if the CAISO had not received the waiver, the CAISO would have implemented the procedure described in Section 10.3.2.1 of the Business Practice Manual, and prices would have still been based on the last economic bid cleared in the applicable fifteen-minute or five-minute interval in the EIM Entity balancing authority area as opposed to the \$1000/MWh bid cap.¹¹ In the December 15, 2014 report the CAISO noted that there was a third case in which it had observed the power balance constraint was relaxed in the scheduling run, but prices did not reflect the \$1000/MWh. The CAISO has since evaluated these cases more closely and as discussed in Attachment A, in some instances the market is in a degeneracy case, and

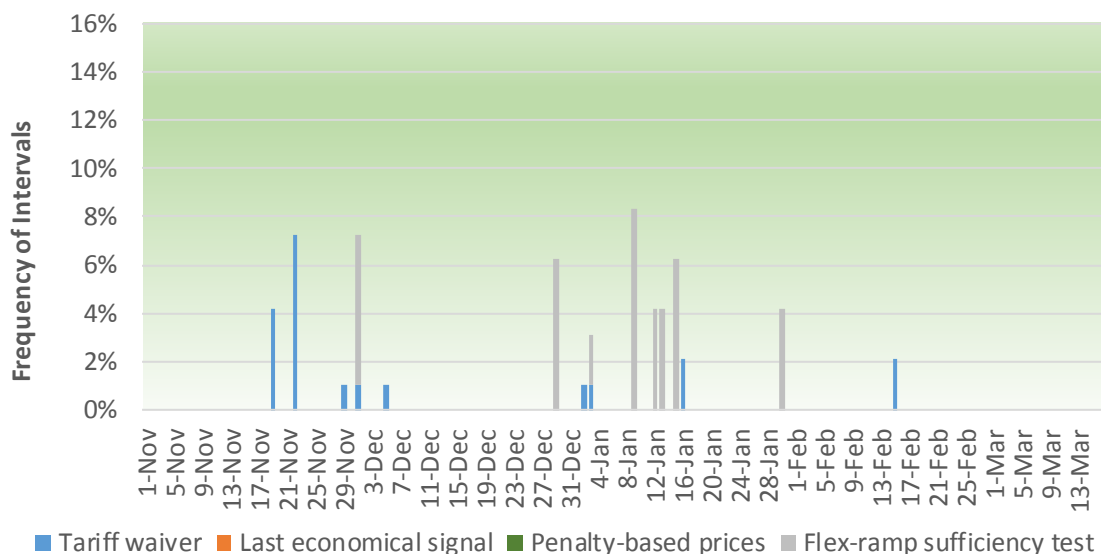
¹⁰ *December 1 Order*, at P 26.

¹¹ The price discovery mechanism under the procedure described in Section 10.3.2.1 of the BPM for Energy Imbalance Market is, however, essentially the same price discovery procedure used under the December 1 Order waiver.

the market clears based on the last economic signal. The CAISO is continuing to investigate these intervals to ensure these events are not due to other abnormalities and are in fact due to degeneracy. As explained in Attachment A, after the implementation of the pricing procedure under the December 1 waiver there is no pricing based on the degenerate cases because the pricing procedure under the December 1 waiver governs over the pricing.

Figure 16 through Figure 23 exclude the intervals that were subject to price corrections because they were invalid. These figures show the frequency of infeasibilities organized by instances in which the prices were set based on 1) the last economic bid price signal as per the tariff waiver, referred to in the figures as “Tariff waiver,” 2) the \$1000/MWh penalty price parameter, referred to in the figures as “Penalty-based prices” 3) last economical signal from degeneracy referred as “Last economical signal” and 4) the last economic signal but because for those intervals the EIM entity failed the flexible ramping sufficient test, referred to as the “Flex-ramp sufficient test.” Each figure of the frequency of infeasibilities is accompanied with a figure the magnitude of infeasibilities. The reported events are also aggregated on a daily basis and depicted with an infeasibility range shown by the vertical line in blue. The ends of the vertical blue lines represent the minimum and maximum values of power balance relaxation in each day. The average magnitude of the infeasibility is shown by the red marker on the blue vertical lines.

Figure 16: Frequency of under-supply infeasibility in PAC West. Fifteen-minute market.



For the period of November 1 through November 13, the data on the magnitude of infeasibility in the fifteen minute market was not preserved in the data system. This impedes the CAISO’s ability to identify the cases with infeasibility and quantify their

magnitude. However, such instances were conservatively estimated by analyzing the cases where prices reached the relaxation-based levels of \$1000/MWh.

Figure 17: Magnitude of undersupply infeasibility in PAC West. Fifteen-minute market.

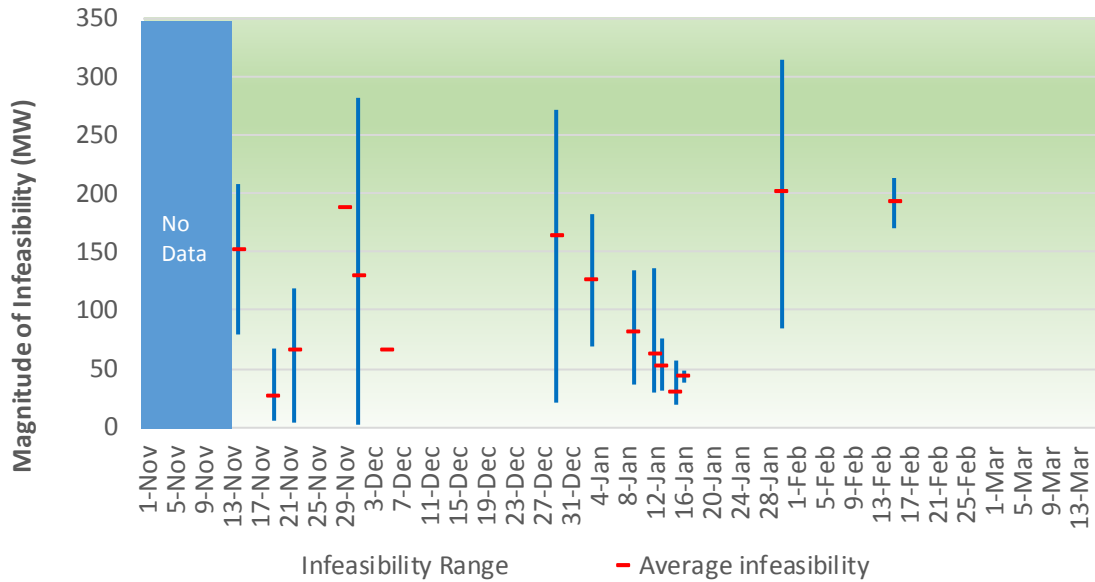


Figure 18: Frequency of undersupply infeasibility PAC East. Fifteen-minute market.

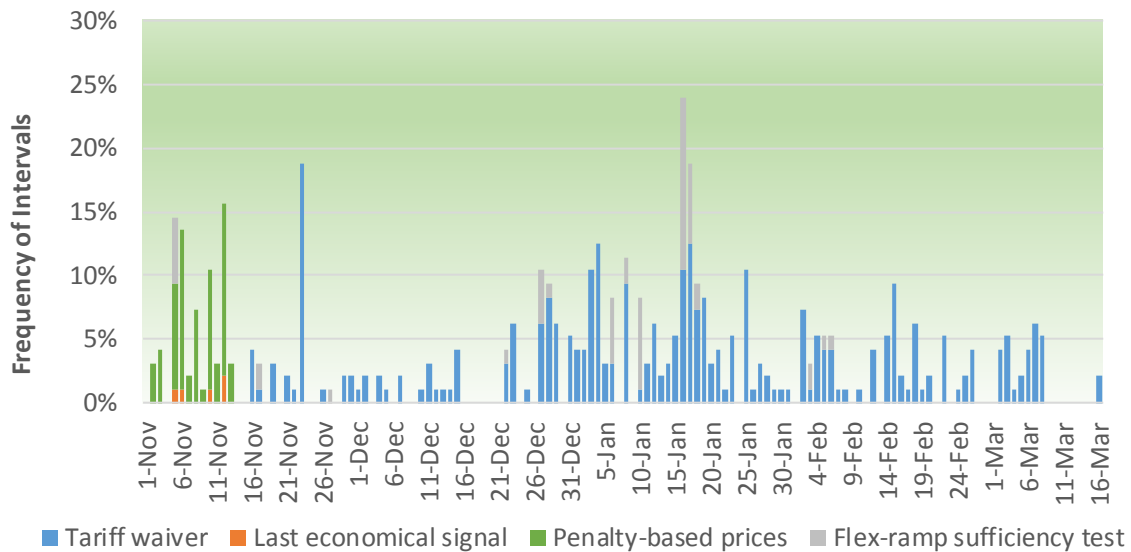


Figure 19: Magnitude of undersupply infeasibility PAC East. Fifteen-minute market.

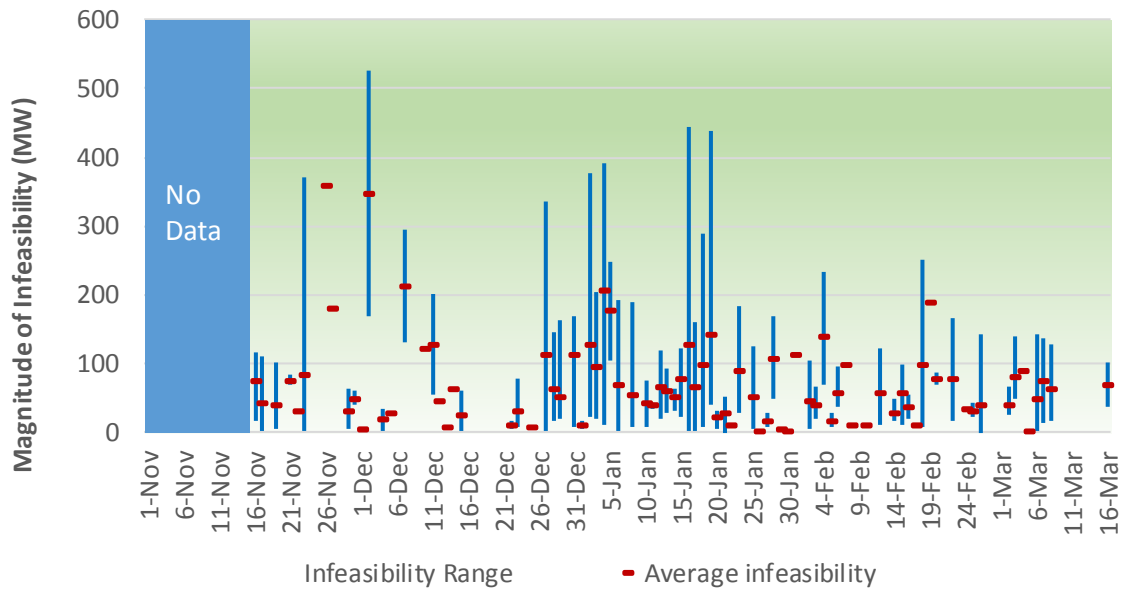


Figure 20: Frequency of undersupply infeasibility PAC West. Five-minute market.

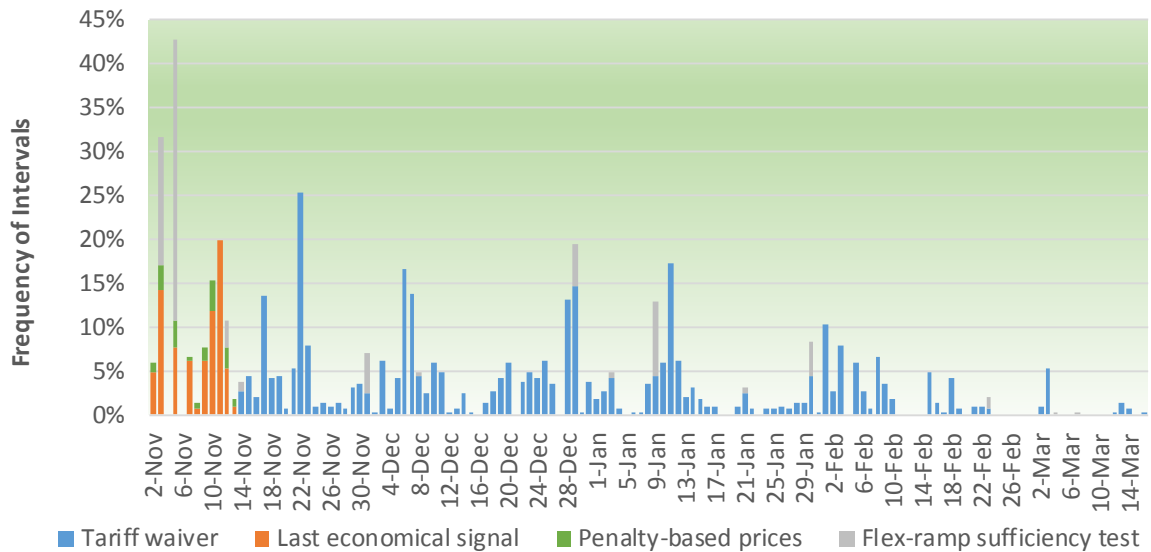


Figure 21: Magnitude of undersupply infeasibility PAC West. Five-minute market.

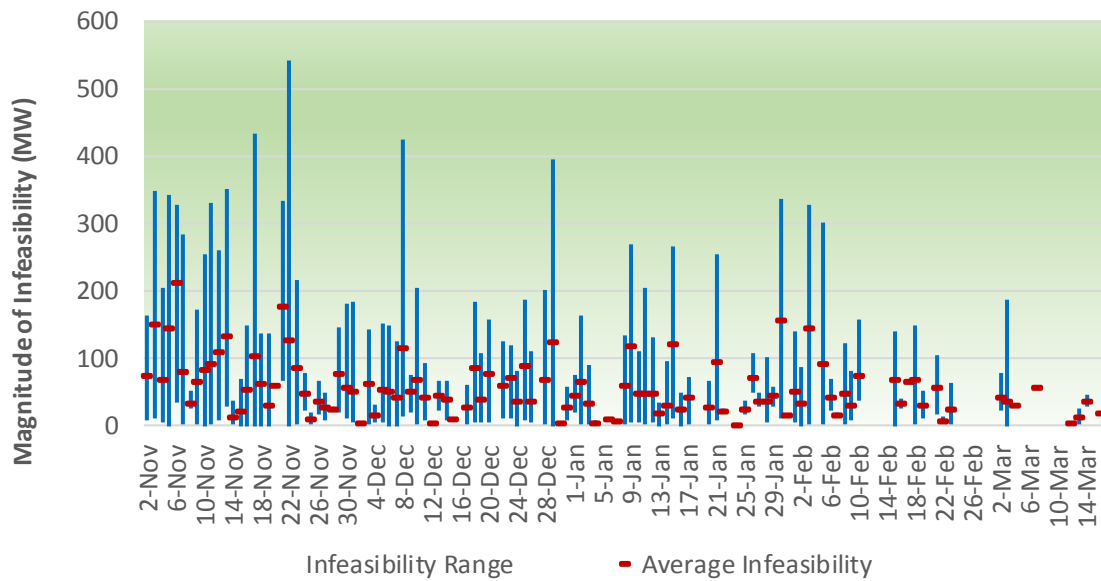


Figure 22: Frequency of undersupply infeasibility PAC East. Five-minute market.

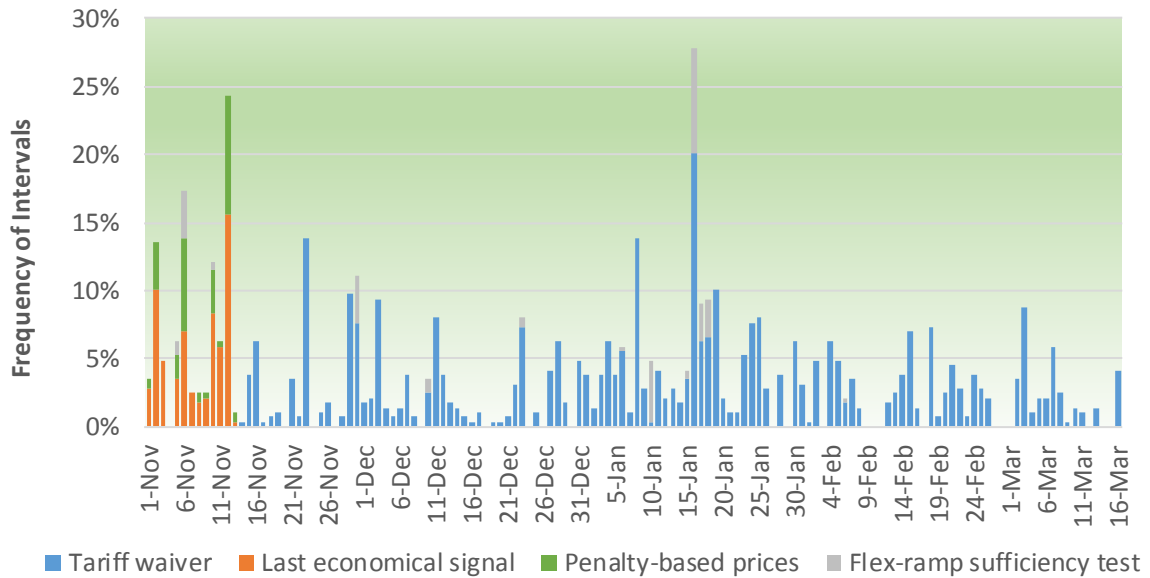


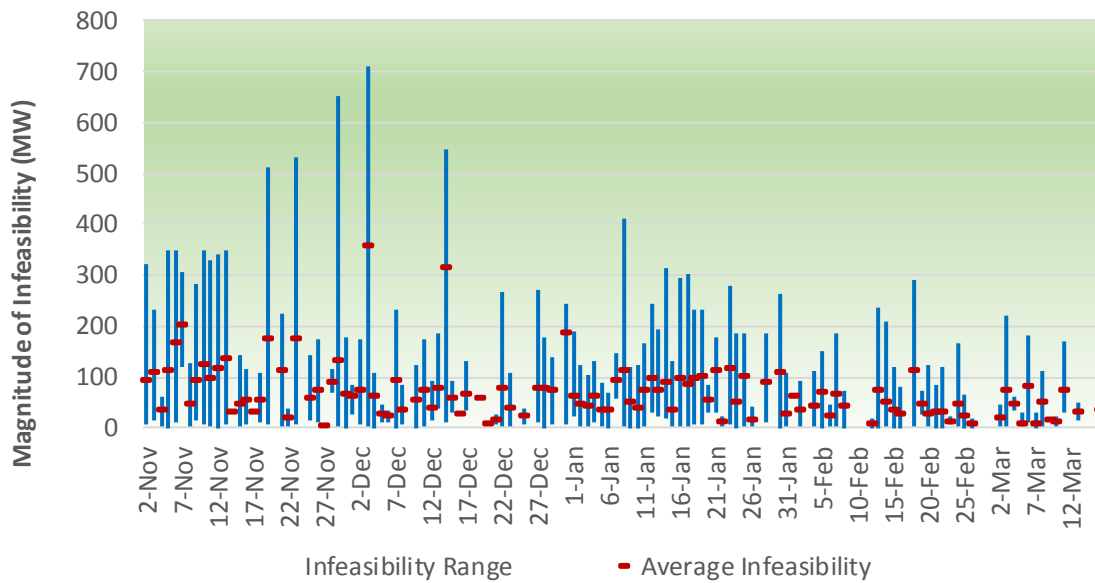
Figure 23: Magnitude of undersupply infeasibility PAC East. Five-minute market.

Figure 24 through Figure 27 show the hourly profile of the undersupply infeasibilities for both PAC West and East by market. This profile is provided to identify any patterns during the day where infeasibilities may be more prone to occur, such as the pull-up periods of load, for the period of January 1 through February 12. This operational data, however, shows no marked pattern of the frequency of infeasibilities with the time of day. This may be an indication that the drivers of infeasibilities are not system condition related.

Figure 24: Hourly undersupply infeasibilities for PAC West. Fifteen-minute market.

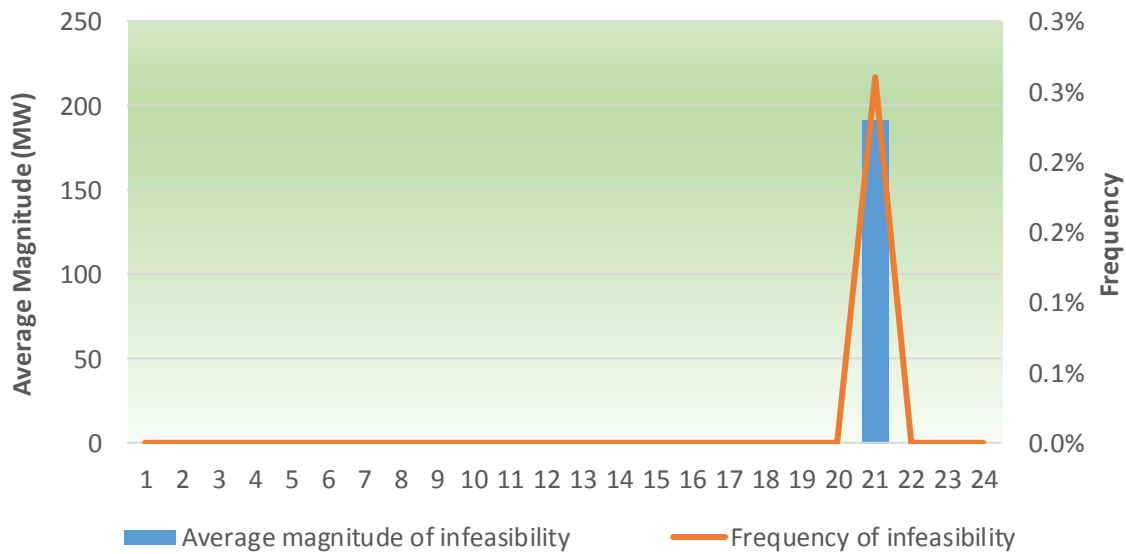


Figure 25: Hourly undersupply infeasibilities for PAC East. Fifteen-minute market.

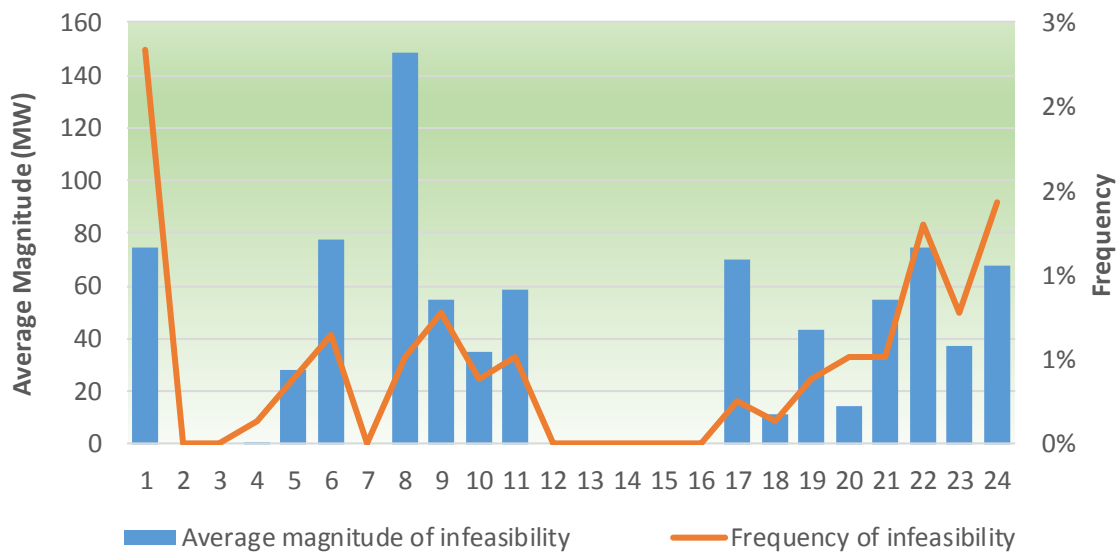


Figure 26: Hourly undersupply infeasibilities for PAC West. Five-minute market.

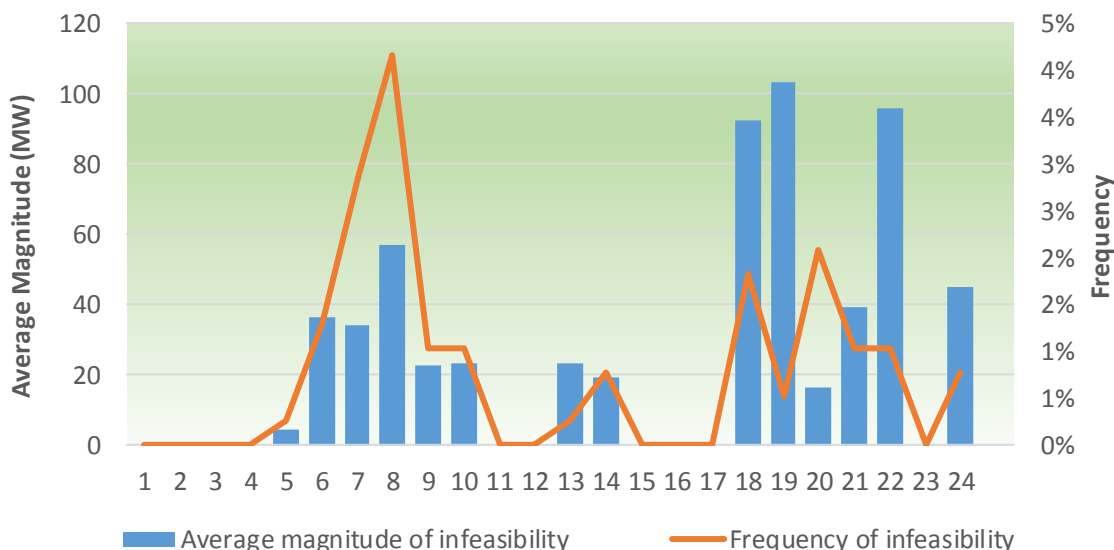
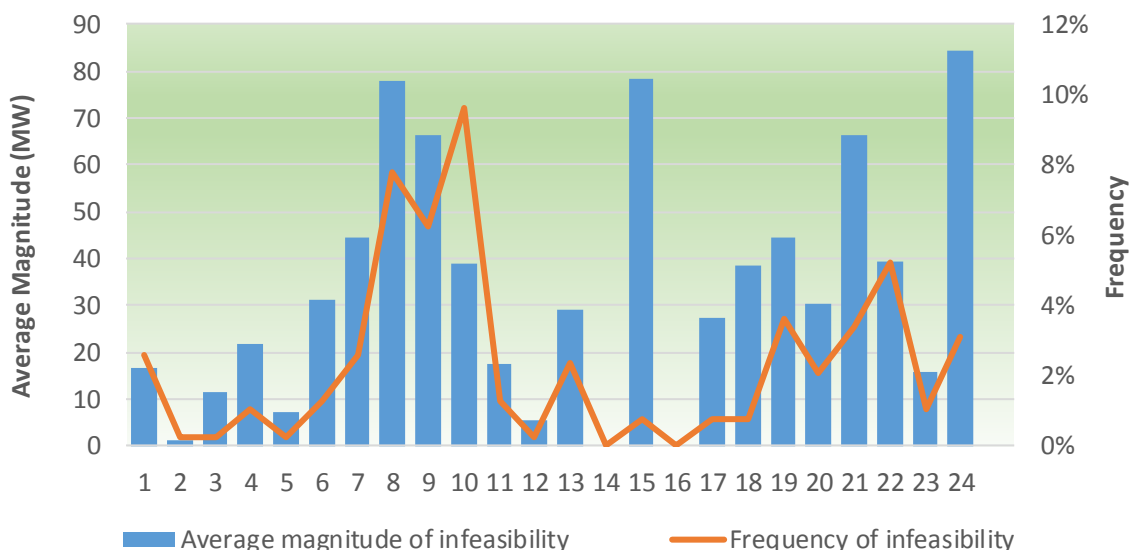


Figure 27: Hourly undersupply infeasibilities for PAC East. Five-minute market.



The imbalance energy transfers may also be subject to relaxation to address infeasibilities; there were few instances only in the PAC East transfer that resulted in relaxation; there were no instances of relaxation of EIM transfers between PAC and CAISO. The summary of these instances are listed in Table 1

Table 2. All these instances occurred before the period applicable for the waiver associated with this report; there were no valid EIM transfer infeasibilities observed in January and February. There were three invalid infeasibilities on PAC East on January 15

due to a software issue that were addressed through the standard process of price corrections.

**Table 1: Statistics of EIM transfer infeasibilities for PAC East.
Fifteen-minute market.**

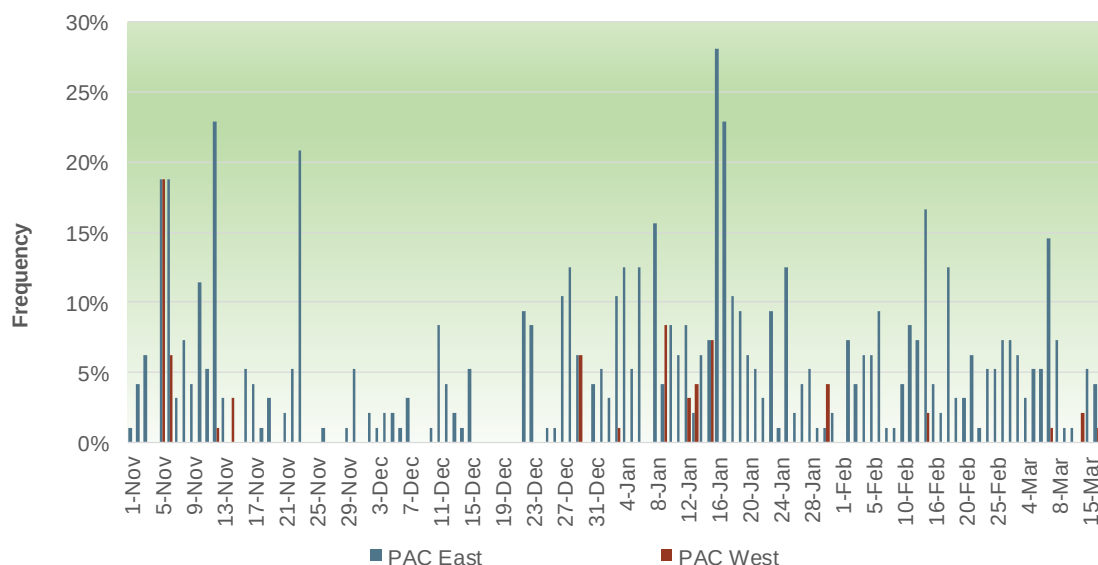
Date	Maximum	Minimum	Average	Count
6-Nov-14	51.4	1.1	26.2	2
10-Nov-14	121.0	121.0	121.0	1
12-Nov-14	126.7	72.0	99.3	2
13-Nov-14	130.9	16.9	76.2	3

**Table 2: Statistics of EIM transfer infeasibilities for PAC East.
Five-minute market.**

Date	Maximum	Minimum	Average	Count
6-Nov-14	65.2	65.2	65.2	1
10-Nov-14	114.3	97.9	106.1	2

For completeness, the data in this report also includes those cases in which there was a relaxation of flexible ramp constraint; the data is organized by PAC West and East in Figure 28. This metric does not include intervals that were subject to price corrections.

Figure 28: Frequency of flexible ramp constraint infeasibility in PAC



Finally, this report also includes information about infeasibility for over supply conditions even though these cases are not reflected in the waiver requested in this proceeding. The penalty prices specified in sections 27.4.3.2 and 27.4.3.4 only pertain to infeasibility cases in which there is under-supply. The penalty prices for the over-supply conditions are specified in section 6.6.5 of the BPM for Market Operations. The over-supply metrics are provided in Figure 29 through Figure 36.

Figure 29: Frequency of oversupply infeasibility PAC West. Fifteen-minute market.

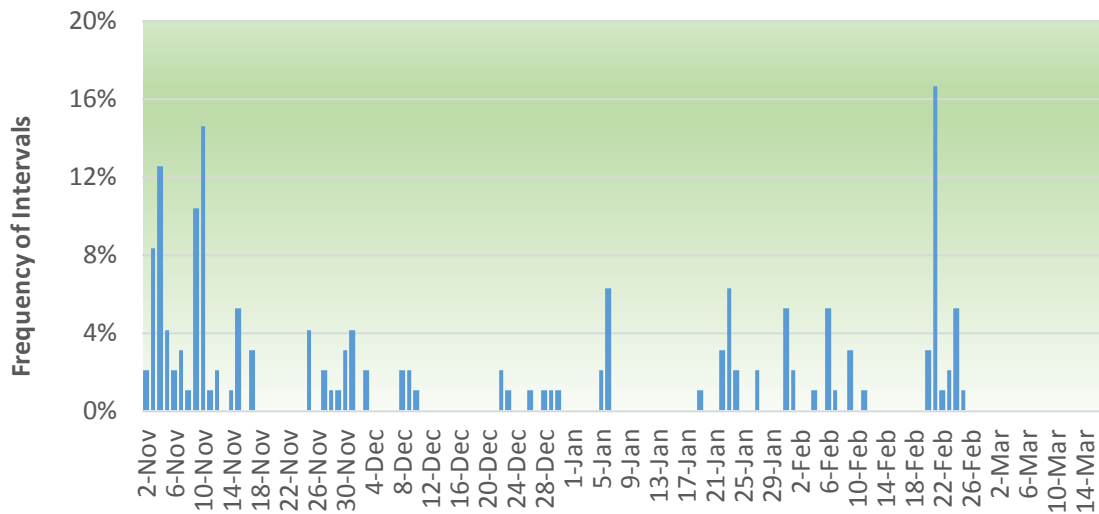


Figure 30: Magnitude of oversupply infeasibility PAC West. Fifteen-minute market.

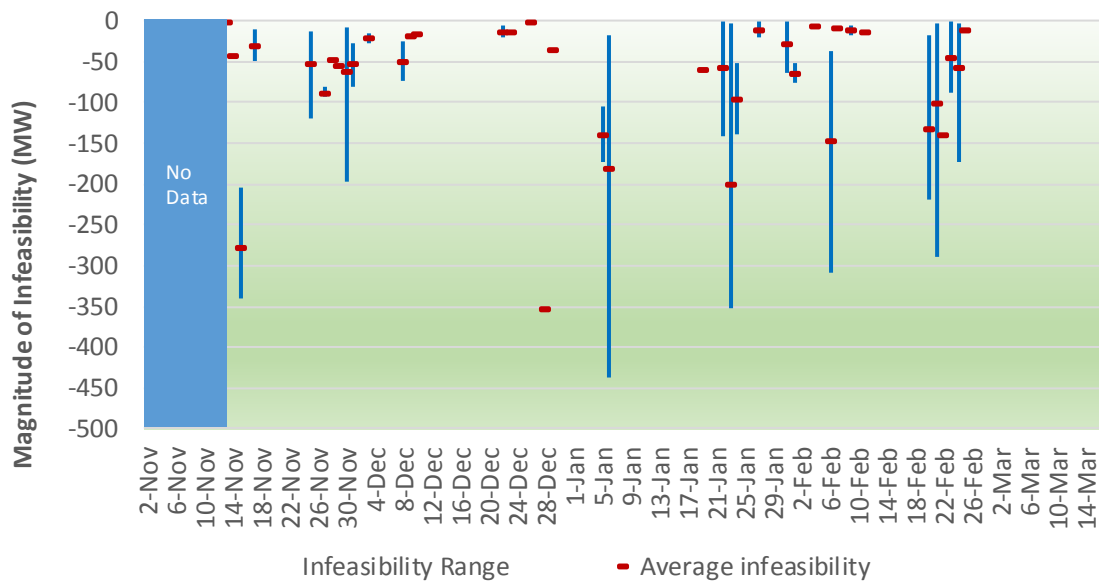


Figure 31: Frequency of oversupply infeasibility PAC East. Fifteen-minute market.

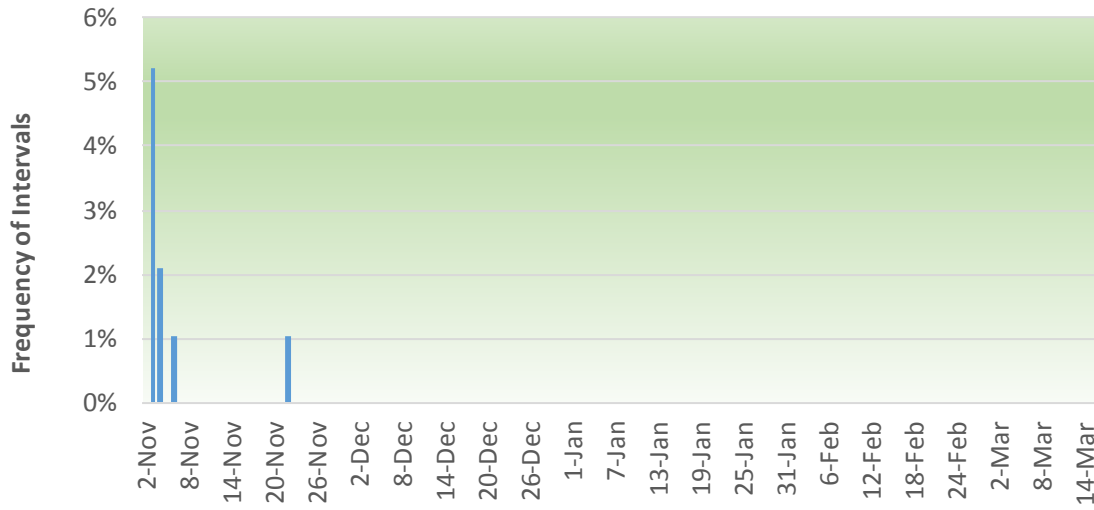


Figure 32: Magnitude of oversupply infeasibility PAC East. Fifteen-minute market.

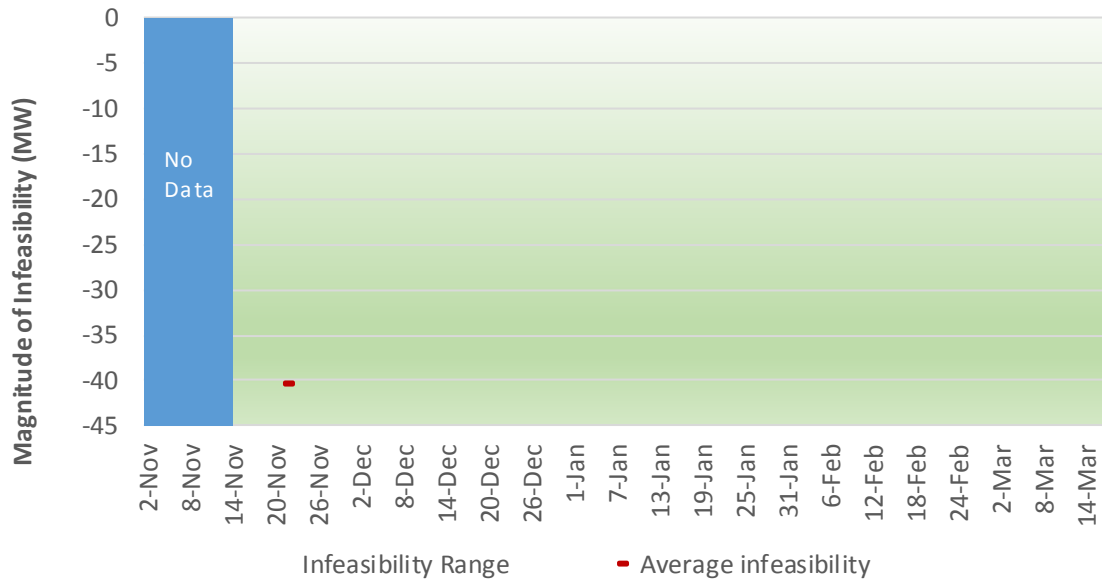


Figure 33: Frequency of oversupply infeasibility PAC West. Five-minute market.

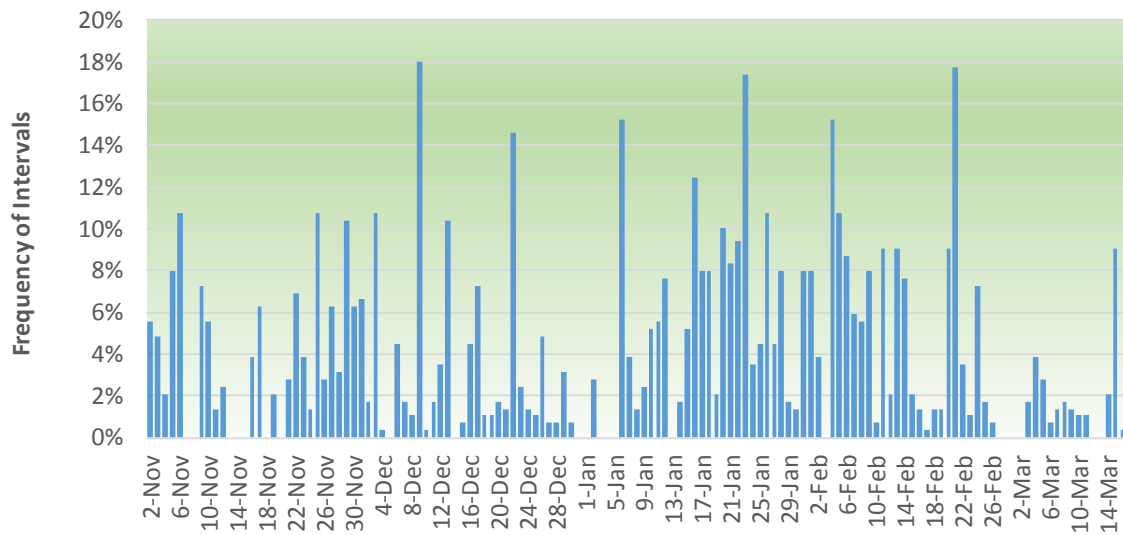


Figure 34: Magnitude of oversupply infeasibility PAC West. Five-minute market.

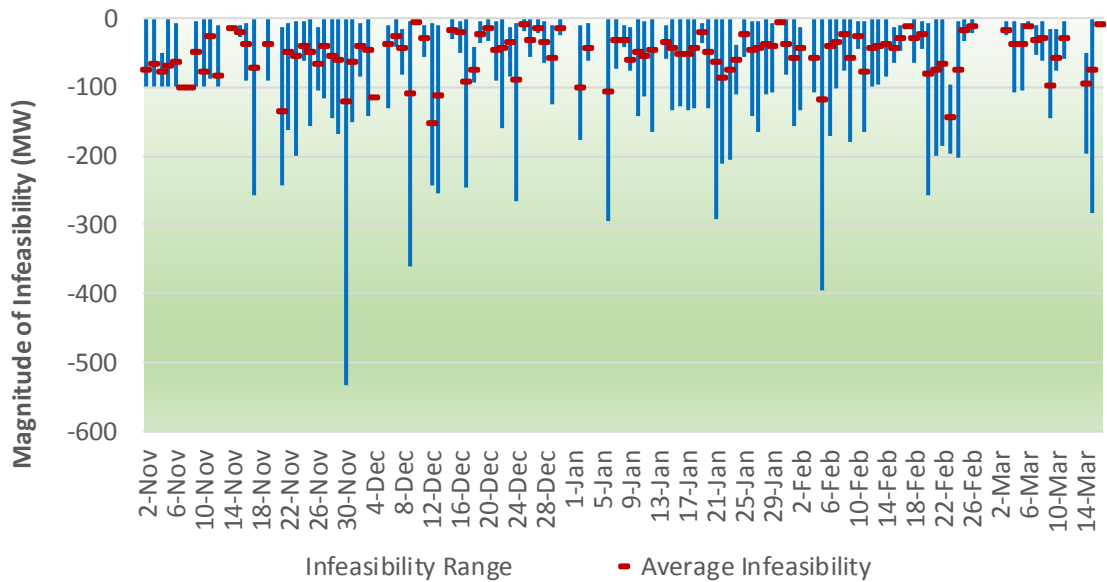


Figure 35: Frequency of oversupply infeasibility PAC East. Five-minute market.

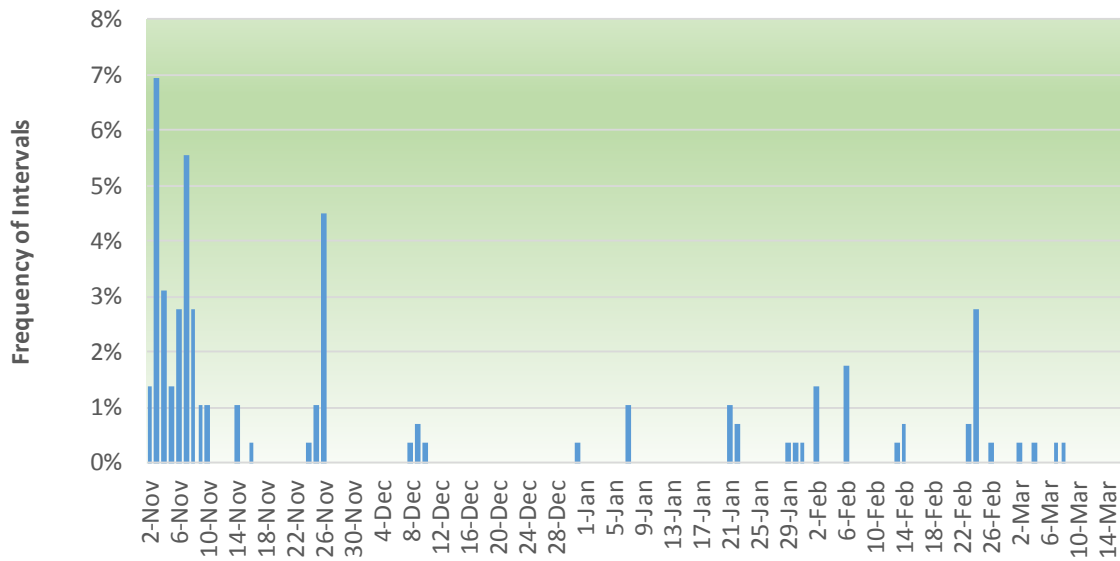
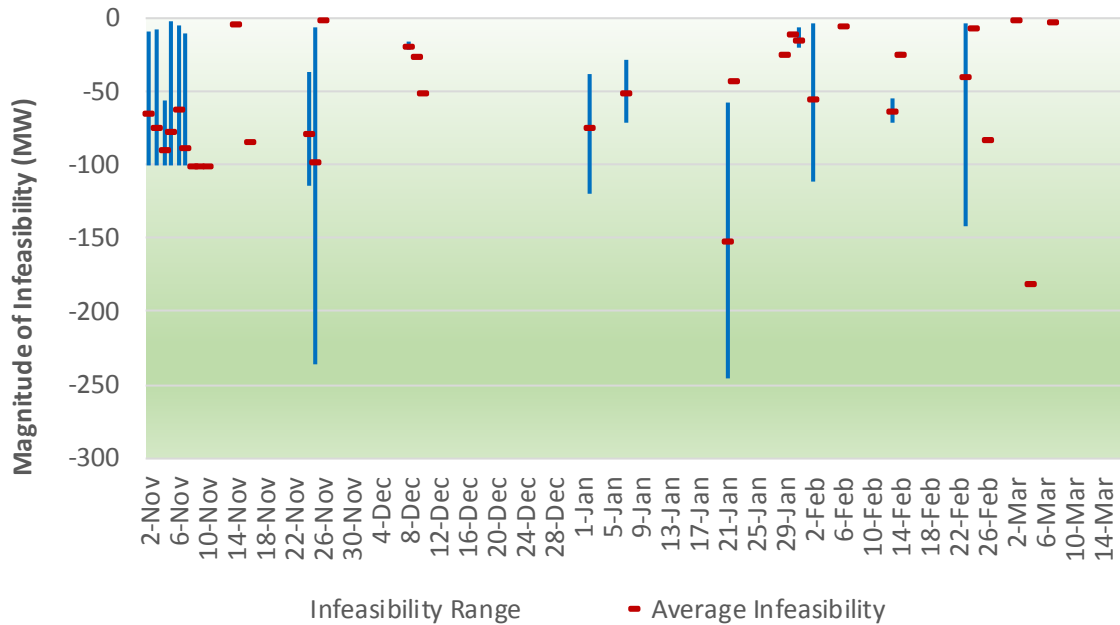


Figure 36: Magnitude of oversupply infeasibility PAC East. Five-minute market.



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 26^h day of March, 2015.

/s/ Anna Pascuzzo
Anna Pascuzzo

April 24, 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
March 2015 Informational Report
Energy Imbalance Market - Price Waiver Report**

Dear Secretary Bose:

The California Independent System Operator Corporation (CAISO) hereby submits its report on the performance of the Energy Imbalance Market for March 1 – March 31, 2015.¹

The Commission also directed the Department of Market Monitoring to submit independent assessments on the causes and solutions identified by CAISO. The CAISO intends to submit the independent assessment of the Department of Market Monitoring in about eight days.

On March 16, 2015, the Commission directed the CAISO to refine the monthly reports to “assist the Commission and the parties in determining the extent to which the price spikes continue to be caused by transitional issues, and the extent to which they may be triggered by lack of adequate supply in the EIM.”² This report complies with the Commission’s March 16 directives. The CAISO will continue filing such reports mid-month consistent with the Commission’s order to continue submitting reports on a 30 day interval until the 206 investigation is concluded or the Commission issues a directive, whichever is earlier.

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

² *California Indep. Sys. Operator Corp. Inc.*, 150 FERC ¶ 61,191 (2015).

Please contact the undersigned with any questions.

Respectfully submitted

By: /s/ Anna A. McKenna

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California ISO

**Energy Imbalance Market
Pricing Waiver Report
March 1 – March 31, 2015**

April 24, 2015

I. Introduction and Background

On December 1, 2014, the Federal Energy Regulatory Commission (FERC) granted the California Independent System Operator Corporation's (CAISO) petition for limited waiver of the pricing parameters in sections 27.4.3.2 and 27.4.3.4 of its tariff for 90 days, as they pertain to the Energy Imbalance Market (EIM), effective November 14, 2014, as requested.¹ In addition, FERC directed CAISO to submit informational reports as further described. The CAISO will submit monthly the requested reports in Attachments A through E. This report covers the CAISO's reporting requirements for the time covering March 1 through March 31, 2015.

The Commission also directed the Department of Market Monitoring (DMM) to submit independent assessments on the causes and solutions identified by CAISO. The DMM requires some additional days to fully review and evaluate the CAISO's report and provide an independent assessment. The DMM will file its report within approximately eight days of the CAISO having filed this report.

On November 1, 2014, the CAISO fully activated the EIM. The EIM allows balancing authorities outside of the CAISO balancing authority area to participate voluntarily in the imbalance energy portion of the CAISO locational marginal price-based real-time market. PacifiCorp, the CAISO, and market participants participated in market simulations prior to the start of the EIM on November 1, including parallel production from October 1 to November 1. However, shortly after go live the CAISO observed challenges that led to artificially high prices where the market application had relax transmission constraints or the power balance constraint to clear the market.

On November 13, 2014, the CAISO sought a 90-day waiver of the applicability of section 27.4.3.2 and the second sentence of section 27.4.3.4 of its tariff to permit CAISO to address, without suspending the EIM, those circumstances which produced atypically high prices. Those two sections of the tariff require that when there is a lack of economic bids, considering resource ramping and other constraints, to clear the fifteen-minute and five-minute markets, the CAISO's market will price the shortages (and therefore establish locational marginal prices) based on the pricing parameters specified in those sections. The pricing parameter is \$1,000/MWh (the maximum energy bid price specified in tariff section 39.6.1.1).

¹ *California Indep. Sys. Operator Corp.*, 149 FERC ¶ 61,194 (2014) (December 1 Order).

The waiver addresses three sets of transitional conditions in the EIM that together have caused the transmission and system energy-balance constraints described in tariff sections 27.4.3.2 and 27.4.3.4 to bind more frequently than expected in the weeks since the EIM began operation on November 1, causing prices in these intervals to be set by the \$1,000/MWh relaxation parameter. Because of these transitional conditions, the high prices are not always indicative of actual physical conditions on the system, and reflect challenges in providing timely and complete data to ensure system visibility under the new procedures, exacerbated by limitations on the resources available to PacifiCorp for the EIM and several forced outages of large EIM participating resources.

On December 1, 2014, FERC granted the CAISO its waiver request and directed monthly reports to FERC on the progress of the issues that led to the need for the waiver. On February 12, 2015, the Commission extended the term of this waiver to March 16, 2015, in its order issued in FERC Docket ER15-861.²

On March 16, 2015, the Commission again extended the waiver to 90 days after the date on which the Commission's order issued on March 16, 2015, in FERC Docket No. ER15-861 is registered in the Federal Register (June 22, 2015).³ In the March 16 order, the Commission also directed the CAISO to refine the monthly reports to "assist the Commission and the parties in determining the extent to which the price spikes continue to be caused by transitional issues, and the extent to which they may be triggered by lack of adequate supply in the EIM."⁴ This report includes the following additional information requested by Commission in its March 16 order:

... identify, for each such event, whether the cause was due to transitional issues or was due to insufficient supply of resources bid into the EIM.

... clarify the information presented in the tables included in Attachment A, Section 2 of the future reports. At a minimum, the clarifications should: (1) differentiate supply deficiencies from transitional issues; (2) provide concise information on required remedial measures, execution responsibility, completion time frame and status; and (3) provide transparent identification of the frequency and market impact of each root cause issue.

² *California Indep. Sys. Operator Corp.*, 150 FERC ¶ 61,086 (2015).

³ *California Indep. Sys. Operator Corp.*, 150 FERC ¶ 61,191 (2015).

⁴ See 150 FERC ¶ 61,191 at P 38.

... identify any [...] seasonal challenges that occur during the reporting period, and describe the operational or business process revisions planned or implemented, as applicable, to address such issues.

The CAISO will continue filing such reports monthly consistent with the Commission's order to continue submitting reports on a 30 day interval until the 206 investigation is concluded or the Commission issues a directive, whichever is earlier.

II. Reports

Attachment A: Provides a quantitative and qualitative description of the issues that prompted the CAISO's waiver request and those observed during the reporting period. This attachment also reports on any such seasonal challenges that occur during the reporting period.

Attachment B: Identifies any remedial measures, execution responsibility, completion timeline, and status for the category of issues identified above.

Attachment C: Provides a description of each relaxation event and a summary of the magnitude and frequency of such events overall, and data on instances where the \$1,000/MWh price would have occurred but for this waiver. This attachment also identifies the frequency and market impact of each root cause issue.

Attachment D: Provides a quantitative and qualitative analysis of the market performance impact of the issues that prompted the CAISO's request for a waiver.

Attachment E: Provides a summary of the magnitude and frequency of the post implementation issues described in Attachment A overall.

ATTACHMENT A

Quantitative and qualitative descriptions of market performance related to the issues that prompted the CAISO's waiver request - CAISO.

This attachment describes the issues that prompted the CAISO to file for the pricing waiver and those observed during the term of the waiver. This attachment also reports on any such seasonal challenges that occurred during the reporting period.

A. Qualitative Description of Issues

The CAISO and the EIM entity have evaluated each interval of infeasibility to determine the root cause of the infeasibility. There are seven categories of issues observed. Each interval of infeasibility may be the product of one or more category of issues. Sometimes, a single reason may drive an infeasibility; but in some cases, a combination of a number of conditions led to the infeasibility. Therefore, it is not possible to identify a single cause for each infeasibility. However, to provide meaningful reports, the CAISO identified what appears to be the most prevalent issue that gave rise to the infeasibility in each interval and assigned the interval to that category. The reports included in this submission qualify and quantify the issues according to these categories, which are as described below:

1. Renewable Deviations

The *Renewable Deviations* category identifies intervals in which the infeasibilities were primarily due to wind and/or solar output deviations from the resource's hourly base schedules that led to the loss of capacity and the need to increase generation from other resources. These types of deviations were beyond deviations the flexible ramping requirement could resolve by the available system ramping capacity. In some cases, there were significant deviations between wind forecasts and the resource's actual output over a period of a number of days. The CAISO utilizes the wind forecast as an indicator of the maximum level to which it can dispatch the resource. If the forecast is significantly flawed, this can create discrepancies between the wind resource's actual output and their forecast. The accuracy of the forecast is dependent on the accuracy of telemetry, which in some cases was problematic. Such issues caused energy imbalance, over-generation, or under-generation conditions as observed by the market systems, leading to infeasibilities.

2. Load Changes

The *Load Changes* category identifies those intervals in which the infeasibility was predominately due to either problematic operator adjustments of load forecasts or changes to those adjustments. The EIM entity grid operators can adjust (or “bias”) the load forecast for reliability to account for any non-modeled issues causing discrepancies between forecast load and actual load in real-time. The operator can make these adjustments after the base schedules are submitted. The operator sets the bias based on his/her judgment of system operational and reliability needs. In some cases, because operators make the adjustments manually, they make these adjustments at a less granular level than is precisely necessary to consider the capability of the system. For example, the operator believes it needs to make an adjustment of 100 MWs due to load changes in real-time. However, because the system is ramp constrained, the operator should make an adjustment of 100.5 MWs to obtain the extra capacity needed to address the system ramp limitations, which is not possible because the operator cannot observe the ramp constrained nature of the system.

In some cases, the load forecast issues were caused by the practice of including large industrial load forecasts in the EIM total load forecast. The EIM entity can adjust these large-scale industrial loads as part of an interruptible load program to balance its system. Prior to April 1, these demand resources were included in the total balancing area load forecast and treated as conforming load, although these loads are non-conforming and independent from the regular conforming loads. After April 1, the CAISO excluded the large industrial load forecast from the total forecast and instead modeled these demand resources as participating resources. This allows the EIM entity to account for their contribution to total supply more effectively and adjust supply as needed.

Distributed energy resources are also included in the market load forecast as conforming load. These resources have both load and generation components, which net to a positive or negative net injection at the load bus. The market systems do not see when these resources are generating and therefore it accounts for more load than what is actually occurring in real time operations. The lack of base schedules for such resources further prevents the market from observing the impact of their output in the market systems.

3. Import/Export Changes

The *Import/Export Changes* category identifies intervals in which the infeasibilities were primarily due to the lack of visibility in the market systems of updates to imports and exports schedules or adjustments made for such updates after the deadline for submitting base schedules at forty minutes before the

trading hour (T-40'). When the CAISO performs the balancing test, the market systems assume that the import and/or export base schedules transactions will materialize. For example, the feasibility test assumes that an import base schedule of 600 MW will be delivered. However, after the deadline for submitting base schedules has passed, *i.e.*, after T-40, only 300 MW is actually tagged, which can be done up to T-20. If market systems do not see sufficient capacity to cover the difference of 300 MW, the power balance constraint will be relaxed and trigger the parameter based pricing.

4. Resource Outages

The *Resource Outages* category identifies intervals in which the infeasibilities were primarily due to outages of supply resources that resulted in loss of capacity observed in the fifteen or five minute market which had been previously identified as available. Sometimes there was untimely or inaccurate communication of outage cancellations, which led to the market systems to perceive insufficient supply. When resources experience full or partial forced outages, the market must be informed in a timely manner of the outage event and the corresponding grid operator measures taken to compensate for the lost megawatt capacity.

The timing in which the EIM entity reports the outage is very important. If the outage occurred before T-75 (*i.e.*, seventy-five minutes before the trading or operating hour) and the entity expects it to last during the operating hour, then it should adjust both the economic bid and base schedule to account for the outage. Otherwise, the assumptions and data used by the market application for the balance test and the look-ahead fifteen-minute market contradict real-time system conditions, which results in less capacity available to the EIM than what was computed before the start of the operating hour, and high prices are imminent due to limited unloaded economic capacity offered into the market.

Sometimes the issues identified in this category are due to purely physical outages such as unit trips, which the market systems may observe through telemetry. However, at times the market systems are not informed of the actions taken by the EIM entity to replace that loss of supply. This results in a perception of insufficiency when none exists because the operator deployed operating reserve or curtailed industrial load but the information was not conveyed to the market.

The CAISO does not approve or reject outages of resources in the EIM entity balancing authority area. However, the EIM entity must provide outage information of EIM participating and non-participating resources in a timely and accurate manner. The CAISO incorporates the outage information submitted by

the EIM entity into the real-time market to ensure the market clears on the most accurate outage information available.

Because the EIM entity remains in control of the outage approval process, the outages may be unrelated to actual physical conditions. In some cases, the EIM entity may submit an outage on a resource as it moves capacity around to manage its reserves and takes corresponding manual dispatch actions. However, if the manual dispatch actions are not conveyed timely and correctly, the market software might observe an infeasibility when in reality the EIM entity is sufficiently resourced.

5. Manual Dispatches

The *Manual Dispatches* category identifies intervals in which the infeasibility was predominantly due to a manual dispatch action taken by the EIM entity. For example, when system operating conditions for a resource change in real time after the resource's base schedule is submitted, the EIM entity may submit a manual dispatch indicating the maximum capacity to which the resource may be dispatched, which would reduce the available capacity to the market but it is more representative of actual system operating conditions. The manual dispatches are in the form of a fixed megawatt value instruction, a minimum megawatt value, a maximum megawatt value, a start-up instruction, or a shut-down instruction. The EIM entity performs Manual Dispatches to address resource bid issues, market system issues, outage management system issues, reliability needs, reserve sharing events, or variable energy forecast deviations that occur after the deadline for submission of base schedules to maintain the reliability of the balancing authority area. The balancing test does not recognize the manual dispatch information, because it occurs after T-75 but before T-40. If the balanced schedules conflict with the manual dispatch, they may trigger an infeasibility.

6. Resource Data Alignment

The *Resource Data Alignment* category identifies intervals where the infeasibilities were not due to any of the other categories, but in which the following issues were observed: 1) resources were deviating from their dispatch, 2) there were differences between base schedules and bids or dispatch operating targets, and 3) multi-stage resources were operating in configurations that contradicted their base schedules. In addition, sometimes, multi-stage resources had large overlapping ranges and long transition times, which created physical infeasibilities and limited the range of flexibility for the market to move the resource

Many of these issues were driven by the EIM entity transitioning to a new market paradigm and learning how best to manage its fleet within the new paradigm using a series of complex systems. For example, initially the EIM entity believed it had registered the characteristics of its multi-stage generating resources consistent with how it intended the units to operate. Multi-stage generating resources have multiple configurations that the operator must carefully manage in the real-time market. The scheduling coordinator registers the configuration characteristics in the master file and the market applications observe and honor them. These include physical, registered characteristics such as transition time, minimum up time and minimum down time, and minimum capacity (Pmin) and maximum capacity output (Pmax) MWs and any overlapping MW regions between configurations. If a configuration is out of service, the EIM entity must submit a timely outage card to inform the market that the corresponding economic bid or base schedule is not available and another configuration is. If it does not perform this task promptly and accurately, or bids do not exist on other configurations, then the market cannot move the resource to other configurations and fails to account for the plant's full available capacity. Through actual operations experience and the EIM entity's evaluation of the dispatch solutions over time, PacifiCorp learned that it should model certain resources differently to allow the market systems to move the resources more efficiently. PacifiCorp modified its practices to find workable market solutions within the technical feasibilities of its resources, and the technical boundaries of the CAISO market features.

On occasion, resources were seen to be deviating from their market dispatch signal because either 1) the plant was unavailable, 2) an outage ticket was not entered on time, or 3) there was a delay in setting the plant on automatic generation control to be dispatched directly from the market signal. Sometimes it was necessary for the EIM entity to make direct phone calls to plant operators to communicate the market signal to move the resource up or down according to the plant's market dispatch signal, which was problematic because these actions take time and are manual in nature.

The EIM entity is sending telemetry values for all PacifiCorp resources registered in the master file. When the quality of the telemetry values is poor, the state estimator solution quality is negatively impacted, which affects the quality of the market solution and the dispatch operating targets of these resources. During the first few weeks of operation, the CAISO found that some resources had telemetry measurements of their auxiliary load and others had gross telemetry measurements that did not include the auxiliary load. In addition, certain wind resources and other small non-participating resources did not have telemetry at all.

The energy management system (EMS) and automatic generation control (AGC) monitors and accounts for the energy of multi-stage generating resources during the startup and shutdown periods when their output is below the PMin. However, the market does not account for this energy because it is below the PMin of the resource. This creates a discrepancy in the load balance test, and the imbalance calculations between market and actual conditions as seen by AGC, which led grid operators to bias the load forecast.

7. Transfer/Congestion Constraints

The *Transfer/Congestion Constraints* category identifies intervals in which the infeasibility was primarily due to the interplay of EIM transfer constraints or congestion in either a PacifiCorp balancing authority area or the CAISO's balancing authority area, which restrict the incremental generation of resources.

The EIM re-optimizes the EIM transfer capacity in both the fifteen-minute and five-minute markets. Regarding the California Oregon Intertie, the added restriction of the dynamic five-minute limit, which is an incremental limit around the fifteen-minute solution, may create infeasibilities. The five-minute dynamic limit constrains the market application from fully re-optimizing the fifteen-minute EIM transfer beyond the amount allowed by the five-minute incremental dynamic limit, which is especially restrictive during on-peak hours.

In addition, the rate-of-change constraints across the Bonneville Power Administration (BPA) network are five-minute flow limit constraints that limit five-minute movement of PacifiCorp West balancing authority area participating resources around the corresponding resources' fifteen-minute schedules due to their flow impact on certain paths and flowgates internal to the BPA balancing authority area. This restriction on the resources' five-minute movements or the corresponding rate-of-change constraint at times created infeasibilities on the affected resources when the corresponding path or flowgate five-minute limit constraint is binding.

B. Frequency with Which Issues Caused Infeasibilities

Figure 1 through Figure 4 show the frequency with which each of the categories of issues discussed above caused price excursions in both the fifteen and five-minute markets. In any market interval, more than one category of issues may have contributed to the price excursion because there are numerous elements at play in any given market run that can influence its outcome. However, as discussed above, the CAISO determined which of the categories of issues was most prevalent in each interval and assigned it that category. The CAISO produced the frequency diagrams based on that data.

Figure 1: Reasons for intervals with undersupply infeasibility in the fifteen-minute market in December 1 to March 31 - PAC West and PAC East combined.

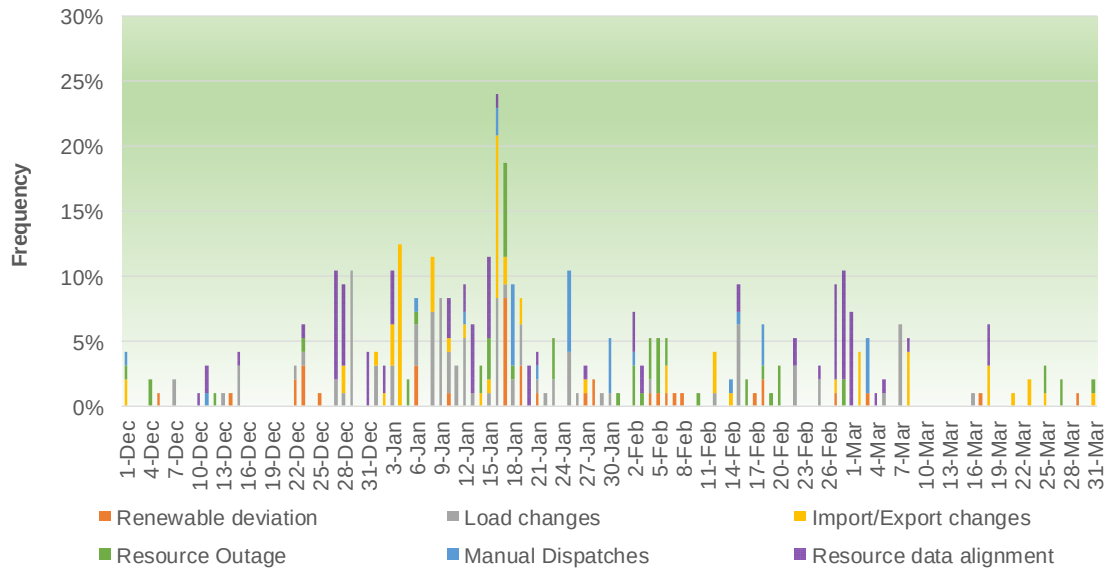


Figure 2: Reasons for intervals with undersupply infeasibility in the five-minute market in December 1 to March 16 - PAC West and PAC East combined.

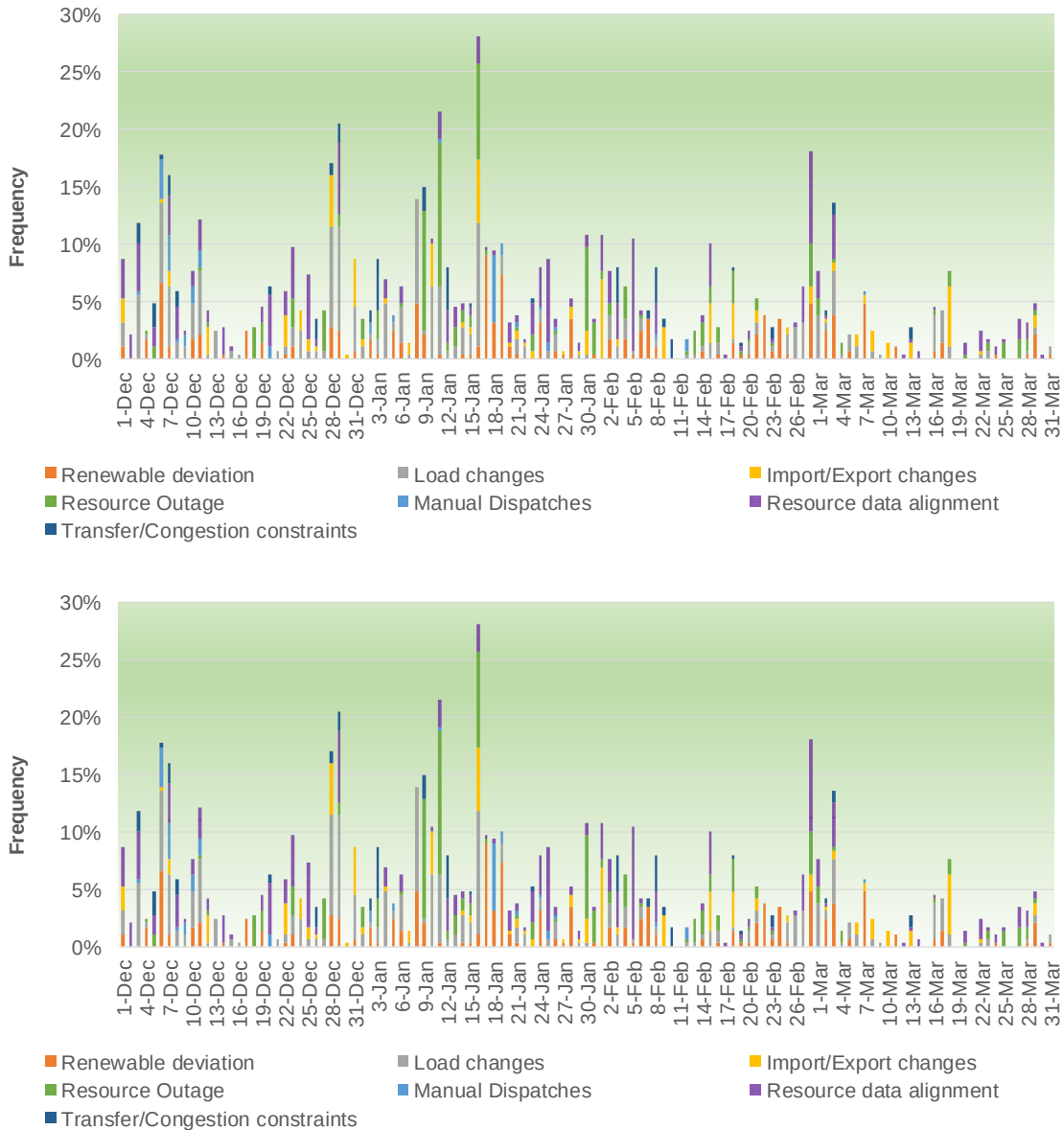


Figure 3: Frequency of undersupply infeasibility in the fifteen-minute market in March - PAC West and PAC East combined.

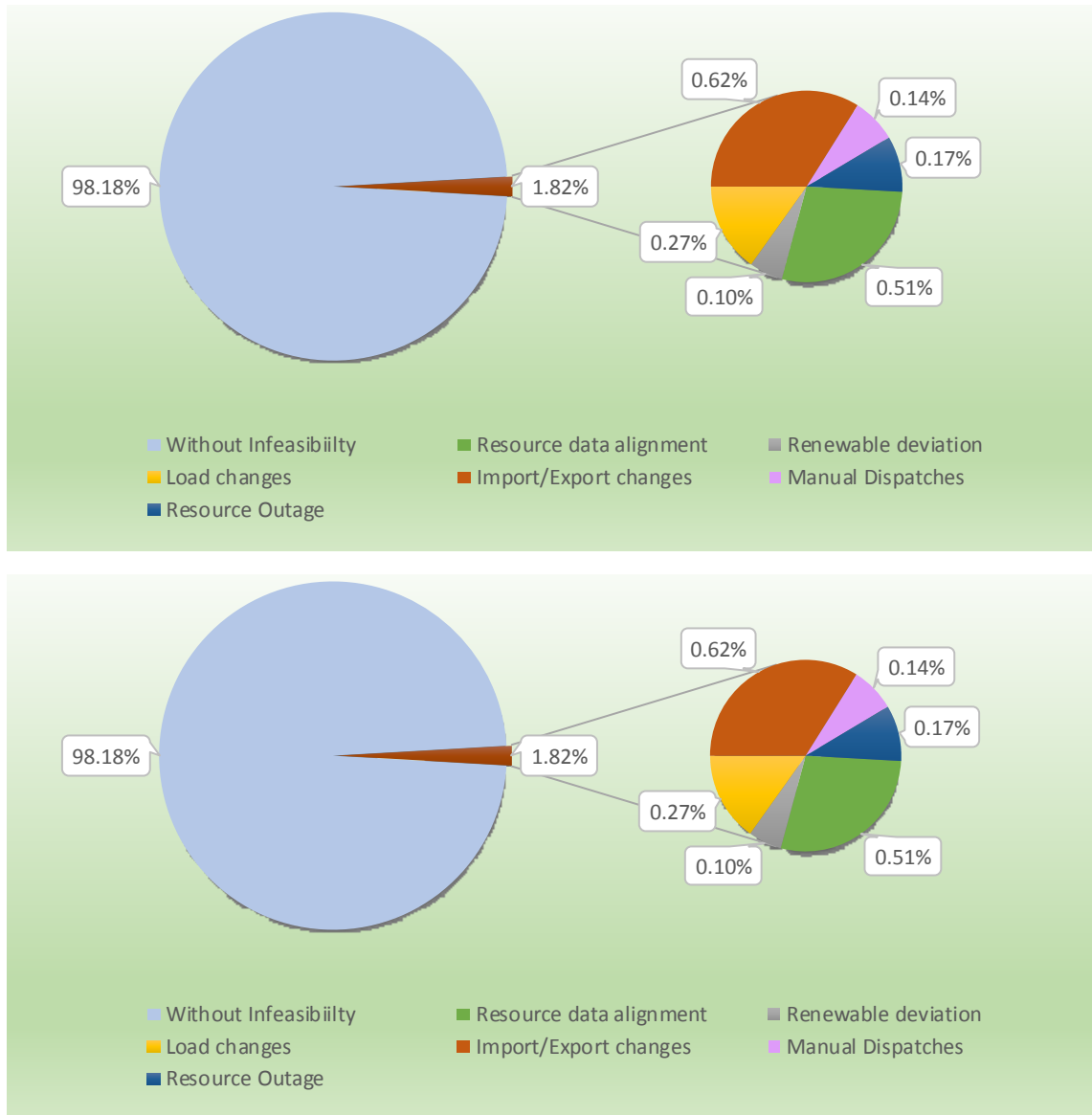
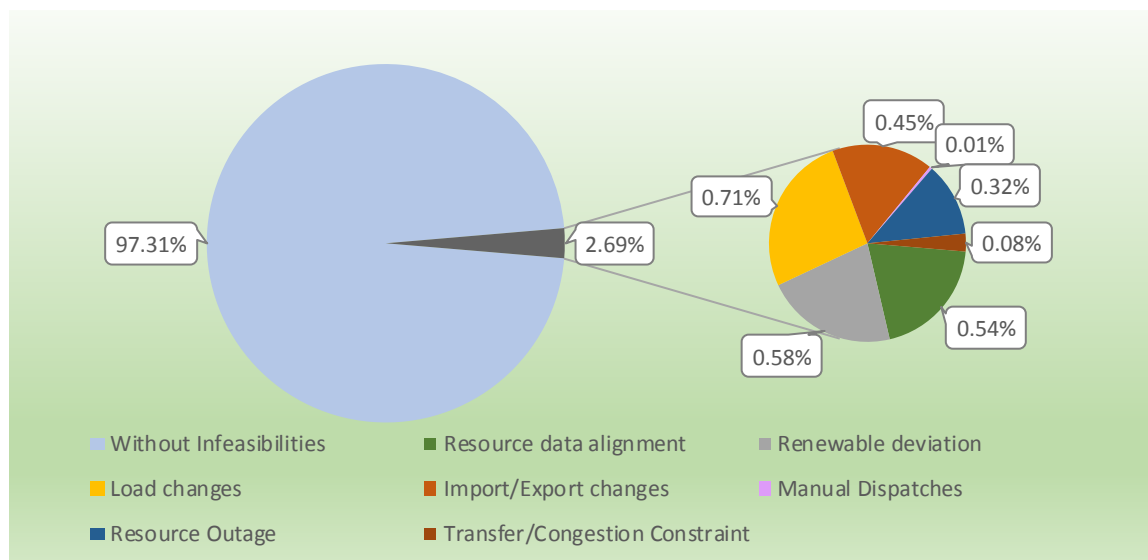
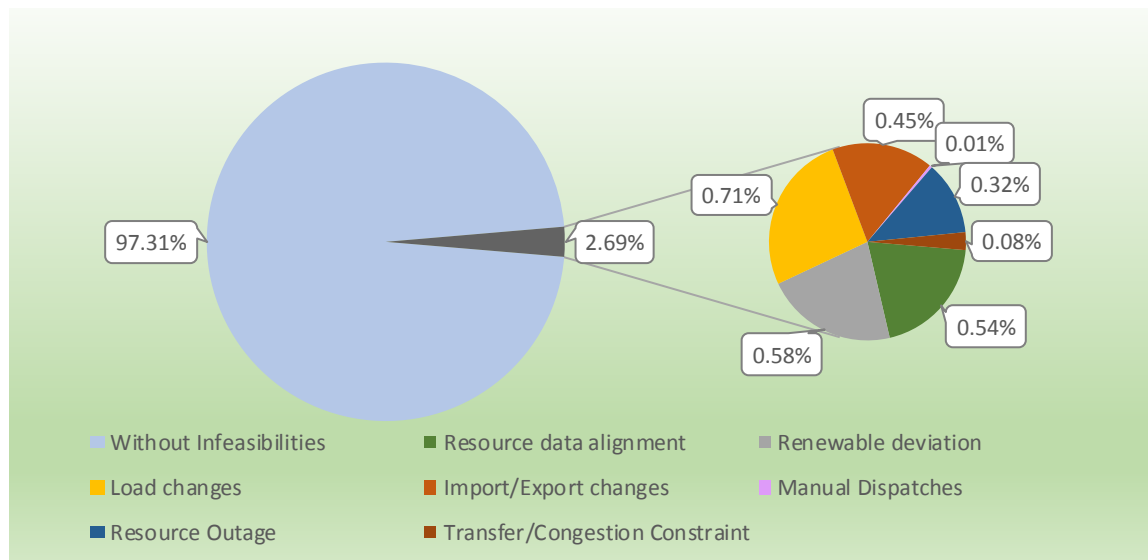


Figure 4: Frequency of undersupply infeasibility in the five-minute market in March - PAC West and PAC East combined.



ATTACHMENT B

Remedial Actions

This attachment includes a report on measures already taken and planned to address the issues discussed above. This report also identifies any remaining deficiencies in processes, procedures, and tools and any additional market issues related to these pricing concerns that the CAISO considers necessary to sustain stable market operations, with the CAISO's plan to address such issues.⁵

Table 1: Remedial Actions taken and planned by the CAISO and PacifiCorp

<i>Number</i>	<i>Solution</i>	<i>Actions and Responsibility</i>	<i>Tariff Changes</i>	<i>Implementation Timeline</i>
1	<i>Recognition of EIM entity operating practices in EIM market. This allows the market to recognize additional capacity available to the EIM entity, while still enabling the EIM entity to retain control over the management of this capacity for operational purposes.</i>	PacifiCorp changed its bidding and use of the outage reporting system to enable the EIM/RTM to recognize the use of the PacifiCorp's reserves (operating and regulation) and additional available capacity in operating its system. Leading to and through the initial stages of implementation, PacifiCorp designed the bid range of units to separate capacity associated with units holding contingency reserves from the bid range. This was based upon an assumption that contingency reserve obligations should be separately accounted for and that capacity	Will require enabling language for automated recognition of the additional capacity. The CAISO presented the proposal at the April 9, 2015, technical conference and submitted the details of the proposal in comments on April 23, 2015 in its initial	Effective at the beginning of April 2015, PacifiCorp has implemented the management of its contingency reserve through outage cards in both the PACW BAA and the PACE BAA. The automated feature for recognition of the available capacity that can only be used inside the EIM BAA when it is short of supply is currently being developed and scheduled to be ready to implement mid to end of August 2015.

⁵

December 1 Order at P 25.

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
		associated with contingency reserves could not be made available. This had the unintentional consequence of overly restricting the capacity of these units when the market models assess potential infeasible market solutions and PacifiCorp’s ability to make operational adjustments to units required by real-time system conditions. The result of this approach was that the bid range and operational capacity of these units were essentially fixed for 75 minutes prior to the operating hour when EIM bids are due and during the operating hour (or approximately 135 minutes), even when system conditions changed. The current solution better approximates PacifiCorp’s actual contingency reserve management using outage cards. Currently, PacifiCorp bids full unit capacity into the market and control the dispatch of contingency reserves with outage cards (as well as through PacifiCorp’s EMS system). PacifiCorp continues to meet its contingency reserve obligation by	comments in FERC Docket No. EL15-53.	

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
		holding sufficient contingency reserves on its units, but is also able to convey adjustments that it makes to which units are carrying the reserves in real time through outage cards. For example, when reserves are deployed or shifted to other units, the associated outage card can be adjusted for reserves being deployed or transferred to other units. This allows for a more transparent, efficient and timely market awareness of contingency reserve management and the ability to increase the amount of capacity available to the EIM, without affecting PacifiCorp's contingency reserve obligations. After further analysis of the post-implementation challenges, the CAISO and PacifiCorp have an enhanced appreciation of the importance of recognizing all available capacity in the market system, even though the EIM entity retains full operational control of its resources. The CAISO and PacifiCorp also agree		

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
		that it is necessary to develop procedures that will allow for the automatic recognition of the available capacity that can only be used within the balancing area when it is short of supply. The CAISO is developing functionality that will enable the EIM entity to reflect the full range of available capacity in the market but retain the ability to ensure the deployment of such capacity is limited to addressing infeasibilities in the EIM balancing area with no allowed transfer of this set aside energy outside the corresponding balancing area.		
2	<i>Refined management of multi-stage generating resources, and addition of multi-stage generation resources configurations</i>	PacifiCorp and the CAISO continue to consult to understand better the quality of the dispatch solution based on the recorded characteristics of the multi-stage generating resources. PacifiCorp reviewed and redefined the registered parameters based on greater understanding of how the market dispatches those resources based on their configuration. PacifiCorp also defined additional configurations with smaller	None identified.	Done Based on better understanding of the definition of the multi-stage generation resources parameters, PacifiCorp revised certain parameters, including defining additional configurations, adjustment of transition times between configurations and revising minimum up and down time, and notification time of these

<i>Number</i>	<i>Solution</i>	<i>Actions and Responsibility</i>	<i>Tariff Changes</i>	<i>Implementation Timeline</i>
		energy range to help balance their base schedules during startup and shutdown processes when the produced energy is below the previously registered PMin values.		different configurations at the end of March 2015. Another set of parameter corrections is scheduled end of April/beginning of May 2015. The CAISO and PacifiCorp continue to review and evaluate performance of multi-stage generating resources.
3	<i>Account for start-up energy in balancing process</i>	CAISO is developing a tool to enable better recognition of start-up profile for multi-stage generating resources. The CAISO is modeling the transition ramping for multi-stage generating resources and has scoped the requirements to add startup and shutdown profiles to the 15-minute market since these features are already in the 5-minute market. PacifiCorp is in the process of collecting data to define the startup and shutdown profiles for many of the resources with high PMin values. PacifiCorp has also made improvements to the bid configurations of PacifiCorp EIM	None identified	PacifiCorp started bidding all configurations and maximized bid ranges in March 2015.

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
		Participating Resources in order to maximize fully the bid range available to the market. This includes recognizing start-up hours for CCGT plants, working to bid in all possible plant operating configurations and accounting for reserves to reflect fully the operational capability to respond to real-time market conditions.		
4.	<i>Effort to improve consistency interchange schedule tags and base schedules</i>	PacifiCorp reviewed its internal process of preparing to submit base schedules at T-40 and changes to interchange values within the hour after T-20 and identified any delayed submission tags. PacifiCorp also improved the accuracy of base schedules submitted for non-EIM export energy share of PacifiCorp joint-owned resources.	None identified	PacifiCorp improved its awareness about the importance of consistent interchange bases schedules and real-time interchange schedules on market results. CAISO is in process of defining additional monitoring to show the interchange megawatt differences to the operator. The implementation is anticipated to be towards end of May 2015
5.	<i>CAISO formalized a production system support plan for Outage Management System to respond quickly to questions or</i>	CAISO implemented a support plan. This support plan consists of a 24/7 email address and telephone number available to PacifiCorp for immediate response to any outage management system issues and for	None identified	Completed early March 2015

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
	<i>situations encountered by PacifiCorp operator when entering outage tickets.</i>	troubleshooting any discrepancy in resources' availability megawatt values. PacifiCorp participated in identifying additional requirements and enhancements to outage management system based on operational needs.		
6.	<i>Enhanced situational awareness displays and improved monitoring of generator availability, capacity, available regulation on a 5 and 15 min basis, and ramp capacity.</i>	PacifiCorp created and/or improved certain Grid Operations displays to monitor generator availability, capacity, and ramp capacity. PacifiCorp has finalized enhancements to its generator database (Pi) displays to provide Grid Operations with situational awareness when there is a deviation between the Dispatch Operating Target (DOT) and the actual dispatch. PacifiCorp developed and implemented additional tools and displays to provide its grid operations personnel with increased visibility and situational	None identified	Major enhancements completed. The CAISO and PacifiCorp continue to monitor and analyze for timely responses to inform the market about any out-of-market manual actions the EIM entity takes or plans to take.

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
		awareness regarding available capacity on a 5- and 15-minute basis. PacifiCorp has coordinated with the CAISO to improve the accuracy of how the EIM understands PacifiCorp’s balancing authority operations by using the information communication tools available in the EIM, including outage cards, to ensure that the EIM is accurately consuming real time system conditions and unit capacity available in PacifiCorp’s balancing authority area. Since go-live, PacifiCorp and the CAISO have engaged in regular discussions to evaluate the root cause of remaining infeasible schedules. PacifiCorp has made improvements to its systems that interface with the CAISO’s base schedules and economic bids systems, as well as systems designed for bidding resources during start-up and shutdown hours for multi-stage generating resources. PacifiCorp further narrowed the gap		

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
		between the persistence forecast methods it uses for VER forecasting and the submission of those forecasts to the market. This ensures the market has a more current view of wind conditions and results in an improved market solution. Additionally, PacifiCorp has worked with the CAISO to improve the load forecast during ramping hours. This has resulted in an even more accurate load forecast during these hours and improved the flexibility available to the market as fewer resource are needed to cover forecast error. For troubleshooting purposes, PacifiCorp continues to work with the CAISO on tools and displays that can compare interchange deviations between EIM entity submissions and confirmation of interchange data used by the Market Operator. PacifiCorp Grid Operations also continues to work with neighboring balancing authority areas to improve visibility and tools.		

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
		PacifiCorp has utilized the CAISO's new displays to identify quickly discrepancies between base schedules and derated maximum capacity of resources. The CAISO added additional information related to re-rated minimum capacity to existing displays to help PacifiCorp identify and fix discrepancies between base schedules and re-rated minimum capacity. The CAISO enhanced situational awareness screens to report on un-qualified MWhs when base schedules were submitted for the resource on an outage to more timely inform the EIM entity of inconsistencies between base schedules and outages.		
7.	<i>Improvements to Flexible Ramp Sufficiency Test</i>	PacifiCorp and the CAISO are coordinating to identify needed improvements. The CAISO is collecting and analyzing both wind and load variability in PacifiCorp's two balancing areas. PacifiCorp and the CAISO have addressed several wind forecasting issues but wind forecast deviations from base schedules continues to be	None identified yet; possible solutions could require additional changes.	CAISO developed improved forecasting of flex ramp requirements for PACEand PACW and started to use these values in the EIM early March 2015. CAISO is also reviewing its flex ramp sufficiency test implementation for possible simplification to be completed

<i>Number</i>	<i>Solution</i>	<i>Actions and Responsibility</i>	<i>Tariff Changes</i>	<i>Implementation Timeline</i>
		among the main reasons for price excursions and infeasibilities. The CAISO is in the process of assessing the flexible ramping requirement for PacifiCorp's two balancing areas based on the collected data for the actual real-time imbalance conditions. The CAISO is also revisiting and reviewing the flexible ramping constraint and associated credit accounting in the flexibility sufficiency test and towards satisfying the flexible ramp requirements in the market optimization.		by end of mid-May 2015
8	<i>Unit deviation displays</i>	The CAISO provided the EIM entity additional user interfaces that provide the grid operator information related to differences between any combination of telemetry, state estimation, base schedules, and cleared target operating points for all resources. The CAISO and PacifiCorp continue to coordinate and provide feedback of additional needed enhancements.	None identified	Completed
9	<i>Load bias logic correction</i>	There were several instances where operators made incorrect load biases	None identified.	The CAISO implement this when the waiver ends.

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
		to dispatch more capacity when the system was out of ramping capability. The CAISO will be implementing software functionality to limit such erroneous load biases, similar to the logic currently used for the CAISO operator bias of load. This feature corrects operator bias of load forecast that are not consistent with system available ramp. The CAISO will provide training to PacifiCorp to ensure operators are familiar with how the feature will work, including explanations on the use of prices as a signal to indicate an issue in meeting load or balancing the system.	The CAISO will add detail in its business practice manual to describe the procedure further.	
10	<i>Increase Pool of EIM Participating Resources</i> <i>PacifiCorp coordinated with the CAISO to increase the pool of owned and third-party resources available to participate in the EIM.</i>	PacifiCorp coordinated with the CAISO to increase the pool of owned and third-party resources available to participate in the EIM. This will result in the Swift 1&2 units becoming a single aggregated PacifiCorp EIM Participating Resource and will add approximately 68 MWs of upper bid range capability.	None identified.	PacifiCorp has completed testing of the Swift 1&2 aggregation project and is planning to make these changes effective in the Master File by the beginning of May 2015. CAISO removed non-conforming Industrial Loads from PACE BAA starting April 1, 2015. PacifiCorp has started

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
		In addition, PacifiCorp continues to work with other transmission customers who may be interested in participating in the EIM with resources, including the recent filing of a construction agreement at FERC to enable resource-metering upgrades, which would facilitate further steps towards participation of resources in the EIM (FERC Docket No. ER15-711). At this time, PacifiCorp has not certified any third-party transmission customers for participation in the EIM, but is hopeful that these efforts will result in additional EIM participation. PacifiCorp has modeled certain industrial customer interruptible loads as participating resources. This was necessary because some of PacifiCorp's industrial customer loads have on-site generation and, as a result, this presents additional complexity for accurate forecasting and balancing. Adding these elements as participating resources has improved operational visibility and added approximately 200 MW of flex capacity in its PACE		submission of industrial load base schedules on April 1, 2015, and will bid them economically end of April or beginning of May 2015

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
		Balancing Authority Area (“BAA”) when they are bid economically in the EIM. PacifiCorp is also improving the modeling of its jointly owned generating resources. Such improvements will further minimize imbalance issues and improve forecast accuracy.		
11	<i>Training</i> <i>Additional training of personnel and improvement of systems with increased EIM operational experience.</i>	PacifiCorp provided personnel with training on outage entry and required the provision of daily spreadsheets from PacifiCorp EIM Participating Resources that describe any operational issues and the resources’ ambient conditions. PacifiCorp’s Grid Operations provided its balancing agent real-time continued training on CAISO EIM tools during the first two weeks of February 2015. PacifiCorp worked with the CAISO to improve load conforming errors. Software enhancements have been introduced that help protect against over-conforming that can exacerbate issues when capacity in the market is near its limit.	None identified.	The PacifiCorp and the CAISO have completed the bulk and CAISO continue to evaluate training requirements.

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
12	<i>Improve Internal Processes and Tools to address identified market performance issues.</i>	PacifiCorp’s Grid Operations drafted and made available to operations personnel, “best practices” procedure documents to aid in personnel’s implementation of critical EIM Entity tasks. PacifiCorp will continue to update these procedure documents in real-time as needed. PacifiCorp also developed a Desk Guide for the 24/7 Grid Operations desk and an EIM Division of Responsibilities document.	None identified.	Completed
13	<i>Improve dynamic transfer capability</i>	PacifiCorp is engaged in ongoing discussions with the Bonneville Power Administration (BPA) to understand the nature and allocation of the dynamic transfer capability on the COI. BPA is in the process of conducting a detailed dynamic transfer capability study. Any additional five-minute capability will help the five-minute market re-optimize the fifteen-minute decisions that are based on system conditions and information available at approximately 30 minutes prior to the five-minute market. The five-minute dynamic COI limits were increased for the off-peak hours but still very limited during on-peak hours.	None identified.	In progress – BPA is in the process of determining new COI dynamic transfer capability limits based on study results. For BPA rate of change constraints, there are currently two methodologies being examined by ISO, PacifiCorp, and BPA in the ISO testing environment with the goal to identify which methodology is superior and acceptable to BPA to the method currently in place.

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
		PacifiCorp is engaged in discussions with BPA to understand the nature and basis behind the five-minute flowgate limits and possible change in the calculation of those limits. BPA is reviewing the five-minute limits, which are based on historical movement of PacifiCorp West resources before the EIM. BPA has also requested more data points to perform a review of the current rate-of-change limits based on actual EIM data. Any additional five-minute capability will help the five-minute market re-optimize the fifteen-minute market decisions that are based on system conditions and information available approximately 30 minutes prior to the five-minute market. The CAISO had provided BPA the requested data points and answered any relevant questions. The CAISO is coordinating with both BPA and PacifiCorp to revise the implementation model for the rate-of-change constraint to reflect ramping 15-minute schedule values.		

ATTACHMENT C

This attachment includes a discussion of whether the cause was due to transitional issues or was due to insufficient supply of resources bid into the EIM, including the time of the instance, the duration, the cause, and the affected node(s) and load. The CAISO evaluated each interval of infeasibility to determine whether it was infeasible due to actual supply insufficiency by calculating the degree to which the infeasibility was in excess of PacifiCorp's available capacity to balance its system. This measure was determined by calculating the difference between the total amount of reserves carried and the minimum amount of reserves required by NERC. The CAISO then subtracted the MWs of infeasibility from that amount to determine the amount of available capacity above the magnitude of the infeasibilities. This amount is displayed for the PACE and PACW areas for each interval. If that value were zero or negative, the CAISO would qualify that interval as infeasible due to an insufficiency of supply. Otherwise, the CAISO concludes the EIM entity had enough capacity available to dispatch as needed to address the infeasibility observed in the market systems.

The tables below show that PAC was not under-resourced except for one of the market intervals on March 23 (for both the Real-Time Dispatch interval and the Fifteen Minute Market interval). Because the market run that produced the infeasibility is conducted from 7.5 and up to 37.5 minutes, respectively for real-time dispatch and the fifteen minute market, the measurements do not account for actions taken between in that timeframe. PacifiCorp reports that there no reserve violations in these interval. The CAISO concludes that all intervals of infeasibilities in March were due to the transitional issues as described above and do not reflect a physical shortage.

Table 2: List of undersupply infeasibilities in the fifteen-minute market for both PAC East and West

Trade Date	Hour Ending	Interval	Infeasibility PACE (MW)	Excess of Capacity PACE (MW)	Infeasibility PACW (MW)	Excess of Capacity PACW (MW)	Reason for infeasibility	Affected locations
03/01/15	10	1	30.2	295.8			Resource data alignment and Load changes	All locations in PAC East
03/01/15	10	2	61.7	270.3			Resource data alignment and Load changes	All locations in PAC East
03/01/15	20	1	56.9	403.1			Resource data alignment	All locations in PAC East
03/01/15	20	2	6.9	451.1			Resource data alignment	All locations in PAC East
03/01/15	22	1	30.9	400.1	125.1	192.0	Resource data alignment, Load changes and Resource outages	All locations in PAC East and West
03/01/15	23	1			24.4	223.6	Resource data alignment and Load changes	All locations in PAC West
03/01/15	24	1			40.5	297.6	Resource data alignment and Load changes	All locations in PAC West
03/02/15	9	1	41.4	363.7			Import/Export changes, Load changes and Resource data alignment	All locations in PAC East
03/02/15	9	2	65.4	290.7			Import/Export changes, Load changes and Resource data alignment	All locations in PAC East
03/02/15	9	4	24.3	318.7			Import/Export changes, Load changes and Resource data alignment	All locations in PAC East
03/02/15	10	1	26.6	324.4			Import/Export changes, Load changes and Resource data alignment	All locations in PAC East

Trade Date	Hour Ending	Interval	Infeasibility PACE (MW)	Excess of Capacity PACE (MW)	Infeasibility PACW (MW)	Excess of Capacity PACW (MW)	Reason for infeasibility	Affected locations
03/03/15	9	4	138.3	198.7			Renewable deviation and Manual Dispatches	All locations in PAC East
03/03/15	10	4	76.0	281.1			Manual Dispatches, Resource outage and Load changes	All locations in PAC East
03/03/15	11	1	70.0	322.0			Manual Dispatches, Resource outage	All locations in PAC East
03/03/15	11	2	48.4	416.6			Manual Dispatches, Resource outage	All locations in PAC East
03/03/15	11	3	78.9	341.1			Manual Dispatches, Resource outage	All locations in PAC East
03/04/15	21	1	91.2	298.8			Resource data alignment	All locations in PAC East
03/05/15	10	3	2.8	400.2			Resource data alignment	All locations in PAC East
03/05/15	21	1	3.0	500.0			Load changes and Resource data alignment	All locations in PAC East
03/06/15	22	1	2.8	277.2			Load changes and Import/Export changes	All locations in PAC East
03/06/15	24	1	142.8	202.2			Import/Export changes, Load changes and Renewable deviation	All locations in PAC East
03/06/15	24	3	35.3	306.8			Import/Export changes, Load changes and Renewable deviation	All locations in PAC East
03/06/15	24	4	12.1	367.9			Import/Export changes, Load changes and Renewable deviation	All locations in PAC East

Trade Date	Hour Ending	Interval	Infeasibility PACE (MW)	Excess of Capacity PACE (MW)	Infeasibility PACW (MW)	Excess of Capacity PACW (MW)	Reason for infeasibility	Affected locations
03/07/15	20	1	13.3	305.7			Load changes, Resource data alignment and Renewable deviation	All locations in PAC East
03/07/15	20	2	28.8	284.2			Load changes, Resource data alignment and Renewable deviation	All locations in PAC East
03/07/15	22	1	22.9	517.1			Load changes	All locations in PAC East
03/07/15	24	1	122.0	113.1			Load changes and Renewable deviation	All locations in PAC East
03/07/15	24	2	124.2	100.8			Load changes and Renewable deviation	All locations in PAC East
03/07/15	24	3	137.7	90.3			Load changes and Renewable deviation	All locations in PAC East
03/08/15	6	1	78.6	176.4			Resource data alignment	All locations in PAC East
03/08/15	22	1	127.8	160.2			Import/Export changes	All locations in PAC East
03/08/15	22	2	61.9	216.1			Import/Export changes	All locations in PAC East
03/08/15	22	4	17.3	280.7			Import/Export changes	All locations in PAC East
03/08/15	23	1	35.0	232.0			Import/Export changes	All locations in PAC East
03/16/15	11	1	38.2	237.8			Load changes and Renewable deviation	All locations in PAC East
03/17/15	12	1	31.7	285.3			Renewable deviation and Resource outage	All locations in PAC East

Trade Date	Hour Ending	Interval	Infeasibility PACE (MW)	Excess of Capacity PACE (MW)	Infeasibility PACW (MW)	Excess of Capacity PACW (MW)	Reason for infeasibility	Affected locations
03/18/15	8	2	22.2	534.9			Resource data alignment and Renewable deviation	All locations in PAC East
03/18/15	8	3	22.9	542.1			Resource data alignment and Renewable deviation	All locations in PAC East
03/18/15	22	1	68.0	350.0			Import/Export changes	All locations in PAC East
03/18/15	22	2	38.4	365.6			Import/Export changes	All locations in PAC East
03/18/15	22	4	8.1	410.9			Import/Export changes	All locations in PAC East
03/18/15	23	1	29.3	357.7			Resource data alignment	All locations in PAC East
03/21/15	21	1	69.3	353.7			Import/Export changes	All locations in PAC East
03/23/15	10	2			324.7	-13.7	Import/Export changes	All locations in PAC West
03/23/15	10	4			133.5	80.6	Import/Export changes	All locations in PAC West
03/25/15	2	2	106.1	467.9			Resource outage	All locations in PAC East
03/25/15	2	3	230.3	197.7			Resource outage	All locations in PAC East
03/25/15	10	1	45.9	426.1			Import/Export changes	All locations in PAC East
03/27/15	10	2	78.0	300.0			Resource outage	All locations in PAC East
03/27/15	10	3	70.8	371.2			Resource outage	All locations in PAC East

Trade Date	Hour Ending	Interval	Infeasibility PACE (MW)	Excess of Capacity PACE (MW)	Infeasibility PACW (MW)	Excess of Capacity PACW (MW)	Reason for infeasibility	Affected locations
03/29/15	13	1	15.1	178.9			Renewable deviation	All locations in PAC East
03/31/15	4	1	93.8	208.3			Resource outage	All locations in PAC East
03/31/15	8	2	236.4	135.6			Import/Export changes	All locations in PAC East

Table 1: List of undersupply infeasibilities in the five-minute market for both PAC East and West

Trade Date	Hour Ending	Interval	PACE Infeasibility	Excess Capacity PACE (MW)	PACW Infeasibility	Excess Capacity PACW (MW)	Reason for infeasibility	Affected locations
03/01/15	8	10			11.77	355.23	Resource data alignment	All locations in PAC West
03/01/15	8	11			101.48	178.52	Resource data alignment and Resource outages	All locations in PAC West
03/01/15	8	12			65.64	173.36	Resource data alignment and Resource outages	All locations in PAC West
03/01/15	9	1			56.78	185.22	Resource data alignment and Renewable deviation	All locations in PAC West
03/01/15	9	2	65.52	235.48			Load changes and Renewable deviation	All locations in PAC East
03/01/15	9	3	54.17	210.83			Load changes and Renewable deviation	All locations in PAC East
03/01/15	9	4	80.91	276.09			Load changes and Renewable deviation	All locations in PAC East
03/01/15	9	5	174.25	243.75			Load changes and Renewable deviation	All locations in PAC East
03/01/15	9	6	206.32	210.68	85.51	271.49	Load changes and Renewable deviation	All locations in PAC East and West
03/01/15	9	7	198.41	170.59			Load changes and Renewable deviation	All locations in PAC East
03/01/15	9	8	216.29	102.71			Load changes and Renewable deviation	All locations in PAC East
03/01/15	9	9	120.34	229.66			Load changes and Renewable deviation	All locations in PAC East
03/01/15	9	10	109.16	265.84			Load changes and Renewable deviation	All locations in PAC East

Trade Date	Hour Ending	Interval	PACE Infeasibility	Excess Capacity PACE (MW)	PACW Infeasibility	Excess Capacity PACW (MW)	Reason for infeasibility	Affected locations
03/01/15	9	11	7.58	376.42			Load changes and Renewable deviation	All locations in PAC East
03/01/15	11	6	112.89	158.11			Resource outages	All locations in PAC East
03/01/15	11	7	63.08	243.92			Resource outages	All locations in PAC East
03/01/15	11	8	54.18	256.82			Resource outages and Resource data alignment	All locations in PAC East
03/01/15	11	10	54.57	200.43			Resource outages and Resource data alignment	All locations in PAC East
03/01/15	11	11	23.72	258.28			Resource outages and Resource data alignment	All locations in PAC East
03/01/15	12	1	14.34	298.66			Load changes and Renewable deviation	All locations in PAC East
03/01/15	22	1			82.47	237.53	Resource data alignment	All locations in PAC West
03/01/15	22	3	23.71	392.29			Resource data alignment, Import/Export changes and Renewable deviation	All locations in PAC East
03/01/15	22	4	1.16	424.84			Resource data alignment, Import/Export changes and Renewable deviation	All locations in PAC East
03/02/15	6	8	6.07	566.93	29.1	347.9	Resource data alignment	All locations in PAC East and West
03/02/15	9	6	19.76	342.24			Renewable deviation	All locations in PAC East
03/02/15	9	7	1.7	354.3			Renewable deviation	All locations in PAC East

Trade Date	Hour Ending	Interval	PACE Infeasibility	Excess Capacity PACE (MW)	PACW Infeasibility	Excess Capacity PACW (MW)	Reason for infeasibility	Affected locations
03/02/15	13	2	18.88	440.12			Import/Export changes	All locations in PAC East
03/02/15	13	4	43.67	395.33			Renewable deviation and Load changes	All locations in PAC East
03/02/15	13	5			23.64	386.36	Renewable deviation and Resource data alignment	All locations in PAC West
03/02/15	13	6	14.34	440.66			Renewable deviation	All locations in PAC East
03/02/15	13	7	24.18	445.82			Renewable deviation	All locations in PAC East
03/02/15	13	8	12.28	449.72			Renewable deviation	All locations in PAC East
03/02/15	17	10	45.58	355.42			Load changes	All locations in PAC East
03/02/15	17	11	26.3	114.7			Load changes	All locations in PAC East
03/02/15	20	1			78.69	169.31	Transfer limit and Renewable deviation	All locations in PAC West
03/03/15	4	5	34.36	351.64			Renewable deviation	All locations in PAC East
03/03/15	6	9			46.97	250.03	Import/Export changes, Renewable deviation and Load changes	All locations in PAC West
03/03/15	6	10			35.36	195.64	Import/Export changes, Renewable deviation and Load changes	All locations in PAC West
03/03/15	6	11			7.96	207.04	Renewable deviation and Load changes	All locations in PAC West
03/03/15	6	12			62.43	154.57	Renewable deviation and Load changes	All locations in PAC West

Trade Date	Hour Ending	Interval	PACE Infeasibility	Excess Capacity PACE (MW)	PACW Infeasibility	Excess Capacity PACW (MW)	Reason for infeasibility	Affected locations
03/03/15	7	1			40.45	173.55	Renewable deviation and Load changes	All locations in PAC West
03/03/15	7	7			29.44	399.56	Load changes	All locations in PAC West
03/03/15	7	10			80.99	284.01	Transfer limit and Load changes	All locations in PAC West
03/03/15	7	11			35.57	327.43	Transfer limit and Load changes	All locations in PAC West
03/03/15	7	12			23.56	337.44	Transfer limit and Load changes	All locations in PAC West
03/03/15	9	1	201.72	232.28			Renewable deviation and Import/Export changes	All locations in PAC East
03/03/15	9	2	220.84	204.16			Renewable deviation and Import/Export changes	All locations in PAC East
03/03/15	9	3	195.05	235.95			Renewable deviation and Import/Export changes	All locations in PAC East
03/03/15	9	4	151	281	23.59	480.41	Renewable deviation, Import/Export changes and Resource data alignment	All locations in PAC East and West
03/03/15	9	5	178.63	248.37			Renewable deviation and Import/Export changes	All locations in PAC East
03/03/15	9	6	151.61	254.39			Renewable deviation and Import/Export changes	All locations in PAC East
03/03/15	9	7	98.45	258.55			Renewable deviation and Import/Export changes	All locations in PAC East
03/03/15	9	12	16.22	333.78			Load changes and Renewable deviation	All locations in PAC East
03/03/15	10	1	14.8	331.2			Load changes and Renewable deviation	All locations in PAC East

Trade Date	Hour Ending	Interval	PACE Infeasibility	Excess Capacity PACE (MW)	PACW Infeasibility	Excess Capacity PACW (MW)	Reason for infeasibility	Affected locations
03/03/15	10	2	44.5	318.5			Load changes and Renewable deviation	All locations in PAC East
03/03/15	10	4	14.4	365.6			Load changes	All locations in PAC East
03/03/15	10	5	75.2	331.8			Resource data alignment and Load changes	All locations in PAC East
03/03/15	10	6	65.4	324.7			Resource data alignment and Load changes	All locations in PAC East
03/03/15	10	7	63.7	290.3			Resource data alignment and Load changes	All locations in PAC East
03/03/15	10	8	43.3	496.8			Resource data alignment and Load changes	All locations in PAC East
03/03/15	10	9	51.4	403.6			Resource data alignment and Load changes	All locations in PAC East
03/03/15	10	10	88.2	286.8			Load changes and Renewable deviation	All locations in PAC East
03/03/15	10	11	89.1	284.9			Load changes and Renewable deviation	All locations in PAC East
03/03/15	10	12	42.6	281.4			Load changes and Renewable deviation	All locations in PAC East
03/03/15	11	1	18.3	356.7			Load changes and Renewable deviation	All locations in PAC East
03/03/15	11	5	17.4	442.6			Resource data alignment	All locations in PAC East
03/03/15	11	9	7.0	425.0			Resource data alignment	All locations in PAC East
03/03/15	11	10	5.8	419.2			Load changes and Renewable deviation	All locations in PAC East
03/03/15	20	1			1.3	258.75	Resource data alignment	All locations in PAC West

Trade Date	Hour Ending	Interval	PACE Infeasibility	Excess Capacity PACE (MW)	PACW Infeasibility	Excess Capacity PACW (MW)	Reason for infeasibility	Affected locations
03/03/15	20	4			2.5	257.51	Resource data alignment	All locations in PAC West
03/03/15	20	5			2.2	261.8	Resource data alignment	All locations in PAC West
03/03/15	20	6			0.1	265.91	Resource data alignment	All locations in PAC West
03/03/15	21	1	5.1	433.0			Resource outages	All locations in PAC East
03/03/15	22	4			188.1	-96.13	Load changes and Resource data alignment	All locations in PAC West
03/04/15	7	6			31.1	222.92	Load changes	All locations in PAC West
03/04/15	10	10	61.3	570.7			Resource outages Renewable deviation	All locations in PAC East
03/04/15	10	11	55.0	564.0			Resource outages and Renewable deviation	All locations in PAC East
03/04/15	10	12	34.6	647.5			Resource outages and Renewable deviation	All locations in PAC East
03/05/15	10	5	7.8	364.2			Load changes	All locations in PAC East
03/05/15	10	6	9.1	372.9			Load changes	All locations in PAC East
03/05/15	10	7	5.9	383.1			Load changes	All locations in PAC East
03/05/15	12	4	5.3	409.7			Load changes	All locations in PAC East
03/05/15	21	1	29.6	410.4			Renewable deviation	All locations in PAC East
03/05/15	22	4	13.1	436.0			Renewable deviation	All locations in PAC East

Trade Date	Hour Ending	Interval	PACE Infeasibility	Excess Capacity PACE (MW)	PACW Infeasibility	Excess Capacity PACW (MW)	Reason for infeasibility	Affected locations
03/06/15	24	1	182.4	116.6			Import/Export changes, Load changes and Renewable deviation	All locations in PAC East
03/06/15	24	2	116.2	225.8			Import/Export changes, Load changes and Renewable deviation	All locations in PAC East
03/06/15	24	3	25.5	370.5			Import/Export changes, Load changes and Renewable deviation	All locations in PAC East
03/06/15	24	10	64.5	255.5			Load changes and Renewable deviation	All locations in PAC East
03/06/15	24	11	109.8	288.2			Load changes and Renewable deviation	All locations in PAC East
03/06/15	24	12	12.7	407.3			Load changes and Renewable deviation	All locations in PAC East
03/07/15	1	1	8.7	345.3			Renewable deviation and Load changes	All locations in PAC East
03/07/15	8	3	5.5	365.5			Renewable deviation	All locations in PAC East
03/07/15	8	4	3.8	351.2			Renewable deviation	All locations in PAC East
03/07/15	8	5	19.6	360.4			Renewable deviation	All locations in PAC East
03/07/15	8	6	23.6	346.4			Renewable deviation	All locations in PAC East
03/07/15	8	7	12.9	328.1			Renewable deviation	All locations in PAC East
03/07/15	8	8	9.9	323.1			Renewable deviation	All locations in PAC East

Trade Date	Hour Ending	Interval	PACE Infeasibility	Excess Capacity PACE (MW)	PACW Infeasibility	Excess Capacity PACW (MW)	Reason for infeasibility	Affected locations
03/07/15	8	10	5.1	327.0			Renewable deviation	All locations in PAC East
03/07/15	9	5	1.1	347.9			Renewable deviation	All locations in PAC East
03/07/15	9	6	13.2	323.8			Renewable deviation	All locations in PAC East
03/07/15	9	7	5.1	334.9			Renewable deviation	All locations in PAC East
03/07/15	9	8	16.3	342.7			Renewable deviation	All locations in PAC East
03/07/15	9	10	7.6	322.4			ED Renewable deviation	All locations in PAC East
03/07/15	20	2	26.6	291.4			Renewable deviation and Import/Export changes	All locations in PAC East
03/07/15	23	11	4.3	246.8			Import/Export changes	All locations in PAC East
03/07/15	23	12	31.7	230.3			Import/Export changes	All locations in PAC East
03/07/15	24	1	10.6	220.4	59.5	414.53	Renewable deviation and Import/Export changes	All locations in PAC East and West
03/08/15	1	1	52.5	202.5			Load changes Resource and data alignment	All locations in PAC East
03/08/15	1	2	1.9	232.1			Load changes Resource and data alignment	All locations in PAC East
03/08/15	22	1	92.2	183.8			Import/Export changes and Resource data alignment	All locations in PAC East
03/08/15	22	2	113.6	181.4			Import/Export changes	All locations in PAC East

Trade Date	Hour Ending	Interval	PACE Infeasibility	Excess Capacity PACE (MW)	PACW Infeasibility	Excess Capacity PACW (MW)	Reason for infeasibility	Affected locations
03/08/15	22	3	73.2	220.8			Import/Export changes	All locations in PAC East
03/08/15	22	4	16.8	244.2			Import/Export changes	All locations in PAC East
03/08/15	22	5	18.8	259.2			Import/Export changes	All locations in PAC East
03/09/15	13	7	20.5	400.5			Load changes and Renewable deviation	All locations in PAC East
03/10/15	8	4	4.7	217.3			Import/Export changes and Renewable deviation	All locations in PAC East
03/10/15	8	5	20.4	153.6			Import/Export changes and Renewable deviation	All locations in PAC East
03/10/15	8	6	24.6	142.4			Import/Export changes and Renewable deviation	All locations in PAC East
03/10/15	8	9	5.1	166.9			Import/Export changes and Renewable deviation	All locations in PAC East
03/11/15	15	2	171.9	115.1			Renewable deviation and Import/Export changes	All locations in PAC East
03/11/15	15	3	33.2	283.8			Renewable deviation	All locations in PAC East
03/11/15	15	4	30.7	342.3			Renewable deviation	All locations in PAC East
03/12/15	5	9			4.4	1061.6	Resource data alignment and Renewable deviation	All locations in PAC West
03/13/15	8	2	28.7	219.3			Import/Export changes	All locations in PAC East
03/13/15	8	3	49.6	107.4			Import/Export changes	All locations in PAC East
03/13/15	8	4	16.1	108.9			Import/Export changes	All locations in PAC East

Trade Date	Hour Ending	Interval	PACE Infeasibility	Excess Capacity PACE (MW)	PACW Infeasibility	Excess Capacity PACW (MW)	Reason for infeasibility	Affected locations
03/13/15	8	5	38.3	127.8			Import/Export changes	All locations in PAC East
03/13/15	14	7			26.6	385.44	Transfer limit	All locations in PAC West
03/13/15	14	8			20.1	391.89	Transfer limit	All locations in PAC West
03/13/15	14	9			12.0	400.03	Transfer limit	All locations in PAC West
03/13/15	18	6			1.7	265.31	Resource data alignment	All locations in PAC West
03/14/15	24	2			29.8	475.25	Resource data alignment and Renewable deviation	All locations in PAC West
03/14/15	24	3			45.2	488.77	Resource data alignment and Renewable deviation	All locations in PAC West
03/16/15	10	2	50.2	180.8			Load changes and Renewable deviation	All locations in PAC East
03/16/15	10	3	58.3	160.7			Load changes and Renewable deviation	All locations in PAC East
03/16/15	10	4	2.1	241.9			Load changes and Renewable deviation	All locations in PAC East
03/16/15	10	5	30.3	213.7			Load changes and Renewable deviation	All locations in PAC East
03/16/15	10	6	5.6	227.4			Load changes and Renewable deviation	All locations in PAC East
03/16/15	10	7	84.5	125.5			Load changes and Renewable deviation	All locations in PAC East
03/16/15	10	8	84.5	164.5			Resource outages and Renewable deviation	All locations in PAC East
03/16/15	10	9			20.7	205.26	Resource data alignment and Renewable deviation	All locations in PAC West

Trade Date	Hour Ending	Interval	PACE Infeasibility	Excess Capacity PACE (MW)	PACW Infeasibility	Excess Capacity PACW (MW)	Reason for infeasibility	Affected locations
03/16/15	10	10	9.2	237.8			Renewable deviation and Load changes	All locations in PAC East
03/16/15	10	11	11.3	259.7			Renewable deviation	All locations in PAC East
03/16/15	13	4	36.5	215.5			Load changes, Resource data alignment and Renewable deviation	All locations in PAC East
03/16/15	13	5	45.6	173.5			Load changes, Resource data alignment and Renewable deviation	All locations in PAC East
03/16/15	13	6	44.7	192.3			Load changes, Resource data alignment and Renewable deviation	All locations in PAC East
03/17/15	8	10	81.1	235.9			Renewable deviation and Resource data alignment	All locations in PAC East
03/17/15	11	2	9.4	328.6			Renewable deviation	All locations in PAC East
03/17/15	11	3	5.7	297.4			Renewable deviation	All locations in PAC East
03/17/15	11	5	30.2	293.8			Renewable deviation	All locations in PAC East
03/17/15	12	2	65.3	252.7			Load changes and Renewable deviation	All locations in PAC East
03/17/15	12	3	77.5	237.5			Load changes and Renewable deviation	All locations in PAC East
03/17/15	12	4	40.7	270.3			Load changes and Renewable deviation	All locations in PAC East
03/17/15	12	5	41.7	259.3			Load changes and Renewable deviation	All locations in PAC East

Trade Date	Hour Ending	Interval	PACE Infeasibility	Excess Capacity PACE (MW)	PACW Infeasibility	Excess Capacity PACW (MW)	Reason for infeasibility	Affected locations
03/17/15	12	6	27.3	297.7			Load changes and Renewable deviation	All locations in PAC East
03/17/15	12	7	32.4	308.6			Load changes and Renewable deviation	All locations in PAC East
03/17/15	12	8	31.1	285.9			Load changes and Renewable deviation	All locations in PAC East
03/17/15	21	1			12.3	411.67	Load changes Renewable deviation	All locations in PAC West
03/18/15	1	3	64.6	421.4			Resource outages and Resource data alignment	All locations in PAC East
03/18/15	1	4	82.9	391.2			Resource outages and Resource data alignment	All locations in PAC East
03/18/15	1	5	64.8	360.2			Resource outages and Resource data alignment	All locations in PAC East
03/18/15	1	6	28.1	351.9			Resource outages and Resource data alignment	All locations in PAC East
03/18/15	21	4			45.1	292.9	Load changes	All locations in PAC East
03/18/15	21	5			34.8	252.17	Load changes	All locations in PAC East
03/18/15	21	6			14.3	202.75	Load changes	All locations in PAC East
03/18/15	22	1	71.4	311.6			Import/Export changes and Renewable deviation	All locations in PAC East
03/18/15	22	3	120.7	295.3	45.7	370.35	Import/Export changes and Renewable deviation	All locations in PAC West
03/18/15	22	4	133.3	290.7			Import/Export changes and Renewable deviation	All locations in PAC East
03/18/15	22	5	179.0	226.0			Import/Export changes and Renewable deviation	All locations in PAC East

Trade Date	Hour Ending	Interval	PACE Infeasibility	Excess Capacity PACE (MW)	PACW Infeasibility	Excess Capacity PACW (MW)	Reason for infeasibility	Affected locations
03/18/15	22	6	164.5	119.5			Import/Export changes and Renewable deviation	All locations in PAC East
03/18/15	22	7	196.4	194.6			Import/Export changes and Renewable deviation	All locations in PAC East
03/18/15	22	8	187.2	248.8			Import/Export changes and Renewable deviation	All locations in PAC East
03/18/15	22	9	165.8	236.2			Import/Export changes and Renewable deviation	All locations in PAC East
03/18/15	22	10	185.9	209.1			Import/Export changes and Renewable deviation	All locations in PAC East
03/18/15	22	11	156.8	285.2			Import/Export changes and Renewable deviation	All locations in PAC East
03/18/15	22	12	153.1	267.9			Import/Export changes and Renewable deviation	All locations in PAC East
03/18/15	23	1	137.3	253.7			Import/Export changes and Renewable deviation	All locations in PAC East
03/18/15	23	2	114.7	279.3			Import/Export changes and Renewable deviation	All locations in PAC East
03/18/15	23	3	60.6	315.4			Import/Export changes and Renewable deviation	All locations in PAC East
03/18/15	23	4	34.3	329.8			Import/Export changes and Renewable deviation	All locations in PAC East
03/22/15	1	8	6.1	194.0			Resource data alignment	All locations in PAC East
03/22/15	5	11	2.3	182.8			Resource data alignment	All locations in PAC East
03/22/15	5	12	56.4	176.6			Resource data alignment	All locations in PAC East
03/22/15	6	1	22.3	194.7			Resource data alignment	All locations in PAC East

Trade Date	Hour Ending	Interval	PACE Infeasibility	Excess Capacity PACE (MW)	PACW Infeasibility	Excess Capacity PACW (MW)	Reason for infeasibility	Affected locations
03/22/15	18	10			27.9	538.11	Load changes	All locations in PAC West
03/22/15	21	1			7.3	415.75	Import/Export changes	All locations in PAC West
03/22/15	22	3			3.2	184.8	Resource data alignment	All locations in PAC West
03/23/15	4	4	24.7	139.4			Resource data alignment	All locations in PAC East
03/23/15	9	10			158.0	-16.01	Resource outages	All locations in PAC West
03/23/15	9	11			113.0	51.99	Resource outages	All locations in PAC West
03/23/15	21	4	116.2	483.8			Load changes	All locations in PAC East
03/23/15	21	5	95.4	607.6			Load changes	All locations in PAC East
03/24/15	6	8	7.5	217.5			Renewable deviation and Renewable deviation	All locations in PAC East
03/24/15	19	10	61.2	379.8			Resource data alignment and Resource data alignment	All locations in PAC East
03/24/15	19	11	59.4	391.7			Resource data alignment and Resource data alignment	All locations in PAC East
03/25/15	1	8	97.9	384.1			Resource outages	All locations in PAC East
03/25/15	1	9	178.0	386.0			Resource outages	All locations in PAC East
03/25/15	1	10	155.5	402.5			Resource outages	All locations in PAC East
03/25/15	1	12	10.0	587.1			Resource outages	All locations in PAC East

Trade Date	Hour Ending	Interval	PACE Infeasibility	Excess Capacity PACE (MW)	PACW Infeasibility	Excess Capacity PACW (MW)	Reason for infeasibility	Affected locations
03/25/15	10	2	13.7	436.3			Resource data alignment	All locations in PAC East
03/27/15	4	9	49.6	79.5			Resource data alignment	All locations in PAC East
03/27/15	4	10	20.2	122.9			Resource data alignment	All locations in PAC East
03/27/15	5	6	0.4	189.6			Resource outages	All locations in PAC East
03/27/15	5	10	11.2	239.8			Resource outages	All locations in PAC East
03/27/15	5	11	4.0	455.0			Resource outages and Renewable deviation	All locations in PAC East
03/27/15	9	9	107.3	85.7			Resource outages	All locations in PAC East
03/27/15	10	8	22.7	415.3			Resource data alignment	All locations in PAC East
03/27/15	17	9	41.5	391.5			Resource data alignment	All locations in PAC East
03/27/15	17	10	15.3	448.7			Resource data alignment	All locations in PAC East
03/27/15	19	12			46.4	371.62	Resource outages	All locations in PAC West
03/28/15	12	1			40.4	882.61	Resource outages	All locations in PAC West
03/28/15	12	2			25.1	922.93	Resource outages	All locations in PAC West
03/28/15	14	7			119.9	906.1	Resource data alignment	All locations in PAC West
03/28/15	14	8			63.9	929.12	Resource data alignment	All locations in PAC West

Trade Date	Hour Ending	Interval	PACE Infeasibility	Excess Capacity PACE (MW)	PACW Infeasibility	Excess Capacity PACW (MW)	Reason for infeasibility	Affected locations
03/28/15	14	9			26.4	871.56	Resource data alignment	All locations in PAC West
03/28/15	15	4	4.1	244.9			Load changes	All locations in PAC East
03/28/15	19	11	0.0	0.0	10.4	863.61	Resource data alignment	All locations in PAC West
03/28/15	20	1	0.0	0.0	32.9	821.14	Resource outages	All locations in PAC West
03/28/15	21	2	57.4	276.6			Renewable deviation and Load changes	All locations in PAC East
03/29/15	5	4	24.6	149.4			Renewable deviation and Resource data alignment	All locations in PAC East
03/29/15	5	7	53.5	105.5			Renewable deviation and Resource data alignment	All locations in PAC East
03/29/15	5	8	95.2	74.8			Renewable deviation and Resource data alignment	All locations in PAC East
03/29/15	5	9	19.8	162.2			Renewable deviation and Resource data alignment	All locations in PAC East
03/29/15	5	10	19.4	185.6			Renewable deviation and Resource data alignment	All locations in PAC East
03/29/15	6	8	6.0	221.0			Renewable deviation	All locations in PAC East
03/29/15	13	1			6.9	467.12	Resource data alignment	All locations in PAC West
03/29/15	13	2	2.1	209.9			Resource data alignment	All locations in PAC East
03/29/15	14	8	0.0	310.0	8.5	301.55	Resource data alignment	All locations in PAC West
03/29/15	18	7	18.0	271.0			Resource outages	All locations in PAC East

Trade Date	Hour Ending	Interval	PACE Infeasibility	Excess Capacity PACE (MW)	PACW Infeasibility	Excess Capacity PACW (MW)	Reason for infeasibility	Affected locations
03/29/15	18	9	1.7	249.3			Load changes	All locations in PAC East
03/29/15	21	8			27.3	292.66	Import/Export changes	All locations in PAC West
03/29/15	21	9			54.1	264.94	Import/Export changes	All locations in PAC West
03/29/15	21	11			12.5	313.48	Import/Export changes	All locations in PAC West
03/31/15	12	3	10.2	260.8			Load changes and Import/Export changes	All locations in PAC East
03/31/15	15	5	5.9	153.1			Renewable deviation and Resource data alignment	All locations in PAC East
03/31/15	19	10	57.1	191.9			Load changes and Renewable deviation	All locations in PAC East

ATTACHMENT D:

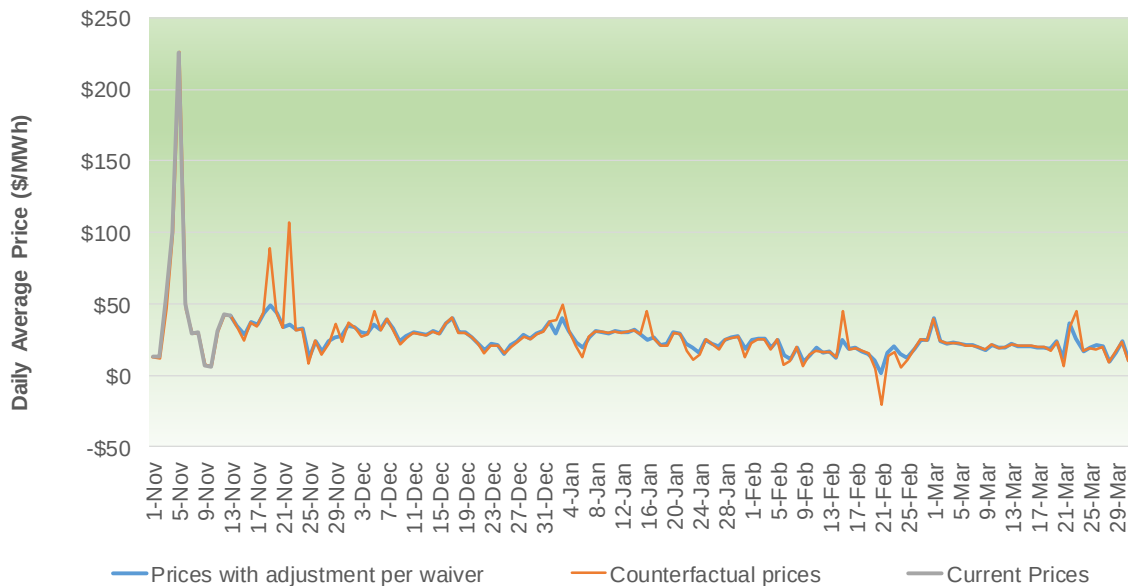
This attachment provides a quantitative and qualitative analysis of the market performance impact of the issues that prompted the CAISO's request for a waiver.

A. Impact of Issues on Market Prices

The figures in this subpart summarize the impact the issues would have had on prices absent the waiver pricing. During the term of the waiver, the CAISO established prices based on the price discovery mechanism and not based on the penalty prices that would have otherwise been in effect. The market does not produce prices as they would have been absent the waiver. Therefore, the CAISO created a counterfactual set of prices it compares to the prices that cleared based on the pricing in effect during the waiver. Because pricing under the waiver pricing is based on the last economic bid price signal, it is a proxy of what the prices would have been absent the seven category of issues. Therefore, the difference between the counterfactual pricing and the price in effect during the term of these reports illustrates the market impact.

The figures in this subpart also summarize the frequency with which the EIM entity failed the flexibility tests during the term of this report and the daily average price trends in the EIM organized by market and area. These trends include pricing for both the PAC West and PAC East external load aggregation points (ELAPs). The report focuses on the ELAP prices because these aggregate prices represent pricing in each area -- PAC West and PAC East --, which allows the CAISO to reflect short-term imbalance shortage for the aggregate area. These daily averages reflect all prices of the real-time market, including the price corrected through the price correction process and the price adjustments under the waiver associated with this report.⁶

⁶ Note a separate waiver has been submitted requesting relief for period of November 1-November 13. These reports do not reflect any adjustments for this separate waiver request, which has not yet ruled on as of the date of this report.

Figure 5: Daily average of fifteen-minute market prices in PAC West.⁷

⁷ From November 14 through November 30 the CAISO implemented the price adjustments under the waiver retroactively and is making the adjustments in settlement statements after the December 1 order was issued. After December 1, there are no retroactive adjustments since the logic of the price discovery feature implemented under the waiver is implemented through the market clearing solution process. These prices, like any other prices, are still subject to the price validation and correction process. Section 35.4 of the CAISO tariff already 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 inconsistent with the CAISO tariff.

Figure 6: Daily average of fifteen-minute market prices in PAC East.

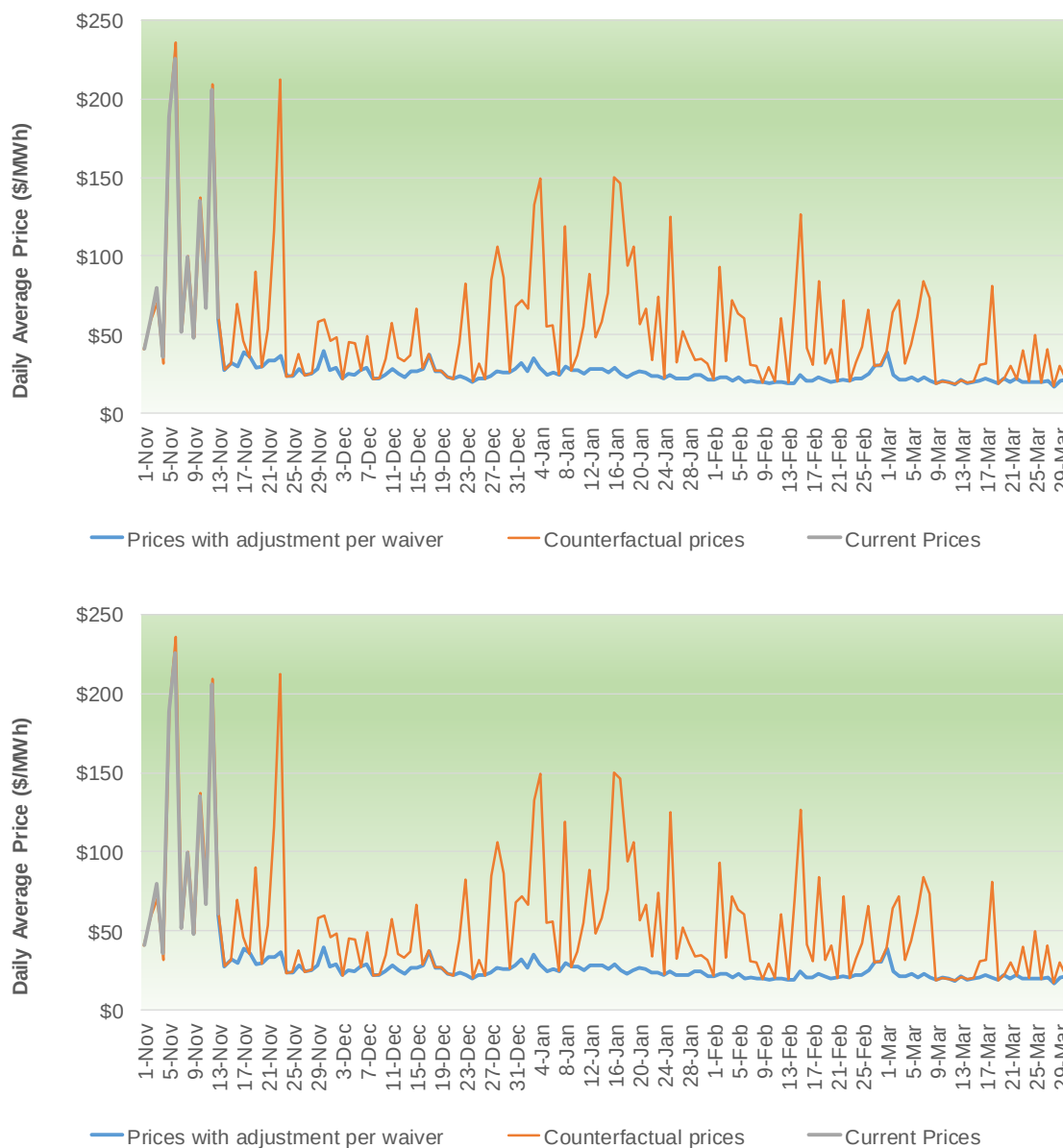


Figure 5 and Figure 6 each compare two trends for the same market and same area, PAC East and West respectively. The blue line illustrates daily average prices from November 14 on and represents the actual and final prices after any price corrections or price adjustments pursuant to the December 1 Waiver, which is the subject of this report. After November 14, even when there were power supply infeasibilities, per the December 1 Waiver, this trend reflects prices that are set based on the the marginal economic signal in the market and are not based on constraint relaxation pricing parameters. The price trends for November 1 through November 13 are represented in a different color than the

the prices after November 14 because those represent the final prices as of this date, after all price corrections have been made. The prices for the November 1-13 include prices based on the constraint relaxation pricing parameters.

The orange line was constructed to estimate the counterfactual case of what prices would have been if they were based on the constraint relaxation pricing parameters, pegged to the \$1000/MWh bid cap. As of December 1, the CAISO adopted the waiver-based pricing in its systems, which means that the market systems produced prices consistent with the pricing mechanism under the waiver and not based on the constraint relaxation pricing parameters. Therefore, the CAISO had to find a way to reconstruct those cases, which it is referred to as the counterfactual case. In other words, the prices represented by the orange line represent the CAISO's estimate of what prices would have been absent the December 1 Waiver. These two lines compare together prices under the December 1 Waiver to what they would have been without that waiver.

The orange line is more volatile and spiky because those prices are calculated based on the \$1000/MWh any time there is an observed undersupply infeasibility. Whereas the blue line shows a more stable pricing trend reflecting dispatched economic bids. For the first 13 days of November, the lines in grey and orange track closely to each other but not exactly. The prices represented by the grey line are final as of now and include prices that even though there was infeasibility, for other reasons the prices were not based on the constraint relaxation pricing parameters. In the counterfactual case, the CAISO estimated that any interval with infeasibility would produce a price based on the constraint relaxation pricing parameter.

In addition, the prices for the counterfactual case in Figure 5 and Figure 6 were constructed based on the following two factors. First, because the goal of this report is to quantify and explain the price changes associated with the implementation of the December 1 Waiver, these trends do not include the reconstruction of prices related to price corrections and flexible ramping constraint infeasibility because:

- i) Price corrections. If a price was associated with a power balance infeasibility, but the interval was rendered to have an invalid price and was subject to price corrections for other reasons, the CAISO did not estimate the counterfactual price and instead the estimated and counterfactual price is equal to the final and current price. This is based on the premise that had the CAISO not experienced the issue that supported the price correction in the first place, the power balance infeasibility would not have triggered. Therefore, the market price would have been based on the tariff-based rules that consider the submitted economic bid prices rather than the penalty prices specified in the tariff; and

- ii) Flexible ramp sufficiency test. As specified in section 29.34(n) of the CAISO tariff and section 10.3.2.1 of the Business Practice Manual for the EIM, 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. For the duration of the restricted interval, the market clearing price in the affected EIM Entity balancing authority area will also be based on the tariff-based rules that look at the last economic bid cleared in the fifteen-minute or five-minute interval in the EIM Entity balancing authority area. This logic is outside waiver of this report and with or without the waiver, the pricing mechanism will be in place. Therefore, the original price for market intervals that had power balance infeasibilities and that failed the flexible ramp test would have remained unchanged absent the waiver as they will not be set by relaxation parameter prices under Section 10.3.2.1 of the BPM for the EIM.

Second, the prices reflecting the tariff-based relaxation parameters were reconstructed for both under-supply and over-supply infeasibilities. This means that when an instance of undersupply was reconstructed, the price was set to the bid cap plus/minus marginal loss component. Similarly, when an oversupply instance was reconstructed, the prices in the counterfactual case were set to the bid floor relaxation parameter plus/minus marginal loss prices.

During the term of these reports, in some intervals the market clearing process experienced “degenerate cases” during which the market may clear at multiple pricing run solutions equally valid from an economic perspective. The CAISO has recently stakeholdered and the CAISO board of governors has approved a solution to this phenomena and intends to file a tariff amendment to implement this change. These upcoming market rule changes eliminate the multiplicity of pricing issue and produce one price that reflects the lack of congestion at the locations. During such cases, even had the market systems observed an infeasibility that would have led to the relaxation of a constraint and triggered the penalty pricing parameters, the pricing run could have landed at a price based on the marginal resource economic bid price, which could differ from the price had it been based on the \$1000/MWh parameter. The CAISO observed many intervals in which this phenomena occurred, in particular in the five minute real-time dispatch. The CAISO does not correct and believes these to be optimal from the perspective of the energy market alone. But because of issues this may

cause in associated markets such as the congestion revenue rights, the CAISO will modify its market rules prospectively to eliminate such occurrences.⁸

The counterfactual case represented by the orange line cannot account for the degeneracy and represents what prices would have been for those intervals based on the tariff-based constraint relaxation pricing parameters because there was an infeasibility. This has implications regarding the trends in the figures below. For the first 13 days in November, the CAISO has not yet modified posted prices based on the waiver-type pricing. The CAISO filed for an additional waiver to conduct this pricing adjustment and it is pending before the Commission in FERC Docket No. ER15-817. Without the waiver, the prices as posted would remain as they are. One would expect the counterfactual case represented by the orange line to be close to the posted prices represented by the blue line. This is the case for the fifteen-minute markets. However, for the real-time dispatch, the lines diverge because in several intervals posted prices appear to have not been determined based on the \$1000/MWh parameter even if there was infeasibility. The CAISO believes this was because many of the affected intervals were subject to degeneracy. After November 13, however, whether or not there would have been degeneracy in the pricing run, is immaterial, because pricing under the December 1 waiver or degeneracy is based on the last economic bid price signal.

⁸ Additional information regarding the stakeholder process and the resulting policy changes is available at: <http://www.caiso.com/informed/Pages/StakeholderProcesses/PricingEnhancements.aspx>. This will be the subject of an upcoming tariff amendment with the Commission.

Figure 7: Daily average of five-minute market prices in PAC West.

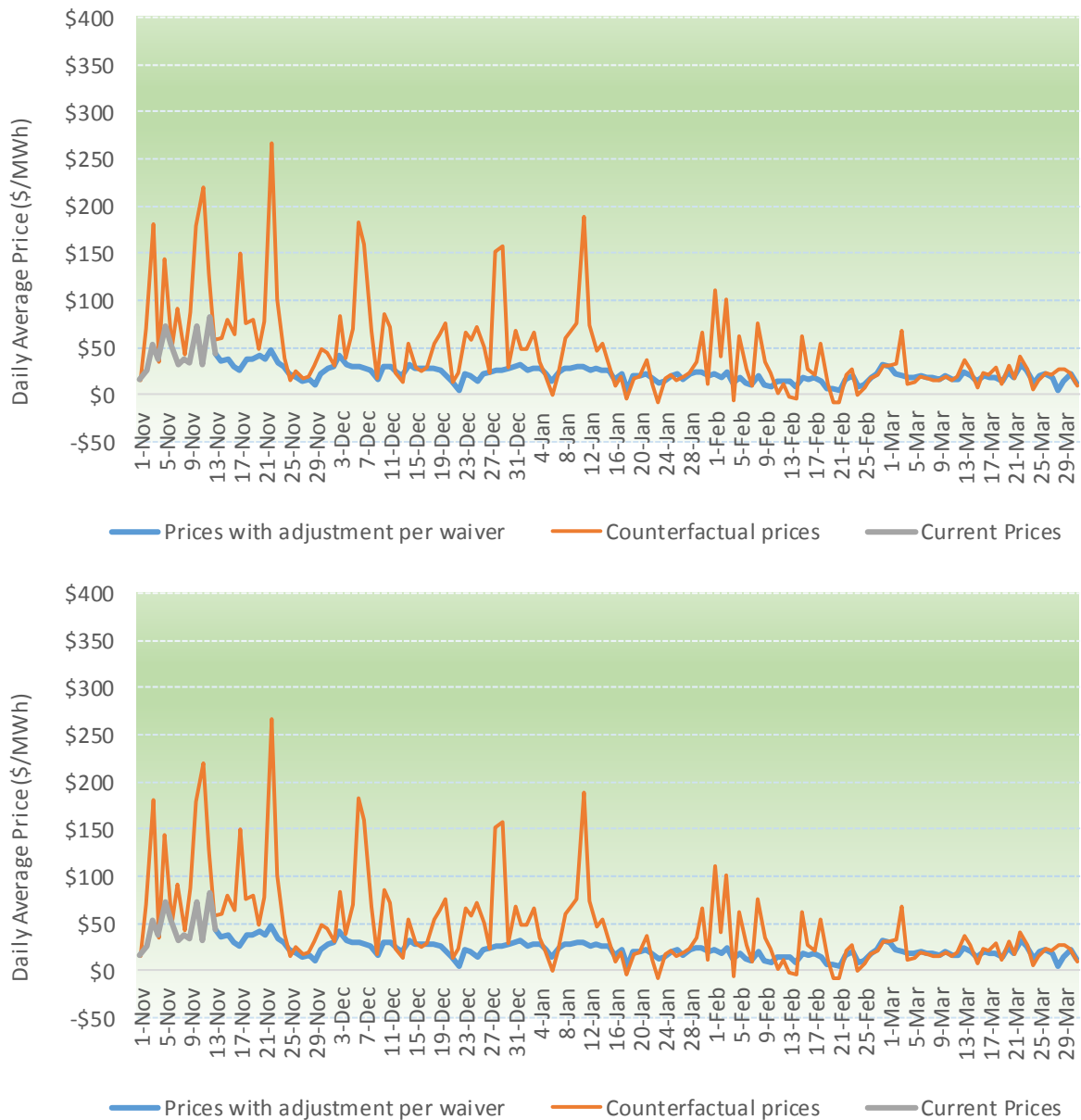
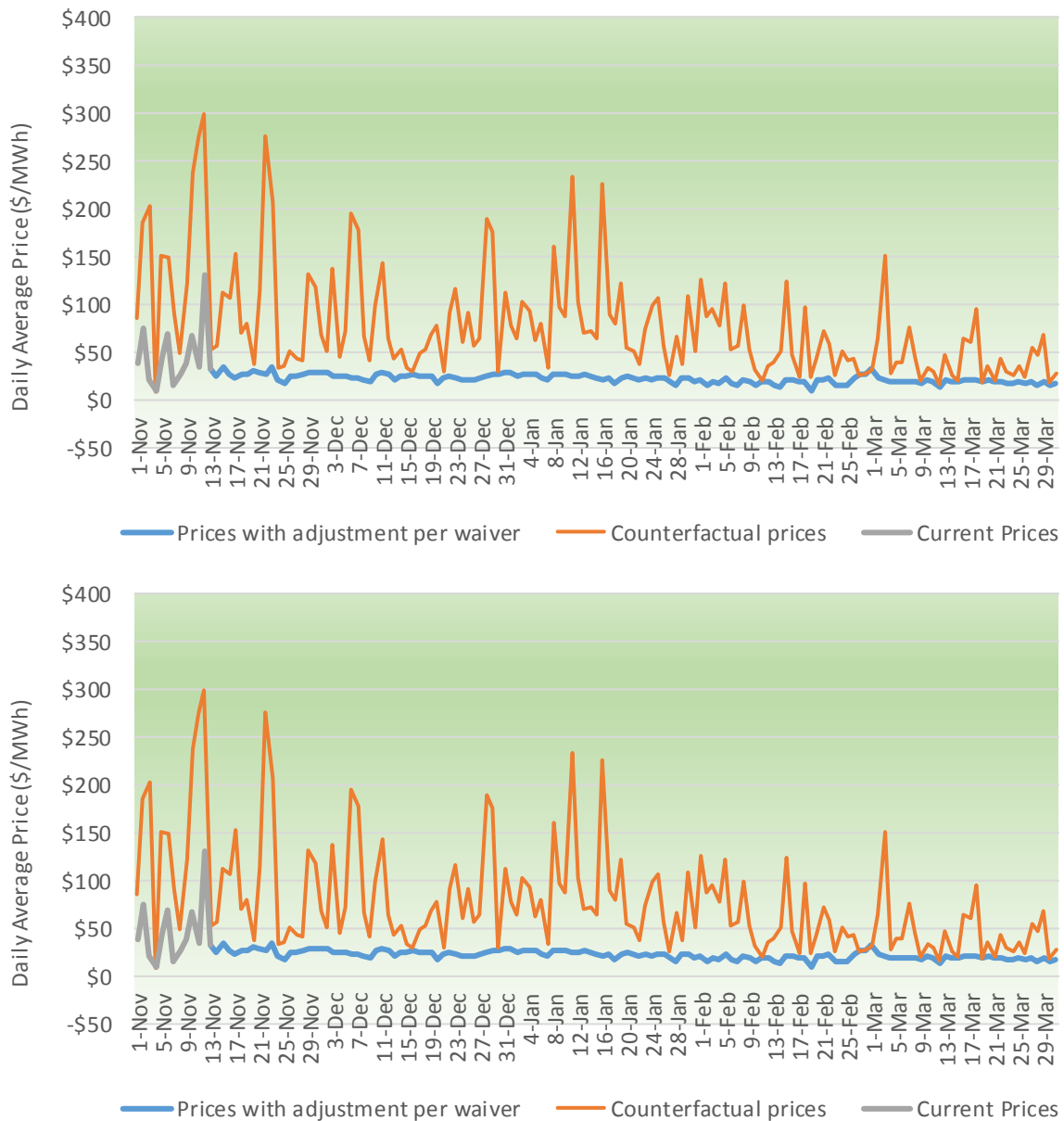


Figure 8: Daily average of five-minute market prices in PAC East.



Overall, PAC East is more volatile and subject to more frequent price excursions than PAC West. This may be due to limited transfers into the PAC East area. PAC West does not share such limitations which enable more transfers in and out of the CAISO balancing authority areas to PAC West.

In both PAC East and PAC West, the five-minute real-time dispatch is notably more volatile than the fifteen minute market. This is because the fifteen-minute market embodies more flexibility as it is further in time than the intervals whereas the five-minute real-time dispatch is closer to real-time. In the five-

minute dispatch, ramping capability is more limited. Figure 9 and Figure 10 provide monthly averages of the prices as modified under the December 1 Waiver and are final as of now. These include price corrections and price adjustments under waiver of this report. These figures show that the average price for energy in both the PAC East and West have increased slight in March 2015, around \$21/MWh in the fifteen-minute market and around \$19/MWh in the five-minute market.

Figure 9: Monthly average of fifteen-minute market prices in PAC West and East.

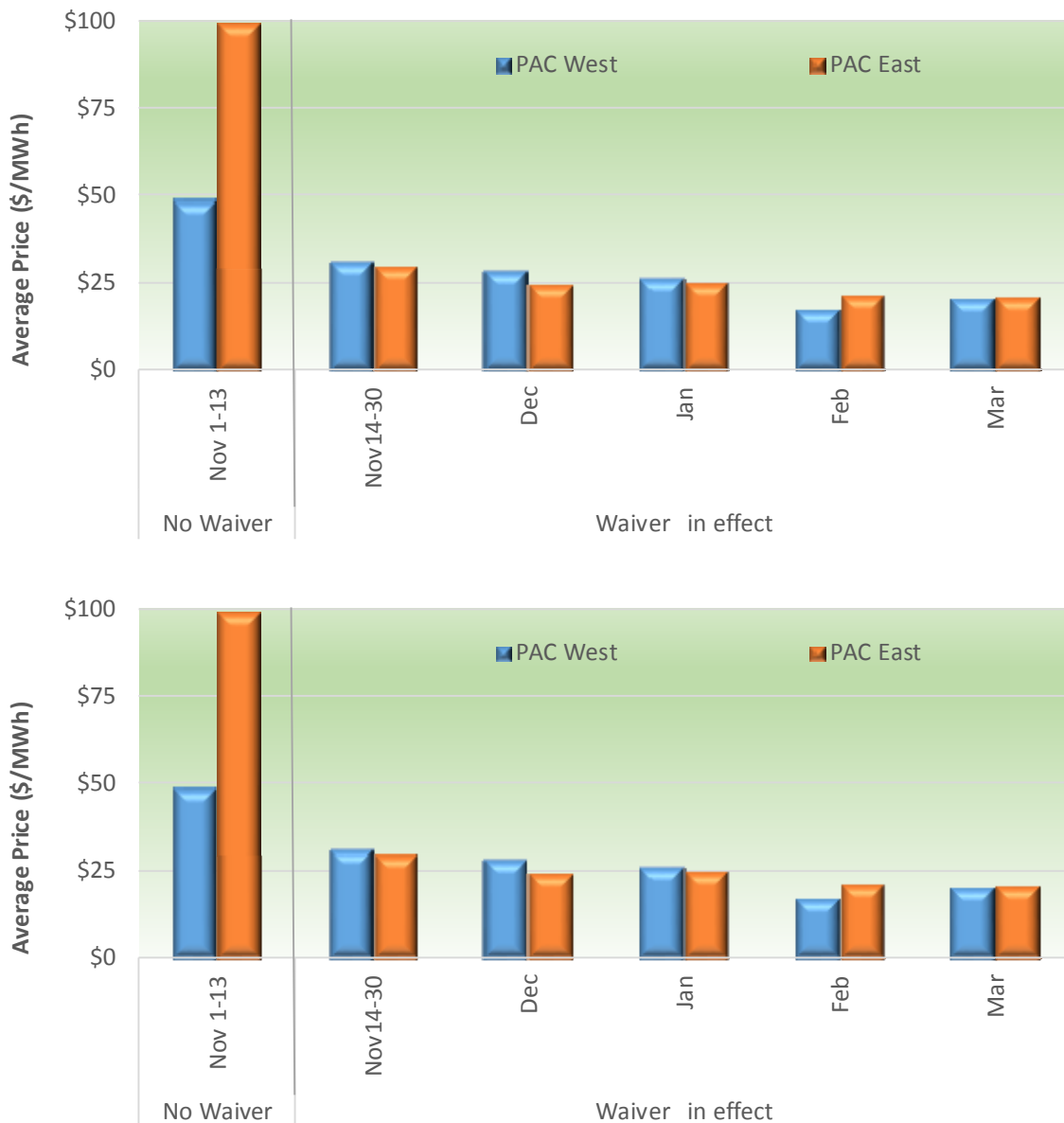
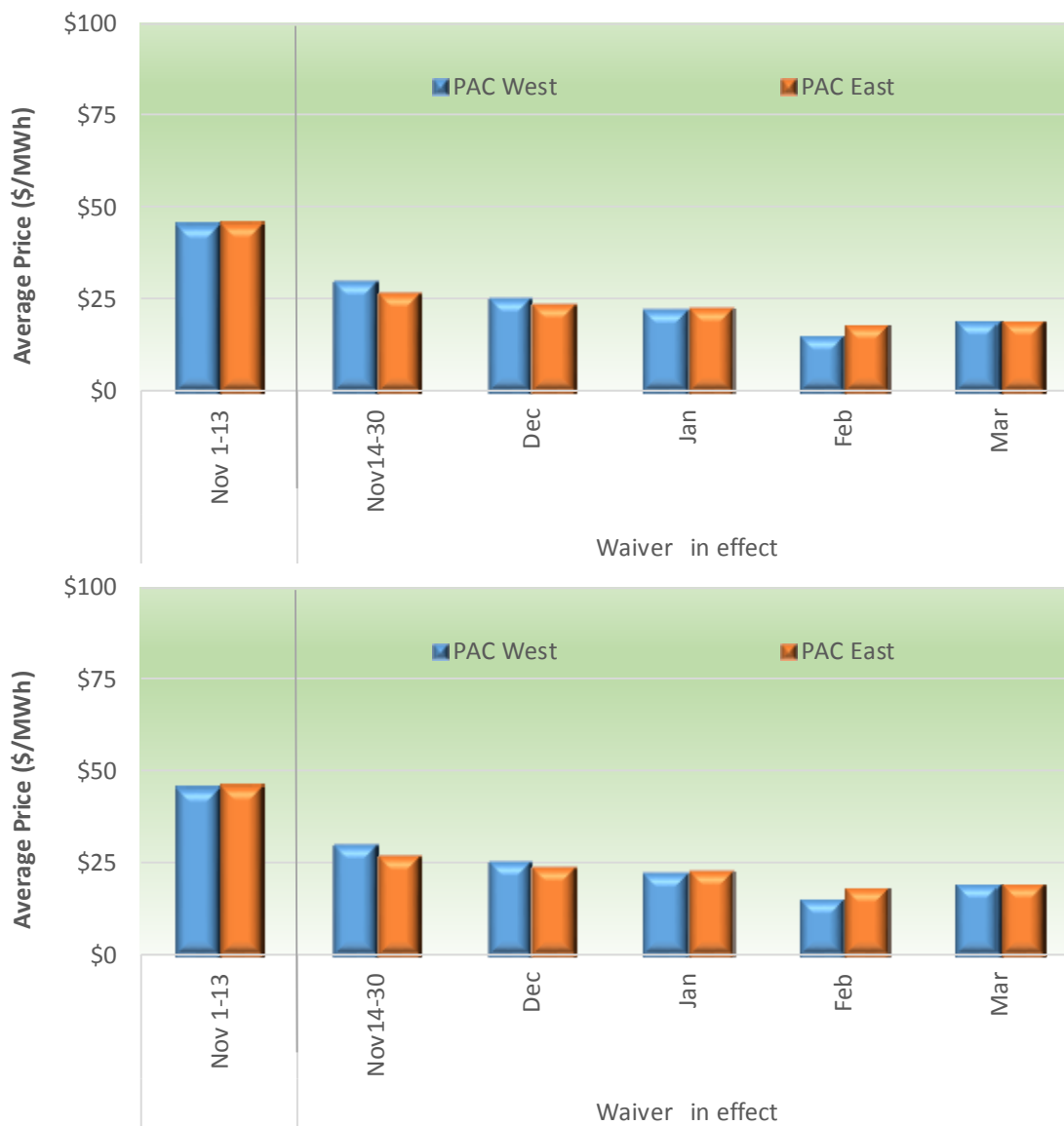


Figure 10: Monthly average of five-minute market prices in PAC West and East.

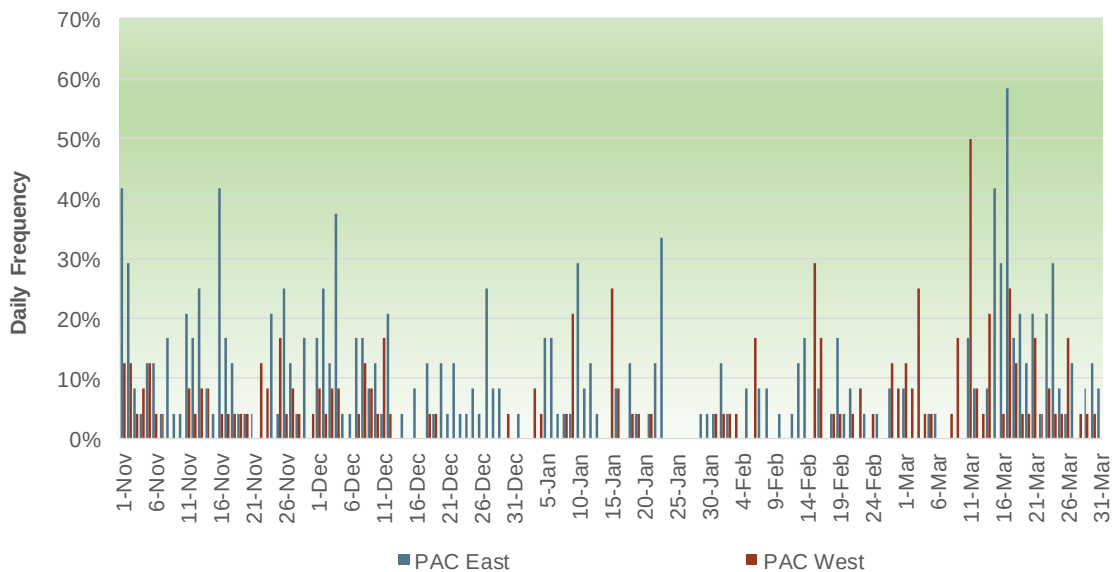
B. Balance Test Failures

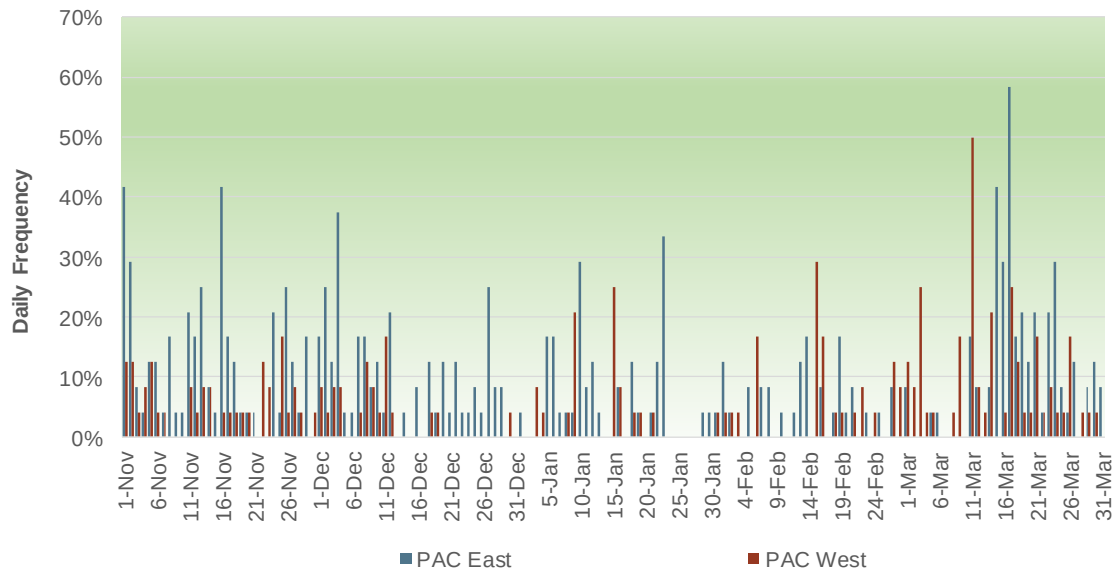
shows the trend of balancing test failures for the period of November 1, 2014, through March 31, 2015 of operation of the EIM by area, PAC West and East. The frequency of balancing test failures increased to a daily average of 10 percent for the period of March 1 through March 31. The average imbalance was 196 MW and 98 MW in PAC East and West, respectively. The increase in frequency of balancing test failure appears to be driven by two issues: 1) an error in the net schedule interchange for both PACE and PACW reported for the balancing test compared to the net schedule interchange supplied for the fifteen

and five minute markets; and 2) incorrect disqualification of base schedules from certain multi-stage generating units. These issues did not appear to influence imbalance infeasibilities.

Figure 11 shows the trend of balancing test failures for the period of November 1, 2014, through March 31, 2015 of operation of the EIM by area, PAC West and East. The frequency of balancing test failures increased to a daily average of 10 percent for the period of March 1 through March 31. The average imbalance was 196 MW and 98 MW in PAC East and West, respectively. The increase in frequency of balancing test failure appears to be driven by two issues: 1) an error in the net schedule interchange for both PACE and PACW reported for the balancing test compared to the net schedule interchange supplied for the fifteen and five minute markets; and 2) incorrect disqualification of base schedules from certain multi-stage generating units. These issues did not appear to influence imbalance infeasibilities.

Figure 11: Frequency of balancing test failures in PAC West and East.



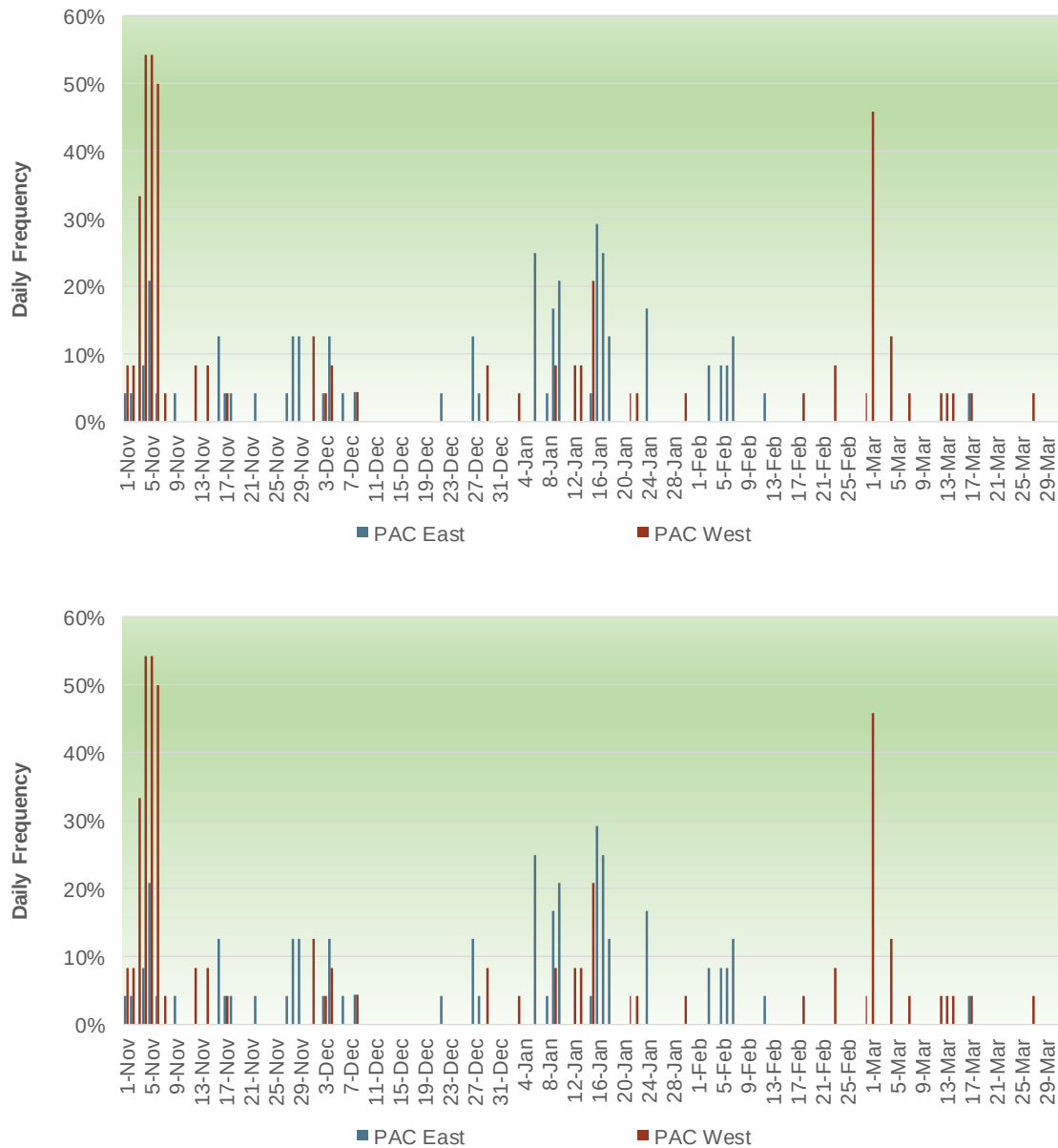


As specified in section 29.34(n) of the CAISO tariff and section 10.3.2.1 of the Business Practice Manual for the EIM, if the EIM Entity balancing authority area fails the sufficient ramp test, or is deemed to have failed the test because it failed the capacity (resource plan) test, CAISO will restrict additional EIM Transfer imports into that EIM Entity balancing authority area during the hour. 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 those balancing authority area-to-area group constraints. This sufficiency test applies to each PAC West and East area on an hourly basis. Figure 12 shows the trend of test failures for flexible ramping for the first two months of operation of the energy imbalance market. The CAISO obtained the frequency by dividing the number of hours failed by 24 hours of a day.⁹

⁹ During the term of the waiver, the procedure described in Section 10.3.2.1 of the Business Practice Manual is made ineffective under the pricing procedure under the waiver.

Figure 12 shows that there has been a downward trend of these infeasibilities through March. In January, there was an increase in failures of the test, which trended down again in February. The downward trend continued in March in PAC East and PAC West, except for one day.

Figure 12: Frequency of flexible ramp sufficiency test failures in PAC West and East.



ATTACHMENT E

In addition to the CAISO reporting on each relaxation event in Appendix B, this Attachment E and a summary of the magnitude and frequency of such events overall.¹⁰

The relaxation events affect numerous market intervals as the CAISO real-time markets contain many fifteen and five minute intervals. The CAISO provides the information at summary level because the data is significant and detail reporting of such events would not be meaningful. The report focuses on the external load aggregation points (ELAP) prices because these aggregate prices represent pricing in each area --West and East—and therefore, reflect short-term imbalance shortage for the aggregate area.

¹⁰ *December 1 Order*, at P 26.

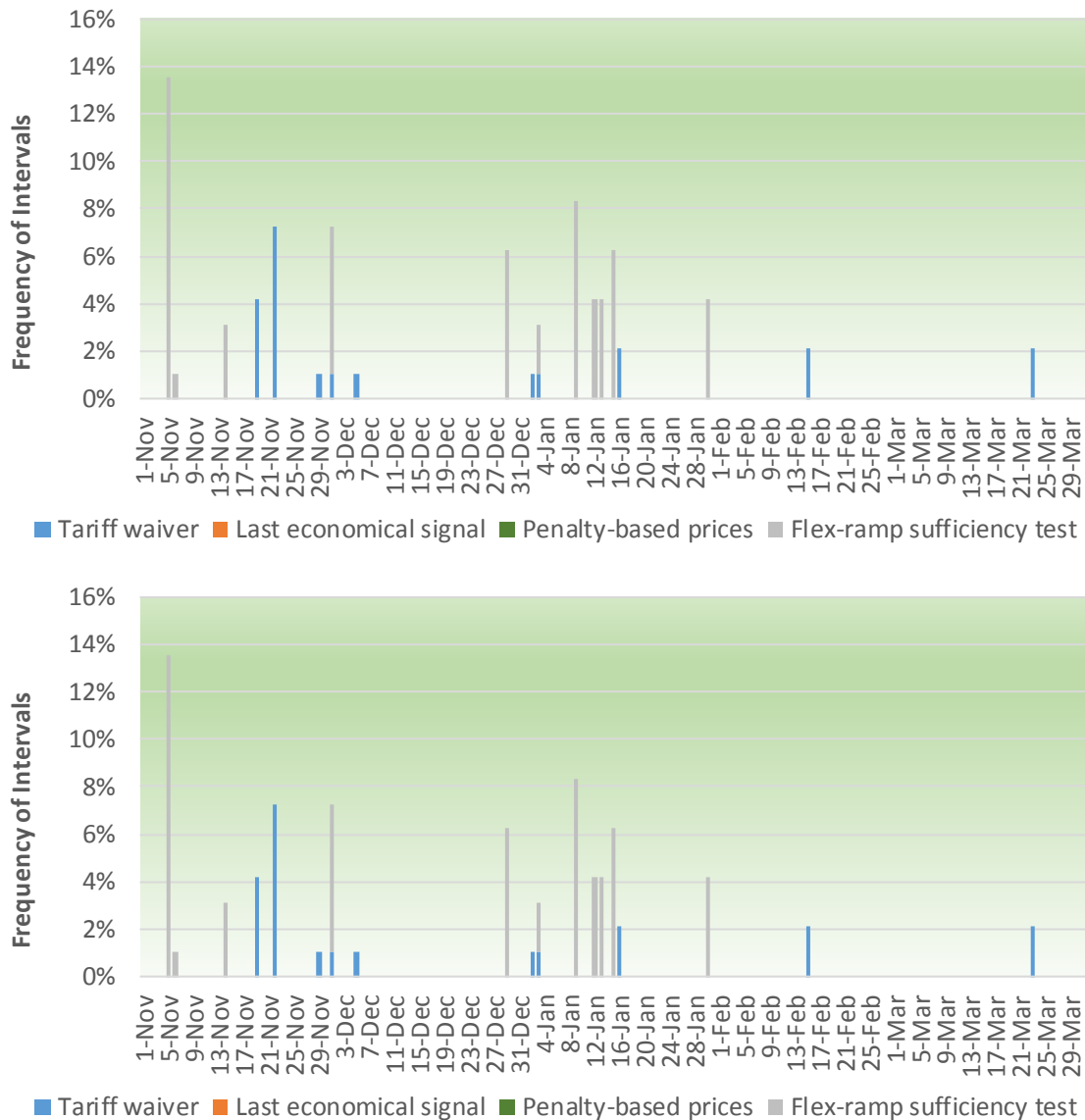
Figure 13 through Figure 20 provide summary information on the instances of power balance relaxation for undersupply (shortage) in the fifteen- and five-minute market in the PAC West and East area. Normally, when there are such infeasibilities, prices will be based on the constraint relaxation pricing parameter, and prices will be near or at \$1000/MWh. However, there are three cases where this would not occur and this is reflected in the data supporting the figures in this report. First, as of December 1st consistent with the December 1 tariff waiver, the price is based on the last economic signal consistent with the pricing principles in the tariff. Second, as described in more detail in Attachment A, when the EIM Entity fails the flexible ramping sufficiency test, prices are calculated using the same approach based on the last economic signal for the duration of the restricted interval. Therefore, in these intervals, even if the CAISO had not received the waiver, the CAISO would have implemented the procedure described in Section 10.3.2.1 of the Business Practice Manual, and price based the last economic bid cleared in the fifteen-minute or five-minute interval in the EIM Entity balancing authority area as opposed to the \$1000/MWh bid cap.¹¹

In the December 15, 2014 report, the CAISO noted there was a third case in which it had observed the power balance constraint was relaxed in the scheduling run, but prices did not reflect the \$1000/MWh. The CAISO has since evaluated these cases more closely and as discussed in Attachment A, sometimes the market is in a degeneracy case, and the market clears based on the last economic signal. The CAISO is continuing to investigate these intervals to ensure these events are not due to other abnormalities and are due to degeneracy. As explained in Attachment A, after implementing the pricing procedure under the December 1 waiver there is no pricing based on the degeneracy cases because the pricing procedure under the December 1 waiver governs over the pricing.

¹¹ The price discovery mechanism under the procedure described in Section 10.3.2.1 of the BPM for Energy Imbalance Market is, however, essentially the same price discovery procedure used under the December 1 Order waiver.

Figure 13 through Figure 20 exclude the intervals invalid. These figures show the frequency of infeasibilities organized by instances in which the prices were set based on 1) the last economic bid price signal as per the tariff waiver, referred to in the figures as “Tariff waiver,” 2) the \$1000/MWh penalty price parameter, referred to in the figures as “Penalty-based prices” 3) last economical signal from degeneracy referred as “Last economical signal” and 4) the last economic signal but because for those intervals the EIM entity failed the flexible ramping sufficient test, referred to as the “Flex-ramp sufficient test.” Each figure of the frequency of infeasibilities is accompanied with a figure the magnitude of infeasibilities. The reported events are also aggregated daily and depicted with an infeasibility range shown by the vertical line in blue. The ends of the vertical blue lines represent the minimum and maximum values of power balance relaxation in each day. The average magnitude of the infeasibility is shown by the red marker on the blue vertical lines.

Figure 13: Frequency of under-supply infeasibility in PAC West. Fifteen-minute market.



For the period of November 1 through November 13, the data on the magnitude of infeasibility in the fifteen-minute market was not preserved in the data system. This impedes the CAISO's ability to identify the cases with infeasibility and quantify their magnitude. However, such instances were conservatively estimated by analyzing the cases where prices reached the relaxation-based levels of \$1000/MWh.

Figure 14: Magnitude of undersupply infeasibility in PAC West. Fifteen-minute market.

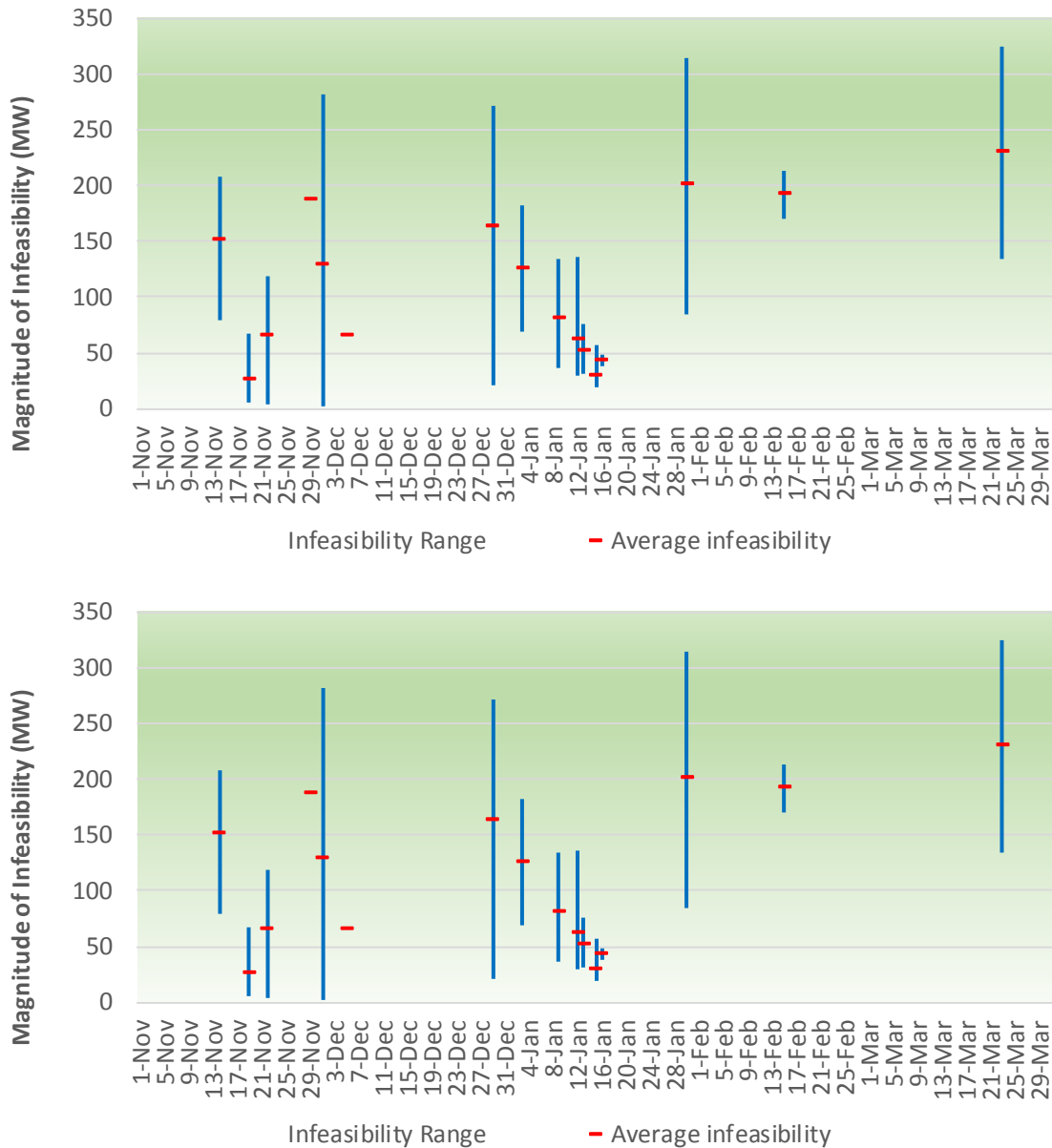


Figure 15: Frequency of undersupply infeasibility PAC East. Fifteen-minute market.

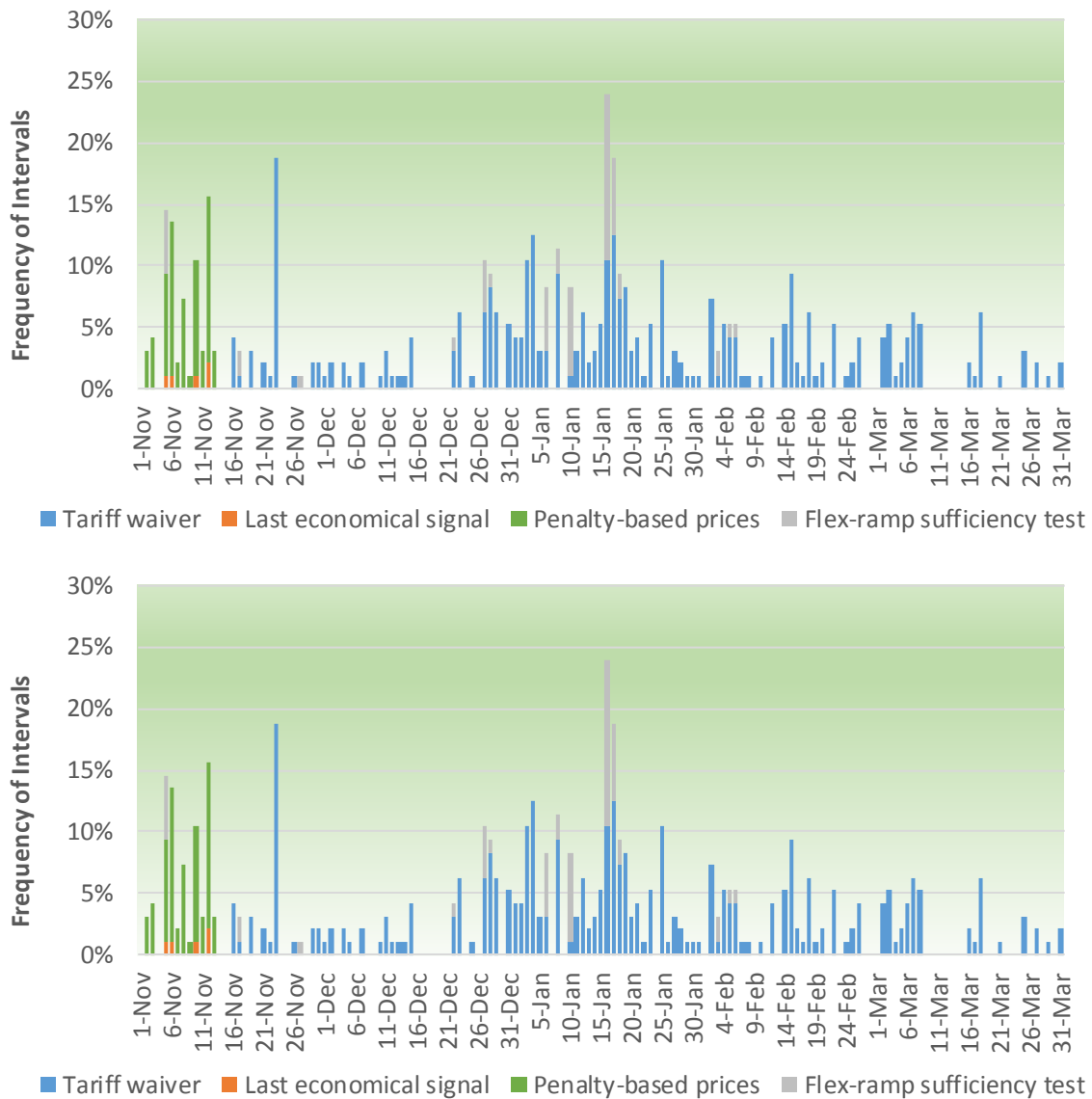


Figure 16: Magnitude of undersupply infeasibility PAC East. Fifteen-minute market.

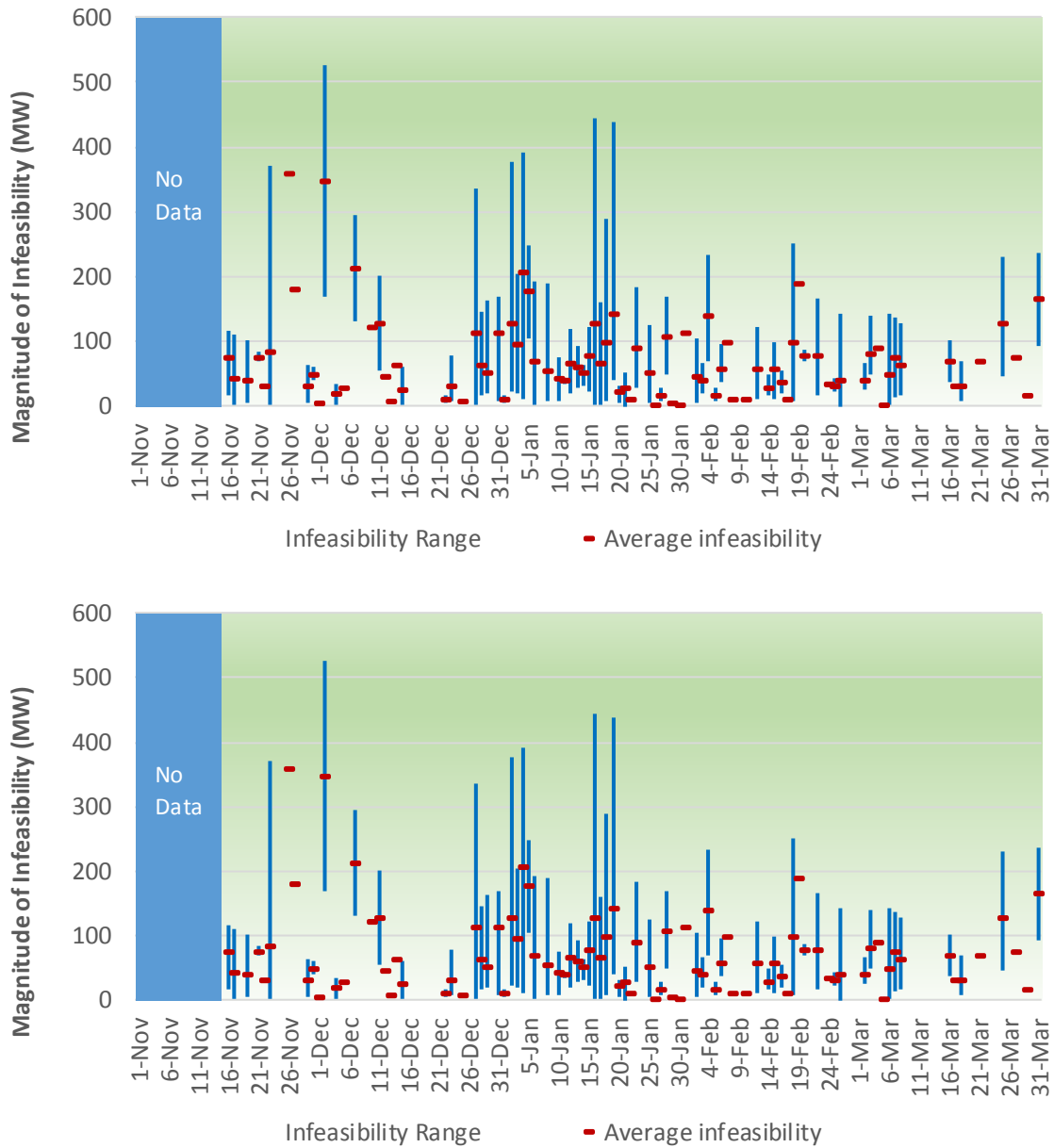


Figure 17: Frequency of undersupply infeasibility PAC West. Five-minute market.

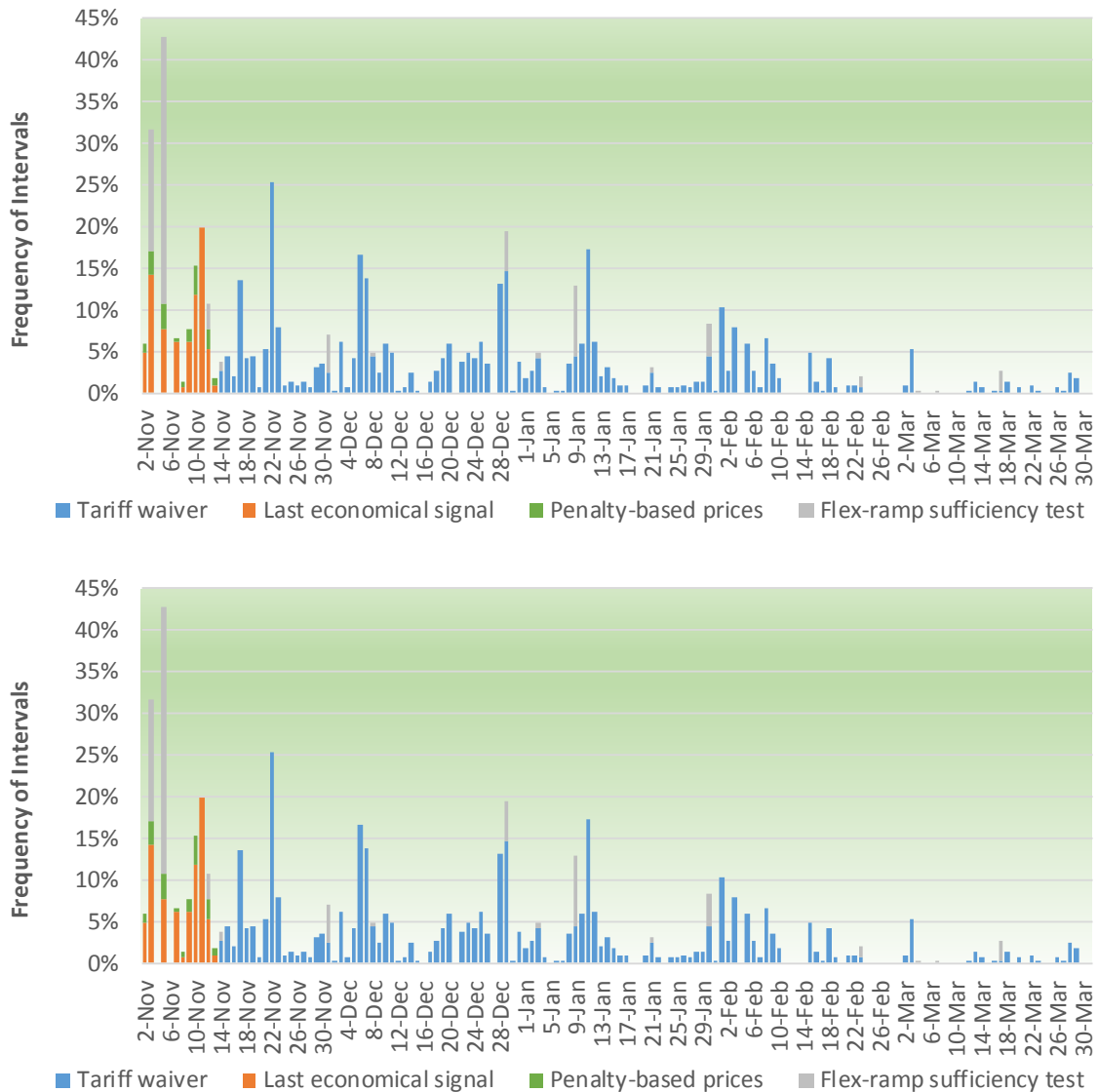


Figure 18: Magnitude of undersupply infeasibility PAC West. Five-minute market.

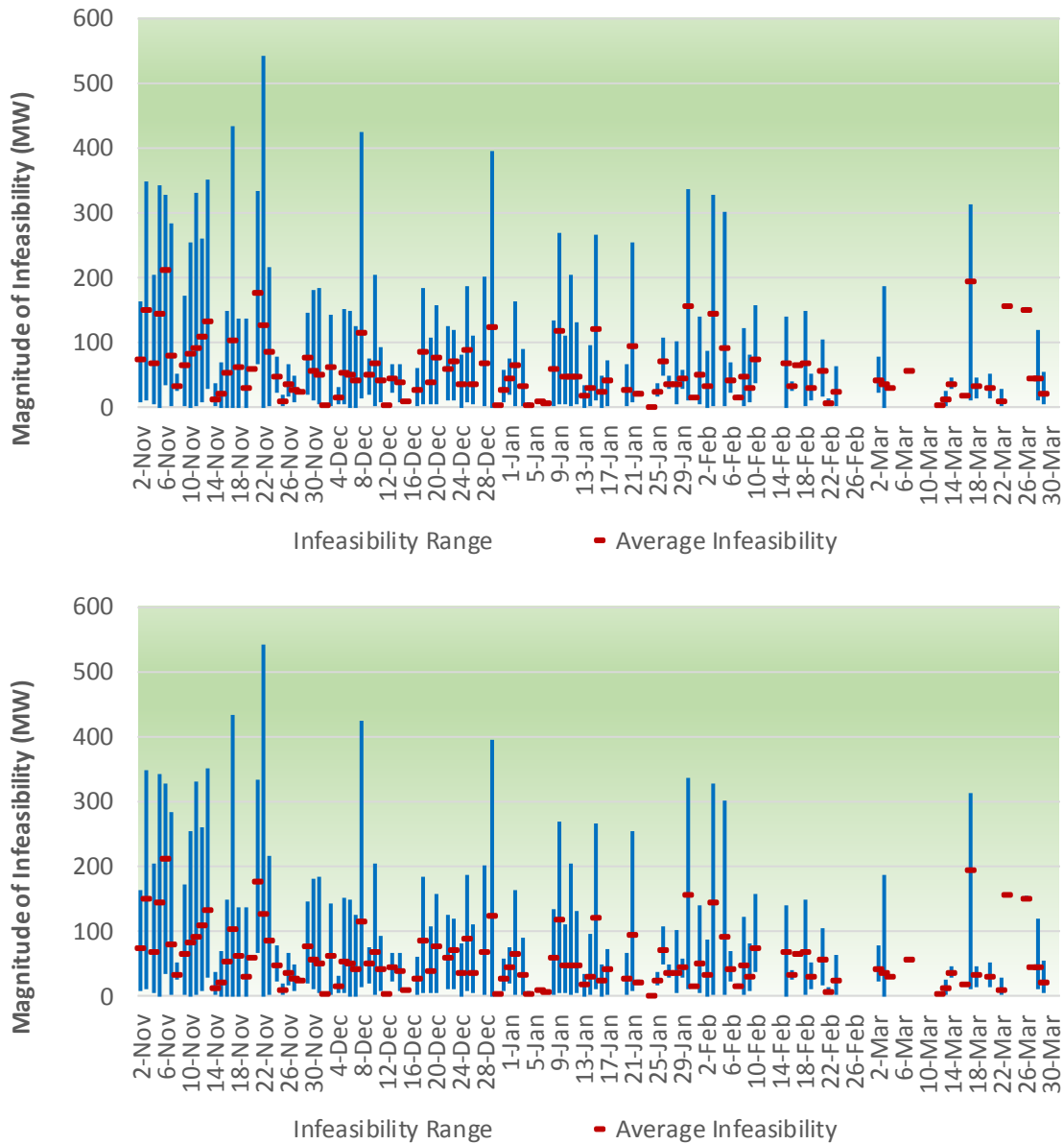


Figure 19: Frequency of undersupply infeasibility PAC East. Five-minute market.

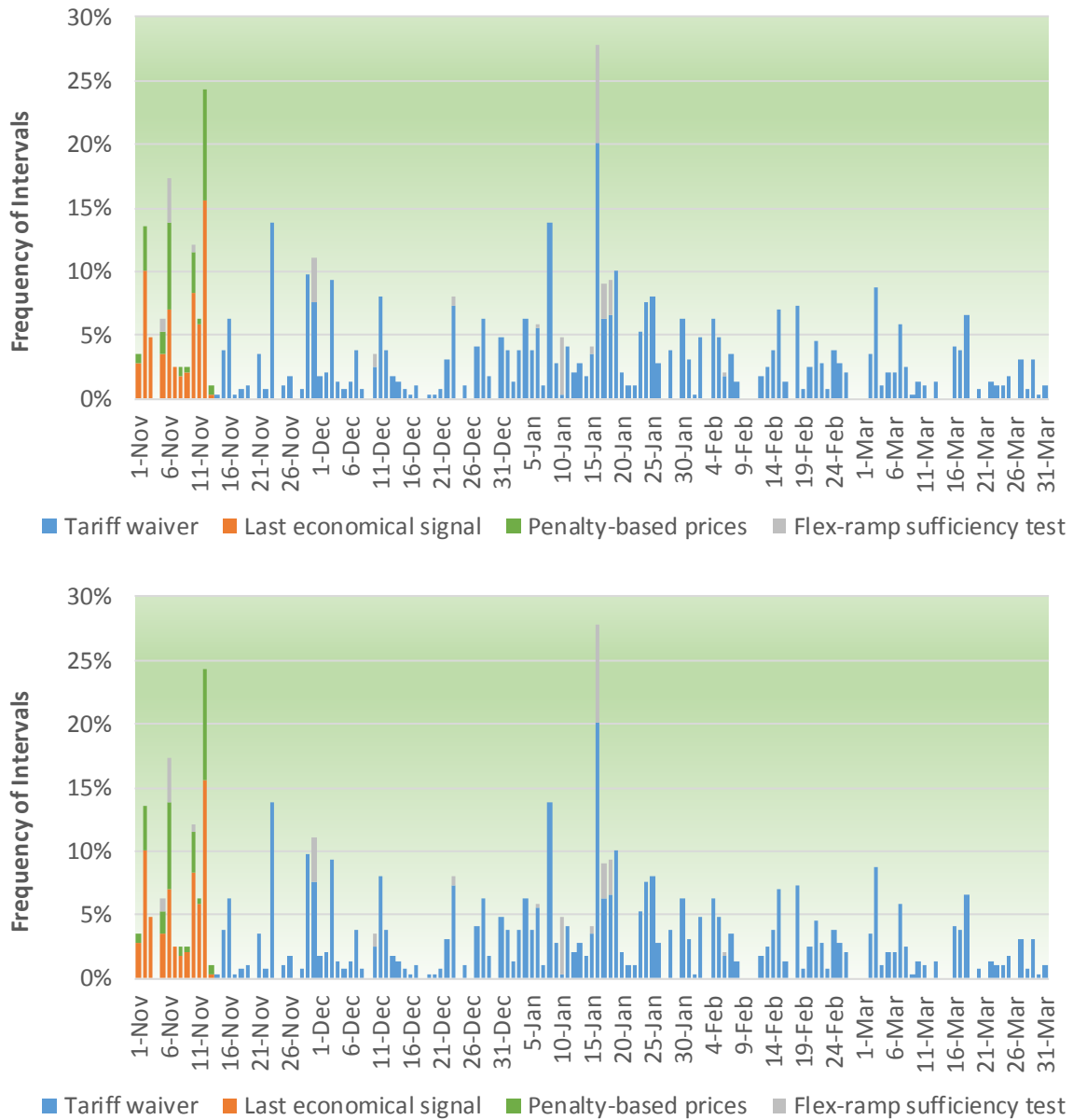
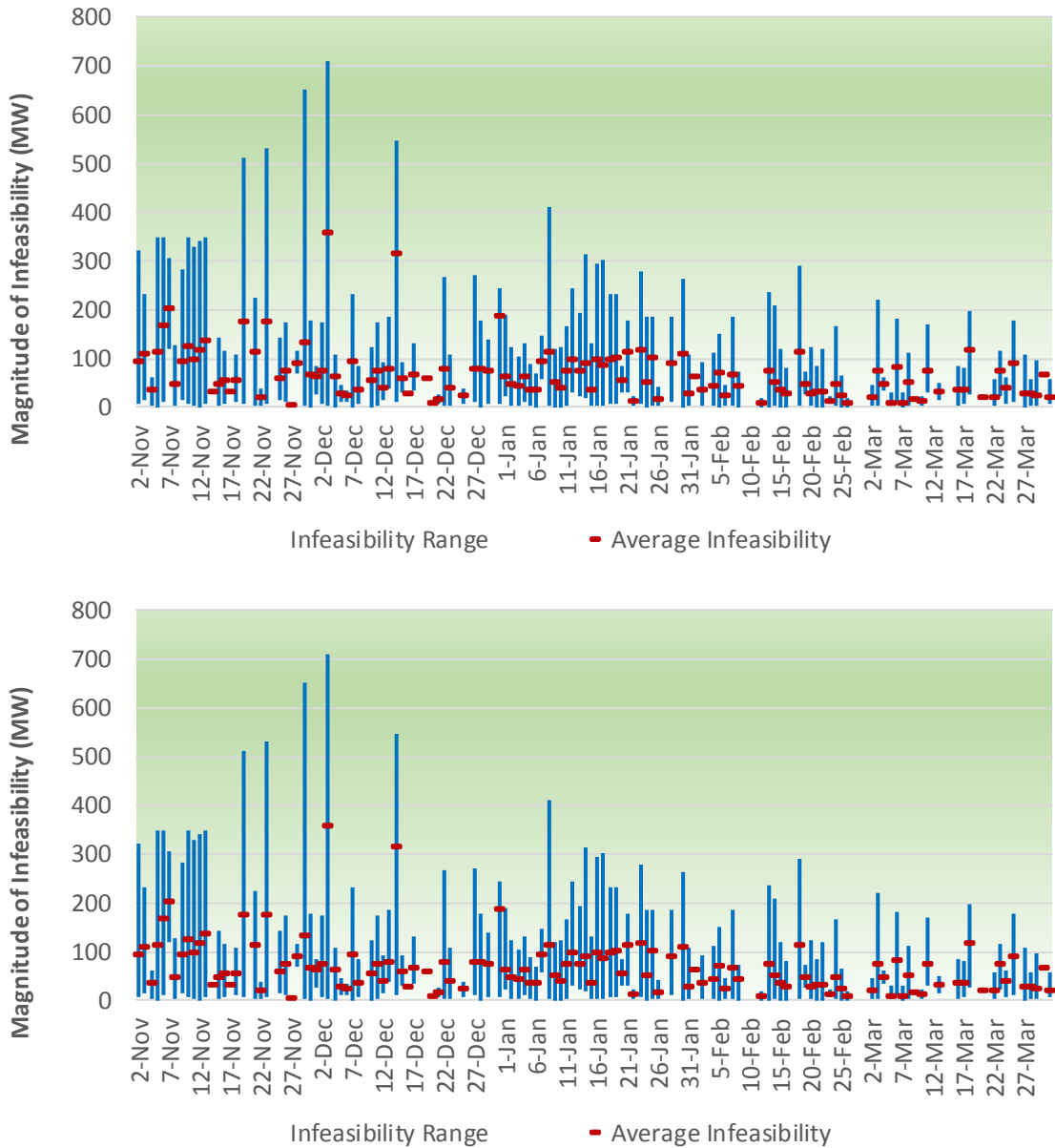


Figure 20: Magnitude of undersupply infeasibility PAC East. Five-minute market.



The imbalance energy transfers may also be subject to relaxation to address infeasibilities. There were few instances only in the PAC East transfer that resulted in relaxation and there were no instances of relaxation of EIM transfers between PAC and CAISO. The summary of these instances are listed in Table 2

Table 3. All these instances occurred before the period applicable for the waiver associated with this report; there were no valid EIM transfer infeasibilities observed in January and February. Three invalid infeasibilities were on PAC East on January 15 due to a software issue addressed through the standard process of price corrections.

**Table 2: Statistics of EIM transfer infeasibilities for PAC East.
Fifteen-minute market.**

Date	Maximum	Minimum	Average	Count
6-Nov-14	51.4	1.1	26.2	2
10-Nov-14	121.0	121.0	121.0	1
12-Nov-14	126.7	72.0	99.3	2
13-Nov-14	130.9	16.9	76.2	3

**Table 3: Statistics of EIM transfer infeasibilities for PAC East.
Five-minute market.**

Date	Maximum	Minimum	Average	Count
6-Nov-14	65.2	65.2	65.2	1
10-Nov-14	114.3	97.9	106.1	2

For completeness, the data in this report also includes those cases in which there was a relaxation of flexible ramp constraint; the data is organized by PAC West and East in

Figure 21. This metric does not include intervals subject to price corrections.

Figure 21: Frequency of flexible ramp constraint infeasibility in PAC



Finally, this report also includes information about infeasibility for over supply conditions even though these cases are not reflected in the waiver requested in this proceeding. The penalty prices specified in sections 27.4.3.2 and 27.4.3.4 only pertain to infeasibility cases in which there is under-supply. The penalty prices for the over-supply conditions are specified in section 6.6.5 of the BPM for Market Operations. The over-supply metrics are provided in Figure 22 through

Figure 29.

Figure 22: Frequency of oversupply infeasibility PAC West. Fifteen-minute market.

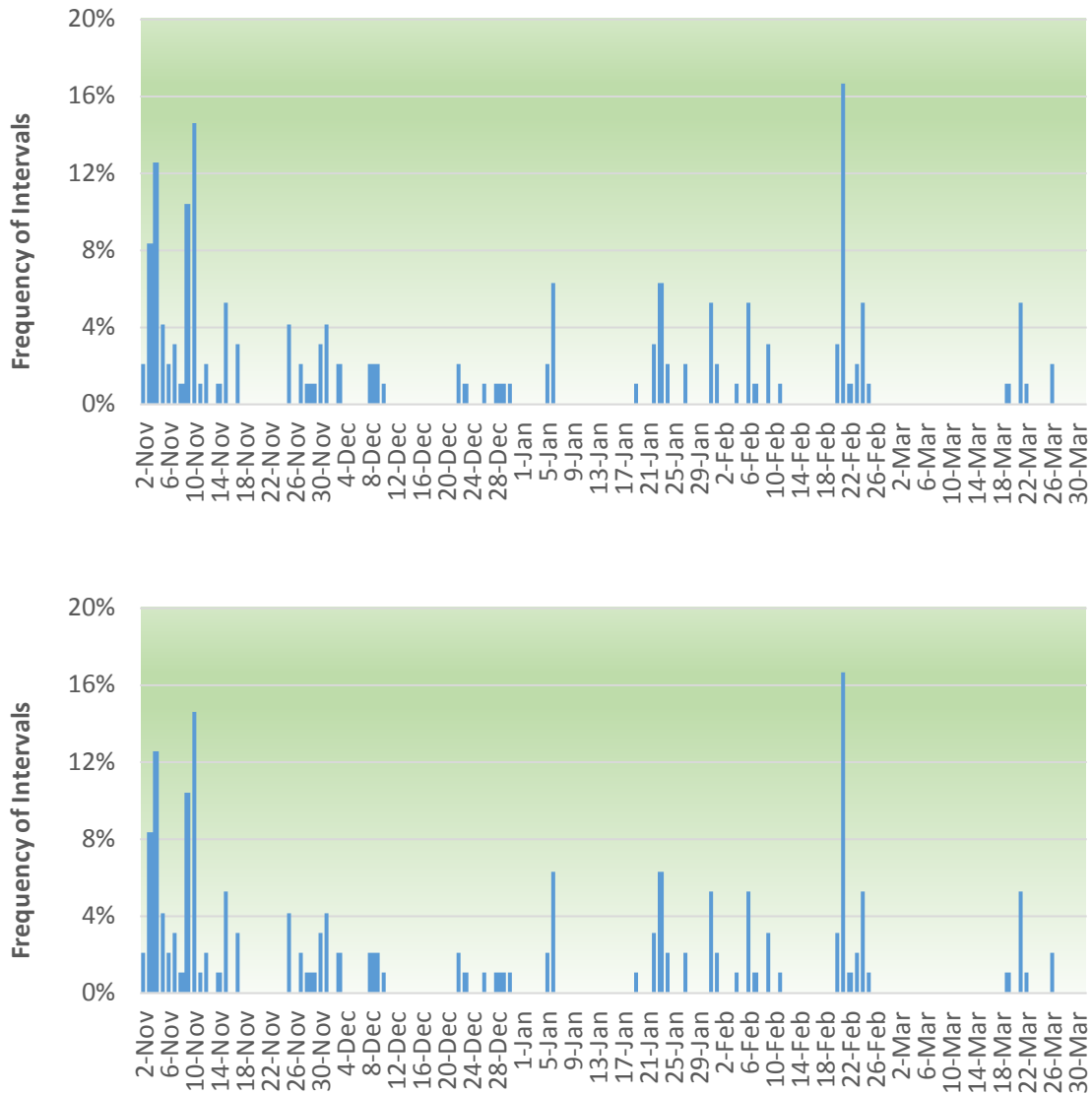


Figure 23: Magnitude of oversupply infeasibility PAC West. Fifteen-minute market.

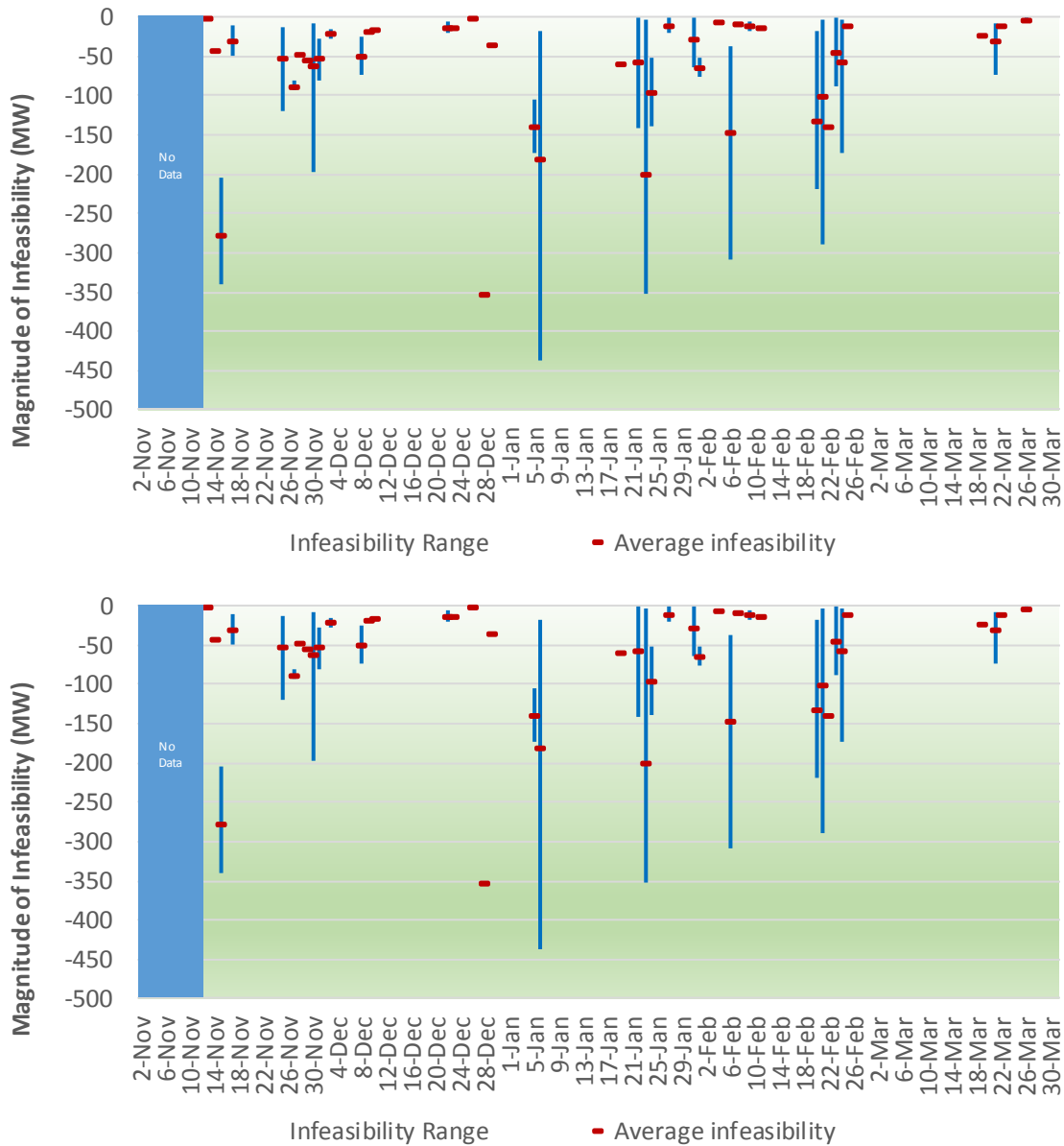


Figure 24: Frequency of oversupply infeasibility PAC East. Fifteen-minute market.

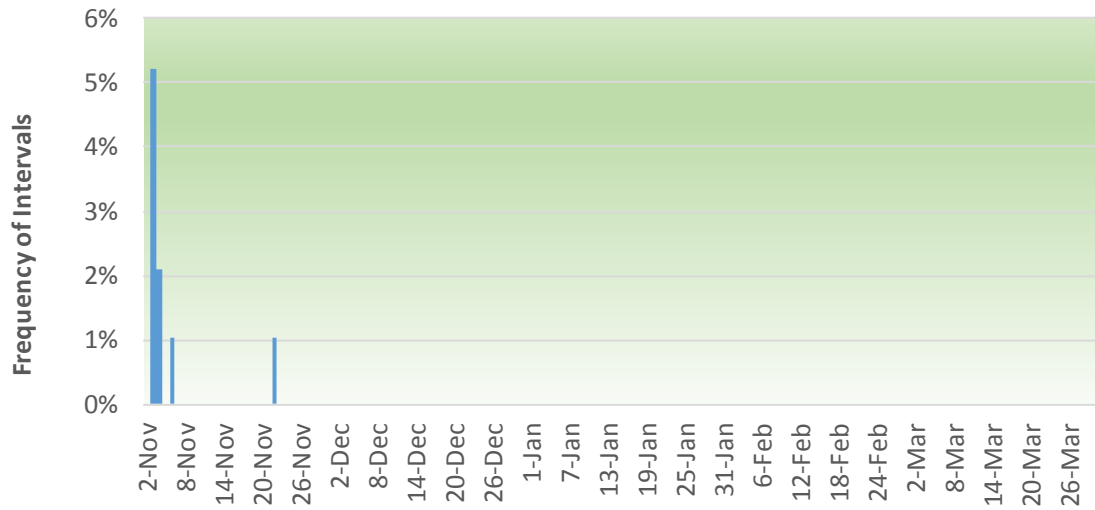


Figure 25: Magnitude of oversupply infeasibility PAC East. Fifteen-minute market.

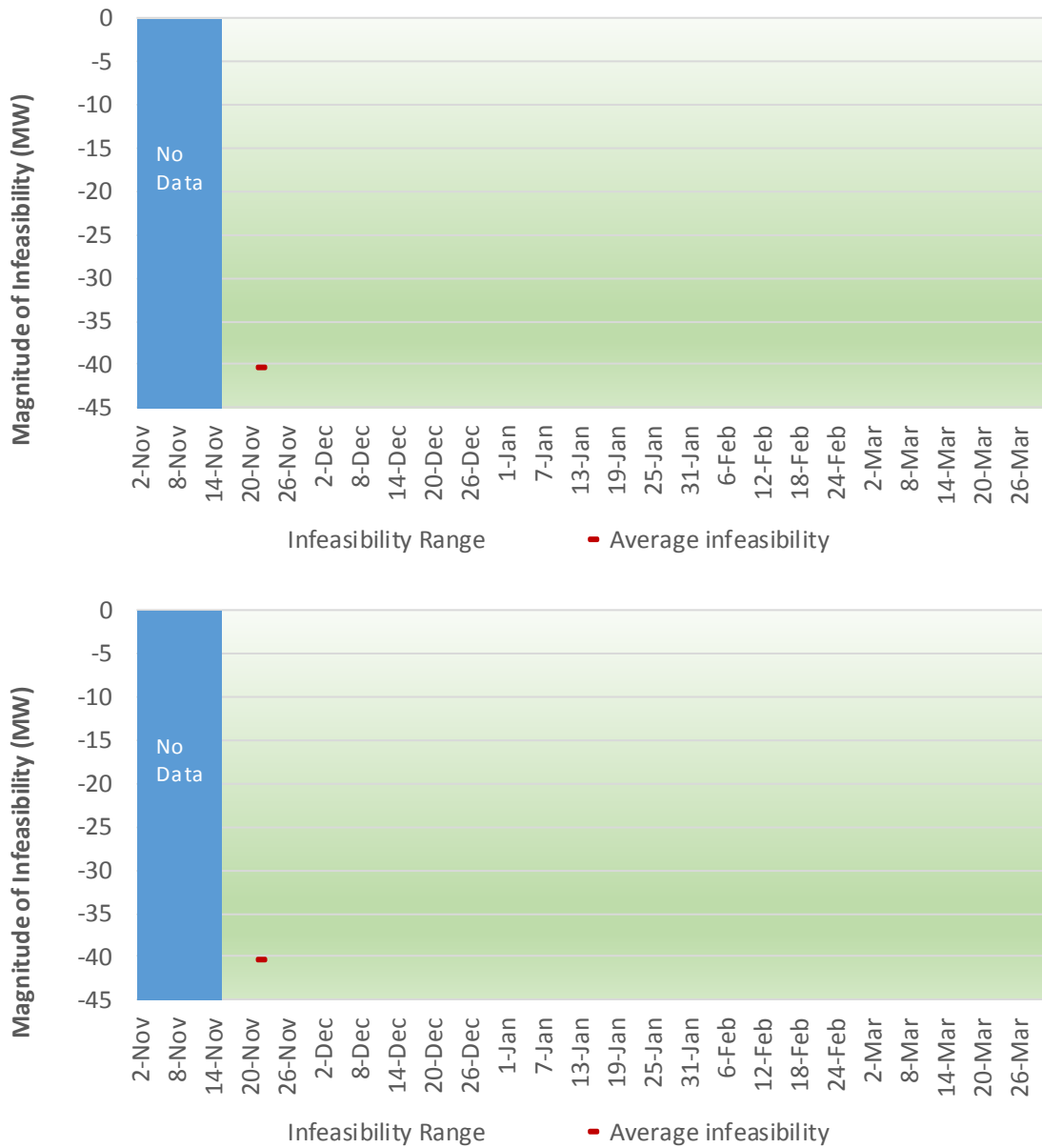


Figure 26: Frequency of oversupply infeasibility PAC West. Five-minute market.

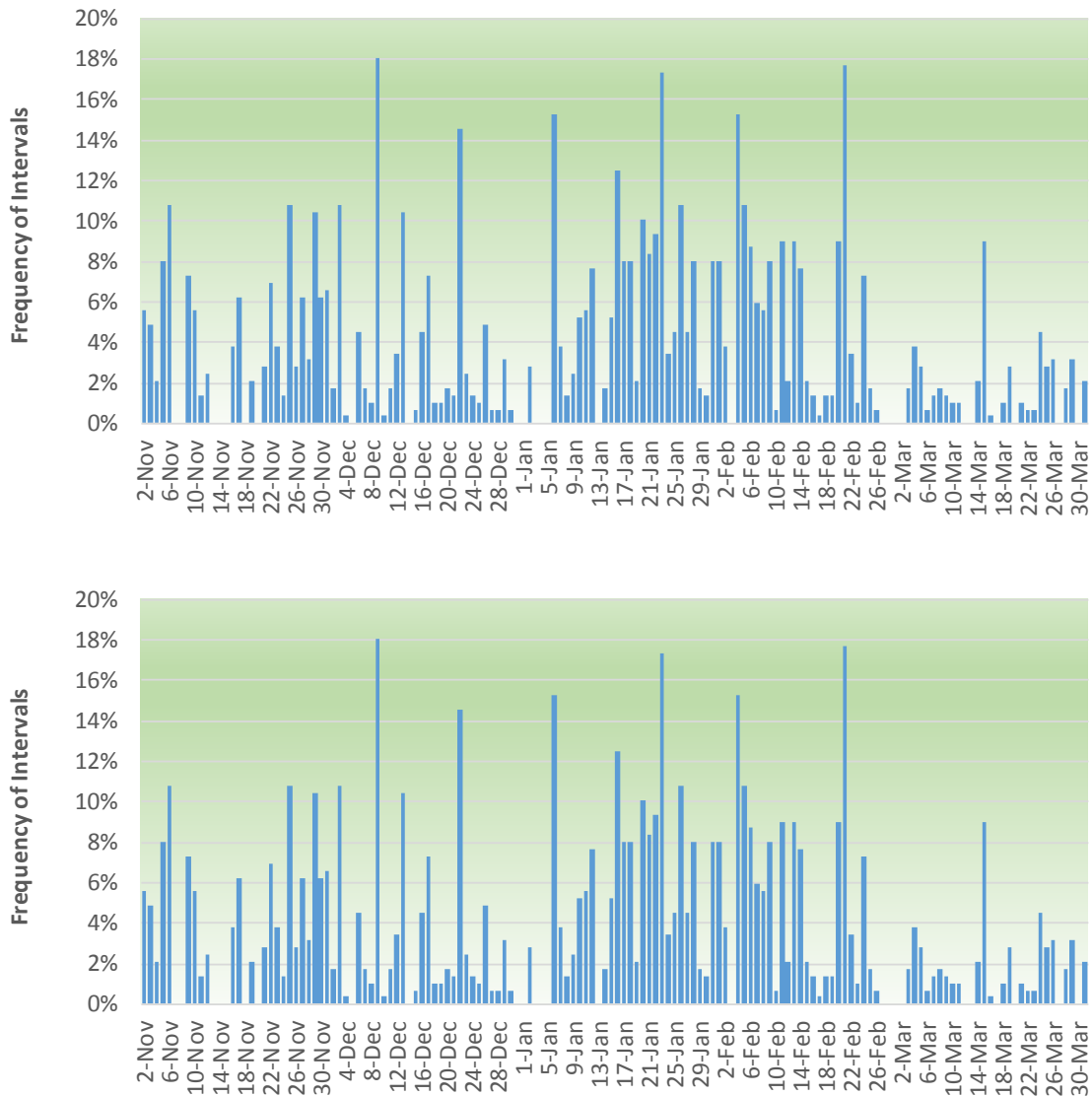


Figure 27: Magnitude of oversupply infeasibility PAC West. Five-minute market.

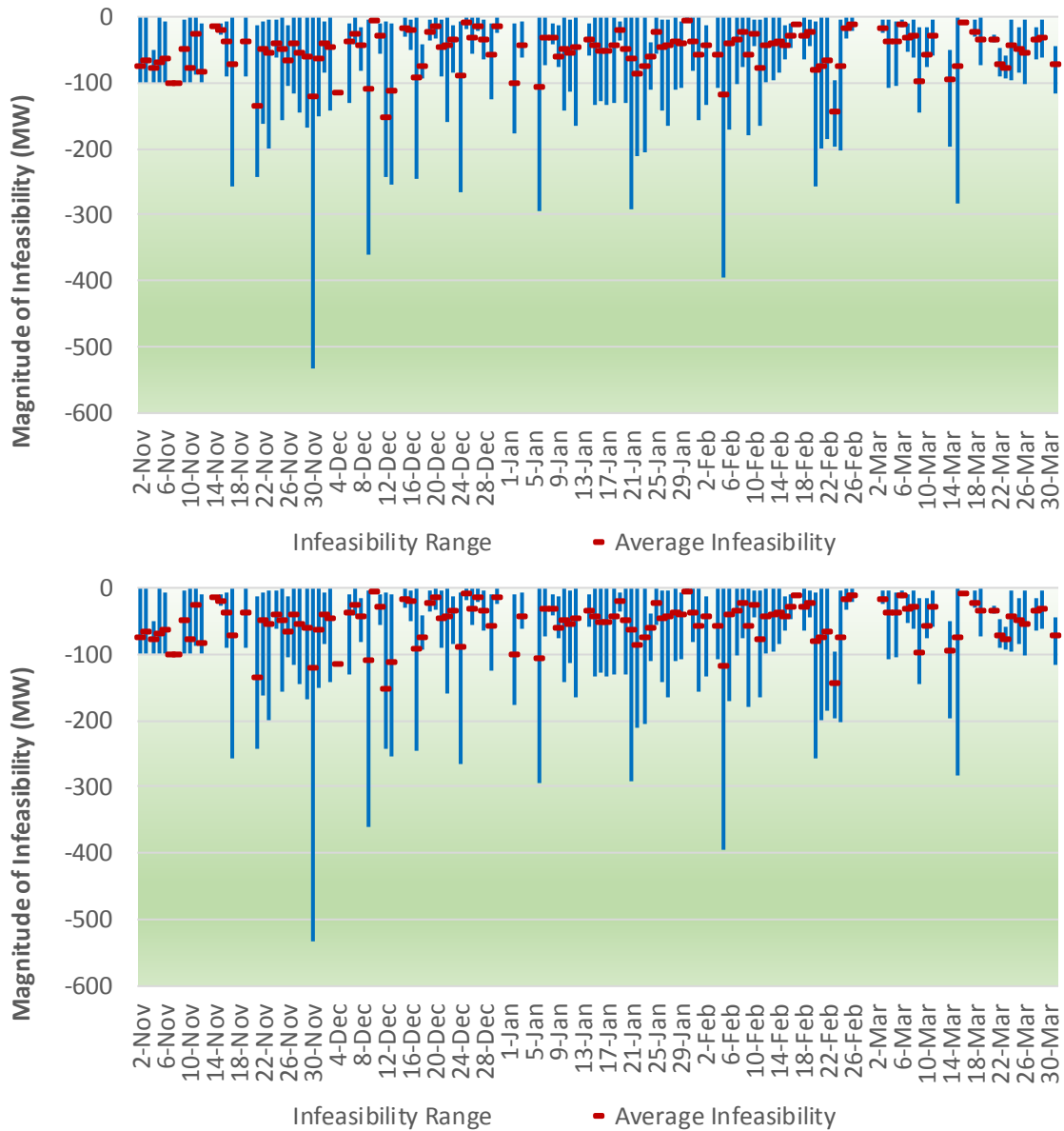


Figure 28: Frequency of oversupply infeasibility PAC East. Five-minute market.

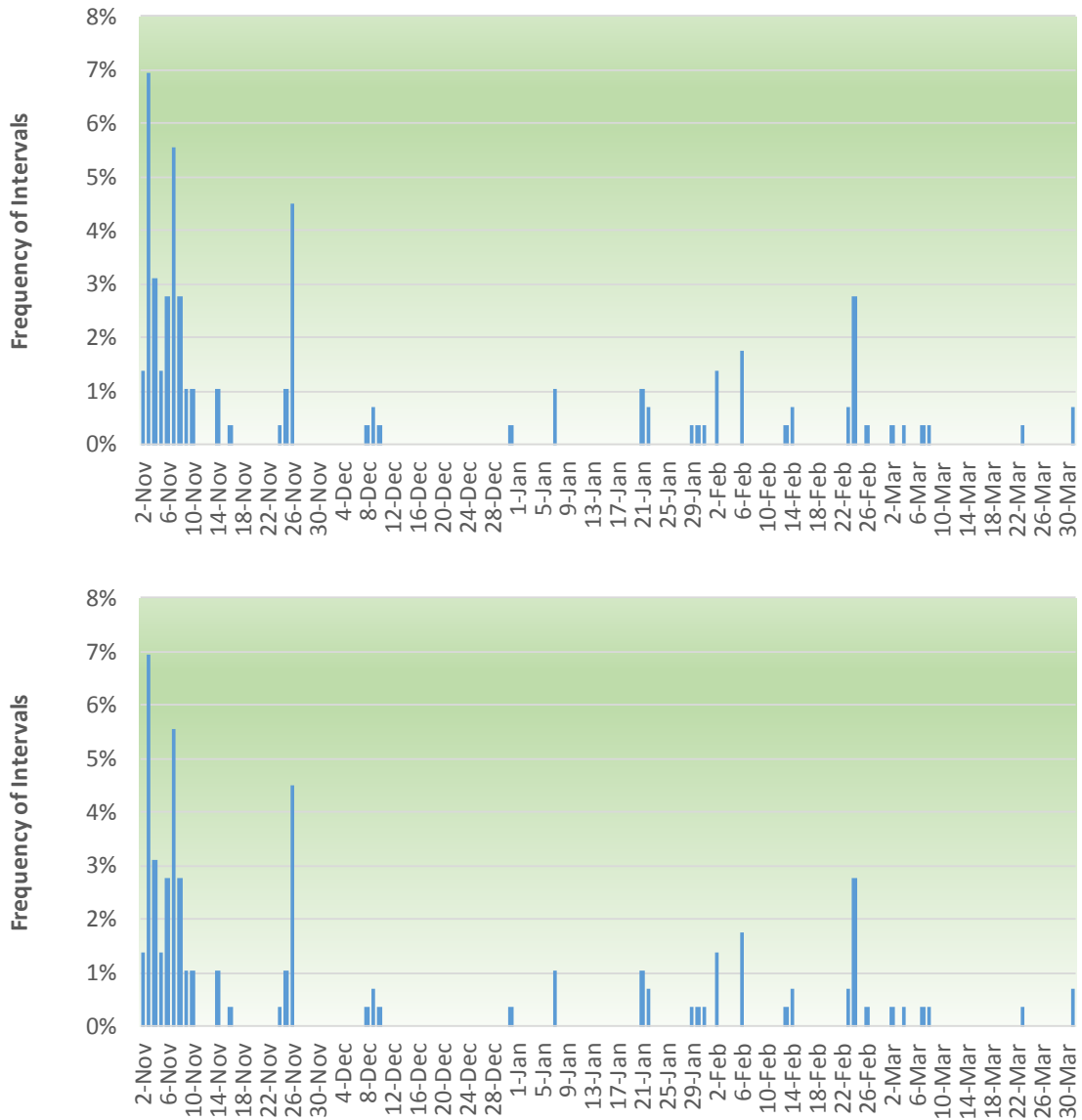
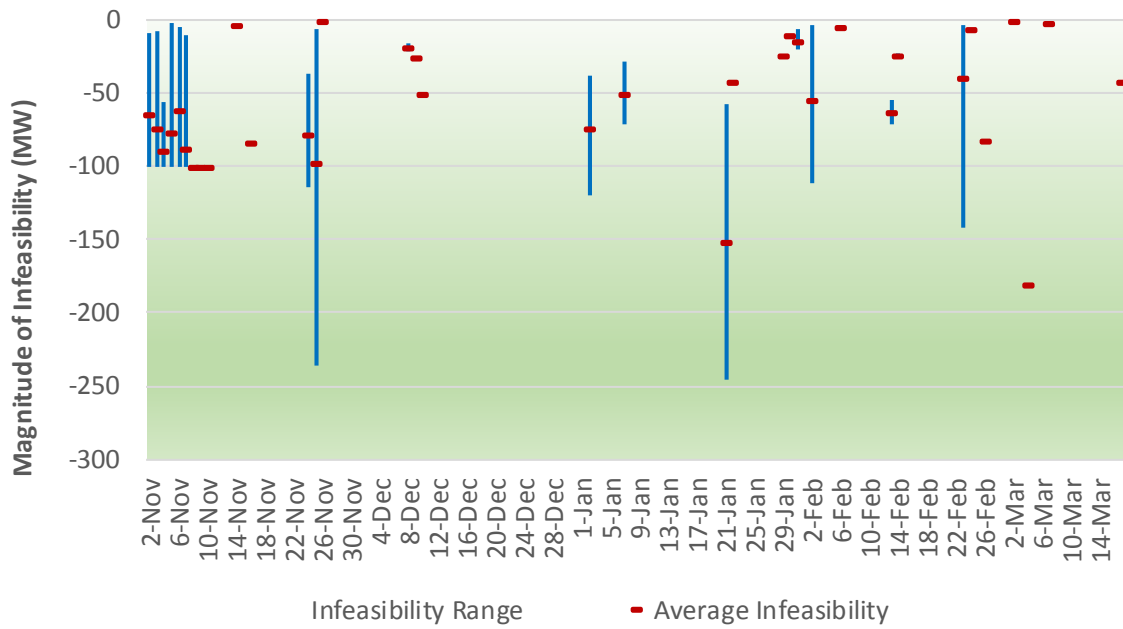


Figure 29: Magnitude of oversupply infeasibility PAC East. Five-minute market.



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 24th day of April, 2015.

/s/ Anna Pascuzzo
Anna Pascuzzo

June 3, 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
April 2015 Informational Report
Energy Imbalance Market - Price Waiver Report**

Dear Secretary Bose:

The California Independent System Operator Corporation (CAISO) hereby submits its report on the performance of the Energy Imbalance Market for April 1 – April 30, 2015.¹

The Commission also directed the Department of Market Monitoring to submit independent assessments on the causes and solutions identified by CAISO. The CAISO intends to submit the independent assessment of the Department of Market Monitoring in about eight days.

The CAISO will continue filing such reports mid-month consistent with the Commission's order to continue submitting reports on a 30 day interval until the 206 investigation is concluded or the Commission issues a directive, whichever is earlier.

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

Please contact the undersigned with any questions.

Respectfully submitted

By: /s/ Anna A. McKenna

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California ISO

**Energy Imbalance Market
Pricing Waiver Report
April 1 – April 30, 2015**

June 3, 2015

I. Introduction and Background

On December 1, 2014, the Federal Energy Regulatory Commission (FERC) granted the California Independent System Operator Corporation's (CAISO) petition for limited waiver of the pricing parameters in sections 27.4.3.2 and 27.4.3.4 of its tariff for 90 days, as they pertain to the Energy Imbalance Market (EIM), effective November 14, 2014, as requested.¹ In addition, FERC directed CAISO to submit informational reports as further described. The CAISO will submit monthly the requested reports in Attachments A through E. This report covers the CAISO's reporting requirements for April 1 through April 30, 2015.

The Commission also directed the Department of Market Monitoring (DMM) to submit independent assessments on the causes and solutions identified by CAISO. The DMM requires some additional days to fully review and evaluate the CAISO's report and provide an independent assessment. The DMM will file its report within approximately eight days of the CAISO having filed this report.

On November 1, 2014, the CAISO fully activated the EIM. The EIM allows balancing authorities outside of the CAISO balancing authority area to participate voluntarily in the imbalance energy portion of the CAISO locational marginal price-based real-time market. PacifiCorp, the CAISO, and market participants participated in market simulations prior to the start of the EIM on November 1, including parallel production from October 1 to November 1. However, shortly after go live the CAISO observed challenges that led to artificially high prices where the market application had to relax transmission constraints or the power balance constraint to clear the market.

On November 13, 2014, the CAISO sought a 90-day waiver of the applicability of section 27.4.3.2 and the second sentence of section 27.4.3.4 of its tariff to permit CAISO to address, without suspending the EIM, those circumstances which produced atypically high prices. Those two sections of the tariff require that when there is a lack of economic bids, considering resource ramping and other constraints, to clear the fifteen-minute and five-minute markets, the CAISO's market will price the shortages (and therefore establish locational marginal prices) based on the pricing parameters specified in those sections. The pricing parameter is \$1,000/MWh (the maximum energy bid price specified in tariff section 39.6.1.1).

¹ *California Indep. Sys. Operator Corp.*, 149 FERC ¶ 61,194 (2014) (December 1 Order).

The waiver addresses three sets of transitional conditions in the EIM that together have caused the transmission and system energy-balance constraints described in tariff sections 27.4.3.2 and 27.4.3.4 to bind more frequently than expected in the weeks since the EIM began operation on November 1, causing prices in these intervals to be set by the \$1,000/MWh relaxation parameter. Because of these transitional conditions, the high prices are not always indicative of actual physical conditions on the system, and reflect challenges in providing timely and complete data to ensure system visibility under the new procedures, exacerbated by limitations on the resources available to PacifiCorp for the EIM and several forced outages of large EIM participating resources.

On December 1, 2014, FERC granted the CAISO its waiver request and directed monthly reports to FERC on the progress of the issues that led to the need for the waiver. On February 12, 2015, the Commission extended the term of this waiver to March 16, 2015, in its order issued in FERC Docket ER15-861.²

On March 16, 2015, the Commission again extended the waiver to 90 days after the date on which the Commission's order issued on March 16, 2015, in FERC Docket No. ER15-861 is registered in the Federal Register (June 22, 2015).³ In the March 16 order, the Commission also directed the CAISO to refine the monthly reports to "assist the Commission and the parties in determining the extent to which the price spikes continue to be caused by transitional issues, and the extent to which they may be triggered by lack of adequate supply in the EIM."⁴ This report includes the following additional information requested by the Commission in its March 16 order:

... identify, for each such event, whether the cause was due to transitional issues or was due to insufficient supply of resources bid into the EIM.

... clarify the information presented in the tables included in Attachment A, Section 2 of the future reports. At a minimum, the clarifications should: (1) differentiate supply deficiencies from transitional issues; (2) provide concise information on required remedial measures, execution responsibility, completion time frame and status; and (3) provide transparent identification of the frequency and market impact of each root cause issue.

² *California Indep. Sys. Operator Corp.*, 150 FERC ¶ 61,086 (2015).

³ *California Indep. Sys. Operator Corp.*, 150 FERC ¶ 61,191 (2015).

⁴ See 150 FERC ¶ 61,191 at P 38.

... identify any [...] seasonal challenges that occur during the reporting period, and describe the operational or business process revisions planned or implemented, as applicable, to address such issues.

The CAISO will continue filing such reports monthly consistent with the Commission's order to continue submitting reports on a 30-day interval until the 206 investigation is concluded or the Commission issues a directive, whichever is earlier.

II. Reports

Attachment A: Provides a quantitative and qualitative description of the issues that prompted the CAISO's waiver request and those observed during the reporting period. This attachment also reports on any such seasonal challenges that occur during the reporting period.

Attachment B: Identifies any remedial measures, execution responsibility, completion timeline, and status for the category of issues identified above.

Attachment C: Provides a description of each relaxation event and a summary of the magnitude and frequency of such events overall, and data on instances where the \$1,000/MWh price would have occurred but for this waiver. This attachment also identifies the frequency and market impact of each root cause issue.

Attachment D: Provides a quantitative and qualitative analysis of the market performance impact of the issues that prompted the CAISO's request for a waiver.

Attachment E: Provides a summary of the magnitude and frequency of the post implementation issues described in Attachment A overall.

ATTACHMENT A

Quantitative and qualitative descriptions of market performance related to the issues that prompted the CAISO's waiver request - CAISO.

This attachment describes the issues that prompted the CAISO to file for the pricing waiver and those observed during the term of the waiver. This attachment also reports on any such seasonal challenges that occurred during the reporting period.

A. Qualitative Description of Issues

The CAISO and the EIM entity have evaluated each interval of infeasibility to determine the root cause of the infeasibility. There are seven categories of issues observed. Each interval of infeasibility may be the product of one or more category of issues. Sometimes, a single reason may drive an infeasibility; but in some cases, a combination of a number of conditions led to the infeasibility. Therefore, it is not possible to identify a single cause for each infeasibility. However, to provide meaningful reports, the CAISO identified what appears to be the most prevalent issue that gave rise to the infeasibility in each interval and assigned the interval to that category. The reports included in this submission qualify and quantify the issues according to these categories, which are as described below:

1. Renewable Deviations

The *Renewable Deviations* category identifies intervals in which the infeasibilities were primarily due to wind and/or solar output deviations from the resource's hourly base schedules that led to the loss of capacity and the need to increase generation from other resources. These types of deviations were beyond deviations the flexible ramping requirement could resolve by the available system ramping capacity. In some cases, there were significant deviations between wind forecasts and the resource's actual output over a period of a number of days. The CAISO utilizes the wind forecast as an indicator of the maximum level to which it can dispatch the resource. If the forecast is significantly flawed, this can create discrepancies between the wind resource's actual output and their forecast. The accuracy of the forecast is dependent on the accuracy of telemetry, which in some cases was problematic. Such issues caused energy imbalance, over-generation, or under-generation conditions as observed by the market systems, leading to infeasibilities.

2. Load Changes

The *Load Changes* category identifies those intervals in which the infeasibility was predominately due to either problematic operator adjustments of load forecasts or changes to those adjustments. The EIM entity grid operators can adjust (or “bias”) the load forecast for reliability to account for any non-modeled issues causing discrepancies between forecast load and actual load in real-time. The operator can make these adjustments after the base schedules are submitted. The operator sets the bias based on his/her judgment of system operational and reliability needs. In some cases, because operators make the adjustments manually, they make these adjustments at a less granular level than is precisely necessary to consider the capability of the system. For example, the operator believes it needs to make an adjustment of 100 MWs due to load changes in real-time. However, because the system is ramp constrained, the operator should make an adjustment of 100.5 MWs to obtain the extra capacity needed to address the system ramp limitations, which is not possible because the operator cannot observe the ramp constrained nature of the system.

In some cases, the load forecast issues were caused by the practice of including large industrial load forecasts in the EIM total load forecast. The EIM entity can adjust these large-scale industrial loads as part of an interruptible load program to balance its system. Prior to April 1, these demand resources were included in the total balancing area load forecast and treated as conforming load, although these loads are non-conforming and independent from the regular conforming loads. After April 1, the CAISO excluded the large industrial load forecast from the total forecast and instead modeled these demand resources as participating resources. This allows the EIM entity to account for their contribution to total supply more effectively and adjust supply as needed.

Distributed energy resources are also included in the market load forecast as conforming load. These resources have both load and generation components, which net to a positive or negative net injection at the load bus. The market systems do not see when these resources are generating and therefore it accounts for more load than what is actually occurring in real time operations. The lack of base schedules for such resources further prevents the market from observing the impact of their output in the market systems.

3. Import/Export Changes

The *Import/Export Changes* category identifies intervals in which the infeasibilities were primarily due to the lack of visibility in the market systems of updates to imports and exports schedules or adjustments made for such updates after the deadline for submitting base schedules at forty minutes before the

trading hour (T-40). When the CAISO performs the balancing test, the market systems assume that the import and/or export base schedules transactions will materialize. For example, the feasibility test assumes that an import base schedule of 600 MW will be delivered. However, after the deadline for submitting base schedules has passed, *i.e.*, after T-40, only 300 MW is actually tagged, which can be done up to T-20. If market systems do not see sufficient capacity to cover the difference of 300 MW, the power balance constraint will be relaxed and trigger the parameter based pricing.

4. Resource Outages

The *Resource Outages* category identifies intervals in which the infeasibilities were primarily due to outages of supply resources that resulted in loss of capacity observed in the fifteen or five minute market which had been previously identified as available. Sometimes there was untimely or inaccurate communication of outage cancellations, which led to the market systems to perceive insufficient supply. When resources experience full or partial forced outages, the market must be informed in a timely manner of the outage event and the corresponding grid operator measures taken to compensate for the lost megawatt capacity.

The timing in which the EIM entity reports the outage is very important. If the outage occurred before T-75 (*i.e.*, seventy-five minutes before the trading or operating hour) and the entity expects it to last during the operating hour, then it should adjust both the economic bid and base schedule to account for the outage. Otherwise, the assumptions and data used by the market application for the balance test and the look-ahead fifteen-minute market contradict real-time system conditions, which results in less capacity available to the EIM than what was computed before the start of the operating hour, and high prices are imminent due to limited unloaded economic capacity offered into the market.

Sometimes the issues identified in this category are due to purely physical outages such as unit trips, which the market systems may observe through telemetry. However, at times the market systems are not informed of the actions taken by the EIM entity to replace that loss of supply. This results in a perception of insufficiency when none exists because the operator deployed operating reserve or curtailed industrial load but the information was not conveyed to the market.

The CAISO does not approve or reject outages of resources in the EIM entity balancing authority area. However, the EIM entity must provide outage information of EIM participating and non-participating resources in a timely and accurate manner. The CAISO incorporates the outage information submitted by

the EIM entity into the real-time market to ensure the market clears on the most accurate outage information available.

Because the EIM entity remains in control of the outage approval process, the outages may be unrelated to actual physical conditions. In some cases, the EIM entity may submit an out-of-service or MW range restriction outage on a resource as it moves capacity around to manage its contingency reserves and takes corresponding manual dispatch actions. However, if the manual dispatch actions are not conveyed timely and correctly, the market software might observe an infeasibility when in reality the EIM entity is sufficiently resourced.

5. Manual Dispatches

The *Manual Dispatches* category identifies intervals in which the infeasibility was predominantly due to a manual dispatch action taken by the EIM entity. For example, when system operating conditions for a resource change in real time after the resource's base schedule is submitted, the EIM entity may submit a manual dispatch indicating the maximum capacity to which the resource may be dispatched, which would reduce the available capacity to the market but it is more representative of actual system operating conditions. The manual dispatches are in the form of a fixed megawatt value instruction, a minimum megawatt value, a maximum megawatt value, a start-up instruction, or a shut-down instruction. The EIM entity performs Manual Dispatches to address resource bid issues, market system issues, outage management system issues, reliability needs, reserve sharing events, or variable energy forecast deviations that occur after the deadline for submission of base schedules to maintain the reliability of the balancing authority area. The balancing test does not recognize the manual dispatch information, because it occurs after T-75 but before T-40. If the balanced schedules conflict with the manual dispatch, they may trigger an infeasibility.

6. Resource Data Alignment

The *Resource Data Alignment* category identifies intervals where the infeasibilities were not due to any of the other categories, but in which the following issues were observed: 1) resources were deviating from their dispatch, 2) there were differences between base schedules and bids or dispatch operating targets, and 3) multi-stage resources were operating in configurations that contradicted their base schedules. In addition, sometimes, multi-stage resources had large overlapping ranges and long transition times, which created physical infeasibilities and limited the range of flexibility for the market to move the resource.

Many of these issues were driven by the EIM entity transitioning to a new market paradigm and learning how best to manage its fleet within the new paradigm using a series of complex systems. For example, initially the EIM entity believed it had registered the characteristics of its multi-stage generating resources consistent with how it intended the units to operate. Multi-stage generating resources have multiple configurations that the operator must carefully manage in the real-time market. The scheduling coordinator registers the configuration characteristics in the master file and the market applications observe and honor them. These include physical, registered characteristics such as transition time, minimum up time and minimum down time, and minimum capacity (Pmin) and maximum capacity output (Pmax) MWs and any overlapping MW regions between configurations. If a configuration is out of service, the EIM entity must submit a timely outage card to inform the market that the corresponding economic bid or base schedule is not available and another configuration is. If it does not perform this task promptly and accurately, or bids do not exist on other configurations, then the market cannot move the resource to other configurations and fails to account for the plant's full available capacity. Through actual operations experience and the EIM entity's evaluation of the dispatch solutions over time, PacifiCorp learned that it should model certain resources differently to allow the market systems to move the resources more efficiently. PacifiCorp modified its practices to find workable market solutions within the technical feasibilities of its resources, and the technical boundaries of the CAISO market features.

On occasion, resources were seen to be deviating from their market dispatch signal because either 1) the plant was unavailable, 2) an outage ticket was not entered on time, or 3) there was a delay in setting the plant on automatic generation control to be dispatched directly from the market signal. Sometimes it was necessary for the EIM entity to make direct phone calls to plant operators to communicate the market signal to move the resource up or down according to the plant's market dispatch signal, which was problematic because these actions take time and are manual in nature.

The EIM entity is sending telemetry values for all PacifiCorp resources registered in the master file. When the quality of the telemetry values is poor, the state estimator solution quality is negatively impacted, which affects the quality of the market solution and the dispatch operating targets of these resources. During the first few weeks of operation, the CAISO found that some resources had telemetry measurements of their auxiliary load and others had gross telemetry measurements that did not include the auxiliary load. In addition, certain wind resources and other small non-participating resources did not have telemetry at all.

The energy management system (EMS) and automatic generation control (AGC) monitors and accounts for the energy of multi-stage generating resources during the startup and shutdown periods when their output is below the PMin. However, the market does not account for this energy because it is below the PMin of the resource. This creates a discrepancy in the load balance test, and the imbalance calculations between market and actual conditions as seen by AGC, which led grid operators to bias the load forecast.

7. Transfer/Congestion Constraints

The *Transfer/Congestion Constraints* category identifies intervals in which the infeasibility was primarily due to the interplay of EIM transfer constraints or congestion in either a PacifiCorp balancing authority area or the CAISO's balancing authority area, which restrict the incremental generation of resources.

The EIM re-optimizes the EIM transfer capacity in both the fifteen-minute and five-minute markets. Regarding the California Oregon Intertie, the added restriction of the dynamic five-minute limit, which is an incremental limit around the fifteen-minute solution, may create infeasibilities. The five-minute dynamic limit constrains the market application from fully re-optimizing the fifteen-minute EIM transfer beyond the amount allowed by the five-minute incremental dynamic limit, which is especially restrictive during on-peak hours.

In addition, the rate-of-change constraints across the Bonneville Power Administration (BPA) network are five-minute flow limit constraints that limit five-minute movement of PacifiCorp West balancing authority area participating resources around the corresponding resources' fifteen-minute schedules due to their flow impact on certain paths and flowgates internal to the BPA balancing authority area. This restriction on the resources' five-minute movements or the corresponding rate-of-change constraint at times created infeasibilities on the affected resources when the corresponding path or flowgate five-minute limit constraint is binding.

B. Frequency with Which Issues Caused Infeasibilities

Figure 1 through Figure 4 show the frequency with which each of the categories of issues discussed above caused price excursions in both the fifteen and five-minute markets. In any market interval, more than one category of issues may have contributed to the price excursion because there are numerous elements at play in any given market run that can influence its outcome. However, as discussed above, the CAISO determined which of the categories of issues was most prevalent in each interval and assigned it that category. The CAISO produced the frequency diagrams based on that data.

Figure 1: Reasons for intervals with undersupply infeasibility in the fifteen-minute market in January 1 to April 30 - PAC West and PAC East combined.

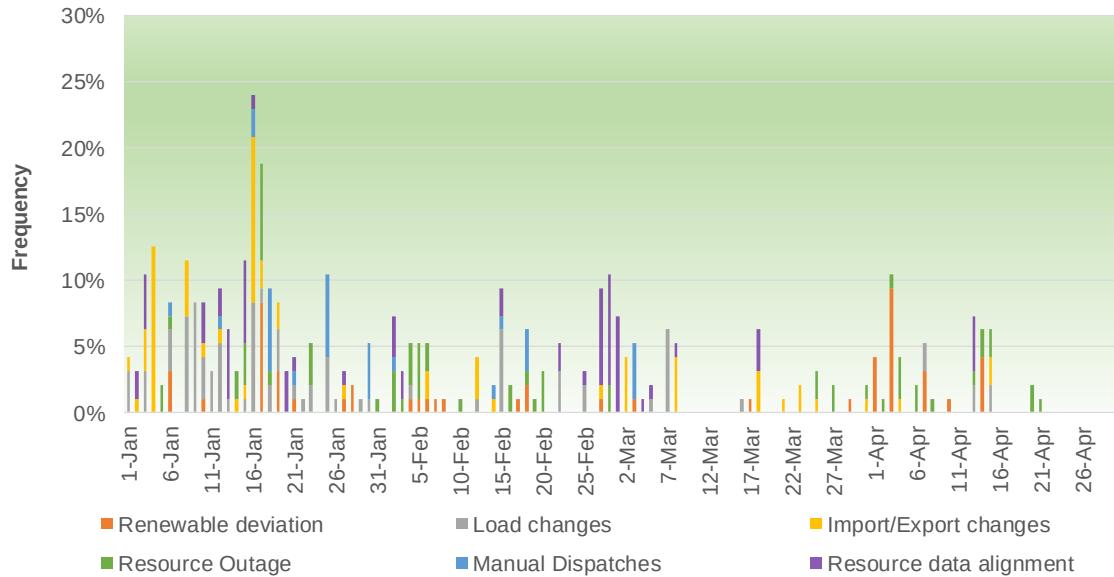


Figure 2: Reasons for intervals with undersupply infeasibility in the five-minute market in January 1 to April 30 - PAC West and PAC East combined.

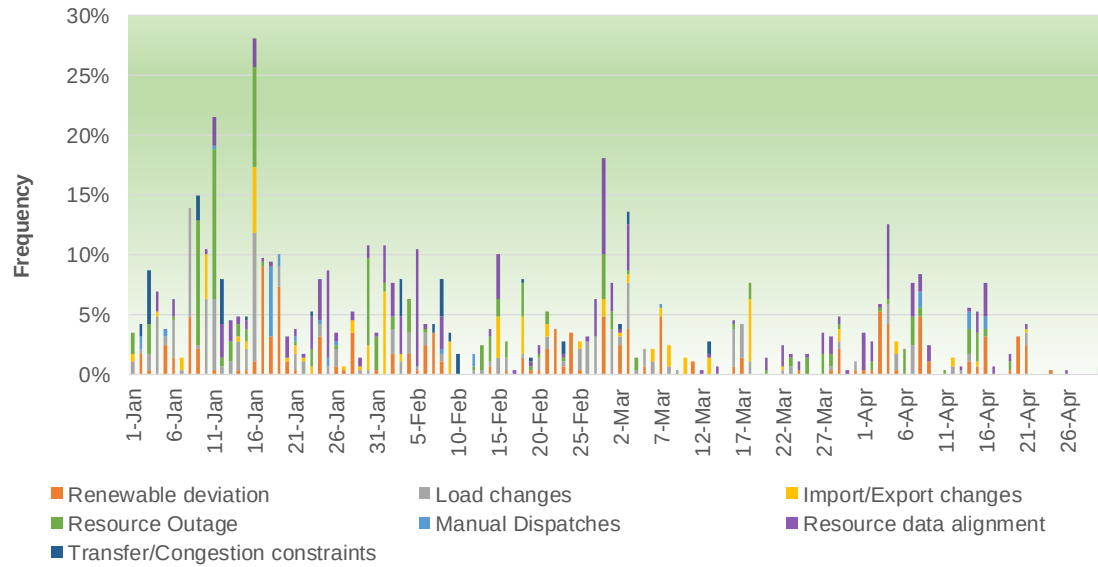


Figure 3: Frequency of undersupply infeasibility in the fifteen-minute market in April - PAC West and PAC East combined.

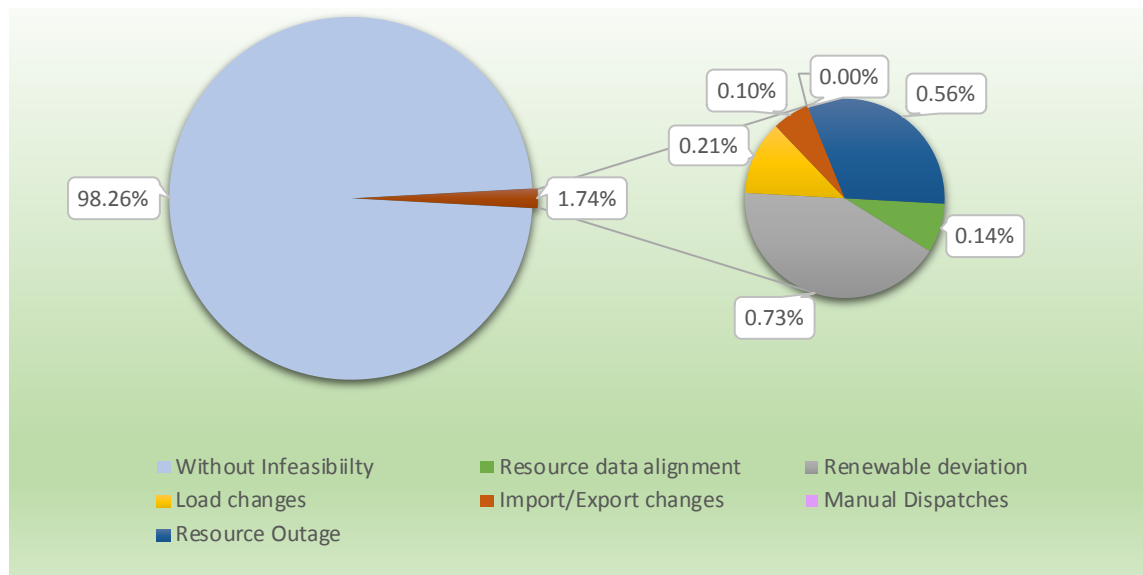
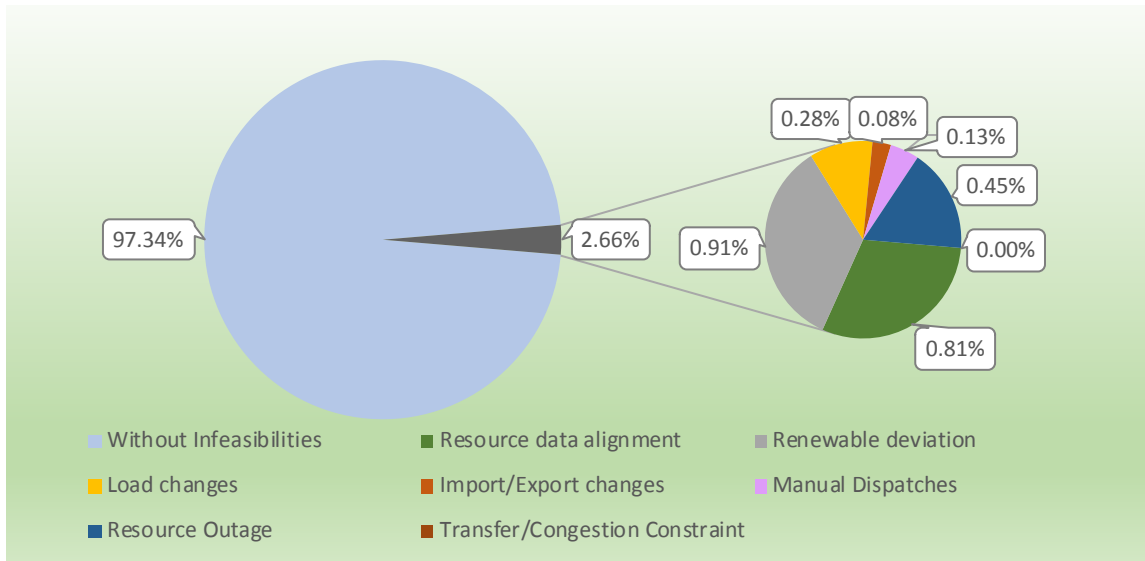


Figure 4: Frequency of undersupply infeasibility in the five-minute market in April - PAC West and PAC East combined.



ATTACHMENT B

Remedial Actions

This attachment includes a report on measures already taken and planned to address the issues discussed above. This report also identifies any remaining deficiencies in processes, procedures, and tools and any additional market issues related to these pricing concerns that the CAISO considers necessary to sustain stable market operations, with the CAISO's plan to address such issues.⁵

Table 1: Remedial Actions taken and planned by the CAISO and PacifiCorp

<i>Number</i>	<i>Solution</i>	<i>Actions and Responsibility</i>	<i>Tariff Changes</i>	<i>Implementation Timeline</i>
1	<i>Recognition of EIM entity operating practices in EIM market. This allows the market to recognize additional capacity available to the EIM entity, while still enabling the EIM entity to retain control over the management of this capacity for operational purposes.</i>	PacifiCorp changed its bidding and use of the outage reporting system to enable the EIM/RTM to recognize the use of the PacifiCorp's reserves (operating and regulation) and additional available capacity in operating its system. Leading to and through the initial stages of implementation, PacifiCorp designed the bid range of units to separate capacity associated with units holding contingency reserves from the bid range. This was based upon an assumption that contingency reserve obligations should be separately accounted for and that capacity	Will require enabling language for automated recognition of the additional capacity. The CAISO presented the proposal at the April 9, 2015, technical conference and submitted the details of the proposal in comments on April	Effective at the beginning of April 2015, PacifiCorp has implemented the management of its contingency reserve through outage cards in both the PACW BAA and the PACE BAA. The automated feature for recognition of the available capacity that can only be used inside the EIM BAA when it is short of supply is currently being developed and scheduled to be ready to implement mid to end of August 2015.

⁵ December 1 Order at P 25.

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
		associated with contingency reserves could not be made available. This had the unintentional consequence of overly restricting the capacity of these units when the market models assess potential infeasible market solutions and PacifiCorp's ability to make operational adjustments to units required by real-time system conditions. The result of this approach was that the bid range and operational capacity of these units were essentially fixed for 75 minutes prior to the operating hour when EIM bids are due and during the operating hour (or approximately 135 minutes), even when system conditions changed. The current solution better approximates PacifiCorp's actual contingency reserve management using outage cards. Currently, PacifiCorp bids full unit capacity into the market and control the dispatch of contingency reserves with outage cards (as well as through PacifiCorp's EMS system). PacifiCorp continues to	23, 2015 in its initial comments in FERC Docket No. EL15-53.	

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
		meet its contingency reserve obligation by holding sufficient contingency reserves on its units, but is also able to convey adjustments that it makes to which units are carrying the reserves in real time through outage cards. For example, when reserves are deployed or shifted to other units, the associated outage card can be adjusted for reserves being deployed or transferred to other units. This allows for a more transparent, efficient and timely market awareness of contingency reserve management and the ability to increase the amount of capacity available to the EIM, without affecting PacifiCorp's contingency reserve obligations. After further analysis of the post-implementation challenges, the CAISO and PacifiCorp have an enhanced appreciation of the importance of recognizing all available capacity in the market system, even though the EIM entity		

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
		retains full operational control of its resources. The CAISO and PacifiCorp also agree that it is necessary to develop procedures that will allow for the automatic recognition of the available capacity that can only be used within the balancing area when it is short of supply. The CAISO is developing functionality that will enable the EIM entity to reflect the full range of available capacity in the market but retain the ability to ensure the deployment of such capacity is limited to addressing infeasibilities in the EIM balancing area with no allowed transfer of this set aside energy outside the corresponding balancing area.		
2	<i>Refined management of multi-stage generating resources, and addition of multi-stage generation resources configurations</i>	PacifiCorp and the CAISO continue to consult to understand better the quality of the dispatch solution based on the recorded characteristics of the multi-stage generating resources. PacifiCorp reviewed and redefined the registered parameters based on	None identified.	Complete. Based on better understanding of the definition of the multi-stage generation resources parameters, PacifiCorp continues to refine certain multi-stage generation resource parameters and adjust

<i>Number</i>	<i>Solution</i>	<i>Actions and Responsibility</i>	<i>Tariff Changes</i>	<i>Implementation Timeline</i>
		greater understanding of how the market dispatches those resources based on their configuration. PacifiCorp also defined additional configurations with smaller energy range to help balance their base schedules during startup and shutdown processes when the produced energy is below the previously registered PMin values.		transition times between resource configurations to reflect their physical characteristics. During the month of April, and throughout May, the CAISO implemented numerous market software fixes to handle transitions between configurations as well as during startup and shutdown. The CAISO has also added additional business logic in the software to protect against invalid Dispatch Operating Target instructions. The CAISO and PacifiCorp continue to review and evaluate performance of multi-stage generating resources.
3	<i>Account for start-up energy in balancing process</i>	CAISO is developing a tool to enable better recognition of start-up profile for multi-stage generating resources. The CAISO is modeling the transition ramping for multi-stage generating resources and has scoped the requirements to add startup and shutdown profiles to the 15-minute market since these features are already in the 5-minute market.	None identified	PacifiCorp started bidding all configurations and maximized bid ranges in March 2015.

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
		PacifiCorp is in the process of collecting data to define the startup and shutdown profiles for many of the resources with high PMin values. PacifiCorp has also made improvements to the bid configurations of PacifiCorp EIM Participating Resources in order to maximize fully the bid range available to the market. This includes recognizing start-up hours for CCGT plants, working to bid in all possible plant operating configurations and accounting for reserves to reflect fully the operational capability to respond to real-time market conditions.		
4.	<i>Effort to improve consistency interchange schedule tags and base schedules</i>	PacifiCorp reviewed its internal process of preparing to submit base schedules at T-40 and changes to interchange values within the hour after T-20 and identified any delayed submission tags. PacifiCorp also improved the accuracy of base schedules submitted for non-EIM export energy share of PacifiCorp joint-owned resources.	None identified	Complete. PacifiCorp improved its awareness about the importance of consistent interchange bases schedules and real-time interchange schedules on market results. CAISO is in the process of defining additional monitoring to show the interchange megawatt differences to the operator. The implementation is anticipated to

<i>Number</i>	<i>Solution</i>	<i>Actions and Responsibility</i>	<i>Tariff Changes</i>	<i>Implementation Timeline</i>
				be towards end of May 2015 PacifiCorp fixed the interchange scheduling software intermittent use of invalid interchange schedules around top of hour the last part of April 2015. The CAISO and PacifiCorp have also agreed on submission of base schedules for several hours in the future to cover the short-term-unit commitment horizon, currently set at 4.5 hour's. The data transfer of future hour's base schedules was implemented towards end of May 2015.
5.	<i>CAISO formalized a production system support plan for Outage Management System to respond quickly to questions or situations encountered by PacifiCorp operator when entering outage tickets.</i>	CAISO implemented a support plan. This support plan consists of a 24/7 email address and telephone number available to PacifiCorp for immediate response to any outage management system issues and for troubleshooting any discrepancy in resources' availability megawatt values. PacifiCorp participated in identifying additional requirements and enhancements to outage	None identified	Completed early March 2015

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
		management system based on operational needs.		
6.	<i>Enhanced situational awareness displays and improved monitoring of generator availability, capacity, available regulation on a 5 and 15 min basis, and ramp capacity.</i>	PacifiCorp created and/or improved certain Grid Operations displays to monitor generator availability, capacity, and ramp capacity. PacifiCorp has finalized enhancements to its generator database (Pi) displays to provide Grid Operations with situational awareness when there is a deviation between the Dispatch Operating Target (DOT) and the actual dispatch. PacifiCorp developed and implemented additional tools and displays to provide its grid operations personnel with increased visibility and situational awareness regarding available capacity on a 5- and 15-minute basis. PacifiCorp has coordinated with the CAISO to improve the accuracy of	None identified	Major enhancements completed. The CAISO and PacifiCorp continue to monitor and analyze for timely responses to inform the market about any out-of-market manual actions the EIM entity takes or plans to take.

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
		how the EIM understands PacifiCorp's balancing authority operations by using the information communication tools available in the EIM, including outage cards, to ensure that the EIM is accurately consuming real time system conditions and unit capacity available in PacifiCorp's balancing authority area. Since go-live, PacifiCorp and the CAISO have engaged in regular discussions to evaluate the root cause of remaining infeasible schedules. PacifiCorp has made improvements to its systems that interface with the CAISO's base schedules and economic bids systems, as well as systems designed for bidding resources during start-up and shutdown hours for multi-stage generating resources. PacifiCorp further narrowed the gap between the persistence forecast methods it uses for VER forecasting and the submission of those forecasts		

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
		to the market. This ensures the market has a more current view of wind conditions and results in an improved market solution. Additionally, PacifiCorp has worked with the CAISO to improve the load forecast during ramping hours. This has resulted in an even more accurate load forecast during these hours and improved the flexibility available to the market as fewer resource are needed to cover forecast error. For troubleshooting purposes, PacifiCorp continues to work with the CAISO on tools and displays that can compare interchange deviations between EIM entity submissions and confirmation of interchange data used by the Market Operator. PacifiCorp Grid Operations also continues to work with neighboring balancing authority areas to improve visibility and tools. PacifiCorp has utilized the CAISO's		

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
		new displays to identify quickly discrepancies between base schedules and derated maximum capacity of resources. The CAISO added additional information related to re-rated minimum capacity to existing displays to help PacifiCorp identify and fix discrepancies between base schedules and re-rated minimum capacity. The CAISO enhanced situational awareness screens to report on un-qualified MWhs when base schedules were submitted for the resource on an outage to more timely inform the EIM entity of inconsistencies between base schedules and outages.		
7.	<i>Improvements to Flexible Ramp Sufficiency Test</i>	PacifiCorp and the CAISO are coordinating to identify needed improvements. The CAISO is collecting and analyzing both wind and load variability in PacifiCorp's two balancing areas. PacifiCorp and the CAISO have addressed several wind forecasting issues but wind forecast deviations from base	None identified yet; possible solutions could require additional changes.	CAISO developed improved forecasting of flex ramp requirements for PACE and PACW and started to use these values in the EIM early March 2015. CAISO is also reviewing its flex ramp sufficiency test implementation for possible simplification to be completed by end of mid-May

<i>Number</i>	<i>Solution</i>	<i>Actions and Responsibility</i>	<i>Tariff Changes</i>	<i>Implementation Timeline</i>
		schedules continues to be among the main reasons for price excursions and infeasibilities. The CAISO is in the process of assessing the flexible ramping requirement for PacifiCorp's two balancing areas based on the collected data for the actual real-time imbalance conditions. The CAISO is also revisiting and reviewing the flexible ramping constraint and associated credit accounting in the flexibility sufficiency test and towards satisfying the flexible ramp requirements in the market optimization.		2015
8	<i>Unit deviation displays</i>	The CAISO provided the EIM entity additional user interfaces that provide the grid operator information related to differences between any combination of telemetry, state estimation, base schedules, and cleared target operating points for all resources. The CAISO and PacifiCorp continue to coordinate and provide feedback of additional needed enhancements.	None identified	Completed

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
9	<i>Load bias logic correction</i>	There were several instances where operators made incorrect load biases to dispatch more capacity when the system was out of ramping capability. The CAISO will be implementing software functionality to limit such erroneous load biases, similar to the logic currently used for the CAISO operator bias of load. This feature limits operator bias of load forecast that are not consistent with system available ramp. The CAISO will provide training to PacifiCorp to ensure operators are familiar with how the feature will work, including explanations on the use of prices as a signal to indicate an issue in meeting load or balancing the system.	None identified. The CAISO will add detail in its business practice manual to describe the procedure further.	The CAISO implemented this feature for EIM on March 20, 2015. However, the feature does not currently trigger because the price waiver-based pricing requires the pricing run to establish prices based on the last economic bid when the market software relaxes the transmission or power balance constraint. For April 2015 about 44 intervals with RTD infeasibilities were covered by this functionality and, therefore, were no longer considered in the metrics of this report.
10	<i>Increase Pool of EIM Participating Resources</i> <i>PacifiCorp coordinated with the CAISO to increase the pool of owned and</i>	PacifiCorp coordinated with the CAISO to increase the pool of owned and third-party resources available to participate in the EIM. This will result in the Swift 1&2 units becoming a single aggregated PacifiCorp EIM Participating Resource	None identified.	PacifiCorp aggregated Swift 1&2 in May 2015. CAISO removed non-conforming Industrial Loads from PACE BAA starting April 1, 2015. PacifiCorp started submission of industrial load base schedules April 1, 2015, and has been bidding them

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
	<i>third-party resources available to participate in the EIM.</i>	and will add approximately 68 MWs of upper bid range capability. In addition, PacifiCorp continues to work with other transmission customers who may be interested in participating in the EIM with resources, including the recent filing of a construction agreement at FERC to enable resource-metering upgrades, which would facilitate further steps towards participation of resources in the EIM (FERC Docket No. ER15-711). At this time, PacifiCorp has not certified any third-party transmission customers for participation in the EIM, but is hopeful that these efforts will result in additional EIM participation. PacifiCorp has modeled certain industrial customer interruptible loads as participating resources. This was necessary because some of PacifiCorp's industrial customer loads have on-site generation and, as a result, this presents additional complexity for accurate forecasting		economically since mid May 2015.

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
		and balancing. Adding these elements as participating resources has improved operational visibility and added approximately 200 MW of flex capacity in its PACE Balancing Authority Area (“BAA”) when they are bid economically in the EIM. PacifiCorp is also improving the modeling of its jointly owned generating resources. Such improvements will further minimize imbalance issues and improve forecast accuracy.		
11	<i>Training</i> <i>Additional training of personnel and improvement of systems with increased EIM operational experience.</i>	PacifiCorp provided personnel with training on outage entry and required the provision of daily spreadsheets from PacifiCorp EIM Participating Resources that describe any operational issues and the resources’ ambient conditions. PacifiCorp’s Grid Operations provided its balancing agent real-time continued training on CAISO EIM tools during the first two weeks of February 2015. PacifiCorp worked with the CAISO to	None identified.	PacifiCorp and the CAISO have completed the bulk of identified training and the CAISO continues to evaluate training requirements.

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
		improve load conforming errors. Software enhancements have been introduced that help protect against over-conforming that can exacerbate issues when capacity in the market is near its limit.		
12	<i>Improve Internal Processes and Tools to address identified market performance issues.</i>	PacifiCorp’s Grid Operations drafted and made available to operations personnel, “best practices” procedure documents to aid in personnel’s implementation of critical EIM Entity tasks. PacifiCorp will continue to update these procedure documents in real-time as needed. PacifiCorp also developed a Desk Guide for the 24/7 Grid Operations desk and an EIM Division of Responsibilities document.	None identified.	Completed
13	<i>Improve dynamic transfer capability</i>	PacifiCorp is engaged in ongoing discussions with the Bonneville Power Administration (BPA) to understand the nature and allocation of the dynamic transfer capability on the COI. BPA is in the process of conducting a detailed dynamic transfer capability study. Any additional five-minute capability will help the five-minute market re-	None identified.	In progress – BPA is in the process of determining new COI dynamic transfer capability limits based on study results. For BPA rate of change constraints, the CAISO, PacifiCorp, and BPA are currently examining two methodologies or approaches in the ISO testing environment to

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
		optimize the fifteen-minute decisions that are based on system conditions and information available at approximately 30 minutes prior to the five-minute market. The five-minute dynamic COI limits were increased for the off-peak hours but still very limited during on-peak hours. PacifiCorp is engaged in discussions with BPA to understand the nature and basis behind the five-minute flowgate limits and possible change in the calculation of those limits. BPA is reviewing the five-minute limits, which are based on historical movement of PacifiCorp West resources before the EIM. BPA has also requested more data points to perform a review of the current rate-of-change limits based on actual EIM data. Any additional five-minute capability will help the five-minute market re-optimize the fifteen-minute market decisions that are based on system conditions and information available approximately		identify which methodology is superior and acceptable to BPA to the method currently in place. The first methodology was deployed mid May 2015. The CAISO/PacifiCorp/BPA are committed and continue to discuss on weekly calls the effectiveness of approach 1, as well as potential better alternatives.

<i>Number</i>	<i>Solution</i>	<i>Actions and Responsibility</i>	<i>Tariff Changes</i>	<i>Implementation Timeline</i>
		30 minutes prior to the five-minute market. The CAISO had provided BPA the requested data points and answered any relevant questions. The CAISO is coordinating with both BPA and PacifiCorp to revise the implementation model for the rate-of-change constraint to reflect ramping 15-minute schedule values.		

ATTACHMENT C

This attachment includes a discussion of whether the cause was due to transitional issues or was due to insufficient supply of resources bid into the EIM, including the time of the instance, the duration, the cause, and the affected node(s) and load. The CAISO evaluated each interval of infeasibility to determine whether it was infeasible due to actual supply insufficiency by calculating the degree to which the infeasibility was in excess of PacifiCorp's available capacity to balance its system. This measure was determined by calculating the difference between the total amount of reserves carried and the minimum amount of reserves required by NERC. The CAISO then subtracted the MWs of infeasibility from that amount to determine the amount of available capacity above the magnitude of the infeasibilities. This amount is displayed for the PACE and PACW areas for each interval. If that value were zero or negative, the CAISO would qualify that interval as infeasible due to an insufficiency of supply. Otherwise, the CAISO concludes the EIM entity had enough capacity available to dispatch as needed to address the infeasibility observed in the market systems. However, the CAISO does not present this measurement to demonstrate that the available capacity could have actually addressed the infeasibility. It is not certain that the available capacity would have been capable to meet the ramping needs to meet the infeasibility. It is merely a measure of the total capacity available at the time of the infeasibility for a future operating interval. An important aspect of the CAISO market runs is that the CAISO conducts the market runs from 37.5 and up to 7.5 minutes ahead of the actual operating interval respectively for the fifteen-minute market and five-minute market. The measurements of the infeasibility below do not reflect the actions taken between the time the market systems detect the infeasible market run and the actual operating interval. The CAISO presumes the EIM entity actually takes manual actions to dispatch available capacity during that time interval to meet their load.

The tables below show that PAC observed under-generation infeasibilities on April 3, hour ending 20 in both the fifteen- and 5-minute markets. The CAISO market systems dispatched two multi-stage generator units based on available bids. However, the bids made available in the market did not support the expected availability projected in the base schedules. The units were actually operating in a higher configuration and were producing about 310 MW more than where the market dispatched them at and had an additional 200 MWs of capacity more than what the market could dispatch them at based on the available bids at the time. This capacity offset the rapidly decreasing wind output of up to 400 MWs also occurring during this time but that was not visible to the market models.

Table 1: List of undersupply infeasibilities in the fifteen-minute market for both PAC East and West

Trade Date	Hour Ending	Interval	Infeasibility PACE (MW)	Excess of Reserves PACE (MW)	Infeasibility PACW (MW)	Excess of Reserves PACW (MW)	Reason for infeasibility	Affected locations
04/01/2015	4	4	2.1	397.7			Renewable deviation	All locations in PAC East
04/01/2015	19	3	9.2	322.3			Renewable deviation	All locations in PAC East
04/01/2015	24	1	11.8	314.3			Renewable deviation	All locations in PAC East
04/01/2015	24	2	88.8	212.9			Renewable deviation, Import/Export changes, Load changes	All locations in PAC East
04/02/2015	10	4	5.1	392.3			Resource outage	All locations in PAC East

Trade Date	Hour Ending	Interval	Infeasibility PACE (MW)	Excess of Reserves PACE (MW)	Infeasibility PACW (MW)	Excess of Reserves PACW (MW)	Reason for infeasibility	Affected locations
04/03/2015	2	2	4.6	243.7			Renewable deviation, Resource data alignment	All locations in PAC East
04/03/2015	12	3	22.1	277.6			Resource outage	All locations in PAC East
04/03/2015	20	1	92.4	76.5			Renewable deviation, Load changes	All locations in PAC East
04/03/2015	20	2	273.3	-90.0			Renewable deviation, Load changes	All locations in PAC East
04/03/2015	20	3	408.6	-144.4			Renewable deviation, Load changes	All locations in PAC East
04/03/2015	20	4	354.7	-91.0			Renewable deviation, Load changes	All locations in PAC East
04/03/2015	21	1	112.0	276.5			Renewable deviation, Load changes	All locations in PAC East
04/03/2015	21	2	217.1	183.2			Renewable deviation, Load changes	All locations in PAC East
04/03/2015	21	3	76.8	64.9			Renewable deviation, Load changes	All locations in PAC East
04/03/2015	21	4	5.4	72.9			Renewable deviation, Load changes	All locations in PAC East
04/04/2015	13	1	15.2	132.4			Resource outage, Import/Export changes, Renewable deviation	All locations in PAC East
04/04/2015	13	4	8.6	130.3			Resource outage, Import/Export changes, Renewable deviation	All locations in PAC East

Trade Date	Hour Ending	Interval	Infeasibility PACE (MW)	Excess of Reserves PACE (MW)	Infeasibility PACW (MW)	Excess of Reserves PACW (MW)	Reason for infeasibility	Affected locations
04/04/2015	22	2	61.2	49.8			Resource outage	All locations in PAC East
04/04/2015	24	1	4.3	180.9			Import/Export changes, Resource outage	All locations in PAC East
04/06/2015	9	3	51.5	151.3			Resource outage	All locations in PAC East
04/06/2015	9	4	42.5	144.0			Resource outage	All locations in PAC East
04/07/2015	9	4	100.8	41.9			Renewable deviation, Load changes, Resource data alignment	All locations in PAC East
04/07/2015	10	1	33.8	191.6			Renewable deviation, Load changes, Resource data alignment	All locations in PAC East
04/07/2015	10	2	0.4	222.4			Renewable deviation, Load changes, Resource data alignment	All locations in PAC East
04/07/2015	10	4	160.4	83.9			Load changes	All locations in PAC East
04/07/2015	11	1	21.1	330.9			Load changes	All locations in PAC East
04/08/2015	14	3	82.4	193.9			Resource outage	All locations in PAC East
04/10/2015	20	3	15.0	168.7			Renewable deviation	All locations in PAC East

Trade Date	Hour Ending	Interval	Infeasibility PACE (MW)	Excess of Reserves PACE (MW)	Infeasibility PACW (MW)	Excess of Reserves PACW (MW)	Reason for infeasibility	Affected locations
04/13/2015	7	4			15.6	165.4	Resource data alignment	All locations in PAC West
04/13/2015	8	3			15.4	205.1	Resource data alignment	All locations in PAC West
04/13/2015	9	1			142.0	48.7	Resource data alignment	All locations in PAC West
04/13/2015	11	3			101.6	99.3	Resource data alignment	All locations in PAC West
04/13/2015	22	4			59.3	113.5	Resource outage	All locations in PAC West
04/13/2015	23	1			174.7	63.0	Load changes	All locations in PAC West
04/13/2015	23	2			81.1	174.2	Load changes	All locations in PAC West
04/14/2015	9	1	62.5	150.0			Renewable deviation	All locations in PAC East
04/14/2015	9	2	80.0	57.8			Renewable deviation	All locations in PAC East
04/14/2015	9	3	104.1	13.7			Renewable deviation	All locations in PAC East
04/14/2015	9	4	120.2	18.5			Renewable deviation	All locations in PAC East
04/14/2015	21	2	45.8	140.0			Resource outage	All locations in PAC East

Trade Date	Hour Ending	Interval	Infeasibility PACE (MW)	Excess of Reserves PACE (MW)	Infeasibility PACW (MW)	Excess of Reserves PACW (MW)	Reason for infeasibility	Affected locations
04/14/2015	21	3	23.0	62.8			Resource outage	All locations in PAC East
04/15/2015	9	3	63.5	76.9			Import/Export changes	All locations in PAC East
04/15/2015	9	4	13.5	104.8			Import/Export changes	All locations in PAC East
04/15/2015	10	1	14.3	120.9			Load changes	All locations in PAC East
04/15/2015	10	2	103.2	36.5			Load changes	All locations in PAC East
04/15/2015	23	1	75.7	89.7			Resource outage	All locations in PAC East
04/15/2015	23	3	17.3	205.2			Resource outage	All locations in PAC East
04/20/2015	19	1	123.6	493.9			Resource outage	All locations in PAC East
04/21/2015	9	2	27.5	197.8			Resource outage	All locations in PAC East

Table 2: List of undersupply infeasibilities in the five-minute market for both PAC East and West

Trade Date	Hour Ending	Interval	Infeasibility PACE (MW)	Excess of Reserves PACE (MW)	Infeasibility PACW (MW)	Excess of Reserves PACW (MW)	Reason for infeasibility	Affected locations
4/1/15	11	4	14.1	279.2			Resource data alignment, Load changes	All locations in PAC East
4/1/15	11	6	1.5	298.1			Resource data alignment, Load changes	All locations in PAC East
4/1/15	18	7	38.0	320.1			Resource data alignment	All locations in PAC East
4/1/15	18	8	2.6	387.0			Resource data alignment	All locations in PAC East
4/1/15	18	9	13.0	346.6			Resource data alignment	All locations in PAC East
4/1/15	18	10	2.1	357.6			Resource data alignment	All locations in PAC East
4/1/15	23	2	4.7	378.8			Renewable deviation	All locations in PAC East
4/1/15	24	2	99.1	245.5			Resource data alignment, Load changes, Renewable deviation	All locations in PAC East

4/1/15	24	3	133.8	169.5			Resource data alignment, Load changes, Renewable deviation	All locations in PAC East
4/1/15	24	4	61.9	229.4			Resource data alignment, Load changes, Renewable deviation	All locations in PAC East
4/2/15	1	2	17.9	324.6			Resource outage, Renewable deviation	All locations in PAC East
4/2/15	1	11	21.0	309.9			Resource outage, Renewable deviation	All locations in PAC East
4/2/15	19	10	96.0	146.1			Renewable deviation	All locations in PAC East
4/2/15	20	10	24.9	300.2			Resource data alignment, Renewable deviation, Load changes	All locations in PAC East
4/2/15	21	7			78.1	75.7	Resource data alignment	All locations in PAC West
4/2/15	21	9			25.9	13.5	Resource data alignment	All locations in PAC West
4/2/15	21	10			25.9	-1.4	Resource data alignment	All locations in PAC West
4/2/15	21	11			25.9	-22.5	Resource data alignment	All locations in PAC West
4/3/15	12	1	41.7	280.3			Resource outage	All locations in PAC East
4/3/15	19	10	5.7	144.0			Renewable deviation, Resource data alignment	All locations in PAC East
4/3/15	19	12	92.1	23.3			Renewable deviation, Resource data alignment	All locations in PAC East
4/3/15	20	1	101.2	48.5			Renewable deviation, Resource data alignment	All locations in PAC East
4/3/15	20	2	150.7	-3.4			Renewable deviation, Resource data alignment	All locations in PAC East

4/3/15	20	3	317.5	-107.5			Renewable deviation, Resource data alignment	All locations in PAC East
4/3/15	20	4	328.5	-123.0			Renewable deviation, Resource data alignment	All locations in PAC East
4/3/15	20	5	356.5	-181.2			Renewable deviation, Resource data alignment	All locations in PAC East
4/3/15	20	6	390.6	-221.3			Renewable deviation, Resource data alignment	All locations in PAC East
4/3/15	20	7	424.2	-174.8			Renewable deviation, Resource data alignment	All locations in PAC East
4/3/15	20	8	639.2	-374.5			Renewable deviation, Resource data alignment	All locations in PAC East
4/3/15	20	9	616.7	-338.1			Renewable deviation, Resource data alignment	All locations in PAC East
4/3/15	20	10	427.0	-176.3			Renewable deviation, Resource data alignment	All locations in PAC East
4/3/15	20	11	334.2	-83.8			Renewable deviation, Resource data alignment	All locations in PAC East
4/3/15	20	12	237.4	52.3			Renewable deviation, Resource data alignment	All locations in PAC East
4/3/15	21	1	119.4	244.5			Renewable deviation, Resource data alignment	All locations in PAC East
4/3/15	21	7	52.2	231.5			Resource data alignment, Renewable deviation	All locations in PAC East
4/4/15	3	9	4.9	257.2			Load changes, Resource data alignment	All locations in PAC East
4/4/15	5	2	9.3	211.9			Resource data alignment, Resource outage	All locations in PAC East
4/4/15	5	3	1.9	196.0			Resource data alignment, Resource outage	All locations in PAC East
4/4/15	5	4	17.3	205.1			Resource data alignment, Resource outage	All locations in PAC East

4/4/15	5	5	23.2	197.0			Resource data alignment, Resource outage	All locations in PAC East
4/4/15	5	6	40.9	174.3			Resource data alignment, Resource outage	All locations in PAC East
4/4/15	5	7	40.6	180.0			Resource data alignment, Resource outage	All locations in PAC East
4/4/15	5	8	46.2	135.1			Resource data alignment, Resource outage	All locations in PAC East
4/4/15	5	9	59.4	127.6			Resource data alignment, Resource outage	All locations in PAC East
4/4/15	5	11	23.8	104.8			Resource data alignment, Resource outage	All locations in PAC East
4/4/15	6	1	72.6	62.9			Resource data alignment, Resource outage	All locations in PAC East
4/4/15	6	2	93.6	35.2			Resource data alignment, Resource outage	All locations in PAC East
4/4/15	6	3	91.9	38.2			Resource data alignment, Resource outage	All locations in PAC East
4/4/15	6	4	58.1	25.0			Resource data alignment, Resource outage	All locations in PAC East
4/4/15	6	5	53.1	47.0			Resource data alignment, Resource outage	All locations in PAC East
4/4/15	6	6	60.9	57.4			Resource data alignment, Resource outage	All locations in PAC East
4/4/15	6	10	27.7	140.0			Resource data alignment, Resource outage	All locations in PAC East
4/4/15	6	11	51.6	137.1			Resource data alignment, Resource outage	All locations in PAC East
4/4/15	6	12	11.5	134.7			Resource data alignment, Resource outage	All locations in PAC East
4/4/15	8	2	58.6	388.3			Load changes, Resource outage	All locations in PAC East

4/4/15	8	3	41.5	320.2			Load changes, Resource outage	All locations in PAC East
4/4/15	8	4	35.4	179.0			Load changes, Resource outage	All locations in PAC East
4/4/15	8	5	67.5	133.6			Load changes, Resource outage	All locations in PAC East
4/4/15	20	7	54.3	67.6			Renewable deviation, Load changes	All locations in PAC East
4/4/15	20	8	20.7	16.7			Renewable deviation, Load changes	All locations in PAC East
4/4/15	20	10	30.2	9.1			Renewable deviation, Load changes	All locations in PAC East
4/4/15	20	11	64.0	-68.7			Renewable deviation, Load changes	All locations in PAC East
4/4/15	21	2	0.4	109.4			Renewable deviation, Load changes	All locations in PAC East
4/4/15	21	3	27.9	110.8			Renewable deviation, Load changes	All locations in PAC East
4/4/15	21	4	58.0	40.9			Renewable deviation, Load changes	All locations in PAC East
4/4/15	21	5	60.4	26.2			Renewable deviation, Load changes	All locations in PAC East
4/4/15	21	6	57.2	42.6			Renewable deviation, Load changes	All locations in PAC East
4/4/15	21	9	38.8	49.1			Renewable deviation, Load changes	All locations in PAC East
4/4/15	21	10	69.4	48.9			Renewable deviation, Load changes	All locations in PAC East
4/4/15	21	11	68.0	67.9			Renewable deviation, Load changes	All locations in PAC East
4/4/15	24	2	1.6	192.3			Outage, Import/Export changes	All locations in PAC East

4/5/15	3	6	55.6	128.9			Load changes	All locations in PAC East
4/5/15	3	7	69.1	93.5			Load changes	All locations in PAC East
4/5/15	3	8	38.2	142.4			Load changes	All locations in PAC East
4/5/15	3	9	38.5	109.0			Load changes	All locations in PAC East
4/5/15	18	8			69.7	42.4	Import/Export changes, Renewable deviation	All locations in PAC West
4/5/15	21	7	6.1	271.6			Import/Export changes, Renewable deviation, Resource data alignment	All locations in PAC East
4/5/15	22	12	0.0	234.6	6.0	337.8	Import/Export changes, Renewable deviation	All locations in PAC West
4/5/15	24	10	23.3	29.7			Renewable deviation	All locations in PAC East
4/6/15	8	12	21.5	158.1			Outage, Renewable deviation, Resource data alignment	All locations in PAC East
4/6/15	9	1	73.5	121.5			Outage, Renewable deviation, Resource data alignment	All locations in PAC East
4/6/15	9	2	85.6	131.1			Outage, Renewable deviation, Resource data alignment	All locations in PAC East
4/6/15	9	3	42.1	174.4			Outage, Renewable deviation, Resource data alignment	All locations in PAC East
4/6/15	12	3	24.2	103.4			Outage, Renewable deviation, Import/Export changes	All locations in PAC East
4/6/15	12	7	19.1	139.2			Outage, Renewable deviation, Import/Export changes	All locations in PAC East
4/7/15	3	11	2.6	458.5			Resource data alignment	All locations in PAC East

4/7/15	4	10	4.4	338.2	1.3	116.1	Resource data alignment	All locations in PAC West
4/7/15	6	9			18.6	280.0	Load changes	All locations in PAC West
4/7/15	6	10			21.2	264.6	Load changes	All locations in PAC West
4/7/15	6	11			7.8	243.3	Load changes	All locations in PAC West
4/7/15	7	7			118.0	111.3	Resource outage	All locations in PAC West
4/7/15	7	8			105.8	142.1	Resource outage	All locations in PAC West
4/7/15	7	9			133.4	109.0	Resource outage	All locations in PAC West
4/7/15	9	6	17.6	155.9			Resource outage	All locations in PAC East
4/7/15	9	7	36.8	113.8			Resource outage	All locations in PAC East
4/7/15	9	8	17.0	148.1			Resource outage	All locations in PAC East
4/7/15	9	9	19.5	144.1			Resource outage	All locations in PAC East
4/7/15	10	4	27.8	204.8			Load changes	All locations in PAC East
4/7/15	10	5	57.1	149.8			Load changes	All locations in PAC East
4/7/15	10	10	17.4	195.4			Load changes	All locations in PAC East
4/7/15	18	10					Load changes	All locations in PAC East
4/7/15	19	10	32.7	260.2			Resource data alignment	All locations in PAC East

4/7/15	19	11	13.6	313.4			Resource data alignment	All locations in PAC East
4/7/15	20	10			138.8	-49.0	Resource data alignment	All locations in PAC West
4/7/15	20	11			73.3	-11.1	Resource data alignment	All locations in PAC West
4/7/15	21	10			7.0	114.6	Resource data alignment	All locations in PAC West
4/7/15	21	11			4.1	111.6	Resource data alignment	All locations in PAC West
4/8/15	1	3	20.6	304.0	10.8	271.7	Manual Dispatches, Resource data alignment	All locations in PAC East and West
4/8/15	2	2	19.1	364.1			Manual Dispatches, Resource data alignment	All locations in PAC East
4/8/15	2	4	29.0	287.1			Manual Dispatches, Resource data alignment	All locations in PAC East
4/8/15	2	5	43.1	291.6			Manual Dispatches, Resource data alignment	All locations in PAC East
4/8/15	6	9	1.9	304.4			Renewable deviation, Resource data alignment	All locations in PAC East
4/8/15	6	10	7.1	282.8			Renewable deviation, Resource data alignment	All locations in PAC East
4/8/15	7	9			43.9	157.6	Resource outage	All locations in PAC West
4/8/15	7	11			13.4	185.0	Resource outage	All locations in PAC West
4/8/15	8	10	5.6	189.5			Renewable deviation	All locations in PAC East
4/8/15	8	12			19.3	123.1	Renewable deviation	All locations in PAC West

4/8/15	9	7	4.7	340.4			Renewable deviation, Load changes	All locations in PAC East
4/8/15	9	9	17.8	282.2			Renewable deviation, Load changes	All locations in PAC East
4/8/15	9	10	12.0	291.1			Renewable deviation, Load changes	All locations in PAC East
4/8/15	9	11	11.9	282.3			Renewable deviation, Load changes	All locations in PAC East
4/8/15	20	8	29.6	178.5			Renewable deviation, Resource data alignment	All locations in PAC East
4/8/15	22	1	27.4	207.1			Renewable deviation, Resource data alignment	All locations in PAC East
4/8/15	22	2	49.9	217.2			Renewable deviation, Resource data alignment	All locations in PAC East
4/8/15	22	3	53.5	189.0			Renewable deviation, Resource data alignment	All locations in PAC East
4/8/15	22	4	34.7	227.8			Renewable deviation, Resource data alignment	All locations in PAC East
4/8/15	23	1	47.8	267.8			Renewable deviation, Resource data alignment	All locations in PAC East
4/8/15	23	3	92.9	235.0			Renewable deviation, Resource data alignment	All locations in PAC East
4/8/15	23	4	39.9	317.3			Renewable deviation, Resource data alignment	All locations in PAC East
4/8/15	23	5	24.4	316.0			Renewable deviation, Resource data alignment	All locations in PAC East
4/8/15	23	6	63.3	261.8			Renewable deviation, Resource data alignment	All locations in PAC East
4/9/15	2	3	2.4	177.0			Renewable deviation	All locations in PAC East
4/9/15	2	9	8.0	186.5			Renewable deviation	All locations in PAC East

4/9/15	2	10	4.3	198.0			Renewable deviation	All locations in PAC East
4/9/15	6	6	18.3	369.0			Resource data alignment	All locations in PAC East
4/9/15	6	8	0.8	392.7			Resource data alignment	All locations in PAC East
4/9/15	6	10	12.8	378.1			Resource data alignment	All locations in PAC East
4/9/15	6	11	32.3	313.2			Resource data alignment	All locations in PAC East
4/11/15	21	8	210.4	104.8			Resource outage	All locations in PAC East
4/12/15	22	3			13.5	258.1	Load changes, Import/Export changes	All locations in PAC West
4/12/15	22	5			21.3	201.4	Load changes, Import/Export changes	All locations in PAC West
4/12/15	23	2	3.9	202.3			Import/Export changes	All locations in PAC East
4/12/15	23	3	13.1	222.4			Import/Export changes	All locations in PAC East
4/13/15	7	9			15.5	123.1	Resource data alignment	All locations in PAC West
4/13/15	22	9	23.3	182.2			Load changes	All locations in PAC East
4/14/15	8	2	2.9	155.6			Renewable deviation, Resource data alignment	All locations in PAC East
4/14/15	8	3	56.5	42.5			Renewable deviation, Resource data alignment	All locations in PAC East
4/14/15	8	9	0.4	199.9			Renewable deviation, Resource data alignment	All locations in PAC East
4/14/15	14	6	0.2	214.7			Resource data alignment, Import/Export changes	All locations in PAC East

4/14/15	17	6			9.1	252.9	Manual Dispatches	All locations in PAC West
4/14/15	17	7			12.7	295.2	Manual Dispatches	All locations in PAC West
4/14/15	17	8			32.3	296.4	Manual Dispatches	All locations in PAC West
4/14/15	17	9			43.3	288.2	Manual Dispatches	All locations in PAC West
4/14/15	17	11	32.7	89.7			Load changes, Resource data alignment	All locations in PAC East
4/14/15	17	12	20.3	94.2			Load changes, Resource data alignment	All locations in PAC East
4/14/15	20	7	7.5	231.0			Resource outage	All locations in PAC East
4/14/15	20	8	73.4	368.4			Resource outage	All locations in PAC East
4/14/15	20	9	213.4	47.0			Resource outage	All locations in PAC East
4/14/15	20	10	202.4	-61.7			Resource outage	All locations in PAC East
4/14/15	21	3	17.0	245.9			Resource outage	All locations in PAC East
4/14/15	21	5	7.0	254.8			Resource outage	All locations in PAC East
4/15/15	8	5	3.8	149.1			Renewable deviation	All locations in PAC East
4/15/15	9	10	64.6	51.5			Renewable deviation, Load changes	All locations in PAC East
4/15/15	17	2	13.2	204.3			Resource data alignment, Import/Export changes	All locations in PAC East
4/15/15	17	3	24.2	195.6			Resource data alignment, Import/Export changes	All locations in PAC East

4/15/15	17	4	11.6	190.5			Resource data alignment, Import/Export changes	All locations in PAC East
4/15/15	17	5	6.1	217.4			Resource data alignment, Import/Export changes	All locations in PAC East
4/15/15	17	6	3.7	176.6			Resource data alignment, Import/Export changes	All locations in PAC East
4/15/15	21	12	4.2	209.9	34.6	240.5	Import/Export changes	All locations in PAC West
4/15/15	22	2	57.3	137.9	27.6	204.8	Resource outage	All locations in PAC West
4/15/15	22	3	78.7	82.4	38.2	189.1	Resource outage	All locations in PAC West
4/15/15	22	4	59.2	99.4			Resource outage	All locations in PAC East
4/15/15	22	5	68.1	121.7			Resource outage	All locations in PAC East
4/15/15	22	6	62.8	131.4			Resource outage	All locations in PAC East
4/15/15	22	7	67.9	126.8			Resource outage	All locations in PAC East
4/15/15	22	8	30.8	164.0	6.2	210.3	Resource outage	All locations in PAC West
4/16/15	7	1	0.9	334.8			Resource outage	All locations in PAC East
4/16/15	7	2	22.0	446.5			Resource outage	All locations in PAC East
4/16/15	11	8			88.1	376.9	Resource data alignment	All locations in PAC West
4/16/15	11	9			36.9	532.8	Resource data alignment	All locations in PAC West
4/16/15	11	10			19.5	548.0	Resource data alignment	All locations in PAC West

4/16/15	11	11			37.5	532.4	Resource data alignment	All locations in PAC West
4/16/15	11	12			6.6	555.2	Resource data alignment	All locations in PAC West
4/16/15	13	3	20.4	227.9			Renewable deviation, Resource outage	All locations in PAC East
4/16/15	13	6	6.6	259.7			Renewable deviation, Resource outage	All locations in PAC East
4/16/15	14	1	1.1	300.6			Renewable deviation, Resource outage	All locations in PAC East
4/16/15	15	11	3.0	261.5			Renewable deviation, Resource data alignment	All locations in PAC East
4/16/15	15	12	23.4	241.1			Renewable deviation, Resource data alignment	All locations in PAC East
4/16/15	16	1	47.0	204.4			Renewable deviation, Resource data alignment	All locations in PAC East
4/16/15	16	2	83.9	189.7			Renewable deviation, Resource data alignment	All locations in PAC East
4/16/15	16	3	78.8	160.1			Renewable deviation, Resource data alignment	All locations in PAC East
4/16/15	16	4	19.5	213.3			Renewable deviation, Resource data alignment	All locations in PAC East
4/16/15	19	8	75.6	129.3			ED, Renewable deviation	All locations in PAC East
4/16/15	19	10	43.2	198.2			ED, Renewable deviation	All locations in PAC East
4/16/15	19	11	42.5	174.1			ED, Renewable deviation	All locations in PAC East
4/16/15	22	2			66.5	51.5	Resource data alignment	All locations in PAC West
4/16/15	22	3			69.0	3.3	Resource data alignment	All locations in PAC West

4/16/15	22	4			2.8	71.5	Resource data alignment	All locations in PAC West
4/17/15	6	8	58.2	182.5			Resource data alignment	All locations in PAC East
4/17/15	15	6	3.4	163.0			Resource data alignment	All locations in PAC East
4/19/15	21	4	38.2	310.8			Resource data alignment	All locations in PAC East
4/19/15	21	5			4.6	29.4	Resource outage	All locations in PAC West
4/19/15	21	7			30.4	3.6	Resource outage	All locations in PAC West
4/19/15	22	3	12.5	81.8			Resource data alignment, Load changes, Renewable deviation	All locations in PAC East
4/19/15	24	12	6.3	223.5			Renewable deviation, Import/Export changes	All locations in PAC East
4/20/15	1	2	5.4	112.6			Renewable deviation, Resource data alignment	All locations in PAC East
4/20/15	1	3	18.9	94.5			Renewable deviation, Resource data alignment	All locations in PAC East
4/20/15	1	4	16.9	124.5			Renewable deviation, Resource data alignment	All locations in PAC East
4/20/15	1	5	19.7	101.7			Renewable deviation, Resource data alignment	All locations in PAC East
4/20/15	1	6	9.0	55.4			Renewable deviation, Resource data alignment	All locations in PAC East
4/20/15	1	8	2.0	104.5			Renewable deviation, Resource data alignment	All locations in PAC East
4/20/15	1	9	2.9	111.4			Renewable deviation, Resource data alignment	All locations in PAC East
4/20/15	1	10	24.2	72.5			Renewable deviation, Resource data alignment	All locations in PAC East

4/20/15	1	11	7.5	112.9			Renewable deviation, Resource data alignment	All locations in PAC East
4/21/15	8	12	3.7	184.7			Import/Export changes, Renewable deviation	All locations in PAC East
4/21/15	9	1	47.9	123.6			Renewable deviation, Resource outage	All locations in PAC East
4/21/15	9	2	79.0	111.1			Renewable deviation, Resource outage	All locations in PAC East
4/21/15	9	3	95.6	141.1			Renewable deviation, Resource outage	All locations in PAC East
4/21/15	9	7	35.0	184.2			Renewable deviation, Resource outage	All locations in PAC East
4/21/15	9	8	38.3	176.7			Renewable deviation, Resource outage	All locations in PAC East
4/21/15	9	9	35.1	165.9			Renewable deviation, Resource outage	All locations in PAC East
4/21/15	9	12	25.7	148.9			Renewable deviation, Resource outage	All locations in PAC East
4/21/15	21	4	6.3	332.0			Load changes, Resource outage	All locations in PAC East
4/21/15	21	5	12.7	294.3			Load changes, Resource outage	All locations in PAC East
4/21/15	21	6	2.0	299.4			Load changes, Resource outage	All locations in PAC East
4/21/15	21	11	9.0	291.6			Resource data alignment	All locations in PAC East
4/24/15	17	2	6.6	161.5			Renewable deviation	All locations in PAC East
4/26/15	18	10			16.7	59.4	Resource data alignment	All locations in PAC West

4/30/15	9	3	21.1	217.4	76.1	115.3	Resource outage	All locations in PAC East and West
4/30/15	9	4			63.3	128.5	Resource outage	All locations in PAC West

ATTACHMENT D:

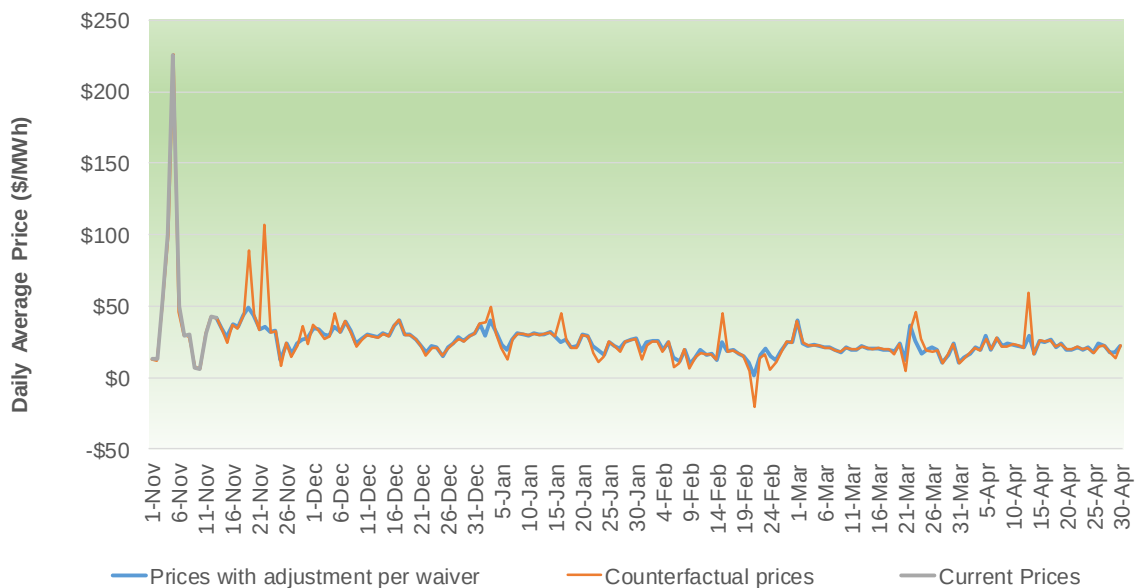
This attachment provides a quantitative and qualitative analysis of the market performance impact of the issues that prompted the CAISO's request for a waiver.

A. Impact of Issues on Market Prices

The figures in this subpart summarize the impact the issues would have had on prices absent the waiver pricing. During the term of the waiver, the CAISO established prices based on the price discovery mechanism and not based on the penalty prices that would have otherwise been in effect. The market does not produce prices as they would have been absent the waiver. Therefore, the CAISO created a counterfactual set of prices it compares to the prices that cleared based on the pricing in effect during the waiver. Because pricing under the waiver pricing is based on the last economic bid price signal, it is a proxy of what the prices would have been absent the seven category of issues. Therefore, the difference between the counterfactual pricing and the price in effect during the term of these reports illustrates the market impact.

The figures in this subpart also summarize the frequency with which the EIM entity failed the flexibility tests during the term of this report and the daily average price trends in the EIM organized by market and area. These trends include pricing for both the PAC West and PAC East external load aggregation points (ELAPs). The report focuses on the ELAP prices because these aggregate prices represent pricing in each area – PAC West and PAC East –, which allows the CAISO to reflect short-term imbalance shortage for the aggregate area. These daily averages reflect all prices of the real-time market, including the price corrected through the price correction process and the price adjustments under the waiver associated with this report.⁶

⁶ Note a separate waiver has been submitted requesting relief for period of November 1-November 13. These reports do not reflect any adjustments for this separate waiver request, which has not yet ruled on as of the date of this report.

Figure 5: Daily average of fifteen-minute market prices in PAC West.⁷

⁷ From November 14 through November 30 the CAISO implemented the price adjustments under the waiver retroactively and is making the adjustments in settlement statements after the December 1 order was issued. After December 1, there are no retroactive adjustments since the logic of the price discovery feature implemented under the waiver is implemented through the market clearing solution process. These prices, like any other prices, are still subject to the price validation and correction process. Section 35.4 of the CAISO tariff already 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 inconsistent with the CAISO tariff.

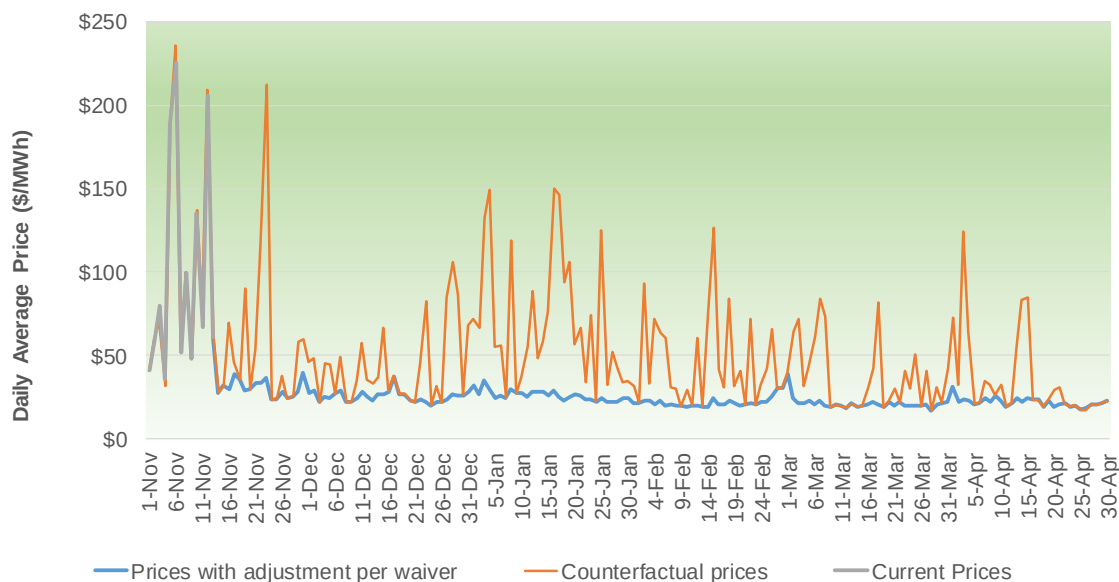
Figure 6: Daily average of fifteen-minute market prices in PAC East.

Figure 5 and Figure 6 each compare two trends for the same market and same area, PAC East and West respectively. The blue line illustrates daily average prices from November 14 on and represents the actual and final prices after any price corrections or price adjustments pursuant to the December 1 Waiver, which is the subject of this report. After November 14, even when there were power supply infeasibilities, per the December 1 Waiver, this trend reflects prices that are set based on the the marginal economic signal in the market and are not based on constraint relaxation pricing parameters. The price trends for November 1 through November 13 are represented in a different color than the the prices after November 14 because those represent the final prices as of this date, after all price corrections have been made. The prices for the November 1-13 include prices based on the constraint relaxation pricing parameters.

The orange line was constructed to estimate the counterfactual case of what prices would have been if they were based on the constraint relaxation pricing parameters, pegged to the \$1000/MWh bid cap. As of December 1, the CAISO adopted the waiver-based pricing in its systems, which means that the market systems produced prices consistent with the pricing mechanism under the waiver and not based on the constraint relaxation pricing parameters. Therefore, the CAISO had to find a way to reconstruct those cases, which it is referred to as the counterfactual case. In other words, the prices represented by the orange line represent the CAISO's estimate of what prices would have been

absent the December 1 Waiver. These two lines compare together prices under the December 1 Waiver to what they would have been without that waiver.

The orange line is more volatile and spiky because those prices are calculated based on the \$1000/MWh any time there is an observed undersupply infeasibility. Whereas the blue line shows a more stable pricing trend reflecting dispatched economic bids. For the first 13 days of November, the lines in grey and orange track closely to each other but not exactly. The prices represented by the grey line are final as of now and include prices that even though there was infeasibility, for other reasons the prices were not based on the constraint relaxation pricing parameters. In the counterfactual case, the CAISO estimated that any interval with infeasibility would produce a price based on the constraint relaxation pricing parameter.

In addition, the prices for the counterfactual case in Figure 5 and Figure 6 were constructed based on the following two factors. First, because the goal of this report is to quantify and explain the price changes associated with the implementation of the December 1 Waiver, these trends do not include the reconstruction of prices related to price corrections and flexible ramping constraint infeasibility because:

- i) Price corrections. If a price was associated with a power balance infeasibility, but the interval was rendered to have an invalid price and was subject to price corrections for other reasons, the CAISO did not estimate the counterfactual price and instead the estimated and counterfactual price is equal to the final and current price. This is based on the premise that had the CAISO not experienced the issue that supported the price correction in the first place, the power balance infeasibility would not have triggered. Therefore, the market price would have been based on the tariff-based rules that consider the submitted economic bid prices rather than the penalty prices specified in the tariff.
- ii) Flexible ramp sufficiency test. As specified in section 29.34(n) of the CAISO tariff and section 10.3.2.1 of the Business Practice Manual for the EIM, 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. For the duration of the restricted interval, the market clearing price in the affected EIM Entity balancing authority area will also be based on the tariff-based rules that look at the last economic bid cleared in the fifteen-minute or five-minute interval in the EIM Entity balancing authority area. This logic is outside waiver of this report and with or without the waiver, the pricing mechanism will be in place. Therefore,

the original price for market intervals that had power balance infeasibilities and that failed the flexible ramp test would have remained unchanged absent the waiver as they will not be set by relaxation parameter prices under Section 10.3.2.1 of the BPM for the EIM.

- iii) Load Bias Limiter. The data shown in this report do not include intervals in which the CAISO has determined that the load-bias limiter functionality would have eliminated the infeasibility. The load bias limiter functionality does not serve the same purpose as the waiver pricing. As fully described in this proceeding, the waiver pricing applies in all instances to ensure learning curve type issues do not trigger parameter pricing.

The load-bias limiter is a feature in the CAISO markets that works independent of the waiver to ensure that an operator's adjustment of the load forecast is consistent with the system conditions. The feature essentially ensures a bias that exceeds the capabilities of the system does not create an infeasibility. The balancing authority operators can adjust the load forecast to ensure the load forecast reflects system need. The CAISO creates a forecast for the EIM balancing authority area as it does for the CAISO balancing authority area. However, the operator adjustments to load forecasts tend to be coarse adjustments, in increments of 10 to 50 MW. Also, the operator cannot know at that time exactly what the system ramp is and in making the adjustment, it could exceed the system's ability to respond. For example, an adjustment of 50-100 MW could exhaust 5-minute ramping capability. Such coarse adjustments, if more than necessary, can produce unnecessarily infeasible market solutions. To prevent such over-adjustment, the CAISO employs a load bias limiter in the CAISO balancing authority area, which automatically limits the course operator adjustment to the market systems to what is feasible as long as the quantify of the infeasibility is less than the operator adjustment and is in the same direction as the operator adjustment.

The CAISO employs the load bias limiter feature through the scheduling and pricing run as follows. If the scheduling run MW quantity of the infeasibility is less than or equal to the load bias, in the pricing run the infeasibility will be removed and will not trigger the pricing. This feature does not take effect if the MW quantity of the infeasibility exceeds the load bias or if the infeasibility is in the opposite direction of the load bias. This feature as applied in the CAISO area has avoided the artificial constraints that may arise from coarse adjustments. It is appropriate to apply the load-bias limiter regardless of the waiver because this is a feature that prevents an infeasibility that

would occur only because of the course adjustment exceeds the capabilities of the system and, and not because it is actually needed. The CAISO's development of this feature pre-dated the implementation of the EIM and is unrelated to the EIM issues that led to the waiver request. The CAISO did not deploy this feature as part of the EIM. However, after implementation and through analysis of infeasibilities and discussions with DMM, the ISO found that certain infeasibilities were caused by biases to load forecast by operators that were not consistent with the system capabilities at the time. In previous reports the ISO reported such instances under the classification of Load Adjustment. Through discussions with DMM, the CAISO pursued to adopt the load bias limiter feature for the EIM as well to prevent the system from observing infeasibilities due to biases that exceed system requirements. This feature was made available to the EIM area starting on March 20, 2015. However, during the term of the waiver, because the waiver pricing procedure does not allow the CAISO to set the price based on the tariff-based parameter when there infeasibility whether or not there is a load bias in a given interval, the load bias limiter is superseded by the waiver based pricing and is not active in the EIM balancing authority area. Once the waiver terminates, the load bias limiter will be active in the EIM as it is in the CAISO balancing authority area.

An important feature of the load bias limiter is that it only prevents the infeasibility in the interval in which there is a bias. If there is no bias the feature does not kick in. Another important aspect of the feature is that eventually, the load forecast itself will catch up to reflect actual load. Therefore, if the load bias was consistent with actual load, the load forecast increases to reflect actual load, and the operator no longer biases the load forecast, the load bias limiter will not trigger. If in such intervals, the power balance constraint is relaxed, absent the waiver pricing rules currently in effect, the CAISO will use the tariff-based parameters to establish prices.

Because but for the waiver the load bias limiter would be effective starting on March 20, in its March report and in this April report, the CAISO did not include in the data reported in Attachment A those intervals in which the load bias limiter would have prevented the infeasibility. These reports target infeasibilities related to learning issues that led to the CAISO's request for the waiver. However, the frequency of these infeasibilities is explicitly provided in Attachment E together with the overall classification of infeasibilities.

Finally, the CAISO is exploring enhancements to the load bias limiter feature for both the CAISO and EIM balancing authority areas, including the recommendation by the Department of Market Monitoring

to better reflect the impact of excessive load bias adjustments on creating power balance shortages. Specifically, DMM recommended that the CAISO consider that the adjustment made by the load limit biaser be based on the *change* in load bias from one interval to the next instead of the *absolute value* of any positive load bias.⁸

Under the current approach, the CAISO may be missing correction of infeasibilities due to sudden changes in biases. For example, the operator may first bias the load forecast down to 500 and then in the next interval down to 300 MW. The reduction to 300MW will not trigger the load bias limiter if the infeasibility is in the positive direction given that the bias was in the opposite direction. However, the sudden change bias causes an infeasibility itself. The CAISO is considering enhancements to ensure that such sudden changes in biases that cause infeasibilities are captured by the feature as well.

The current approach may also result in unnecessary triggering of the load bias limiter in intervals that have a persistent bias that is not really intended. For example, as discussed above operators make coarse biases to the load forecast and sometimes set the bias for a number of intervals and then inadvertently do not remove the bias even when it is no longer necessary. The CAISO is considering enhancements to reduce such persistent bias because they may trigger the load limit biaser unnecessarily.

Second, the prices reflecting the tariff-based relaxation parameters were reconstructed for both under-supply and over-supply infeasibilities. This means that when an instance of undersupply was reconstructed, the price was set to the bid cap plus/minus marginal loss component. Similarly, when an oversupply instance was reconstructed, the prices in the counterfactual case were set to the bid floor relaxation parameter plus/minus marginal loss prices.

During the term of these reports, in some intervals the market clearing process experienced “degenerate cases” during which the market may clear at multiple pricing run solutions equally valid from an economic perspective. The CAISO has recently stakeholdered and the CAISO board of governors has approved a solution to this phenomena and intends to file a tariff amendment to implement this change. These upcoming market rule changes eliminate the multiplicity of pricing issue and produce one price that reflects the lack of congestion at the locations. During such cases, even had the market systems observed an infeasibility that would have led to the relaxation of a constraint and triggered the penalty pricing parameters, the pricing run could have landed at a price based on the marginal resource economic bid price, which could differ from

⁸ See DMM Report, p. 13 (May 7, 2015).

the price had it been based on the \$1000/MWh parameter. The CAISO observed many intervals in which this phenomena occurred, in particular in the five minute real-time dispatch. The CAISO does not correct and believes these to be optimal from the perspective of the energy market alone. But because of issues this may cause in associated markets such as the congestion revenue rights, the CAISO will modify its market rules prospectively to eliminate such occurrences.⁹

The counterfactual case represented by the orange line cannot account for the degeneracy and represents what prices would have been for those intervals based on the tariff-based constraint relaxation pricing parameters because there was an infeasibility. This has implications regarding the trends in the figures below. For the first 13 days in November, the CAISO has not yet modified posted prices based on the waiver-type pricing. The CAISO filed for an additional waiver to conduct this pricing adjustment and it is pending before the Commission in FERC Docket No. ER15-817. Without the waiver, the prices as posted would remain as they are. One would expect the counterfactual case represented by the orange line to be close to the posted prices represented by the blue line. This is the case for the fifteen-minute markets. However, for the real-time dispatch, the lines diverge because in several intervals posted prices appear to have not been determined based on the \$1000/MWh parameter even if there was infeasibility. The CAISO believes this was because many of the affected intervals were subject to degeneracy. After November 13, however, whether or not there would have been degeneracy in the pricing run, is immaterial, because pricing under the December 1 waiver or degeneracy is based on the last economic bid price signal.

⁹ Additional information regarding the stakeholder process and the resulting policy changes is available at: <http://www.caiso.com/informed/Pages/StakeholderProcesses/PricingEnhancements.aspx>. This will be the subject of an upcoming tariff amendment with the Commission.

Figure 7: Daily average of five-minute market prices in PAC West.

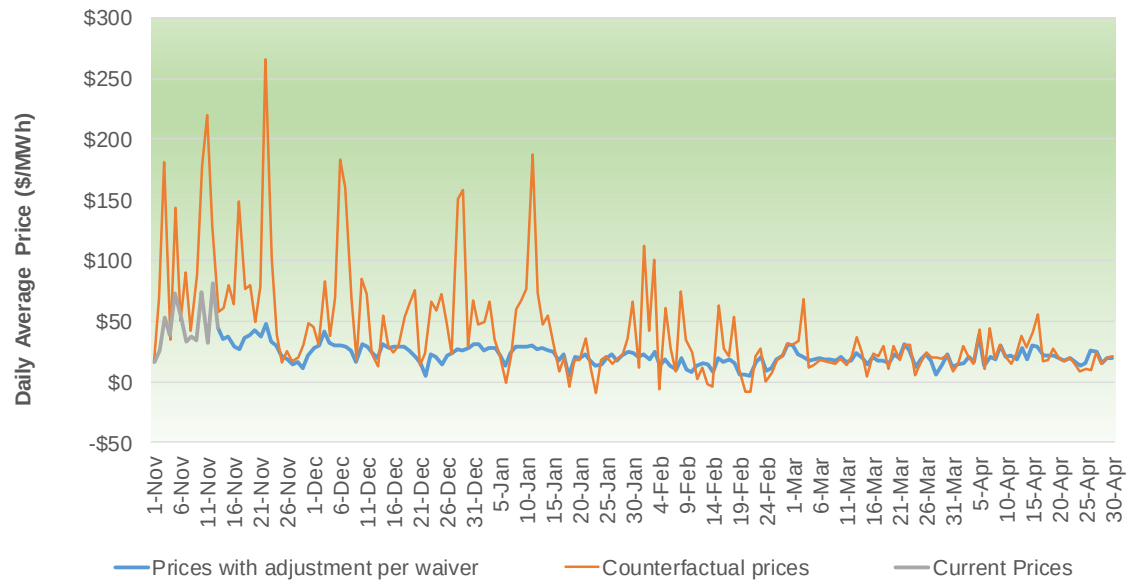
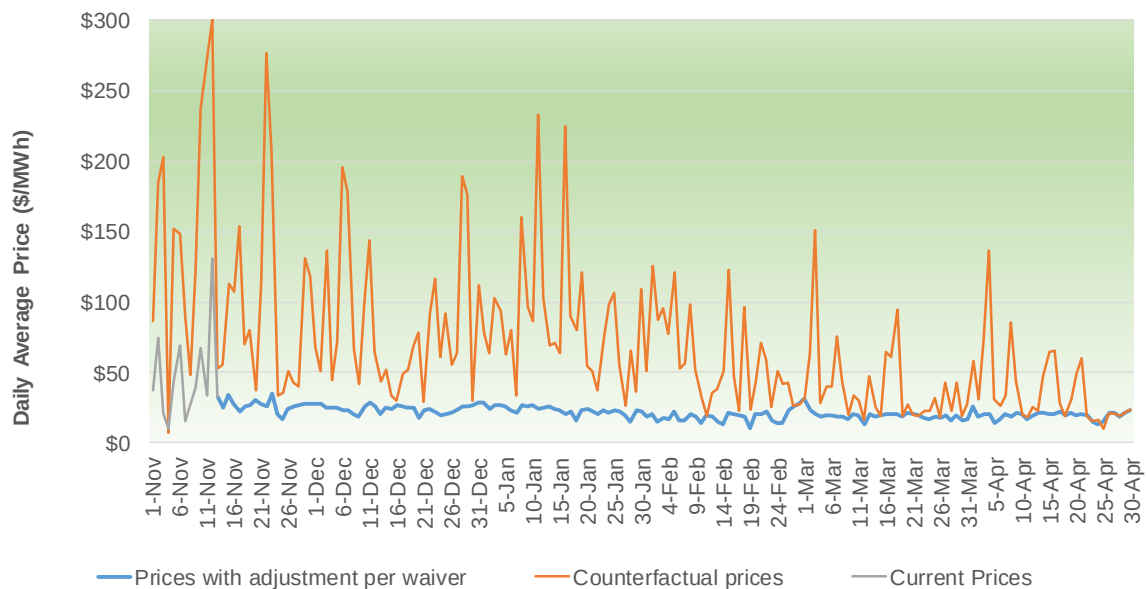


Figure 8: Daily average of five-minute market prices in PAC East.

Overall, PAC East is more volatile and subject to more frequent price excursions than PAC West. This may be due to limited transfers into the PAC East area. PAC West does not share such limitations which enable more transfers in and out of the CAISO balancing authority areas to PAC West.

In both PAC East and PAC West, the five-minute real-time dispatch is notably more volatile than the fifteen-minute market. This is because the fifteen-minute market embodies more flexibility as it is further in time than the intervals whereas the five-minute real-time dispatch is closer to real-time. In the five-minute dispatch, ramping capability is more limited. Figure 9 and Figure 10 provide monthly averages of the prices as modified under the December 1 Waiver and are final as of now. These include price corrections and price adjustments under waiver of this report. These figures show that the average price for energy in both the PAC East and West have increased slightly in April 2015, around \$21.8/MWh in the fifteen-minute market and around \$20/MWh in the five-minute market.

Figure 9: Monthly average of fifteen-minute market prices in PAC West and East.

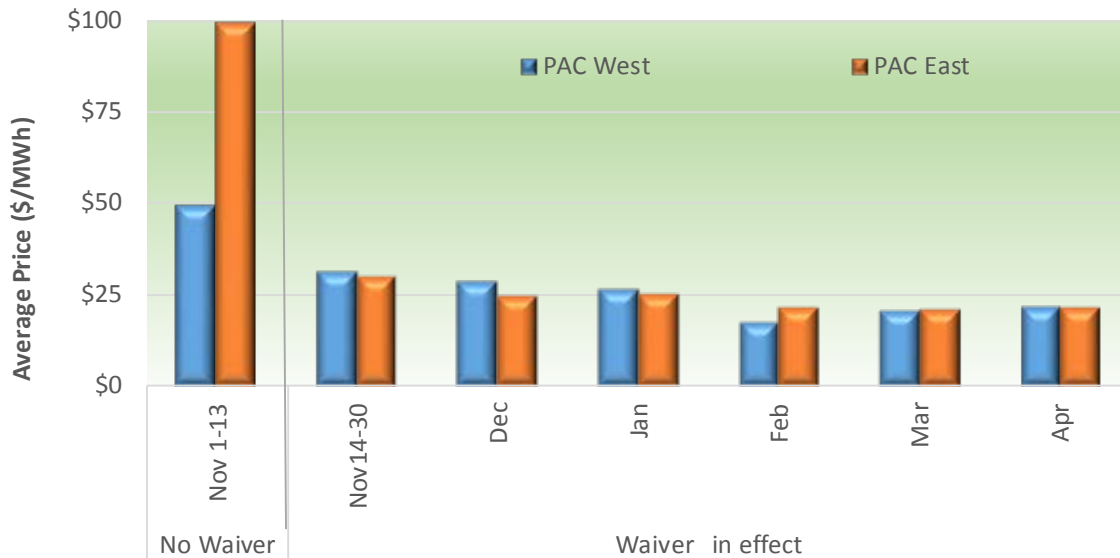
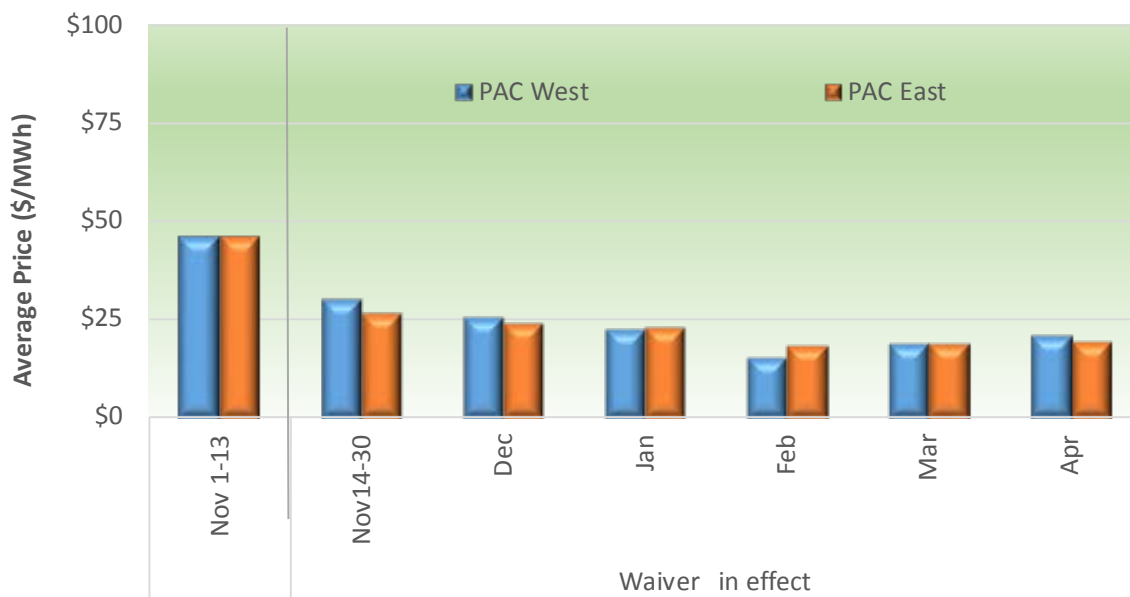


Figure 10: Monthly average of five-minute market prices in PAC West and East.

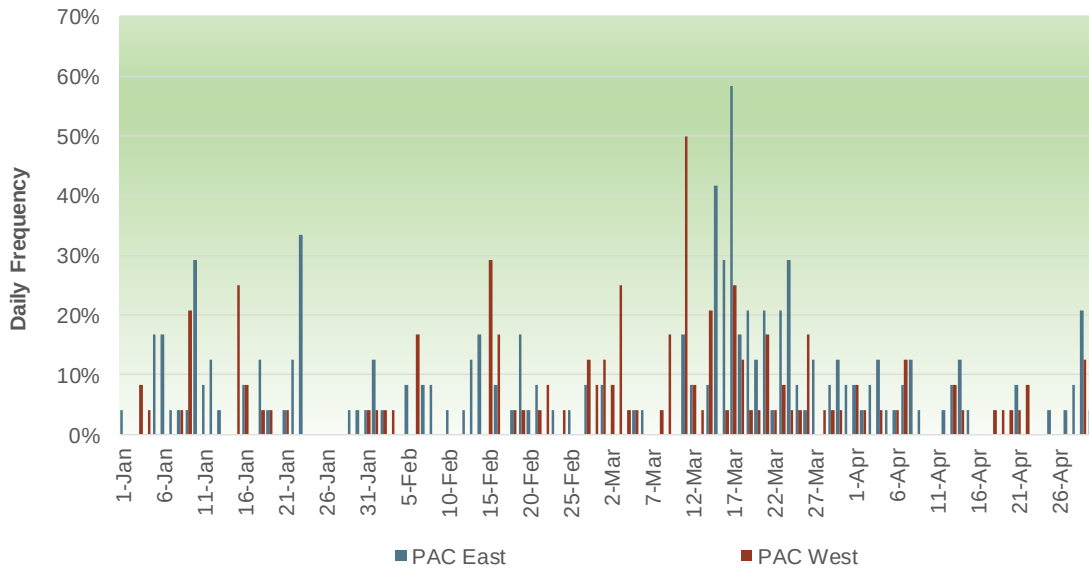


B. Balance Test Failures

Figure 11 shows the trend of balancing test failures for the period of January 1, 2015, through April 30, 2015, of operation of the EIM by area, PAC West and East. The frequency of balancing test failures decreased to a daily

average of 3.9 percent in the month of April. The average imbalance was 98 MW and 34 MW in PAC East and West, respectively. The increase in frequency of balancing test failure appears to be driven by two issues: 1) an error in the net schedule interchange for both PACE and PACW reported for the balancing test compared to the net schedule interchange supplied for the fifteen- and five-minute markets; and 2) incorrect disqualification of base schedules from certain multi-stage generating units. These issues did not appear to influence imbalance infeasibilities.

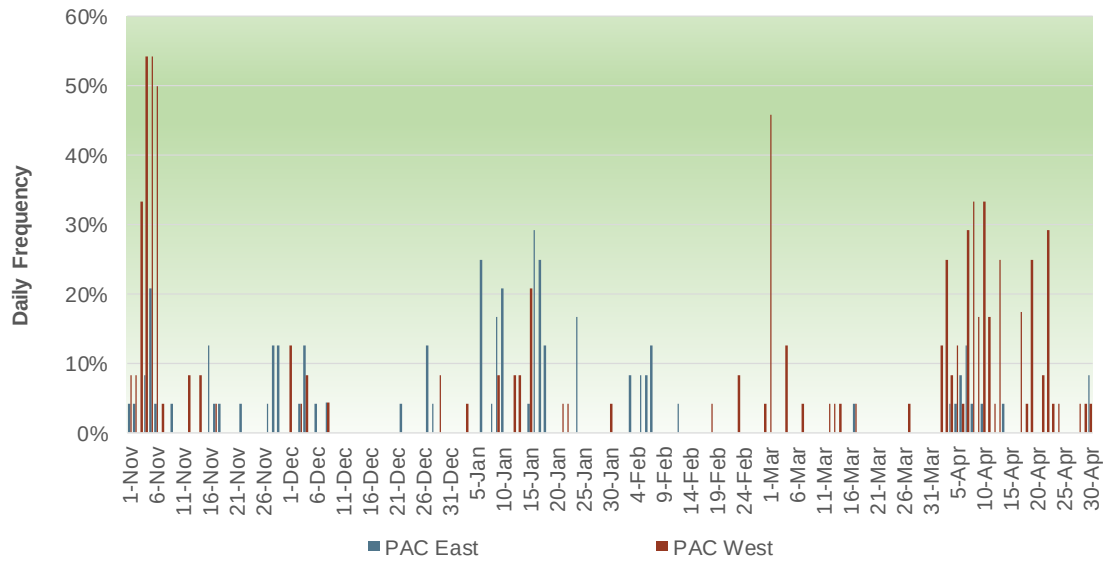
Figure 11: Frequency of balancing test failures in PAC West and East.



As specified in section 29.34(n) of the CAISO tariff and section 10.3.2.1 of the Business Practice Manual for the EIM, 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. 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 those balancing authority area-to-area group constraints. This sufficiency test applies to each PAC West and East area on an hourly basis. Figure 12 shows the trend of test failures for flexible ramping for the first two months of operation of the energy imbalance market. The CAISO obtained the frequency by dividing the number of hours failed by 24 hours of a day.¹⁰

¹⁰ During the term of the waiver, the procedure described in Section 10.3.2.1 of the Business Practice Manual is made ineffective under the pricing procedure under the waiver.

Figure 12: Frequency of flexible ramp sufficiency test failures in PAC West and East.



ATTACHMENT E

In addition to the CAISO reporting on each relaxation event in Attachment B, this Attachment E provides a summary of the magnitude and frequency of such events overall.¹¹

The relaxation events affect numerous market intervals as the CAISO real-time markets contain many fifteen- and five-minute intervals. The CAISO provides the information at summary level because the data is significant and detailed reporting of such events would not be meaningful. The report focuses on the external load aggregation points (ELAP) prices because these aggregate prices represent pricing in each area – West and East – and therefore, reflect short-term imbalance shortage for the aggregate area.

Figure 13 through Figure 23 provide summary information on the instances of power balance relaxation for undersupply (shortage) in the fifteen- and five-minute market in the PAC West and East area. Normally, when there are such infeasibilities, prices will be based on the constraint relaxation pricing parameter, and prices will be near or at \$1000/MWh. However, there are three cases where this would not occur and this is reflected in the data supporting the figures in this report. First, as of December 1st consistent with the December 1 tariff waiver, the price is based on the last economic signal consistent with the pricing principles in the tariff. Second, as described in more detail in Attachment A, when the EIM Entity fails the flexible ramping sufficiency test, prices are calculated using the same approach based on the last economic signal for the duration of the restricted interval. Therefore, in these intervals, even if the CAISO had not received the waiver, the CAISO would have implemented the procedure described in Section 10.3.2.1 of the Business Practice Manual, and price based the last economic bid cleared in the fifteen-minute or five-minute interval in the EIM Entity balancing authority area as opposed to the \$1000/MWh bid cap.¹²

In the December 15, 2014 report, the CAISO noted there was a third case in which it had observed the power balance constraint was relaxed in the scheduling run, but prices did not reflect the \$1000/MWh. The CAISO has since evaluated these cases more closely and as discussed in Attachment A, sometimes the market is in a degeneracy case, and the market clears based on the last economic signal. The CAISO is continuing to investigate these intervals

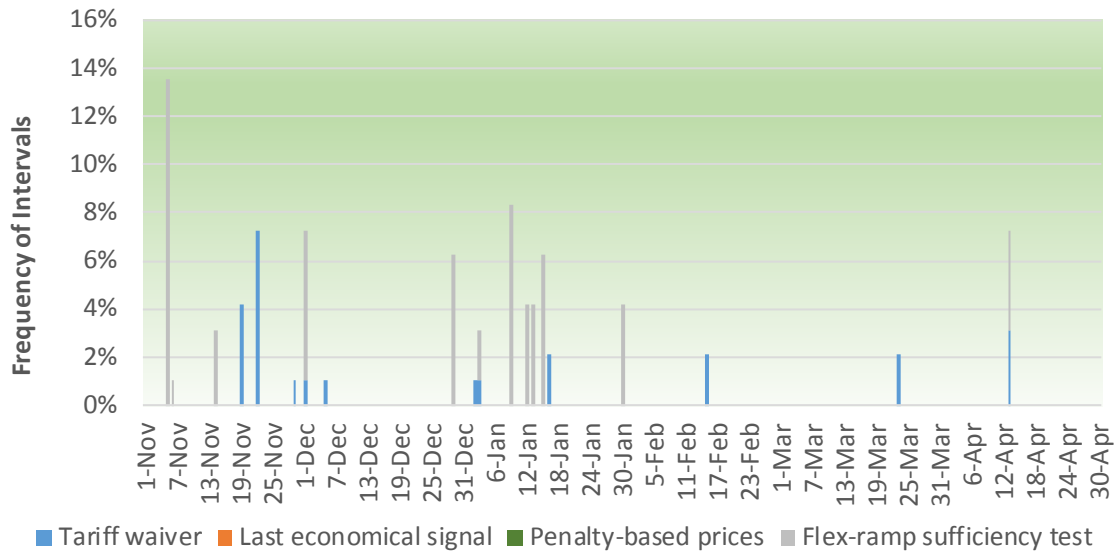
¹¹ *December 1 Order*, at P 26.

¹² The price discovery mechanism under the procedure described in Section 10.3.2.1 of the BPM for Energy Imbalance Market is, however, essentially the same price discovery procedure used under the December 1 Order waiver.

to ensure these events are not due to other abnormalities and are due to degeneracy. As explained in Attachment A, after implementing the pricing procedure under the December 1 waiver there is no pricing based on the degeneracy cases because the pricing procedure under the December 1 waiver governs over the pricing.

Figure 13 through Figure 20 exclude the intervals invalid. These figures show the frequency of infeasibilities organized by instances in which the prices were set based on 1) the last economic bid price signal as per the tariff waiver, referred to in the figures as “Tariff waiver,” 2) the \$1000/MWh penalty price parameter, referred to in the figures as “Penalty-based prices” 3) last economical signal from degeneracy referred as “Last economical signal” and 4) the last economic signal but because for those intervals the EIM entity failed the flexible ramping sufficient test, referred to as the “Flex-ramp sufficient test.” Each figure of the frequency of infeasibilities is accompanied with a figure the magnitude of infeasibilities. The reported events are also aggregated daily and depicted with an infeasibility range shown by the vertical line in blue. The ends of the vertical blue lines represent the minimum and maximum values of power balance relaxation in each day. The average magnitude of the infeasibility is shown by the red marker on the blue vertical lines.

Figure 13: Frequency of under-supply infeasibility in PAC West. Fifteen-minute market.



For the period of November 1 through November 13, the data on the magnitude of infeasibility in the fifteen-minute market was not preserved in the data system. This impedes the CAISO's ability to identify the cases with infeasibility and quantify their magnitude. However, such instances were conservatively estimated by analyzing the cases where prices reached the relaxation-based levels of \$1000/MWh.

Figure 14: Magnitude of undersupply infeasibility in PAC West. Fifteen-minute market.

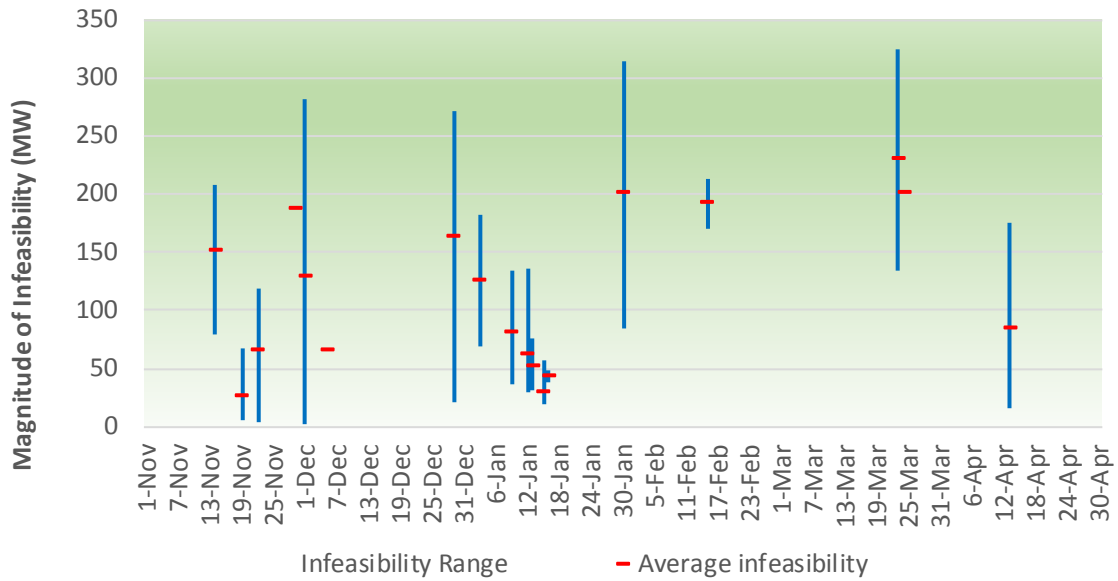


Figure 15: Frequency of undersupply infeasibility PAC East. Fifteen-minute market.

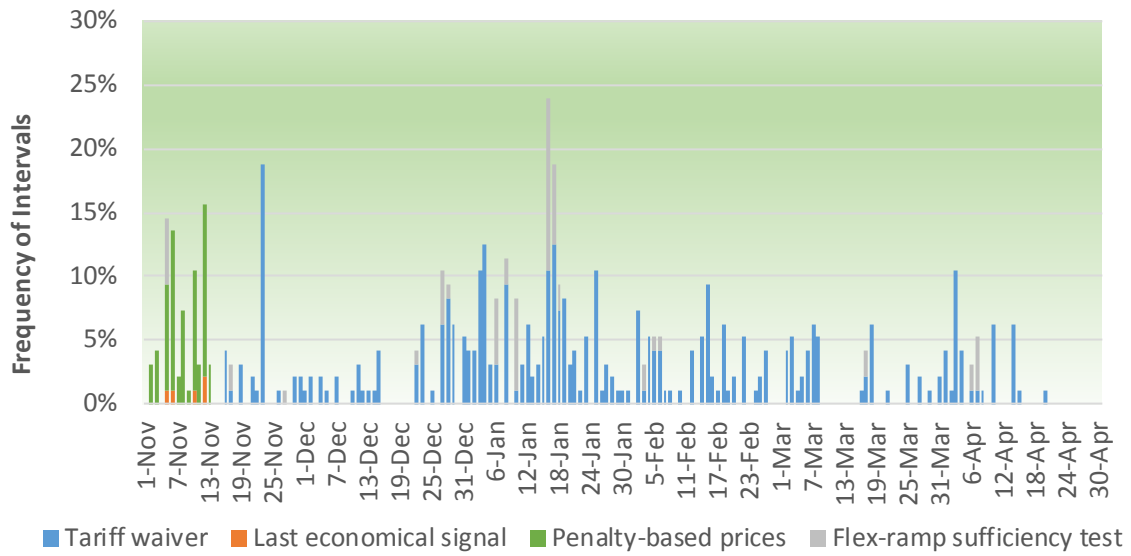


Figure 16: Magnitude of undersupply infeasibility PAC East. Fifteen-minute market.

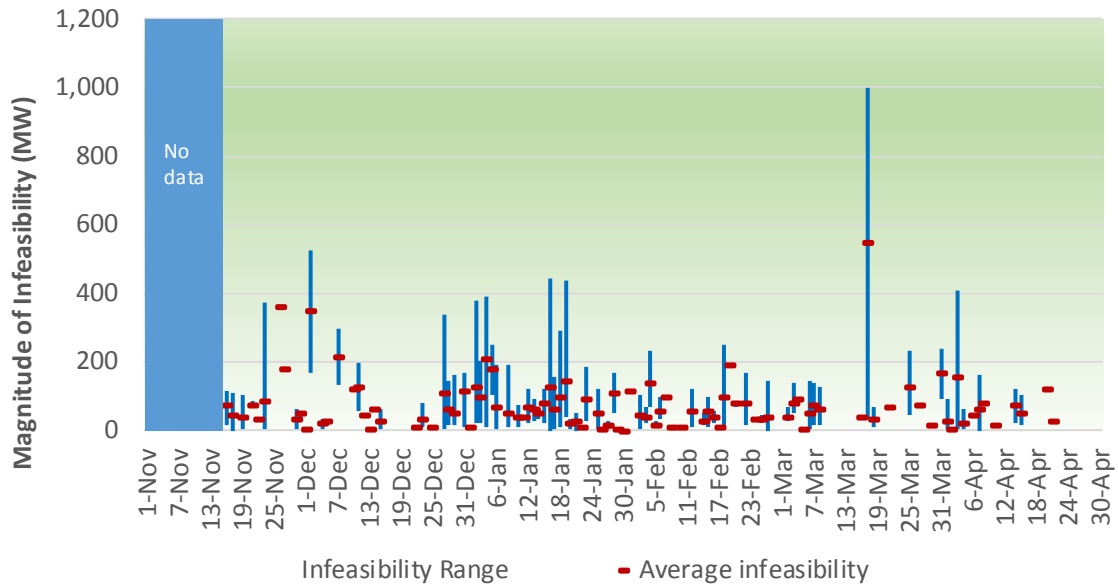


Figure 17: Frequency of undersupply infeasibility PAC West. Five-minute market.

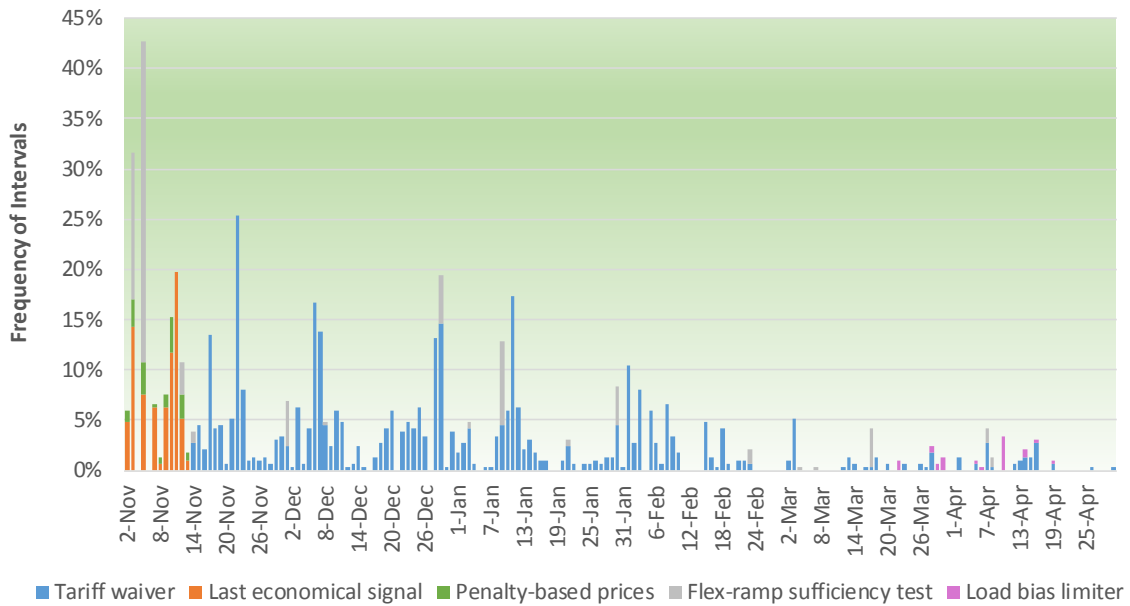


Figure 18: Magnitude of undersupply infeasibility PAC West. Five-minute market.

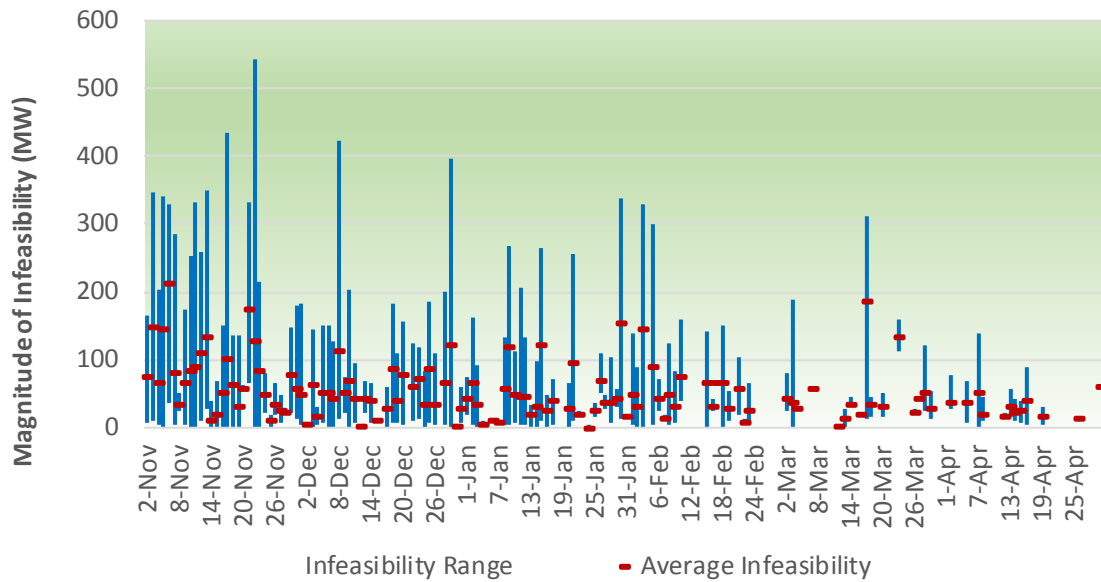


Figure 19: Frequency of undersupply infeasibility PAC East. Five-minute market.

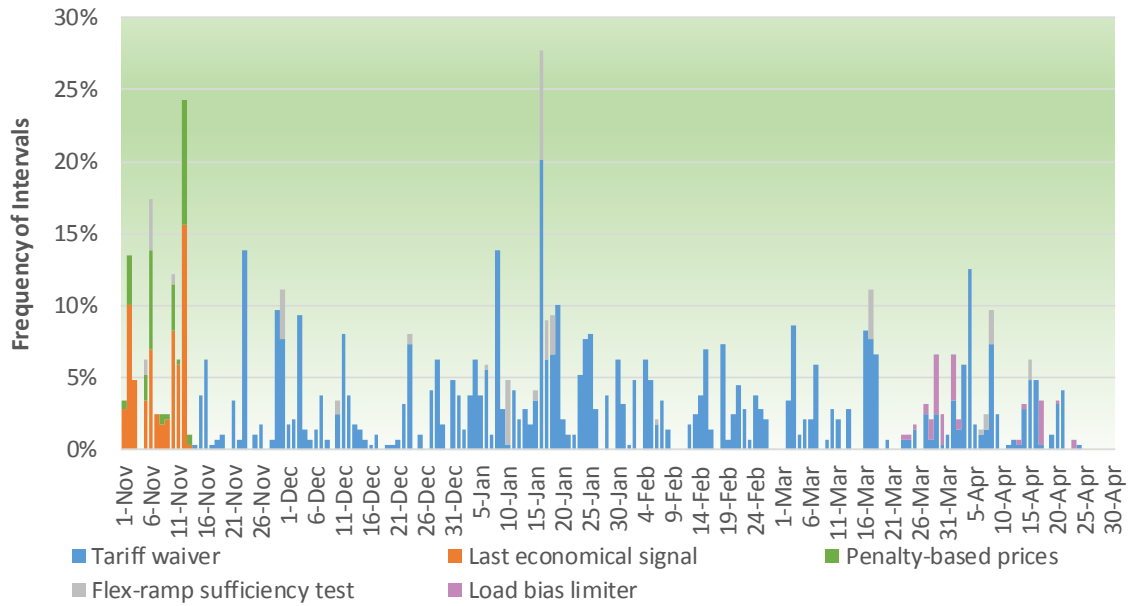
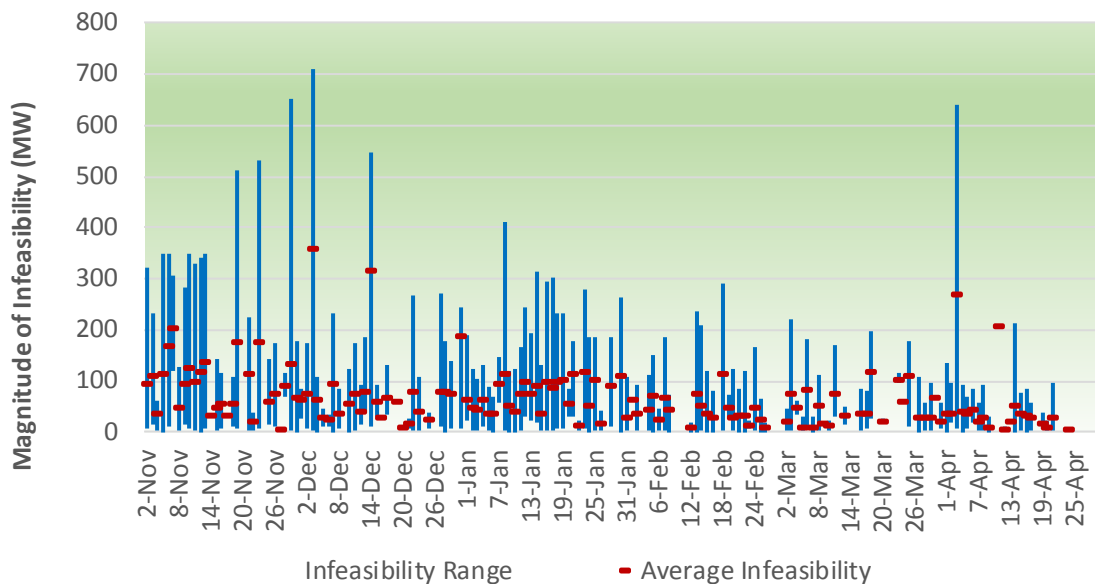


Figure 20: Magnitude of undersupply infeasibility PAC East. Five-minute market.

The imbalance energy transfers may also be subject to relaxation to address infeasibilities. There were few instances only in the PAC East transfer that resulted in relaxation and there were no instances of relaxation of EIM transfers between PAC and CAISO. The summary of these instances are listed in Table 1.

Table 2. All these instances occurred before the period applicable for the waiver associated with this report; there were no valid EIM transfer infeasibilities observed in January and February. Three invalid infeasibilities were on PAC East on January 15 due to a software issue addressed through the standard process of price corrections.

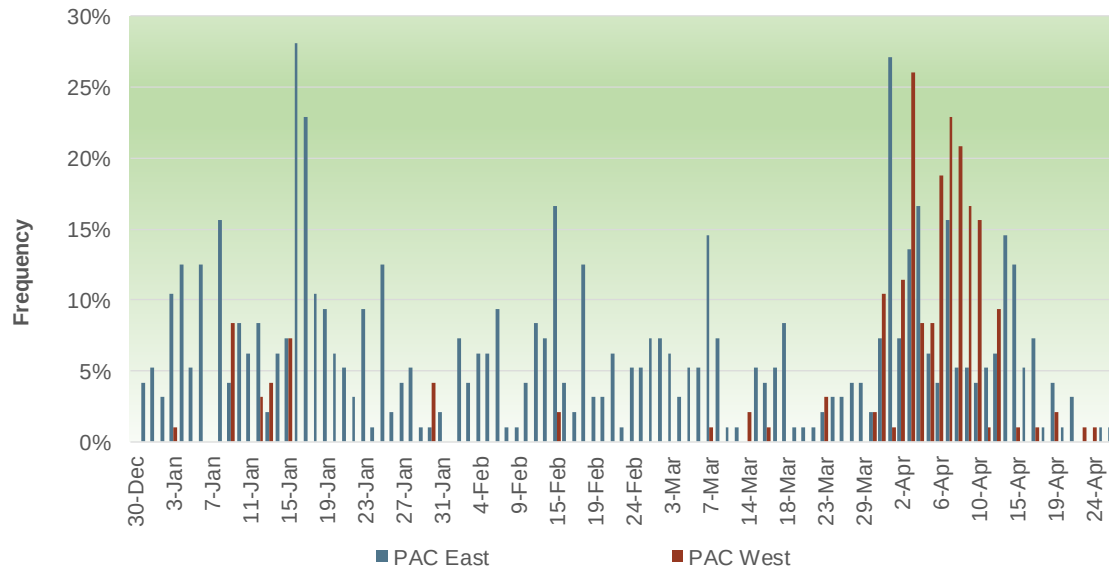
Table 1: Statistics of EIM transfer infeasibilities for PAC East. Fifteen-minute market.

Date	Maximum	Minimum	Average	Count
6-Nov-14	51.4	1.1	26.2	2
10-Nov-14	121.0	121.0	121.0	1
12-Nov-14	126.7	72.0	99.3	2
13-Nov-14	130.9	16.9	76.2	3

**Table 2: Statistics of EIM transfer infeasibilities for PAC East.
Five-minute market.**

Date	Maximum	Minimum	Average	Count
6-Nov-14	65.2	65.2	65.2	1
10-Nov-14	114.3	97.9	106.1	2

For completeness, the data in this report also includes those cases in which there was a relaxation of flexible ramp constraint; the data is organized by PAC West and East in Figure 28. This metric does not include intervals subject to price corrections.

Figure 21: Frequency of flexible ramp constraint infeasibility in PAC

Finally, this report also includes information about infeasibility for over supply conditions even though these cases are not reflected in the waiver requested in this proceeding. The penalty prices specified in sections 27.4.3.2 and 27.4.3.4 only pertain to infeasibility cases in which there is under-supply. The penalty prices for the over-supply conditions are specified in section 6.6.5 of the BPM for Market Operations. Figure 22 through Figure 29 provide the over-supply metrics.

Figure 22: Frequency of oversupply infeasibility PAC West. Fifteen-minute market.

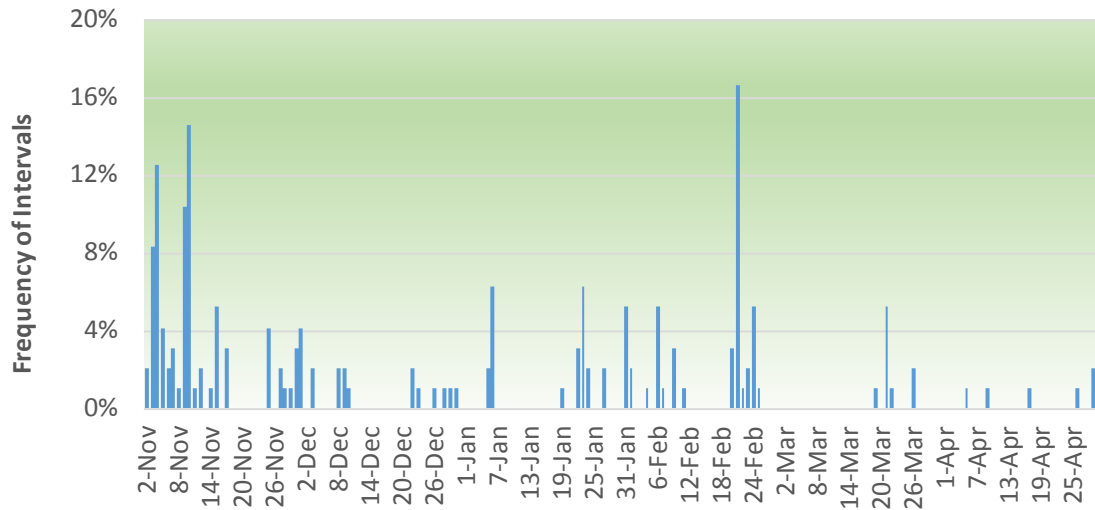


Figure 23: Magnitude of oversupply infeasibility PAC West. Fifteen-minute market.

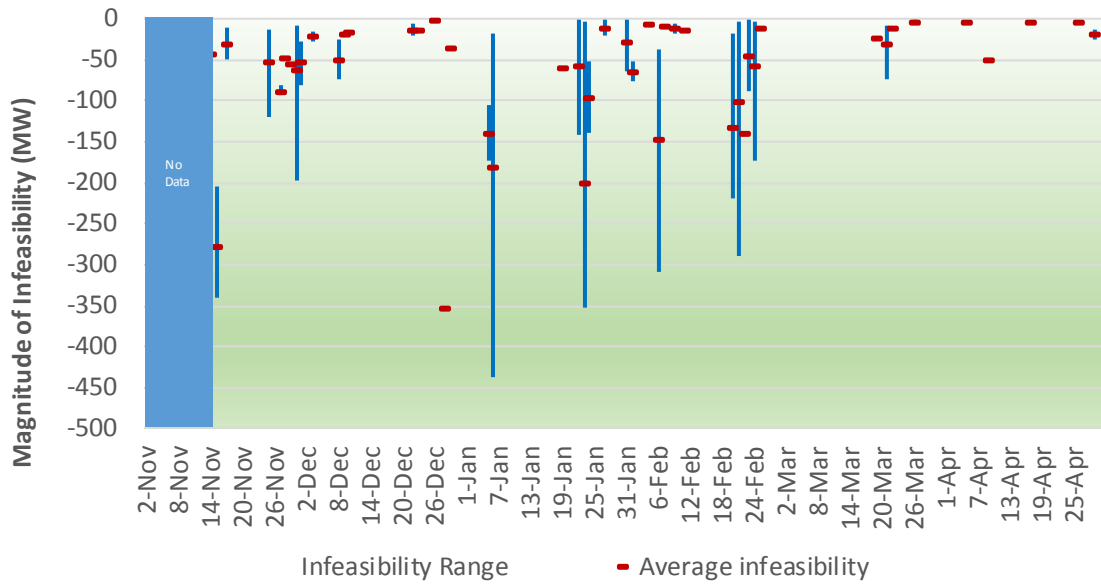


Figure 24: Frequency of oversupply infeasibility PAC East. Fifteen-minute market.

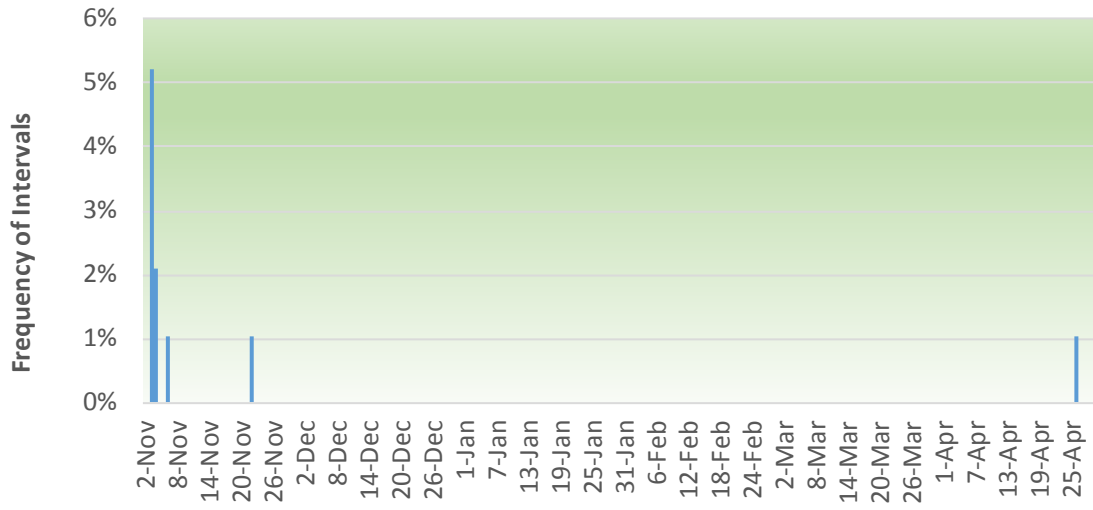


Figure 25: Magnitude of oversupply infeasibility PAC East. Fifteen-minute market.

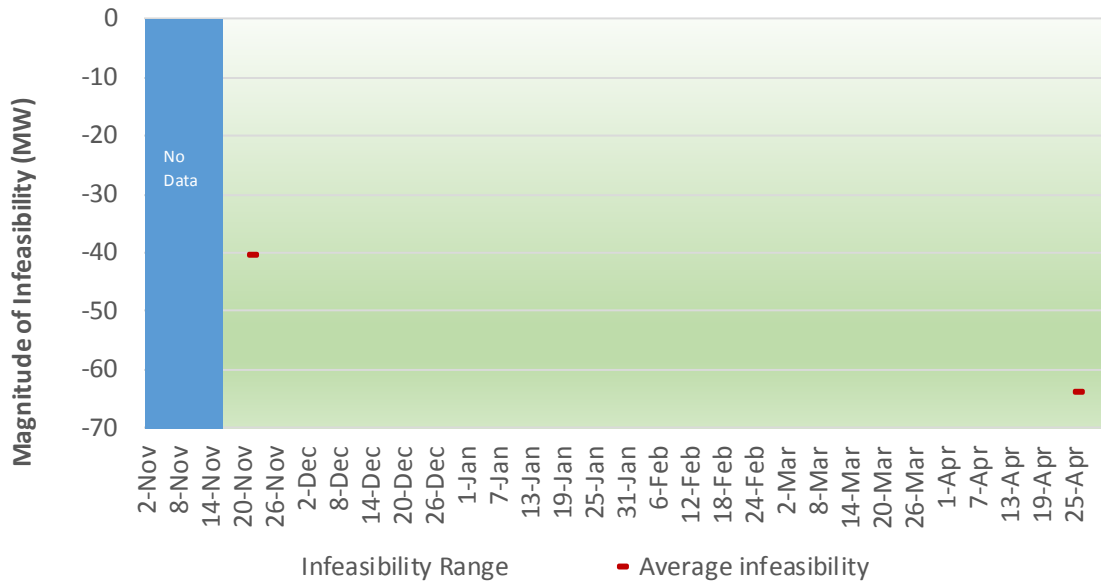


Figure 26: Frequency of oversupply infeasibility PAC West. Five-minute market.

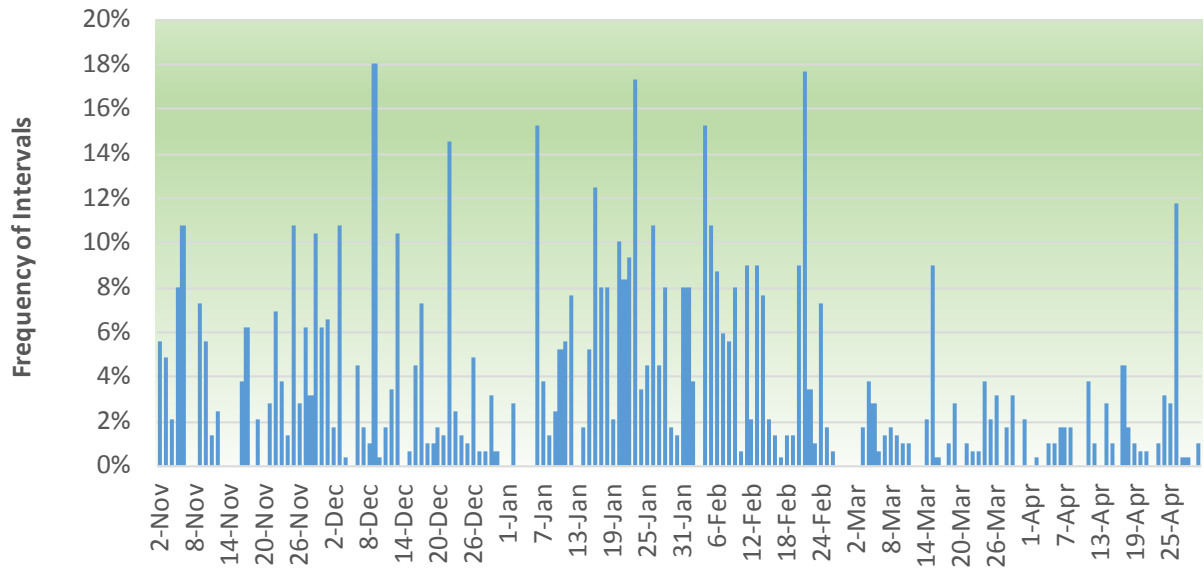


Figure 27: Magnitude of oversupply infeasibility PAC West. Five-minute market.

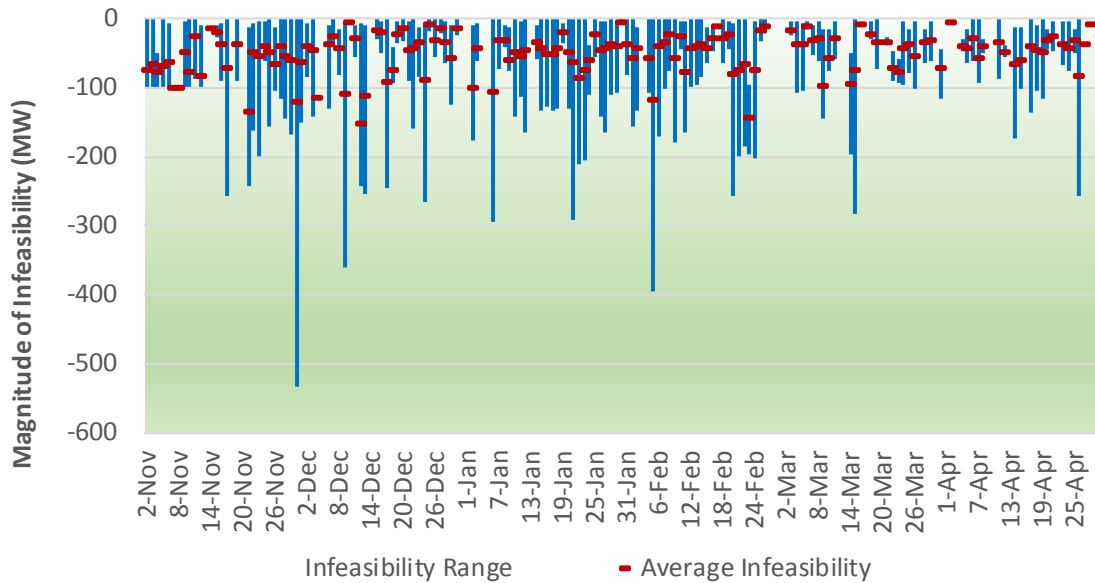


Figure 28: Frequency of oversupply infeasibility PAC East. Five-minute market.

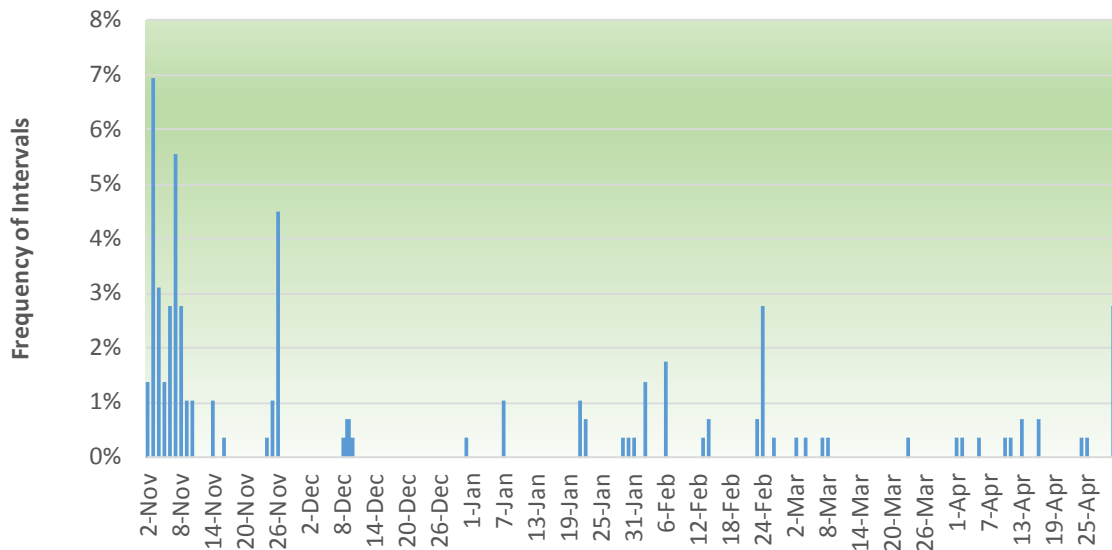
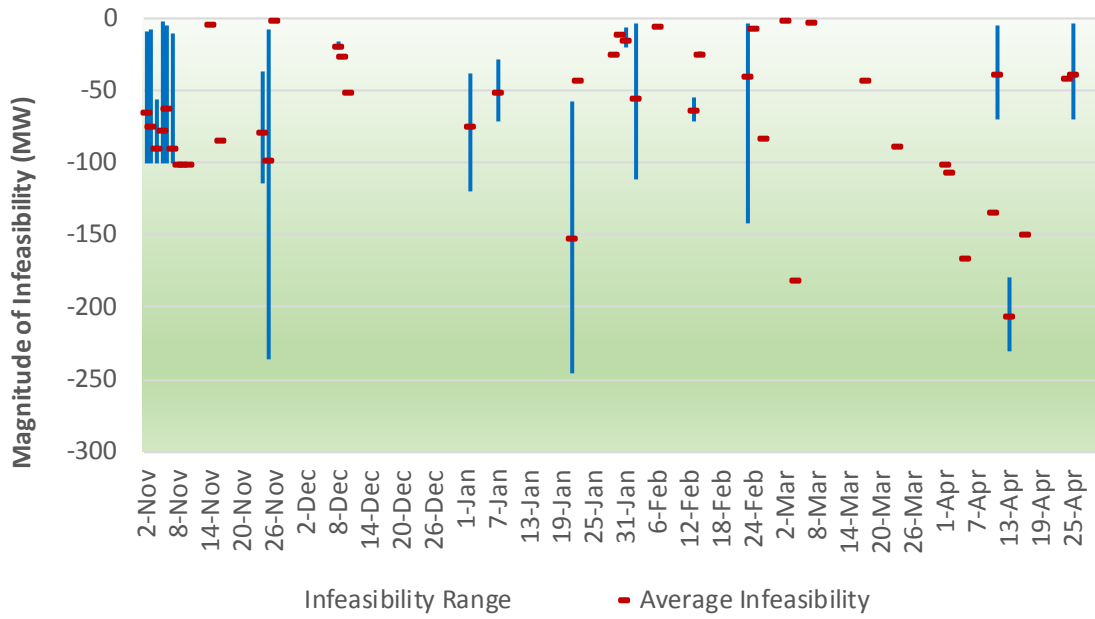


Figure 29: Magnitude of oversupply infeasibility PAC East. Five-minute market.



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 3rd day of June, 2015.

/s/ Jennifer Rotz
Jennifer Rotz

July 14, 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____
May 2015 Informational Report
Energy Imbalance Market - Price Waiver Report**

Dear Secretary Bose:

The California Independent System Operator Corporation (CAISO) hereby submits its report on the performance of the Energy Imbalance Market for May 1 – May 31, 2015.¹

The Commission also directed the Department of Market Monitoring to submit independent assessments on the causes and solutions identified by CAISO. The CAISO intends to submit the independent assessment of the Department of Market Monitoring in about eight days.

The CAISO will continue filing such reports consistent with the Commission's order to continue submitting reports on a 30 day interval until the 206 investigation is concluded or the Commission issues a directive, whichever is earlier.

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

Please contact the undersigned with any questions.

Respectfully submitted

By: /s/ Anna A. McKenna

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Anna A. McKenna
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California ISO

**Energy Imbalance Market
Pricing Waiver Report
May 1 – May 31, 2015**

July 14, 2015

I. Introduction and Background

On December 1, 2014, the Federal Energy Regulatory Commission (FERC) granted the California Independent System Operator Corporation's (CAISO) petition for limited waiver of the pricing parameters in sections 27.4.3.2 and 27.4.3.4 of its tariff for 90 days, as they pertain to the Energy Imbalance Market (EIM), effective November 14, 2014, as requested.¹ In addition, FERC directed CAISO to submit informational reports as further described. The CAISO will submit monthly the requested reports in Attachments A through E. This report covers the CAISO's reporting requirements for May 1 through May 31, 2015.

The Commission also directed the Department of Market Monitoring (DMM) to submit independent assessments on the causes and solutions identified by CAISO. The DMM requires some additional days to fully review and evaluate the CAISO's report and provide an independent assessment. The DMM will file its report within approximately eight days of the CAISO having filed this report.

On November 1, 2014, the CAISO fully activated the EIM. The EIM allows balancing authorities outside of the CAISO balancing authority area to participate voluntarily in the imbalance energy portion of the CAISO locational marginal price-based real-time market. PacifiCorp, the CAISO, and market participants participated in market simulations prior to the start of the EIM on November 1, including parallel production from October 1 to November 1. However, shortly after go live the CAISO observed challenges that led to artificially high prices where the market application had to relax transmission constraints or the power balance constraint to clear the market.

On November 13, 2014, the CAISO sought a 90-day waiver of the applicability of section 27.4.3.2 and the second sentence of section 27.4.3.4 of its tariff to permit CAISO to address, without suspending the EIM, those circumstances which produced atypically high prices. Those two sections of the tariff require that when there is a lack of economic bids, considering resource ramping and other constraints, to clear the fifteen-minute and five-minute markets, the CAISO's market will price the shortages (and therefore establish locational marginal prices) based on the pricing parameters specified in those sections. The pricing parameter is \$1,000/MWh (the maximum energy bid price specified in tariff section 39.6.1.1).

¹ *California Indep. Sys. Operator Corp.*, 149 FERC ¶ 61,194 (2014) (December 1 Order).

The waiver addresses three sets of transitional conditions in the EIM that together have caused the transmission and system energy-balance constraints described in tariff sections 27.4.3.2 and 27.4.3.4 to bind more frequently than expected in the weeks since the EIM began operation on November 1, causing prices in these intervals to be set by the \$1,000/MWh relaxation parameter. Because of these transitional conditions, the high prices are not always indicative of actual physical conditions on the system, and reflect challenges in providing timely and complete data to ensure system visibility under the new procedures, exacerbated by limitations on the resources available to PacifiCorp for the EIM and several forced outages of large EIM participating resources.

On December 1, 2014, FERC granted the CAISO its waiver request and directed monthly reports to FERC on the progress of the issues that led to the need for the waiver. On February 12, 2015, the Commission extended the term of this waiver to March 16, 2015, in its order issued in FERC Docket ER15-861.²

On March 16, 2015, the Commission again extended the waiver to 90 days after the date on which the Commission's order issued on March 16, 2015, in FERC Docket No. ER15-861 is registered in the Federal Register (June 22, 2015).³ In the March 16 order, the Commission also directed the CAISO to refine the monthly reports to "assist the Commission and the parties in determining the extent to which the price spikes continue to be caused by transitional issues, and the extent to which they may be triggered by lack of adequate supply in the EIM."⁴ This report includes the following additional information requested by the Commission in its March 16 order:

... identify, for each such event, whether the cause was due to transitional issues or was due to insufficient supply of resources bid into the EIM.

... clarify the information presented in the tables included in Attachment A, Section 2 of the future reports. At a minimum, the clarifications should: (1) differentiate supply deficiencies from transitional issues; (2) provide concise information on required remedial measures, execution responsibility, completion time frame and status; and (3) provide transparent identification of the frequency and market impact of each root cause issue.

² *California Indep. Sys. Operator Corp.*, 150 FERC ¶ 61,086 (2015).

³ *California Indep. Sys. Operator Corp.*, 150 FERC ¶ 61,191 (2015).

⁴ See 150 FERC ¶ 61,191 at P 38.

... identify any [...] seasonal challenges that occur during the reporting period, and describe the operational or business process revisions planned or implemented, as applicable, to address such issues.

The CAISO will continue filing such reports monthly consistent with the Commission's order to continue submitting reports on a 30-day interval until the 206 investigation is concluded or the Commission issues a directive, whichever is earlier.

II. Reports

Attachment A: Provides a quantitative and qualitative description of the issues that prompted the CAISO's waiver request and those observed during the reporting period. This attachment also reports on any such seasonal challenges that occur during the reporting period.

Attachment B: Identifies any remedial measures, execution responsibility, completion timeline, and status for the category of issues identified above.

Attachment C: Provides a description of each relaxation event and a summary of the magnitude and frequency of such events overall, and data on instances where the \$1,000/MWh price would have occurred but for this waiver. This attachment also identifies the frequency and market impact of each root cause issue.

Attachment D: Provides a quantitative and qualitative analysis of the market performance impact of the issues that prompted the CAISO's request for a waiver.

Attachment E: Provides a summary of the magnitude and frequency of the post implementation issues described in Attachment A overall.

ATTACHMENT A

Quantitative and qualitative descriptions of market performance related to the issues that prompted the CAISO's waiver request - CAISO.

This attachment describes the issues that prompted the CAISO to file for the pricing waiver and those observed during the term of the waiver. This attachment also reports on any such seasonal challenges that occurred during the reporting period.

A. Qualitative Description of Issues

The CAISO and the EIM entity have evaluated each interval of infeasibility to determine the root cause of the infeasibility. There are seven categories of issues observed. Each interval of infeasibility may be the product of one or more category of issues. Sometimes, a single reason may drive an infeasibility; but in some cases, a combination of a number of conditions led to the infeasibility. Therefore, it is not possible to identify a single cause for each infeasibility. However, to provide meaningful reports, the CAISO identified what appears to be the most prevalent issue that gave rise to the infeasibility in each interval and assigned the interval to that category. The reports included in this submission qualify and quantify the issues according to these categories, which are as described below:

1. Renewable Deviations

The *Renewable Deviations* category identifies intervals in which the infeasibilities were primarily due to wind and/or solar output deviations from the resource's hourly base schedules that led to the loss of capacity and the need to increase generation from other resources. These types of deviations were beyond deviations the flexible ramping requirement could resolve by the available system ramping capacity. In some cases, there were significant deviations between wind forecasts and the resource's actual output over a period of a number of days. The CAISO utilizes the wind forecast as an indicator of the maximum level to which it can dispatch the resource. If the forecast is significantly flawed, this can create discrepancies between the wind resource's actual output and their forecast. The accuracy of the forecast is dependent on the accuracy of telemetry, which in some cases was problematic. Such issues caused energy imbalance, over-generation, or under-generation conditions as observed by the market systems, leading to infeasibilities.

2. Load Changes

The *Load Changes* category identifies those intervals in which the infeasibility was predominately due to either problematic operator adjustments of load forecasts or changes to those adjustments. The EIM entity grid operators can adjust (or “bias”) the load forecast for reliability to account for any non-modeled issues causing discrepancies between forecast load and actual load in real-time. The operator can make these adjustments after the base schedules are submitted. The operator sets the bias based on his/her judgment of system operational and reliability needs. In some cases, because operators make the adjustments manually, they make these adjustments at a less granular level than is precisely necessary to consider the capability of the system. For example, the operator believes it needs to make an adjustment of 100 MWs due to load changes in real-time. However, because the system is ramp constrained, the operator should make an adjustment of 100.5 MWs to obtain the extra capacity needed to address the system ramp limitations, which is not possible because the operator cannot observe the ramp constrained nature of the system.

In some cases, the load forecast issues were caused by the practice of including large industrial load forecasts in the EIM total load forecast. The EIM entity can adjust these large-scale industrial loads as part of an interruptible load program to balance its system. Prior to April 1, these demand resources were included in the total balancing area load forecast and treated as conforming load, although these loads are non-conforming and independent from the regular conforming loads. After April 1, the CAISO excluded the large industrial load forecast from the total forecast and instead modeled these demand resources as participating resources. This allows the EIM entity to account for their contribution to total supply more effectively and adjust supply as needed.

Distributed energy resources are also included in the market load forecast as conforming load. These resources have both load and generation components, which net to a positive or negative net injection at the load bus. The market systems do not see when these resources are generating and therefore it accounts for more load than what is actually occurring in real time operations. The lack of base schedules for such resources further prevents the market from observing the impact of their output in the market systems.

3. Import/Export Changes

The *Import/Export Changes* category identifies intervals in which the infeasibilities were primarily due to the lack of visibility in the market systems of updates to imports and exports schedules or adjustments made for such updates after the deadline for submitting base schedules at forty minutes before the

trading hour (T-40). When the CAISO performs the balancing test, the market systems assume that the import and/or export base schedules transactions will materialize. For example, the feasibility test assumes that an import base schedule of 600 MW will be delivered. However, after the deadline for submitting base schedules has passed, *i.e.*, after T-40, only 300 MW is actually tagged, which can be done up to T-20. If market systems do not see sufficient capacity to cover the difference of 300 MW, the power balance constraint will be relaxed and trigger the parameter based pricing.

4. Resource Outages

The *Resource Outages* category identifies intervals in which the infeasibilities were primarily due to outages of supply resources that resulted in loss of capacity observed in the fifteen or five minute market which had been previously identified as available. Sometimes there was untimely or inaccurate communication of outage cancellations, which led to the market systems to perceive insufficient supply. When resources experience full or partial forced outages, the market must be informed in a timely manner of the outage event and the corresponding grid operator measures taken to compensate for the lost megawatt capacity.

The timing in which the EIM entity reports the outage is very important. If the outage occurred before T-75 (*i.e.*, seventy-five minutes before the trading or operating hour) and the entity expects it to last during the operating hour, then it should adjust both the economic bid and base schedule to account for the outage. Otherwise, the assumptions and data used by the market application for the balance test and the look-ahead fifteen-minute market contradict real-time system conditions, which results in less capacity available to the EIM than what was computed before the start of the operating hour, and high prices are imminent due to limited unloaded economic capacity offered into the market.

Sometimes the issues identified in this category are due to purely physical outages such as unit trips, which the market systems may observe through telemetry. However, at times the market systems are not informed of the actions taken by the EIM entity to replace that loss of supply. This results in a perception of insufficiency when none exists because the operator deployed operating reserve or curtailed industrial load but the information was not conveyed to the market.

The CAISO does not approve or reject outages of resources in the EIM entity balancing authority area. However, the EIM entity must provide outage information of EIM participating and non-participating resources in a timely and accurate manner. The CAISO incorporates the outage information submitted by the EIM entity into the real-time market to ensure the market clears on the most accurate outage information available.

Because the EIM entity remains in control of the outage approval process, the outages may be unrelated to actual physical conditions. In some cases, the EIM entity may submit an out-of-service or MW range restriction outage on a resource as it moves capacity around to manage its contingency reserves and takes corresponding manual dispatch actions. However, if the manual dispatch actions are not conveyed timely and correctly, the market software might observe an infeasibility when in reality the EIM entity is sufficiently resourced.

5. Manual Dispatches

The *Manual Dispatches* category identifies intervals in which the infeasibility was predominantly due to a manual dispatch action taken by the EIM entity. For example, when system operating conditions for a resource change in real time after the resource's base schedule is submitted, the EIM entity may submit a manual dispatch indicating the maximum capacity to which the resource may be dispatched, which would reduce the available capacity to the market but it is more representative of actual system operating conditions. The manual dispatches are in the form of a fixed megawatt value instruction, a minimum megawatt value, a maximum megawatt value, a start-up instruction, or a shut-down instruction. The EIM entity performs Manual Dispatches to address resource bid issues, market system issues, outage management system issues, reliability needs, reserve sharing events, or variable energy forecast deviations that occur after the deadline for submission of base schedules to maintain the reliability of the balancing authority area. The balancing test does not recognize the manual dispatch information, because it occurs after T-75 but before T-40. If the balanced schedules conflict with the manual dispatch, they may trigger an infeasibility.

6. Resource Data Alignment

The *Resource Data Alignment* category identifies intervals where the infeasibilities were not due to any of the other categories, but in which the following issues were observed: 1) resources were deviating from their dispatch, 2) there were differences between base schedules and bids or dispatch operating targets, and 3) multi-stage resources were operating in configurations that contradicted their base schedules. In addition, sometimes, multi-stage resources had large overlapping ranges and long transition times, which created physical infeasibilities and limited the range of flexibility for the market to move the resource.

Many of these issues were driven by the EIM entity transitioning to a new market paradigm and learning how best to manage its fleet within the new

paradigm using a series of complex systems. For example, initially the EIM entity believed it had registered the characteristics of its multi-stage generating resources consistent with how it intended the units to operate. Multi-stage generating resources have multiple configurations that the operator must carefully manage in the real-time market. The scheduling coordinator registers the configuration characteristics in the master file and the market applications observe and honor them. These include physical, registered characteristics such as transition time, minimum up time and minimum down time, and minimum capacity (Pmin) and maximum capacity output (Pmax) MWs and any overlapping MW regions between configurations. If a configuration is out of service, the EIM entity must submit a timely outage card to inform the market that the corresponding economic bid or base schedule is not available and another configuration is. If it does not perform this task promptly and accurately, or bids do not exist on other configurations, then the market cannot move the resource to other configurations and fails to account for the plant's full available capacity. Through actual operations experience and the EIM entity's evaluation of the dispatch solutions over time, PacifiCorp learned that it should model certain resources differently to allow the market systems to move the resources more efficiently. PacifiCorp modified its practices to find workable market solutions within the technical feasibilities of its resources, and the technical boundaries of the CAISO market features.

On occasion, resources were seen to be deviating from their market dispatch signal because either 1) the plant was unavailable, 2) an outage ticket was not entered on time, or 3) there was a delay in setting the plant on automatic generation control to be dispatched directly from the market signal. Sometimes it was necessary for the EIM entity to make direct phone calls to plant operators to communicate the market signal to move the resource up or down according to the plant's market dispatch signal, which was problematic because these actions take time and are manual in nature.

The EIM entity is sending telemetry values for all PacifiCorp resources registered in the master file. When the quality of the telemetry values is poor, the state estimator solution quality is negatively impacted, which affects the quality of the market solution and the dispatch operating targets of these resources. During the first few weeks of operation, the CAISO found that some resources had telemetry measurements of their auxiliary load and others had gross telemetry measurements that did not include the auxiliary load. In addition, certain wind resources and other small non-participating resources did not have telemetry at all.

The energy management system (EMS) and automatic generation control (AGC) monitors and accounts for the energy of multi-stage generating resources during the startup and shutdown periods when their output is below the PMin.

However, the market does not account for this energy because it is below the PMin of the resource. This creates a discrepancy in the load balance test, and the imbalance calculations between market and actual conditions as seen by AGC, which led grid operators to bias the load forecast.

7. Transfer/Congestion Constraints

The *Transfer/Congestion Constraints* category identifies intervals in which the infeasibility was primarily due to the interplay of EIM transfer constraints or congestion in either a PacifiCorp balancing authority area or the CAISO's balancing authority area, which restrict the incremental generation of resources.

The EIM re-optimizes the EIM transfer capacity in both the fifteen-minute and five-minute markets. Regarding the California Oregon Intertie, the added restriction of the dynamic five-minute limit, which is an incremental limit around the fifteen-minute solution, may create infeasibilities. The five-minute dynamic limit constrains the market application from fully re-optimizing the fifteen-minute EIM transfer beyond the amount allowed by the five-minute incremental dynamic limit, which is especially restrictive during on-peak hours.

In addition, the rate-of-change constraints across the Bonneville Power Administration (BPA) network are five-minute flow limit constraints that limit five-minute movement of PacifiCorp West balancing authority area participating resources around the corresponding resources' fifteen-minute schedules due to their flow impact on certain paths and flowgates internal to the BPA balancing authority area. This restriction on the resources' five-minute movements or the corresponding rate-of-change constraint at times created infeasibilities on the affected resources when the corresponding path or flowgate five-minute limit constraint is binding.

B. Frequency with Which Issues Caused Infeasibilities

Figure 1 through Figure 4 show the frequency with which each of the categories of issues discussed above caused price excursions in both the fifteen and five-minute markets. In any market interval, more than one category of issues may have contributed to the price excursion because there are numerous elements at play in any given market run that can influence its outcome. However, as discussed above, the CAISO determined which of the categories of issues was most prevalent in each interval and assigned it that category. The CAISO produced the frequency diagrams based on that data.

Figure 1: Reasons for intervals with undersupply infeasibility in the fifteen-minute market in February 1 to May 31 - PAC West and PAC East combined.

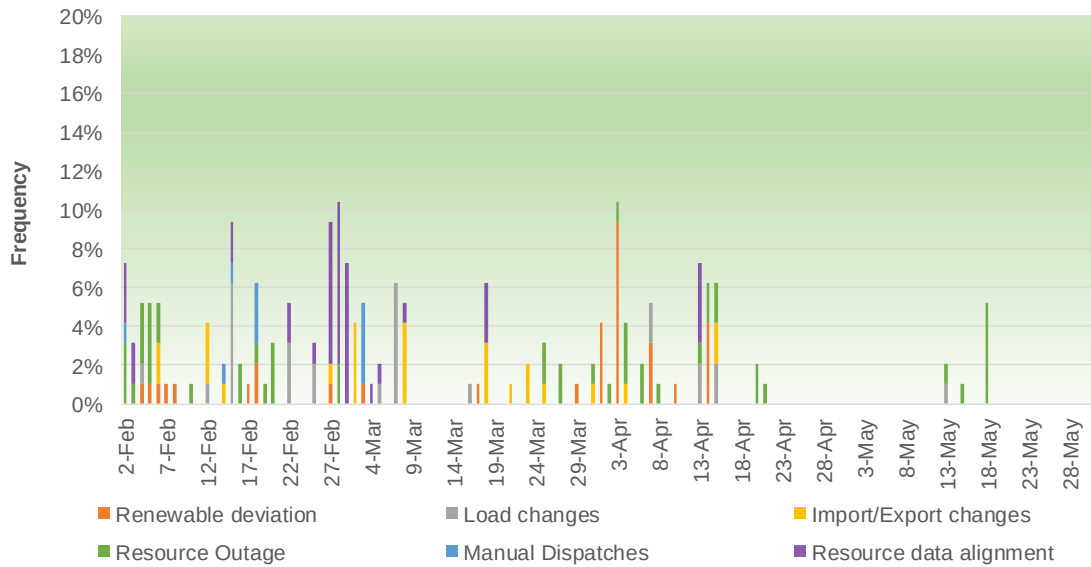


Figure 2: Reasons for intervals with undersupply infeasibility in the five-minute market in February 1 to May 31 - PAC West and PAC East combined.

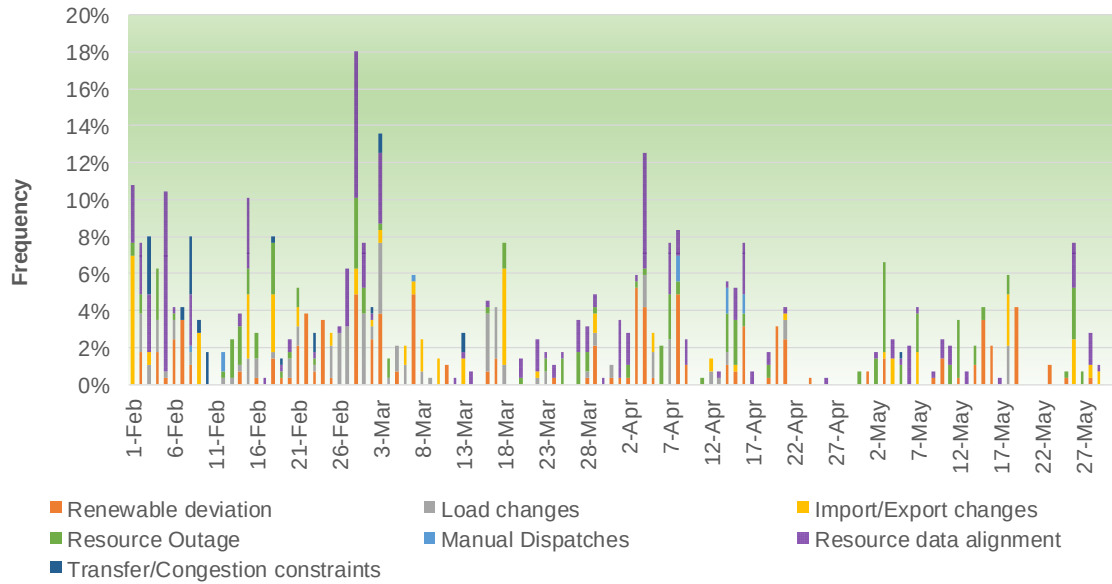


Figure 3: Frequency of undersupply infeasibility in the fifteen-minute market in May - PAC West and PAC East combined.

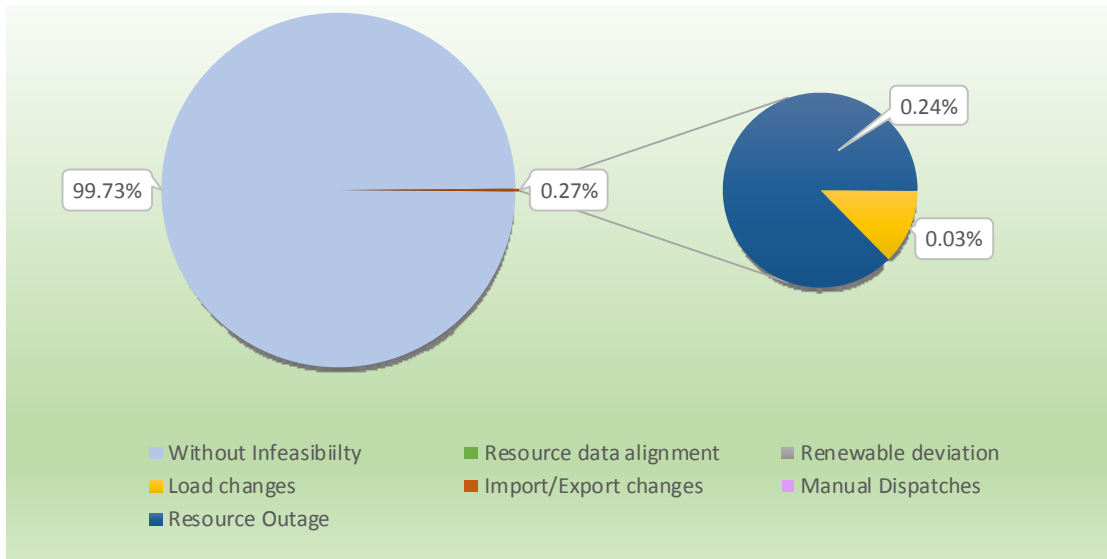
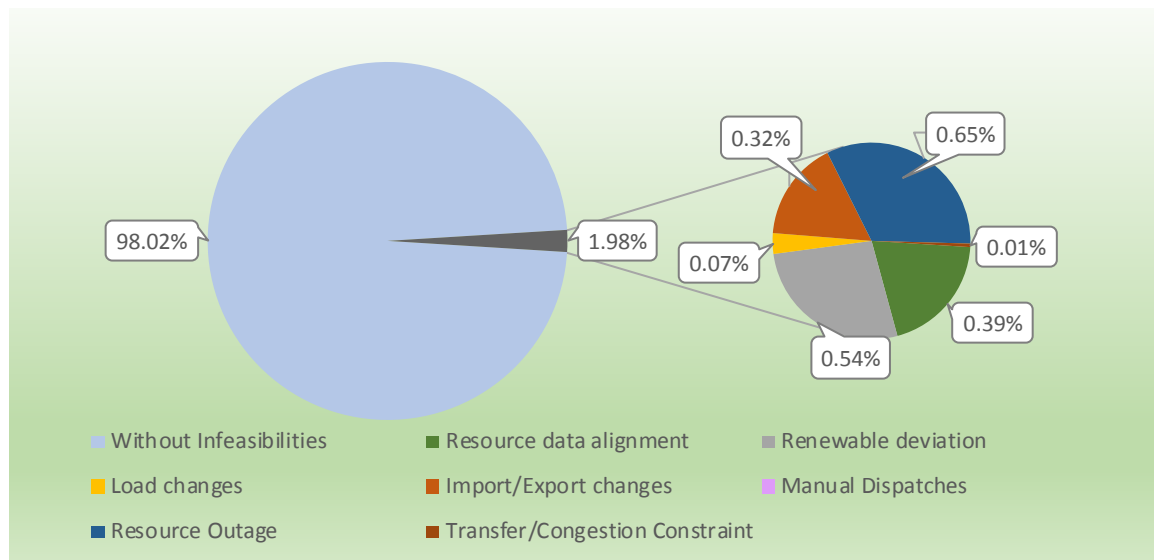


Figure 4: Frequency of undersupply infeasibility in the five-minute market in May - PAC West and PAC East combined.



ATTACHMENT B

Remedial Actions

This attachment includes a report on measures already taken and planned to address the issues discussed above. This report also identifies any remaining deficiencies in processes, procedures, and tools and any additional market issues related to these pricing concerns that the CAISO considers necessary to sustain stable market operations, with the CAISO's plan to address such issues.⁵

Table 1: Remedial Actions taken and planned by the CAISO and PacifiCorp

<i>Number</i>	<i>Solution</i>	<i>Actions and Responsibility</i>	<i>Tariff Changes</i>	<i>Implementation Timeline</i>
1.	<i>Recognition of EIM entity operating practices in EIM market. This allows the market to recognize additional capacity available to the EIM entity, while still enabling the EIM entity to retain control over the management of this capacity for operational purposes.</i>	PacifiCorp changed its bidding and use of the outage reporting system to enable the EIM/RTM to recognize the use of the PacifiCorp's reserves (operating and regulation) and additional available capacity in operating its system. Leading to and through the initial stages of implementation, PacifiCorp designed the bid range of units to separate capacity associated with units holding contingency reserves from the bid range. This was based upon an assumption that contingency reserve obligations should be separately accounted for and that capacity	Will require enabling language for automated recognition of the additional capacity. The CAISO presented the proposal at the April 9, 2015, technical conference and submitted the details of the proposal in comments on April	Effective at the beginning of April 2015, PacifiCorp has implemented the management of its contingency reserve through outage cards in both the PACW BAA and the PACE BAA. The automated feature for recognition of the available capacity that can only be used inside the EIM BAA when it is short of supply is currently being developed and scheduled to be ready to implement mid to end of August 2015.

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
		associated with contingency reserves could not be made available. This had the unintentional consequence of overly restricting the capacity of these units when the market models assess potential infeasible market solutions and PacifiCorp's ability to make operational adjustments to units required by real-time system conditions. The result of this approach was that the bid range and operational capacity of these units were essentially fixed for 75 minutes prior to the operating hour when EIM bids are due and during the operating hour (or approximately 135 minutes), even when system conditions changed. The current solution better approximates PacifiCorp's actual contingency reserve management using outage cards. Currently, PacifiCorp bids full unit capacity into the market and control the dispatch of contingency reserves with outage cards (as well as through PacifiCorp's EMS system). PacifiCorp continues to	23, 2015 in its initial comments in FERC Docket No. EL15-53.	

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
		meet its contingency reserve obligation by holding sufficient contingency reserves on its units, but is also able to convey adjustments that it makes to which units are carrying the reserves in real time through outage cards. For example, when reserves are deployed or shifted to other units, the associated outage card can be adjusted for reserves being deployed or transferred to other units. This allows for a more transparent, efficient and timely market awareness of contingency reserve management and the ability to increase the amount of capacity available to the EIM, without affecting PacifiCorp's contingency reserve obligations. After further analysis of the post-implementation challenges, the CAISO and PacifiCorp have an enhanced appreciation of the importance of recognizing all available capacity in the market system, even though the EIM entity		

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
		retains full operational control of its resources. The CAISO and PacifiCorp also agree that it is necessary to develop procedures that will allow for the automatic recognition of the available capacity that can only be used within the balancing area when it is short of supply. The CAISO is developing functionality that will enable the EIM entity to reflect the full range of available capacity in the market but retain the ability to ensure the deployment of such capacity is limited to addressing infeasibilities in the EIM balancing area with no allowed transfer of this set aside energy outside the corresponding balancing area.		
2.	<i>Refined management of multi-stage generating resources, and addition of multi-stage generation resources configurations</i>	PacifiCorp and the CAISO continue to consult to understand better the quality of the dispatch solution based on the recorded characteristics of the multi-stage generating resources. PacifiCorp reviewed and redefined the registered parameters based on	None identified.	Complete. Based on better understanding of the definition of the multi-stage generation resources parameters, PacifiCorp continues to refine certain multi-stage generation resource parameters and adjust

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
		greater understanding of how the market dispatches those resources based on their configuration. PacifiCorp also defined additional configurations with smaller energy range to help balance their base schedules during startup and shutdown processes when the produced energy is below the previously registered PMin values.		transition times between resource configurations to reflect their physical characteristics. During the month of April, and throughout May, the CAISO implemented numerous market software fixes to handle transitions between configurations as well as during startup and shutdown. The CAISO has also added additional business logic in the software to protect against invalid Dispatch Operating Target instructions. The CAISO and PacifiCorp continue to review and evaluate performance of multi-stage generating resources.
3.	<i>Account for start-up energy in balancing process</i>	CAISO is developing a tool to enable better recognition of start-up profile for multi-stage generating resources. The CAISO is modeling the transition ramping for multi-stage generating resources and has scoped the requirements to add startup and shutdown profiles to the 15-minute market since these features are already in the 5-minute market.	None identified	PacifiCorp started bidding all configurations and maximized bid ranges in March 2015. CAISO is in the process of refining the startup and transition profile logic by introducing the two-segment approach. This is to better model the energy output during startup or transition. This feature is currently in design

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
		PacifiCorp is in the process of collecting data to define the startup and shutdown profiles for many of the resources with high PMin values. PacifiCorp has also made improvements to the bid configurations of PacifiCorp EIM Participating Resources in order to maximize fully the bid range available to the market. This includes recognizing start-up hours for CCGT plants, working to bid in all possible plant operating configurations and accounting for reserves to reflect fully the operational capability to respond to real-time market conditions.		phase.
4.	<i>Effort to improve consistency interchange schedule tags and base schedules</i>	PacifiCorp reviewed its internal process of preparing to submit base schedules at T-40 and changes to interchange values within the hour after T-20 and identified any delayed submission tags. PacifiCorp also improved the accuracy of base schedules submitted for non-EIM export energy share of PacifiCorp joint-owned resources.	None identified	Complete. PacifiCorp improved its awareness about the importance of consistent interchange bases schedules and real-time interchange schedules on market results. CAISO is in the process of defining additional monitoring to show the interchange megawatt differences to the operator. The implementation is anticipated to

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
		PacificCorp has agreed to provide further base schedules based on the existing tagged values for future hours to help ISO short-term-unit-commitment.		be towards end of May 2015 PacifiCorp fixed the interchange scheduling software intermittent use of invalid interchange schedules around top of hour the last part of April 2015. The CAISO and PacifiCorp have also agreed on submission of base schedules for several hours in the future to cover the short-term-unit commitment horizon, currently set at 4.5 hour's. The data transfer of future hour's base schedules was implemented towards end of May 2015.
5.	<i>CAISO formalized a production system support plan for Outage Management System to respond quickly to questions or situations encountered by PacifiCorp operator when entering outage tickets.</i>	CAISO implemented a support plan. This support plan consists of a 24/7 email address and telephone number available to PacifiCorp for immediate response to any outage management system issues and for troubleshooting any discrepancy in resources' availability megawatt values. PacifiCorp participated in identifying additional requirements and enhancements to outage	None identified	Completed in early March 2015.

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
		management system based on operational needs.		
6.	<i>Enhanced situational awareness displays and improved monitoring of generator availability, capacity, available regulation on a 5 and 15 min basis, and ramp capacity.</i>	PacifiCorp created and/or improved certain Grid Operations displays to monitor generator availability, capacity, and ramp capacity. PacifiCorp has finalized enhancements to its generator database (Pi) displays to provide Grid Operations with situational awareness when there is a deviation between the Dispatch Operating Target (DOT) and the actual dispatch. PacifiCorp developed and implemented additional tools and displays to provide its grid operations personnel with increased visibility and situational awareness regarding available capacity on a 5- and 15-minute basis. PacifiCorp has coordinated with the CAISO to improve the accuracy of	None identified	Major enhancements completed. The CAISO and PacifiCorp continue to monitor and analyze for timely responses to inform the market about any out-of-market manual actions the EIM entity takes or plans to take.

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
		how the EIM understands PacifiCorp’s balancing authority operations by using the information communication tools available in the EIM, including outage cards, to ensure that the EIM is accurately consuming real time system conditions and unit capacity available in PacifiCorp’s balancing authority area. Since go-live, PacifiCorp and the CAISO have engaged in regular discussions to evaluate the root cause of remaining infeasible schedules. PacifiCorp has made improvements to its systems that interface with the CAISO’s base schedules and economic bids systems, as well as systems designed for bidding resources during start-up and shutdown hours for multi-stage generating resources. PacifiCorp further narrowed the gap between the persistence forecast methods it uses for VER forecasting and the submission of those forecasts		

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
		to the market. This ensures the market has a more current view of wind conditions and results in an improved market solution. Additionally, PacifiCorp has worked with the CAISO to improve the load forecast during ramping hours. This has resulted in an even more accurate load forecast during these hours and improved the flexibility available to the market as fewer resource are needed to cover forecast error. For troubleshooting purposes, PacifiCorp continues to work with the CAISO on tools and displays that can compare interchange deviations between EIM entity submissions and confirmation of interchange data used by the Market Operator. PacifiCorp Grid Operations also continues to work with neighboring balancing authority areas to improve visibility and tools. PacifiCorp has utilized the CAISO's		

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
		new displays to identify quickly discrepancies between base schedules and derated maximum capacity of resources. The CAISO added additional information related to re-rated minimum capacity to existing displays to help PacifiCorp identify and fix discrepancies between base schedules and re-rated minimum capacity. The CAISO enhanced situational awareness screens to report on un-qualified MWhs when base schedules were submitted for the resource on an outage to more timely inform the EIM entity of inconsistencies between base schedules and outages.		
7.	<i>Improvements to Flexible Ramp Sufficiency Test</i>	PacifiCorp and the CAISO are coordinating to identify needed improvements. The CAISO is collecting and analyzing both wind and load variability in PacifiCorp's two balancing areas. PacifiCorp and the CAISO have addressed several wind forecasting issues but wind forecast deviations from base	None identified yet; possible solutions could require additional changes.	On 02/03/2015, CAISO implemented a feature to limit the flexible ramping capacity credit by dynamic transfer limit. Before this change, the fifteen-minute market calculated the flexible ramping capacity credit as the EIM transfer export in the last 15 minutes of the previous hour. It erroneously

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
		schedules continues to be among the main reasons for price excursions and infeasibilities. The CAISO is in the process of assessing the flexible ramping requirement for PacifiCorp’s two balancing areas based on the collected data for the actual real-time imbalance conditions. The CAISO is also revisiting and reviewing the flexible ramping constraint and associated credit accounting in the flexibility sufficiency test and towards satisfying the flexible ramp requirements in the market optimization.		assumed that the entire export transfer can be reduced in RTD, which was not true because of the 5 min dynamic limit. As a result, the fifteen-minute market procured less flexible ramping capacity than needed by the system leading potentially to more frequent price excursions. This change was to limit the credit by the five-minute incremental dynamic EIM Transfer limit. On 06/03/2015, CAISO has implemented a feature to separate the flexible ramping capacity requirement into ‘net movement’ and ‘uncertainty’. This allows the “uncertainty” requirement not to be accumulated over the four 15-minute intervals of the hour upon which the flexible ramping sufficiency test is performed. CAISO developed improved forecasting of flex ramp requirements for PACE and PACW and started to use these values in

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
				the EIM early March 2015. CAISO is also reviewing its flex ramp sufficiency test implementation for possible simplification to be completed by end of mid-May 2015
8.	<i>Unit deviation displays</i>	The CAISO provided the EIM entity additional user interfaces that provide the grid operator information related to differences between any combination of telemetry, state estimation, base schedules, and cleared target operating points for all resources. The CAISO and PacifiCorp continue to coordinate and provide feedback of additional needed enhancements.	None identified.	Completed.
9.	<i>Load bias logic correction</i>	There were several instances where operators made incorrect load biases to dispatch more capacity when the system was out of ramping capability. The CAISO will be implementing software functionality to limit such erroneous load biases, similar to the logic currently used for the CAISO operator bias of load. This feature limits operator bias of load forecast that are not consistent with system	None identified. The CAISO will add detail in its business practice manual to describe the procedure further.	The CAISO implemented this feature for EIM on March 20, 2015. However, the feature does not currently trigger because the price waiver-based pricing requires the pricing run to establish prices based on the last economic bid when the market software relaxes the transmission or power balance constraint. For May 2015 about 89 intervals with RTD infeasibilities

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
		available ramp. The CAISO will provide training to PacifiCorp to ensure operators are familiar with how the feature will work, including explanations on the use of prices as a signal to indicate an issue in meeting load or balancing the system.		were covered by this functionality and, therefore, were no longer considered in the metrics of this report.
10.	<i>Increase Pool of EIM Participating Resources</i> <i>PacifiCorp coordinated with the CAISO to increase the pool of owned and third-party resources available to participate in the EIM.</i>	PacifiCorp coordinated with the CAISO to increase the pool of owned and third-party resources available to participate in the EIM. This will result in the Swift 1&2 units becoming a single aggregated PacifiCorp EIM Participating Resource and will add approximately 68 MWs of upper bid range capability. In addition, PacifiCorp continues to work with other transmission customers who may be interested in participating in the EIM with resources, including the recent filing of a construction agreement at FERC to enable resource-metering upgrades, which would facilitate	None identified.	PacifiCorp aggregated Swift 1&2 in May 2015. CAISO removed non-conforming Industrial Loads from PACE BAA starting April 1, 2015. PacifiCorp started submission of industrial load base schedules April 1, 2015, and has been bidding them economically since mid May 2015.

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
		further steps towards participation of resources in the EIM (FERC Docket No. ER15-711). At this time, PacifiCorp has not certified any third-party transmission customers for participation in the EIM, but is hopeful that these efforts will result in additional EIM participation. PacifiCorp has modeled certain industrial customer interruptible loads as participating resources. This was necessary because some of PacifiCorp’s industrial customer loads have on-site generation and, as a result, this presents additional complexity for accurate forecasting and balancing. Adding these elements as participating resources has improved operational visibility and added approximately 200 MW of flex capacity in its PACE Balancing Authority Area (“BAA”) when they are bid economically in the EIM. PacifiCorp is also improving the modeling of its jointly owned generating resources. Such improvements will further minimize		

<i>Number</i>	<i>Solution</i>	<i>Actions and Responsibility</i>	<i>Tariff Changes</i>	<i>Implementation Timeline</i>
		imbalance issues and improve forecast accuracy.		
11.	<i>Training</i> <i>Additional training of personnel and improvement of systems with increased EIM operational experience.</i>	PacifiCorp provided personnel with training on outage entry and required the provision of daily spreadsheets from PacifiCorp EIM Participating Resources that describe any operational issues and the resources' ambient conditions. PacifiCorp's Grid Operations provided its balancing agent real-time continued training on CAISO EIM tools during the first two weeks of February 2015. PacifiCorp worked with the CAISO to improve load conforming errors. Software enhancements have been introduced that help protect against over-conforming that can exacerbate issues when capacity in the market is near its limit.	None identified.	PacifiCorp and the CAISO have completed the bulk of identified training and the CAISO continues to evaluate training requirements.
12.	<i>Improve Internal Processes and Tools to address identified market performance issues.</i>	PacifiCorp's Grid Operations drafted and made available to operations personnel, "best practices" procedure documents to aid in personnel's implementation of	None identified.	Completed.

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
		critical EIM Entity tasks. PacifiCorp will continue to update these procedure documents in real-time as needed. PacifiCorp also developed a Desk Guide for the 24/7 Grid Operations desk and an EIM Division of Responsibilities document.		
13.	<i>Improve dynamic transfer capability</i>	PacifiCorp is engaged in ongoing discussions with the Bonneville Power Administration (BPA) to understand the nature and allocation of the dynamic transfer capability on the COI. BPA is in the process of conducting a detailed dynamic transfer capability study. Any additional five-minute capability will help the five-minute market re-optimize the fifteen-minute decisions that are based on system conditions and information available at approximately 30 minutes prior to the five-minute market. The five-minute dynamic COI limits were increased for the off-peak hours but still very limited during on-peak hours. PacifiCorp is engaged in discussions	None identified.	In progress – BPA is in the process of determining new COI dynamic transfer capability limits based on study results. For BPA rate of change constraints, the CAISO, PacifiCorp, and BPA are currently examining two methodologies or approaches in the ISO testing environment to identify which methodology is superior and acceptable to BPA to the method currently in place. The first methodology was deployed mid May 2015. The CAISO/PacifiCorp/BPA are committed and continue to discuss on weekly calls the effectiveness of approach 1, as well as potential better alternatives.

Number	Solution	Actions and Responsibility	Tariff Changes	Implementation Timeline
		with BPA to understand the nature and basis behind the five-minute flowgate limits and possible change in the calculation of those limits. BPA is reviewing the five-minute limits, which are based on historical movement of PacifiCorp West resources before the EIM. BPA has also requested more data points to perform a review of the current rate-of-change limits based on actual EIM data. Any additional five-minute capability will help the five-minute market re-optimize the fifteen-minute market decisions that are based on system conditions and information available approximately 30 minutes prior to the five-minute market. The CAISO had provided BPA the requested data points and answered any relevant questions. The CAISO is coordinating with both BPA and PacifiCorp to revise the implementation model for the rate-of-change constraint to reflect ramping 15-minute schedule values.		

ATTACHMENT C

This attachment includes a discussion of whether the cause was due to transitional issues or was due to insufficient supply of resources bid into the EIM, including the time of the instance, the duration, the cause, and the affected node(s) and load. The CAISO evaluated each interval of infeasibility to determine whether it was infeasible due to actual supply insufficiency by calculating the degree to which the infeasibility was in excess of PacifiCorp's available capacity to balance its system. This measure was determined by calculating the difference between the total amount of reserves carried and the minimum amount of reserves required by NERC. The CAISO then subtracted the MWs of infeasibility from that amount to determine the amount of available capacity above the magnitude of the infeasibilities. This amount is displayed for the PACE and PACW areas for each interval. If that value were zero or negative, the CAISO would qualify that interval as infeasible due to an insufficiency of supply. Otherwise, the CAISO concludes the EIM entity had enough capacity available to dispatch as needed to address the infeasibility observed in the market systems. However, the CAISO does not present this measurement to demonstrate that the available capacity could have actually addressed the infeasibility. It is not certain that the available capacity would have been capable to meet the ramping needs to meet the infeasibility. It is merely a measure of the total capacity available at the time of the infeasibility for a future operating interval. An important aspect of the CAISO market runs is that the CAISO conducts the market runs from 37.5 and up to 7.5 minutes ahead of the actual operating interval respectively for the fifteen-minute market and five-minute market. The measurements of the infeasibility below do not reflect the actions taken between the time the market systems detect the infeasible market run and the actual operating interval. The CAISO presumes the EIM entity actually takes manual actions to dispatch available capacity during that time interval to meet their load.

The tables below show that there were certain intervals during which there measure of excess reserves presented were negative and there was an infeasibility due to market imbalances exceeding supply bids available to clear the market. All the events were in the five-minute real-time dispatch and none occurred in the fifteen-minute market. The CAISO and PacifiCorp have evaluated market and reliability conditions during all of these intervals and have determined that while the magnitude of the infeasibility is greater than the amount of reserves available, at all times during these intervals based on the ACE and available capacity, the PACE and PACW systems were operated reliably. The system issues were not apparent during the price corrections time horizon to determine if these instances should have been

excluded from the list of infeasibilities. The infeasibilities were due to lack of visibility of the market to the available capacity.

Table 1: List of undersupply infeasibilities in the fifteen-minute market for both PAC East and West

Trade Date	Hour Ending	Interval	Infeasibility PACE (MW)	Excess of Reserves PACE (MW)	Infeasibility PACW (MW)	Excess of Reserves PACW (MW)	Reason for infeasibility	Affected locations
13-May	7	2	61.3	103.0			Resource Outage	All locations in PAC East
13-May	22	1	14.5	134.3			Load Changes	All locations in PAC East
15-May	18	4	20.3	146.4			Resource Outage	All locations in PAC East
18-May	20	4	11.0	184.5			Resource Outage	All locations in PAC East
18-May	22	1	101.9	93.3			Resource Outage	All locations in PAC East
18-May	22	2	54.8	46.5			Resource Outage	All locations in PAC East
18-May	23	1	86.9	94.5			Resource Outage	All locations in PAC East
18-May	23	2			7.7	157.3	Resource Outage	All locations in PAC West

Table 2: List of undersupply infeasibilities in the five-minute market for both PAC East and West								
Trade Date	Hour Ending	Interval	Infeasibility PACE (MW)	Excess of Reserves PACE (MW)	Infeasibility PACW (MW)	Excess of Reserves PACW (MW)	Reason for infeasibility	Affected locations
1-May	24	2			36.8	182.1	Renewable Deviation	All locations in PAC West
1-May	24	3			10.0	209.0	Renewable Deviation	All locations in PAC West
2-May	22	2			24.0	140.1	Resource Outage	All locations in PAC West
2-May	22	3			24.8	139.3	Resource Outage	All locations in PAC West
2-May	22	5			74.7	0.0	Resource Outage	All locations in PAC West
2-May	22	6	60.5	144.1			Resource Outage	All locations in PAC East
2-May	23	2	59.2	171.3			Resource Data Alignment	All locations in PAC East
3-May	4	5	0.7	294.1			Renewable Deviation and Resource Data Alignment	All locations in PAC East
3-May	4	9	7.1	254.6			Renewable Deviation and Resource Data Alignment	All locations in PAC East

Table 2: List of undersupply infeasibilities in the five-minute market for both PAC East and West								
Trade Date	Hour Ending	Interval	Infeasibility PACE (MW)	Excess of Reserves PACE (MW)	Infeasibility PACW (MW)	Excess of Reserves PACW (MW)	Reason for infeasibility	Affected locations
3-May	4	10	19.4	271.7			Renewable Deviation and Resource Data Alignment	All locations in PAC East
3-May	4	11	13.4	277.7			Renewable Deviation and Resource Data Alignment	All locations in PAC East
3-May	20	8	55.9	216.4			Resource Outage and Renewable Deviation	All locations in PAC East
3-May	20	9	44.0	228.2			Resource Outage and Renewable Deviation	All locations in PAC East
3-May	20	10	213.4	-11.4			Resource Outage and Renewable Deviation	All locations in PAC East
3-May	20	11	185.4	16.6			Resource Outage and Renewable Deviation	All locations in PAC East
3-May	20	12	176.9	25.0			Resource Outage and Renewable Deviation	All locations in PAC East
3-May	21	1	61.1	108.5			Resource Outage and Renewable Deviation	All locations in PAC East
3-May	21	2	52.2	117.5			Resource Outage and Renewable Deviation	All locations in PAC East

Table 2: List of undersupply infeasibilities in the five-minute market for both PAC East and West								
Trade Date	Hour Ending	Interval	Infeasibility PACE (MW)	Excess of Reserves PACE (MW)	Infeasibility PACW (MW)	Excess of Reserves PACW (MW)	Reason for infeasibility	Affected locations
3-May	21	4	98.3	65.1			Resource Outage and Renewable Deviation	All locations in PAC East
3-May	21	5	114.0	49.4			Resource Outage and Renewable Deviation	All locations in PAC East
3-May	21	6	136.9	26.5			Resource Outage and Renewable Deviation	All locations in PAC East
3-May	21	7	112.3	53.9			Resource Outage and Renewable Deviation	All locations in PAC East
3-May	21	8	106.5	59.7			Resource Outage and Renewable Deviation	All locations in PAC East
3-May	21	9	92.0	74.2			Resource Outage and Renewable Deviation	All locations in PAC East
3-May	21	10	12.3	135.0			Resource Outage and Renewable Deviation	All locations in PAC East
3-May	23	3	51.6	122.0			Import/Export Changes and Renewable Deviation	All locations in PAC East
4-May	1	2	10.2	292.7			Resource Data Alignment and Renewable Deviation	All locations in PAC East

Table 2: List of undersupply infeasibilities in the five-minute market for both PAC East and West								
Trade Date	Hour Ending	Interval	Infeasibility PACE (MW)	Excess of Reserves PACE (MW)	Infeasibility PACW (MW)	Excess of Reserves PACW (MW)	Reason for infeasibility	Affected locations
4-May	10	5	13.3	215.3			Import/Export Changes and Renewable Deviation	All locations in PAC East
4-May	10	6	13.3	215.2			Import/Export Changes and Renewable Deviation	All locations in PAC East
4-May	10	10	44.6	38.2			Import/Export Changes and Renewable Deviation	All locations in PAC East
4-May	10	11	47.5	35.3			Import/Export Changes and Renewable Deviation	All locations in PAC East
4-May	23	1	45.7	316.1			Resource Data Alignment	All locations in PAC East
4-May	23	2	19.0	342.9			Resource Data Alignment	All locations in PAC East
5-May	8	7	26.0	143.7			Resource Data Alignment and Renewable Deviation	All locations in PAC East
5-May	18	7			1.2	224.2	Transfer/Congestion Constraints	All locations in PAC West
5-May	21	4			126.2	90.5	Resource Outage	All locations in PAC West

Table 2: List of undersupply infeasibilities in the five-minute market for both PAC East and West								
Trade Date	Hour Ending	Interval	Infeasibility PACE (MW)	Excess of Reserves PACE (MW)	Infeasibility PACW (MW)	Excess of Reserves PACW (MW)	Reason for infeasibility	Affected locations
5-May	21	5			124.7	92.0	Resource Outage	All locations in PAC West
5-May	23	1	93.4	119.2			Resource Outage	All locations in PAC East
6-May	24	2	3.6	244.3			Resource Data Alignment and Renewable Deviation	All locations in PAC East
6-May	24	4	10.0	180.0			Resource Data Alignment and Renewable Deviation	All locations in PAC East
6-May	24	5	8.9	181.1			Resource Data Alignment and Renewable Deviation	All locations in PAC East
6-May	24	6	4.6	185.4			Resource Data Alignment and Renewable Deviation	All locations in PAC East
6-May	24	7	1.1	195.6			Resource Data Alignment and Renewable Deviation	All locations in PAC East
6-May	24	9	3.9	192.8			Resource Data Alignment and Renewable Deviation	All locations in PAC East
7-May	6	10			61.7	44.9	Import/Export Changes	All locations in PAC West

Table 2: List of undersupply infeasibilities in the five-minute market for both PAC East and West								
Trade Date	Hour Ending	Interval	Infeasibility PACE (MW)	Excess of Reserves PACE (MW)	Infeasibility PACW (MW)	Excess of Reserves PACW (MW)	Reason for infeasibility	Affected locations
7-May	6	11			52.1	54.5	Import/Export Changes	All locations in PAC West
7-May	7	10			52.2	75.0	Import/Export Changes	All locations in PAC West
7-May	7	11			69.3	57.9	Import/Export Changes	All locations in PAC West
7-May	7	12			56.4	70.8	Import/Export Changes	All locations in PAC West
7-May	10	8	38.2	221.1			Resource Data Alignment	All locations in PAC East
7-May	21	4			59.7	8.0	Resource Outage	All locations in PAC West
7-May	21	5			64.4	3.4	Resource Outage	All locations in PAC West
7-May	21	6			51.6	16.1	Resource Outage	All locations in PAC West
7-May	21	7			50.7	33.1	Resource Outage	All locations in PAC West

Table 2: List of undersupply infeasibilities in the five-minute market for both PAC East and West								
Trade Date	Hour Ending	Interval	Infeasibility PACE (MW)	Excess of Reserves PACE (MW)	Infeasibility PACW (MW)	Excess of Reserves PACW (MW)	Reason for infeasibility	Affected locations
7-May	21	8			30.0	53.8	Resource Outage	All locations in PAC West
7-May	21	9			26.3	57.4	Resource Outage	All locations in PAC West
9-May	8	1	93.7	222.6			Renewable Deviation	All locations in PAC East
9-May	20	7			11.1	167.4	Resource Data Alignment	All locations in PAC West
10-May	14	10			60.4	86.2	Resource Data Alignment	All locations in PAC West
10-May	14	11			5.6	141.0	Resource Data Alignment	All locations in PAC West
10-May	14	12			21.0	125.6	Resource Data Alignment	All locations in PAC West
10-May	22	2			13.2	129.6	Renewable Deviation	All locations in PAC West
10-May	22	4			38.7	148.9	Renewable Deviation	All locations in PAC West

Table 2: List of undersupply infeasibilities in the five-minute market for both PAC East and West								
Trade Date	Hour Ending	Interval	Infeasibility PACE (MW)	Excess of Reserves PACE (MW)	Infeasibility PACW (MW)	Excess of Reserves PACW (MW)	Reason for infeasibility	Affected locations
10-May	22	5			56.0	131.7	Renewable Deviation	All locations in PAC West
10-May	22	6			5.3	182.3	Renewable Deviation	All locations in PAC West
11-May	10	6			26.7	124.4	Resource Outage	All locations in PAC West
11-May	10	10			68.7	69.9	Resource Outage	All locations in PAC West
11-May	10	11			47.3	91.3	Resource Outage	All locations in PAC West
11-May	12	1			73.8	86.6	Resource Data Alignment	All locations in PAC West
11-May	12	2			51.4	109.0	Resource Data Alignment	All locations in PAC West
11-May	12	3			49.9	110.4	Resource Data Alignment	All locations in PAC West
12-May	1	3	221.9	71.1			Resource Outage	All locations in PAC East

Table 2: List of undersupply infeasibilities in the five-minute market for both PAC East and West								
Trade Date	Hour Ending	Interval	Infeasibility PACE (MW)	Excess of Reserves PACE (MW)	Infeasibility PACW (MW)	Excess of Reserves PACW (MW)	Reason for infeasibility	Affected locations
12-May	1	4	26.3	143.0			Resource Outage	All locations in PAC East
12-May	1	5	23.2	146.1			Resource Outage	All locations in PAC East
12-May	1	6	12.6	156.7			Resource Outage	All locations in PAC East
12-May	1	7	42.9	119.1			Resource Outage	All locations in PAC East
12-May	1	8	39.2	122.7			Resource Outage	All locations in PAC East
12-May	1	9	40.5	121.5			Resource Outage	All locations in PAC East
12-May	1	10	39.3	163.9			Resource Outage	All locations in PAC East
12-May	1	11	26.7	176.5			Resource Outage	All locations in PAC East
12-May	18	7			24.0	221.0	Renewable Deviation and Transfer/Congestion Constraints	All locations in PAC West

Table 2: List of undersupply infeasibilities in the five-minute market for both PAC East and West								
Trade Date	Hour Ending	Interval	Infeasibility PACE (MW)	Excess of Reserves PACE (MW)	Infeasibility PACW (MW)	Excess of Reserves PACW (MW)	Reason for infeasibility	Affected locations
13-May	22	1	95.8	52.9			Resource Data Alignment and Resource Outage	All locations in PAC East
13-May	22	2	65.0	83.8			Resource Data Alignment and Resource Outage	All locations in PAC East
14-May	11	4			107.3	-31.2	Resource Outage	All locations in PAC West
14-May	11	5	122.5	15.2			Resource Outage and Renewable Deviation	All locations in PAC East
14-May	11	6	142.3	-4.6			Resource Outage and Renewable Deviation	All locations in PAC East
14-May	20	10	33.2	165.3			Renewable Deviation	All locations in PAC East
14-May	20	11	126.9	71.6			Renewable Deviation	All locations in PAC East
14-May	20	12	27.9	170.6			Renewable Deviation	All locations in PAC East
15-May	2	11	9.7	239.7			Renewable Deviation	All locations in PAC East

Table 2: List of undersupply infeasibilities in the five-minute market for both PAC East and West								
Trade Date	Hour Ending	Interval	Infeasibility PACE (MW)	Excess of Reserves PACE (MW)	Infeasibility PACW (MW)	Excess of Reserves PACW (MW)	Reason for infeasibility	Affected locations
15-May	2	12	15.2	234.2			Renewable Deviation	All locations in PAC East
15-May	3	1	8.5	233.0			Renewable Deviation	All locations in PAC East
15-May	3	2	3.4	238.1			Renewable Deviation	All locations in PAC East
15-May	3	5	19.0	215.1			Renewable Deviation	All locations in PAC East
15-May	3	6	44.7	189.4			Renewable Deviation	All locations in PAC East
15-May	3	7	8.8	180.9			Renewable Deviation	All locations in PAC East
15-May	3	8	15.0	174.8			Renewable Deviation	All locations in PAC East
15-May	3	9	11.2	178.5			Renewable Deviation	All locations in PAC East
15-May	3	10	23.2	162.3			Renewable Deviation	All locations in PAC East

Table 2: List of undersupply infeasibilities in the five-minute market for both PAC East and West								
Trade Date	Hour Ending	Interval	Infeasibility PACE (MW)	Excess of Reserves PACE (MW)	Infeasibility PACW (MW)	Excess of Reserves PACW (MW)	Reason for infeasibility	Affected locations
15-May	10	9			2.1	66.4	Resource Outage	All locations in PAC West
15-May	10	10			2.6	124.3	Resource Outage	All locations in PAC West
16-May	14	8			65.2	28.3	Renewable Deviation	All locations in PAC West
16-May	14	9			57.0	36.5	Renewable Deviation	All locations in PAC West
16-May	14	10			52.6	92.8	Renewable Deviation	All locations in PAC West
16-May	14	11			46.4	99.0	Renewable Deviation	All locations in PAC West
16-May	14	12			48.2	97.2	Renewable Deviation	All locations in PAC West
16-May	15	12			12.5	182.9	Renewable Deviation	All locations in PAC West
17-May	22	5			41.7	107.2	Resource Data Alignment and Renewable Deviation	All locations in PAC West

Table 2: List of undersupply infeasibilities in the five-minute market for both PAC East and West								
Trade Date	Hour Ending	Interval	Infeasibility PACE (MW)	Excess of Reserves PACE (MW)	Infeasibility PACW (MW)	Excess of Reserves PACW (MW)	Reason for infeasibility	Affected locations
18-May	19	5			39.2	158.4	Load Changes	All locations in PAC West
18-May	19	6			49.0	148.5	Load Changes	All locations in PAC West
18-May	22	1	46.5	148.7			Load Changes	All locations in PAC East
18-May	22	2	42.5	152.7			Load Changes and Import/Export Changes	All locations in PAC East
18-May	22	3	30.4	164.7			Load Changes and Import/Export Changes	All locations in PAC East
18-May	22	4	107.1	-5.7			Load Changes and Import/Export Changes	All locations in PAC East
18-May	22	5	87.1	14.2			Import/Export Changes	All locations in PAC East
18-May	22	6	92.3	9.0			Import/Export Changes	All locations in PAC East
18-May	22	7	52.4	79.8			Import/Export Changes	All locations in PAC East

Table 2: List of undersupply infeasibilities in the five-minute market for both PAC East and West								
Trade Date	Hour Ending	Interval	Infeasibility PACE (MW)	Excess of Reserves PACE (MW)	Infeasibility PACW (MW)	Excess of Reserves PACW (MW)	Reason for infeasibility	Affected locations
18-May	22	8	61.2	70.9			Import/Export Changes	All locations in PAC East
18-May	23	2			66.3	135.3	Resource Outage and Import/Export Changes	All locations in PAC West
18-May	23	4	53.7	130.7	62.3	102.8	Resource Outage ,Renewable Deviation and Resource Data Alignment	All locations in PAC East and West
18-May	23	5	19.6	164.8	45.7	119.4	Resource Outage ,Renewable Deviation and Resource Data Alignment	All locations in PAC East and West
18-May	24	3			12.7	197.3	Import/Export Changes	All locations in PAC West
18-May	24	4			28.0	209.1	Import/Export Changes	All locations in PAC West
18-May	24	5			66.8	170.2	Import/Export Changes	All locations in PAC West
18-May	24	6			58.9	178.1	Import/Export Changes	All locations in PAC West
19-May	22	3	51.9	180.3			Renewable Deviation	All locations in PAC East

Table 2: List of undersupply infeasibilities in the five-minute market for both PAC East and West								
Trade Date	Hour Ending	Interval	Infeasibility PACE (MW)	Excess of Reserves PACE (MW)	Infeasibility PACW (MW)	Excess of Reserves PACW (MW)	Reason for infeasibility	Affected locations
19-May	23	2			19.2	186.6	Renewable Deviation	All locations in PAC West
19-May	24	2	6.2	259.7			Renewable Deviation and Resource Data Alignment	All locations in PAC East
19-May	24	3	67.0	198.9			Renewable Deviation and Resource Data Alignment	All locations in PAC East
19-May	24	4	20.3	119.3			Renewable Deviation and Resource Data Alignment	All locations in PAC East
19-May	24	5	12.7	126.9			Renewable Deviation and Resource Data Alignment	All locations in PAC East
19-May	24	6	33.4	106.3			Renewable Deviation and Resource Data Alignment	All locations in PAC East
19-May	24	7	17.8	95.8			Renewable Deviation and Resource Data Alignment	All locations in PAC East
19-May	24	8	13.8	99.8			Renewable Deviation and Resource Data Alignment	All locations in PAC East
19-May	24	9	8.8	104.7			Renewable Deviation and Resource Data Alignment	All locations in PAC East

Table 2: List of undersupply infeasibilities in the five-minute market for both PAC East and West								
Trade Date	Hour Ending	Interval	Infeasibility PACE (MW)	Excess of Reserves PACE (MW)	Infeasibility PACW (MW)	Excess of Reserves PACW (MW)	Reason for infeasibility	Affected locations
19-May	24	10	85.7	101.9			Renewable Deviation and Resource Data Alignment	All locations in PAC East
19-May	24	11	56.8	130.7			Renewable Deviation and Resource Data Alignment	All locations in PAC East
23-May	22	7	16.0	284.6			Renewable Deviation and Resource Data Alignment	All locations in PAC East
23-May	22	8	20.2	280.4			Renewable Deviation and Resource Data Alignment	All locations in PAC East
23-May	22	12	40.4	353.9			Renewable Deviation and Resource Data Alignment	All locations in PAC East
25-May	7	9			1.5	134.0	Resource Outage	All locations in PAC West
25-May	13	7			59.5	0.1	Renewable Deviation and Import/Export Changes	All locations in PAC West
26-May	10	7			3.2	140.6	Import/Export Changes	All locations in PAC West
26-May	10	8			9.7	134.1	Import/Export Changes	All locations in PAC West

Table 2: List of undersupply infeasibilities in the five-minute market for both PAC East and West								
Trade Date	Hour Ending	Interval	Infeasibility PACE (MW)	Excess of Reserves PACE (MW)	Infeasibility PACW (MW)	Excess of Reserves PACW (MW)	Reason for infeasibility	Affected locations
26-May	10	9			190.5	-46.7	Resource Outage and Import/Export Changes	All locations in PAC West
26-May	10	10			75.6	160.0	Resource Outage and Import/Export Changes	All locations in PAC West
26-May	10	11			120.4	115.1	Resource Outage and Import/Export Changes	All locations in PAC West
26-May	10	12			234.7	0.9	Resource Outage and Import/Export Changes	All locations in PAC West
26-May	11	6			126.0	75.8	Resource Data Alignment and Renewable Deviation	All locations in PAC West
26-May	11	7			21.4	194.3	Resource Data Alignment and Renewable Deviation	All locations in PAC West
26-May	11	8			84.1	131.6	Resource Data Alignment and Renewable Deviation	All locations in PAC West
26-May	11	9			38.0	177.7	Resource Data Alignment and Renewable Deviation	All locations in PAC West
26-May	11	10			118.3	33.7	Resource Data Alignment and Renewable Deviation	All locations in PAC West

Table 2: List of undersupply infeasibilities in the five-minute market for both PAC East and West								
Trade Date	Hour Ending	Interval	Infeasibility PACE (MW)	Excess of Reserves PACE (MW)	Infeasibility PACW (MW)	Excess of Reserves PACW (MW)	Reason for infeasibility	Affected locations
26-May	11	11	80.6	108.7			Resource Data Alignment and Renewable Deviation	All locations in PAC East
26-May	11	12	37.4	151.9			Resource Data Alignment and Renewable Deviation	All locations in PAC East
26-May	12	1			29.6	126.4	Resource Outage and Import/Export Changes	All locations in PAC West
26-May	12	2			14.8	141.2	Resource Outage and Import/Export Changes	All locations in PAC West
26-May	12	3	6.7	110.2			Resource Outage and Import/Export Changes	All locations in PAC East
26-May	19	11			32.7	179.6	Import/Export Changes and Renewable Deviation	All locations in PAC West
26-May	19	12			3.6	208.7	Import/Export Changes and Renewable Deviation	All locations in PAC West
26-May	22	1			0.1	174.3	Import/Export Changes	All locations in PAC West
26-May	22	2			44.0	130.4	Import/Export Changes	All locations in PAC West

Table 2: List of undersupply infeasibilities in the five-minute market for both PAC East and West								
Trade Date	Hour Ending	Interval	Infeasibility PACE (MW)	Excess of Reserves PACE (MW)	Infeasibility PACW (MW)	Excess of Reserves PACW (MW)	Reason for infeasibility	Affected locations
26-May	22	3			2.4	171.9	Import/Export Changes	All locations in PAC West
26-May	22	6			5.6	166.7	Resource Outage and Import/Export Changes	All locations in PAC West
27-May	7	12			56.1	47.5	Resource Outage	All locations in PAC West
27-May	8	4			50.3	108.6	Resource Outage	All locations in PAC West
28-May	7	5	135.8	257.0	7.2	117.0	Resource Data Alignment	All locations in PAC East and West
28-May	7	6	105.5	287.3	16.8	107.5	Resource Data Alignment	All locations in PAC East and West
28-May	7	7	111.0	109.5			Resource Data Alignment	All locations in PAC East
28-May	7	8			23.3	94.2	Resource Data Alignment	All locations in PAC West
28-May	8	1	49.4	91.5			Resource Data Alignment	All locations in PAC East

Table 2: List of undersupply infeasibilities in the five-minute market for both PAC East and West								
Trade Date	Hour Ending	Interval	Infeasibility PACE (MW)	Excess of Reserves PACE (MW)	Infeasibility PACW (MW)	Excess of Reserves PACW (MW)	Reason for infeasibility	Affected locations
28-May	10	10			22.2	83.1	Import/Export Changes	All locations in PAC West
28-May	10	11			37.8	67.5	Import/Export Changes	All locations in PAC West
28-May	20	11			62.1	-36.2	Renewable Deviation	All locations in PAC West
29-May	10	11	27.1	89.8			Resource Data Alignment	All locations in PAC East
29-May	12	11	36.5	167.7			Import/Export Changes and Renewable Deviation	All locations in PAC East
29-May	13	1	15.1	155.8			Import/Export Changes and Renewable Deviation	All locations in PAC East

ATTACHMENT D:

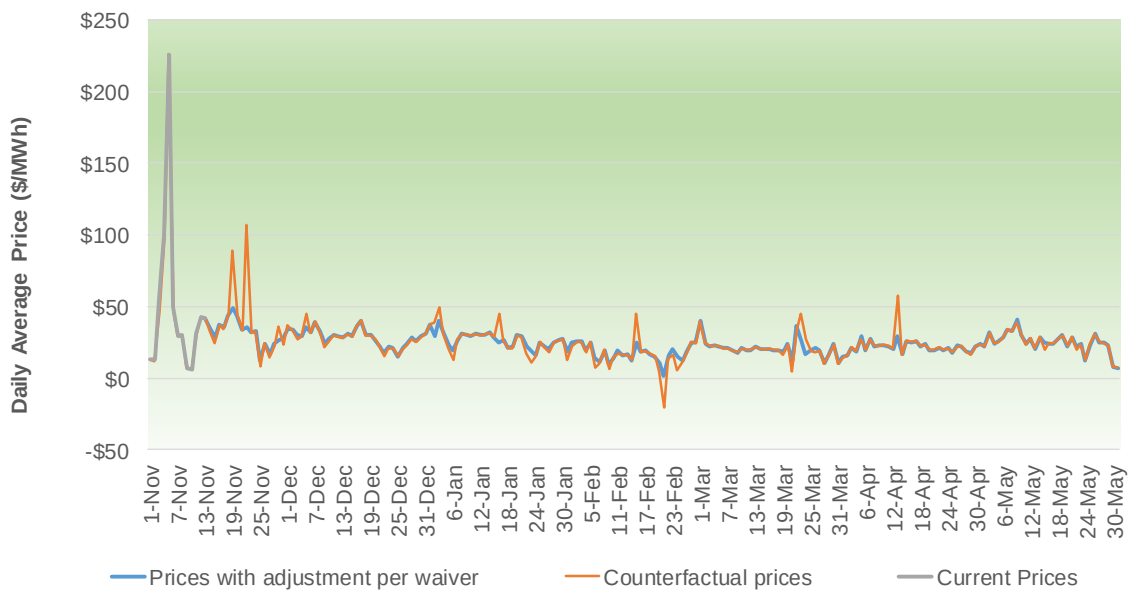
This attachment provides a quantitative and qualitative analysis of the market performance impact of the issues that prompted the CAISO's request for a waiver.

A. Impact of Issues on Market Prices

The figures in this subpart summarize the impact the issues would have had on prices absent the waiver pricing. During the term of the waiver, the CAISO established prices based on the price discovery mechanism and not based on the penalty prices that would have otherwise been in effect. The market does not produce prices as they would have been absent the waiver. Therefore, the CAISO created a counterfactual set of prices it compares to the prices that cleared based on the pricing in effect during the waiver. Because pricing under the waiver pricing is based on the last economic bid price signal, it is a proxy of what the prices would have been absent the seven category of issues. Therefore, the difference between the counterfactual pricing and the price in effect during the term of these reports illustrates the market impact.

The figures in this subpart also summarize the frequency with which the EIM entity failed the flexibility tests during the term of this report and the daily average price trends in the EIM organized by market and area. These trends include pricing for both the PAC West and PAC East external load aggregation points (ELAPs). The report focuses on the ELAP prices because these aggregate prices represent pricing in each area – PAC West and PAC East –, which allows the CAISO to reflect short-term imbalance shortage for the aggregate area. These daily averages reflect all prices of the real-time market, including the price corrected through the price correction process and the price adjustments under the waiver associated with this report.⁶

⁶ Note a separate waiver has been submitted requesting relief for period of November 1-November 13. These reports do not reflect any adjustments for this separate waiver request, which has not yet ruled on as of the date of this report.

Figure 5: Daily average of fifteen-minute market prices in PAC West.⁷

⁷ From November 14 through November 30 the CAISO implemented the price adjustments under the waiver retroactively and is making the adjustments in settlement statements after the December 1 order was issued. After December 1, there are no retroactive adjustments since the logic of the price discovery feature implemented under the waiver is implemented through the market clearing solution process. These prices, like any other prices, are still subject to the price validation and correction process. Section 35.4 of the CAISO tariff already 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 inconsistent with the CAISO tariff.

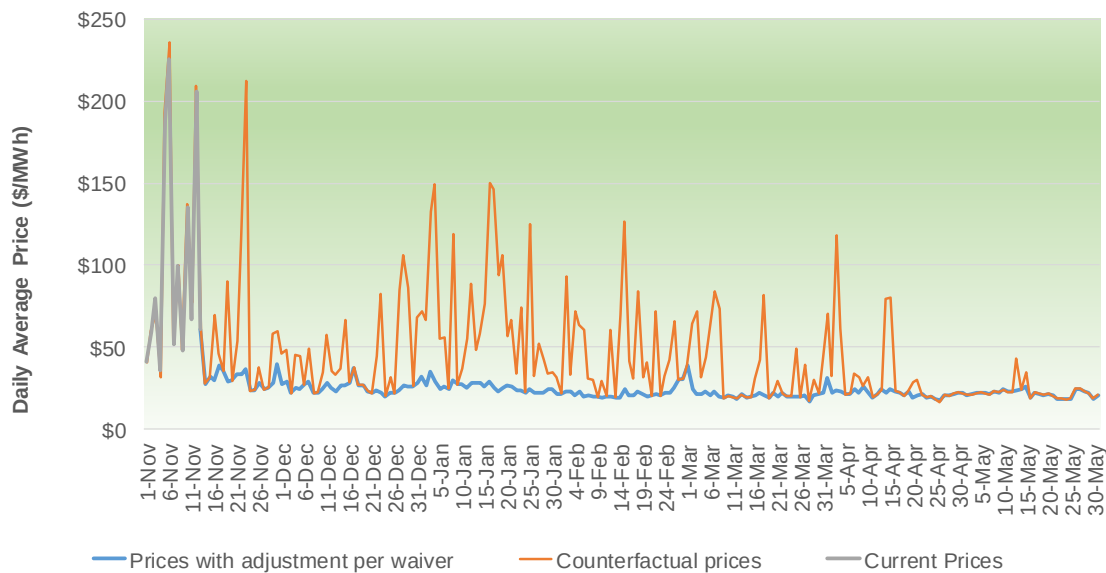
Figure 6: Daily average of fifteen-minute market prices in PAC East.

Figure 5 and Figure 6 each compare two trends for the same market and same area, PAC East and West respectively. The blue line illustrates daily average prices from November 14 on and represents the actual and final prices after any price corrections or price adjustments pursuant to the December 1 Waiver, which is the subject of this report. After November 14, even when there were power supply infeasibilities, per the December 1 Waiver, this trend reflects prices that are set based on the the marginal economic signal in the market and are not based on constraint relaxation pricing parameters. The price trends for November 1 through November 13 are represented in a different color than the the prices after November 14 because those represent the final prices as of this date, after all price corrections have been made. The prices for the November 1-13 include prices based on the constraint relaxation pricing parameters.

The orange line was constructed to estimate the counterfactual case of what prices would have been if they were based on the constraint relaxation pricing parameters, pegged to the \$1000/MWh bid cap. As of December 1, the CAISO adopted the waiver-based pricing in its systems, which means that the market systems produced prices consistent with the pricing mechanism under the waiver and not based on the constraint relaxation pricing parameters. Therefore, the CAISO had to find a way to reconstruct those cases, which it is referred to as the counterfactual case. In other words, the prices represented by the orange line represent the CAISO's estimate of what prices would have been absent the December 1 Waiver. These two lines compare together prices under the December 1 Wavier to what they would have been without that waiver.

The orange line is more volatile and spiky because those prices are calculated based on the \$1000/MWh any time there is an observed undersupply infeasibility. Whereas the blue line shows a more stable pricing trend reflecting dispatched economic bids. For the first 13 days of November, the lines in grey and orange track closely to each other but not exactly. The prices represented by the grey line are final as of now and include prices that even though there was infeasibility, for other reasons the prices were not based on the constraint relaxation pricing parameters. In the counterfactual case, the CAISO estimated that any interval with infeasibility would produce a price based on the constraint relaxation pricing parameter.

In addition, the prices for the counterfactual case in Figure 5 and Figure 6 were constructed based on the following two factors. First, because the goal of this report is to quantify and explain the price changes associated with the implementation of the December 1 Waiver, these trends do not include the reconstruction of prices related to price corrections and flexible ramping constraint infeasibility because:

- i) Price corrections. If a price was associated with a power balance infeasibility, but the interval was rendered to have an invalid price and was subject to price corrections for other reasons, the CAISO did not estimate the counterfactual price and instead the estimated and counterfactual price is equal to the final and current price. This is based on the premise that had the CAISO not experienced the issue that supported the price correction in the first place, the power balance infeasibility would not have triggered. Therefore, the market price would have been based on the tariff-based rules that consider the submitted economic bid prices rather than the penalty prices specified in the tariff.
- ii) Flexible ramp sufficiency test. As specified in section 29.34(n) of the CAISO tariff and section 10.3.2.1 of the Business Practice Manual for the EIM, 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. For the duration of the restricted interval, the market clearing price in the affected EIM Entity balancing authority area will also be based on the tariff-based rules that look at the last economic bid cleared in the fifteen-minute or five-minute interval in the EIM Entity balancing authority area. This logic is outside waiver of this report and with or without the waiver, the pricing mechanism will be in place. Therefore, the original price for market intervals that had power balance infeasibilities and that failed the flexible ramp test would have remained unchanged absent the waiver as they will not be set by

relaxation parameter prices under Section 10.3.2.1 of the BPM for the EIM.

- iii) Load Bias Limiter. The data shown in this report do not include intervals in which the CAISO has determined that the load-bias limiter functionality would have eliminated the infeasibility. The load bias limiter functionality does not serve the same purpose as the waiver pricing. As fully described in this proceeding, the waiver pricing applies in all instances to ensure learning curve type issues do not trigger parameter pricing.

The load-bias limiter is a feature in the CAISO markets that works independent of the waiver to ensure that an operator's adjustment of the load forecast is consistent with the system conditions. The feature essentially ensures a bias that exceeds the capabilities of the system does not create an infeasibility. The balancing authority operators can adjust the load forecast to ensure the load forecast reflects system need. The CAISO creates a forecast for the EIM balancing authority area as it does for the CAISO balancing authority area. However, the operator adjustments to load forecasts tend to be coarse adjustments, in increments of 10 to 50 MW. Also, the operator cannot know at that time exactly what the system ramp is and in making the adjustment, it could exceed the system's ability to respond. For example, an adjustment of 50-100 MW could exhaust 5-minute ramping capability. Such coarse adjustments, if more than necessary, can produce unnecessarily infeasible market solutions. To prevent such over-adjustment, the CAISO employs a load bias limiter in the CAISO balancing authority area, which automatically limits the course operator adjustment to the market systems to what is feasible as long as the quantify of the infeasibility is less than the operator adjustment and is in the same direction as the operator adjustment.

The CAISO employs the load bias limiter feature through the scheduling and pricing run as follows. If the scheduling run MW quantity of the infeasibility is less than or equal to the load bias, in the pricing run the infeasibility will be removed and will not trigger the pricing. This feature does not take effect if the MW quantity of the infeasibility exceeds the load bias or if the infeasibility is in the opposite direction of the load bias. This feature as applied in the CAISO area has avoided the artificial constraints that may arise from coarse adjustments. It is appropriate to apply the load-bias limiter regardless of the waiver because this is a feature that prevents an infeasibility that would occur only because of the course adjustment exceeds the capabilities of the system and, and not because it is actually needed. The CAISO's development of this feature pre-dated the implementation of the EIM and is unrelated to the EIM issues that led to the waiver

request. The CAISO did not deploy this feature as part of the EIM. However, after implementation and through analysis of infeasibilities and discussions with DMM, the ISO found that certain infeasibilities were caused by biases to load forecast by operators that were not consistent with the system capabilities at the time. In previous reports the ISO reported such instances under the classification of Load Adjustment. Through discussions with DMM, the CAISO pursued to adopt the load bias limiter feature for the EIM as well to prevent the system from observing infeasibilities due to biases that exceed system requirements. This feature was made available to the EIM area starting on March 20, 2015. However, during the term of the waiver, because the waiver pricing procedure does not allow the CAISO to set the price based on the tariff-based parameter when there infeasibility whether or not there is a load bias in a given interval, the load bias limiter is superseded by the waiver based pricing and is not active in the EIM balancing authority area. Once the waiver terminates, the load bias limiter will be active in the EIM as it is in the CAISO balancing authority area.

An important feature of the load bias limiter is that it only prevents the infeasibility in the interval in which there is a bias. If there is no bias the feature does not kick in. Another important aspect of the feature is that eventually, the load forecast itself will catch up to reflect actual load. Therefore, if the load bias was consistent with actual load, the load forecast increases to reflect actual load, and the operator no longer biases the load forecast, the load bias limiter will not trigger. If in such intervals, the power balance constraint is relaxed, absent the waiver pricing rules currently in effect, the CAISO will use the tariff-based parameters to establish prices.

Because but for the waiver the load bias limiter would be effective starting on March 20, in its March report and in this April report, the CAISO did not include in the data reported in Attachment A those intervals in which the load bias limiter would have prevented the infeasibility. These reports target infeasibilities related to learning issues that led to the CAISO's request for the waiver. However, the frequency of these infeasibilities is explicitly provided in Attachment E together with the overall classification of infeasibilities.

Finally, the CAISO is exploring enhancements to the load bias limiter feature for both the CAISO and EIM balancing authority areas, including the recommendation by the Department of Market Monitoring to better reflect the impact of excessive load bias adjustments on creating power balance shortages. Specifically, DMM recommended that the CAISO consider that the adjustment made by the load limit biaser

be based on the *change* in load bias from one interval to the next instead of the *absolute value* of any positive load bias.⁸

Under the current approach, the CAISO may be missing correction of infeasibilities due to sudden changes in biases. For example, the operator may first bias the load forecast down to 500 and then in the next interval down to 300 MW. The reduction to 300MW will not trigger the load bias limiter if the infeasibility is in the positive direction given that the bias was in the opposite direction. However, the sudden change bias causes an infeasibility itself. The CAISO is considering enhancements to ensure that such sudden changes in biases that cause infeasibilities are captured by the feature as well.

The current approach may also result in unnecessary triggering of the load bias limiter in intervals that have a persistent bias that is not really intended. For example, as discussed above operators make coarse biases to the load forecast and sometimes set the bias for a number of intervals and then inadvertently do not remove the bias even when it is no longer necessary. The CAISO is considering enhancements to reduce such persistent bias because they may trigger the load limit biaser unnecessarily.

Second, the prices reflecting the tariff-based relaxation parameters were reconstructed for both under-supply and over-supply infeasibilities. This means that when an instance of undersupply was reconstructed, the price was set to the bid cap plus/minus marginal loss component. Similarly, when an oversupply instance was reconstructed, the prices in the counterfactual case were set to the bid floor relaxation parameter plus/minus marginal loss prices.

During the term of these reports, in some intervals the market clearing process experienced “degenerate cases” during which the market may clear at multiple pricing run solutions equally valid from an economic perspective. The CAISO has recently stakeholdered and the CAISO board of governors has approved a solution to this phenomena and intends to file a tariff amendment to implement this change. These upcoming market rule changes eliminate the multiplicity of pricing issue and produce one price that reflects the lack of congestion at the locations. During such cases, even had the market systems observed an infeasibility that would have led to the relaxation of a constraint and triggered the penalty pricing parameters, the pricing run could have landed at a price based on the marginal resource economic bid price, which could differ from the price had it been based on the \$1000/MWh parameter. The CAISO observed many intervals in which this phenomena occurred, in particular in the five minute real-time dispatch. The CAISO does not correct and believes these to be optimal

⁸ See DMM Report, p. 13 (May 7, 2015).

from the perspective of the energy market alone. But because of issues this may cause in associated markets such as the congestion revenue rights, the CAISO will modify its market rules prospectively to eliminate such occurrences.⁹

The counterfactual case represented by the orange line cannot account for the degeneracy and represents what prices would have been for those intervals based on the tariff-based constraint relaxation pricing parameters because there was an infeasibility. This has implications regarding the trends in the figures below. For the first 13 days in November, the CAISO has not yet modified posted prices based on the waiver-type pricing. The CAISO filed for an additional waiver to conduct this pricing adjustment and it is pending before the Commission in FERC Docket No. ER15-817. Without the waiver, the prices as posted would remain as they are. One would expect the counterfactual case represented by the orange line to be close to the posted prices represented by the blue line. This is the case for the fifteen-minute markets. However, for the real-time dispatch, the lines diverge because in several intervals posted prices appear to have not been determined based on the \$1000/MWh parameter even if there was infeasibility. The CAISO believes this was because many of the affected intervals were subject to degeneracy. After November 13, however, whether or not there would have been degeneracy in the pricing run, is immaterial, because pricing under the December 1 waiver or degeneracy is based on the last economic bid price signal.

⁹ Additional information regarding the stakeholder process and the resulting policy changes is available at: <http://www.caiso.com/informed/Pages/StakeholderProcesses/PricingEnhancements.aspx>. This will be the subject of an upcoming tariff amendment with the Commission.

Figure 7: Daily average of five-minute market prices in PAC West.

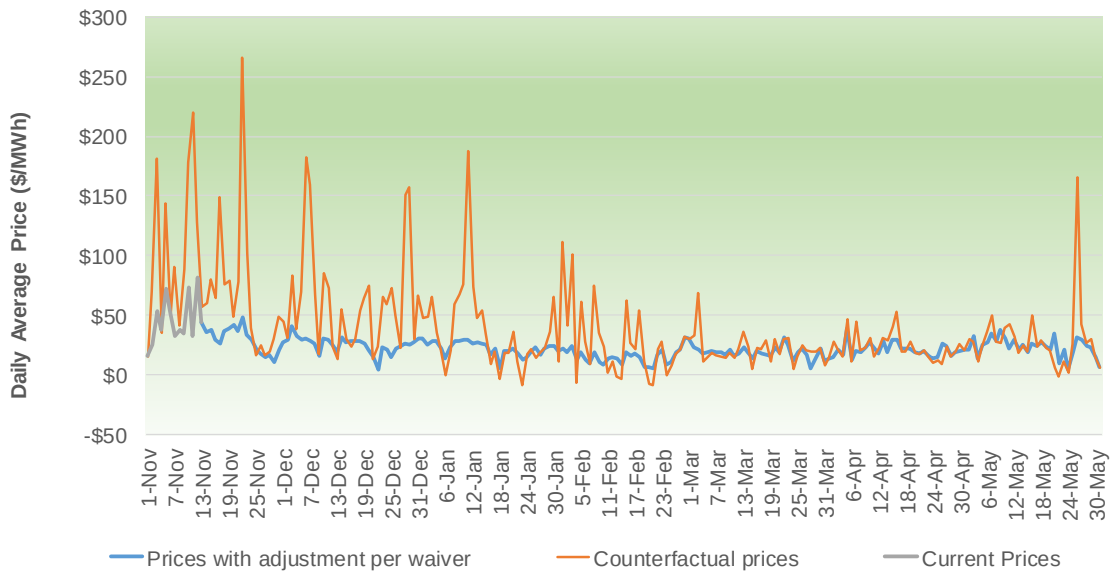
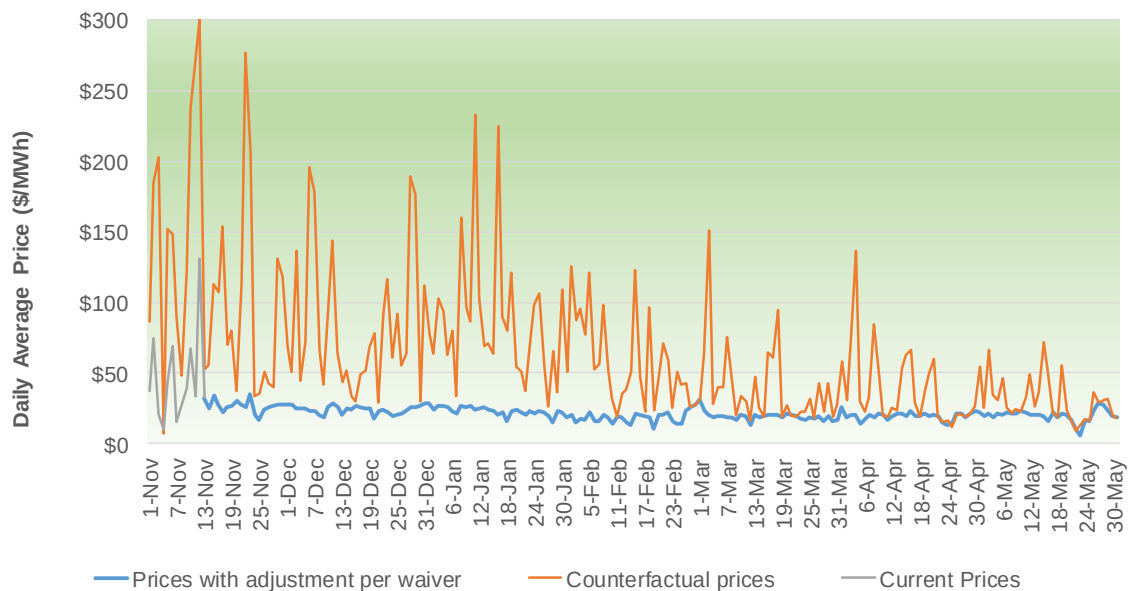


Figure 8: Daily average of five-minute market prices in PAC East.

Overall, PAC East is more volatile and subject to more frequent price excursions than PAC West. This may be due to limited transfers into the PAC East area. PAC West does not share such limitations that enable more transfers in and out of the CAISO balancing authority areas to PAC West.

In both PAC East and PAC West, the five-minute real-time dispatch is notably more volatile than the fifteen-minute market. This is because the fifteen-minute market embodies more flexibility as it is further in time than the intervals whereas the five-minute real-time dispatch is closer to real-time. In the five-minute dispatch, ramping capability is more limited. Figure 9 and Figure 10 provide monthly averages of the prices as modified under the December 1 Waiver and are final as of now. These include price corrections and price adjustments under waiver of this report. These figures show that the average price for energy in both the PAC East and West have increased slight in April 2015, around \$21.8/MWh in the fifteen-minute market and around \$20/MWh in the five-minute market.

Figure 9: Monthly average of fifteen-minute market prices in PAC West and East.

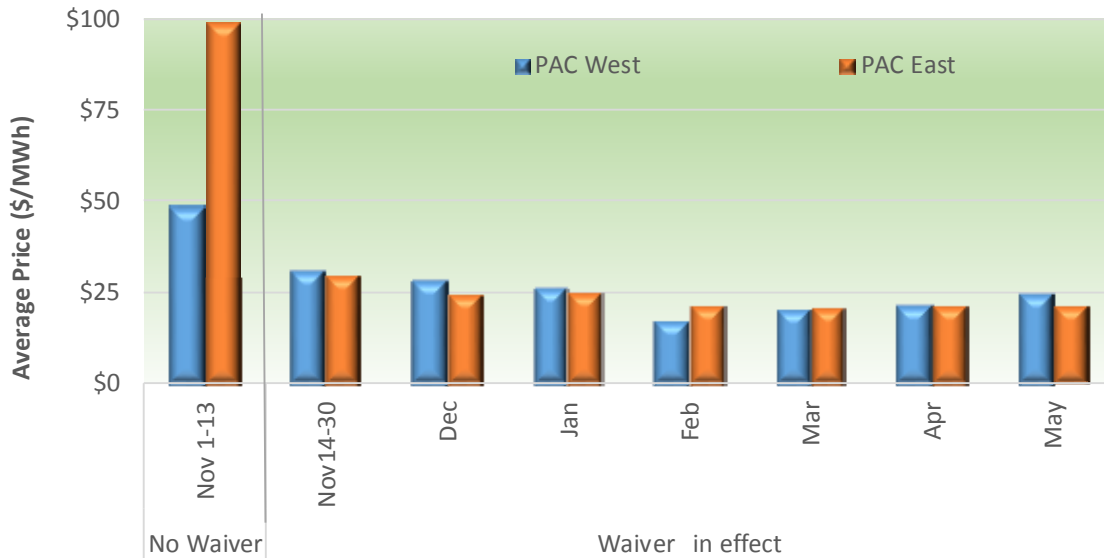
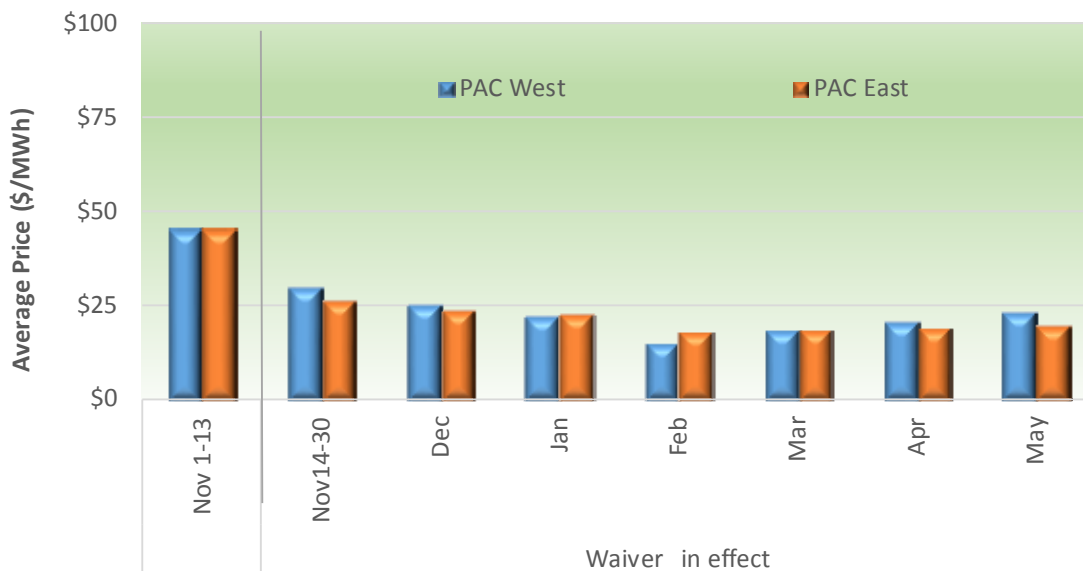


Figure 10: Monthly average of five-minute market prices in PAC West and East.



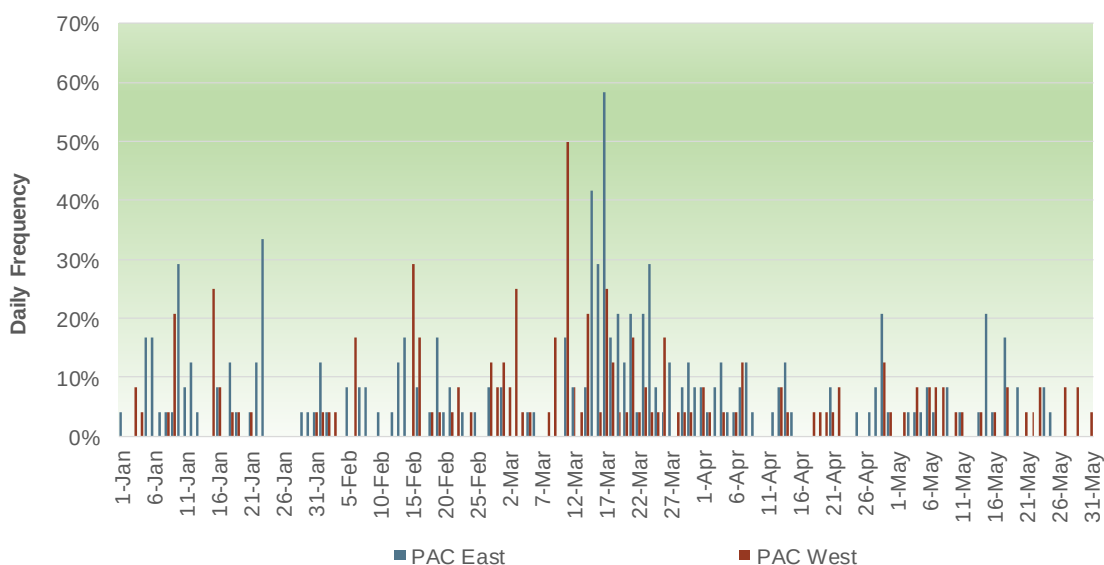
B. Balance Test Failures

shows the trend of balancing test failures for the period of January 1, 2015, through April 30, 2015, of operation of the EIM by area, PAC West and East. The frequency of balancing test failures decreased to a daily average of 3.9 percent in the month of April. The average imbalance was 98 MW and 34 MW in PAC East and West, respectively. The increase in frequency of balancing test failure appears to be driven by two issues: 1) an error in the net schedule

interchange for both PACE and PACW reported for the balancing test compared to the net schedule interchange supplied for the fifteen- and five-minute markets; and 2) incorrect disqualification of base schedules from certain multi-stage generating units. These issues did not appear to influence imbalance infeasibilities.

Figure 11 shows the trend of balancing test failures for the period of January 1, 2015, through April 30, 2015, of operation of the EIM by area, PAC West and East. The frequency of balancing test failures decreased to a daily average of 3.9 percent in the month of April. The average imbalance was 98 MW and 34 MW in PAC East and West, respectively. The increase in frequency of balancing test failure appears to be driven by two issues: 1) an error in the net schedule interchange for both PACE and PACW reported for the balancing test compared to the net schedule interchange supplied for the fifteen- and five-minute markets; and 2) incorrect disqualification of base schedules from certain multi-stage generating units. These issues did not appear to influence imbalance infeasibilities.

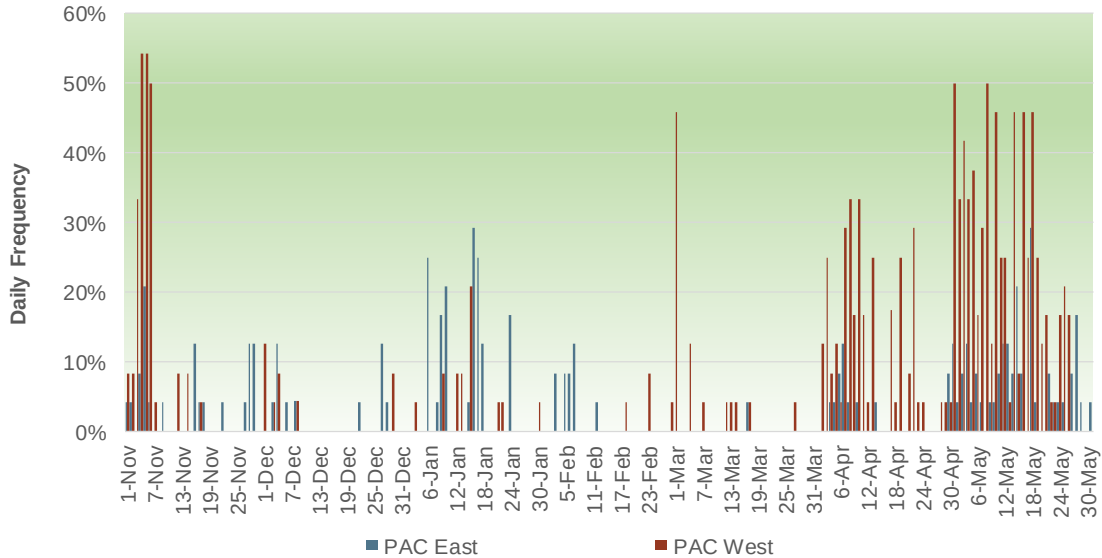
Figure 11: Frequency of balancing test failures in PAC West and East.



As specified in section 29.34(n) of the CAISO tariff and section 10.3.2.1 of the Business Practice Manual for the EIM, 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. 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 those balancing authority area-to-area group constraints. This sufficiency

test applies to each PAC West and East area on an hourly basis. Figure 12 shows the trend of test failures for flexible ramping for the first two months of operation of the energy imbalance market. The CAISO obtained the frequency by dividing the number of hours failed by 24 hours of a day.¹⁰

Figure 12: Frequency of flexible ramp sufficiency test failures in PAC West and East.



¹⁰ During the term of the waiver, the procedure described in Section 10.3.2.1 of the Business Practice Manual is made ineffective under the pricing procedure under the waiver.

ATTACHMENT E

In addition to the CAISO reporting on each relaxation event in Attachment B, this Attachment E provides a summary of the magnitude and frequency of such events overall.¹¹

The relaxation events affect numerous market intervals as the CAISO real-time markets contain many fifteen- and five-minute intervals. The CAISO provides the information at summary level because the data is significant and detailed reporting of such events would not be meaningful. The report focuses on the external load aggregation points (ELAP) prices because these aggregate prices represent pricing in each area – West and East – and therefore, reflect short-term imbalance shortage for the aggregate area.

¹¹ *December 1 Order*, at P 26.

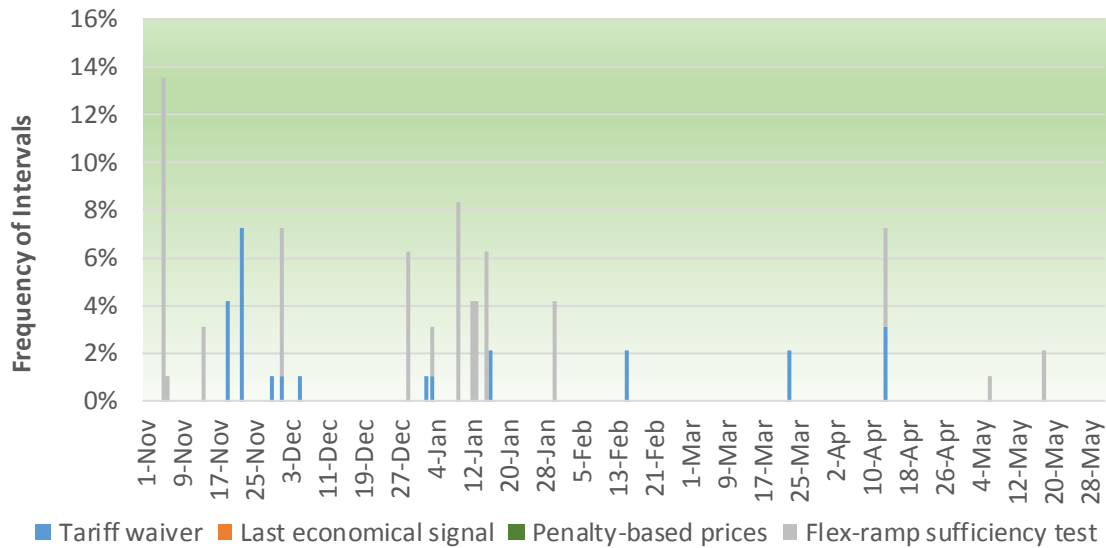
Figure 13 through Figure 20 provide summary information on the instances of power balance relaxation for undersupply (shortage) in the fifteen- and five-minute market in the PAC West and East area. Normally, when there are such infeasibilities, prices will be based on the constraint relaxation pricing parameter, and prices will be near or at \$1000/MWh. However, there are three cases where this would not occur and this is reflected in the data supporting the figures in this report. First, as of December 1st consistent with the December 1 tariff waiver, the price is based on the last economic signal consistent with the pricing principles in the tariff. Second, as described in more detail in Attachment A, when the EIM Entity fails the flexible ramping sufficiency test, prices are calculated using the same approach based on the last economic signal for the duration of the restricted interval. Therefore, in these intervals, even if the CAISO had not received the waiver, the CAISO would have implemented the procedure described in Section 10.3.2.1 of the Business Practice Manual, and price based the last economic bid cleared in the fifteen-minute or five-minute interval in the EIM Entity balancing authority area as opposed to the \$1000/MWh bid cap.¹²

In the December 15, 2014 report, the CAISO noted there was a third case in which it had observed the power balance constraint was relaxed in the scheduling run, but prices did not reflect the \$1000/MWh. The CAISO has since evaluated these cases more closely and as discussed in Attachment A, sometimes the market is in a degeneracy case, and the market clears based on the last economic signal. The CAISO is continuing to investigate these intervals to ensure these events are not due to other abnormalities and are due to degeneracy. As explained in Attachment A, after implementing the pricing procedure under the December 1 waiver there is no pricing based on the degeneracy cases because the pricing procedure under the December 1 waiver governs over the pricing.

¹² The price discovery mechanism under the procedure described in Section 10.3.2.1 of the BPM for Energy Imbalance Market is, however, essentially the same price discovery procedure used under the December 1 Order waiver.

Figure 13 through Figure 20 exclude the intervals invalid. These figures show the frequency of infeasibilities organized by instances in which the prices were set based on 1) the last economic bid price signal as per the tariff waiver, referred to in the figures as “Tariff waiver,” 2) the \$1000/MWh penalty price parameter, referred to in the figures as “Penalty-based prices” 3) last economical signal from degeneracy referred as “Last economical signal” and 4) the last economic signal but because for those intervals the EIM entity failed the flexible ramping sufficient test, referred to as the “Flex-ramp sufficient test.” Each figure of the frequency of infeasibilities is accompanied with a figure the magnitude of infeasibilities. The reported events are also aggregated daily and depicted with an infeasibility range shown by the vertical line in blue. The ends of the vertical blue lines represent the minimum and maximum values of power balance relaxation in each day. The average magnitude of the infeasibility is shown by the red marker on the blue vertical lines.

Figure 13: Frequency of under-supply infeasibility in PAC West. Fifteen-minute market.



For the period of November 1 through November 13, the data on the magnitude of infeasibility in the fifteen-minute market was not preserved in the data system. This impedes the CAISO’s ability to identify the cases with infeasibility and quantify their magnitude. However, such instances were conservatively estimated by analyzing the cases where prices reached the relaxation-based levels of \$1000/MWh.

Figure 14: Magnitude of undersupply infeasibility in PAC West. Fifteen-minute market.

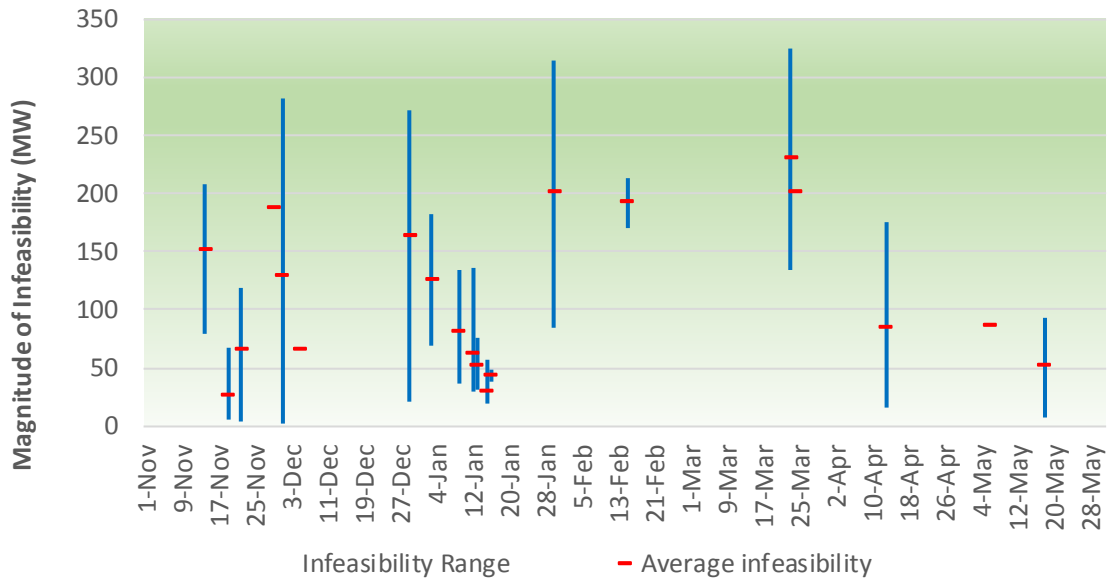


Figure 15: Frequency of undersupply infeasibility PAC East. Fifteen-minute market.

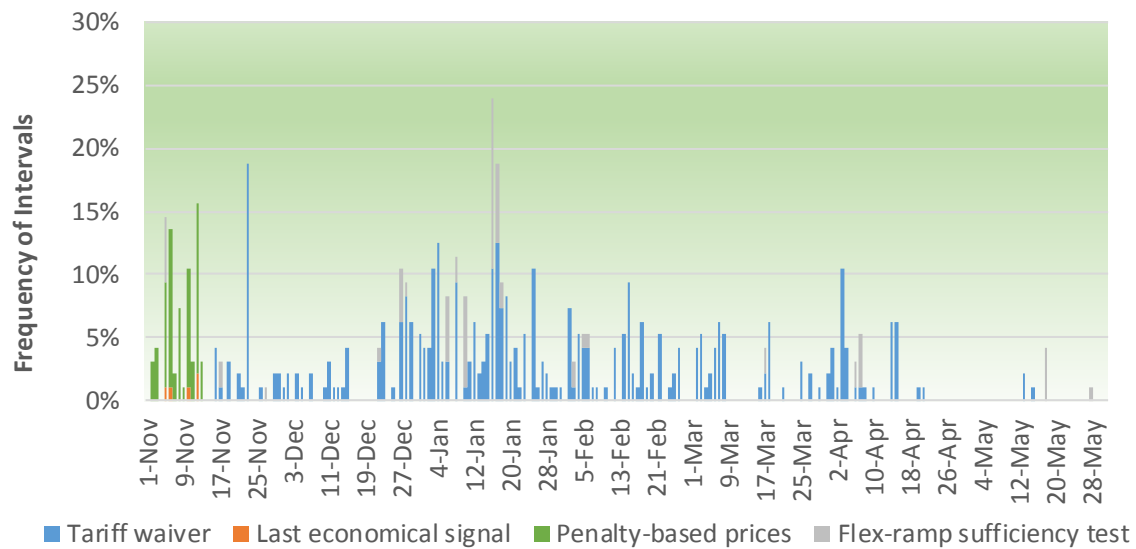


Figure 16: Magnitude of undersupply infeasibility PAC East. Fifteen-minute market.

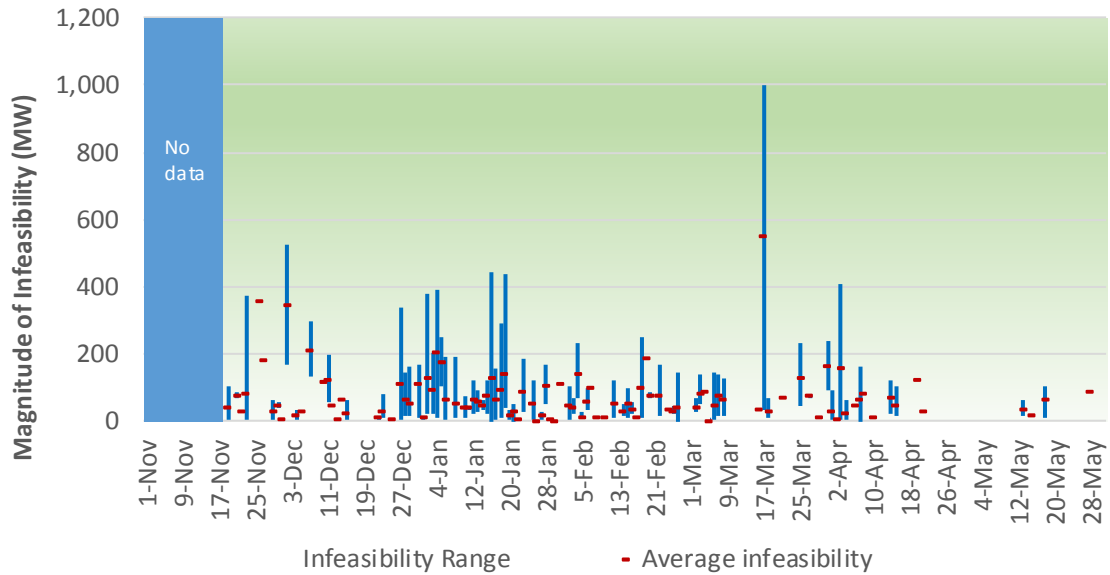


Figure 17: Frequency of undersupply infeasibility PAC West. Five-minute market.

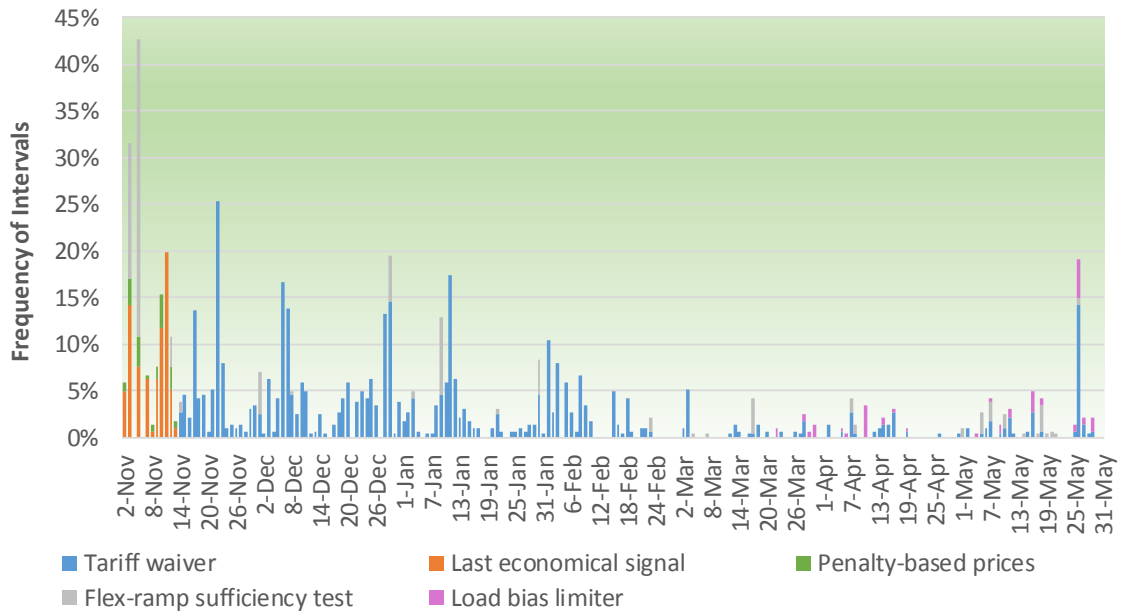


Figure 18: Magnitude of undersupply infeasibility PAC West. Five-minute market.

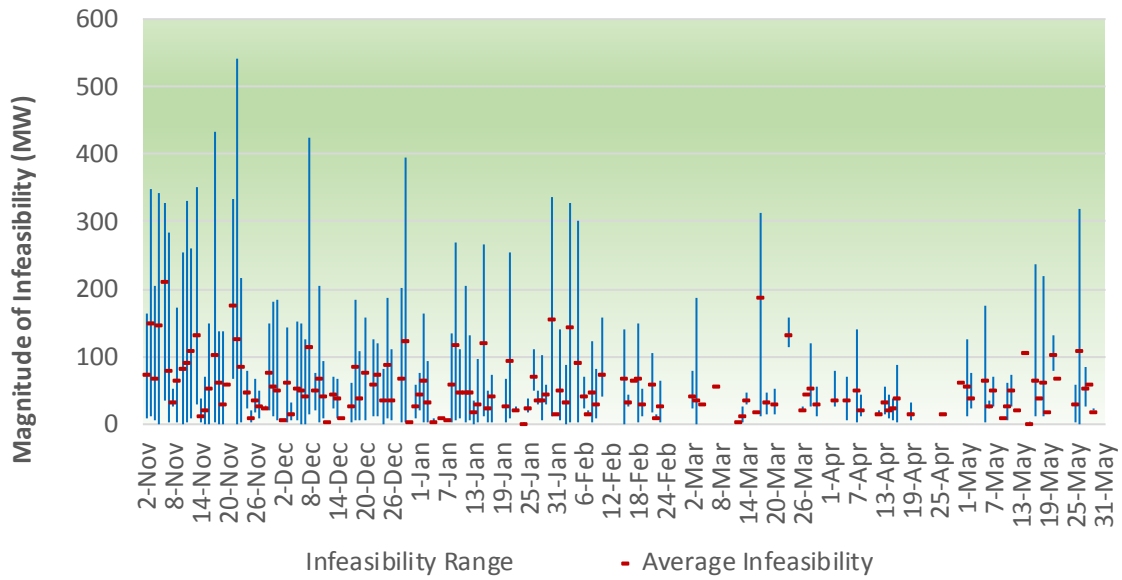


Figure 19: Frequency of undersupply infeasibility PAC East. Five-minute market.

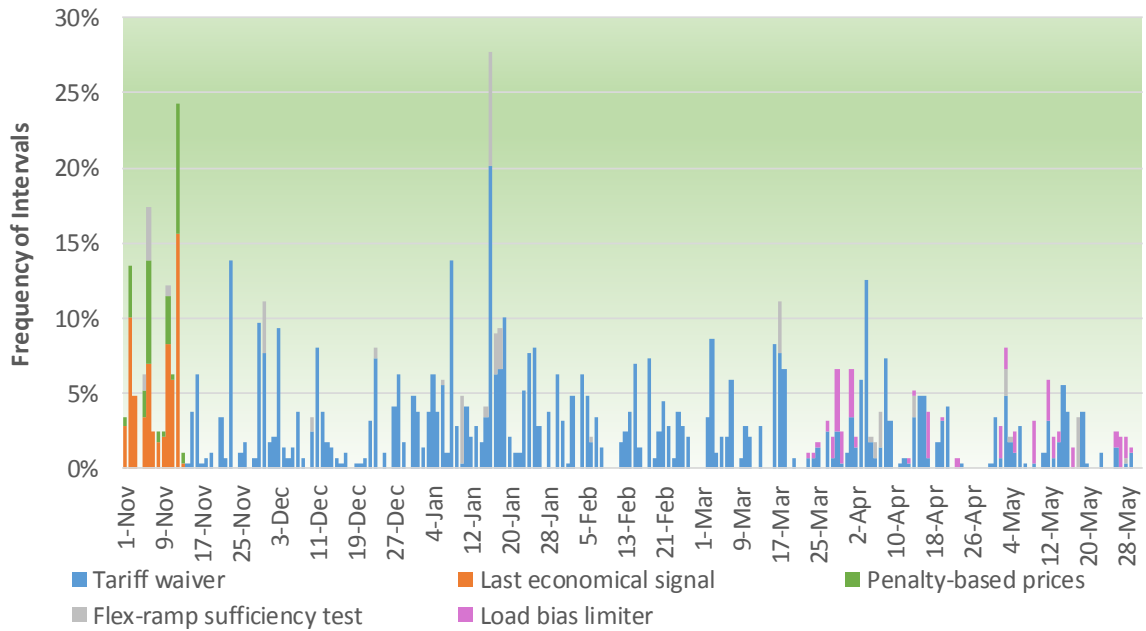
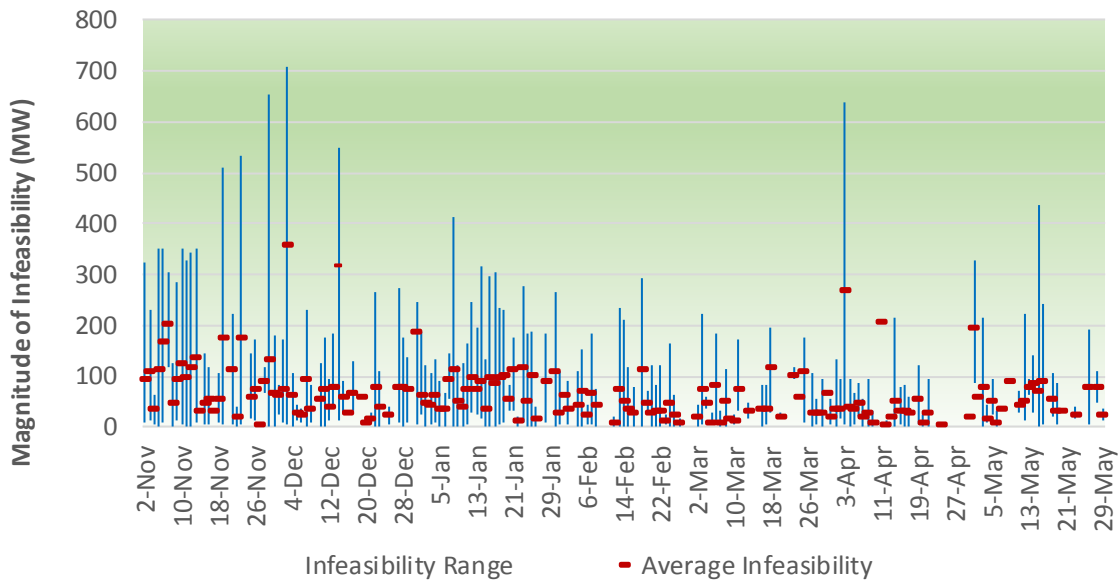


Figure 20: Magnitude of undersupply infeasibility PAC East. Five-minute market.



The imbalance energy transfers may also be subject to relaxation to address infeasibilities. There were few instances only in the PAC East transfer that resulted in relaxation and there were no instances of relaxation of EIM transfers between PAC and CAISO. The summary of these instances are listed in Table 1.

Table 2. All these instances occurred before the period applicable for the waiver associated with this report; there were no valid EIM transfer infeasibilities observed in January and February. Three invalid infeasibilities were on PAC East on January 15 due to a software issue addressed through the standard process of price corrections.

**Table 1: Statistics of EIM transfer infeasibilities for PAC East.
Fifteen-minute market.**

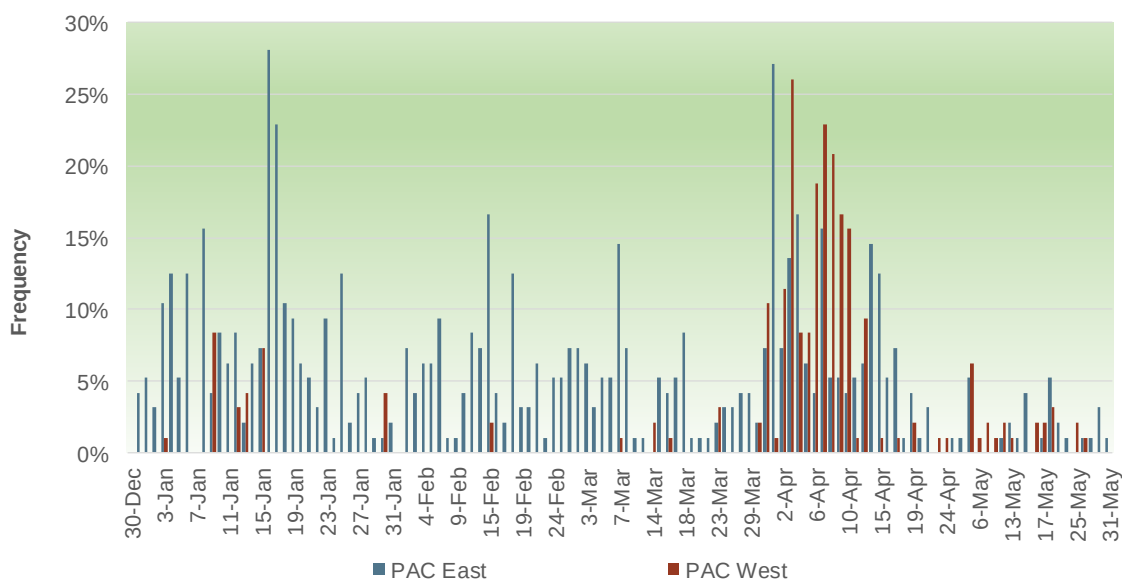
Date	Maximum	Minimum	Average	Count
6-Nov-14	51.4	1.1	26.2	2
10-Nov-14	121.0	121.0	121.0	1
12-Nov-14	126.7	72.0	99.3	2
13-Nov-14	130.9	16.9	76.2	3

**Table 2: Statistics of EIM transfer infeasibilities for PAC East.
Five-minute market.**

Date	Maximum	Minimum	Average	Count
6-Nov-14	65.2	65.2	65.2	1
10-Nov-14	114.3	97.9	106.1	2

For completeness, the data in this report also includes those cases in which there was a relaxation of flexible ramp constraint; the data is organized by PAC West and East in Figure 21.

Figure 21: Frequency of flexible ramp constraint infeasibility in PAC



Finally, this report also includes information about infeasibility for over supply conditions even though these cases are not reflected in the waiver requested in this proceeding. The penalty prices specified in sections 27.4.3.2 and 27.4.3.4 only pertain to infeasibility cases in which there is under-supply. The penalty prices for the over-supply conditions are specified in section 6.6.5 of the BPM for Market Operations. Figure 22 through

Figure 29 provide the over-supply metrics.

Figure 22: Frequency of oversupply infeasibility PAC West. Fifteen-minute market.

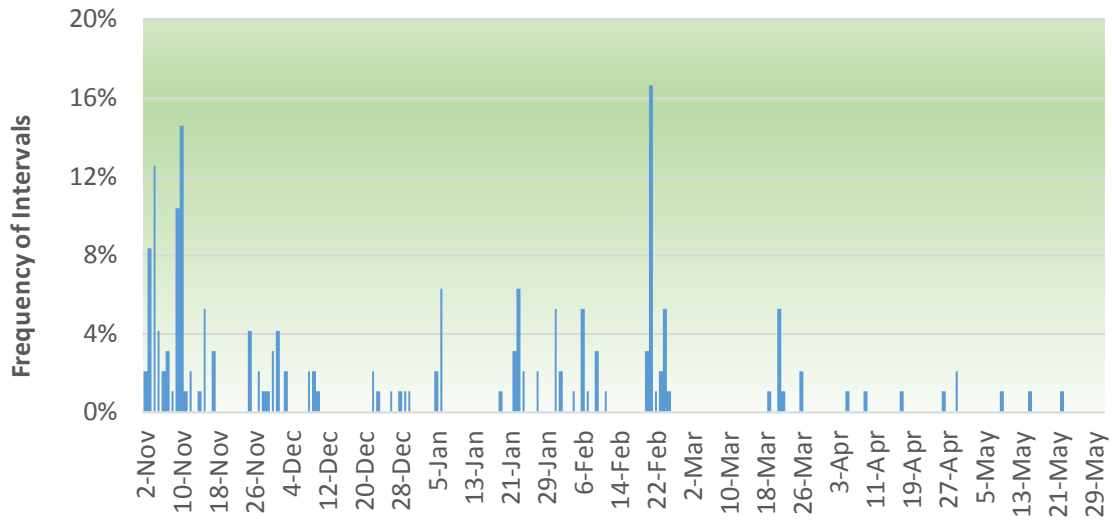


Figure 23: Magnitude of oversupply infeasibility PAC West. Fifteen-minute market.

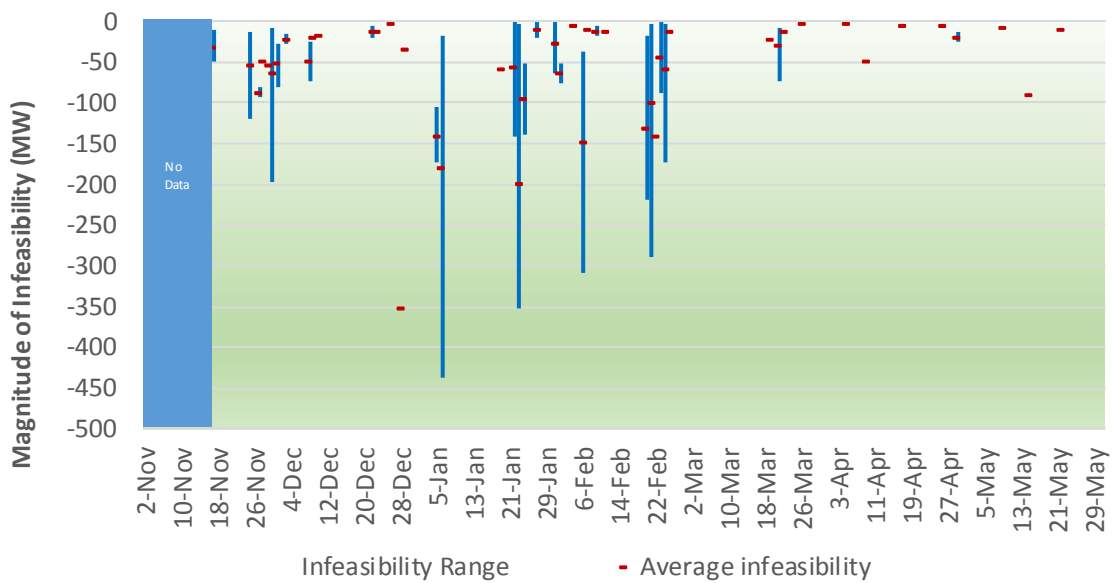


Figure 24: Frequency of oversupply infeasibility PAC East. Fifteen-minute market.

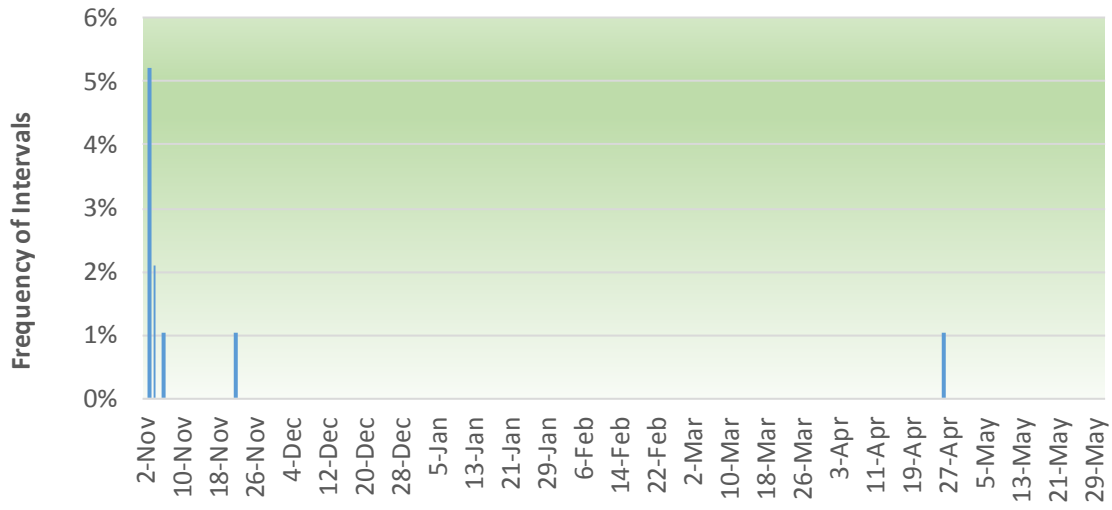


Figure 25: Magnitude of oversupply infeasibility PAC East. Fifteen-minute market.

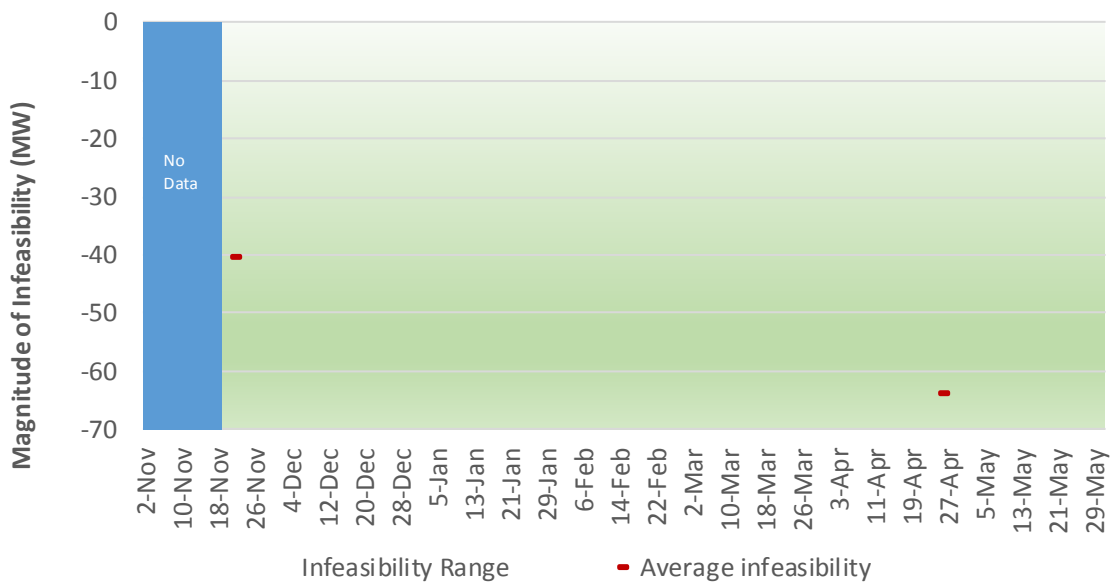


Figure 26: Frequency of oversupply infeasibility PAC West. Five-minute market.

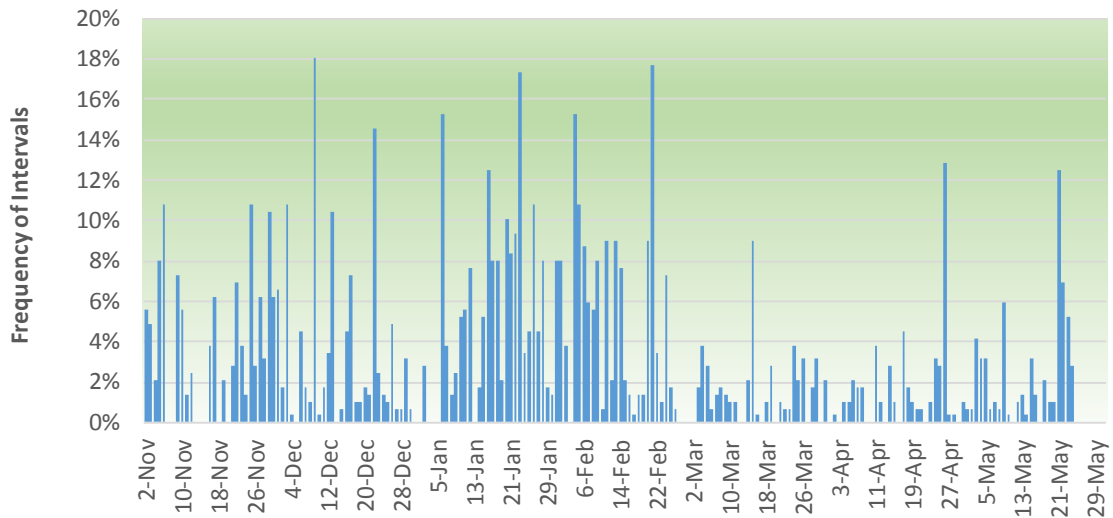


Figure 27: Magnitude of oversupply infeasibility PAC West. Five-minute market.

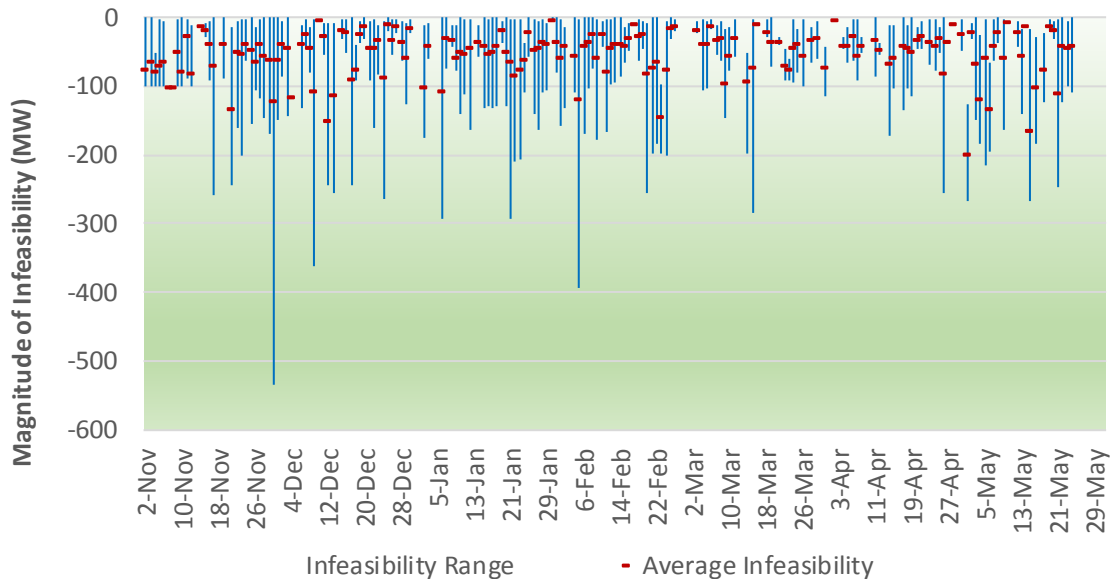


Figure 28: Frequency of oversupply infeasibility PAC East. Five-minute market.

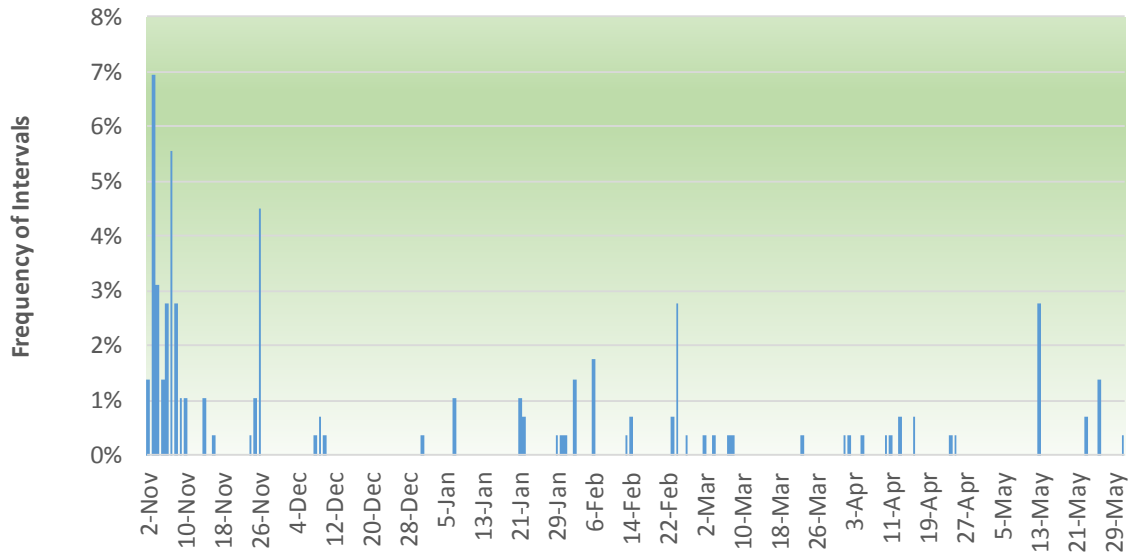
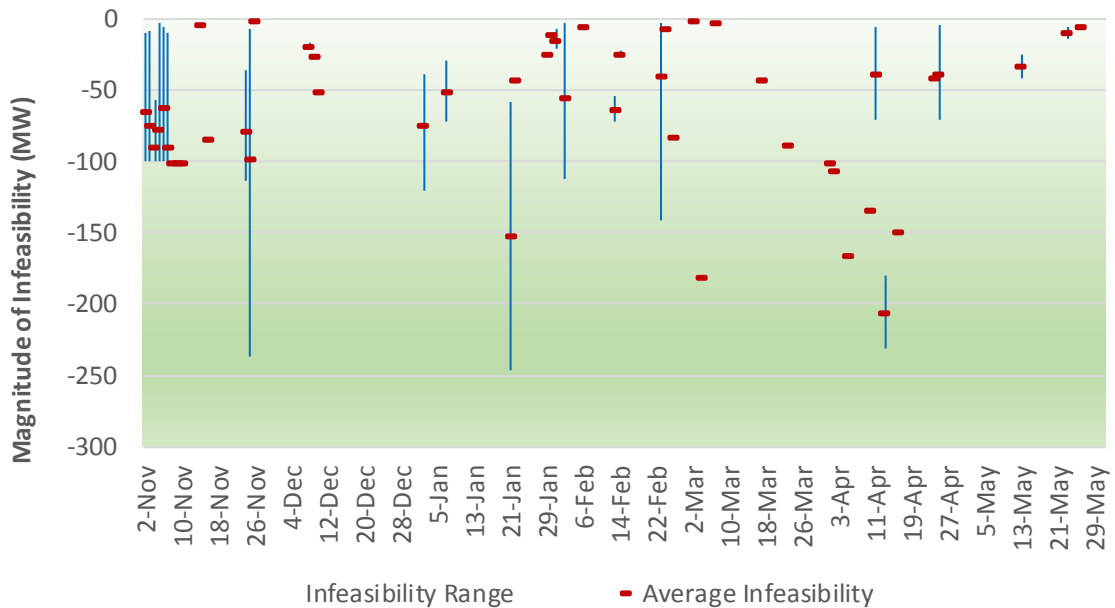


Figure 29: Magnitude of oversupply infeasibility PAC East. Five-minute market.



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 14th day of July, 2015.

/s/ Anna Pascuzzo
Anna Pascuzzo

Attachment 4

**UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION**

**California Independent System
Operator Corporation**

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)
)

**Docket Nos. ER15-861-000
and EL15-53-000**

**COMMENTS OF THE
CALIFORNIA INDEPENDENT SYSTEM OPERATOR CORPORATION
ON TECHNICAL CONFERENCE**

The California Independent System Operator Corporation (CAISO) submits these comments on the technical conference held on April 9, 2015, regarding certain pricing excursions based on constraint relaxation parameters and not actual bids that have occurred in the CAISO's Energy Imbalance Market (EIM). During the technical conference, the CAISO indicated that it was developing a market enhancement to address the pricing excursions and would present its proposed solution in comments filed on the technical conference. The CAISO describes its proposal below. The CAISO also responds to questions posed by Commission staff at the technical conference.

Over the past six months the CAISO and PacifiCorp have undertaken significant efforts to successfully implement the first in the Western interconnection. Both shared a substantial amount of information at the April 9, 2015 technical conference and provided a robust survey of the types of post implementation issues they have experienced in the EIM. The CAISO and PacifiCorp have submitted 6 reports, providing detailed information on the issues experienced, the magnitude and frequency of the issues, and the remedial actions each party has taken. The information provided by the CAISO and

PacifiCorp illustrate that the price excursions experienced after the launch, which would have persisted but for the waiver granted by the Commission, resulted from several post-launch issues that could only be identified in an actual production environment. Further, the CAISO and PacifiCorp could only remedy the root causes of such price excursions after gaining experience with the new market and developing, testing, deploying, and reevaluating procedures and remedial measures. Closer evaluation of the total capacity available to PacifiCorp as the balancing authority shows that PacifiCorp has been sufficiently resourced to balance its system and meet load consistent with NERC requirements during this time.

Lessons learned by both parties have led to an enhanced appreciation for the importance of ensuring that the market systems are accurately and timely informed of the amount of capacity available to the EIM entity balancing authority area to balance load. In 95% of market intervals there were sufficient effective economic bids available to manage the imbalance needs. However, in a much smaller number of intervals there were infeasibilities, which were primarily caused by imperfect or delayed information that left the market systems to conclude that there were infeasibilities, when in fact the EIM entity was sufficiently resourced and used those resources to balance the system reliably. Some of these information gaps were due to processing issues related to the post-implementation learning curve. Deeper analysis of the post-implementation issues reveals that under the current EIM functionality there is insufficient time to manually reflect the actions the EIM balancing authority takes in manually deploying its load following and regulation capacity accurately to the market systems. Therefore, the CAISO proposes to adopt an automated feature that will ensure the CAISO market

systems accurately and timely reflect available capacity and operator actions taken in the EIM balancing areas.

The CAISO can implement the automated solution discussed in these comments in a relatively short time and anticipates to be ready to do so by August 24, 2015. This solution will better inform the market systems of capacity available to the EIM balancing authority to address infeasibilities of either the transmission or power balance constraints within the EIM balancing authority area. This will eliminate pricing excursions resulting from misinformed market runs based on false scarcity conditions, when in fact, the EIM balancing authority area was not actually short of available capability including load following or regulation capability. This solution will not, however, eliminate the potential for price excursions that are related to the EIM's learning to manage its total supply resources to balance its balancing area in concert with operating in the new market environment.

In the interim, PacifiCorp and the CAISO will continue to deploy the manual solutions that enable PacifiCorp to inform the EIM of its deployment of additional available capacity. Although the manual measures will minimize the false infeasibilities previously observed, they are still susceptible to human error and processing challenges. The automated feature proposed by the CAISO would significantly ameliorate such risks.

The CAISO respectfully requests that the Commission issue an order directing the CAISO to file tariff revisions to implement these enhancements and resolve the

Commission's investigation in Docket EL15-53. The CAISO believes it can implement these measures by August 24, 2015.¹

I. Background

The CAISO implemented the EIM on November 1, 2014. Following implementation, certain transitional conditions arose that restricted the timing and amount of capacity available through the market clearing process. These conditions caused the transmission and power balance constraints described in sections 27.4.3.2 and 27.4.3.4 of the CAISO tariff to bind more frequently than expected, producing atypically high prices in the fifteen-minute and five-minute markets in the balancing authority areas of PacifiCorp, the first participating EIM entity. The CAISO determined that a combination of factors -- system conditions, operations processes, the contemporaneous level of EIM participating resources, timeliness and accurate transmission of information regarding manual balancing authority actions, and the new operating environment -- restricted the amount of effective economic bids to relieve the power balance and transmission constraints.

To address these circumstances, on November 13, 2014, the CAISO requested that the Commission grant a 90-day limited waiver of CAISO tariff section 27.4.3.2 and the second sentence of section 27.4.3.4 to allow the CAISO to retain the ability to relax the constraints described in those sections without applying the administrative pricing parameter that sets the price at the maximum energy bid price of \$1,000/MWh. Instead, under the requested waiver, the CAISO proposed to use the pricing mechanism that

¹ On April 15, 2015, the CAISO moved that the Commission modify the refund effective date to this date and extend the current waiver to enable the CAISO to develop the proposed solution and implement it as soon as possible with minimal impact to rate-payers.

applies when there are sufficient effective economic bids to allow a feasible market solution, *i.e.*, market participants will pay or receive the fifteen-minute market or real-time dispatch locational marginal price, as determined using the locational marginal prices, consistent with Sections 27.1.1, 34.20, and Appendix C of the CAISO tariff.² On December 1, 2014, the Commission granted the CAISO's requested waiver.³ On February 12, 2015, the Commission extended the waiver, at the CAISO's request, until the earlier of March 16, 2015 or the date the Commission issued a subsequent order in this proceeding.

Although by then the CAISO and PacifiCorp had made substantial progress in addressing the issues that gave rise to the price excursions, the CAISO concluded that integration into a sophisticated centralized market would be a major paradigm shift for any new EIM entity. Such a transition requires a learning period to develop new capabilities and mitigate deficiencies in market tools and procedures that may otherwise misinform the market systems and produce anomalous results. Therefore, on January 15, 2015, the CAISO proposed tariff revisions that would apply to each new EIM Entity during such EIM Entity's initial year of EIM participation. Proposed tariff section 29.27(b)(1) provided that the CAISO would determine prices for intervals that experience transmission or system balance constraints within the new EIM Entity's balancing authority area using the last economic bid to establish the market clearing price, rather than using the existing tariff's \$1,000/MWh penalty price. Proposed tariff section 29.27(b)(2) stated that, for a 12-month transition period after a new EIM Entity

² To effectuate this pricing mechanism, it was also necessary to adjust the penalty price for the flexible ramping constraint parameter for the EIM balancing authority area in order to allow the market software to discover the marginal energy bid price that would set the locational marginal price.

³ *Cal. Indep. Sys. Operator Corp.*, 149 FERC ¶ 61.194 (2014).

commences operations in the EIM, the CAISO will set the flexible ramping constraint relaxation parameter specified in tariff section 27.10 for the new EIM Entity's balancing authority area at an amount between \$0 and \$0.01 (instead of \$60).

In its March 16, 2015 order, the Commission rejected the proposed tariff amendments. The Commission instituted a proceeding under section 206 of the Federal Power Act, to investigate the justness and reasonableness of the EIM provisions in CAISO's existing tariff related to the imbalance energy price excursions in PacifiCorp's balancing authority areas that the CAISO had described in the tariff and waiver filings discussed above. The Commission established a refund effective date 90 days from publication of notice in the Federal Register.⁴ The Commission also directed staff to hold a technical conference to explore the issues raised by the CAISO.⁵ The technical conference occurred on April 9, 2015.

On April 10, 2015, the CAISO filed a motion seeking relief pending the Commission's final order or, in the alternative, requesting rehearing on a discrete aspect of the Commission's March 16, 2015 order. The CAISO requested that the Commission either (1) revise the refund effective date to September 2, 2015, and extend the existing waiver of sections 27.4.3.2 and 27.4.3.4 of the CAISO's tariff to that date, or (2) extend the existing waiver of sections 27.4.3.2 and 27.4.3.4 of the CAISO's tariff to the date of the CAISO's compliance with an order resolving proceeding Docket No. EL15-53. On April 14, 2015, the Commission extended the time for the CAISO to submit its proposal and initial comments until April 23, 2015. The Commission also established May 7,

⁴ Notice appeared in the Federal Register on March 24, 2015. 80 Fed. Reg. 15594 (Mar. 24, 2015). The refund effective date is thus June 22, 2015.

⁵ *Cal. Indep. Sys. Operator Corp.*, 150 FERC ¶ 61,191 (2015).

2015 as the date for parties to submit comments on CAISO's proposal and May 21, 2015 as the date for parties to file reply comments.

II. Discussion

A. Lessons learned over the past six months reveal the need for automatic recognition of all available capacity in the EIM area.

The launch of the first Energy Imbalance Market in the Western Interconnection has been an overall success and, after only six months of operations, overall both the CAISO and PacifiCorp and their market participants are experiencing significant benefits. As with any new significant market launch, there have been some challenges. One challenge was false scarcity in the market clearing process leading to unexpected price excursions. The price excursions experienced since the launch of the new EIM resulted from infeasibilities observed in the market runs that require the relaxation of transmission constraints or the power balance constraint triggering an administrative pricing parameter of \$1000/MWh. This occurred because the market systems observed an insufficient amount of effective economic ramp constrained bids to clear the fifteen and five minute markets. These price excursions were intermittent but were more frequent than expected and spanned a few intervals.

After months of investigation and analysis, the CAISO confirmed that these events were not the product of actual capacity insufficiencies in the PacifiCorp balancing areas, but rather resulted from issues that limited the visibility of capacity that is available to PacifiCorp to meet load in its balancing areas. In part these were due to learning curve, but in part due to a market structure issue that obscures the markets ability to observe such available capacity. As PacifiCorp reported at the April 9 conference, despite the signals of infeasibility in the EIM systems, PacifiCorp was

resource sufficient and maintained reliability in its balancing authority areas. Most notably, PacifiCorp reported that since November 1 to present, PacifiCorp has experienced no Reliability Based Control violations, which is the reliability measure applicable to PacifiCorp that measures Area Control Error to ensure maintenance of steady-state frequencies at PacifiCorp's balancing authority area interconnections.

Although the EIM is an extension of the CAISO's real-time market, it is unique in several respects, which are important to understanding the issues experienced after the launch the solutions considered. Under the EIM construct, EIM entities retain all of their balancing authority responsibilities and must perform their balancing functions in concert with the EIM in real-time. In fulfilling the balancing function, the EIM entity must maintain a certain amount of capacity within its balancing authority area, it deems necessary to reliably operate its system within the confines of the transfer capability limitations that exist. With PacifiCorp, the post-go live experience demonstrated that although PacifiCorp has successfully been able to manually dispatch this capacity outside of the EIM to address infeasibilities the EIM has not always been able to recognize the dispatch of this capacity. Dispatch outside of the EIM and retaining control of this capacity is not done for the purpose of withholding capacity from the market, but to ensure capacity is available to the EIM in the event of a reliability event that requires the deployment of such capacity or in the case that reserve requirements increase within the hour. To obtain robust market solutions under the EIM paradigm, it is imperative that information exchanges between the EIM Entity and the CAISO as the market operator timely and accurately account for both balancing authority actions and market operations. If balancing authority actions are not incorporated timely and

accurately in the market optimization, false scarcity will occur because the market optimization will not consider this available capacity in determining if the balancing authority area is infeasible.

The monthly reports submitted by the CAISO and PacifiCorp over the past six months reveal that many of the infeasibilities are due to “learning curve” challenges as operations personnel of EIM Entities become accustomed to coordinating balancing authority operations with new market systems. Other infeasibilities have resulted from operational challenges associated with the need to finely calibrate and improve EIM market systems so that in clearing the real-time market the systems would recognize the full scope of PacifiCorp’s available capacity and the dynamic nature of PacifiCorp’s real-time BAA operations.

The CAISO and PacifiCorp have made significant progress moving along the learning curve and reducing constraint relaxation infeasibilities by closely coordinating their analysis of root causes of the infeasibilities and deploying numerous system and process improvements. At the technical conference, the CAISO addressed questions including what actions have been taken to address the underlying causes of the price excursions and what remedial enhancements under consideration. The remedial actions already taken include enhancements to market systems visibility for PacifiCorp and extensive training and numerous operational and process improvements adopted by PacifiCorp.⁶

Despite these improvements, the CAISO believes it is necessary to enhance the functionality of the market systems to ensure that systems are automatically informed of

6

the full scope of available capacity and recognize the actions the EIM entity takes to manage such capacity to balance its system. The CAISO has concluded that an automated process that accounts for an EIM entity's management of its other available capacity, including regulation and load-following capacity, is necessary for reasons unrelated to the learning curve. First, the current procedures for recognizing EIM operator actions are largely manual and require timely and accurate responses, which leaves the final outcome susceptible to human error and process breakdowns. Second, while it is possible for the EIM entity to speculate and account for the infeasibilities in the fifteen and five minute markets, it is not possible to definitely know them at the time that the EIM entity and EIM participants are required to submit their bids and base schedules. Therefore, under the current functionality, the EIM entity must estimate what these infeasibilities may be and incorporate the needed capacity in their base schedules and bids. While this is not impossible, it requires the EIM entity to quickly and accurately surmise and estimate the potential infeasibilities and convey the release of capacity to the market systems. This practice is risky for two reasons. First, the EIM entity may estimate the infeasibility incorrectly, which could trigger other issues. Second, if it deploys the capacity into the EIM, there is no guarantee that the energy will not be sold to serve load in California, which may pose a problem for the balancing authority in the event that an actual reliability issue materializes and the balancing authority is dependent on that capacity.

The EIM flexibility requirements are intended to cover a range of load and supply variability and uncertainty conditions up to the 95% confidence level. However, the EIM itself was designed to other imbalance conditions such as a trip of a large resource

which would trigger activation of contingency reserves. Therefore, when actual imbalance conditions fall outside the set of conditions the EIM is designed to address, the balancing authority still has responsibility and must therefore maintain capability to manage such conditions. Rather than waiting for balancing authority to inform the EIM of such action manually, the proposal would automatically account for such balancing authority actions. An automated mechanism would further reduce price excursions by eliminating the risks discussed above.⁷

B. Functionality to automatically recognize available capacity and operator deployment such capacity.

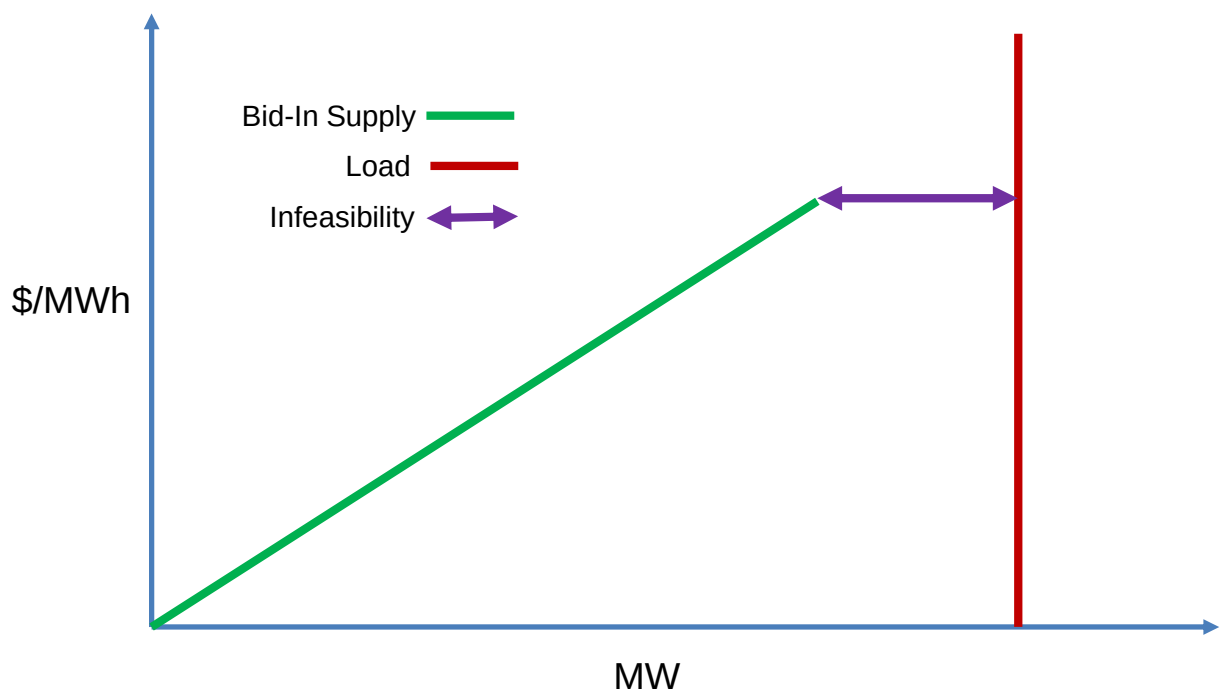
As discussed above, the EIM entity should retain control over the amount of capacity it deems necessary to balance its area reliably, under the current EIM construct that capacity does not normally participate in the EIM. Rather, the EIM entity maintains this capacity in reserve to fulfill its balancing authority area responsibilities such as frequency, tie-line control, balancing, load-following, and reliability. Currently, the EIM does not consider additional capacity that is available to an EIM entity to remediate power balance violations. In contrast, the CAISO optimizes the use of ancillary services and energy. If the CAISO requires additional ancillary services in its balancing authority area, the market processes will co-optimize ancillary services bids and energy bids and release available ancillary services capacity to avoid, to the extent possible, any power balance violations. The EIM does not perform this function for non-CAISO balancing authority areas.

⁷ The CAISO may nonetheless still request a form of transition for new EIM Entities.

The discussion below illustrates how the CAISO would deploy the additional available capacity if a power balance violation is detected in the EIM balancing area. The available capacity can also be dispatched to resolve over-generation and transmission constraints internal to the EIM balancing authority area.

Under the current CAISO market design, if there is a lack of effective economic ramp constrained bids to clear demand, the market software will observe a gap and will not reach a feasible solution unless it relaxes the power balance constraint. Figure 1 illustrates the potential gap between load and the bid-in supply capable of serving that load in an EIM entity balancing authority area. The purple line illustrates the degree of the infeasibility in serving the load represented by the red line.

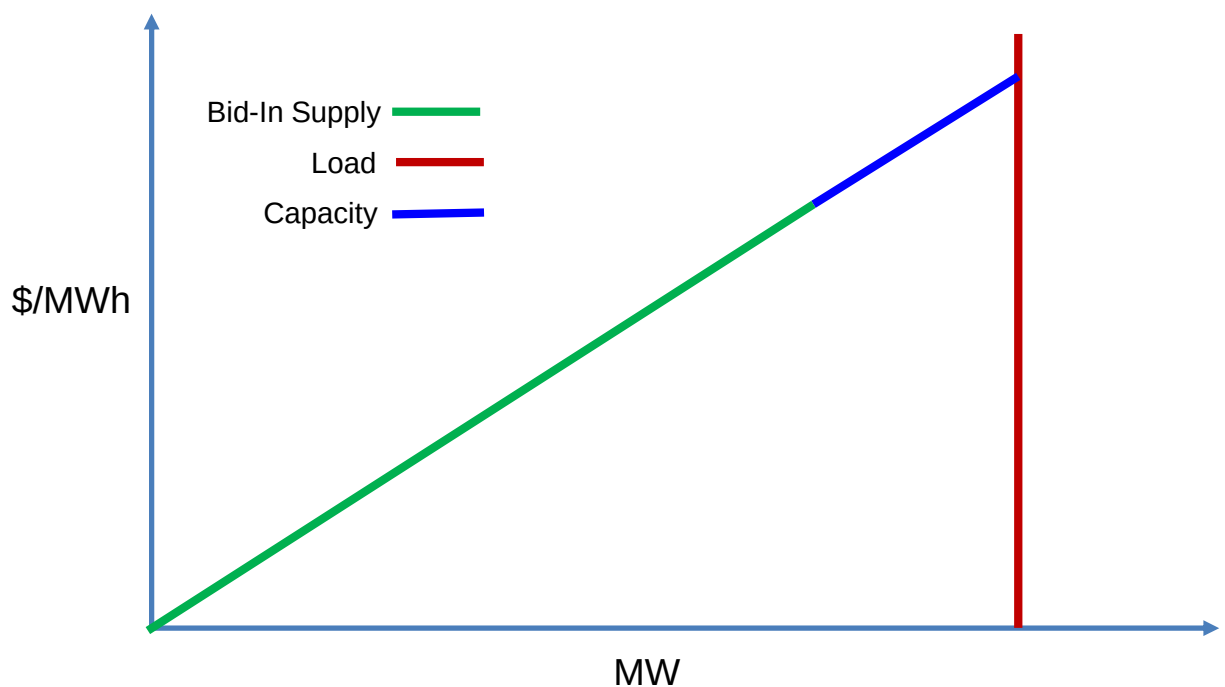
Figure 1



Under the CAISO's proposed enhancement, the market optimization process will automatically recognize and account for available capacity identified by the EIM entity of

the balancing authority area which could be in the form of, regulation and load-following capacity, or other capacity the balancing authority has determined is necessary for reliable operations (referred to generally as “available capacity”). Once recognized and incorporated in the CAISO market, this available capacity will be available to be used if a potential transmission or power balance constraint violation occurs in the EIM entity’s balancing area (see Figure 2 below). Figure 2 illustrates the use of the available capacity to bridge the gap and eliminate the infeasibility.

Figure 2

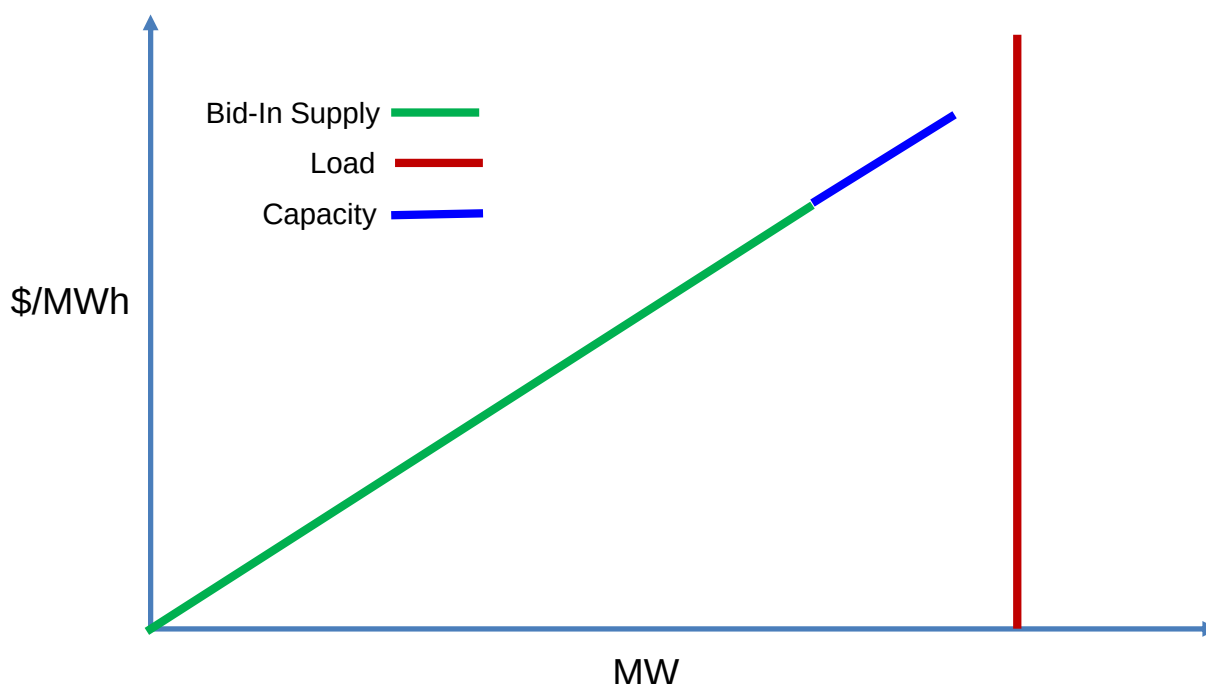


A key element of this proposal is that the EIM entity will still retain capacity it deems necessary to operate its systems consistent with good utility practice and NERC requirements, but it allows the EIM entity to deploy such capacity through the EIM to reflect the actions it would take to resolve any infeasibilities in its operations. This is possible because, with the improved functionality, the CAISO’s market optimization will

only recognize and use this available capacity if a potential power balance infeasibility occurs within an EIM Entity's balancing authority area. Also, because the EIM entity uses the available capacity to meet balancing area reliability requirements, the available capacity cannot be used to support incremental EIM transfers. Because the available capacity is included in the market optimization process, any dispatch of this available capacity will be at the resource level, and therefore consider actual telemetry, physical unit characteristics, and congestion. This allows the CAISO to produce feasible solutions and ensure prices reflect the true nature of the deployed capacity.

Under the CAISO's proposal, if after deploying the available capacity the EIM entity still has insufficient participating resource energy bids and available capacity to clear the gap and resolve the infeasibility, the market software will relax the transmission or power balance constraint at the existing \$1000 relaxation parameter. Figure 3 illustrates that a gap between load and total capacity will still exist if the available capacity retained by the EIM entity is either not fully deployed to resolve the infeasibility or is not available.

Figure 3



Under the proposed enhancement, available capacity would automatically be deployed in the CAISO markets to resolve infeasible power balance conditions in EIM balancing area only, as follows. First, by 75 minutes prior to the trading hour, the EIM entity scheduling coordinator would identify the available capacity from each of its EIM participating and non-participating resources. This available capacity will be identified in the regulation up and regulation down fields of the EIM resource plan.⁸ The EIM entity will validate and finalize each EIM resource plan by 40 minutes prior to trading hour, reflecting any changes the EIM entity has made based upon the outcome of the resource sufficiency evaluation.⁹ The CAISO will not consider the available capacity

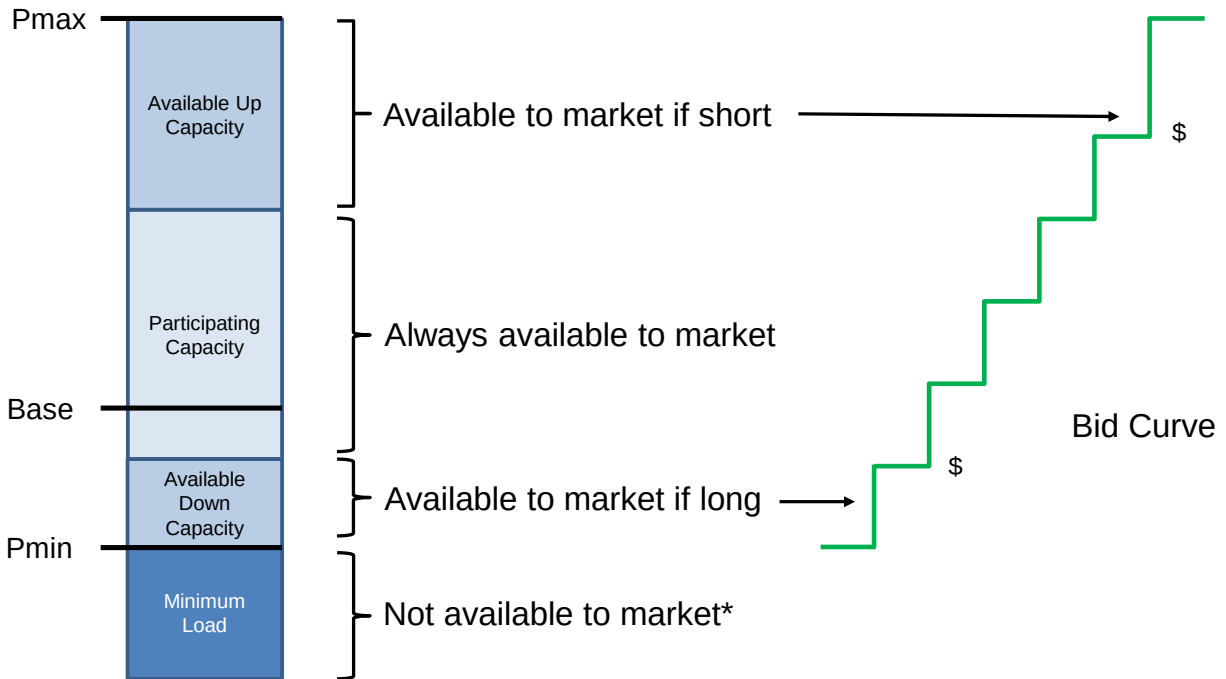
⁸⁸ The CAISO recognizes that the full scope of the available capacity may be comprised of load following and actual AGC available capacity, which is different than the CAISO's own definition of regulation up and down. But the existing category functionality can be used for conveying this information to the CAISO systems.

⁹ See CAISO Tariff, Section 29.34(l)(1).

identified by the EIM entity scheduling coordinator when performing the resource sufficiency evaluation test which evaluates whether the EIM entity has offered sufficient capacity to meet forecast load and offered sufficient capacity to meet its ramping requirements.

EIM participating resource scheduling coordinators will continue to submit energy bids for EIM participating resources. However, as shown in Figure 4 below, such bids must include a bid curve that spans the range of any additional available capacity the EIM entity wants to make available to relieve potential power balance or transmission infeasibilities in the EIM balancing areas. The CAISO will validate these bids and apply the real-time local market power mitigation procedures under the existing tariff-based rules.

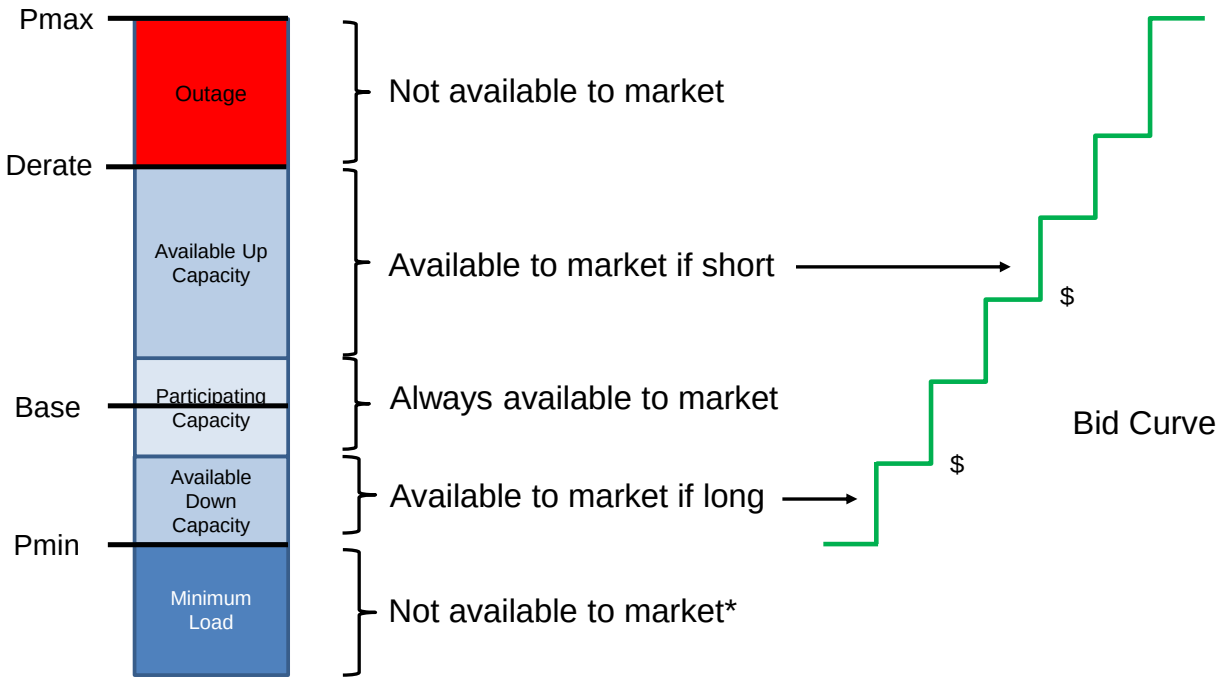
Figure 4



* Can't de-commit since the resource is providing regulation down

As shown in Figure 5 below, if an outage occurs affecting an EIM Participating Resource, the outage will be reflected as a reduction in the resource's overall available capacity before reducing the up/down available capacity available to address market infeasibilities.

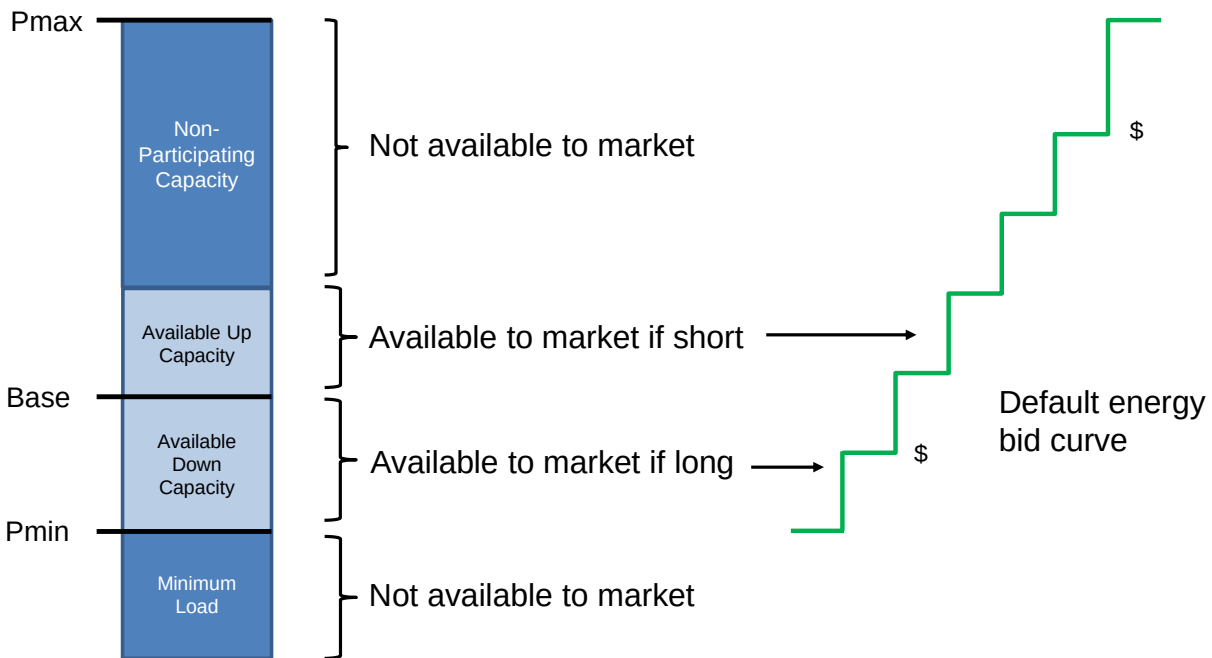
Figure 5



* Can't de-commit since the resource is providing regulation down

Similarly, this feature would apply to non-participating resources in the EIM balancing authority area that the EIM entity also plans to use to address transmission or power balance infeasibilities in its balancing area. However, non-participating resources, by definition, do not submit energy bids in the EIM. Therefore, as illustrated in Figure 6 below, the EIM entity can request that the CAISO calculate a form of the default energy bids for such a non-participating resource to be used in the event the non-participating resource is needed to resolve an infeasibility in the EIM area. The CAISO will calculate these default energy bids consistent with the relevant principles of the CAISO's calculation of default energy bids described in Section 39.7.1 of the CAISO tariff. This will allow the EIM entity to reflect the availability capacity from non-participating resources to balance its system in the EIM and avoid false infeasibilities, but not require that the resource participate in the EIM for economic dispatch.

Figure 6



The CAISO's market clearing software calculates the optimal dispatch in two passes -- the scheduling and pricing runs. The scheduling run is a full optimization run where constraints may be relaxed at penalty prices to avoid infeasibilities.¹⁰ The pricing run is a simple economic dispatch, initialized from the scheduling run solution, where penalty prices are replaced by administrative prices, and any infeasibility is constrained so the ultimate dispatch solution does not significantly vary from the solution of the scheduling run. The pricing run produces both binding schedules and prices. To appropriately use the available capacity to resolve false infeasibilities in the EIM, the CAISO plans to make modifications to the real-time market's scheduling and pricing

¹⁰ See CAISO Tariff, Section 27.4.3.

runs, including the components of the fifteen-minute market and real-time dispatch optimization processes.

The scheduling run will use the capacity available to address potential power balance infeasibilities based on the bid curves submitted by scheduling coordinators for EIM participating resources and the proxy energy bids for non-participating resources. In determining commitments, the scheduling run will respect the economic merit order of capacity available to relieve power balance infeasibilities relative to the value of that capacity, and will allow resource awards. The CAISO will add a factor to the bid prices of the deployed capacity so they are used after bids from participating resources are exhausted but prior to relaxing the power balance constraint or transmission constraints

The CAISO will also add a constraint to the scheduling run to ensure that the amount of available capacity released cannot exceed the supply and demand infeasibility within the balancing authority area without any EIM transfer. This will prevent the use of available capacity to support EIM transfers, to ensure that the energy dispatched from this available capacity will not be transferred to other balancing authority areas in the EIM.

The CAISO will add a surplus variable to the EIM transfer equation in the scheduling run at a high penalty price. The surplus variable will ensure that in the event the available capacity released cannot solve a particular infeasibility, the constraint will be relaxed in order that the market can reach a solution.

In the pricing run, the dispatch of available capacity will be limited to the dispatch scheduled in the scheduling run solution. The market will utilize the bids associated with the available capacity absent the adjustment made for the scheduling run. There is

no need to add a constraint to prevent EIM transfers in the pricing run, because available capacity released in the pricing run is limited to the available capacity dispatched in the scheduling run. The CAISO will then reduce the load forecast for the balancing authority area by a small tolerance to allow for price determination. If the amount of available capacity is sufficient to address the infeasibility, the market will clear with the benefit of the additional bids for the amount of the deployed capacity, obviating the need to relax the transmission or power balance constraint, and instead setting prices consistent with the pricing principles already contained in the tariff. If, on the other hand, the deployed capacity cannot resolve a potential transmission or power balance infeasibility in the pricing run, then the \$1000 penalty price associated with parameter relaxations will apply.

When the market optimization dispatches available capacity through the 15-minute market and 5-minute market to resolve an infeasibility within an EIM Entity's balancing authority area, the CAISO will send a new dispatch operating target to the scheduling coordinator representing the resource. This new operating target will be the basis for that resource's imbalance energy settlement for the interval. For an EIM participating resource, the CAISO will settle the energy used to resolve a potential power balance infeasibility in an identical manner to energy dispatched from the range of the resource that would have been available to the market regardless of any infeasibility.

The CAISO will settle energy dispatched from non-participating resources to resolve a potential power balance infeasibility as follows. Before October 1, 2015, if the resource is dispatched to resolve a constraint in the 15-minute market, it will be settled

as instructed imbalance energy at the relevant 15-minute price; if the resource is dispatched to resolve a constraint in the 5-minute real-time dispatch, it will be settled as uninstructed imbalance energy at the 5-minute price.¹¹ After October 1, 2015, if the resource is dispatched to resolve a constraint in the 15-minute market, it will be settled as instructed imbalance energy at the relevant 15-minute price; if the resource is dispatched to resolve a constraint in the 5-minute real-time dispatch, it will be settled as instructed imbalance energy at the 5-minute price.

The CAISO believes that the foregoing proposal will solve the differences in how reliability responsibilities are met by EIM entities which is a major cause of the EIM price excursions. The proposal recognizes that the EIM entity maintains available capacity to meet regulation and load following requirements of its balancing authority area. To prevent false market infeasibility being manifested in a balancing authority area, the market can now incorporate the actions that will be taken by the EIM entity to address the infeasibility using its load balancing capability. The PacifiCorp West and PacifiCorp East EIM balancing authority areas, after the start of the EIM are not due to actual capacity or ramp capability shortages. The proposed enhancement will appropriately allow the market to account for such available capacity in its dispatch. It will also allow the EIM dispatch to rationally price the available capacity necessary to resolve potential infeasibilities, based on the fact that PacifiCorp has sufficient capacity to balance its

¹¹ The current tariff provisions require that the CAISO settle deviations from FMM schedules for non-participating resources as uninstructed imbalance energy. The CAISO is planning on filing a proposed EIM year one enhancement in a separate docket that will modify this settlement to recognize instructed imbalance energy in the 5-minute dispatch in the same manner as ISO resources who do not re-bid their day-ahead schedules into the real-time market.

balancing authority areas at a cost far below the administrative price of \$1,000/MWh that the CAISO tariff imposes for power balance constraint violations.

C. The CAISO's Proposed Solution follows Mechanisms Adopted by other ISO/RTOs to Avoid Potential Market Infeasibilities.

As Mr. Harvey explained in his comments at the technical conference, the power balance constraint issues faced by the CAISO and PacifiCorp are not at all unique to the EIM market. Other market operators have faced similar issues regarding the feasibility of balancing the system on a five-minute basis using economic bids. Data from the Midcontinent Independent System Operator (MISO) and the New York Independent System Operator (NYISO) suggest that, in a five-minute dispatch, a market operator's software cannot reach a feasible market solution based solely on economic bids in approximately around one half to one percent of all intervals.¹² This inability to balance load and generation within the time frame of the five minute dispatch does not mean that market operators cannot balance load and generation. Rather, it reflects that the resources and ramp capability used to balance load and generation includes

¹² New York Independent System Operator, Enhanced Shortage Pricing, Market Issues Working Group (June 21, 2010) NYISO at 30 (showing the activation of shortage pricing as a percentage of day-ahead and real-time market intervals in NYISO zones) available at http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_miwg/meeting_materials/2010-06-21/Enhanced_Shortage_Pricing.pdf; Ramp Capability in MISO Markets, Midwest Independent System Operator Stakeholder 5th Technical Workshop (April 14, 2012) at 47 (indicating that price spike events had occurred in 1.6% of intervals during the March 1, 2010 to December 8, 2011), available at <https://www.misoenergy.org/Library/Repository/Meeting%20Material/Stakeholder/Workshop%20Materials/Ramp%20Management%20Workshop/20120419/20120419%20Ramp%20Workshop%205%20Presentation.pdf>; Spinning Reserve Demand Curve –Construct, Midwest Independent System Operator Market Subcommittee (January 6, 2012) (analysis of spinning reserve shortages indicating that the spinning reserve constraint was relaxed in 915 out of 113,863(.8%).8% intervals over the period August 1, 2010 to August 31, 2011, which in most cases was likely the result of ramp constraints creating potential load balance violations), available at <https://www.misoenergy.org/Library/Repository/Meeting%20Material/Stakeholder/MS/2012/20120106/20120106%20MSC%20Item%2006c%20Spinning%20Reserve%20Demand%20Curve%20Proposal.pdf>

resources and ramp capability not available in the 5 minute dispatch.

The MISO and NYISO mechanisms to address these concerns are instructive. Both the MISO and NYISO have market designs that account for the additional resources available to balance load and generation in setting real-time prices when ramping constraints are binding, and employing, for a limited period, capacity that would otherwise provide regulation or spinning reserves. These mechanisms do so by employing penalty prices when they exhaust the bid-in supply of resources with sufficient ramping capability to meet demand. However, neither MISO nor NYISO employs a single high penalty tied to constraint relaxation such as the CAISO's \$1000 price.

MISO's situation is relevant because, like the EIM, MISO has faced the challenge of managing imbalance energy across multiple balancing authorities without market dispatch of ancillary services in other balancing authority areas. Prior to January 2009, MISO did not coordinate ancillary services across the balancing areas that made up MISO. Instead, as with EIM, the individual balancing authority areas performed this function. To address this situation, in 2006, MISO filed, and the Commission approved, a proposal to allow MISO to implement, under certain energy shortage situations, a procedure known as Adequate Ramp Capability (ARC).¹³ This procedure permitted MISO to employ, for up to 60 minutes, up to 50 percent of a unit's capacity above its hourly economic maximum dispatch level, including the uppermost portion of a resource's reserve capacity, until the output of other units could catch up to the required

¹³ Midwest Independent Transmission Operator, Inc., Docket No. ER06-1099-000 (June 5, 2006); *Midwest Independent Transmission System Operator, Inc.*, 118 FERC ¶ 61,009 (2007).

demand level.¹⁴ In its filing, MISO noted that one of the typical situations in which it would implement the ARC procedures involves a substantial curtailment of imports, either by MISO or another Reliability Coordinator, which could quickly lead to a large demand-supply gap that exceeded the capability of on-line resources.¹⁵ This is analogous to the situation in the EIM markets where the CAISO's ability to dispatch sufficient imbalance energy to meet demand can be significantly hampered by the limited transfer capability between EIM regions available for use in a five-minute timeframe, particularly from PacifiCorp East to PacifiCorp West.¹⁶

MISO took over responsibility as the balancing authority within its footprint and coordinated ancillary services markets in both day-ahead and real-time in 2009.¹⁷ As part of this design change, MISO implemented a \$98 penalty price associated with relaxing the spinning reserve requirement to allow capacity that would otherwise provide spinning reserves to balance load and generation when ramp constraints were binding in the 5 minute dispatch. When MISO relaxed the constraint, it set prices based on the opportunity cost of spinning reserves and the incremental cost of the supply dispatched to meet load. However, MISO observed the lack of an adequate correlation between prices and scarcity. Therefore, MISO proposed, and the Commission accepted, an amendment to implement demand curves that set the price when there is insufficient

¹⁴ In compensating resources for providing this service, MISO established a proxy price to act as a surrogate for competitive wholesale energy prices, based on a theoretical offer from a natural gas peaking unit.

¹⁵ Midwest Independent Transmission Operator, Inc., Docket No. ER06-1099-000 (June 5, 2006), Affidavit of Mr. Joe Gardner at 4.

¹⁶ The CAISO expects that transfer capability between EIM regions will significantly improve with the participation of NV Energy in EIM.

¹⁷ Midwest Independent Transmission Operator Inc., ER07-1372-000 (September 14, 2007).

capacity to meet the spinning reserve requirements: \$65/MW when the cleared capacity is within ten percent of the requirement and \$98/MW when the cleared capacity is less than ninety percent of the requirement.¹⁸ Upon implementing these demand curves, MISO resolves ramping constraints by using capacity to meet load that would otherwise provide spinning reserve, with the penalty price directly reflected in energy and reserve prices.

NYISO faced similar challenges when it began operations because capacity designated to provide regulation and 10-minute reserves was blocked off from real-time dispatch absent manual operator intervention. In 2005, the NYISO implemented market design changes that assigned explicit shortage values to the dispatch of capacity to meet load that would otherwise provide regulation, spinning reserves, or 10 minute reserves.¹⁹ It amended these shortage values in 2011. For regulation, if the shortage is less than 25 MW, then the regulation price is set to \$80/MW, reflecting the relative cost of energy. If the shortage is equal to 25 MW but less than 80 MW, then the price is set to \$180, and if the shortage is 80 MW or more, the price is set to \$400, which reflects the cost of starting a gas turbine. For spinning reserves, the shortage price is \$500, \$25 for eastern spinning reserves, and \$150 for 10-minute reserves.²⁰

As the practices of these other market operators show, there is nothing unique about the EIM in terms of power balance violations in the timeframe of a 5-minute

¹⁸ Midwest Independent Transmission Operator Inc., Docket No. ER12-1185 (February 29, 2012); *Midwest Independent Transmission System Operator, Inc.*, 139 FERC ¶ 61,081 (2012).).

¹⁹ New York Independent System Operator, Inc., Docket No. ER04-230-000 (November 26, 2003); *New York Independent System Operator, Inc.*, 106 FERC ¶ 61,111 (2004).

²⁰ New York ISO Market Services Tariff Sections 15.3.7 and 15.4.7; *N.Y. Indep. Sys. Operator, Inc.*, Docket No. ER10-2454 (December 21, 2010). The NYISO is currently in the process of implementing further refinements in its shortage pricing design, proposed for implementation in November 2015, pending FERC approval in Docket No. ER15-1061-000.

dispatch. Using capacity scheduled to provide regulation and other ancillary services to resolve such issues is well understood and accepted. Shortage pricing must be rationally related to actual shortage. The shortage component of imbalance energy prices in EIM should not be zero when the CAISO is having difficulty balancing load and generation and needs additional resources. The shortage component of energy prices should not be \$1000 just because some capacity providing regulation is used, temporarily, to meet load during the interval because of ramp constraints. The CAISO believes that its proposal described meets this standard, similar to the mechanism utilized in MISO and NYISO, and should therefore be accepted by the Commission as a just and reasonable solution to the issues that led to the Commission to initiate this proceeding.

III. Infeasibilities When Flexibility Sufficiency Tests were Passed

During the technical conference Commission staff asked the CAISO to identify the percentage of intervals that were infeasible but during which the EIM entity had passed the flexibility sufficiency test. The following figures show the daily trend of infeasibilities. The bars in grey indicate the portion of infeasibilities where the EIM entity failed the flexibility sufficiency test. This metric has been reported in the monthly informational reports submitted by CAISO about the EIM tariff waiver.

Figure 7

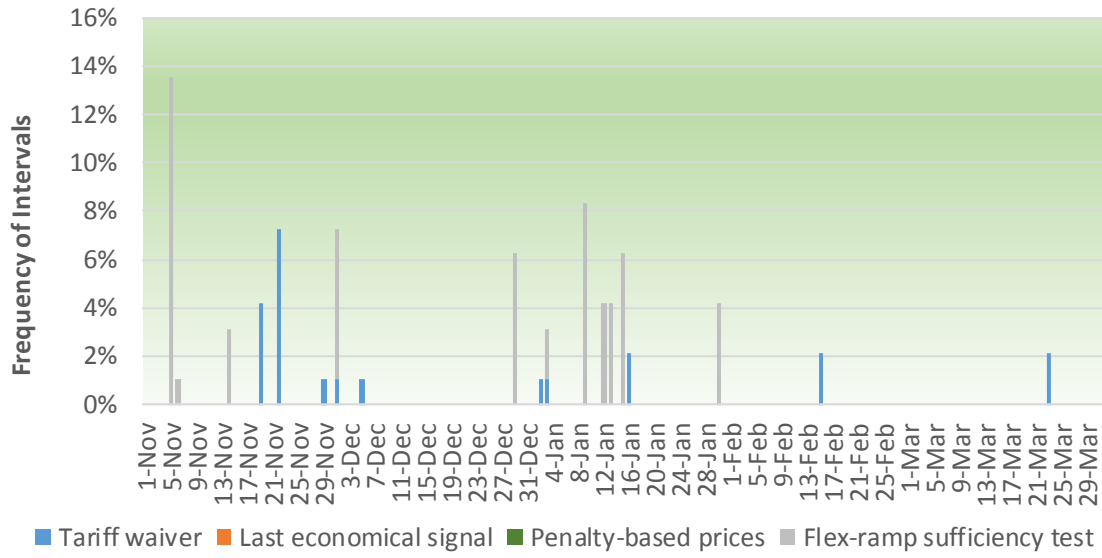
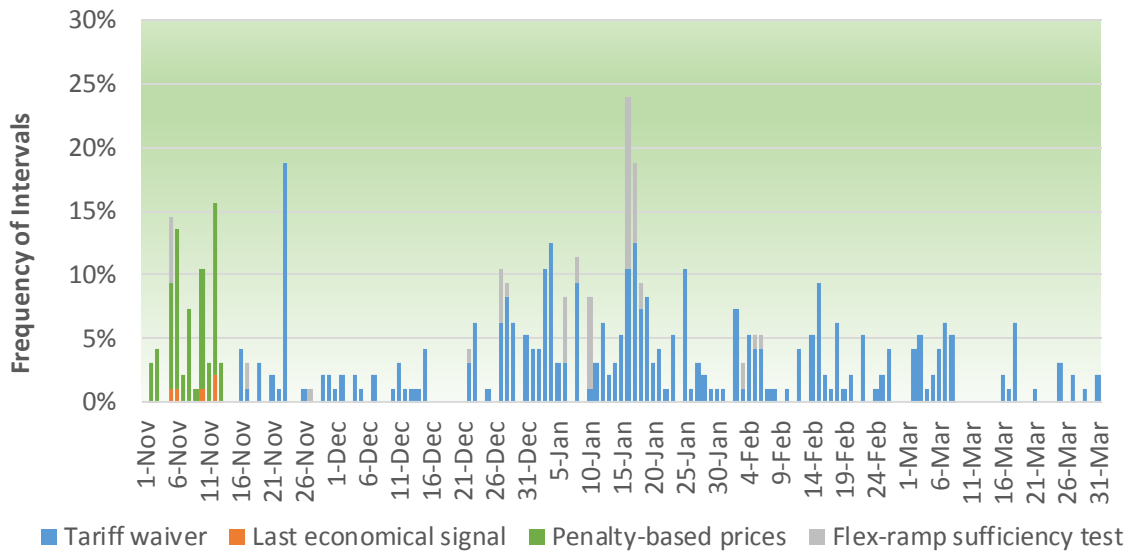


Figure 8



The following table summarizes this metric by PAC East and West. The percentage reflects how frequently the intervals in the fifteen-minute market that had infeasibilities had previously passed the flex sufficiently test.

Table 1

Period	PAC West	PAC East
Nov-Dec	25%	87%
Mar	100%	100%

By design the flexible requirements cover imbalanced up to a 95% confidence interval. In addition, conditions can change from the time base schedules are submitted and when the last flexibility sufficiency test is made. Therefore, because of these two conditions, it may happen that infeasibilities may be occurring when the flexibility test passed.

IV. Conclusion

For the foregoing reasons, the CAISO requests that the Commission accept these comments and issue an order directing the CAISO to file tariff revisions to implement the EIM enhancements described herein, in order to resolve the Commission's investigation in Docket EL15-53.

Respectfully submitted,

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Dated: April 23, 2015

CERTIFICATE OF SERVICE

I hereby certify that I have served the foregoing document upon all of the parties listed on the official service list for the above-referenced proceeding, under 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 23rd day of April, 2015.

/s/ Anna Pascuzzo
Anna Pascuzzo