

California ISO

**EIM power balance constraint relaxation
and imbalance conformance limiter**

January 18, 2019

Department of Market Monitoring

Summary

The ISO is proposing to change the criteria used to determine when the *load conformance limiter* is triggered during intervals when the power balance constraint is infeasible and must be relaxed in the real-time market.¹ When the load conformance limiter is triggered due to a shortage of upward ramping capacity in the real-time market, prices are set by the highest price bid dispatched rather than the \$1,000/MW penalty price.² The load conformance limiter was implemented to limit the impact on market prices of excessive load adjustments that cause power balance constraint infeasibilities.

As indicated in DMM's comments on the ISO's proposal filed at FERC, DMM supports the proposed changes as an improvement over the current logic used to determine when the load conformance limiter is triggered.³ DMM's monitoring and review of real-time market performance suggests that the proposed logic for the load conformance limiter is likely to better capture the cause-and-effect relationship between an excessive operator adjustment and an infeasibility. By reducing instances when the infeasibility is attributed to the level of load conformance during intervals with possible scarcity conditions, the enhancement will provide more appropriate pricing signals in the market.

DMM's comments filed at FERC included analysis of load conformance and the load conformance limiter in different energy imbalance market (EIM) areas. This analysis indicated that under 2018 conditions the proposed changes to the load conformance limiter may have a significant upward impact on prices in two EIM balancing areas: the Arizona Public Service and the NV Energy areas. In the other EIM areas the impact of the proposed approach relative to the current method would be minimal. This report provides additional detail and analysis related to power balance constraint infeasibilities and the imbalance conformance limiter in different EIM areas, updated through the end of 2018.

This report highlights the significant role that the flexible ramping sufficiency test plays in contributing to power balance constraint infeasibilities in EIM areas, which, in turn, are a key determinant of the impact that the load conformance limiter has on prices. When an EIM area fails the flexible ramping sufficiency test, the market software limits the area's ability to transfer energy through the EIM during that entire hour.⁴ This significantly increases the likelihood that a power balance constraint infeasibility (or relaxation) will occur. While the overall frequency of flexible ramping sufficiency test failures and power balance constraint infeasibilities is relatively low in the EIM, these events are likely to have a more significant impact on prices after the proposed changes to the load conformance limiter.

¹ *Tariff Amendment to Enhance Detail on Load Forecast Conformance*, ER19-538-000, December 12, 2018.
<http://www.caiso.com/Documents/Dec12-2018-TariffAmendment-ImbalanceConformanceEnhancement-ER19-538.pdf>

² Similarly, when the load conformance limited is triggered due to an *excess* of energy (or insufficient *downward* ramping capacity), prices are set by the *lowest* price bid dispatched rather than the -\$155/MWh penalty price.

³ *Revised Comments of the Department of Market Monitoring of the California Independent System Operator*, ER19-538-000, January 9, 2019.
<http://www.caiso.com/Documents/RevisedCommentsOfDepartmentOfMarketMonitoring-LoadConformanceLimiter-Jan092019.pdf>

⁴ If an area fails the upward sufficiency test, net EIM imports (negative) during the hour cannot exceed the lower of either the base transfer or optimal transfer from the last 15-minute interval prior to the hour. Similarly, if an area fails the downward sufficiency test, net EIM exports are capped during the hour at the higher of either the base transfer or optimal transfer from the last 15-minute interval prior to the hour.

Analysis in this report for 2018 shows that 81 percent of under-supply power balance constraint infeasibilities in the 5-minute market for EIM areas occurred during hours when an area failed the upward flexible ramping sufficiency test. During 62 percent of these intervals, the current method for the load conformance limiter triggered. Under the proposed methodology, the limiter would have been triggered in only 5 percent of these intervals.

In the 15-minute market, hours when EIM areas failed the upward flexible ramping sufficiency test accounted for 95 percent of under-supply infeasibilities during 2018. The load conformance limiter was triggered in 67 percent of these intervals under the current methodology and would have been triggered in 11 percent of intervals under the proposed methodology.

Since the frequency of flexible ramping sufficiency test failures (and the resulting infeasibilities) has been greatest in the Arizona Public Service and NV Energy areas, the potential impact of the proposed changes on average prices is also greatest in these areas. The impact of the load conformance limiter under the current and proposed approaches also depends on two other key factors: (1) how the load conformance is set by the balancing area operators, and (2) the price of the last bid dispatched when the load conformance limiter is triggered. While these two factors vary from one balancing area to another, DMM's review indicates that an EIM entity's ability to consistently pass the flexible ramping sufficiency test is a key determinant for the estimated impact on the area's prices associated with the change to the imbalance conformance limiter.

The changes in the load conformance limiter is currently scheduled to be implemented in the first quarter of 2019, if approved by FERC. DMM is providing more detailed analysis in this report to help EIM areas be better prepared for when the ISO implements the new load conformance limiter methodology. For instance:

- EIM area operators may also more closely review and monitor the load adjustments which are made and the impact these are having on power balance infeasibilities.
- EIM area operators may take additional steps to reduce hours in which the area does not pass the flexible ramping sufficiency test.

In addition, the ISO plans to implement three key changes to the EIM Resource Sufficiency test in spring 2019 which may reduce the frequency of hours when EIM areas fails this test.⁵ These changes result from a 2018 stakeholder process which included several workshops, stakeholder comments, and an ISO whitepaper on this issue.⁶

⁵ *Energy Imbalance Market Resource Sufficiency Enhancements: Business Requirements Specification Posted*, Market Notice, January 16, 2019.

<http://www.caiso.com/Documents/EnergyImbalanceMarketResourceSufficiencyEnhancements-BusinessRequirementsSpecificationPosted.html>

⁶ *Energy Imbalance Market Resource Sufficiency Evaluation White Paper*, California ISO, September 19, 2018.

<http://www.caiso.com/Documents/WhitePaper-EnergyImbalanceMarketResourceSufficiencyTest.pdf#search=ISO%E2%80%99s%20EIM%20Resource%20Sufficiency%20Enhancements%20policy%20initiative>

Background

The ISO is proposing changes to the methodology for determining if the *load conformance limiter* is triggered during intervals when the power balance constraint must be relaxed in the real-time market. This is often referred to as a *power balance infeasibility*, due to either a shortage or excess of bids for upward or downward ramping capacity that can be dispatched by the market software to meet projected imbalance demand in the real-time market.

The load conformance limiter was implemented to limit the impact of excessive load adjustments on the market through relaxing the power balance constraint. When a power balance infeasibility occurs due to a shortage of upward ramping capacity, and the imbalance conformance limiter is triggered, the size of the load adjustment is automatically reduced such that the resulting price is set based on the highest economic bid dispatched by the market software. Otherwise, prices are set based on the \$1,000/MWh penalty price.⁷ Thus, the methodology for determining if the *load conformance limiter* is triggered can have a significant impact on real-time market prices.

Currently, when the magnitude of a load adjustment made by grid operators exceeds the magnitude of a power balance constraint relaxation, the imbalance conformance limiter is triggered. However, there have been instances in which the application of the current logic did not appear to reflect actual conditions. For example, DMM observed times when a persistent load adjustment across multiple intervals would resolve smaller infeasibilities that did not appear to be related to the level of the load conformance.

The ISO is proposing to change the criteria used to determine when the load conformance limiter is triggered. Under the proposed method, the load conformance limiter would be triggered by a measure based on the change in load adjustments from one interval to the next, rather than the total level of load conformance. This change will significantly reduce the intervals in which the limiter is triggered. The enhancement is expected to be implemented in the first quarter of 2019.

Analysis

This report highlights the significant role that the flexible ramping sufficiency test plays in contributing to power balance constraint infeasibilities in EIM areas, which, in turn, are a key determinant of the impact that the load conformance limiter has on prices. This hourly test is designed to ensure that each EIM area, including the ISO area, has sufficient ramping capacity to meet real-time market requirements without relying on transfers from other balancing areas. If an area fails the upward sufficiency test, energy imbalance market transfers into that area cannot be increased.

Figure 1 shows the frequency of flexible ramping sufficiency test failures (hourly) and/or power balance constraint relaxations (5-minute market) in EIM areas during 2018.⁸ The frequency of flexible ramping

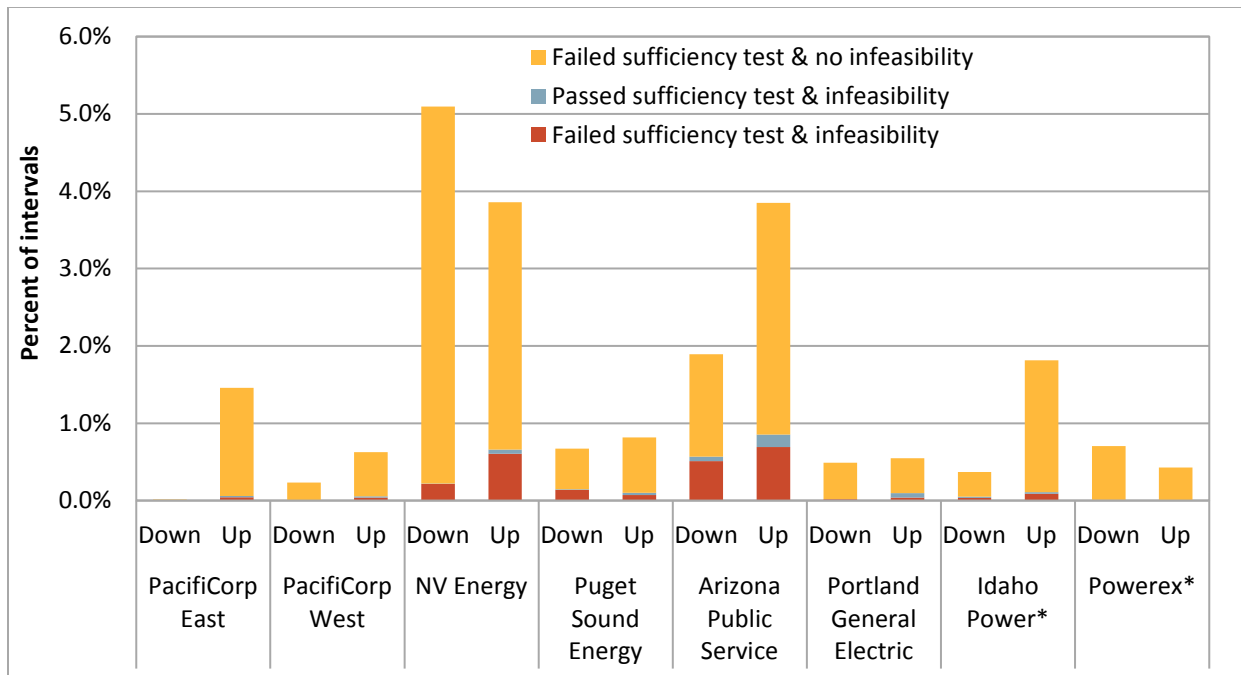
⁷ During the first six months after joining the EIM, prices for new EIM entities are not set by the penalty parameters when the power balance constraint is relaxed. Instead, prices are set by the last dispatched economic bid. This is known as transition period pricing. During periods when transition period pricing is in effect for an area, the application of the load conformance limiter is duplicative in terms of the final price impact.

⁸ Intervals when the power balance constraint needed to be relaxed due to a shortage of downward ramping capacity or within an hour when the area failed the downward sufficiency test are labeled "Down." Intervals when the power balance constraint needed to be relaxed due to a shortage of upward ramping capacity or within an hour when the area failed the upward sufficiency test are labeled "Up".

sufficiency test failures for upward ramping capacity in 2018 was relatively low in most EIM areas (about 0.5 to 2 percent of hours), but almost 4 percent of hours in the Arizona Public Service and NV Energy areas. While power balance infeasibilities do not occur in most of the corresponding real-time intervals, limits on EIM transfers that are enforced when flexible ramping sufficiency test failures occur can increase the likelihood of power balance constraint infeasibilities in EIM areas. Figure 2 shows the frequency of infeasibilities in the 5-minute market and whether the EIM entity passed or failed the flexible ramping sufficiency test in the same direction and hour.⁹ During 2018, 81 percent of under-supply power balance constraint infeasibilities in the 5-minute market for EIM entities occurred after failing the upward flexible ramping sufficiency test during the same hour. However, the current method for the load conformance limiter was triggered in 62 percent of these intervals, so that prices were set by the highest priced bid dispatched rather than a penalty parameter reflecting scarcity conditions. Under the proposed methodology, the limiter would have been triggered in only 5 percent of these intervals.

In the 15-minute market, hours when an EIM area failed the upward flexible ramping sufficiency test accounted for 95 percent of under-supply infeasibilities during 2018. Similarly, the load conformance limiter was triggered in 67 percent of these intervals under the current methodology and would have been triggered in 11 percent of intervals under the proposed methodology.

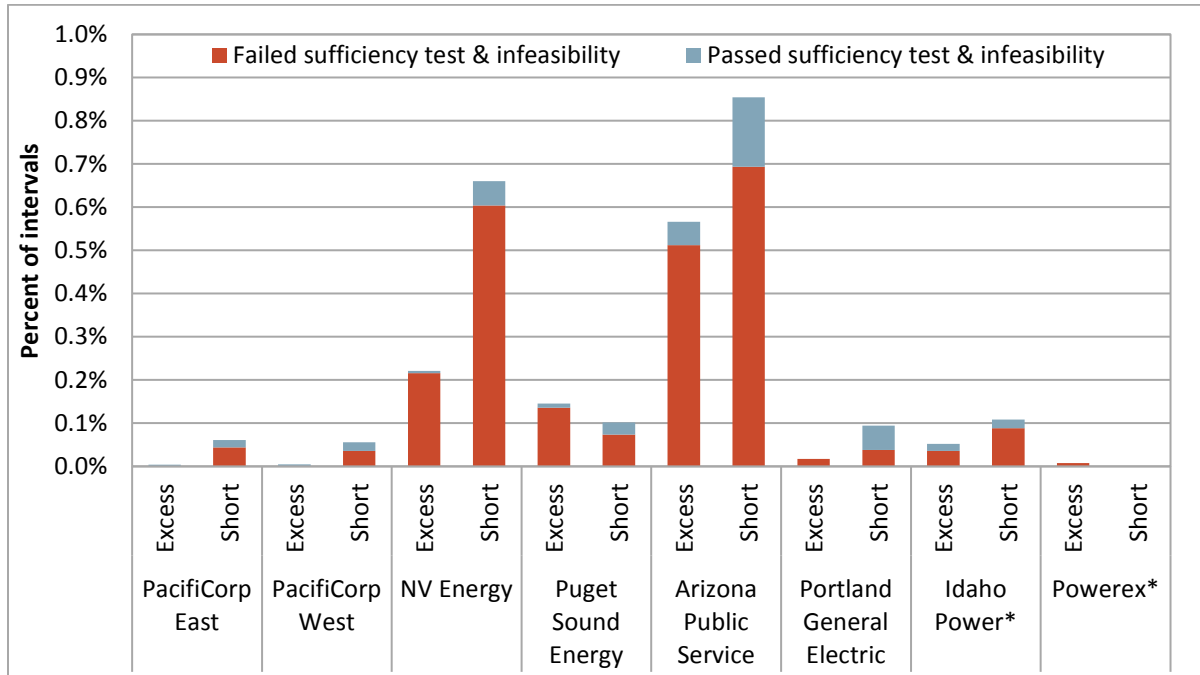
Figure 1. Flexible ramping sufficiency test failures and/or power balance constraint relaxations (2018)



* Entity joined EIM on April 4, 2018

⁹ In Figure 2, intervals when the power balance constraint needed to be relaxed in the negative direction due to excess supply are labeled “Excess”. Intervals when the power balance constraint needed to be relaxed in the positive direction due to shortage of upward ramping are labeled “Short”.

Figure 2. Power balance constraint relaxations in the 5-minute market (2018)



* Entity joined EIM on April 4, 2018

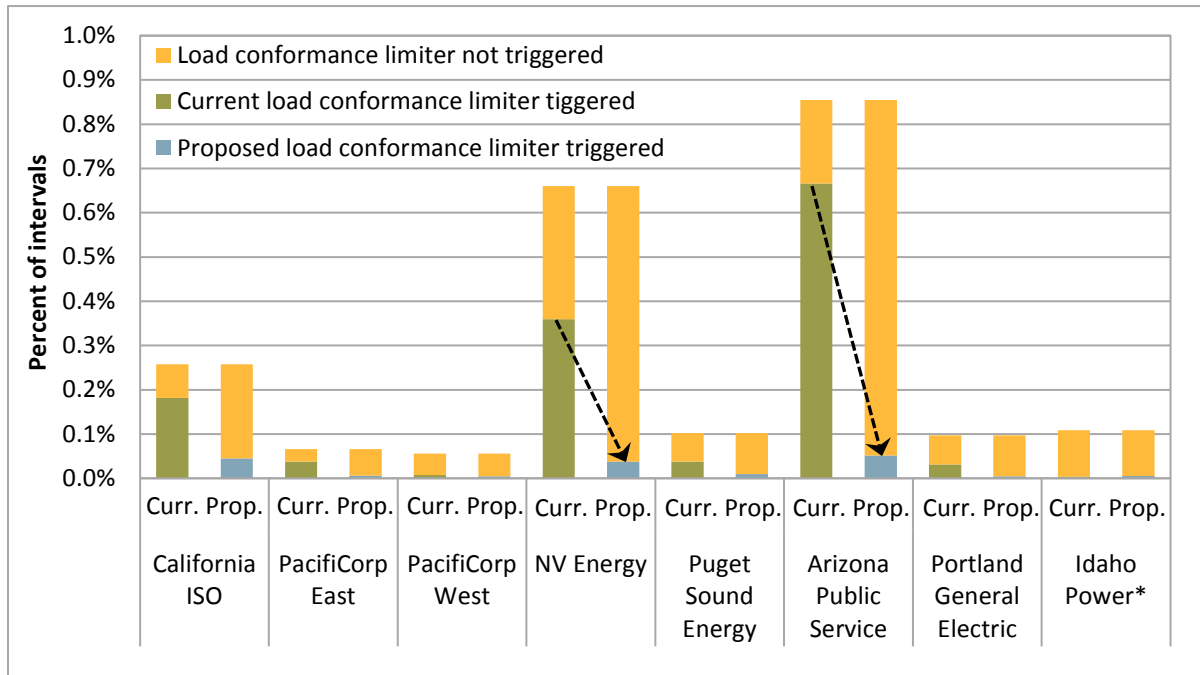
Figure 3 shows the frequency of valid *under-supply* infeasibilities in the 5-minute market during 2018 and whether the load conformance limiter triggered under the current approach or would have triggered under the proposed approach.¹⁰ As shown in Figure 3, the current limiter triggered in 55 percent of under-supply infeasibilities in the NV Energy area and 77 percent of under-supply infeasibilities in the Arizona Public Service Area, resulting in prices based on the last dispatched economic bid. However, had the proposed limiter been in effect, it would have been applied in only 6 percent of infeasibilities in each of the NV Energy and Arizona Public Service areas.

Figure 4 compares the distribution of actual EIM prices under the current limiter with the distribution of estimated EIM prices had the proposed limiter been in effect instead. EIM prices in the \$200/MWh to \$300/MWh range generally reflect prices set by the value of the flexible ramping product. Resulting EIM prices greater than \$900/MWh after the current limiter triggered largely reflect similarly high system prices.

As shown in Figure 4, the resulting price after the limiter triggered for an under-supply infeasibility in the EIM was \$300/MWh or less in almost 90 percent of instances during 2018. Had the proposed limiter been in effect, the resulting price would have been \$300/MWh in less than 10 percent of these under-supply infeasibilities. Figure 4 also includes the California ISO as a point of comparison. During 2018, resulting prices in the ISO after the limiter triggered for under-supply were greater than \$900/MWh in over 95 percent of instances.

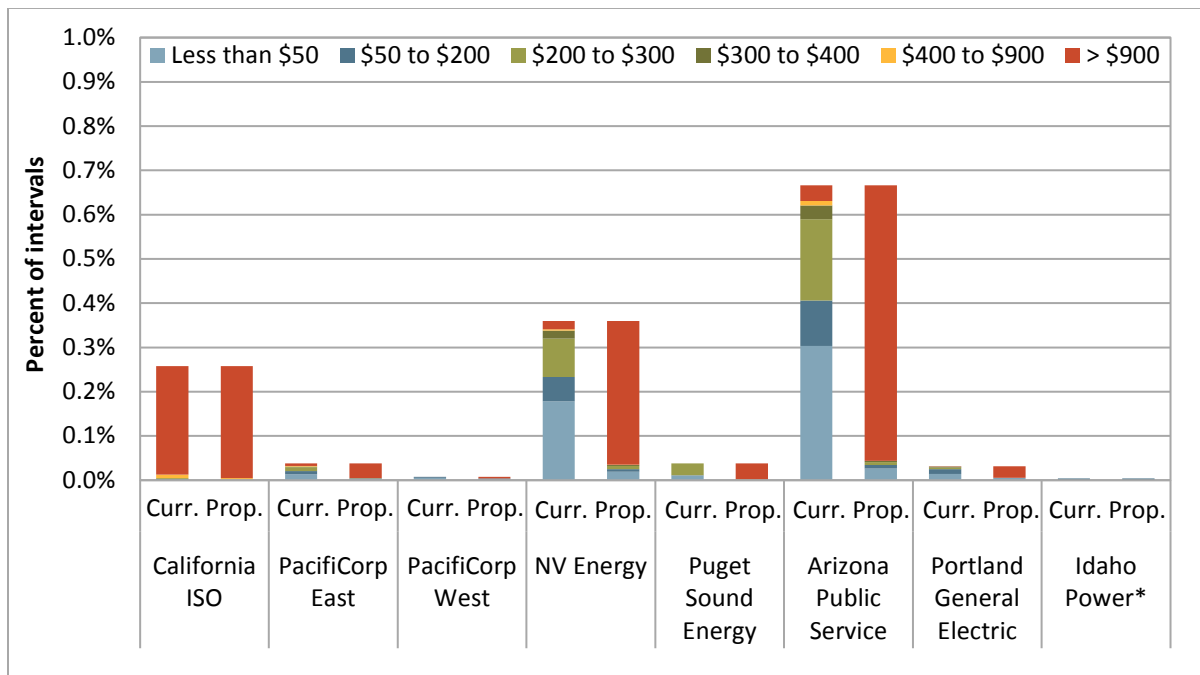
¹⁰ During 2018, there were no valid under-supply infeasibilities for Powerex. In addition, Powerex is not a balancing authority area or transmission service provider like the other EIM entities and do not have the ability to enter conformances. As a result, Powerex is not depicted in Figure 3, Figure 4, or Table 1.

Figure 3. Under-supply power balance constraint relaxations and load conformance limiter in the 5-minute market (2018)



* Entity joined EIM on April 4, 2018

Figure 4. Distribution of EIM prices in the 5-minute market after the limiter triggered for under-supply (2018)



* Entity joined EIM on April 4, 2018

Table 1 summarizes the estimated impact of the proposed method for triggering the conformance limiter on average prices in each EIM area during 2018. If the proposed load conformance limiter method had been in effect, average prices in the Arizona Public Service area would have been higher by roughly \$4/MWh (10%) in the 15-minute market and \$5/MWh (13%) in the 5-minute market. In the NV Energy area, average prices would have been almost \$2/MWh (5%) higher in the 15-minute market and around \$3/MWh (7%) higher in the 5-minute market.

Table 1. Impact of proposed load conformance limiter in EIM (2018)

	Average EIM price (with current conformance limiter)	Average estimated price with the proposed conformance limiter	Estimated impact of proposal	
			Dollars	Percent
<i>PacifiCorp East</i>				
15-minute market (FMM)	\$29.39	\$29.48	\$0.09	
5-minute market (RTD)	\$29.09	\$29.29	\$0.20	
<i>PacifiCorp West</i>				
15-minute market (FMM)	\$25.92	\$25.92	\$0.00	
5-minute market (RTD)	\$25.44	\$25.47	\$0.03	
<i>NV Energy</i>				
15-minute market (FMM)	\$35.75	\$37.60	\$1.85	5%
5-minute market (RTD)	\$35.30	\$37.91	\$2.61	7%
<i>Puget Sound Energy</i>				
15-minute market (FMM)	\$26.25	\$26.27	\$0.03	
5-minute market (RTD)	\$25.48	\$25.67	\$0.19	
<i>Arizona Public Service</i>				
15-minute market (FMM)	\$34.96	\$38.52	\$3.55	10%
5-minute market (RTD)	\$34.66	\$39.33	\$4.68	13%
<i>Portland General Electric</i>				
15-minute market (FMM)	\$26.08	\$26.08	\$0.00	
5-minute market (RTD)	\$25.32	\$25.53	\$0.21	
<i>Idaho Power*</i>				
15-minute market (FMM)	\$31.82	\$31.82	\$0.00	
5-minute market (RTD)	\$31.15	\$31.15	\$0.00	
<i>California ISO (LAP average)</i>				
15-minute market (FMM)	\$39.46	\$39.47	\$0.01	
5-minute market (RTD)	\$39.05	\$39.10	\$0.04	

* Entity joined EIM on April 4, 2018

Appendix B provides charts showing the hourly impact of the proposal for NV Energy and Arizona Public Service. In the other EIM areas, the impact of the proposed approach relative to the current method would be minimal.

Appendix A. Hourly frequency of infeasibilities in EIM

Figure A.1. Hourly frequency of infeasibilities in the 5-minute market – PacifiCorp East (2018)

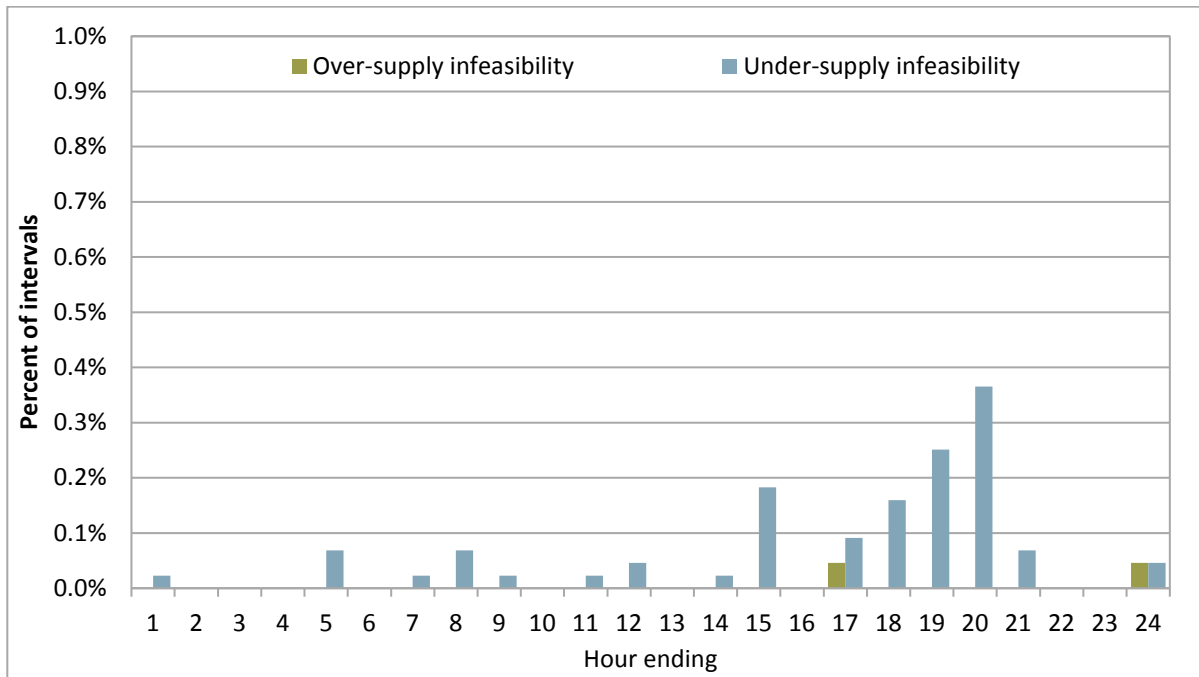


Figure A.2. Hourly frequency of infeasibilities in the 5-minute market – PacifiCorp West (2018)

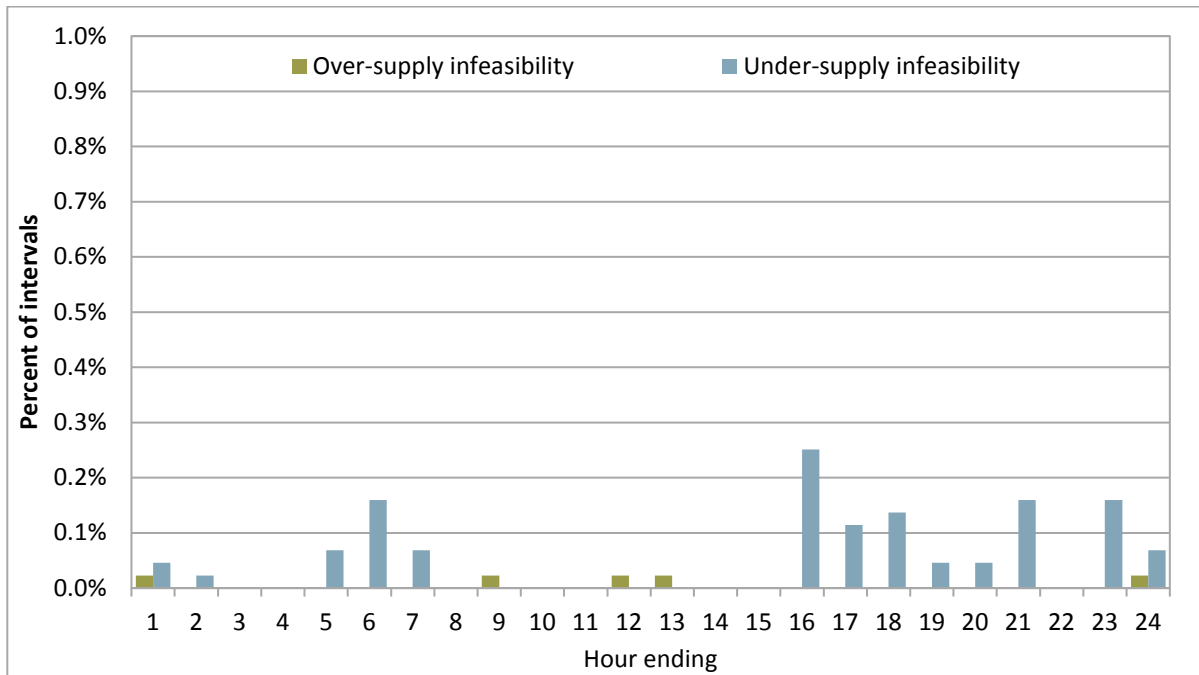


Figure A.3. Hourly frequency of infeasibilities in the 5-minute market – NV Energy (2018)

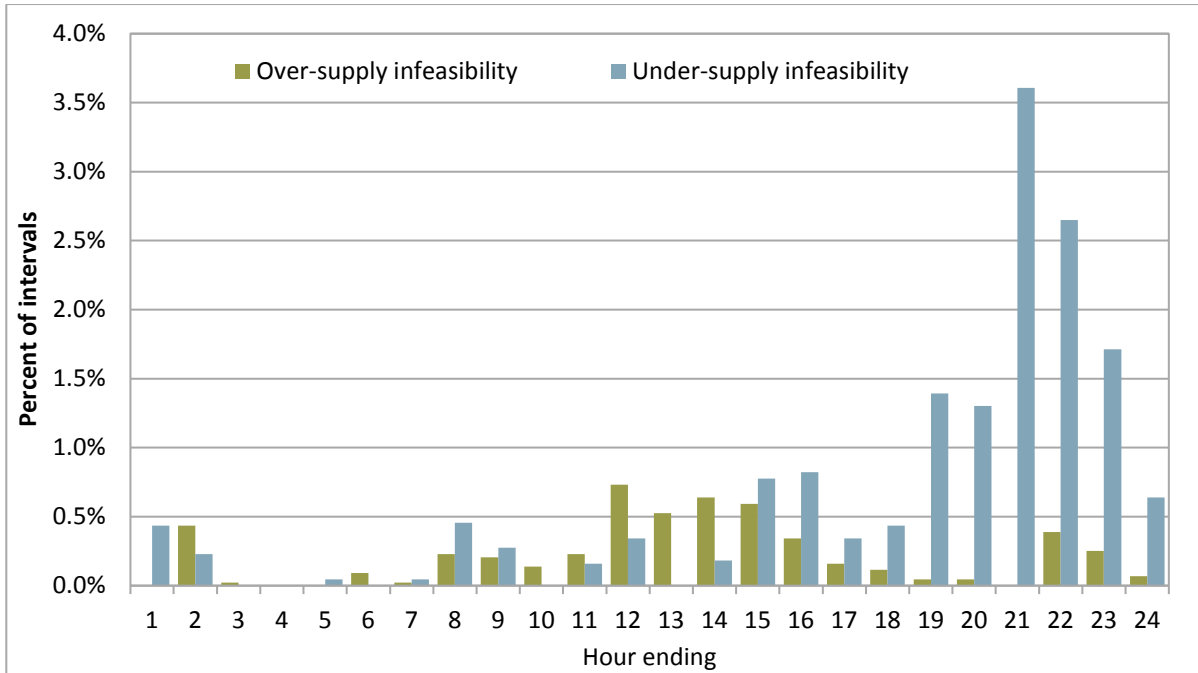


Figure A.4. Hourly frequency of infeasibilities in the 5-minute market – Puget Sound Energy (2018)

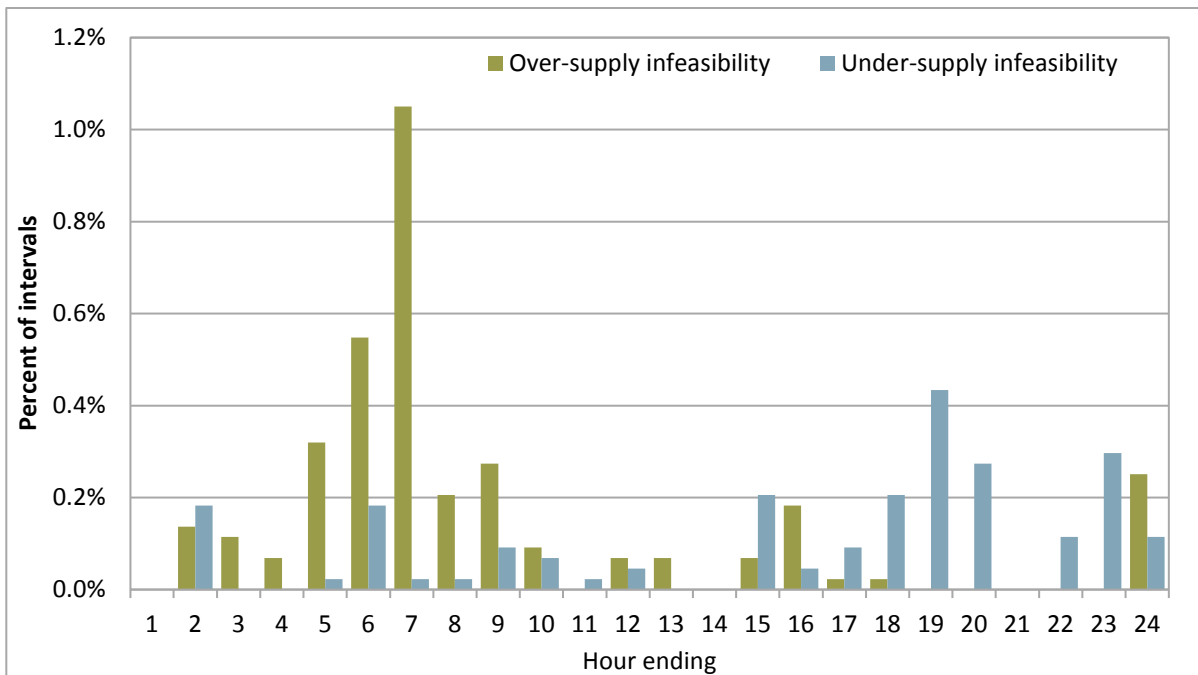


Figure A.5. Hourly frequency of infeasibilities in the 5-minute market – Arizona Public Service (2018)

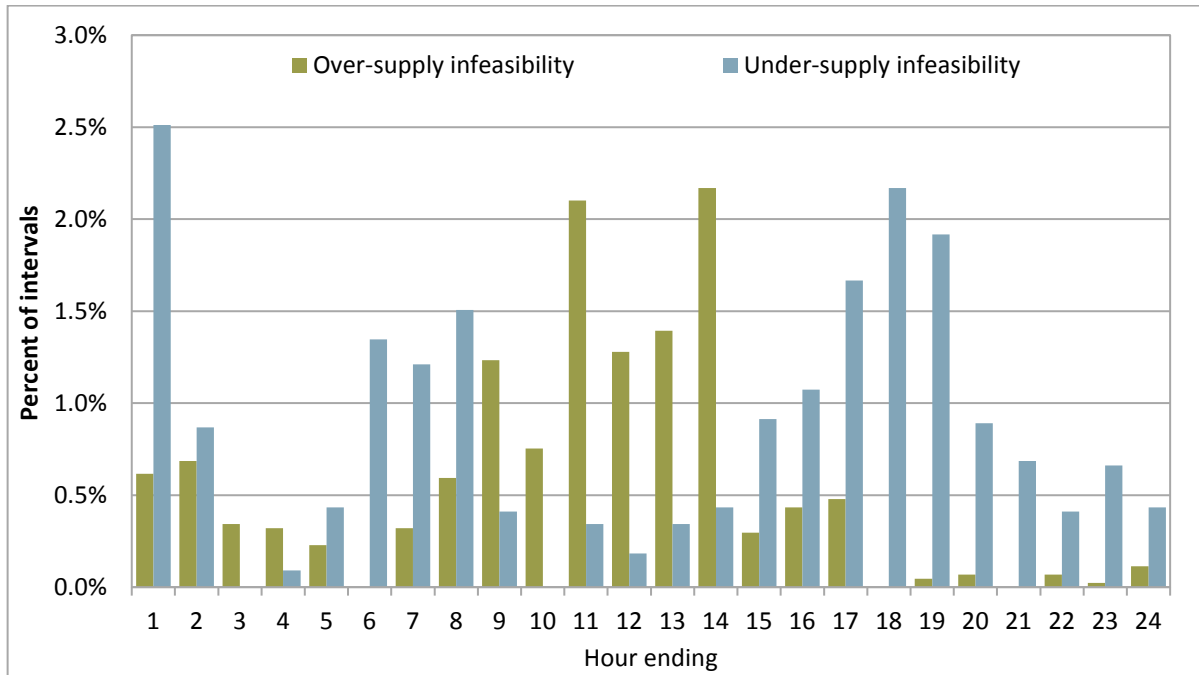


Figure A.6. Hourly frequency of infeasibilities in the 5-minute market – Portland General Electric (2018)

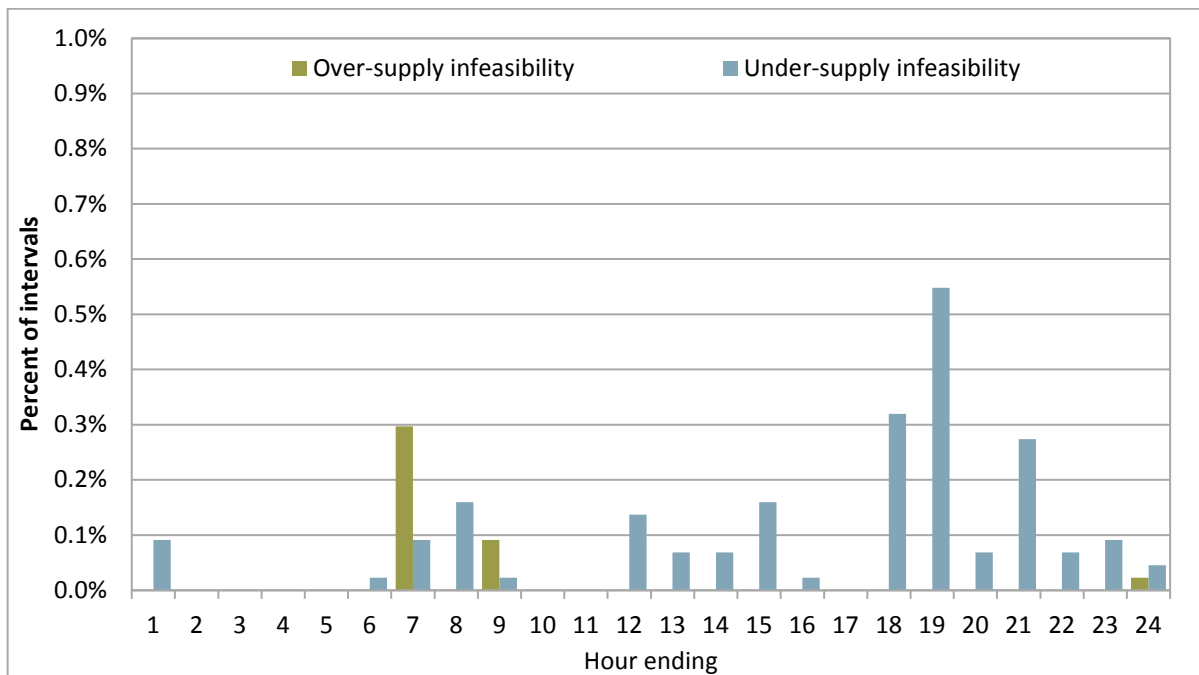
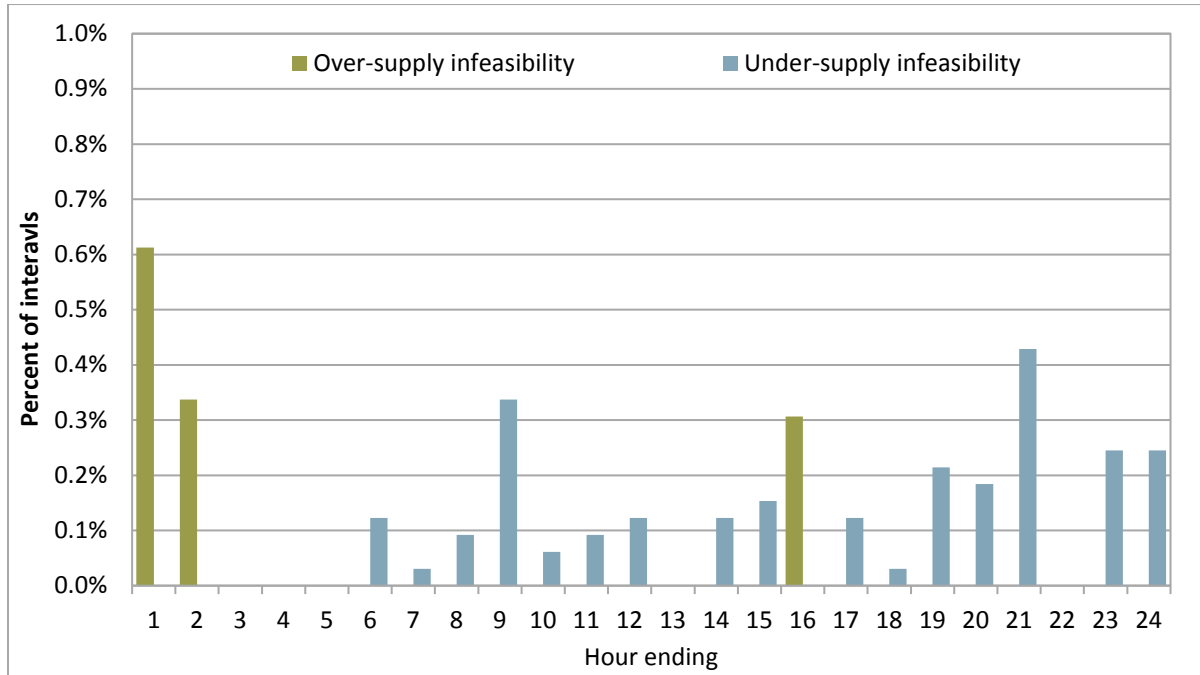
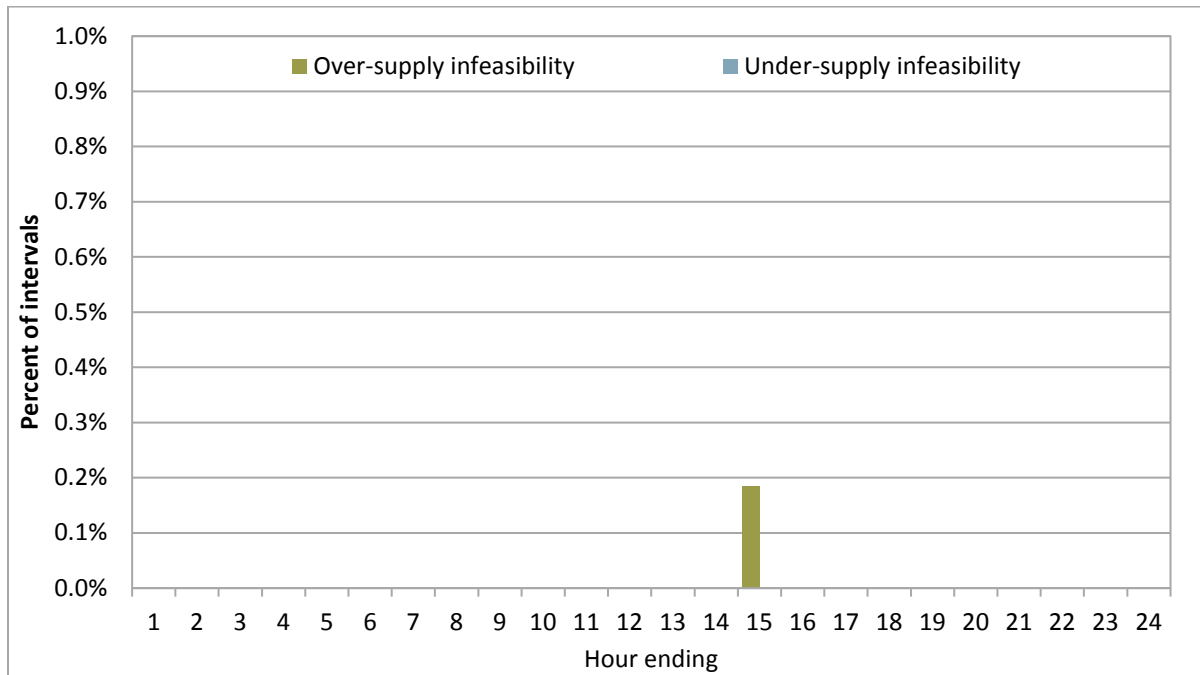


Figure A.7. Hourly frequency of infeasibilities in the 5-minute market – Idaho Power (2018)



* Entity joined EIM on April 4, 2018

Figure A.8. Hourly frequency of infeasibilities in the 5-minute market – Powerex (2018)



* Entity joined EIM on April 4, 2018

Appendix B. Impact of load conformance limiter on average hourly prices

Figure B.1. Impact of limiter on average 5-minute price in the NV Energy area (2018)

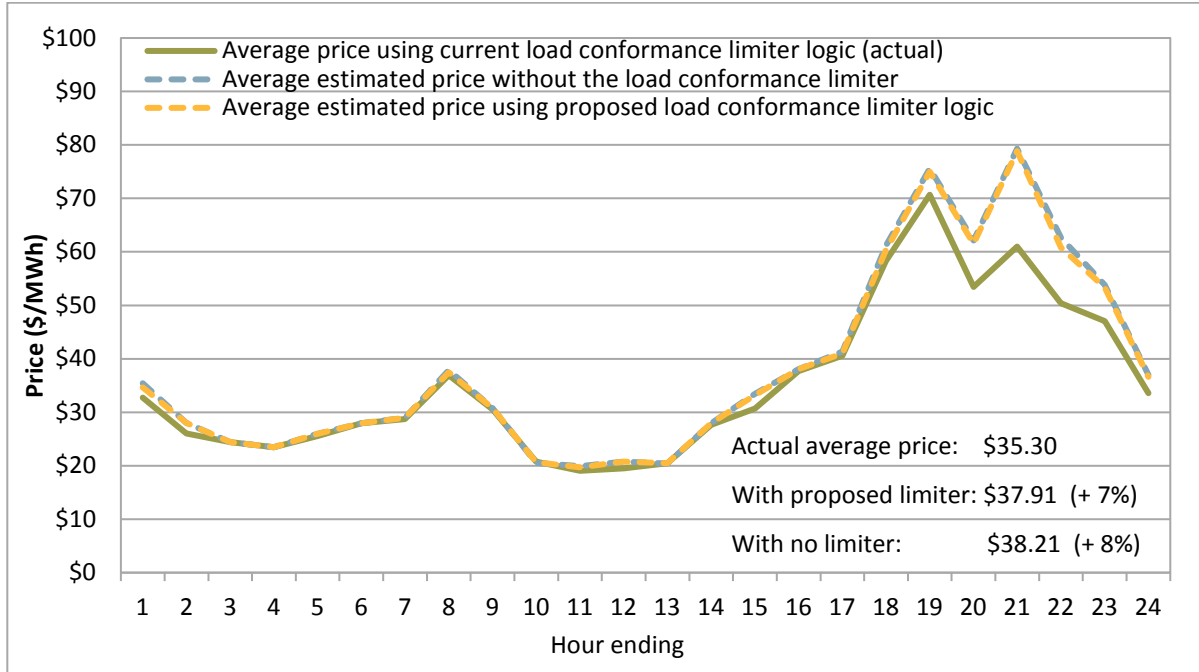


Figure B.2. Impact of limiter on average 5-minute price in the Arizona Public Service area (2018)

