

**Comments of Powerex Corp. on
Imbalance Conformance Enhancements**

Submitted by	Company	Date Submitted
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Powerex appreciates the opportunity to provide comments on the CAISO’s November 29, 2017 Imbalance Conformance Enhancements Issue Paper & Straw Proposal. In its proposal, CAISO explains that the purpose of this proceeding is to clarify CAISO’s authority to make manual adjustments to load forecasts in the integrated forward market and the real-time markets (commonly referred to as “load biasing”).¹

Powerex recognizes the need for system operators to be able to enter manual adjustments to load forecasts in order to more accurately reflect system needs. Powerex also recognizes that, even though these manual adjustments are made to the load forecast, they are used to adjust the need for imbalance energy more generally, which may be due to factors other than load, such as uninstructed deviations in generation. For these reasons, Powerex would not oppose tariff amendments that clarify the authority for CAISO operators to enter a load bias.

As a threshold matter, however, Powerex believes that ***the goal should be to develop objective, data-driven tools that ensure that grid conditions are accurately reflected in market processes each interval, minimizing the need for manual interventions, including load biasing.*** In that regard, existing CAISO operations appear to be moving away from this objective, as recent data from the CAISO Department of Market Monitoring (“DMM”) indicates that the amount of load biasing in the CAISO balancing authority area (“BAA”) has increased dramatically over the past year. Specifically, DMM’s Q3 2017 Report on Market Issues and Performance notes that, “[c]ompared to the prior year, load forecast adjustment in the ISO’s hour-ahead and 15-minute markets increased dramatically in 2017.”² Of particular concern, load biasing activity in the CAISO BAA appears to be excessively large, and systemically in the upward direction, particularly during the morning and evening net load upward ramping hours. This large and persistent load biasing occurs in both the hourly and 15-minute markets, while the magnitude of the load biasing appears to be relatively smaller in the 5-minute market. These patterns strongly suggest that load biasing is not being used only to correct for random errors and last-minute changes in grid conditions that may occur from time to time, but instead are

¹ In the Issue Paper and Straw Proposal, CAISO introduces the term “imbalance conforming.” For consistency with its prior comments, and the terminology used in other reports, Powerex uses the term “load biasing” in these comments.

² Q3 2017 Report on Market Issues and Performance at 17 (Dec. 8, 2017).

being used to address systemic challenges in the CAISO's markets during these hours. Thus, while Powerex recognizes that the focus of this proceeding is on clarifying CAISO's authority to engage in load biasing and the application of the load bias limiter, Powerex believes that more transparency is needed on the use of load biasing in the CAISO BAA, and that the CAISO's authority to engage in load biasing needs to be coupled with increased transparency, as well as limitations on its intended purpose.

Powerex also remains concerned that CAISO's application of the load bias limiter—both under the current and the proposed designs—degrades price formation and results in inefficient incentives for investments in, ensuring availability of, and the operation of physical resources. Specifically, the application of the load bias limiter is not tied to an objective assessment of the accuracy of the manual load adjustment it seeks to limit. In other words, the load bias limiter appears designed merely to prevent manual load adjustments from triggering shortage pricing, including in intervals when it *should* apply, as opposed to ensuring that manual load adjustments accurately reflect system needs.

I. Load Biasing In The CAISO BAA Needs To Be Further Examined

Powerex agrees that grid operators need the ability to make last-minute adjustments to the load used in the market solution to more accurately reflect the need for imbalance energy on the grid. The Issue Paper identifies some of the circumstances under which the automated market systems may fail to fully reflect grid conditions, and hence may over- or under-state the need for imbalance energy in the market solution. These circumstances include changes in load not yet reflected in automated forecasting tools, or uninstructed deviations in generation. Powerex believes it is appropriate for operators to use load biasing to make adjustments to the inputs to the market optimization in order to improve the accuracy of the solution, and does not oppose clarifying the Tariff to recognize this authority.

Given that the purpose of load biasing is to correct for inaccuracy or gaps in the information from automated systems, it should be expected that the use of load biasing would be infrequent, limited in magnitude, and unpredictable in direction. That is, load biasing that reflects genuine errors should itself be unpredictable, and tend toward an average value of zero in each operating hour of the day. To the extent that load biasing exhibits predictable patterns, however, it is a clear indication that there is a more fundamental flaw in the market systems leading to systemic over- or under-statement of the need for imbalance energy. The proper response to systemic errors is to address them through enhancements to the underlying automated systems, not to rely on load biasing to meet system needs.

Unfortunately, it appears that for the CAISO BAA, load biasing has indeed become a frequently-used and growing operator intervention to compensate for systemic inaccuracies in the information used to run the market optimization. The table below is reproduced from DMM's quarterly report for Q3 2017, and shows the frequency, direction, and magnitude of load biasing in the CAISO BAA, as well as in the BAAs participating in the CAISO Energy Imbalance Market ("EIM").

Table 2.3 Average frequency and size of load adjustments (July - September)

	Positive load adjustments			Negative load adjustments			Average hourly bias MW
	Percent of intervals	Average MW	Percent of total load	Percent of intervals	Average MW	Percent of total load	
California ISO							
15-minute market	57%	674	2.0%	6%	-328	1.2%	367
5-minute market	48%	370	1.1%	29%	-289	1.1%	97
PacifiCorp East							
15-minute market	11%	87	1.4%	4%	-85	1.5%	7
5-minute market	37%	83	1.4%	15%	-76	1.3%	19
PacifiCorp West							
15-minute market	3%	56	2.3%	4%	-42	1.8%	0
5-minute market	6%	55	2.3%	22%	-47	2.2%	-7
NV Energy							
15-minute market	15%	90	1.5%	5%	-136	2.7%	7
5-minute market	22%	63	1.1%	32%	-105	2.1%	-20
Puget Sound Energy							
15-minute market	3%	45	1.5%	14%	-66	2.9%	-8
5-minute market	4%	51	1.8%	21%	-65	2.8%	-11
Arizona Public Service							
15-minute market	91%	155	3.5%	4%	-317	8.0%	129
5-minute market	90%	155	3.5%	4%	-356	9.1%	126

Source: DMM Q3 2017 Report on Market Issues and Performance³

In some BAAs, such as PacifiCorp East and PacifiCorp West, the data appears generally consistent with load biasing being used to correct for random errors. The frequency of load biasing was moderate, load biasing occurred with similar frequency in both the upward and downward directions, and the adjustments made were of similar magnitude in the upward and downward directions. The average hourly load bias in each of these BAAs was less than 20 MW.

In the CAISO BAA, however, the use of load biasing is starkly different. It was used in over 60% of all 15-minute market intervals, and in 77% of all 5-minute market intervals. Moreover, the use of load biasing in the 15-minute market is heavily tilted toward the upward direction, where it was nearly ten times as frequent, as well as twice as large, as in the downward direction. As a result, the average load bias across all 15-minute market intervals during Q3 was 367 MW. This average is over 70 times larger than the average 15-minute market load bias of the combined PacifiCorp BAAs,⁴ even though the CAISO BAA is less than four times as large.⁵

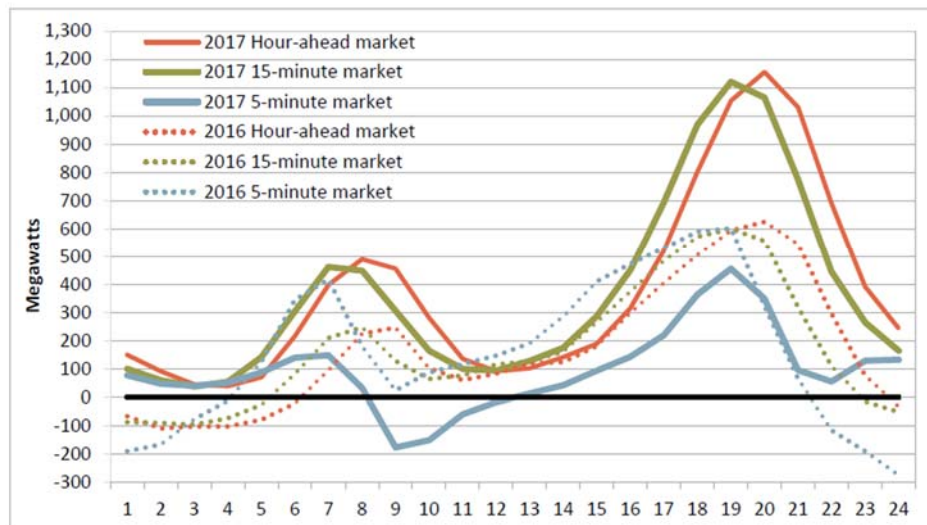
³ Available at: <http://www.caiso.com/Documents/2017ThirdQuarterReport-MarketIssuesandPerformance-December2017.pdf>.

⁴ The average hourly bias in the 15-minute market was 7 MW for PacifiCorp East and 0 MW for PacifiCorp West. Weighting this average hourly bias by the total load implied in the table gives an average bias for the two PacifiCorp BAAs of approximately 5 MW.

⁵ Based on 2016 Net Energy For Load from FERC Form 714, which is approximately 228 TWh for CAISO and approximately 70 TWh for the combined PacifiCorp BAAs.

In addition to these aggregate statistics over all hours, DMM’s Q3 2017 report also reveals that there are predictable patterns to load biasing in the CAISO BAA. The figure below is reproduced from DMM’s report, and shows the average quantity of load biasing by operating hour and by market process (hourly, 15-minute, and 5-minute).

Figure 1.7 Average 3rd quarter hourly load adjustment (2016 – 2017)



Source: DMM Q3 2017 Report on Market Issues and Performance

This figure shows that the load biasing in the CAISO BAA exceeds 1,000 MW *on average* during the evening peak, and is close to 500 MW *on average* during the morning ramp. Moreover, the figure shows that the quantity of load biasing during these hours is approximately twice as large as during the same quarter in 2016. Finally, the figure shows that load biasing in the 5-minute market—while less severe than in the 15-minute and hourly market process—exhibits strong and persistent patterns across the day.

The inescapable conclusion is that the use of load biasing in the CAISO BAA is not limited to correcting for random and unpredictable errors. Rather, load biasing in the CAISO BAA has become a mainstay of market operations, and appears to be used to compensate for persistent inaccuracies in the information regarding grid conditions and/or resource capabilities and expected performance.

Powerex reiterates that, given inaccurate information, grid operators can and should enter manual load adjustments in an effort to bring the market solution closer to the actual imbalance energy needs of the grid. However, regular use of load biasing should be recognized as potentially masking market design or information issues. The root causes of these issues need to be identified and addressed. In particular, CAISO needs to examine and explain:

- Why it is that operators need to regularly apply large, positive load biases during the morning load ramp hours and during the evening peak net load ramp hours, apparently day after day?

- Why has the amount of load bias grown so significantly in the past year?
- Why do these load biases occur primarily in the hourly and 15-minute market runs, with far smaller load bias in the 5-minute market?

An examination of the root causes of the need for operator load biasing is necessary because the underlying flaws may have far-reaching impacts on the performance of the CAISO markets. For instance, one possible cause of the persistent need for upward load biasing during ramp-up hours is that generation resources are either over-scheduling expected output and/or choosing to under-perform relative to dispatch instructions. This would reflect an incentive compatibility problem that needs to be addressed, similar to the intertie deviation challenge that CAISO has separately identified as a priority to address during this upcoming year.

Another possible cause of a persistent need for upward load biasing during ramp-up hours is if generators are unable to follow CAISO upward dispatch instructions, such as if the resource ramp rates in the master file are overstated, or if the lead-times are understated. If the capability of resources in the CAISO BAA is overstated, this has potential consequences for other aspects of CAISO's markets. For instance, the overstated flexibility may be leading the CAISO BAA to appear to satisfy EIM resource sufficiency requirements, when in fact it cannot; it may mask the need to procure greater amounts of Flexible Resource Adequacy capacity on a forward basis; it can result in leaning on imports, either through intertie bids or through EIM transfers for capacity and/or flexibility; and it can result in ACE excursions and degraded reliability scores. Finally, inaccuracy in the stated ramp rates or lead times of resources in the CAISO BAA can mask the existence of actual scarcity of capacity or flexibility, and the suppression of scarcity pricing.

The large, persistent, and growing use of load biasing in the CAISO BAA indicates systemic inaccuracies in the CAISO market systems' representation of grid conditions and capabilities. The inaccuracies may have far-reaching impacts on the performance of CAISO's markets, including price formation, EIM resource sufficiency, and the short- and long-term procurement of flexible capacity, and the associated prices for such services. For these reasons, Powerex believes that the use of load biasing in the CAISO BAA merits a comprehensive analysis by CAISO and/or by DMM, including the recommendation of near-term and longer-term improvements to reduce the frequency, magnitude, and directional nature of load biasing in the CAISO BAA. CAISO's clarification of authority under its tariff to engage in load biasing must be accompanied by a strong and ongoing commitment to minimize the need for load biasing in the first place, as well as increased transparency on the causes of load biasing.

II. Powerex Opposes The Existing And Proposed Designs Of The Load Bias Limiter, As They Are Designed To Asymmetrically Prevent The Application Of Penalty Pricing Without Regard To Accuracy

A. *It is Necessary to Recognize the Full Range of Potential Load Forecast Errors—and that a Limiter May Create New Errors*

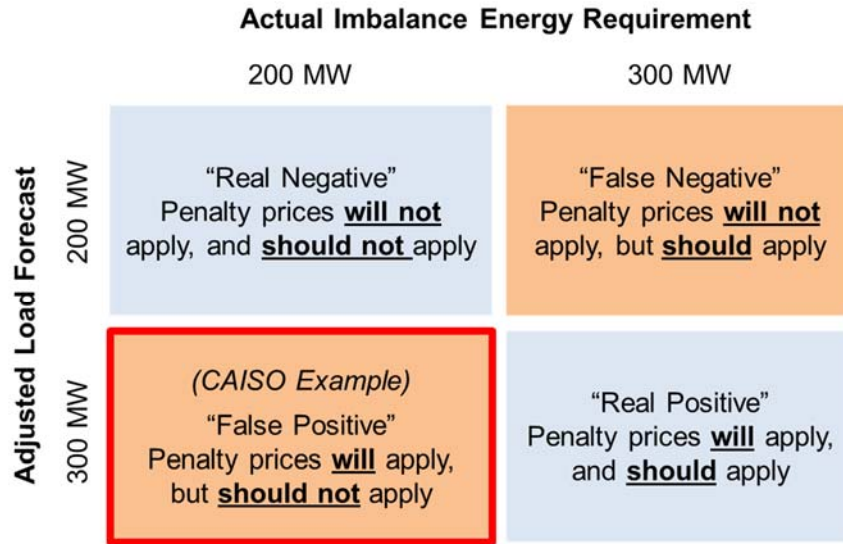
Like all manual operator interventions, load biasing carries with it the risk of error. Furthermore, as explained by CAISO during the workshop, manual load adjustments tend to be “coarse,” reflecting the operator’s assessment of whether the automated information systems are generally over-stating or under-stating the grid’s imbalance energy needs. As a result, there is a potential that the manual load adjustment that is made might still over- or understate the actual need for imbalance energy. The expectation, of course, is that the adjusted forecast will more accurately reflect actual system needs than if no adjustment had been made at all. Powerex believes that this is the critical standard under which all deviations from the objective market inputs should be assessed: does it result in a more accurate representation of the market’s need for imbalance energy?

Powerex believes that this same standard must guide the design and application of any automated tools that override manual load forecast adjustments, such as the load bias limiter. The stated goal of the load bias limiter is “to correct for an action that would otherwise cause a spurious price spike that coincides with the artificial infeasible solution”;⁶ that is, to prevent load bias from triggering the application of penalty prices when scarcity did not, in fact, exist.⁷ The specific example presented by CAISO to illustrate the need for a load bias limiter involves a manual load forecast adjustment that resulted in imbalance needs that exceeded ramp-limited supply, whereas the actual system need for imbalance energy did not exceed ramp-limited supply. CAISO argues that penalty pricing should not apply under this circumstance. Powerex agrees: prices should not reflect scarcity when, in fact, there is sufficient supply to meet imbalance energy needs. ***However, this scenario is only one of four potential outcomes regarding the accuracy of load forecasts used in the market run.***

The figure below expands upon the example in the CAISO’s workshop presentation, in which ramp-limited supply is limited to 250 MW, the operator manually adjusts the imbalance requirement to 300 MW, but the actual imbalance need was 200 MW. This scenario is represented as the lower left corner below.

⁶ Issue Paper at 8.

⁷ See CAISO presentation at December 8, 2017 workshop, at 21, available at: http://www.caiso.com/Documents/Agenda-Presentation-ImbalanceConformanceEnhancements-Dec8_2017.pdf.



Ramp-limited supply is 250 MW in all scenarios

The illustration above highlights two important points. First, the load bias limiter addresses only one of the two erroneous outcomes that may arise when operators manually adjust load forecasts. That is, it attempts to address “false positive” outcomes, where the adjusted forecast overstates actual imbalance energy requirements, and hence penalty prices will apply when in fact they should not. The load bias limiter does nothing to address the other erroneous outcome: when the adjusted forecast understates actual imbalance energy requirements, and hence fails to trigger penalty prices when they should, in fact, apply. This asymmetry of the load bias limiter—which attempts to address “False Positives” while not addressing “False Negatives—will have the intended effect of avoiding penalty prices when they should not apply, but without also ensuring they are triggered when they should apply. This will result in an overall suppression of price volatility and price levels.

Second, the illustration also shows that there are “real positive” outcomes in which penalty prices *should* apply, because ramp-limited supply *is actually insufficient* to meet the system need for imbalance energy. If the load bias limiter prevents penalty prices from applying in these instances, **it will be creating pricing errors rather than preventing them**. Critically, however, neither the current load bias limiter nor the proposed new load bias limiter design includes a mechanism that distinguishes between conditions of “false” as opposed to “real” scarcity. While the entire premise of the load bias limiter is to avoid “spurious” prices due to “artificial” scarcity, nothing in the design of the load bias limiter establishes whether the scarcity conditions are, indeed, “artificial” as opposed to genuine. Without the ability to distinguish between “artificial” and genuine scarcity, the load bias limiter is fatally defective.

Designing a limiter in a manner that does not prevent shortage pricing from being triggered during actual scarcity conditions is critical to ensuring just and reasonable rates. In particular, it is well-established that failing to apply penalty prices during periods where there is a supply shortage—even a transient shortage—mutes efficient short-term and

long-term price signals for the deployment, development, and maintenance of capacity necessary to maintain reliability. As Professor William Hogan has explained, failure to apply shortage pricing during periods of scarcity contributes to the “missing money” problem, whereby the revenues received from short-term markets for energy and ancillary services are insufficient to support investments in new generation capacity.⁸ Application of shortage pricing, in contrast, can reduce the “missing money” problem by generating revenues that can be applied to the fixed costs of developing or maintaining generation resources and represents an important complement to forward markets for capacity. As Dr. Hogan has explained, “[c]apacity markets may provide additional capacity that could be available in real-time,” but they “do not create the correct incentives to operate capacity or change load in response to short-run scarcity conditions.”

FERC recently affirmed the importance of shortage pricing in ensuring just and reasonable rates by mandating that RTOs apply shortage pricing in any interval in which a shortage of energy or operating reserves occurs, regardless of the duration or cause of the shortage at issue. FERC has explained that applying shortage pricing in any interval in which there is a shortage of energy or operating reserves helps maintain just and reasonable rates “by providing appropriate incentives for market participants to follow commitment and dispatch instructions, maintain reliability, provide transparency of the underlying value of the services so that operational and investment decisions are based on prices that reflect the actual marginal cost of serving load and the operational constraints of reliable system operation, and encourage efficient investments in facilities and equipment.”⁹

B. The Load Bias Limiter Impairs the Appropriate Application of Shortage Pricing

Powerex believes that the current application of the load bias limiter runs counter to these objectives by interfering with the appropriate application of shortage pricing. More specifically, as designed, the load bias limiter restricts a load adjustment from exceeding the available resources offered in the market, even if the forecast adjustment was entirely accurate and exposed a supply shortage in the market. At the same time, the current load bias limiter does nothing to prevent an incorrect or erroneous load adjustment from eliminating a shortage. The result is that the limiter does not identify or correct for errors in load adjustments, but simply reduces the frequency with which the CAISO market software applies shortage pricing compared to the frequency of shortages that would be recognized if the market was run using the most accurate load forecast available.

Not only is such a result inconsistent with FERC policy, but the use of the limiter may be contributing to the flexibility challenges experienced by CAISO. As Dr. Scott Harvey explained at a May 2017 Market Surveillance Committee (“MSC”) meeting, it appears that

⁸ *William W. Hogan, Electricity Scarcity Pricing and Resource Adequacy at 2 (Feb. 27, 2014), available at https://sites.hks.harvard.edu/fs/whogan/Hogan_HEPG_022714.pdf.*

⁹ *Settlement Intervals and Shortage Pricing in Markets Operated by Regional Transmission Organizations and Independent System Operators*, Order No. 825, 155 FERC ¶ 61,276 at P 163 (2016).

the limiter is being applied in a manner that suppresses prices during those periods in which the need for flexible capacity is greatest. More specifically, data from the CAISO DMM's 2015 annual market report, shows that application of the load bias limiter "eliminated a substantial proportion of the shortages of upward ramp capability in the" CAISO real-time dispatch and directly reduced "the market value of flexible capacity during . . . high ramp hours."

Powerex believes that thwarting the application of shortage pricing during periods where the need for ramping capability is greatest is directly contrary to CAISO's goal of ensuring that it has sufficient flexible capacity available to effectively balance its system. "If the California ISO needs flexible capacity and upward ramp during these hours, real-time prices should reflect this need and not be artificially depressed through the application of the load bias limiter." By suppressing pricing during these periods, the load bias limiter prevents flexible resources from being compensated for the services that they provide to the grid. The result may be that the compensation received by flexible resources that are critical to meeting the challenges of renewable integration is not significantly different than the compensation received by other resources, thereby reducing the incentive for internal and external flexible resources to be available to meet CAISO's operational needs.

While Powerex acknowledges that CAISO has an interest in preventing inaccurate load adjustments from undermining efficient dispatch or distorting prices, there is nothing to suggest that application of the current limiter is necessary to achieve these objectives. As an initial matter, the load bias limiter has no effect on the dispatch or commitment of resources, as it is applied in the pricing run and not the scheduling run. In other words, the application of the load bias limiter does nothing to promote the efficient use of resources or prevent inaccurate adjustments from impacting the scheduling and commitment of resources. In addition, as CAISO recognized at the May 5, 2017 MSC meeting, CAISO can use its existing authority under the tariff to correct prices to address the impact of erroneous adjustments (e.g., "fat finger errors") on prices. Furthermore, while Powerex is aware that other ISO/RTO markets enable operators to manually adjust load forecasts, Powerex is not aware of other ISO/RTO markets that use automated tools that override those operator adjustments in order to avoid triggering penalty prices.

Finally, as a mechanism specifically designed only to impact prices, and not the scheduling and dispatch of physical resources, the load bias limiter has the direct and intended outcome of affecting the market clearing prices paid for energy between suppliers and purchasers in the real-time market. While discussions regarding the impact of the load bias limiter have largely focused on prices *within* the CAISO BAA, it is important to note that the load bias limiter also affects the settlement for energy associated with EIM Transfers, as well as the settlement of energy transacted through the CAISO's intertie bidding process. Stated differently, the application of the load bias limiter in the CAISO BAA has impacts that extend beyond the CAISO BAA, as it also reduces the price that participants in other BAAs receive for real-time energy delivered to the CAISO BAA during the intervals that the load bias limiter is triggered.

For the foregoing reasons, Powerex believes that CAISO should refocus this proceeding on examining whether any automated load bias limiter can be applied in a manner that

prevents potentially erroneous or “coarse” load forecast adjustments from triggering artificial scarcity pricing while also ensuring that a limiter does not suppress scarcity pricing when it should apply, even if the supply shortage is short-lived. Until CAISO designs a limiter that appropriately protects against both false positives and false negatives, and that does not improperly suppress penalty prices during conditions of genuine scarcity, Powerex believes that CAISO should forego further use of the limiter.

C. Tariff Clarifications Should Include Any Load Bias Limiter Mechanism

The Issue Paper and Straw Proposal explain that CAISO plans to make amendments to clarify its authority under the tariff for operators to manually adjust the load forecast. Powerex supports CAISO making a filing to clarify the tariff in this manner. However, the Issue Paper and Straw Proposal is ambiguous as to whether CAISO will seek to clarify its tariff authority to implement a load bias limiter.

Powerex believes that, like CAISO’s authority to manually adjust load, any limiter must be set out in the CAISO tariff. A load bias limiter, by its very design, changes the load forecast that would otherwise be used in the market run. Moreover, a load bias limiter results in a different load forecast being used in the scheduling run than is used in the pricing run. Powerex therefore believes that CAISO’s clarification of its authority to manually adjust its load forecast should also specify the extent to which those adjustments would be subject to any automated tools such as the load bias limiter. The proposed tariff amendments should specify the conditions that will trigger application of a load bias limiter and the amount by which the load forecast will be changed when the load bias limiter is triggered.

III. Next Steps

Powerex believes stakeholders would benefit from CAISO providing additional, detailed data regarding the use and accuracy of load biasing and the load bias limiter in the CAISO BAA. Powerex requests that CAISO provide the following data for each 15-minute and each 5-minute interval for at least the past year for the CAISO BAA:

- Final load forecast used in the market run
- Manual load adjustment entered by operator, if any
- Change to manual load adjustment due to load bias limiter, if any
- Actual measured demand
- Net uninstructed deviation of supply
- Amount, if any, of power balance constraint infeasibility (from scheduling run)

The above data would support greater transparency regarding the two key issues discussed above. First, it would provide granular data regarding the use of load biasing in the CAISO BAA. Second, it would reveal how often each of the four types of scarcity-related conditions defined above actually occur in practice, and enable an assessment of the accuracy of manual adjustments and the application of the load bias limiter. Powerex

believes that this information will provide stakeholders will valuable insight into the accuracy of these load adjustments and, in turn, can be used to establish guidelines to help identify inaccurate load adjustments that should be subject to the limiter.