Market Parameter Changes Enhancement

Draft Final Proposal

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Introduction

As part of its continued assessment of market performance, the CAISO has identified two enhancements to how it manages market parameters. Since implementing either change would require amending the CAISO tariff, the CAISO is initiating a formal stakeholder process to introduce the issues to be addressed and identify a solution. The scope of this initiative is twofold:

1. Address market issues arising from the utilization of a shift factor threshold in the CAISO's energy market for aggregated locations, which has implications in the congestion revenue right market, and
2. Develop a mechanism to effectuate expedited changes to the values of the penalty prices utilized in the CAISO's energy market to address production issues that may arise.

These two items fall within the same general subject matter of market parameters but they are not interdependent. The following sections describe each issue and the associated proposal to address them.

Changes from Straw Proposal and Responses to Stakeholder Feedback

The CAISO appreciates the comments received from market participants and stakeholders and has carefully considered all stakeholder input in developing this draft final proposal. This draft final proposal changes, clarifies, or confirms a few elements of the straw proposal based on stakeholder feedback. This draft final proposal:

- **Defines the numerical shift factor threshold that is being proposed for DLAPs and THs.** In the straw proposal, the CAISO indicated using a threshold of zero percent or as close to zero percent as possible. Some participants suggested that this threshold also apply to intertie locations or even to all locations. Southern California Edison (SCE) suggested that the threshold not be completely eliminated but rather lowered to a more reasonable level to avoid unintended consequences. After further consideration, the CAISO proposes to use a shift factor threshold for Default Load Aggregation Points (DLAPs) and Trading Hubs (THs) of 0.2 percent. This proposed threshold is a significant reduction relative to the existing threshold of 2 percent. The proposed value strikes a balance between capturing the flow contribution of these aggregated points for significantly smaller shift factors while mitigating for potential performance concerns if shift factors smaller than 0.2 percent were to be considered.

  SCE is concerned that no longer using a threshold for DLAPs and THs could lead to an increased amount of constraint infeasibilities. To the contrary, allowing the contributions of DLAPs and THs to be considered in the congestion management will indeed provide more control variables to the clearing process to achieve an economical solution. In addition, it may potentially result in less frequent conditions of constraint infeasibilities. The CAISO also considered SCE's concern about fully eliminating the thresholds for DLAPs and THs and has adjusted the proposal to use a 0.2 percent threshold. Based on a simulation performed from historical cases, the CAISO found that

in some cases, shift factors of up to 0.2 percent were contributing to power flows. Not using smaller values represents a practical solution to mitigate for any unintended numerical performance issues.

- **Clarifies that the revised shift factor threshold will apply only to CAISO DLAPs and THs.** In the straw proposal, the CAISO explored whether the revised shift factor threshold would apply to other aggregated locations in the western energy imbalance market (WEIM) areas, such as EIM Load Aggregation Points (ELAPs). After further consideration, the CAISO proposes to apply the revised shift factor threshold to DLAPs and THs only, which are aggregated locations in the CAISO balancing area. This proposed shift factor threshold will not apply to any aggregated locations, such as ELAPs, in the WEIM balancing areas. The main driver for this proposal is to address an unintended outcome in the Congestion Revenue Rights (CRR) settlements that relates to the day-ahead market, which currently only applies to CAISO balancing area. For consistency between the day-ahead and real-time markets, the proposed shift factor threshold is also considered for real-time market. The issue to be addressed by reducing the shift factor threshold does not impact WEIM locations *per se* as they are not participating in the day-ahead market and are not subject to CRR settlements.

- **Defers the proposal to apply the shift factor threshold to intertie locations or other locations**. Several participants proposed to either apply a smaller shift factor to other locations like large generation points or interties, or even apply it to all locations. As indicated in the straw proposal, there are practical considerations for not being able to eliminate or significantly reduce the threshold for all locations. These concerns are still relevant. Therefore, the CAISO will not explore further whether the shift factor threshold can be eliminated or significantly reduced at all locations. However, the CAISO sees merits to the suggestion about intertie locations; specifically and narrowly for scheduling points associated with sizable intertie capacity such as Malin and Paloverde. The CRR settlements could potentially benefit from applying a lower shift factor threshold to scheduling points with large capacity. Unfortunately, this would require the CAISO to perform simulations and additional analysis for these locations, which is not currently possible because the market functionality is not configured to apply a different shift factor to intertie locations. Instead, the CAISO proposes to defer this consideration to a future time once the CAISO has the ability to simulate these conditions in the market functionality. If the CAISO finds technical merits to applying the proposed threshold of 0.2 percent to large intertie locations, it could extend it in a future effort. The CAISO aims to file Tariff language which will give the flexibility to apply the proposed threshold to large intertie locations within in the scope of this filing.

- **Provides a specific timeline and procedure for informing participants of parameter changes.** Regarding the second part of the proposal to implement an expeditious procedure to implement parameter (penalty prices) changes, some participants suggested the CAISO commits to a more specific timeline to communicate about parameter changes. The CAISO finds this request reasonable and has expanded the language in the proposal to say that the CAISO will provide notice and explanation about the changes within three business days of implementing the change.

  Some participants expressed concerns that this temporal procedure could occur too frequently and preferred that the CAISO opens up a stakeholder process if it becomes a recurrent practice.

Given historical events, the CAISO does not expect to use this procedure frequently. For every policy initiative or project implementation, the CAISO assesses the required synchronization of new penalty prices with the existing ones and programmatically determines the numerical values that are needed to maintain the scheduling priorities. Given the complexity of capturing all possible permutations of conditions in the market, once in production the CAISO may find edge cases where a specific penalty price or prices may result in unintended market outcomes. Based on these outlier production cases, the CAISO assesses what potential re-calibration can address the identified issue. The CAISO anticipates using infrequently the proposed procedure for these types of corner scenarios.

- **Furthermore, CAISO addresses other comments and suggestions. These include**

  Explanations on general conditions for the need of this parameter change procedure. Some participants asked to provide more details and illustration of the cases that may trigger this procedure and the CAISO has provided more details in this proposal. The inherent nature of the complexity of the outcomes that can be due to unintended interplay of penalty prices precludes the ISO to specifically characterize specific illustrations of what foreseeable scenarios may require the use of this procedure. Instead, CAISO can refer to a general dynamic of penalty prices that may show in different permutation of outcomes.

  One general condition that ISO may foresee is the need for calibration of specific penalty prices of certain self-schedules to ensure some outlier pricing conditions would not result in losing the relative priorities among schedules. For instance, in practical terms the penalty prices used for different self-schedules maintain certain distance among them, while one penalty price may be set at, say, $1,250, another self-schedule with lower priority may be set at a lower price of, say, $1,150. This will ensure that the optimization can clearly differentiate between the relative priorities. This price separation may work very well under most market conditions. However, under some other interplay of conditions, such as the impact of marginal losses leading to large price differentials, the distance between these two penalty prices may not be sufficiently large to keep them apart and thus the optimization may no longer follow the expected and relative scheduling priorities. This precise type of analysis is performed when CAISO assesses the penalty price to be used to achieve certain priority. An example of how this works was elaborated in detail in the expedited policy initiative implemented on May 2022 to mitigate for the unintended overscheduling of intertie constraints[1]. In the proposal, there is a specific illustration of how CAISO planned to have enough room to account for other corner pricing dynamics. Sometimes that headroom may prove to no longer be sufficient

[1] The material of this policy initiative is available at https://stakeholdercenter.caiso.com/StakeholderInitiatives/Adjustment-to-intertie-constraint-penalty-prices
The description of the assessment to have a headroom between penalty prices to account for other pricing factors such as marginal losses is described in the final proposal page 16.

and, thus, CAISO may need to revise those quickly to mitigate for the identified market issues.

Additional analysis on impact and pricing. Middle River Power (MRP) suggests that instead of introducing a threshold to the shift factors for DLAPs and THs in the energy market, CAISO should use the same shift factor of 2 percent in the clearing process of CRRs to align it with the energy market threshold. MRP's concern is that the application of a lower threshold at some locations in the CAISO market will result in higher prices that participants will have to hedge. There are several considerations for this suggestion.

First, accounting for DLAPs and THs flow contributions on transmission constraints will result in a more accurate representation of the impact of these locations in the congestion management process. This will consequently be reflected in the price formation of these locations more precisely. As discussed further in this proposal, the price impact will be inherently bounded by the magnitude of the flow contribution, which is based on the magnitude of the shift factor. Considering contributions from locations with effectiveness of less than two percent (once the threshold is lowered for DLAPs and THs) means that the price impact will also be proportional to that shift factor. Thus, the resulting price impact will be less than two percent of the shadow price of transmission constraints. Beyond the merits of the magnitude of the price change, the relevant point is that these prices will be reflective of more accurate formation and pricing of power flows.

Second, the impact on prices will not necessary mean it will always be an increase. There will also be cases where prices will decrease. Any location in the system will have a shift factor, which can be positive or negative, to reflect whether it will exacerbate congestion or provide counter-flow to prevailing congestion depending on the position of the location relative to the transmission constraint. Therefore, DLAPs and THs, like any other location, may reflect either a positive or a negative contribution to the marginal congestion component, which will result in either lower or higher prices. The end impact will depend on the relative contribution of the DLAP or THs to the specific constraint (e.g. weather the location is on the upside or downside of the congestion).

Third, the suggestion of using a threshold on the clearing process of CRRs represent several more complex challenges that cannot be considered lightly. Critically, in the CRR process, CRRs based on DLAPs and THs are actually decomposed into the individual locations that make up the definition of these aggregated points. The actual clearing process is based on clearing the individual components, not on the aggregated location; therefore, trying to apply a shift factor threshold to the aggregated locations in the CRR process will be irrelevant and ineffective to limit the contributions of these locations to the formation and pricing of power flows in the CRR clearing process. The CRR clearing process actually utilizes the difference of shift factors between the source and sink to determine what is called power transfer distribution factors. These factors reflect the pair-wise source-to-sink effectiveness of a CRR to determine the awards and pricings in

the CRR process. Imposing a threshold will naturally be at the pairwise reference instead of individual source-only or sink-only shift factors. That will create an inconsistency with respect to the consideration of shift factors in the energy market that uses a 2 percent threshold on a location-by-location basis. In the energy market clearing process, the congestion management to comply with transmission limits inherently effectuates re-dispatches by inc'ng resources on one side of the constraint while dec'ing resources on the other side of the constraint. It's not feasible to try to apply dynamically a shift factor threshold based on the redispatch movements to try to come with a similar construct of CRRs.

Clarification about the scope for solutions to address CRR settlements issues. DC energy raised the concerns about broader aspects of the pro-rata funding policy. The scope of this initiative is very narrow and specific to address only the implications of the shift factor threshold because this is an item more in the nuances of implementation and not on the specifics of the policy developed for pro-rata funding. Therefore, other areas that go more into the specific principles of the policy implementation are beyond this initiative. Moving forward, CAISO will perform more targeted analysis on the drivers for the settlements outcomes observed by market participants. This analysis will serve as a more specific reference of the areas for further consideration. The drivers identified through this analysis will largely defined the next steps for potential changes.

Shift Factor Threshold

Background

Since the inception of its nodal market in 2009, CAISO has used a threshold for shift factors in its market optimization. This threshold effectively determines what power injections (from resources) are used in the congestion management process. Based on impact studies and simulations, CAISO arrived at a two percent threshold to determine which resources will be used for congestion management in its markets. CAISO deemed this threshold to achieve a reasonable balance between good utility practice for grid operations and undesirable market outcomes.

Since the initial implementation of the nodal market, CAISO has identified two impacts that the shift factor threshold has on its markets. First, CAISO identified a discrepancy in the price formation for aggregated pricing locations. In 2014, CAISO pursued a market enhancement to change the price formation logic for these aggregated locations. This new logic effectively eliminated the potential for a price discrepancy between default load aggregation points (DLAPs) and trading hubs (THs). Second, as early as 2014, CAISO identified that the shift factor threshold also exacerbated revenue inadequacy for congestion revenue rights (CRRs). Since then, CAISO has continued to monitor its impacts on the market.

On January 1, 2019, CAISO implemented a new policy of pro-rata funding for CRRs. Under this policy, the impacts of a shift factor threshold on the CAISO markets were more visible in market outcomes. Under certain conditions, the shift factor threshold negatively impacted the efficient interaction of the day-

ahead market with the CRR market. CAISO provided specific analysis on this interplay in its CRR market performance report published on May 2020. This draft final proposal addresses the inefficiency introduced by the use of the shift factor threshold for aggregated locations in the CAISO's markets.

Shift factors, also known as sensitivity factors, measure a specific location's effectiveness relative to the change of power flow on a specific constraint. The shift factors depend on the transmission topology, the slack node choice, and the transmission system's specific characteristics like impedances. A location will typically be either a supply (generation) node or demand (load) node. For instance, a 40 percent shift factor means that 0.4 MW will flow on a constraint if 1 MW is injected and withdrawn between a given node and the slack node. If the shift factor is positive, the flow will increase by 0.4 MW on the given constraint. If the shift factor is negative, the flow will reduce by 0.4 MW on the given constraint. CAISO's market uses shift factors in both its congestion management process and its price formation mechanism. Shift factor values are typically in the range of negative 100 percent to positive 100 percent.[2]

CAISO's market produces and uses shift factors for both individual and aggregated nodes, such as generator-specific nodes or DLAPs. These are calculated for both physical and virtual resources, such as interties, internal generators, convergence bids, and demand resources. The market calculates shift factor values relative to the slack node, which can be either an individual or distributed slack reference. Since its inception, CAISO's market has used a distributed slack node.

Congestion Management in CAISO Market

CAISO's market uses locational marginal pricing in its clearing process. This accounts for the locational nature of congestion and losses by producing Locational Marginal Prices (LMPs) that include energy, congestion, and loss pricing components. CAISO's market bases the LMP's decomposition on the slack reference choice. However, that choice does not affect the overall LMP value.

Congestion management refers to re-dispatches of market resources to comply with transmission limits. In order to comply with a transmission limit, the market relies on resources' operational characteristics, shift factors, and market bids. The shift factors determine the direction of the re-dispatch since some resources can exacerbate congestion while others can mitigate congestion. Resources located on one side of the constraint will increase generation, while resources located on the other side of the constraint will decrease generation.

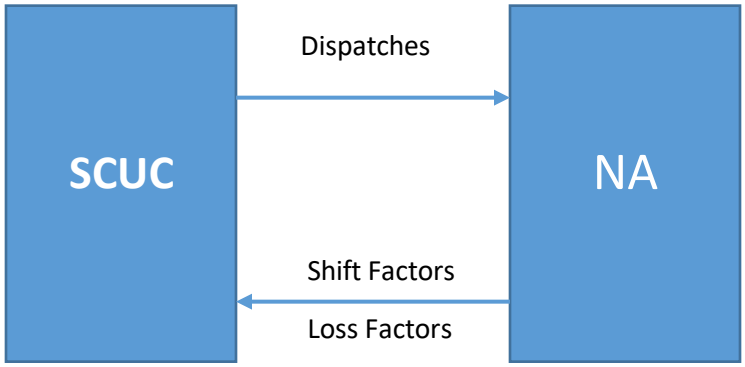
Re-dispatching resources for congestion management is an integral part of the market clearing process. Transmission constraints are one type of constraint the market optimization considers to achieve a least-cost solution.

The CAISO's market clearing process uses a Security Constraint Unit Commitment (SCUC). This type of technology has become ubiquitous in electricity markets. As shown in Figure 1, the CAISO's SCUC design

[2] There have been some infrequent instances in which CAISO has posted shift factors outside the 100% range; this applies for nomograms which typically have not been normalized.

relies on two modules: one that solves for the SCUC problem and another that handles the network application (NA).

Figure 1. Iterative calculation in the CAISO's market clearing process



The SCUC module solves for unit commitments and dispatches. Then, the NA module uses these resource dispatches to run a full alternating current (AC) power flow. The AC power flow produces both shift factors and loss penalty factors at a given operating point. The SCUC module then uses these shift factors to form linearized power flow constraints. These constraints also rely on the base operating point to estimate the full power flow contribution. The SCUC module will enforce these constraints and dispatch resources so that transmission limits are respected. This process represents the congestion management performed through the market clearing process.

As part of the solution, the market determines updated resource dispatches, which in turn are sent to the NA module which performs another estimation of AC power flows. Based on this new AC power flow, the NA module calculates a new set of shift factors and loss penalty factors, which in turn are sent back to the SCUC module. This iterative process converges to a solution after a finite number of cycles and within certain timeframe and optimality criteria.

Every SCUC-NA iteration finds what transmission constraints become overloaded in the AC power flow to then enforce them in the SCUC module and apply congestion management. Since a given market may have hundreds of transmission constraints with hundreds of locations with associated shift factors, the number of shift factors and constraints to optimize can grow rapidly and pose a computational burden on the SCUC solution. For this reason, only constraints that have a capacity loading of at least 85 percent are actively considered in the market and subject to congestion management.

When any linearized power flow enforced in the SCUC module binds, or reaches its limit, it will be priced accordingly with a shadow price.[3] The marginal congestion component of the LMPs at a given node *i* is formed by using the linear combination of the shadow prices $\mu_k$of all transmission constraints *k* binding and the shift factor $SF_{k,i}$ of that given node, or

[3] As part of its transparency effort, CAISO posts all shadow prices for the various types of constraints binding across the CAISO markets.

$$MCC_i = \sum_k SF_{k,i}\mu_k \quad \forall\, i$$

Shift Factor Threshold

CAISO markets currently apply a 2 percent threshold on shift factors. The impact of this threshold is reflects in both resource re-dispatch and price formation.

In the congestion management process, only resources with a shift factor greater than 2 percent will be effectively considered for re-dispatch. When the nodal market was launched in 2009, it was observed that the market could potentially utilize generators located far away, electrically speaking, from the constraints being managed and be measured by a small shift factor. This could lead to an unreasonable re-dispatch of these generators for very little congestion relief on the constraint in question. This would not be prudent or consistent with good utility practice.

In the price formation process, shift factors below the threshold for any binding constraint are not utilized to derive the marginal congestion component. This consistently disregards the impact of resources (injections/withdrawals) shift factors for both resource dispatches and their prices. This also means that resources will receive dispatches that are consistent with the prices cleared in the market.

The threshold applies to any shift factors derived in the market, with no consideration to whether they are associated with locations that have only certain type of resources. The threshold is applied the same way to individual resources or aggregated resources, and to physical or virtual resources.

Market Issues

The use of a shift factor threshold in the congestion management of day-ahead energy market has manifested in two main issues. First, the use of a shift factor threshold can result in an overpayment of CRR settlements due to overestimating the implied CRR flow on a given transmission constraint. Second, the use of a shift factor threshold may result in flow contributions not accounted for in the day-ahead flow settlements by means of not collecting sufficient congestion rents, and in some extreme cases it can lead to flow reversals in the CRR settlements. These two issues are explained in more detail in subsequent sections below.

Overestimation of CRR Payments

The first issue due to the application of a shift factor threshold also arose in the analysis of the CRR performance. Both the day-ahead energy and the CRR markets perform congestion management as part of the clearing process. Both markets calculate shift factors and produce marginal congestion components as part of the price formation mechanism.

The shift factors from the CRR processes can be different than the day-ahead market shift factors due to a variety of reasons including transmission configuration and model differences. For instance, an outage

modelled in the day-ahead market but not modelled in the CRR auction may potentially yield different shift factors. However, the largest contributor to the CRR deficit is the use of the shift factor threshold in the day-ahead market but not in the CRR market. The CRR auctions use direct current- (DC) based shift factors with no threshold in place. When the CRR auction clears for CRRs, it takes into account any shift factor contributions even if they are smaller than 2 percent. The flow estimated in the CRR auction will consider the contributions of all CRRs. When these CRR injections are applied to the day-ahead shift factors to calculate CRR payments, only the injections and withdrawals related to shift factors greater than 2 percent will contribute to the CRR estimated flow. These flow contributions on the CRR flows can be in either direction – prevailing or counter-flow – and can result in a higher or lower CRR flow than was released in the CRR processes. The lack of accounting for the contributions for locations with shift factors below the threshold resulted in a settlements CRR flow higher than what the CRR flow was in the CRR process. Once these contributions are actually factored in, the flows between the day-ahead market and the CRRs processes converged closer.

Although this issue can be observed at any pricing location, the most significant impact occurs when the issue involves DLAPs and THs with shift factors below the 2 percent threshold. Since these aggregated locations have large injections up to thousands of megawatts, dropping injections/withdrawals with relatively small shift factor even under 2 percent will still not account for a large flow contribution.

This issue was systemic and resulted in CRR deficits for the Devers-Valley constraint, which was binding in last quarter of 2019 and the first two months of 2020. Based on a targeted analysis of this issue, about 40 percent of the CRR deficit on this constraint was caused by using a shift factor threshold in the energy markets but not in the CRR markets.[4]

Under-collection of Congestion Rents

The day-ahead congestion rent measures how much transmission capacity is priced in the day-ahead market. In the congestion management process of the day ahead market, the linearized power flows are estimated at a given based flow from the most recent operating point, and the incremental change around that operating point given the day-ahead shift factors and injections from supply and demand. The base flow is not optimized in the market, only the incremental flow using the shift factors with the supply and demand dispatches being the optimized variables. When estimating the base flow on a constraint in the NA module, the contribution of the aggregate locations will be accounted for but if the DLAPs and THs have shift factors below 2 percent, they will not contribute to the redispatch for congestion management in the SCUC module. The market issue identified in the CRR performance becomes relevant when dealing with aggregated locations such as default load aggregation points (DLAPs) or Trading Hubs, which are significantly larger than any typical individual resource. For instance, in the summer with loads over 45,000 MW of peak load, the DLAPs can easily be greater than 10,000 MW. When the shift factor of 2 percent is applied, it means that an injection of 10,000 MW with an effectiveness of, say, 1.5 percent will not contribute to congestion rents, even though this means a flow contribution of 150 MW (10,000 MW *

[4] Full analysis results can be found in section 8.3 of the CRR performance report available at http://www.caiso.com/InitiativeDocuments/CongestionRevenueRightsMarketAnalysisReport-May12-2020.pdf

1.5%) on a given constraint. This market issue of under collecting congestion rents can be observed only for constraints in which DLAPs and THs have shift factors that may fall below the 2 percent threshold. In the analysis of the CRR performance, CAISO observed multiple instances of this interplay being more likely to occur when constraints are of small capacity relative to the DLAPs and THs flow contributions. This condition can easily lead the constraint to reverse direction in the CRR settlements. In relative terms to the overall CRR settlements, this issue is small, but it alone does represented an impact of $3 million of settlements reversal in the first 15 months of the implementation of the new policy[5].

Impact Analysis

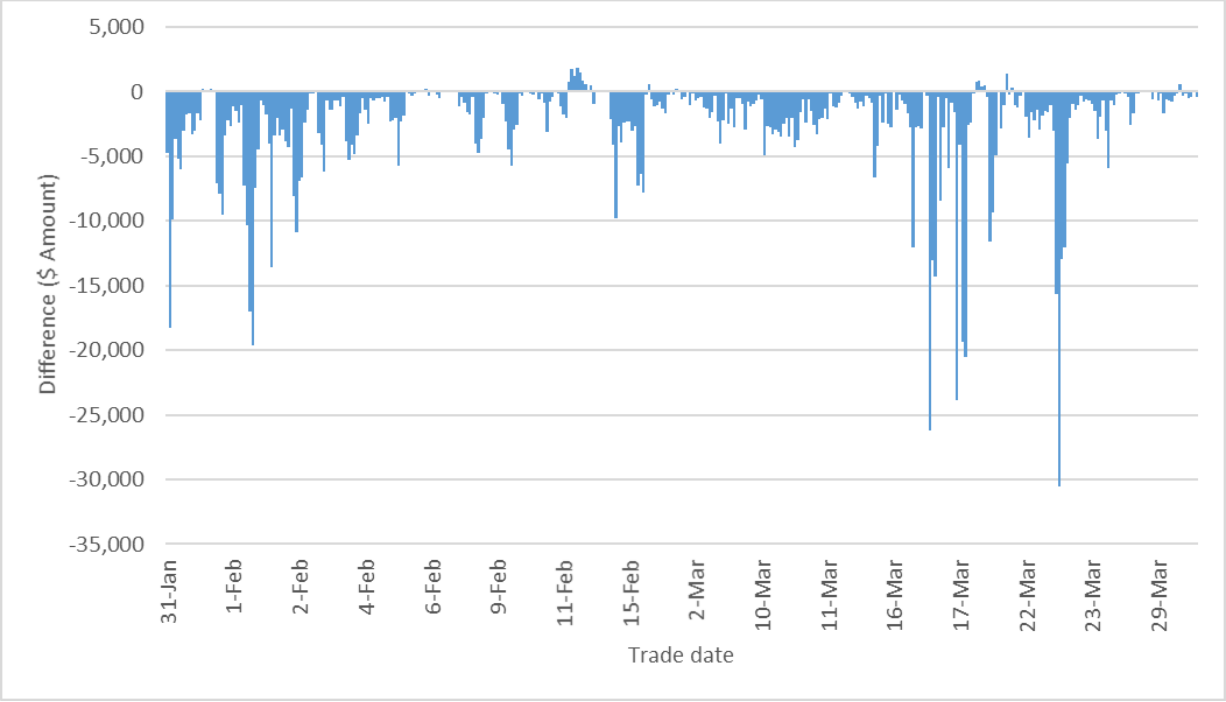
This market issue was observed in the first months of 2022 on the constraint 33020_MORAGA _115_32780_CLARMNT _115_BR_1 _1. This constraint started binding frequently in the day-ahead market between January 31, 2022 to March 31, 2022. Since it was binding in the day-ahead market, the congestion rents collected from the day-ahead market should ideally be sufficient to fund the CRR payments for this constraint.

Since the implementation of the CRR auction efficiency initiative in January 2019, the CRR payments are adjusted based on the entities' CRRs contributions on deficits on a constraint-by-constraint basis. The initiative introduced the terms notional amount and offset amount. The notional amount is the face-value numerical amount based on the CRR awarded amounts, while the offset amount represents the revenues that would be reduced due to the mechanism of partial funding. When the difference between the notional amount of the constraint and offset amount on the same constraint for the trade date is positive, the scheduling coordinator will be paid the reduced amount through the CRR settlement. If the difference is negative, the scheduling coordinator will be charged the CRR settlement (negative amount).

Figure 2 shows the difference between the notional amount and offset amount (deficit) for the 33020_MORAGA _115_32780_CLARMNT _115_BR_1 _1 constraint between January 31, 2022 and March 31, 2022. For approximately 89 percent of the hours when the constraint was binding, the difference was negative, which indicates that the offset amount was greater than the notional amount. Consequently, scheduling coordinators holding CRRs on this constraint needed to pay for holding CRRs settled on that constraint.

[5] Full analysis results can be found in section 8.2 of the CRR performance report available at http://www.caiso.com/InitiativeDocuments/CongestionRevenueRightsMarketAnalysisReport-May12-2020.pdf

Figure 2: Difference between Notional and Offset amount for 33020_MORAGA _115_32780_CLARMNT _115_BR_1 _1 constraint



More granular analysis of February 1, 2022 helps illustrate these issues in more detail. Figure 3: shows the comparison of notional amount and offset amount (deficit) and shows that the offset amount was significantly higher than notional amount that is the face value of CRR-awarded payments.

Figure 3: Comparison of Notional Revenue and Offset Revenue for one sample trade (February 1, 2022)

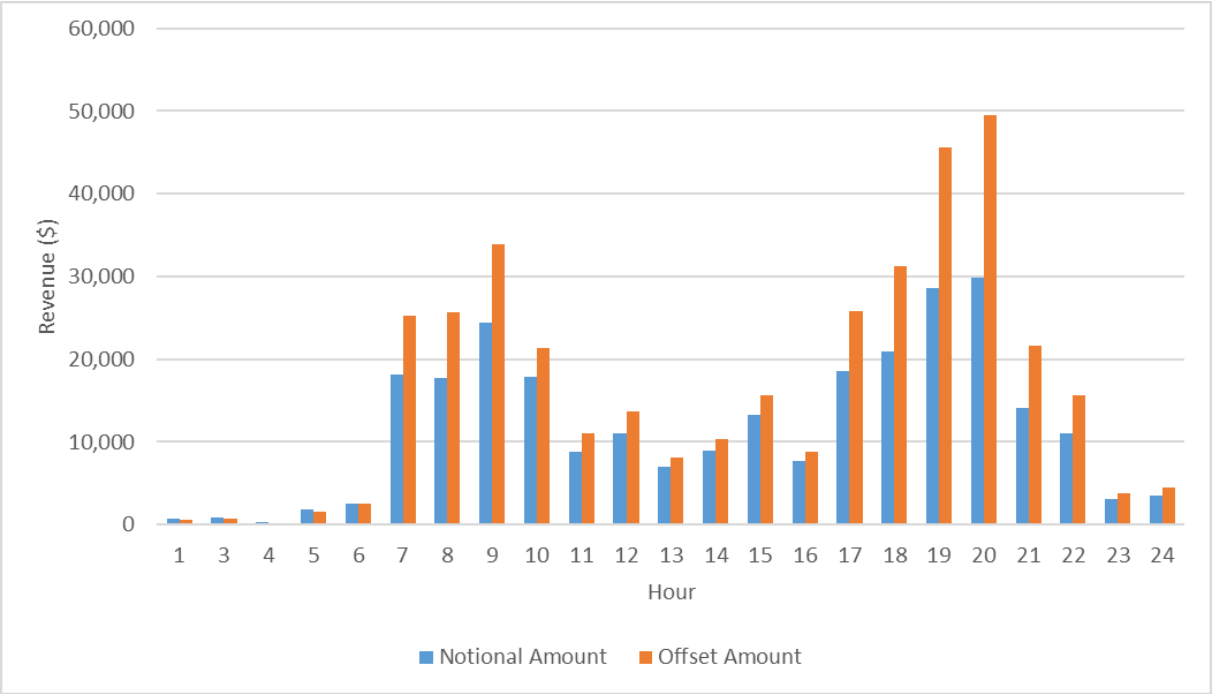
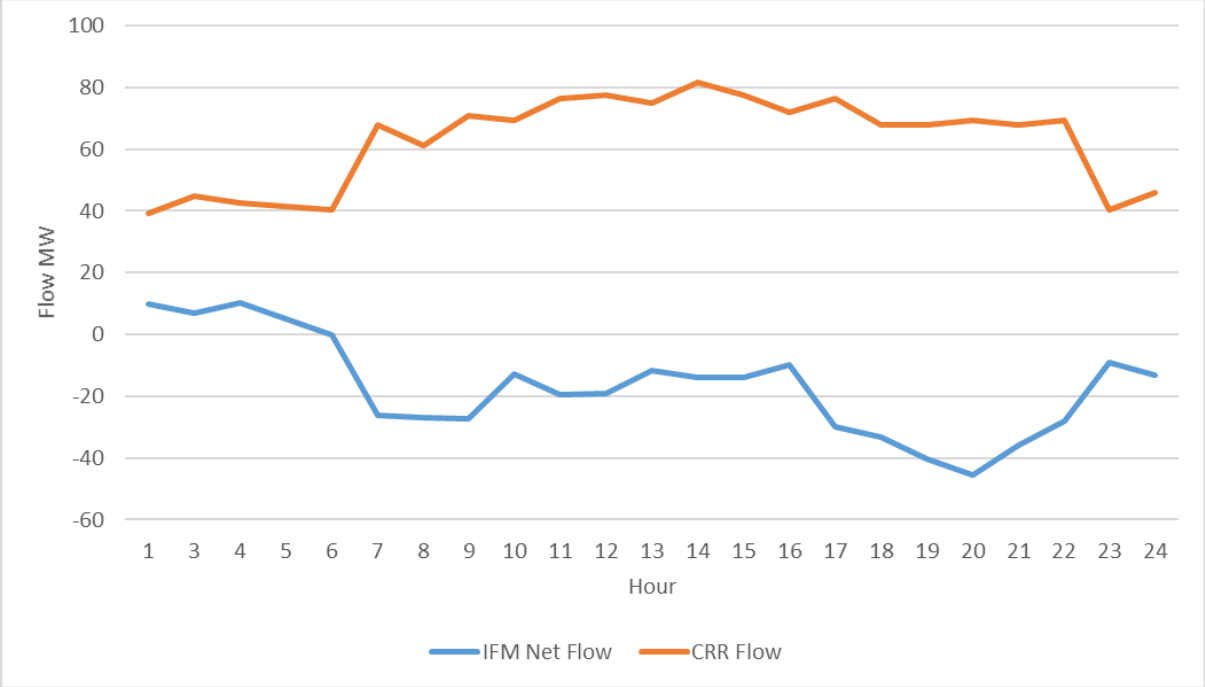


Figure 4 below shows the comparison of IFM flows and CRR flows on this constraint for the same trade. It shows that the IFM flows and the CRR flows are significantly different. The IFM net flow is the amount of flow that collected congestion rents on this constraint from the day-ahead market. The limit of this constraint is about 120 MW for this trade date and the equivalent CRR flow on this constraint (based on the awarded CRRs) is between 60 and 80 MW, while the settled IFM flows are between -5 and -45 MW.

Figure 4 Comparison of IFM net flows with the CRR flows for one sample trade date (February 1, 2022)



For instance, the CRR flows for hour-ending 20 is about 69 MW; however, the corresponding IFM net flow was around -45 MW. For this scenario, the flow contribution of the DLAP injections was not being accounted for in the calculation of IFM net flow because the DLAP shift factor was below the threshold of 2 percent. By missing that contribution, the resulting IFM flow is much lower with less congestion rents being collected.

Additional analysis was performed for the months of January 2022 – October 2022, and it shows the impact amount for the constraints when the offset amount is greater than notional amount. Although the proposal in this initiative is more targeted to the issue driven by the shift factor threshold, there may be other drivers for this type of outcome. Another reason identified in previous analysis efforts is the impact of loop flows considered in the day-ahead market solution.

However, the offset revenue impact is the amount of offset revenues that exceeded the notional revenues based on the historical percentages of offsets for those same constraints. The assumption was based on the average percentages of offset revenues for the constraint and applied that percentage to the intervals when offset revenues was greater than notional revenues.

For example, consider constraint A to be binding and having notional revenues of $1,000 for one hour. The issue of the lack of shift factors for the DLAPs and THs (less than 2 percent) will have an impact on the offset revenues on constraint A. The offset revenues would be greater than notional revenues; in this case, assume offset revenues to be -$1,600. The negative quantity indicates a deficit that would need to be offset from the notional revenues. However, based on the historical offset percentage over notional revenues for the same constraint, let's assume the offset revenue is estimated at -$400. So the offset revenue impact for this example would be -$1,200, which is the offset being applied in excess.

Figure 5 shows the offset revenue impact classified by transmission lines with their voltage level, nodal group constraints, nomogram and interties. The more significant impact is on lower-voltage transmission constraints such as those 115 kV and 230 kV. It does not impact the higher 500 kV lines or other interfaces such as nomograms or interties or nodal group constraints.

Figure 5: Offset revenue impact for all the constraints from January – October 2022

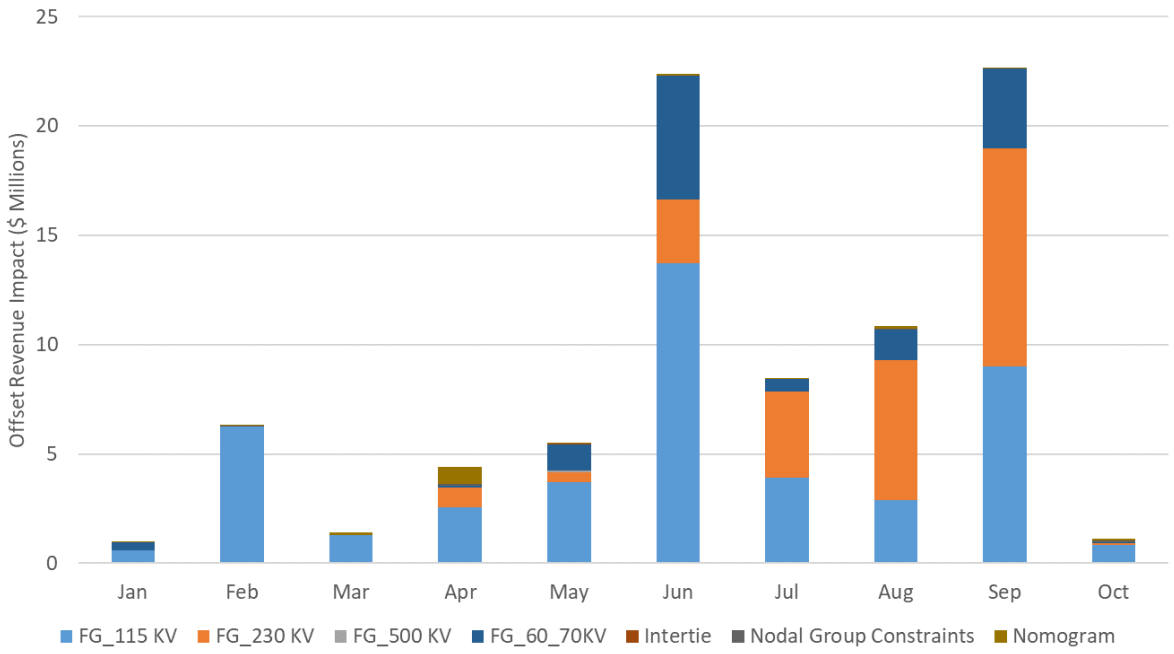


Figure 6 shows the offset revenue impact on an hourly pattern showing that the majority of the impact is on the 115 kV lines and 230 kV lines impacting during the peak hours. It shows that the majority of the impact is seen in the peak hours (HE 15 – 21) and mostly on the 115kV and 230 kV lines.

Figure 6 Offset revenue impact for all the constraints from January – October 2022 on hourly basis

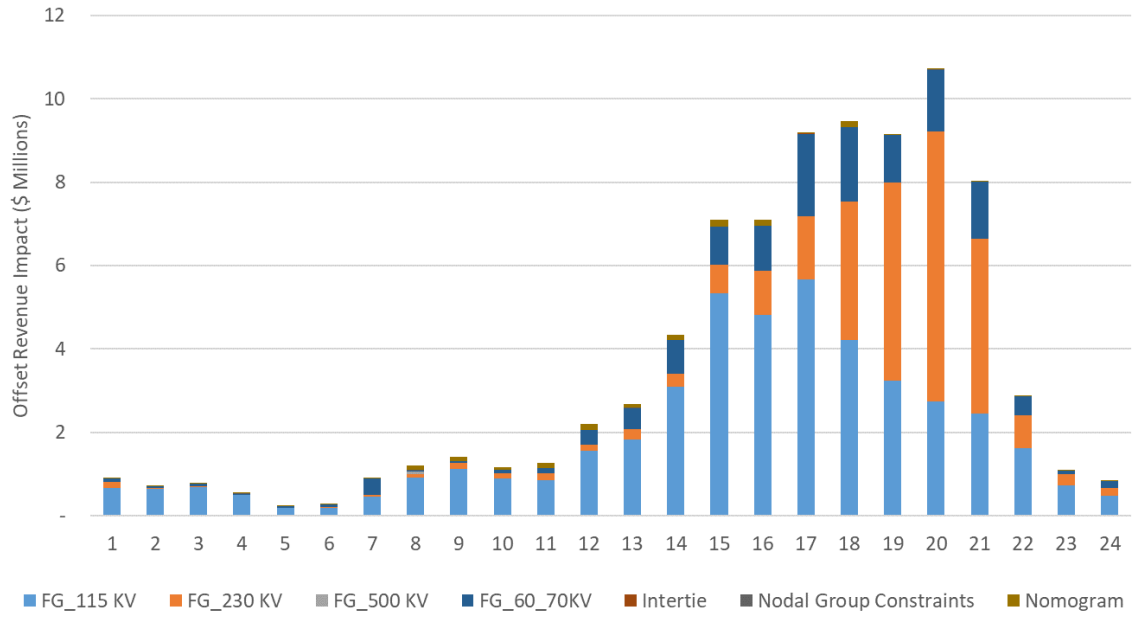
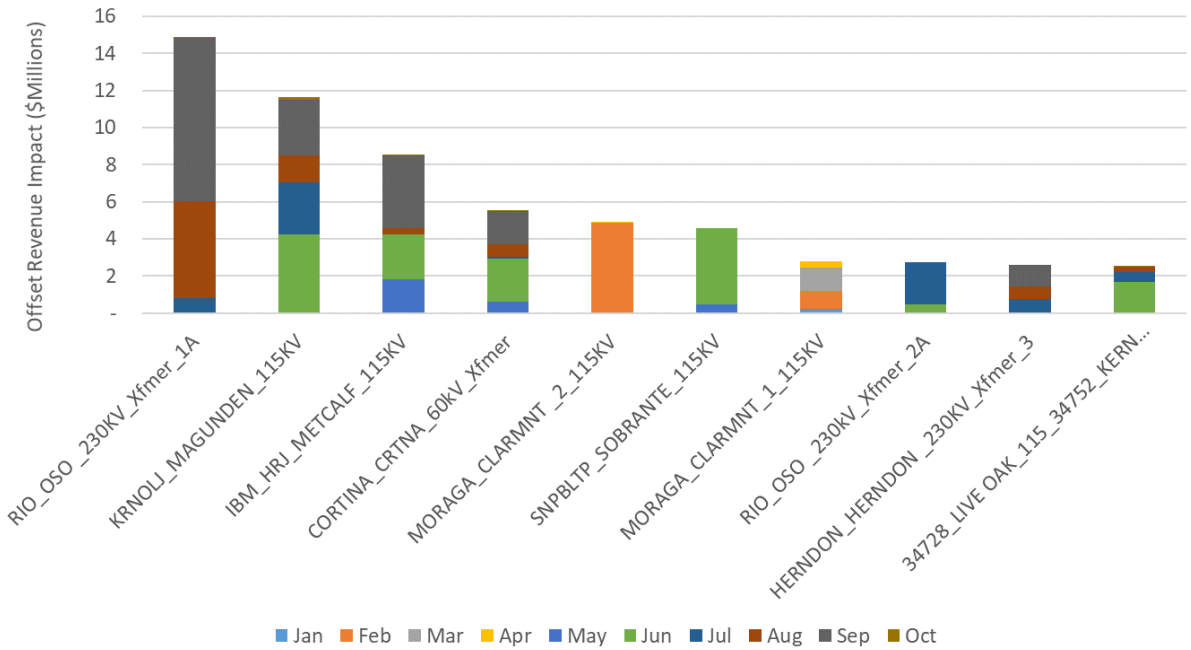


Figure 7 shows the top ten constraints that were most impacted due to the shift factor thresholds. The 32214_RIO OSO _115_30330_RIO OSO _230_XF_1A had the most offset revenue impact from all the months analyzed, followed by 34724_KRN OL J_115_34736_MAGUNDEN_115_BR_1 _1. It shows that there are mostly 115 kV line that are impacted from the list of top 10 constraints.

Figure 7 Offset revenue impact for the top ten constraints from January – October 2022



Pricing Analysis

Some participants requested pricing analysis of this proposed change. This section has been added to the draft to illustrate the impact of the proposed change on prices.

By considering flow contributions of DLAPs and THs below 2 percent, they will not be considered in the congestion management for re-dispatch and consequently will also be part of the price formation. Therefore, it is expected that this change will have an impact on congestion management and congestion prices for the CAISO area. On one hand, the price impacts are expected to be relatively minor because the contributions that will be included are based on fairly small shift factors. When the shadow prices of the constraints is multiplied by the small shift factor, the price contribution will be in proportion of the shift factor value. For example, if a shadow price of $100 is now accounted for the DLAP injection with a shift factor of 0.8 percent, the price change of the marginal congestion component will be $0.8=$100*0.008.

Since congestion management is part of the market clearing process, the price impact cannot be determined accurately based on an original market solution. Therefore, to perform the price impact analysis, the day-ahead market was re-run with the shift factor for DLAPs and THs lowered to 0.00001.

Since the congestion management will not consider additional flow contributions, in general it will impact the overall clearing process. Thus, in addition to impacting the formation of the MCCs, it may also lead to small changes in the system energy marginal prices. There were eight trade dates chosen for analysis which were identified from the offset revenues analysis presented in the section above. There are two aspects of price impact analysis: 1) impact on the system marginal energy component, or energy prices, and 2) impact on the marginal congestion component. One trade date analyzed was during the summer heat wave on September 7th, 2022 when one of the constraints in the PGAE area was impacted significantly due to the lack of DLAPs flow contributions with using the shift factor threshold of 2 percent.

System Marginal Energy Component Impact

With the inclusion of the reduced shift factors for DLAPs and THs, the impact on energy component was negligible when examined in the counterfactual analysis. Figure 8 shows that energy component increased in some peak hours and decreased in some off-peak hours. However, there was an increase of about $3 – 4/MWh in some peak hours, indicating there was not a significant impact on the energy prices as seen by the difference in energy prices with and without the shift factor threshold reruns.

Figure 8 Average difference in SMEC for the eight trade dates analyzed

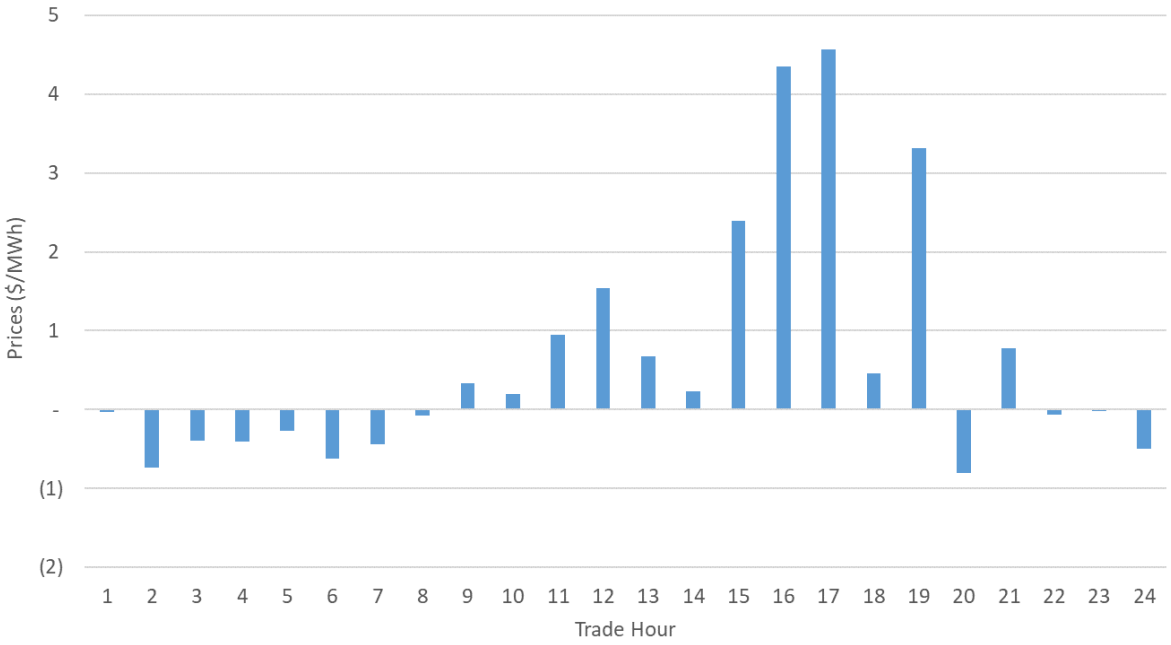
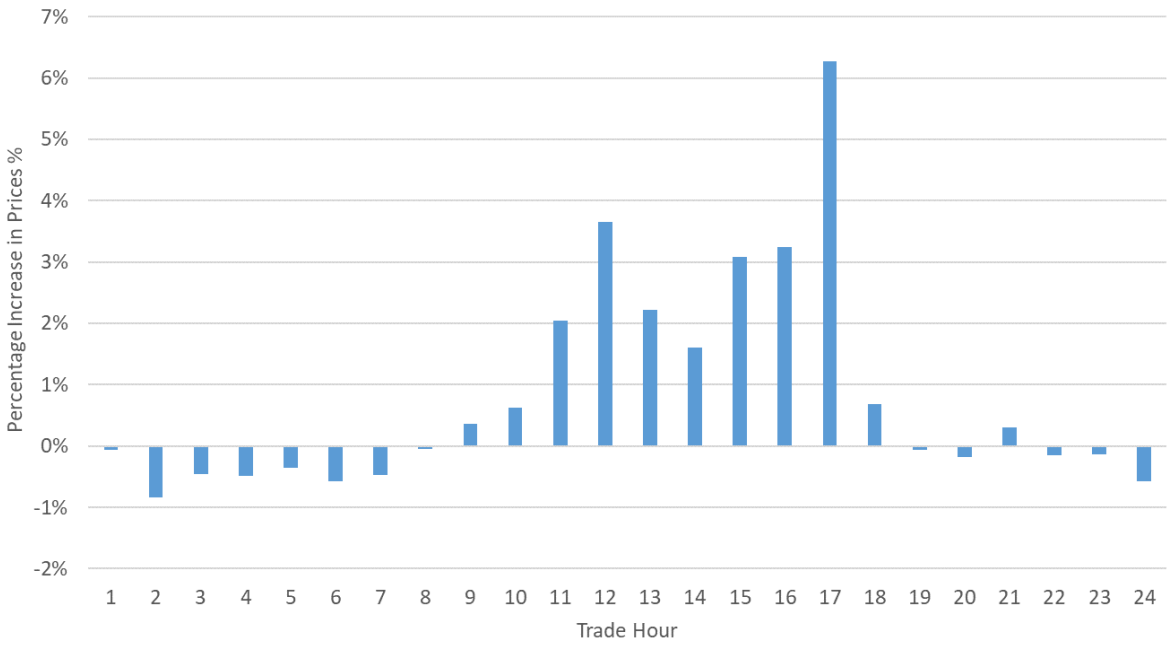


Figure 9 shows the percentage change in energy prices across the eight trade dates analyzed. Both metrics show there is not any significant impact on the energy prices if the shift factor threshold of 2 percent is removed from DLAPs and THs.

Figure 9 Average percentage change in energy prices



Marginal Congestion Component Impact

The more direct impact of this proposed change will materialize in the marginal congestion component. Figure 10 shows the difference in marginal congestion component by using reduced shift factor threshold for DLAPs and THs. A positive difference in the chart indicates that the marginal congestion component increased when reducing the shift factor threshold for DLAPs and THs.

With the introduction of shift factor for DLAPs and THs, the flow contribution will be impacted and there is an expected slight change in congestion component (positive or negative) because the flow contribution has changed. A positive shift factor indicates an active power injection at the node increases the power flow on the transmission line whereas a negative shift factor indicates an active power injection at the node decreases the power flow on the transmission line and direction.

For the trade date September 7, 2022, hour-ending 19, the marginal congestion component saw an increase as the shift factor for the DLAP PGAE was negative; however, the shift factor for SDGE and SCE were positive, resulting in a reduction of the marginal congestion component. There are other constraints that are binding and that contribute to the MCC.

Figure *11* shows the comparison of marginal congestion component for all four DLAPs between the original and the rerun. It shows the magnitude of the increase in MCC with respect to the original price.

Figure 10 Difference in marginal congestion component for September 7, 2022

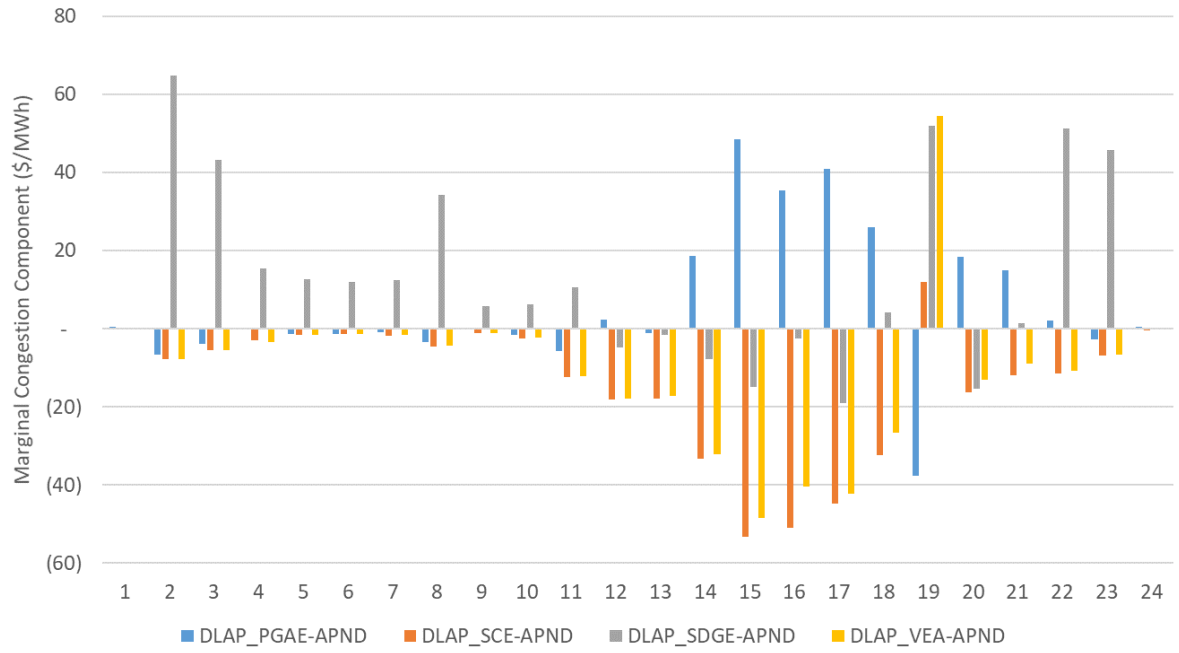
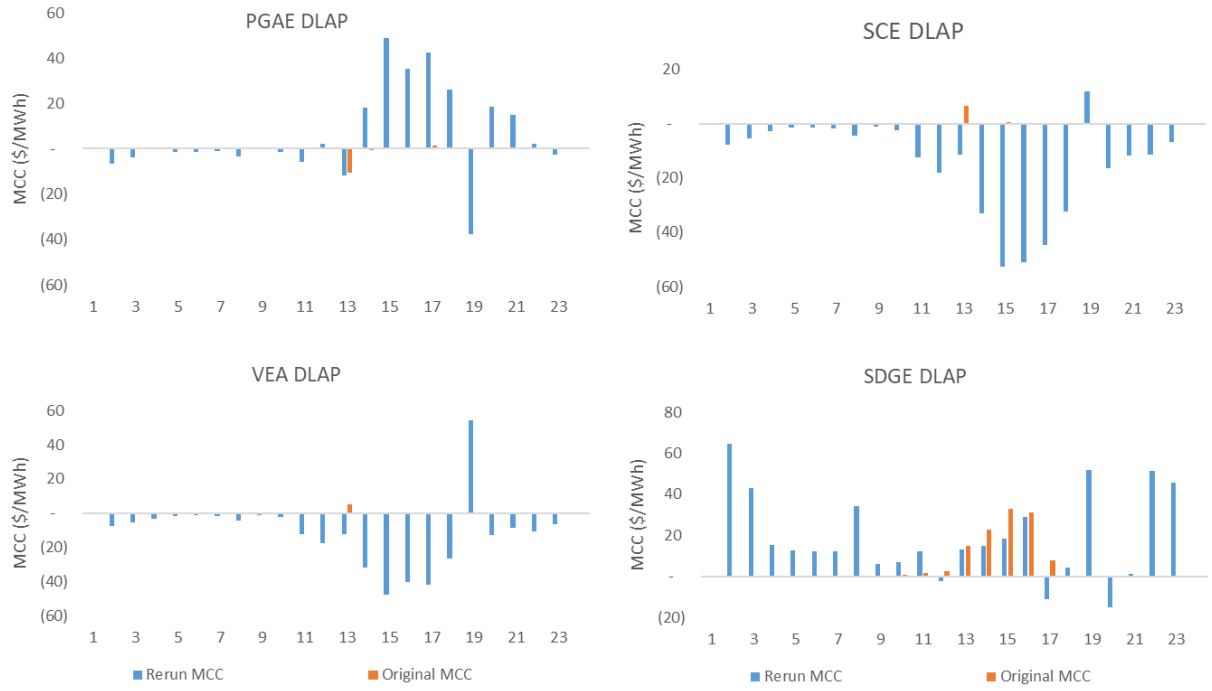


Figure 11 Comparison of marginal congestion component for September 7, 2022



January 31, 2022 which saw an increase in the marginal congestion component for the PGAE DLAP due to a negative shift factor for this constraint. Due to the positive shift factor for SCE and SDGE DLAPs, the MCC of those DLAPs decreased.

Figure 13 shows the comparison of MCCs for both the original results and the counterfactual. It does indicate that there was an increase in PGAE DLAP MCC for this trade date as compared to the original solution. However, other DLAPs saw either a decrease in MCCs or more hours with negative MCCs as compared to the original runs. There was an increase in the hours when there was non-zero MCC for the reruns.

Figure 12 Difference in marginal congestion component for January 31, 2022

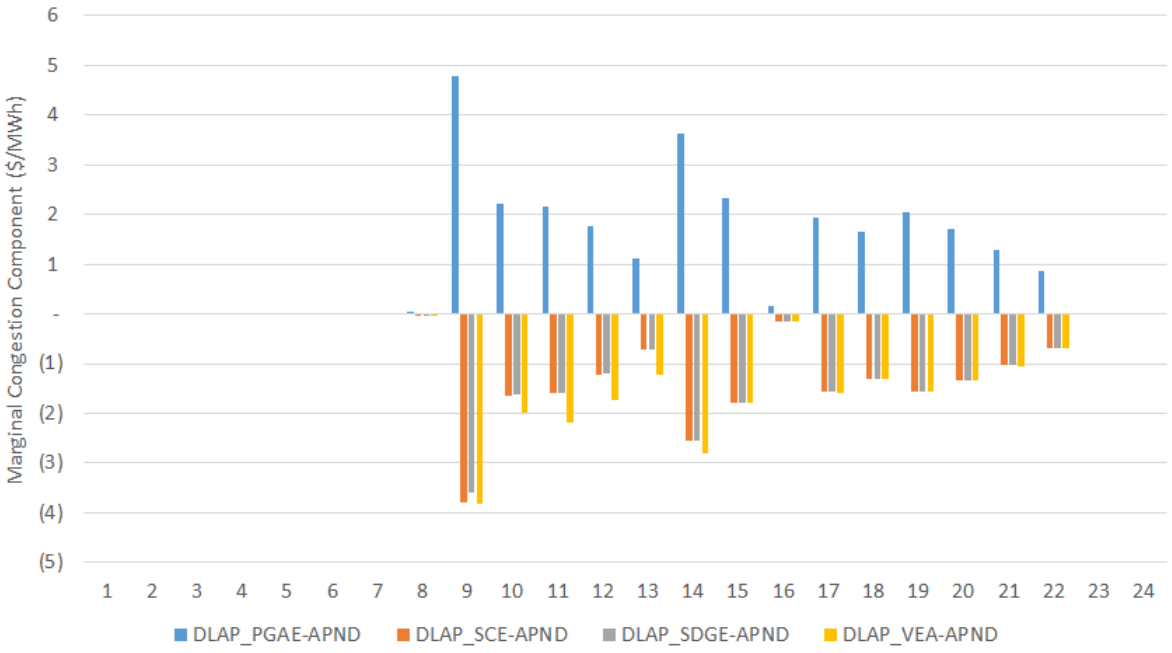
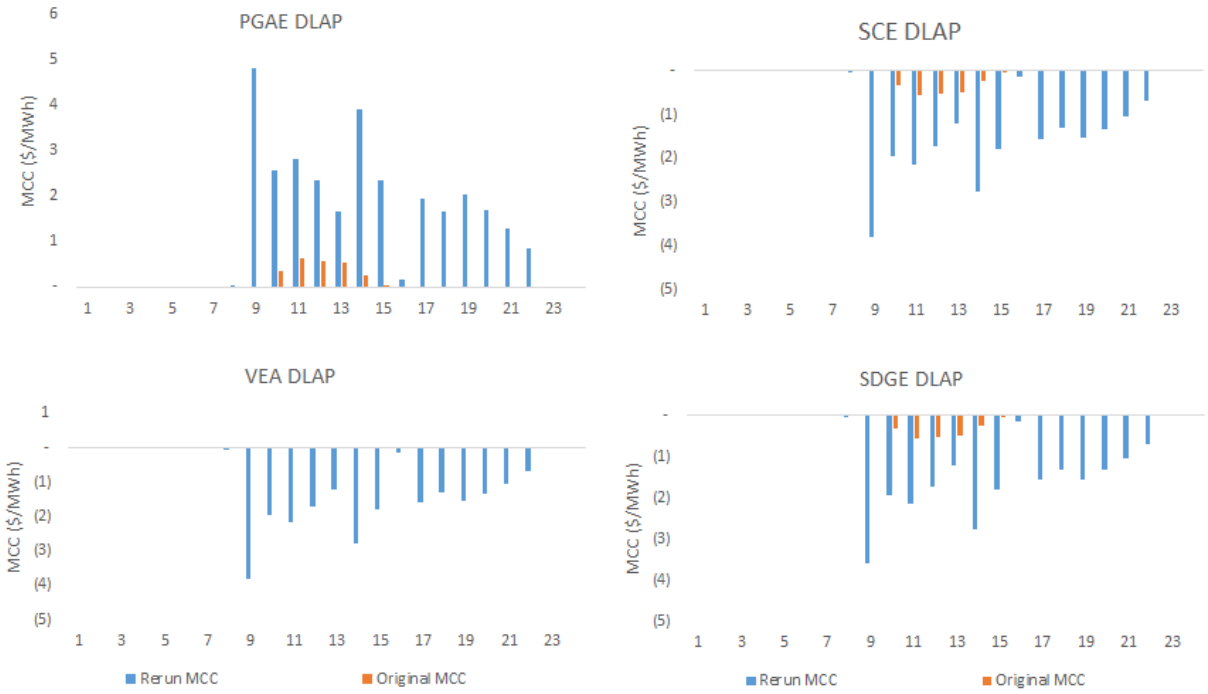


Figure 13 Comparison of marginal congestion component for January 31, 2022



Another trade date that was analyzed was August 1, 2022 as shown in Figure 14. This trade date had several constraints binding especially in HE 13 where the interplay between shift factors for different constraints and direction causing the marginal congestion component for SCE, SDGE and VEA DLAP to increase and PGAE DLAP to decrease.

Figure 15 shows the comparison of MCCs between the original results and reruns for August 1, 2022. It shows the MCC does not change significantly for the first 12 hours of the trade date. However for HE 13, the MCC in the original run was almost zero for all the DLAPs however with the introduction of shift factor threshold, all the DLAPs saw a non-zero MCC showing the impact of this proposal.

Figure 14 Difference in marginal congestion component for August 1, 2022

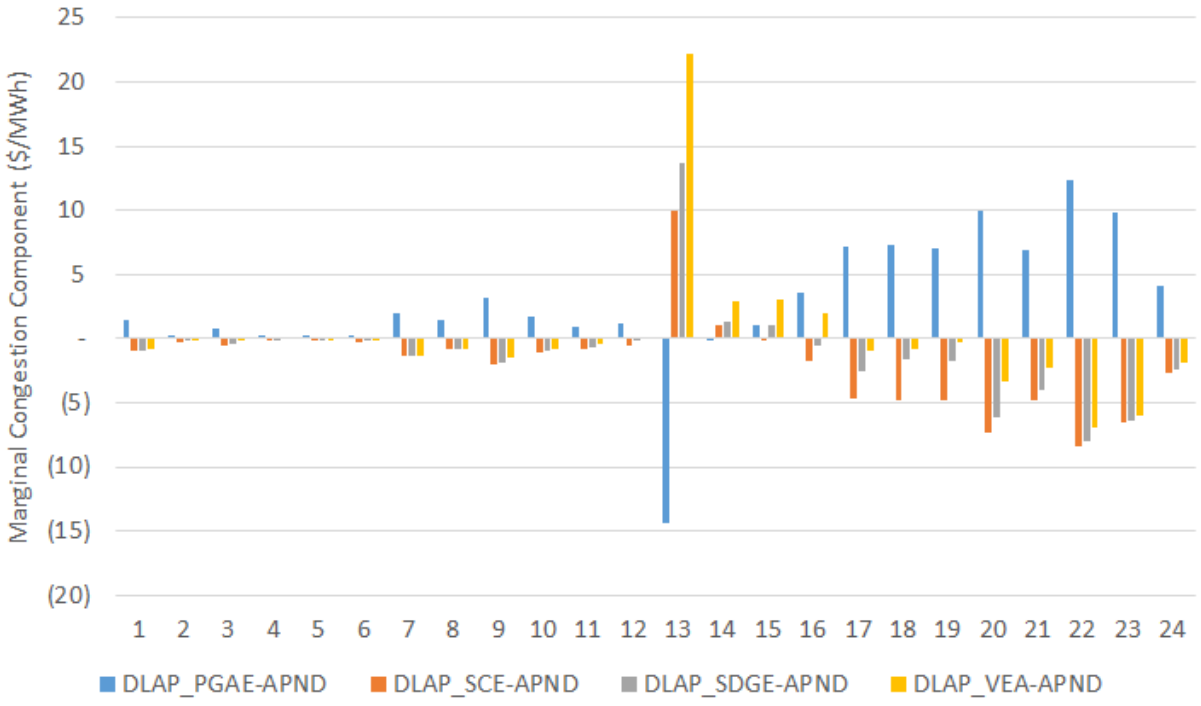
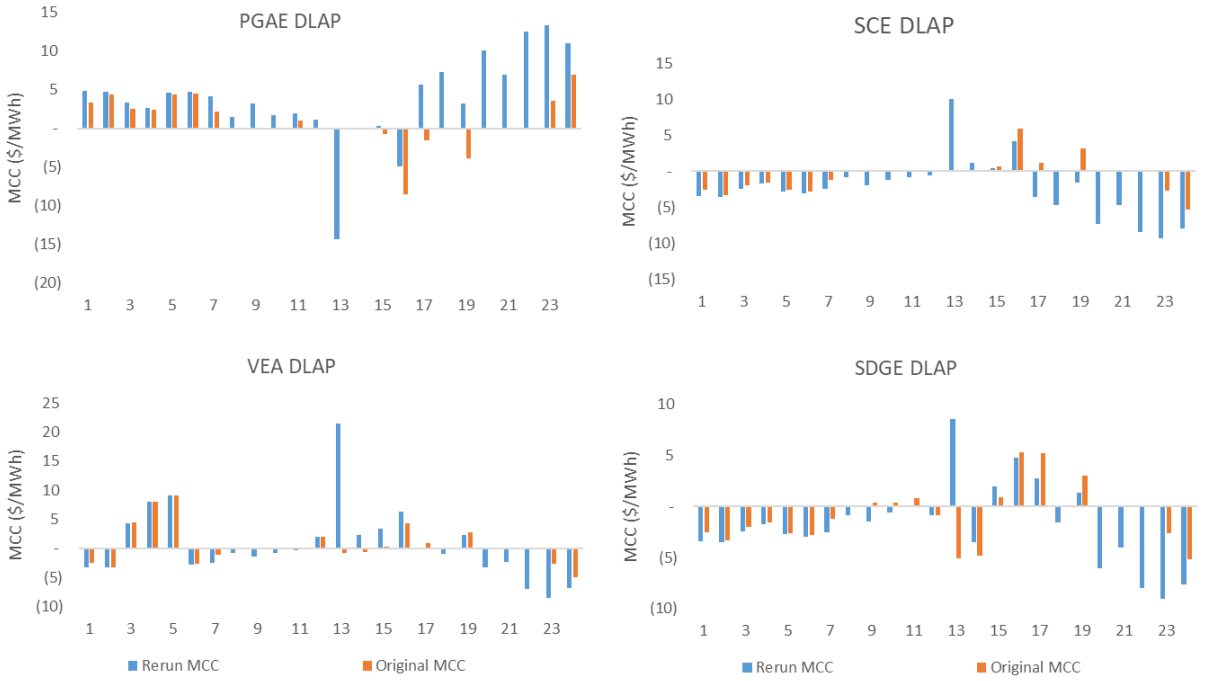


Figure 15 Comparison of marginal congestion component for August 1, 2022



One additional trade date analyzed was April 19, 2022 as shown in Figure 16, when there were several constraints binding for all hours. The change in the marginal congestion component depends on the shift factors for that constraint and the direction. Figure 17 shows the comparison of MCCs for different DLAPs for April 19, 2022 between the original solution and the counterfactual. It shows that there was non-zero MCC for several hours in the original case. There was a change in the congestion pattern for the DLAPs depending on the impact of shift factor from different constraints.

Figure 16 Difference in marginal congestion component for April 19, 2022

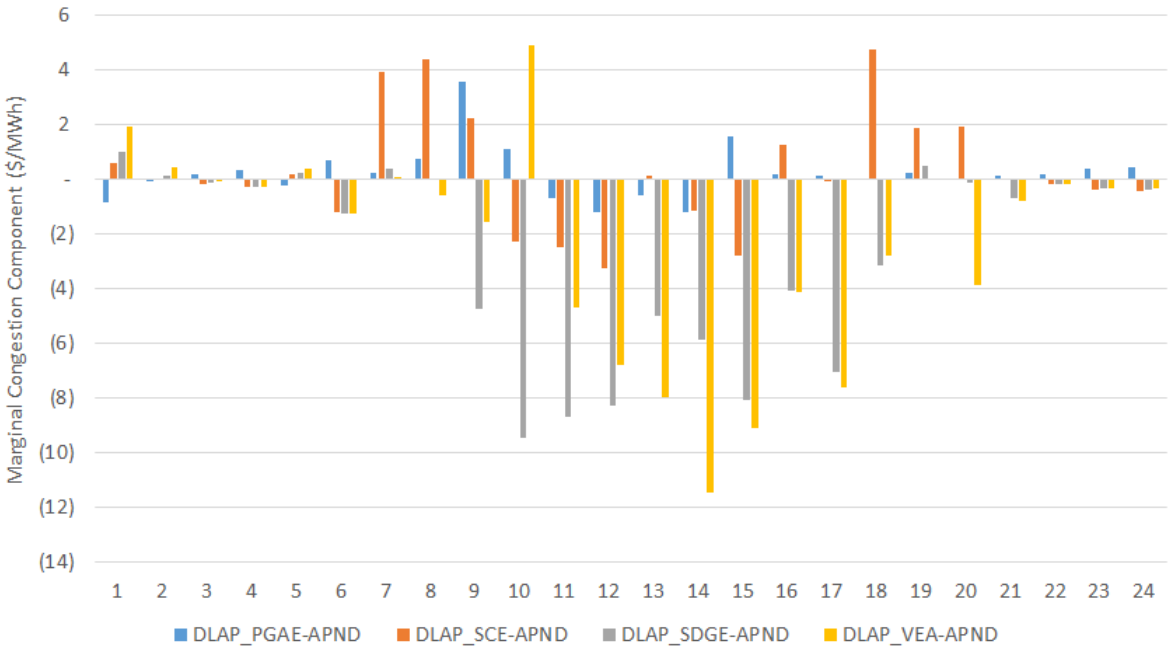
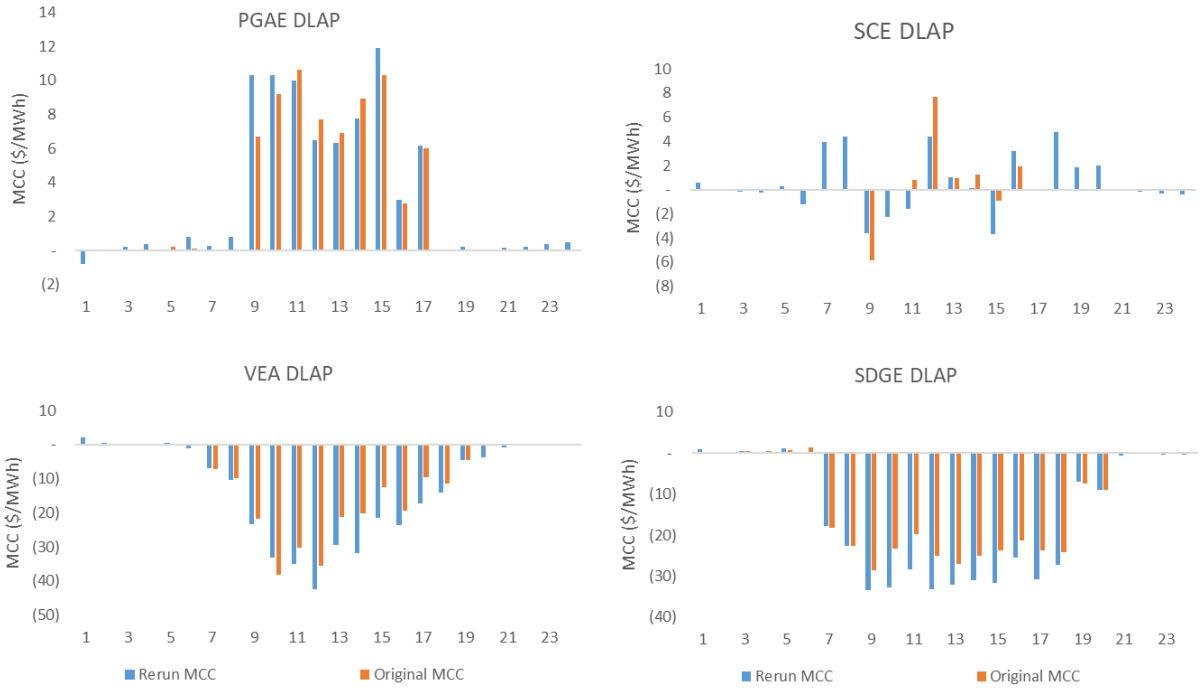


Figure 17 Comparison of marginal congestion component for April 19, 2022



The marginal congestion component impact due to reducing the shift factor threshold for the DLAPs and THs is not significant. The increase or decrease of the MCCs is a factor of the sign convention of the shift factors indicating the direction of the power flow and congestion pattern.

In summary, the proposed change will impact the price formation of the MCCs for DLAPs and THs; the price change can be either an increase or reduction on the price depending on the relative effectiveness of the DLAP and THs to the congestion management on the given transmission constraint.

Proposed Solution

To address the issues identified with the use of a shift factor threshold in the CAISO's energy market, CAISO proposes to adjust the use of the shift factor. The two percent threshold will continue to apply largely to all locations with the exception of the large aggregated demand and generation locations, namely DLAPs and THs. For these two sets of specific aggregated locations, the two percent threshold will be reduced to 0.2 percent. This proposed value strikes a balance between not considering extremely low values that can result in an impactful increase of computational efforts in the market clearing process while still trying to capture the flow contributions of these large aggregated locations. This logic will apply in both the congestion management process and in the price formation of marginal congestion components (MCCs) in the same way it is currently done for locations with shift factors above 2 percent. This will ensure that dispatches and prices remain consistent.

This modification will apply to both physical and virtual resources in both the day-ahead and real-time markets. In the day-ahead market, DLAP resources are active variables use for congestion management and thus the application of the threshold has implications on these resources' dispatches and their price formation. In the real-time market, such DLAPs and ELAPs are not variables in the congestion management because the real-time market uses demand forecasts instead of bid-in demand. Thus, this has no implications in the real-time re-dispatch of DLAPs, but is still used in the real-time price formation to derive MCCs. Thus, this will also apply in the price formation process in the real-time market.

Since the underlying driver is the CRR implications with the day-ahead settlements, this change will apply only to CAISO's DLAPs and THs; this will not apply to ELAPs and DGAPs of the Western Energy Imbalance Market. This item will need further consideration for large aggregated locations in areas participating in the Extended Day-Ahead Market.

CAISO is proposing to move forward with a resolution to the issue driven by the shift factor threshold and will continue to assess and identify any other drivers for the CRR outcome where the pro-rata allocation of deficiencies result in reversal of CRR settlements.

Proposed Tariff Language

Since the proposed solution is very narrow to the application of a reduced threshold to specifically DLAPs and THs location in the CAISO balancing area, CAISO proposes the following Tariff language within the scope of this draft final proposal in lieu of a dedicated stakeholder iteration for Tariff Language changes. Participants are encourage to provide feedback on the proposed Tariff Language.

27.4.3.5 Effectiveness Threshold

The CAISO Markets software includes a lower effectiveness threshold setting that governs whether the software will consider a bid "effective" for managing congestion on a congested Transmission Constraint, which in the case of Nomograms will be applied to the individual flowgates that make up the Nomogram, rather than to the Nomogram itself. The CAISO sets this threshold at two-tenth of a percent (.2%) for Bids at Trading Hubs and Default LAPs and sets the threshold at two percent (2%) for Bids at all other Nodes. ~~The CAISO will set this threshold at two percent (2%).~~

Market Parameter Change Process

Background

The optimization process of the CAISO's energy market uses a set of parameters known as penalty prices to enforce the relative scheduling and relaxation priorities in the market clearing process. The values of these parameters are defined based on studies and analysis to ensure the expected priority under different scenarios is maintained. When new functionality and market features are introduced, all the values of these parameters are assessed for any needed updates. However, given the large number of different scenarios and conditions that the market can encounter on a day-to-day basis, there may be some conditions under which the pre-defined values of the penalty prices may not work as intended. This may typically arise under extreme and stressed market and system conditions that require the market to clear in the range of uneconomical adjustments in which the penalty prices play a role to attain a solution. The resulting market solutions under this type of condition may pose market and operational inefficiencies. To mitigate for this type of risk, CAISO would assess required changes to some of these penalty prices. Since some of these penalty prices may be defined in the CAISO's tariff provisions, CAISO may not have the ability to effectuate these changes expeditiously.

These events are not frequent but have occurred in the past. Indeed, the first part of this stakeholder initiative refers to a market issue that can be addressed by changing a market parameter for the shift factor threshold. Another case of this condition is the overscheduling of imports observed on July 9, 2021 when CAISO's system faced tight supply conditions due to supply imports lost due to fire impacts. This issue has been addressed through a targeted stakeholder initiative with the expectation to implement it prior to summer 2022. This last issue highlights the concern of the long process period it may take to pursue a parameter value change currently defined in the tariff while the market be still producing unintended outcomes.

On April 28, 2021, the CAISO submitted a tariff amendment to modify load, export, and wheeling through priorities in the day-ahead and real-time market optimization processes and implement other market rules (Tariff Amendment). The Commission accepted the proposed tariff revisions in a June 25 Order. However, the Commission also found that "the penalty pricing parameters that determine the relative scheduling priorities of transactions in the CAISO market optimization software must be in the Tariff." The Commission concluded such penalty prices significantly affect the conditions of transmission service on the CAISO grid. Accordingly, the Commission directed the CAISO to submit a compliance filing within 30 days of the June 25 Order that "incorporates the penalty pricing parameters associated with the revised scheduling priorities into the relevant sections of the CAISO tariff."[6]

To comply with the June 25 Order, on June 26, 2021 the CAISO submitted tariff revisions in a compliance filing (June 26 Compliance Filing) that reflected the penalty pricing parameters associated with the revised scheduling priorities. The proposed tariff revisions included the addition of tables to existing tariff sections

[6] *California Independent System Operator Corporation,* 175 FERC ¶61, 181 at P 167 (2021).

31.4, 34.12.1, and 34.12.2 listing the revised scheduling priorities and their associated penalty pricing parameters.

The tariff revisions in the June 26 Compliance Filing also included a new tariff section 31.4.1 to provide "a process for making temporary changes to the scheduling parameter values specified in sections 31.4, 34.12.1, and 34.12.2 (referred to hereinafter as the 'Parameter Change Procedure')."[7] The CAISO stated that the Parameter Change Provision "will allow the CAISO to modify the scheduling run parameters when necessary to ensure feasible market solutions or avoid future operational or reliability problems the resolution of which would require recurring operator intervention outside of normal market scheduling procedures."[8] As explained in the Compliance Filing, other independent system operators (ISOs) and regional transmission organizations (RTOs) have tariff provisions permitting them to make temporary changes to the transmission constraint penalty factor values specified in their tariffs.[9] Further, in Order No. 844, where the Commission required each ISO and RTO to include in its tariff its transmission constraint penalty factor values, the Commission also permitted them to include any procedures for temporarily changing such values with "notice of the change to market participants."[10] The proposed Parameter Change Procedure also tracks the CAISO's current authority to change the penalty pricing parameter values on an expedited basis in emergency situations without following the usual procedure for revising the business practice manual.

After the CAISO submitted the June Compliance Filing, some stakeholders expressed concern about the potential scope of the Parameter Change Provision. They suggested the Parameter Change Provision might be interpreted as allowing the CAISO to change temporarily not only the scheduling parameter values (*i.e.*, the dollar amounts shown in the second and third columns of the new tables in revised tariff sections 31.4, 34.12.1, and 34.12.2), but also the revised scheduling priorities in the tariff (*i.e.*, the scheduling priorities shown in the first column of the new tables).

Accordingly, on August 4, 2021, the CAISO made a supplemental compliance filing. Because the CAISO did not intend that the Parameter Change Procedure would allow it to change the relative scheduling priorities (as opposed to the penalty price values), the CAISO proposed to add the following sentence to the end of the Parameter Change Procedure in section 31.4.1: "This section does not authorize the CAISO to change the scheduling run parameter values in a manner that changes the relative scheduling run priorities specified in sections 31.4, 34.12.1, and 34.12.2."

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[7] Transmittal letter for June 26 Compliance Filing at 6; Compliance Filing, attachment B, new tariff section 31.4.1.

[8] Transmittal letter for June 26 Compliance Filing at 6-7.

[9] Midcontinent Independent System Operator Tariff, Schedule 28A, § 3.3; New York Independent System Operator, Inc. Market Administration and Control Area Services Tariff, § 17.1.4; PJM Interconnection, L.L.C. Open Access Transmission Tariff, Attachment K –Appendix, § 5.6.3.

[10] *Uplift Cost Allocation and Transparency in Markets Operated by Regional Transmission Organizations and Independent System Operators*, Order No. 844, 163 FERC ¶ 61,041, at PP 121-22 (2018).

On March 15, 2022, FERC issued an order on the CAISO's compliance filing, as supplemented.[11] FERC rejected the Parameter Change Procedure "as outside the scope of the compliance directive."[12] However, FERC ruled that if it wished to pursue the Parameter Change Procedure, the CAISO could submit a tariff amendment filing under Section 205 of the Federal Power Act.[13]

Proposed Parameter Change Procedure

The CAISO seeks to pursue the same Parameter Change Procedure it proposed in its July 26 Compliance Filing, as supplemented on August 4, 2021. Specifically, the CAISO proposes to add the following provision to its tariff:

> **31.4.1 Temporary Changes to Scheduling Run Parameter Values**
> If the CAISO determines it is necessary to modify the scheduling run parameter values in sections 31.4, 34.12.1, or 34.12.2 to ensure the market clearing solution is feasible or avoid operational or reliability problems the resolution of which would otherwise require recurring operator intervention outside normal scheduling and market procedures, it may temporarily modify the value for a period up to ninety days, provided however CAISO will file such change with FERC under Section 205 of the Federal Power Act within thirty days of such modification. If circumstances reasonably allow, CAISO will consult with FERC and the CAISO's Market Monitoring Unit before implementing such modification. In all circumstances, the CAISO will (i) consult with those entities as soon as reasonably possible after implementing a temporary modification, and (ii) notify Market Participants within three business days after the change of any temporary modification and explain the reasons for the change. This section does not authorize the CAISO to change the scheduling run parameter values in a manner that changes the relative scheduling run priorities specified in sections 31.4, 34.12.1, and 34.12.2."

The parameter change provisions the Commission has approved for other ISOs and RTOs informed the CAISO's development of its Parameter Change Procedure. The Parameter Change Procedure will allow the CAISO to modify the scheduling run parameters only on a temporary basis when necessary to ensure feasible market solutions or avoid future operational or reliability problems the resolution of which would require recurring operator intervention outside of normal market scheduling procedures. The CAISO may temporarily modify the scheduling run parameter for a period up to 90 days, provided the CAISO must file a tariff amendment with the Commission within 30 days of the modification. If circumstances reasonably allow, the CAISO will consult with the Commission and Department of Market Monitoring (DMM) before implementing any such modification. In all circumstances, the CAISO must consult with DMM and the Commission as soon as reasonably possible after implementing a temporary modification. Further, under the Parameter Change Procedure, the CAISO must notify market participants of any temporary modification and explain the reasons for the change. Importantly, the proposed Parameter Change Procedure only allows the CAISO to change temporarily the scheduling parameter values themselves (i.e.,

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11 *California Independent System Operator Corporation,* 178 FERC¶ 61,181 (2022).
12 *Id.* at P 9.
13 *Id.* at n 17.

the dollar amounts shown in the second and third columns of the tables in tariff sections 31.4, 34.12.1, and 34.12.2); it does not allow the CAISO to change the scheduling priorities in the tariff (i.e., the scheduling priorities shown in the first column of the tables).

WEIM Decisional Classification

This initiative proposes two sets of tariff amendments:

(1) Reducing the existing 2 percent shift factor threshold to 0.2 percent for default load aggregation points and trading hubs, which are aggregated locations within the CAISO balancing authority area only.
(2) Creating a procedure to enable the CAISO to adjust identified penalty price values to address production issues. This procedure may apply equally to the CAISO balancing authority area and WEIM balancing authority areas.

To the extent these proposed tariff changes apply to the real-time market, the ISO believes that the WEIM Governing Body will have joint authority over the second change and an advisory role with respect to the first change, as explained below.

The Board and the EIM Governing Body have joint authority over a

> proposal to change or establish any CAISO tariff rule(s) applicable to the EIM Entity balancing authority areas, EIM Entities, or other market participants within the EIM Entity balancing authority areas, in their capacity as participants in EIM. This scope excludes from joint authority, without limitation, any proposals to change or establish tariff rule(s) applicable only to the CAISO balancing authority area or to the CAISO-controlled grid.

Charter for EIM Governance § 2.2.1 The first set of proposed tariff changes fall outside this scope, because the changes to the shift factor threshold would not apply "to EIM Entity balancing authority areas, EIM Entities, or other market participants within EIM Entity balancing authority areas, in their capacity as participants in EIM." Instead, these proposed tariff rules would be applicable "only to the CAISO balancing authority area or to the CAISO-controlled grid." This is because the default load aggregation points and trading hubs are used only for settling transactions in the CAISO balancing authority area; no WEIM transactions are settled based on a price calculated for either of these load aggregation points or trading hubs. The WEIM Governing Body would have an advisory role on this set of changes to the extent they involve rules of the real-time market, because the Governing Body "may provide advisory input over proposals to change or establish tariff rules that would apply to the real-time market but are not within the scope of joint authority." Id.

In contrast, the changes to the procedure to adjust penalty price values, item (2) above, would be "applicable to EIM Entity balancing authority areas, EIM Entities, or other market participants within EIM Entity balancing authority areas, in their capacity as participants in EIM." The proposed tariff amendments to implement item (2) therefore would fall within the joint authority of the WEIM Governing Body.

Stakeholders are encouraged to comment on this proposed classification, particularly if they have concerns or questions.

Next Steps

The table below outlines the proposed schedule to complete the policy for this initiative:

Date	Milestone
Publish Draft Final Proposal	19-Jan-23
Stakeholder Call on Draft Final Proposal	26-Jan-23
Stakeholder comments due	31-Jan-23
Joint ISO Board of Governors and WEIM Governing Body	22-Mar-23
Expected Implementation	June-23