System-Level Market Power Mitigation

Conceptual Design Proposal

September 19, 2019

Perry Servedio

California Independent System Operator

I. Introduction

This whitepaper presents a conceptual market power mitigation design the CAISO could potentially implement to address system-level market power in the CAISO's market in the CAISO Balancing Authority Area.[1]

The CAISO's analysis found that there were 201 hours in 2018 where its supply mix was potentially uncompetitive.[2] The potential for system-level market power in the CAISO balancing area is a significant issue because the CAISO's current market power mitigation provisions currently are based on the assumption that the CAISO market is competitive at the balancing area (i.e. "system") level. Because of this, the CAISO market's market power mitigation processes for the CAISO balancing area only address market power at the local transmission constraint level. Also because of this, the market power processes used for both the CAISO balancing area as well as the other balancing areas in the Western Energy Imbalance Market ("energy imbalance market"), use a "competitive locational marginal price" calculated based on the prices within the CAISO balancing area.

The CAISO intends for this conceptual design to serve as the basis of discussion regarding the benefits and the drawbacks of adding system-level market power mitigation to the CAISO market. The CAISO believes putting forward this specific conceptual design will allow for more concrete discussions than merely discussing system-level market power mitigation at a theoretical level.

A number of stakeholders advocate that it is imperative that the CAISO implement system-level market power mitigation for its balancing area to address instances of the CAISO balancing area potentially not being competitive at a system-level. On the other hand, other stakeholders and the Market Surveillance Committee have pointed out that the adverse effects of implementing system-level market power mitigation potentially outweigh the benefits.

CAISO management plans to brief the CAISO Board of Governors at its November 2019 meeting as to whether it believes it would be beneficial to implement system-level market power mitigation. In conjunction with this, the Market Surveillance Committee plans to provide a formal opinion to the Board on the merits of this conceptual system-level market power mitigation design as well as on the benefits and drawbacks of implementing system-level market power mitigation in general.

[1] The remainder of this document refers to the NERC-defined Balancing Authority Area as "balancing area." Implementing system-level market for the CAISO balancing authority area would also involve concomitant changes to market power mitigation in balancing areas in the EIM outside the CAISO.

[2] "Analysis of Structural System-Level Competitiveness in the CAISO Balancing Authority Area, Revised Version," September 3, 2019, http://www.caiso.com/Documents/RevisedWhitePaper-SystemMarketPowerAnalysis.pdf

In the **Background** section of this document, the CAISO discusses the CAISO's current local market power mitigation process applied within the CAISO's balancing area and balancing areas within the energy imbalance market, system-level market power mitigation applied to energy imbalance market balancing areas, the CAISO's relationship to the broader western interconnected system, and the CAISO's general market power mitigation design principles.

In the **Conceptual Proposal** section, the CAISO discusses a potential system-level market power mitigation design to apply to the CAISO balancing area. The design conceptually aligns with the mitigation applied to balancing areas within the energy imbalance market by first testing whether the CAISO balancing area is import constrained before testing the competitiveness of the supply mix. It also ensures that the CAISO energy market remains competitive within the bilateral market in the broader western interconnected system. The conceptual proposal is limited to evaluating only an area in which the CAISO has enough information to determine whether conditions are potentially uncompetitive. The conceptual proposal does not address potential broader western interconnection-wide uncompetitiveness because any action the CAISO alone could take under this circumstance would likely not result in positive market outcomes.

In the **Other Considerations** section, the CAISO discusses the appropriate treatment of economic import offers when the CAISO is not import constrained, a theoretical approach to determining when it may be appropriate to mitigate such offers, and potential measures the CAISO could design if it no longer assumes the broader western interconnection is competitive along with the likely market effects of those designs.

In the **Conclusions** section, the CAISO summarizes the conceptual design, key concepts, and considerations.

II. Background

Competitiveness, market power, and market power mitigation

The CAISO operates a competitive energy market where energy is priced based on marginal cost. Market power is the ability of a supplier to artificially raise market clearing prices above marginal cost by physically or economically withholding supply from the market. Suppliers that exercise market power undermine efficient market operations and efficient energy price formation. The CAISO market includes features to automatically detect structurally uncompetitive conditions and mitigate submitted energy offers to estimated cost based levels.

Suppliers have the potential to exercise market power when overall market conditions are uncompetitive. The CAISO measures competitiveness in its energy market by assessing whether supply that is not controlled by the largest three suppliers can serve demand.

In locational marginal priced-based markets, it is imperative that market operators have the ability to mitigate the potential exercise of market power in transmission-constrained areas when that area is found to be uncompetitive. Otherwise, suppliers located in such areas could be in a position to artificially raise prices above marginal costs due to the lack of competitive alternatives.

The CAISO markets employ a dynamic local market power mitigation process that identifies local areas, identifies when the local area is not competitive, and mitigates local suppliers' offers to the greater of a pre-established estimate of marginal costs or the broader system competitive energy price.

The dynamic local market power mitigation process tests transmission constraints for competitiveness by comparing the demand for counter-flow to a constraint to the available supply of counter-flow. The test employs a "residual supply index," which is the ratio of the supply of counter-flow to the demand for counter-flow. The test assumes some portion of the supply for counter-flow from potentially pivotal suppliers is withheld. A transmission constraint is deemed competitive if the ratio of non-pivotal supply to demand is greater than or equal to one and uncompetitive if less than one. Currently, the test treats the three highest ranked suppliers, in terms of capacity that can be withheld, as potentially pivotal.

The same dynamic local market power mitigation process also assesses individual transmission constraints within balancing areas participating in the Western Energy Imbalance Market.

In addition to the dynamic local market power mitigation process, each balancing area participating in the energy imbalance market is also subject to a system-level market

power mitigation process.[3] This mitigation process tests whether demand within the balancing area has access to competitive external supply by first finding whether the balancing area is import constrained. If the balancing area is import constrained, the mitigation process tests whether the internal supply mix is competitive using the residual supply index. If the area is found uncompetitive, the market uses mitigated supply offers inside that area. The CAISO uses mitigated supply offers because suppliers in the constrained area could potentially exercise market power on demand within the constrained area.

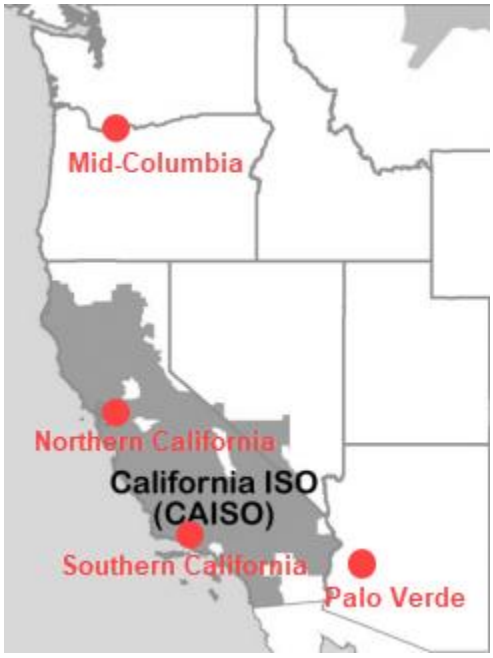
Generally, the CAISO mitigates supply offers to the greater of what it calls "default energy bids" or the competitive locational marginal price. Default energy bids are the CAISO's estimate of resource marginal costs. The competitive locational marginal price is the energy price outside of the constrained area.

The broader western interconnected system

The CAISO operates the only locational marginal price-based energy market in the western interconnection. Suppliers in the western interconnection that are not participating in the Western Energy Imbalance Market may offer their power to the CAISO at its intertie locations or to other buyers through the bilateral market.

One way buyers and sellers engage in bilateral transactions is by bidding for and offering power at various western energy trading hubs. Trading hubs are pricing locations where buyers and seller transact energy. The figure below shows the relationship between various western energy trading hubs and the CAISO.

[3] The balancing area-wide mitigation process is applied to all balancing areas other than the CAISO.



Suppliers that offer their power to the CAISO at its intertie locations must procure external transmission rights in order to deliver power to the CAISO. Transmission rights are generally available to all market participants and the quantity of these rights generally exceed the CAISO's locational import capability.[4] All market participants may purchase these external transmission rights because transmission owners must release unused transmission capacity by the time the CAISO executes its real-time market.

While the CAISO operates an energy market with varying hourly prices, the broader western energy market generally transacts energy blocks of peak and off-peak power. There is one energy price for all hours within the block. Suppliers that offer their power in the broader western interconnected system presumably compare the CAISO's expected average locational marginal price during the peak or off-peak period to the expected peak or off-peak western trading hub energy prices.

General market power mitigation design principles

The objective of market power mitigation is to provide effective measures against the exercise of market power when there is an opportunity for suppliers to exercise market power. The CAISO has historically addressed system-wide market power through

[4] Public data show that there are numerous holders of firm transmission rights to the major interties with California. For instance, nineteen different entities hold transmission rights on the Pacific AC and Pacific DC transmission facilities that connect the Pacific Northwest with California, with thirteen different entities holding more than 100 MW of rights and five different entities holding more than 500 MW of rights. The total firm capacity to deliver external supply to these two locations alone is 7,900 MW – in excess of the approximate 4,800 MW that these locations are generally limited to in the CAISO's markets.

"damage control" bid caps as it understood that system-wide market power concerns can be more effectively addressed through greater demand participation and additional long-term contracting between supply and demand. Also, the CAISO has not applied a system-level market power mitigation process to its market because it generally has access to large amounts of presumably competitive west-wide power through economic offers at its interties.

To this end, the CAISO carefully considers the question of whether or not suppliers have the opportunity to exercise market power (i.e. when conditions are uncompetitive) because mitigation during actual competitive conditions may discourage supply and demand participation in the market. The CAISO understands that potential mitigation of suppliers during actual competitive conditions may discourage suppliers from participating in the CAISO's markets altogether as they seek competitive sales elsewhere in the western interconnection rather than risk under-compensation through the CAISO's market. As for the demand side, potential mitigation of suppliers during actual competitive conditions may discourage demand from aggressively participating in the market and engaging in additional long-term contracting.

Effective market power mitigation should result in energy prices that approximate the prices that would result in a competitive market (i.e. prices should reflect the marginal cost of the highest cost unit dispatched). Without a market power mitigation process in place, suppliers within constrained areas could exercise market power on demand within constrained areas when conditions within the constrained areas are uncompetitive. This condition would lead to energy prices that are above the prices that would result from a competitive market. To achieve an effective market power mitigation design that does not discourage supply and demand participation, the CAISO's market power mitigation measures include an evaluation of the competitiveness of the supply within the constrained area before mitigating supply offers within the constrained area.

The CAISO's current market power mitigation design reflects these principles by following a three-step process where the CAISO market:

(1) Identifies a constrained area (or constraint)
(2) Tests the supplier concentration in the constrained area
(3) Mitigates offers within the constrained area when the supplier concentration test fails

For example, consider a stressed afternoon in southern California. Transmission lines into southern California from the North and the East are limiting the ability of demand within southern California to access additional competitive supply outside of southern California. In the figure below, the box represents the constrained southern California area. The black circles represent supply within southern California (circle **A**) as well as

supply outside of southern California (circles **B** and **C**).[5] Energy prices within southern California are $300 while prices outside southern California are $50 due to the binding constraints into southern California (represented by the red arrows).

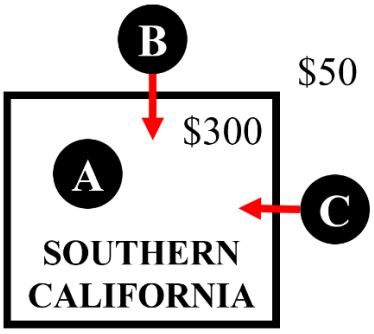


Figure 1: A constrained southern California on a stressed afternoon.

The CAISO does not mitigate offers in southern California unless it first finds that the constrained area is potentially uncompetitive. **Supplier A** may be able to exercise market power on demand in southern California if the supply mix inside southern California is found to be uncompetitive. The CAISO tests competitiveness using a residual supply index which finds if the demand within the constrained southern California can be served without the largest three suppliers in the constrained southern California. The CAISO mitigates supplier offers within southern California only when this test fails.

The CAISO does not mitigate offers from **suppliers B** and **C** because neither **supplier B** nor **supplier C** could exercise market power on demand within southern California. Both **supplier B** and **supplier C** are located in an unconstrained competitive area. If **supplier B** or **supplier C** would try to exercise market power by raising their offer prices above marginal costs, they would risk losing the sale to another supplier in the unconstrained competitive area. **Supplier A**, on the other hand, may be able to exercise market power by raising its offer prices above marginal costs, because demand in southern California cannot access cheaper sources of power due to the transmission constraints.

[5] This example is a simplification of the actual local market power mitigation process which identifies specific constraints and evaluates the ability of resources to provide relief on the specific constraints. Under the actual local market power mitigation process, constrained areas are implicitly defined by the ability of a subset of generators to provide relief on specific constraints. Nonetheless, it remains that a constrained area is identified, competitiveness is tested, and resources within the constrained area may be mitigated.

III. Conceptual Proposal

Proposal to apply system-level market power mitigation to the CAISO balancing area

The CAISO intends for this conceptual design to serve as the basis of discussion regarding the benefits and the drawbacks of adding system-level market power mitigation to the CAISO market. The CAISO believes putting forward this specific conceptual design will allow for more concrete discussions than merely discussing system-level market power mitigation at a theoretical level.

Similar to the preceding example shown for southern California, if the CAISO balancing area is import constrained as a whole, suppliers within the balancing area may be able to exercise market power on demand within the balancing area.

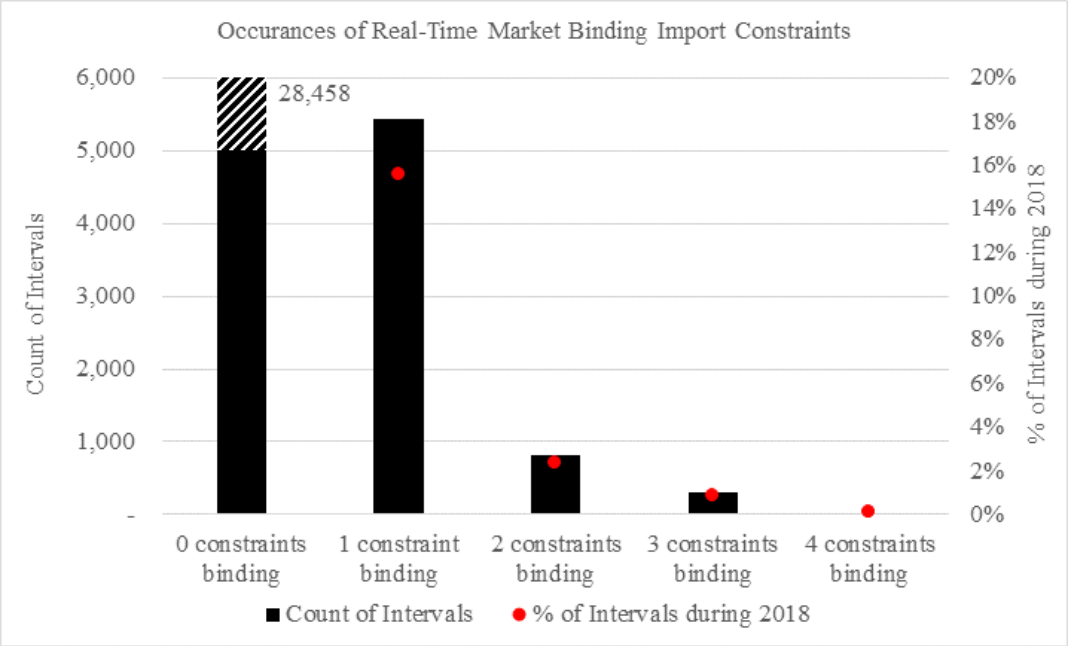
The CAISO proposes to address system market power concerns by applying its general market power mitigation design principles to its balancing area in the real-time market. When the CAISO balancing area is import constrained and when the residual supply index shows that demand within the CAISO balancing area cannot be served without the three largest suppliers within the CAISO balancing area, it will mitigate supplier offers within the constrained and potentially uncompetitive CAISO balancing area.

First, the CAISO will determine if it is import constrained. It is extremely unlikely that all CAISO import limits will simultaneously bind. Such a condition would completely cut off access to competitive west-wide supply. Based on a preliminary review of data, in 2018, the CAISO never had more than three import limits simultaneously binding in the real-time market.[6] However, losing access to competitive west-wide supply on the CAISO's major interties may negatively impact competitive conditions within the CAISO balancing area. A reasonable approach is for the CAISO to consider itself import constrained if its three major interties (Malin, NOB, Palo Verde) are constrained. This only occurred in one interval in the real-time market in 2018.[7] Regardless of how often this condition happened in the past, it could occur more frequently in the future as a result of tightening supply conditions in California.

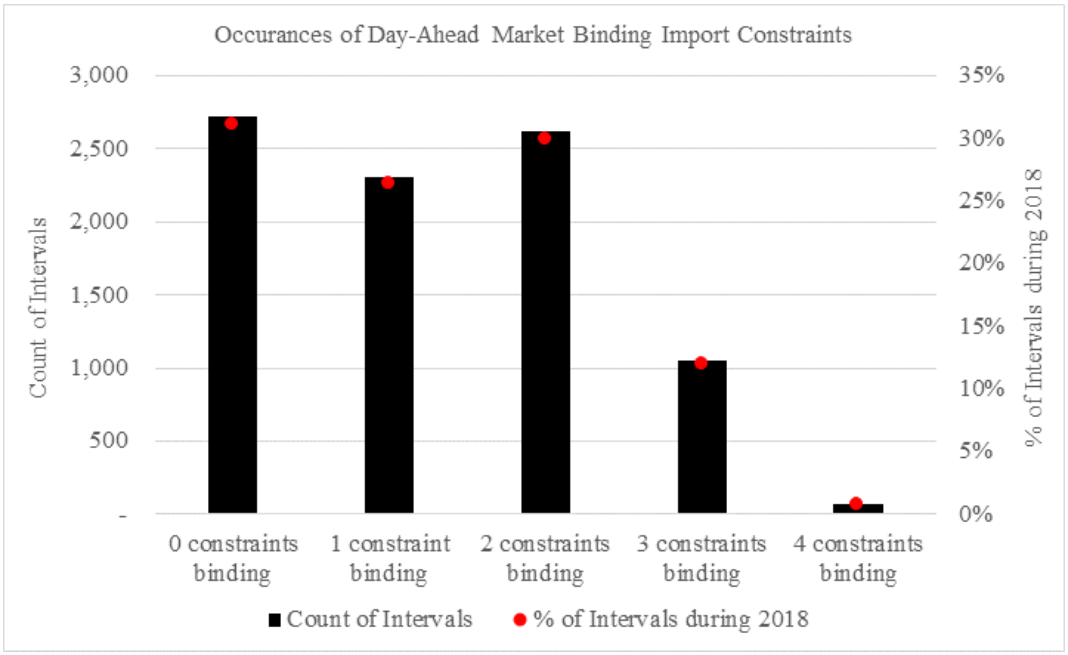
The figure below shows the number of intervals in the real-time market in which import constraints were simultaneously binding.

[6] The data presented in this whitepaper is a preliminary review of import scheduling constraints. The CAISO may additionally need to evaluate the way in which physical intertie constraints may limit access to competitive west-wide power.

[7] Based on a preliminary review of market data, Malin, Palo Verde, and NOB were simultaneously binding in one fifteen-minute interval in 2018.



For reference, the CAISO generally finds itself import constrained more often in its day-ahead market. The CAISO's three major import limits were simultaneously binding in nine intervals in the day-ahead market in 2018.[8] The figure below shows the number of intervals in the day-ahead market in which import constraints were simultaneously binding.



[8] In nine hourly intervals in 2018, Malin, Palo Verde, and NOB were simultaneously binding.

The CAISO is open to evaluating other methods to determine when it would consider itself import constrained. The proposal to evaluate the CAISO's three major interties is based on limited information and a general understanding that there are major competitive entryways into the CAISO market. The CAISO understands that there may exist other constraining conditions that closely align with hours in which it observes indicators of potentially uncompetitive conditions. For instance, it may consider evaluating market outcomes when a different set of import constraints are binding. Perhaps there even exists a set of import constraining conditions, any of which could trigger the system-level market power mitigation process. However, as discussed in **Section IV** below, the CAISO does not currently believe that a simple evaluation of offers in its market alone, without evaluating whether the CAISO balancing area is also import constrained, would determine if demand is captive in an uncompetitive and constrained area.

Next, if the CAISO balancing area is import constrained, the CAISO proposes to test if its constrained area is competitive. The CAISO will test if the demand inside the constrained CAISO balancing area can be served by supply from internal suppliers without the three largest internal suppliers' offers.[9] When this comparison falls below one, the CAISO will consider its constrained balancing area potentially uncompetitive.

Finally, if the CAISO balancing area is import constrained and found potentially uncompetitive, the CAISO proposes to mitigate supply offers within the constrained and potentially uncompetitive CAISO balancing area. The CAISO will mitigate internal resources to their default energy bid. The CAISO will not mitigate import supply offers because import supply offers, which are outside of the constrained area, cannot exercise market power on demand inside the constrained area.

For example, consider a stressed afternoon in California when import scheduling limits into the CAISO balancing area from the North and the East are limiting the ability of demand within the CAISO balancing area to access additional competitive supply outside of the CAISO balancing area. In the figure below, the box represents a constrained California balancing area and the black circles represent supply within California (circles **A** and **B**) as well as supply outside of California (circles **C** and **D**). Energy prices within California are $300 while prices outside California are $50 due to the binding constraints into California (represented by the red arrows).

[9] Similar to its local market power mitigation design, the CAISO would exclude "net buyers" from its list of potentially pivotal suppliers because net buyers do not have an incentive to bid above marginal costs.

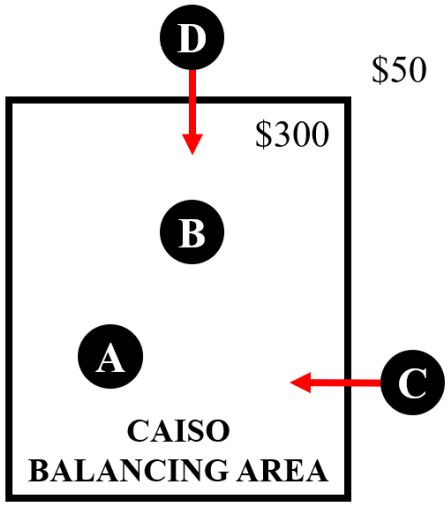


Figure 2: A constrained CAISO balancing area on a stressed afternoon.

The CAISO does not mitigate offers in California unless it first finds that the constrained area is potentially uncompetitive. **Supplier A** and **supplier B** may be able to exercise market power on demand in California if the supply mix inside California is found to be uncompetitive. The CAISO tests competitiveness using a residual supply index which finds if the demand within the constrained California area can be served without the largest three suppliers in the constrained California area. The CAISO mitigates supplier offers within California only when this test fails.

The CAISO does not mitigate offers from **supplier C** and **supplier D** because neither **supplier C** nor **supplier D** could exercise market power on demand within California.

Proposal to only apply system-level market power mitigation to the real-time market

The CAISO proposes to take a cautious approach to applying a system-level market power mitigation process to its markets to avoid instances of unnecessary or inappropriate mitigation which may discourage supply and demand participation in its markets. The CAISO's understanding is that if the economics of the interaction between the day-ahead and real-time markets work as presumed, it should not be necessary to apply a system-wide market power mitigation to the day-ahead market. The CAISO also understands that the market may not behave as presumed. If a decision is made to go forward with applying system-level market power mitigation to the CAISO balancing area, the CAISO believes it is appropriate to first implement the proposed design in the real-time market. After it is in place, the CAISO would monitor day-ahead to real-time market price convergence in instances where supply conditions trigger system-level market power mitigation in the real-time market before deciding whether to extend the

design to the day-ahead market. In any case, it is likely to be only practical at this time to implement a real-time market balancing area-wide market power mitigation process because it can extend its current energy imbalance market process to the CAISO balancing area with some minor modifications.

There are a few structural limitations that make the real-time market susceptible to suppliers potentially exercising market power. First, the real-time market clears supply against a fixed demand forecast. Under this design, consumers must pay the market clearing price for a quantity of energy determined by the market operator. Since power purchasers are unable to bid the price they are willing to pay in the real-time market, a supplier in a constrained and uncompetitive area may increase the market clearing prices above marginal costs without risking losing the sale of its power as too expensive. Second, the real-time markets lack a mechanism for non-physical entities (i.e. financial entities offering virtual supply) to apply competitive pricing pressure on suppliers. Without competitive pressures from financial entities offering virtual supply, physical suppliers in a constrained and uncompetitive area may increase the market clearing prices above marginal costs without risking losing the sale of its power as uncompetitive.

The day-ahead market does not have these same structural limitations. The day-ahead market clears offered supply against bid-in demand. Consumers are free to purchase power only at prices they are willing to pay. With power purchasers actively participating in the day-ahead market, suppliers in a constrained and uncompetitive area are not free to increase offer prices because they risk losing the sale of their power if buyers or financial traders believe the offers are above competitive levels. The day-ahead market allows any entity to offer virtual supply bids which apply competitive pricing pressure on suppliers offering physical supply. With competitive pressures from financial entities offering virtual supply, physical suppliers in a constrained and uncompetitive area are not free to increase offer prices because they risk losing the sale of their power as uncompetitive. Given demand's ability to submit bids that limit how much it is willing to pay for power and the role of virtual bidders to converge prices to competitive levels, the CAISO does not find that it is necessary to apply a balancing area-wide market power mitigation process to its day-ahead market at this time.

The granular nature of local market power warrants the current mitigation process in the day-ahead market, but these granularity concerns do not apply to system-level uncompetitive conditions. In the day-ahead market, consumers generally bid to buy power at aggregated pricing locations. The market software then translates these aggregated purchase bids down to individual pricing nodes. Consumers bidding at aggregate pricing locations mutes the impact that demand participation can have on granular local constraints because they are not directly targeting power purchases at the same granularity as the local constraints. The granularity difference between the way

power is purchased versus the way a supplier could influence an individual constraint is one reason the CAISO needs local market power mitigation processes in the day-ahead market. However, demand participation at aggregate pricing nodes would be effective at combating market power on a balancing area-wide basis.

Virtual bidding participation in aggregate would be effective at combating market power on a balancing area-wide basis in the day-ahead market. While virtual demand bidders could theoretically fill the void for lack of demand participation at a granular level in the day-ahead market, they are likely to be less effective. The ever-varying location and magnitude of constrained local conditions that could occur causes the need for local market power mitigation processes in the day-ahead market. These granularity issues do not apply at the balancing area-wide level. Virtual bidding participation at aggregate pricing nodes would be effective at combating market power on a balancing area-wide basis.

Supply elasticity differences between the day-ahead and real-time market may allow for some residual opportunity for the exercise of market power in the day-ahead market. The CAISO understands that if supply elasticity in the real-time market is materially lower than supply elasticity in the day-ahead market, regardless of demand elasticity, there may exist a residual opportunity for the exercise of market power in the day-ahead market. However, at this time, the CAISO does not propose applying a balancing area-wide market power mitigation process to the day-ahead market.

Proposal to consider interactions with the energy imbalance market

Given the proposal for the CAISO to consider itself import constrained when major interties are simultaneously binding, the balancing area may be import constrained while it still has transfer capability with neighboring balancing areas participating in the energy imbalance market. In this situation, any competitiveness test should also include the supply and demand mix of balancing areas in the energy imbalance market to which the CAISO is converged.

The CAISO clears import offers on its interties as well as transfers from energy imbalance market participants. Although these offers both compete for the same physical transmission, they are separate transactions: transactions within the Western Energy Imbalance Market and imports into the CAISO balancing area. Economic import offers on the CAISO's interties compete to enter the energy imbalance market through the CAISO's balancing area while energy imbalance market transfers are the result of economic resource-specific dispatch within the energy imbalance market.

The figure below shows the relationship between economic import offers and energy imbalance market transfers. The top graphic shows that, economically, importers from anywhere in the western interconnection compete with each other to enter the energy imbalance market through the CAISO's intertie offer locations. The bottom graphic shows that import offers may flow on the same underlying physical transmission as transfers between energy imbalance market participants. This shows that economic import offers impact the amount of transfers available between the CAISO and other energy imbalance market participants and vice versa. If the CAISO is import constrained on a transmission line, it cannot access more energy imbalance market supply over the same physical transmission line.

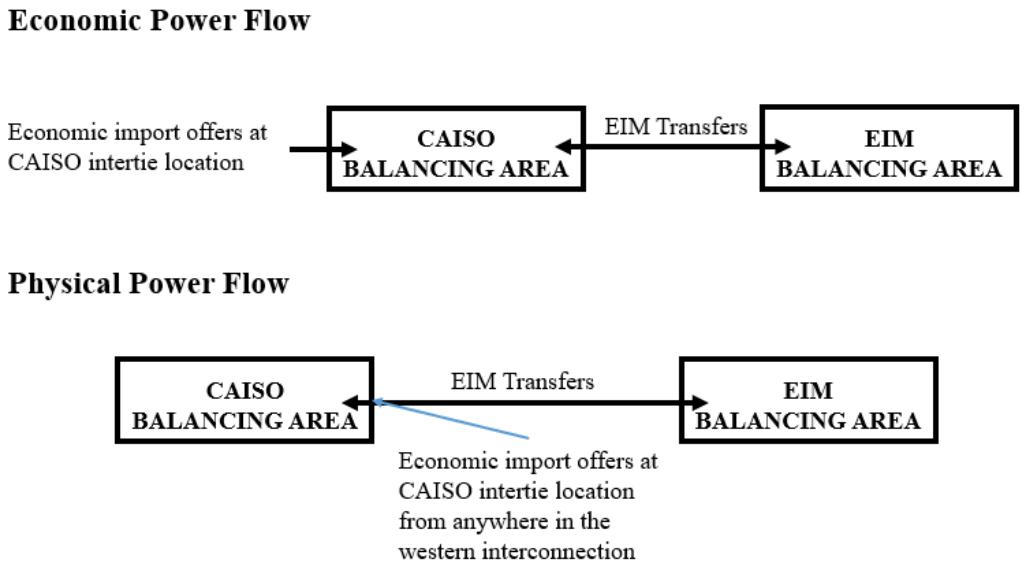


Figure 3: Economic power flow versus physical power flow

In order to assess if supply conditions are uncompetitive, the CAISO must consider if it has access to additional transfers from energy imbalance market participants. Assuming the CAISO considers its balancing area import-constrained when three major interties are binding, the CAISO balancing area may have access to additional energy imbalance market transfers on its non-binding interties. If the CAISO cannot access competitive west-wide supply through its major interties but it can access additional energy imbalance market supply, under this proposal the competitiveness test and potential mitigation would include the entire constrained area. The entire constrained area would include the CAISO balancing area and any other energy imbalance market balancing area to which the CAISO is converged.

Consider the following example where the CAISO is import constrained, but still has access to transfers between itself and other energy imbalance market entities. This situation could occur if the CAISO considered itself import constrained even though not all of its import scheduling limits are binding. In the example, it is shown that the constrained area includes the CAISO balancing area as well as two other balancing areas participating in the energy imbalance market.

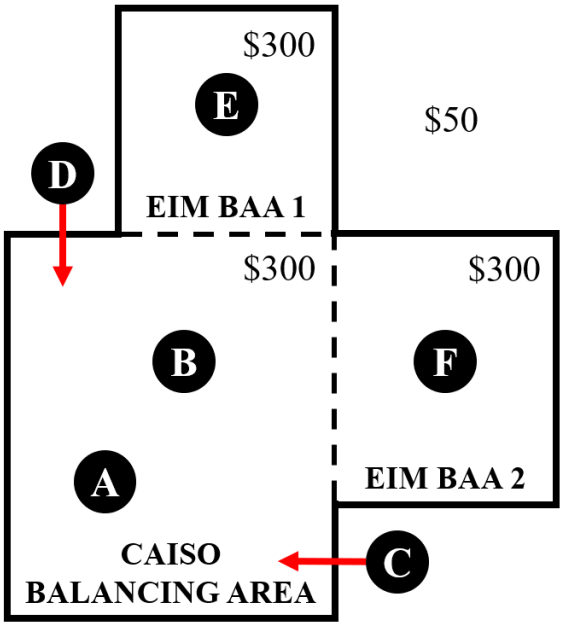


Figure 4: The CAISO balancing area converges with other EIM balancing areas and the broader constrained area is import constrained.

In this situation, an appropriate market power mitigation design must test competitiveness of the supply mix in the entire constrained area. The CAISO proposes to follow its general market power mitigation design principles by first finding if the CAISO is import constrained and using a residual supply index to evaluate if the demand in the full constrained area (including the converged energy imbalance market balancing areas) can be met without the three largest suppliers in the full constrained area (including the converged energy imbalance market balancing areas). If this test fails, the CAISO proposes to mitigate all suppliers within the full constrained area (suppliers **A**, **B**, **E**, and **F**).

The CAISO may find that it is import constrained at the same time that it is constrained from accepting transfers from energy imbalance market participants. In this situation, an appropriate market power mitigation design must test competitiveness of the supply mix in the constrained area, which is only the CAISO balancing area.

Consider the following example where the CAISO is import constrained and it does not have access to transfers from other energy imbalance market entities because it is transfer

constrained. In the example, it is shown that the constrained area includes only the CAISO balancing area.

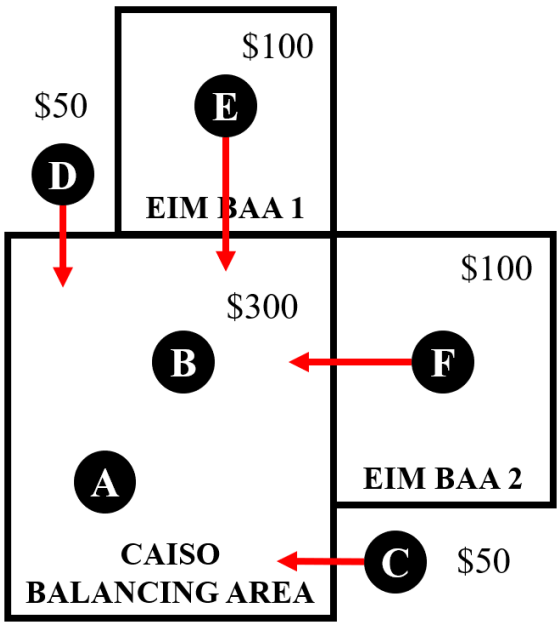


Figure 5: The CAISO balancing area is not converged with other EIM balancing areas and it is import constrained.

In this situation, an appropriate market power mitigation design must test competitiveness of the supply mix in the constrained area that includes only the CAISO balancing area. The CAISO proposes to follow its general market power mitigation design principles by first finding if the CAISO is import constrained and using a residual supply index to evaluate if the demand in the constrained area (only the CAISO balancing area) can be met without the three largest suppliers in the constrained area (only the CAISO balancing area). If this test fails, the CAISO proposes to mitigate all suppliers within the constrained area (suppliers **A** and **B**).

The general mitigation pattern discussed in this proposal can be further extended to the energy imbalance market, but the CAISO does not propose to enhance the energy imbalance market mitigation process at this time. The CAISO could develop a market power mitigation process that groups balancing areas into tiers based on each balancing area's marginal energy costs. The process could then evaluate the competitive conditions in each tier starting in the highest cost tier followed by lower cost tiers. As the evaluation progresses to lower cost tiers the pool of supply and demand in the competitive test would grow to encompass supply and demand all tiers of equal marginal energy cost or higher.

IV. Other Considerations

Competitiveness evaluations and economic import offers

Some stakeholders have advocated that the CAISO must only evaluate offers in its market to determine whether it should mitigate supply offers, rather than consider whether the CAISO is import constrained. These suggested measures imply that the CAISO is import constrained when the CAISO runs out of import offers rather than when its import constraints are actually binding. As discussed below, unless import constraints are actually binding, the CAISO balancing area is part of a broader constrained area within the western interconnection. Also as discussed below, under this circumstance it would be incomplete for the CAISO to only evaluate offers in its own area and unworkable for the CAISO to test the true supply competitiveness. Finally discussed below, the suggestion for the CAISO to evaluate and potentially mitigate offers in its market regardless of if it is import constrained also necessarily implicates the offers within the energy imbalance market.

The CAISO's conceptual proposal only mitigates suppliers' offers when they are in potentially uncompetitive constrained areas. By first finding whether an area is import constrained, the market power mitigation design considers whether demand in an area has access to presumably competitive west-wide supply. The CAISO has not seen evidence to suggest that suppliers outside of CAISO markets have the opportunity to exercise market power.

In energy markets built to foster transparency, price discovery, and competition, it would be inappropriate to mitigate suppliers to estimated costs without first showing that they are in a potentially uncompetitive constrained area. The question frequently arises: to what estimated cost does one mitigate import offers? However, this question bypasses the critical first question: is the import offer in a potentially uncompetitive constrained area?

Consider the following example where the CAISO balancing area is only import constrained on its northern interface. To keep this example simple, ignore the interaction with the energy imbalance market.[10] The CAISO balancing area is import constrained on its northern interface, but not import constrained on its southeastern interface. In the example below, there is price separation between **supplier D** and the western interconnection area that includes the CAISO balancing area. This price separation occurs because of the binding northern import constraint.

[10] While not discussed here, the concepts in this section extend to a CAISO market that also includes its participation in the Western Energy Imbalance Market.

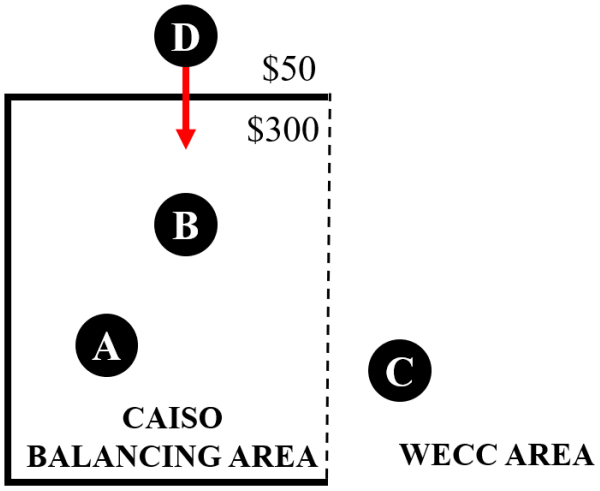


Figure 6: When only the northern import constraint is binding, the CAISO is theoretically converged to the broader western interconnection.

A residual supply index test that only accounts for **supplier A**, **supplier B**, and **supplier C** would be incomplete because it would fail to account for the supply and demand mix of the entire constrained area which includes an unknown portion of the broader western interconnection.

Given that there is a binding constraint between **supplier D** and the CAISO balancing area, theoretically a portion of the western interconnection that includes the CAISO balancing area is import constrained. The figure below illustrates this theoretical boundary. Note that the theoretical constrained area includes suppliers participating internal to the CAISO balancing area (**supplier A** and **supplier B**), suppliers offering imports to the CAISO balancing area (**supplier C**), as well as suppliers participating in western bilateral markets. Some of those resources participating in western bilateral markets are within the theoretical constrained area (**supplier X**) while others are not within the theoretical constrained area (**supplier Y**).

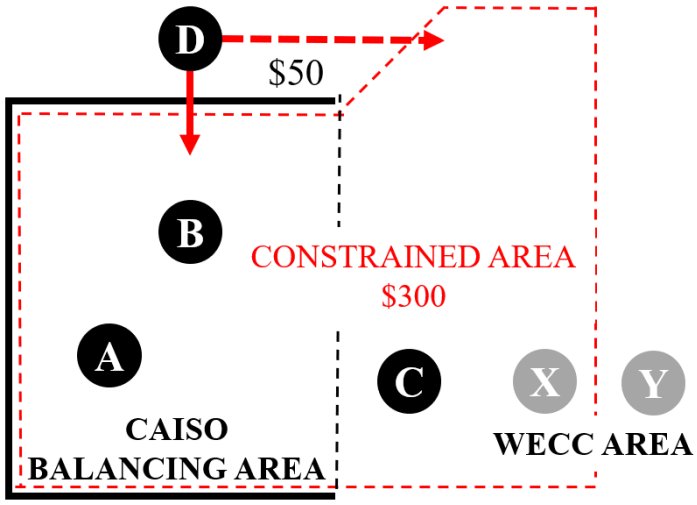


Figure 7: There exists a theoretical constrained area that includes the CAISO balancing area as well as a portion of the western interconnection.

While a market power mitigation test is theoretically possible, it would be unworkable and incomplete for a single market operator to perform. Assuming a market operator could first define the constrained area within the western interconnection, it would then need to understand the resource ownership within the constrained area and the aggregate demand and supply offered within the constrained area. It could then use this information to perform a pivotal supplier test which could be used to appropriately flag a constrained and potentially uncompetitive condition in which it may be justifiable to mitigate resources to estimated costs.

This process is unworkable because it requires much more information than available to the CAISO and improper because some of the information would be required from entities not participating in the CAISO's markets. First, the CAISO would need to be able to fully define a constrained area that includes portion of the western interconnection that it does not control. Next, the CAISO would require information about the supply ownership in a portion of the western interconnection that it does control. The CAISO also would require information about the demand bids and supply offers at locations outside its market made by schedulers that are not participating in CAISO markets. Finally, the CAISO would need resource-specific information on all resources in the constrained area so that it could estimate resource costs and appropriately mitigate those resources.

It would be incomplete to only mitigate a portion of suppliers in an uncompetitive constrained area. All suppliers in the uncompetitive constrained area could exercise market power, but the CAISO does not itself have the authority to mitigate resources outside of its market. On a given day, an economically rational supplier that understands

that the CAISO will mitigate its offers will chose instead to participate in a parallel western market that may also be in the uncompetitive constrained area.

Finally, the suggestion for the CAISO to evaluate offers in its market regardless of if it is import constrained also necessarily implicates the offers within the energy imbalance market. The suggested competitiveness test implies that the CAISO is import constrained when the CAISO runs out of import offers rather than when its import constraints are actually binding.

Under this circumstance, an appropriate market power mitigation process would evaluate and potentially mitigate all supply offers in the wider energy imbalance market footprint. As discussed in the previous section, the CAISO balancing area may be converged with other balancing areas participating in the energy imbalance market. The pivotal supplier test should consider all supply offers within this presumed constrained area that includes the converged balancing areas participating in the energy imbalance market. The CAISO would necessarily perform a pivotal supplier test for the wider energy imbalance market footprint in every interval in the real-time market. If the test fails, the CAISO would need to mitigate all supply offers within its balancing area as well as the converged balancing areas participating in the energy imbalance market. If the CAISO did not mitigate all offers, a supply offer in a converged balancing area participating in the energy imbalance market would set the overall system marginal energy price.

Potential measures the CAISO could take and likely market effects

Some stakeholders have advocated that the CAISO could simply mitigate all internal and import supply offers if an evaluation of offers into its market alone fails. These suggested measures appear to be based on an assumption that the broader western interconnection is uncompetitive. As discussed below, under these circumstances, it would be the purview of the Federal Energy Regulatory Commission to address the uncompetitive west-wide conditions. As also discussed below, if the broader western interconnection actually is uncompetitive, these suggested measures are not likely to have positive impacts on market outcomes and may drive an overall lack of supply in the CAISO's markets.

Assuming the wider western interconnection is competitive, CAISO clearing prices that converge with western energy trading hub prices along unconstrained edges should indicate that the CAISO's clearing prices are competitive. In the recent past, it has been likely that the broader western interconnection is competitive. Indeed, market participants traded close to 120,000 GWh of power in bilateral western markets in

2018.[11] Overall, if there is not a binding constraint between the CAISO and a neighboring western energy trading hub, the CAISO expects fairly close convergence between its price and the western trading hub price.

If instead, the CAISO first presumes that it is in an uncompetitive constrained area when there is no binding constraint between it and the broader western interconnection (i.e. presume the broader western interconnection is uncompetitive), there are a number of mitigation measures stakeholders have advocated the CAISO explore. Below, the CAISO explores whether a CAISO-only mitigation process would have any positive impact on market outcomes if it presumes the broader western interconnection is uncompetitive.

First, consider if the CAISO only mitigated offers from internal suppliers. During the net demand peak hours in which the CAISO is generally concerned about its market competitiveness, demand in California relies heavily on imported energy to supplement its internal capability. If external conditions actually are uncompetitive (as presumed), then one must presume that external offers will drive the overall CAISO clearing prices up to levels at least as high as observed today as the CAISO must dispatch at least a portion of imports to serve demand. Even if the CAISO were to mitigate its internal suppliers, one can expect no appreciable effect on CAISO clearing prices when the CAISO is not import constrained along one of its major interfaces. Prices will continue to converge to the presumed uncompetitive wider western market prices.

Next, consider if the CAISO chose to mitigate internal suppliers and import suppliers. During the net demand peak hours in which the CAISO is generally concerned about its market competitiveness, demand in California relies heavily on imported energy to supplement its internal capability. If external conditions actually are uncompetitive (as presumed), then one must also presume that import suppliers anticipating offer mitigation in CAISO's market will either withhold supply from the CAISO's market or choose to offer it into parallel western markets rather than risk offer mitigation. The result would be detrimental because those imports that California demand relies on would offer their power in the bilateral markets in the west rather than risk offer mitigation in the CAISO's market. If the CAISO were to mitigate its internal and import suppliers, one can expect an overall lack of supply and likely higher CAISO clearing prices.

Another variant on a CAISO-only mitigation approach is for the CAISO to only mitigate internal and import *resource adequacy* supply offers. In this approach, the market power concern will likely shift to bilateral resource adequacy import contracts and the CAISO would also need to mitigate supply offers from resources in the energy imbalance market.

[11] "Federal Energy Regulatory Commission State of the Markets Report 2018," https://www.ferc.gov/market-oversight/reports-analyses/st-mkt-ovr/2018-A-3-report.pdf

If external conditions actually are uncompetitive (as presumed), then one must also presume that resource adequacy resource owners will seek the amount of revenues that they expect to gain by exercising market power in the spot energy markets (CAISO and the broader western markets) in their bilateral resource adequacy contracts. The CAISO would also need to mitigate all supply offers within its balancing area as well as the converged balancing areas participating in the energy imbalance market. If the CAISO did not mitigate all offers, an energy imbalance market supply offer in a converged balancing area would set the overall system marginal energy price regardless of the mitigated resource adequacy offer price.

The only workable solution, presuming an uncompetitive western interconnection, would be for all supply offers within the constrained area that includes a portion of the non-CAISO western interconnection to be mitigated which goes beyond the purview of the CAISO. Under these circumstances, it would be the purview of the Federal Energy Regulatory Commission to address the uncompetitive west-wide conditions.

V. Conclusions

In this whitepaper, the CAISO outlines a conceptual design for a system-wide market power mitigation design to apply to the CAISO balancing area. Under this conceptual design, the CAISO real-time market in each market interval would first determine if the CAISO balancing area is import constrained. Next, if the CAISO balancing area is import constrained, the CAISO market would test if the supplier mix within its constrained balancing area is competitive at a system level. This competitive analysis would also include supply and demand within any energy imbalance market balancing area that is price converged with the CAISO balancing area. Finally, if the CAISO balancing area is import constrained and found potentially uncompetitive, the CAISO market would mitigate supply offers for resources within the constrained and potentially uncompetitive CAISO balancing area. If other energy imbalance market balancing areas are price converged with the CAISO when it fails the competitive test, the CAISO market would also mitigate supply offers for resources within the converged balancing areas. The CAISO market would not mitigate import supply offers because import supply offers, which are outside of the constrained area, cannot exercise market power on demand inside the constrained area.

This design follows the general market power mitigation design principles discussed in this whitepaper:

- The design provides an effective measure against the exercise of market power when there is an opportunity for suppliers to exercise market power.
- The design encourages robust market participation and long-term forward contracting because it first evaluates the entire supply concentration within an identified constrained area before mitigating supply offers.

As the CAISO has shown, demand in the CAISO balancing area has access to competitive west-wide supply most of the time. However, there are instances when the CAISO's major interties may limit this this access and these instances could occur more frequently as supply conditions tighten in California.

This design allows the CAISO to mitigate offers from resources within its balancing area when it finds its balancing area constrained and potentially uncompetitive. As the CAISO has shown, if it were to instead presume that the western interconnection is uncompetitive and undergo mitigation measures even when the CAISO is not import constrained, any measure it could take on its own would have little effect on overall market outcomes.

This design is practical to implement because the CAISO can extend its current energy imbalance market mitigation process to the CAISO balancing area with some minor modifications.

Finally, this design can be expanded to the day-ahead market in the future. However, given the low overall instances in which major interties limit the flow of competitive west-wide power and the effectiveness of demand and virtual bidding in the day-ahead market, the CAISO believes that if a decision is made to go forward with applying system market power mitigation to the CAISO balancing area, it is appropriate to first implement the proposed design in the real-time market. After it is in place, the CAISO would monitor day-ahead to real-time market price convergence in instances where supply conditions trigger system-level market power mitigation in the real-time market before deciding whether to extend the design to the day-ahead market.