



California ISO

Congestion Revenue Rights Auction Efficiency

Track 1B Draft Final Proposal Addendum

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1 Executive Summary

The CAISO proposes to change the congestion revenue shortfall allocation to equitably allocate shortfalls among congestion revenue rights and eliminate incentives to bid for low-priced high-payout paths. The CAISO proposes to do this by reducing congestion revenue right payments, so as to not exceed the congestion revenue collected in each day-ahead market, based on each congestion revenue right's settled flow on market constraints generating congestion revenue right payment shortfalls.

This document also describes three other alternatives the CAISO considered: (1) reducing the percentage of system capacity available in the annual allocation and auction process to more accurately model the transmission that is ultimately available in the day-ahead markets, (2) reducing congestion revenue right quantities each day prior to the day-ahead market so that they reflect available transmission, and (3) not releasing any transmission capacity in the congestion revenue rights auction so that bids would only clear if there was a corresponding bid in the opposite direction.

Since 2014, market participants purchased congestion revenue rights in the auction for an average of \$99.5 million per year less than their eventual payouts (termed "auction revenue shortfall" in this document). On average, market participants purchase congestion revenue rights for 63 cents on the dollar. When day-ahead congestion charges are insufficient to cover the difference, it is allocated as uplift to load serving entities.

These auction prices are likely inefficient because the auction prices are substantially below the congestion revenue right payouts based on day-ahead market congestion. Auctioned congestion revenue rights are primarily intended for hedging congestion associated with supply delivery in the CAISO's locational marginal price-based day-ahead market. If congestion revenue rights were priced on this basis, then congestion revenue rights auction prices would, at least over the long-term, be more reflective of actual day-ahead market congestion revenues.¹

Track 1A of this initiative addressed low auction prices with changes intended to make the auction more competitive through concentrating congestion revenue right bidding activity by restricting eligible node pairs in the auction. Track 1A also partially addressed unforeseen transmission outages by requiring additional outage information prior to the annual congestion revenue right allocation and auction process. The CAISO filed these proposed changes with the Federal Energy Regulatory Commission (FERC) on April 11, 2018 and FERC is currently considering them in FERC Docket No. ER18-1344.

This Track 1B proposal further addresses high payouts to congestion revenue rights that are due to modeling differences between the auction and the day-ahead markets, resulting in day-ahead market congestion revenue shortfalls.

¹ As adjusted for CAISO charges and the time value of money.

The CAISO targets the June 2018 Board of Governors' meeting for policies developed in this Track 1B proposal so that they can be in effect by this year's annual congestion revenue right allocation and auction process.

2 Changes to this proposal

The CAISO previously described the changes to its proposal that were based on stakeholder feedback on its straw proposal in the draft final proposal published on May 11, 2018.² This section describes the changes the CAISO made to its draft final proposal that can be found in this addendum.

The CAISO originally proposed a shortfall allocation approach in which it would reduce both (1) the day-ahead payment to congestion revenue rights in the prevailing flow direction and, (2) the payment received from counter-flow congestion revenue rights. In **Section 6.2.1** and the **Appendix**, the CAISO has reconsidered this approach, and now proposes to only reduce the payment to congestion revenue rights in the prevailing flow direction in the event of an over-subscribed constraint. This is more consistent with the design of the simultaneous feasibility test, minimizes total shortfall revenue requirements, and reduces the potential for lower auction revenues.

In **Section 6.2.1** and the **Appendix**, the CAISO also clarifies how this proposal interacts with the existing congestion revenue rights claw-back rule as well as existing transmission rights and transmission ownership rights settlement.

3 Scope of this proposal

The *Congestion Revenue Rights Auction Analysis Report* showed that auction revenue shortfalls are caused by congestion revenue rights that (1) have low prices in the auction and (2) have high payouts relative to their prices because the congestion revenue right auction did not accurately model day-ahead market conditions, primarily due to unforeseen transmission facility outages and outages lasting less than 24 hours.

Track 1A of this initiative addressed low auction prices by making the auction more competitive through concentrating bidding activity by restricting eligible node pairs in the auction. Track 1A also partially addressed unforeseen transmission outages by requiring additional outage information prior to the annual congestion revenue right allocation and auction process.

This Track 1B proposal further addresses high payouts to congestion revenue rights that are due to modeling differences between the auction and the day-ahead markets. It does this by reducing congestion revenue right payments to not exceed the congestion revenue collected in each day-ahead market. The CAISO proposes to change the congestion revenue shortfall uplift allocation to equitably allocate shortfalls among congestion revenue rights and eliminate incentives to bid for low-priced high-payout paths. This change will also appropriately allocate congestion revenue shortfalls

² Draft Final Proposal – Congestion Revenue Rights Auction Efficiency, Track1B
(<http://www.caiso.com/Documents/DraftFinalProposal-CongestionRevenueRightsAuctionEfficiencyTrack1B.pdf>)

among congestion revenue rights for outages lasting less than 24 hours, which may otherwise be inefficient to include in the auction model.

Although these day-ahead market congestion revenue shortfalls are different than auction revenue shortfalls, the two items are related. Day-ahead market congestion revenue shortfalls are caused by modeling differences between the congestion revenue right auction and the day-ahead market models. These modeling differences result in day-ahead market congestion that cannot be priced into the auction because a constraint causing congestion in the day-ahead market was not in the auction model. Eliminating day-ahead market congestion revenue shortfalls will bring payments to congestion revenue rights more in line with the conditions modeled and priced in the congestion revenue right auction.

The CAISO considered three other alternatives, one intended to more accurately model the transmission that will ultimately be available, one to reduce congestion revenue rights quantities each day prior to the day-ahead market, and one to completely eliminate the release of available transmission capacity to market participants in the auction. .

The CAISO evaluated proposals and alternatives against the following criteria:

1. Potential to equitably allocate revenue shortfalls
2. Potential to improve auction efficiency
3. Implementable in time for 2019 congestion revenue rights settlement

The CAISO targets the June 2018 Board of Governors' meeting for policies developed in this Track 1B proposal.

4 Initiative background

4.1 Initiative organization and status

4.1.1 Initiative organization

In early 2017, the CAISO began a stakeholder initiative to address the congestion revenue rights auction efficiency. The CAISO is concerned about the large payments made to holders of auctioned congestion revenue rights in comparison to the revenues collected when awarding the congestion revenue rights through the auctions.

This initiative is composed of two main phases: analysis phase and policy phase.

The analysis stage culminated in a report outlining many drivers of low auction congestion revenue rights valuations published on November 21, 2017 (See CRR Auction Analysis Report).

The CAISO began the policy stage at a stakeholder working group on December 19, 2017. The policy stage is organized into three tracks: Track 0, Track 1, and Track 2.

The CAISO is focusing **Track 0** on enhancements it can pursue outside of the broader initiative because they do not require changes to the existing CAISO tariff. This draft final proposal does not discuss efforts associated with Track 0.

The CAISO is focusing **Track 1A** on items that can be implemented in time for the 2019 annual process. To allow time for FERC approval and implementation, the CAISO plans to bring Track 1A policy items to the CAISO Board of Governors for approval at their March 2018 meeting.

The CAISO is also focusing **Track 1B**, the subject of this proposal, on items affecting 2019 congestion revenue rights. In this track, the CAISO will pursue policy development that could achieve FERC approval in time for the 2019 annual process, but may be implemented over a longer time horizon. The CAISO plans to bring Track 1B policy items to the CAISO Board of Governors for approval at their June 2018 meeting.

The CAISO is focusing **Track 2** on addressing potential comprehensive design changes in time for CAISO Board of Governors' consideration in late 2018.

4.1.2 Status

4.1.2.1 Track 0

In late 2017, the ISO started a parallel effort to the broader policy initiative. The parallel effort ("Track 0") focuses on enhancements the ISO can pursue outside of the broader

initiative because they do not require changes to the existing CAISO tariff. It includes internal process improvements, changes to business rules, and operational guidance.

The ISO discussed the outage reporting findings of its CRR Auction Analysis Report with transmission owners along with other outage reporting expectations. It clarified the methodology used in determining the on-time outage reporting percentage, and used input from the conversations to better target its Track 1A policy proposals. The ISO is still developing a monthly outage reporting performance metric and will be collaborating with transmission owners to develop the business rules.

The ISO completed its review of the default enforced constraints list for the congestion revenue rights market and the day-ahead market and determined that it will expand the list and consider managing a separate, more comprehensive, constraint list for the congestion revenue rights market. The list for the congestion revenue rights market will include most constraints that could potentially be used in the day-ahead market.

The ISO will now identify and define potential nomogram constraint definitions in time for congestion revenue rights auctions. It has also determined that many nomogram constraints it uses are for generator or remedial action scheme type contingencies, which will be fully modeled in both the congestion revenue rights market and day-ahead market once it implements the Generator Contingency and Remedial Action Scheme initiative which was approved by the board of governors in September 2017.

The ISO is still reviewing its outage coordination practices and operating agreements with neighboring balancing authorities.

The ISO completed its review of the default enforced contingency list for the congestion revenue rights market and determined that it will expand the list to include most contingencies of elements that impact the ISO controlled grid. The ISO stress tested its congestion revenue rights market software and found that it can support the required increase in contingency modeling.

The ISO is still reviewing its current congestion revenue rights market outage modeling criteria to better capture the impact of outages lasting less than 10 days.

4.1.2.2 Track 1A

The CAISO Board of Governors approved Track 1A policy at its March 2018 Board of Governors' meeting. The CAISO filed tariff changes with the Federal Energy Regulatory Commission on April 11, 2018.³

³ http://www.caiso.com/Documents/Apr11_2018_TariffAmendment-CRRAuctionEfficiencyTrack1A_ER18-1344.pdf

4.2 Stakeholder engagement

4.2.1 Energy Imbalance Market Governing Body

This initiative does not fall within the authority delegated to the Energy Imbalance Market (EIM) Governing Body. The initiative will go to the CAISO Board for approval and the EIM Governing Body will have no role in approval.

The initiative proposes to change the rules for the annual and monthly congestion revenue rights auctions and allocation processes. Congestion revenue rights are settled based on the outcome of the auctions and day-ahead market prices, with no input from the real-time market. Under the Guidance for Handling Policy Initiatives within the Decisional Authority or Advisory Role of the EIM Governing Body and the Charter for EIM Governance, the EIM Governing Body does not have a decisional role in approving these proposed changes because they are neither rules of the real-time market, nor rules that govern any participation in all ISO markets.

4.2.2 Schedule

The schedule for stakeholder engagement is provided below. The CAISO targets the June 2018 Board of Governors' meeting for **Track 1B** policy items.

Date	Event
5/25/2018	Publish track 1B draft final proposal addendum
6/7/2018	Stakeholder comments due
6/21/2018	June Board of Governors' meeting – Track 1B policy

4.2.3 Summary of stakeholder comments

Calpine Energy Solutions, a non-utility load-serving entity, is concerned that the proposal contradicts the purpose of congestion revenue rights to appropriately hedge supply delivery and does not adequately protect the individual consumer whose cost of energy tracks market clearing prices. Calpine Energy Solutions argues that load-serving entities and suppliers have virtually no control over the conditions that give rise to revenue inadequacies. It states that under the proposal, consumers would purchase congestion revenue rights as insurance without confidence that it will be fully insured thus increasing its energy costs. It recommends the CAISO abandons its targeted reduction in congestion revenue rights payments and adopt an approach that spreads congestion revenue shortfalls across all congestion revenue rights at an aggregate level. If the CAISO adopted an aggregate approach, Calpine Energy Solutions notes that congestion revenue rights would effectively become an insurance program with the risk of disaster being taken by all those that participate in the insurance pool.

The City and County of San Francisco (San Francisco), an owner and operator of both a municipal electric utility and community choice aggregator program, is concerned that the proposal fails to address the underlying auction efficiency problem and does not equitably allocate congestion revenue shortfalls. Additionally, it is concerned that the CAISO has not demonstrated the impact of the proposal on market participants and that the CAISO has not adequately considered alternative solutions. San Francisco favors prioritizing shortfall allocations according to auction value with allocated congestion revenue rights receiving the highest priority. It argues that such a proposal would recognize that the auctioned congestion revenue rights contribute more to the revenue inadequacy than the allocated congestion revenue rights because the revenue inadequacy would be decreased in the absence of the auctioned congestion revenue rights.

The energy division of the California Public Utilities Commission states that the proposal is a commendable step towards ensuring that consumers do not pay costs incurred for congestion revenue rights held purely for speculative purposes or that do not otherwise hedge the congestion risks that load-serving entities face in connection with their service obligations. However, the energy division recommends that the CAISO further consider alternate proposals. It also requests the CAISO to clarify that its Track 1A and Track 1B proposals are intended as interim solutions.

DC Energy finds that the proposal to allocate congestion revenue rights payment shortfalls to congestion revenue rights holders by constraint is an important step toward aligning the assignment of revenue inadequacy to responsible parties. It agrees that a constraint-by-constraint allocation is the best approach when compared to more socialized methods of allocating congestion revenue rights payment shortfalls. DC Energy agrees that the most equitable allocation method treats all congestion revenue rights equally whether received in the allocation process or purchased in the auction. It recommends that the CAISO allocate surpluses and deficiencies symmetrically per constraint. DC Energy also recommends that the CAISO distribute any residual constraint surplus after the targeted surplus and deficit allocation to all congestion revenue rights proportional to remaining short-payments, rather than to measured demand.

NRG Energy agrees that the proposal has the potential to be the most equitable method to address congestion revenue right payment shortfalls. It agrees that eliminating the release of available transmission capacity in the auction may result in an unworkably illiquid market for non-utility load-serving entities, generator owners, and generation marketers.

The Office of Ratepayer Advocates supports the proposal recognizing that continuing with fully funded congestion revenue rights would maintain incentives for rent-seeking entities to target congestion revenue rights that are likely to contain constraints that are modeled in the day-ahead market but not in the auction, thereby exacerbating auction revenue shortfalls. It recommends that the CAISO apply surplus revenues generated over each constraint to reduce Transmission Access Charge paid by consumers.

Finally, it recommends that the CAISO continue to consider all three alternatives identified in its proposal.

The Pacific Gas and Electric Company supports pursuing a reduction of congestion revenue rights payments based on effectiveness on constraints. Understanding the granularity differences between the congestion revenue rights auction and the day-ahead market, it finds that this proposal will be more efficient than full month de-rates of congestion revenue rights by not overly constraining the available transmission. It also agrees that allocating congestion revenue rights payment shortfall costs by constraint adds necessary fairness to revenue inadequacy as well as promotes the type of risk-sharing that is likely to reduce the amount of speculative bidding that triggers significant auction revenue shortfalls. However, Pacific Gas and Electric Company recommends that the CAISO modify the shortfall calculation to ensure that counter-flows are not adjusted when binding constraints lead to revenue deficiencies because it could lead to reducing the payments that congestion revenue rights holders must pay the CAISO for taking the negative position of expected flows. It argues that regardless of the fact that the congestion revenue right flows in the opposite direction, the constraint was still over-allocated in the prevailing flow direction. Finally, Pacific Gas and Electric Company urges the CAISO to adopt a surplus allocation methodology that does not promote rent seeking from modeling inconsistencies.

Powerex supports the proposal as an interim measure to allocate congestion revenue rights inadequacy to the entities that hold congestion revenue rights. It states that the proposal is a major improvement over the status quo, under which one group of participants benefits from the congestion revenue rights funded in substantial part by an entirely different group of participants that bear the burden of congestion revenue rights payment shortfalls. However, Powerex strongly urges the CAISO to more efficiently de-rate congestion revenue right quantities prior to the day-ahead market in Track 2 of this initiative.

Southern California Edison recommends that the CAISO re-evaluate its proposal to adopt changes that address its underlying concerns with the congestion revenue rights auction. It is concerned that the technical, competitive, and legal/regulatory issues identified by other stakeholders at the April 10, 2018 working group are not appropriate reasons for abandoning its proposal.

Sonoma Clean Power and Peninsula Clean Energy, both community choice aggregators, support the CAISO Track 1A proposals that were submitted to FERC on April 11, 2018 as practical solutions to reduce congestion revenue right uplift while preserving the auction as an important market process. However, it recommends that the CAISO take an appropriate amount of time to design and implement its preferred solution in this Track 1B, rather than the current proposal for a targeted reduction in congestion revenue rights payments. Furthermore, they recommend that the CAISO should scrutinize any further reform carefully to ensure anti-competitive dynamics between load-serving entities are not created.

San Diego Gas & Electric is generally supportive of the direction of the proposal to equitably allocate congestion revenue rights payment shortfalls to congestion revenue rights holders as opposed to one of the alternate proposal put forth by Southern California Edison. It requests additional information so it can quantify the impacts of various surplus allocation schemes.

The Six Cities is concerned that the proposal to equitably allocate congestion revenue rights payment shortfalls to congestion revenue rights holders does not reflect cost-causation principles. It states that the imperfect nature of the modeling process itself (which is to some degree unavoidable) and established transmission capacity amounts actually represent the true cost causation driver. It is concerned that the proposal degrades the fundamental purpose of the whole congestion revenue rights market, because it will no longer be possible for a market participant to guarantee that a physical power delivery path is 100 percent hedged. It continues to support the alternate proposal to eliminate available transmission in the auction. The Six Cities also provides another alternative congestion revenue right payment shortfall allocation methodology it says is based on all of the costs and revenues associated with market participant activity in the market.

Silicon Valley Power argues that an equitable approach to allocating congestion revenue rights payment shortfalls should consider the costs for participating in the allocation and auction processes, as well as the contribution of the congestion revenue right to the shortfall. This approach would effectively prioritize allocated congestion revenue rights over auctioned congestion revenue rights. To support a prioritized approach, it argues that there would be no revenue insufficiency if congestion revenue rights were not auctioned. Silicon Valley Power recommends allocating constraint surpluses to all congestion revenue rights holders regardless of the constraint.

Western Power Trading Forum recommends that the CAISO first evaluate impacts from its Track 0 and Track 1A policies before implementing its proposal to equitably allocate congestion revenue rights payment shortfalls to congestion revenue rights holders. It continues to recommend further consideration of adopting a balancing auction design framework. It strongly prefers that congestion revenue rights remain fully funded. To the extent that the current proposal moves forward, the Western Power Trading Forum proposes that some portion of the congestion revenue right payment shortfall be allocated to participating transmission owners and that the CAISO should ensure that the shortfall allocation is symmetrical by allocating net shortages and excesses. Finally, the Western Power Trading Forum supports the constraint specific approach because it will avoid socializing risks across all congestion revenue rights.

5 Proposal background

5.1 General discussion

The CAISO operates a wholesale market where buyers and sellers across many locations transact energy. The market minimizes costs of supply required to meet demand while respecting physical transmission limitations. When demand for transmission exceeds the transmission capacity, termed “congestion,” prices vary to reflect this congestion. The market results in many and varying energy prices across the entire system reflecting the different conditions across the system.

The CAISO employs locational marginal price congestion management design to achieve this least cost dispatch subject to the physical limitations of the transmission system. Because the physical transmission system is made up of many thousands of miles of transmission lines at various voltage levels and hundreds of physical generators, energy prices are settled at over 1,100 pricing nodes. Nodal markets employing locational marginal price congestion management design are incredibly effective at achieving the least cost dispatch and sending efficient price signals.

The CAISO market did not always clear energy in this way. Prior to the implementation of nodal markets, the CAISO employed zonal pricing design in which all generation in larger pre-defined zones received the same price. Fewer market pricing points exposed energy forward contracting activity to less price uncertainty than the current nodal design. However, under the previous market design, the market could dispatch supply within a zone in a manner that overloaded transmission and caused congestion. This would necessitate market operators to manage generator dispatch manually outside of the market. Consequently, this zonal approach did not produce efficient generation pricing or dispatch.

Locational marginal pricing provides a market mechanism for allocating the short-term use of the transmission system, but it has been argued that it does not by itself provide a framework for market participants to hedge long-term participation in the market. Upon implementation of nodal market designs to gain price and dispatch efficiency, supply and demand are spread out to thousands of pricing nodes exposing market participants to a much higher degree of uncertainty of future congestion charges. Congestion charges can be volatile and actual dispatch costs are not known until the market runs. This uncertainty of future congestion charges under a market-based congestion pricing system creates a need for congestion hedges to enable long-term participation in the market including entities entering into long-term energy and/or capacity contracts or having load serving obligations.⁴

The CAISO has argued that congestion revenue rights are essential to long-term participation in its market and to enable forward contracting by providing a means for market participants to lock in the cost of transmission service on a forward basis. Congestion revenue rights effectively provide the financial equivalent of monthly or

⁴ MRTU Filing, Exh. No. ISO-2 at 24.

annual firm point-to-point physical transmission service under the pro forma OATT. Either approach—whether based on financial rights or physical scheduling rights—enables market participants to obtain certainty regarding the cost of the transmission service. Enabling forward transactions, in turn, reduces reliance on spot markets and is widely recognized as critical to properly functioning electricity markets.

Forward contracts for physical supply do not require that congestion revenue rights be held specifically by load serving entities, as the purchasing party, as opposed to other parties involved in the forward contracting arrangements. There are a variety of potential forward contracting arrangements that lead to a useful outcome for both load serving entities and suppliers, such as contracts for delivery of power at trading hubs or delivery of power to the load location. The congestion revenue rights auction allows all market participants, regardless of their function, size, or location, access to congestion revenue rights, and therefore enables this variety of forward contract arrangements among contracting parties.

Market participants should be willing to pay for the price certainty that congestion revenue rights offer, or, at a certain price, forgo purchase of the product opting instead to take on the day-ahead market price risk. The prices cleared in the congestion revenue rights auction do not appear to reflect the intended purpose of hedging congestion associated with supply delivery in the CAISO's locational marginal price-based day-ahead market.

5.2 Congestion revenue rights

Congestion revenue rights allow market participants to obtain financial protection for the risk of congestion charges associated with the CAISO market's locational marginal price congestion management design. They facilitate long-term contracting by load serving entities and generators by hedging congestion associated with supply delivery in the CAISO's locational marginal price-based day-ahead market.

In general, a congestion revenue right is a forward contract that settles on the day-ahead market energy price difference between two locations (i.e. the cost of congestion).⁵ For instance, if location A has a locational marginal price of \$30/MWh and location B has a locational marginal price of \$50/MWh, the holder of a congestion revenue right from location A to location B will receive \$20/MWh (the difference between location A and location B day-ahead energy prices). An entity with supply at location A but with demand at location B would be exposed to \$20/MWh in congestion charges if it does not acquire a congestion revenue right from location A to location B. The entity would receive \$30/MWh in day-ahead market energy payments for supply at location A, but would be charged \$50/MWh for energy delivered to location B in the day-ahead market. This entity can hedge the \$20/MWh congestion cost by purchasing the congestion revenue right.

⁵ This is a generalized description. Congestion revenue rights actually settle on the difference in the marginal congestion components of the locational marginal prices between two locations.

5.3 Auction efficiency

To measure congestion revenue right auction efficiency, the CAISO compares the price auction participants pay for congestion revenue rights in the auction to the payment that the right receives in the day-ahead market. For instance, if a market participant can consistently pay 50 cents for a congestion revenue right that pays it a dollar, the auction is not producing an efficient price. For this measure, the CAISO compares the congestion revenue rights payments generated by the day-ahead market to congestion revenue right auction proceeds.

ISO/RTOs, including the CAISO, have traditionally focused on financial transmission right revenue adequacy in addition to auction efficiency. Financial transmission rights are considered revenue adequate when day-ahead market congestion charges are greater than or equal to payments to financial transmission rights. Financial transmission rights will be revenue adequate if the transmission models used in both the auction and day-ahead market are identical.⁶ When the auction limits or network models are different, congestion revenue rights may be revenue inadequate.

The purpose of auctioned congestion revenue rights is to hedge congestion associated with supply delivery in the CAISO's locational marginal price-based day-ahead market, including facilitating long-term contracting by load serving entities and generators.⁷ Congestion revenue rights enable this by providing a means to lock in the cost of day-ahead market transmission service on a forward basis. This price certainty should come at a cost. If congestion revenue rights are priced on this basis, then congestion revenue rights auction prices should reflect market participants' expectations of congestion price exposure in the day-ahead market and should exceed the expected congestion revenue right payments.⁸ Generally, over the long-term, congestion revenue rights prices should reflect the value of the hedge provided against day-ahead market congestion charges.

Historically, CAISO congestion revenue right prices have been low for some congestion revenue rights relative to the eventual payout. Total payouts to auctioned congestion revenue rights in 2014 of \$292 million were significantly more than auction revenues of \$104 million, resulting in a \$187 million auction revenue shortfall. The congestion revenue rights payouts to auctioned congestion revenue rights reduced significantly in 2015 to \$169 million, further reduced in 2016 to \$138 million, and increased to \$140 million in 2017 (through November). The difference between the auctioned congestion revenue rights payouts and auction proceeds decreased in 2015 to about \$60 million,

⁶ Hogan, William W. 1992. "Contract Networks for Electric Power Transmission." *Journal of Regulatory Economics*. See the version at: <http://www.hks.harvard.edu/fs/whogan/acnetref.pdf>.

⁷ MRTU Filing, Exh. No. ISO-2 at 22.

⁸ Harvey, Scott. February 2017. "Congestion revenue rights prices and pay outs: Are congestion revenue rights auctions valuing congestion revenue rights as hedges or as risky financial instruments." Presentation at February 2017 California ISO Market Surveillance Committee meeting.

further decreasing in 2016 to about \$51 million, followed by an increase to \$73 million in 2017 (through November).⁹

Figure 1 below compares congestion revenue rights and payouts. The blue line compares the proportion of auction proceeds to congestion revenue rights payments. A value of 100 percent indicates the auction proceeds equal the congestion revenue rights payments. A value lower than 100 percent indicates the congestion revenue rights holder collected a payment above the amount paid to acquire the congestion revenue right in the auctions.

Auction participants consistently purchase congestion revenue rights at a steep discount to eventual payouts. The auction is not producing an efficient price for congestion revenue rights.

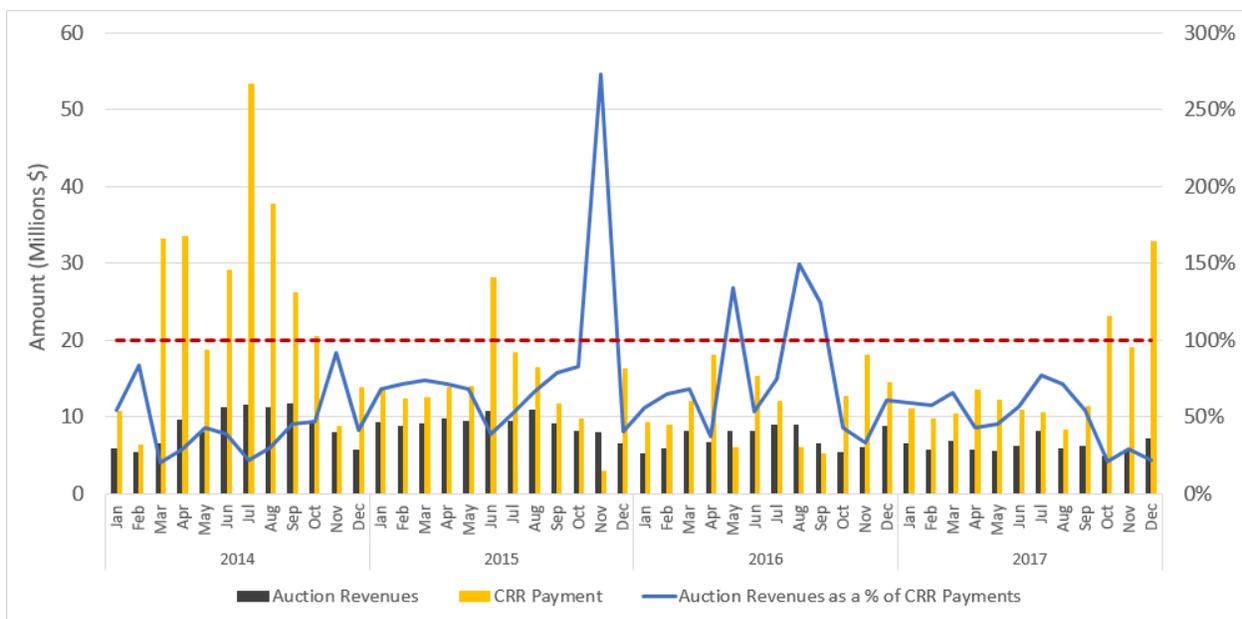


Figure 1: Auction proceeds versus payouts

Achieving market valuations consistent with hedging activity is not an abstract hypothetical.

- The monthly auction price of a New York ISO Zone G to Zone J TCC has averaged 111.7% of the day-ahead market payout over the period June 2000 through December 2016.
- The monthly auction price of a PJM western hub to PECO FTR has averaged 137% of the day-ahead market target payout over the period May 1999 through December 2016.

⁹ California ISO. November 2017. "Congestion revenue rights auction analysis report." Pg. 49.

- The monthly auction price of a PJM western hub to PECO FTR has averaged 143% of the day-ahead market prorated payout over the period January 2005 through December 2016.

These valuations are consistent with the market valuing these products as hedges priced at a premium to the expected payout.¹⁰

5.4 Specifics of the CAISO congestion revenue rights processes

The CAISO conducts both an annual and a monthly congestion revenue rights allocation and auction process to issue congestion revenue rights which cover specific periods of time. Market participants can receive seasonal congestion revenue rights in the annual process which cover seasonal periods of the upcoming calendar year. For each of these seasons, market participants can receive on-peak and off-peak products. Additionally, market participants can receive monthly congestion revenue rights in the monthly process which cover every day of the upcoming calendar month. For the upcoming month, market participants can receive on-peak and off-peak products. Market participants also use the monthly process to reconfigure their seasonal congestion revenue rights received in the annual process.

5.4.1 Annual process

The CAISO conducts the annual congestion revenue rights allocation and auction process once a year, mid-year, which releases congestion revenue rights that cover the upcoming calendar year. The annual process occurs well in advance of the term of the congestion revenue rights released. For instance, the CAISO releases congestion revenue rights for the first quarter of the upcoming calendar year approximately five months prior to that quarter and releases congestion revenue rights for the last quarter of the upcoming calendar year approximately 14 months prior to that quarter.

Through the annual process, the CAISO releases seasonal congestion revenue rights for four seasonal periods and two time-of-use periods, on peak and off peak. These seasonal/time-of-use periods coincide with the calendar quarters (season 1 – January through March, season 2 – April through June, season 3 – July through September, and season 4 – October through December).

The annual process, results in seasonal releases that cover the upcoming calendar year. Market participants request congestion revenue rights for each season and for a time-of-use period (on-peak and off-peak). This means that there are actually eight congestion revenue right products that are released through the annual process: an on-peak and off-peak congestion revenue right for each of four seasons in the upcoming calendar year.

¹⁰ Harvey, Scott. February 2018. "CRR Prices and Pay Outs: Are CRR Auctions Valuing CRRs as Hedges or as Risky Financial instruments?"

The figure below shows that the CAISO conducts its annual congestion revenue right allocation and auction process approximately five months prior to the prompt year and awards eight products.

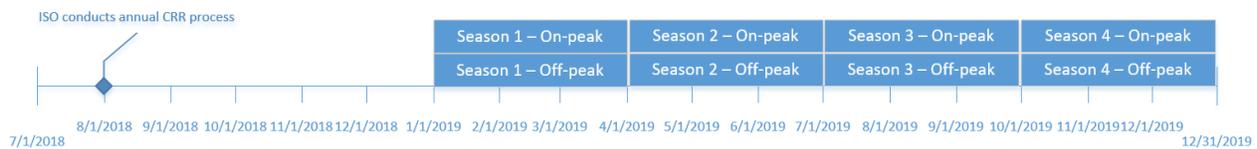


Figure 2: Mid-year annual process awards CRRs for upcoming calendar year

The annual process occurs in five consecutive rounds:

1. First allocation round which the CAISO refers to as the “priority nomination process”
2. Second allocation round which the CAISO refers to as “tier 2”
3. Third allocation round which the CAISO refers to as “tier 3”
4. Allocation round for long-term rights which the CAISO refers to as “tier long-term”
5. Auction round which the CAISO refers to as the “congestion revenue rights auction”

In the first allocation round, the market rules allow load serving entities that acquired rights in the immediately previous year’s annual allocation process the opportunity to re-acquire those rights that were previously allocated. The market rules limit the congestion revenue right source, sink, and quantities based on the load serving entity’s allocation in the previous year and account for other factors including load migration. The CAISO releases congestion revenue rights for all four seasons and two time-of-use periods in this round and releases congestion revenue rights corresponding to a total of 75% of system capacity.

In the second and third allocation rounds, load serving entities request rights from any generation source location to any load location limited to a qualified megawatt value based on historical and forecasted demand; this limitation is only on the sink location. The CAISO awards congestion revenue rights for all four seasons and two time-of-use periods in these rounds. The CAISO releases a total of 75% of system capacity. After the second allocation round the CAISO reserves half of the un-allocated inertia capacity for the auction round. If no inertia capacity is left after the second allocation round, nothing is reserved for the auction round.

In the allocation round for long-term rights, the CAISO releases long-term congestion revenue rights, which provide the ability to obtain allocated congestion revenue rights for a period of ten years. The terms of these rights begin on the first of the year, *the year after* the upcoming calendar year. For instance, in its annual process occurring mid-year 2017, the CAISO awarded 10 year rights with terms from January 1, 2019 through December 31, 2028. In this process, the CAISO releases a total of 60% of system capacity.

In the auction round, all market participants may bid for rights from any biddable pricing point on the CAISO system to any other biddable pricing point on the CAISO system. The auction maximizes revenues and awards congestion revenue rights for all four seasons and two time-of-use periods. The CAISO releases a total of 75% of system capacity.

In all annual allocation rounds and the auction, the CAISO limits the release of total system capacity to 75%. In the nomination round for long-term rights, the CAISO limits the release of total system capacity across the 10-year horizon to 60%. Any previously awarded long-term rights produce transmission flows that are accounted for in every round of the process.

To prepare for its annual allocation and auction process, the CAISO gathers load serving entity demand information, existing transmission rights information, transmission ownership rights information, transmission facility outage information, and new/retiring transmission facility information. It develops load metrics and qualified nomination quantities for each load serving entity to use in the nomination rounds, accounts for existing transmission rights and transmission ownership rights, and incorporates known transmission topology information into its congestion revenue rights model.

Participating transmission owners are currently not required to report outages that could have significant impact on congestion revenue rights revenue adequacy in time for the annual process. However, some transmission owners do report major maintenance in time for the annual process. When available, the CAISO uses this outage information to study the transmission system. It determines which constraints should be enforced in the congestion revenue rights market model, which contingencies should be enforced in the model, derives special nomogram definitions and line limitations, determines interface limitations, and determines which outages should be represented as out-of-service transmission elements in the model. The CAISO uses the developed model to conduct the annual congestion revenue right allocation and auction process.

The CAISO currently shares its developed model with market participants prior to accepting nominations and bids in its annual congestion revenue right allocation and auction process. The information includes constraint enforcement status, contingency enforcement status, and which particular outages the CAISO chose to model as out-of-service transmission elements. The CAISO also shares all known transmission outage information as of the time that it releases the final model.

In the allocation rounds, the CAISO maximizes the quantity of congestion revenue rights awarded subject to the modeled transmission topology, associated transmission limitations, nodal group limitations, and the 75% system capacity limitation. Load serving entities receive an award of a congestion revenue rights associated with a source and a sink location.

In the auction round, the CAISO maximizes the total bid value subject to the modeled transmission topology, associated transmission limitations, nodal group limitations, and

the 75% system capacity limitation. Market participants receive an award of a congestion revenue rights associated with a source and a sink location.

5.4.2 Monthly process

The CAISO conducts monthly congestion revenue rights allocations and auctions twelve times a year in advance of each month. Within each monthly congestion revenue rights allocation and auction process, the CAISO performs a distinct process for each on-peak and off-peak period.

The CAISO conducts the monthly process once a month and awards congestion revenue rights that cover the upcoming calendar month. The monthly process occurs in advance of the term of the congestion revenue right awarded. For instance, the CAISO begins its monthly process for congestion revenue rights with terms including the last day of the upcoming calendar month approximately 60 days prior to that day.

Through the monthly process, the CAISO releases congestion revenue rights for two time-of-use periods with terms covering the upcoming calendar month. Market participants request or bid for congestion revenue rights for each time-of-use period.

Figure 3 below shows that the CAISO begins its monthly process approximately four weeks prior to the relevant month and awards two products.

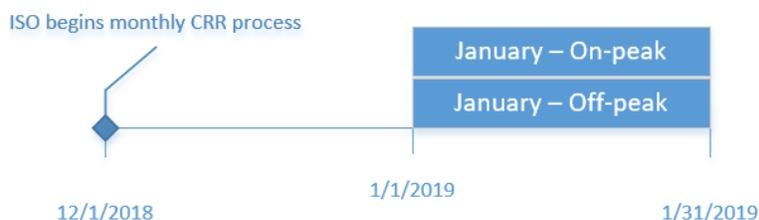


Figure 3: Monthly process awards CRRs for upcoming calendar month

The monthly process occurs in three consecutive rounds:

1. First allocation round which the CAISO refers to as “tier 1”
2. Second allocation round which the CAISO refers to as “tier 2”
3. Auction round which the CAISO refers to as the “congestion revenue rights auction”

In the first and second allocation rounds, load serving entities request rights from any generation source location to any load location limited to a quantity based on historical and forecasted demand. The CAISO awards congestion revenue rights for both time-of-use periods in these rounds. The CAISO releases congestion revenue rights representing a total of 100% of system capacity minus a pre-determined de-rate factor which generally limits the available system capacity to approximately 82.5%. After the first allocation round the CAISO reserves half of the un-allocated intertie capacity for the auction round. If no intertie capacity is left after the first allocation round, nothing is reserved for the auction round.

In the auction round, all market participants may bid for rights from any biddable pricing point on the CAISO system to any other biddable point on the CAISO system. The auction maximizes collected revenues and awards congestion revenue rights for both time-of-use periods. The CAISO releases congestion revenue rights representing a total of 100% of system capacity minus a pre-determined de-rate factor which generally limits the available system capacity to approximately 82.5%.

In both monthly allocation rounds and the auction, the CAISO limits the release congestion revenue rights to approximately 82.5% of total system capacity (depending on the pre-determined de-rate factor used). Any previously awarded rights produce transmission flows in the model that are accounted for in every round of the process.

To prepare for its monthly process, the CAISO gathers load serving entity demand information, existing transmission rights information, transmission ownership rights information, transmission facility outage information, and new/retiring transmission facility information. It develops load metrics and qualified nomination quantities for each load serving entity to use in the nomination rounds, accounts for existing transmission rights and transmission ownership rights, and incorporates known transmission topology information into its congestion revenue rights model.

Participating transmission owners report outages that could have significant impact on congestion revenue rights revenue adequacy 30 days prior to the month that the outage is scheduled to start. They report outages of at least 24 hour duration on all transmissions facilities operated at greater than 200 kV. They also report outages of certain facilities, specified in CAISO operating procedures, operated at less than 200 kV. The CAISO uses this outage information to study the transmission system. It determines which constraints should be enforced in the congestion revenue rights model, which contingencies should be enforced in the model, derives special nomogram definitions and line limitations, determines interface limitations, and determines which outages should be represented as out-of-service transmission elements in the model. The CAISO uses the developed model to conduct the monthly congestion revenue rights allocation and auction process.

The CAISO currently shares its developed congestion revenue rights market model with market participants prior to accepting nominations and bids for its monthly congestion revenue rights allocation and auction process. These disclosures include constraint enforcement status, contingency enforcement status, and which particular outages it chose to model as out-of-service transmission elements. The CAISO also discloses all known outage information as of the time that it releases the final model.

In the allocation rounds, the CAISO maximizes the quantity of congestion revenue rights awarded subject to the modeled transmission topology, associated transmission limitations, nodal group limitations, and the system capacity limitation. Load serving entities receive an award of a congestion revenue right associated with a source and a sink location.

In the auction round, the CAISO maximizes the total bid value subject to the modeled transmission topology, associated transmission limitations, nodal group limitations, and the system capacity limitation. Market participants receive an award of a congestion revenue right associated with a source and a sink location.

5.5 Certain aspects of other ISO/RTO financial transmission rights markets

All ISO/RTOs in the United States of America operate financial transmission rights markets. Each market is designed differently, however, they all release obligations to pay or be paid based on day-ahead market congestion. **Table 1** below summarizes certain aspects of financial transmission rights processes employed at each organization.

Table 1: Certain aspects of other ISO/RTO financial transmission rights markets

ISO/RTO	Total system capacity released 4 to 16 months forward	FTR Shortfall and Surplus Distribution Methodologies
CAISO	75%	Shortfalls and surpluses distributed to measured demand, which is metered load and exports.
ERCOT	40-55%	FTRs that include resource nodes charged for shortfalls based on effectiveness on constraints. All other shortfalls and surpluses distributed pro-rata to FTR holders based on total payments due. Maintains \$10 million buffer in balancing account to pay back short-paid FTRs.
ISO-NE	50%	Shortfalls and surpluses distributed pro-rata to FTR holders based on total payments due.
MISO	~60%	Shortfalls and surpluses distributed pro-rata to FTR holders based on total payments due.
NYISO	5-100%	Shortfalls and surpluses distributed to transmission owners based on contribution to the shortfall.
PJM	100%	Shortfalls and surpluses distributed pro-rata to FTR holders based on total payments due.

SPP	0-60%	Shortfalls and surpluses distributed pro-rata to FTR holders based on total payments due.
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The CAISO reviewed the total system capacity released as financial transmission rights by other ISO/RTOs in a timeframe covering from four months after their annual process to 16 months after their annual process. The CAISO reviewed this window of time to find approximately how much system capacity has been released in other markets as compared to the CAISO’s annual congestion revenue right allocation and auction process. For instance, as of the CAISO’s annual process time, it releases congestion revenue rights for 75% of transmission capacity for the following calendar year (the time period covering four months after the annual process to 16 months after the annual process). Southwest Power Pool releases financial transmission rights for 60% of system capacity for the time period covering 4 months after its annual allocation and auction process to 12 months after its annual process and 0% of system capacity after that. NYISO releases financial transmission rights for 100% of system capacity for the time period covering from 4 to 6 months after its annual allocation and auction process, 30% for 6 to 12 months after, and 5% for 12 to 16 months after. ERCOT releases financial transmission rights for 40-55% of system transmission capacity and ISO-NE releases financial transmission rights for 50% of system capacity.

The CAISO reviewed financial transmission rights payment methodologies used by other ISO/RTOs. In general, when congestion revenues are insufficient to fully fund amounts due to financial transmission rights holders, payments are pro-rated based on the total dollar amounts due to each financial transmission rights holder. If excess congestion revenues are available at the end of the month or year, they are distributed pro-rata to short-paid financial transmission rights holders up to the full amount of shortfall. ERCOT charges any financial transmission right that includes a resource node based on effectiveness on constraints driving shortfalls. It charges all other financial transmission rights pro-rata based on total payments. ERCOT also keeps a running 10 million dollar buffer in the financial transmission rights balancing account and uses this buffer to pay back short-paid financial transmission rights. If the balancing account has a surplus above the 10 million dollar buffer, ERCOT distributes the surplus to load-serving entities. NYISO distributes shortfall charges and surplus payments to its transmission owners based on their contribution to the shortfall.

6 Proposals and alternatives considered

In this section, the CAISO proposes a change related to its congestion revenue rights allocation and auction processes. The change is intended to equitably allocate congestion revenue shortfalls among congestion revenue rights to bring payments to congestion revenue rights more in line with the conditions modeled and priced in the congestion revenue right auction. This will also eliminate incentives to exploit model differences between the congestion revenue rights market and the day-ahead market, thereby eliminating incentives to bid in the auction for low-priced but potentially high-payout paths.

- In **Section 6.2.1**, the CAISO proposes to reduce congestion revenue rights payments based on effectiveness on constraints generating congestion revenue shortfalls.

In addition to the proposals, the CAISO also discusses two alternative policy options it considered.

- In **Section 6.3.1**, the CAISO describes an alternative policy to lower the percentage of system capacity available in the annual allocation and auction.
- In **Section 6.3.2**, the CAISO describes an alternative policy to reduce congestion revenue rights quantities each day prior to the day-ahead market.
- In **Section 6.3.3**, the CAISO describes an alternative policy to eliminate using available transmission system capacity in the congestion revenue rights auction

6.1 General discussion

The congestion revenue rights allocation and auction processes release the financial equivalent of long-term firm point-to-point transmission service on the CAISO controlled transmission system. These congestion rights are financially firm and fully funded by load. At the time the CAISO conducts the congestion revenue rights market the actual transmission that will be available in the day-ahead market is uncertain. As the transmission system changes between the congestion revenue rights market and the day-ahead market, the uncertainty results in congestion revenue rights revenue inadequacy because CAISO pays each congestion revenue right for its full awarded quantity even if the day-ahead transmission system no longer supports those schedules. The CAISO charges an uplift to load when day-ahead market congestion revenues are insufficient to cover payments to congestion revenue rights holders.

As described earlier, although these day-ahead market congestion revenue shortfalls are different than auction revenue shortfalls, the two items are related. Day-ahead market congestion revenue shortfalls are caused by modeling differences between the congestion revenue right auction and the day-ahead market models. These modeling differences result in day-ahead market congestion that cannot be priced into the auction because a constraint causing congestion in the day-ahead market was not in the auction model. Eliminating day-ahead market congestion revenue shortfalls will bring payments to congestion revenue rights more in line with the conditions modeled and priced in the congestion revenue right auction.

Under full funding, a congestion revenue right holder that has measured demand can receive a net lower payment than another market participant that holds an identical congestion revenue right but does not have measured demand because the ISO allocates revenue shortfalls to measured demand.

The congestion revenue rights uplift allocation maintains full funding of congestion revenue rights; each congestion revenue right is paid for its full megawatt value. This allocation method transfers the cost of all congestion revenue rights holders' underfunded congestion revenue rights to congestion revenue rights holders who have measured demand even though measured demand may have little to no control over the causes of the shortfall.

Full funding of congestion revenue rights creates incentives that exacerbate congestion revenue right revenue inadequacy and auction revenue shortfalls. For example, market participants can bid to obtain low-priced congestion revenue rights in the auction with the strategy that these congestion revenue rights will have high payouts if a constraint not modeled in the auction turns out to be enforced in the day-ahead markets. Allocating this revenue shortfall directly back to congestion revenue rights rather than to load would reduce these incentives.

Congestion revenue rights payment shortfalls occur due to a particular constraint when the congestion revenue right auction releases more capacity over that constraint than is

actually available in the day-ahead market. When this occurs, congestion revenue rights that have flows over the constraint are paid based on more transmission capacity over the constraint than is available for day-ahead market flows, which generate congestion revenues to pay the congestion revenue rights. Thus, there is not enough revenue to pay the congestion revenue rights.

The diagram below illustrates that the day-ahead market only collects congestion revenues on the day-ahead market scheduled flow on each constraint, while the congestion revenue rights receive payment on the total quantity of congestion revenue rights flow on the same constraint. The difference between the two is the congestion revenue shortfall.

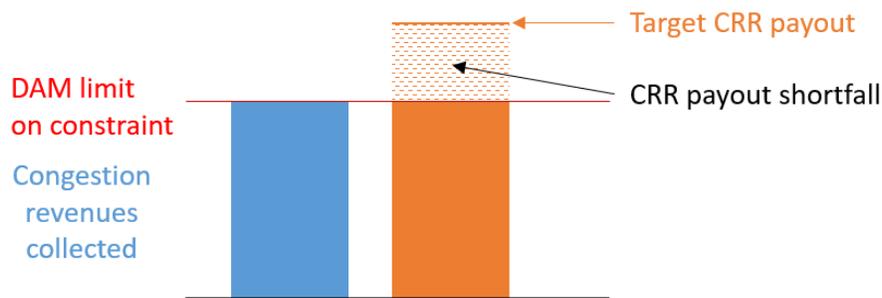


Figure 4: Congestion revenue shortfall between day-ahead market congestion revenues and congestion revenue rights payments per constraint

When there is a total congestion revenue rights shortfall the CAISO allocates the shortfall cost to load.

All potential revenue shortfall allocation approaches fall into two categories: ex-ante versus ex-post. Ex-ante approaches reduce congestion revenue rights prior to running the day-ahead market using the most recent day-ahead market transmission system models. Ex-post approaches de-rate payments made to congestion revenue rights holders after the day-ahead market through the final congestion revenue rights settlements process. All of these approaches have the advantage of more equitable congestion revenue rights between market participants with measured demand and those without. They all also reduce incentives for bidding to exploit model differences between the congestion revenue rights auctions and the day-ahead markets.

An advantage of reducing congestion revenue rights prior to the day-ahead market is that it affords market participants the opportunity to adjust their bi-lateral positions prior to the day-ahead market or change their participation in the day-ahead market to be consistent with their supply delivery hedge. A specific ex-ante approach described in **Section 6.3.2** would also provide an incentive for auction participants to continue to offer to purchase congestion revenue rights at higher prices than they otherwise would under other revenue sufficient funding approaches. However, ex-ante approaches require a higher implementation effort.

On the other hand, an advantage of reducing congestion revenue rights payments after the day-ahead market is that the final settlement will be based on the exact model that was used in the day-ahead market. However, the ex-post approaches have a some potential disadvantages: (1) market participants may have an incentive to bid lower in the auction than they otherwise would have because congestion revenue rights will be subject to unknown ex-post payment reductions, which may limit the effect on auction revenue shortfall, (2) market participants will not be able to adjust their bi-lateral positions prior to the day-ahead market, and (3) market participants will not be able to change their participation in the day-ahead market to be consistent with their supply delivery hedge. The ex-post approaches require a lower implementation effort, and some have been implemented by ISO/RTOs in the United States. The CAISO proposes the most desirable ex-post revenue sufficient funding approach in **Section 6.2.1**.

Of the revenue sufficient funding approaches considered, the CAISO believes **reducing congestion revenue rights quantities each day prior to the day-ahead market** is likely the best option, at least in the long-term. However it may take much more time to develop and implement appropriate policies than available in the Track 1B schedule. Of the alternatives, this approach likely provides market participants the most incentive to not reduce their bids for congestion revenue rights in the auction, relative to full funding, given the risk of having their congestion revenue rights only partially funded. This is because it would result in payment reductions to the lowest priced congestion revenue rights.

This alternative also affords market participants the capability to adjust their bi-lateral positions prior to the day-ahead market or change their participation in the day-ahead market to be consistent with their supply delivery hedge.

Other partial funding options likely have the risk that that market participants will reduce their congestion revenue rights bids, relative to if the CAISO paid the full day-ahead value of the congestion revenue rights, resulting in lower auction revenue and potentially limiting the reduction in auction revenue shortfall. However, as described in the following sections, one ex-post approach described in **Section 6.2.1** likely limits this incentive and may be particularly effective at eliminating incentives to exploit model differences between the congestion revenue rights market and the day-ahead market, thereby eliminating bidding for low-priced high-payout paths.

As an alternative to equitably allocating congestion revenue shortfalls among all congestion revenue rights holders and eliminating incentives to exploit transmission system differences between the congestion revenue rights market and the day-ahead market, Southern California Edison (SCE) proposed that CAISO eliminate releasing available transmission system capacity in the auction. This approach is described in **Section 6.3.3**.

6.2 Proposal

6.2.1 Reduce congestion revenue rights payments based on effectiveness on constraints

As described in this section, the CAISO proposes to reduce congestion revenue rights payments based on each congestion revenue right's flow over constraints generating congestion revenue rights payment shortfalls. This will ensure that the CAISO does not pay congestion revenue rights more than it collects in day-ahead market congestion revenue.

As described above, congestion revenue rights payment shortfalls occur due to particular constraints when the congestion revenue right auction releases more capacity over that constraint than is actually available in the day-ahead market. Revenue adequacy could be maintained by reducing the payments to congestion revenue rights on a constraint by constraint and hour by hour basis so that the congestion revenue rights settled flows are not greater than the day-ahead market settled flows.

Allocating congestion revenue rights payment shortfall costs by constraint back to the congestion revenue rights in proportion to their flows over each constraint has the equivalent effect on congestion revenue rights revenue imbalances as dynamically de-rating the congestion revenue rights.¹¹ This allocation method has similarities to methods employed at other ISO/RTOs. The PJM¹² and MISO¹³ markets allocate congestion revenue rights payment shortfall costs back to congestion revenue rights holders at an aggregated level. The NYISO allocates imbalance costs due to transmission capacity reductions on a constraint by constraint basis to transmission owners responsible for the outages.¹⁴

¹¹ This method is also described in Oren, Shmuel "Derating CRRs" November 25th, 2003 Public Utility Commission of Texas Workshop and also in Oren, Shmuel S. "Point to Point Flow-based Financial Transmission Rights: Revenue Adequacy and Performance Incentives" Chapter 3 of Financial Transmission Rights: Analysis, Experience and Prospects 2013 Rosellón, Juan and Tarjei Kristiansen Editors

¹² See Section 8 of the PJM Manual 06 "Financial Transmission Rights" Revision 15 October 10, 2013 available at: <http://www.pjm.com/~media/documents/manuals/m06.ashx>. Note that there is a difference in that Oren outlines de-rating CRRs to constraint limits where here the de-rate is down to settled DAM flows.

¹³ See Section 2.9.3 of the MISO Business Practice Manual "BPM 005 – Market Settlements" June 12, 2014 available at: <https://www.misoenergy.org/Library/BusinessPracticesManuals/Pages/BusinessPracticesManuals.aspx>.

¹⁴ Harvey, Scott M. "Shortfall Allocation Methodology" 2005 available at http://www.nyiso.com/public/webdocs/committees/bic_spwg/meeting_materials/2005-02-18/shortfall_alloc_whitepaper_revised_21505_clean.pdf. Alternatively see the LECG "NYISO Congestion Reduction Proposal" 2003 NYISO Market Structures Working Group http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_mswg/meeting_materials/2003-05-01/crtf_presentation_rev.pdf http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_mswg/meeting_materials/2003-05-01/dam_congestion_reductionProposal_Rev8.pdf

The *Congestion Revenue Rights Auction Analysis Report* showed that auction revenue shortfalls are caused by congestion revenue rights that (1) have low prices in the auction and (2) have high payouts relative to their prices because the congestion revenue right auction did not accurately model day-ahead market conditions, due to unforeseen transmission facility outages and outages lasting less than 24 hours.

Track 1A of this initiative addressed low auction prices with changes intended to make the auction more competitive through concentrated bidding activity by restricting eligible node pairs in the auction. Track 1A also partially addressed unforeseen transmission outages by requiring additional outage information prior to the annual congestion revenue right allocation and auction process.

This Track 1B proposal further addresses high payouts to congestion revenue rights that are due to modeling differences between the auction and the day-ahead markets. It does this by reducing congestion revenue right payments to not exceed the congestion revenue collected in each day-ahead market. The CAISO proposes to change the congestion revenue shortfall uplift allocation to equitably allocate shortfalls among congestion revenue rights and eliminate incentives to bid for low-priced high-payout paths. This change will also appropriately allocate congestion revenue shortfalls among congestion revenue rights for short duration outages, which would otherwise be inefficient to include in the auction model.

It is impossible to predict and adjust the congestion revenue rights market model for every possible unknown outage situation. A targeted reduction of congestion revenue rights payouts on a constraint by constraint basis ensures congestion revenue shortfalls due to unforeseen outages will not drive a large payout obligation to load. Instead, congestion revenue rights would share in the shortfall commensurate with their flows over constraints in the day-ahead market.

This approach also addresses modeling transmission outages in the annual congestion revenue right auction that span less than a season or modeling outages in the monthly auction that do not span an entire month. For instance, it may be inefficient to model transmission equipment outages that last a single day because the congestion revenue rights market lacks the daily granularity required to accurately model this outage situation. If the congestion revenue rights market had the capability to accurately release hourly granularity congestion revenue rights, it would ensure that the volume of congestion revenue rights released would be no more than the available transmission capacity and thus ensure no congestion revenue shortfall. A targeted reduction of congestion revenue rights payouts on a constraint by constraint basis has the same net effect as if the congestion revenue rights auction released available transmission capacity daily or hourly. Put another way, congestion revenue rights would still receive congestion payments for the portion of transmission capacity that is actually available in the day-ahead market.

One may think that the CAISO must simply model the transmission line as out-of-service in its auction model to reduce overall transfer capability. For example, if a major

transmission line is scheduled to be out for a single day, the CAISO could model that line as out for the entire month for the CRR auction. However, auction participants may engage in different strategies that specifically profit from the model difference regardless of whether the CAISO chooses to model the transmission line as in-service or out-of-service. Dr. Scott Harvey explains that “[t]he valuation problem cannot be corrected simply by modeling all outages during the month in the auction. Not only would such a modeling change greatly overstate the actual reduction in transfer capability due to outages, it would enable a converse strategy of buying counter-flow congestion revenue rights that would have high prices in the auction when the outage is modeled, but require minimal congestion revenue rights payments in the day-ahead market when the outage is not modeled.”¹⁵ A targeted reduction of congestion revenue rights payouts on a constraint by constraint basis removes any incentive to engage in this practice. Congestion revenue rights are still compensated for the portion of the transmission that is still available for day-ahead schedules. For instance, the CAISO observed its proposed shortfall allocation methodology on the January 2017 “crosstrip” constraint that generated \$6.48M of revenue insufficiency. The CAISO found that 59% of shortfalls allocated to auctioned congestion revenue rights would have been charged to congestion revenue rights purchased for less than \$0.10 per MWh.

Today, load pays all congestion revenue shortfalls generated by congestion revenue rights held by all categories of market participants. A targeted reduction of congestion revenue rights payouts on a constraint by constraint basis is equitable among all categories of market participants because each congestion revenue rights holder pays shortfalls associated with their own congestion revenue rights. Congestion revenue rights are still compensated for the portion of the transmission that is still available for day-ahead schedules. On the same January 2017 “crosstrip” constraint mentioned above, the CAISO found that load-serving entities with allocated congestion revenue rights would bear 60% of the total revenue insufficiency instead of the effective 100% that they bear today.

A targeted reduction of congestion revenue rights payouts on a constraint by constraint basis is not only equitable among all congestion revenue rights holders, it is equitable among the various load-serving entities holding allocated rights. For instance, if a binding constraint in northern California collects much less revenue than required to pay congestion revenue rights holders whose congestion revenue rights are effective on the constraint, it will be those holders that bear the commensurate portion of the congestion revenue shortfall. The CAISO would not require load-serving entities in southern California with congestion revenue rights that are not effective on the binding constraint to cover the associated congestion revenue shortfall.

Instances in which a constraint is over-subscribed by congestion revenue rights in the prevailing flow direction lead to revenue inadequacy on those constraints. The CAISO originally proposed a symmetric shortfall allocation approach in which it would reduce both (1) the day-ahead payment to congestion revenue rights in the prevailing flow

¹⁵ See [http://www.caiso.com/Documents/Presentation-CongestionRevenueRightsAuction Efficiency-HarveyApr5_2018.pdf](http://www.caiso.com/Documents/Presentation-CongestionRevenueRightsAuction%20Efficiency-HarveyApr5_2018.pdf).

direction and, (2) the payment received from counter-flow congestion revenue rights. The CAISO has reconsidered this approach, and now proposes to only reduce the payment to congestion revenue rights in the prevailing flow direction in the event of an over-subscribed constraint. This is more consistent with the design of the simultaneous feasibility test, minimizes total shortfall revenue requirements, and reduces the potential for lower auction revenues.

The shortfall allocation approach should align with the simultaneous feasibility test design. Under a simultaneous feasibility test, flows over a congested constraint are only reduced in the prevailing flow direction as counter-flows enable the net prevailing flow to be reduced to the amount of the constraint. For example, the simultaneous feasibility test used in the monthly auction would reduce only those congestion revenue rights flowing in the prevailing direction while potentially increasing the awards to counter-flow congestion revenue rights to resolve a congested constraint.

By not scaling counter-flow congestion revenue rights, which would have reduced the payment received from them in the day-ahead market, the CAISO will also reduce total shortfall revenue requirements. Reducing payments received from counter-flow congestion revenue rights would have increased total shortfall requirements on constraints. The counter-flow congestion revenue rights payments do not have to be reduced to ensure revenue adequacy since the counter-flow congestion revenue rights do not contribute to over-subscription of the constraint. Reducing payments from counter-flow congestion revenue rights actually makes revenue insufficiency worse on the constraint by increasing the amount by which payments to positively valued congestion revenue rights must be reduced. This would not be an economically efficient de-rate.

By minimizing the total revenues required in shortfall allocations, the CAISO will reduce potential negative auction revenue impacts. As discussed in **Section 6.1**, any revenue adequacy provision will have the potential to reduce auction revenues as market participants anticipate lower payments and consequently bid less for congestion revenue rights. Minimizing the total shortfall allocation by only reducing payments to those congestion revenue rights contributing to the over-subscribed constraint in the prevailing direction will thus reduce the premiums market participants will put into their congestion revenue rights bids. The CAISO should collect higher auction revenues than under the previously proposed shortfall allocation system where it would have reduced the payment required from counter-flow congestion revenue rights in the day-ahead market.

The CAISO proposes to only distribute congestion revenues to the extent that it collected the requisite revenue on the constraint over the month. It will determine hourly deficits per constraint and withhold payments to congestion revenue rights in ratio to each congestion revenue right settled flow on the constraint in the hour that the deficit occurred. Over the course of the month, the CAISO will allow surpluses collected on a constraint in one hour to offset shortfalls incurred on the same constraint in a different

hour. It will do this by first settling offsets across each 24 hour period, then by re-settling the offsets at the end of the month.¹⁶

The existing congestion revenue rights clawback rule, which measures the impact of virtual bids on transmission constraints that cause an increase to congestion revenue rights portfolio values, will continue to withhold payments to congestion revenue rights based on the same methodology it uses today. The revenue inadequacy shortfall allocation described in this proposal will consider the revenue inadequacy that remains on constraints after the existing clawbacks. This means that all congestion revenue rights flowing over constraints where clawbacks occur receive their proportion of an offending entity's clawback credit. Also, each congestion revenue right's proportion of the revenue inadequacy shortfalls and surpluses will be adjusted by the amount that the entity is charged for the existing clawback. For instance, the proportion becomes zero for congestion revenue rights that have had their full quantity rescinded using the existing clawback rule. Other entities' proportions on the constraint increase, but on the lower overall constraint shortfall or higher overall surplus.

Existing transmission rights and transmission ownership rights will continue to be settled as "perfect hedges." Constraint-specific shortfalls will not be allocated to these instruments. As it does today, the CAISO will continue to charge related uplifts to measured demand.

The CAISO describes the specific calculation methodology in the **Appendix**. The CAISO updated both the constraint flow difference equation ($CFD_{k,m,t}$) and the congestion revenue right's proportion of the congestion revenue right flow on the short constraint ($\alpha_{q,k,m,t}$) to only apply to the congestion revenue rights flowing in the direction of the over-subscribed constraint.

In summary, the CAISO proposes to modify the settlement of congestion revenue rights to equitably allocate congestion revenue shortfalls among all congestion revenue rights.

- The CAISO proposes to only reduce the payment to congestion revenue rights in the prevailing flow direction in the event of an over-subscribed constraint.
- The CAISO proposes to allow surpluses on one constraint in one hour to offset deficits on the same constraint in another hour over the course of the month. It will accomplish this by first allowing netting over each day then re-settling the congestion revenue rights at the end of the month allowing inter-day surpluses on one constraint in one day to offset deficits on the same constraint in another day.

¹⁶ The CAISO proposes daily settlement of congestion revenue rights including offsets followed by a monthly re-settlement to minimize impacts on congestion revenue rights credit requirements. If it were to wait until the end of the month to collect all net deficits per constraint, it may need to re-evaluate credit requirements.

- The CAISO proposes to only distribute surpluses to congestion revenue rights if the surplus is collected on a constraint that the congestion revenue right accrued a deficit, and only up to the full target payment value of the congestion revenue right. Surplus revenues that the CAISO pays to congestion revenue rights will not exceed the full target payment value of the congestion revenue right.
- The CAISO proposes to distribute remaining surplus revenue at the end of the month, which are associated with constraints that collect more surplus over the month than deficits, to measured demand.

6.3 Alternatives considered

This section summarizes two alternatives the CAISO considered but for various reasons decided not to propose.

6.3.1 Lower the percentage of system capacity available in the annual allocation and auction

Annually, the CAISO operates a long-term congestion revenue right allocation where it releases 60% of system capacity to load serving entities for 10 year terms beginning in the following calendar year. Also annually, the CAISO operates an allocation and auction where it releases 75% of system capacity for the following calendar year.

The *Congestion Revenue Rights Auction Efficiency Analysis Report* shows a significant amount of congestion revenue rights auction revenue shortfall associated with congestion revenue rights auctioned in the annual process. The data also shows that the introduction of new constraints due to new outage situations not known at the time of the annual allocation and auction process contributes to auction revenue shortfalls. As a more recent example, in February 2018 the Serrano constraint drove an auction revenue shortfall of over \$8 million. The CAISO paid 89% of the auction revenue shortfall to congestion revenue rights awarded in the annual congestion revenue rights auction.

The CAISO regularly releases congestion revenue rights in the annual process that later create flows that exceed day-ahead market constraints due to later outages and de-rates that create congestion revenue rights auction revenue shortfalls. A lower bound estimate, based on just monthly congestion revenue right infeasibilities, is that since 2014, the CAISO averaged 18,800 MW of such infeasibilities per year. Based on these historical realities, it is clear that not all of the 75% of system capacity available in the annual processes actually turns out to be available.

The CAISO reviewed the total system capacity released as congestion revenue rights by other ISO/RTOs in a timeframe covering from four months after their annual congestion revenue right process to 16 months after their annual process. The CAISO reviewed this window of time to find approximately how much system capacity has been released in other markets in a similar timeframe to its own annual process. For instance, as of the timeframe of the CAISO's annual allocation and auction process time, CAISO releases congestion revenue rights for 75% of system capacity in the following calendar year (the time period covering four months after the annual process to 16 months after the annual process). Southwest Power Pool releases financial transmission rights for 60% of system capacity for the time period covering 4 months after its annual process to 12 months after its annual process and for 0% of system capacity after that. ERCOT releases financial transmission rights for 40-55% of system capacity and ISO-NE releases financial transmission rights for 50% of system capacity.

The CAISO should only release congestion revenue rights in its annual allocation and auction process for transmission capacity reasonably expected to be available. Given that outages of equipment after the annual process lead to congestion revenue rights auction revenue shortfalls, the CAISO re-evaluated the current level of system capacity it releases in the long-term and annual processes.

By lowering the percentage of transmission system capacity for which the CAISO releases congestion revenue rights in the annual allocation and auction process, the quantity of congestion revenue rights released in the annual process would presumably decrease. This would shift the release of a greater portion of the congestion revenue rights the CAISO releases into the monthly processes. This should reduce the congestion revenue right auction revenue shortfall as the CAISO has more information about the ultimate state of the transmission system in the monthly process timeframe and can model the transmission ultimately available more accurately.

The CAISO evaluated the annual capacity release level at which a majority of monthly infeasibilities would have been prevented over a recent outage season (October 2017 through December 2017). After reducing the amount of system capacity released in the annual process by 10% to 65%, the CAISO observed a 57% reduction in infeasibilities.

Under this alternative, the CAISO would reduce the amount of system capacity it releases into its long-term and annual processes.

1. The CAISO would release congestion revenue rights for 60% of system capacity into the long-term allocation process going forward.
2. The CAISO would release congestion revenue rights for 65% of system capacity into the annual allocation and auction process going forward.
3. All previously allocated congestion revenue rights would still be honored.

The CAISO may further consider this alternative in this Track 1B if major policy development or implementation concerns arise with its current proposal.

6.3.2 Reduce congestion revenue rights quantities each day prior to the day-ahead market

The purpose of this approach is to shape congestion revenue rights to the hourly granularity of the day-ahead market, ensuring that the day-ahead market will collect sufficient congestion revenue to pay all adjusted congestion revenue rights.

Under this approach, the CAISO would reduce congestion revenue rights quantities prior to each day-ahead market using the most recent outage information available. The adjustment results in congestion revenue rights shaped to the hourly available transmission on the trade day. This ensures the congestion revenue rights will be revenue adequate as long as transmission is not further reduced after the adjustment run.

The adjustment keeps the highest value congestion revenue rights by re-running the simultaneous feasibility test using the monthly auction clearing prices as bids for each congestion revenue right and the most recent hourly day-ahead market models. The daily adjustment caps the congestion revenue rights at the previously awarded value to ensure no participant receives adjustments that increase its final awarded value. The ISO settles the adjusted congestion revenue rights hourly.

The CAISO would also include allocated congestion revenue rights in this adjustment process, inserting bids for them at the monthly market clearing price. This would ensure allocated congestion revenue rights would be valued equitably among all congestion revenue rights.

Revenue surpluses or shortfalls that arise due to the difference in the model from the time the CAISO runs the congestion revenue rights adjustment process (the day prior to the day-ahead market) to the time the CAISO runs the day-ahead market would be shared among load-serving entities in the same method used today.

As a variation, this proposal could volumetrically reduce congestion revenue rights per time-of-use or per day instead of hourly.

Using monthly clearing prices as bid-values to adjust only the lowest value congestion revenue rights is advantageous because it counterbalances the incentive market participants might have to bid lower under a partial payment approach relative to without a partial payment approach. The approach ensures that the congestion revenue rights with the lowest market value will be reduced first, making it more likely that market participants will not reduce bids for higher valued congestion revenue rights. While market participants may have an incentive to reduce bids for lower valued congestion revenue rights, many of these are the congestion revenue rights that have very high payouts relative to auction price. Thus, the likelihood that these lower bids would add to auction revenue shortfall is diminished.

This approach also has the advantage that market participants would be able to adjust their bilateral positions prior to the day-ahead market or change their participation in the day-ahead market to be consistent with their congestion revenue right supply delivery hedge.

While the CAISO views this approach as likely the best option, at least in the long-term, it may take much more time to develop and implement policies than available in the Track 1B schedule. It may consider this proposal or a variation of this proposal in Track 2.

6.3.3 Eliminating release of available transmission system capacity in the auction

Southern California Edison (SCE) proposed that CAISO maintain its auction structure but set auction limits for all transmission constraints to zero. Under this approach, auction bids would only clear to the extent that bids from other market participants create an equal but opposite counter-flow. This would result in congestion revenue right payments due to day-ahead market congestion to each auctioned congestion revenue right being equally offset by charges collected from the offsetting congestion revenue right.

SCE's proposal would not change the allocation process in which only load-serving entities nominate congestion revenue rights on available transmission capacity. SCE's proposal would allow auctioned congestion revenue rights to source from any location on the transmission system and sink to any other location on the transmission system.

Some stakeholders support the SCE proposal but a number of other stakeholders raised technical, competitive, and legal/regulatory concerns with the SCE proposal.

One issue discussed at the April 10, 2018 working group is that it may be extremely rare for auction participants to bid at perfectly opposite locations on the 1,100 node transmission system resulting in stranded counterparties. Indeed, there are over 1.2M permutations of source and sink pairs in the CAISO transmission system. One auction participant may bid for a congestion revenue right from location A1 to location B, while another participant may bid for a congestion revenue right from location B to location A2. Location A2 may be electrically close to A1 and therefore may have very similar energy prices. However, neither of these bids would clear in auction. During the April 5, 2018 Market Surveillance Committee meeting, Drs. Ben Hobbs and Jim Bushnell discussed these technical difficulties with proposals that force counterparties to transact at equal and opposite locations on a 1,100 node transmission system. By using the transmission model and available transmission capacity today, auction participants rarely worry about being a stranded counterparty.

SCE admits that some supplemental methods may need to be developed to minimize stranded counterparties. It proposes a bulletin board with either binding or indicative

public offers prior to the congestion revenue rights auction, multi-stage auctions to reveal interested sources and sinks, or creating an exchange where bids and offers could be matched as they occur during specific windows of time. If the CAISO were to implement a bulletin board, it is not clear that participants would use it and to the extent that they do, it is not clear that it would support participation in the CAISO's congestion revenue rights auction. Bulletin board users may just decide to transact outside of the CAISO process, further reducing the transaction volumes in the auction. Bulletin board users also may wish to remain anonymous as to not negatively impact their negotiation positions. Transparent multi-stage auctions and exchanges are an improvement over a bulletin board in mitigating the stranded counterparty issue, however many major policy decisions remain and it is not clear whether these methods would be better than the current congestion revenue rights auction using available transmission capability.

The ISO views a potential bulletin board as inferior to today's process which efficiently connects market participants anonymously in a single auction. Where the CAISO relied on bulletin board options in the past, stakeholders have expressed the view that it was ineffective. Finally, it would take much more time to develop and implement multi-stage auctions or exchange policies than available in the Track 1B schedule.

Flynn Resource Consultants presented another alternative to resolve the stranded counterparty issue whereby the CAISO would issue counter-flow congestion revenue rights to market participants that indicate they would be willing to receive a counter-flow congestion revenue right between other locations if required to match their primary congestion revenue right bids. The CAISO uses a similar method in its allocation process to match counterparties at the trading hubs today. This method would require an auction participant to be willing to potentially receive an unknown secondary counter-flow congestion revenue right while wishing to purchase rights on a specific primary path on the system. It is not clear that any auction participant would actually be willing to take on the unknown counter-flow, and if they were willing to take on counter-flow in order for their primary congestion revenue right to clear, they would be able to do it in a more targeted way by actually bidding for specific counter-flows in the auction.

At the working group on April 10, 2018, it was clear that there is a divide between utility load-serving entities and some smaller load-serving entities and load-serving entities serving direct access customers. In general, the smaller load-serving entities express concern that they would be adversely impacted by the SCE proposal because it would limit flexibility in hedging congestion risks and would prevent suppliers from obtaining congestion revenue rights that sink at trading hubs, which is where many non-utility load serving entities transact.

Based on comments submitted, the SCE proposal may increase transactional costs and reduce access to congestion revenue rights for non-utility load serving entities. Today, many non-utility load-serving entities participate in the auction to reconfigure allocated congestion revenue rights. To the extent that the allocation process is ineffective at delivering non-utility load-serving entities the supply delivery hedges needed, the cost to reconfigure those allocated congestion revenue rights or purchase new congestion

rights would rise under the SCE proposal because otherwise available transmission capacity would be removed from the auction process. The SCE proposal would likely not only raise the costs of these transactions for these smaller load-serving entities, but also may completely prevent them from acquiring otherwise available transmission capacity.

Other non-utility load-serving entities use the allocation process to procure congestion revenue rights from trading hubs to their load aggregation point. It is likely that these load-serving entities primarily contract for energy delivery to the trading hub. Supply counterparties, who can only purchase congestion revenue rights in the auction, would face increased costs to hedge supply delivery to the trading hubs if the CAISO eliminated available transmission capacity in the auction process. Those suppliers would likely pass these increased costs on to the non-utility load-serving entity.

The current market design, which releases congestion revenue rights on available transmission through a combination of allocation and auction procedures, ensures that all market participants, and in particular all load serving entities and their counterparties have an opportunity to obtain hedges for congestion cost risks associated with supply delivery transactions. To avoid such adverse consequences, the SCE proposal cannot be considered without careful consideration of whether the existing allocation rules and structure would also need to change.

SCE's proposal under which congestion revenue rights would only clear in the auction to the extent that there are opposite bids could also add additional costs to hedging supply delivery through congestion revenue rights. As described in the CAISO Market Surveillance Committee Opinion on the ISO's Phase 1A proposal:

However, congestion revenues, like locational prices, fluctuate with market and network conditions, at times in unpredictable ways. The congestion revenues collected by ISOs therefore constitute an uncertain, or "risk creating," revenue stream. The market participants paying those congestion prices face the opposite risk position. Importantly, when a CRR, which pays the price difference (or congestion cost) between two locations, is transferred from the CAISO to a market participant that will using the network in those locations, both sides reduce their risk exposure to congestion costs. In other words, when distributed to firms using them as hedging instruments, CRRs reduce risk for both sides and constitute an efficient allocation of risk, particularly when the parties involved are risk averse. The significance of this efficiency benefit will depend upon how risk averse the parties are, and the degree to which annual and monthly CRRs help to reduce those risks.

The ISO, or indirectly the ratepayers who are residual claimants to congestion revenues, are therefore in a unique position to provide CRRs to market participants. They are the natural counter-parties since they have the opposite revenue stream. The DMM [and SCE] has argued that financial firms or other third parties could provide CRRs to those who need them, but these firms would

be taking on risk, rather than shedding it, to do so. The costs to the CRR holder would be higher, but it is hard to determine how much higher.¹⁷

Finally, SCE maintains that since load pays the transmission system cost, load is entitled to all day-ahead market congestion revenue. SCE proposes that auction bids should only clear to the extent that there are opposite bids because SCE believes “ISO-backed” congestion revenue rights have the potential to pay out more day-ahead market congestion payments than the congestion revenue rights sell for in the auction. SCE maintains that this undermines the CAISO’s ability to return all day-ahead market congestion revenue to load.

The FERC has rejected arguments that financial transmission rights such as congestion revenue rights should be designed to return all congestion revenues to load. In a recent order addressing financial transmission right cost-shifting issues in PJM, the FERC addressed arguments by the PJM Market Monitor and certain state commissions that the market rules governing PJM financial transmission rights (FTRs) should be redesigned to ensure loads receive all congestion revenues:

We reject the arguments that the sole purpose of FTRs is to return congestion revenue to load and the market should therefore be redesigned to accomplish that directive. FTRs were designed to serve as the financial equivalent of firm transmission service and play a key role in ensuring open access to firm transmission service by providing a congestion hedging function. The purpose of FTRs to serve as a congestion hedge has been well established.¹⁸

During the April 10, 2018 working group, market participants raised further regulatory concerns with the SCE proposal. Stakeholders argued that because the SCE proposal eliminates available transmission capacity in the auction, the clearing process effectively would not depend on the particulars of the transmission system. Some stakeholders opined that this may risk the CAISO’s U.S. Commodities Futures Trading Commission exemption.

Due to these technical, competitive, and legal/regulatory concerns, the CAISO does not propose to eliminate the release of available transmission system capacity in the auction.

7 Next Steps

Stakeholders should submit written comments by June 7, 2018 to InitiativeComments@caiso.com.

¹⁷ http://www.caiso.com/Documents/MSCFinalOpiniononCongestionRevenueRightsAuctionEfficiency-Mar15_2018.pdf, at P4

¹⁸ *PJM Interconnection, L.L.C.*, 158 FERC ¶ 61,093, at P 27 (2017).

Appendix

The CAISO proposes to only distribute congestion revenues to congestion revenue rights holders to the extent that it collected the requisite revenue on the constraint over the month. It will determine hourly deficits per constraint and withhold payments to congestion revenue rights in ratio to each congestion revenue right's settled flow on the constraint in the hour that the deficit occurred. Over the course of the month, the CAISO will allow surpluses collected on a constraint in one hour to offset shortfalls incurred on the same constraint in a different hour. It will do this by first settling offsets across each 24 hour period, then by re-settling the offsets at the end of the month.

The CAISO calculates an offset for each congestion revenue right per contingency case per monitored element per hour. This is a megawatt figure representing the portion of the constraint's deficit or surplus attributable to that congestion revenue right in that hour based on the congestion revenue right settled flow. The overall congestion revenue rights flow on the constraint is adjusted to account for portions that have been paid back using the existing congestion revenue rights clawback rule.

$$OffsetMW_{q,k,m,t} = \alpha_{q,k,m,t} \times \left[\sum_{n=0}^N SF_{n,k,m,t} \cdot IFMMW_{n,t} - \sum_{q=0}^Q \{CRRMW_q(SF_{q,k,m,t}^{src} - SF_{q,k,m,t}^{snk}) - CRRClawbackMW_{q,k,m,t}\} \right]$$

Where,

N	number of nodes on the system indexed by \mathbf{n}
Q	number of congestion revenue rights indexed by \mathbf{q}
K	number of preventive contingencies indexed by \mathbf{k} ¹⁹
M	number of monitored elements indexed by \mathbf{m} ²⁰
T	number of time intervals indexed by \mathbf{t}
$CRRMW_q$	megawatt capacity awarded to CRR_q
SF	day ahead market shift factor
$SF_{q,k,m,t}^{src}$	day ahead shift factor from CRR_q source location to constraint \mathbf{k}, \mathbf{m} in time interval \mathbf{t}
$SF_{q,k,m,t}^{snk}$	day ahead shift factor from CRR_q sink location to constraint \mathbf{k}, \mathbf{m} in time interval \mathbf{t}
$IFMMW_{n,t}$	net megawatt injection ²¹ at node \mathbf{n} in time interval \mathbf{t} of the integrated forward market
$\alpha_{q,k,m,t}$	CRR_q 's proportion of the prevailing flow on constraint \mathbf{k}, \mathbf{m} in time interval \mathbf{t}
$CRRClawbackMW_{q,k,m,t}$	megawatt representation of revenue clawback on CRR_q on constraint \mathbf{k}, \mathbf{m} in time interval \mathbf{t}

Simplify the notation to the product of two terms: congestion revenue right q 's **portion of congestion revenue right settled flow** ($\alpha_{q,k,m,t}$) and the day-ahead market **constraint flow difference** ($CFD_{k,m,t}$). Alpha will be positive if the congestion revenue right flows in the prevailing direction and zero if the congestion revenue right flows in the counter-flow direction. The constraint flow difference will be positive if the constraint generates a surplus and negative if the constraint generates a shortfall.

$$OffsetMW_{q,k,m,t} = \alpha_{q,k,m,t} \times CFD_{k,m,t}$$

Where,

$$\alpha_{q,k,m,t} = \begin{cases} 0, & CRRMW_q \times (SF_{q,k,m,t}^{src} - SF_{q,k,m,t}^{snk}) \leq 0 \\ \frac{CRRMW_q \times (SF_{q,k,m,t}^{src} - SF_{q,k,m,t}^{snk}) - CRRClawbackMW_{q,k,m,t}}{\sum_{q=0}^Q \max[0, CRRMW_q \times (SF_{q,k,m,t}^{src} - SF_{q,k,m,t}^{snk}) - CRRClawbackMW_{q,k,m,t}]}, & \text{otherwise} \end{cases}$$

And

$$CFD_{k,m,t} = \sum_{n=0}^N SF_{n,k,m,t} \cdot IFMMW_{n,k,m,t} - \sum_{q=0}^Q CRRMW_q (SF_{q,k,m,t}^{src} - SF_{q,k,m,t}^{snk}) - CRRClawbackMW_{q,k,m,t}$$

And

$$CRRClawbackMW_{q,k,m,t} = \frac{CRRClawbackRevenue_{q,k,m,t}}{\mu_{k,m,t}}$$

The $CRRClawbackRevenue_{q,k,m,t}$ is an output of the existing clawback rule and therefore a known value per congestion revenue right per constraint per time interval.

¹⁹ Consistent with its previously approved contingency modeling enhancements policy proposals, congestion revenue rights will only be settled using the preventive constraints. The CAISO will not settle congestion accrued on preventive-corrective constraints to congestion revenue rights.

²⁰ The monitored element is oriented in the direction of the $IFMMW_{n,t}$ flow, so the $IFMMW_{n,t}$ flow is always positive.

²¹ $IFMMW$ includes ETC/TOR injections and withdrawals

A known portion of each congestion revenue right flows on the constraint each hour.

$$CRRMW_{q,k,m,t} = CRRMW_q \times (SF_{q,k,m,t}^{src} - SF_{q,k,m,t}^{snk})$$

The CAISO calculates a dollar figure for the offset ($OffsetRevenue_{q,k,m,t}$) and a dollar figure for the portion of congestion revenue right flowing on the constraint each hour ($TargetCRRRevenue_{q,k,m,t}$).

$$\begin{aligned} OffsetRevenue_{q,k,m,t} &= OffsetMW_{q,k,m,t} \times \mu_{k,m,t} \\ TargetCRRRevenue_{q,k,m,t} &= CRRMW_{q,k,m,t} \times \mu_{k,m,t} \end{aligned}$$

Daily Settlement

For each congestion revenue right, the CAISO calculates a daily dollar figure for the offset, a daily dollar figure for the target congestion revenue right revenue allowing positive and negative revenues per constraint to offset each other over the day, and a daily dollar figure for the congestion revenue right revenues withhold under the existing clawback rule.

$$\begin{aligned} DailyOffsetRevenue_{q,k,m,d} &= \sum_{t=1}^T OffsetRevenue_{q,k,m,t} \\ DailyTargetCRRRevenue_{q,k,m,d} &= \sum_{t=1}^T TargetCRRRevenue_{q,k,m,t} \\ DailyCRRClawbackRevenue_{q,k,m,d} &= \sum_{t=1}^T CRRClawbackRevenue_{q,k,m,t} \end{aligned}$$

If the daily target congestion revenue right revenue associated with a particular constraint is positive, meaning flows on are in the prevailing direction, the CAISO will add the negative daily offset revenue associated with that constraint and add the positive daily offset revenue associated with that constraint to the Daily Remainder Account.

$$\begin{aligned} DailyCRRPayment_{q,k,m,d} &= DailyTargetCRRRevenue_{q,k,m,d} \\ &\quad - DailyCRRClawbackRevenue_{q,k,m,d} \\ &\quad + \min(0, DailyOffsetRevenue_{q,k,m,d}) \\ DailyRemainder_{q,k,m,d} &= \max(0, DailyOffsetRevenue_{q,k,m,d}) \end{aligned}$$

At the end of each day, the CAISO will settle each congestion revenue right over all constraints.

$$DailyCRRPayment_{q,d} = \sum_{k=0}^K \sum_{m=0}^M DailyCRRPayment_{q,k,m,d}$$

Monthly re-settlement

At the end of the month, the CAISO will reverse the daily congestion revenue right settlement, and repeat the above calculations netting $DailyOffsetRevenue_{q,k,m}$ and $DailyTargetCRRRevenue_{q,k,m}$ over the entire month as follows:

$$MonthlyOffsetRevenue_{q,k,m} = \sum_{d=1}^D DailyOffsetRevenue_{q,k,m,d}$$

$$MonthlyTargetCRRRevenue_{q,k,m} = \sum_{d=1}^D DailyTargetCRRRevenue_{q,k,m,d}$$

$$MonthlyCRRClawbackRevenue_{q,k,m} = \sum_{d=1}^D DailyCRRClawbackRevenue_{q,k,m,d}$$

$$MonthlyCRRPayment_{q,k,m} = MonthlyTargetCRRRevenue_{q,k,m} - MonthlyCRRClawbackRevenue_{q,k,m} + \min(0, MonthlyOffsetRevenue_{q,k,m})$$

$$MonthlyRemainder_{q,k,m} = \max(0, MonthlyOffsetRevenue_{q,k,m})$$

The CAISO will then settle each congestion revenue right over all constraints ($MonthlyCRRPayment_q$) and the remainder is paid to measured demand.

$$MonthlyCRRPayment_q = \sum_{k=0}^K \sum_{m=0}^M MonthlyCRRPayment_{q,k,m}$$

$$MonthlyRemainder_q = \sum_{k=0}^K \sum_{m=0}^M MonthlyRemainder_{q,k,m}$$

Existing Transmission Rights and Transmission Ownership Rights settlement

Existing transmission rights and transmission ownership rights will continue to be settled as “perfect hedges.” Constraint-specific shortfalls will not be allocated to these instruments. As it does today, the CAISO will continue to charge related uplifts to measured demand.