October 1, 2018

The Honorable Kimberly D. Bose
Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

Re: California Independent System Operator Corporation
Docket No. ER18-____-000

Tariff Amendment to Eliminate Full Funding of Congestion Revenue Rights

Request for Expedited Treatment Pursuant to Commission Guidance Order

Dear Secretary Bose:

The California Independent System Operator Corporation (CAISO) proposes tariff revisions to pay Congestion Revenue Rights (CRR) holders for their CRR entitlements only to the extent the CAISO collects sufficient revenue through day-ahead market congestion charges and CRR charges.[1] Today, the CAISO guarantees full funding of CRRs it releases by allocating the cost of funding congestion revenue insufficiency to metered demand and exports. Going forward, the CAISO proposes no longer to provide full funding of released CRRs and instead to allocate any day-ahead revenue insufficiency to CRR holders on a constraint-by-constraint basis by scaling their CRR entitlement based on the CRR holder's net modeled (or implied)[2] flow over a particular constraint in the direction of the congestion.

The Commission recently rejected an earlier CAISO proposal to eliminate the guarantee of full funding of CRRs without prejudice to the CAISO refiling the proposal with certain modifications identified by the Commission.[3] Consistent

[1] The CAISO submits this filing pursuant to section 205 of the Federal Power Act, 16 U.S.C. § 824d, and Part 35 of the Commission's Regulations, 18 C.F.R. Part 35.

[2] The terms implied flow or modeled flow are used interchangeably to describe the flow the CAISO models in the CRR settlement process that a CRR places on the constraints in the day-ahead market.

[3] *California Indep. Sys. Operator Corp.*, 164 FERC ¶ 61,209 (2018) (September 20 Order).

with the Commission's September 20 Order, the CAISO is refiling a modified version of that prior proposal that now "allows CRR holders to consistently net prevailing and counterflow CRRs against each other as in other ISO and RTO markets."[4]

The CAISO requests expedited consideration of the proposed amendment under the procedures described in the Commission's Guidance Order on Expedited Tariff Revisions for Regional Transmission Organizations and Independent System Operators.[5] The CAISO's CRR markets continue to face the risk that the CAISO will collect insufficient funds based on day-ahead congestion revenues to cover CRR entitlements issued through the annual and monthly CRR allocations and auctions.

The CAISO respectfully requests that the Commission act on an expedited basis. Because the Commission already has an extensive record on the issues raised by this filing, the CAISO requests that the Commission establish an expedited comment date on this filing of no later than October 11, 2018.[6] The CAISO also requests that the Commission issue an order by November 9, 2018, that accepts the tariff revisions contained in this filing, to be effective on January 1, 2019. Commission approval on this expedited basis will ensure that market participants have certainty regarding how CRRs acquired through the 2019 annual auction will be settled prior to the November 13, 2018, deadline for submitting bids to that annual auction. A January 1, 2019, effective date also will enable the CAISO to implement the changes it proposes in time for CRRs that are for 2019 terms so that load serving entities will not bear the full burden of CRR revenue insufficiencies beyond 2018.

I. Executive Summary

CRRs are financial instruments the CAISO releases on a year-ahead and month-ahead basis through both allocation and auction processes. The CAISO allocates CRRs to load-serving entities at no cost and auctions CRRs to registered market participants based on cleared bids. The primary purpose of CRRs is to facilitate long-term contracting by load-serving entities and suppliers by permitting them to hedge congestion costs incurred in the day-ahead market.

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4 *Id.*

5 Guidance Order on Expedited Tariff Revisions for Regional Transmission Organizations and Independent System Operators, 111 FERC ¶ 61,009 (2005) ("Guidance Order").

6 The proposal in this amendment is substantially similar to the CAISO's proposal in FERC Docket No. ER18-2034-000, except for one modification to address the Commission's September 20 Order.

Today, the CAISO holds all CRRs it releases through the CRR allocation and auction processes as financially firm, and fully funds them even if the payments made to settle CRRs exceed revenue the CAISO collects from day-ahead market congestion and CRR auctions. The CAISO funds CRR revenue insufficiencies by charging load-serving entities and exports (*i.e.*, demand).

Ideally, the congestion revenue the CAISO collects in its day-ahead market would cover payments to CRR holders.[7] In recent years, however, congestion revenues collected from the CAISO's day-ahead market have been insufficient to fund entitlements issued through the CRR allocation and auction processes, and auction revenues collected from CRR holders in the CAISO's CRR auctions have been significantly lower than the corresponding day-ahead market congestion revenue. The CAISO analyzed the performance of the CRR auction and the degree of revenue insufficiency and on November 21, 2017, released an in-depth report on the issues that have plagued the CRR markets (CRR Auction Analysis Report).[8]

More recently, the CAISO continues to experience CRR revenue insufficiency, meaning the CAISO has had to pay more to CRR holders than it collected in day-ahead market congestion revenues. The shortfall for 2017 was approximately $100 million and in 2018, the year-up-to-date is approximately $30 million.

In addition to CRR day-ahead congestion revenue sufficiency, another measure of CRR market efficiency is CRR auction revenue shortfall, which is the difference between CRR auction revenues and day-ahead market payouts to holders of auctioned CRRs. CRR auction prices generally should reflect market participants' expectations of congestion price exposure in the day-ahead market because market participants should be willing to pay its expected congestion costs to protect itself against uncertain and volatile congestion costs.[9] The CAISO analyzed the CRR auction performance to identify the root causes of the disparity between auction prices and CRR payouts. This analysis showed that, since 2014, CRRs purchased at auction received $99.5 million per year more in CRR revenues from the day-ahead market than bidders paid for those CRRs in the auctions.

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7 Day-ahead market CRR revenue insufficiency results from the current market rules in which the CAISO makes day-ahead market payments to CRR holders for the full megawatt (MW) quantity of their CRRs awarded in the auction regardless of the amount of transmission that remains available in the day-ahead market.

8 The CAISO's CRR Auction Analysis Report is also available at http://www.caiso.com/Documents/CRRAuctionAnalysisReport.pdf, and is provided as Attachment C to this filing.

9 As adjusted by hedging value, risk premium, and/or time value of money.

To address the findings in its report, the CAISO filed a tariff amendment to address the CRR auction revenue shortfall. The CAISO intended that filing to be the first of two rounds of near-term changes to address the issues identified in the CAISO's CRR Auction Analysis Report. The Commission approved that filing in Docket No. ER18-1344-000 (Track 1A tariff changes).[10] The CAISO will implement these measures in time for the release of CRRs that have terms in 2019 and anticipates those changes will improve auction efficiency significantly.

After it completed the stakeholder process for the first round of measures, the CAISO turned its efforts to address other remaining issues highlighted in the CRR Auction Analysis Report. Most notably, this second round of near-term changes focused on how to address CRR revenue insufficiency in the day-ahead market.

Revenue insufficiency arises because the CAISO pays CRR holders in full even if a corresponding amount of power needed to generate the congestion revenue, which is in turn needed to pay the CRR holders, is not scheduled in the day-ahead market. The circumstances in which this can occur particularly include when the CAISO must enforce constraints in the day-ahead market that were not in the annual CRR process's model or when the CAISO must tighten a constraint in the day-ahead market. This occurs due to unexpected events such as transmission outages. A constraint enforced in the day-ahead market that was not enforced in the auction, or that is tightened in the day-ahead market, also results in higher congestion prices than were priced in the CRR auction.

Under the existing tariff, the CAISO collects day-ahead market congestion revenue, charges it makes to counterflow CRR holders, and CRR auction revenue in the CRR balancing account. The CAISO uses the CRR balancing account to pay positively valued CRRs. The CAISO then allocates total shortfalls and surpluses in the CRR balancing account to "measured demand," which is metered demand within the CAISO balancing authority area plus exports.[11] Measured demand effectively underwrites the risk of these condition changes because CRR holders are guaranteed payment of their CRR's full notional value (*i.e.*, the congestion price differential between CRR source and sink multiplied by the quantity of the CRR), even when a corresponding amount of power is not scheduled in the day-ahead market because of market model changes between the annual CRR process and the day-ahead market.

On July 17, 2018, the CAISO submitted a tariff amendment in Docket No. ER18-2034 (the July 17 Amendment) that would allow the CAISO to no longer

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10 *Cal. Indep. Sys. Operator Corp.*, 163 FERC ¶ 61,237 (2018).

11 "Load" consists of the devices of end-use customers. "Demand" is a measure of the power that a load receives or requires.

fully fund CRRs and instead allocate CRR revenue insufficiency to CRR holders. The CAISO proposed to scale CRR payments so that it would pay CRR holders for their CRRs only if day-ahead market congestion revenue and revenue from counterflow CRRs is sufficient to fund the payments. The CAISO also proposed to assign to CRR holders revenue shortfalls on a constraint-by-constraint basis *pro rata* based on the CRRs with implied flow over each constraint in the direction of congestion.

The Commission rejected the CAISO's partial funding proposal without prejudice to the CAISO refiling a partial funding proposal that allows CRR holders to consistently net prevailing and counterflow CRRs against each other.[12] Therefore, the CAISO is filing substantially the same proposal it submitted previously with the singular change that it now proposes to net the implied flows that all CRRs within a CRR holder's CRR portfolio have on a given constraint. This netting will occur regardless of whether the implied flows from the multiple CRRs are in the same direction or opposite directions. The CAISO would then assign to the netted MW quantity the revenue shortfalls *pro rata* on a constraint-by-constraint basis. This change will align the CAISO's methodology for allocation of CRR revenue insufficiency more closely with the approved methodologies for most other independent system operators (ISOs) and regional transmission organizations (RTOs), where congestion revenue shortfalls are allocated to the holders of financial transmission rights rather than uplifted to load. This change also specifically addresses the Commission's concern that the CAISO's prior proposal treated "prevailing and counterflow CRRs differently such that the holder of a prevailing flow CRR from A to B cannot offset that obligation by holding a CRR from B to A."[13]

The changes the CAISO proposes in this revised amendment will alleviate the current burden placed on load-serving entities for CRR revenue insufficiency, regardless of their CRR holdings' association with the insufficiency. As a result of these changes, demand no longer will be required to fund auctioned CRRs owned by other parties that later become infeasible. These changes will ensure CRR revenue sufficiency and align payments to CRR holders with the conditions modeled and priced in the day-ahead market.

The proposed changes will also more equitably allocate revenue shortfalls incurred in funding CRRs allocated among the various load-serving entities. For example, under today's design load-serving entities in the southern portion of the CAISO balancing authority area could have to pay for CRR revenue insufficiency due entirely to changes in system conditions in the northern portion of the balancing authority area. In addition, exports must contribute to the full funding

12 September 20 Order at P 53.

13 September 20 Order at P 51.

of CRRs even if the market participants that are scheduling such exports have no CRRs.

Although the CRR revenue insufficiency issue differs from the CRR auction revenue shortfall issue that was addressed in the Commission's order earlier this year accepting the CAISO's Track 1A tariff amendment, the two issues are related.[14] The CRR revenue insufficiency results when the CAISO models a more constrained electrical grid in the day-ahead market than what was modeled and priced in the CRR auction. When this occurs, CRR payouts will also likely exceed auction revenues. Thus, the changes proposed in this filing further address the CRR auction revenue shortfall issue.

Eliminating full funding of CRRs, however, also has the potential to reduce the amount market participants will pay for CRRs in the auction. If auction prices decrease significantly, the proposed change to the allocation methodology could increase CRR auction revenue shortfalls. This concern was in part addressed by the Commission's approval of the CAISO's proposal to reduce the capacity released in the annual CRR allocation and auction process to 65 percent of system capacity instead of 75 percent. This change reduces the likelihood that the partial funding approach will reduce payments to CRR holders because it increases the probability that CRRs released in the annual process will be feasible.

The CAISO also proposes to mitigate further any impact of the updated revenue insufficiency allocation approach on auction prices by netting congestion revenue shortfalls in particular hours with any congestion revenue surplus from other hours resulting from the same constraint over the same month. This will decrease the probability that a CRR will receive a net payment reduction over the course of the month.

The enhancements proposed in this filing will work in tandem with the tariff changes in Track 1A and Track 1B that address CRR auction shortfalls and the reduction of capacity released in the annual processes, respectively.[15] The Track 1A tariff changes are designed to improve efficiency of the CRR auctions by limiting eligible source and sink pairs to those associated with supply delivery transactions in the CAISO's day-ahead market and through the new outage reporting requirements that will allow the CAISO to improve the accuracy of the network model used for the annual CRR allocation and auction process. The enhancements proposed in this filing will align payments to CRR holders with the conditions modeled and priced in the day-ahead market.

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14 *Cal. Indep. Sys. Operator Corp.*, 163 FERC ¶ 61,237 (2018).

15 *Id.*

For the reasons explained in this filing, the CAISO respectfully requests that the Commission issue an order by November 9, 2018, accepting the proposed tariff revisions to be effective January 1, 2019.

II. Background

A. Overview of CRRs in the CAISO Markets

The CAISO wholesale market structure includes a day-ahead market and a real-time market. The Commission-approved rules for these markets call for the CAISO to minimize the cost of dispatching electricity to address customer needs while taking into account physical limitations in the transmission system. Congestion occurs when demand for transmission exceeds the available capacity. The CAISO manages transmission congestion through a locational marginal pricing design. Years of experience by the CAISO and other ISOs and RTOs shows that nodal markets employing locational marginal pricing are effective at achieving least-cost dispatch and sending efficient price signals. Because the transmission system operated by the CAISO comprises thousands of miles of transmission lines connecting hundreds of resources with the end-use customers consuming electric power, the CAISO settles energy prices in its markets at over 1,100 pricing modes.

CRRs are financial instruments that market participants can acquire through a CAISO-administered allocation and auction process.[16] All other ISOs and RTOs offer comparable financial transmission rights.

The primary purpose of CRRs is to hedge day-ahead market congestion costs. When transmission demand exceeds capacity, locational marginal prices vary depending on congestion levels. On an aggregate level, this typically results in supply locations having lower locational prices than load. Congestion charges can change dramatically based on system conditions and patterns of supply and demand. The sum of all the congestion charges in the market is referred to as the market's congestion revenue. As the Commission has recognized repeatedly, CRRs give market participants a level of financial protection against the risks associated with unpredictable congestion charges.[17]

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16 CRRs are primarily addressed in section 36 of the CAISO tariff and the business practice manual for CRRs. References in this transmittal letter to section numbers are references to sections of the CAISO tariff, as revised by this tariff amendment, unless otherwise stated.

17 *See, e.g.*, *Cal. Indep. Sys. Operator Corp.*, 149 FERC ¶ 61,093 at P 2 (2014) (citations omitted) ("CRRs are financial instruments that enable their holders to hedge variability in congestion costs. Entities acquire CRRs primarily to offset integrated forward market congestion costs reflected in the congestion component of locational marginal prices (LMPs).").

The CAISO financially settles CRRs based on the difference in the marginal cost of congestion component of the locational marginal price between two pricing points – called a source and a sink – on the CAISO's system (as determined in the integrated forward market),[18] multiplied by the MW quantity of the CRRs a market participant holds between the two points.[19] For instance, if location A has a locational marginal price of $30 a megawatt/hour ($30/MWh) and location B has a locational marginal price of $50/MWh, the holder of a 1 MW CRR from location A to location B will receive $20/MWh (the difference between location A and location B day-ahead energy prices).[20] 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 CRR from location A (the source) to location B (the sink). 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 acquiring the CRR.

The differences in locational marginal prices between the source and sink of a CRR are due to congestion over one or more constraints in the market. Although the day-ahead market does not model CRRs, a CRR can be thought of as having an "implied flow" over constraints for which the CAISO settles the CRR. The price differences between two points are determined by the power flow distribution factors, or "shift factors," and the constraint prices in the day-ahead market. These same day-ahead market shift factors can be used to calculate a CRR "implied flow" on a constraint by treating the CRR's source as a power injection and a CRR's sink as a withdrawal. The sum of these implied flows priced at each constraint's shadow price equals the locational marginal prices difference for which the CRR receives compensation.[21]

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[18] For purposes of this filing the CAISO will refer generally to the day-ahead market when referencing the market in which it clears energy and creates the locational marginal prices on which the CRRs are settled.

[19] Tariff sections 11.2.4.2 – 11.2.4.2.2. Each pair of source-sink points is sometimes called a bid pair. The CAISO's Track 1A tariff changes proposed to refine the source and sink pairs for CRRs that market participants can purchase in the CRR auctions to eliminate those source and sink pairs that are not associated with supply delivery transactions. The Commission approved this proposal in an order issued June 29, 2018. *Cal. Indep. Sys. Operator Corp.*, 163 FERC ¶ 61,237 (2018).

[20] This example and remainder of discussion in this filing assumes the price difference between the two nodes is due solely to differences in the marginal cost of congestion. Two nodes also could have different locational marginal prices because of divergent transmission loss components.

[21] The shadow price of congestion on a constraint is the production cost savings if the constraint could be relaxed by 1 MW.

Aside from their source, sink, and MW quantity, CRRs are also defined by a time-of-use period (either on-peak or off-peak). The CAISO only settles on-peak and off-peak CRRs based on congestion prices during the on-peak and off-peak hours, respectively. The CRR section of the CAISO website includes documentation on which hours of which days are defined as being on-peak as opposed to off-peak.[22]

The CAISO releases a portion of CRRs at no cost to load-serving entities through an allocation process based on individual entities' load-serving obligations. The CAISO also conducts CRR auctions that allow all market participants to bid to obtain CRRs. The CRR allocation and auction processes occur annually and monthly. Both the annual and monthly processes proceed iteratively. The annual processes begin with four allocation rounds, and conclude with an auction round. The monthly processes begin with two allocation rounds, followed by an auction round.[23] Once the CAISO releases CRRs, market participants can also trade those CRRs through secondary market transactions.[24]

Consistent with the Commission's September 20 Order, the CAISO currently makes 65% of system capacity available in the annual CRR allocation and auction process and 100% available in the monthly CRR allocation and auction process.[25] For the annual and monthly CRR allocations and auctions, the CAISO maintains a CRR model that is based on the most up-to-date direct current full network model. This model includes constraints and network topology and is intended to reflect, as closely as possible, similar constraints and network topology expected in the day-ahead market.

As previously noted, the Commission recently approved tariff revisions addressing the eligible source and sink pairs in the CRR auctions.[26] Effective July 1, 2018, only those pairs associated with supply delivery will be in future CRR auctions.[27]

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22 The CRR section of the CAISO website is available at: http://www.caiso.com/market/Pages/ProductsServices/CongestionRevenueRights/Default.aspx.

23 Tariff sections 36.8-36.11 and 36.13.

24 Tariff section 36.7.

25 Tariff section 36.4.1. The system capacity released in the CRR allocation and auction processes is adjusted to take into account capacity reserved for Transmission Ownership Rights as well as available information on outages and derates.

26 *See Cal. Indep. Sys. Operator Corp.*, 163 FERC ¶ 61,237 (2018).

27 Specifically, the only eligible source and sink pairs are: (1) from a generator bus to either a load aggregation point, a trading hub, or a scheduling point; (2) from a trading hub to either a load aggregation point or a scheduling point; and (3) from a scheduling point to either a load aggregation point or a trading hub. Tariff section 36.13.5.

The CAISO's CRR design currently provides for full funding of CRRs. The CAISO maintains a CRR balancing account, in which it collects hourly day-ahead market congestion revenues and CRR auction revenues. To the extent funds in the CRR balancing account are insufficient to fully fund allocated and auctioned CRRs, the CAISO allocates the shortfall to measured demand, which includes both metered demand and exports. Similarly, the CAISO allocates any excess funds in the CRR balancing account to measured demand. Because the CAISO settles all funds through the CRR balancing account including CRR auction revenues and distributes the final excesses and shortfalls to measured demand, the CAISO effectively distributes both the auction revenues to measured demand and the total revenue sufficiency or insufficiency to measured demand.

B. Stakeholder Initiative on CRR Auction Efficiency

With an efficient CRR auction, prices of auctioned CRRs are expected generally to reflect market participants' expectations of congestion exposure in the day-ahead market, as adjusted for risk premium, time value of money, and hedge value.[28] In recent years, however, the outcomes of the CRR auctions have not reflected this expectation. The discount in CRR auction prices relative to CRR payouts far exceeds any reasonable risk premium and time value of money adjustment.

In early 2017, the CAISO began a stakeholder initiative to address the inefficiency of the CRR auction resulting in this discount in auction prices.[29] The CAISO intended the initiative to consider concerns regarding the large payments made to holders of auctioned CRRs in comparison to the prices paid for those CRRs through the auctions. This initiative included an analysis phase and a policy phase. The analysis phase involved intensive efforts to understand what has driven the persistently low auction prices relative to payouts. The policy phase focused on measures the CAISO could take to address the drivers of the CRR auction and payment issues identified in the analysis phase.

The CAISO divided the policy phase into three tracks. Track 0 focused on CRR auction enhancements that the CAISO could implement within its current tariff authority. These included greater transparency on transmission outage reporting performance, CAISO process improvements, and reviewing current modeling criteria. Track 1 focuses on enhancements the CAISO can implement

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28 *See* CRR Auction Efficiency, Track 1B Draft Final Proposal Second Addendum, June 11, 2018 provided as Attachment D to this filing at 16, available on the CAISO website at http://www.caiso.com/Documents/DraftFinalProposalSecondAddendum-CongestionRevenueRightsAuctionEfficiencyTrack1B.pdf.

29 Materials related to the stakeholder initiative are available at http://www.caiso.com/informed/Pages/StakeholderProcesses/CongestionRevenueRightsAuctionEfficiency.aspx.

this year. Track 2 is planned to consider potential more comprehensive changes to the CRR allocation and auction design.

The CAISO subsequently subdivided Track 1 into Track 1A and Track 1B. Track 1A focused on enhancements the CAISO was able to implement by this summer. The CAISO filed its Track 1A tariff changes on April 11, 2018, in Docket No. ER18-1344-000. The Commission approved these changes on June 29, 2018.[30]

The changes in Track 1A are twofold. First, transmission owners are now required to submit an annual transmission outage plan by July 1 each year for known transmission outages they plan to take in the upcoming year that affect power flows in the CRR model and therefore could impact revenue sufficiency in the day-ahead market. The CAISO will use this information to improve the accuracy of its model used for the annual CRR allocation and auction. Second, source and sink pairs for CRRs available in auctions are now limited to those nodal pairs associated only with delivery of supply. CRR holders also now have an express right to sell CRRs back into subsequent auctions.

Track 1B focuses on enhancements to be completed in time for the settlement of CRRs that have terms in 2019. The tariff revisions proposed in this filing implement the Track 1B recommendations as documented in the CAISO's CRR Auction Efficiency, Track 1B Draft Final Proposal Second Addendum dated June 11, 2018, provided as Attachment D to this filing. As explained below, the tariff revisions in this filing include certain modifications to those Track 1B recommendations in response to guidance provided by the Commission in its September 20 Order.

The CAISO solicited multiple rounds of stakeholder comments on CRR auction efficiency issues, beginning after the April 2017 working group to determine the scope of the analysis phase.[31] Stakeholders submitted written comments following publication of a Track 1B Draft Final Proposal Addendum on May 15, 2018. Stakeholders also provided comments on the Track 1B Draft Final Proposal Second Addendum during a stakeholder web conference on June 13, 2018.[32] On June 21, 2018, the CAISO Board of Governors approved the

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30 *Cal. Indep. Sys. Operator Corp.*, 163 FERC ¶ 61,237 (2018).

31 Complete details of the stakeholder process leading to this filing are available on the stakeholder initiative site at http://www.caiso.com/informed/Pages/StakeholderProcesses/CongestionRevenueRightsAuctionEfficiency.aspx.

32 A Summary of Submitted Stakeholder Comments on CRR Auction Efficiency provided to the CAISO Board is provided as Attachment F to this filing, available on the CAISO website at: http://www.caiso.com/Documents/DecisiononCongestionRevenueRightsAuctionEfficiencyTrack1BProposal-AttachmentA-Jun2018.pdf. Responses to stakeholder comments are addressed separately below, in Section IV.

Track 1B proposals. Following Board approval, the CAISO held a stakeholder call on July 2, 2018, to discuss the draft tariff language. The CAISO considered submitted comments and posted proposed tariff language on July 5, 2018 and reposted its revised proposed tariff language on July 6, 2018. The original set of Track 1B proposals was submitted to the Commission in the July 17 Amendment.

After the Commission issued its September 20 Order identifying certain issues with the CAISO's initial proposal in the July 17 Amendment to eliminate full funding of CRRs, the CAISO determined that it is appropriate to refile the proposal with the modifications identified by the Commission in that order. The CAISO published revised tariff language for stakeholder review on September 24 and held a stakeholder conference call to discuss the proposed modifications. Stakeholders generally supported or did not oppose the netting proposal.

The Track 1B proposed changes are incremental to the changes proposed in Track 1A. The Track 1B proposed changes will complement, rather than supersede, the Track 1A tariff changes. Any proposals in Track 1B are not directly linked to the enhancements proposed in the Track 1A filing.

The CAISO believes that the combined Track 1A and updated Track 1B proposals will resolve the bulk of the observed inefficiencies with the CRR auction. As noted above, Track 2 of the CRR auction efficiency stakeholder initiative is planned to consider more comprehensive potential changes to the CRR allocation and auction design. The CAISO believes it is reasonable to assess the impact of these changes on auction performance prior to pursuing further potential design changes. To allow time for this assessment, the CAISO intends to initiate the policy development process with stakeholders beginning mid-2019, targeting implementation of any further CRR allocation and auction enhancements in time for the 2022 allocation and auction process, which begins in September 2021.

1. CRR Auction Analysis

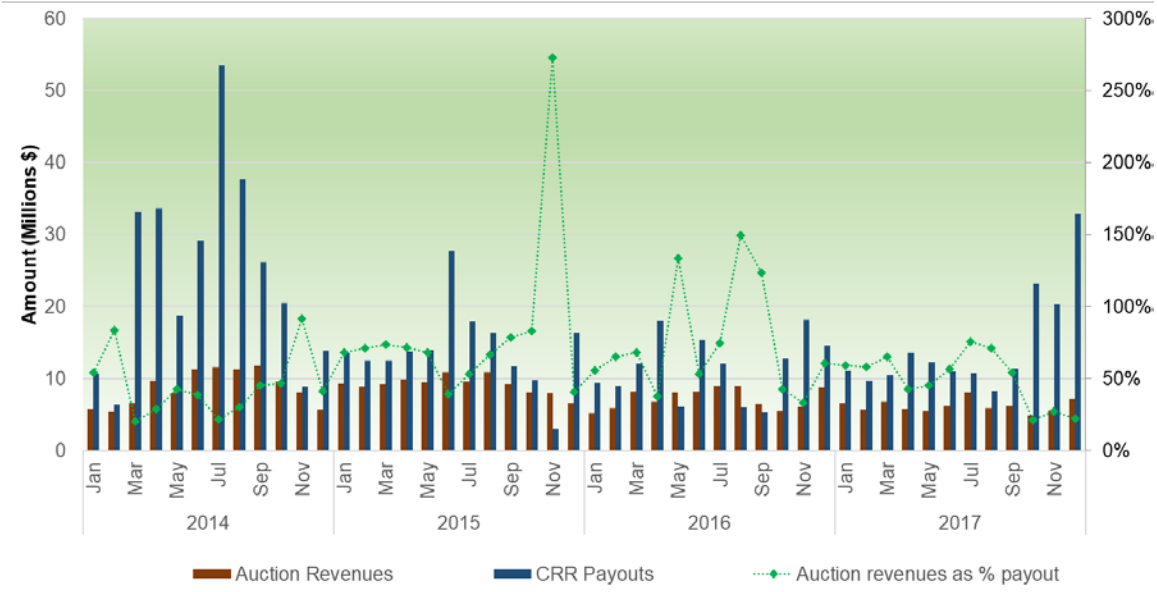
In the initiative's analysis phase, the CAISO studied the differences between CRR auction prices and payouts to CRR holders. The CAISO held a workshop with market participants in early 2017 to obtain input on the scope of the analysis. The CAISO reported its progress on the analysis during the July 2017 market planning and performance forum meeting. The CAISO issued a CRR Auction Analysis Report on November 21, 2017.

Historically, CRR auction prices have been low for some CRRs relative to the day-ahead payout. The CAISO's analysis of the period from 2014 to 2017 shows that market participants purchased CRRs at auction at a total average cost of $99.5 million per year less than the amount that was eventually paid out on those CRRs. Total payouts to auctioned CRRs in 2014 of $292 million

significantly exceeded the auction revenues of $104 million, resulting in a $187 million auction revenue shortfall. The payouts to auctioned CRRs dropped significantly in 2015 to $169 million, dropped further in 2016 to $138 million, and increased to $140 million in 2017 (through November). The difference between the payouts to auctioned CRRs and auction proceeds decreased in 2015 to about $60 million, further decreased in 2016 to about $51 million, and then increased to $73 million in 2017 (through November).[33]

Figure 1 provides a more granular illustration of these auction revenue shortfalls.

Figure 1: Auction Revenue Shortfalls



These auction revenue shortfalls show that CRRs were purchased at auction for an average of 63 cents on the dollar over the period studied.

Among other issues, the CRR Auction Analysis Report identified that auction revenue shortfalls are caused by CRRs that have low auction prices, but high payouts because the CRR auction did not accurately model day-ahead market conditions.

2. CRR Revenue Insufficiency

CRR revenue insufficiency occurs when congestion charges from the day-ahead market and payments from counterflow CRR holders are not sufficient to fund

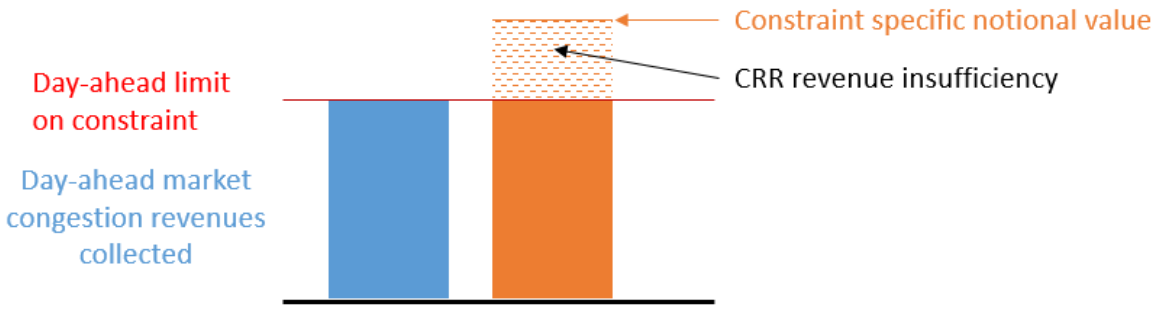
33 Attachment D, Draft Final Proposal Second Addendum at 16-17.

payments to CRR holders. The primary cause of CRR revenue insufficiency is differences in transmission modeling between the CRR auction model and the day ahead market model.

If the CRR auction and the day-ahead market model the same constraints and utilize the same transmission limits, then pricing congestion in the day-ahead market should be sufficient to fully fund payments to CRR holders. However, in the actual CAISO energy market, modeling differences between the CRR allocation and auction processes and the day-ahead market result in CRR revenue insufficiency.[34] These modeling inconsistencies result from transmission outages or other conditions that can cause constraints to be introduced in the day-ahead market that were not modeled in the auction or cause constraints' limits to be tightened in the day-ahead market relative to the CRR allocation and auction.

Full funding of CRRs requires that in the event the CRR payout based on the CRR's full MW value entitlement, the CRRs "notional value," exceeds the congestion revenues and payments from counterflow CRR holders that are collected in the day-ahead market, CRR holders will still receive congestion payments based on their CRR's notional value. The following figure illustrates this point.

Figure 2: Revenue Insufficiency



The above figure illustrates the payments to CRRs due to congestion on a constraint that has a lower limit enforced in the day-ahead market than was enforced in the CRR auction. The CRR's payout based on its notional value is illustrated in orange to the right in the figure and the congestion revenues collected are illustrated in blue on the left.[35] As the above figure shows, a lower limit in the day-ahead market results in CRR revenue insufficiency because there is less congestion revenue collected in the day-ahead market, due to the lower day-ahead market flow,

34 Attachment G, MSC Opinion at 8.

35 This simplified example assumes there are no CRRs with implied counterflows in the constraint.

than the CRRs' notional value payout based on the MWs of CRRs. Thus, the CRRs' implied flow in the day-ahead market is not feasible. Since 2014, the CRRs released in the annual auction have averaged 18,800 MW of differences between the annual and monthly auctions, representing transmission capacity sold in the annual auction that was no longer available as of the monthly auction. The CAISO makes up for CRR revenue insufficiency by allocating the cost to fund the shortfall to measured demand.

Fully funding CRRs also can create incentives that exacerbate the issue of auction revenue shortfalls. For example, market participants can bid low for CRRs during auctions, betting that those CRRs will have high payouts if a constraint not modeled during the auction will be ultimately enforced in the day-ahead markets. In other words, market participants can benefit purely from modeling differences, as they will receive a full payout on a constraint in the day-ahead market that can be purchased for nothing in the auction because it was not modeled in the auction. 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.[36]

As noted in the CAISO's CRR Auction Analysis Report CRR revenue insufficiency is a separate issue from the auction revenue shortfall issue but the two issues are related. This is because although the two issues relate to different measures of the CRR auction efficiency, the conditions resulting in CRR revenue insufficiency also result in auction revenue shortfalls. Both issues are related to differences in transmission modelling between the model used in the CRR allocation and auction processes and that used in the day-ahead market.[37]

An illustration of this was of this was when the CAISO enforced a single constraint in the day-ahead market, the "Serrano" constraint, in February 2018. On a single day, this resulted in payments to CRR holders with CRRs that exceeded what those CRRs were purchased in the auction for by $8 million. Not only were auction revenues grossly inadequate, the constraint incurred close to $7.5 million in revenue insufficiency on the same day demonstrating that day-ahead market congestion revenues were $7.5 million deficient compared to CRR entitlements. Eighty nine percent of auction revenue shortfall was attributable to CRRs awarded in the annual congestion revenue rights auction.[38] This is largely because the annual CRR allocation and auction process is conducted far in advance of the applicable day-ahead market and outage situations arising in the day-ahead market are

36 Attachment D, Draft Final Proposal Second Addendum at 31.

37 Attachment C, CRR Auction Analysis Report at 9.

38 Attachment D, Draft Final Proposal Second Addendum at 34.

unknown at the time of the annual CRR process.[39]

When constraints in the day-ahead market are enforced at a lower limit than they were in the CRR allocation and auction, or were not enforced in the auction, the day-ahead market congestion payments to the CRR holder reflect system conditions that are more constrained than modeled and priced in the CRR allocation and auction. If the auction had accurately modeled these constrained conditions, the price of the CRR in the auction would likely have been higher if the auction had modeled these more constrained conditions, reflecting the greater value of the CRR because of the higher expected day-ahead market congestion payments. The changes proposed in this filing to address the CRR revenue insufficiency will bring payments to CRRs in this situation more in line with the conditions modeled and priced in the CRR auction, thereby also addressing the auction revenue shortfall.

The CAISO's Market Surveillance Committee noted that the proposal to eliminate full funding of CRRs will address the CRR auction revenue shortfalls in that, if CRR payments to auctioned CRRs are reduced more than CRR auction revenues, then the gap between CRR payouts and auction revenues will be reduced.[40] The Market Surveillance Committee also concluded that it is appropriate to direct attention to CRR revenue insufficiency regardless of the auction revenue shortfall.[41]

III. Proposed Tariff Revisions

The CAISO proposes modified tariff changes that will eliminate the burden placed on load serving entities to fund CRR revenue insufficiency and will contribute to improving the auction efficiency. Specifically, the CAISO proposes to eliminate the current full funding of CRRs held by market participants, and instead scale CRR payouts on a constraint-by-constraint basis in the amount needed to eliminate revenue insufficiency. Prior to performing this scaling, the CAISO will net the MWs of implied flow that all of the obligation CRRs in each CRR holder's CRR portfolio place over a particular constraint. This will eliminate the potential that a CRR issued in the allocation or auction will receive a payout in excess of the amount supported by day-ahead congestion revenues and charges to counterflow CRR holders. This will also ensure that a holder of a prevailing flow CRR from A to B can offset that obligation by holding a CRR from B to A.

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39 Attachment C, CRR Auction Analysis Report at 9.

40 Attachment G, MSC Opinion at 2.

41 Attachment G, MSC Opinion at 2. The Market Surveillance Committee also notes that the history of high CRR revenue insufficiency in the CAISO's markets as compared to those of other ISOs and RTOs suggests that addressing the causes of revenue insufficiency may also help to correct the auction revenue shortfall issues. *Id.* at 5.

A. Scaling CRR Payments Based on CRR Effectiveness on Constraints

The CAISO proposes to fund CRR entitlements based on the day-market congestion revenue rather than relying on the CRR balancing account to make up any revenue insufficiency. Today, the CRR balancing account collects day-ahead market congestion revenues as well as revenues from the CRR auctions and allocates any deficiency to measured demand.[42] The CAISO proposes instead to measure whether a CRR is revenue sufficient based on day-ahead market congestion revenues attributable to each constraint on which the CRR has an implied flow in the day-ahead market.

The CAISO proposes essentially the same methodology it submitted in its July 17 Amendment with one important modification to address the Commission's concern in its September 20 Order. In the July 17 Amendment the CAISO did not include a proposal to net CRRs with both modeled prevailing flow and counter-flow CRRs within a CRR holder's portfolio. In this tariff amendment, the CAISO proposes a methodology that ensures that a CRR holder with a prevailing flow CRR from A to B can offset its obligation by holding a counterflow CRR from B to A. The CAISO proposes to first net a CRR holder's portfolio of obligation CRRs of prevailing flow and counterflow CRRs with modeled flows on a particular constraint. After it nets these flows, the CAISO then would implement the same procedure it previously proposed through which it would scale CRR payments based on day-ahead market congestion revenue collected on individual constraints. To minimize reductions to CRR payments, the CAISO will continue to net any congestion revenue surpluses generated due to the same constraint against the scaled payments. It will do this daily and monthly for the other hours of the month.

The CAISO proposes to scale CRR payments using a constraint-specific approach rather than evaluating revenue sufficiency and scaling payments by CRR or allocating the cost of CRR revenue insufficiency more broadly, such as to all CRRs. The CAISO proposes this approach for several reasons.

First, stakeholders stated that, in valuing CRRs, they could better estimate the risk of transmission outages that will result in a constraint-specific scaling than they could estimate their potential share of the overall pool of CRR revenue insufficiency under a broader congestion revenue allocation approach.

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[42] With one exception related to "perfect hedge" treatment for existing transmission contracts (ETCs) and transmission ownership rights (TORs), the CRR balancing account now will exist to allocate surplus CRR-related funds to measured demand but will not be a mechanism for spreading costs to measured demand.

Second, this constraint-specific approach is expected to reduce incentives to obtain CRRs that receive payments based on congestion prices that were not priced in the auction due to modeling differences between the auction and the day-ahead market. These CRRs add to the auction revenue shortfall and also are likely associated with day-ahead market CRR revenue insufficiency.

Third, allocating revenue insufficiency in proportion to overall CRR payments, rather than using a constraint-specific approach, could inequitably affect CRRs purchased in the auction at a higher price relative to their payout in the day-ahead market to a greater extent than it would affect CRRs purchased at a lower price. CRRs purchased at a lower price could still have an inflated profit after being allocated a share of overall revenue insufficiency while CRRs purchased at a higher price have less "headroom" to absorb a charge to allocate CRR revenue insufficiency.

Finally, the constraint-specific approach more equitably allocates shortfalls among allocated CRR holders because it does not burden a CRR holder that has been allocated a CRR involved in one portion of the CAISO system with day-ahead market CRR revenue shortfalls incurred in an area of the system that their day-ahead market schedules do not involve.

In allocating this revenue insufficiency, the CAISO proposes to net the megawatts of a CRR holder's obligation CRR portfolio with modeled flow over a binding constraint. This provides symmetrical treatment of that CRR holder's prevailing flow and counterflow CRRs on a particular constraint so that the modeled flow of those CRRs are offset. In its July 17 Amendment, the CAISO indicated that scaling counterflow CRRs would reduce payments due from CRR holders used to fund payments to prevailing flow CRRs. However, the Commission found it continued to believe that a symmetric approach was just and reasonable consistent with its findings in certain prior Commission orders.[43] The Commission stipulated that the CAISO's proposal specifically failed to ensure that a CRR holder with prevailing flow from A to B would be prevented from offsetting that obligation by holding a CRR from B to A.

In response to the Commission's order, the CAISO established a procedure through which it can ensure a CRR holder's modeled flow in both the prevailing and counter flow direction on a specific constraint offset each other. The CAISO's approach is one that can be overlaid on the software changes the CAISO already began developing based on its prior proposal and which it can

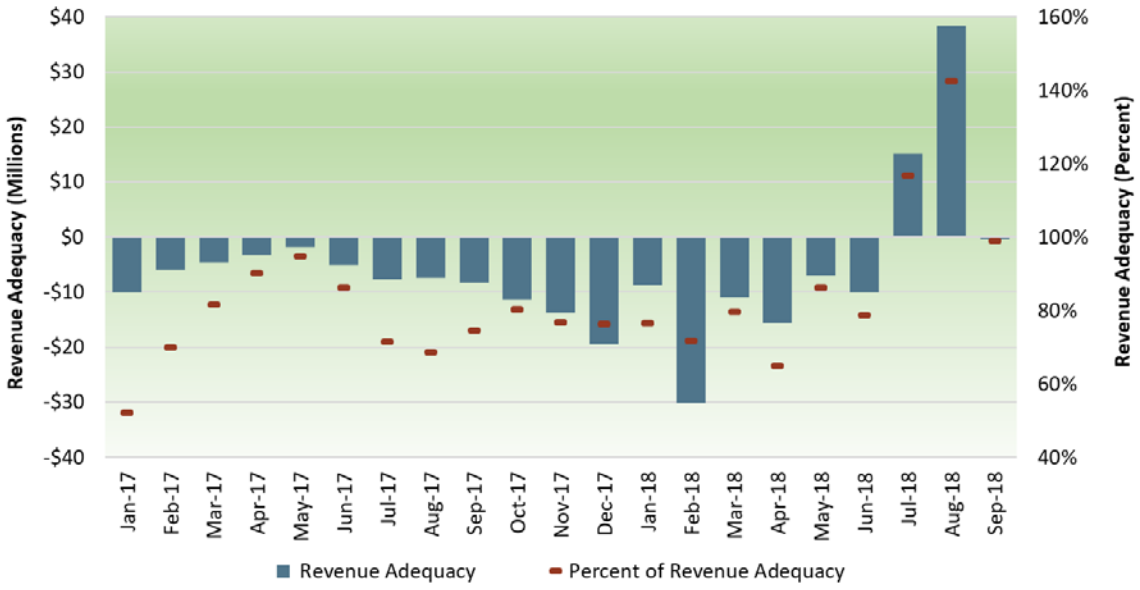
[43] September 20 Order at P 51. The Commission cited *Cal. Indep. Sys. Operator Corp.,* 116 FERC ¶ 61,274, at (2006) (an order accepting the CAISO's Market Redesign and Technology Upgrade, referred to in the September 20 Order as the "MRTU Order"). The Commission also cited *PJM Interconnection, L.L.C.*, 156 FERC ¶ 61,180, (2016) (referred to in the September 20 Order as the "2016 PJM FTR Order").

therefore implement as of January 1, 2019, to provide the market protection from any future revenue insufficiency in an expedited manner.

The CAISO has developed an approach that allows for netting of prevailing flow and counterflow CRRs to address the Commission's comments for two reasons. First, it is important that load not remain exposed to the costs of full funding in 2019, because of the potential for significant revenue insufficiencies. Therefore, it is important to select a process that is just and reasonable and meets the Commission's requirements but can be implemented by January 1, 2019. The CAISO determined that complete symmetrical treatment of CRRs would prevent the CAISO from partially funding CRRs as of January 1, 2019 because it would require greater redesign of the software enhancements already underway. The CAISO is able to follow the Commission's guidance without a major redesign with the proposal it submits here today because it can net the prevailing flow and counterflow a CRR holder's CRRs place on a constraint upstream in the process and then feed that information into the scaling methodology the CAISO developed as part of its original CRR Track 1B proposal.

Figure 3 shows the most recent trend of revenue adequacy for 2017 and 2018; this shows how persistent the revenue shortfall has historically been. The bars in blue is the dollar value of revenue deficiency while the dots in red show the relative percentage of revenue adequacy; a value of 100 percent reflects revenue neutrality while a percentage lower than 100 means there is a revenue deficiency.

Figure 3: Recent trend of CRR revenue Adequacy



Although revenue deficiency can vary greatly over time, the overall balance is consistently a deficiency. Even in 2018 when the ISO observed a revenue surplus for the months of July and August, the overall balance is still a net revenue deficiency. In July and August, the system experienced unusually high flow patterns that resulted in higher congestion rents than CRR payments.

History with revenue insufficiency shows that capacity availability can easily change conditions in the day-ahead market that readily trigger extended periods of revenue insufficiency. Because the CAISO's proposal is just and reasonable and it can be implemented by January 1, 2019, it is unjust and unreasonable to force the CAISO and market participants to have to deal with the risks of revenue inadequacy for another year.

Second, as the CAISO's proposal to net the model flow CRR holder's CRR place in the prevailing and counterflow direction completely addresses the Commission's concern in the September 20 Order. The Commission was particularly concerned that under the CAISO's prior proposal the CAISO would treat "prevailing and counterflow CRRs differently such that the holder of a prevailing flow CRR from A to B cannot offset that obligation by holding CRR from B to A." The CAISO proposal in this tariff filing directly addresses this issue. There is no reason why the Commission cannot accept the CAISO's proposal in time to prevent exposing load serving entities to such costs in 2019.

The CAISO's proposal more equitably allocates CRR revenue insufficiency than the current full funding methodology in which measured demand covers all CRR revenue shortfalls. Today, measured demand is the guarantor of meeting the full funding requirement for CRRs. For example, one constraint in January 2017 generated $6.48 million of revenue insufficiency.[44] Under current market rules, load-serving entities with allocated CRRs were required to pay for the full $6.48 million shortfall. By calculating specific payouts on a constraint-by-constraint basis, the CAISO's proposed changes make each CRR holder responsible for the revenue shortfalls associated with their own CRRs.[45] Under the CAISO's proposed constraint-by-constraint approach, load-serving entities would have only had to bear 60% of the revenue insufficiency, the amount that corresponded to CRRs held by load-serving entities.

The CAISO's proposal also more equitably allocates revenue shortfalls among load-serving entities attributable to their allocated CRRs. If a binding constraint in one geographic area of the transmission system generates less congestion revenue than required to pay CRR holders that hold CRRs with implied flow on the constraint, under the CAISO's proposal only those load

44 Attachment D, Draft Final Proposal Second Addendum at 31.

45 Revised tariff section 11.2.4.2.2.

serving entities who hold CRRs with implied flow on the constraint would bear the CRR revenue shortfall. Other load-serving entities outside of that area, with no implied CRR flows on those constraints, would not be responsible.

1. Description of Proposed Tariff Amendments – Scaling CRR Values

The mechanics of implementing the CAISO's proposal involve the CAISO following an iterative process that first calculates the net MW that reflects netting the prevailing and counterflow a CRR holder's CRRs place on a specific constraint; then calculates an hourly value for the netted MW amounts that is sufficiently funded by day-ahead market congestion revenue, that includes offsets funded by revenue surpluses, and potential monthly offsets for each CRR funded by revenue surpluses carried over the month.

In Attachment I to this transmittal letter, the CAISO provides examples that illustrate in greater detail how the CAISO will scale CRR payments.

a. Netting Prevailing and Counterflow A CRR Holder Places on a Given Constraint

The first step in the CAISO's partial funding methodology is to net the modeled flow a CRR holder's obligation CRRs place in the prevailing and counterflow directions on a particular constraint. This is the salient change to the CAISO's previously filed proposal to address the Commission's concern. When the CRR allocation and auction process releases a CRR, the CRR is designated in terms of a MW quantity for a particular source/sink combination. The CAISO can trace the MW quantity to the modeled flow those CRRs have on the CAISO constraints and net any prevailing or counterflow they place on a particular constraint. Once the CAISO nets these modeled flows, a CRR holder's prevailing flow and counterflow CRRs on a constraint will offset.

The CAISO will not net modeled flow from CRR options against that of the CRR obligations or against other option's modeled flow.[46] CRR option holders actually expect that options do not net on constraints. Consider a CRR holder that holds an option from A to B and holds an option of equal quantity from B to A. The CRR holder expects to receive congestion revenues from A to B, associated with its option from A to B, when those revenues are positive. In addition, the CRR holder expects to receive congestion revenues from B to A, associated with its option from B to A, when those revenues are positive. If the CAISO were to net the options, the CRR holder would be entitled to a net $0 of

[46] The proposed definition in Appendix A of the term "Net Modeled CRR Flow" states that the CAISO will "not net the MWs of modeled flow from a given CRR Obligation with MWs of modeled flow from CRR Obligations or other CRR Options in a CRR Holder's portfolio."

congestion revenues, contrary to the expected payout on the options.

The netting process is illustrated in Attachment I to this transmittal letter, where the CAISO provides an example of how its partial funding proposal will work, including the CAISO's new proposal for netting prevailing and counterflow on a constraint. The example is based on a three node system, A, B and C, with flows placed in multiple directions by CRRs held by four different CRR holders. In column G of Table 2 the CAISO shows that through the netting process the CAISO will net 100 MWs of a holder's CRRs placed on B to C and -50MW of a CRR from C to A placed on the B to C constraint.

In its prior proposal, that CAISO would not have taken this step and would have instead just calculated the CRR's notional value. The CRRs released in the CRR annual and monthly processes have a notional monetary value, which is the day-ahead market payment that the CRR holder would receive based on the CRR's full MW amount (*i.e.*, the day-ahead locational marginal price difference between CRR's source and sink multiplied by the MW quantity of the CRR). That notional value can be disaggregated to the various constraints that the CRR has implied flows over in the day-ahead market. For example, a CRR that has a 10 MW implied flow over a constraint in the day-ahead market would have a notional value of $70 on that constraint in an hour of the day-ahead market if the day-ahead market congestion price of that constraint was $7/MWh. Attachment I shows the CRR notional values in column 5 of Table 1.

The CAISO will still calculate the notional value of a CRR but will not use that as a starting point of determining how much of a CRR holder's CRRs are supported by the day-ahead market revenue.

The CAISO will instead settle the CRRs based on the net modeled CRR flow. The net modeled CRR flow on a particular constraint may or may not be supported by the actual congestion revenue generated in the day-ahead market. The CAISO will scale payments to CRR holders based on the net modeled CRR flow as described further below.

b. Calculating a Revenue-Supported CRR Value

Under the CAISO's proposal, for each hour of the day-ahead market, the CAISO will compare the congestion revenue attributable to each constraint to the payments that the day-ahead market would have to make to CRR holders due to that constraint based on the CRR holder's net modeled CRR flow. The CAISO will then scale that portion of all CRR holders' payments attributable to the constraint until the total payment is no greater than the congestion revenue generated by the day-ahead market due to that constraint plus payments received from net counterflow positions held by CRR holders due to that constraint. In other words, the day-ahead market congestion revenue-supported

value.[47]

The first step in this process is calculating the revenue that the CAISO has collected due to a constraint that is available to pay CRRs that have an implied flow over that constraint.[48] This also will entail the CAISO modeling each CRR's implied flow on each constraint using the shift factors used by the day-ahead market. The CAISO will create hourly constraint-specific CRR congestion revenue funds that will be funded by: (1) the portion of the total day-ahead market congestion revenue the CAISO received due to the specific constraint, as opposed to the other constraints on the CAISO system; (2) charges collected from CRR MW quantities that have a net implied counterflow within a CRR holder's portfolio on the constraint; and (3) any revenue adjustment associated with that constraint made under the existing "CRR clawback" rule, which rescinds CRR payments that may be inflated by virtual bids submitted by the same market participant, and circular trade rules, which adjusts CRR payments for entities that engage in prohibited circular scheduling at the interties, in tariff sections 11.2.4.6 and 11.2.4.7, respectively.[49]

The second step is to determine how much of the net modeled flow value is supported by the revenues collected in the hourly constraint-specific congestion revenue funds.[50] If the CAISO determines a CRR holder has net modeled CRR flow over a binding constraint in the prevailing direction, the CAISO will pay the CRR holder their congestion-supported value, which is equal to the ratio of that CRR holder's prevailing net modeled CRR flow over that constraint (accounting for revenue adjustments made pursuant to the CRR and bidding claw back rules), as compared to the sum of all CRR holders' prevailing net modeled flow over that constraint (accounting for revenue adjustments made pursuant to the CRR and bidding claw back rules). This provides the CRR holder payment to cover their portfolio hedge over that constraint having netted prevailing and counterflow CRRs. However, the CAISO will not pay a CRR holder in excess of the CRR holder's net modeled Flow multiplied by the shadow price of that binding constraint. This, in essence, captures the notional value of the CRR MWs flowing over that constraint. The shadow price of the constraint captures the congestion cost differential between the two sides of the constraint. Once summed over all constraints, this is functionally equivalent to calculating the difference in MCC components between two nodes.

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47 This process is defined in proposed tariff section 11.2.4.4.1. The revenue-supported CRR values are described in the proposed tariff as "Congestion-Supported CRR Value."

48 This fund is labeled in the proposed tariff language as the "Hourly CRR Congestion Fund."

49 Revised tariff section 11.2.4.1.2.

50 Revised tariff section 11.2.4.4.1. In the proposed tariff language these amounts are labeled as the "Congestion-Supported CRR Value."

Attachment I illustrates this process and shows that CRR holder 1 who has two CRRs that have modeled flow on the B to C constraint will have a settlement value of $3,050 for the netted value, instead of a notional value of $2,000 for CRR 1 and $1,250 CRR 2. CRR holders 3 and 4, whom each own a single CRR placing prevailing flow on the constraint between B and C have their CRRs scaled by their portion of the total prevailing flow on the constraint taking into account CRR holder 1's net prevailing flow on the same constraint.

If, on the other hand, the CAISO determines that a CRR holder's net modeled flow over a binding constraint is in the counter-flow direction, the CAISO will charge the CRR holder the congestion-supported value equal to the net modeled CRR flow multiplied by the shadow price of that binding constraint. Again, this captures the notional value of the CRR MW quantity as to that particular constraint. Attachment I illustrates this treatment with CRR holder 2, that is, CRR holders with net counterflow positions on constraint are charged the constraint shadow price for their net negative position.

For CRR options, the CAISO will limit the overall charges for such modeled flows to zero so that they will never be charged for their option, as is the case today.

It is possible that funds will remain in a constraint-specific congestion revenue fund after the CAISO has credited all CRRs for their net modeled flow value as to that constraint. As described in the following subsections, the CAISO proposes to hold these revenue surpluses and use them to offset CRR payment adjustments to address concerns that the elimination of full funding would provide less than a full hedge for congestion. The CAISO will do this for each day and at the end of each month, and by constraint each time. If the CAISO collects revenue surpluses in one hour due to a constraint that is revenue insufficient in other hours, the CAISO will use those funds to attempt to make CRRs whole to their notional value on that constraint. This ensures the CRR holder has the maximum benefit of the hedge for the specific CRR, to the extent it is supported by the revenue fund.

To the extent the CAISO collects a surplus in the day-ahead market, the surplus consists of congestion revenues over which no market participant obtained an entitlement in the CRR allocation or auction. As such, there are no "owners" of such surpluses. The CAISO and stakeholders merely decided it would be best to offset reduced CRR payments with any surpluses to better assure the funding of CRRs so they would provide better hedge value and better preserve CRRs' value in the auction. Moreover, if there is no implied CRR flow over a particular constraint, there will be no deliveries that require a hedge. In other words, if a market participant holds a CRR between points A and B, and there is no implied flow on a constraint between points A and B, the CRR holder

is fully hedged for any congestion on that constraint because the CRR holder would not be charged for congestion on the constraint in question. In such circumstances, there is no reason why the holder of a CRR between points A and B should expect to receive congestion revenues from other constraints not associated with flow between points A and B. Although no CRR holder had an entitlement on those revenues, the CAISO has nonetheless chosen to allow, and stakeholders supported allowing, a certain reasonable amount of surplus distribution (described as netting) to CRRs to "firm up" the CRR product.

The CAISO will use surplus revenues to provide surplus distribution payments to offset CRR payment adjustments by determining each CRR's commensurate portion of the surplus in each hour. The CAISO will roll the surplus revenue over to the daily CRR congestion fund and reserve it for CRRs with a net modeled flow over the applicable constraint in that hour to make up for any amounts scaled in other hours.[51] By doing so, each CRR will only have a claim to surplus revenues if it had net implied flow on the constraint in the hour the CAISO collected the surplus. Consider an example where in one hour a single CRR holder has a net modeled flow over a constraint, whereas in the next hour two different CRR holders have the net modeled flow over that same constraint. If the CAISO collects excess congestion revenue on that constraint in the first hour, then that revenue would be reserved for the single CRR holder in that hour to offset any amounts the CAISO scales that same CRR holder in other hours. The two different CRR holders that share the constraint in the second hour did not flow on the constraint in the first hour and therefore do not have access to the first hour surplus revenues.

The CAISO may find in some hours that CRRs do not place any implied flows on some constraints. These excess revenues represent transmission capacity for which no CRR holder has purchased an entitlement. The congestion revenue associated with these constraints in these hours will go into the CRR balancing account to be settled daily to measured demand.

b. Calculating a Daily CRR Settlement Value

A CRR's daily settlement will be the sum of its revenue-supported values across the hours of that day, plus whatever daily CRR offset funded by revenue surpluses there may be for that CRR.

The CAISO will reserve congestion revenue surplus distribution offsets in daily constraint-specific CRR congestion revenue funds. On a daily basis, the CAISO will use those funds to offset any amounts in hours in which the CAISO did not receive sufficient revenue on a constraint to pay CRRs the portion of their

51 Revised tariff section 11.2.4.4.2.

net modeled CRR flow corresponding to that constraint.[52] These offsets reverse the amounts scaled to the extent each daily CRR congestion fund contains sufficient funds due to congestion revenue surpluses.[53]

Making these offsets daily is important to avoid unnecessarily exposing market participants to the CAISO credit requirements. The credit requirements trigger daily, and forcing CRR holders to wait until the end of the month to offset the amounts they owe could make them appear to be a greater credit risk than they are.

Any funds remaining in a daily constraint-specific CRR congestion fund after the CAISO clears the daily settlement will roll over to a monthly constraint-specific CRR congestion fund. Through either surplus distribution payments or contributions to the monthly congestion fund, each daily CRR congestion fund will balance at the end of each day's CRR settlement process.

c. Calculating a Monthly CRR Settlement

Similar to the daily process, CRRs for which the sum of their daily CRR settlement values on a constraint for the month are less than the sum of their CRR notional value on a constraint over that month are eligible for a monthly offset to the payments scaled. Again, the CAISO will credit back CRR holders up to the net modeled CRR value from the whole month to the extent the corresponding monthly constraint-specific CRR congestion fund contains sufficient revenue reserved for a CRR holder and that CRR holder has not yet received its full notional value corresponding to the constraint over the month. The CAISO will settle any amount remaining in the monthly constraint-specific CRR congestion fund after the CAISO makes the necessary monthly credits to monthly measured demand.

In developing its proposal, the CAISO recognized that netting over a reasonable period is appropriate to offset any payment reductions to allow CRRs to be firm enough to provide a hedge against congestion costs. There are several reasons, however, why a close out period longer than a month is not justified in the context of the CAISO's CRR framework. First, CRRs acquired through the monthly CRR release process are a monthly product. Other CRRs are allocated or auctioned on a seasonal basis. Under the Track 1A tariff revisions approved by the Commission, market participants can sell back seasonal CRRs in monthly

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52 Proposed tariff section 11.2.4.4.2. These credits are referred to in the proposed tariff language as "Daily CRR Surplus Distribution Payments."

53 Because a CRR is defined as being either on-peak or off-peak and because the funds in the daily and monthly congestion fund are all reserved for the specific CRRs that had a modeled flow over the constraint for the hour in which the excess congestion revenue was collected, there is no need to define separate congestion funds specific to on-peak and off-peak hours.

increments. As such, seasonal or annual netting is not feasible because the original CRR holder might not hold a CRR for longer than a single month. For example, consider a scenario in which a seasonal CRR is sold as a monthly CRR. There may be a revenue surplus due to a constraint during the period the original CRR holder held the CRR and the purchaser of the CRR may benefit from the surplus when a shortage occurs in a later month, even though the later CRR holder had no claim to the CRR when the surplus occurred.

This disconnect would be exacerbated by the fact that transmission system conditions can change dramatically from month to month. For example, congestion revenue may be insufficient in a summer month due to wildfires or other unanticipated changes in system conditions. There is no reason why a holder of a monthly CRR (that originated as a seasonal CRR that was sold on a monthly basis) for that summer month should benefit from very different system conditions in an earlier month when the CRR was associated with surplus congestion revenue.

d. The CRR Balancing Account's Role in the New CRR Settlement Design

The CAISO will continue to have a CRR balancing account. The nature of that account will change. Today, that balancing account is cleared on a daily basis and is used to process CRR revenue shortfalls or surpluses, CRR auction revenues, and funds received from CRR clawback settlement rules. At the end of each day, the CAISO allocates any shortfalls in the balancing account (or surpluses) to measured demand.

The CAISO proposes that the balancing account continue to be cleared on a daily basis. As is the case today, the balancing account will be allocated to measured demand. However, the balancing account will now be funded by four streams of revenue.[54] The first stream is revenue from the CRR auction, as it is today. The second stream is congestion revenues associated with constraints in hours where no CRRs have implied flows on the constraint, which differs from today. The third stream is Integrated Forward Market (IFM) congestion fund credits associated with existing transmission rights and transmission ownership rights, as it is today. The fourth stream of revenue to the balancing account will be any charges collected for day-ahead ancillary service awards at the interties because the CAISO has not identified a way to allocate these charges to specific constraints, as these charges are allocated today.[55] This change, however, maintains the *status quo* in the sense that these charges currently are added to the pool of funds available to compensate CRRs but essentially are allocated to

54 Revised tariff section 11.2.4.5.

55 *See* tariff section 11.10.1.1.1.

measured demand as the ultimate guarantor of CRR revenue adequacy. With that guarantee no longer in place, those funds will now be directly allocated to measured demand.

e. Additional Adjustments to CRR Payments for Prohibited Behavior

The CAISO tariff contains two sets of rules that take back payments for prohibited behavior. The first is in section 11.2.4.6 of the CAISO tariff and it takes back CRR payments from market participants that engage in virtual bidding that inappropriately expands CRR payments based on the impact of the virtual bid on transmission constraints, also referred to as the "CRR clawback rule." The second is in section 11.2.4.7 of the CAISO tariff and it takes back CRR payments from market participants that engage in prohibited circular trades at the interties. These rules will remain in place.

The proposed CRR revenue insufficiency shortfall allocation will consider the revenue insufficiency that remains associated with each constraint after the clawback rule and circular trade adjustments have been applied. All CRRs with implied flow over constraints where clawbacks or circular trade adjustments occur will receive their proportion of a market participant's clawback or circular trade credit. Also, each CRR's proportion of the revenue insufficiency shortfalls and surpluses will be adjusted by the amount that the CRR holder is charged for the existing clawback or circular trade adjustment. Finally, a CRR subject to a revenue adjustment will not be able to recoup the clawback or circular trade adjustment through an allocation of excess congestion revenue in other hours. Any eligibility that CRR has for surplus distribution payments will account for the revenue adjustment.

2. Comparison of CAISO Proposal to Existing Practices in Other Markets

These proposed changes will align the CAISO's methodology for allocating congestion revenue insufficiency more closely with the approved methodologies for most ISOs and RTOs, where congestion revenue shortfalls are allocated to the holders of financial transmission rights.

PJM Interconnection, L.L.C. (PJM), ISO New England Inc. (ISO-NE), the Midcontinent Independent System Operator, Inc. (MISO), and Southwest Power Pool, Inc. (SPP) each compare congestion revenues with the amounts due to financial transmission rights holders[56] on an aggregated basis over various

[56] The other ISOs and RTOs use terms other than CRR to designate their own financial transmission rights products. PJM, ISO-NE, and the MISO use the term financial transmission right (FTR) and SPP uses the term transmission congestion right (TCR). The market designs of those other ISOs and RTOs also include auction revenue rights (ARRs) that can be converted

defined periods of time (hourly, daily, monthly and/or annual). Any shortfalls or surpluses based on those comparisons over the defined periods are allocated pro rata to the rights holders, up to the levels of their target financial transmission rights values, and any residual surpluses are carried forward to a subsequent period. At the end of the last period, any remaining surplus is allocated pro rata to financial transmission rights holders, auction revenue rights holders, market participants, and/or transmission customers, depending on the specific tariff provisions of the ISO or RTO.[57]

Similar to the approaches taken by PJM, ISO-NE, the MISO, and SPP, albeit on a constraint-specific rather than an aggregated basis, the CAISO will reduce CRR payments so as not to exceed the collected congestion revenues. For each constraint that has a CRR payment shortfall, the CAISO will reduce CRR payments in the hourly CRR settlement pro rata based on settled CRR flow over the constraint in the hour that the shortfall occurred. As discussed above, the CAISO has determined that, in the context of the CAISO market design, isolating the allocation of the revenue insufficiency by constraint is more equitable in that it does not force CRRs held in less constrained areas to fund insufficiencies in more constrained areas.

The New York Independent System Operator, Inc. (NYISO) allocates shortfalls in congestion rents in its day-ahead market on a constraint-by-constraint basis.[58] The NYISO differs from the other ISOs and RTOs discussed above in that it allocates net congestion rent shortfalls or excess on a monthly basis among transmission owners that have taken on the obligation to support the full funding of transmission congestion contracts (TCCs), which are the NYISO version of financial transmission rights.[59] The CAISO proposes to allocate CRR payment shortfall costs on individual constraints, which is how the NYISO allocates shortfalls in congestion rents.

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into FTRs and TCRs. For purposes of the discussion in the paragraph above, the CAISO refers to FTRs and TCRs together as financial transmission rights.

57 *See* PJM Open Access Transmission Tariff (OATT), attachment K, at sections 5.2.3 and 5.2.5 – 5.2.6; ISO-NE Transmission, Markets, and Services Tariff, Market Rule 1, at section III.5.2.4 – III.5.2.6; MISO Open Access Transmission, Energy and Operating Reserve Markets Tariff at section 39.3.4; SPP OATT, attachment AE, at sections 8.5.12 – 8.5.14. Implementation details regarding these tariff provisions are provided, respectively, in sections 8.4, 16.4, and 17.3 of PJM Manual 28: Operating Agreement Accounting (June 1, 2018); section 6 of ISO-NE Manual M-28: Market Rule Accounting (March 1, 2017); section 2.9.3 of MISO Business Practices Manual 005: Market Settlements (June 9, 2018); and sections 4.5.8.14 through 4.5.8.17 of the Market Protocols for the SPP Integrated Marketplace (June 12, 2018). The ISOs and RTOs also apply comparable provisions to allocations of ARR shortfalls.

58 NYISO OATT, attachment N, at section 20.2.4.

59 NYISO OATT, attachment N, at section 20.2.5.

Although some stakeholders have proposed allocating CRR revenue insufficiency to transmission owners, the CAISO believes allocation to CRR holders is reasonable for all the reasons discussed above. One of the objectives of this initiative is to improve the efficiency of the CRR auction. Allocating the revenue insufficiency to the CRR holders has the benefit of assigning the shortfalls to entities that have the ability to take positions in the auction or choose CRRs that are aligned with the expected value of the CRR. Assigning the costs to the transmission owners does not create any beneficial targets for market participants because the transmission owners do not participate in those processes. In addition, allocating revenue deficiencies to transmission owners would be a more extensive change than the CAISO could develop and implement as part of Track 1B, which is proposed for implementation in September 2018 prior to its annual CRR allocation and auction processes for 2019.

IV. Responses to Stakeholder Comments

Stakeholders submitted multiple rounds of comments addressing the Track 1B initiative.[60] A number of stakeholders support the CAISO's proposals in their entirety.

Some stakeholders support the proposal to allocate CRR shortfalls to CRR flow over each constraint associated with the revenue insufficiency as an improvement to the current market rules, but seek to effectively eliminate the current CRR auction. Specifically, they contend that a "willing counterparty" system is preferable to the current proposal, where a willing counterparty would fund a CRR's payments in exchange for a fixed payment. However, as noted in the Track 1A filing, while there is some room for improving the CRR auction process, there is no evidence to suggest that there are problems with the CRR auction design itself.[61] Such an overhaul is unsupported, especially in light of the Commission's findings that the CAISO's general CRR auction model is just and reasonable.[62]

The CAISO agrees that CRR market rules should be enhanced to minimize auction revenue shortfalls. The CAISO is concerned, however, that the

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60 A table summarizing stakeholder comments, and the CAISO's responses to those comments, is provided as Attachment F to this tariff amendment.

61 *See* April 11 Tariff Amendment in Docket No. ER18-1344 at 22.

62 *Cal. Indep. Sys. Operator Corp.*, 116 FERC ¶ 61,274 (2006) (September 2006 MRTU Order), *order on reh'g*, 119 FERC ¶ 61,076, *order on reh'g*, 120 FERC ¶ 61,023 (2007), *reh'g denied*, 124 FERC ¶ 61,094 (2008), *aff'd, Sacramento Mun. Util. Dist. v. FERC*, 616 F.3d 520 (D.C. Cir. 2010). *See also Cal. Indep. Sys. Operator Corp.*, 149 FERC ¶ 61,093 (2014) (order approving tariff revisions to include "nodal megawatt limit constraints" in calculating market participants' CRR settlement statements.).

adverse impact to the overall wholesale energy market of discontinuing the CRR auction's sales of CAISO-market backed CRRs would exceed the benefit of eliminating the auction revenue shortfall. The Commission has long held that the availability of financial transmission rights to market participants is a key element of providing open access in regions that have markets based on locational marginal pricing.[63] The Commission has also recognized that financial transmission right "allocation methods that combine a direct allocation of auction revenue rights with a transmission rights auction offer many advantages."[64]

Auctioned CRRs enable all classes of market participants to participate in the CAISO markets under equivalent conditions by providing them all the same means to efficiently hedge day-ahead market congestion cost risk, particularly the risk associated with delivering power as part of forward contracts. This enables efficient forward contracting, which enables load to be served at the least cost and protects load against market power, particularly during tight supply conditions. This is particularly important in today's environment in which generation is retiring and a significant percentage of load is migrating to community choice aggregators. Community choice aggregators often must purchase at least a portion of their CRRs in the auction because the CAISO's CRR allocations are based on historical load and their load is increasing. The auction also allows suppliers to have access to the same hedging mechanism that load does so they can participate in the market under equivalent conditions.

Some commenters argue that the CAISO should allocate congestion revenue shortfalls in the day-ahead market to transmission owners or a combination of transmission owners and allocated CRR holders. The CAISO believes that the allocation of congestion revenue shortfalls to CRR holders themselves – a methodology used by many ISOs and RTOs – is an equitable approach to allocation. As explained above, each CRR holder will be allocated their own shortfalls. All allocated and auctioned CRRs represent the same market product, and suggesting that revenue deficiencies should be borne by transmission owners and allocated CRR holders would provide auctioned CRR holders with an unfair advantage. In addition, the alternative allocation methodologies proposed by some stakeholders would require more extensive changes to the CAISO's settlement systems than can be implemented in time for the 2019 CRR allocation and auction process.

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63 *Cent. Hudson Gas & Elec. Corp.*, 86 FERC ¶ 61,062, at 61,208 n.13 (1999) (finding that TCCs "significantly enhance the open access requirements of the *pro forma* tariff as an efficient substitute for the reassignment of physical transmission rights that entities obtain under the *pro forma* tariff.").

64 *Long-Term Firm Transmission Rights in Organized Electricity Markets*, Order No. 681, FERC Stats. & Regs. ¶ 31,226 at P 391, *reh'g denied*, Order No. 681-A, 117 FERC ¶ 61,201 (2006).

Other stakeholders contend that shortfall allocation should be based on the prices actually submitted to the auction, or to change the CRR auction timing to address shortfalls. But similar to the above stakeholder suggestion, those proposed changes would need more time to consider and cannot be implemented in time for CRR financial settlements in 2019. The CAISO can instead implement the proposed Track 1B changes before the 2019 settlement process. These other suggestions are potential topics for the Track 2 stakeholder initiative.

Some stakeholders oppose moving the revenue shortfall from measured demand to CRRs, claiming that CRRs should instead pool outage risks. As described earlier in this filing, the CAISO does not propose this for several reasons. Stakeholders have stated that it would be easier to estimate transmission outage risk on their own CRRs than it would be to anticipate their responsibility of a portion of overall CRR revenue adequacy. Moreover, by allocating risk to all CRR holders, incentives to exploit differences between constraints modeled in the CRR market and the day-ahead market would remain unaddressed. Allocating revenue insufficiency in this way would inequitably affect those market participants who purchased CRRs at a higher price relative to ultimate payouts versus those who purchased CRRs at a lower price.

The Department of Market Monitoring supports the Track 1B constraint-specific allocation as an improvement over the currently implemented method of allocating revenue inadequacy to measured demand.[65] The Department of Market Monitoring also recommends that, in Track 2 of the CRR auction efficiency initiative, the CAISO should consider a proposal to replace the current CRR auction with an approach where a willing counterparty would fund a CRR's payments in exchange for a fixed payment.[66] The CAISO continues to believe this effectively eliminates the auction, which as discussed above is not just and reasonable.

The Market Surveillance Committee generally supports the proposal to shift revenue shortfalls from measured demand to CRRs. In fact, the Market Surveillance Committee states that the "spirit of open access argues for distributing CRRs whose payout can be supported by the congestion rents collected in the day-ahead market, but not for selling CRRs whose payout would

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65 *See* Department of Market Monitoring Comments on CRR Auction Efficiency Initiative, dated June 18, 2018, provided as Attachment H to this filing.

66 As discussed above, the CAISO has concerns about the adverse impact to the overall wholesale energy market of discontinuing the CRR auction's sales of CAISO-market backed CRRs.

require funding from more network capacity than actually exists."[67] The Market Surveillance Committee does have concerns that the reduced CRR payouts in the day-ahead market could cause market participants to value CRRs less in the auction, potentially leading to decreasing auction revenues that are not offset by the lowered payouts.[68] Consequently, the Market Surveillance Committee suggested a decrease to the system capacity released in the annual allocation and auction process.[69] The CAISO proposed to reduce the overall amount of capacity released in the annual process to 65% in the July 17 Amendment, and the Commission accepted this proposal in the September 20 Order.

Although the CAISO did not have the time needed to accept written comments on changes it made to its proposal in response to the September 20 Order, based on stakeholder comments during the September 27, 2018, stakeholder conference call and conversations with stakeholders prior to this filing, the CAISO believes the majority of stakeholders support the CAISO's netting proposal. Moreover, a large number of stakeholders continue to believe some form of partial funding is better than no form of partial funding. The CAISO understands that some participants continue to argue that full funding is more just and reasonable and the CAISO should not pursue these changes at this time. For all the reasons stated herein, although the CAISO understands that the CAISO's current full funding has been approved by the Commission as just and reasonable, the CAISO continues to believe that it is not just and reasonable to continue to subject load serving entities to the costs of full funding. Moreover, the CAISO's proposal is consistent with the methodologies of partial funding in other ISO and RTOs the Commission has found to be just and reasonable.

V. Effective Date and Request for Expedited Treatment

In order to permit the CAISO to implement the partial funding proposal by January 1, 2019, and to afford market participants certainty over how their CRRs will be settled by the type they have to bid into the CRR auction, the CAISO respectfully requests expedited treatment of this amendment pursuant to the Guidance Order, including a shortened comment period.

In the Guidance Order, the Commission stated that a request by a RTO or ISO for expedited treatment of a tariff revision should clearly demonstrate that a rule change is required due to a flaw, why action is necessary in the market, and that the proposed tariff revision will correct the flaw.

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67 Attachment G, MSC Opinion at 7.

68 *See id.* at 11, 16, 22.

69 *Id.* at 22-23 ("We suggest that a modest reduction to 65%-70% in the annual process . . . be considered as a step toward reducing the risk of revenue shortfalls[.]").

A proposed tariff amendment qualifies for expedited treatment if the flaw meets the following criteria:

(1) it materially adversely impacts the market (due to the unanticipated workings of the tariff or unanticipated actions by market participants);

(2) it requires prompt action to prospectively revise the tariff to remove the ability to cause such material adverse impacts; and

(3) it is susceptible to a clear-cut revision or interim tariff revision or market rule.[70]

The proposed tariff amendment meets all of these criteria and qualifies for expedited treatment as it would grant the CAISO authority to implement partial funding by January 1, 2019, and it would allow market participants an opportunity to bid into the CRR annual auction, set to commence on November 13, 2018, taking into consideration the proposed settlement rules will have on the market participants.

As discussed in greater detail above, the full funding approach under the CAISO's tariff requirements today, has exposed load serving entities to significant costs driven by the insufficiency of day-ahead congestion revenue. The existing full funding approach therefore has a material adverse impact on the market. Although the CAISO has been working with stakeholders to address issues related to the efficiency of its CRR markets, the CAISO did not anticipate lacking authority to implement its partial funding proposal. The CAISO endeavored to formulate a robust proposal earlier this year, which it did and brought it to the Commission in time to implement the partial funding by January 1, 2019. Since other ISOs and RTOs do not have full funding of their financial transmission rights, it was reasonable to anticipate that a comparable proposal would be accepted.

The Commission's rejection of the partial funding proposal in the CAISO's July 17 Amendment raises the potential that customers in the CAISO market will be exposed to the potentially high costs of revenue inadequacy over the 2019 CRR year. The CAISO recognizes that, given it is requesting an effective date of January 1, 2019, some could claim there is no need for expedited treatment. Any such claims, however, would fail to consider a key factor. Bids for the annual CRR auction are due on November 13, 2019. The CRR annual auctions are the last opportunity for market participants to adjust their seasonal CRR portfolio to take into account their expected settlement exposure. Because,

[70] Guidance Order at P 2.

under the CAISO's proposal, CRRs will be settled differently than they are today, participants may need to adjust their holdings to ensure they are adequately hedged for delivery. With clear rules in place before the auction begins, participants will not be forced to bid blindly in the auction as to the fundamental rules regarding how the instruments on which they are bidding will be settled financially. For these reasons, the CAISO has determined that prompt action is required to prospectively revise the tariff. The Commission should act quickly and accept CAISO proposal so that participants have an opportunity to adjust their bids accordingly.

In its September 20 Order, the Commission did not reject the CAISO's partial funding proposal on the basis of the fundamental of the proposal to no longer fully fund CRRs. Rather it rejected it because of one element of the proposal that the CAISO can readily address in time for CRRs that have terms that settle in 2019 and provide relief to the market. The CAISO is proposing in this filing essentially the same tariff enhancements as it did in the July 17 Amendment with a singular (albeit significant) minor change that addresses the Commission's concerns in the September 20 Order. As such, the CAISO's filing involves a clear-cut modification to the CAISO tariff, consistent with the requirements of the Guidance Order.

Stakeholders have already had the opportunity to comment on the CAISO's overall proposal and the Commission has already considered the CAISO's proposal and all submitted comments in Docket No. ER18-2034-000. As such, the Commission and all interested parties already have a well-developed record to inform consideration of the CAISO's modified proposal.

The Commission did not reject the CAISO's proposal on the basis of any other feature other than the fact that the CAISO had not included netting of prevailing and counterflow CRRs. There is no need for a lengthier process to consider a change to the proposal that is fashioned to address the Commission's concerns directly. On the other hand, extending an order to beyond November 9, 2018, cause market participants to miss an opportunity to adjust their bids taking into consideration how CRRs will be settled in 2019.

Moreover, an order by the requested date will provide both the CAISO and its market participants with needed certainty to finalize implementation of these revisions in advance of the proposed effective date.

For the foregoing reasons, the CAISO requests that the Commission establish an expedited comment date no later than October 11, 2018, and issue

an order accepting this filing by November 9, 2018 with an effective date of January 1, 2019.[71]

VI. Communications

The CAISO requests that all correspondence and other communications concerning this filing be served upon the following:

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The CAISO also requests waiver of Rule 203(b)(3) of the Commission's Rules of Practice and Procedure,[72] to allow more than two persons to be added to the service list in this proceeding.

VII. Service

The CAISO has served copies of this filing on the California Public Utilities Commission, the California Energy Commission, and all parties with scheduling coordinator agreements under the CAISO tariff. In addition, the CAISO has posted a copy of the filing on the CAISO website.

[71] The Guidance Order contemplates expedited comment periods. 111 FERC ¶ 61,009 at P 4.

[72] 18 C.F.R. § 385.203(b)(3).

VIII. Contents of Filing

In addition to this transmittal letter, this filing includes the following attachments:

Attachment A	Clean CAISO tariff sheets incorporating this tariff amendment
Attachment B	Red-lined document showing the revisions contained in this tariff amendment
Attachment C	CRR Auction Analysis Report, dated November 21, 2017
Attachment D	CRR Auction Efficiency Track 1B Draft Final Proposal Second Addendum, dated June 11, 2018
Attachment E	Memorandum of Keith Casey, Vice President, Market & Infrastructure Development, to Board of Governors on CRR Auction Efficiency Track 1B Proposal, dated June 14, 2018
Attachment F	Summary of Submitted Stakeholder Comments and Management Response, dated June 14, 2018
Attachment G	Opinion of the Market Surveillance Committee on CRR Auction Efficiency, Track 1B, dated June 13, 2018
Attachment H	Department of Market Monitoring Comments on CRR Auction Efficiency Initiative, dated June 18, 2018
Attachment I	Example of Scaling Proposal

IX. Conclusion

For the reasons set forth in this filing, the CAISO respectfully requests that the Commission issue an expedited order by November 9, 2018, accepting the tariff revisions contained in this filing effective January 1, 2019.

Respectfully submitted,

/s/ Anna McKenna

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Attachment A – Clean Tariff

Tariff Amendment to Increase Efficiency of

Congestion Revenue Rights Auctions Track 1B

California Independent System Operator Corporation

6.5.1 Communication with Market and CRR Participants and Public

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6.5.1.3 Public Market Information

6.5.1.3.1 Annually, the CAISO shall publish the following information including, but not limited to:

(a) Market Clearing Prices for all Aggregated PNodes used in the CRR Auction clearing for on-peak and off-peak.

(b) CRR Holdings by CRR Holder (including):

(i) CRR Source name(s);

(ii) CRR Sink name(s);

(iii) CRR quantity (MW) for each CRR Source(s) and CRR Sink(s);

(iv) CRR start and end dates;

(v) Time of use specifications for the CRR(s); and

(vi) Whether the CRR is a CRR Option or CRR Obligation.

6.5.1.3.2 Monthly, the CAISO shall publish the following information including, but not limited to:

(a) Market Clearing Prices for all Aggregated PNodes used in the CRR Auction clearing for on-peak and off-peak.

(b) CRR Holdings by CRR Holder (including):

(i) CRR Source name(s);

(ii) CRR Sink name(s);

(iii) CRR quantity (MW) for each CRR Source(s) and CRR Sink(s);

(iv) CRR start and end dates;

(v) Time of use specifications for the CRR(s); and

(vi) Whether the CRR is a CRR Option or a CRR Obligation.

(c) Information on how the CAISO has settled CRRs based on Transmission Constraint-specific factors pursuant to Section 11.2.4.

* * * * *

11.2.4 CRR Settlements

The CAISO will pay or charge CRR Holders as further specified in this Section 11.2.4 and its subsections.

* * * * *

11.2.4.1.2 Calculation of Hourly CRR Congestion Fund

The CAISO calculates an Hourly CRR Congestion Fund for every Transmission Constraint that is congested in the IFM in a Settlement Period. The Hourly CRR Congestion Fund specific to a particular binding Transmission Constraint in a given Settlement Period is the sum of the: (a) portion of the IFM Congestion Fund in that Settlement Period attributable to congestion on the Transmission Constraint to which the congestion fund corresponds; (b) charges specific to the Transmission Constraint calculated pursuant to Section 11.2.4.4.1; and (c) CRR revenue adjustments the CAISO may make pursuant to Sections 11.2.4.6 or 11.2.4.7 that are associated with the Transmission Constraint.

11.2.4.2 Settlement Calculation for the Different CRR Types

For the purposes of settling the various CRR Types, the CAISO will calculate the Settlement of CRRs as described in this Section 11.2.4.2. When a CRR Source or CRR Sink is a LAP, the CAISO will use the Load Distribution Factors used in the IFM to produce the LAP Price at which it will settle the CRR. When a CRR Source or CRR Sink is a Trading Hub, the CAISO will use the weighting factors used in the IFM, and in the CRR Allocation and CRR Auction processes, to produce the Trading Hub prices that it will use to settle the various CRR Types.

11.2.4.2.1 [Not Used]

11.2.4.2.2 [Not Used]

11.2.4.3 Payments and Charges for Monthly and Annual Auctions

The CAISO will charge CRR Holders for the Market Clearing Price for CRRs obtained through the clearing of the CRR Auction as described in Section 36.13.6. To the extent the CRR Holder purchases a CRR through a CRR Auction that has a negative value, the CAISO will retain the CRR Auction proceeds and apply them to credit requirements of the applicable CRR Holder, in accordance with Section 12.6.3 of the CAISO Tariff. The CAISO will net all revenue received and payments made through this process.

CRR Auction net revenue amounts for on-peak and off-peak usage from each CRR Auction will be separated. The CAISO will allocate CRR Auction revenues for each season coming from the annual auction uniformly across the three months comprising each season based on time of use. The CAISO will then add these on-peak and off-peak monthly amounts from the seasonal auctions to the corresponding monthly on-peak and off-peak amounts from the monthly CRR Auction for the same month to form the monthly net CRR Auction on-peak and off-peak revenues, respectively. Furthermore, the CAISO will convert these monthly net CRR Auction revenues into daily values and add them to the daily CRR Balancing Account. In particular, the daily CRR Balancing Account contribution will be the sum of: (1) the monthly net CRR Auction on-peak amount multiplied by the ratio of daily on-peak hours to monthly on-peak hours; and (2) the monthly net CRR Auction off-peak amount multiplied by the ratio of daily off-peak hours to monthly off-peak hours.

11.2.4.4 Hourly CRR Calculations, Daily CRR Settlement, and Potential Monthly Surplus Distribution Payments

11.2.4.4.1 Calculating CRR Holders' Congestion-Supported Values

For each Settlement Period, the CAISO uses the funds in the Hourly Congestion Funds calculated in Section 11.2.4.1.2 to determine the Congestion-Supported Values paid and charged to CRR Holders, by first determining all Net Modeled CRR Flow quantities. The CAISO then determines whether the Net Modeled CRR Flow results in a payment or charge to the CRR Holder.

For a CRR Holder whose Net Modeled CRR Flow over a binding Transmission Constraint is in the prevailing direction, the Congestion-Supported Value is a payment equal to the ratio of that CRR Holder's prevailing Net Modeled CRR Flow over that Transmission Constraint (accounting for revenue adjustments made pursuant to Sections 11.2.4.6 or 11.2.4.7), as compared to the sum of all CRR Holders' prevailing Net Modeled CRR Flow over that Transmission Constraint (accounting for revenue adjustments made pursuant to Sections 11.2.4.6 or 11.2.4.7). The CAISO will not pay a CRR Holder from an Hourly CRR Congestion Fund in excess of the CRR Holder's Net Modeled CRR Flow multiplied by the Shadow Price of that binding Transmission Constraint, minus any revenue adjustments made pursuant to Sections 11.2.4.6 or 11.2.4.7 that are allocated to that Transmission Constraint.

For a CRR Holder whose Net Modeled CRR Flow over a binding Transmission Constraint is in the

counter-flow direction, the Congestion-Supported Value is a charge equal to the Net Modeled CRR Flow multiplied by the Shadow Price of that binding Transmission Constraint.

The lower bound of the sum of Congestion-Supported Values for a CRR Option across the Settlement Periods of a day is zero.

The CAISO transfers any funds in an Hourly CRR Congestion Fund associated with binding Transmission Constraints to which no CRR has a positive or negative difference between the source and sink PTDFs to the CRR Balancing Account.

Any funds remaining in an Hourly CRR Congestion Fund after all funds have been allocated to CRRs or transferred to the CRR Balancing Account for that hour are reserved for potential Daily CRR Surplus Distribution Payments or Monthly CRR Surplus Distribution Payments to CRR Holders. The funds the CAISO holds in reserve for a CRR Holder pertaining to a Transmission Constraint are held in proportion to that CRR Holder's Net Modeled CRR Flow in that Settlement Period (accounting for revenue adjustments made pursuant to Sections 11.2.4.6 or 11.2.4.7) relative to the Net Modeled CRR Flow over that Transmission Constraint for all CRR Holders in that Settlement Period (accounting for revenue adjustments made pursuant to Sections 11.2.4.6 or 11.2.4.7).

11.2.4.4.2 Calculating Daily CRR Surplus Payments

The CAISO allocates the funds in a Daily Congestion Fund as a Daily CRR Surplus Distribution Payment to CRR Holders that have funds reserved for them in a Daily CRR Congestion Fund pursuant to Section 11.2.4.4.1, and whose total Congestion-Supported Values pertaining to that Transmission Constraint during the day are less than the sum of the Net Modeled CRR Flow multiplied by the Shadow Price of that binding Transmission Constraint across the day (accounting for revenue adjustments made pursuant to Sections 11.2.4.6 or 11.2.4.7). A Daily CRR Surplus Distribution Payments specific to a CRR Holder and Transmission Constraint cannot exceed the sum of the Net Modeled CRR Flow multiplied by the Shadow Price of that binding Transmission Constraint across all Settlement Periods of the day (account for revenue adjustments made pursuant to Sections 11.2.4.6 or 11.2.4.7). The CAISO adds any funds remaining in a Daily CRR Congestion Fund after it has made all necessary Daily CRR Surplus Distribution Payments to that Transmission Constraint's Monthly CRR Congestion Fund.

11.2.4.4.3 Monthly Clearing of the Monthly Constraint-Specific CRR Congestion Fund

The CAISO distributes the total of the Monthly CRR Congestion Fund at the end of each month.

The CAISO first distributes the funds in a Monthly CRR Congestion Fund as Monthly CRR Surplus Distribution Payments to CRR Holders that have funds reserved for them in a Monthly CRR Congestion Fund pursuant to Section 11.2.4.4.1 and whose total Congestion-Supported Values pertaining to that Transmission Constraint during the month, plus the Daily CRR Surplus Distribution Payments, are less than the sum of the Net Modeled CRR Flow multiplied by the Shadow Price of that binding Transmission Constraint across all Settlement Periods of the month (accounting for revenue adjustments made pursuant to Sections 11.2.4.6 or 11.2.4.7).

The CAISO distributes any funds remaining in a Monthly CRR Congestion Fund after it has made all required Monthly CRR Surplus Distribution Payments to Scheduling Coordinators in an amount equal to: (a) the funds in the Monthly CRR Congestion Fund, multiplied by (b) the ratio of each Scheduling Coordinator's Measured Demand for the relevant Trading Month (net of the Scheduling Coordinator's Measured Demand associated with valid and balanced ETC or TOR Self-Schedule quantities, which IFM Congestion Credits and/or RTM Congestion Credits were provided in the same relevant Trading Month), divided by (c) the total Measured Demand for all Scheduling Coordinators for the relevant Trading Month (net of the total Measured Demand associated with valid and balanced ETC or TOR Self-Schedule quantities, which IFM Congestion Credits and/or RTM Congestion Credits were provided in the same relevant Trading Month).

11.2.4.5 CRR Balancing Account

11.2.4.5.1 Accumulation of CRR Balancing Account Funds

The CAISO will accumulate the daily CRR Balancing Account: (1) seasonal and monthly CRR Auction revenues as described in Section 11.2.4.3; (2) any funds in an Hourly CRR Congestion Fund associated with binding Transmission Constraints to which no CRR has a positive or negative difference between the source and sink PTDF; (3) any IFM Congestion Charges associated with Day-Ahead Ancillary Services Awards as provided in Section 11.10.1.1.1; and (4) IFM Congestion Fund Credits as specified in Section 11.2.1.5.

11.2.4.5.2 Distribution of CRR Balancing Account Funds

The CAISO distributes the CRR Balancing Account to Scheduling Coordinators in an amount equal to: (a)

the funds in the CRR Balancing Account, multiplied by (b) the ratio of each Scheduling Coordinator's Measured Demand for the relevant Trading Day (net of the Scheduling Coordinator's Measured Demand associated with valid and balanced ETC or TOR Self-Schedule quantities, which IFM Congestion Credits and/or RTM Congestion Credits were provided in the same relevant Trading Day), divided by (c) the total Measured Demand for all Scheduling Coordinators for the relevant Trading Day (net of the total Measured Demand associated with valid and balanced ETC or TOR Self-Schedule quantities, which IFM Congestion Credits and/or RTM Congestion Credits were provided in the same relevant Trading Day).

11.2.4.5.3 Interest on CRR Balancing Account

Interest accruing due to the CRR Balancing Account will be at the CAISO's received interest rate and will be credited to each monthly CRR Balancing Account accrued interest fund, which is then allocated to monthly Measured Demand excluding Measured Demand associated with valid and balanced ETC, TOR, or Converted Rights Self-Schedule quantities, which IFM Congestion Credits and/or RTM Congestion Credits were provided in the same month.

11.2.4.6 Adjustment of CRR Revenue Related to Virtual Awards

In accordance with this Section 11.2.4.6, the CAISO will adjust the revenue from the CRRs of a CRR Holder that is also a Convergence Bidding Entity whenever either of the following creates a significant impact on the value of the CRRs held by that entity: the CRR Holder/Convergence Bidding Entity submits Virtual Bids; or the CRR Holder/Convergence Bidding Entity reduces in the RTM an import or export awarded in a Day-Ahead Schedule. As set forth in Section 11.32, the CAISO will also adjust the revenue from the CRRs of a CRR Holder (regardless of whether the CRR Holder is also a Convergence Bidding Entity) where the Scheduling Coordinator representing that CRR Holder reduces in the RTM an import or export awarded in a Day-Ahead Schedule.

(a) For purposes of this Section 11.2.4.6 and the definition of Flow Impact, a reduction by a Scheduling Coordinator submitting Schedules on behalf of an entity that is a CRR Holder to an import or export Schedule in the RTM will be treated as a Virtual Award if the segment of Economic Bids (but not Self-Schedule) leading to the Schedule reduction is: at an Energy Bid price greater than the Day-Ahead Market LMP at the relevant intertie, in the case of an import; or at any Energy Bid price less than the Day-Ahead Market LMP at

the relevant intertie, in the case of an export.

In addition, if the RTM Bid does not include the full MW quantity of the Day-Ahead Schedule through some combination of Economic Bid and Self-Schedule, then the MW range not covered by the RTM Bid that was included in the Day-Ahead Schedule will be treated as a Virtual Award.

For each CRR Holder subject to this Section 11.2.4.6, for each hour, and for each Transmission Constraint binding in the IFM or FMM the CAISO will calculate the Flow Impact of the Virtual Awards awarded to the Scheduling Coordinator that represents the CRR Holder. For the purposes of calculating the CRR adjustments as specified in this Section 11.2.4.6, the CAISO will include nodal MW constraints that the CAISO applies to Eligible PNodes in the IFM pursuant to Section 30.10.

(b) The CAISO will determine the peak and off-peak hours of the day where Congestion on the Transmission Constraint was significantly impacted by the Virtual Awards awarded to the Scheduling Coordinator that represents the CRR Holder. Congestion on the Transmission Constraint will be deemed to have been significantly impacted by the Virtual Awards awarded to the Scheduling Coordinator that represents the CRR Holder if the Flow Impact passes two criteria. First, the Flow Impact must be in the direction to increase the sum of the CRR Holder's Notional CRR Values in their portfolio in that Settlement Period. Second, the Flow Impact must exceed the threshold percentage of the flow limit for the Transmission Constraint. The threshold percentage is ten (10) percent of the flow limit for each Transmission Constraint.

(c) For each peak or off-peak hour that passes both criteria in Section 11.2.4.6(b), the CAISO will compare the Transmission Constraint's impact on the Day-Ahead Market value of the CRR Holder's CRR portfolio with the Transmission Constraint's impact on the FMM value of the CRR Holder's CRR portfolio, as applicable.

(d) The CAISO will adjust the peak or off-peak period revenue from the CRR Holder's CRRs in the event that, over the peak or off-peak period of a day, the Transmission Constraint's contribution to the Day-Ahead Market value of the CRR Holder's CRR portfolio exceeds

the Transmission Constraint's contribution to the FMM value of the CRR Holder's CRR portfolio, as applicable. The amount of the peak period adjustment will be the amount that the Transmission Constraint's contribution to the Day-Ahead Market value of the CRR Holder's CRR portfolio exceeds the Transmission Constraint's contribution to the FMM value of the CRR Holder's CRR portfolio for the peak-period hours that passed both criteria in Section 11.2.4.6(b), as applicable. The amount of the off-peak period adjustment will be the amount that the Transmission Constraint's contribution to the Day-Ahead Market value of the CRR Holder's CRR portfolio exceeds the Transmission Constraint's contribution to the FMM value of the CRR Holder's CRR portfolio for the off-peak period hours that passed both criteria in Section 11.2.4.6(b), as applicable.

The CAISO includes all adjustments of CRR revenue calculated pursuant to this Section 11.2.4.6 in the Hourly CRR Congestion Fund for the applicable Transmission Constraint corresponding to the CRR payments that would have been made but for the revenue adjustments as specified in Section 11.2.4.1.2.

11.2.4.7 Adjustment of CRR Revenue Related to Schedules that Source and Sink in the Same Balancing Authority Area

The CAISO will adjust the revenue from the CRRs of a CRR Holder where the Scheduling Coordinator representing that CRR Holder has submitted Bids (including Self-Schedules), in violation of Section 30.5.5 and the resulting Schedule(s) impacts the value of the CRRs in the DAM held by that CRR Holder. Such adjustment will occur if the following circumstances are all met:

(a) A portion of the E-Tag that uses the CAISO Controlled Grid relates to a Schedule in the Day-Ahead Market;

(b) The scheduled MW on the portion of the E-Tag using the CAISO Controlled Grid has a positive PTDF on a congested transmission element, where that congestion is measured in the direction of the CRR; and

(c) The CRR Holder would receive payments from CRRs on the congested transmission element.

If such circumstances occur, the CAISO adjusts the CRR revenue in that Settlement Period sot that the additional net CRR revenue that otherwise would be earned from the congestion created by the Schedule

that results from the Bids submitted in violation of Section 30.5.5 is not paid to the CRR Holder. Instead, the CAISO will add those funds to the Hourly CRR Congestion Fund for the applicable Transmission Constraint.

* * * * *

11.29.5.3 Data Files

Settlement Statements relating to each Scheduling Coordinator, CRR Holder, Black Start Generator or Participating TO will be accompanied by data files of supporting information that includes the following for each Settlement Period of the Trading Day:

(a) the aggregate quantity (in MWh) of Energy supplied or withdrawn by the Scheduling Coordinator Metered Entities represented by the Scheduling Coordinator;

(b) the aggregate quantity (in MW) and type of Ancillary Services capacity provided or purchased;

(c) the relevant prices that the CAISO has applied in its calculations;

(d) details of the scheduled quantities of Energy and Ancillary Services accepted by the CAISO in the Day-Ahead Market and the RTM;

(e) details of FMM Instructed Imbalance Energy or RTD Imbalance Energy and penalty payments;

(f) details of any payments or charges associated with the CRR Auctions; and

(g) detailed calculations of all fees, charges and payments allocated among Scheduling Coordinators and each Scheduling Coordinator's share.

* * * * *

36.2.1 CRR Obligation

A CRR Obligation entitles its holder to receive a payment from the CAISO or obligates it to make a payment to the CAISO as detailed in Section 11.2.4.4.

36.2.2 CRR Options

A CRR Option entitles its holder to receive payments as detailed in Section 11.2.4.4.

* * * * *

36.2.8 Limitations on Funding of CRRs

Payments of CRR-related payments may be suspended if a System Emergency as described in Section 7.7.4, an Uncontrollable Force as described in Section 14, or a Participating TO's withdrawal of facilities or Entitlements from the CAISO Controlled Grid as described in Section 36.8.7 leaves the CAISO with inadequate revenues.

* * * * *

- Congestion-Supported Value

As provided in Section 11.2.4.4, a value, specific to a given Transmission-Constraint and Settlement period, that a CRR Holder is paid or charged for its CRRs based on Net Modeled CRR Flow.

* * * * *

- [Not Used]

* * * * *

- CRR Obligation

A financial instrument that entitles the CRR Holder to payments or charges as specified in Section 11.2.4.

* * * * *

- CRR Option

A financial instrument that entitles its holder to payments as specified in Section 11.2.4.

* * * * *

- [Not Used]

* * * * *

- Daily CRR Congestion Fund

The pool of funds, corresponding to a specific Transmission Constraint, held by the CAISO, that the CAISO uses to make Daily CRR Surplus Distribution Payments corresponding to that Transmission Constraint.

* * * * *

- Daily CRR Surplus Distribution Payment

A payment, corresponding to a specific Transmission Constraint, the CAISO makes available to a CRR Holder as described in Section 11.2.4.4.2.

* * * * *

- Hourly CRR Congestion Fund

The pool of funds the CAISO collects and holds pursuant to Section 11.2.4.1.2, corresponding to a specific Transmission Constraint and Settlement Period, that the CAISO has available to pay CRR Holders for the portion of their CRRs modeled as having a PTDF on that Transmission Constraint.

* * * * *

- [Not Used]

* * * * *

- Monthly CRR Congestion Fund

The pool of funds the CAISO collects and holds, corresponding to a specific Transmission Constraint, to make Monthly CRR Surplus Distribution Payments corresponding to that Transmission Constraint.

* * * * *

- Monthly CRR Surplus Distribution Payment

A payment, corresponding to a specific Transmission Constraint, the CAISO makes to a CRR Holder as described in Section 11.2.4.4.2.

* * * * *

- Net Modeled CRR Flow

For CRR Obligations, the net MW quantity from CRR Obligations within a CRR Holder’s portfolio that the

CAISO models as flowing over a particular binding Transmission Constraint (accounting both for prevailing flow and counter-flow modeled over that binding Transmission Constraint).

For CRR Options, the net MW quantity from a given CRR Option that the CAISO models as flowing over a particular binding Transmission Constraint. The CAISO does not net the MWs of modeled flow from a given CRR Obligation with MWs of modeled flow from CRR Obligations or other CRR Options in a CRR Holder's portfolio.

* * * * *

- Notional CRR Value

For a given CRR in a Settlement Period, the product of: (A) the MCC at the CRR Sink minus the MCC at the CRR Source; and (B) the MW quantity for that Settlement Period. The Notional CRR Value for a CRR Obligation can be a non-positive value for a Settlement Period. The CAISO sets the Notional CRR Value for a CRR Option in a given Settlement Period to zero (0) if the products of the MW quantity of the CRR Option and the difference between the MCC at the CRR Sink and MCC at the CRR Source is a negative amount.

* * * * *

Attachment B – Marked Tariff

Tariff Amendment to Increase Efficiency of

Congestion Revenue Rights Auctions Track 1B

California Independent System Operator Corporation

6.5.1 Communication with Market and CRR Participants and Public

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6.5.1.3 Public Market Information

6.5.1.3.1 Annually, the CAISO shall publish the following information including, but not limited to:

(a) Market Clearing Prices for all Aggregated PNodes used in the CRR Auction clearing for on-peak and off-peak.~~;~~

(b) CRR Holdings by CRR Holder (including):

(i) CRR Source name(s);

(ii) CRR Sink name(s);

(iii) CRR quantity (MW) for each CRR Source(s) and CRR Sink(s);

(iv) CRR start and end dates;

(v) Time of use specifications for the CRR(s); and

(vi) Whether the CRR is a CRR Option or CRR Obligation.

6.5.1.3.2 Monthly, the CAISO shall publish the following information including, but not limited to:

(a) Market Clearing Prices for all Aggregated PNodes used in the CRR Auction clearing for on-peak and off-peak.~~;~~

(b) CRR Holdings by CRR Holder (including):

(i) CRR Source name(s);

(ii) CRR Sink name(s);

(iii) CRR quantity (MW) for each CRR Source(s) and CRR Sink(s);

(iv) CRR start and end dates;

(v) Time of use specifications for the CRR(s); and

(vi) Whether the CRR is a CRR Option or a CRR Obligation.

(c) Information on how the CAISO has settled CRRs based on Transmission Constraint-specific factors pursuant to Section 11.2.4.

* * * * *

11.2.4 CRR Settlements

The CAISO will pay or charge CRR Holders as further specified in this Section 11.2.4 and its subsections. ~~CRR Holders will be paid or charged for Congestion costs depending on the type of CRRs held by the CRR Holder, the direction of Congestion as measured through the IFM, and the LMP as calculated in the IFM. CRRs will be funded through the revenues associated with the IFM Congestion Charge, CRR Charges, and the CRR Balancing Account. The CRR Payments and CRR Charges will be settled first on a daily basis for each Settlement Period of the DAM. A daily true up will then be conducted in the clearing of the CRR Balancing Account pursuant to Section 11.2.4.4.1.~~

* * * * *

11.2.4.1.2 Calculation of ~~IFM~~ Hourly CRR Congestion Fund

The CAISO calculates an Hourly CRR Congestion Fund for every Transmission Constraint that is congested in the IFM in a Settlement Period. The Hourly CRR Congestion Fund specific to a particular binding Transmission Constraint in a given Settlement Period is the sum of the: (a) portion of the IFM Congestion Fund in that Settlement Period attributable to congestion on the Transmission Constraint to which the congestion fund corresponds; (b) charges specific to the Transmission Constraint calculated pursuant to Section 11.2.4.4.1; and (c) CRR revenue adjustments the CAISO may make pursuant to Sections 11.2.4.6 or 11.2.4.7 that are associated with the Transmission Constraint. ~~For each Settlement Period of the IFM, the CAISO will determine the IFM Congestion Fund, which will consist of the funds available to pay CRR Holders in any Settlement Period as follows:~~

- ~~The CAISO will add to the IFM Congestion Fund the IFM Congestion Charge computed as described in Section 11.2.4.1, minus any IFM Congestion Credits as specified in Section 11.2.1.5;~~
- ~~The CAISO will add to the IFM Congestion Fund any CRR Charges calculated pursuant to Section 11.2.4.2.2; and~~
- ~~The CAISO will add to the IFM Congestion Fund any IFM Congestion Charges associated with Day-Ahead Ancillary Services Awards as provided in Section 11.10.1.1.1.~~

11.2.4.2 Settlement Calculation for the Different CRR Types

For the purposes of settling ~~determining the CRR Payments and CRR Charges based on~~ the various CRR Types, the CAISO will calculate the Settlement of CRRs as described in this Section 11.2.4.2. When a CRR Source or CRR Sink is a LAP, the CAISO will use the Load Distribution Factors used in the IFM ~~will be used~~ to produce the LAP Price at which it will settle the CRR ~~Payments or CRR Charges will be settled~~. When a CRR Source or CRR Sink is a Trading Hub, the CAISO will use the weighting factors used in the IFM, and in the CRR Allocation and CRR Auction processes, ~~will also be used~~ to produce the Trading Hub prices that it will ~~be~~ use~~d~~ to settle the various CRR Types~~CRR Payments and CRR Charges~~.

11.2.4.2.1 [Not Used] ~~Point-to-Point CRR Options~~

~~For each CRR Holder, the CAISO will calculate a CRR Payment for each Point-to-Point CRR Option held by the CRR Holder equal to the product of: 1) the MCC at the CRR Sink minus the MCC at the CRR Source; and 2) the MW quantity of the CRR, if that amount is positive. If the resulting amount is negative, the CAISO will not assess a charge for the relevant CRR Holder for the negative amount.~~

11.2.4.2.2 [Not Used] ~~Point-to-Point CRR Obligations~~

~~For each CRR Holder, the CAISO will calculate a CRR Payment for each CRR Obligation for a Point-to-Point CRR held by the CRR Holder, equal to the product of: 1) the MCC at the CRR Sink minus the MCC at the CRR Source; and 2) the MW quantity of the CRR, if that amount is positive. If the resulting amount is negative, the CAISO will calculate a CRR Charge for the relevant CRR Holder equal to that negative amount.~~

11.2.4.3 Payments and Charges for Monthly and Annual Auctions

The CAISO will charge CRR Holders for the Market Clearing Price for CRRs obtained through the clearing of the CRR Auction as described in Section 36.13.6. To the extent the CRR Holder purchases a CRR through a CRR Auction that has a negative value, the CAISO will retain the CRR Auction proceeds and apply them to credit requirements of the applicable CRR Holder, in accordance with Section 12.6.3 of the CAISO Tariff. The CAISO will net all revenue received and payments made through this process. CRR Auction net revenue amounts for on-peak and off-peak usage from each CRR Auction will be separated. The CAISO will allocate CRR Auction revenues for each season coming from the annual auction ~~are first allocated~~ uniformly across the three months comprising each season based on time of

use. The CAISO will then add ~~T~~these on-peak and off-peak monthly amounts from the seasonal auctions ~~are then added~~ to the corresponding monthly on-peak and off-peak amounts from the monthly CRR Auction for the same month to form the monthly net CRR Auction on-peak and off-peak revenues, respectively. Furthermore, the CAISO will convert these monthly net CRR Auction revenues ~~will then be converted~~ into daily values and add~~ed~~ them to the ~~D~~daily CRR Balancing Account~~s~~. In particular, the daily CRR Balancing Account contribution will be the sum of: (1) the monthly net CRR Auction on-peak amount multiplied by the ratio of daily on-peak hours to monthly on-peak hours; and (2) the monthly net CRR Auction off-peak amount multiplied by the ratio of daily off-peak hours to monthly off-peak hours.

11.2.4.4 Hourly CRR Calculations, Daily CRR Settlement, and Potential Monthly Surplus Distribution Payments

11.2.4.4.1 Calculating CRR Holders' Congestion-Supported Values

For each Settlement Period, the CAISO uses the funds in the Hourly ~~IFM~~ Congestion Funds calculated in Section 11.2.4.1.2 to determine the Congestion-Supported Values paid and charged to CRR Holders, by first determining all Net Modeled CRR Flow quantities. The CAISO then determines whether the Net Modeled CRR Flow results in a payment or charge to the CRR Holder.

For a CRR Holder whose Net Modeled CRR Flow over a binding Transmission Constraint is in the prevailing direction, the Congestion-Supported Value is a payment equal to the ratio of that CRR Holder's prevailing Net Modeled CRR Flow over that Transmission Constraint (accounting for revenue adjustments made pursuant to Sections 11.2.4.6 or 11.2.4.7), as compared to the sum of all CRR Holders' prevailing Net Modeled CRR Flow over that Transmission Constraint (accounting for revenue adjustments made pursuant to Sections 11.2.4.6 or 11.2.4.7). The CAISO will not pay a CRR Holder from an Hourly CRR Congestion Fund in excess of the CRR Holder's Net Modeled CRR Flow multiplied by the Shadow Price of that binding Transmission Constraint, minus any revenue adjustments made pursuant to Sections 11.2.4.6 or 11.2.4.7 that are allocated to that Transmission Constraint.

For a CRR Holder whose Net Modeled CRR Flow over a binding Transmission Constraint is in the counter-flow direction, the Congestion-Supported Value is a charge equal to the Net Modeled CRR Flow multiplied by the Shadow Price of that binding Transmission Constraint.

The lower bound of the sum of Congestion-Supported Values for a CRR Option across the Settlement

Periods of a day is zero.

The CAISO transfers any funds in an Hourly CRR Congestion Fund associated with binding Transmission Constraints to which no CRR has a positive or negative difference between the source and sink PTDFs to the CRR Balancing Account.

Any funds remaining in an Hourly CRR Congestion Fund after all funds have been allocated to CRRs or transferred to the CRR Balancing Account for that hour are reserved for potential Daily CRR Surplus Distribution Payments or Monthly CRR Surplus Distribution Payments to CRR Holders. The funds the CAISO holds in reserve for a CRR Holder pertaining to a Transmission Constraint are held in proportion to that CRR Holder's Net Modeled CRR Flow in that Settlement Period (accounting for revenue adjustments made pursuant to Sections 11.2.4.6 or 11.2.4.7) relative to the Net Modeled CRR Flow over that Transmission Constraint for all CRR Holders in that Settlement Period (accounting for revenue adjustments made pursuant to Sections 11.2.4.6 or 11.2.4.7)~~will be used to pay CRR Holders that are owed CRR Payments. In the hourly settlement of CRR Payments for the Settlement Period, all CRR Holders will be paid and charged fully according to their entitlements. Any surplus revenue for the Settlement Period after making all hourly CRR Payments will go to the CRR Balancing Account for use in the end-of-day clearing of the CRR Balancing Account processes pursuant to Section 11.2.4.4.1. Any revenue deficiency for the Settlement Period, will be tracked for further Settlement during the monthly clearing process as described in Section 11.2.4.4.1. The hourly Settlement of CRRs for each CRR Holder will be based on the type of CRR holdings as described in Section 11.2.4.2. The CRR Holder's hourly CRR Settlement amount will be the net of the holder's CRR Payments for CRR Options or CRR Obligations, and the holder's CRR Charges for CRR Obligations out of these holdings~~.

11.2.4.4.2~~1~~ Calculating Daily CRR Surplus Payments ~~Daily Clearing of the CRR Balancing Account - Full Funding of CRRs~~

The CAISO allocates the funds in a Daily Congestion Fund as a Daily CRR Surplus Distribution Payment to CRR Holders that have funds reserved for them in a Daily CRR Congestion Fund pursuant to Section 11.2.4.4.1, and whose total Congestion-Supported Values pertaining to that Transmission Constraint during the day are less than the sum of the Net Modeled CRR Flow multiplied by the Shadow Price of that binding Transmission Constraint across the day (accounting for revenue adjustments made pursuant to

Sections 11.2.4.6 or 11.2.4.7). A Daily CRR Surplus Distribution Payments specific to a CRR Holder and Transmission Constraint cannot exceed the sum of the Net Modeled CRR Flow multiplied by the Shadow Price of that binding Transmission Constraint across all Settlement Periods of the day (account for revenue adjustments made pursuant to Sections 11.2.4.6 or 11.2.4.7). The CAISO adds any funds remaining in a Daily CRR Congestion Fund after it has made all necessary Daily CRR Surplus Distribution Payments to that Transmission Constraint's Monthly CRR Congestion Fund~~At the end of each day, all CRR Payment shortfalls for all CRR Holders will be paid in full and all CRR Charge shortfalls will be fully charged through the CRR Balancing Account clearing process. The net of these CRR Charges and CRR Payment shortfalls will be added to the CRR Balancing Account for the applicable day. Any surplus or shortfall revenue amounts in the CRR Balancing Account will be distributed to Scheduling Coordinators in an amount equal to (a) the CRR Balancing Account surplus or shortfall amounts, times (b) the ratio of each Scheduling Coordinator's Measured Demand (net of the Scheduling Coordinator's Measured Demand associated with valid and balanced ETC or TOR Self-Schedule quantities, which IFM Congestion Credits and/or RTM Congestion Credits were provided in the same relevant day), divided by (c) the total Measured Demand for all Scheduling Coordinators for the relevant day (net of the total Measured Demand associated with valid and balanced ETC or TOR Self-Schedule quantities, which IFM Congestion Credits and/or RTM Congestion Credits were provided in the same relevant day)~~.

11.2.4.4.3 Monthly Clearing of the Monthly Constraint-Specific CRR Congestion Fund

The CAISO distributes the total of the Monthly CRR Congestion Fund at the end of each month.

The CAISO first distributes the funds in a Monthly CRR Congestion Fund as Monthly CRR Surplus Distribution Payments to CRR Holders that have funds reserved for them in a Monthly CRR Congestion Fund pursuant to Section 11.2.4.4.1 and whose total Congestion-Supported Values pertaining to that Transmission Constraint during the month, plus the Daily CRR Surplus Distribution Payments, are less than the sum of the Net Modeled CRR Flow multiplied by the Shadow Price of that binding Transmission Constraint across all Settlement Periods of the month (accounting for revenue adjustments made pursuant to Sections 11.2.4.6 or 11.2.4.7).

The CAISO distributes any funds remaining in a Monthly CRR Congestion Fund after it has made all required Monthly CRR Surplus Distribution Payments to Scheduling Coordinators in an amount equal to:

(a) the funds in the Monthly CRR Congestion Fund, multiplied by (b) the ratio of each Scheduling Coordinator's Measured Demand for the relevant Trading Month (net of the Scheduling Coordinator's Measured Demand associated with valid and balanced ETC or TOR Self-Schedule quantities, which IFM Congestion Credits and/or RTM Congestion Credits were provided in the same relevant Trading Month), divided by (c) the total Measured Demand for all Scheduling Coordinators for the relevant Trading Month (net of the total Measured Demand associated with valid and balanced ETC or TOR Self-Schedule quantities, which IFM Congestion Credits and/or RTM Congestion Credits were provided in the same relevant Trading Month).

11.2.4.5 CRR Balancing Account

11.2.4.5.1 Accumulation of CRR Balancing Account Funds

The CAISO will accumulate the daily CRR Balancing Account ~~will accumulate~~: (1) ~~the~~ seasonal and monthly CRR Auction revenues ~~amounts that were converted into daily CRR Balancing Account values~~ as described in Section 11.2.4.3; (2) any funds in an Hourly CRR Congestion Fund associated with binding Transmission Constraints to which no CRR has a positive or negative difference between the source and sink PTDF~~surplus revenue or shortfall generated from hourly CRR Settlements as described in Section 11.2.4.4~~; ~~and~~ (3) any IFM Congestion Charges associated with Day-Ahead Ancillary Services Awards as provided in Section 11.10.1.1.1; and (4) IFM Congestion Fund Credits as specified in Section 11.2.1.5~~adjustments of CRR revenue due to virtual bidding or Intertie scheduling practices as described in Section 11.2.4.6~~.

11.2.4.5.2 Distribution of CRR Balancing Account Funds

The CAISO distributes the CRR Balancing Account to Scheduling Coordinators in an amount equal to: (a) the funds in the CRR Balancing Account, multiplied by (b) the ratio of each Scheduling Coordinator's Measured Demand for the relevant Trading Day (net of the Scheduling Coordinator's Measured Demand associated with valid and balanced ETC or TOR Self-Schedule quantities, which IFM Congestion Credits and/or RTM Congestion Credits were provided in the same relevant Trading Day), divided by (c) the total Measured Demand for all Scheduling Coordinators for the relevant Trading Day (net of the total Measured Demand associated with valid and balanced ETC or TOR Self-Schedule quantities, which IFM Congestion Credits and/or RTM Congestion Credits were provided in the same relevant Trading Day).

11.2.4.5.3 Interest on CRR Balancing Account

Interest accruing due to the CRR Balancing Account will be at the CAISO's received interest rate and will be credited to each monthly CRR Balancing Account accrued interest fund, which is then allocated to monthly Measured Demand excluding Measured Demand associated with valid and balanced ETC, TOR, or Converted Rights Self-Schedule quantities, which IFM Congestion Credits and/or RTM Congestion Credits were provided in the same month.

11.2.4.6 Adjustment of CRR Revenue Related to Virtual Awards

In accordance with this Section 11.2.4.6, the CAISO will adjust the revenue from the CRRs of a CRR Holder that is also a Convergence Bidding Entity whenever either of the following creates a significant impact on the value of the CRRs held by that entity: the CRR Holder/Convergence Bidding Entity submits Virtual Bids; or the CRR Holder/Convergence Bidding Entity reduces in the RTM an import or export awarded in a Day-Ahead Schedule. As set forth in Section 11.32, the CAISO will also adjust the revenue from the CRRs of a CRR Holder (regardless of whether the CRR Holder is also a Convergence Bidding Entity) where the Scheduling Coordinator representing that CRR Holder reduces in the RTM an import or export awarded in a Day-Ahead Schedule.

(a) For purposes of this Section 11.2.4.6 and the definition of Flow Impact, a reduction by a Scheduling Coordinator submitting Schedules on behalf of an entity that is a CRR Holder to an import or export Schedule in the RTM will be treated as a Virtual Award if the segment of Economic Bids (but not Self-Schedule) leading to the Schedule reduction is: at an Energy Bid price greater than the Day-Ahead Market LMP at the relevant intertie, in the case of an import; or at any Energy Bid price less than the Day-Ahead Market LMP at the relevant intertie, in the case of an export.

In addition, if the RTM Bid does not include the full MW quantity of the Day-Ahead Schedule through some combination of Economic Bid and Self-Schedule, then the MW range not covered by the RTM Bid that was included in the Day-Ahead Schedule will be treated as a Virtual Award.

For each CRR Holder subject to this Section 11.2.4.6, for each hour, and for each Transmission Constraint binding in the IFM or FMM the CAISO will calculate the Flow

Impact of the Virtual Awards awarded to the Scheduling Coordinator that represents the CRR Holder. For the purposes of calculating the CRR adjustments as specified in this Section 11.2.4.6, the CAISO will include nodal MW constraints that the CAISO applies to Eligible PNodes in the IFM pursuant to Section 30.10.

(b) The CAISO will determine the peak and off-peak hours of the day where Congestion on the Transmission Constraint was significantly impacted by the Virtual Awards awarded to the Scheduling Coordinator that represents the CRR Holder. Congestion on the Transmission Constraint will be deemed to have been significantly impacted by the Virtual Awards awarded to the Scheduling Coordinator that represents the CRR Holder if the Flow Impact passes two criteria. First, the Flow Impact must be in the direction to increase the ~~value~~ sum of the CRR Holder's Notional CRR Values in their portfolio in that Settlement Period. Second, the Flow Impact must exceed the threshold percentage of the flow limit for the Transmission Constraint. The threshold percentage is ten (10) percent of the flow limit for each Transmission Constraint.

(c) For each peak or off-peak hour that passes both criteria in Section 11.2.4.6(b), the CAISO will compare the Transmission Constraint's impact on the Day-Ahead Market value of the CRR Holder's CRR portfolio with the Transmission Constraint's impact on the FMM value of the CRR Holder's CRR portfolio, as applicable.

(d) The CAISO will adjust the peak or off-peak period revenue from the CRR Holder's CRRs in the event that, over the peak or off-peak period of a day, the Transmission Constraint's contribution to the Day-Ahead Market value of the CRR Holder's CRR portfolio exceeds the Transmission Constraint's contribution to the FMM value of the CRR Holder's CRR portfolio, as applicable. The amount of the peak period adjustment will be the amount that the Transmission Constraint's contribution to the Day-Ahead Market value of the CRR Holder's CRR portfolio exceeds the Transmission Constraint's contribution to the FMM value of the CRR Holder's CRR portfolio for the peak-period hours that passed both criteria in Section 11.2.4.6(b), as applicable. The amount of the off-peak period adjustment will be the amount that the Transmission Constraint's contribution to the Day-

Ahead Market value of the CRR Holder's CRR portfolio exceeds the Transmission Constraint's contribution to the FMM value of the CRR Holder's CRR portfolio for the off-peak period hours that passed both criteria in Section 11.2.4.6(b), as applicable.

The CAISO includes ~~A~~all adjustments of CRR revenue calculated pursuant to this Section 11.2.4.6 in~~will be added to~~ the Hourly CRR Congestion Fund~~Balancing Account~~ for the applicable Transmission Constraint corresponding to the CRR payments that would have been made but for the revenue adjustments as specified in Section 11.2.4.1.2.

11.2.4.7 Adjustment of CRR Revenue Related to Schedules that Source and Sink in the Same Balancing Authority Area

The CAISO will adjust the revenue from the CRRs of a CRR Holder where the Scheduling Coordinator representing that CRR Holder has submitted Bids (including Self-Schedules), in violation of Section 30.5.5 and the resulting Schedule(s) impacts the value of the CRRs in the DAM held by that CRR Holder. Such adjustment will occur if the following circumstances are all met:

(a) A portion of the E-Tag that uses the CAISO Controlled Grid relates to a Schedule in the Day-Ahead Market;

(b) The scheduled MW on the portion of the E-Tag using the CAISO Controlled Grid has a positive PTDF on a congested transmission element, where that congestion is measured in the direction of the CRR; and

(c) The CRR Holder would receive payments from CRRs on the congested transmission element.

If such circumstances occur, the CAISO adjusts the CRR revenue ~~adjustment~~ in that Settlement Period sot that ~~will be a reduction in payments, or increase in charges, to the CRR Holder equal to~~ the additional net CRR revenue that otherwise would be earned from the congestion created by the Schedule that results from the Bids submitted in violation of Section 30.5.5 is not paid to the CRR Holder. Instead, the CAISO will add those funds to the Hourly CRR Congestion Fund for the applicable Transmission Constraint.

* * * * *

11.29.5.3 Data Files

Settlement Statements relating to each Scheduling Coordinator, CRR Holder, Black Start Generator or Participating TO will be accompanied by data files of supporting information that includes the following for each Settlement Period of the Trading Day:

(a) the aggregate quantity (in MWh) of Energy supplied or withdrawn by the Scheduling Coordinator Metered Entities represented by the Scheduling Coordinator;

(b) the aggregate quantity (in MW) and type of Ancillary Services capacity provided or purchased;

(c) the relevant prices that the CAISO has applied in its calculations;

(d) details of the scheduled quantities of Energy and Ancillary Services accepted by the CAISO in the Day-Ahead Market and the RTM;

(e) details of FMM Instructed Imbalance Energy or RTD Imbalance Energy and penalty payments;

(f) details of ~~the CRR Payments or CRR Charges, and~~ any payments or charges associated with the CRR Auctions; and

(g) detailed calculations of all fees, charges and payments allocated among Scheduling Coordinators and each Scheduling Coordinator's share.

* * * * *

36.2.1 CRR Obligation

A CRR Obligation entitles its holder to receive a payment from the CAISO or obligates it to make a payment to the CAISO as detailed in Section 11.2.4.4~~CRR Payment if the Congestion in a given Trading Hour is in the same direction as the CRR Obligation, and requires the CRR Holder to pay a CRR Obligation charge if the Congestion in a given Trading Hour is in the opposite direction of the CRR. The CRR Payment or CRR Obligation charge is equal to the per-MWh cost of Congestion (which equals the MCC at the CRR Sink minus the MCC at the CRR Source) multiplied by the MW quantity of the CRR~~.

36.2.2 CRR Options

A CRR Option entitles its holder to receive payments as detailed in Section 11.2.4.4~~CRR Holder to a CRR Payment if the Congestion is in the same direction as the CRR Option, but requires no CRR Obligation charge if the Congestion is in the opposite direction of the CRR. The CRR Payment is equal to the per-MWh cost of Congestion (which equals the MCC at the CRR Sink minus the MCC at the CRR Source, when this quantity is positive and zero otherwise) multiplied by the MW quantity of the CRR~~.

* * * * *

36.2.8 ~~Full~~ Limitations on Funding of CRRs

~~All CRRs will be fully funded; provided however, that full funding of CRRs will~~ Payments of CRR-related payments may be suspended if a System Emergency as described in Section 7.7.4, an Uncontrollable Force as described in Section 14, or a Participating TO's withdrawal of facilities or Entitlements from the CAISO Controlled Grid as described in Section 36.8.7 leaves the CAISO with inadequate revenues.

* * * * *

- Congestion-Supported Value

As provided in Section 11.2.4.4, a value, specific to a given Transmission-Constraint and Settlement period, that a CRR Holder is paid or charged for its CRRs based on Net Modeled CRR Flow.

* * * * *

- [Not Used] ~~CRR Charge~~

~~The charge assessed by the CAISO on the holder of a CRR Obligation when Congestion is in the opposite direction of the CRR Source to CRR Sink specification as described in Section 11.2.4.~~

* * * * *

- CRR Obligation

A financial instrument that entitles the CRR ~~h~~Holder to ~~a CRR P~~payments or charges ~~when Congestion is in the direction of the CRR Source to CRR Sink specification and imposes on its holder a CRR Charge~~

~~when Congestion is in the opposite direction of the CRR Source to CRR Sink specification~~ as ~~described~~ specified in Section 11.2.4.

* * * * *

- CRR Option

A financial instrument that entitles its holder to ~~a CRR P~~payments as specified in Section 11.2.4 ~~when Congestion is in the direction of the CRR Source to CRR Sink specification~~.

* * * * *

- [Not Used] ~~CRR Payment~~

~~A payment from the CAISO to a CRR Holder as specified in Section 11.2.4.~~

* * * * *

- Daily CRR Congestion Fund

The pool of funds, corresponding to a specific Transmission Constraint, held by the CAISO, that the CAISO uses to make Daily CRR Surplus Distribution Payments corresponding to that Transmission Constraint.

* * * * *

- Daily CRR Surplus Distribution Payment

A payment, corresponding to a specific Transmission Constraint, the CAISO makes available to a CRR Holder as described in Section 11.2.4.4.2.

* * * * *

- Hourly CRR Congestion Fund

The pool of funds the CAISO collects and holds pursuant to Section 11.2.4.1.2, corresponding to a specific Transmission Constraint and Settlement Period, that the CAISO has available to pay CRR Holders for the portion of their CRRs modeled as having a PTDF on that Transmission Constraint.

* * * * *

- [Not Used] ~~IFM Congestion Fund~~

~~The funds the CAISO shall have available in each Settlement Period from which the CAISO will pay CRR Holders for the CRR(s) they hold in any Settlement Period, which shall determined as provided in Section 11.2.4.1.2.~~

* * * * *

- Monthly CRR Congestion Fund

The pool of funds the CAISO collects and holds, corresponding to a specific Transmission Constraint, to make Monthly CRR Surplus Distribution Payments corresponding to that Transmission Constraint.

* * * * *

- Monthly CRR Surplus Distribution Payment

A payment, corresponding to a specific Transmission Constraint, the CAISO makes to a CRR Holder as described in Section 11.2.4.4.2.

* * * * *

- Net Modeled CRR Flow

For CRR Obligations, the net MW quantity from CRR Obligations within a CRR Holder's portfolio that the CAISO models as flowing over a particular binding Transmission Constraint (accounting both for prevailing flow and counter-flow modeled over that binding Transmission Constraint).

For CRR Options, the net MW quantity from a given CRR Option that the CAISO models as flowing over a particular binding Transmission Constraint. The CAISO does not net the MWs of modeled flow from a given CRR Obligation with MWs of modeled flow from CRR Obligations or other CRR Options in a CRR Holder's portfolio.

* * * * *

- Notional CRR Value

For a given CRR in a Settlement Period, the product of: (A) the MCC at the CRR Sink minus the MCC at the CRR Source; and (B) the MW quantity for that Settlement Period. The Notional CRR Value for a CRR Obligation can be a non-positive value for a Settlement Period. The CAISO sets the Notional CRR Value for a CRR Option in a given Settlement Period to zero (0) if the products of the MW quantity of the CRR Option and the difference between the MCC at the CRR Sink and MCC at the CRR Source is a negative amount.

* * * * *

Attachment C – CRR Auction Analysis Report

Tariff Amendment to Increase Efficiency of

Congestion Revenue Rights Auctions Track 1B

California Independent System Operator Corporation

CRR Auction Analysis Report

November 21, 2017

Prepared by: MQRI

California Independent System Operator

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1 Executive Summary

The report is organized in four main areas, including CRR auctions, market performance, modelling of transmission outages and detailed analysis of auctions for a representative set of months. The following bullets provide a summary of the main findings.

- The number of participants in the CAISO CRR auctions have steadily increased over the years, going from 33 participants in 2014 to 49 participant in 2017 in the annual auction, and from 41 participants in 2014 to 63 participants in 2017 in the monthly auctions. Participation from financial entities has increased more than any other type of participant throughout the timeframe analyzed.

- The number of CRR bids has increased from 10,000 in 2014 to more than 20,000 in 2017 in the annual auctions, while the monthly auctions have observed an increase from 16,000 in 2014 to about 33,000 bids in 2017. The number of CRR source-to-sink definitions cleared in the annual and monthly auctions have increased by about 44 and 51 percent, respectively, between 2014 and 2017.

- The bid-in volume of CRRs submitted in the annual and monthly auctions has been as high as 230,000 MW and 320,000 MW, respectively. The volume of cleared CRR awards, has consistently been in the range of 20 percent (about 30,000 to 50,000 MW).

- About 45 percent of the total volume of CRR awards in both the annual and monthly auctions has been for unique CRRs source-to-sink definitions with one single award.

- Between 20 and 44 percent of CRR awards in the CRR auctions have been cleared at negative prices in the annual auction, while 50 to 60 percent of CRR awards in the monthly auction have been cleared at negative prices. Since the transmission capacity made available for the auctions is the leftover capacity after the allocation, a fair portion of this volume reflect counter-flow positions among CRRs.

- Over 60 percent of CRR prices are consistently cleared in the annual auction in the low and tight price band between -$0.25/MWh and +$0.25/MWh. In the monthly auction this is even more pronounced with about 90 percent of CRRs valued in this price range. Furthermore, there is a small but persistent volume of CRRs cleared at $0/MWh in both the annual and monthly auctions.

- In the annual auctions, over 90 percent of the CRR volume was awarded at prices between $0/MWh and $1/MWh, while for monthly auctions over 90 percent of the total volume of CRRs awarded in the monthly auctions between at prices

between -0.25/MWh and +$0.25/MWh, which is a relative low price range. The volume of CRRs awarded at zero price in the monthly auctions used to be about 25 percent until May 2015; starting with June 2015, the volume of CRRs at zero prices has dropped to about 7 percent. This steep reduction is a by-product of starting to enforce nodal group constraints in the CRR auctions; these constraints impose limitation on the amount of CRR that can be awarded at the location level.

- About 100 to 200 constraints consistently appear binding in the annual and monthly auctions, respectively. With the introduction of the nodal group constraints in the CRR auctions in 2015, the number of additional types of constraints binding reduced. Nodal group constraints have been binding persistently since being introduced, reaching up to 1,000 constraints in the monthly auction. Since many nodal group constraints appear binding, this type of constraint becomes in many instances the limiting factor for CRR awards and prevents other types of constraints from binding.

- About 80 percent of the CRRs have internal locations (either individual or aggregated locations) used as the CRR source in both annual and monthly auctions, with a declining trend in 2016 and 2017. Interties are the second most frequently type of location where CRRs are sourced. This is not surprising given the fair volume of energy coming through the interties. Aggregated locations such as default load aggregation points (DLAPs) or Trading Hubs (THs) do not appear as frequently.

- About 56 percent of all net CRR payments accrued on CRRs awarded (in both annual and monthly auctions and both times of use had a source-to-sink definition) from generation location to generation location, while over 85 percent of all net CRR payment accrued on CRRs from supply to supply locations.

- Total monthly auction revenues have seen a declining trend, going from as high as $11.9 million in September 2014 to about $6.7 million in March 2017. Auction revenues are distributed across annual versus monthly auctions, and between on-peak and off-peak time of use. Overall, auction revenues were the highest in the in summer months and lowest in the winter months.

- The proportion of negative auction revenues (where a counter-party pays the CRR holders to acquire the CRR) to positive auction revenues amounted to about 40 percent and 50 percent of the annual and monthly auctions, respectively. The higher percentage in monthly auctions is expected given that the monthly auctions have CRRs with a shorter life term (a month versus a quarter of the annual auction) and are run closer to day-ahead market conditions (a couple of weeks in advance of the settlement months, compared to up to 10 months in advance of the annual auction).

- Congestion rents comprise the total surplus collected by the CAISO when congestion arises and account for the amount used to fund the CRR payments. Of the years analyzed, 2014 saw a spike in congestion rents reaching $430 million, and then stabilized in subsequent years, reducing to approximately $213 million in 2015, $235 million in 2016 and finally reaching $108 million in 2017 (January to May).

- CRR revenue adequacy measures the overall alignment between the CRR market and the day-ahead market by quantifying the balance between the money collected from the day-ahead market and the CRR payment made to CRR holders. For the period of analysis, there has always been a CRR revenue deficiency or shortfall, meaning the CAISO has had to payout more to CRR holders than it has collected from the day-ahead market. The largest shortfall was observed in July 2014 with over $40 million, while 2015 through 2017 have observed revenue deficiencies of up to $22 million in a given month.

- As part of the CRR markets design, auction revenues, which are the proceeds from selling CRRs in the auction, go into the balancing account and can be used as a buffer to offset revenue shortfalls. When these auction revenues are used, about 45 percent of the monthly shortfalls were fully offset.

- Based on the period under analysis, there does not seem to be any direct impact on revenue shortfalls driven by market system changes, such as the additions of new market functionalities or regular network model updates. Furthermore, in analyzing the hours when the day-ahead market had direct current (DC) solutions, there was no strong evidence that those DC solutions in the day-ahead market lead to a better or worse performance of revenue shortfall.

- For most of the time, when auction revenues were collected from CRRs released in the CRR auctions, the net amount was lower than the money paid to auction CRRs. Throughout this report, the difference between these two quantities is referenced as the net CRR payment. In 2014, the money paid to auction CRRs was as high as five times the auction revenues collected on these CRRs. In 2017, that ratio oscillated between 1.5 to 2.2 times.

- Net CRR payments have been rising from both annual and monthly auctions, as well as from both time of use definitions. A large share of these net CRR payments are associated with CRRs that have a source or sink from individual internal locations in the CAISO balancing authority area. The amount (in dollars settled) where participants received less from CRR payments than what they paid for in the auction represents about 32 percent of the amount settled, compared to when CRR holders received more CRR payments than what they paid for in the auction. Although a modest proportion, this shows that there are CRR holders in

every auction which end up in a position where the money collected through CRR payments was less than the money they paid to acquire CRRs.

- When comparing auction revenues versus CRR payments, about 47.6 percent of CRR awards account for when CRR holders paid for auction CRRs and received CRR payments. 13.9 percent of CRR awards are associated with when CRR holders paid for auction CRRs and were charged CRR payments. About 28 percent of CRR awards represent when CRR holders were paid in the CRR auction and were charged when settling CRRs. Finally, about 10.5 percent of the CRR awards signify when the CRR holders were paid in the CRR auction and also received CRR payments.

- Overall, about 17 percent of CRRs acquired in the auction had a net negative money inflow (net CRR payments) from holding CRRs. Although a modest percentage, this shows that holding CRRs from the auctions do not always present a winning proposition. Holding CRRs pose a certain level of risk since congestion patterns may change in the day-ahead market with respect to projected conditions when participating in the CRR auctions.

- CRRs with zero auction revenues exist when the CRR holder did not have to pay for or be charged for acquiring CRRs, have predominantly seen a CRR payment when settled in the day-ahead market at non-zero prices. However, there are cases when these CRRs have actually become a liability and their holders have been charged. The settlement value of these CRRs have diminished over time.

- For the period under analysis, the top and bottom CRR source-to-sink pairs based on their associated net CRR payment, do not show a systemic pattern over time. These particular CRRs have been mostly driven by the occurrence of a specific event that influenced their payments.

- The current requirement for planned outages that last at least 24 hours in duration must be submitted to the CAISO at least 30 days in advance of the start of the month in which the outage will take place. Consideration of outages in the CRR auctions is critical to ensure the CRR auctions will reflect the conditions expected for the day-ahead market. About 80 percent of planned outages, regardless of their duration, were not reported within this timeframe. The majority of these outages had a duration of less than 24 hours, for which there is no timing requirement to submit to the ISO.

- For outages subject to the 30-day submission requirement, about 57 percent of these outages were not submitted to the ISO in time. PG&E, SCE and SDG&E outages subject to the 30-day submission window were not received in time in about 50 percent, 65 percent and 70 percent of the time, respectively.

- About 15 percent of the planned outages that were compliant with the submission requirements were modelled as out-of-service, meaning that they had a duration of at least 10 days. Outages with a duration of less than 10 days are modelled with a pro-rata derate for the period of the auction the outages exists within. Outages with a duration of less than 24 hours are not modelled in the CRR auctions. These outages represented the largest portion of outages in the system for the time period analyzed.

- The analysis in this report shows that there is a persistent and strong correlation between CRR revenue inadequacy (congestion rents not being sufficient to cover all CRR payouts) and net CRR payments (difference between auction CRR payments and auction revenues). This does not indicate that one is the cause of the other; instead, it reflects that both items are being driven by a common cause. This common factor happens to be the misalignment of transmission modelling between the CRR auctions and the day-ahead market.

- The last part of the analysis focuses on the auction performance at the individual transmission constraint level. Through this detailed analysis, one common finding arose that leads to late or missed outages and constraints in the CRR auctions being the primary driver for revenue shortfalls and large net CRR payments to auction CRRs. In some cases, like January 2017, one single constraint missed being modelled in the annual and monthly auctions and as a result drove over 80 percent of the revenue shortfall and accounted for a significant portion of the large payout to auction CRR holders.

- There are different levels of complexity in this dynamic; there are cases where the outages are not known by the time the CRR auctions are run; in other cases, outages may be known but they have a short duration (less than 24 hours) and pose a dilemma of how to incorporate them into the CRR auctions. There are two available options once this dilemma arises; do nothing (current approach), or model the outage as a derate or as a full outage which implies having modelled for the full period of the auction. Modelling as a full outage may be seen as an extreme approach for outages that may last a few hours, but in these few hours there may be large revenue shortfalls and CRR payments. Then there is another set of instances where specific constraints are not captured or not known by the time the auctions are run and then these are only enforced in the day-ahead market. Typically these instances involve nomograms that may or may not be associated with specific outages. Regardless of the origin, the end result is that the CRR auctions do not reflect these changing conditions in transmission system and thus, these conditions are not priced accordingly in the auction. Once they are in the day-ahead market and congestion arises, a persistent divergence between markets is created.

From these findings, there are several items that need consideration for further improvements, including:

- Enforcement of constraints. Misalignment of transmission constraints between CRR auctions and the day-ahead market is a systemic issue impacting the overall efficiency of the CRR auctions. If a constraint is not enforced in the CRR auction but is enforced in the day-ahead market, this can lead to a lack of pricing the transmission properly in the CRR auction, and can also result in releasing more transmission capacity on that element in the CRR auctions.

- Consideration of outages. There is a large set of outages that last less than 24 hours in duration, that even when known in advance are not considered in the CRR auctions. These outages can drive steep and concentrated revenue deficiencies and large net CRR payments due to a misalignment of transmission configuration between markets. Furthermore, even when outages are known on time and have a duration longer than 24 hours, there is a modelling challenge of how to consider these outages in the CRR auction. Currently, if these outages last less than 10 days, they are modelled as pro-rata derate. This aims at balancing the potential large impact of the days on outage with the lower limit applied to the rest of the period. Then the most systemic issue is for outages not submitted on time and are not considered in the CRR auctions at all; these outages have a straight negative impact on the CRR auction performance, as illustrated in the monthly analysis.

- Zero priced CRRs. There is a set of CRRs in every auction that clear at $0 prices. Usually these CRRs have sources and sinks located close one to another, electrically speaking. These represent CRRs that are acquired by CRR holders at zero cost. Although these CRRs may turn to a liability for CRR holders in some conditions, it is not clear what value these CRR add to the overall efficiency of the market.

Lastly, based on the analysis of auction CRRs, the vast majority of CRR payments are for auction CRR definitions between individual supply points, mostly from generation point to generation point and from intertie point to intertie point. A large volume of CRRs released in the auction are for CRR definitions with very few awards. Indeed, about half of the CRR volume released in the auctions are based on CRR definitions with one single award. This opens the question on how much liquidity or hedging the auctions may be generally providing with such large volume of single definition awards.

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2 Acronyms

AC	Alternating current
CAISO	California Independent System Operator
CRR	Congestion revenue right
CLAP	Custom load aggregation point
DAM	Day ahead market
DC	Direct current
FNM	Full network model
IFM	Integrated forward market
ISO	Independent System Operator
LMP	Locational marginal pricing
MCC	Marginal congestion component
MSS	Metered Subsystem
OMS	Outage management system
PGAE	Pacific Gas and Electric
PTO	Participating transmission owner
RTM	Real-time market
SDGE	San Diego Gas and Electric
SCE	Southern California Edison
TH	Trading hub
TOU	Time of use
VEA	Valley Electric Association

3 Introduction

The nodal market implemented by the California ISO (CAISO) on April 1, 2009 consists of the standard elements of a market design ubiquitous for ISO's in the United States; this standard design consists of a real-time market complemented with a day-ahead market, which in turn is complemented with a market for congestion revenue rights (*aka* financial transmission rights in other ISO's). The CAISO's design is based on a tiered approach. First, there is an allocation process in which CRRs are directly allocated to load serving entities. Once the allocation is complete, the CRR auctions are open to any entity qualified to participate in the CRR market, regardless if they have an obligation to serve load or any other type of participation in the ISO markets.

The CAISO's CRR market includes both an allocation and auction process for the annual and monthly timeframes. The annual auction runs in the last quarter of the year preceding the binding year and is organized in calendar seasons. The monthly auctions are run a couple of weeks in advance of the binding month. CRRs are defined for two times of use (TOU): on-peak and off-peak. The CAISO's design also provides for full funding; *i.e*., when the money paid to CRR holders is greater than the money collected to fund the CRR payouts, the CRRs are still fully paid their face value and any shortfall from this balance is allocated to the measured demand. Only congestion rents from the day-ahead market are utilized to fund CRRs; congestion from the real-time markets are settled separately. Any surplus, is allocated to the measured demand. Under this design, proceeds from auction revenues as well as clawback proceeds are used to fund CRR revenue adequacy.

Over the years, the CAISO has been monitoring the performance of the CRR markets and has or is in the process of implementing several market and or process changes to improve its performance, including:

- Implementation of a break-even analysis for interties to ensure the amount of transmission capacity released in CRR auctions reflects the historical availability;
- Systematic enforcement of nodal group constraints to align the CRR auctions with the day-ahead market;
- Internal process improvements to better handle outages in the CRR auctions;
- CRR clawback rule modifications to better consider convergence bids; and
- Contingency modelling enhancements.

In early 2017, the CAISO opened up an initiative to address a concern with the CRR auction efficiency. This concern was on the large CRR payments made to holders of auction CRRs in comparison to the auction revenues collected when releasing the CRRs through the auctions.

This initiative is composed of two main stages:

1. Analysis stage. In this part of the initiative the CAISO committed to carry out a comprehensive analysis of the CRR auction performance. This stage was separated in three different phases depending on the type of analysis carried out. The CAISO held a workshop with market participants in April 2017 to layout the plan for the scope of the analysis. The CAISO reported its progress on the analysis track during the July 2017 market planning and performance forum meeting and committed to complete this stage of the initiative in the last quarter of 2017.

2. Policy stage. Once the analysis stage is complete the CAISO will formally start up the policy discussion. The results of the analysis stage will serve to guide the policy discussion.

In terms of the analysis carried out in the first part of this initiative, the CAISO focused on the performance that can be analyzed within the scope of the CAISO market data. Although it can be recognized that there may be other benefits provided through CRRs and the auction processes, this analysis only illustrates those benefits that are tangible to the CAISO.

Finally, the CAISO will host a technical workshop on December 19, 2017 to discuss the analysis presented in this report.

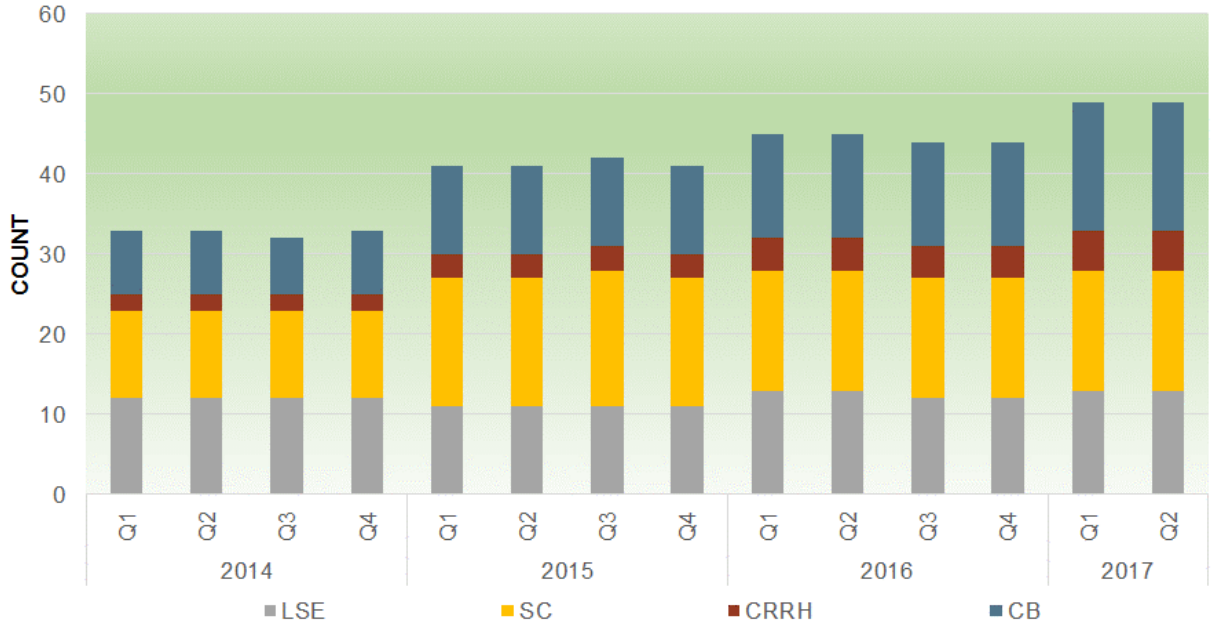
4 Congestion Revenue Right Auctions

CRR auctions are available both in annual and monthly processes. Each auction is treated individually as a different market. Additionally, two time of use (TOU) are defined for CRRs: On-peak and Off-peak.

Participation

Figure 1 shows the number of participants in annual auctions by type of participant[1] (Load serving entity, scheduling coordinator, CRR holder and convergence bidding participant only). The count of participants is by season for Off-peak. The number of participants in the annual CRR auction has steadily increased year after year, going from 33 participants in 2014 to 49 participants in 2017.

Figure 1: Number of participants in annual CRR auctions by CRR type for off peak

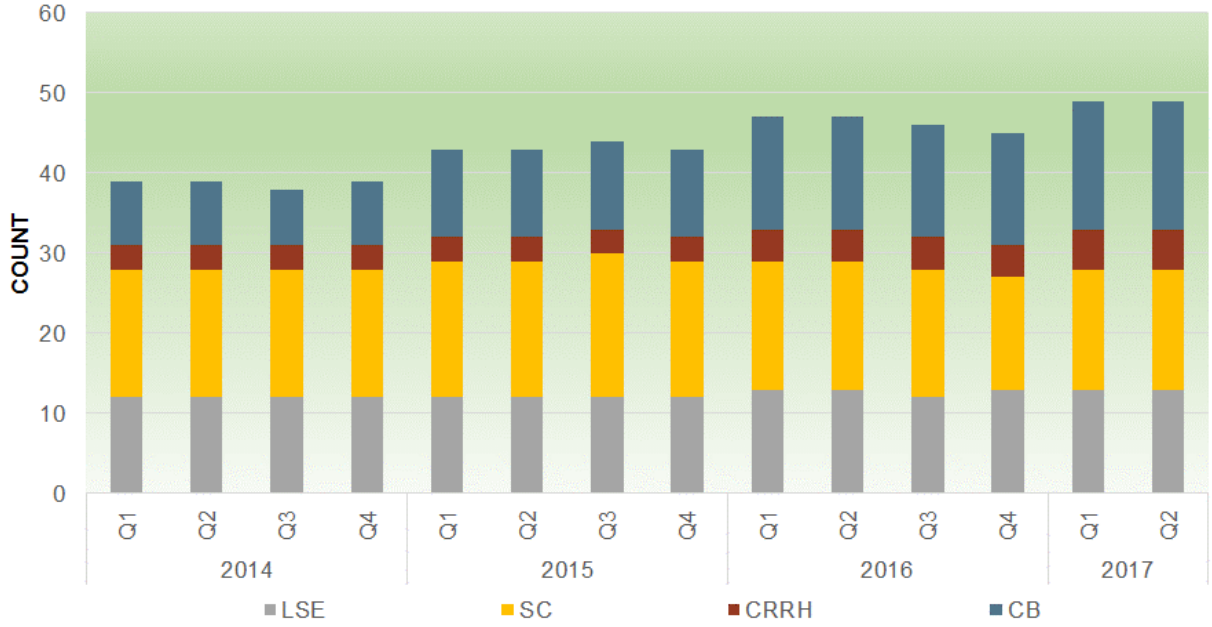


Similarly Figure 2 shows the number of participants in annual auctions by CRR type. The count of participants is by season for On-peak and similar to the Off-peak there is a steady increase in the count of participants from year to year. Since there is a separate annual auction

[1] This classification is based on the definition used by the ISO in the participant registration. CRRH stands for entities participating only in the CRR auctions; CB stand for entities participating in both the CRR auction and with convergence bids in the day-ahead market; LSE is for entities that have participated in the allocation process and as such have an obligation as load serving entities. Any other participant is classified as a scheduling coordinator. This classification is available at http://www.caiso.com/Documents/ListofSchedulingCoordinatorsCRRHoldersandConvergenceBiddingEntities.pdf

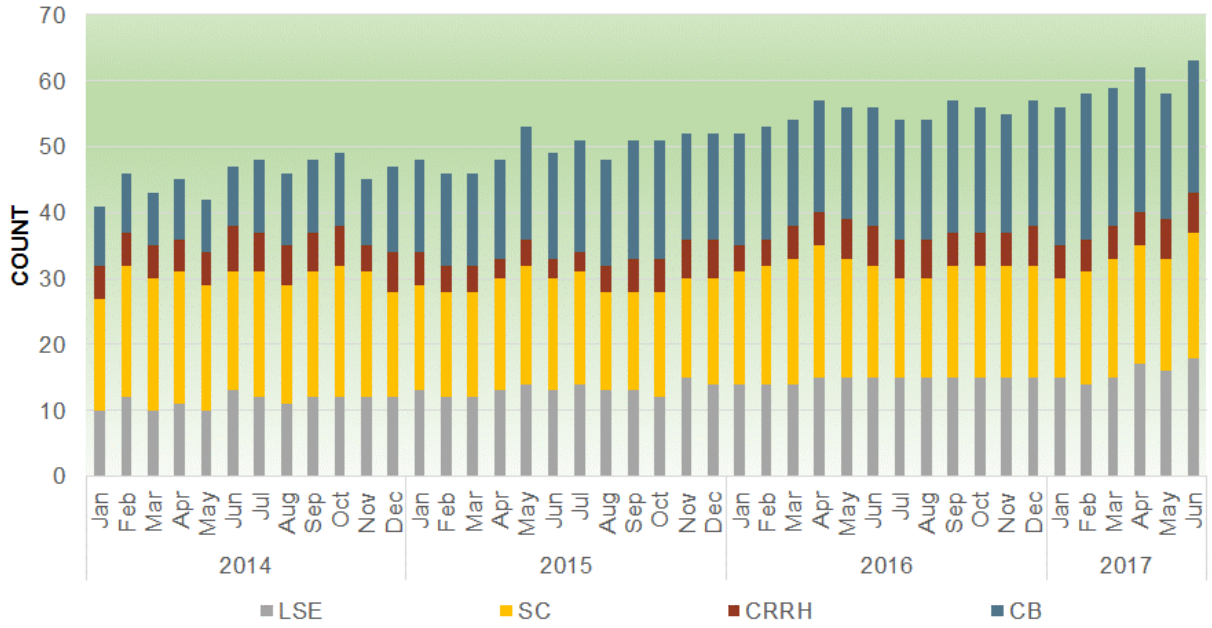
for each time of use, participants have the flexibility to participate in both or any of the two auctions; this is the reason the number of participants is different for each time of use.

Figure 2: Number of participants in annual CRR auctions by CRR type for on peak



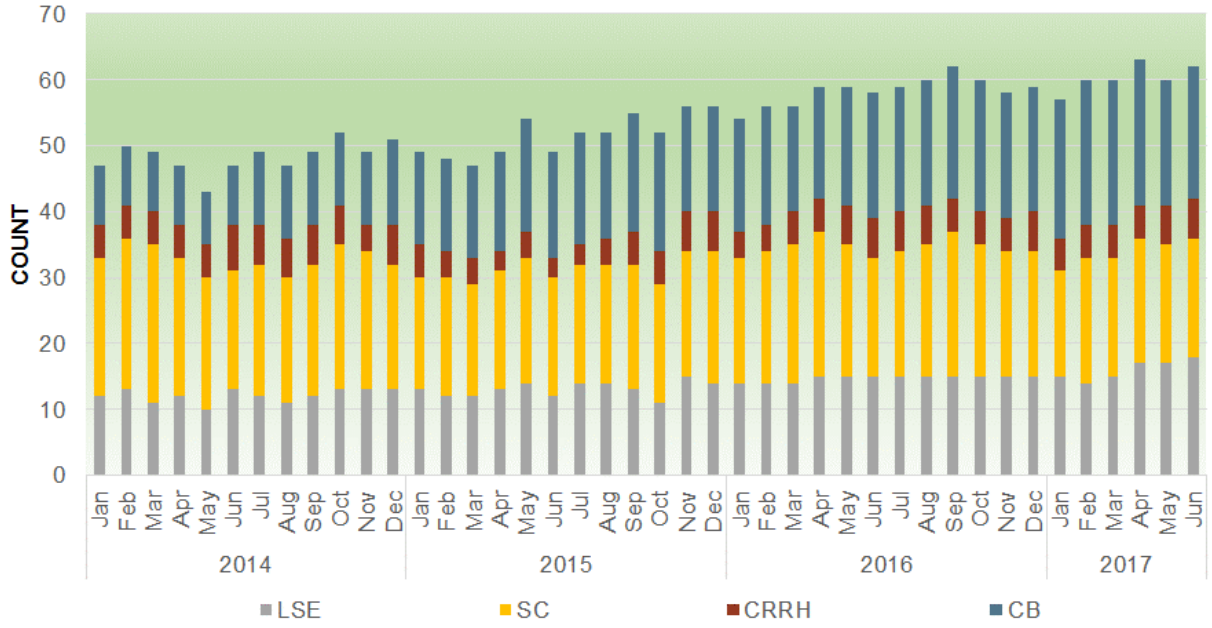
Correspondingly, Figure 3 shows the number of entities participating in the monthly CRR auctions by type of participant for Off-peak. The number of participants has also steadily increased from 41 entities in 2014 to 63 entities in May 2017.

Figure 3: Number of participants in monthly CRR auctions by CRR type for off peak



Similarly, Figure 4 shows the number of entities participating in the monthly CRR auctions by CRR type for the On-peak market. There was higher participation in the On-peak market during 2014 than the Off-peak market. Entities participating in both the CRR auctions and convergence bids saw the most increased participation from 2014 to June 2017, going from 9 to 20 participants; this type of financial participants in the market have no load serving obligations or scheduling coordinator responsibilities, thus they have a profit seeking objective. The fact that this type of participation has steadily increased may reflect that participants may find attractive to participate in this financial market. This participation also increases the activity in the CRR auction and may drive for more liquidity in the market.

Figure 4: Number of participants in monthly CRR auctions by CRR type for on peak



Market bids

Figure 5 shows the number of bids submitted in the annual auctions by season, TOU and year. The number of bids in the annual auctions have observed an increased over the years, going from about 10,000 in 2014 to more than 20,000 in 2017.

Figure 5: Number of bids in annual CRR auctions by TOU

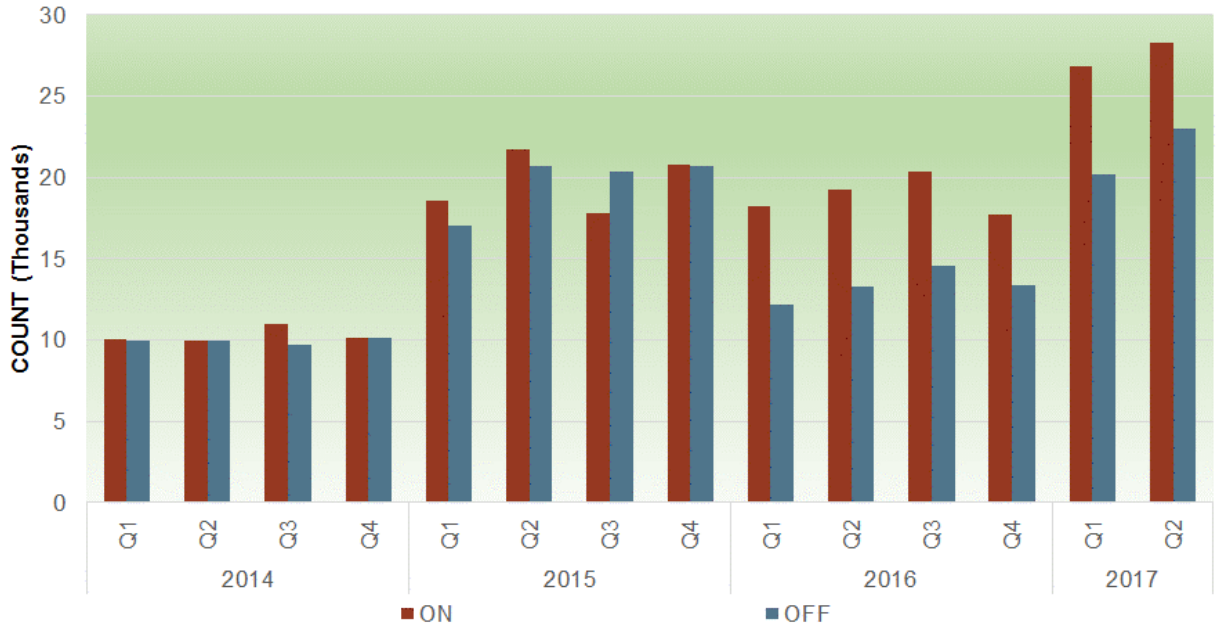
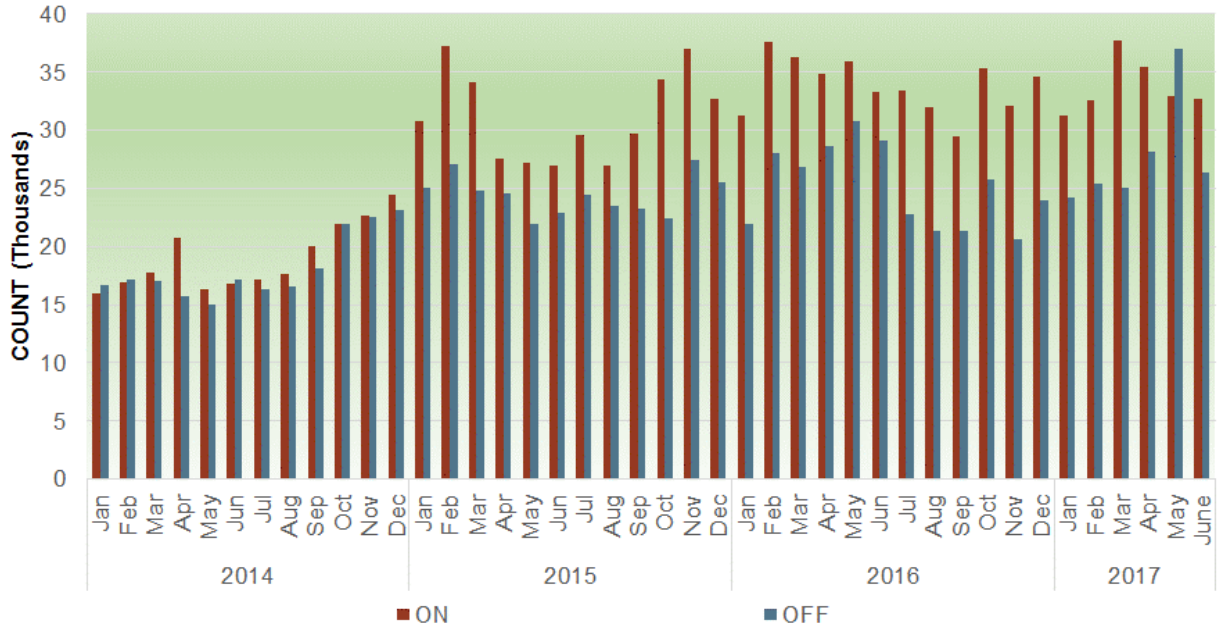


Figure 6 shows the number of the bids in the monthly CRR auctions by month, TOU and year. The number of bids have increased over time, going from about 16,000 bids in early 2014 to as high as almost 33,000 bids in 2017. It is important to note that the number of bids is not a direct metric of CRR awards, but it is a reflection of the activity and liquidity in the auction and the willingness to acquire CRRs.

Figure 6: Number of bids in monthly auctions by TOU



CRR source-to-sink definitions

Figure 7 and Figure 8 show the number of different CRR definitions awarded in the annual and monthly auctions, respectively, by TOU and year. The number of different CRR definitions cleared in the annual auction have shown an increase of about 44 percent from 2014 to the first two quarters of 2017. Correspondingly, the number of CRR definitions cleared in the monthly auctions has increased by about 51 percent between 2014 and 2017.

Figure 7: Number of different CRR definitions in annual auctions

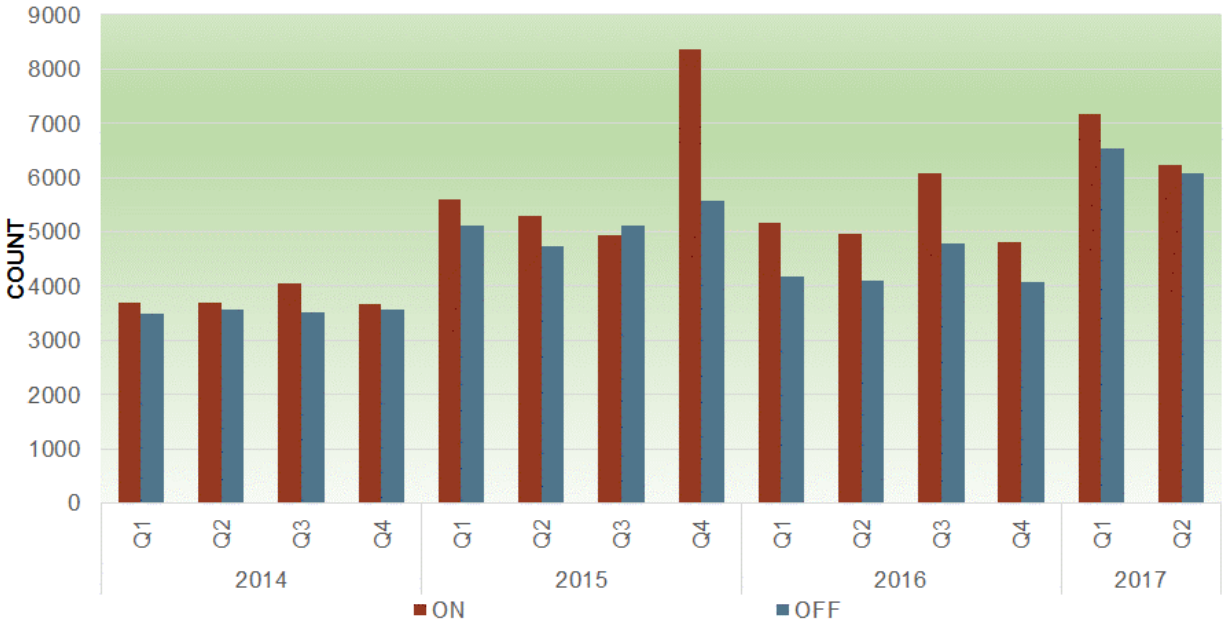


Figure 8: Number of different CRR definitions in monthly auctions

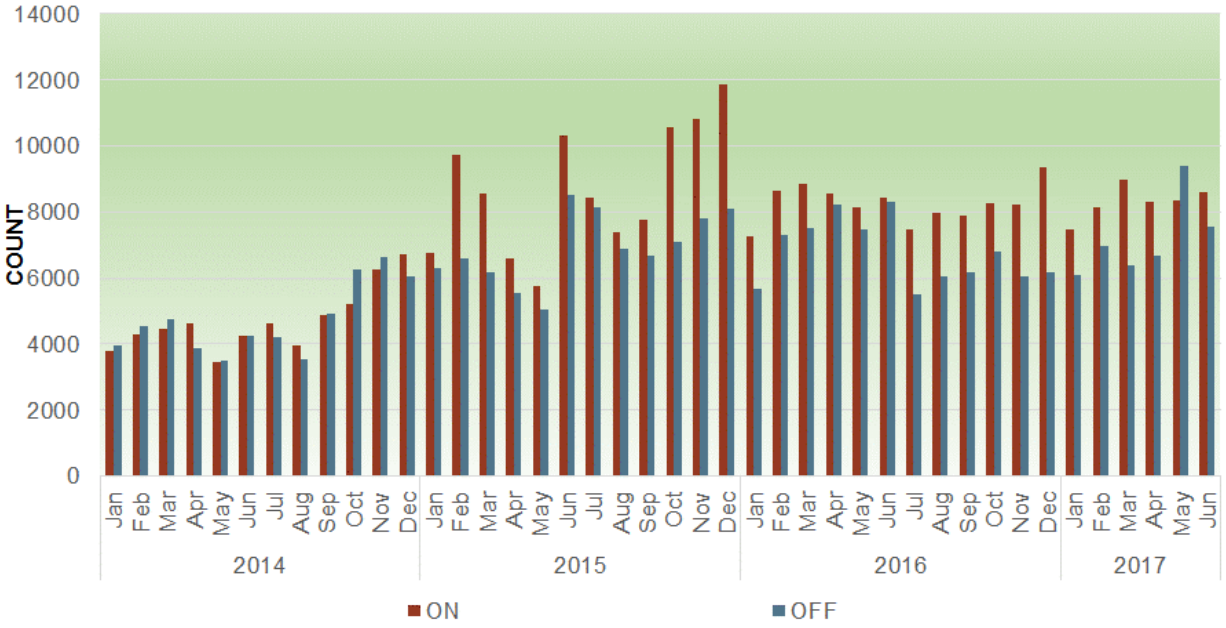


Figure 9 through Figure 12 show the volume of CRRs awards cleared in the annual and monthly auctions by time of use. These volumes are grouped into sets of numbers of awards for each CRR definition. For instance, the bin associated with the label "1" is the estimate of CRR volume with awards for definitions that are unique; i.e. there is only one single award for a specific and different source-to-sink definition. In both the annual and monthly auctions, about 45 percent of the overall CRR award volume was for CRRs source-to-sink definitions that had one single award.

Figure 9: Volume of annual CRR organized by number of awards per definition –On peak

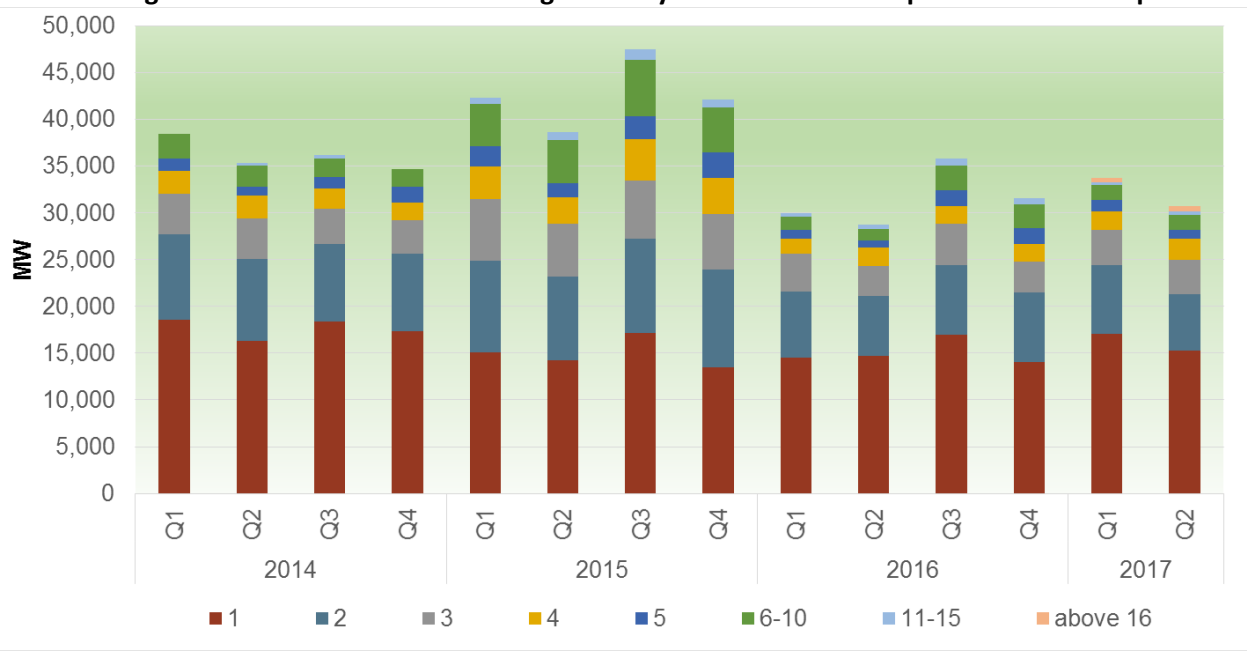


Figure 10: Volume of annual CRR organized by number of awards per definition –Off peak

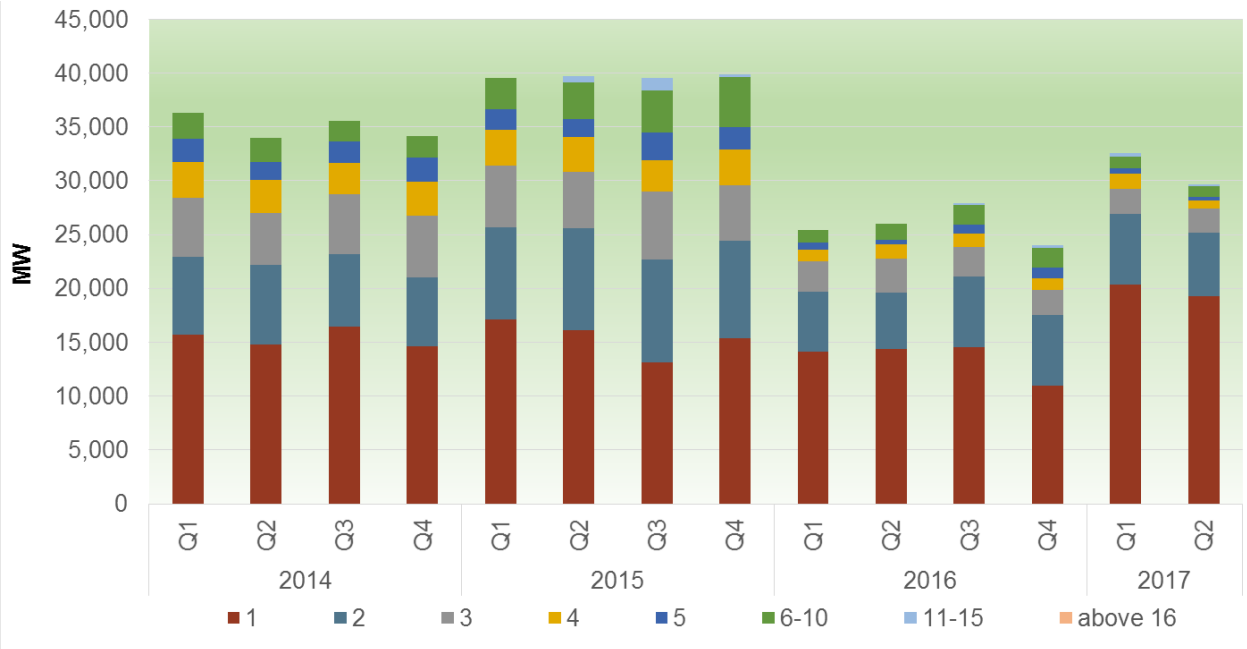


Figure 11: Volume of monthly CRR organized by number of awards per definition –On peak

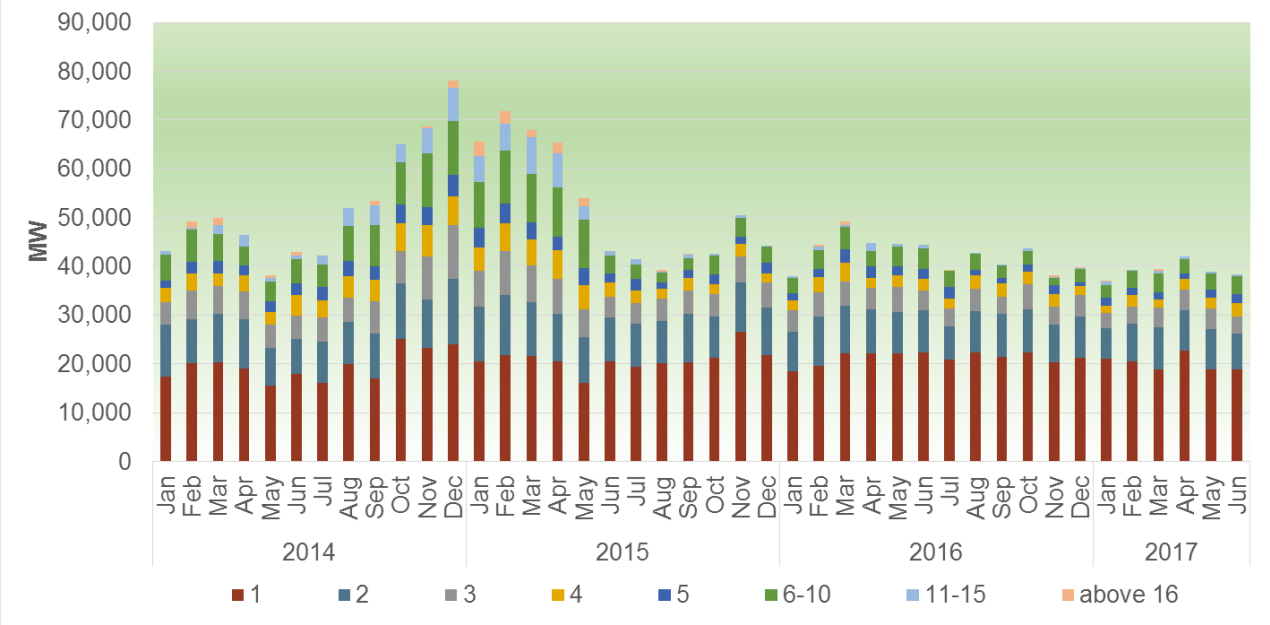
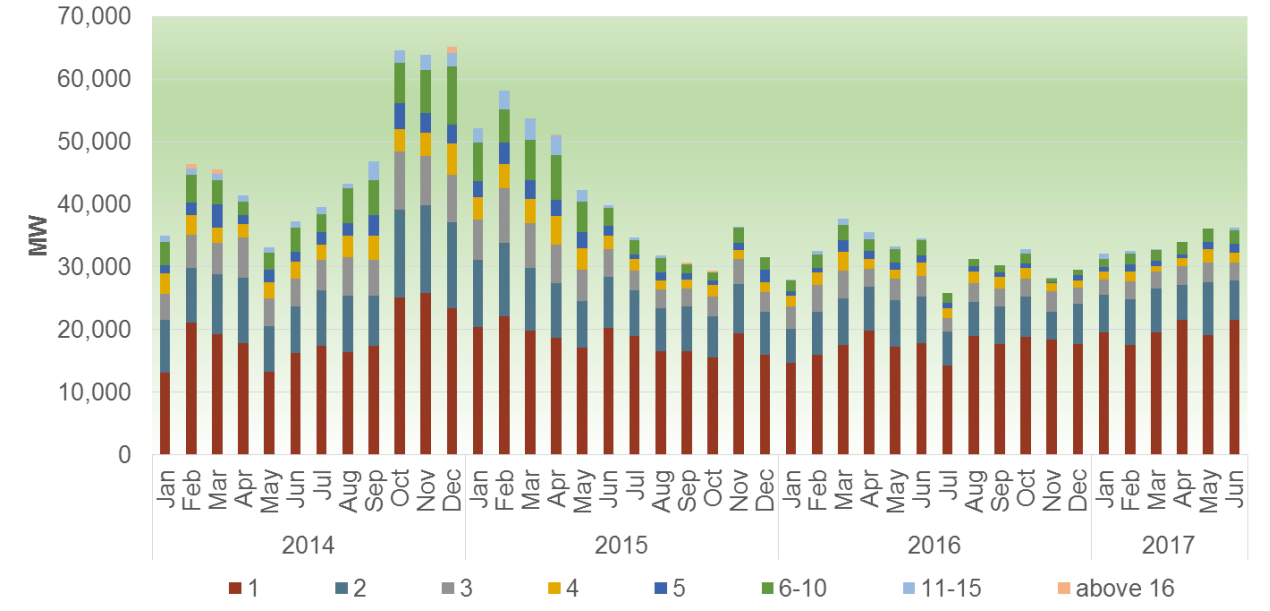


Figure 12: Volume of annual CRR organized by number of awards per definition –On peak



Bid-in volumes and awards

Figure 13 and Figure 14 show the trend of bid-in and award volumes in annual auctions organized by TOU and year. Although the number of bids submitted in the auctions have shown a steady increase, the bid-in MW volume has been relatively stable; this may indicate that the increase of bids in the auction could be driven by an increase of bids with a relatively small MW offer, which usually are bids used to discover prices. The percentage of bid volume cleared in the annual auctions has been declining, going from 26 percent in early 2014 to about 20 to 18 percent in 2017.

Figure 13: Volume of bids and awards in annual auctions for off peak

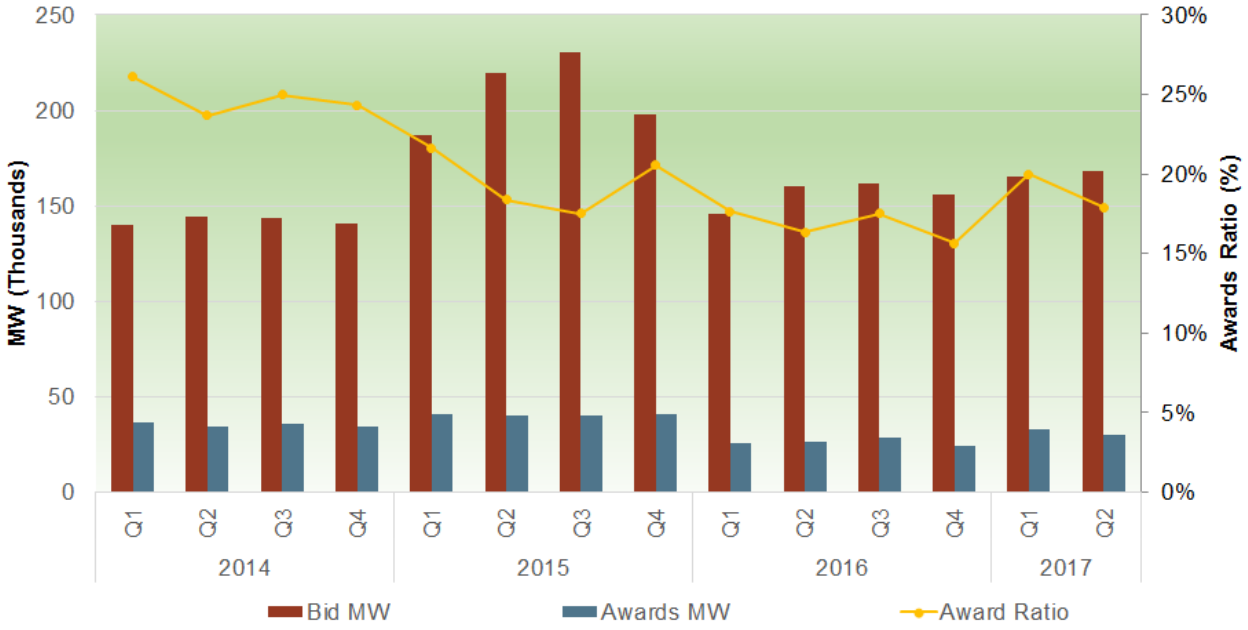


Figure 14: Volume of bids and awards in annual auctions for on peak

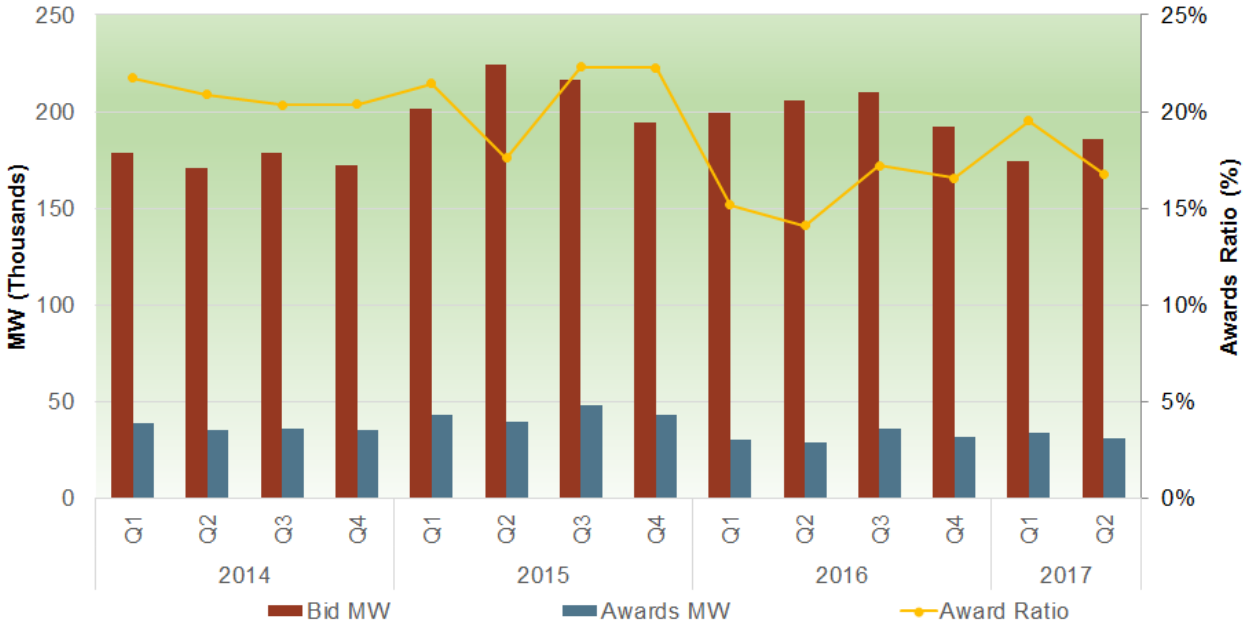


Figure 15 shows the trend of bid-in and award volumes in monthly auctions for the Off-peak period, organized by month and year. The awards for the Off-peak period, have been steady and clearing at about 31,000 to 36,000 MW in the last two years.

Figure 15: Volume of bids and awards in monthly auctions for off peak

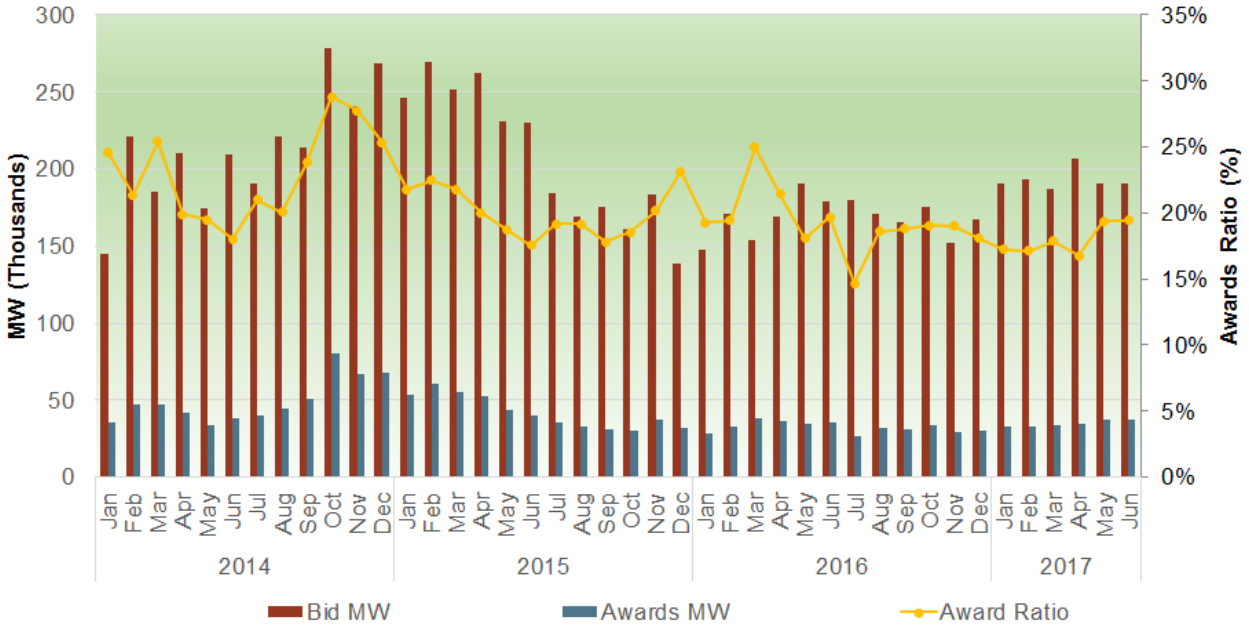
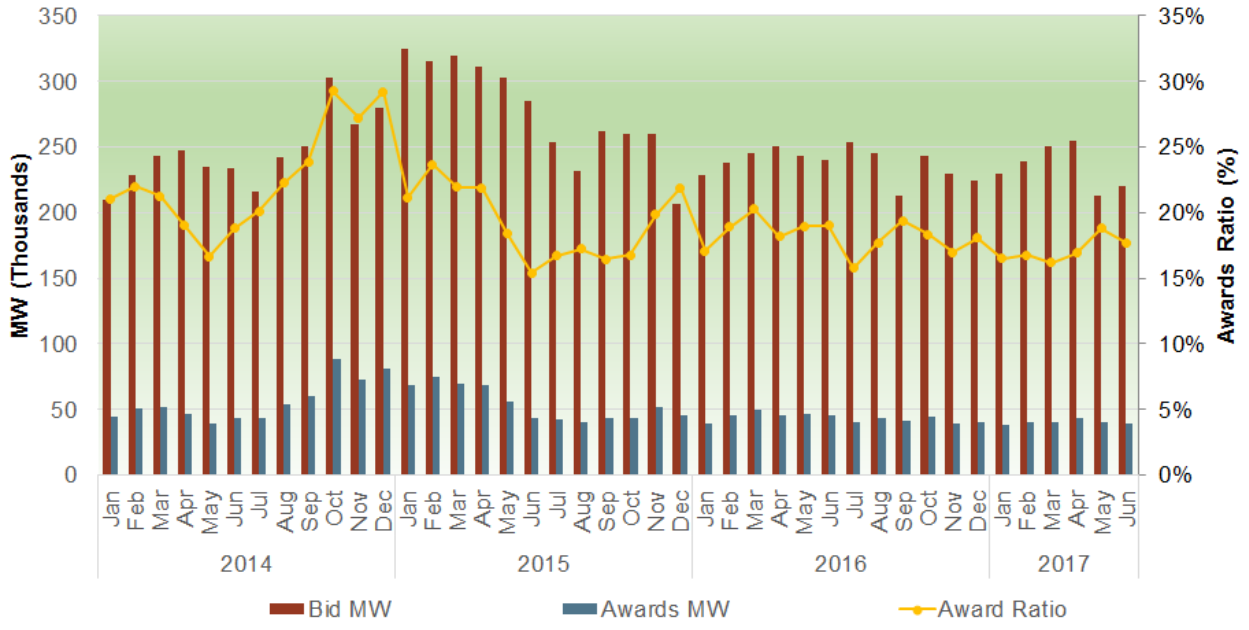


Figure 16 shows the trend of the bid-in volume compared to the volume of awards for monthly auctions for on-peak and shows that bid-in volume has been steady with a slight increase in 2015, ranging from about 220,000 to 320,000 MW. However the award ratio for on-peak period is about 15 to 20 percent in the last two years.

Figure 16: Volume of bids and awards in monthly auctions for on peak



A key point in CRR auctions is that participants can bid negatively for CRRs. This will usually be associated with counter-flow CRRs. The expectation is that an awarded CRR will have an associated negative price, and this implies that the bidder will be paid to take on the CRRs. Once

the CRR award materializes in the energy market, the CRR holder of these negatively valued CRRs expects to be charged, i.e., the CRR becomes a liability.

Figure 17 classifies CRR awards by the type of payment they are associated with in the annual auctions. A volume labeled as positive quantifies the volume of CRRs sold to participants through the auction; i.e., participants paid the CAISO to acquire CRRs. On the other hand, volumes labeled as negative, quantify the CRR volume for which participants were paid by the CAISO to acquire CRRs. Similarly, Figure 18 classifies CRR awards by the type of payment they are associated with in the monthly auctions.

Figure 17: Volume of awards in annual auctions by TOU

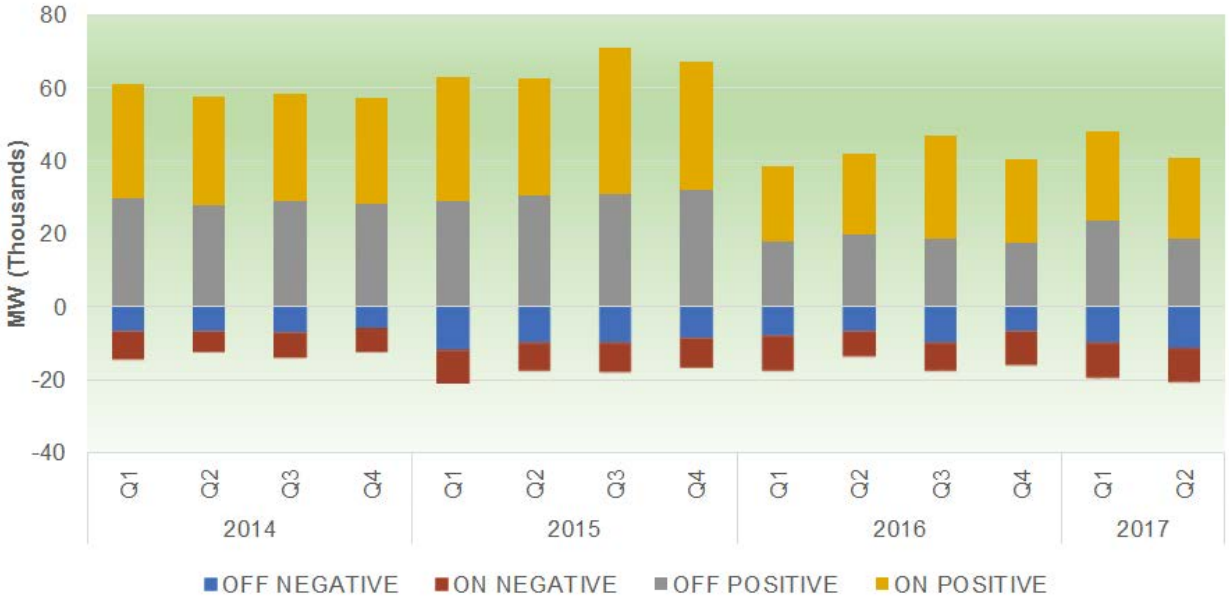
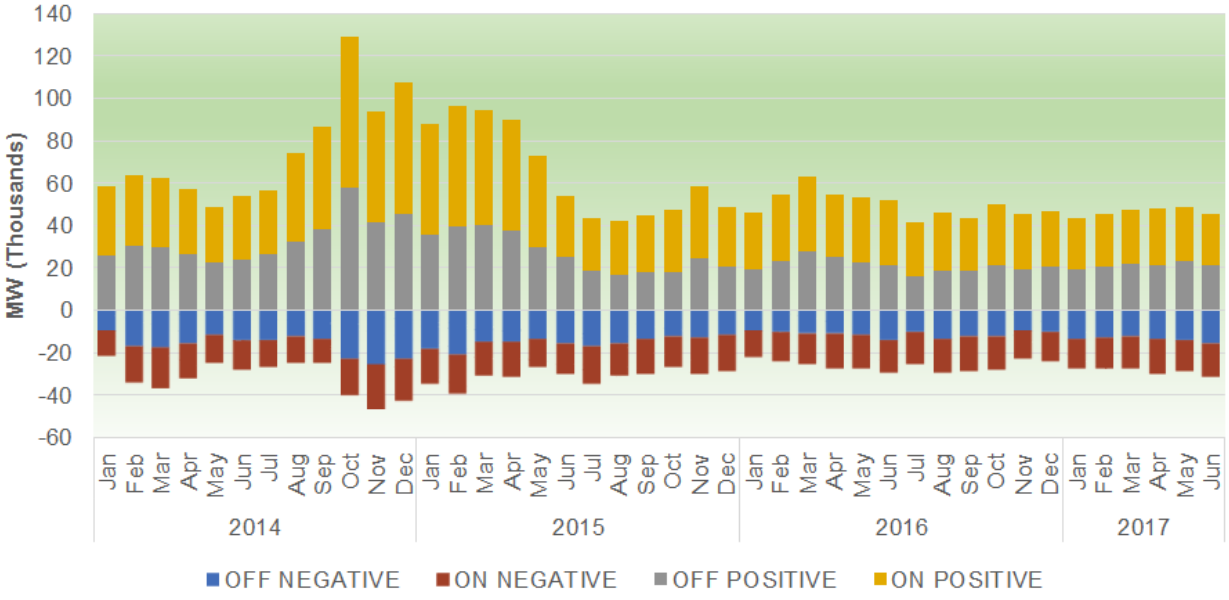


Figure 18: Volume of awards in monthly auctions by TOU



Generally, the volume of negatively priced CRRs in the annual and monthly auctions have been about 22.5 and 44 percent of the positively priced CRRs for the annual auction and 50 and 61 percent of the positively priced CRRs for the monthly auction.

Auction prices

The trend of prices from annual auctions is presented in Figure 19 and Figure 20. The vertical axis shows the count of prices only for CRRs that have an award greater than zero.

Figure 19: Hourly prices from annual auctions - Off peak

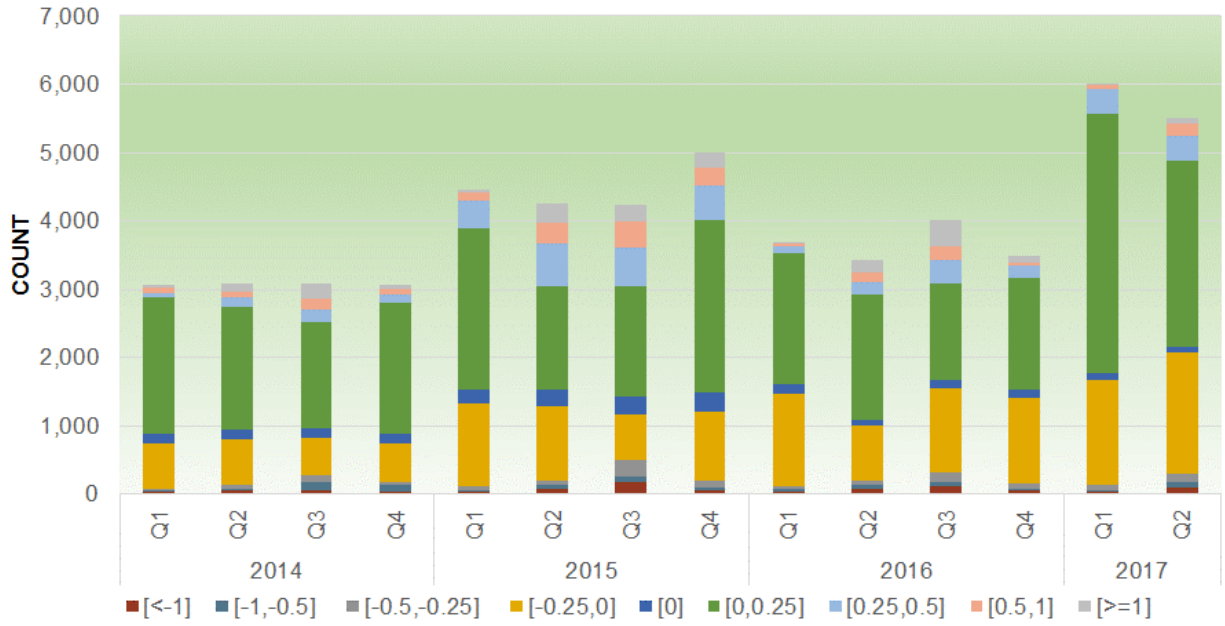
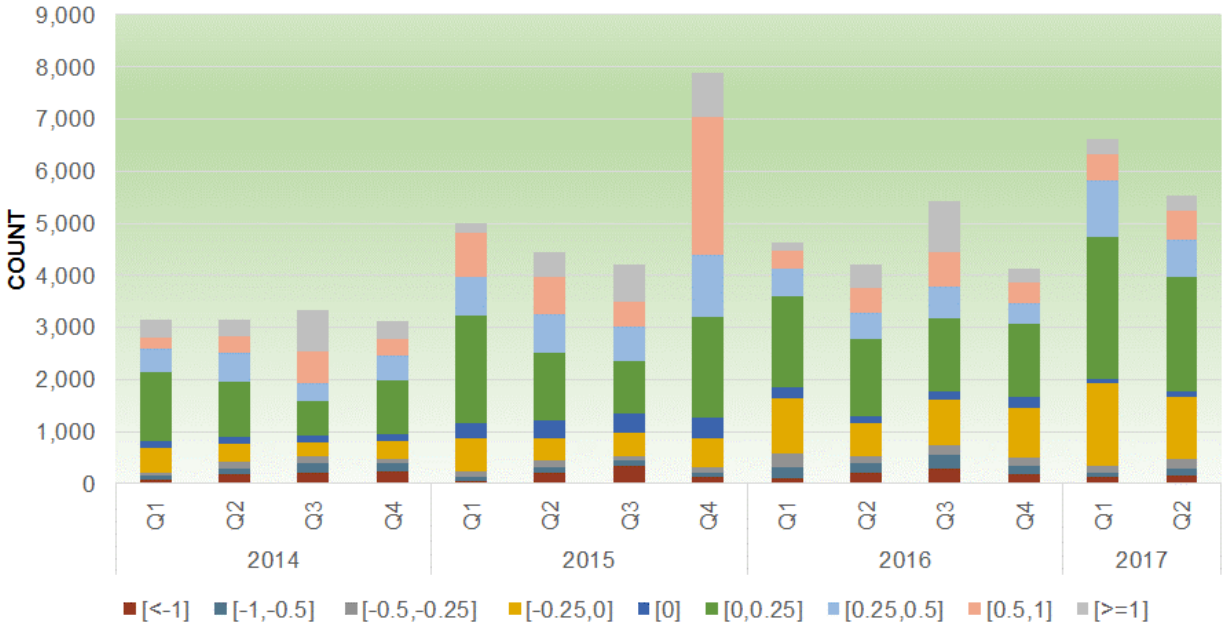


Figure 20: Hourly prices from annual auctions - On peak



Prices are computed as the auction prices divided by the number of hours for the corresponding TOU of each season. Therefore, prices are on an hourly basis of $/MWh. About 61 percent of the CRR awards are valued in the low price range of -$0.25/MWh and +$0.25/MWh.

Similar grouping of prices is used to estimate the volume (in MW) of CRR awarded in the annual auction; Figure 21 and Figure 22 and shows this distribution for the annual Off-peak CRRs. Over 90 percent of the CRR volume was awarded between $0/MWh and $1/MWh.

Figure 21: Volume of annual auction CRRs organized by prices from annual auctions - Off peak

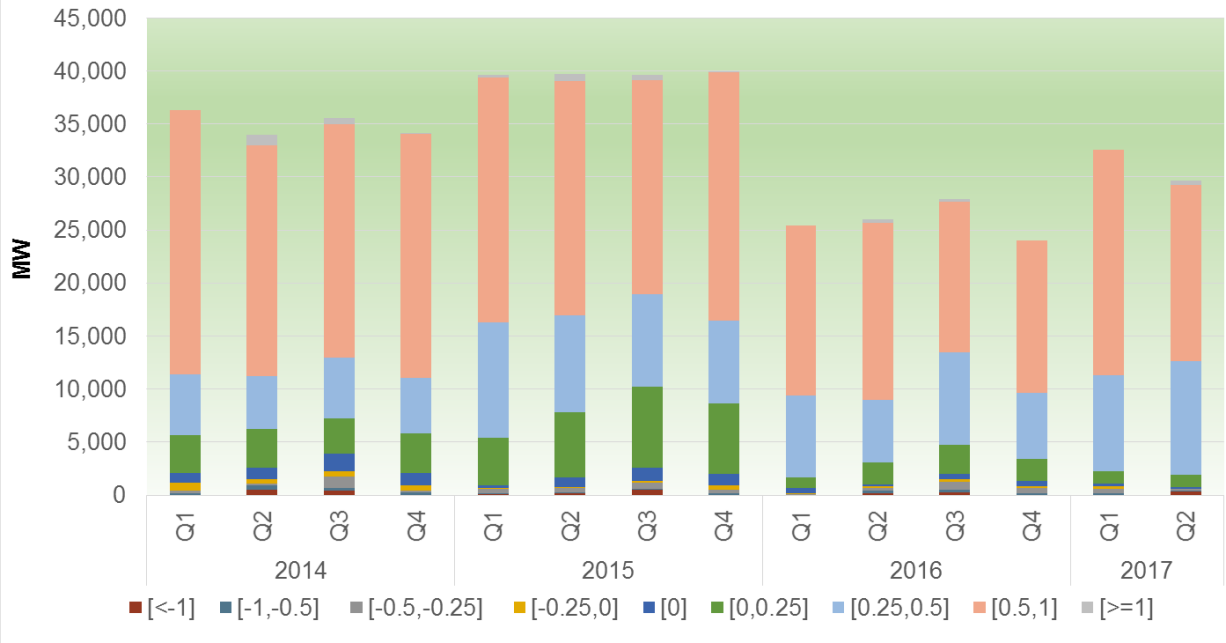


Figure 22: Volume of annual auction CRRs organized by prices from annual auctions - On peak

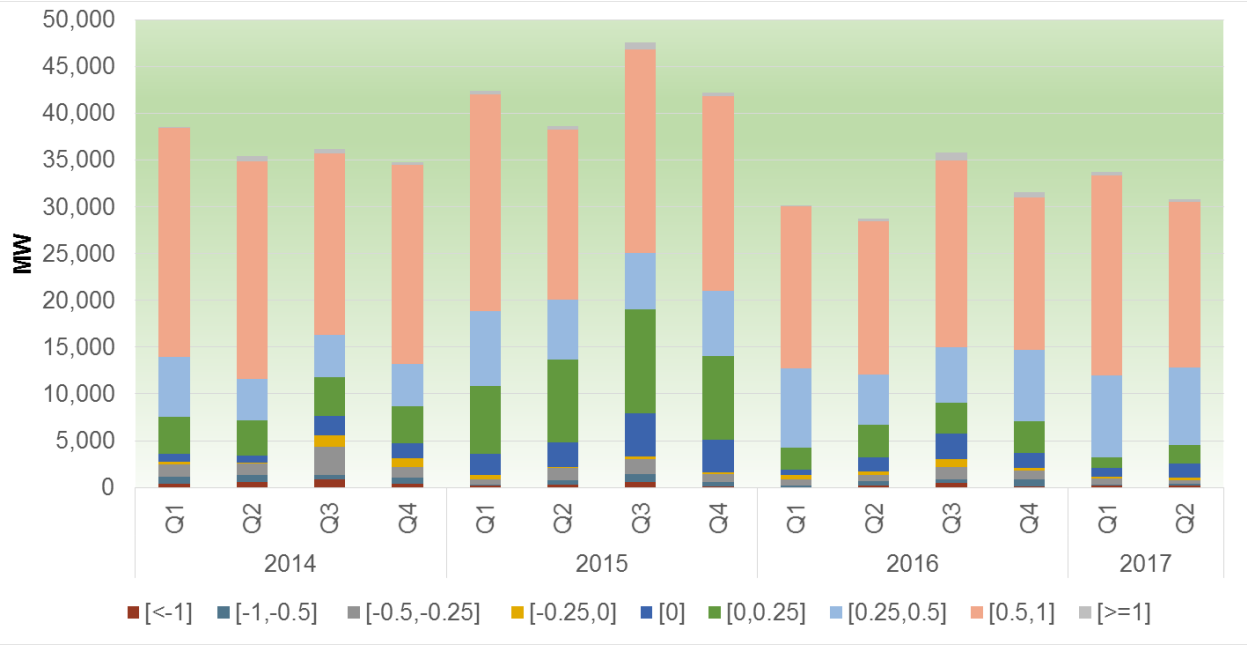


Figure 23 and Figure 24 shows the monthly auction prices organized by price ranges and TOU. Over time, most of the paths cleared in the monthly auctions fell in the price range of -0.25 and 0.25 $/MWh. This trend is indeed more vivid in the Off-peak periods, in which about 92 percent of the paths were cleared in the price range of -0.25$/MWh and 0.25 $/MWh as compared to 76 percent of the paths cleared for the same price range in the On-peak period.

Figure 23: Hourly prices from monthly auctions - Off peak

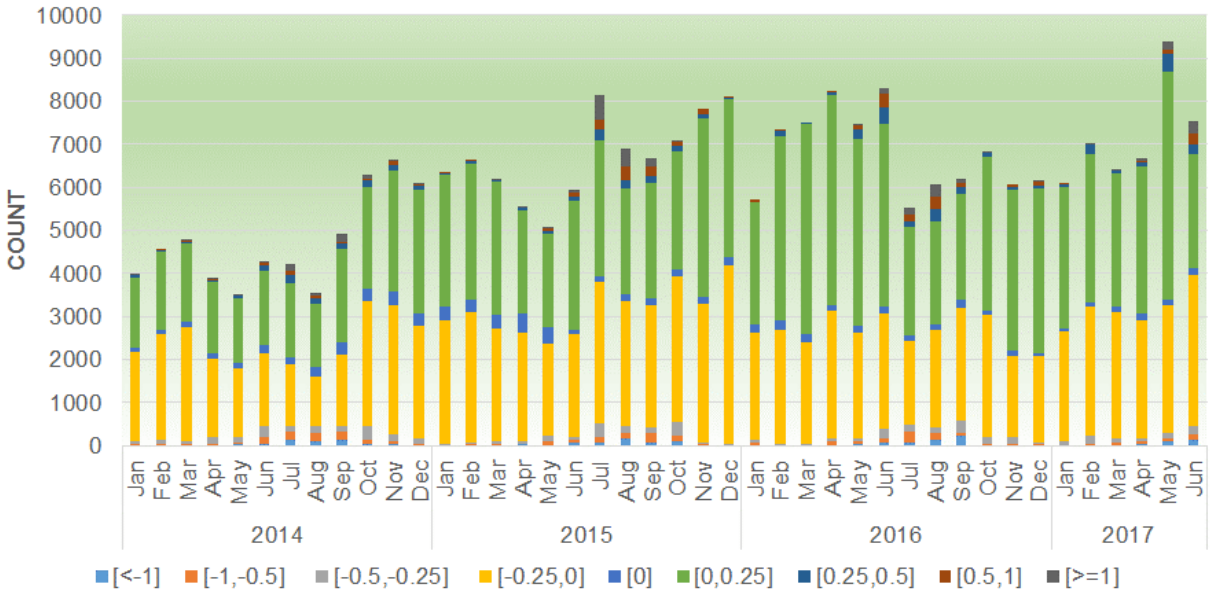
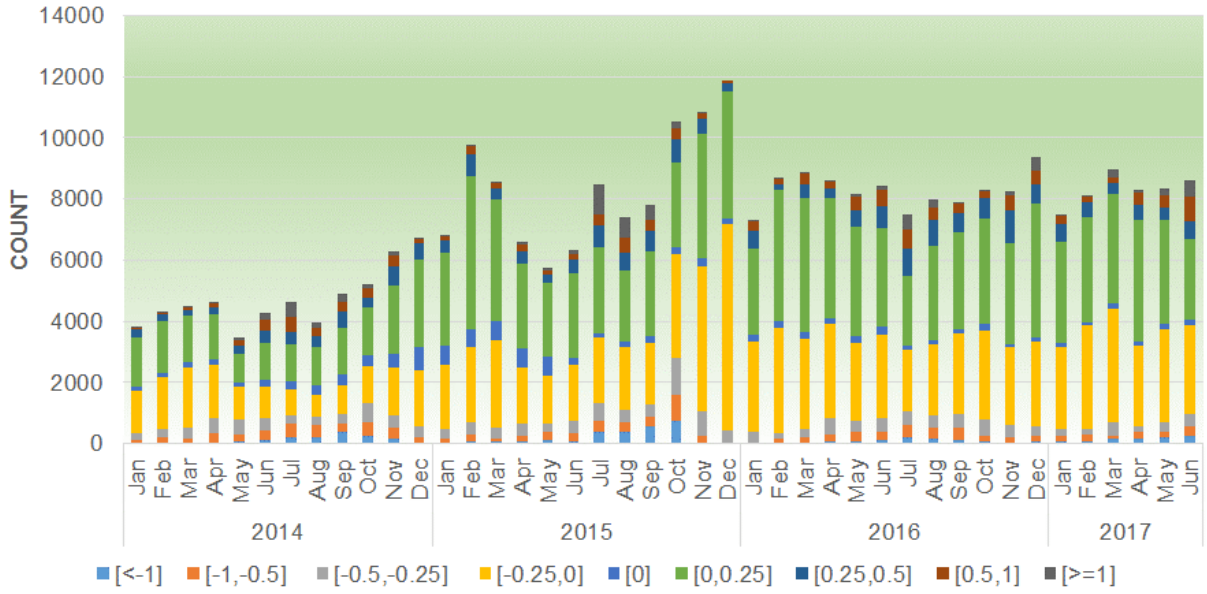


Figure 24: Hourly prices from monthly auctions - On peak



Furthermore, there is a set of CRRs awards cleared at $0/MWh. This set is persistently cleared in every CRR auction for the period under analysis. Those CRRs that are acquired at zero cost in the CRR market were found, based on further analysis, most of the time to have not

accrued any CRR payments in the day-ahead market. However, there are several instances where these CRRs actually have a non-zero CRR payout.

Figure 25 and Figure 26 show the volume of monthly CRRs in MW awarded in the monthly auctions by time of use. Similar to the pattern observed on the count of CRRs, over 90 percent of the total volume of CRRs awarded in the monthly auctions between at prices between -0.25/MWh and +$0.25/MWh, which is a relative low price range. The volume of CRRs awarded at zero price in the monthly auctions used to be about 25 percent until May 2015; starting with June 2015, the volume of CRRs at zero prices has dropped to about 7 percent. This steep reduction is a by-product of starting to enforce nodal group constraints in the CRR auctions; these constraints impose limitation on the amount of CRR that can be awarded at the location level.

Figure 25: Volume of monthly auction CRRs by hourly prices from monthly auctions - Off peak

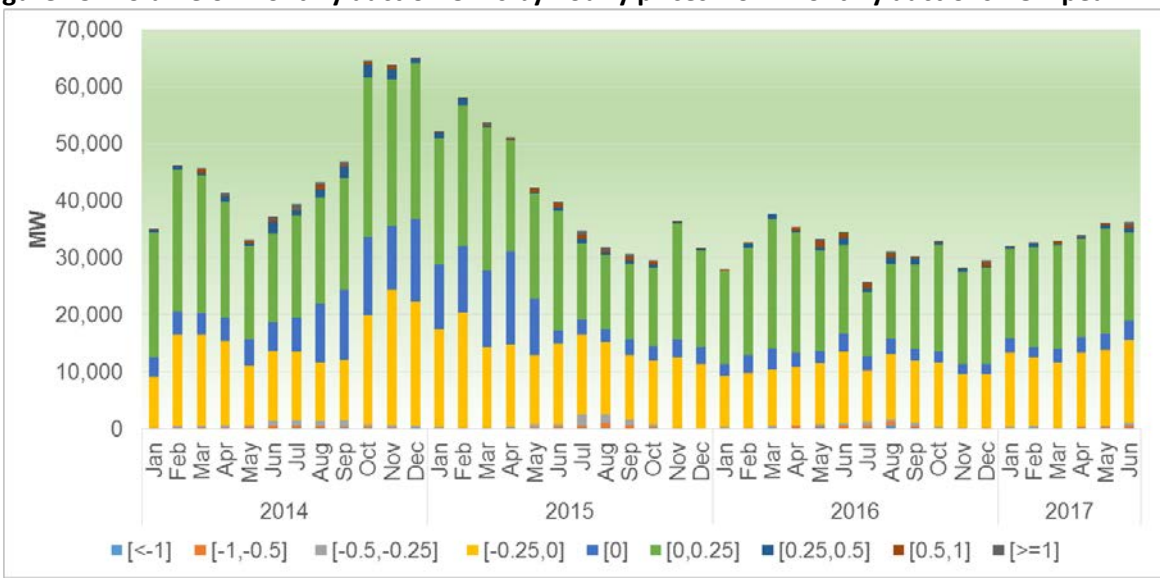
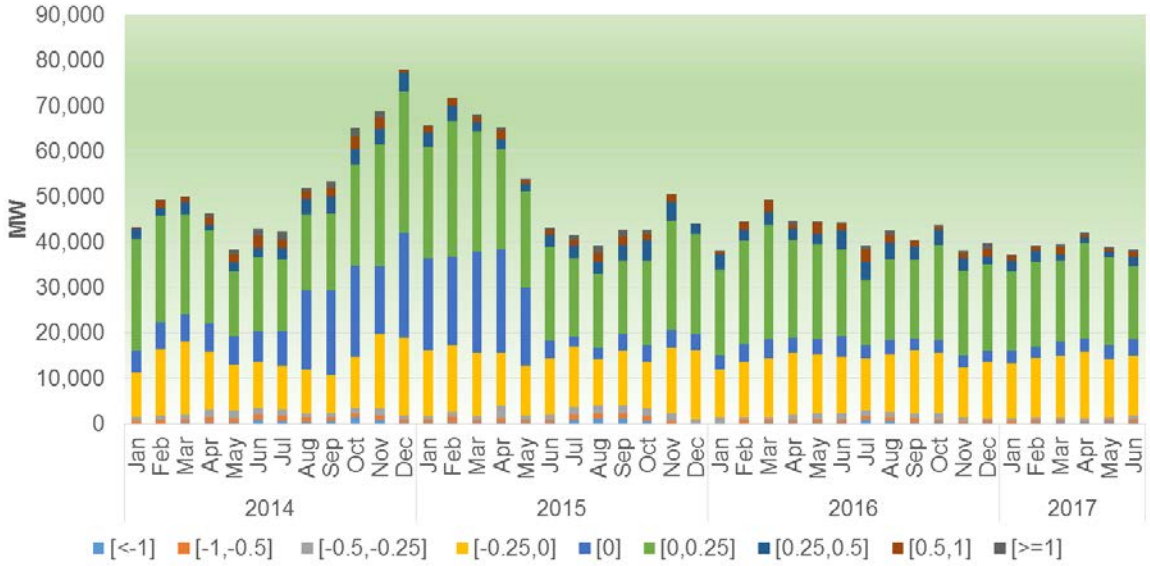


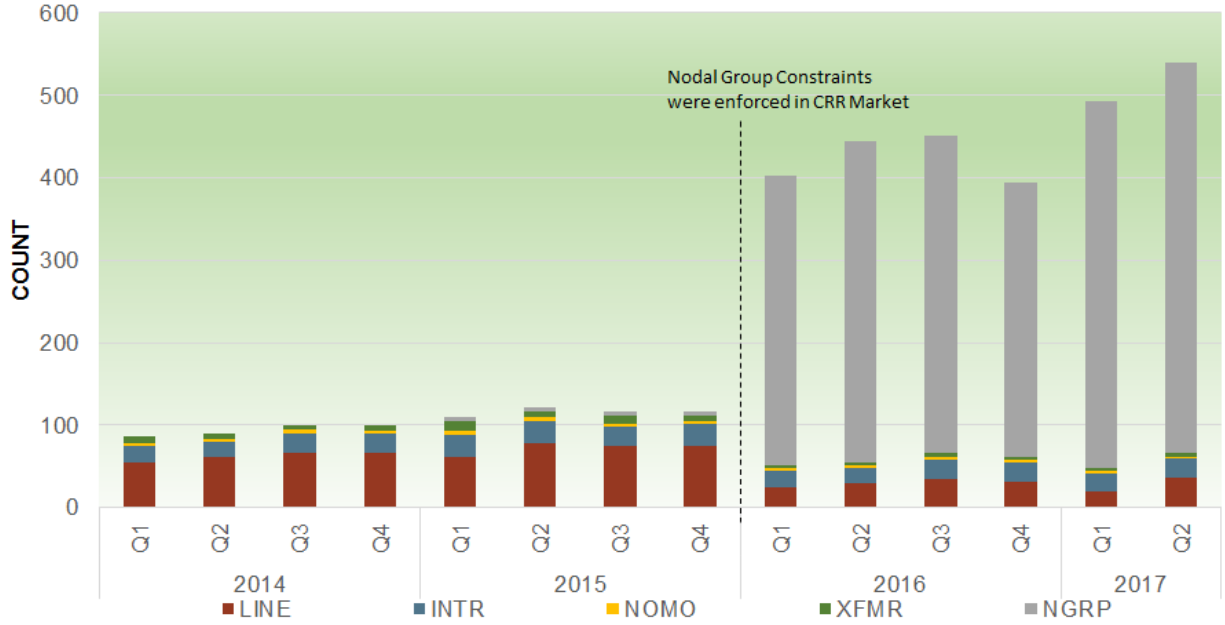
Figure 26: Volume of monthly auction CRRs by hourly prices from monthly auctions - On peak



CRR Binding constraints

Figure 27 and Figure 28 show the trends of binding constraints in the CRR annual auctions. These figures show that there was significant increase in binding constraints in annual auctions for Off- and On-peak due to the introduction of nodal group constraints. Prior to 2016, very few nodal constraints were modelled in the CRR auctions.

Figure 27: Number of binding constraints in annual auctions by type - Off peak



Starting with the annual auction of 2016, nodal group constraints were more comprehensively modelled and enforced in the 2016. An interesting by-product effect observed

with the enforcement of nodal constraints is that the frequency of binding constraints for the other type of constraints has sharply decreased by 40 percent. One possibility for this effect is that with the nodal constraints enforced and binding, they have become more limiting at locational level. By limiting the injections at the nodal level, excessive flows to bind the typical transmission constraints like flowgates or nomograms are prevented.

Figure 28: Number of binding constraints in annual auctions by type - On peak

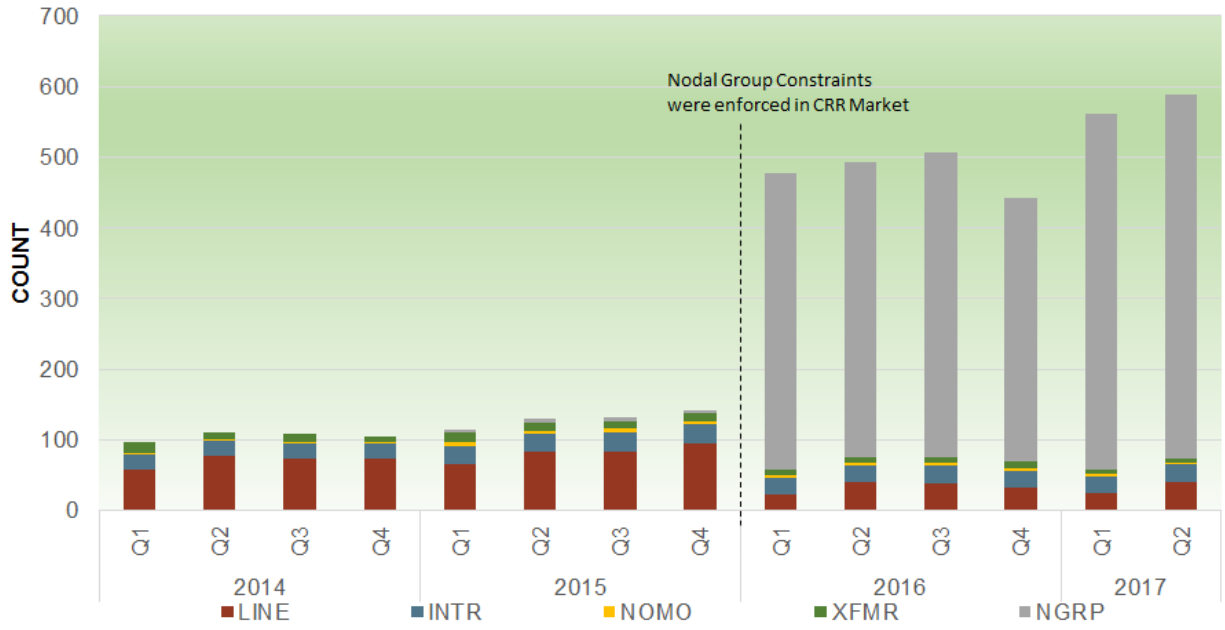


Figure 29 and Figure 30 show the trends of binding constraints in CRR monthly auctions. Similarly, these figures show that in the monthly auctions there was a significant increase in binding constraints for both Off- and On-peak periods due to the introduction of nodal group constraints. Nodal group constraints started to be modeled and enforced in the June 2015 monthly auction market.

Figure 29: Number of binding constraints in monthly auctions by type -Off peak

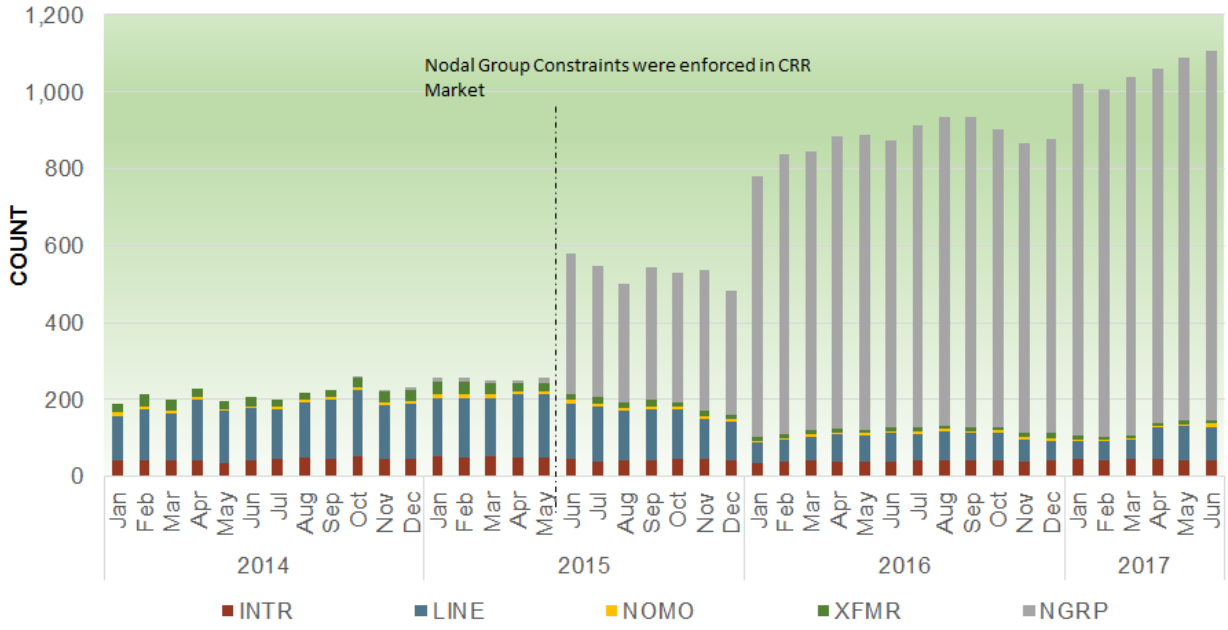
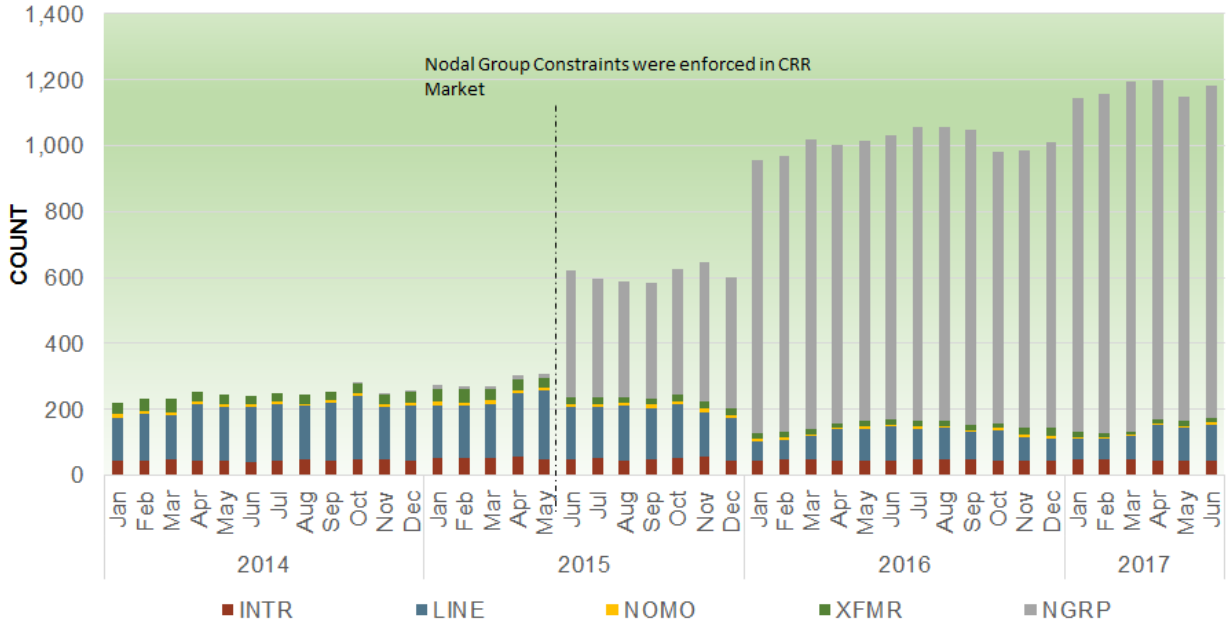


Figure 30: Number of binding constraints in monthly auctions by type -On peak



CRR awards

Figure 31 and Figure 32 show the volume of CRR awards in the annual auctions for off and on-peak periods, respectively, by the type of location used as a CRR source. The CRR award sources were categorized as default load aggregated point (DLAP), Trading Hub, Interties and all of the rest are others. About 84 percent of the CRRs have internal locations (either individual or aggregated locations) used as the CRR source, with a declining trend in 2016 and 2017; interties then become the second predominant type of location where CRRs are

sourced. This is not surprising given the fair volume of energy coming through the interties. It is not conclusive if the enforcement of the nodal constraints resulted in the lower volume of CRRs with sources at internal locations or if it is simply due to other dynamics.

Figure 31: Volume of awards in annual auctions by source type - Off peak

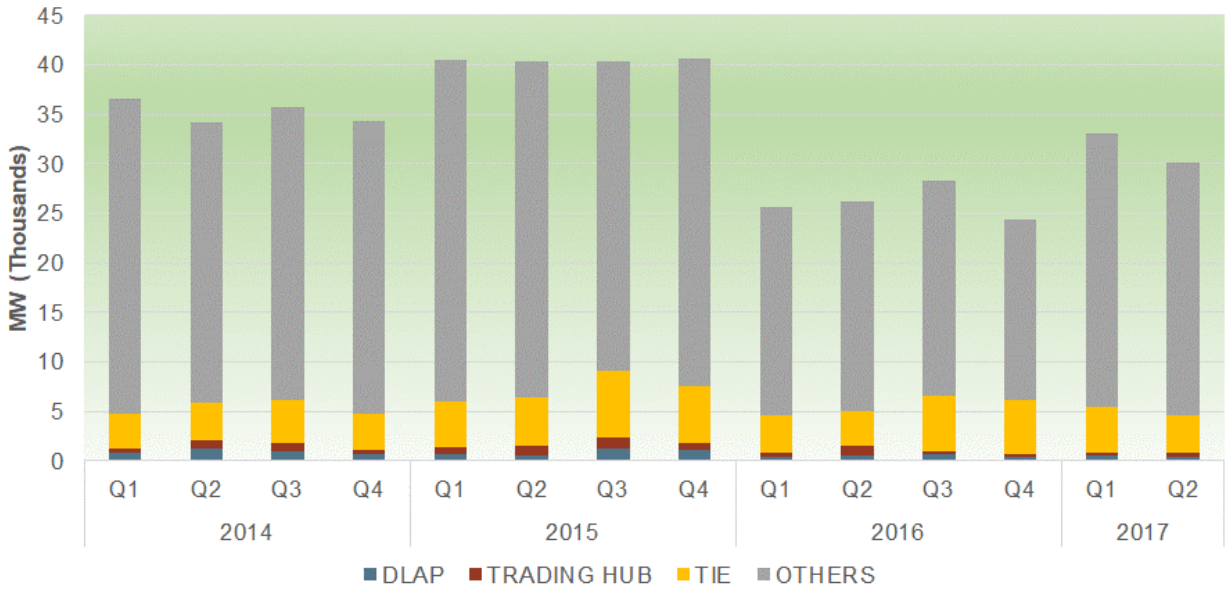
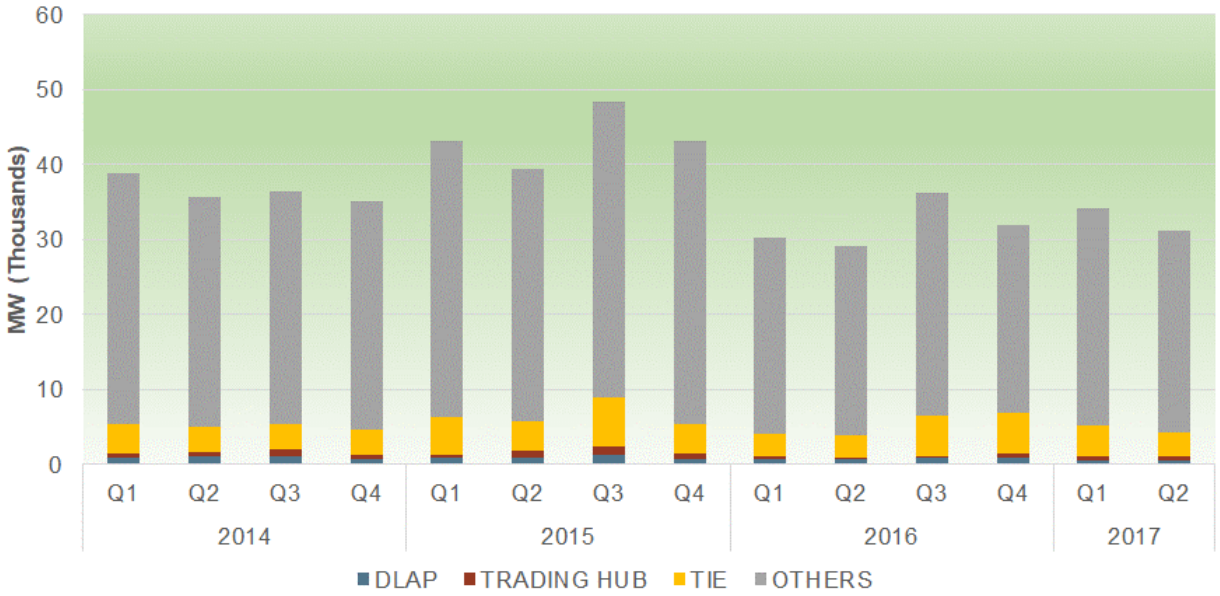


Figure 32: Volume of awards in annual auctions by source type - On peak



Similarly, Figure 33 and Figure 34 show the volume of CRR awards from the monthly auctions for Off- and On-peak periods, respectively, by the type of locations used as a CRR source.

Figure 33: Volume of awards in monthly auctions by source type - Off peak

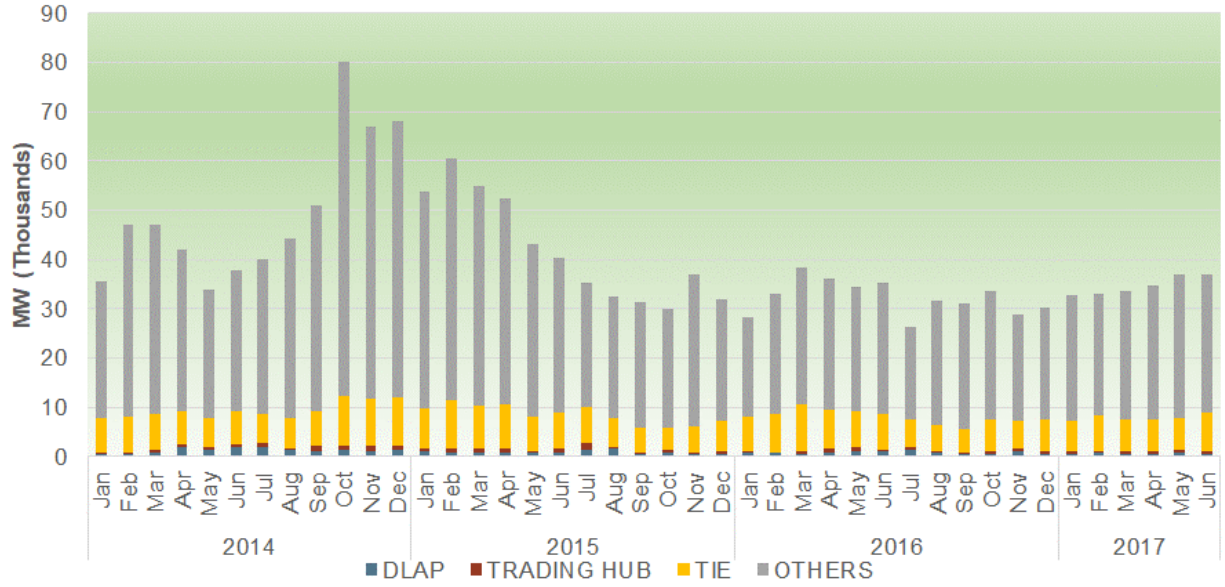
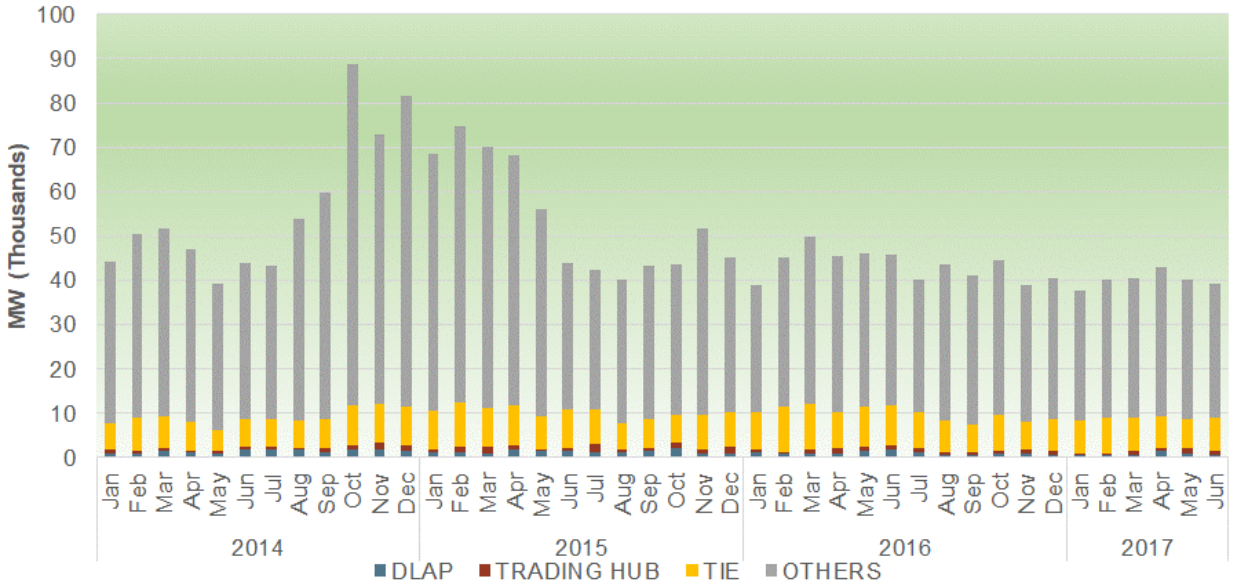


Figure 34: Volume of awards in monthly auctions by source type - On peak



Auction revenues

Participants in CRR auctions may get charged or paid to acquire CRRs. Participants receiving CRRs at positive prices pay the CRR awards at their clearing price. The expectation for participants looking to acquire CRRs for profit seeking opportunities, is that the revenue stream from the IFM congestion component prices will at least offset this cost plus some risk premium and any other costs associated with their participation in the CRR market. For participants looking to acquire CRRs for hedging needs, this may not be ultimate goal but

rather they seek to hedge their position in the energy market. Conversely, participants acquiring CRRs at negative prices are paid the CRR award at the clearing price. Negative auction revenues are funded with positive revenues. The net balance is the CRR auction revenues collected by the ISO. Figure 35 shows the total auction revenues collected in each month through the annual and monthly CRR auction process. The annual CRR auction revenues are attributed to each month through a pro-rata share of seasonal revenues based on the number of hours for each month.

Figure 35: Auction revenues by month

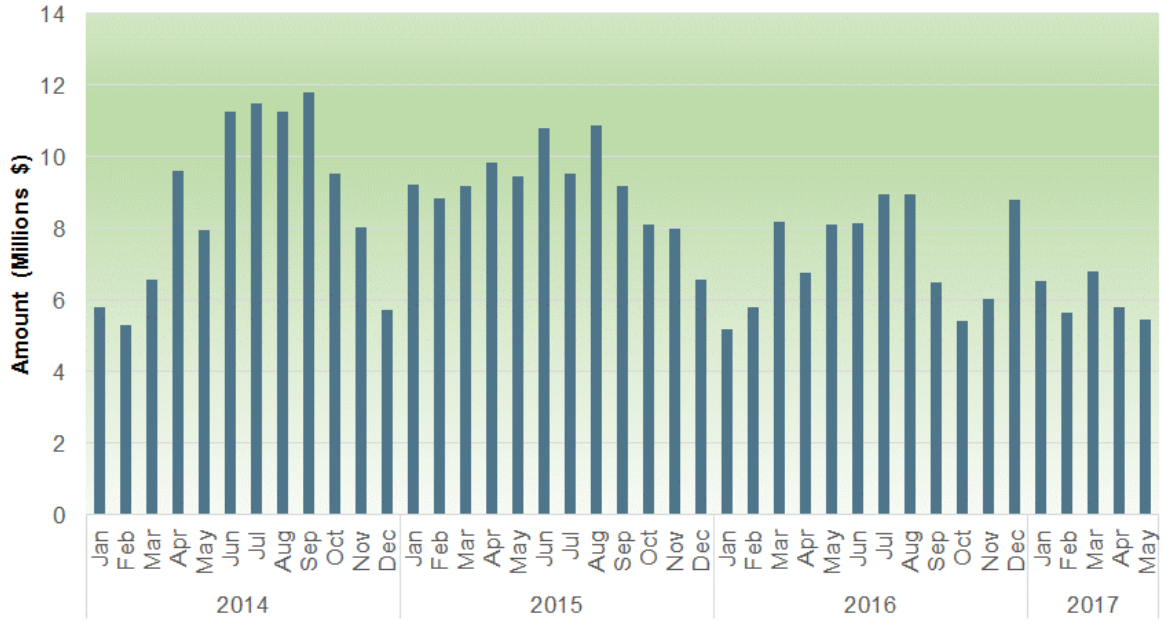
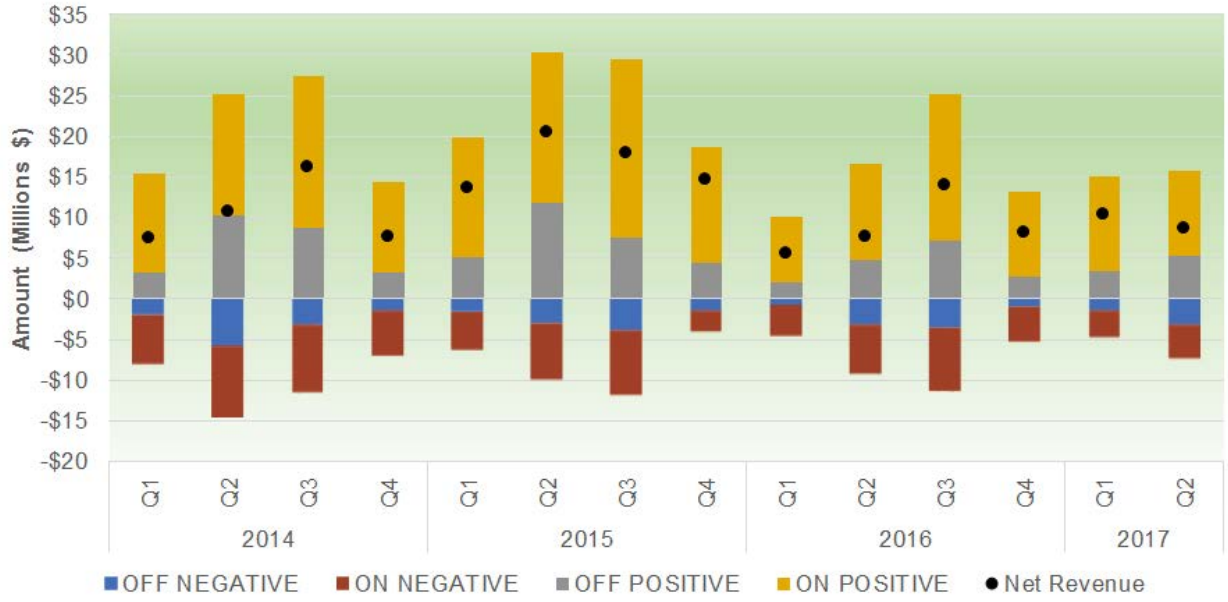


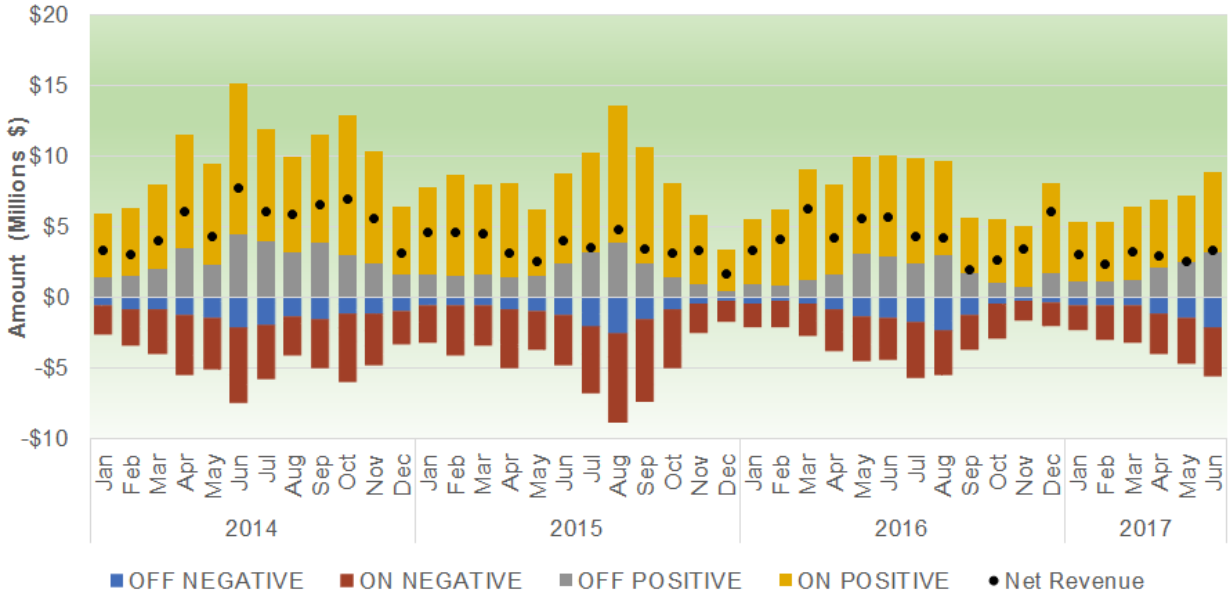
Figure 36 and Figure 37 show the auction revenues organized by positive and negative revenues in each TOU from annual and monthly auctions. These figures also show the net auction revenues collected by the ISO by TOU with a black dot on the chart. This net revenue illustration shows a trend with higher auction revenues collected in summer months.

Figure 36: Revenues collected from annual auctions by TOU



The monthly auctions observe more negative auction revenues offsetting the positive auction revenues, indicating the dynamic where more counter-flow positions may be bidding and clearing in the shorter-term auction. In the annual and monthly auctions, negative auction revenues amount to about 40 percent and 50 percent, respectively, of those of positive auction revenues. This would be expected given that the more frequent (monthly auction) can have CRRs with a shorter life term (a month versus a quarter of the annual) and this auction is run closer to day-ahead conditions (a couple of weeks in advance of the settlement months in contrast to up to 10 months in advance of the annual auction).

Figure 37: Revenues collected from monthly auctions by TOU



5 Market Performance

DA congestion rents

Congestion rent is a by-product of using locational pricing to trade energy and stands for the market surplus collected by the CAISO when congestion arises. This surplus is obtained from the basic principle of having demand paying higher prices than what is paid to supply due to using scarce transmission. From a settlements perspective, congestion rents are defined as the difference between congestion charges from demand (physical and virtual) and exports, minus congestion payments to generation (physical and virtual) and imports[2]. With the current nodal market design, ancillary services can also be awarded over interties and they have to compete for transmission capacity over those ties. If ancillary services (AS) are awarded over a congested inter-tie, then that AS award also has to pay for congestion, contributing to congestion rents. For each hour of the IFM, demand and exports are charged the scheduled MW amount times the marginal congestion component (MCC), and supply and imports are paid the scheduled MW amount times the MCC. The MCC is at the applicable individual pricing locations (Pnodes), aggregated pricing locations (APnodes) or scheduling points (SP). The monthly congestion rents shown in Figure 38 are computed as the sum of hourly congestion rents across all hours of the day, for all days in a month.

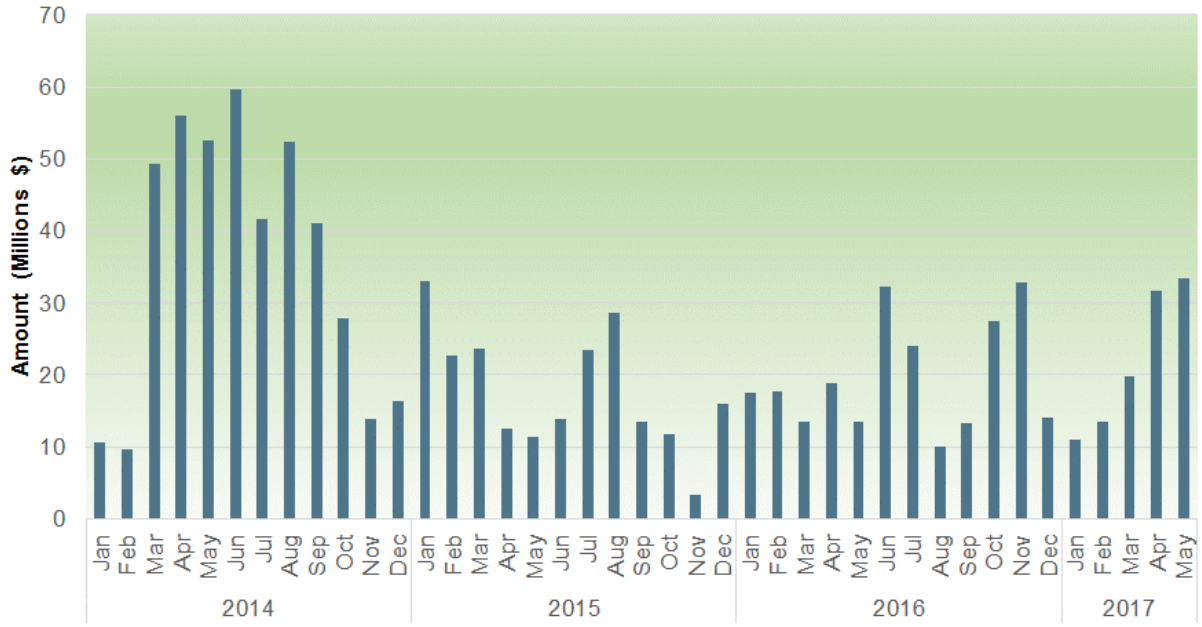
In addition, the revenue stream available from the IFM to fund the CRR payments are reduced by the amount to be paid back to holders of existing rights (TOR, ETC and CVR), as they are fully exempt from congestion charges. This requirement is contractual and is a tariff requirement[3]. The CAISO explicitly tracks the costs of the existing right exemptions so that the costs of honoring the contracts associated with the existing rights holders can be clearly broken out for analysis. Figure 38 shows the summation of IFM congestion rents reduced by the cost of existing rights exemption that would be used to fund the CRR payments.

Over the recent years under analysis, 2014 saw about $430 million in 2014, and then stabilized in subsequent years, reducing to about $213 million in 2015 and about $235 million in 2016 and about $108 million in 2017 (January to May).

[2] Throughout this document, congestion rents have been estimated in two different ways. At the system wide level, congestion rents can be estimated based on the settlements data, which reflects payments and charges to participants based on the congestion component of the LMP. However, when the analysis needs to be carried out by each transmission constraint, two variations can be used. One variation relies on reconstructing the implied congestion rents on each element by using the shift factors, resource awards and the MCCs. A simpler calculation relies on the shadow prices and nominal power flow on each transmission constraint. The difference between these two estimates is that the latter does not reflect the effect of the 2 percent shift factor threshold and, therefore, it becomes an upper bound on the estimate for congestion rents. Generally the difference is expected to be small, even though there may be some cases where a specific constraint may be impacted more significantly due to the shift factor threshold. Throughout this document, when the analysis is carried out by transmission constraint, the latter approach is used for simplicity; again, this will always provide an upper bound on the congestion rents estimate, which generally can be estimated more optimistically than it actually was in settlements.

[3] CAISO tariff section 11.2.1.5.

Figure 38: Monthly IFM congestion rents including costs of existing rights exemptions



CRR revenue adequacy

The requirement to maintain revenue adequacy is the main factor that limits the number of CRRs released through allocations and auctions. Simply, it means that there should be sufficient congestion rents emanating from the IFM energy market to pay all of the CRR entitlements. Conceptually, and under certain assumptions, such as the use of the same transmission configuration in both the CRR and energy markets, revenue adequacy may be guaranteed when limiting the release of CRRs with a simultaneous feasibility test. The CAISO's market for CRRs uses a simultaneous feasibility test in each of the release processes (allocations and auctions) to ensure, to the extent possible, the appropriate number of CRRs are released. In real-world markets, and based on the inherently changing nature of the transmission system configuration, the theoretical assumptions to guarantee revenue adequacy at every single hour may not be possible to fulfill without overly restricting the number of CRRs released. The CRR market is a forward-looking market, and at the time that the CRRs are released some outages and constraints are not known and, therefore, cannot be modeled in the network used in the simultaneous feasibility test. Hence, shift factors, transmission limits and constraint enforcements used in the CRR market may be different to the ones actually used in the energy market, which may lead to revenue deficiencies. For instance, the annual processes release CRRs as far 10 months in advance and, consequently, even planned outages may not be known by the time CRRs are released. Although the CAISO's energy market is based on an AC-based model, the CRR market is a DC-based model. This simplified model is obtained by following the well-known linearization of the power flow expressions.

For annual processes, all transmission facilities are considered in service, and outages of any significant elements known before the start of the processes may be modeled in the

network for the season in which the outage occurs[4]. Furthermore, for monthly processes the CAISO has in place a process for transmission owners to submit requests to the CAISO to schedule significant outages at least 30 days prior to the start of the month in which the outage will take place. This 30-day rule provides a critical mechanism for the CAISO to account for significant transmission outages when determining the network capacity available for each monthly CRR release process. The monthly processes are the last occasion wherein the CAISO may make adjustments to the release of CRRs with the intention of protecting revenue adequacy based on feedback from the prior months' performance. At the same time, the CAISO is trying to ensure revenue adequacy without adversely affecting the quantity of CRRs released. There are three adjustments the CAISO uses for this purpose:

a) Modeling of outages in monthly CRR release processes. As transmission outages play an important role in revenue adequacy, a critical element of the ISO's monthly CRR release process is to account for the impact of expected transmission outages in the monthly CRR releases. The CAISO tariff requires that Participating Transmission Owners (PTO) submit requests to the CAISO to schedule significant outages at least 30 days prior to the start of the month in which the outage will occur[5]. The transmission outages spanning less than 10 days were modeled with pro-rata derates to reflect the portion of the month they were planned to be out of service.
b) Global Derate Factor. Outages that cannot be captured by the 30-day rule, such as unscheduled outages, cannot be explicitly reflected in the CRR release process. To account for the likelihood of unscheduled outages, the monthly CRR process employs a global derate factor which reduces the system-wide transmission capacity available in the release process and thereby limits the number of CRRs released. The global derate factor has been 17.5 percent since January 2014.
c) Local Derate Factor. For known outages that can impact interface or branch group limits the CRR process makes pro-rata adjustments to reflect and reduce interface limits. For unscheduled outages the CRR process can apply a Local Derate Factor to any individual interface or branch group in a manner similar to the Global Derate Factor. The Local Derate Factor is not applied across all interfaces and branch groups but only on specific locations.

Figure 39 illustrates the monthly congestion revenue adequacy ratio and CRR entitlements. The ratio was below 1 for all the months indicating that CAISO was revenue deficient, when congestion rents collected in the day-ahead market were not sufficient to fund the CRR payments.

[4] CAISO tariff section 36.4.
[5] Tariff sections 9.3.6.3.2 and 36.4.3. See also BPM for CRRs section 10.3.1 and Operating Procedure 3210 appendices B,C and D.

Figure 39: Monthly comparison of congestion rents with CRR entitlements

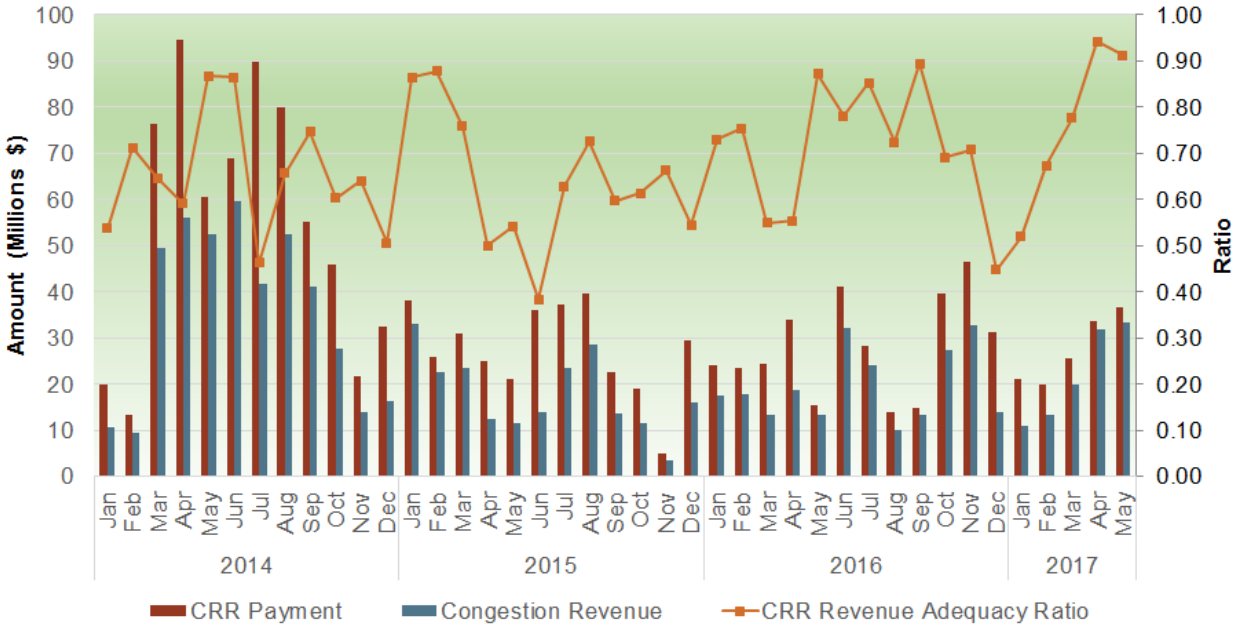


Figure 40 illustrates the monthly congestion revenue adequacy before including the auction revenues. Although auction revenues can be used to offset any CRR revenue deficiency that results from the IFM, the intention of the CAISO's CRR release process is that proceeds from the IFM will be sufficient to cover all CRR payments over the course of each month. The annual and monthly processes to release CRRs through allocations and auctions are built upon this concept. In addition, transmission capacity is set aside in the release processes in order to account for the perfect hedge congestion payment reversal for existing transmission rights.

Figure 40: Monthly CRR revenue adequacy before auction revenues

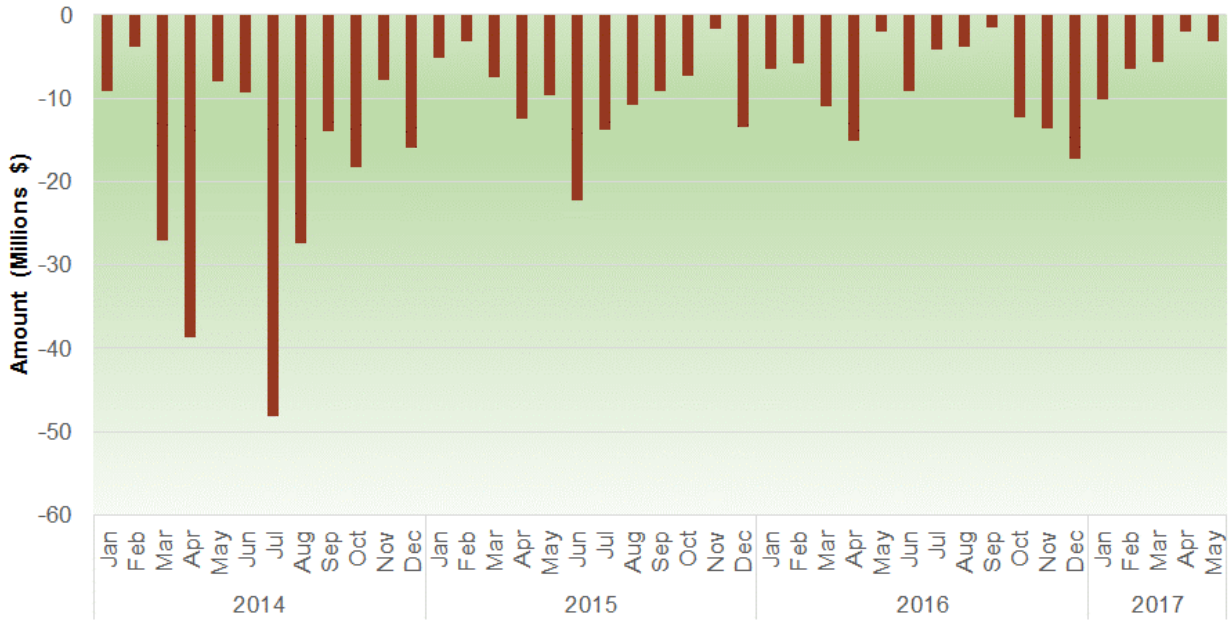


Figure 41: Monthly comparison of congestion rents incl. auction revenue with CRR entitlements

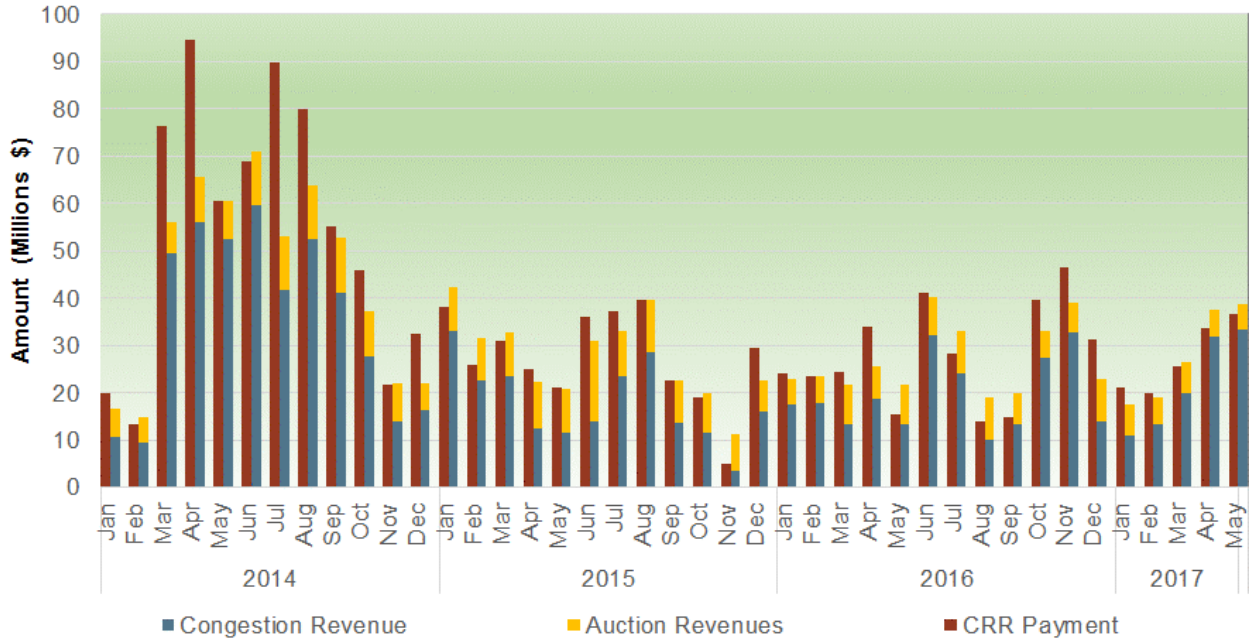


Figure 41 shows the comparison of congestion rents from IFM with CRR payments; this also includes the auction revenues from the monthly and annual CRR auctions. Similarly, Figure 42 shows the difference between congestion rent from IFM and CRR payments including the auction revenue to check if the proceeds from the IFM will be sufficient to cover net CRR payments over the course of each month. This figure represents the money available in the CRR balancing account which is allocated to the measured demand. This balancing account money (whether representing a surplus or shortfall) is allocated to the measured demand. Once the auction revenues are used as a buffer, multiple months regained sufficiency; still, there are many other months in which there is a revenue deficiency even with the auction revenues being fully used.

Figure 43 shows daily revenue adequacy on the system level. Along with the daily revenue adequacy, it also shows the comparison of updates in the Full Network Model (FNM) with the revenue adequacy. Each FNM promotion has been marked in the chart starting from 2014 along with high revenue deficient days and the top transmission constraints that impacted the revenue deficiency. From this trend, there is no clear correlation over this period of time in which a system change may have driven the pattern of revenue deficiency in one way or another. Indeed the level of congestion and revenue deficiency seem to have diluted after the full network implementation in October 2014.

Figure 42: Balancing account allocated to measured demand

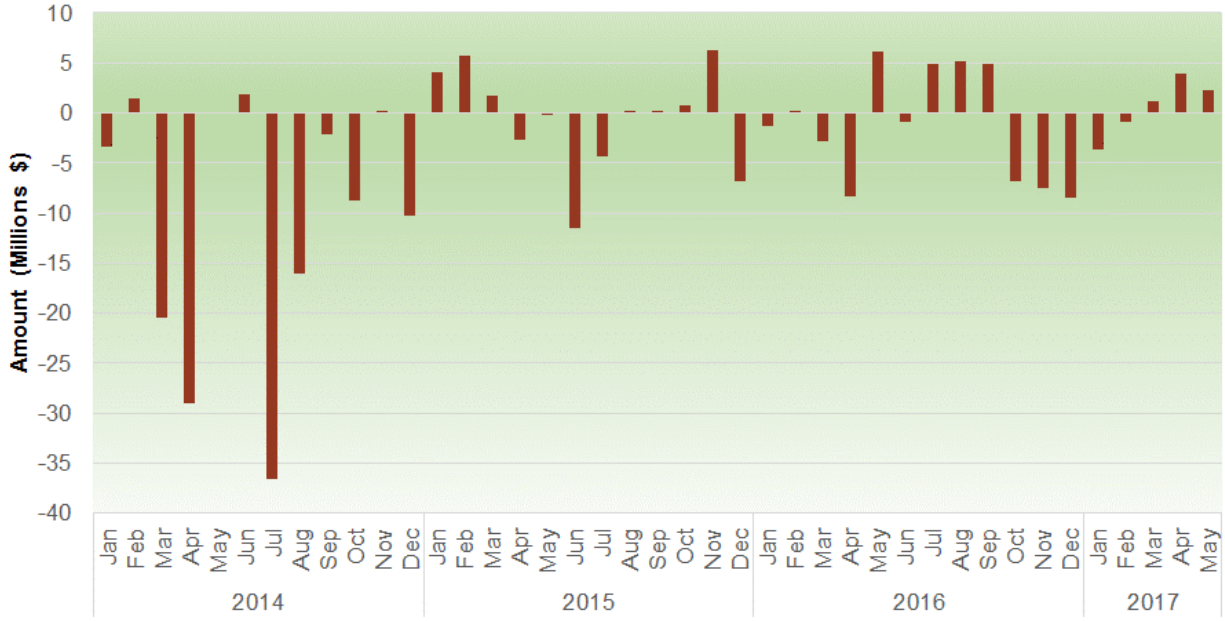
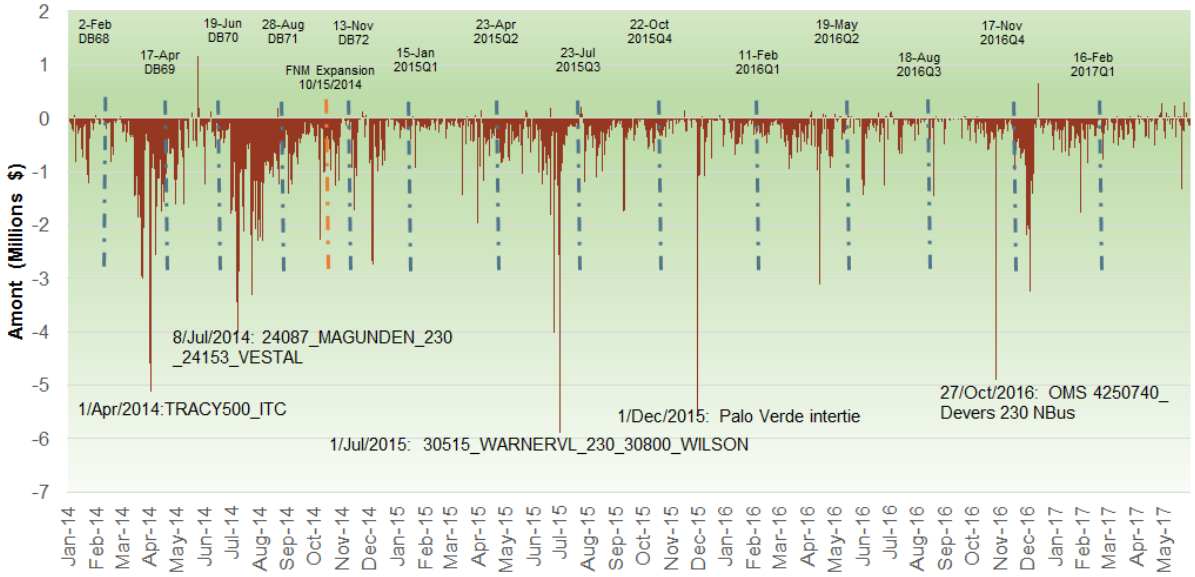


Figure 43: Daily CRR revenue adequacy

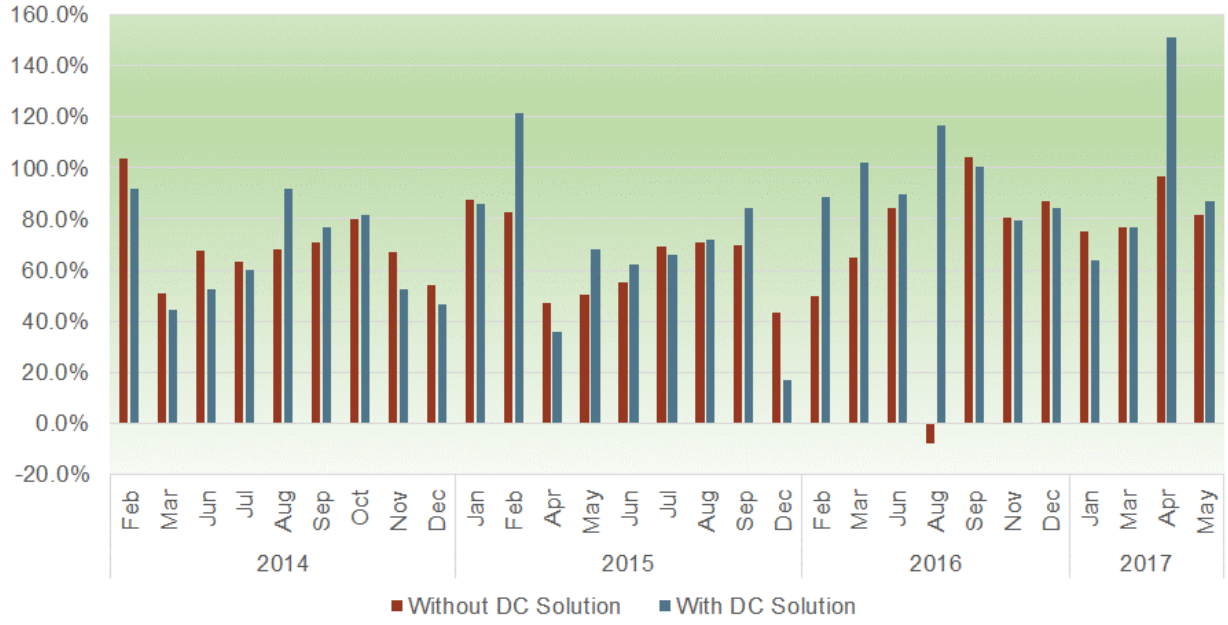


DC solutions and CRR revenue shortfalls

The CAISO markets are based on the use of a linearized AC power solution; when the AC power flow does not converge, the market application defaults to use a DC power flow solution. There has been some concern that with the CRR auctions using a DC model while the day-ahead market uses linearized AC power flows, systemic high payout or revenue shortfalls could be attained. An approach aiming to quantify this model difference was set-up by using instances of the day-ahead market when an AC solution could not be attained and the DAM

defaulted to a DC solution. Since the day-ahead market cannot be rerun with the all DC solution, an alternative approach to gauge the impact on revenue adequacy for having DC solutions is to identify the hours when there was a DC solution and then compare the level of revenue adequacy with AC and DC solutions for only the set of days in which there was at least one hour with DC solutions. Figure 44 shows the monthly comparison of CRR revenue adequacy ratio when the IFM market solved with a DC solution. The trade dates with any hour with a DC solution were identified and then a comparison was made of revenue adequacy ratios for hours with a DC solution and hours without a DC solution for the same trade dates. In general the results are mixed, even though there are more instances in which the hours with DC solutions have a better revenue adequacy (higher revenue adequacy ratios).

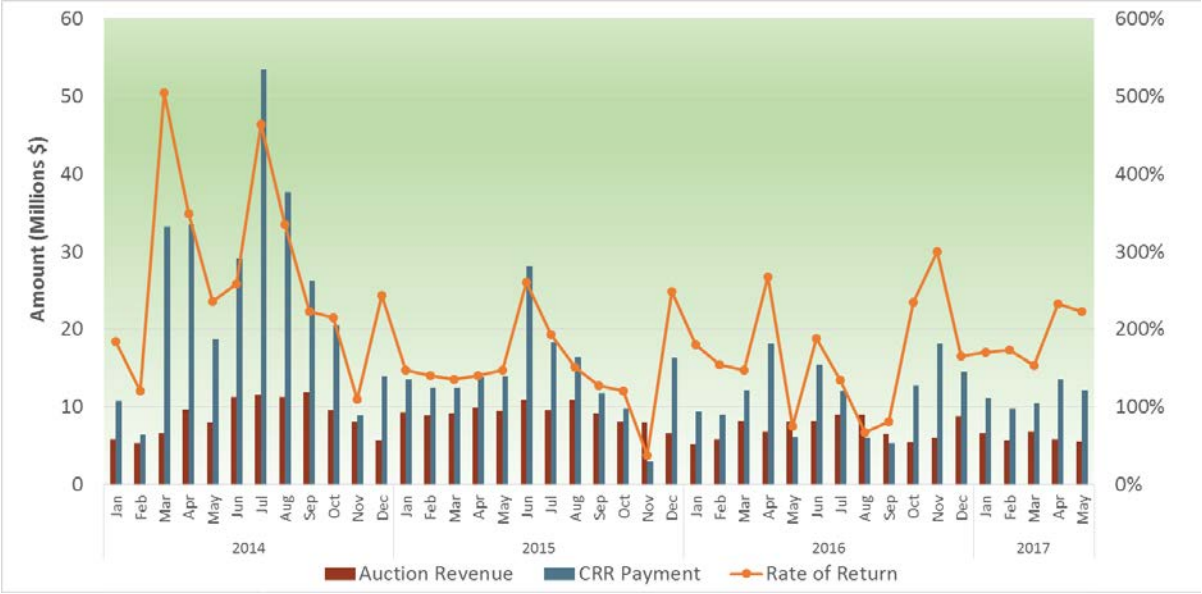
Figure 44: CRR revenue adequacy ratio - for trade dates with DC solution in IFM



Auction revenues *vs.* payments to auction CRRs

Figure 45 shows the comparison between auction revenues (monthly and annual) with the payments to auction CRRs by month. The auction revenues collected from the annual auctions for each season are distributed pro-rata to each month of the season based on the number of hours in each TOU. It shows that the amount collected from the auction market was less than the payments to holders of auction CRRs. The payments to auction CRRs were significantly high in 2014 at approximately $292 million. The auction revenues for the same year were about $104 million. This resulted in a net CRR payment of $187 million. The CRR payments to auction CRRs reduced significantly in 2015 to about $169 million and further reducing in 2016 to about $138 million. The delta between the CRR payments to auction CRRs and auction revenues reduced in 2015 to about -$60 million, further reducing in 2016 to about -$51 million. In 2017 (January to May) the total delta was at about -$21 million. The negative sign indicates that the payments made to the CRR holders for auction CRRs were higher than the total amount collected through auction revenues.

Figure 45: Comparison of auction revenues and CRR entitlements from auction CRRs



This graph also shows the proportion of CRR payments to auction revenues with the line in orange. A value of 100 percent indicates the CRR payment equals the auction revenues. A value higher than 100 percent indicates the CRR holder is collecting a CRR payment above the money paid to acquire the CRR in the CRR auctions.

Although this metric is useful to see the system-wide pattern, it does not show how and why this is happening. In order to further understand this dynamic, this metric was analyzed from different perspectives, breaking it down by TOU, annual and monthly auctions and source and sink locations. Figure 46 shows the difference between CRR payments to auction CRRs and the auction revenues; this difference is what is referred to as net CRR payments and is estimated from the CAISO's point of view, with a negative value meaning the CAISO has an overall payment to the holder of auction CRRs (CRR payments are greater than the auction revenues collected in the auction). Broken out by TOU to see if this pattern is common to both time of use or not, this trend shows that the negative net CRR payment is significantly more concentrated in the on-peak period. The net CRR payment for on-peak in 2014 was about -$132 million, reducing to about -$62 million in 2015 and -$41 million in 2016. The delta was about -$15 million in 2017 (January to May) for the on-peak period.

For the off-peak period, the net CRR payments were about -$55 million in 2014, and reduced to about $2 million in 2015. In 2016 and 2017 (January to May), the net CRR payment was about -$10 million and -$11 million respectively.

Figure 46: Net CRR payments to CRRs released in auctions organized by TOU

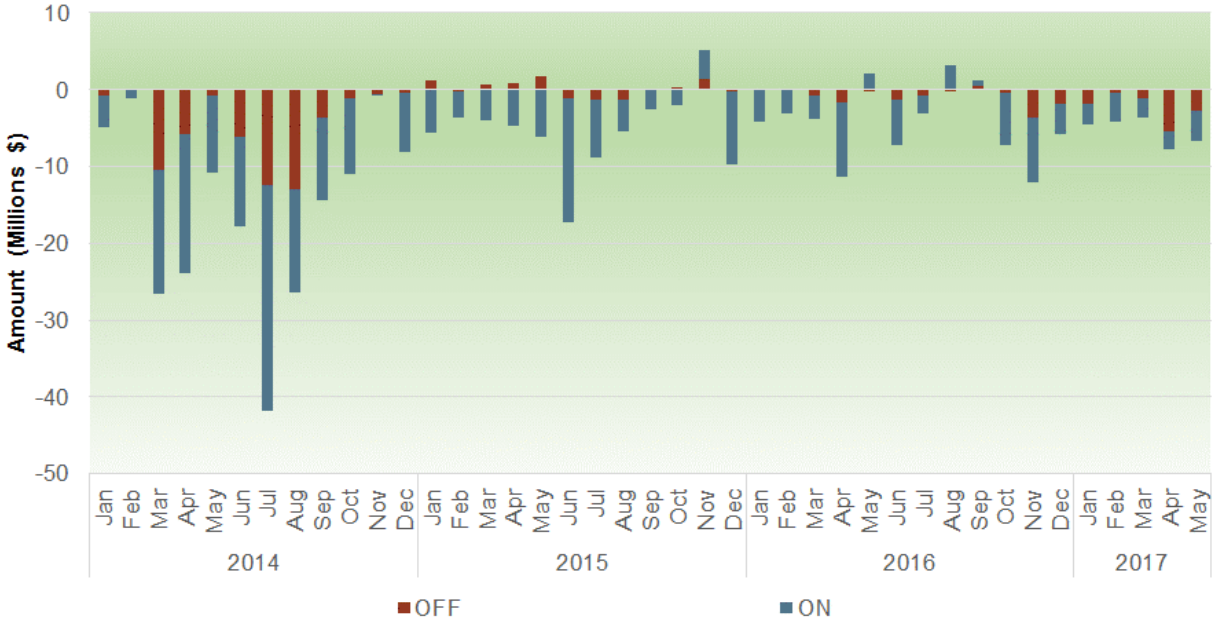
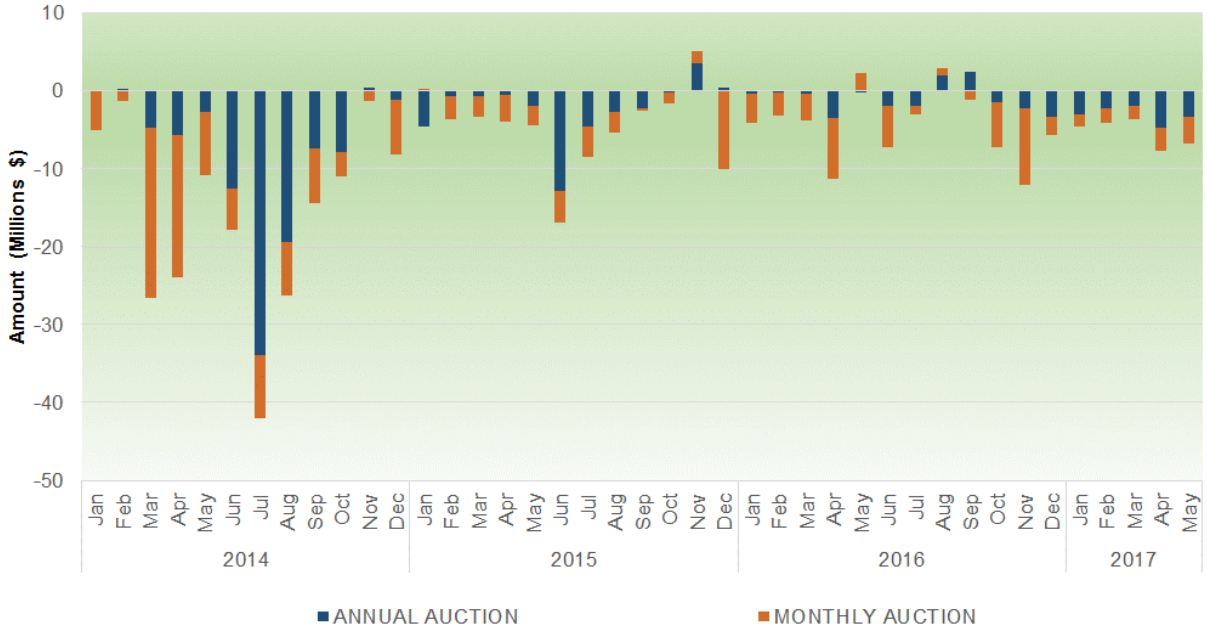


Figure 47 shows the net CRR payments for CRRs organized by annual and monthly auctions. The trend shows that the difference between the payments from the auction CRRs and auction revenues are evenly distributed between the monthly auction market and the annual auction market. The net CRR payments to the monthly auction CRRs was about -$93 million for 2014, reducing it to about -$32 million in 2015 and -$40 million in 2016. The delta was about -$11 million in 2017 (January to May).

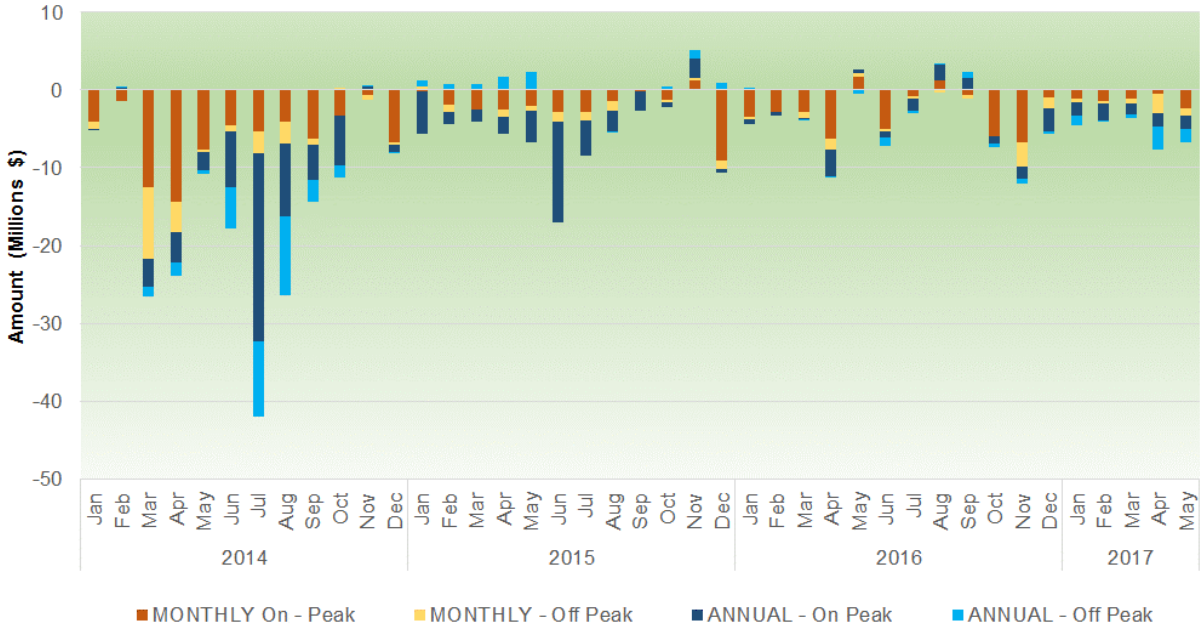
Figure 47: Net CRR payments to CRRs released in the monthly auctions



For the annual auction market, the net CRR payment was about -$94 million in 2014, reducing to about -$26 million in 2015, and further reducing it to -$11 million in 2016. In 2017 (January to May), the delta was about -$15 million.

Figure 48 shows another variation of the metric with the annual and monthly market by TOU. It shows that out of -$94 million delta from the annual auction market in 2014, about -$61 million came from the on-peak period. Similarly, about -$35 million and -$8 million came from the annual auction market for the on-peak period in 2015 and 2016.

Figure 48: Net CRR payments organized by auction and TOU



For the monthly auction market, out of -$93 million delta in 2014, about -$71 million came from the on-peak period. It shows that the on-peak period delta was higher than the off-peak for both the annual and monthly auction markets.

Figure 49 shows another variation of the metric by source type. The source types are categorized by DLAPs, Trading Hubs, Interties and the rest are *Others*. If a CRR is sourced from the DLAP then it falls under the DLAP type. This figure shows that net CRR payments have been mainly collected in CRRs with source or sinks locations at internal CAISO locations, such as individual pricing locations, group in the bin of *Others*. This may seem to be related more to counter-flow CRRs since the source and sink location happens at targeted internal pricing locations rather than DLAPs or trading hubs which reflect aggregated load and generation locations. The second largest source location is from interties, which is expected given the fair volume of energy coming from interties.

Figure 49: Net CRR payments broken out by type of source location

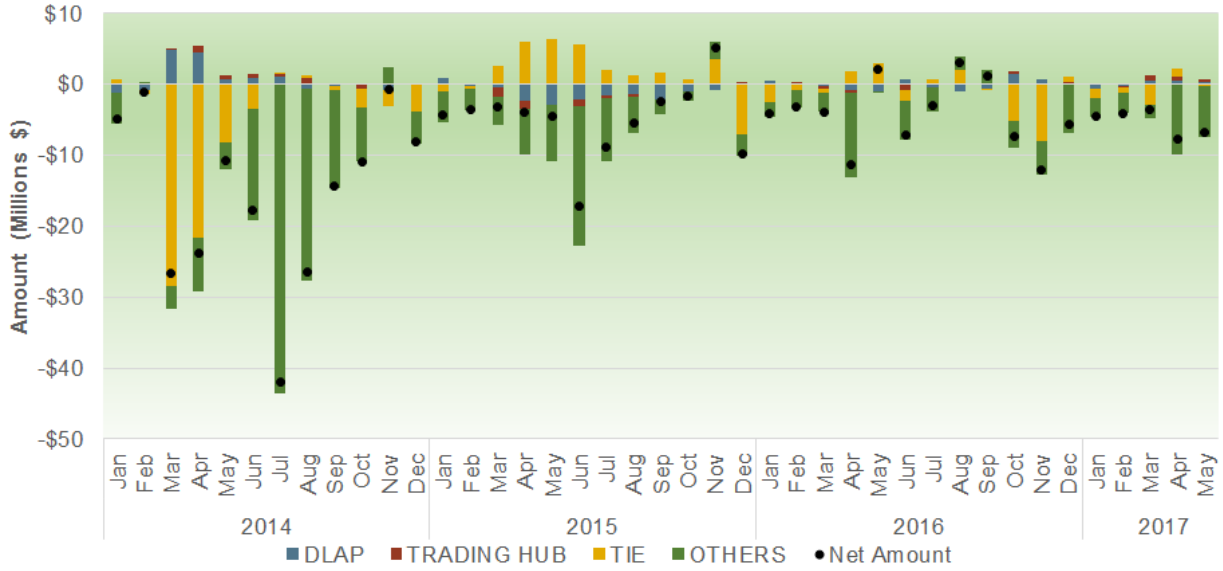
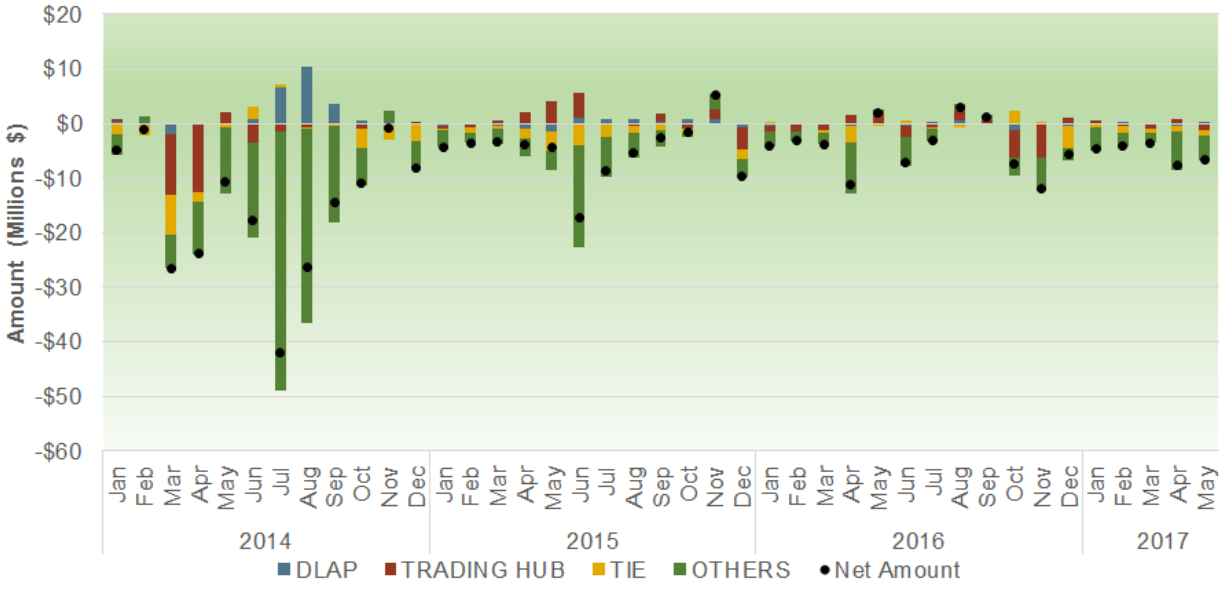


Figure 50 shows a similar metric by grouping the net CRR payments by type of sink location. This trend shows that overtime a particular sink type, namely the *Others*, has been the most lucrative sink for the auction CRR holders.

Figure 50: Net CRR payments broken out by type of sink location



In the auction process there is a set of pricing locations that are eligible for sources and sinks. Such locations can be Intertie scheduling points, DLAPs, Trading Hubs, Custom and Sub LAPs, Metered Sub=systems (MSS), and locations where a generating resource is located. Unlike the allocation process where CRRs are defined with source from supply-type locations and sinks

with load-type locations. There is no limitation what type of location can be used for sources and locations. Auction CRRs typically result in counter-flows to allocation CRRs and also to each other auction CRRs. Figure 51 shows the net CRR payments organized by the various source-to-sink definitions that were awarded the auction CRRs; both time of use and both the annual and monthly auctions are all together. About 56 percent of the net CRR payments were accrued on CRR awarded from a generation location to another generation location, followed by 7 percent and 6 percent for CRRs defined from intertie location to TH, and from intertie to intertie, respectively. Although some intertie locations may be seen some times in the energy market with export schedules, the dominant flow on interties is generally as imports, meaning that the intertie points can be seen as supply type of locations; with this reference, over 85 percent of awarded CRRs were with supply locations for both sources and sinks.

Figure 51: Net CRR payments broken out by type of sink location

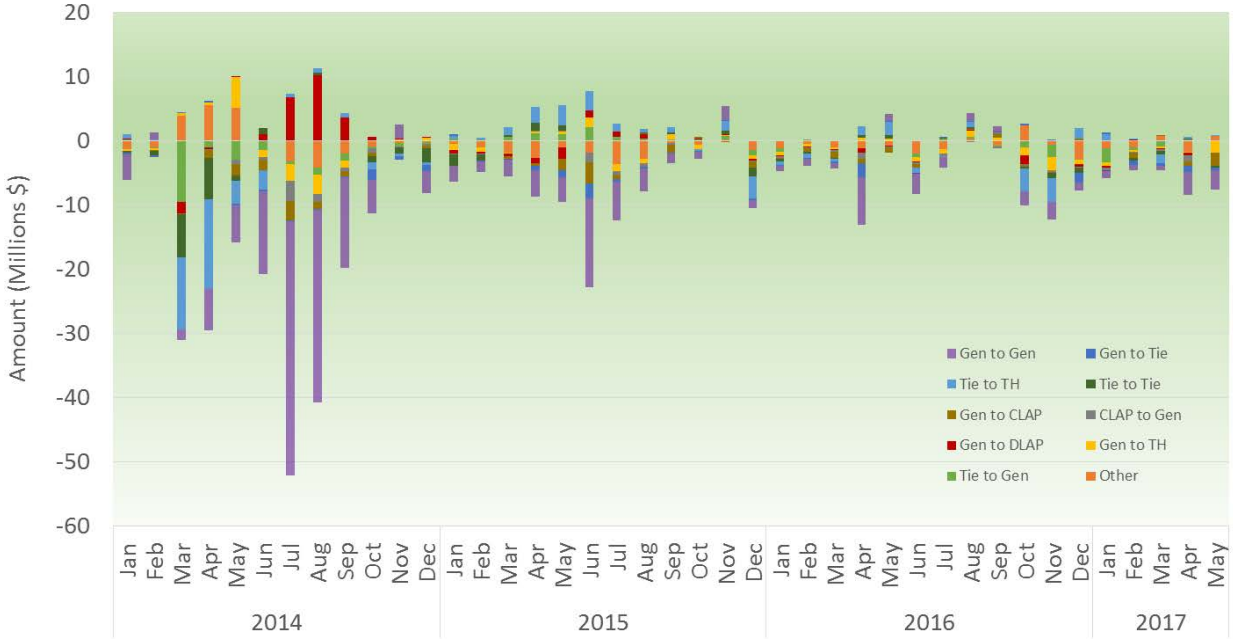


Table 1 summarizes the net CRR payments accrued on all potential combinations of location type to be used as source and sinks in auction CRRs. The summary is broken out by year. The columns list the different types of sinks while the rows shows the different types of sources; the diagonal entries will show the CRR definitions that have both the sources and sinks to be of the same type. This breakdown still shows that the largest share of net CRR payments accrued on CRRs bid in for generation points to be used for both source and sinks, even though over the years it shows a declining trend.

Table 1: Net CRR payments by type of source and sink

2014		Sink					
		CLAP	DLAP	GEN	PNODE	TIE	TH
Source	CLAP	1.5	0.1	7.5	0.1	0.5	0.0
	DLAP	0.1	0.3	1.1	0.0	-9.8	0.2
	GEN	10.6	-20.9	119.5	6.1	4.6	1.8
	PNODE	0.2	0.0	-1.3	0.0	0.3	0.0
	TIE	0.1	0.4	18.5	1.1	17.6	30.9
	TH	-0.1	0.1	1.2	0.0	0.3	-5.0

2015		Sink					
		CLAP	DLAP	GEN	PNODE	TIE	TH
Source	CLAP	1.2	-0.1	2.9	0.1	1.5	0.1
	DLAP	0.1	-0.2	2.2	0.0	11.7	0.2
	GEN	8.5	1.2	39.5	0.8	5.1	1.7
	PNODE	0.0	0.0	0.9	0.0	-0.3	0.0
	TIE	-1.1	-1.9	-7.1	-1.4	1.0	-10.6
	TH	0.1	1.1	1.1	0.0	0.6	0.7

2016		Sink					
		CLAP	DLAP	GEN	PNODE	TIE	TH
Source	CLAP	0.8	0.1	3.6	0.1	-0.2	0.0
	DLAP	0.0	0.0	0.4	0.0	0.2	0.0
	GEN	3.0	2.9	17.8	-0.8	3.5	4.5
	PNODE	0.2	0.1	3.5	0.5	1.5	0.1
	TIE	0.5	0.3	3.0	-0.1	1.1	4.0
	TH	0.0	-0.3	0.3	0.0	-0.3	1.4

2017		Sink					
		CLAP	DLAP	GEN	PNODE	TIE	TH
Source	CLAP	0.5	0.0	1.8	0.2	0.6	0.1
	DLAP	0.0	0.0	0.1	0.0	1.5	0.1
	GEN	3.2	0.4	5.1	0.4	2.3	2.6
	PNODE	0.0	0.0	1.5	0.9	-0.1	0.1
	TIE	-0.1	-0.2	2.6	0.0	0.8	-2.2
	TH	0.0	0.0	0.0	0.0	0.1	-1.9

Figure 52 shows the breakdown of CRR payments by its direction, a negative CRR payment indicates that the CRR payment to the CRR holder was greater than the auction revenue collected in the CRR auction. The yellow dot shows the net result of the two directions. This trend illustrates that auction CRR holders see profit by holding auction CRRs. The amount (in dollars settled) where participants were short in the CRR payments (losses) is about 32 percent of the amount

when CRR holders received a net money inflow by holding auction CRRs. Although a modest proportion, it still shows that there are CRR holders in every auction which end up with a position where the money collected through CRR payments was less than the money they paid to acquire CRRs.

Figure 52: Net CRR Payment by direction

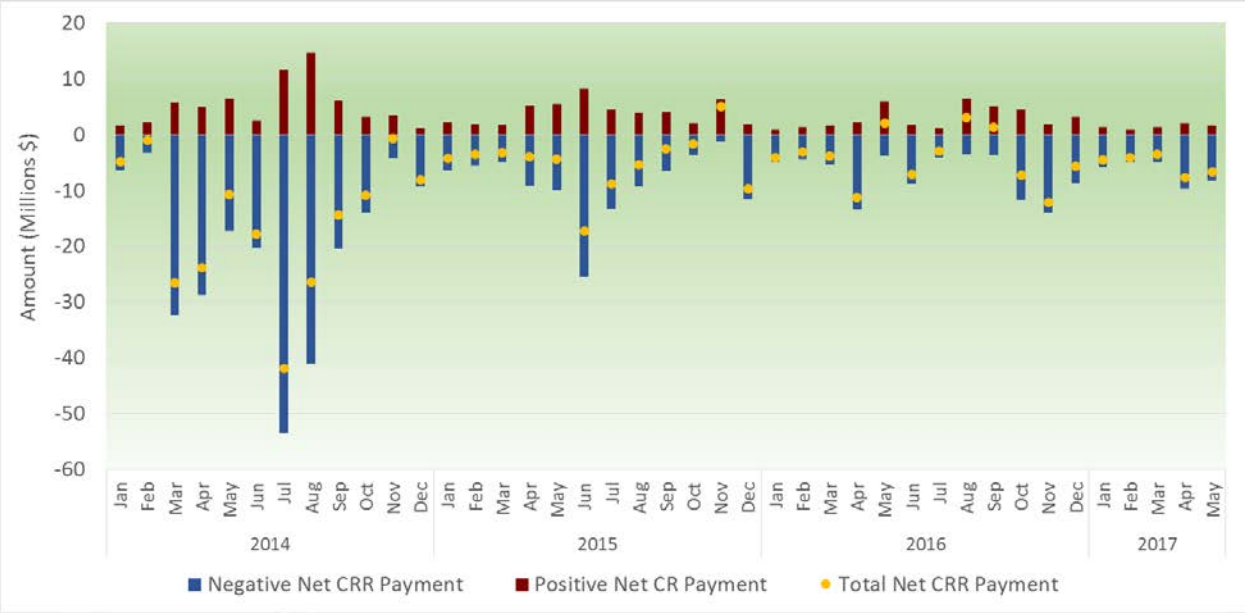


Figure 53 shows the frequency of auction CRRs that have payments less than the money collected through auction revenues. For some cases, a CRR holder might take a counter flow position and it might be a payment to the CRR holders in auction revenues. It shows that about 25 percent of CRRs have less payments than auction revenues.

Similarly, Figure 54 shows the percentage of CRR awards that have a payment less than the auction revenues. About 55 percent of CRR awards have CRR payments to be less than the auction revenues, meaning that the CRR holder had a negative net money inflow for holding a CRR.

Figure 53: Number of CRRs with CRR payments less than auction revenues

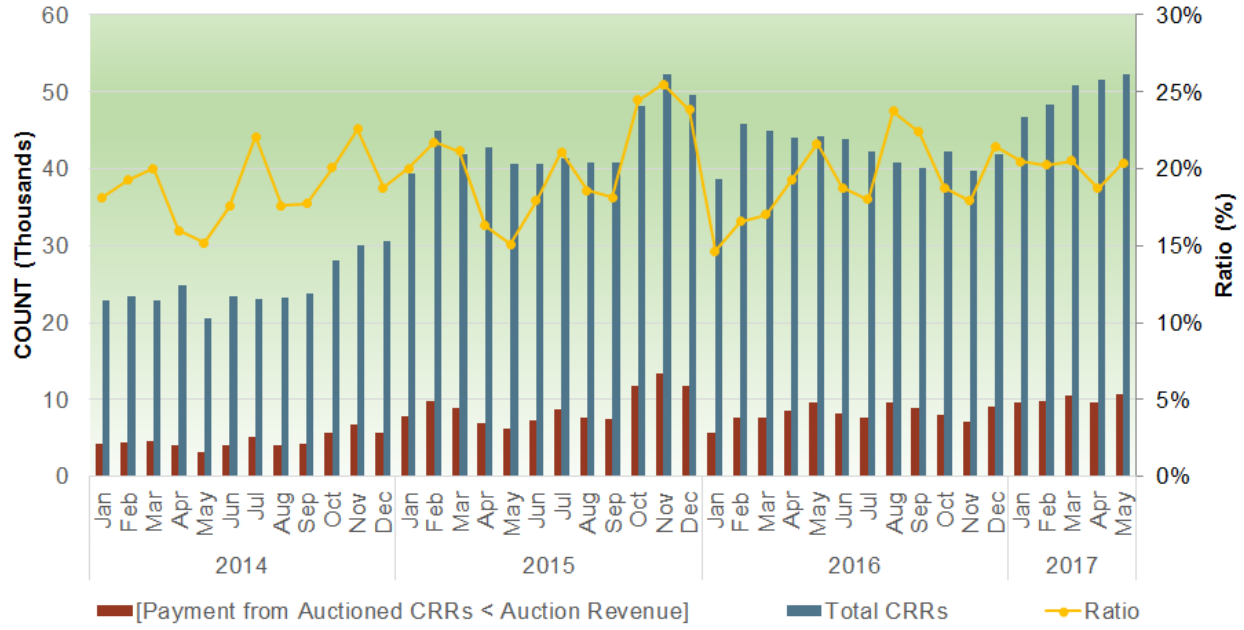
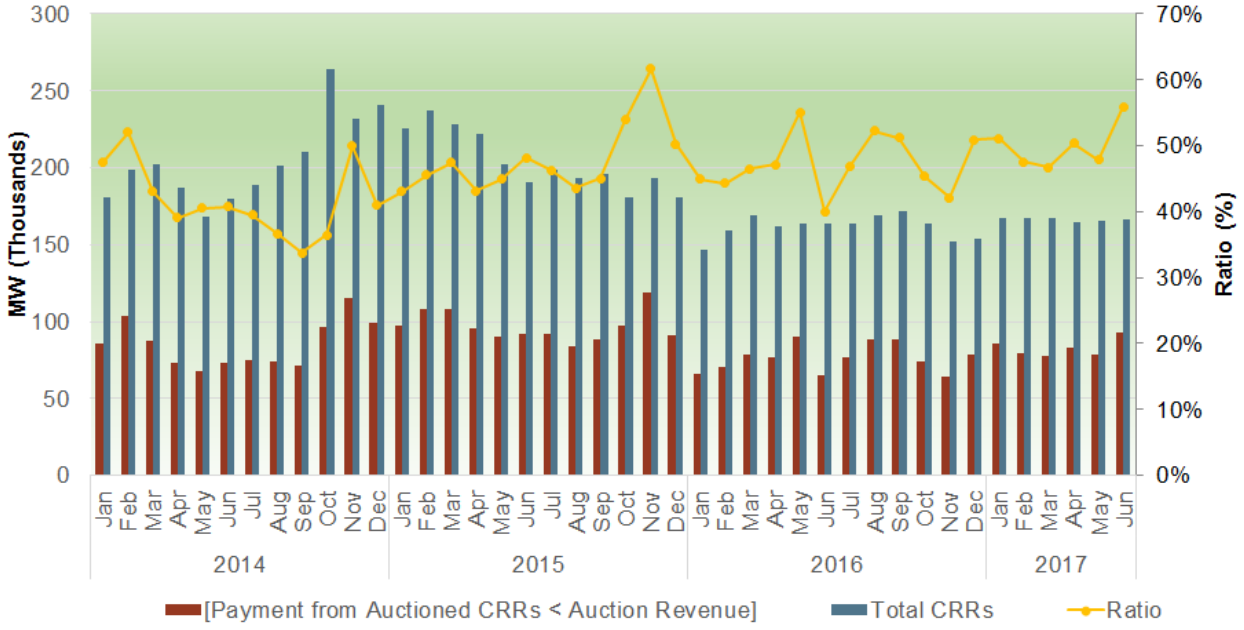


Figure 54: CRR awards with CRR payments less than auction revenues



Looking further into the spread of net CRR payments, Figure 55 shows a scatter plot of each CRR payment and its auction revenue. The scatter plot is illustrated with two sections divided by a 45 degree line. The line indicates when the auction revenues are exactly equal to the CRR payments for the auction CRRs. The blue section is when the CRR holders have a net CRR payment that results in a money inflow (negative net CRR payment from the CAISO's perspective) on their positions on a particular CRR source-sink award in the CRR market. The

pink section stands for when CRR holders makes less from the CRR payments than what they had paid in auction revenues.

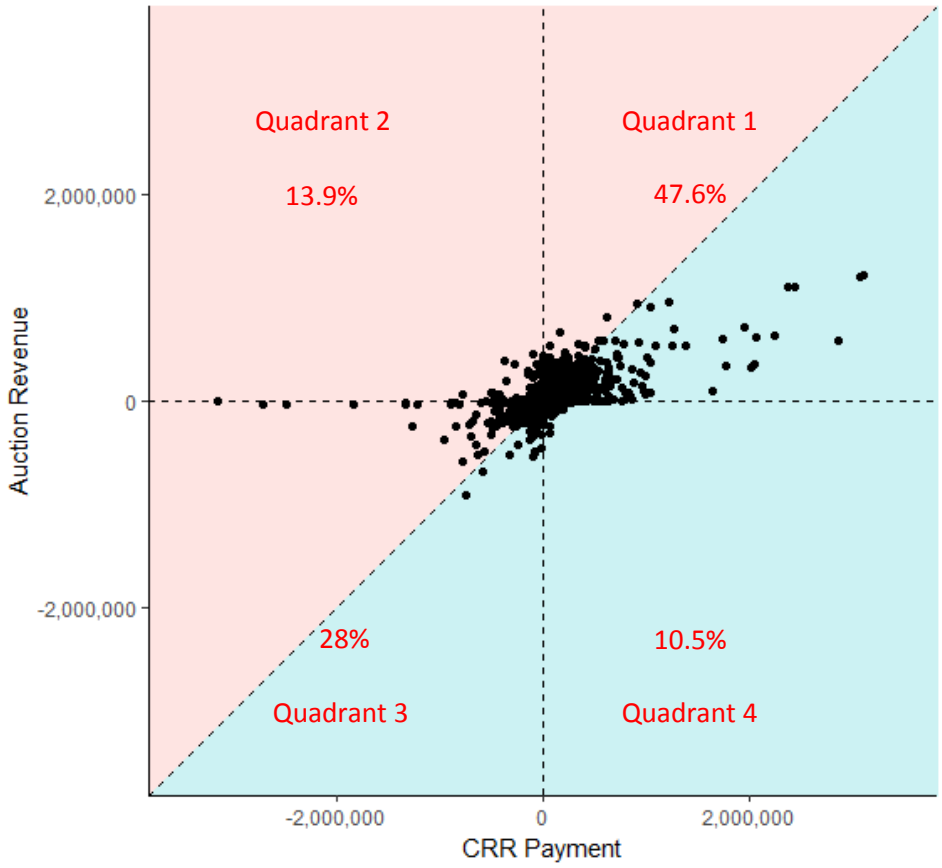
The scatter plot is divided into four quadrants with the following characterizations:

Quadrant 1) CRR holders pay for in the auction and receive CRR payments,
Quadrant 2) CRR holders pay for in the auction and are charged CRR payments,
Quadrant 3) CRR holders get paid in auction and are charged CRR payments and
Quadrant 4) CRR holders get paid in auction and receive CRR payments.

About 47.6 percent of CRR awards account for when CRR holders paid for in the auction and received CRR payments for the auction CRRs.

Similarly, about 13.9 percent of CRR awards, represent when CRR holders paid for in the auction and were charged through the CRR payments. This means that the CRR holder had to pay for the CRR position in the auction market and the direction got reversed when the CRR payments were made; thus, the CRR holders also had to pay through CRR payments.

Figure 55: Spread of auction revenues vs CRR payments for auction CRRs



In about 28 percent of the CRR awards, the CRR holders got paid in the auction revenues and were charged when settling CRRs. This means that the CRR holder had a counter flow

position in the CRR auction market and hence got paid for that position in the auction market. In the CRR payment process, the CRR holder had to pay because of the counter flow position. If the CRR award falls in the blue section, then the holder would have made a net positive money inflow from that counter flow position.

About 10.5 percent of the CRR awards resulted in the CRR holder getting paid in the CRR auction and also getting paid through the CRR payments. This indicates that CRR holder had a counter flow position in the auction market, and was paid in the auction market. However, the directions got reversed and the holder was paid in the CRR settlements as well. All of the CRR awards that fall in this quadrant make a net positive money inflow (negative net CRR payment from CAISO's perspective). The chart shows all the CRR awards from January 2014 to May 2017. Overall, about 17 percent of CRRs had a net and negative money inflow from holding CRRs (dots in the pink region). This shows that holding CRRs from auctions is not always a winning proposition or a one-sided equation. Holding CRRs poses a certain level of risk since congestion patterns may change in the day-ahead market with respect to projected conditions.

Figure 56 through Figure 59Figure 59 show the same plot but organized by each year under analysis. These figures show that most of the CRR awards that accrued significant profits or losses happened in 2014. For 2015 and 2016 the points are more concentrated towards the center axis indicating that the CRR holders did not make a significant profit or loss from a particular CRR position in any auction market.

Figure 56: Spread of auction revenues vs CRR entitlements for auction CRRs – 2014

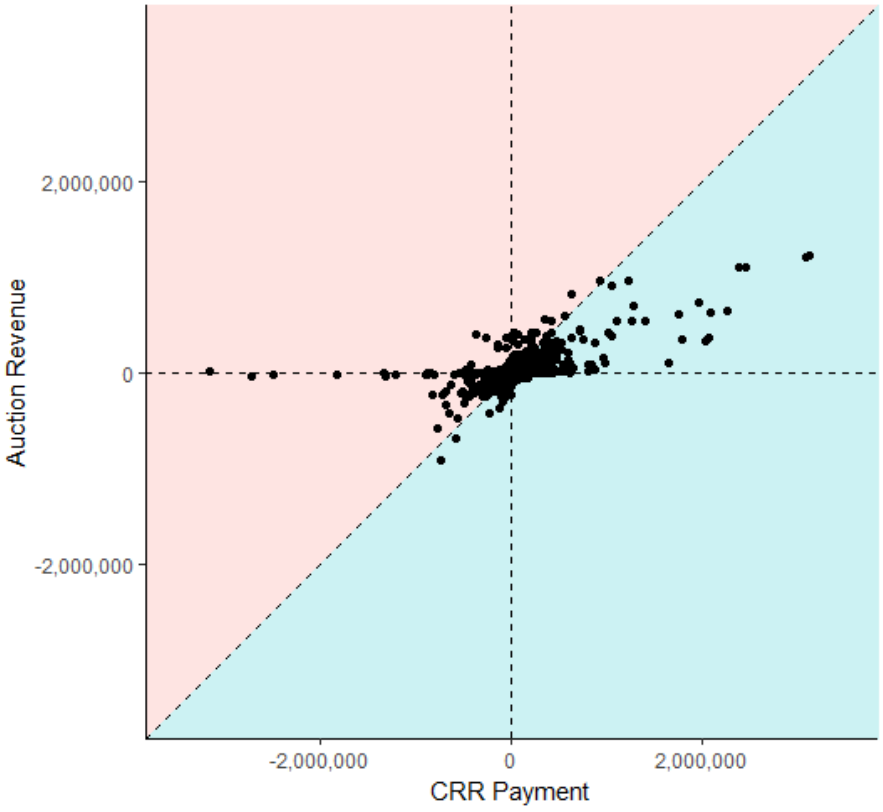


Figure 57: Spread of auction revenues vs CRR entitlements for auction CRRs – 2015

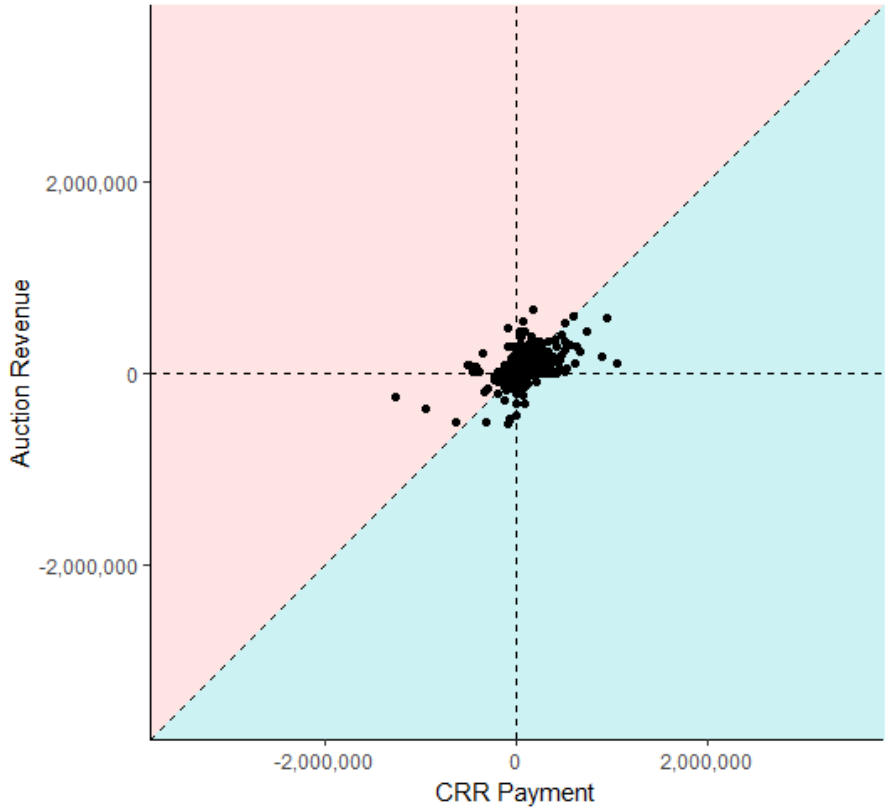


Figure 58: Spread of auction revenues vs CRR entitlements for auction CRRs - 2016

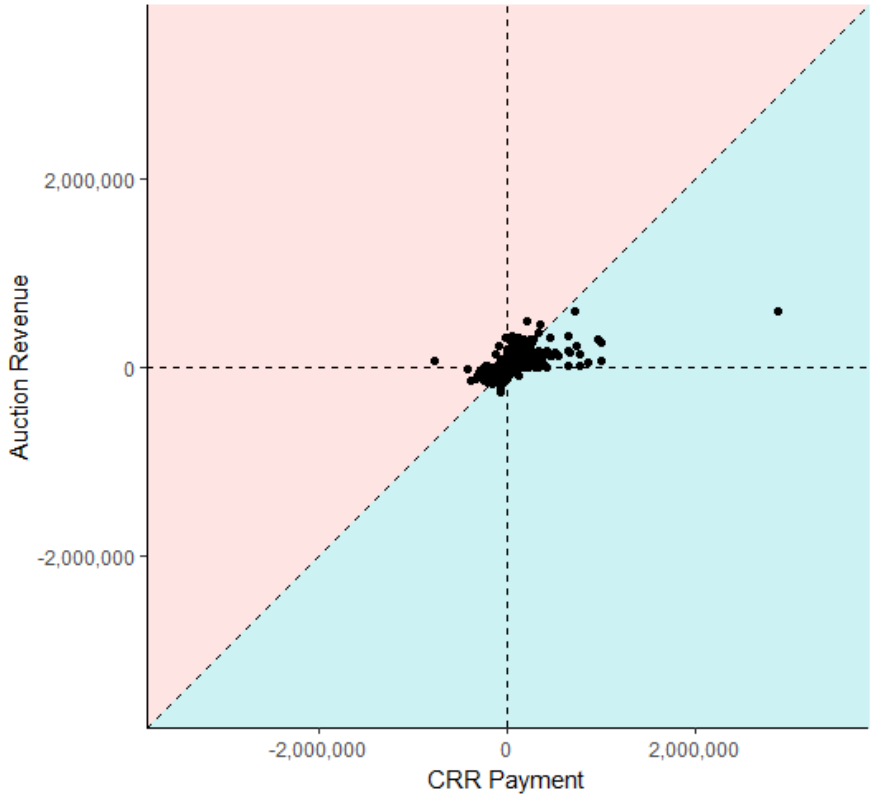


Figure 59: Spread of auction revenues vs CRR entitlements for auction CRRs – 2017

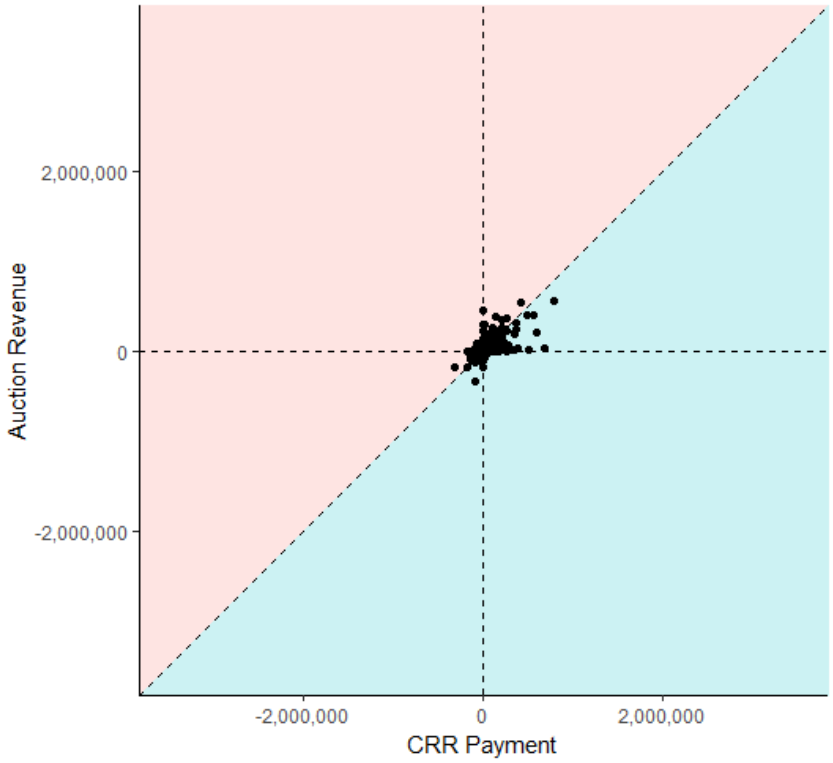


Figure 60 shows the scatter plot comparing the auction revenues and CRR payments organized by CRR holder instead of CRR award. For this metric, all of the auction revenues and payments are summed up for each CRR holder (for all their CRR positions). It shows that there are a few CRR holders that were paid significantly higher than their auction revenues.

Figure 61 to Figure 64 show a similar metric comparing the auction revenues and payments made to the CRR holders for auction CRRs by CRR holders by year. This illustrates that the payments to CRR holders and revenues collected through auctions by CRR holders have reduced over time from 2014 to 2017.

Figure 60: Spread of auction revenues vs CRR payments by CRR holder

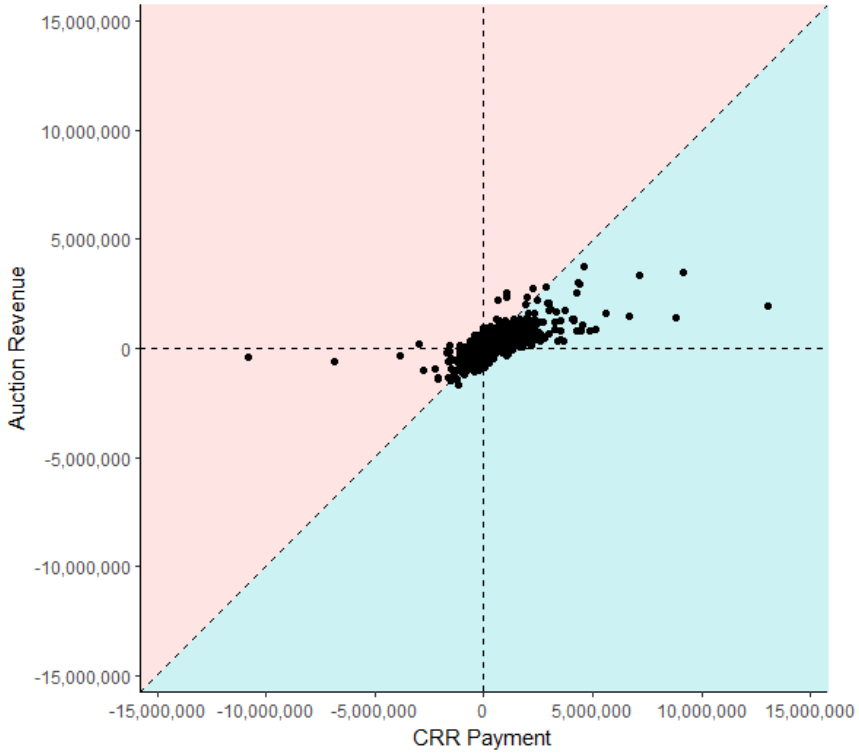


Figure 61: Spread of auction revenues vs CRR payments by CRR holder – 2014

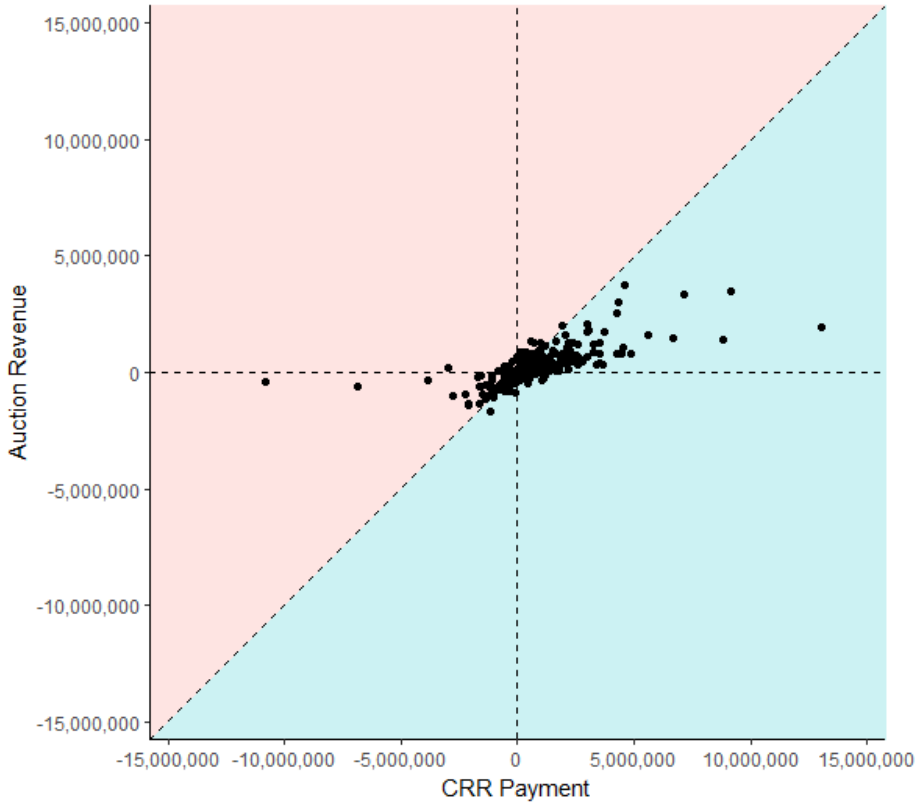


Figure 62: Spread of auction revenues vs CRR payments by CRR holder – 2015

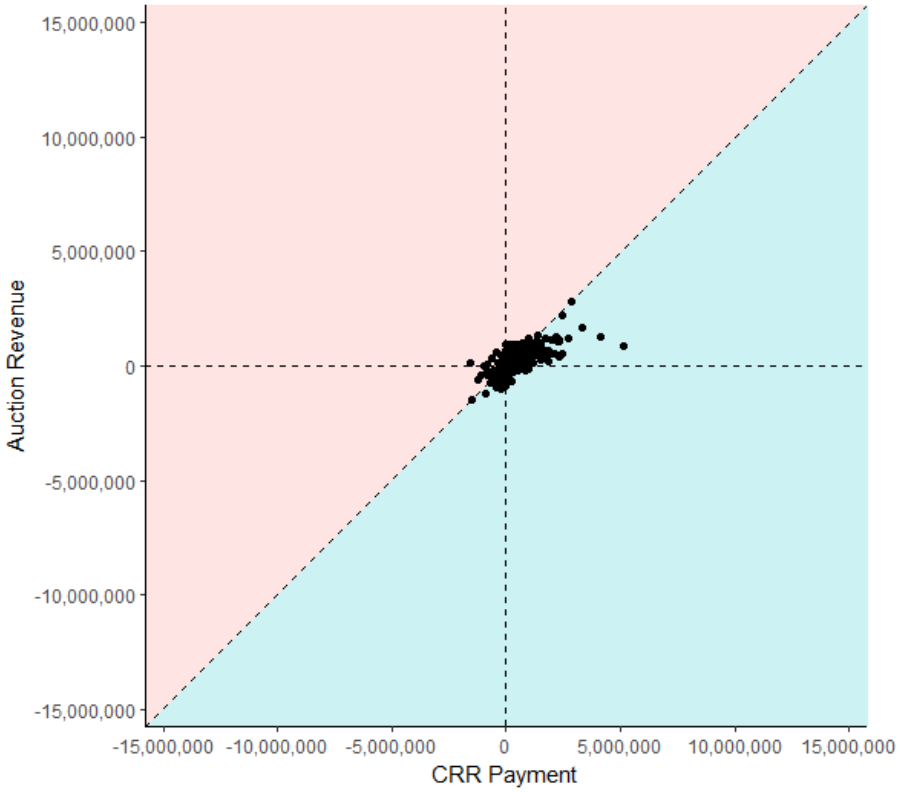


Figure 63: Spread of auction revenues vs CRR payments by CRR holder – 2016

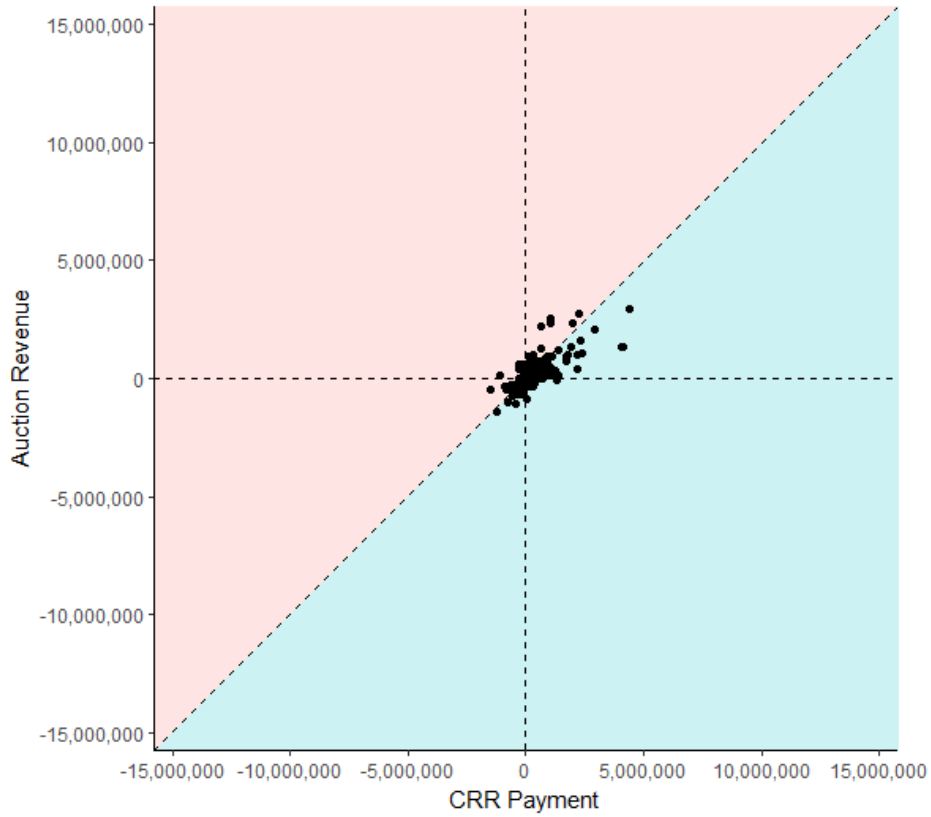
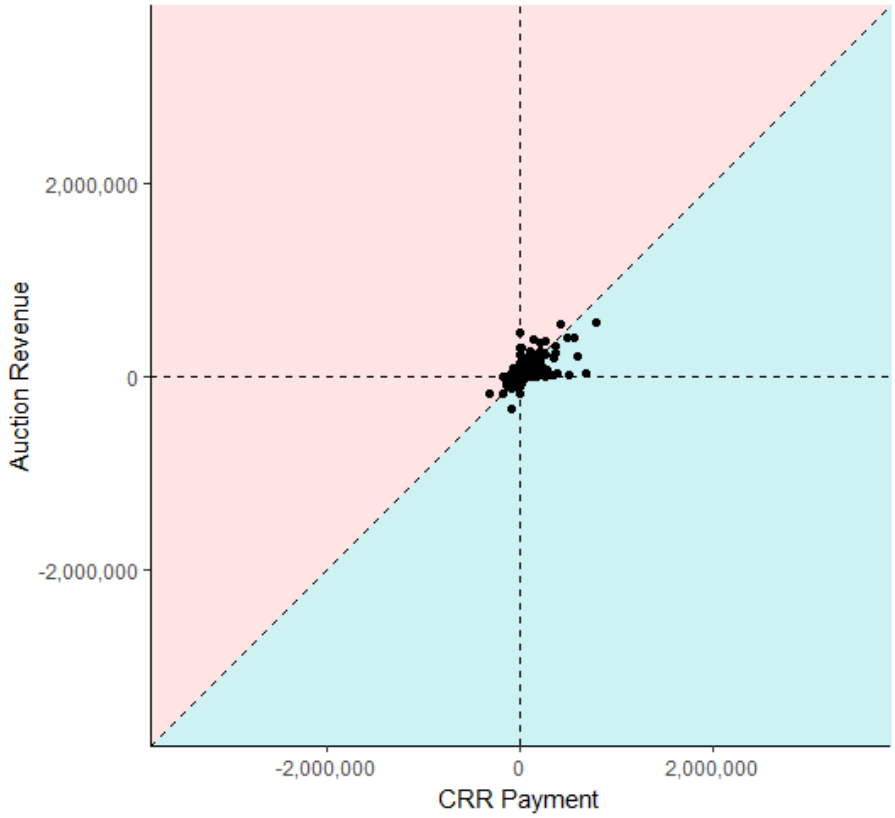


Figure 64: Spread of auction revenues vs CRR payments by CRR holder – 2017



As observed in a section above, there is a set of CRRs acquired in the auctions that cleared at zero prices. A point of interest is to see how these CRR have performed. Figure 65 shows the scatter plot comparing the payments made to the CRR holders for auction CRRs which had no auction revenues. This means, CRR holders were either paid or charged through the CRR payment process and did not have to pay anything in the CRR auctions revenues to acquire these CRRs. It clearly indicates that even if the CRR positions are free for the CRR holders, it does not necessarily translate into a profit for the CRR holder for that CRR position.

Figure 66 to Figure 69 show a similar metric comparing the zero auction revenues and payments made to the CRR holders for the auction CRRs by year.

Figure 71 to Figure 74 shows a variation of the similar metric comparing the zero auction revenues and CRR payments made to the CRR holders for auction CRRs by CRR holder. It shows that CRR payments made to the CRR holders have reduced over time from 2014 to 2017.

Figure 65: Spread of auction revenues vs. CRR payments for CRRs with zero auction revenue

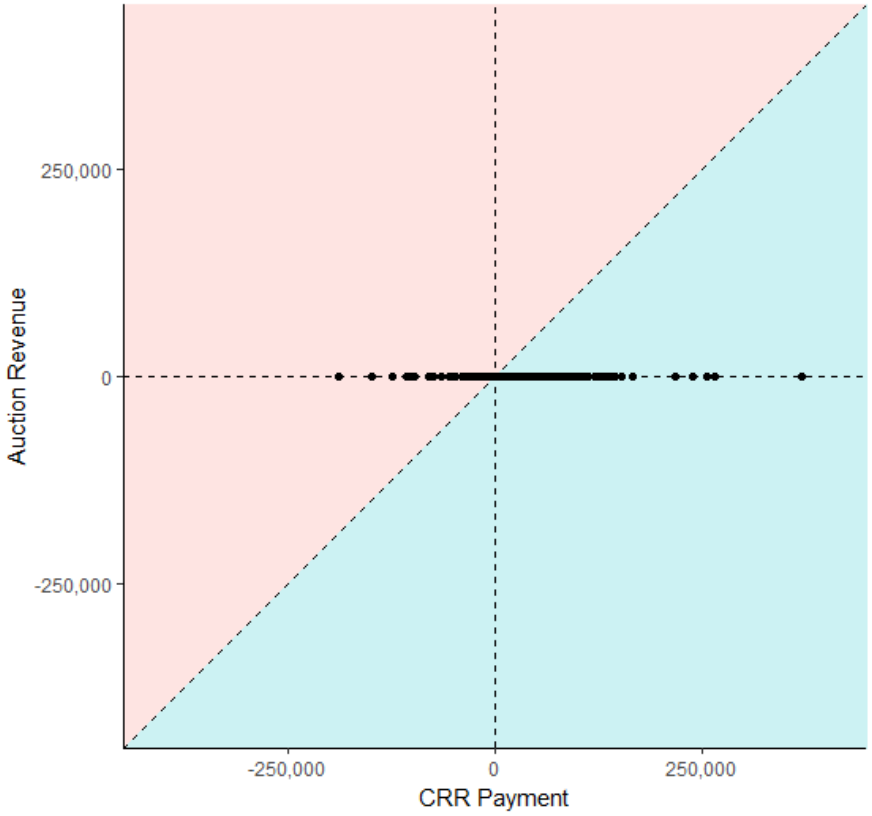


Figure 66: Spread of auction revenues vs. CRR payments for CRRs with zero auction revenue - 2014

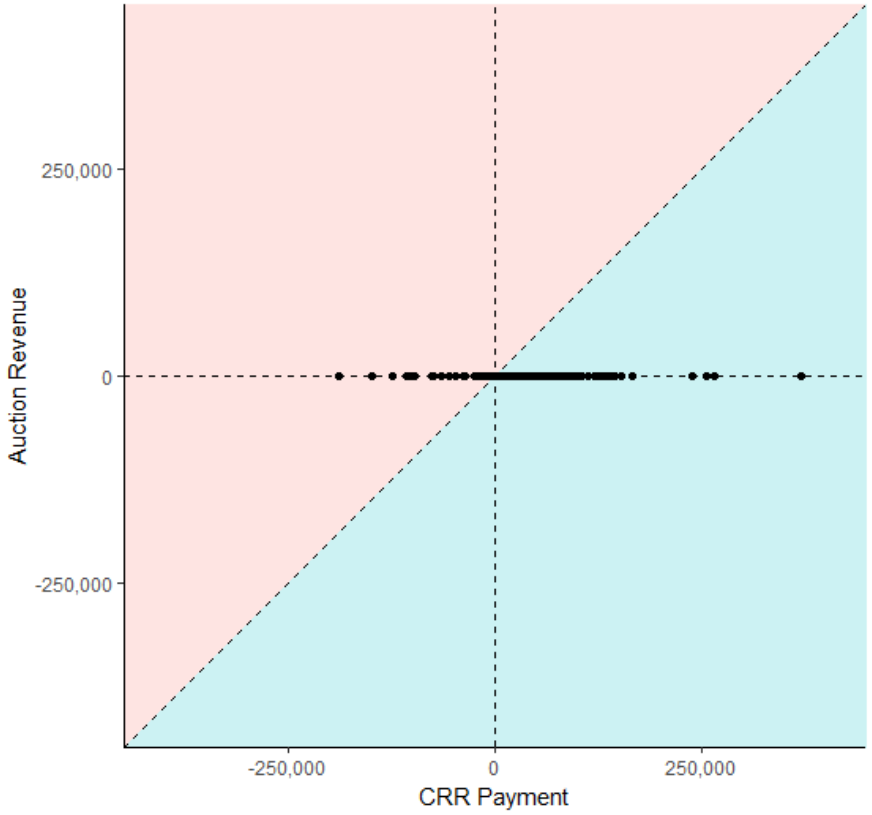


Figure 67: Spread of auction revenues vs. CRR payments for CRRs with zero auction revenue - 2015

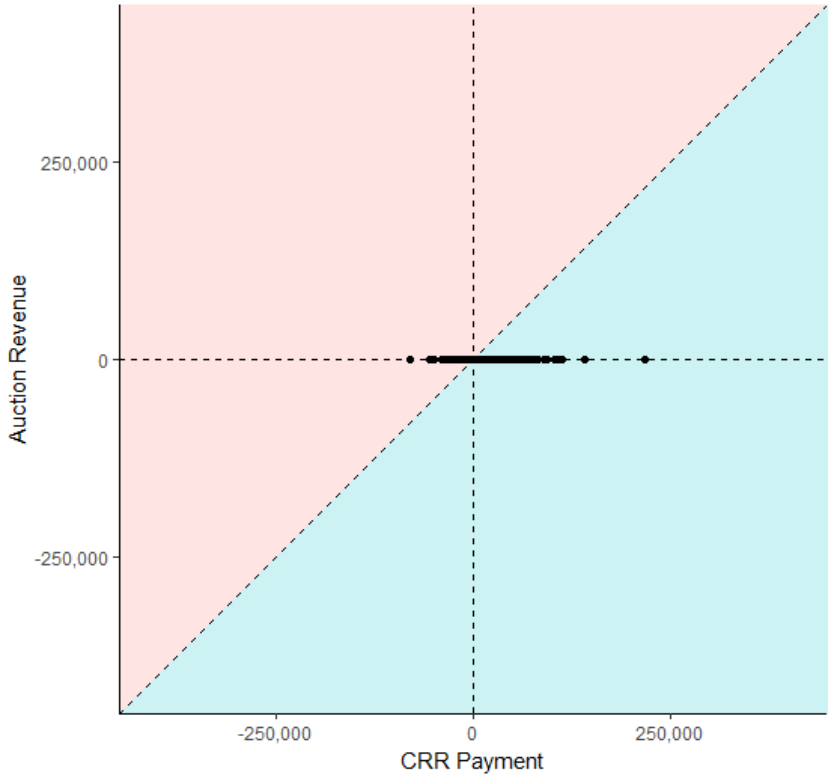


Figure 68: Spread of auction revenues vs. CRR payments for CRRs with zero auction revenue - 2016

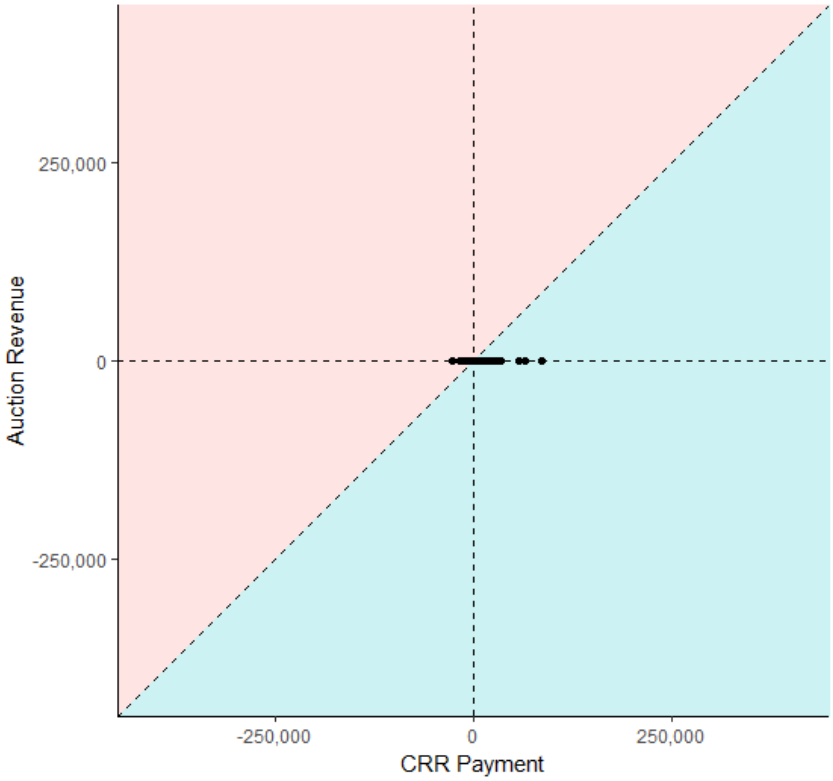


Figure 69: Spread of auction revenues vs. CRR payments for CRRs with zero auction revenue - 2017

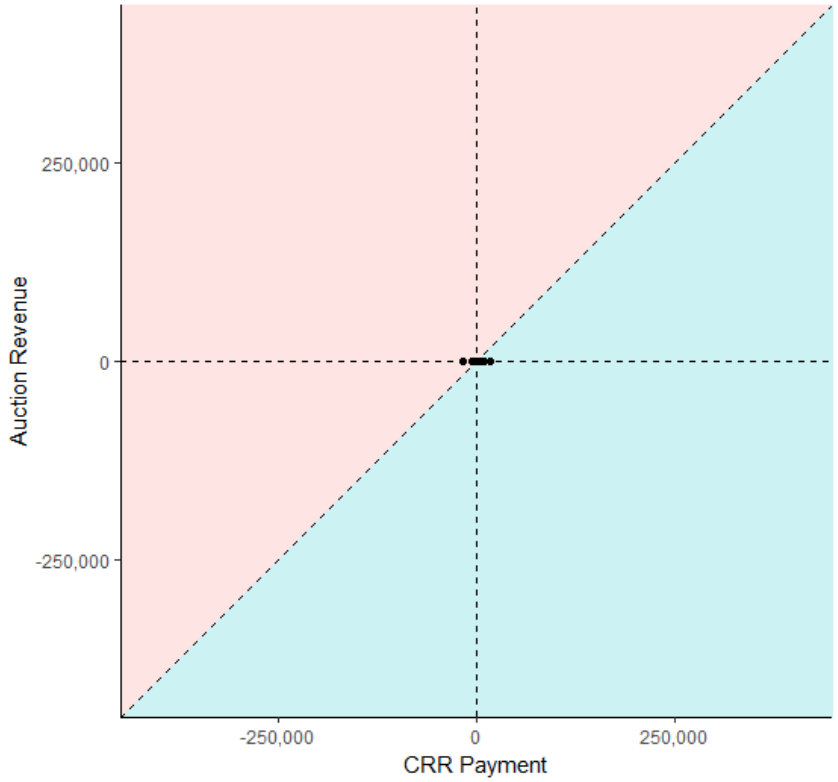


Figure 70: Spread of CRR payments for auction CRRs with zero auction revenue by CRR holder

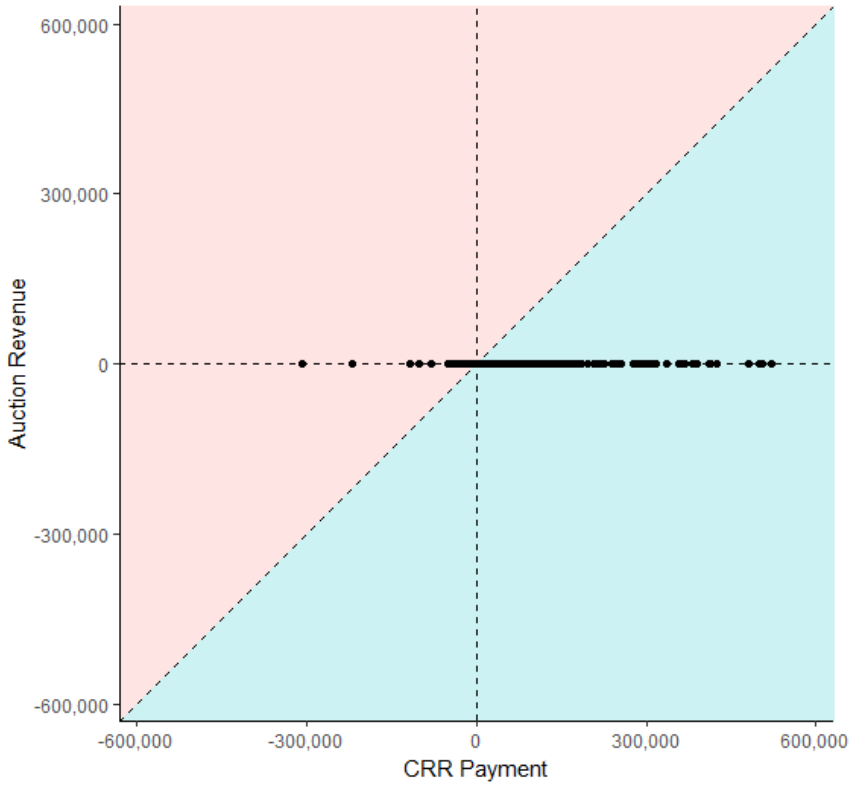


Figure 71: Spread of CRR payments for auction CRRs with zero auction revenue by CRR holder - 2014

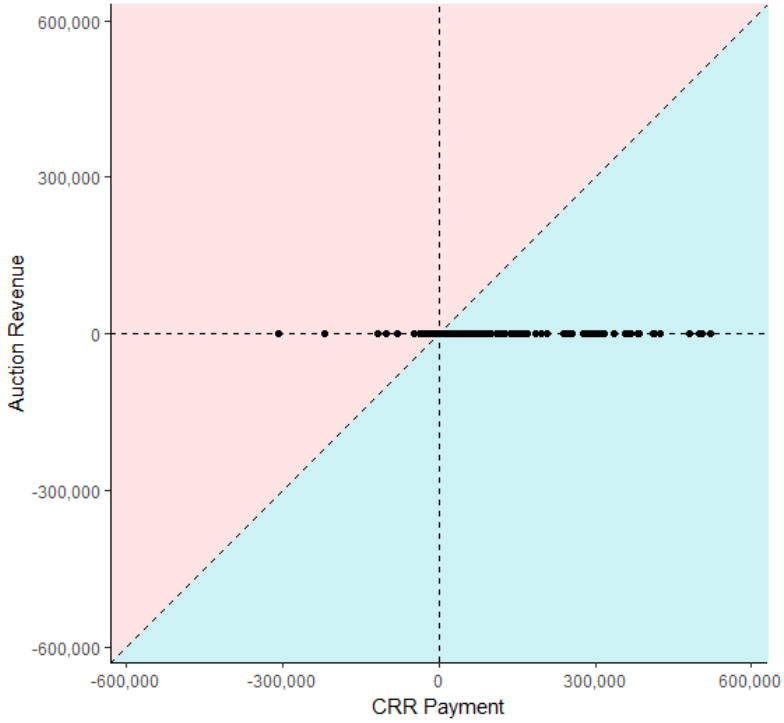


Figure 72: Spread of CRR payments for auction CRRs with zero auction revenue by CRR holder - 2015

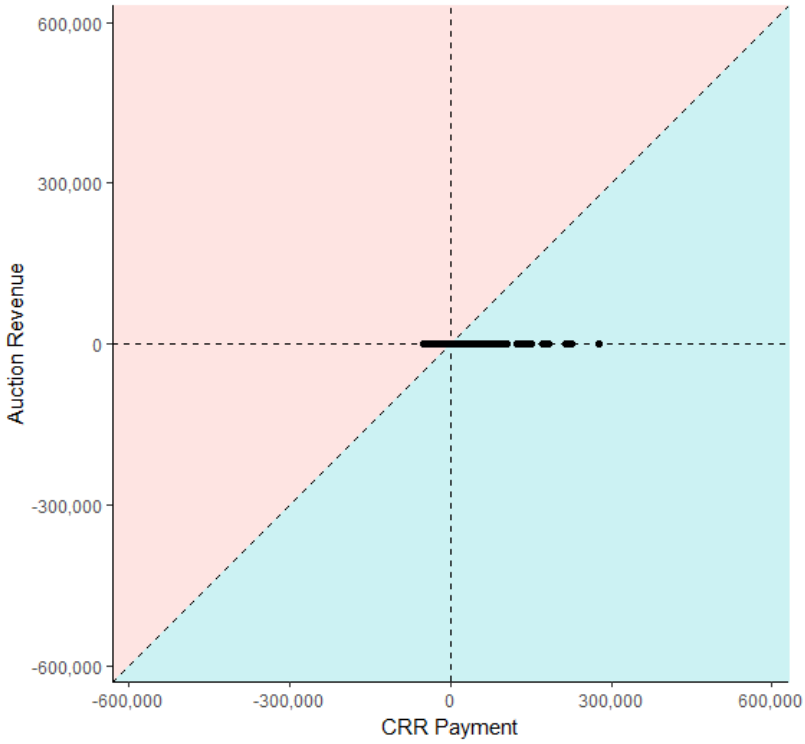


Figure 73: Spread of CRR payments for auction CRRs with zero auction revenue by CRR holder - 2016

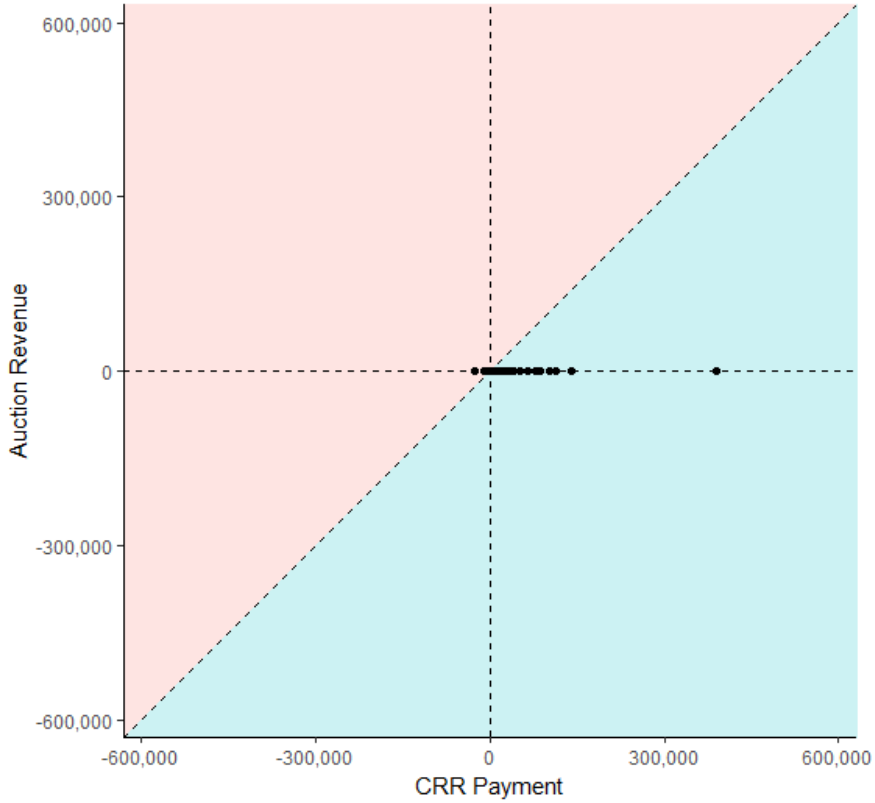
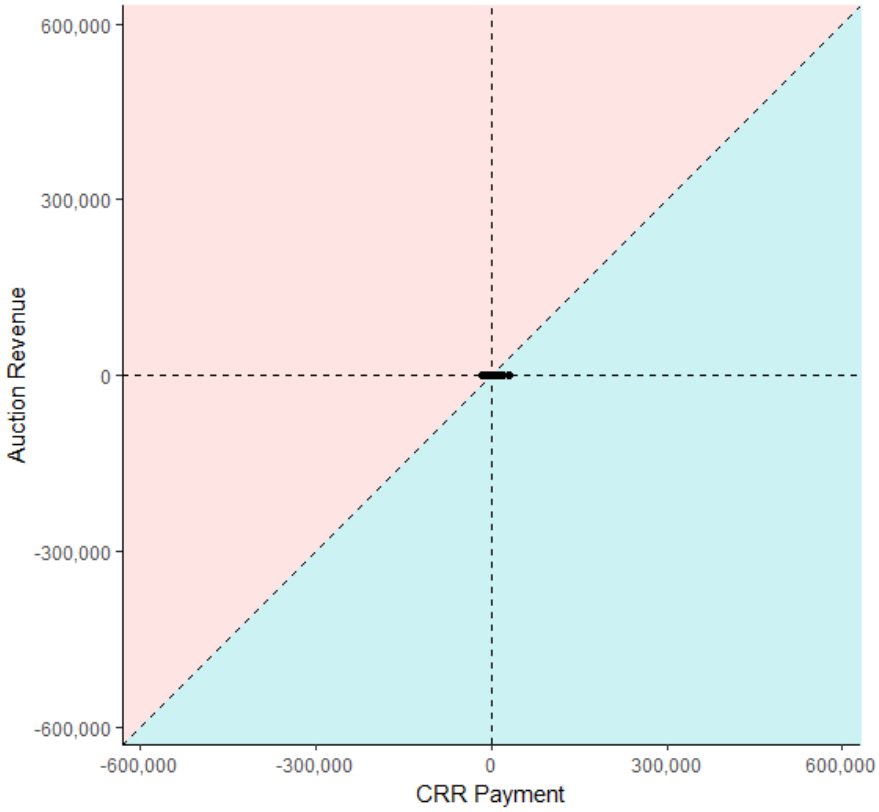


Figure 74: Spread of CRR payments for auction CRRs with zero auction revenue by CRR holder - 2017



Most valuable CRRs

Table 2 and Table 3 shows the top 10 and bottom 10 source – sink pairs in terms of payments made to the CRR holders for auction CRRs and money collected through auction revenue. This is based on the analysis period of January 2014 through May 2017. Top 10 would mean that the net CRR payments (CRR payment less auction revenues) were the highest to the CRR holders (largest negative CRR payments from the ISO perspective). Similarly, bottom 10 CRR would mean that these CRR positions had the lowest net CRR payment for auction CRRs.

Table 2: Top 10 - CRR source/sink pair

CRR_SOURCE	CRR_SINK
MALIN_5_N101	TH_NP15_GEN-APND
SYLMARDC_2_N501	TH_NP15_GEN-APND
PALOVRDE_ASR-APND	TH_SP15_GEN-APND
PALOVRDE_ASR-APND	C643TM1_7_N001
POD_GATES_6_PL1X2-APND	POD_HELMPG_7_UNIT 2-APND
POD_LAROA2_2_UNITA1-APND	TH_SP15_GEN-APND
MALIN_5_N101	TH_SP15_GEN-APND
DLAP_SCE-APND	FOURCORN_5_N501
AGUCALG1_7_B1	NGILA1_5_N001
POD_LAROA1_2_UNITA1-APND	TH_SP15_GEN-APND

Table 3: Bottom 10 CRR source/sink pair

CRR_SOURCE	CRR_SINK
POD_HELMPG_7_UNIT 2-APND	DLAP_PGAE-APND
POD_HELMPG_7_UNIT 1-APND	DLAP_PGAE-APND
TH_NP15_GEN-APND	TH_SP15_GEN-APND
POD_HELMPG_7_UNIT 3-APND	DLAP_PGAE-APND
POD_BIGCRK_2_EXESWD-APND	DLAP_SCE-APND
POD_LMEC_1_PL1X3-APND	TH_NP15_GEN-APND
DLAP_PGAE-APND	SYLMARDC_2_N501
POD_EXCHEC_7_UNIT 1-APND	DLAP_PGAE-APND
DLAP_PGAE-APND	MALIN_5_N101
VESTAL_6_N002	DLAP_SCE-APND

Figure 75 to Figure 77 show the trend of the Top 3 source-sink pairs from January 2014 to May 2017. These trends show that generally, these top CRRs were so because of performance was concentrated in a specific period instead of a systematic performance, most of that arising from 2014.

Figure 75: Comparison of CRR payments (auction CRRs) vs auction revenue for - MALIN_5_N101 to TH_NP15_GEN_APND

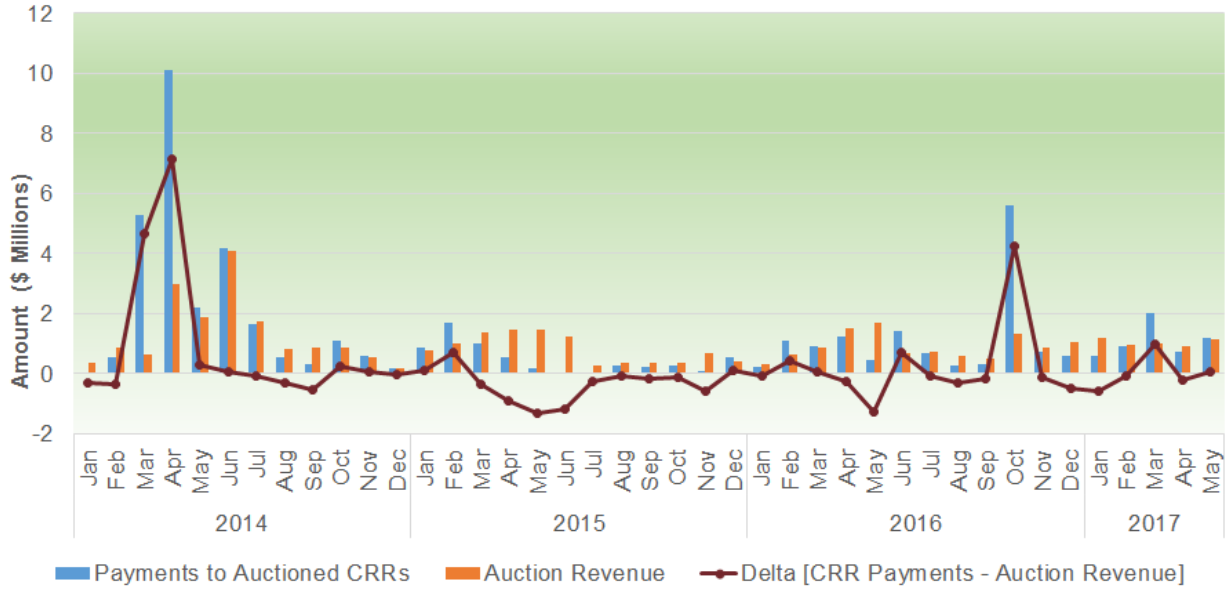


Figure 76: Comparison of CRR payments (auction CRRs) vs auction revenue for - SYLMARDC_2_N501 to TH_NP15_GEN_APND

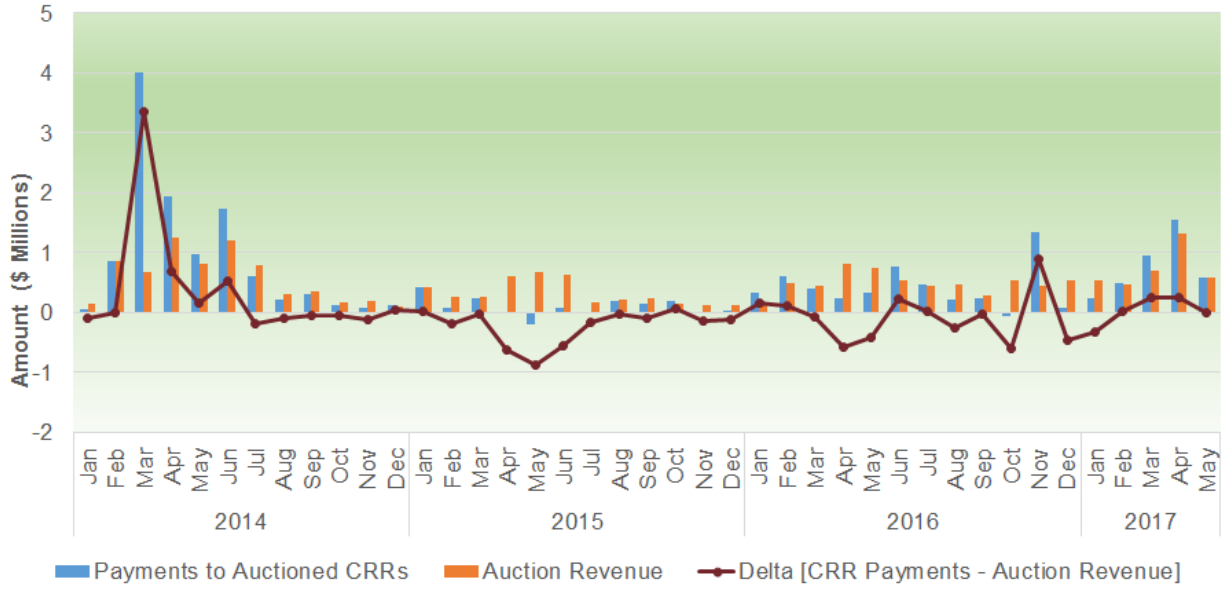


Figure 77: Comparison of CRR payments (auction CRRs) vs auction revenue for - PALOVRDE_ASR_APND to TH_SP15_GEN_APND

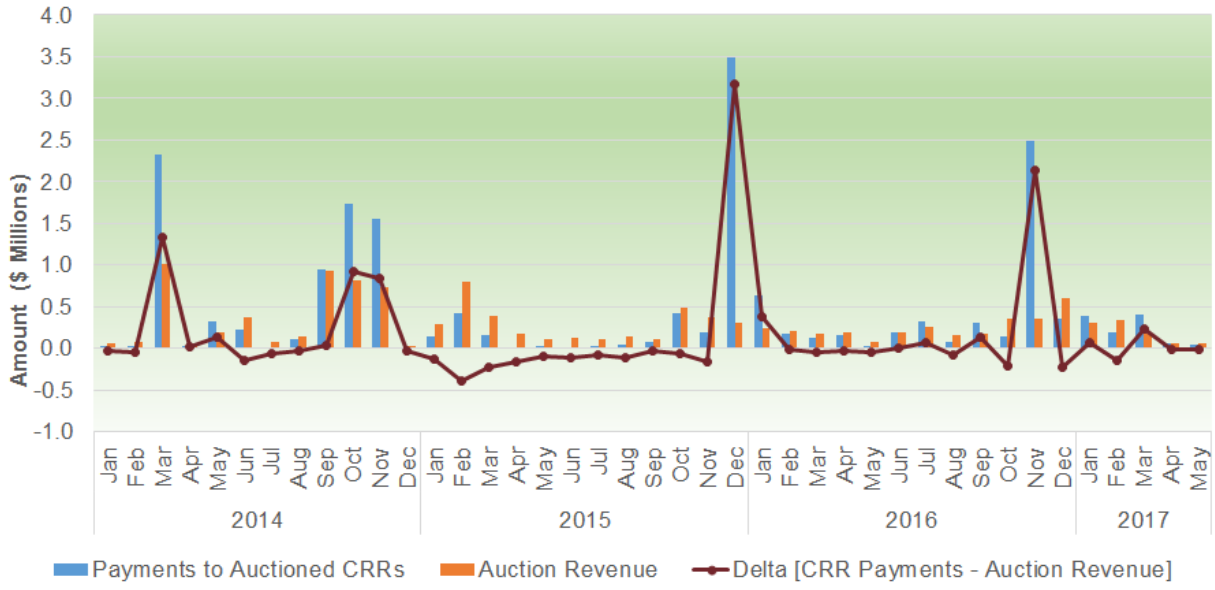


Figure 78 to Figure 80 show the trend of the bottom 3 source-sink pairs from January 2014 to May 2017.

Figure 78: Comparison of CRR payments (auction CRRs) vs auction revenue for - POD_HELMPG_7_UNIT 2-APND to DLAP_PGAE-APND

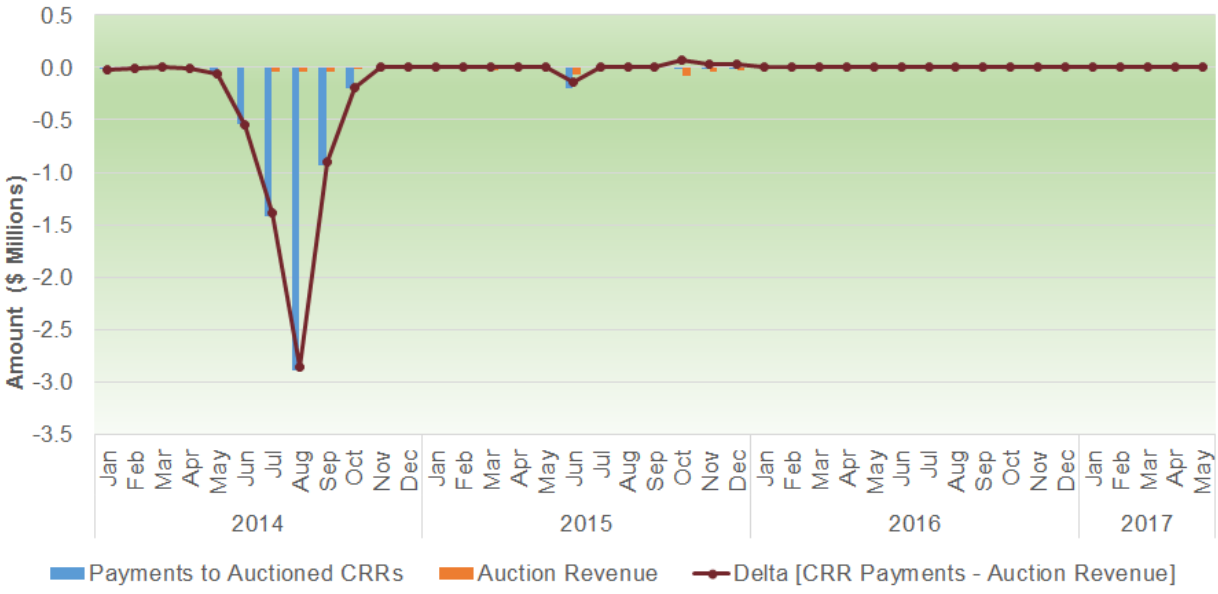


Figure 79: Comparison of CRR payments (auction CRRs) vs auction revenue for - POD_HELMPG_7_UNIT 1-APND to DLAP_PGAE-APND

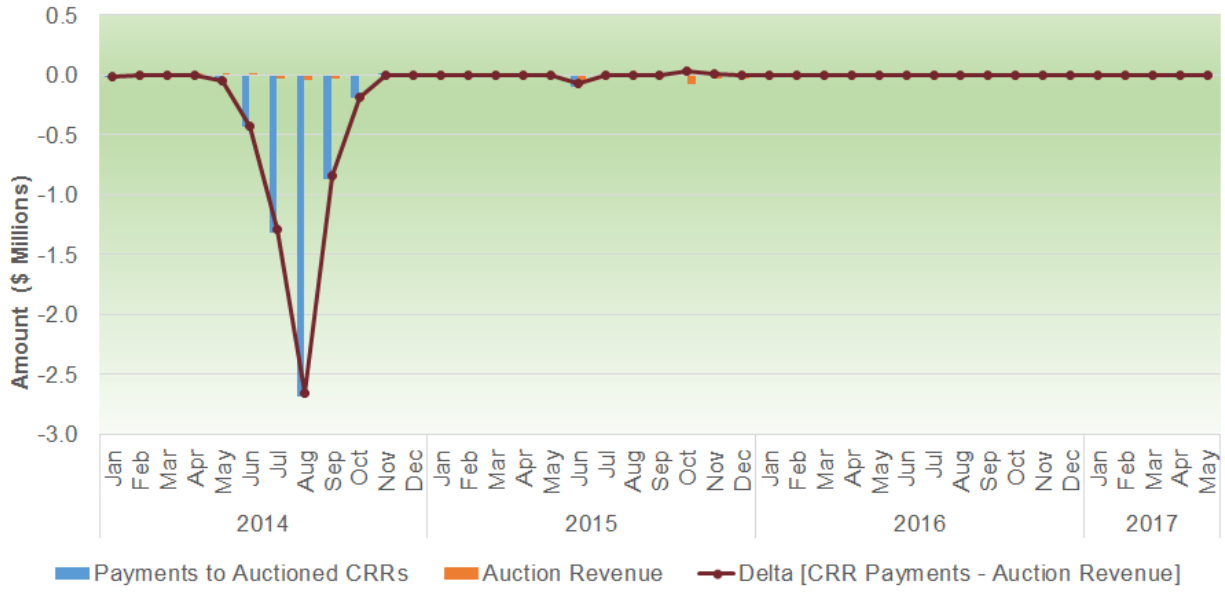
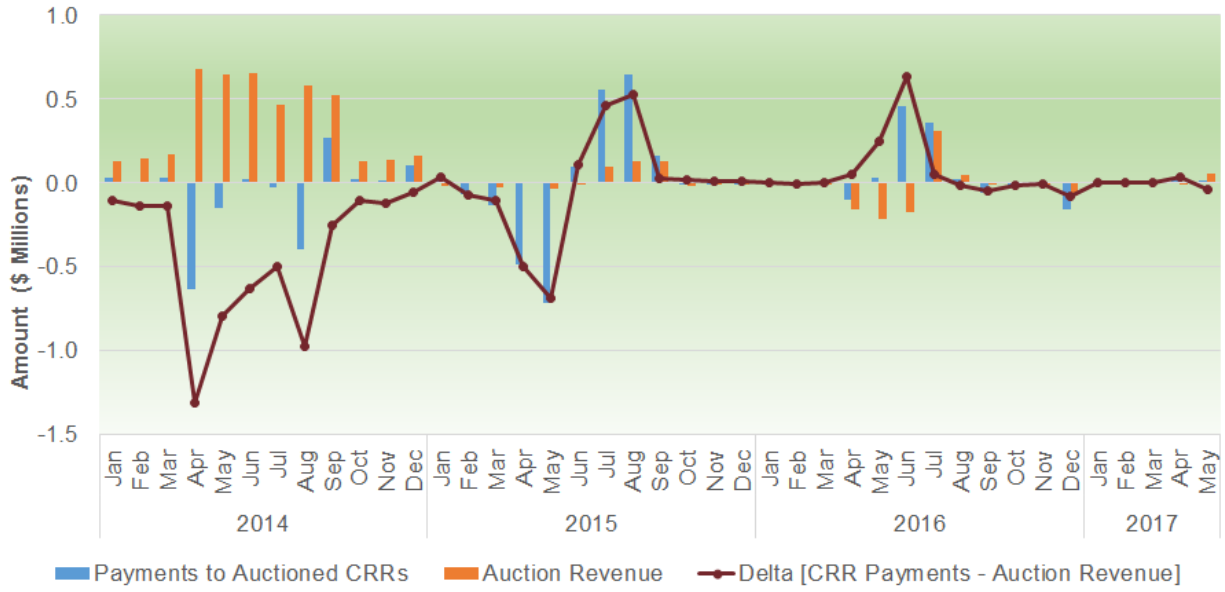


Figure 80: Comparison of CRR payments (auction CRRs) vs auction revenue for - TH_NP15_GEN-APND to TH_SP15_GEN-APND



Previous metrics show that the top and bottom CRRs in terms of profitability do not show a persistent performance; rather there are specific short periods where large net CRR payments accrued. Although interesting to see the pattern on the top and bottom CRRs, there is still a need to see the extent to which CRRs show a persistent pattern. Figure 81 and Figure 82 show the top 200 CRRs based on the amount of net CRR payments; i.e., the CRRs where the difference between the payments to CRR holders in the day-ahead market and the auction revenues holders had to

pay in the auction were the largest. This top 200 CRRs represent about a half of the net CRR payments accrued for the period under analysis. These CRRs are shown in two parts for a better graphical representation. The horizontal axis stands for every month of the period under analysis, the vertical axis stands for the enumeration of the top CRRs, with label 1 being for the top CRR, a 100 for the top 100 CRR, etc.[6]. The bubbles in blue and red are for the net CRR payment to represent a money inflow or outflow for the holders of these auction CRRs.

For the plot with the first 100 top CRRs, the largest bubble in blue reflect a net CRR payment of about $7 million; for the second set of top CRRs it is scaled to show the relative value of these CRRs and the largest bubble reflects a net CRR payment of about $0.7 million. The first pattern to note in these plots is that even for the top CRRs, there is no persistent positions over time, some top CRR see large inflows followed by large outflow. For many other top CRRs, they are more scattered over time, meaning that there is no persistent system conditions where they can be profiting from over time. To a great extent this is expected given the constantly changing dynamics of congestion in the system. For multiple CRRs, the CRR payment are clustered in short period of few consecutive months.

Figure 83

Figure 83 shows a different organization of top CRRs; this plot shows the top CRR based on the frequency of CRRs having a money inflow from net CRR payments. This is to portray the top CRR which are persistently over time resulting in a net CRR payment to their holders. This metric only takes into account the absolute frequency of the months in which CRRs represent a money inflow to their holders. In relative terms the top 100 CRRs shown with the most consistent performance amount to just 2 percent of the overall net CRR payment for the period under analysis. This means that the top 100 CRRs that have consistently profit from the day-ahead market represent a very small sample of all the set auction CRRs.

For the top 100 most consistent CRRs shown in Figure 83, the corresponding number of awards are now shown in Figure 84. This reflects the number of awards (arising from different bids) for these CRRs. The largest bubble stand for 35 different awards. For instance, for some CRRs, including the top CRR, it shows that the number of awards has grown from six different awards in early 2014 to 35 different awards in summer 2015. This could be expected that for consistently profitable CRRs, more fierce competition could happen when such opportunities are found such that more participants could get a share of that CRR. There are other cases in which the number of awards for a given CRR definition is relatively constant over time, which may indicate less competition to acquire that CRR in the auctions.

[6] Due to space the actual source-to-sink definition cannot fit into the plot.

Figure 81: Top 200 CRRs based on net CRR payments

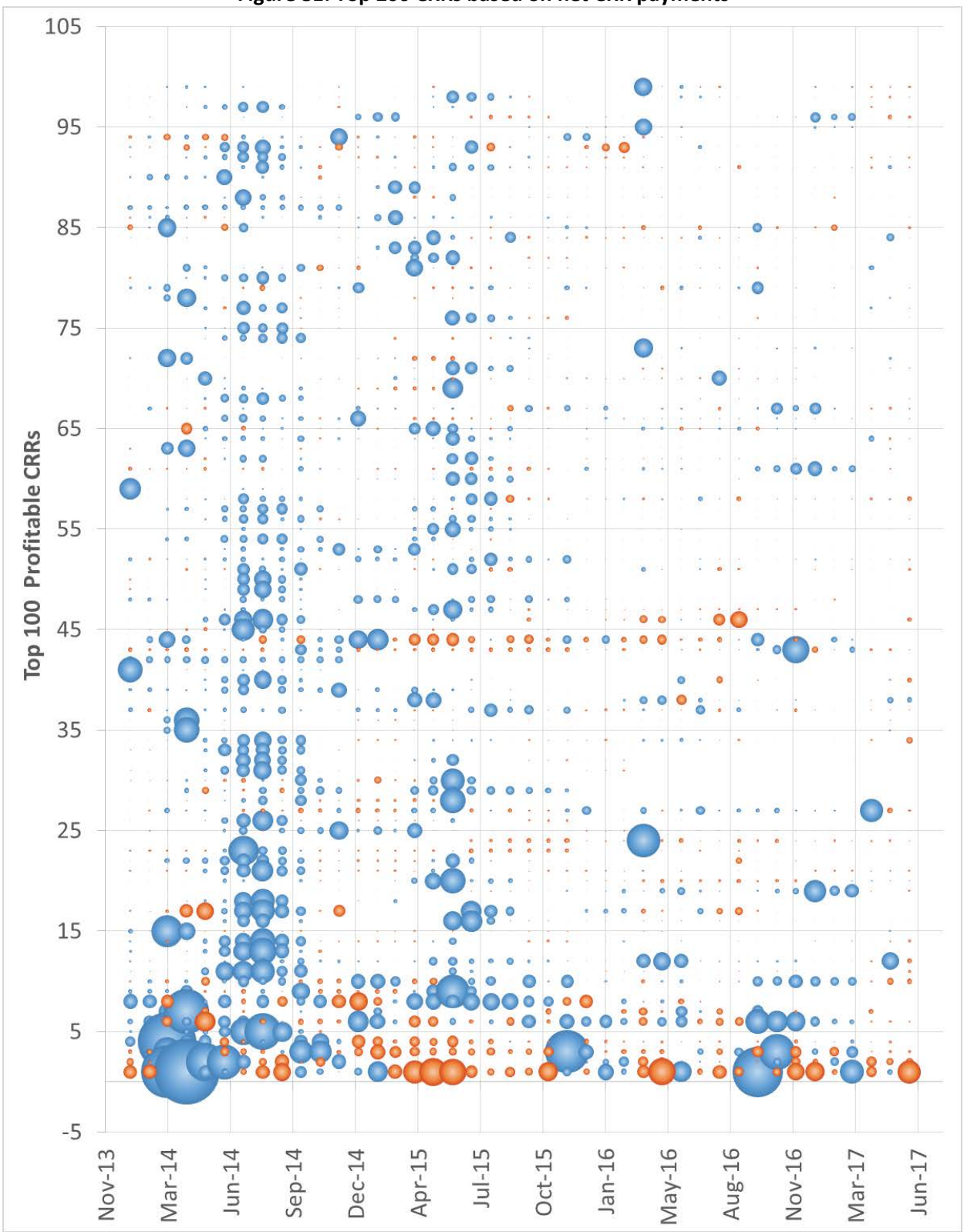


Figure 82: Top 200 CRRs based on net CRR payments

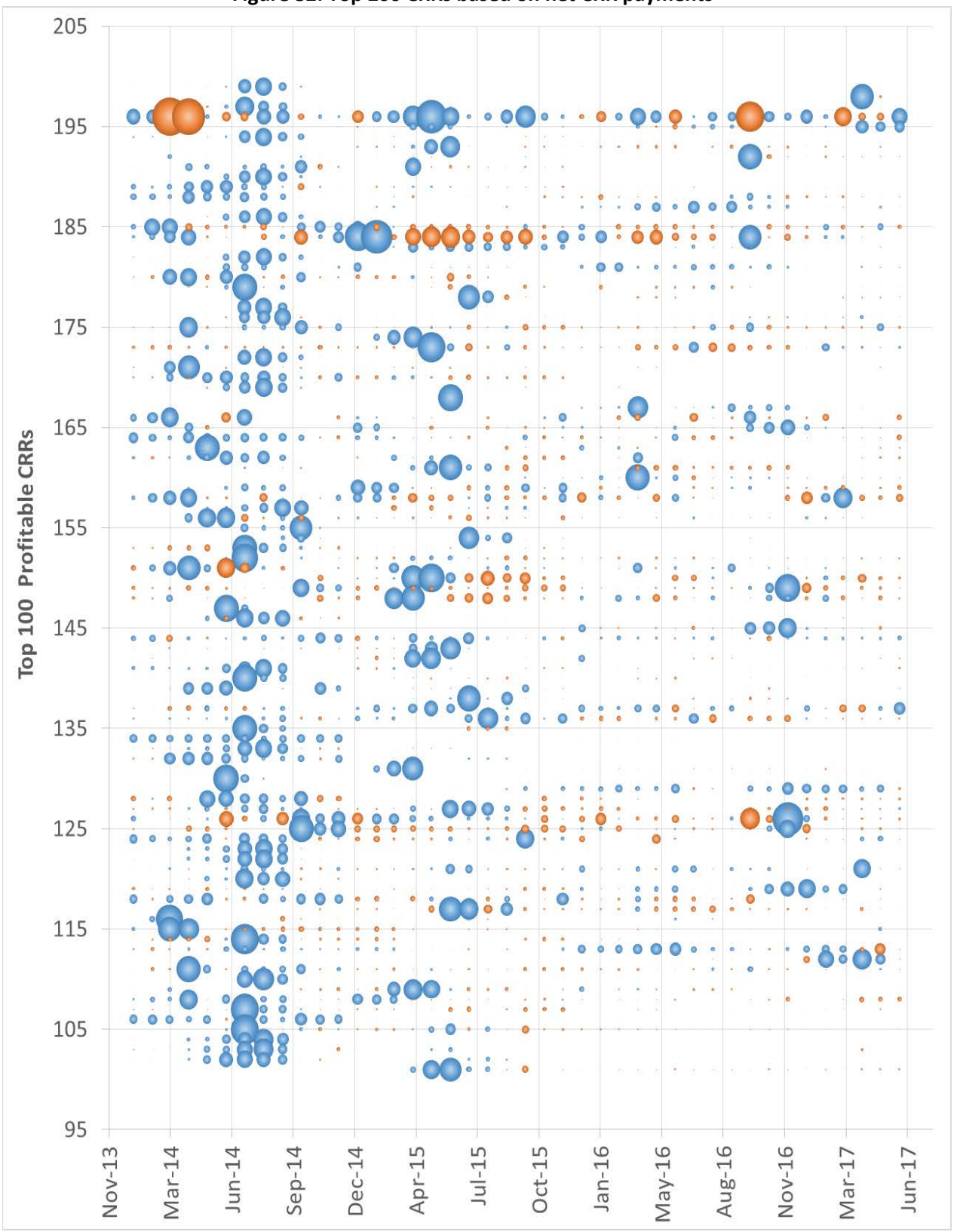


Figure 83: Top 200 CRRs based on consistency of monthly net CRR payments

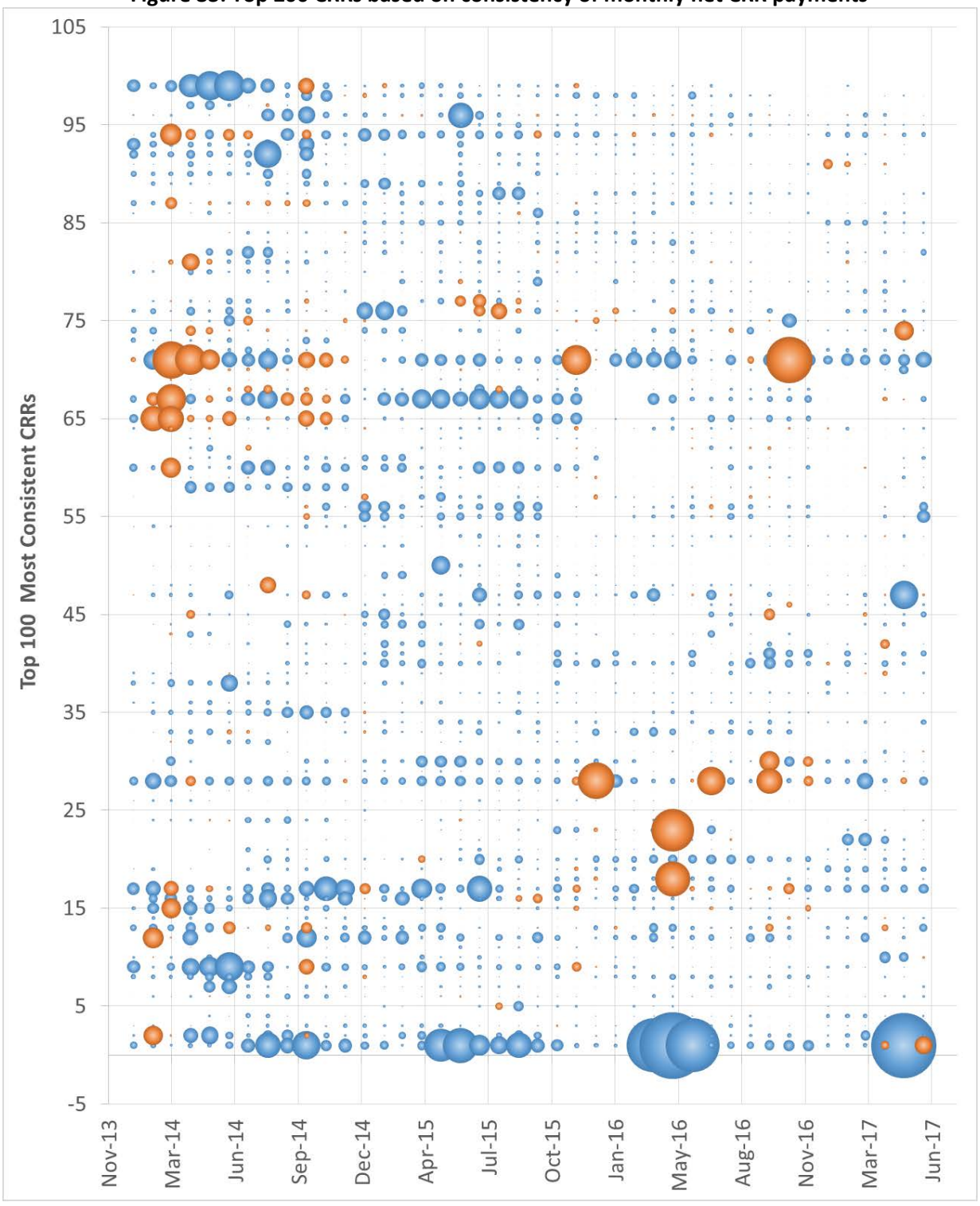
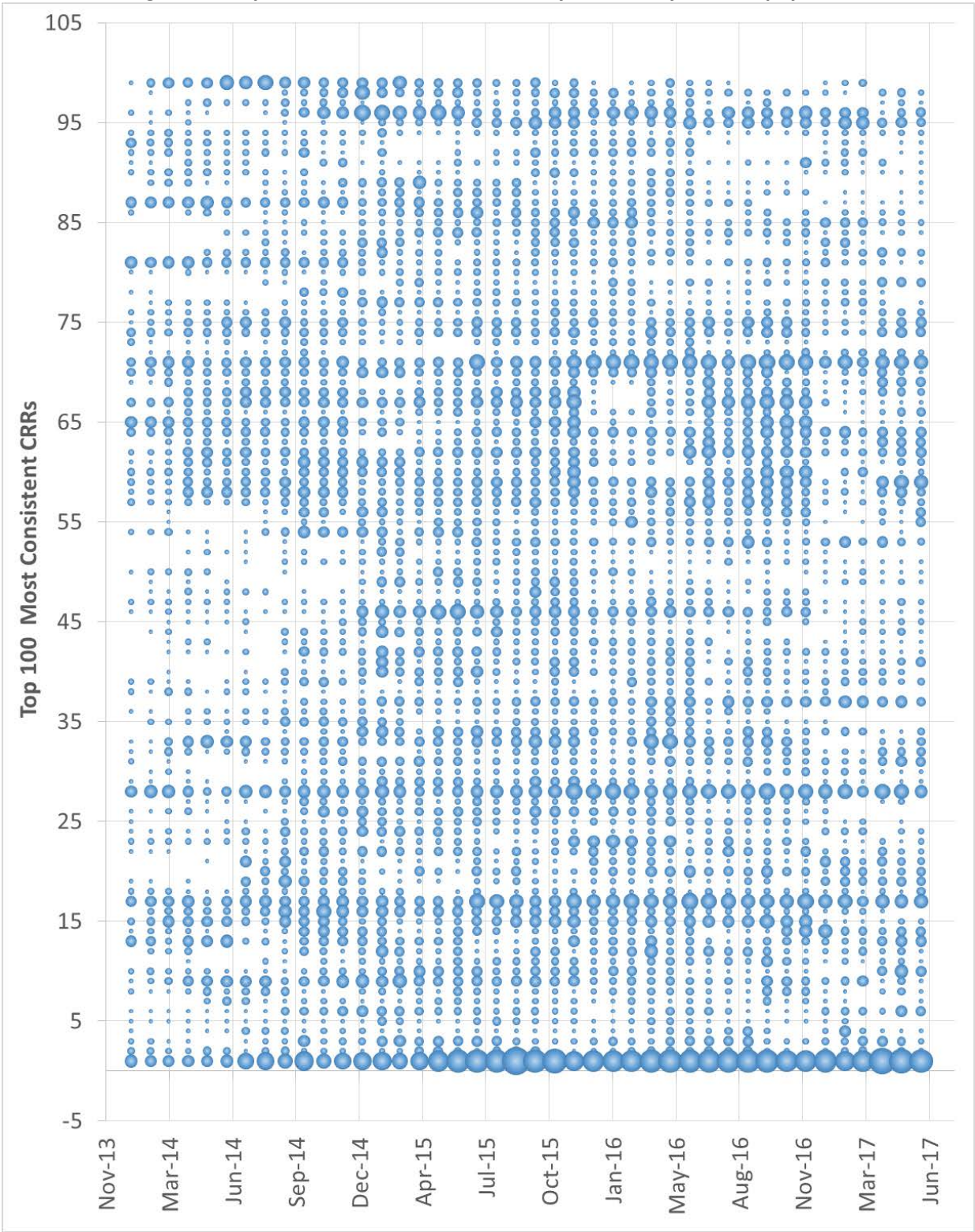


Figure 84: Top 200 CRRs based on consistency of monthly net CRR payments

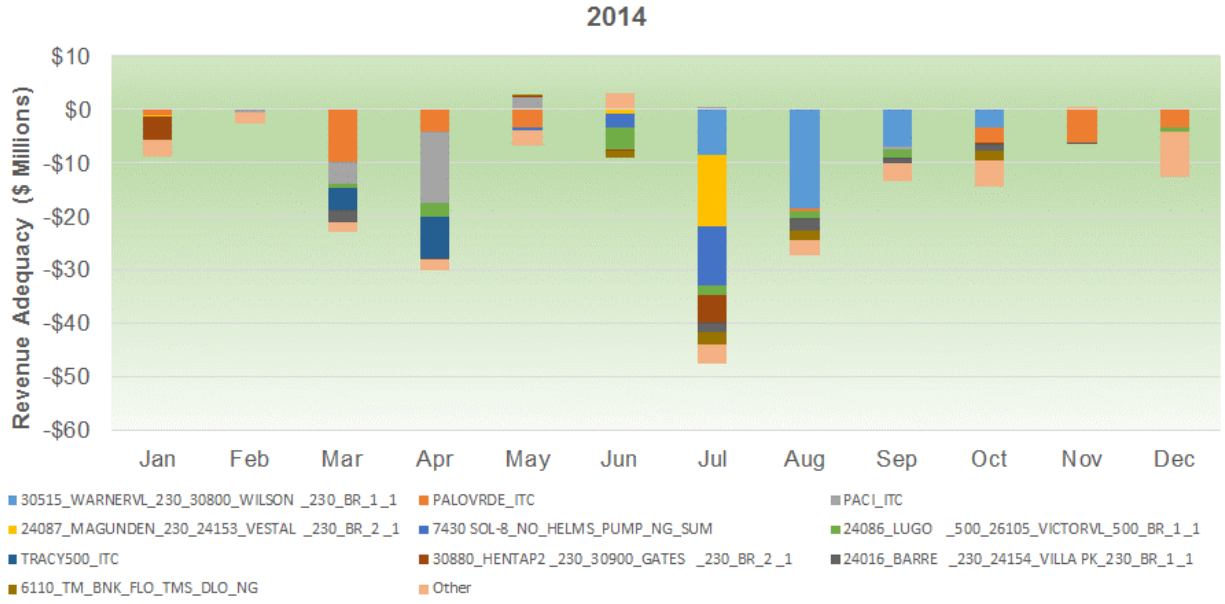


CRR revenue adequacy by transmission element

Revenue adequacy for CRRs reflects the extent to which the net congestion revenues available from the integrated forward market are sufficient to cover the net payments to CRR holders. On one side, when congestion arises in the integrated forward market, congestion rents are collected. These congestion rents are the market surplus resulting from pricing scarce transmission at locational marginal prices. On the other side, the congestion revenue rights released through the CRR markets are funded with such congestion rents. Since congestion rents are only collected on transmission elements experiencing congestion, it is possible to determine equivalently how many CRRs were paid on these same transmission elements, and then determine the level of revenue adequacy by each transmission element that experienced congestion.

Figure 85 illustrates the revenue adequacy (congestion rents less exemptions of existing transmission rights less CRR entitlements) for CRRs in the corresponding month for the various transmission elements that experienced congestion during the month for 2014. A positive value indicates that there is a surplus and a negative value indicates there is a shortfall. For illustration purposes, the CRR revenue adequacy amounts are computed hourly and then aggregated across all hours of each day and month. The chart illustrates only the top 10 most revenue deficient transmission elements across the year and indicates their revenue adequacy trends across the months to check if they have been revenue deficient in one month or distributed across the months for the particular year.

Figure 85: Top 10 CRR revenue inadequate transmission elements



Similarly, Figure 86 through Figure 88 illustrates the revenue adequacy (congestion rents less exemptions of existing transmission rights less CRR entitlements) for CRRs in the corresponding month for the top 10 transmission elements that experienced congestion during the month from 2015 to 2017 respectively.

Figure 86: Top 10 CRR revenue inadequate transmission elements

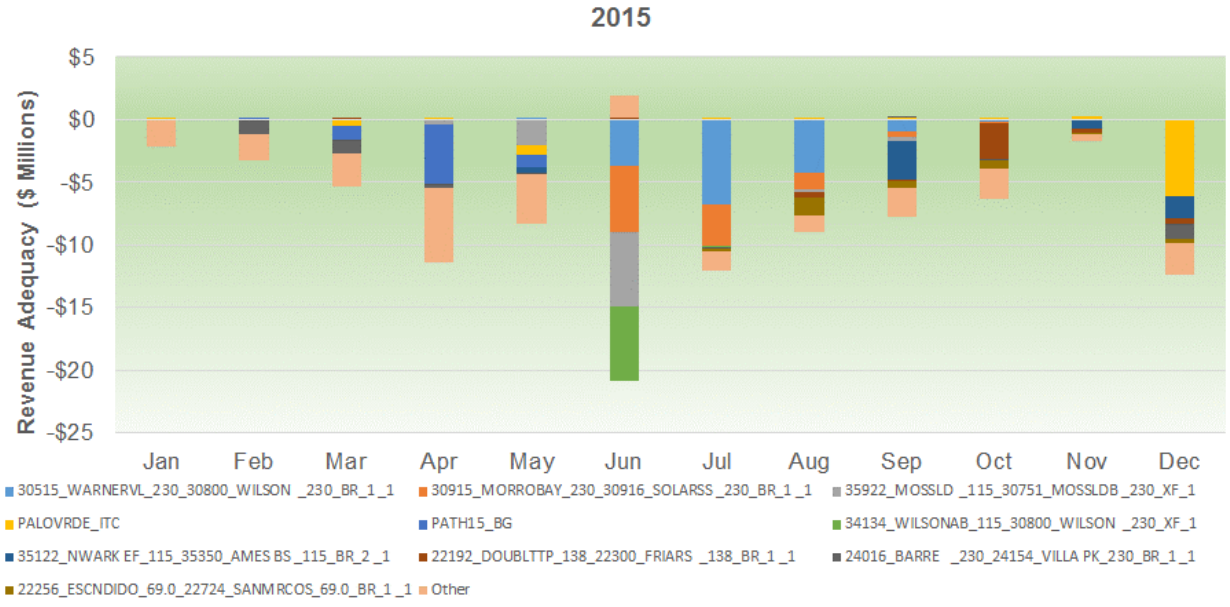


Figure 87: Top 10 CRR revenue inadequate transmission elements

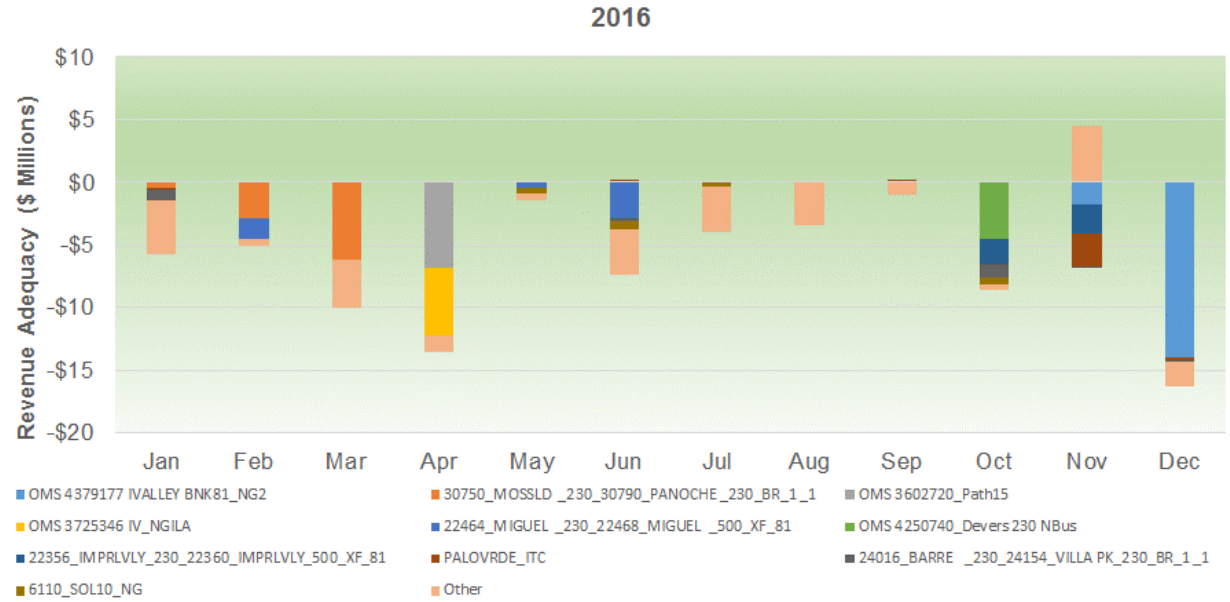
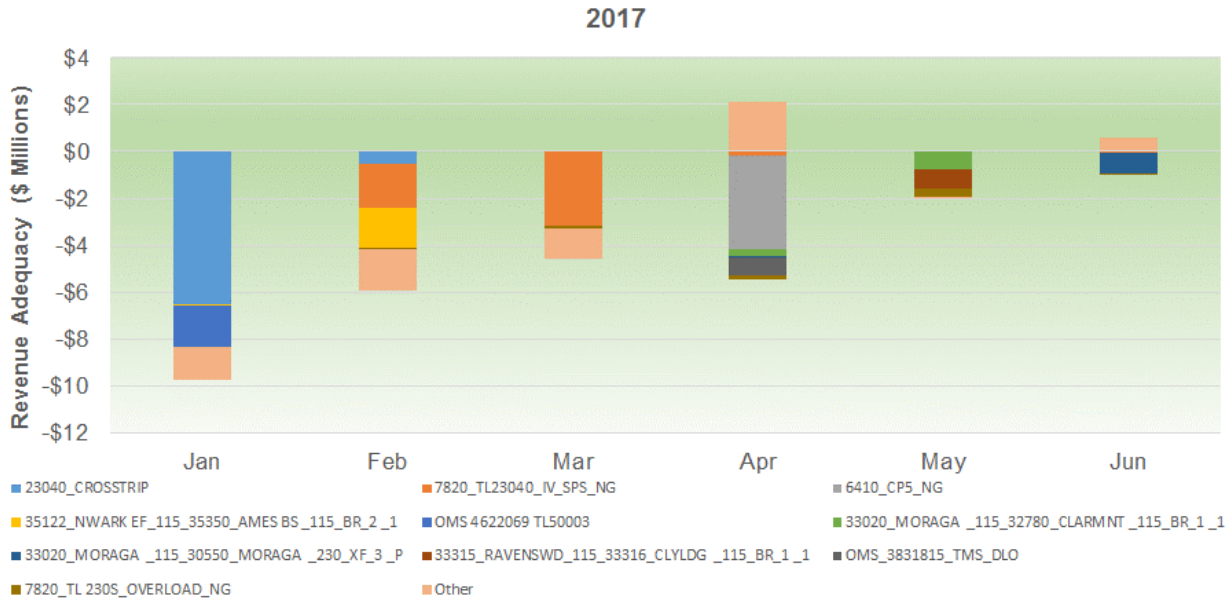


Figure 88: Top 10 CRR revenue inadequate transmission elements



6 Transmission Outages

Outages of transmission facilities rated above 200 kV are considered to have a significant effect upon CRR revenue adequacy. These outages that are more than 24 hours in duration must be submitted for CAISO approval at least 30 days in advance of the first day of the month the outage is scheduled.[7] The CAISO analyzed the planned transmission outages with transmission facilities rated above 200 kV in four sub control areas (VEA, SDGE, SCE, PGAE), whose start dates are between March 2015 and June 2017[8].

Figure 89 shows the total number of planned transmission outages, regardless of their duration. For the period under analysis, about 80 percent of the outages were not scheduled in time to be modelled in the CRR monthly auctions.

Figure 89: Total number of planned transmission outages timely submissions

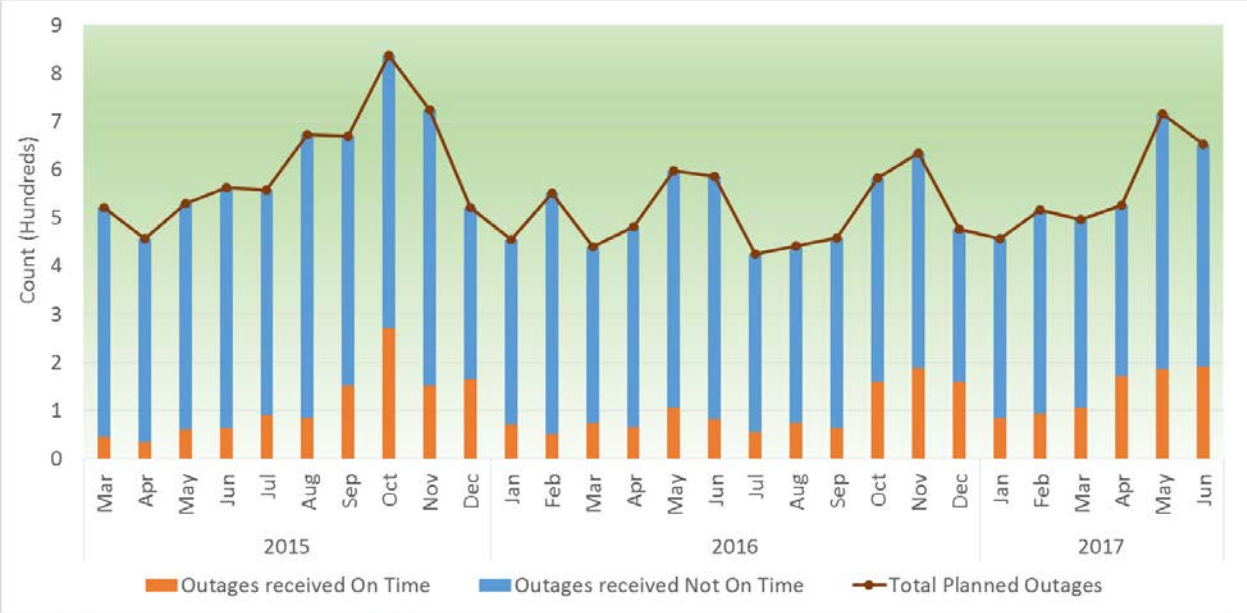


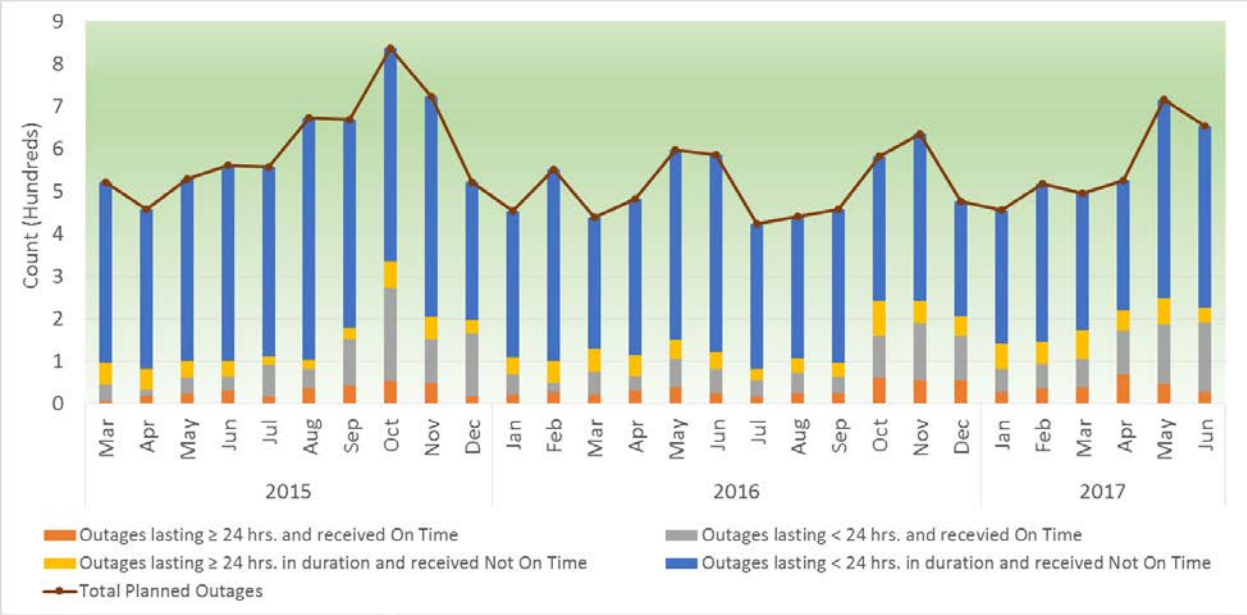
Figure 90 shows the total number of planned transmission outages associated with the number of outages broken out in two main groups; one group to identify if the outages have a duration of at least 24 hours, and the second grouping to identify the portion of outages submitted on time. The majority of outages that were not submitted on time had a duration of less than 24 hours; such outages are not subject to the 30-day submission window. For practical purposes in the CRR markets, these outages, even when submitted on time, are not considered

[7] This deadline and limitation on duration for planned transmission outages are set by the ISO Tariff Section 36.4.3 *Outages That May Affect CRR Revenue; Scheduling Requirements*.

[8] The time period for this metric is shorter than the general time period of analysis of this report because this is the period in which the outage information became available in a new application named Outage Management System (OMS); prior to that the legacy system of SLIC was used to record the outages.

explicitly in the modelling of the CRR market[9]. Out of the 2,200 outages for the period under analysis and that are subject to the 30-day window for submission, about 57 percent of them were not submitted in time.

Figure 90: Total number of planned transmission outages organized by duration



Furthermore, even when an outage with a duration of less than 24 hours is submitted well in advanced for being considered in the CRR auctions, there is an inherent limiting factor on how to model it. With such a short duration, generally the element under outage is not fully modelled on outage but rather it is derated based on some logic taking a pro-rata value based on the number of hours out of service. This derate over the period of the CRR market may not fully capture the nature of the short-term outage and what may be observed is that the small derate applied over the month (or season) may not bring enough congestion rents to offset the potential impact of the outage for the short duration. Needless to say, this can lead to instances of such short duration outages causing large revenue deficiency accrued in the few hours of its duration.

Currently, the CAISO models outages equal to or greater than 10 days as out-of-service in the CRR auction. Figure 91 shows the total number of planned transmission outages with a duration of 24 hours or longer. This metric is then broken out further by outages with a duration of less than 10 days and outages with a duration of at least 10 days. The grouping is also done by whether the outages were received on time or not. The significance of the 10 day threshold is based on the CAISO's practice to model the element with outage with just a pro-rata derate in the CRR auction if the duration is less than 10 days; otherwise, the outage is modelled fully in the CRR market. On average, about 15 percent of outages submitted in time were modelled as full outages.

[9] Outages lasting less than 24 hours are not modelled by any means (derate or full outage in the CRR market model); the exception is only for outages that accrue multiple partial days; in this case if the total number of hours of the outages span 24 hours or more then they are modelled in the CRR market. This is the case of daily outages that are scheduled for multiple days for only certain hours of each day.

Figure 91: Total number of planned transmission outages based on duration and timely submissions

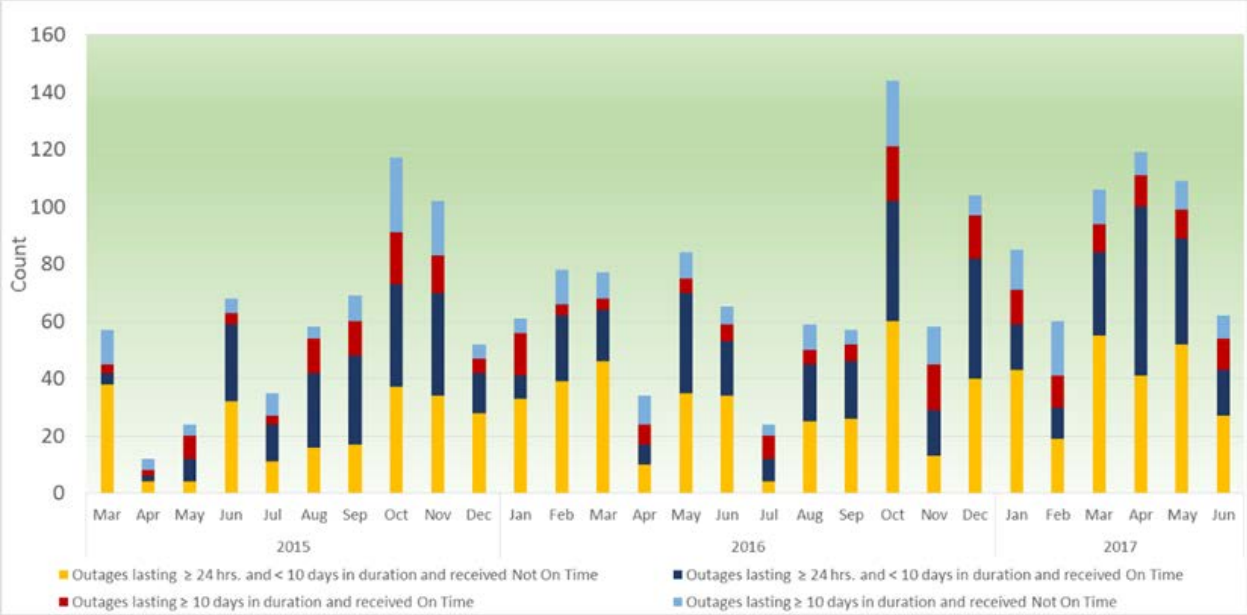
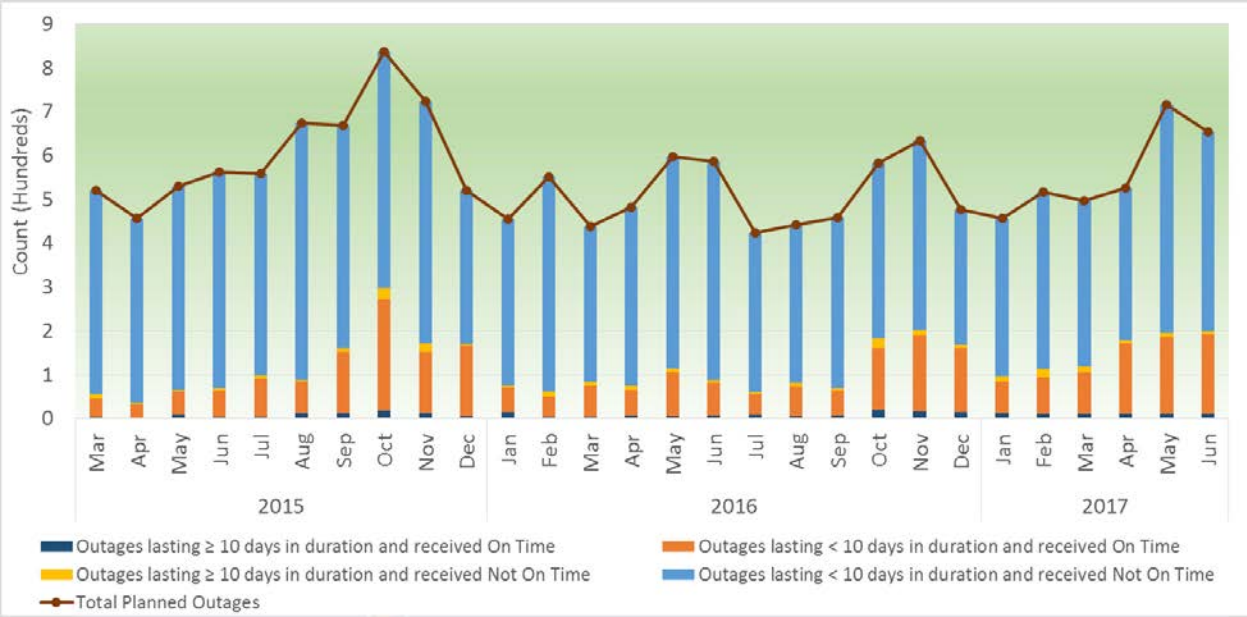


Figure 92: Total number of planned transmission outages organized by 10-day duration



In previous metrics, the outage information was provided at the CAISO system level; subsequent figures show the same information organized by PTO. Figure 93 and Figure 94 show the total number of planned transmission outages that the CAISO analyzed in the sub control area of PGAE. This figure is outlined by the timeliness of when the CAISO received the outages. On average, about 50 percent of PGAE's system outages that were subject to the 30-day submission window were not received in time.

Figure 93: Total number of planned transmission outages timely submissions for PGAE

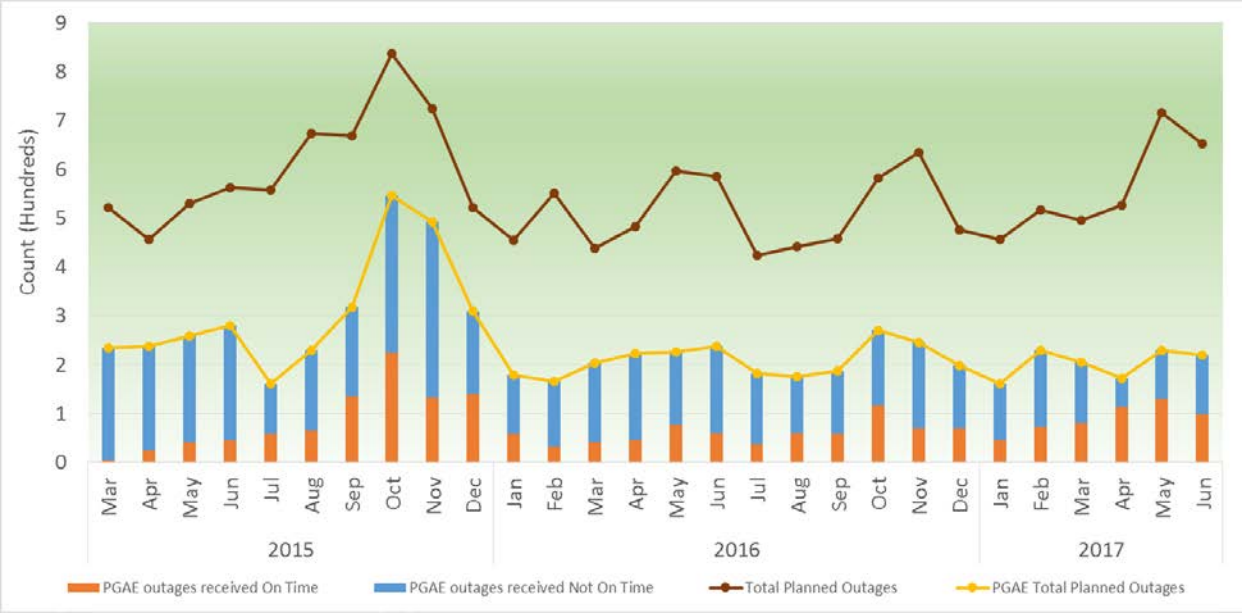


Figure 94: Total number of planned transmission outages subject to submission window for PGAE

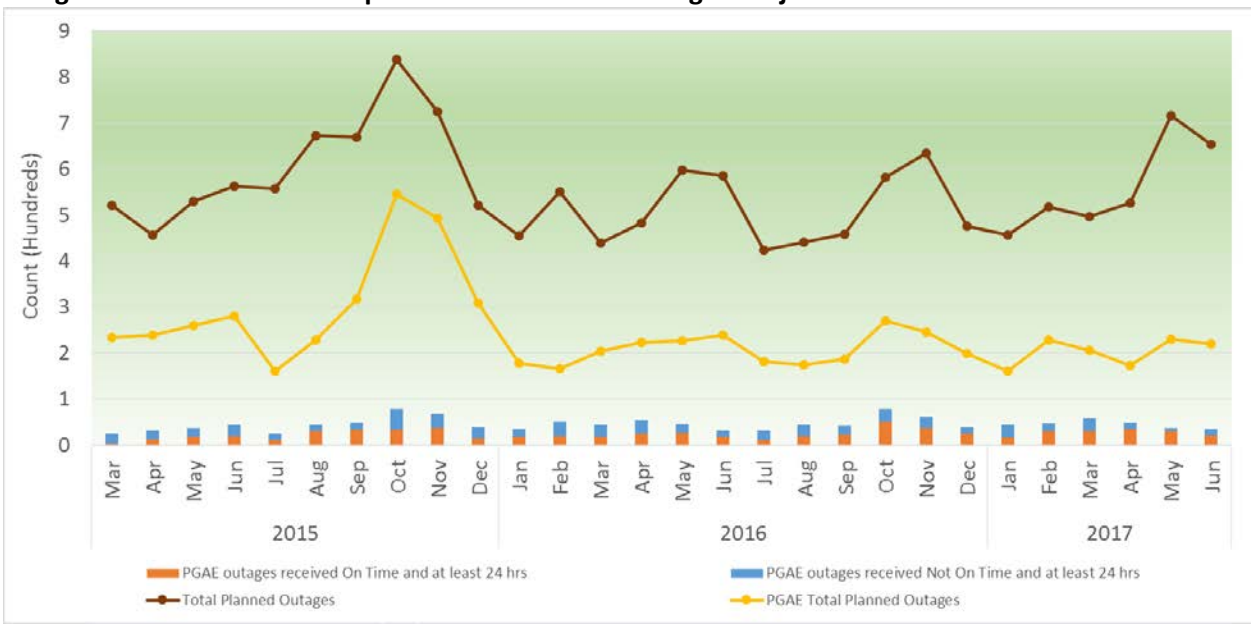


Figure 95 and Figure 96 shows the total number of planned transmission outages that the CAISO analyzed in the sub control area of SCE. This figure is outlined by the timeliness of when the CAISO received the outages. On average, about 65 percent of SCE's system outages subject to the 30-day submission requirement were not received in time.

Figure 95: Total number of planned transmission outages timely submissions for SCE

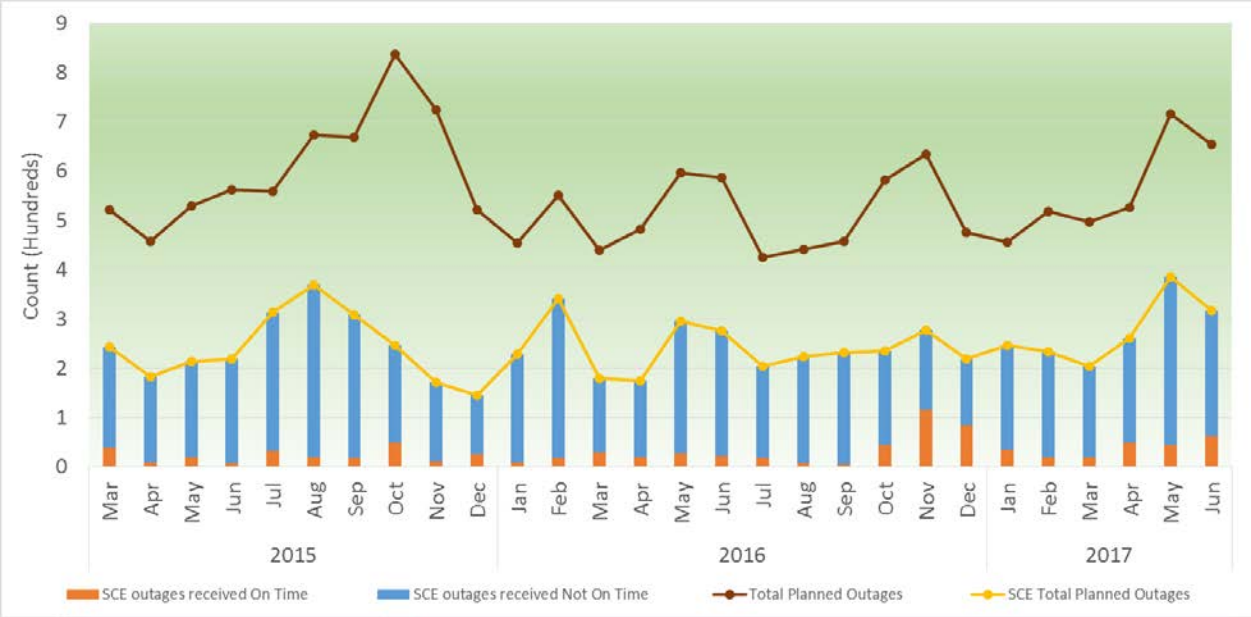


Figure 96: Total number of planned transmission outages subject to submission window for SCE

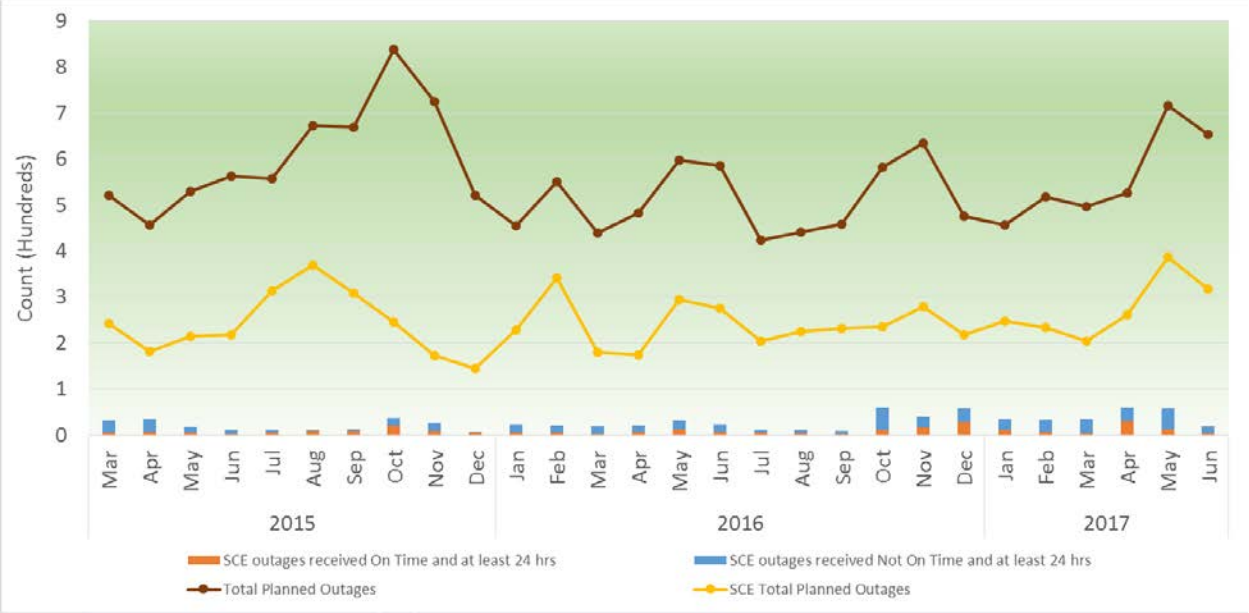


Figure 97 and Figure 98 shows the total number of planned transmission outages that the CAISO analyzed in the sub control area of SDGE. This figure is outlined by the timeliness of when the CAISO received the outages. On average, about 70 percent of SDGE's system outages subject to the 30-day submission requirement were not received in time. For the VEA system, there were no applicable outages.

Figure 97: Total number of planned transmission outages timely submissions for SDGE

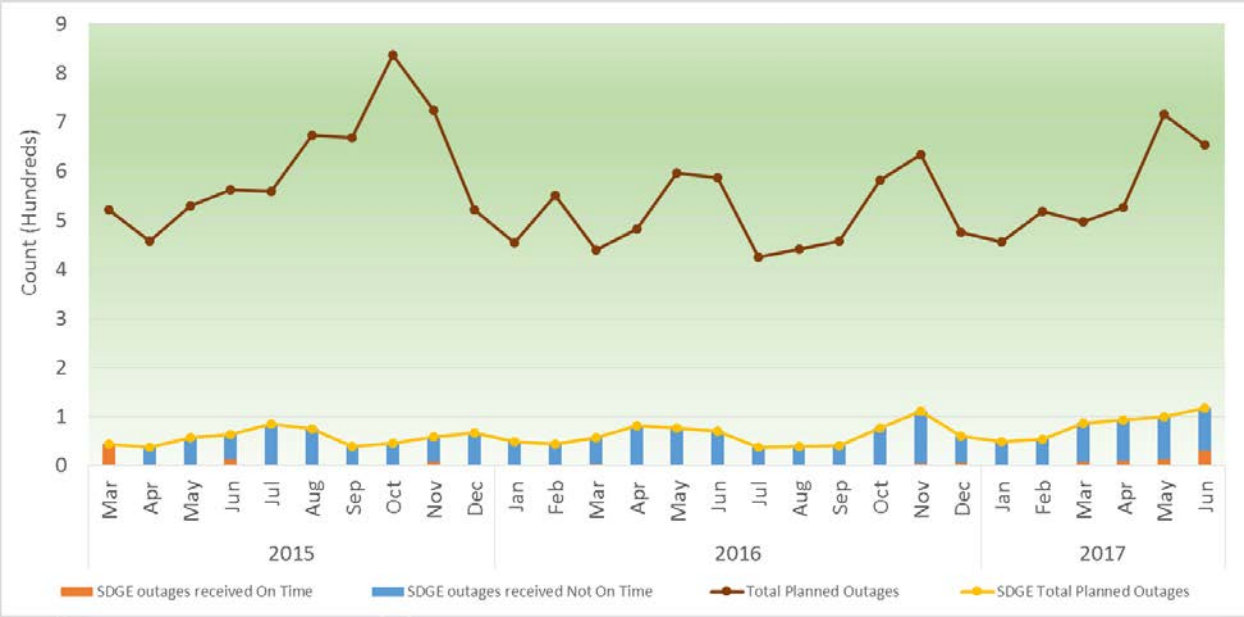
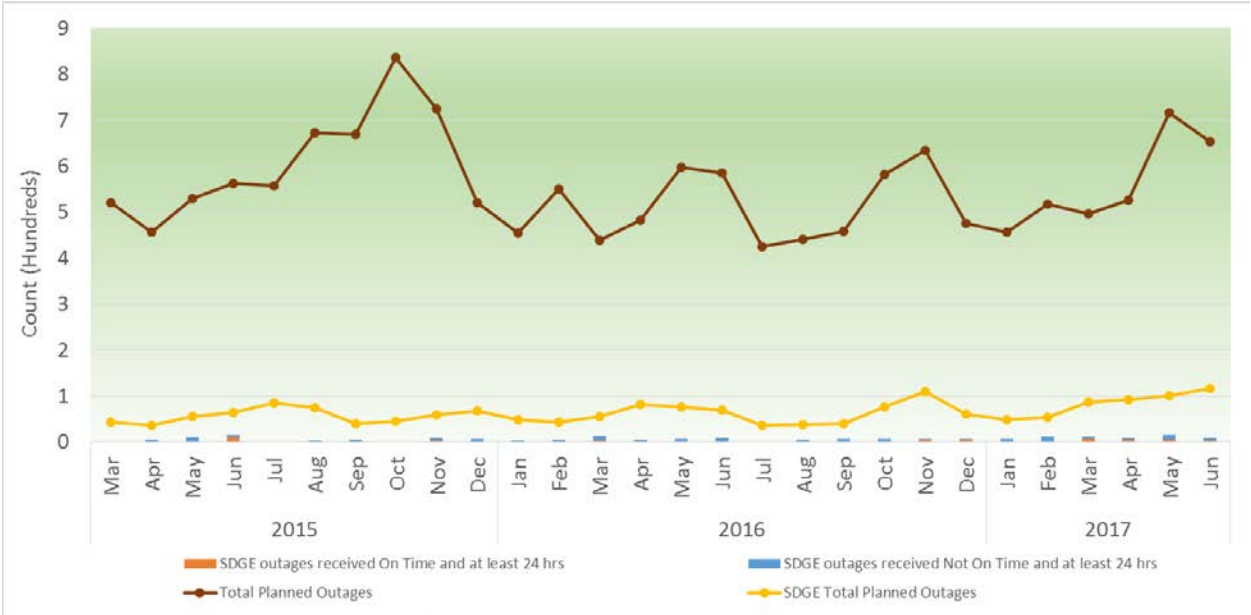


Figure 98: Total number of planned transmission outages subject to submission window for SDGE



7 CRR Auction Performance

The previous sections of this report covered different items for the CRR auction performance; these trends can provide insights on developing patterns and help guide more focused analysis. However, in order to specifically understand the performance of the CRR auction, a more focused and deeper analysis of the basics of CRR auctions is needed. Both CRR awards and prices cleared in the auction process define the auction revenues collected; the clearing prices are not only a reflection of the willingness to buy CRRs from market participants but also reflect the given value of transmission released in the auction. The conceptual construct of auction CRRs is that over time they converge towards the day-ahead congestion prices. If day-ahead congestion prices are simply the reality of the market, they are naturally the point of reference of what transmission is valued at; therefore, from that perspective, it is expected that the CRR auction prices converge towards the day-ahead prices, not the other way around. If there is a persistent divergence, naturally the reference for analysis is the CRR auction rather than the day-ahead market.

The CRR auction prices are primarily driven by the bids reflecting the willingness of participants to pay for CRRs and the available transmission capacity released in the auctions. The prices defined for each CRR source-to-sink combination are not, however, the most fundamental basis of the auction; these are by-product prices and are a reflection of the value of scarce transmission measured by the shadow prices of the underlying transmission constraints binding in the auction.[10] Thus, to understand the fundamental drivers of auction revenues, whether they are too low or too high, implying the transmission is valued too low or too high, it is necessary to analyze the underlying elements: transmission capacity released in the CRR auctions.

The concept of auction revenues is defined as the money collected by the CAISO by releasing CRRs at the auction clearing prices. In settlements, these revenues are simply calculated as the product of quantity and price for each CRR. This gives the actual value of auction revenues; however, this metric has no information to decipher what has defined such clearing prices and thus the level of auction revenues. Similar to the analysis done for CRR revenue adequacy, auction revenues and net CRR payments can be derived on a more basic level by de-constructing these auction revenues and payments on an individual transmission constraint contribution. This is applicable to both annual and monthly CRR auctions. This section provides such analysis for the most recent months.

[10] This construct is ubiquitous in the technical literature, in which the marginal congestion component of a given location is defined as the linear combination of the different shadow prices for transmission constraints binding in the market where the factors of the linear combination are no more than the shift factors.

August 2016

Table 4 summarizes the main settlements metrics for CRR performance in the month of August 2016. The sign convention is based from the CAISO's perspective; a positive value indicates the CAISO collects or has a surplus of money; a negative value indicates the CAISO pays or has a shortfall. Day-ahead congestion rents will be positive, CRR payments will be negative and auction revenues will be positive.

Table 4: Summary of CRR performance for August 2016

Metric	Amount
DA Congestion Rents	$10,432,605
Perfect Hedge	-$562,954
CRR Clawback	$130,037
CRR Payments [Auction + Allocation]	-$13,816,558
CRR Payments to Auction CRRs	-$5,983,425
CRR Payments to Monthly Auction CRRs	-$3,227,669
CRR Payments to Annual Auction CRRs	-$2,755,756
CRR Payments to Allocation CRRs	-$7,833,133
CRR Auction Revenue Monthly	$4,189,193
CRR Auction Revenue Annual	$4,758,563
Revenue Adequacy	-$3,816,871
Revenue Adequacy with Auction Revenues	$5,130,885
Net payment to auction CRR	$2,964,331

In August, there was a revenue deficiency of $3.81 million, which is the difference between all of the proceeds from day-ahead congestion rents, CRR clawback and the payments made to CRR holders. About 43 percent of the CRR payments were to CRRs originating from the annual and monthly auctions. The auction revenues represent the proceeds from selling CRRs through the auction. The revenues arising from the annual auction for each season are estimated pro-rata to each month of the calendar quarter based on the number of hours in each time of use. The net payment to auction CRRs stands for the difference between the money paid to CRR holders and the money charged to CRR holders to acquire that portfolio of CRRs through the corresponding auction. This does not take into account any expenses the CRR holders incur associated with their participation in the CRR market and use of money. This is only a net accounting from the point of view of the cash inflow and outflow in the CAISO system in the CRR settlements. August was one of the few months in which the auction revenues collected by selling CRRs in the auction were higher than the CRR payments to auction CRRs, in the amount of $2.96 million.

In order to further understand this performance, there is a need to estimate over time and by constraint the CRR settlements. Figure 99 shows the daily congestion rents accrued on each transmission constraint that was binding in the day-ahead market in the month of August. August 2nd, 19th, and 31st account for about 32% of the total congestion rents for the entire month. Correspondingly, Figure 100 shows the daily CRR revenue adequacy also illustrated by transmission constraint. On

August 19th, about $1.4 million of revenue deficiency was accrued which accounts for about 37 percent of the total deficiency.

Figure 99: Daily congestion rents - August 2016

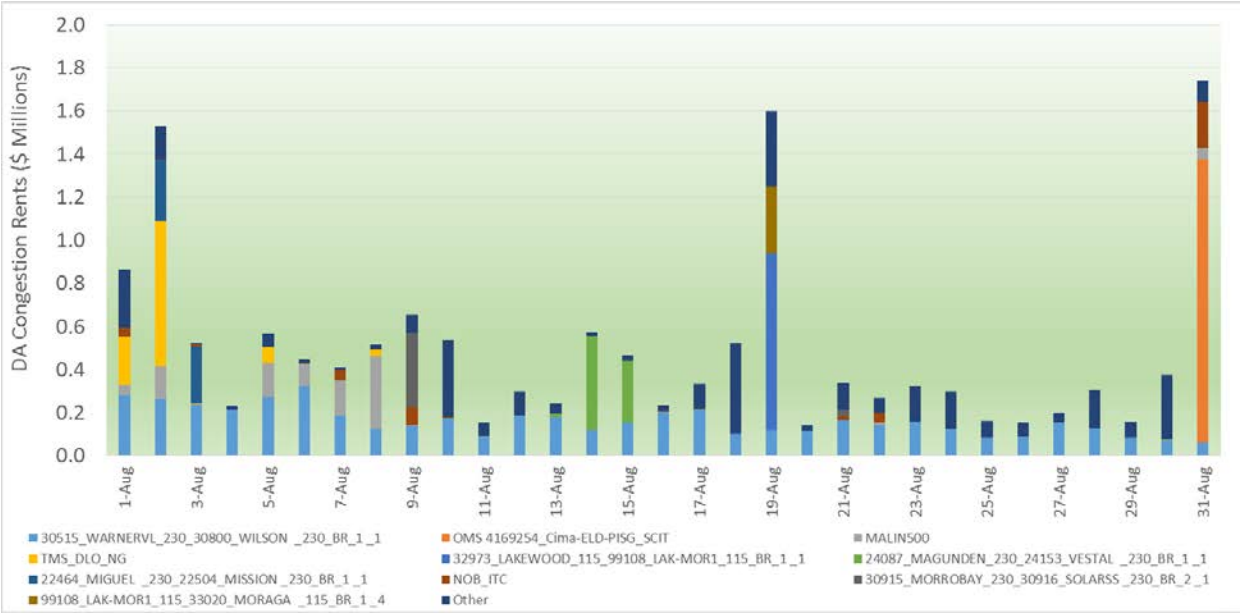


Figure 100: Daily CRR revenue adequacy - August 2016

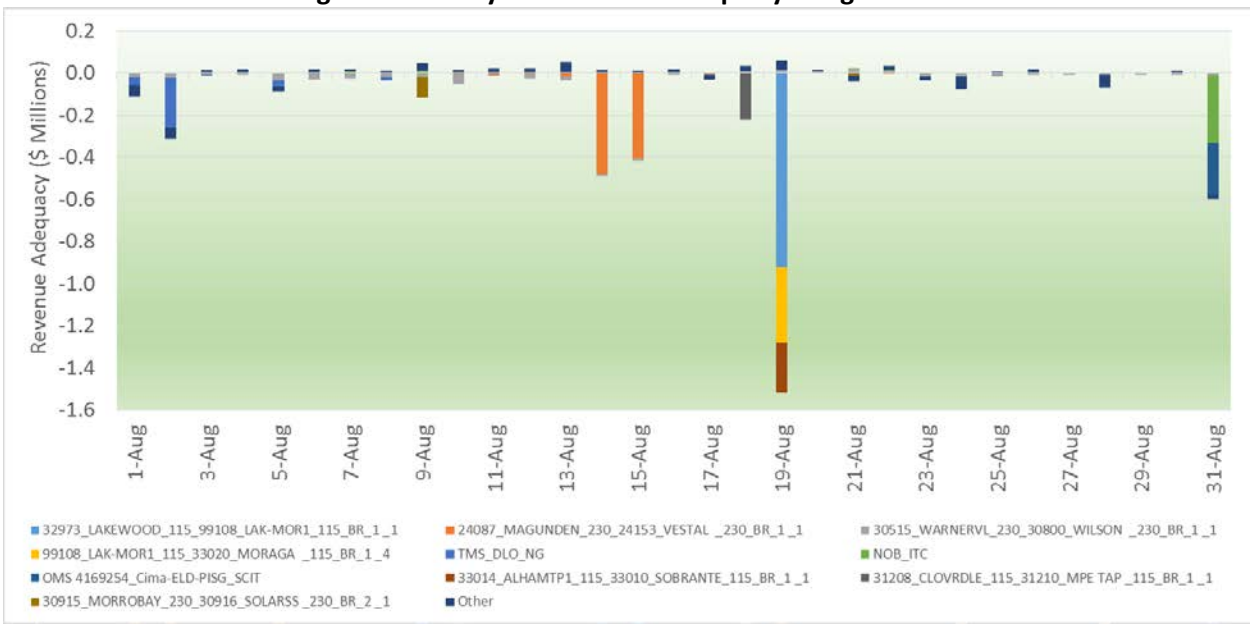


Figure 101 shows the net CRR payment per day. This net payment is the difference between the CRR payments to CRR holders and the auction revenues collected by the CAISO through the CRR auction process; such revenues become a lump revenue for the auction. For this metric, the annual auction revenues are allocated on a pro-rata estimation to each day of the month based on the number of hours in each time of use. The CRR payments are estimated as the total sum of CRR payments over the hours of the day only for CRRs that were released

through both the annual and monthly CRR auctions; that is, no CRR payments to allocated CRRs are included. The purpose of this estimate for net CRR payments is to calculate the net balance for CRRs that were released only in the auctions. For August, there was a persistent positive net CRR payment, indicating that overall the money paid to CRR holders was less than the money the CAISO collected when releasing such CRRs in the annual and monthly auctions.

Figure 101: Daily net CRR payment to auction CRRs - August 2016

Figure 102 compares the level of CRR revenue deficiency and the level of net CRR payments paid to holders for CRRs released in the auction processes. This plot shows that both metrics move together to some extent; in this month in particular, the correlation was weaker than observed in other months. A negative value for CRR revenue adequacy represents a shortfall for the CAISO, while a negative value for net CRR payment represents a payment to holders of auction CRRs from the CAISO. This indicates that the CAISO paid more to auction CRRs than it charged to release CRRs in the auction process.

Figure 102: Comparison of daily net CRR payment with CRR revenue adequacy – August 2016

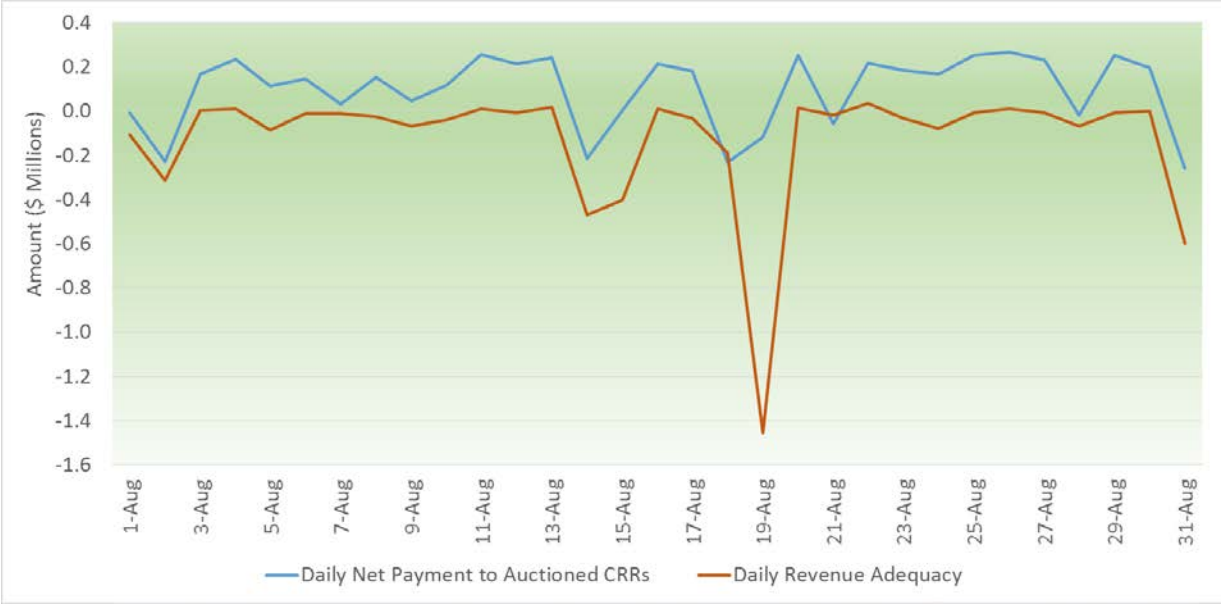
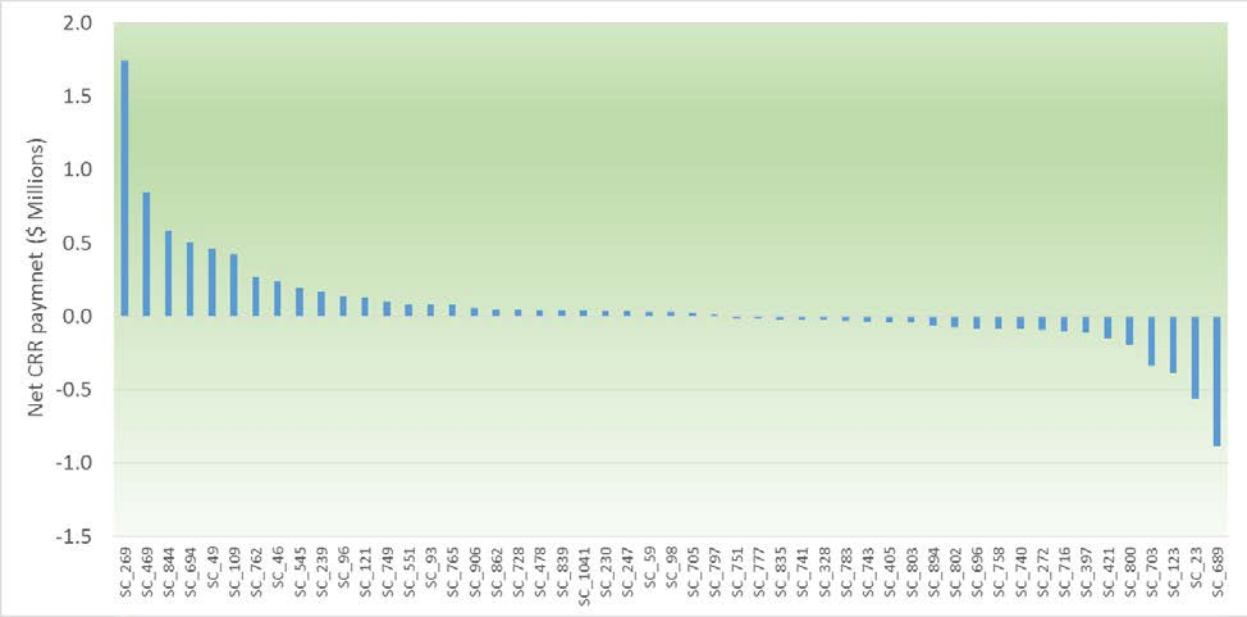


Figure 103 shows the net CRR payments to CRR participants, regardless of the type of participant. This only reflects the payments for CRRs released in both the annual and monthly CRR auctions applicable for the month of August 2016. Since this is from the CAISO's perspective, a negative value means the CAISO disbursed a net CRR payment to the CRR holder (or a net money inflow to the CRR holder). The names of the CRR holders are masked, but the identifier shown in the plot is unique across all the months provided in this analysis. A positive value represents a net inflow for the CAISO since it paid less to CRR holders in the day-ahead market than what it charged to release CRRs in the auction. For August, a large share of holders of auction CRRs saw a net loss from having these positions[11].

[11] CRR holders with net CRR payments between -$10,000 and +$10,000 were dropped from this plot for simplicity in the presentation.

Figure 103: Net CRR payment to auction CRR – August 2016

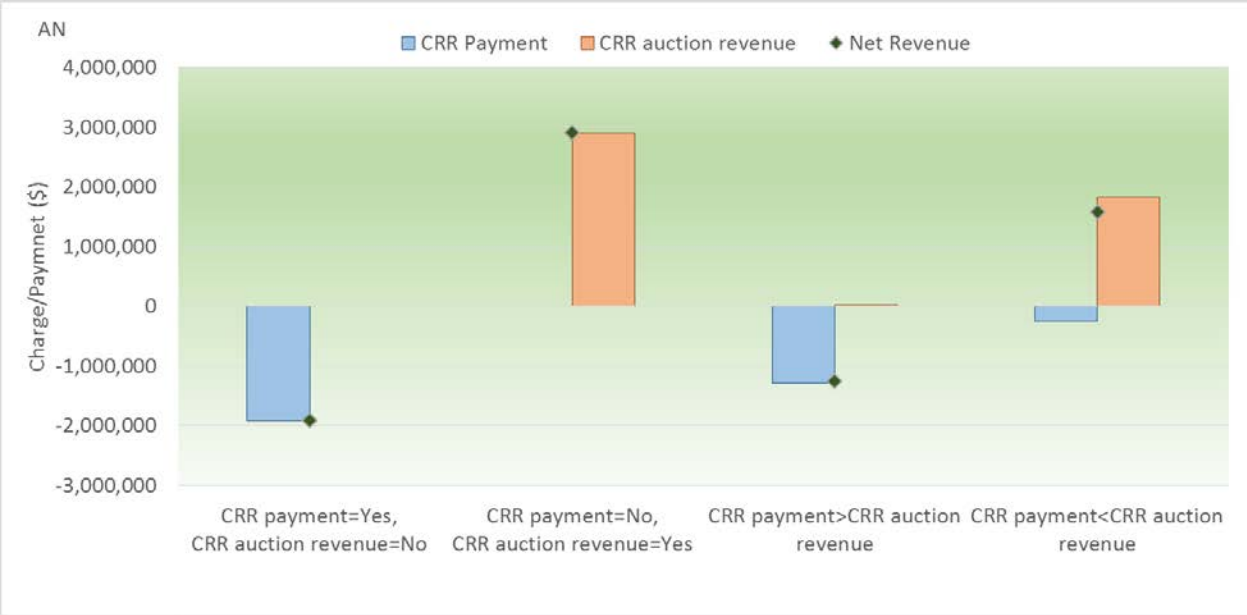


To better understand the dynamics leading to such an outcome, the CAISO shifted the analysis to the fundamentals of the CRR auction construct by analyzing the CRR auction results at the constraint level. CRRs are released and priced based on the CRR clearing prices; such prices are derived as the relative difference between locational prices between the source and the sink locations. These locational prices originate from the cleared prices when any transmission constraint becomes binding with nonzero pries in the CRR auction, commonly referred as *shadow prices*. The CAISO turned out to analyze what constraints have been binding in the CRR auction process and compared that with the set of constraints that were binding in the day-ahead market. To some extent, one expects that there is certain level of alignment between the markets. Figure 104Figure 104 and Figure 105 show a comparison of net CRR payments. The CRR payments reflect the CRR settlements for CRRs with the day-ahead congestion rents, while the CRR auction revenues are the money the CAISO collected from releasing CRRs through the auctions. That is, it reflects the net money participants were charged to acquire CRRs and the money they were paid; in a loose sense, it could be interpreted as profits for holding.

There are four possible permutations to analyze. The first case represents when a CRR payment to CRR holders was made in the day-ahead market settlement, but the CAISO did not collect any revenues from releasing these CRRs from the auctions because the constraint was not binding in the CRR auction. This is shown for both the pro-rata portion of the annual auction for August and for the monthly CRR auction. A negative value indicates that the CAISO had a net CRR payment to CRR holders. The second case is the opposite in which there was no CRR payments when settling CRRs in the day-ahead market but the CAISO collected revenue when releasing these CRRs in the auction process. The third and fourth cases are for CRRs that had a CRR payment in the day-ahead market and the CAISO also charged them in the CRR auctions to release these CRRs. The third case is when the net CRR payment is negative, while the fourth case

is when the net CRR payment is positive[12]. This metric reveals any potential misalignment of constrains enforced and binding between the day-ahead market and CRR auctions.

Figure 104: CRR payment versus CRR auction revenues for annual CRR - August 2016



[12] This type of breakdown of net CRR payments can be easily done using straight CRR settlements data since it simply classifies CRRs by the potential positions they had in both the CRR auctions and the day-ahead market settlements. However, with the need to further understand how this was originated, the CAISO based this estimate on a constraint by constraint analysis. That is, the CAISO first estimated the day-ahead congestion rents by constraint and also the CRR auction revenue by constraint. This type of analysis provides an estimate of the net CRR payment by each constraint. With this approach, the estimates provided in this analysis may observe a small discrepancy when comparing against the actual settlements data. The reason for this potential discrepancy relies on the fact that when dissecting the CRR payment by each constraint, the CAISO uses the underlying shift factors and CRR MW values and constraints shadow prices to derive the corresponding payments and revenues. With the CAISO day-ahead market using a shift factor threshold of 2 percent, the estimates for congestion rents by constraint may be slightly different than simply estimating the congestion rents as the product of shadow price of a constraint times its transmission limit.

Figure 105: CRR payment versus CRR auction revenues for monthly CRR - August 2016

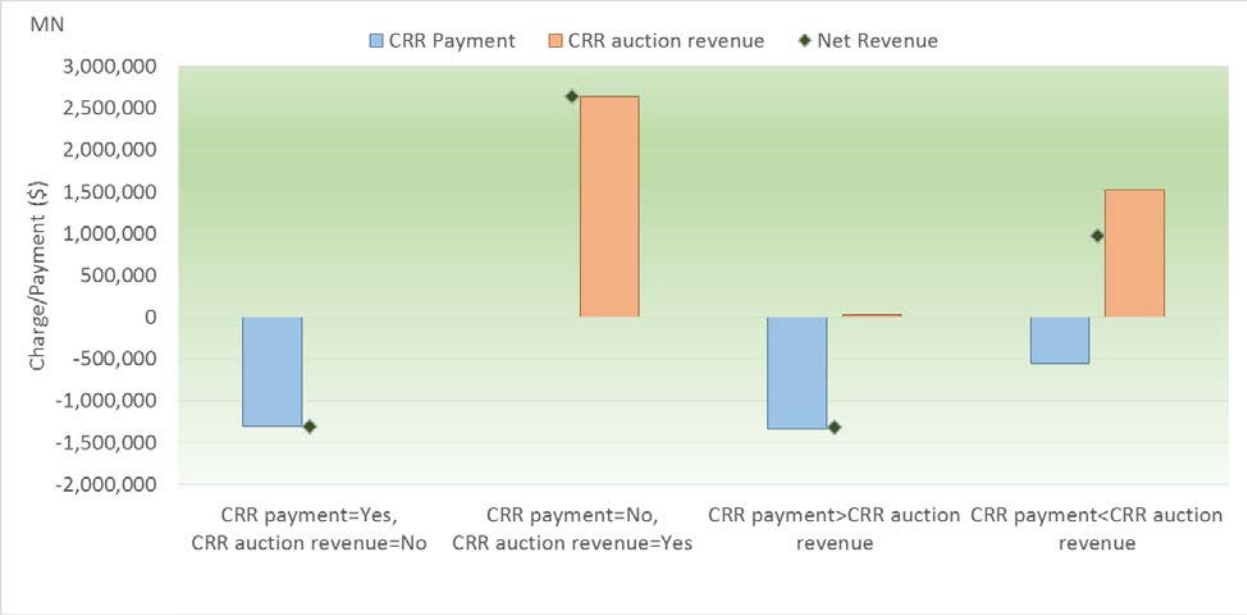


Table 5 provides one level deeper of understanding of such misalignments between markets. This tables show the top and bottom constraints when sorted by net CRR payments. In the first column it shows the estimated CRR payment to CRR holders accrued by each constraint; the second column shows the auction revenues collected by the CAISO on that same constraint; the last column shows the net CRR payment, which is the balance between this money outflow (CRR payment) and money inflow (CRR auction revenues). Table 6 shows the same information for CRRs released in the monthly auction for August 2016. The top constraints reflect cases where large CRR payments to auction CRRs accrued when the CRR market collected little or no auction revenues when releasing these CRRs. The bottom constraints reflect cases where the net CRR payment is actually positive meaning cases where the CAISO collected more auction revenues than it had to pay to auction CRRs, mostly because the constraints were not binding in the CRR auction.

Table 5: Net CRR payment by constraint – August 2016, annual process

Constraints	Total CRR Payment	Total CRR Auction Revenue	Net CRR Payment
30515_WARNERVL_230_30800_WILSON _230_BR_1 _1	-$1,110,625.9	$24.5	-$1,110,601.3
31208_CLOVRDLE_115_31210_MPE TAP _115_BR_1 _1	-$559,476.2	$0.0	-$559,476.2
24087_MAGUNDEN_230_24153_VESTAL _230_BR_1 _1	-$315,218.1	$0.0	-$315,218.1
32973_LAKEWOOD_115_99108_LAK-MOR1_115_BR_1 _1	-$263,724.2	$0.0	-$263,724.2
OMS 4169254_Cima-ELD-PISG_SCIT	-$252,780.6	$0.0	-$252,780.6
TMS_DLO_NG	-$161,976.3	$0.0	-$161,976.3
99108_LAK-MOR1_115_33020_MORAGA _115_BR_1 _4	-$99,606.0	$0.0	-$99,606.0
33014_ALHAMTP1_115_33010_SOBRANTE_115_BR_1 _1	-$87,256.0	$0.0	-$87,256.0
30915_MORROBAY_230_30916_SOLARSS _230_BR_2 _1	-$86,960.3	$0.0	-$86,960.3
31566_KESWICK _60.0_31582_STLLWATR_60.0_BR_1 _1	-$96,426.7	$23,982.0	-$72,444.7
34752_KERN PWR_115_34797_KERNWTP2_115_BR_1 _1	-$53,909.0	$3,840.5	-$50,068.5
22604_OTAY _69.0_22616_OTAYLKTP_69.0_BR_1 _1	-$33,760.0	$0.0	-$33,760.0
OMS 4216681 TL50001OUT_NG	-$24,032.8	$0.0	-$24,032.8
22464_MIGUEL _230_22504_MISSION _230_BR_1 _1	-$22,485.5	$0.0	-$22,485.5
31378_FULTON _60.0_31382_FTCHMTNP_60.0_BR_1 _1	-$18,982.2	$0.0	-$18,982.2
22256_ESCNDIDO_69.0_22724_SANMRCOS_69.0_BR_1 _1	-$17,484.4	$0.0	-$17,484.4
34112_EXCHEQUR_115_34116_LE GRAND_115_BR_1 _1	-$16,656.6	$0.0	-$16,656.6
OMS 4059507 Path15_S_N	-$13,254.3	$0.0	-$13,254.3
24016_BARRE _230_24154_VILLA PK_230_BR_1 _1	-$14,594.2	$2,336.1	-$12,258.1
OMS 3969865 Path15_S_N	-$11,019.4	$0.0	-$11,019.4
34104_ATWATER _115_34114_JRWD GEN_115_BR_1 _1	$0.0	$56,980.8	$56,980.8
31581_OREGNTRL_60.0_31578_LOMS JCT_60.0_BR_1 _1	$66,235.5	$0.0	$66,235.5
31218_ER_FTNJT_115_31220_EGLE RCK_115_BR_1 _1	$0.0	$70,457.4	$70,457.4
6110_SOL10_NG	-$16,927.8	$89,489.2	$72,561.4
35922_MOSSLD _115_30751_MOSSLDB _230_XF_1	$0.0	$73,925.4	$73,925.4
33542_LEPRINO _115_33546_TRACY JC_115_BR_1 _1	$0.0	$78,108.1	$78,108.1
34116_LE GRAND_115_34134_WILSONAB_115_BR_1 _1	-$26,554.7	$105,940.0	$79,385.3
WARNRVIL_STNDIFRD_TOR	$0.0	$84,494.3	$84,494.3
OAKDL_MOCASN_TOR	$0.0	$87,494.1	$87,494.1
NdGrp_POD_INTKEP_2_UNITS-APND	$0.0	$89,160.9	$89,160.9
24087_MAGUNDEN_230_24153_VESTAL _230_BR_2 _1	$0.0	$114,943.6	$114,943.6
PALOVRDE_ITC	-$59,156.1	$175,099.0	$115,943.0
NdGrp_COGNTNL_7_B1	$0.0	$128,659.9	$128,659.9
24086_LUGO _500_26105_VICTORVL_500_BR_1 _1	-$25,930.7	$176,170.1	$150,239.4
MALIN500	-$94,906.9	$245,268.4	$150,361.5
33310_SANMATEO_115_30700_SANMATEO_230_XF_7 _S	$0.0	$175,828.2	$175,828.2
32782_STATIN D_115_32788_STATIN L_115_BR_1 _1	$0.0	$182,642.5	$182,642.5
PATH15_BG	$0.0	$193,766.4	$193,766.4
6110_TM_BNK_FLO_TMS_DLO_NG	$0.0	$246,778.1	$246,778.1
30915_MORROBAY_230_30916_SOLARSS _230_BR_1 _1	-$39,970.4	$769,923.4	$729,953.0

Table 6: Net CRR payment by constraint – August 2016, monthly process.

Constraints	Total CRR Payment	Total CRR Auction Revenue	Net CRR Payment
30515_WARNERVL_230_30800_WILSON _230_BR_1 _1	-$924,512.8	$90.4	-$924,422.4
24087_MAGUNDEN_230_24153_VESTAL _230_BR_1 _1	-$392,790.4	$17,373.0	-$375,417.4
TMS_DLO_NG	-$285,054.8	$0.0	-$285,054.8
OMS 4169254_Cima-ELD-PISG_SCIT	-$216,901.1	$0.0	-$216,901.1
32973_LAKEWOOD_115_99108_LAK-MOR1_115_BR_1 _1	-$177,275.9	$0.0	-$177,275.9
34112_EXCHEQUR_115_34116_LE GRAND_115_BR_1 _1	-$107,682.2	$0.0	-$107,682.2
24016_BARRE _230_24154_VILLA PK_230_BR_1 _1	-$79,025.1	$0.0	-$79,025.1
31208_CLOVRDLE_115_31210_MPE TAP _115_BR_1 _1	-$75,407.4	$0.0	-$75,407.4
99108_LAK-MOR1_115_33020_MORAGA _115_BR_1 _4	-$66,983.0	$0.0	-$66,983.0
30915_MORROBAY_230_30916_SOLARSS _230_BR_1 _1	-$62,860.1	$0.0	-$62,860.1
OMS 4059507 Path15_S_N	-$59,109.5	$0.0	-$59,109.5
6110_SOL10_NG	-$51,299.2	$0.0	-$51,299.2
OMS 4216681 TL50001OUT_NG	-$45,563.7	$0.0	-$45,563.7
OMS 3969865 Path15_S_N	-$38,682.8	$0.0	-$38,682.8
PATH15_S-N	-$31,685.4	$0.0	-$31,685.4
31566_KESWICK _60.0_31582_STLLWATR_60.0_BR_1 _1	-$21,425.0	$0.0	-$21,425.0
22476_MIGUELTP_69.0_22456_MIGUEL _69.0_BR_1 _1	-$17,762.1	$0.0	-$17,762.1
33014_ALHAMTP1_115_33010_SOBRANTE_115_BR_1 _1	-$15,679.0	$0.0	-$15,679.0
22464_MIGUEL _230_22468_MIGUEL _500_XF_81	-$13,884.1	$0.0	-$13,884.1
22192_DOUBLTTP_138_22300_FRIARS _138_BR_1 _1	-$10,965.2	$0.0	-$10,965.2
NdGrp_AGUCALG1_7_B1	$0.0	$40,512.1	$40,512.1
NdGrp_ELNIDBIO_6_N001	$0.0	$43,328.4	$43,328.4
30523_CC SUB _230_30525_C.COSTA _230_BR_1 _1	$0.0	$44,043.6	$44,043.6
32782_STATIN D_115_32788_STATIN L_115_BR_1 _1	$0.0	$45,928.8	$45,928.8
30750_MOSSLD _230_30760_COBURN _230_BR_1 _1	$0.0	$62,285.9	$62,285.9
33308_SFIA-MA _115_33303_EST GRND_115_BR_2 _1	$0.0	$63,127.2	$63,127.2
WARNRVIL_STNDIFRD_TOR	$0.0	$64,912.3	$64,912.3
30915_MORROBAY_230_30916_SOLARSS _230_BR_2 _1	-$130,625.5	$203,155.5	$72,530.0
22831_SYCAMORE_138_22124_CHCARITA_138_BR_1 _1	-$10,323.0	$89,538.2	$79,215.3
24086_LUGO _500_26105_VICTORVL_500_BR_1 _1	-$30,518.7	$117,868.0	$87,349.2
24901_VSTA _230_24804_DEVERS _230_BR_1 _1	$0.0	$122,877.3	$122,877.3
30900_GATES _230_30970_MIDWAY _230_BR_1 _1	$0.0	$148,475.3	$148,475.3
24016_BARRE _230_25201_LEWIS _230_BR_1 _1	-$31,511.5	$197,937.4	$166,425.9
22464_MIGUEL _230_22504_MISSION _230_BR_1 _1	-$95,424.5	$265,126.5	$169,701.9
30040_TESLA _500_30042_METCALF _500_BR_1 _1	$0.0	$170,564.8	$170,564.8
MALIN500	-$139,701.6	$311,645.4	$171,943.8
PATH26_BG	$0.0	$210,046.9	$210,046.9
22468_MIGUEL _500_22472_MIGUELMP_1.0_XF_80	$0.0	$217,545.6	$217,545.6
40687_MALIN _500_30010_INDSPRNG_500_BR_2 _3	$0.0	$283,385.6	$283,385.6
24132_SANBRDNO_230_24804_DEVERS _230_BR_1 _1	$0.0	$351,058.0	$351,058.0

These two tables illustrate instances of constraint misalignment between the CRR auctions and the day-ahead market. To understand this mismatch one level deeper, Table 7 lists the subset of constraints that are not binding or not enforced in the CRR monthly auction or that have a significant CRR payment. The portion that were paid only to CRRs from the annual and monthly auctions is also provided. Then it compares the average transmission limit used in the day-ahead market and the limits actually used in both the annual and monthly auctions. These are the constraints that will mostly drive the divergence between the day-ahead and CRR markets. One of the cornerstones of the CRR market efficiency is for the CRR market to closely reflect the transmission capacity of the day-ahead market. When the transmission capacity released in the CRR market is less than that of the day-ahead market, there may be an exposure of revenue deficiency. This may also have a fair impact on the level of CRR net payments and how transmission capacity is valued in the CRR auction. This occurs because when CRRs are released in the auction process they are priced on the value of the capacity made available, or on the lack of it. A systemic issue identified during the evaluation of the CRR auction efficiency is that multiple transmission constraints are not modelled or enforced in the CRR auctions.

In cases where the constraint was enforced in the day-ahead market but not modelled or enforced in the CRR auctions, the amount of transmission capacity by means of CRRs that may be released on that constraints is effectively unbounded, which indicates that more transmission capacity may be released in the CRR auction than in the day-ahead market. This is a major problem to the efficiency of the CRR market. For the case of August 2016 and relative to other months analyzed, there were relatively few instances of constraints not enforced in the CRR auctions. In such cases the level of congestion rents and CRR payments were relatively modest, such that even with the misalignment, the financial impact was low. In further investigating why these constraints were not modelled/enforced in the CRR auctions, the common factors are related to how outages were considered and when transmission constraints were enforced in the CRR auction.

1. Constraint OMS 4169254_Cima-ELD-PISG_SCIT. This constraint was associated with an outage (4169254) submitted after the monthly CRR cutoff date and lasted less than 24 hours in duration.
2. Constraint OMS 4216681 TL50001OUT_NG. This constraint was associated with an outage (4216681) submitted after the monthly CRR cutoff date and lasted less than 24 hours in duration.
3. Constraint 22476_MIGUELTP_69.0_22456_MIGUEL _69.0_BR_1 _1. This element is not part of the normally enforced list of transmission elements. There was no known outage at the time of the running of the CRR process that activated this flowgate.
4. Constraint OMS 3969865 Path15_S_N. This outage (3969865) was picked up in the CRR model but was reflected as a derate to the PATH15_S-N constraint. The new NG was added just after the monthly CRR outage cutoff and the outage also lasted less than 24 hours in duration.
5. Constraint 22604_OTAY_69.0_22616_OTAYLKTP_69.0_BR_1 _1. This element is not part of the normally enforced list of transmission elements. There is no known outage at the time of the running of the CRR process that required the activation of this flowgate.

There are several other constraints that accrued congestion in the day-ahead market and, even though they were enforced in the market, they were not binding in the CRR auctions. These cases are labelled as auction economics since it is based on the auction clearing prices whether these constraint were binding or not.

Furthermore, there are some constraints that were enforced and binding in the CRR auctions but still caused a large difference between the day-ahead and CRR auctions. In cases like 30515_WARNERVL_230_30800_WILSON _230_BR_1 _1 constraint, the limit binding in the day-ahead market was lower in multiple hours than the limits used in the CRR auctions.

Table 7: Top constraints binding in the day-ahead market not binding in CRR market - August 2016

Constraint	Constraint Type	TOU	Payment to annual CRR	Payment to monthly CRR	DAM Limit	Annual CRR Limit	Monthly CRR Limit	Annual CRR Status	Monthly CRR Status	Reason
30515_WARNERVL_230_30800_WILSON _230_BR_1 _1	FLOWGATE	OFF	-$838,267.7	-$633,190.5	227.7	255.6	210.9	Binding	Binding	Higher Limit
30515_WARNERVL_230_30800_WILSON _230_BR_1 _1	FLOWGATE	ON	-$272,358.1	-$291,322.3	201.5	255.6	210.9	Binding	Binding	Higher Limit
32973_LAKEWOOD_115_99108_LAK-MOR1_115_BR_1 _1	FLOWGATE	ON	-$263,724.2	-$177,275.9	154.8	123.1	101.6	Not Binding	Not Binding	Auction Economics
OMS 4169254_Cima-ELD-PISG_SCIT	NOMOGRAM	ON	-$252,780.6	-$216,901.1	15266.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missed Outage
TMS_DLO_NG	NOMOGRAM	ON	-$159,917.8	-$281,680.5	472.0	462.6	462.6	Not Binding	Not Binding	Auction Economics
24087_MAGUNDEN_230_24153_VESTAL _230_BR_1 _1	FLOWGATE	OFF	-$173,816.6	-$178,952.5	308.4	335.1	276.4	Not Binding	Not Binding	Auction Economics
MALIN500	INTER_TIE	ON	-$71,667.2	-$139,780.6	3165.0	1825.4	2800.0	Binding	Binding	Auction Economics
24087_MAGUNDEN_230_24153_VESTAL _230_BR_1 _1	FLOWGATE	ON	-$141,401.5	-$213,837.9	312.4	335.1	276.4	Not Binding	Binding	Auction Economics
99108_LAK-MOR1_115_33020_MORAGA _115_BR_1 _4	FLOWGATE	ON	-$99,606.0	-$66,983.0	155.2	123.1	Unbounded	Not Binding	Not Enforced	Higher Limit
31208_CLOVRDLE_115_31210_MPE TAP _115_BR_1 _1	FLOWGATE	ON	-$403,959.9	-$57,142.1	147.6	119.5	98.6	Not Binding	Not Binding	Auction Economics
33014_ALHAMTP1_115_33010_SOBRANTE_115_BR_1 _1	FLOWGATE	ON	-$87,256.0	-$15,679.0	100.2	78.8	65.0	Not Binding	Not Binding	Auction Economics
24016_BARRE _230_24154_VILLA PK_230_BR_1 _1	FLOWGATE	ON	-$14,594.2	-$79,025.1	1254.3	1136.1	937.3	Not Binding	Not Binding	Auction Economics
6110_SOL10_NG	NOMOGRAM	ON	-$16,927.8	-$51,299.2	276.0	285.2	395.9	Binding	Not Binding	Higher Limit
30915_MORROBAY_230_30916_SOLARSS _230_BR_1 _1	FLOWGATE	ON	-$22,154.8	-$55,556.7	386.9	312.4	257.7	Binding	Not Binding	Auction Economics
OMS 4216681 TL50001OUT_NG	NOMOGRAM	OFF	-$24,032.8	-$45,563.7	789.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missed Outage
31208_CLOVRDLE_115_31210_MPE TAP _115_BR_1 _1	FLOWGATE	OFF	-$155,516.3	-$18,265.3	147.7	119.5	98.6	Not Binding	Not Binding	Auction Economics
24086_LUGO _500_26105_VICTORVL_500_BR_1 _1	FLOWGATE	ON	-$12,965.3	-$15,259.4	2527.7	2469.7	2037.5	Binding	Not Binding	Higher Limit
22464_MIGUEL _230_22468_MIGUEL _500_XF_81	FLOWGATE	ON	-$1,407.4	-$13,884.1	1104.3	1064.7	624.3	Not Binding	Not Binding	Auction Economics
22476_MIGUELTP_69.0_22456_MIGUEL _69.0_BR_1 _1	FLOWGATE	ON	$6,518.7	-$17,762.1	129.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late Enforcement
34112_EXCHEQUR_115_34116_LE GRAND_115_BR_1 _1	FLOWGATE	OFF	-$6,105.5	-$63,144.9	78.5	64.9	53.6	Not Binding	Not Binding	Auction Economics
OMS 3969865 Path15_S_N	NOMOGRAM	OFF	-$11,019.4	-$38,682.8	2250.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missed Outage
30055_GATES1 _500_30900_GATES _230_XF_11_P	FLOWGATE	OFF	$126.1	-$2,268.7	1098.1	1066.6	879.9	Not Binding	Not Binding	Auction Economics
34112_EXCHEQUR_115_34116_LE GRAND_115_BR_1 _1	FLOWGATE	ON	-$10,551.1	-$44,537.3	78.9	64.9	53.6	Not Binding	Not Binding	Auction Economics
22604_OTAY _69.0_22616_OTAYLKTP_69.0_BR_1 _1	FLOWGATE	ON	-$33,760.0	$8,588.8	56.8	Unbounded	Unbounded	Not Enforced	Not Enforced	Late Enforcement
30915_MORROBAY_230_30916_SOLARSS _230_BR_1 _1	FLOWGATE	OFF	-$17,815.6	-$7,303.3	386.9	312.4	257.7	Binding	Not Binding	Auction Economics

September 2016

Table 8 summarizes the main settlements metrics for CRR performance in the month of September 2016. The sign convention is based from the CAISO's perspective; a positive value indicates the CAISO collects or has a surplus of money; a negative value indicates the CAISO pays or has a shortfall. Day-ahead congestion rents will be positive, CRR payments will be negative and auction revenues will be positive.

Table 8: Summary of CRR performance for September 2016

Metric	Amount
DA Congestion Rents	$14,025,706
Perfect Hedge	-$708,604
CRR Clawback	$29,246
CRR Payments [Auction + Allocation]	-$14,914,141
CRR Payments to Auction CRRs	-$5,254,466
CRR Payments to Monthly Auction CRRs	-$3,061,390
CRR Payments to Annual Auction CRRs	-$2,193,076
CRR Payments to Allocation CRRs	-$9,659,675
CRR Auction Revenue Monthly	$1,931,820
CRR Auction Revenue Annual	$4,568,346
Revenue Adequacy	-$1,567,793
Revenue Adequacy with Auction Revenues	$4,932,372
Net payment to auction CRRs	$1,245,699

In September, there was a revenue deficiency of over $1.5 million, which is the difference between all of the proceeds from day-ahead congestion rents, CRR clawback and the payments made to CRR holders. About 35 percent of the CRR payments were to CRRs originating from the annual and monthly auctions, which is relatively low percentage. The auction revenues represent the proceeds from selling CRRs through the auction. The revenues arising from the annual auction for each season are estimated pro-rata to each month of the calendar quarter based on the number of hours in each time of use. The net payment to auction CRRs stands for the difference between the money paid to CRR holders and the money charged to CRR holders to acquire that portfolio of CRRs in the auction. This does not take into account any expenses the CRR holders incur associated with their participation in the CRR market and use of money. This is only a net accounting balance from the point of view of the cash inflow and outflow in the CAISO system.

For the month of September, the net CRR payment for auction CRRs was actually positive, meaning the CAISO collected more auction revenues when releasing CRRs in the auction than it paid to holders of auction CRRs; overall this net CRR payment represent in excess of $1.24 million. This net payment was the product of having an over-collection of $2.37 million in the annual auction, and under-collection of $1.13 million in the monthly auction.

In order to further understand the origin of this outcome, there is a need to estimate over time and by constraint the CRR settlements. Figure 106 shows the daily congestion rents accrued on each transmission constraint that was binding in the day-ahead market in the month of

September. Correspondingly, Figure 107 shows the daily CRR revenue adequacy also broken out by transmission constraint. Approximately, $950,000 of the revenue deficiency was accrued in the last 5 days of September. This accounts for about 60 percent of the total revenue deficiency for September.

Figure 106: Daily congestion rents – September 2016

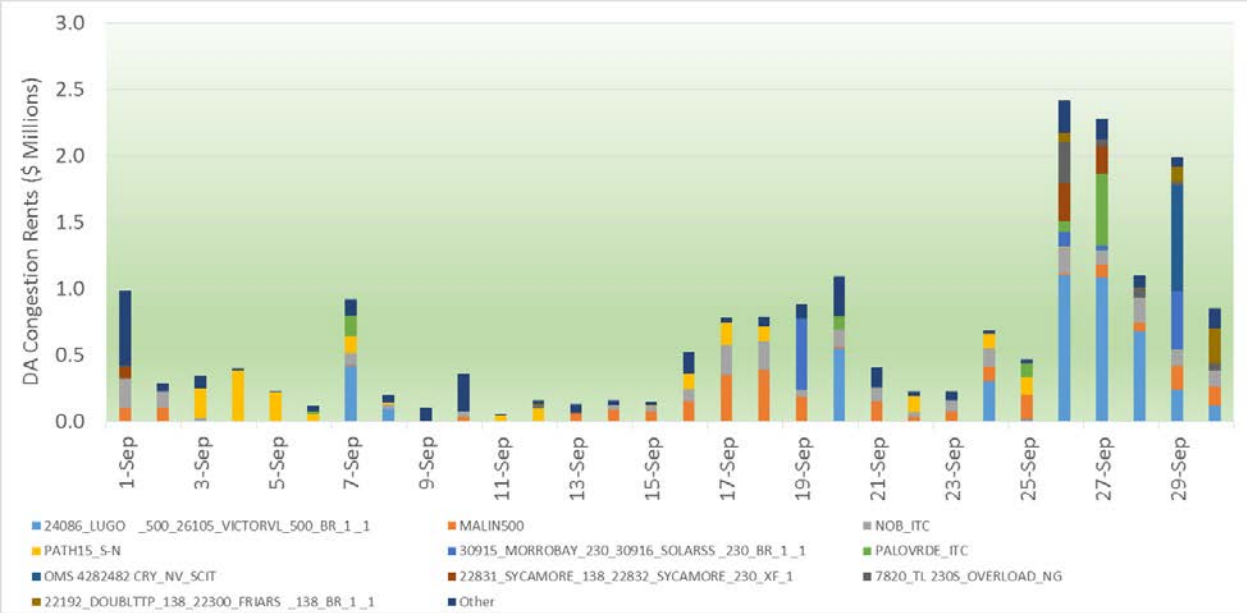


Figure 107: Daily CRR revenue adequacy - September 2016

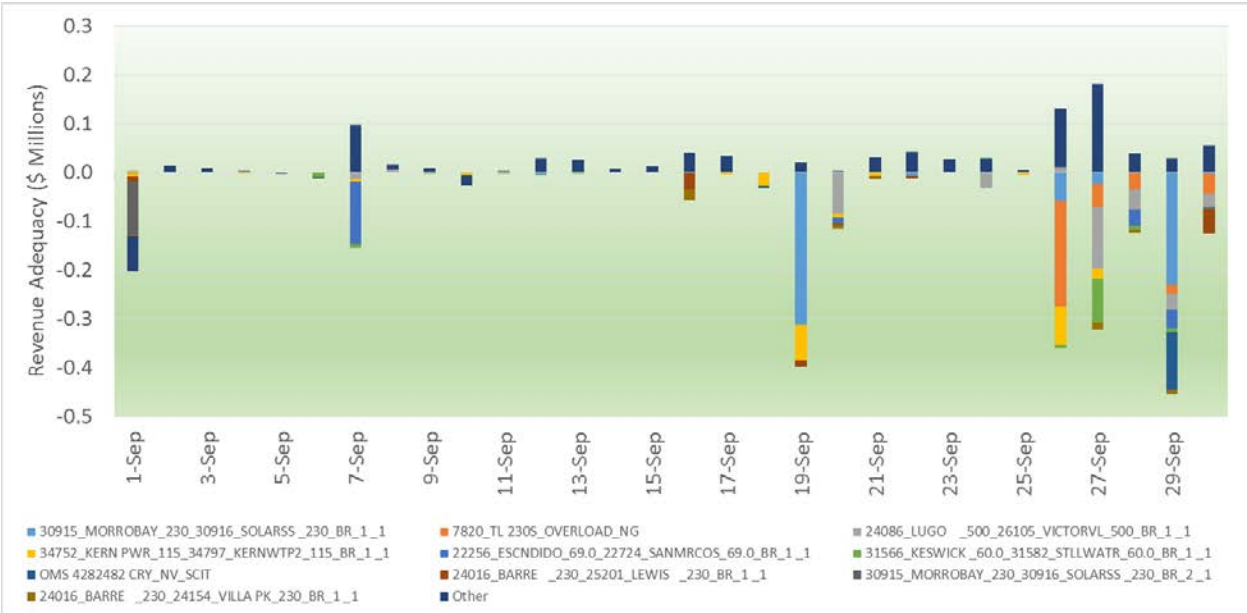


Figure 108 shows the net CRR payment per day. This net payment is the difference between the CRR payments to CRR holders and the auction revenues collected by the CAISO through the CRR auction process; such revenues become a lump revenue for the auction. For this

metric, the annual auction revenues are allocated on a pro-rata estimation to each day of the month based on the number of hours in each time of use. The CRR payments are estimated as the total sum of CRR payments over the hours of the day only for CRRs that were released through both the annual and monthly CRR auction; that is, no CRR payments to allocated CRRs are included. The purpose of this estimate for net CRR payments is to calculate the net balance for CRRs that were released only in the auctions. For September, there was a persistent positive net CRR payment, indicating that overall the money paid to CRR holders was less than the money the CAISO collected when releasing such CRRs in the annual and monthly auctions.

Figure 108: Daily net CRR payment to auction CRRs – September 2016

Figure 109 compares the level of CRR revenue deficiency and the level of net CRR payments paid to holders for CRRs released in the auction processes. This plot shows that both metrics move together to some extent; in this month in particular, the correlation was weaker than observed in other months. A negative value for CRR revenue adequacy represents a shortfall for the CAISO, while a negative value for net CRR payment represents a payment to holders of auction CRRs from the CAISO. This indicates the CAISO paid more to auction CRRs than it charged to release CRRs in the auction process.

Figure 109: Comparison of daily net CRR payment with CRR revenue adequacy – September 2016

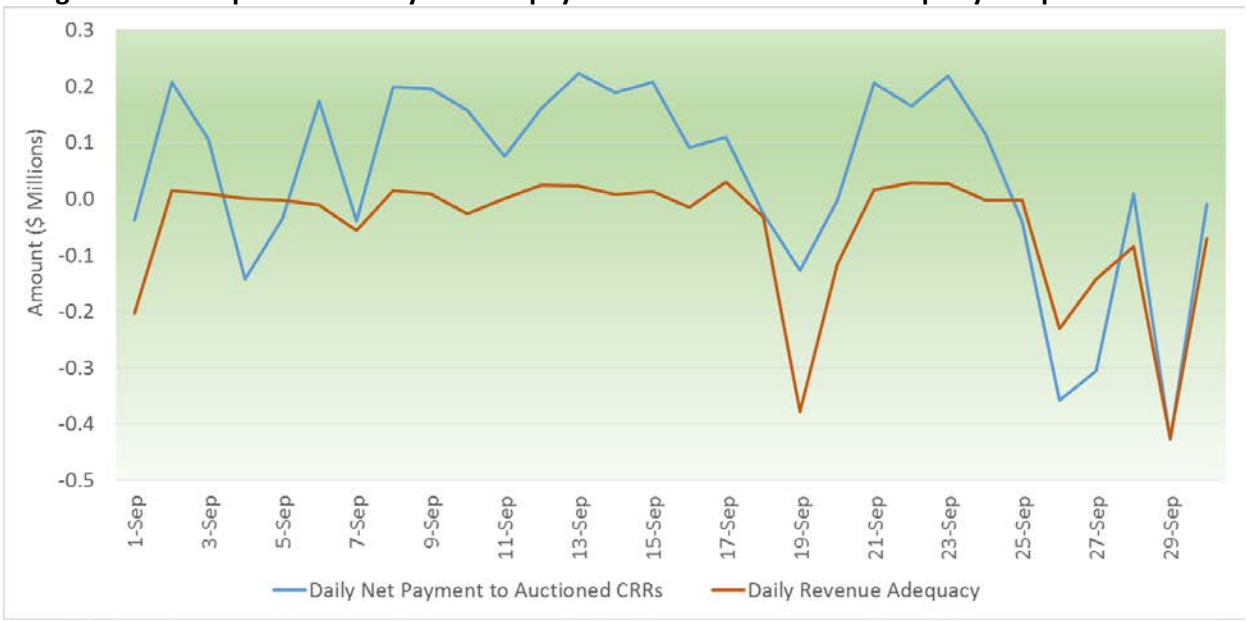
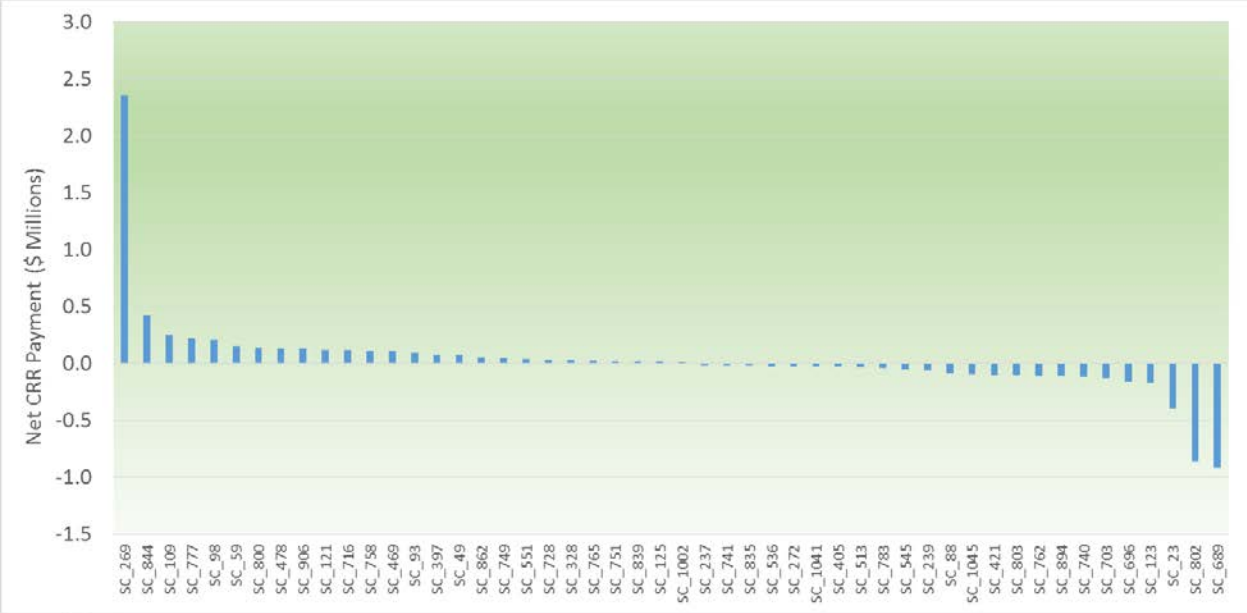


Figure 110 shows the net CRR payments to CRR participants, regardless of the type of participant. This only reflects the payments for CRRs released in both the annual and monthly CRR auctions applicable for the month of September 2016.

Figure 110: Net CRR payment to auction CRR – September 2016



Since this is from the CAISO's perspective, a negative value means the CAISO disbursed a net CRR payment to the CRR holder (or a net money inflow to the CRR holder). The names of the CRR holders are masked, but the identifier shown in the plot is unique across all the months provided in this analysis. A positive value represents a net inflow for the CAISO since it paid less

to CRR holders in the day-ahead market than what it charged to release CRRs in the auction. For September, the positive CRR payment fairly offset the negative CRR payments.

To better understand the dynamics leading to such an outcome, the CAISO shifted the analysis to the fundamentals of the CRR auction construct by analyzing the CRR auction results at the constraint level. CRRs are released and priced based on the CRR clearing prices; such prices are derived as the relative difference between locational prices between the source and the sink locations. These locational prices originate from the cleared prices when any transmission constraint becomes binding with nonzero pries in the CRR auction, commonly referred as *shadow prices*. The CAISO turned out to analyze what constraints have been binding in the CRR auction process and compared that with the set of constraints that were binding in the day-ahead market. To some extent, one expects that there is a certain level of alignment between the markets.

Figure 111 and Figure 112 show a comparison of net CRR payments. The CRR payments reflect the CRR settlements for CRRs with day-ahead congestion rents, while the CRR auction revenues is the money the CAISO collected from releasing CRRs through the auctions. That is, it reflects the net money participants were charged to acquire CRRs and the money they were paid; in a loose sense, it could be interpreted as profits for holding.

There are four possible permutations to analyze. The first case represents when a CRR payment to CRR holders was made in the day-ahead market settlement, but the CAISO did not collect any revenues from releasing these CRRs from the auctions because the constraint was not binding in the CRR auction. This is shown for both the pro-rata portion of the annual auction for September and for the monthly CRR auction. A negative value indicates that the CAISO had a net CRR payment to CRR holders. The second case is the opposite in which there was no CRR payments when settling CRRs in the day-ahead market but the CAISO collected revenue when releasing these CRRs in the auction process. The third and fourth cases are for CRRs that had a CRR payment in the day-ahead market and the CAISO also charged them in the CRR auctions to release these CRRs. The third case is when the net CRR payment is negative, while the fourth case is when the net CRR payment is positive. This metric reveals any potential misalignment of constrains enforced and binding between the day-ahead market and CRR auctions.

Figure 111: CRR payment versus CRR auction revenues for annual CRR – September 2016

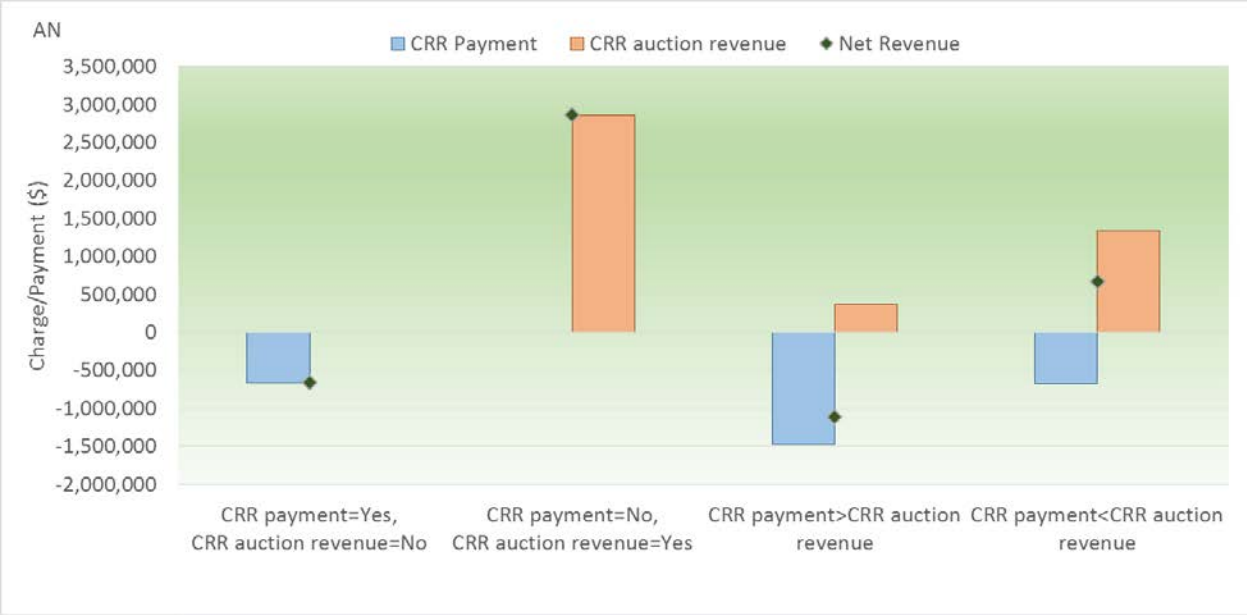


Figure 112: CRR payment versus CRR auction revenues for monthly CRR - September 2016

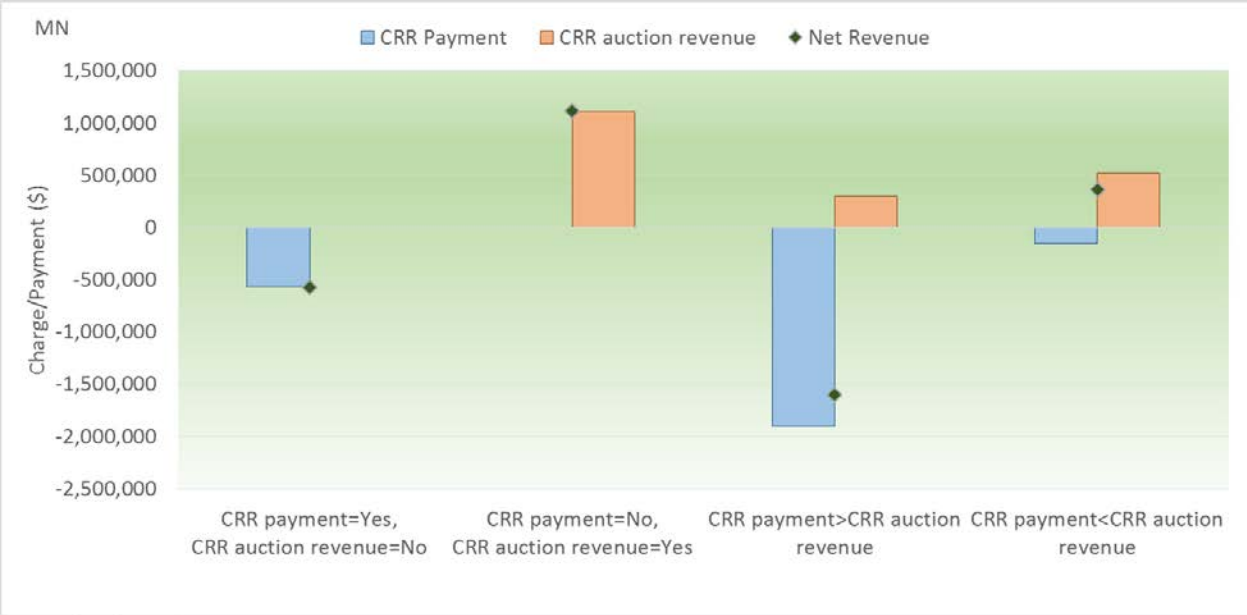


Table 9 provides one level deeper of understanding of such misalignments between markets. This tables show the top and bottom constraints when sorted by net CRR payments. In the first column it shows the estimated CRR payment to CRR holders accrued by each constraint; the second column shows the auction revenues collected by the CAISO on that same constraint; the last column shows the net CRR payment, which is the balance between this money outflow (CRR payment) and money inflow (CRR auction revenues). Table 5Table 10 shows the same information for CRRs released in the monthly auction for September 2016. The top constraints reflect cases where large CRR payments to auction CRRs accrued when the CRR market collected

little or no auction revenues when releasing these CRRs. The bottom constraints reflect cases where the net CRR payment is actually positive meaning cases where the CAISO collected more auction revenues than it had to pay to auction CRRs, mostly because the constraints were not binding in the CRR auction.

Table 9: Net CRR payment by constraint – September 2016, annual auction

Constraints	Total CRR Payment	Total CRR Auction Revenue	Net CRR Payment
24086_LUGO _500_26105_VICTORVL_500_BR_1 _1	-$976,360.3	$168,897.4	-$807,462.9
OMS 4282482 CRY_NV_SCIT	-$167,417.0	$0.0	-$167,417.0
22256_ESCNDIDO_69.0_22724_SANMRCOS_69.0_BR_1 _1	-$152,266.8	$0.0	-$152,266.8
PATH15_S-N	-$127,428.9	$0.0	-$127,428.9
30915_MORROBAY_230_30916_SOLARSS _230_BR_2 _1	-$117,114.3	$0.0	-$117,114.3
34752_KERN PWR_115_34797_KERNWTP2_115_BR_1 _1	-$99,924.7	$3,646.0	-$96,278.7
PALOVRDE_ITC	-$260,869.9	$168,754.5	-$92,115.4
7820_TL 230S_OVERLOAD_NG	-$62,705.0	$0.0	-$62,705.0
31566_KESWICK _60.0_31582_STLLWATR_60.0_BR_1 _1	-$79,626.5	$23,140.2	-$56,486.3
22831_SYCAMORE_138_22832_SYCAMORE_230_XF_1	-$42,916.9	$0.0	-$42,916.9
24086_LUGO _500_24092_MIRALOMA_500_BR_3 _1	-$22,792.9	$0.0	-$22,792.9
7430_SOL-6_NG_SUM	-$22,499.7	$0.0	-$22,499.7
24016_BARRE _230_25201_LEWIS _230_BR_1 _1	-$20,358.3	$61.3	-$20,297.0
31556_TRINITY _60.0_31555_MSS TAP2_60.0_BR_1 _1	-$17,774.3	$0.0	-$17,774.3
30515_WARNERVL_230_30800_WILSON _230_BR_1 _1	-$17,313.9	$24.3	-$17,289.6
32218_DRUM _115_32222_DTCH2TAP_115_BR_1 _1	-$12,123.3	$1,578.7	-$10,544.6
24016_BARRE _230_24154_VILLA PK_230_BR_1 _1	-$11,691.7	$2,316.8	-$9,374.9
22208_EL CAJON_69.0_22408_LOSCOCHS_69.0_BR_1 _1	-$7,741.9	$0.0	-$7,741.9
34112_EXCHEQUR_115_34116_LE GRAND_115_BR_1 _1	-$6,470.2	$0.0	-$6,470.2
22773_BAY BLVD_69.0_22604_OTAY _69.0_BR_1 _1	-$6,314.3	$0.0	-$6,314.3
NdGrp_GRIZZLY_7_N101	$0.0	$39,631.6	$39,631.6
24132_SANBRDNO_230_24804_DEVERS _230_BR_1 _1	$0.0	$44,626.8	$44,626.8
30505_WEBER _230_30624_TESLA E _230_BR_1 _1	$0.0	$51,101.3	$51,101.3
34104_ATWATER _115_34114_JRWD GEN_115_BR_1 _1	$0.0	$55,027.1	$55,027.1
31218_ER_FTNJT_115_31220_EGLE RCK_115_BR_1 _1	$0.0	$67,254.0	$67,254.0
35922_MOSSLD _115_30751_MOSSLDB _230_XF_1	$0.0	$70,510.1	$70,510.1
33542_LEPRINO _115_33546_TRACY JC_115_BR_1 _1	$0.0	$74,372.3	$74,372.3
WARNRVIL_STNDIFRD_TOR	$0.0	$80,216.4	$80,216.4
MALIN500	-$156,503.9	$239,072.5	$82,568.6
6110_SOL10_NG	-$2,462.5	$86,007.9	$83,545.5
NdGrp_POD_INTKEP_2_UNITS-APND	$0.0	$86,504.7	$86,504.7
OAKDL_MOCASN_TOR	$0.0	$86,528.4	$86,528.4
34116_LE GRAND_115_34134_WILSONAB_115_BR_1 _1	-$4,142.2	$103,018.2	$98,876.0
24087_MAGUNDEN_230_24153_VESTAL _230_BR_2 _1	$0.0	$110,035.6	$110,035.6
NdGrp_COGNTNL_7_B1	$0.0	$122,747.6	$122,747.6
33310_SANMATEO_115_30700_SANMATEO_230_XF_7 _S	$0.0	$166,925.5	$166,925.5
32782_STATIN D_115_32788_STATIN L_115_BR_1 _1	$0.0	$174,387.3	$174,387.3
PATH15_BG	$0.0	$188,741.6	$188,741.6
6110_TM_BNK_FLO_TMS_DLO_NG	$0.0	$235,318.3	$235,318.3
30915_MORROBAY_230_30916_SOLARSS _230_BR_1 _1	-$482,428.4	$735,391.2	$252,962.8

Table 10: Net CRR payment by constraint – September 2016, monthly auction.

Constraints	Total CRR Payment	Total CRR Auction Revenue	Net CRR Payment
PATH15_S-N	-$848,294.1	$15,170.4	-$833,123.6
24086_LUGO _500_26105_VICTORVL_500_BR_1 _1	-$443,651.9	$36,238.3	-$407,413.6
22192_DOUBLTTP_138_22300_FRIARS _138_BR_1 _1	-$190,014.7	$0.0	-$190,014.7
7820_TL 230S_OVERLOAD_NG	-$142,287.3	$20,321.8	-$121,965.5
OMS 4282482 CRY_NV_SCIT	-$102,734.2	$0.0	-$102,734.2
30915_MORROBAY_230_30916_SOLARSS _230_BR_1 _1	-$81,594.2	$0.0	-$81,594.2
24016_BARRE _230_24154_VILLA PK_230_BR_1 _1	-$65,400.3	$0.0	-$65,400.3
34752_KERN PWR_115_34797_KERNWTP2_115_BR_1 _1	-$62,338.8	$13,234.8	-$49,104.0
OMS 4235148 TL50001_NG	-$47,979.2	$0.0	-$47,979.2
24016_BARRE _230_25201_LEWIS _230_BR_1 _1	-$129,956.6	$82,489.0	-$47,467.6
31581_OREGNTRL_60.0_31578_LOMS JCT_60.0_BR_1 _1	-$46,485.3	$0.0	-$46,485.3
30515_WARNERVL_230_30800_WILSON _230_BR_1 _1	-$38,745.7	$48.6	-$38,697.1
MALIN500	-$108,991.4	$84,377.7	-$24,613.7
34112_EXCHEQUR_115_34116_LE GRAND_115_BR_1 _1	-$62,024.6	$40,904.6	-$21,120.0
OMS 3994241 TVYVLY CB42	-$19,335.8	$0.0	-$19,335.8
22831_SYCAMORE_138_22832_SYCAMORE_230_XF_1	-$17,215.4	$0.0	-$17,215.4
NOB_ITC	-$16,315.6	$0.3	-$16,315.3
32218_DRUM _115_32222_DTCH2TAP_115_BR_1 _1	-$15,511.1	$443.1	-$15,068.0
IPPUTAH_ITC	-$17,281.4	$6,213.7	-$11,067.8
24086_LUGO _500_24092_MIRALOMA_500_BR_3 _1	-$10,520.4	$0.0	-$10,520.4
24723_CONTROL _115_24791_TAP710 _115_BR_2 _1	$18,275.9	$0.0	$18,275.9
30735_METCALF _230_30042_METCALF _500_XF_12	$0.0	$18,912.2	$18,912.2
22456_MIGUEL _69.0_22464_MIGUEL _230_XF_2	$0.0	$18,915.6	$18,915.6
OMS 3938352 LBN_S-N	$19,869.2	$0.0	$19,869.2
33020_MORAGA _115_32790_STATIN X_115_BR_1 _1	-$336.4	$20,614.1	$20,277.6
22828_SYCAMORE_69.0_22756_SCRIPPS _69.0_BR_1 _1	$29.1	$21,925.7	$21,954.8
WARNRVIL_STNDIFRD_TOR	$0.0	$21,968.4	$21,968.4
22831_SYCAMORE_138_22124_CHCARITA_138_BR_1 _1	-$56,983.9	$79,066.1	$22,082.2
NdGrp_AGUCALG1_7_B1	$0.0	$22,121.7	$22,121.7
IID-SCE_BG	$0.0	$24,339.2	$24,339.2
SILVERPK_BG	$29,707.5	$0.0	$29,707.5
PATH26_BG	$0.0	$30,305.6	$30,305.6
24132_SANBRDNO_230_24804_DEVERS _230_BR_1 _1	$0.0	$30,546.5	$30,546.5
30105_COTTNWD _230_30245_ROUND MT_230_BR_2 _1	$0.0	$41,885.3	$41,885.3
PALOVRDE_ITC	-$100,146.4	$160,433.0	$60,286.6
30900_GATES _230_30970_MIDWAY _230_BR_1 _1	$0.0	$72,083.4	$72,083.4
30915_MORROBAY_230_30916_SOLARSS _230_BR_2 _1	-$19,004.0	$104,152.4	$85,148.4
24087_MAGUNDEN_230_24153_VESTAL _230_BR_1 _1	-$2,764.9	$109,525.3	$106,760.4
32950_PITSBURG_115_30527_PITSBRG _230_XF_13	$0.0	$117,935.6	$117,935.6
22468_MIGUEL _500_22472_MIGUELMP_1.0_XF_80	$0.0	$301,855.4	$301,855.4

These two tables illustrate instances of constraint misalignment between the CRR auctions and the day-ahead market. To understand this mismatch one level deeper, Table 11 lists the subset of constraints that are not binding or not enforced in the CRR monthly auction or that have a significant CRR payment. The portion that were paid only to CRRs from the annual and monthly auctions is also provided. Then it compares the average transmission limit used in the day-ahead market and the limits actually used in both the annual and monthly auctions. These are the constraints that will mostly drive the divergence between the day-ahead and CRR markets. One of the cornerstones of the CRR market efficiency is for the CRR market to closely reflect the transmission capacity of the day-ahead market. When the transmission capacity released in the CRR market is less than that of the day-ahead market, there may be an exposure of revenue deficiency. This may also have a fair impact on the level of CRR net payments and how transmission capacity is valued in the CRR auction. This occurs because when CRRs are released in the auction process they are priced on the value of the capacity made available, or on the lack of it. A systemic issue identified during the evaluation of the CRR auction efficiency is that multiple transmission constraints are not modelled or enforced in the CRR auctions.

In cases where the constraint was enforced in the day-ahead market but not modelled or enforced in the CRR auctions, the amount of transmission capacity by means of CRRs that may be released on that constraints is effectively unbounded, which indicates that more transmission capacity may be released in the CRR auction than in the day-ahead market. This is a major problem to the efficiency of the CRR market. For the case of September 2016 and relative to other months analyzed, there were relatively few instances of constraints not enforced in the CRR auctions. In such cases the level of congestion rents and CRR payments were relatively modest, such that even with the misalignment, the financial impact was low. In further investigating why these constraints were not modelled/enforced in the CRR auctions, the common factors are related to how outages were considered and when transmission constraints were enforced in the CRR auction.

1. OMS 4282482 CRY_NV_SCIT. This constraint was associated with an outage (4282482) that lasted less than 24 hours and, therefore, was not modelled in the CRR auctions.
2. OMS 4235148 TL50001_NG. This constraint was associated with an outage (4235148) that lasted less than 24 hours and, therefore, was not modelled in the CRR auctions.
3. 31581_OREGNTRL_60.0_31578_LOMS JCT_60.0_BR_1 _1. This element is not part of the normally enforced list of transmission elements. There was no known outage at the time of the running of the CRR process that activated this flowgate.
4. 22208_EL CAJON_69.0_22408_LOSCOCHS_69.0_BR_1 _1. This element is not part of the normally enforced list of transmission elements. There was no known outage at the time of the running of the CRR process that activated this flowgate.
5. Constraint 7430_SOL-6_NG_SUM. This constraint was enforced in the CRR model for September 2016 but was with a slightly different format to the name: 7430_SOL6_NG_SUM.

There are several other constraints that accrued congestion in the day-ahead market and, even though they were enforced in the market, they were not binding in the CRR auctions. These

cases are labelled as auction economics since it is based on the auction clearing process whether these constraints were binding or not based on the economics driven by the CRR bids.

Furthermore, there are some constraints that were enforced and binding in the CRR auctions but still there was a large difference between the day-ahead and CRR auctions. In several cases, the limit binding in the day-ahead market was lower in multiple hours than the limits used in the CRR auctions. Even though the average limit shown for the day-ahead market may show a value higher than the CRR limit, there may be hours when the limit was actually lower than the average and represented more restrictive conditions in the day-ahead market.

Table 11: Top constraints binding in the day-ahead market not binding in CRR market - September 2016

Constraint	Constraint Type	TOU	Payment to annual CRR	Payment to monthly CRR	DAM Limit	Annual CRR Limit	Monthly CRR Limit	Annual CRR Status	Monthly CRR Status	Reason
24086_LUGO _500_26105_VICTORVL_500_BR_1 _1	FLOWGATE	ON	-$481,417.8	-$220,728.7	2531.7	2469.7	2037.5	Binding	Not Binding	Auction Economics
30915_MORROBAY_230_30916_SOLARSS _230_BR_1 _1	FLOWGATE	ON	-$482,428.4	-$81,594.2	343.1	312.4	257.7	Binding	Not Binding	Higher Limit
OMS 4282482 CRY_NV_SCIT	NOMOGRAM	ON	-$167,417.0	-$102,734.2	15183.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missing Outage
22192_DOUBLTTP_138_22300_FRIARS _138_BR_1 _1	FLOWGATE	ON	$15,358.3	-$190,014.7	162.1	143.4	118.3	Not Binding	Not Binding	Higher Limit
22831_SYCAMORE_138_22832_SYCAMORE_230_XF_1	FLOWGATE	ON	-$42,916.9	-$17,215.4	332.4	372.6	307.4	Not Binding	Not Binding	Auction Economics
24016_BARRE _230_24154_VILLA PK_230_BR_1 _1	FLOWGATE	ON	-$11,691.7	-$65,400.3	1256.9	1136.1	937.3	Not Binding	Not Binding	Auction Economics
PATH15_S-N	NOMOGRAM	ON	-$66,957.5	-$355,733.5	2994.1	Unbounded	2940.0	Not Enforced	Not Binding	Auction Economics
OMS 4235148 TL50001_NG	NOMOGRAM	ON	$5,522.9	-$47,979.2	789.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missing Outage
24086_LUGO _500_24092_MIRALOMA_500_BR_3 _1	FLOWGATE	ON	-$22,792.9	-$10,520.4	3256.8	3251.7	2682.7	Not Binding	Not Binding	Auction Economics
31990_DAVIS _115_31962_WDLND_BM_115_BR_1 _1	FLOWGATE	ON	$25,919.1	$6,226.6	114.9	113.6	Unbounded	Not Binding	Not Enforced	Higher Limit
31581_OREGNTRL_60.0_31578_LOMS JCT_60.0_BR_1 _1	FLOWGATE	ON	$35,342.4	-$43,490.1	31.9	Unbounded	Unbounded	Not Enforced	Not Enforced	Late Enforcement
6110_SOL10_NG	NOMOGRAM	ON	-$2,462.5	-$5,290.8	276.0	285.2	285.2	Binding	Not Binding	Higher Limit
22208_EL CAJON_69.0_22408_LOSCOCHS_69.0_BR_1 _1	FLOWGATE	ON	-$7,741.9	$1,735.5	70.2	Unbounded	Unbounded	Not Enforced	Not Enforced	Late Enforcement
30105_COTTNWD _230_30245_ROUND MT_230_BR_3 _1	FLOWGATE	ON	-$5,184.8	-$3,479.3	291.3	240.9	198.7	Not Binding	Not Binding	Auction Economics
24016_BARRE _230_25201_LEWIS _230_BR_1 _1	FLOWGATE	OFF	-$1,078.2	-$5,839.7	1401.3	1136.1	937.3	Not Binding	Not Binding	Auction Economics
24086_LUGO _500_26105_VICTORVL_500_BR_1 _1	FLOWGATE	OFF	-$6,762.3	-$1,097.2	2543.7	2469.7	2037.5	Binding	Not Binding	Auction Economics
MEAD_ITC	INTER_TIE	ON	$654.3	-$2,372.3	1619.0	947.7	1586.6	Binding	Not Binding	Auction Economics
7430_SOL-6_NG_SUM	NOMOGRAM	ON	-$22,499.7	$11,773.3	286.5	Unbounded	Unbounded	Not Enforced	Not Enforced	Late Enforcement
TMS_DLO_NG	NOMOGRAM	ON	-$2,344.6	-$5,352.9	472.0	462.6	462.6	Not Binding	Not Binding	Auction Economics
33310_SANMATEO_115_33312_BELMONT _115_BR_1 _1	FLOWGATE	ON	-$5,709.4	$2,190.0	99.6	93.7	77.3	Not Binding	Not Binding	Auction Economics
30261_BELDENTP_230_30300_TABLMTN _230_BR_1 _1	FLOWGATE	ON	-$746.0	-$2,052.4	295.6	281.0	231.8	Not Binding	Not Binding	Auction Economics

October 2016

Table 12 summarizes the main settlements metrics for CRR performance in the month of October 2016. The sign convention is based from the CAISO's perspective; a positive value indicates the CAISO collects or has a surplus of money; a negative value indicates the CAISO pays or has a shortfall. Day-ahead congestion rents will be positive, CRR payments will be negative and auction revenues will be positive.

Table 12: Summary of CRR performance for October 2016

Metric	Amount
DA Congestion Rents	$31,233,392
Perfect Hedge	-$3,784,388
CRR Clawback	$58,463
CRR Payments [Auction + Allocation]	-$39,750,837
CRR Payments to Auction CRRs	-$12,716,717
CRR Payments to Monthly Auction CRRs	-$8,515,006
CRR Payments to Annual Auction CRRs	-$4,201,711
CRR Payments to Allocation CRRs	-$27,034,120
CRR Auction Revenue Monthly	$2,625,251
CRR Auction Revenue Annual	$2,789,547
Revenue Adequacy	-$12,243,371
Revenue Adequacy with Auction Revenues	-$6,828,572
Net payment to auction CRRs	-$7,301,919

In October, the overall CRR performance was poor since there was a revenue deficiency of $12.2 million, which is the difference between all of the proceeds from day-ahead congestion rents, CRR clawback and the payments made to CRR holders. About 32 percent of the CRR payments were to CRRs originating from the annual and monthly auctions. The auction revenues represent the proceeds from selling CRRs through the auction. The revenues arising from the annual auction for each season are estimated pro-rata to each month of the calendar quarter based on the number of hours in each time of use. The net payment to auction CRRs stands for the difference between the money paid to CRR holders less the money charge to CRR holders to acquire that portfolio of CRRs in the auction. This does not take into account any expenses the CRR holders incur associated with their participation in the CRR market and use of money. This is only a net accounting balance from the point of view of the cash inflow and outflow in the CAISO system. Net the CRR payments was -$7.3 million (a net payment to auction CRR holders), from which $5.89 million was originated from monthly auction CRRs; this amounts to 80 percent of the total CRR payments.

In order to further understand the origin of this poor performance, there is a need to estimate over time and by constraint the CRR settlements. Figure 113 shows the daily congestion rents accrued on each transmission constraint that was binding in the day-ahead market in the month of October. For entire month the constraint *MALIN500* was binding and contributing to the daily congestion rent amount. Correspondingly, Figure 114 shows the daily CRR revenue adequacy also broken out by transmission constraint. On October 27th, about $4.9 million of

revenue deficiency was accrued which accounts for about 40 percent of the total deficiency. The constraint *OMS 4250740_Devers 230 NBus* accounts for about 94 percent of the total revenue deficiency for this day and about 38 percent of the total revenue deficiency for the entire month.

Figure 113: Daily congestion rents – October 2016

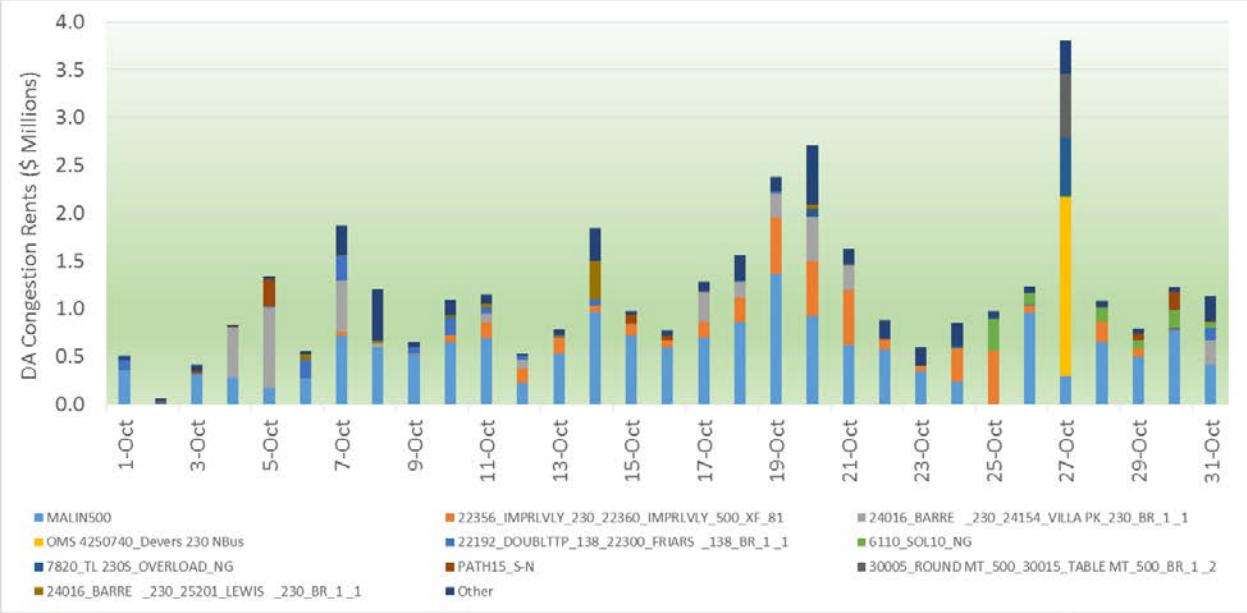


Figure 114: Daily CRR revenue adequacy - October 2016

Figure 115 shows the net CRR payment per day. This net revenue is the difference between the CRR payments to CRR holders and the auction revenues collected by the CAISO through the CRR auction process; such revenues become a lump revenue for the auction. For this metric, the annual auction revenues are allocated on a pro-rata estimation to each day of the

month based on the number of hours in each time of use. The CRR payments are estimated as the total sum of CRR payments over the hours of the day only for CRRs that were released through both the annual and monthly CRR auction; that is, no CRR payments to allocated CRRs are included. The purpose of this estimate for net CRR payments is to calculate the net balance for CRRs that were released only in the auctions. For October, there was a persistent negative net CRR payment, indicating that overall the money paid to CRR holders was higher than the money the CAISO collected when releasing such CRRs in the annual and monthly auctions.

Figure 115: Daily net CRR payment to auction CRRs – October 2016

As shown in Figure 116, there is a strong correlation between the level of CRR revenue deficiency and the level of net CRR payments paid to holders of CRRs released in the auction processes. This is not surprising since both metrics reflect to some extent the effect of CRRs released (and priced) in the CRR auction and the capacity released (and priced) in the day-ahead market. A negative value for CRR revenue adequacy represents a shortfall for the CAISO, while a negative value for net CRR payment represents a payment to holders of auction CRRs from the CAISO. This indicates that the CAISO paid more to auction CRRs than it charged to release CRRs in the auction process.

Figure 116: Comparison of daily net CRR payment with CRR revenue adequacy – October 2016

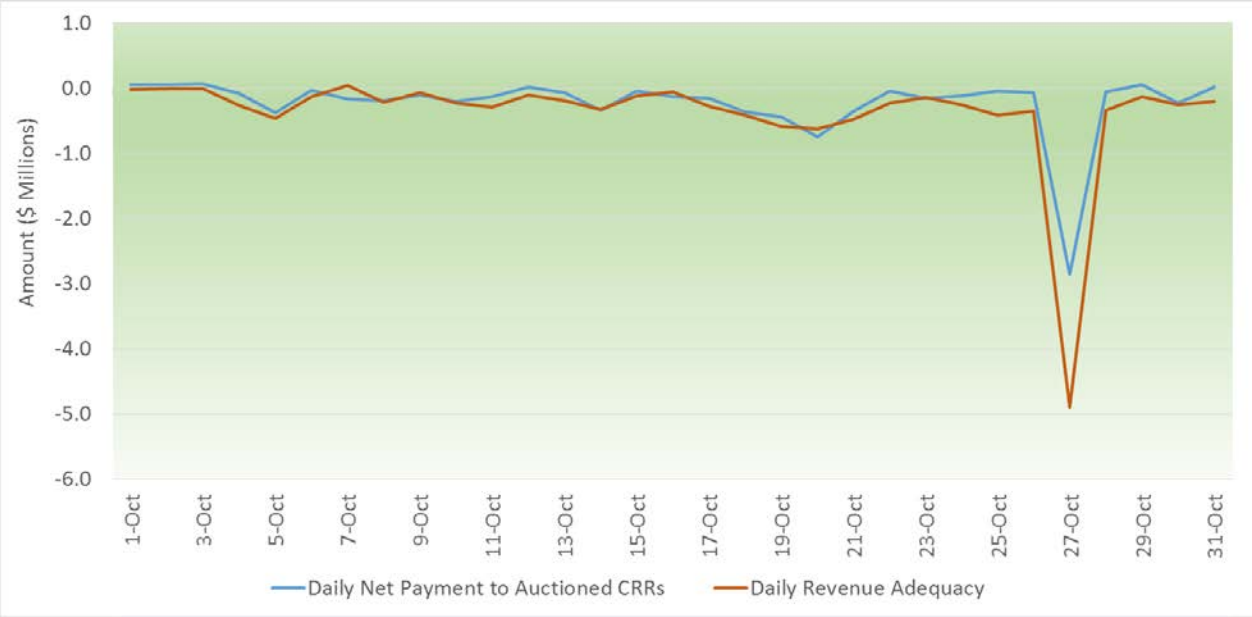


Figure 117 shows the net CRR payments to CRR participants, regardless of the type of participant. This only reflects the payments for CRRs released in both the annual and monthly CRR auctions applicable for the month of October 2016. Since this is from the CAISO's perspective, a negative value means the CAISO disbursed a net CRR payment to the CRR holder (or a net money inflow to the CRR holder).

Figure 117: Net CRR payment to auction CRR – October 2016

The names of the CRR holders are masked, but the identifier shown in the plot is unique across all the months provided in this analysis. A positive value represents a net inflow for the CAISO since it settled less to CRR holders in the day-ahead market than what it charged to release CRRs in the auction. For October, the majority of holders of auction CRRs saw a net gain from having these positions.

To better understand the dynamics leading to such an outcome, the CAISO shifted the analysis to the fundamentals of the CRR auction construct by analyzing the CRR auction results at the constraint level. CRRs are released and priced based on the CRR clearing prices; such prices are derived as the relative difference between locational prices between the source and the sink locations. These locational prices originate from the cleared prices when any transmission constraint becomes binding with nonzero pries in the CRR auction, commonly referred as *shadow prices*. The CAISO turned out to analyze what constraints have been binding in the CRR auction process and compared that with the set of constraints that were binding in the day-ahead market. To some extent, one expects that there is certain level of alignment between the markets. Figure 118 and Figure 119 show a comparison of net CRR payments. The CRR payments reflect the CRR settlements for CRRs with the day-ahead congestion rents, while the CRR auction revenues are the money the CAISO collected from releasing CRRs through the auctions. That is, it reflects the net money participants were charged to acquire CRRs and the money they were paid; in a loose sense, it could be interpreted as profits for holding.

There are four possible permutations to analyze. The first case represents when a CRR payment to CRR holders was made in the day-ahead market settlement, but the CAISO did not collect any revenues from releasing these CRRs from the auctions because the constraint was not binding in the CRR auction. This is shown for both the pro-rata portion of the annual auction for October and for the monthly CRR auction. A negative value indicates that the CAISO had a net CRR payment to CRR holders. The second case is the opposite in which there was no CRR payments when settling CRRs in the day-ahead market but the CAISO collected revenue when releasing these CRRs in the auction process. The third and fourth cases are for CRRs that had a CRR payment in the day-ahead market and the CAISO also charged them in the CRR auctions to release these CRRs. The third case is when the net CRR payment is negative, while the fourth case is when the net CRR payment is positive. This metric reveals any potential misalignment of constrains enforced and binding between the day-ahead market and CRR auctions.

Figure 118: CRR payment versus CRR auction revenues for annual CRR – October 2016

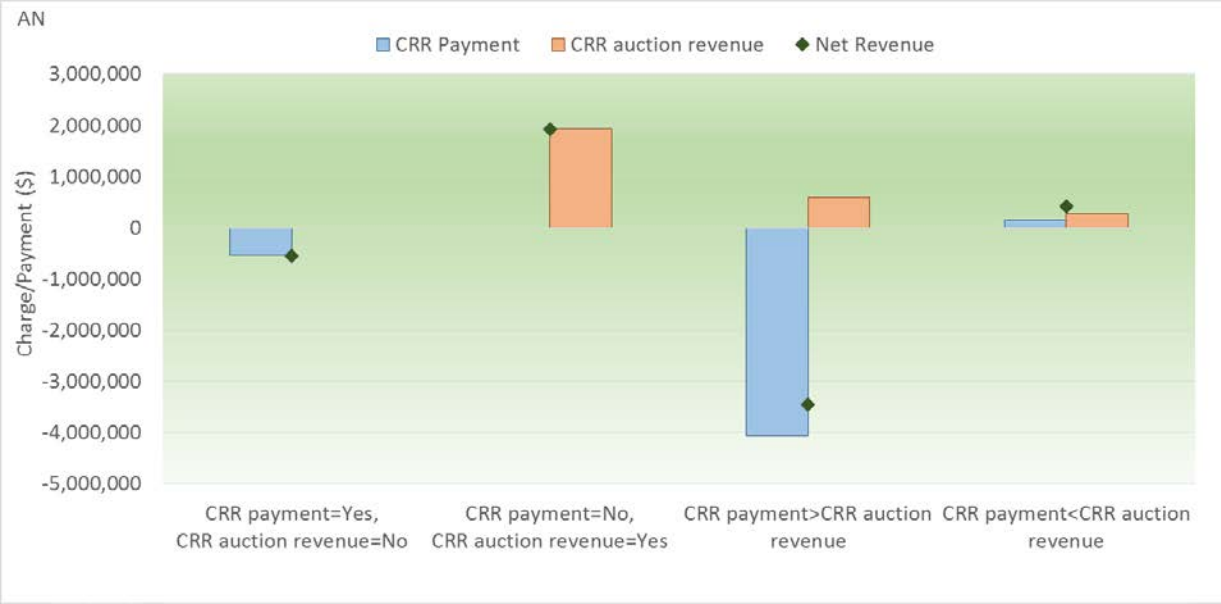


Figure 119: CRR payment versus CRR auction revenues for monthly CRR - October 2016

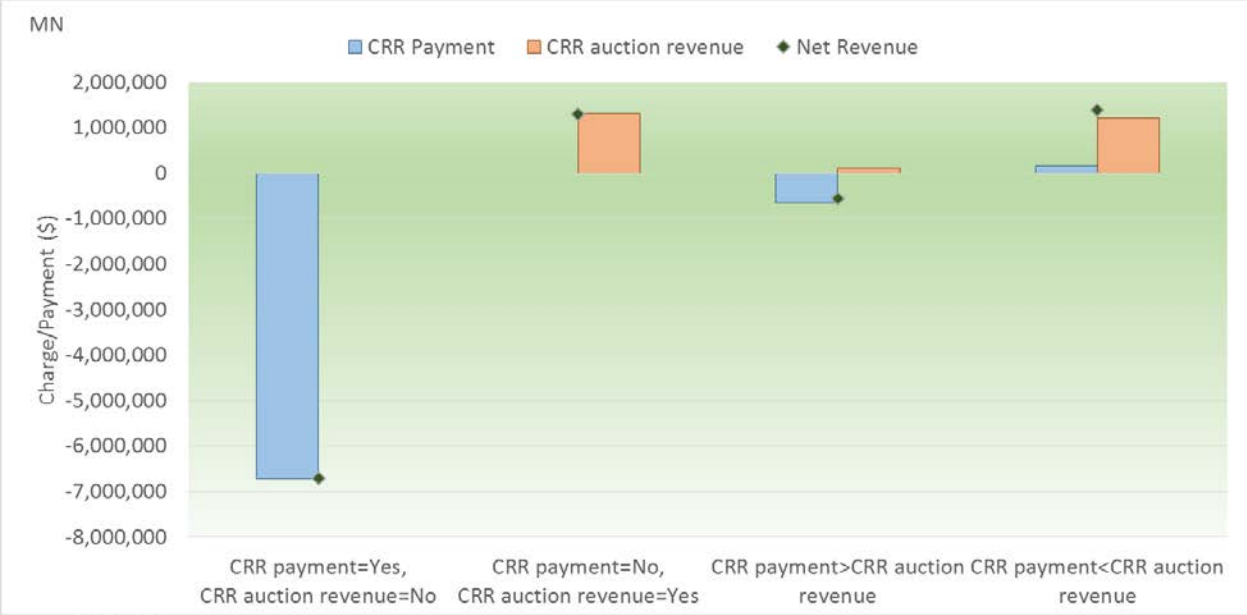


Table 13 provides one level deeper of understanding of such misalignments between markets. This tables shows the top and bottom constraints when sorted by net CRR payments. In the first column it shows the estimated CRR payment to CRR holders accrued in each constraint; the second column shows the revenues collected by the CAISO on that same constraint; the last column shows the net CRR payment, which is the balance between this money outflow (CRR payment) and money inflow (CRR auction revenues) from the CAISO's perspective. Table 14 shows the same information for CRRs released in the monthly auction for October 2016. The top constraints reflect cases where large CRR payments to auction CRRs accrued when the CRR market did not collect any auction revenues when releasing these CRRs.

Table 13: Net CRR payment by constraint – October 2016, annual process

Constraints	Total CRR Payment	Total CRR Auction Revenue	Net CRR Payment
MALIN500	-$3,557,161.4	$509,232.0	-$3,047,929.4
31334_CLER LKE_60.0_31338_KONOCTI6_60.0_BR_1 _1	-$379,256.0	$0.0	-$379,256.0
30005_ROUND MT_500_30015_TABLE MT_500_BR_1 _2	-$271,600.9	$0.0	-$271,600.9
CASCADE_ITC	-$159,587.2	$12,966.0	-$146,621.2
6110_SOL10_NG	-$199,772.1	$65,749.6	-$134,022.5
32380_WEMR SWS_60.0_32382_FORST HL_60.0_BR_1 _1	-$110,186.8	$0.0	-$110,186.8
32218_DRUM _115_32222_DTCH2TAP_115_BR_1 _1	-$81,049.7	$895.2	-$80,154.4
PATH15_S-N	-$79,535.6	$0.0	-$79,535.6
PATH26_BG	-$78,093.3	$0.0	-$78,093.3
22256_ESCNDIDO_69.0_22724_SANMRCOS_69.0_BR_1 _1	-$55,068.0	$0.0	-$55,068.0
22208_EL CAJON_69.0_22408_LOSCOCHS_69.0_BR_1 _1	-$46,165.9	$0.0	-$46,165.9
22604_OTAY _69.0_22616_OTAYLKTP_69.0_BR_1 _1	-$45,048.4	$0.0	-$45,048.4
OMS 4008893 Path15_SN	-$44,034.3	$0.0	-$44,034.3
31336_HPLND JT_60.0_31370_CLVRDLJT_60.0_BR_1 _1	-$40,291.8	$0.0	-$40,291.8
31556_TRINITY _60.0_31555_MSS TAP2_60.0_BR_1 _1	-$34,633.2	$0.0	-$34,633.2
22596_OLD TOWN_230_22504_MISSION _230_BR_1 _1	-$26,732.2	$0.0	-$26,732.2
31566_KESWICK _60.0_31582_STLLWATR_60.0_BR_1 _1	-$30,288.4	$3,969.0	-$26,319.3
31576_WNTU PMS_60.0_31570_BENTON _60.0_BR_1 _1	-$24,968.7	$0.0	-$24,968.7
NdGrp: 22999_LAROA1 _230_B1	-$20,614.5	$0.0	-$20,614.5
6110 SOL7_NG	-$17,110.5	$0.0	-$17,110.5
33020_MORAGA _115_30550_MORAGA _230_XF_1 _P	$0.0	$33,649.5	$33,649.5
WARNRVIL_STNDIFRD_TOR	$0.0	$34,439.6	$34,439.6
NdGrp_POD_PALOMR_2_PL1X3-APND	$0.0	$39,158.3	$39,158.3
7820_TL 230S_OVERLOAD_NG	$49,094.6	$0.0	$49,094.6
22468_MIGUEL _500_22472_MIGUELMP_ 1.0_XF_80	$0.0	$53,223.6	$53,223.6
SILVERPK_BG	$53,396.9	$1,191.8	$54,588.8
35922_MOSSLD _115_30751_MOSSLDB _230_XF_1	$0.0	$54,969.9	$54,969.9
33310_SANMATEO_115_30700_SANMATEO_230_XF_7 _S	$0.0	$73,868.1	$73,868.1
34116_LE GRAND_115_34134_WILSONAB_115_BR_1 _1	$0.0	$74,142.8	$74,142.8
6110_TM_BNK_FLO_TMS_DLO_NG	$0.0	$97,727.6	$97,727.6
30915_MORROBAY_230_30916_SOLARSS _230_BR_1 _1	-$9,769.4	$124,695.9	$114,926.5
OMS 4250740_Devers 230 NBus	$117,348.1	$0.0	$117,348.1
34651_DERIKTP _70.0_34572_TORNADO _70.0_BR_1 _1	$126,820.9	$0.0	$126,820.9
29408_WIRLWIND_230_29402_WIRLWIND_500_XF_1 _P	$132,855.9	$0.0	$132,855.9
COTPISO_ITC	$134,671.8	$278.7	$134,950.5
PATH15_BG	$0.0	$137,967.7	$137,967.7
30515_WARNERVL_230_30800_WILSON _230_BR_1 _1	$0.0	$149,594.0	$149,594.0
24086_LUGO _500_26105_VICTORVL_500_BR_1 _1	$0.0	$175,671.8	$175,671.8
NOB_ITC	$0.0	$237,523.1	$237,523.1
22356_IMPRLVLY_230_22360_IMPRLVLY_500_XF_81	$330,886.6	$0.0	$330,886.6

Table 14: Net CRR payment by constraint – October 2016, monthly process.

Constraints	Total CRR Payment	Total CRR Auction Revenue	Net CRR Payment
OMS 4250740_Devers 230 NBus	-$2,005,769.8	$0.0	-$2,005,769.8
22356_IMPRLVLY_230_22360_IMPRLVLY_500_XF_81	-$1,954,930.4	$0.0	-$1,954,930.4
24016_BARRE _230_24154_VILLA PK_230_BR_1 _1	-$1,132,190.6	$0.0	-$1,132,190.6
22192_DOUBLTTP_138_22300_FRIARS _138_BR_1 _1	-$612,578.9	$0.0	-$612,578.9
22596_OLD TOWN_230_22504_MISSION _230_BR_1 _1	-$209,097.5	$0.0	-$209,097.5
7820_TL 230S_OVERLOAD_NG	-$211,875.2	$4,910.3	-$206,964.9
30005_ROUND MT_500_30015_TABLE MT_500_BR_1 _2	-$194,105.4	$0.0	-$194,105.4
31334_CLER LKE_60.0_31338_KONOCTI6_60.0_BR_1 _1	-$175,622.7	$0.0	-$175,622.7
MEAD_ITC	-$151,949.1	$0.0	-$151,949.1
6110_SOL10_NG	-$175,818.8	$41,556.1	-$134,262.8
OMS 4008893 Path15_SN	-$106,808.8	$0.0	-$106,808.8
32218_DRUM _115_32222_DTCH2TAP_115_BR_1 _1	-$73,759.4	$4,126.6	-$69,632.7
32380_WEMR SWS_60.0_32382_FORST HL_60.0_BR_1 _1	-$60,831.9	$0.0	-$60,831.9
OMS 4008879 Path15_SN	-$56,158.4	$0.0	-$56,158.4
SILVERPK_BG	-$54,321.7	$0.0	-$54,321.6
31556_TRINITY _60.0_31555_MSS TAP2_60.0_BR_1 _1	-$47,278.3	$0.0	-$47,278.3
31566_KESWICK _60.0_31582_STLLWATR_60.0_BR_1 _1	-$37,627.2	$1,811.8	-$35,815.3
32212_E.NICOLS_115_32214_RIO OSO _115_BR_1 _1	-$34,587.0	$0.0	-$34,587.0
PATH26_BG	-$31,342.0	$0.0	-$31,342.0
OMS 3959238 Path15_SN	-$28,746.4	$0.0	-$28,746.4
24086_LUGO _500_24092_MIRALOMA_500_BR_3 _1	$0.0	$26,162.8	$26,162.8
30900_GATES _230_30970_MIDWAY _230_BR_1 _1	$0.0	$27,395.2	$27,395.2
30879_HENTAP1 _230_30885_MUSTANGS_230_BR_1 _1	$0.0	$31,330.1	$31,330.1
CFETIJ_ITC	$0.0	$37,066.2	$37,066.2
24016_BARRE _230_25201_LEWIS _230_BR_1 _1	-$151,819.8	$192,512.1	$40,692.3
CASCADE_ITC	$37,110.9	$10,199.3	$47,310.2
29408_WIRLWIND_230_29402_WIRLWIND_500_XF_1 _P	$50,218.5	$0.0	$50,218.5
COTPISO_ITC	$52,924.6	$48.8	$52,973.4
30515_WARNERVL_230_30800_WILSON _230_BR_1 _1	$0.0	$59,193.5	$59,193.5
PATH15_S-N	-$368,558.4	$437,437.6	$68,879.2
34774_MIDWAY _115_34225_BELRDG J_115_BR_1 _1	$78,424.0	$0.0	$78,424.0
34651_DERIKTP _70.0_34572_TORNADO _70.0_BR_1 _1	$86,992.4	$0.0	$86,992.4
33541_AEC_TP1 _115_33540_TESLA _115_BR_1 _1	$94,223.5	$310.0	$94,533.4
30040_TESLA _500_30042_METCALF _500_BR_1 _1	$0.0	$116,744.7	$116,744.7
24132_SANBRDNO_230_24804_DEVERS _230_BR_1 _1	$0.0	$146,427.1	$146,427.1
24086_LUGO _500_26105_VICTORVL_500_BR_1 _1	$0.0	$186,880.5	$186,880.5
22468_MIGUEL _500_22472_MIGUELMP_ 1.0_XF_80	$0.0	$194,353.0	$194,353.0
PALOVRDE_ITC	-$59,661.9	$267,858.1	$208,196.2
22831_SYCAMORE_138_22124_CHCARITA_138_BR_1 _1	-$7,927.5	$218,890.5	$210,963.0
MALIN500	$565,643.1	$67,653.8	$633,296.9

These two tables illustrate instances of constraint misalignment between the CRR auctions and the day-ahead market. To understand this mismatch one level deeper, Table 15 lists the subset of constraints that are not binding or not enforced in the CRR monthly auction or that have a significant CRR payment. The portion that were paid only to CRRs from the annual and monthly auctions is also provided. Then it compares the average transmission limit used in the day-ahead market and the limits actually used in both the annual and monthly auctions. These are the constraints that will mostly drive the divergence between the day-ahead and CRR markets. One of the cornerstones of the CRR market efficiency is for the CRR market to closely reflect the transmission capacity of the day-ahead market. When the transmission capacity released in the CRR market is less than that of the day-ahead market, there may be an exposure of revenue deficiency. This may also have a fair impact on the level of CRR net payments and how transmission capacity is valued in the CRR auction. This occurs because when CRRs are released in the auction process they are priced on the value of the capacity made available, or on the lack of it. A systemic issue identified during the evaluation of the CRR auction efficiency is that multiple transmission constraints are not modelled or enforced in the CRR auctions.

In cases where the constraint was enforced in the day-ahead market but not modelled or enforced in the CRR auctions, the amount of transmission capacity by means of CRRs that may be released on that constraints is effectively unbounded, which indicates that more transmission capacity may be released in the CRR auction than in the day-ahead market. This is a major problem to the efficiency of the CRR market. For the case of October 2016 and relative to other months analyzed, there were relatively few instances of constraints not enforced in the CRR auctions. In such cases the level of congestion rents and CRR payments were relatively modest, such that even with the misalignment, the financial impact was low. In further investigating why these constraints were not modelled/enforced in the CRR auctions, the common factors are related to how outages were considered and when transmission constraints were enforced in the CRR auction.

1. Constraint OMS 4250740_Devers 230 NBus. The requirement for having a Nomogram was found out later in the short-term outage study and after the CRR auction. The associated outage lasted las than 24 hours.
2. Constraint OMS 4008893 Path15_SN. The path derate was needed due to later submitted overlapping outages and more detail study in the short-term outage study. This outage was received on time and lasted more than 24 hours but less than 10 days; in this case the outage should have been modeled with a derate. With IRO-017 requirement came in effect this year, this kind of scenario will be less frequent.
3. Constraint 32380_WEMR SWS_60.0_32382_FORST HL_60.0_BR_1 _1. This element is not part of the normally enforced list of transmission elements. No known outage at the time of the running of the CRR process that activated this flowgate.
4. Constraint 22208_EL CAJON_69.0_22408_LOSCOCHS_69.0_BR_1 _1. This element is not part of the normally enforced list of transmission elements. No known outage at the time of the running of the CRR process that activated this flowgate.
5. Constraint 22476_MIGUELTP_69.0_22456_MIGUEL _69.0_BR_1 _1. This element is not part of the normally enforced list of transmission elements. No known outage at the time of the running of the CRR process that activated this flowgate.

6. Constraint 22604_OTAY _69.0_22616_OTAYLKTP_69.0_BR_1 _1. This element is not part of the normally enforced list of transmission elements. No known outage at the time of the running of the CRR process that activated this flowgate.
7. Constraint OMS 3959238 Path15_SN. The path derate was needed due to later submitted overlapping outages and more detailed study in short-term outage study. This outage was received well in advance but it lasted last than 24 hours. With IRO-017 requirement came in effect this year, this kind of scenario will be less frequent.
8. Constraint OMS 4008879 Path15_SN. It seems like the path Derate was needed due to later submitted overlapping outages and more detail study in short-term outage study. With IRO-017 requirement came in effect this year, this kind of will be less frequent.

There are several other constraints that accrued congestion in the day-ahead market and, even though they were enforced in the market, they were not binding in the CRR auctions. These cases are labelled as auction economics since it is based on the auction clearing process whether these constraint were binding or not based on the economics driven by the CRR bids.

Furthermore, there are some constraints that were enforced and binding in the CRR auctions but still there was a large difference between the day-ahead and CRR auctions. In several cases, the limit binding in the day-ahead market was lower in multiple hours than the limits used in the CRR auctions. Even when the average limit shown for the day-ahead market may show a value higher than the CRR limit, there may be hours when the limit was actually lower than the average and represented more restrictive conditions in the day-ahead market, some instances are

1. Malin500. The Malin intertie observed steep derates during October, due to multiple outages.
2. Imperial Valley transformer. The limit used in the CRR auction was higher than the limit used in the DAM market, resulting in more transmission capacity released on this constraint that what was made available in the day-ahead market. The limit used in the day-ahead market was as low as 620MW.

Table 15: Top constraints binding in the day-ahead market not binding in CRR market - October 2016

Constraint	Constraint Type	TOU	Payment to annual CRR	Payment to monthly CRR	DAM Limit	Annual CRR Limit	Monthly CRR Limit	Annual CRR Status	Monthly CRR Status	Reason
MALIN500	INTER_TIE	ON	-$2,702,755.7	$618,929.9	2095.1	1747.2	2088.3	Binding	Binding	Auction Economics
22356_IMPRLVLY_230_22360_IMPRLVLY_500_XF_81	FLOWGATE	ON	$369,069.7	-$3,706,277.1	710.3	1064.7	878.4	Not Binding	Not Binding	Higher Limit
OMS 4250740_Devers 230 NBus	NOMOGRAM	ON	$117,348.1	-$4,011,539.7	249.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late Enforcement
MALIN500	INTER_TIE	OFF	-$854,405.7	-$53,286.8	2134.0	1789.1	2088.3	Binding	Binding	Auction Economics
24016_BARRE _230_24154_VILLA PK_230_BR_1 _1	FLOWGATE	ON	$14,715.4	-$2,264,381.2	1237.1	1136.1	937.3	Not Binding	Not Binding	Auction Economics
30005_ROUND MT_500_30015_TABLE MT_500_BR_1 _2	FLOWGATE	ON	-$271,600.9	-$388,210.8	1838.7	1811.1	1494.1	Not Binding	Not Binding	Auction Economics
22192_DOUBLTTP_138_22300_FRIARS _138_BR_1 _1	FLOWGATE	ON	$36,425.9	-$1,139,914.0	164.4	143.4	118.3	Not Binding	Not Binding	Auction Economics
31334_CLER LKE_60.0_31338_KONOCTI6_60.0_BR_1 _1	FLOWGATE	ON	-$338,569.7	-$322,850.9	37.7	Unbounded	26.9	Not Enforced	Not Binding	Auction Economics
22596_OLD TOWN_230_22504_MISSION _230_BR_1 _1	FLOWGATE	ON	-$26,732.2	-$418,194.9	499.2	433.6	357.7	Not Binding	Not Binding	Auction Economics
MEAD_ITC	INTER_TIE	ON	$93.1	-$303,898.2	1619.0	991.1	1586.6	Binding	Not Binding	Auction Economics
22356_IMPRLVLY_230_22360_IMPRLVLY_500_XF_81	FLOWGATE	OFF	-$38,183.1	-$203,583.7	694.0	1064.7	878.4	Not Binding	Not Binding	Higher Limit
PATH26_BG	FLOWGATE	ON	-$78,093.3	-$62,684.0	4000.1	3920.0	3920.0	Not Binding	Not Binding	Auction Economics
OMS 4008893 Path15_SN	NOMOGRAM	ON	-$44,034.3	-$213,617.6	2450.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late Enforcement
32380_WEMR SWS_60.0_32382_FORST HL_60.0_BR_1 _1	FLOWGATE	ON	-$97,174.3	-$111,996.0	11.7	Unbounded	Unbounded	Not Enforced	Not Enforced	Late Enforcement
22208_EL CAJON_69.0_22408_LOSCOCHS_69.0_BR_1 _1	FLOWGATE	ON	-$46,165.9	-$6,240.3	69.9	Unbounded	Unbounded	Not Enforced	Not Enforced	Late Enforcement
22476_MIGUELTP_69.0_22456_MIGUEL _69.0_BR_1 _1	FLOWGATE	ON	$2,332.4	-$47,504.0	121.5	Unbounded	Unbounded	Not Enforced	Not Enforced	Late Enforcement
22192_DOUBLTTP_138_22300_FRIARS _138_BR_1 _1	FLOWGATE	OFF	-$18,614.1	-$85,243.7	164.4	143.4	118.3	Binding	Not Binding	Auction Economics
31556_TRINITY _60.0_31555_MSS TAP2_60.0_BR_1 _1	FLOWGATE	ON	-$33,919.9	-$89,279.8	33.6	29.9	24.7	Not Binding	Not Binding	Auction Economics
22604_OTAY _69.0_22616_OTAYLKTP_69.0_BR_1 _1	FLOWGATE	ON	-$45,048.4	-$11,249.4	61.2	Unbounded	Unbounded	Not Enforced	Not Enforced	Late Enforcement
31334_CLER LKE_60.0_31338_KONOCTI6_60.0_BR_1 _1	FLOWGATE	OFF	-$40,686.3	-$28,394.6	37.4	Unbounded	26.9	Not Enforced	Not Binding	Auction Economics
OMS 3959238 Path15_SN	NOMOGRAM	ON	-$12,168.8	-$57,492.8	2250.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late Enforcement
OMS 4008879 Path15_SN	NOMOGRAM	OFF	$5,271.1	-$73,811.2	2300.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late Enforcement
31092_MPLE CRK_60.0_31093_HYMPOMJT_60.0_BR_1 _1	FLOWGATE	ON	-$12,994.9	-$36,277.8	27.8	29.9	24.7	Not Binding	Not Binding	Auction Economics

November 2016

Table 16 summarizes the main settlements metrics for CRR performance in the month of November 2016. The sign convention is based from the CAISO's perspective; a positive value indicates the CAISO collects or has a surplus of money; a negative value indicates the CAISO pays or has a shortfall. Day-ahead congestion rents will be positive, CRR payments will be negative and auction revenues will be positive.

Table 16: Summary of CRR performance for November 2016

Metric	Amount
DA Congestion Rents	$35,317,671
Perfect Hedge	-$2,461,714
CRR Clawback	$36,311
CRR Payments [Auction + Allocation]	-$46,465,351
CRR Payments to Auction CRRs	-$18,117,875
CRR Payments to Monthly Auction CRRs	-$13,119,561
CRR Payments to Annual Auction CRRs	-$4,998,314
CRR Payments to Allocation CRRs	-$28,347,476
CRR Auction Revenue Monthly	$3,407,136
CRR Auction Revenue Annual	$2,623,909
Revenue Adequacy	-$13,573,083
Revenue Adequacy with Auction Revenues	-$7,542,039
Net payment to auction CRRs	-$12,086,830

In November, the overall CRR performance was poor since there was a revenue deficiency of $13.5 million, which is the difference between all the proceeds from day-ahead congestion rents, CRR clawback and the payments made to CRR holders. About 39 percent of the CRR payments were to CRRs originating from the annual and monthly auctions. The auction revenues represent the proceeds from selling CRRs through the auction. The revenues arising from the annual auction for each season are estimated pro-rata to each month of the calendar quarter based on the number of hours in each time of use. The net payment to auction CRRs stands for the difference between the money paid to CRR holders less the money charge to CRR holders to acquire that portfolio of CRRs in the auction. This does not take into account any expenses the CRR holders incur associated with their participation in the CRR market and use of money. This is only a net accounting balance from the point of view of the cash inflow and outflow in the CAISO system. Overall, the net CRR payments to auction CRRs were $12.08 million, with $9.7 million originating from monthly auction CRRs (80 percent of the overall CRR payments).

In order to further understand the origin of this poor performance, there is a need to estimate over time and by constraint the CRR settlements.

Figure 120 shows the daily congestion rents accrued on each transmission constraint that was binding in the day-ahead market in the month of November. Correspondingly, Figure 121 shows the daily CRR revenue adequacy also broken out by transmission constraint. On November 29th and November 30th, about $3.5 million of revenue deficiency was accrued which accounts for about 26 percent of the total deficiency. The constraint *OMS 4379177 IVALLEY BNK81_NG2*

accrued about $2 million of revenue deficiency during these two days which accounts for 15 percent of the total deficiency.

Figure 120: Daily congestion rents – November 2016

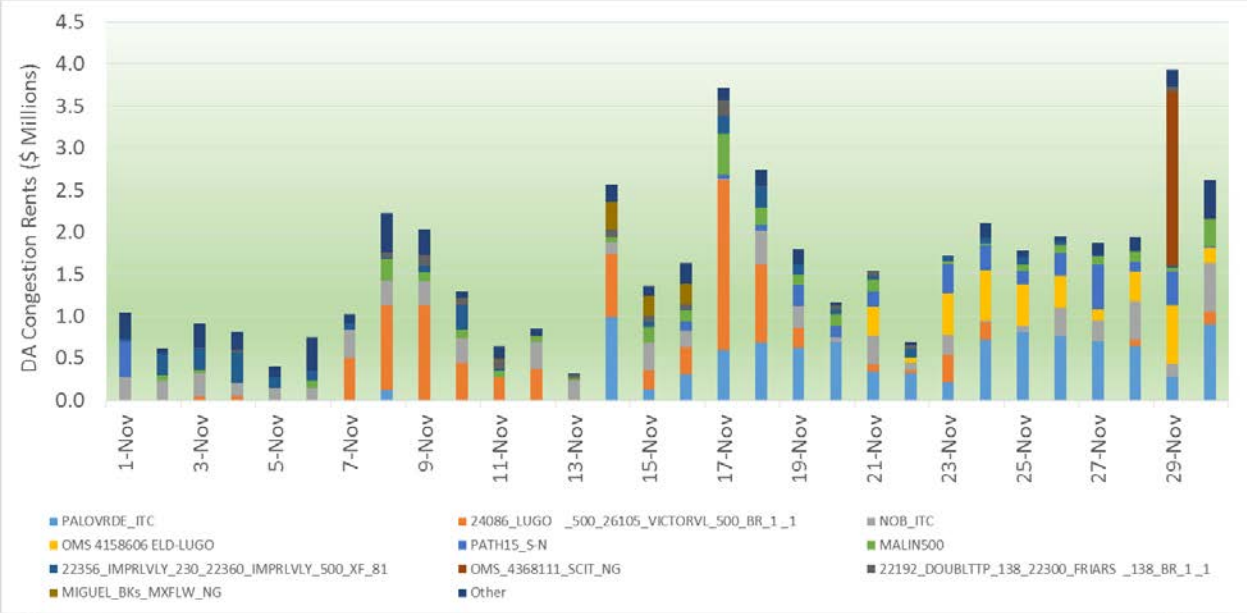


Figure 121: Daily CRR revenue adequacy - November 2016

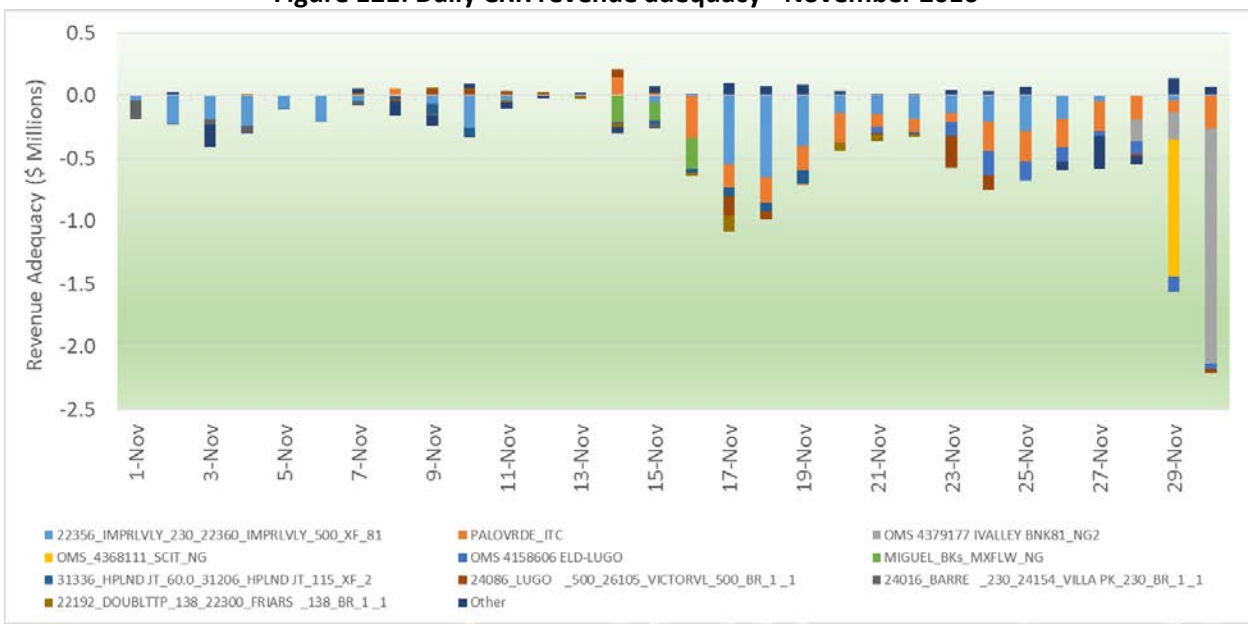
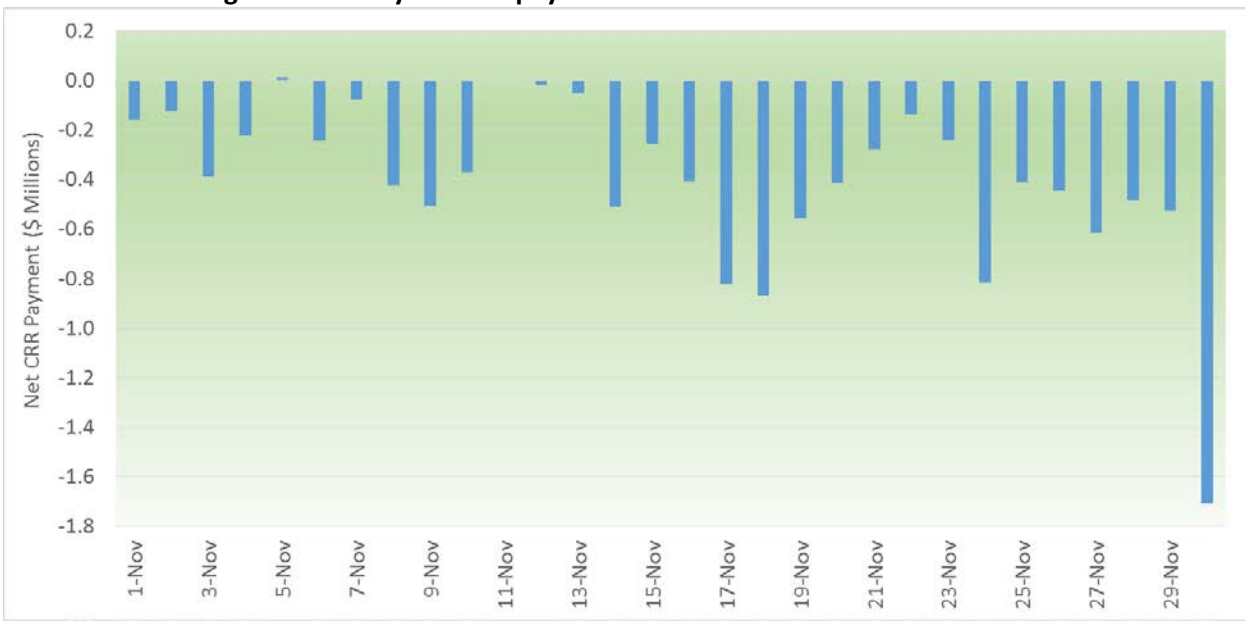


Figure 122 shows the net CRR payment per day. This net revenue is the difference between the CRR payments to CRR holders and the auction revenues collected by the CAISO through the CRR auction process; such revenues become a lump revenue for the auction. For this metric, the annual auction revenues are allocated on a pro-rata estimation to each day of the month based on the number of hours in each time of use. The CRR payments are estimated as

the total sum of CRR payments over the hours of the day only for CRRs that were released through both the annual and monthly CRR auction; that is, no CRR payments to allocated CRRs are included. The purpose of this estimate for net CRR payments is to calculate the net balance for CRR that were auction. For November, there was a persistent negative net CRR payment, indicating that overall the money paid to CRR holders was higher than the money the CAISO collected when releasing such CRRs in the annual and monthly auctions.

Figure 122: Daily net CRR payment to auction CRRs – November 2016



As shown in Figure 123 , there is a strong correlation between the level of CRR revenue deficiency and the level of net CRR payments paid to holders of CRRs released in the auction processes. This is not surprising since both metrics reflect to some extent the effect of CRRs released (and priced) in the CRR auction and the capacity released (and priced) in the day-ahead market. A negative value for CRR revenue adequacy represents a shortfall for the CAISO, while a negative value for net CRR payment represents a payment to holders of auction CRRs from the CAISO, meaning the CAISO paid more to auction CRRs than it charged to release CRRs in the auction process.

Figure 123: Comparison of daily net CRR payment with CRR revenue adequacy – November 2016

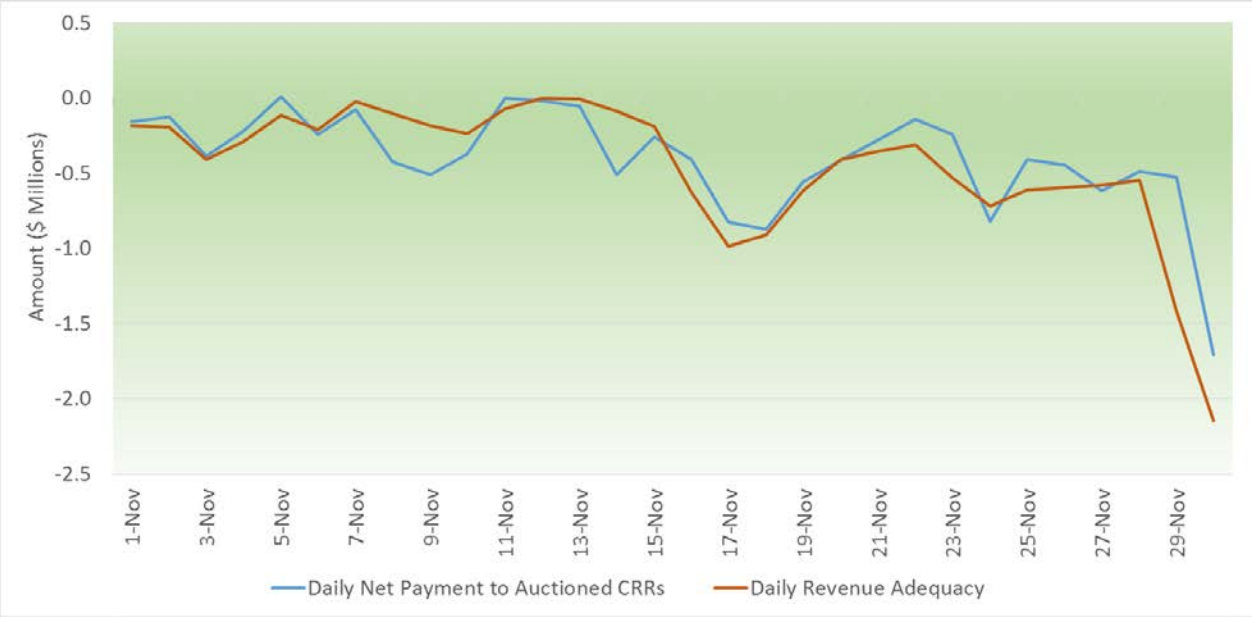


Figure 124 shows the net CRR payments to CRR participants, regardless of the type of participant. This only reflects the payments for CRRs released in both the annual and monthly CRR auctions applicable for the month of November 2016.

Figure 124: Net CRR payment to auction CRR – November 2016

Since this is from the CAISO's perspective, a negative value means the CAISO disbursed a net CRR payment to the CRR holder (or a net money inflow to the CRR holder). The names of the

CRR holders are masked, but the identifier shown in the plot is unique across all the months provided in this analysis. A positive value represents a net inflow for the CAISO since it settled less to CRR holders in the day-ahead market than what it charged to release CRRs in the auction. For November, the majority of holders of auction CRRs saw a net gain from having these positions.

To better understand the dynamics leading to such an outcome, the CAISO shifted the analysis to the fundamentals of the CRR auction construct by analyzing the CRR auction results at the constraint level. CRRs are released and priced based on the CRR clearing prices; such prices are derived as the relative difference between locational prices between the source and the sink locations. These locational prices originate from the cleared prices when any transmission constraint becomes binding with nonzero pries in the CRR auction, commonly referred as *shadow prices*. The CAISO turned out to analyze what constraints have been binding in the CRR auction process and compared that with the set of constraints that were binding in the day-ahead market. To some extent, one expects that there is a certain level of alignment between the markets.

Figure 125 and Figure 126 show a comparison of net CRR payments. The CRR payments reflect the CRR settlements for CRRs with day-ahead congestion rents, while the CRR auction revenues is the money the CAISO collected from releasing CRRs through the auctions. That is, it reflects the net money participants were charged to acquire CRRs and the money they were paid; in a loose sense, it could be interpreted as profits for holding.

There are four possible permutations to analyze. The first case represents when a CRR payment to CRR holders was made in the day-ahead market settlement, but the CAISO did not collect any revenues from releasing these CRRs from the auctions because the constraint was not binding in the CRR auction. This is shown for both the pro-rata portion of the annual auction for November and for the monthly CRR auction. A negative value indicates that the CAISO had a net CRR payment to CRR holders. The second case is the opposite in which there was no CRR payments when settling CRRs in the day-ahead market but the CAISO collected revenue when releasing these CRRs in the auction process. The third and fourth cases are for CRRs that had a CRR payment in the day-ahead market and the CAISO also charged them in the CRR auctions to release these CRRs. The third case is when the net CRR payment is negative, while the fourth case is when the net CRR payment is positive. This metric reveals any potential misalignment of constrains enforced and binding between the day-ahead market and CRR auctions.

Figure 125: CRR payment versus CRR auction revenues for annual CRR – November 2016

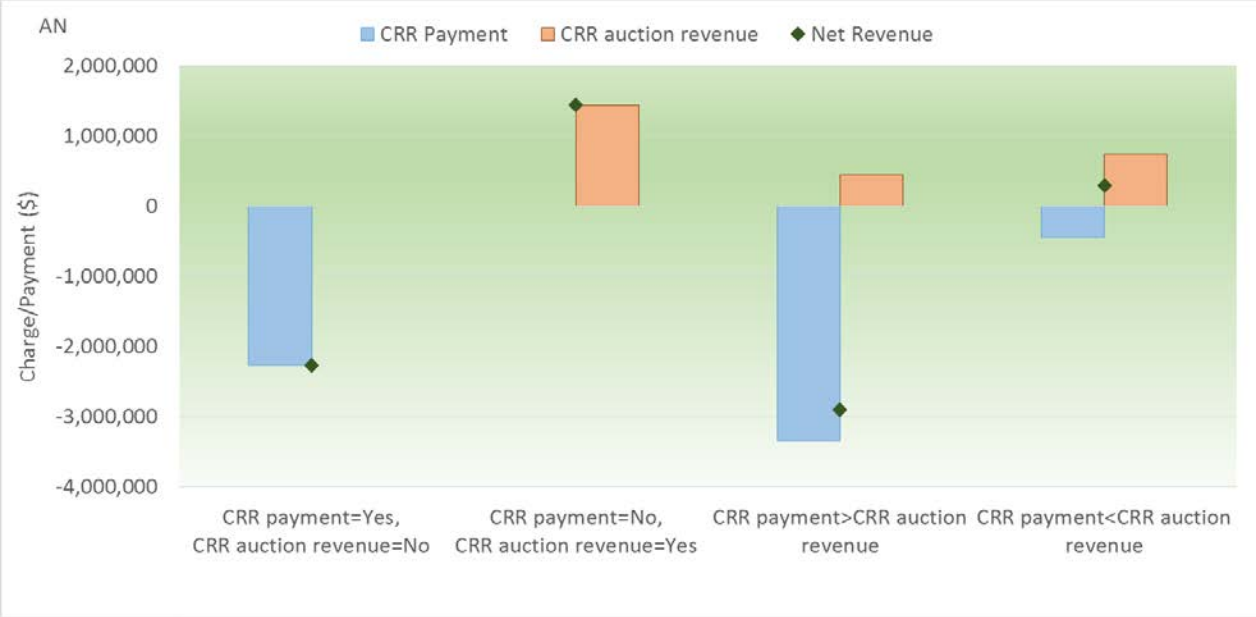


Figure 126: CRR payment versus CRR auction revenues for monthly CRR -November 2016

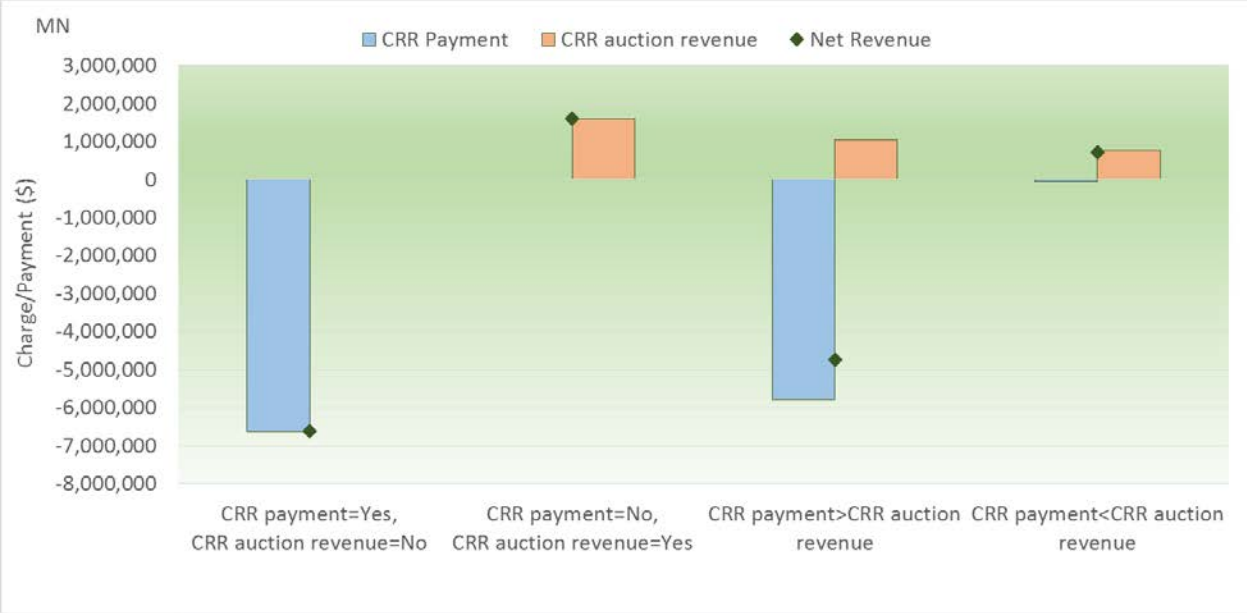


Table 17 provides one level deeper of understanding of such misalignments between markets. This tables shows the top and bottom constraints when sorted by net CRR payments. In the first column it shows the estimated CRR payment to CRR holders accrued in each constraint; the second column shows the revenues collected by the CAISO on that same constraint; the last column shows the net CRR payment, which is the balance between this money outflow (CRR payment) and money inflow (CRR auction revenues) from the CAISO's perspective. Table 18 shows the same information for CRRs released in the monthly auction for November 2016. The

top constraints reflect cases where large CRR payments to auction CRRs accrued when the CRR market did not collect any auction revenues when releasing these CRRs.

Table 17: Net CRR payment by constraint – November 2016, annual auction

Constraints	Total CRR Payment	Total CRR Auction Revenue	Net CRR Payment
24086_LUGO _500_26105_VICTORVL_500_BR_1 _1	-$1,520,118.0	$162,242.3	-$1,357,875.7
NOB_ITC	-$860,027.3	$229,727.4	-$630,299.9
OMS 4158606 ELD-LUGO	-$510,030.2	$0.0	-$510,030.2
OMS 4379177 IVALLEY BNK81_NG2	-$469,832.5	$0.0	-$469,832.5
WSTWGMEAD_ITC	-$486,968.4	$30,113.9	-$456,854.5
PATH15_S-N	-$448,683.0	$0.0	-$448,683.0
PALOVRDE_ITC	-$279,076.1	$0.0	-$279,076.1
OMS_4368111_SCIT_NG	-$198,240.3	$0.0	-$198,240.3
31336_HPLND JT_60.0_31206_HPLND JT_115_XF_2	-$159,901.4	$14,940.3	-$144,961.1
30750_MOSSLD _230_30760_COBURN _230_BR_1 _1	-$121,398.0	$0.0	-$121,398.0
22356_IMPRLVLY_230_22360_IMPRLVLY_500_XF_81	-$99,465.1	$0.0	-$99,465.1
MIGUEL_BKs_MXFLW_NG	-$95,642.9	$0.0	-$95,642.9
22256_ESCNDIDO_69.0_22724_SANMRCOS_69.0_BR_1 _1	-$68,492.2	$0.0	-$68,492.2
PATH26_BG	-$57,719.4	$0.0	-$57,719.4
OMS 4186537 FL1	-$38,580.4	$0.0	-$38,580.4
ADLANTO-SP_ITC	-$35,292.0	$0.0	-$35,292.0
30900_GATES _230_30970_MIDWAY _230_BR_1 _1	-$25,240.7	$0.0	-$25,240.7
OMS 4379177 IVALLEY BNK81_NG1	-$23,548.6	$0.0	-$23,548.6
SYLMAR-AC_ITC	-$23,061.2	$6,189.6	-$16,871.7
HUMBOLDT_IMP_NG	-$15,209.1	$3.2	-$15,206.0
22430_SILVERGT_230_22596_OLD TOWN_230_BR_1 _1	$0.0	$17,070.2	$17,070.2
MSOLAR_XFMR_BG	$0.0	$25,252.3	$25,252.3
MKTPCADLN_ITC	$0.0	$26,174.8	$26,174.8
24087_MAGUNDEN_230_24153_VESTAL _230_BR_2 _1	$0.0	$27,210.8	$27,210.8
32782_STATIN D_115_32788_STATIN L_115_BR_1 _1	$0.0	$27,485.4	$27,485.4
33020_MORAGA _115_30550_MORAGA _230_XF_1 _P	$0.0	$31,400.7	$31,400.7
WARNRVIL_STNDIFRD_TOR	$0.0	$31,427.2	$31,427.2
NdGrp_POD_PALOMR_2_PL1X3-APND	$0.0	$35,732.0	$35,732.0
MALIN500	-$442,880.8	$491,197.7	$48,316.9
22468_MIGUEL _500_22472_MIGUELMP_ 1.0_XF_80	$0.0	$48,566.6	$48,566.6
35922_MOSSLD _115_30751_MOSSLDB _230_XF_1	$0.0	$50,174.3	$50,174.3
IPPUTAH_ITC	-$22,996.2	$74,504.6	$51,508.4
22192_DOUBLTTP_138_22300_FRIARS _138_BR_1 _1	$43,636.8	$9,675.1	$53,311.9
6110_SOL10_NG	$0.0	$62,167.1	$62,167.1
33310_SANMATEO_115_30700_SANMATEO_230_XF_7 _S	$0.0	$67,404.7	$67,404.7
34116_LE GRAND_115_34134_WILSONAB_115_BR_1 _1	$0.0	$70,261.5	$70,261.5
6110_TM_BNK_FLO_TMS_DLO_NG	$0.0	$91,293.8	$91,293.8
30915_MORROBAY_230_30916_SOLARSS _230_BR_1 _1	-$16,647.2	$114,616.8	$97,969.6
PATH15_BG	$0.0	$127,576.4	$127,576.4
30515_WARNERVL_230_30800_WILSON _230_BR_1 _1	$0.0	$136,514.3	$136,514.3

Table 18: Net CRR payment by constraint – November 2016, monthly auction

Constraints	Total CRR Payment	Total CRR Auction Revenue	Net CRR Payment
22356_IMPRLVLY_230_22360_IMPRLVLY_500_XF_81	-$3,172,578.4	$0.0	-$3,172,578.4
PALOVRDE_ITC	-$2,532,835.8	$422,309.3	-$2,110,526.4
NOB_ITC	-$1,703,470.0	$99,070.3	-$1,604,399.7
OMS 4379177 IVALLEY BNK81_NG2	-$980,124.4	$0.0	-$980,124.4
22192_DOUBLTTP_138_22300_FRIARS _138_BR_1 _1	-$623,069.7	$0.0	-$623,069.7
24086_LUGO _500_26105_VICTORVL_500_BR_1 _1	-$708,240.0	$90,847.2	-$617,392.8
OMS_4368111_SCIT_NG	-$261,117.1	$0.0	-$261,117.1
24016_BARRE _230_24154_VILLA PK_230_BR_1 _1	-$252,486.7	$0.0	-$252,486.7
OMS 4158606 ELD-LUGO	-$251,611.0	$0.0	-$251,611.0
PATH15_S-N	-$612,164.5	$362,641.7	-$249,522.8
MIGUEL_BKs_MXFLW_NG	-$188,347.0	$0.0	-$188,347.0
OMS 4186537 Path15_S-N	-$161,067.3	$0.0	-$161,067.3
OMS 4379177 IVALLEY BNK81_NG1	-$124,590.4	$0.0	-$124,590.4
31336_HPLND JT_60.0_31206_HPLND JT_115_XF_2	-$129,780.4	$5,439.8	-$124,340.6
30750_MOSSLD _230_30760_COBURN _230_BR_1 _1	-$101,329.8	$0.0	-$101,329.8
OMS 4392033 TL50003_NG	-$91,702.8	$0.0	-$91,702.8
OMS 4391827 TL50003_NG	-$91,411.0	$0.0	-$91,411.0
22596_OLD TOWN_230_22504_MISSION _230_BR_1 _1	-$82,137.4	$0.0	-$82,137.4
OMS 4402394 TL50003_NG	-$69,349.0	$0.0	-$69,349.0
PATH26_BG	-$47,041.8	$0.0	-$47,041.8
30750_MOSSLD _230_30045_MOSSLAND_500_XF_9	$0.0	$13,806.1	$13,806.1
22828_SYCAMORE_69.0_22756_SCRIPPS _69.0_BR_1 _1	$0.0	$15,744.9	$15,744.9
NdGrp_NEORBLF_7_B1	$0.0	$18,830.1	$18,830.1
32218_DRUM _115_32222_DTCH2TAP_115_BR_1 _1	-$893.4	$20,255.2	$19,361.8
CASCADE_ITC	$0.0	$22,187.4	$22,187.4
NdGrp_POD_MDFKRL_2_PROJCT-APND	$0.0	$22,966.9	$22,966.9
30515_WARNERVL_230_30800_WILSON _230_BR_1 _1	$0.0	$24,487.5	$24,487.5
NdGrp_AGUCALG1_7_B1	$0.0	$27,168.7	$27,168.7
6110_SOL7_NG	$0.0	$28,795.8	$28,795.8
33310_SANMATEO_115_30700_SANMATEO_230_XF_7 _S	$0.0	$35,014.7	$35,014.7
SDGE_CFEIMP_BG	$0.0	$39,684.8	$39,684.8
NdGrp_CHCARITA_1_N012	$0.0	$43,519.7	$43,519.7
IID-SDGE_ITC	$0.0	$69,902.1	$69,902.1
22831_SYCAMORE_138_22832_SYCAMORE_230_XF_1	$0.0	$70,782.0	$70,782.0
IID-SCE_BG	-$1,972.3	$81,291.0	$79,318.7
SYLMAR-AC_BG	$0.0	$190,136.6	$190,136.6
24132_SANBRDNO_230_24804_DEVERS _230_BR_1 _1	$0.0	$214,939.0	$214,939.0
22355_I VALLY2_230_22360_IMPRLVLY_500_XF_80	$0.0	$286,037.5	$286,037.5
22831_SYCAMORE_138_22124_CHCARITA_138_BR_1 _1	-$20,486.7	$313,934.6	$293,447.9
24016_BARRE _230_25201_LEWIS _230_BR_1 _1	-$3,126.7	$319,045.8	$315,919.1

These two tables illustrate instances of constraint misalignment between the CRR auctions and the day-ahead market. To understand this mismatch one level deeper, Table 19 lists the subset of constraints that are not binding or not enforced in the CRR monthly auction or that have a significant CRR payment. The portion that were paid only to CRRs from the annual and monthly auctions is also provided. Then it compares the average transmission limit used in the day-ahead market and the limits actually used in both the annual and monthly auctions. These are the constraints that will mostly drive the divergence between the day-ahead and CRR markets. One of the cornerstones of the CRR market efficiency is for the CRR market to closely reflect the transmission capacity of the day-ahead market. When the transmission capacity released in the CRR market is less than that of the day-ahead market, there may be an exposure of revenue deficiency. This may also have a fair impact on the level of CRR net payments and how transmission capacity is valued in the CRR auction. This occurs because when CRRs are released in the auction process they are priced on the value of the capacity made available, or on the lack of it. A systemic issue identified during the evaluation of the CRR auction efficiency is that multiple transmission constraints are not modelled or enforced in the CRR auctions.

In cases where the constraint was enforced in the day-ahead market but not modelled or enforced in the CRR auctions, the amount of transmission capacity by means of CRRs that may be released on that constraints is effectively unbounded, which indicates that more transmission capacity may be released in the CRR auction than in the day-ahead market. This is a major problem to the efficiency of the CRR market. For the case of November 2016 and relative to other months analyzed, there were relatively few instances of constraints not enforced in the CRR auctions. In such cases the level of congestion rents and CRR payments were relatively modest, such that even with the misalignment, the financial impact was low. In further investigating why these constraints were not modelled/enforced in the CRR auctions, the common factors are related to how outages were considered and when transmission constraints were enforced in the CRR auction.

1. Constraint OMS_4368111_SCIT_NG. This constraint was associated with an outage (4368111) that was submitted after the CRR cutoff date.
2. Constraint OMS 4158606 ELD-LUGO. This constraint was associated with an outage (4158606) that was submitted after the CRR cutoff date.
3. Constraint OMS 4379177 IVALLEY BNK81_NG2. This constraint was associated with an outage (4379177) that was submitted after the CRR cutoff date.
4. Constraint OMS 4392033 TL50003_NG. This constraint was associated with an outage (4392033) that was submitted after the CRR cutoff date.
5. Constraint OMS 4391827 TL50003_NG. This constraint was associated with an outage (4391827) that was submitted after the CRR cutoff date.
6. Constraint OMS 4379177 IVALLEY BNK81_NG1. This constraint was associated with an outage (4379177) that was submitted after the CRR cutoff date.
7. Constraint OMS 4402394 TL50003_NG. This constraint was associated with an outage (4402394) that was submitted after CRR cutoff date.
8. Constraint OMS 4186537 FL1. It seems like the requirement for Nomogram was found out later in short-term outage study. With IRO-017 requirement came in effect this year, this

kind of scenario should go down. This outage lasted more than 24 but less than 10 days and was submitted on time.

There are several other constraints that accrued congestion in the day-ahead market and, even though they were enforced in the market, they were not binding in the CRR auctions. These cases are labelled as auction economics since it is based on the auction clearing prices whether these constraint were binding or not.

Furthermore, there are some constraints that were enforced and binding in the CRR auctions but still there was a large difference between the day-ahead and CRR auction limits. In several, the limit binding in the day-ahead market was lower in multiple hours than the limits used in the CRR auctions. Even when the average limit shown for the day-ahead market may show a value higher than the CRR limit, there may be hours when the limit was actually lower than the average and represented more restrictive conditions in the day-ahead market. Constraints include:

1. Paloverde intertie. This constraint was heavily derated during the month of November due to outages in the area. The monthly auction considered these derates for the majority; however, the annual auction run with nominal limit.
2. NOB intertie. This constraint did not bind in the CRR auctions but bind heavily in the day-ahead market. This was caused by using more restrictive limits in the day ahead market than the ones used in the CRR auctions.

Table 19: Top constraints binding in the day-ahead market not binding in CRR market - November 2016

Constraint	Constraint Type	TOU	Payment to annual CRR	Payment to monthly CRR	DAM Limit	Annual CRR Limit	Monthly CRR Limit	Annual CRR Status	Monthly CRR Status	Reason
24086_LUGO _500_26105_VICTORVL_500_BR_1 _1	FLOWGATE	ON	-$684,955.7	-$349,158.0	2402.9	2469.7	2037.5	Binding	Binding	Auction Economics
PALOVRDE_ITC	INTER_TIE	OFF	-$192,089.9	-$1,462,296.1	2367.9	1114.1	1565.8	Binding	Binding	Auction Economics
PALOVRDE_ITC	INTER_TIE	ON	-$86,986.2	-$1,070,539.7	2158.0	1160.9	1565.8	Binding	Binding	Auction Economics
NOB_ITC	INTER_TIE	ON	-$506,221.8	-$1,379,203.1	1564.0	1016.7	1450.0	Binding	Binding	Auction Economics
22356_IMPRLVLY_230_22360_IMPRLVLY_500_XF_81	FLOWGATE	ON	-$15,415.3	-$2,827,120.9	591.4	1064.7	878.4	Not Binding	Not Binding	Higher Limit
OMS_4368111_SCIT_NG	NOMOGRAM	ON	-$198,240.3	-$261,117.1	7674.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missing Outage
OMS 4158606 ELD-LUGO	NOMOGRAM	ON	-$261,087.4	-$214,228.6	2301.3	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missing Outage
OMS 4379177 IVALLEY BNK81_NG2	NOMOGRAM	ON	-$454,412.1	-$946,164.5	335.1	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missing Outage
NOB_ITC	INTER_TIE	OFF	-$353,805.5	-$324,266.9	1564.0	950.7	1450.0	Binding	Binding	Auction Economics
MIGUEL_BKs_MXFLW_NG	NOMOGRAM	ON	-$95,642.9	-$188,347.0	1084.2	Unbounded	1313.2	Not Enforced	Not Binding	Higher Limit
22192_DOUBLTTP_138_22300_FRIARS _138_BR_1 _1	FLOWGATE	ON	$64,629.2	-$569,445.4	164.2	143.4	118.3	Not Binding	Not Binding	Auction Economics
24016_BARRE _230_24154_VILLA PK_230_BR_1 _1	FLOWGATE	ON	$1,048.9	-$252,486.7	1257.4	1136.1	937.3	Not Binding	Not Binding	Auction Economics
OMS 4158606 ELD-LUGO	NOMOGRAM	OFF	-$248,942.8	-$37,382.4	2297.4	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missing Outage
22356_IMPRLVLY_230_22360_IMPRLVLY_500_XF_81	FLOWGATE	OFF	-$84,049.8	-$345,457.5	600.8	1064.7	878.4	Not Binding	Not Binding	Higher Limit
30750_MOSSLD _230_30760_COBURN _230_BR_1 _1	FLOWGATE	ON	-$121,398.0	-$101,329.8	300.5	281.0	249.9	Not Binding	Not Binding	Auction Economics
OMS 4392033 TL50003_NG	NOMOGRAM	ON	-$8,300.1	-$91,702.8	789.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missing Outage
OMS 4391827 TL50003_NG	NOMOGRAM	ON	-$7,907.2	-$91,411.0	789.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missing Outage
OMS 4379177 IVALLEY BNK81_NG1	NOMOGRAM	ON	-$21,160.6	-$118,638.5	404.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missing Outage
OMS 4186537 Path15_S-N	NOMOGRAM	OFF	$32,505.9	-$136,928.0	2950.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missing Outage
22596_OLD TOWN_230_22504_MISSION _230_BR_1 _1	FLOWGATE	ON	$1,826.4	-$82,137.4	502.8	433.6	357.7	Not Binding	Not Binding	Auction Economics
24086_LUGO _500_26105_VICTORVL_500_BR_1 _1	FLOWGATE	OFF	-$75,103.3	-$4,962.0	2407.2	2469.7	2037.5	Binding	Binding	Auction Economics
OMS 4402394 TL50003_NG	NOMOGRAM	ON	-$5,271.0	-$69,349.0	789.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missing Outage
PATH26_BG	FLOWGATE	ON	-$57,719.4	-$47,041.8	2700.1	3920.0	3622.8	Not Binding	Not Binding	Higher Limit
22192_DOUBLTTP_138_22300_FRIARS _138_BR_1 _1	FLOWGATE	OFF	-$20,992.4	-$53,624.2	164.1	143.4	118.3	Binding	Not Binding	Auction Economics
OMS 4186537 FL1	NOMOGRAM	ON	-$38,580.4	-$18,940.8	470.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missing Outage
ADLANTO-SP_ITC	INTER_TIE	ON	-$35,292.0	$3,049.4	1340.4	1029.7	1340.6	Not Binding	Not Binding	Higher Limit
OMS 4379177 IVALLEY BNK81_NG2	NOMOGRAM	OFF	-$15,420.5	-$33,959.9	267.1	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missing Outage

December 2016

Table 20 summarizes the main settlements metrics for CRR performance in the month of December 2016. The sign convention is based from the CAISO's perspective; a positive value indicates the CAISO collects or has a surplus of money; a negative value indicates the CAISO pays or has a shortfall. Day-ahead congestion rents will be positive, CRR payments will be negative and auction revenues will be positive.

Table 20: Summary of CRR performance for December 2016

Metric	Amount
DA Congestion Rents	$15,066,599
Perfect Hedge	-$1,100,593
CRR Clawback	$84,822
CRR Payments [Auction + Allocation]	-$31,400,209
CRR Payments to Auction CRRs	-$14,511,510
CRR Payments to Monthly Auction CRRs	- $8,459,523
CRR Payments to Annual Auction CRRs	-$6,051,987
CRR Payments to Allocation CRRs	-$16,888,698
CRR Auction Revenue Monthly	$6,048,734
CRR Auction Revenue Annual	$2,754,467
Revenue Adequacy	-$17,349,381
Revenue Adequacy with Auction Revenues	-$8,546,180
Net payment to auction CRRs	-$5,708,310

In December, the overall CRR performance was poor since there was a revenue deficiency of over $17 million, which is the difference between all of the proceeds from day-ahead congestion rents, CRR clawback, and the payments made to CRR holders. About 46 percent of the CRR payments were to CRRs originating from the annual and monthly auctions. The auction revenues represent the proceeds from selling CRRs through the auction. The revenues arising from the annual auction for each season are estimated pro-rata to each month of the calendar quarter based on the number of hours in each time of use. The net payment to auction CRRs stands for the difference between the money paid to CRR holders less the money charge to CRR holders to acquire that portfolio of CRRs in the auction. This does not take into account any expenses the CRR holders incur associated with their participation in the CRR market and use of money. This is only a net accounting balance from the point of view of the cash inflow and outflow in the CAISO system. In this month there was a net CRR payment to auction CRR of $5.7 million, with $3.29 million and $2.4 million paid to CRRs from the monthly and annual auctions.

In order to further understand the origin of this poor performance, there is a need to estimate over time and by constraint the CRR settlements.

Figure 127 shows the daily congestion rents accrued on each transmission constraint that was binding in the day-ahead market in the month of December. Correspondingly, Figure 128 shows the daily CRR revenue adequacy also broken out by transmission constraint. In December, about $14.5 million of revenue deficiency was accrued on the constraint *OMS 4379177 IVALLEY BNK81_NG2* which accounts for over 84 percent of the total revenue deficiency.

Figure 127: Daily congestion rents – December 2016

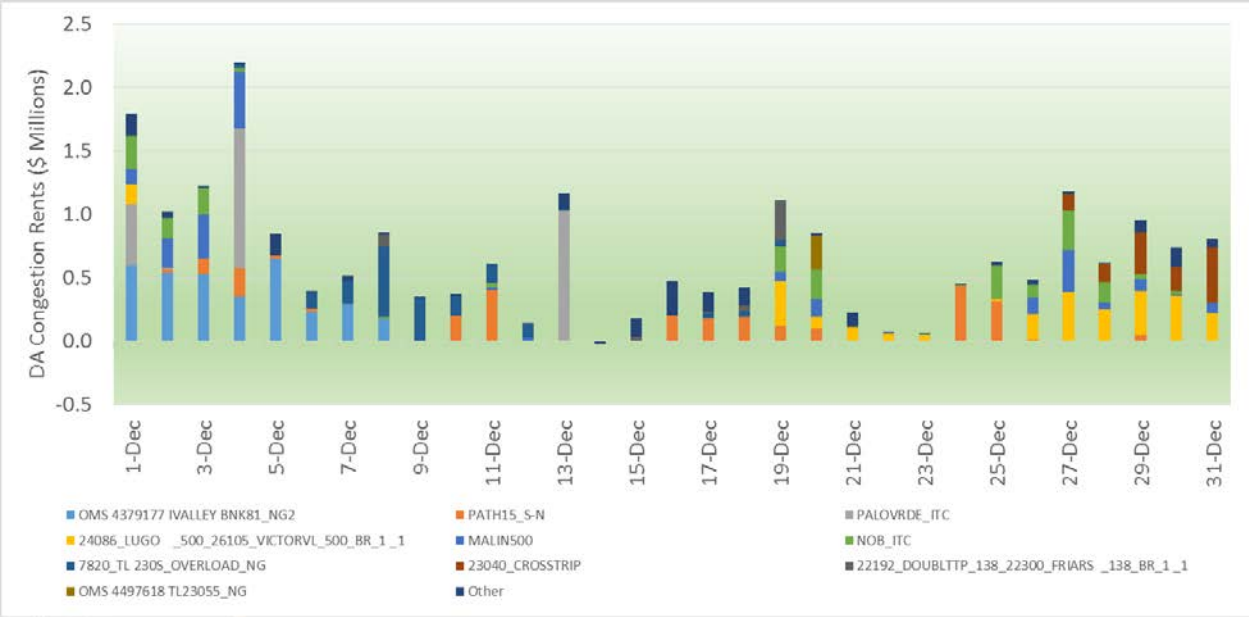
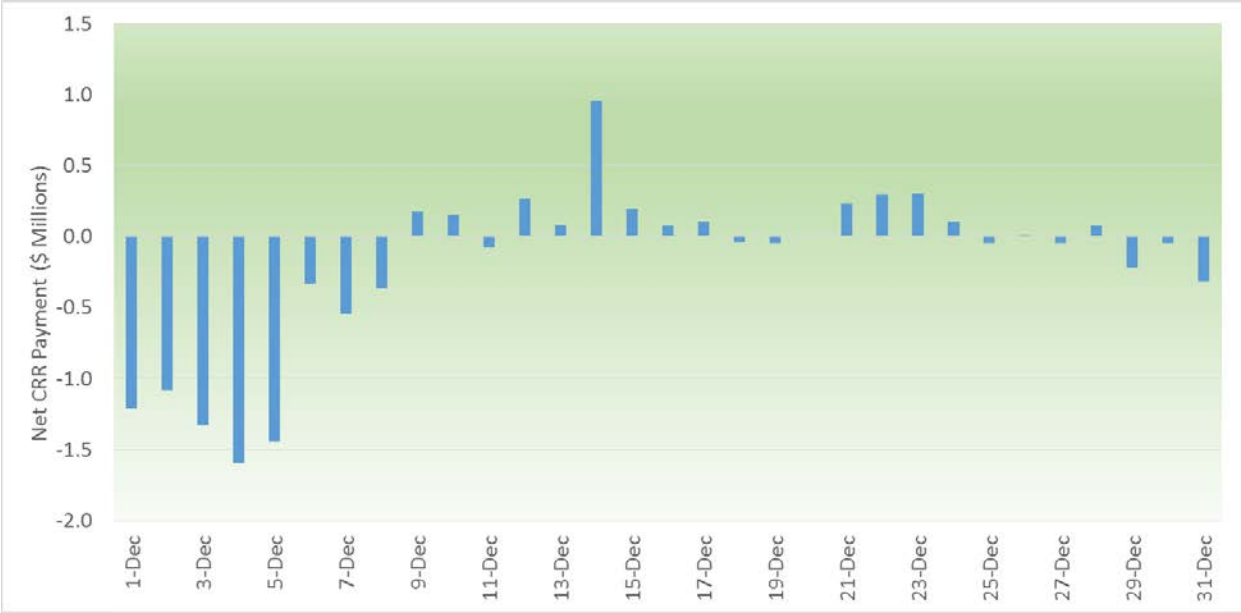


Figure 128: Daily CRR revenue adequacy - December 2016

Figure 129 shows the net CRR payment per day. This net revenue is the difference between the CRR payments to CRR holders and the auction revenues collected by the CAISO through the CRR auction process; such revenues become a lump revenue for the auction. For this metric, the annual auction revenues are allocated on a pro-rata estimation to each day of the month based on the number of hours in each time of use. The CRR payments are estimated as the total sum of CRR payments over the hours of the day only for CRRs that were released through both the annual and monthly CRR auction; that is, no CRR payments to allocated CRRs are included. The

purpose of this estimate for net CRR payments is to calculate the net balance for CRRs that were released only in the auctions. For December, there was a persistent negative net CRR payment during the beginning quarter of the month, indicating that overall the money paid to CRR holders was higher than the money the CAISO collected when releasing such CRRs in the annual and monthly auctions. During the last three quarters of the month there was a persistent positive net CRR payment, indicating that overall the money paid to CRR holders was less than the money the CAISO collected when releasing such CRRs in the annual and monthly auctions.

Figure 129: Daily net CRR payment to auction CRRs – December 2016



As shown in Figure 130, there is a strong correlation between the level of CRR revenue deficiency and the level of net CRR payments paid to holders of CRRs released in the auction processes. This is not surprising since both metrics reflect to some extent the effect of CRRs released (and priced) in the CRR auction and the capacity released (and priced) in the day-ahead market. A negative value for CRR revenue adequacy represents a shortfall for the CAISO, while a negative value for net CRR payment represents a payment to holders of auction CRRs from the CAISO. This indicates that the CAISO paid more to auction CRRs than it charged to release CRRs in the auction process.

Figure 130: Comparison of daily net CRR payment with CRR revenue adequacy – December 2016

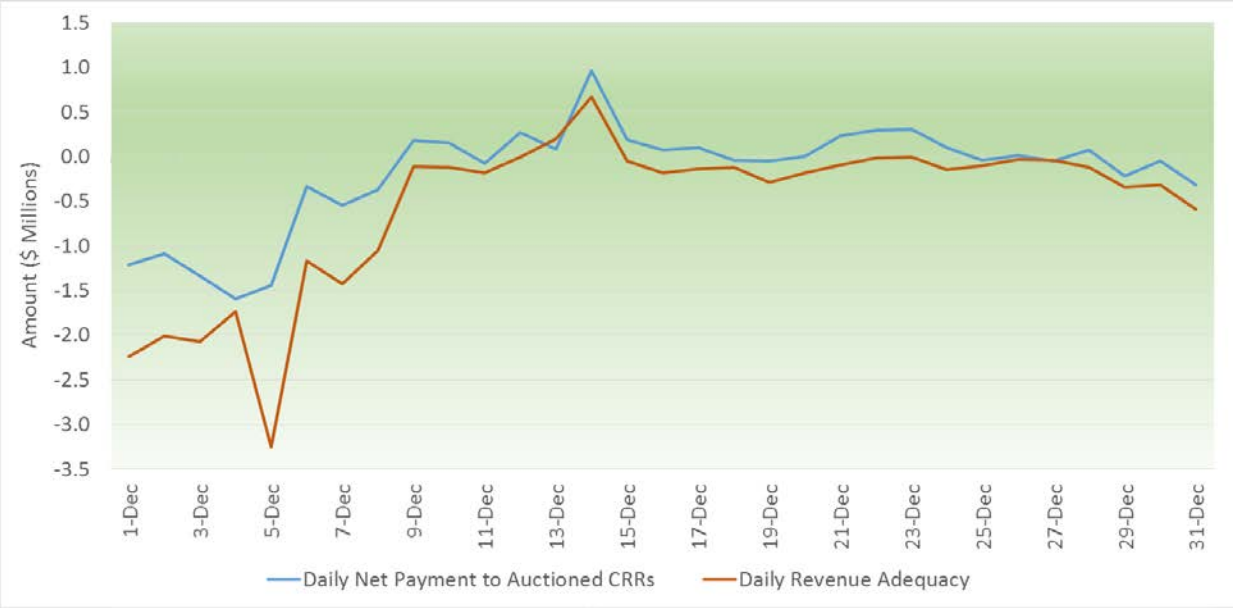
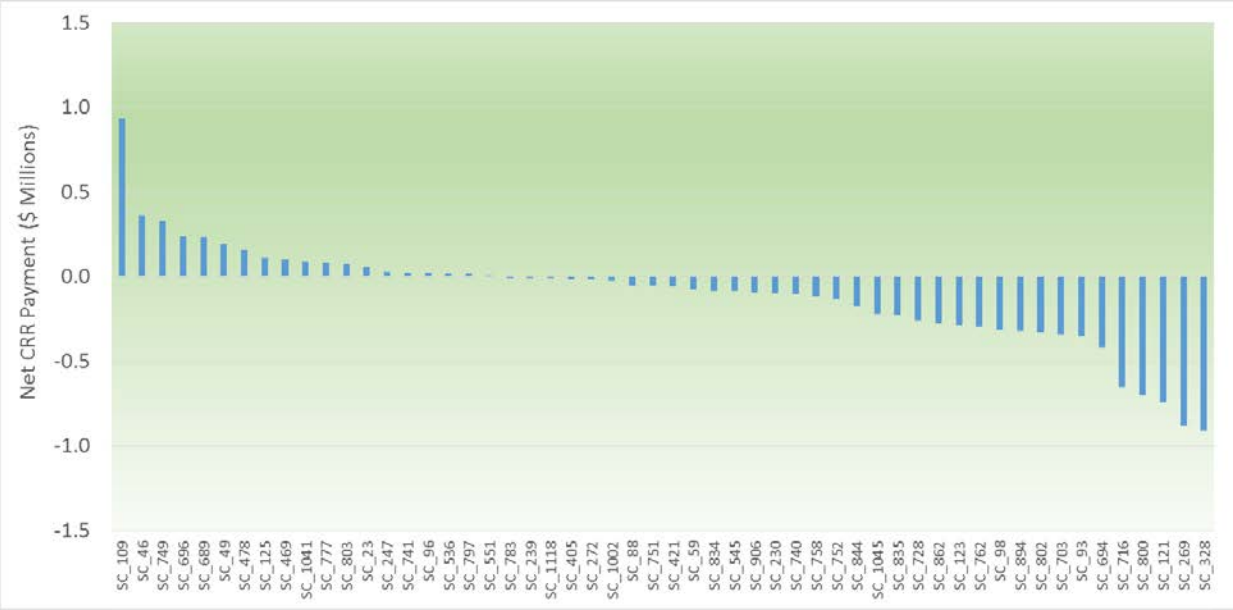


Figure 131 shows the net CRR payments to CRR participants, regardless of the type of participant. This only reflects the payments for CRRs released in both the annual and monthly CRR auctions applicable for the month of December 2016. Since this is from the CAISO's perspective, a negative value means the CAISO disbursed a net CRR payment to the CRR holder (or a net money inflow to the CRR holder). The names of the CRR holders are masked, but the identifier shown in the plot is unique across all the months provided in this analysis. A positive value represents a net inflow for the CAISO since it settled less to CRR holders in the day-ahead market than what it charged to release CRRs in the auction. For December, the majority of holders of auction CRRs saw a net gain from having these positions.

Figure 131: Net CRR payment to auction CRR –December 2016



To better understand the dynamics leading to such an outcome, the CAISO shifted the analysis to the fundamentals of the CRR auction construct by analyzing the CRR auction results at the constraint level. CRRs are released and priced based on the CRR clearing prices; such prices are derived as the relative difference between locational prices between the source and the sink locations. These locational prices originate from the cleared prices when any transmission constraint becomes binding with nonzero pries in the CRR auction, commonly referred as *shadow prices*. The CAISO turned out to analyze what constraints have been binding in the CRR auction process and compared that with the set of constraints that were binding in the day-ahead market. To some extent, one expects that there is a certain level of alignment between the markets.

Figure 132 and Figure 133 show a comparison of net CRR payments. The CRR payments reflect the CRR settlements for CRRs with day-ahead congestion rents, while the CRR auction revenues is the money the CAISO collected from releasing CRRs through the auctions. That is, it reflects the net money participants were charged to acquire CRRs and the money they were paid; in a loose sense, it could be interpreted as profits for holding.

There are four possible permutations to analyze. The first case represents when a CRR payment to CRR holders was made in the day-ahead market settlement, but the CAISO did not collect any revenues from releasing these CRRs from the auctions because the constraint was not binding in the CRR auction. This is shown for both the pro-rata portion of the annual auction for December and for the monthly CRR auction. A negative value indicates that the CAISO had a net CRR payment to CRR holders. The second case is the opposite in which there was no CRR payments when settling CRRs in the day-ahead market but the CAISO collected revenue when releasing these CRRs in the auction process. The third and fourth cases are for CRRs that had a CRR payment in the day-ahead market and the CAISO also charged them in the CRR auctions to release these CRRs. The third case is when the net CRR payment is negative, while the fourth case is when the net CRR payment is positive. This metric reveals any potential misalignment of constrains enforced and binding between the day-ahead market and CRR auctions.

Figure 132: CRR payment versus CRR auction revenues for annual CRR – December 2016

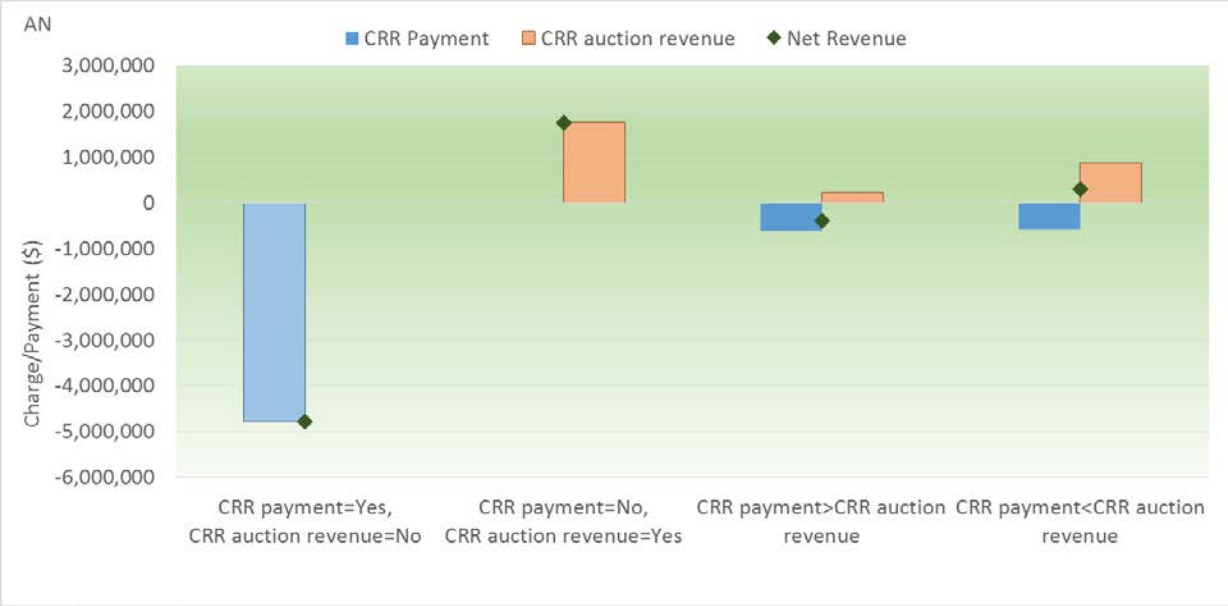


Figure 133: CRR payment versus CRR auction revenues for monthly CRR - December 2016

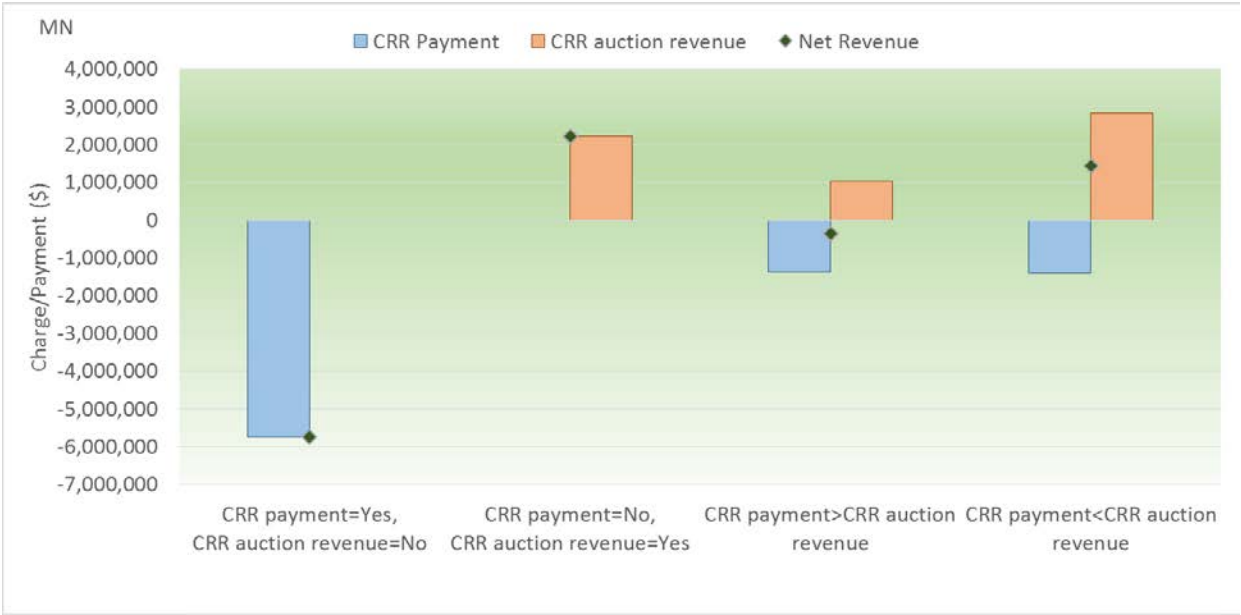


Table 21 provides one level deeper of understanding of such misalignments between markets. This tables shows the top and bottom constraints when sorted by net CRR payments. In the first column it shows the estimated CRR payment to CRR holders accrued in each constraint; the second column shows the revenues collected by the CAISO on that same constraint; the last column shows the net CRR payment, which is the balance between this money outflow (CRR payment) and money inflow (CRR auction revenues) from the CAISO's perspective. Table 22 shows the same information for CRRs released in the monthly auction for December 2016. The top constraints reflect cases where large CRR payments to auction CRRs accrued when the CRR market did not collect any auction revenues when releasing these CRRs.

Table 21: Net CRR payment by constraint – December 2016, annual auction

Constraints	Total CRR Payment	Total CRR Auction Revenue	Net CRR Payment
OMS 4379177 IVALLEY BNK81_NG2	-$4,333,492.6	$0.0	-$4,333,492.6
PATH15_S-N	-$285,606.3	$0.0	-$285,606.3
23040_CROSSTRIP	-$217,429.9	$0.0	-$217,429.9
24086_LUGO _500_26105_VICTORVL_500_BR_1 _1	-$204,028.2	$0.0	-$204,028.2
PALOVRDE_ITC	-$60,922.3	$0.0	-$60,922.3
NORTHGILA500_ITC	-$58,506.0	$12,686.8	-$45,819.3
OMS_3849098_LBN_SN	-$29,887.3	$0.0	-$29,887.3
31334_CLER LKE_60.0_31338_KONOCTI6_60.0_BR_1 _1	-$28,371.8	$0.0	-$28,371.8
OMS3877502 DV_SB	-$28,160.2	$0.0	-$28,160.2
34874_WHEELER _70.0_34756_WHEELER _115_XF_2	-$27,996.0	$0.0	-$27,996.0
HUMBOLDT_IMP_NG	-$23,516.9	$3.2	-$23,513.7
22604_OTAY _69.0_22616_OTAYLKTP_69.0_BR_1 _1	-$23,022.3	$0.0	-$23,022.3
OMS 4489686 TL23055_NG	-$17,456.0	$0.0	-$17,456.0
35122_NWARK EF_115_35350_AMES BS _115_BR_2 _1	-$16,202.7	$0.0	-$16,202.7
WSTWGMEAD_ITC	-$47,443.1	$31,506.8	-$15,936.4
OMS 4497618 TL23055_NG	-$15,101.3	$0.0	-$15,101.3
22256_ESCNDIDO_69.0_22724_SANMRCOS_69.0_BR_1 _1	-$13,849.6	$0.0	-$13,849.6
30750_MOSSLD _230_30790_PANOCHE _230_BR_1 _1	-$10,685.2	$0.0	-$10,685.2
OMS4489577_PATH15_S-N	-$9,610.1	$0.0	-$9,610.1
OMS3877502 DV_VST2	-$9,520.1	$0.0	-$9,520.1
MSOLAR_XFMR_BG	$0.0	$26,790.0	$26,790.0
24087_MAGUNDEN_230_24153_VESTAL _230_BR_2 _1	$0.0	$28,682.5	$28,682.5
32782_STATIN D_115_32788_STATIN L_115_BR_1 _1	$0.0	$28,999.8	$28,999.8
33020_MORAGA _115_30550_MORAGA _230_XF_1 _P	$0.0	$33,115.6	$33,115.6
WARNRVIL_STNDIFRD_TOR	$0.0	$33,579.0	$33,579.0
NdGrp_POD_PALOMR_2_PL1X3-APND	$0.0	$38,179.3	$38,179.3
COTPISO_ITC	$41,521.4	$288.0	$41,809.5
22468_MIGUEL _500_22472_MIGUELMP_ 1.0_XF_80	$0.0	$51,893.1	$51,893.1
35922_MOSSLD _115_30751_MOSSLDB _230_XF_1	$0.0	$53,601.9	$53,601.9
IPPUTAH_ITC	-$21,992.0	$77,214.8	$55,222.7
6110_SOL10_NG	$0.0	$65,064.8	$65,064.8
33310_SANMATEO_115_30700_SANMATEO_230_XF_7 _S	$0.0	$72,021.4	$72,021.4
34116_LE GRAND_115_34134_WILSONAB_115_BR_1 _1	$0.0	$73,440.6	$73,440.6
6110_TM_BNK_FLO_TMS_DLO_NG	$0.0	$96,219.8	$96,219.8
30915_MORROBAY_230_30916_SOLARSS _230_BR_1 _1	$0.0	$121,946.0	$121,946.0
PATH15_BG	$0.0	$135,261.1	$135,261.1
OMS 4282107_TVYVLY	$136,188.4	$0.0	$136,188.4
30515_WARNERVL_230_30800_WILSON _230_BR_1 _1	$0.0	$145,858.4	$145,858.4
MALIN500	-$342,656.4	$508,219.4	$165,563.0
7820_TL 230S_OVERLOAD_NG	$191,250.4	$0.0	$191,250.4

Table 22: Net CRR payment by constraint – December 2016, monthly auction

Constraints	Total CRR Payment	Total CRR Auction Revenue	Net CRR Payment
OMS 4379177 IVALLEY BNK81_NG2	-$3,759,187.7	$0.0	-$3,759,187.7
23040_CROSSTRIP	-$1,126,775.5	$0.0	-$1,126,775.5
7820_TL 230S_OVERLOAD_NG	-$805,214.8	$0.0	-$805,214.8
PATH15_S-N	-$705,885.0	$594,446.1	-$111,439.0
OMS 4497618 TL23055_NG	-$100,330.6	$0.0	-$100,330.6
OMS 4489686 TL23055_NG	-$95,799.7	$0.0	-$95,799.7
24132_SANBRDNO_230_24804_DEVERS _230_BR_1 _1	-$88,475.1	$0.0	-$88,475.1
24016_BARRE _230_24154_VILLA PK_230_BR_1 _1	-$88,424.8	$0.0	-$88,424.8
34874_WHEELER _70.0_34756_WHEELER _115_XF_2	-$57,273.4	$0.0	-$57,273.4
OMS_3849098_LBN_SN	-$41,973.4	$0.0	-$41,973.4
OMS 4497673 TL23055_NG	-$36,308.6	$0.0	-$36,308.6
OMS3877502 DV_SB	-$30,636.5	$0.0	-$30,636.5
30750_MOSSLD _230_30790_PANOCHE _230_BR_1 _1	-$18,582.2	$0.0	-$18,582.2
IPPUTAH_ITC	-$16,880.6	$1,184.8	-$15,695.8
OMS4489577_PATH15_S-N	-$15,254.5	$0.0	-$15,254.5
MEAD_ITC	-$29,688.7	$14,578.6	-$15,110.1
OMS3877502 DV_VST2	-$12,626.7	$0.0	-$12,626.7
OMS4489569_PATH15_S-N	-$9,403.2	$0.0	-$9,403.2
31334_CLER LKE_60.0_31338_KONOCTI6_60.0_BR_1 _1	-$6,392.4	$0.0	-$6,392.4
35122_NWARK EF_115_35350_AMES BS _115_BR_2 _1	-$6,092.1	$0.0	-$6,092.1
22356_IMPRLVLY_230_21025_ELCENTRO_230_BR_1 _1	$0.0	$24,820.9	$24,820.9
IID-SCE_BG	-$21,252.7	$47,190.7	$25,938.0
NdGrp_AGUCALG1_7_B1	$0.0	$27,620.0	$27,620.0
WSTWGMEAD_ITC	-$52,996.9	$82,158.1	$29,161.1
CASCADE_BG	$0.0	$29,274.8	$29,274.8
NdGrp_POD_ENERSJ_2_WIND-APND	$0.0	$29,608.9	$29,608.9
30515_WARNERVL_230_30800_WILSON _230_BR_1 _1	$0.0	$32,799.7	$32,799.7
NOB_ITC	-$248,740.7	$283,851.0	$35,110.3
22831_SYCAMORE_138_22832_SYCAMORE_230_XF_1	$0.0	$37,328.5	$37,328.5
COTPISO_ITC	$52,459.8	$2.0	$52,461.8
30900_GATES _230_30970_MIDWAY _230_BR_1 _1	$0.0	$77,179.1	$77,179.1
RM_TM12_NG	$0.0	$86,238.2	$86,238.2
24086_LUGO _500_26105_VICTORVL_500_BR_1 _1	-$312,245.3	$405,299.0	$93,053.7
22192_DOUBLTTP_138_22300_FRIARS _138_BR_1 _1	-$159,893.1	$344,154.4	$184,261.3
24138_SERRANO _500_24137_SERRANO _230_XF_3	$0.0	$222,442.4	$222,442.4
MALIN500	-$212,588.9	$438,388.7	$225,799.8
24016_BARRE _230_25201_LEWIS _230_BR_1 _1	$0.0	$339,476.3	$339,476.3
OMS 4282107_TVYVLY	$554,536.8	$0.0	$554,536.8
22356_IMPRLVLY_230_22360_IMPRLVLY_500_XF_81	$0.0	$627,915.8	$627,915.8
PALOVRDE_ITC	-$757,130.8	$1,617,624.5	$860,493.7

These two tables illustrate instances of constraint misalignment between the CRR auctions and the day-ahead market. To understand this mismatch one level deeper, Table 23 lists the subset of constraints that are not binding or not enforced in the CRR monthly auction or that have a significant CRR payment. The portion that were paid only to CRRs from the annual and monthly auctions is also provided. Then it compares the average transmission limit used in the day-ahead market and the limits actually used in both the annual and monthly auctions. These are the constraints that will mostly drive the divergence between the day-ahead and CRR markets. One of the cornerstones of the CRR market efficiency is for the CRR market to closely reflect the transmission capacity of the day-ahead market. When the transmission capacity released in the CRR market is less than that of the day-ahead market, there may be an exposure of revenue deficiency. This may also have a fair impact on the level of CRR net payments and how transmission capacity is valued in the CRR auction. This occurs because when CRRs are released in the auction process they are priced on the value of the capacity made available, or on the lack of it. A systemic issue identified during the evaluation of the CRR auction efficiency is that multiple transmission constraints are not modelled or enforced in the CRR auctions.

In cases where the constraint was enforced in the day-ahead market but not modelled or enforced in the CRR auctions, the amount of transmission capacity by means of CRRs that may be released on that constraints is effectively unbounded, which indicates that more transmission capacity may be released in the CRR auction than in the day-ahead market. This is a major problem to the efficiency of the CRR market. For the case of December 2016 and relative to other months analyzed, there were relatively few instances of constraints not enforced in the CRR auctions. In such cases the level of congestion rents and CRR payments were relatively modest, such that even with the misalignment, the financial impact was low. In further investigating why these constraints were not modelled/enforced in the CRR auctions, the common factors are related to how outages were considered and when transmission constraints were enforced in the CRR auction.

1. Constraint OMS 4379177 IVALLEY BNK81_NG2. This constraint was associated with an outage (4379177) that was picked up in the CRR process but the need to include a nomogram was not known at the time of the CRR cutoff.
2. Constraint 23040_CROSSTRIP. This constraint was not known at the time the CRR auction was run, and was later on added into the February 2017 monthly model.
3. Constraint OMS 4497618 TL23055_NG. This constraint was associated with an outage (4497618) that was for less than 24 hours and was received after CRR cutoff.
4. Constraint OMS 4489686 TL23055_NG. This constraint was associated with an outage (4489686) that was for less than 24 hours and was received after CRR cutoff.
5. Constraint OMS 4497673 TL23055_NG. This constraint was associated with an outage (4497673) that was for less than 24 hours and was received after CRR cutoff.
6. Constraint 34874_WHEELER _70.0_34756_WHEELER _115_XF_2. This element is not part of the normally enforced list of transmission elements. There was no known outage at the time of the running of the CRR process that activated this flowgate.
7. Constraint OMS3877502 DV_SB. The nomogram associated with this outage was not added until after the CRR cutoff. This outage lasted more than 24 hours but less than 10 days and was submitted in time.

8. Constraint 31334_CLER LKE_60.0_31338_KONOCTI6_60.0_BR_1 _1. This element is not part of the normally enforced list of transmission elements. There was no known outage at the time of the running of the CRR process that activated this flowgate.
9. Constraint 22604_OTAY _69.0_22616_OTAYLKTP_69.0_BR_1 _1. This element is not part of the normally enforced list of transmission elements. There was no known outage at the time of the running of the CRR process that activated this flowgate.
10. Constraint OMS3877502 DV_VST2. The nomogram associated with this outage was not added until after the CRR cutoff. This outage lasted more than 24 hours but less than 10 days and was submitted in time.
11. Constraint OMS4489577_PATH15_S-N. This constraint was associated with an outage (4489577) that was for less than 24 hours and was received after CRR cutoff.

Table 23: Top constraints binding in the day-ahead market not binding in CRR market - December 2016

Constraint	Constraint Type	TOU	Payment to annual CRR	Payment to monthly CRR	DAM Limit	Annual CRR Limit	Monthly CRR Limit	Annual CRR Status	Monthly CRR Status	Reason
OMS 4379177 IVALLEY BNK81_NG2	NOMOGRAM	ON	-$3,508,302.8	-$2,648,257.1	170.1	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missed Outage
OMS 4379177 IVALLEY BNK81_NG2	NOMOGRAM	OFF	-$825,189.8	-$1,110,930.6	172.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missed Outage
23040_CROSSTRIP	NOMOGRAM	ON	-$175,832.7	-$960,157.0	458.8	Unbounded	Unbounded	Not Enforced	Not Enforced	Late Enforcement
7820_TL 230S_OVERLOAD_NG	NOMOGRAM	ON	$189,169.9	-$607,412.0	304.5	Unbounded	392.0	Not Enforced	Not Binding	Auction Economics
OMS 4497618 TL23055_NG	NOMOGRAM	ON	-$15,101.3	-$100,330.6	997.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missed Outage
OMS 4489686 TL23055_NG	NOMOGRAM	ON	-$17,456.0	-$95,799.7	998.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missed Outage
7820_TL 230S_OVERLOAD_NG	NOMOGRAM	OFF	$2,080.5	-$197,802.9	303.4	Unbounded	392.0	Not Enforced	Not Binding	Higher Limit
23040_CROSSTRIP	NOMOGRAM	OFF	-$41,597.2	-$166,618.6	449.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late Enforcement
24016_BARRE _230_24154_VILLA PK_230_BR_1 _1	FLOWGATE	ON	$844.2	-$88,424.8	1327.4	1136.1	937.3	Not Binding	Not Binding	Auction Economics
OMS 4497673 TL23055_NG	NOMOGRAM	ON	-$5,496.7	-$36,308.6	997.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missed Outage
24132_SANBRDNO_230_24804_DEVERS _230_BR_1 _1	FLOWGATE	ON	-$8,787.0	-$88,399.4	316.5	301.1	248.4	Binding	Not Binding	Auction Economics
34874_WHEELER _70.0_34756_WHEELER _115_XF_2	FLOWGATE	ON	-$26,054.9	-$51,055.3	69.8	Unbounded	Unbounded	Not Enforced	Not Enforced	Late Enforcement
OMS3877502 DV_SB	NOMOGRAM	OFF	-$28,160.2	-$30,636.5	310.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missed Outage
31334_CLER LKE_60.0_31338_KONOCTI6_60.0_BR_1 _1	FLOWGATE	ON	-$28,371.8	-$6,392.4	58.9	Unbounded	Unbounded	Not Enforced	Not Enforced	Late Enforcement
22604_OTAY _69.0_22616_OTAYLKTP_69.0_BR_1 _1	FLOWGATE	ON	-$23,022.3	-$5,154.0	61.2	Unbounded	Unbounded	Not Enforced	Not Enforced	Late Enforcement
35122_NWARK EF_115_35350_AMES BS _115_BR_2 _1	FLOWGATE	ON	-$16,202.7	-$6,092.1	118.7	78.6	87.4	Not Binding	Not Binding	Auction Economics
30750_MOSSLD _230_30790_PANOCHE _230_BR_1 _1	FLOWGATE	ON	-$10,685.2	-$18,582.2	318.7	281.0	249.9	Not Binding	Not Binding	Auction Economics
31566_KESWICK _60.0_31582_STLLWATR_60.0_BR_1 _1	FLOWGATE	ON	-$6,916.0	-$2,821.6	37.7	24.1	29.2	Binding	Not Binding	Auction Economics
OMS3877502 DV_VST2	NOMOGRAM	OFF	-$9,262.1	-$11,339.5	483.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missed Outage
OMS4489577_PATH15_S-N	NOMOGRAM	ON	-$9,610.1	-$15,254.5	3100.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missed Outage

January 2017

Table 24 summarizes the main settlements metrics for CRR performance in the month of January 2017. The sign convention is based from the CAISO's perspective; a positive value indicates the CAISO collects or has a surplus of money; a negative value indicates the CAISO pays or has a shortfall. Day-ahead congestion rents will be positive, CRR payments will be negative and auction revenues will be positive.

Table 24: Summary of CRR performance for January 2017

Metric	Amount
DA Congestion Rents	$11,265,612
Perfect Hedge	-$295,793
CRR Clawback	$14,555
CRR Payments [Auction + Allocation]	-$21,139,516
CRR Payments to Auction CRRs	-$11,093,405
CRR Payments to Monthly Auction CRRs	-$4,599,038
CRR Payments to Annual Auction CRRs	-$6,494,367
CRR Payments to Allocation CRRs	-$10,046,111
CRR Auction Revenue Monthly	$3,014,927
CRR Auction Revenue Annual	$3,524,436
Revenue Adequacy	-$10,155,142
Revenue Adequacy with Auction Revenues	-$3,615,779
Net payment to auction CRR	-$4,554,041

In January, the overall CRR performance was poor since there was a revenue deficiency of $10.1 million, which is the difference between all of the proceeds from day-ahead congestion rents, CRR clawback and the payments made to CRR holders. About 52 percent of the CRR payments were to CRRs originated from the annual and monthly auctions. The auction revenues represent the proceeds from selling CRRs through the auction. The revenues arising from the annual auction for each season are estimated pro-rata to each month of the calendar quarter based on the number of hours in each time of use. The net payment to auction CRRs stands for the difference between the money paid to CRR holders less the money charge to CRR holders to acquire that portfolio of CRRs in the auction. This does not take into account any expenses the CRR holders incur associated with their participation in the CRR market and use of money. This is only a net accounting balance from the point of view of the cash inflow and outflow in the CAISO system.

In order to further understand the origin of this poor performance, there is a need to estimate over time and by constraint the CRR settlements. Figure 134 shows the daily congestion rents accrued on each transmission constraint that was binding in the day-ahead market in the month of January. Correspondingly, Figure 135Figure 135 shows the daily CRR revenue adequacy also broken out by transmission constraint. In January, about $6.4 million of revenue deficiency was accrued on the Crosstrip transmission constraint alone, which accounts for over 60 percent of the total deficiency. Furthermore, an additional $1.8 million of deficiency accrued on the constraint *OMS 4622069 TL50003*. This constraint was indeed a constraint also associated to the Crosstrip constraint for

outage ID 4622069. When this constraint was enforced on January 29, the Crosstrip constraint was unenforced. Overall, the Crosstrip constraint drove about 80 percent of the revenue deficiency in January.

Figure 134: Daily congestion rents - January 2017

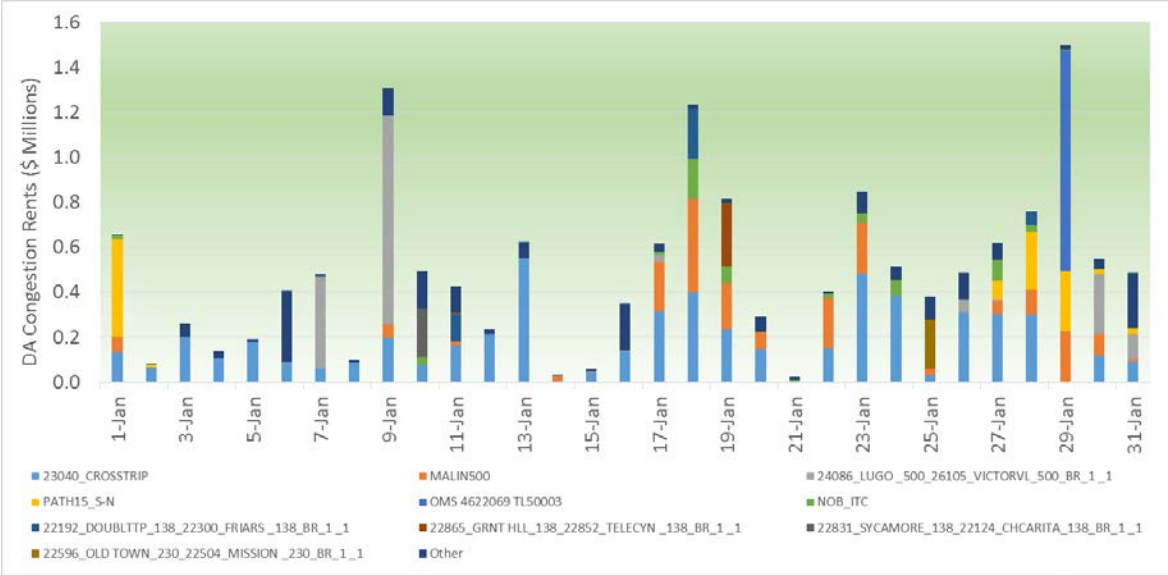


Figure 135: Daily CRR revenue adequacy - January 2017

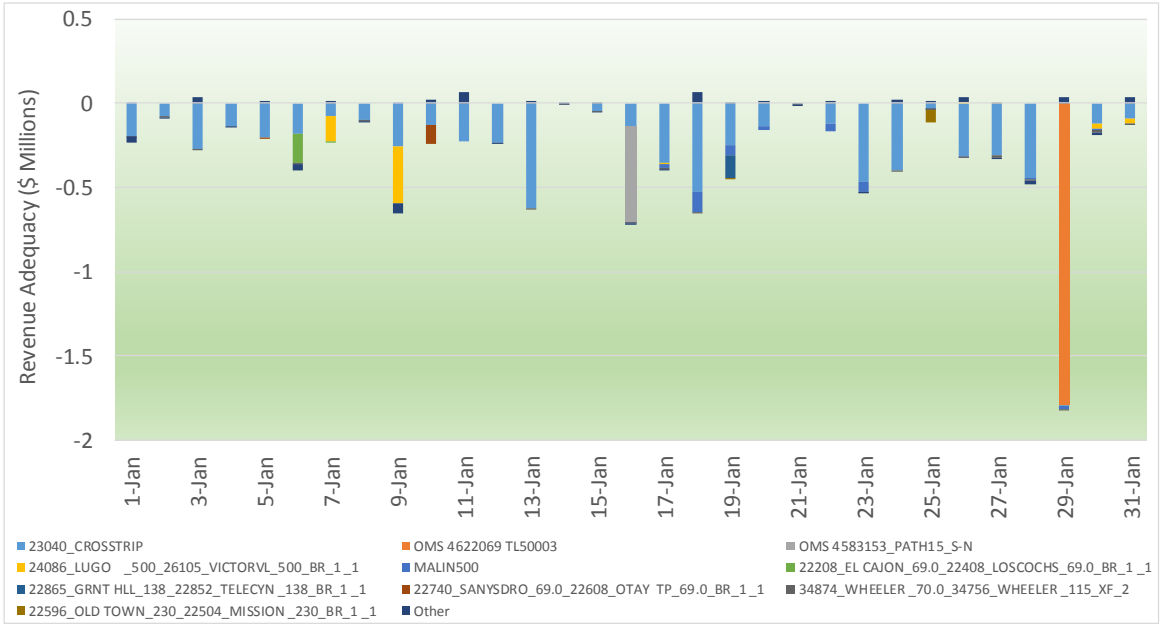
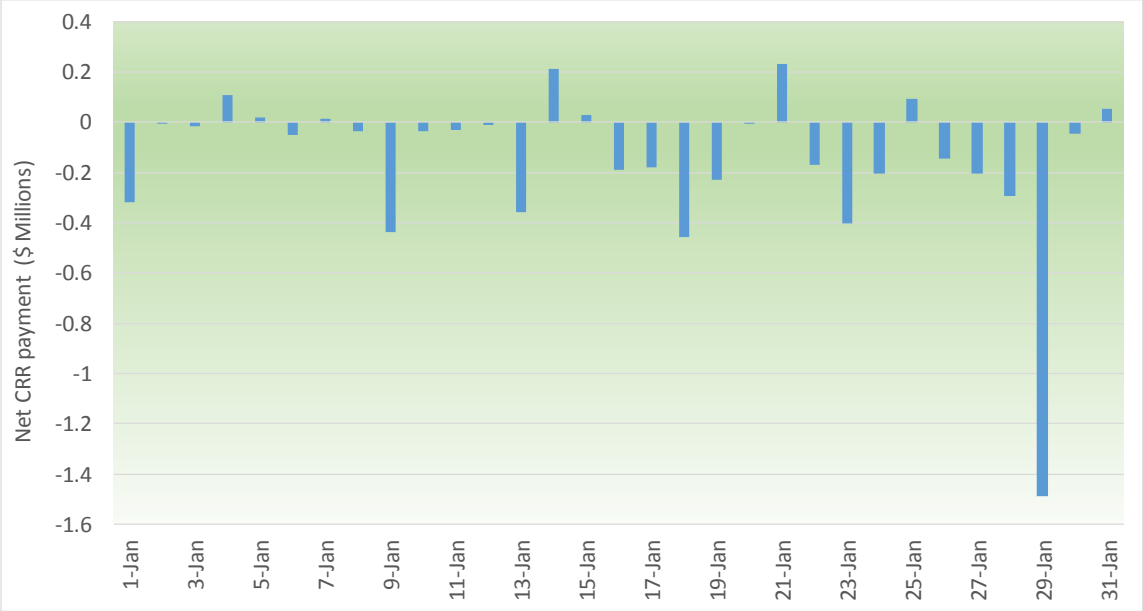


Figure 136 shows the net CRR payment per day. This net revenue is the difference between the CRR payments to CRR holders and the auction revenues collected by the CAISO through the CRR auction process; such revenues become a lump revenue for the auction. For this metric, the annual auction revenues are allocated on a pro-rata estimation to each day of the month based on the number of hours in each time of use. The CRR payments are estimated as the total sum of CRR payments over the hours of the

day only for CRRs that were released through both the annual and monthly CRR auction; that is, no CRR payments to allocated CRRs are included. The purpose of this estimate for net CRR payments is to calculate the net balance for CRR that were auction. For January, there was a persistent negative net CRR payment, indicating that overall the money paid to CRR holders was higher than the money the CAISO collected when releasing such CRRs in the annual and monthly auctions.

Figure 136: Daily net CRR payment to auction CRRs – January 2017

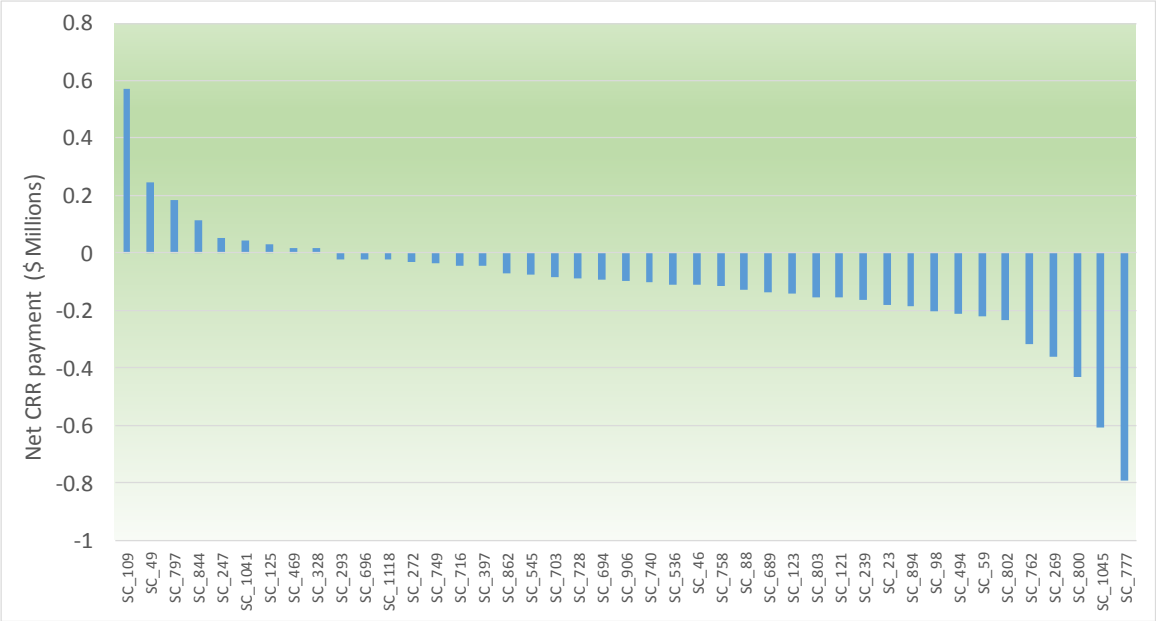


As shown in Figure 137, there is a strong correlation between the level of CRR revenue deficiency and the level of net CRR payments paid to holders of CRRs released in the auction processes. This is not surprising since both metrics reflect to some extent the effect of CRRs released (and priced) in the CRR auction and the capacity released (and priced) in the day-ahead market. A negative value for CRR revenue adequacy represents a shortfall for the CAISO, while a negative value for net CRR payment represents a payment to holders of auction CRRs from the CAISO, meaning the CAISO paid more to auction CRRs than it charged to release CRRs in the auction process.

Figure 137: Comparison of daily net CRR payment with CRR revenue adequacy – January 2017

Figure 138 shows the net CRR payments to CRR participants, regardless of the type of participant. This only reflects the payments for CRRs released in both the annual and monthly CRR auctions applicable for the month of January 2017. Since this is from the CAISO's perspective, a negative value means the CAISO disbursed a net CRR payment to the CRR holder (or a net money inflow to the CRR holder). The names of the CRR holders are masked, but the identifier shown in the plot is unique across all the months provided in this analysis. A positive value represents a net inflow for the CAISO since it settled less to CRR holders in the day-ahead market than what it charged to release CRRs in the auction. For January, the majority of holders of auction CRRs saw a net gain from having these positions.

Figure 138: Net CRR payment to auction CRR – January 2017



To better understand the dynamics leading to such an outcome, the CAISO shifted the analysis to the fundamentals of the CRR auction construct by analyzing the CRR auction results at the constraint level. CRRs are released and priced based on the CRR clearing prices; such prices are derived as the relative difference between locational prices between the source and the sink locations. These locational prices originate from the cleared prices when any transmission constraint becomes binding with nonzero pries in the CRR auction, commonly referred as *shadow prices*. The CAISO turned out to analyze what constraints have been binding in the CRR auction process and compared that with the set of constraints that were binding in the day-ahead market. To some extent, one expects that there is a certain level of alignment between the markets.

Figure 139 and Figure 140 show a comparison of net CRR payments. The CRR payments reflect the CRR settlements for CRRs with day-ahead congestion rents, while the CRR auction revenues is the money the CAISO collected from releasing CRRs through the auctions. That is, it reflects the net money participants were charged to acquire CRRs and the money they were paid; in a loose sense, it could be interpreted as profits for holding.

There are four possible permutations to analyze. The first case represents when a CRR payment to CRR holders was made in the day-ahead market settlement, but the CAISO did not collect any revenues from releasing these CRRs from the auctions because the constraint was not binding in the CRR auction. This is shown for both the pro-rata portion of the annual auction for January and for the monthly CRR auction. A negative value indicates that the CAISO had a net CRR payment to CRR holders. The second case is the opposite in which there was no CRR payments when settling CRRs in the day-ahead market but the CAISO collected revenue when releasing these CRRs in the auction process. The third and fourth cases are for CRRs that had a CRR payment in the day-ahead market and the CAISO also charged them in the CRR auctions to release these CRRs. The third case is when the net CRR payment is negative, while the fourth case is when the net CRR payment is positive. This metric reveals any potential misalignment of constrains enforced and binding between the day-ahead market and CRR auctions.

Figure 139: CRR payment versus CRR auction revenues for annual CRR - January 2017

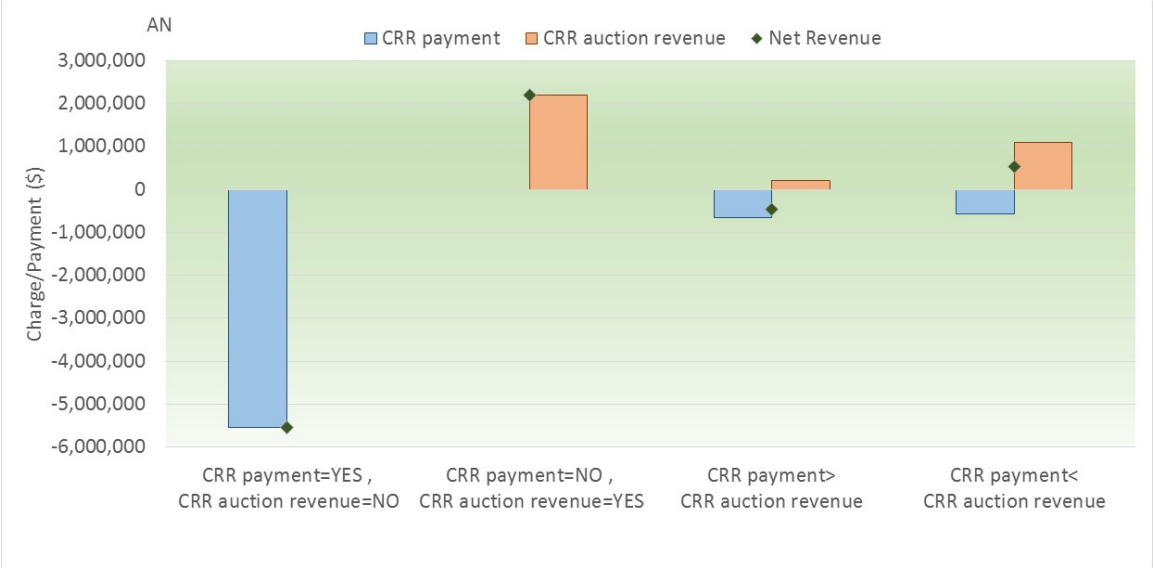


Figure 140: CRR payment versus CRR auction revenues for monthly CRR - January 2017

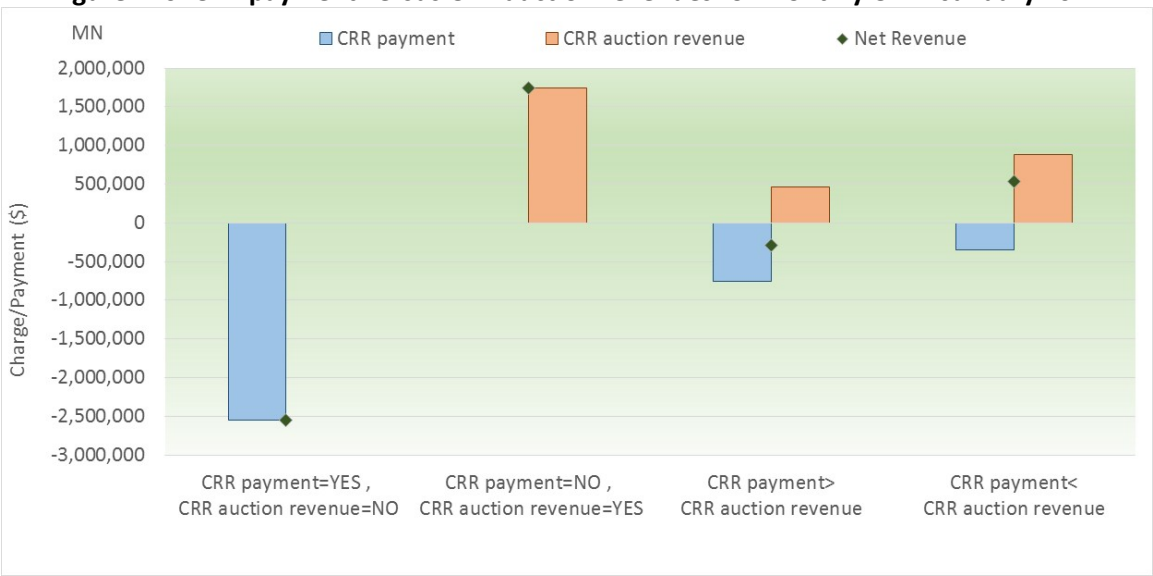


Table 25 provides one level deeper of understanding of such misalignments between markets. This tables shows the top and bottom constraints when sorted by net CRR payments. In the first column it shows the estimated CRR payment to CRR holders accrued in each constraint; the second column shows the revenues collected by the CAISO on that same constraint; the last column shows the net CRR payment, which is the balance between this money outflow (CRR payment) and money inflow (CRR auction revenues) from the CAISO's perspective. Table 26 shows the same information for CRRs released in the monthly auction for January 2017. The top constraints reflect cases where large CRR payments to auction CRRs accrued when the CRR market did not collect any auction revenues when releasing these CRRs.

Table 25: Net CRR payment by constraint - January 2017, annual auction

Constraints	Total CRR Payment	Total CRR Auction Revenue	Net CRR Payment
23040_CROSSTRIP	-$3,963,393.0	$0.0	-$3,963,393.0
OMS 4622069 TL50003	-$932,224.1	$0.0	-$932,224.1
24086_LUGO _500_26105_VICTORVL_500_BR_1 _1	-$383,394.1	$142,491.5	-$240,902.6
OMS 4583153_PATH15_S-N	-$155,226.2	$0.0	-$155,226.2
NOB_ITC	-$88,365.6	$0.0	-$88,365.6
35122_NWARK EF_115_35350_AMES BS _115_BR_2 _1	-$70,969.9	$0.0	-$70,969.9
22865_GRNT HLL_138_22852_TELECYN _138_BR_1 _1	-$59,520.8	$0.0	-$59,520.8
OMS_4444156_Path15_S_N	-$54,856.3	$0.0	-$54,856.3
22596_OLD TOWN_230_22504_MISSION _230_BR_1 _1	-$53,174.7	$0.0	-$53,174.7
32314_SMRTSVLE_60.0_32316_YUBAGOLD_60.0_BR_1 _1	-$51,468.6	$0.0	-$51,468.6
22192_DOUBLTTP_138_22300_FRIARS _138_BR_1 _1	-$47,812.0	$0.0	-$47,812.0
22208_EL CAJON_69.0_22408_LOSCOCHS_69.0_BR_1 _1	-$37,506.3	$0.0	-$37,506.3
22740_SANYSDRO_69.0_22608_OTAY TP_69.0_BR_1 _1	-$35,980.2	$0.0	-$35,980.2
HUMBOLDT_IMP_NG	-$47,107.2	$13,797.3	-$33,309.9
22256_ESCNDIDO_69.0_22724_SANMRCOS_69.0_BR_1 _1	-$39,189.7	$7,471.1	-$31,718.6
24085_LUGO _230_24086_LUGO _500_XF_1 _P	-$20,553.8	$0.0	-$20,553.8
30056_GATES2 _500_30060_MIDWAY _500_BR_2 _3	-$18,655.4	$0.0	-$18,655.4
31566_KESWICK _60.0_31582_STLLWATR_60.0_BR_1 _1	-$17,085.7	$0.0	-$17,085.7
Devers NORTH BUS OUTAGE NG	-$11,611.0	$0.0	-$11,611.0
31461_JESSTAP _115_31464_COTWDPGE_115_BR_1 _1	-$10,224.9	$0.0	-$10,224.9
PATH26_BG	$0.0	$29,150.5	$29,150.5
WSTWGMEAD_ITC	$0.0	$30,645.6	$30,645.6
PATH15_S-N	-$251,216.9	$286,182.7	$34,965.8
SYLMAR-AC_ITC	-$96.9	$35,162.0	$35,065.1
IID-SDGE_ITC	$0.0	$35,597.7	$35,597.7
BLYTHE_BG	$0.0	$37,852.9	$37,852.9
MSOLAR_XFMR_BG	$0.0	$39,200.3	$39,200.3
30005_ROUND MT_500_30245_ROUND MT_230_XF_1 _P	$0.0	$41,535.1	$41,535.1
PALOVRDE_ITC	$0.0	$46,109.2	$46,109.2
30515_WARNERVL_230_30800_WILSON _230_BR_1 _1	$0.0	$50,635.0	$50,635.0
30523_CC SUB _230_30525_C.COSTA _230_BR_1 _1	$0.0	$55,450.2	$55,450.2
22831_SYCAMORE_138_22832_SYCAMORE_230_XF_1	$0.0	$56,823.2	$56,823.2
22456_MIGUEL _69.0_22464_MIGUEL _230_XF_2	$0.0	$73,875.7	$73,875.7
22831_SYCAMORE_138_22124_CHCARITA_138_BR_1 _1	-$30,111.3	$129,564.6	$99,453.3
SDGE_CFEIMP_BG	$0.0	$112,447.0	$112,447.0
22828_SYCAMORE_69.0_22756_SCRIPPS _69.0_BR_1 _1	$0.0	$116,143.0	$116,143.0
22464_MIGUEL _230_22504_MISSION _230_BR_1 _1	$0.0	$127,891.3	$127,891.3
30750_MOSSLD _230_30790_PANOCHE _230_BR_1 _1	$0.0	$264,875.9	$264,875.9
MALIN500	-$382,095.7	$703,411.6	$321,315.8
24016_BARRE _230_25201_LEWIS _230_BR_1 _1	$0.0	$409,044.8	$409,044.8

Table 26: Net CRR payment by constraint - January 2017, monthly auction

Constraints	Total CRR Payment	Total CRR Auction Revenue	Net CRR Payment
23040_CROSSTRIP	-$1,769,340.9	$0.0	-$1,769,340.9
OMS 4622069 TL50003	-$312,298.1	$0.0	-$312,298.1
OMS 4583153_PATH15_S-N	-$121,071.5	$0.0	-$121,071.5
24086_LUGO _500_26105_VICTORVL_500_BR_1 _1	-$310,756.4	$197,327.1	-$113,429.3
22208_EL CAJON_69.0_22408_LOSCOCHS_69.0_BR_1 _1	-$62,323.8	$0.0	-$62,323.8
22865_GRNT HLL_138_22852_TELECYN _138_BR_1 _1	-$58,999.5	$0.0	-$58,999.5
22740_SANYSDRO_69.0_22608_OTAY TP_69.0_BR_1 _1	-$55,496.6	$0.0	-$55,496.6
OMS_4444156_Path15_S_N	-$48,200.7	$0.0	-$48,200.7
34874_WHEELER _70.0_34756_WHEELER _115_XF_2	-$47,149.8	$0.0	-$47,149.8
32214_RIO OSO _115_30330_RIO OSO _230_XF_2	-$34,813.3	$0.0	-$34,813.3
22596_OLD TOWN_230_22504_MISSION _230_BR_1 _1	-$31,150.3	$1,837.2	-$29,313.2
22831_SYCAMORE_138_22124_CHCARITA_138_BR_1 _1	-$20,177.5	$0.0	-$20,177.5
22192_DOUBLTTP_138_22300_FRIARS _138_BR_1 _1	-$17,717.8	$0.1	-$17,717.7
35122_NWARK EF_115_35350_AMES BS _115_BR_2 _1	-$16,335.7	$0.0	-$16,335.7
30056_GATES2 _500_30060_MIDWAY _500_BR_2 _3	-$15,953.5	$0.0	-$15,953.5
MALIN500	-$316,461.7	$302,864.1	-$13,597.6
22256_ESCNDIDO_69.0_22724_SANMRCOS_69.0_BR_1 _1	-$9,586.9	$204.3	-$9,382.7
Devers NORTH BUS OUTAGE NG	-$3,608.5	$0.0	-$3,608.5
32214_RIO OSO _115_30330_RIO OSO _230_XF_1	-$3,497.7	$0.0	-$3,497.7
24085_LUGO _230_24086_LUGO _500_XF_1 _P	-$1,867.6	$0.0	-$1,867.6
32314_SMRTSVLE_60.0_32316_YUBAGOLD_60.0_BR_1 _1	$17,398.7	$0.0	$17,398.7
22773_BAY BLVD_69.0_22604_OTAY _69.0_BR_2 _1	$0.0	$23,154.4	$23,154.4
MEAD_ITC	$0.0	$28,994.8	$28,994.8
30515_WARNERVL_230_30800_WILSON _230_BR_1 _1	$0.0	$29,547.3	$29,547.3
PATH26_BG	$0.0	$30,534.0	$30,534.0
MEADMKTPC_ITC	$0.0	$32,932.2	$32,932.2
MKTPCADLN_ITC	$0.0	$47,489.6	$47,489.6
22468_MIGUEL _500_22472_MIGUELMP_ 1.0_XF_80	$0.0	$47,860.2	$47,860.2
IID-SCE_BG	-$18,489.9	$68,353.6	$49,863.6
24016_BARRE _230_25201_LEWIS _230_BR_1 _1	$0.0	$57,802.4	$57,802.4
NdGrp_AGUCALG1_7_B1	$0.0	$86,411.8	$86,411.8
30040_TESLA _500_30042_METCALF _500_BR_1 _1	$0.0	$92,295.7	$92,295.7
22355_I VALLY2_230_22360_IMPRLVLY_500_XF_80	$0.0	$95,580.0	$95,580.0
PALOVRDE_ITC	$0.0	$95,930.4	$95,930.4
NdGrp_MISSION_2_N035	$0.0	$97,409.7	$97,409.7
22831_SYCAMORE_138_22832_SYCAMORE_230_XF_1	$0.0	$139,965.1	$139,965.1
NORTHGILA500_BG	$0.0	$145,443.3	$145,443.3
NOB_ITC	-$64,306.1	$239,213.1	$174,907.0
SDGE_CFEIMP_BG	$0.0	$185,696.2	$185,696.2
PATH15_S-N	-$342,401.2	$541,518.5	$199,117.2

These two tables illustrate instances of constraint misalignment between the CRR auctions and the day-ahead market. To understand this mismatch one level deeper, Table 27 lists the subset of constraints that are not binding or not enforced in the CRR monthly auction or that have a significant CRR payment. The portion that were paid only to CRRs from the annual and monthly auctions is also provided. Then it compares the average transmission limit used in the day-ahead market and the limits actually used in both the annual and monthly auctions. These are the constraints that will mostly drive the

divergence between the day-ahead and CRR markets. One of the cornerstones of the CRR market efficiency is for the CRR market to closely reflect the transmission capacity of the day-ahead market. When the transmission capacity released in the CRR market is less than that of the day-ahead market, there may be an exposure of revenue deficiency. This may also have a fair impact on the level of CRR net payments and how transmission capacity is valued in the CRR auction. This occurs because when CRRs are released in the auction process they are priced on the value of the capacity made available, or on the lack of it. A systemic issue identified during the evaluation of the CRR auction efficiency is that multiple transmission constraints are not modelled or enforced in the CRR auctions.

In cases where the constraint was enforced in the day-ahead market but not modelled or enforced in the CRR auctions, the amount of transmission capacity by means of CRRs that may be released on that constraints is effectively unbounded, which indicates that more transmission capacity may be released in the CRR auction than in the day-ahead market. This is a major problem to the efficiency of the CRR market. For the case of January 2017 and relative to other months analyzed, there were relatively few instances of constraints not enforced in the CRR auctions. In such cases the level of congestion rents and CRR payments were relatively modest, such that even with the misalignment, the financial impact was low. In further investigating why these constraints were not modelled/enforced in the CRR auctions, the common factors are related to how outages were considered and when transmission constraints were enforced in the CRR auction.

1. Constraint 23040_CROSSTRIP. It started to be enforced on December 27, 2016 due to an upgrade of procedure 7820, which required more generation to be re-dispatched in the market. By the time it was enforced in the day-ahead market, both the annual and monthly CRR auctions for January 2017 had already been run. This outage lasted less than 24 hours.
2. Constraint OMS 4622069 TL50003. The outage (4622069) that required the enforcement of this nomogram was submitted on January 27, 2017 to be effective on January 2017. By this time, the monthly CRR auction (and annual auction as well) has already run. The enforcement of this constraint required the un-enforcement of constraint 23040_CROSSTRIP.
3. Constraint OMS 4583153_PATH15_S-N. The outage (4583153) that required this nomogram to be created and enforced was submitted on 1/12/17 for start date of 1/16/17; this was to late submission to be considered in the annual and monthly auctions.
4. Constraint 22208_EL CAJON_69.0_22408_LOSCOCHS_69.0_BR_1 _1. The outage 4365195 was picked up in the CRR outage review but the enforcement of flowgate 22208_EL CAJON_69.0_22408_LOSCOCHS_69.0_BR_1 _1 was added after the CRR model cutoff. This outage lasted more than 24 hours but less than 10 days and was submitted in time.
5. Constraint 34874_WHEELER _70.0_34756_WHEELER _115_XF_2. Outage 4452779 was picked up in the CRR outage review and was set for enforcement in the January CRR model. During the process of putting it into the CRR model this

transformer was inadvertently excluded. The process picked it up correctly, but the manual data entry was missed.

6. Constraint 22740_SANYSDRO_69.0_22608_OTAY TP_69.0_BR_1 _1. Outage 4529499 submitted on 12/20 and 4563688 submitted on 1/5, both were too late to be included in CRR model. These outages lasted less than 24 hours.
7. Constraint OMS_4444156_Path15_S_N. This outage was picked up in the CRR outage review but at the time of the CRR review the market impacts were not known. Nomograms added after CRR model cutoff.
8. Constraint Devers NORTH BUS OUTAGE NG. Outage 4347088 was picked up in the CRR outage review but at the time of the CRR review the market impacts were not known. Nomogram was added after the CRR model cutoff. This outage lasted less than 24 hours and was submitted in time.

Table 27: Top constraints binding in the day-ahead market not binding in CRR market - January 2017

Constraint	Constraint Type	TOU	Payment to Annual CRR	Payments to monthly CRR	DAM limit	Annual CRR Limit	Monthly CRR Limit	Annual CRR Status	Monthly CRR Status	Reason
23040_CROSSTRIP	NOMOGRAM	ON	-$3,297,367.0	-$1,594,164.9	433.8	Unbounded	Unbounded	Not Enforced	Not Enforced	Late Enforcement
OMS 4622069 TL50003	NOMOGRAM	OFF	-$932,224.1	-$312,298.1	450.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missed Outage
23040_CROSSTRIP	NOMOGRAM	OFF	-$666,026.0	-$175,176.0	435.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late Enforcement
OMS 4583153_PATH15_S-N	NOMOGRAM	ON	-$155,226.2	-$121,071.5	1250.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missed Outage
22865_GRNT HLL_138_22852_TELECYN _138_BR_1 _1	FLOWGATE	ON	-$59,520.8	-$58,999.5	420.2	303.8	250.6	Not Binding	Not Binding	Auction economics
22208_EL CAJON_69.0_22408_LOSCOCHS_69.0_BR_1 _1	FLOWGATE	ON	-$37,506.3	-$62,323.8	69.6	Unbounded	Unbounded	Not Enforced	Not Enforced	Late Enforcement
34874_WHEELER _70.0_34756_WHEELER _115_XF_2	FLOWGATE	ON	-$1,214.1	-$33,285.1	70.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Missed Enforcement
35122_NWARK EF_115_35350_AMES BS _115_BR_2 _1	FLOWGATE	ON	-$70,969.9	-$16,335.7	111.4	106.0	87.4	Not Binding	Not Binding	Auction economics
32214_RIO OSO _115_30330_RIO OSO _230_XF_2	FLOWGATE	ON	$7,692.1	-$34,813.3	146.4	127.4	105.1	Not Binding	Not Binding	Auction economics
22831_SYCAMORE_138_22124_CHCARITA_138_BR_1 _1	FLOWGATE	ON	-$30,111.3	-$20,177.5	206.8	194.0	160.1	Binding	Not Binding	Auction economics
OMS_4444156_Path15_S_N	NOMOGRAM	ON	-$54,856.3	-$48,200.7	2950.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missed Outage
22740_SANYSDRO_69.0_22608_OTAY TP_69.0_BR_1 _1	FLOWGATE	ON	-$35,980.2	-$55,496.6	53.6	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missed Outage
24085_LUGO _230_24086_LUGO _500_XF_1 _P	FLOWGATE	ON	-$20,553.8	-$1,867.6	1326.3	1064.7	878.4	Not Binding	Not Binding	Auction economics
30056_GATES2 _500_30060_MIDWAY _500_BR_2 _3	FLOWGATE	ON	-$18,655.4	-$15,953.5	1897.3	2469.7	1514.4	Not Binding	Not Binding	Auction economics
32314_SMRTSVLE_60.0_32316_YUBAGOLD_60.0_BR_1 _1	FLOWGATE	OFF	-$30,171.4	$12,576.6	33.2	35.4	29.2	Not Binding	Not Binding	Auction economics
30300_TABLMTN _230_30066_TB MT 1M_ 1.0_XF_1	FLOWGATE	OFF	$0.0	$0.0	1118.1	1066.6	879.9	Not Binding	Not Binding	Auction economics
34874_WHEELER _70.0_34756_WHEELER _115_XF_2	FLOWGATE	OFF	-$7,047.8	-$13,864.7	70.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Missed Enforcement
31566_KESWICK _60.0_31582_STLLWATR_60.0_BR_1 _1	FLOWGATE	ON	-$17,085.7	-$1,561.6	33.5	35.4	29.2	Not Binding	Not Binding	Auction economics
32314_SMRTSVLE_60.0_32316_YUBAGOLD_60.0_BR_1 _1	FLOWGATE	ON	-$21,297.2	$4,822.1	32.4	35.4	29.2	Not Binding	Not Binding	Auction economics
31461_JESSTAP _115_31464_COTWDPGE_115_BR_1 _1	FLOWGATE	ON	-$10,224.9	-$1,509.1	76.2	75.8	62.5	Not Binding	Not Binding	Auction economics
Devers NORTH BUS OUTAGE NG	NOMOGRAM	ON	-$11,611.0	-$3,608.5	351.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missed Outage

February 2017

Table 28 summarizes the main settlements metrics for CRR performance in the month of February 2017. The sign convention is based from the CAISO's perspective; a positive value indicates the CAISO collects or has a surplus of money; a negative value indicates the CAISO pays or has a shortfall. Day-ahead congestion rents will be positive, CRR payments will be negative and auction revenues will be positive.

Table 28: Summary of CRR performance for February 2017

Metric	Amount
DA Congestion Rents	$13,909,669
Perfect Hedge	-$560,580
CRR Clawback	$64,684
CRR Payments [Auction + Allocation]	-$19,907,010
CRR Payments to Auction CRRs	-$9,749,790
CRR Payments to Monthly Auction CRRs	-$4,101,152
CRR Payments to Annual Auction CRRs	-$5,648,638
CRR Payments to Allocation CRRs	-$10,157,220
CRR Auction Revenue Monthly	$2,348,850
CRR Auction Revenue Annual	$3,286,084
Revenue Adequacy	-$6,493,237
Revenue Adequacy with Auction Revenues	-$858,303
Net payment to auction CRR	-$4,114,856

In February, the overall CRR performance was poor since there was a revenue deficiency of $6.4 million, which is the difference between all of the proceeds from day-ahead congestion rents, CRR clawback and the payments made to CRR holders. About 49 percent of the CRR payments were to CRRs originated from the annual and monthly auctions. The auction revenues represent the proceeds from selling CRRs through the auction. The revenues arising from the annual auction for each season are estimated pro-rata to each month of the calendar quarter based on the number of hours in each time of use. The net payment to auction CRRs stands for the difference between the money paid to CRR holders less the money charge to CRR holders to acquire that portfolio of CRRs in the auction. This does not take into account any expenses the CRR holders incur associated with their participation in the CRR market and use of money. This is only a net accounting balance from the point of view of the cash inflow and outflow in the CAISO system.

In order to further understand the origin of this poor performance, there is a need to estimate over time and by constraint the CRR settlements. Figure 141 shows the daily congestion rents accrued on each transmission constraint that was binding in the day-ahead market in the month of February. Correspondingly, Figure 142 shows the daily CRR revenue adequacy also broken out by transmission constraint. In February, about $2 million of revenue deficiency was accrued on the constraint *7820_TL23040_IV_SPS_NG*. This constraint was added to the CRR model in February but was called

23040_CROSSTRIP_NG when it was first set up and was later changed to *7820_TL23040_IV_SPS_NG.* The Crosstrip constraint alone accrued about $0.5 million of revenue deficiency in February.

Figure 141: Daily Congestion rents - February 2017

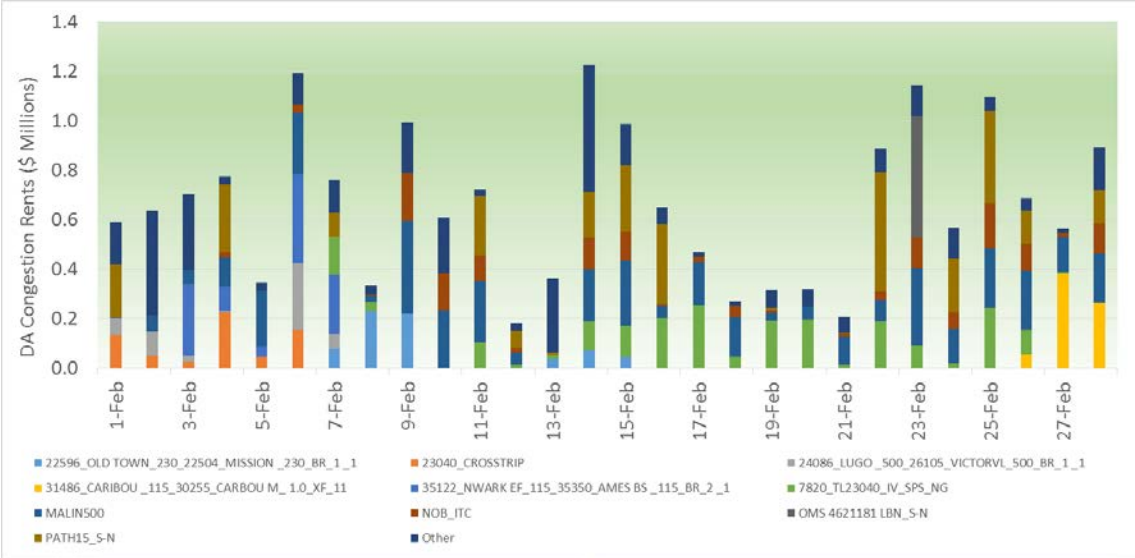


Figure 142: Daily CRR revenue adequacy - February 2017

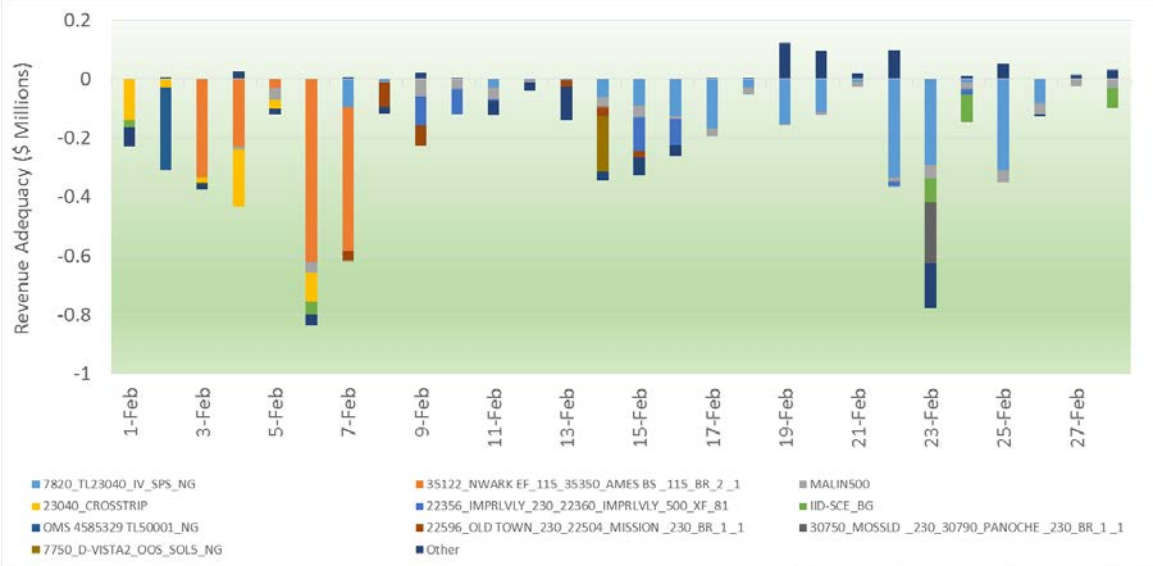


Figure 143 shows the net CRR payment per day. This net revenue is the difference between the CRR payments to CRR holders and the auction revenues collected by the CAISO through the CRR auction process; such revenues become a lump revenue for the auction. For this metric, the annual auction revenues are allocated on a pro-rata estimation to each day of the month based on the number of hours in each time of use. The CRR payments are estimated as the total sum of CRR payments over the hours of the day only for CRRs that were released through both the annual and monthly CRR auction; that is, no CRR payments to allocated CRRs are included. The purpose of this estimate for

net CRR payments is to calculate the net balance for CRR that were auction. For February, there was a persistent negative net CRR payment, indicating that overall the money paid to CRR holders was higher than the money the CAISO collected when releasing such CRRs in the annual and monthly auctions.

Figure 143: Daily net CRR payment to auction CRRs – February 2017

As shown in Figure 144 , there is a strong correlation between the level of CRR revenue deficiency and the level of net CRR payments paid to holders of CRRs released in the auction processes. This is not surprising since both metrics reflect to some extent the effect of CRRs released (and priced) in the CRR auction and the capacity released (and priced) in the day-ahead market. A negative value for CRR revenue adequacy represents a shortfall for the CAISO, while a negative value for net CRR payment represents a payment to holders of auction CRRs from the CAISO, meaning the CAISO paid more to auction CRRs than it charged to release CRRs in the auction process.

Figure 144: Comparison of daily net CRR payment with CRR revenue adequacy – February 2017

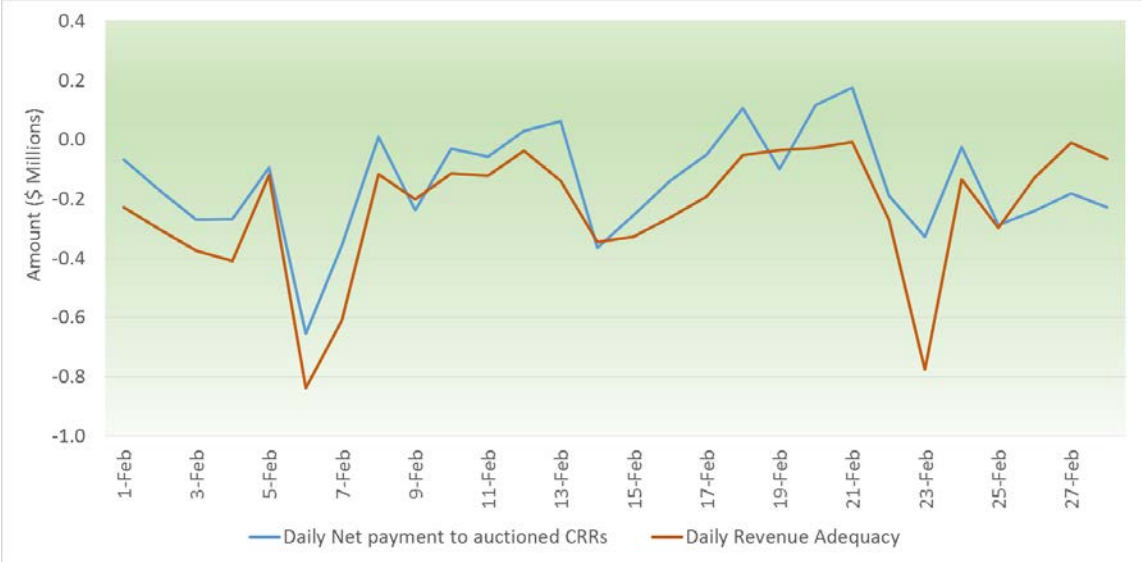
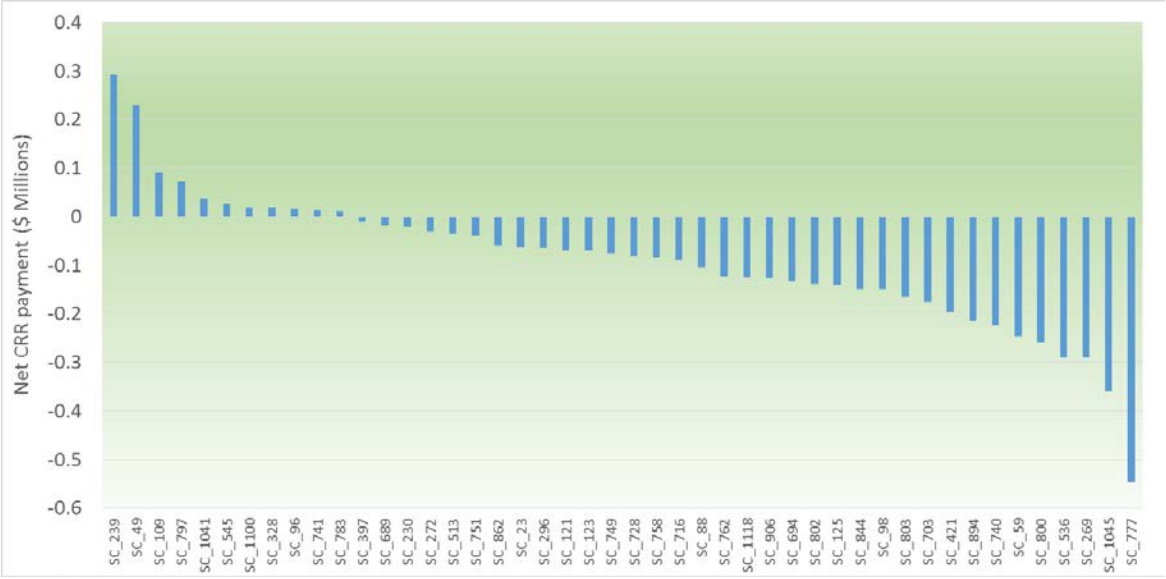


Figure 145 shows the net CRR payments to CRR participants, regardless of the type of participant. This only reflects the payments for CRRs released in both the annual and monthly CRR auctions applicable for the month of February 2017. Since this is from the CAISO's perspective, a negative value means the CAISO disbursed a net CRR payment to the CRR holder (or a net money inflow to the CRR holder). The names of the CRR holders are masked, but the identifier shown in the plot is unique across all the months provided in this analysis. A positive value represents a net inflow for the CAISO since it settled less to CRR holders in the day-ahead market than what it charged to release CRRs in the auction. For February, the majority of holders of auction CRRs saw a net gain from having these positions.

Figure 145: Net CRR payment to auction CRR – February 2017



To better understand the dynamics leading to such an outcome, the CAISO shifted the analysis to the fundamentals of the CRR auction construct by analyzing the CRR auction results at the constraint level. CRRs are released and priced based on the CRR clearing prices; such prices are derived as the relative difference between locational prices between the source and the sink locations. These locational prices originate from the cleared prices when any transmission constraint becomes binding with nonzero pries in the CRR auction, commonly referred as *shadow prices*. The CAISO turned out to analyze what constraints have been binding in the CRR auction process and compared that with the set of constraints that were binding in the day-ahead market. To some extent, one expects that there is a certain level of alignment between the markets.

Figure 146 and Figure 147 show a comparison of net CRR payments. The CRR payments reflect the CRR settlements for CRRs with day-ahead congestion rents, while the CRR auction revenues is the money the CAISO collected from releasing CRRs through the auctions. That is, it reflects the net money participants were charged to acquire CRRs and the money they were paid; in a loose sense, it could be interpreted as profits for holding.

There are four possible permutations to analyze. The first case represents when a CRR payment to CRR holders was made in the day-ahead market settlement, but the CAISO did not collect any revenues from releasing these CRRs from the auctions because the constraint was not binding in the CRR auction. This is shown for both the pro-rata portion of the annual auction for January and for the monthly CRR auction. A negative value indicates that the CAISO had a net CRR payment to CRR holders. The second case is the opposite in which there was no CRR payments when settling CRRs in the day-ahead market but the CAISO collected revenue when releasing these CRRs in the auction process. The third and fourth cases are for CRRs that had a CRR payment in the day-ahead market and the CAISO also charged them in the CRR auctions to release these CRRs. The third case is when the net CRR payment is negative, while the fourth case is when the net CRR payment is positive. This metric reveals any potential misalignment of constrains enforced and binding between the day-ahead market and CRR auctions.

Figure 146: CRR payment versus CRR auction revenues for annual CRR - February 2017

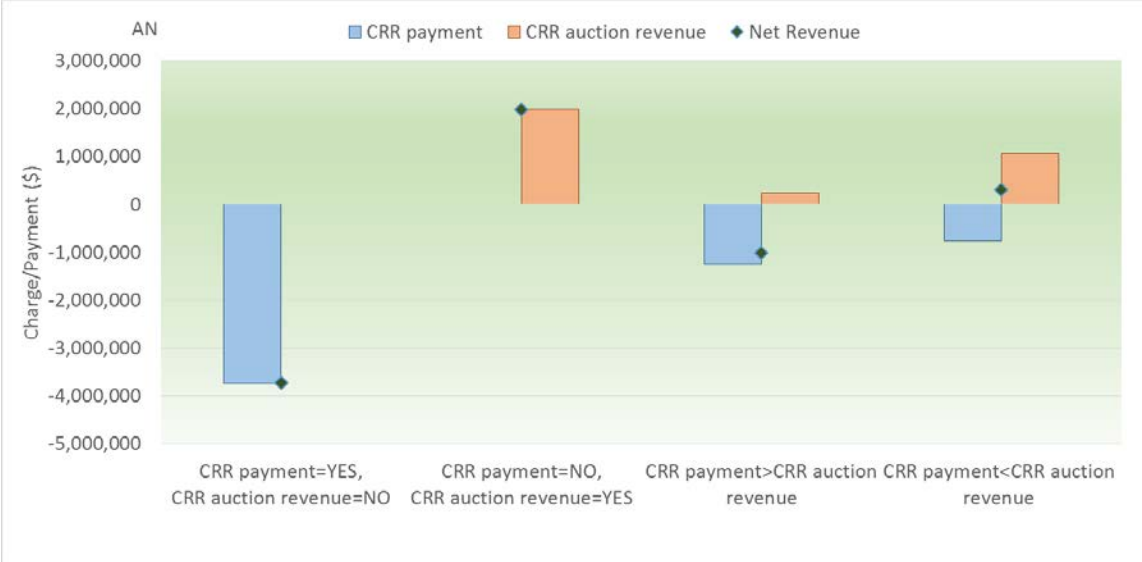


Figure 147: CRR payment versus CRR auction revenues for monthly CRR - February 2017

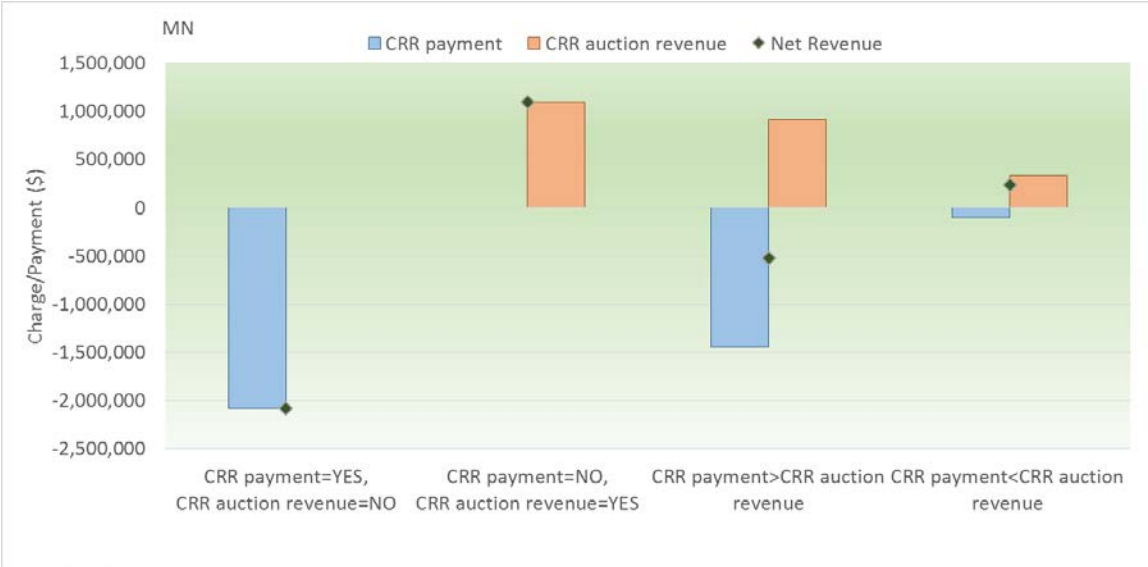


Table 29 provides one level deeper of understanding of such misalignments between markets. This tables shows the top and bottom constraints when sorted by net CRR payments. In the first column it shows the estimated CRR payment to CRR holders accrued in each constraint; the second column shows the revenues collected by the CAISO on that same constraint; the last column shows the net CRR payment, which is the balance between this money outflow (CRR payment) and money inflow (CRR auction revenues) from the CAISO's perspective. Table 30 shows the same information for CRRs released in the monthly auction February 2017. The top constraints reflect cases where large CRR payments to auction CRRs accrued when the CRR market did not collect any auction revenues when releasing these CRRs.

Table 29: Net CRR payment by constraint - February 2017, annual auction

Constraints	Total CRR Payment	Total CRR Auction Revenue	Net CRR Payment
7820_TL23040_IV_SPS_NG	-$1,156,252.8	$0.0	-$1,156,252.8
35122_NWARK EF_115_35350_AMES BS _115_BR_2 _1	-$898,747.4	$0.0	-$898,747.4
PATH15_S-N	-$876,463.7	$265,109.3	-$611,354.4
23040_CROSSTRIP	-$326,493.5	$0.0	-$326,493.5
22356_IMPRLVLY_230_22360_IMPRLVLY_500_XF_81	-$317,575.7	$0.0	-$317,575.7
NOB_ITC	-$265,244.1	$0.0	-$265,244.1
7750_D-VISTA2_OOS_SOL5_NG	-$196,651.4	$0.0	-$196,651.4
22596_OLD TOWN_230_22504_MISSION _230_BR_1 _1	-$174,714.8	$0.0	-$174,714.8
OMS 4621181 LBN_S-N	-$159,164.8	$0.0	-$159,164.8
OMS 4585329 TL50001_NG	-$121,341.9	$0.0	-$121,341.9
22192_DOUBLTTP_138_22300_FRIARS _138_BR_1 _1	-$106,403.1	$0.0	-$106,403.1
31486_CARIBOU _115_30255_CARBOU M_ 1.0_XF_11	-$52,520.8	$0.0	-$52,520.8
31658_BANGOR _60.0_32308_COLGATE _60.0_BR_1 _1	-$48,110.5	$0.0	-$48,110.5
HUMBOLDT_IMP_NG	-$57,821.8	$13,120.9	-$44,700.8
IPPUTAH_ITC	-$70,328.2	$30,755.5	-$39,572.6
7750_D-VISTA2_OOS_SOL6_NG	-$39,131.2	$0.0	-$39,131.2
OMS 4608811 MG_BK80_NG	-$35,039.7	$0.0	-$35,039.7
7820_TL 230S_OVERLOAD_NG	-$31,001.2	$0.0	-$31,001.2
OMS 4436916_PATH15_S-N	-$29,036.7	$0.0	-$29,036.7
31580_CASCADE _60.0_31581_OREGNTRL_60.0_BR_1 _1	-$20,627.2	$0.0	-$20,627.2
PATH26_BG	$0.0	$27,721.5	$27,721.5
WSTWGMEAD_ITC	$0.0	$27,953.9	$27,953.9
SYLMAR-AC_ITC	$0.0	$33,006.3	$33,006.3
IID-SDGE_ITC	$0.0	$33,234.5	$33,234.5
BLYTHE_BG	$0.0	$35,997.3	$35,997.3
MSOLAR_XFMR_BG	$0.0	$37,278.7	$37,278.7
30005_ROUND MT_500_30245_ROUND MT_230_XF_1 _P	$0.0	$38,503.9	$38,503.9
PALOVRDE_ITC	$0.0	$40,811.1	$40,811.1
30515_WARNERVL_230_30800_WILSON _230_BR_1 _1	$0.0	$43,702.8	$43,702.8
30523_CC SUB _230_30525_C.COSTA _230_BR_1 _1	$0.0	$51,965.9	$51,965.9
22831_SYCAMORE_138_22832_SYCAMORE_230_XF_1	$0.0	$54,037.8	$54,037.8
22456_MIGUEL _69.0_22464_MIGUEL _230_XF_2	$0.0	$67,898.1	$67,898.1
24087_MAGUNDEN_230_24153_VESTAL _230_BR_1 _1	$79,576.7	$0.0	$79,576.7
MALIN500	-$553,511.9	$645,766.4	$92,254.4
SDGE_CFEIMP_BG	$0.0	$106,370.7	$106,370.7
22828_SYCAMORE_69.0_22756_SCRIPPS _69.0_BR_1 _1	$0.0	$109,361.5	$109,361.5
22464_MIGUEL _230_22504_MISSION _230_BR_1 _1	$0.0	$121,622.2	$121,622.2
22831_SYCAMORE_138_22124_CHCARITA_138_BR_1 _1	$0.0	$122,527.7	$122,527.7
30750_MOSSLD _230_30790_PANOCHE _230_BR_1 _1	-$67,220.9	$249,365.8	$182,145.0
24016_BARRE _230_25201_LEWIS _230_BR_1 _1	$0.0	$387,946.0	$387,946.0

Table 30: Net CRR payment by constraint - February 2017, monthly auction

Constraints	Total CRR Payment	Total CRR Auction Revenue	Net CRR Payment
31486_CARIBOU _115_30255_CARBOU M_ 1.0_XF_11	-$536,743.4	$0.0	-$536,743.4
7820_TL23040_IV_SPS_NG	-$480,755.6	$0.0	-$480,755.6
35122_NWARK EF_115_35350_AMES BS _115_BR_2 _1	-$349,222.1	$0.0	-$349,222.1
MALIN500	-$829,944.0	$547,067.4	-$282,876.6
22596_OLD TOWN_230_22504_MISSION _230_BR_1 _1	-$168,688.1	$0.0	-$168,688.1
23040_CROSSTRIP	-$148,788.7	$0.1	-$148,788.6
IID-SCE_BG	-$146,036.6	$25,198.4	-$120,838.2
7750_D-VISTA2_OOS_SOL5_NG	-$120,429.3	$0.0	-$120,429.3
OMS 4585329 TL50001_NG	-$76,276.8	$0.0	-$76,276.8
22356_IMPRLVLY_230_22360_IMPRLVLY_500_XF_81	-$47,001.7	$0.0	-$47,001.7
22192_DOUBLTTP_138_22300_FRIARS _138_BR_1 _1	-$54,083.9	$14,072.3	-$40,011.6
OMS 4621181 LBN_S-N	-$37,503.6	$0.0	-$37,503.6
OMS 4608811 MG_BK80_NG	-$24,718.7	$0.0	-$24,718.7
31658_BANGOR _60.0_32308_COLGATE _60.0_BR_1 _1	-$23,925.3	$0.0	-$23,925.3
22208_EL CAJON_69.0_22408_LOSCOCHS_69.0_BR_1 _1	-$20,079.0	$0.0	-$20,079.0
22865_GRNT HLL_138_22852_TELECYN _138_BR_1 _1	-$17,222.8	$0.0	-$17,222.8
31580_CASCADE _60.0_31581_OREGNTRL_60.0_BR_1 _1	-$16,126.2	$156.8	-$15,969.4
32214_RIO OSO _115_32244_BRNSWKT2_115_BR_2 _1	-$15,502.1	$0.0	-$15,502.1
7820_TL 230S_OVERLOAD_NG	-$15,500.4	$0.0	-$15,500.4
22597_OLDTWNTP_230_22504_MISSION _230_BR_1 _1	-$12,588.6	$0.0	-$12,588.6
PATH15_S-N	-$227,204.3	$245,115.3	$17,911.0
HUMBOLDT_IMP_NG	$20,035.0	$3.2	$20,038.2
NdGrp_POD_IVWEST_2_SOLAR1-APND	$0.0	$20,543.6	$20,543.6
PARKER_ITC	$0.0	$21,123.0	$21,123.0
PATH26_BG	$0.0	$23,861.5	$23,861.5
NdGrp_AGUCALG1_7_B1	$0.0	$24,623.5	$24,623.5
PALOVRDE_ITC	$0.0	$25,446.9	$25,446.9
PARKER_BG	$0.0	$25,786.2	$25,786.2
30515_WARNERVL_230_30800_WILSON _230_BR_1 _1	$0.0	$26,420.7	$26,420.7
WSTWGMEAD_ITC	$0.0	$27,700.1	$27,700.1
NdGrp_POD_CNTNLA_2_SOLAR1-APND	$0.0	$31,146.8	$31,146.8
22773_BAY BLVD_69.0_22604_OTAY _69.0_BR_2 _1	$0.0	$32,035.6	$32,035.6
NdGrp_POD_CPVERD_2_SOLAR-APND	$0.0	$35,317.6	$35,317.6
24087_MAGUNDEN_230_24153_VESTAL _230_BR_1 _1	$36,964.8	$1,656.5	$38,621.4
NdGrp_POD_IVSLRP_2_SOLAR1-APND	$0.0	$46,845.1	$46,845.1
IPPDCADLN_ITC	$59,194.2	$0.0	$59,194.2
30040_TESLA _500_30042_METCALF _500_BR_1 _1	$0.0	$70,485.8	$70,485.8
24016_BARRE _230_25201_LEWIS _230_BR_1 _1	$0.0	$99,078.3	$99,078.3
24086_LUGO _500_26105_VICTORVL_500_BR_1 _1	-$89,195.7	$203,431.8	$114,236.1
NORTHGILA500_BG	$0.0	$197,695.9	$197,695.9

These two tables illustrate instances of constraint misalignment between the CRR auctions and the day-ahead market. To understand this mismatch one level deeper, Table 31 lists the subset of constraints that are not binding or not enforced in the CRR monthly auction or that have a significant CRR payment. The portion that were paid only to CRRs from the annual and monthly auctions is also provided. Then it compares the average transmission limit used in the day-ahead market and the limits actually used in

both the annual and monthly auctions. These are the constraints that will mostly drive the divergence between the day-ahead and CRR markets. One of the cornerstones of the CRR market efficiency is for the CRR market to closely reflect the transmission capacity of the day-ahead market. When the transmission capacity released in the CRR market is less than that of the day-ahead market, there may be an exposure of revenue deficiency. This may also have a fair impact on the level of CRR net payments and how transmission capacity is valued in the CRR auction. This occurs because when CRRs are released in the auction process they are priced on the value of the capacity made available, or on the lack of it. A systemic issue identified during the evaluation of the CRR auction efficiency is that multiple transmission constraints are not modelled or enforced in the CRR auctions.

In cases where the constraint was enforced in the day-ahead market but not modelled or enforced in the CRR auctions, the amount of transmission capacity by means of CRRs that may be released on that constraints is effectively unbounded, which indicates that more transmission capacity may be released in the CRR auction than in the day-ahead market. This is a major problem to the efficiency of the CRR market. For the case of February 2017 and relative to other months analyzed, there were relatively few instances of constraints not enforced in the CRR auctions. In such cases the level of congestion rents and CRR payments were relatively modest, such that even with the misalignment, the financial impact was low. In further investigating why these constraints were not modelled/enforced in the CRR auctions, the common factors are related to how outages were considered and when transmission constraints were enforced in the CRR auction.

1. Constraint 7820_TL23040_IV_SPS_NG. This constraint was added to the CRR model in February but it was called "23040_CROSSTRIP_NG" when it was first set up. It was later changed to "7820_TL23040_IV_SPS_NG" in the April CRR model.
2. Constraint OMS 4585329 TL50001_NG. Outage 4585329 received by the CAISO after CRR model cutoff date. This outage lasted less than 24 hours.
3. Constraint 31486_CARIBOU _115_30255_CARBOU M_ 1.0_XF_11. No outage associated with this line was included in the list of CRR outages. This constraint is not part of the normally enforced list from 3610B version that was used for the February 2017 CRR model.
4. Constraint 7750_D-VISTA2_OOS_SOL5_NG. For outage 4358200 the market impacts of adding this nomogram were not included in the outage card until after the CRR model cutoff date. Outage 4649742 received after CRR model cutoff date. The first outage lasted more than 24 hours but less than 10 days and was submitted in time, while the second lasted less than 24 hours.
5. Constraint OMS 4621181 LBN_S-N. Outage 4621181 received by the CAISO after CRR model cutoff date.
6. Constraint OMS 4608811 MG_BK80_NG. Outage 4608811 received by CAISO after CRR model cutoff date.
7. Constraint 22208_EL CAJON_69.0_22408_LOSCOCHS_69.0_BR_1 _1. All outages listed that were associated with this device (4602629, 4609444, 4614650, 4652453) were received by the CAISO after the CRR model cutoff date. This element is not part of the normally enforced list from 3610B version that was

used for the February 2017 CRR model. All outages but one lasted less than 24 hours.

8. Constraint OMS 4436916_PATH15_S-N. For outage 4436916 the market impacts of adding this nomogram were not included in the outage card until after the CRR model cutoff date. This outage lasted more than 24 hours but less than 10 days and was submitted in time.

Table 31: Top constraints binding in the day-ahead market not binding in CRR market - February 2017

Constraint	Constraint Type	TOU	Payment to Annual CRR	Payment to Monthly CRR	DAM Limit	Annual CRR Limit	Monthly CRR Limit	Annual CRR Status	Monthly CRR Status	Reason
7820_TL23040_IV_SPS_NG	NOMOGRAM	ON	$880,577.2	$376,883.3	453.4	Unbounded	Unbounded	Not Enforced	Not Enforced	Late Enforcement
35122_NWARK EF_115_35350_AMES BS _115_BR_2 _1	FLOWGATE	ON	$854,331.6	$343,169.6	87.2	106.0	87.4	Not Binding	Not Binding	Higher Limit
22596_OLD TOWN_230_22504_MISSION _230_BR_1 _1	FLOWGATE	ON	$174,714.8	$168,688.1	510.8	433.6	357.7	Not Binding	Not Binding	Auction Economics
22356_IMPRLVLY_230_22360_IMPRLVLY_500_XF_81	FLOWGATE	ON	$317,575.7	$47,001.7	690.3	1064.7	878.4	Not Binding	Not Binding	Higher Limit
7820_TL23040_IV_SPS_NG	NOMOGRAM	OFF	$275,675.6	$103,872.3	453.1	Unbounded	Unbounded	Not Enforced	Not Enforced	Late Enforcement
OMS 4585329 TL50001_NG	NOMOGRAM	ON	$121,341.9	$76,276.8	600.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missed Outage
31486_CARIBOU _115_30255_CARBOU M_ 1.0_XF_11	FLOWGATE	ON	$10,671.4	$347,211.7	95.8	Unbounded	Unbounded	Not Enforced	Not Enforced	Late Enforcement
7750_D-VISTA2_OOS_SOL5_NG	NOMOGRAM	ON	$196,651.4	$120,429.3	310.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missed Outage
31486_CARIBOU _115_30255_CARBOU M_ 1.0_XF_11	FLOWGATE	OFF	$41,849.5	$189,531.8	95.5	Unbounded	Unbounded	Not Enforced	Not Enforced	Late Enforcement
OMS 4621181 LBN_S-N	NOMOGRAM	ON	$159,164.8	$37,503.6	1650.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missed Outage
OMS 4608811 MG_BK80_NG	NOMOGRAM	ON	$35,039.7	$24,718.7	1333.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missed Outage
34874_WHEELER _70.0_34756_WHEELER _115_XF_2	FLOWGATE	ON	-$693.3	$4,900.5	66.9	Unbounded	47.1	Not Enforced	Not Binding	Auction Economics
35122_NWARK EF_115_35350_AMES BS _115_BR_2 _1	FLOWGATE	OFF	$44,415.8	$6,052.5	84.8	106.0	87.4	Not Binding	Not Binding	Higher Limit
22865_GRNT HLL_138_22852_TELECYN _138_BR_1 _1	FLOWGATE	ON	$16,906.9	$17,222.8	419.4	303.8	250.6	Not Binding	Not Binding	Auction Economics
22208_EL CAJON_69.0_22408_LOSCOCHS_69.0_BR_1 _1	FLOWGATE	ON	$12,735.4	$20,079.0	69.6	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missed Outage
7820_TL 230S_OVERLOAD_NG	NOMOGRAM	OFF	$21,089.4	$9,301.8	332.4	368.5	392.0	Not Binding	Not Binding	Higher Limit
22597_OLDTWNTP_230_22504_MISSION _230_BR_1 _1	FLOWGATE	ON	$8,804.0	$9,451.6	478.7	433.6	357.7	Not Binding	Not Binding	Auction Economics
OMS 4436916_PATH15_S-N	NOMOGRAM	ON	$29,036.7	$8,236.8	2770.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missed Outage
32214_RIO OSO _115_32244_BRNSWKT2_115_BR_2 _1	FLOWGATE	ON	$2,998.5	$12,403.1	68.3	75.8	62.5	Not Binding	Not Binding	Auction Economics
22500_MISSION _138_22865_GRNT HLL_138_BR_1 _1	FLOWGATE	ON	$8,227.1	$8,633.5	401.6	295.4	243.7	Not Binding	Not Binding	Auction Economics
IPPDCADLN_ITC	INTER_TIE	ON	-$26,161.6	-$57,215.3	673.4	300.4	634.1	Not Binding	Not Binding	Auction Economics

March 2017

Table 32 summarizes the main settlements metrics for CRR performance in the month of March 2017. The sign convention is based from the CAISO's perspective; a positive value indicates the CAISO collects or has a surplus of money; a negative value indicates the CAISO pays or has a shortfall. Day-ahead congestion rents will be positive, CRR payments will be negative and auction revenues will be positive.

Table 32: Summary of CRR performance for March 2017

Metric	Amount
DA Congestion Rents	$20,755,457
Perfect Hedge	-$1,019,574
CRR Clawback	$42,736
CRR Payments [Auction + Allocation]	-$25,466,860
CRR Payments to Auction CRRs	-$10,427,145
CRR Payments to Monthly Auction CRRs	- $4,959,178
CRR Payments to Annual Auction CRRs	-$5,468,664
CRR Payments to Allocation CRRs	-$15,039,715
CRR Auction Revenue Monthly	$3,202,807
CRR Auction Revenue Annual	$3,595,627
Revenue Adequacy	-$5,688,241
Revenue Adequacy with Auction Revenues	$1,110,193
Net payment to auction CRR	-$3,628,710

In March, the overall CRR performance was poor since there was a revenue deficiency of over $5.5 million, which is the difference between all of the proceeds from day-ahead congestion rents, CRR clawback and the payments made to CRR holders. About 41 percent of the CRR payments were to CRRs originated from the annual and monthly auctions. The auction revenues represent the proceeds from selling CRRs through the auction. The revenues arising from the annual auction for each season are estimated pro-rata to each month of the calendar quarter based on the number of hours in each time of use. The net payment to auction CRRs stands for the difference between the money paid to CRR holders less the money charge to CRR holders to acquire that portfolio of CRRs in the auction. This does not take into account any expenses the CRR holders incur associated with their participation in the CRR market and use of money. This is only a net accounting balance from the point of view of the cash inflow and outflow in the CAISO system.

In order to further understand the origin of this poor performance, there is a need to estimate over time and by constraint the CRR settlements. Figure 148 shows the daily congestion rents accrued on each transmission constraint that was binding in the day-ahead market in the month of March. Correspondingly, Figure 149 shows the daily CRR revenue adequacy also broken out by transmission constraint. In March, about $3.2 million of revenue deficiency was accrued on the constraint *7820_TL23040_IV_SPS_NG*. This constraint was added to the CRR model but was called *23040_CROSSTRIP_NG* when it was first set up and was later changed to *7820_TL23040_IV_SPS_NG.* Furthermore,

about $2 million of revenue deficiency was accrued on the constraint *MALIN500*. When combined, the constraints *7820_TL23040_IV_SPS_NG* and *MALIN500*, account for approximately 90 percent of the total deficiency.

Figure 148: Daily congestion rents - March 2017

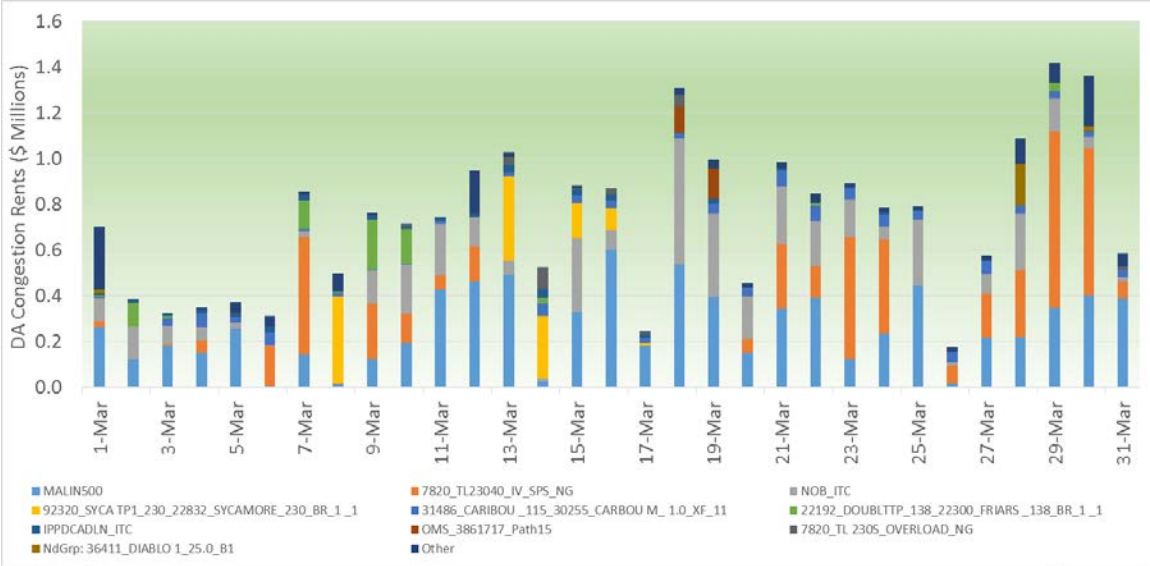


Figure 149: Daily CRR revenue adequacy - March 2017

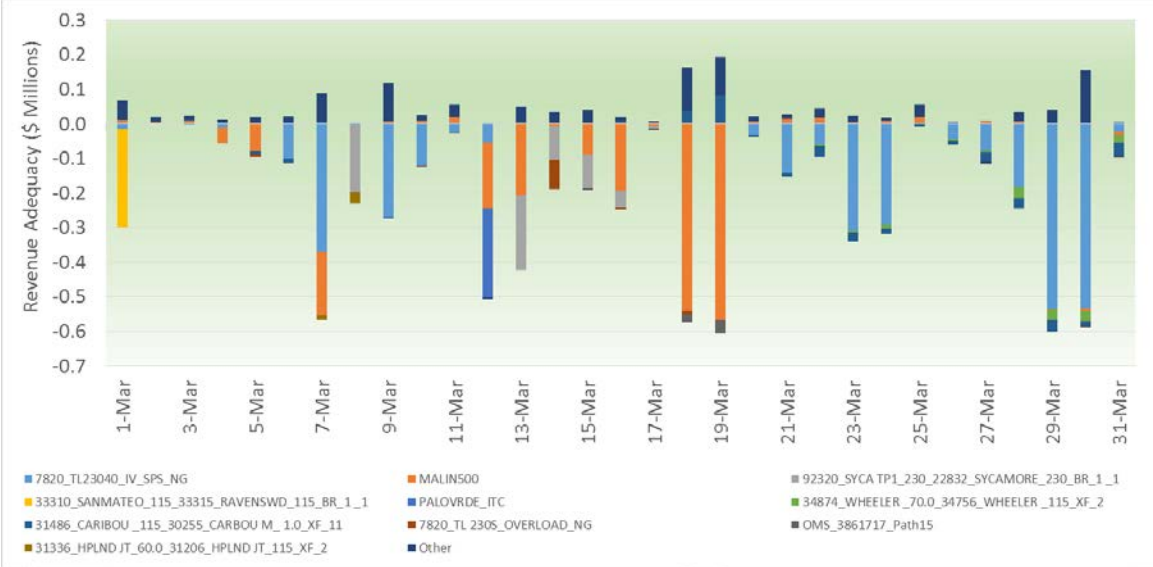
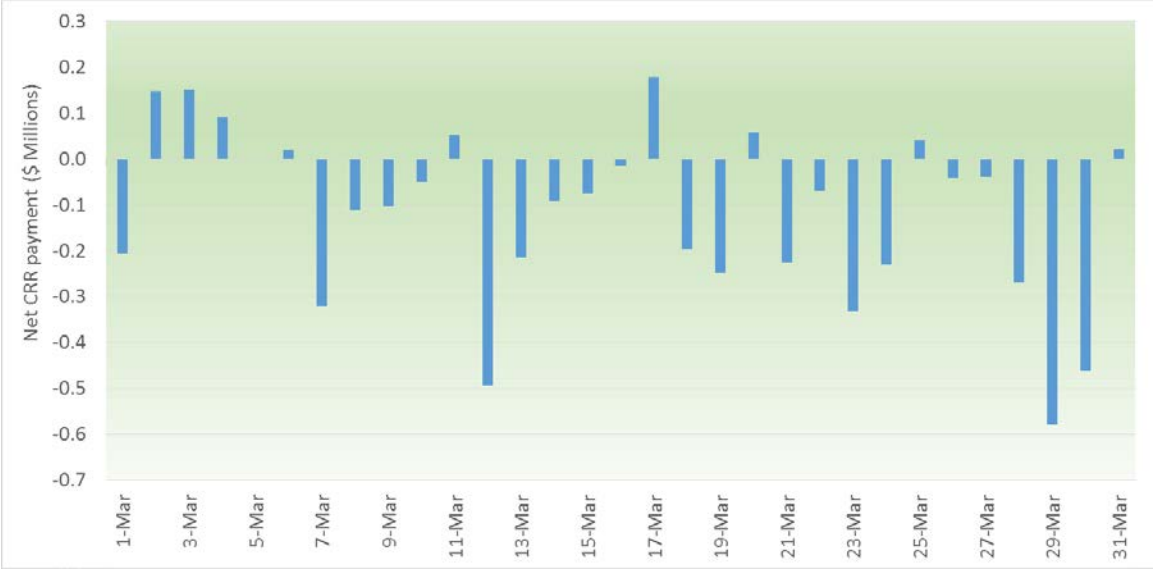


Figure 150 shows the net CRR payment per day. This net revenue is the difference between the CRR payments to CRR holders and the auction revenues collected by the CAISO through the CRR auction process; such revenues become a lump revenue for the auction. For this metric, the annual auction revenues are allocated on a pro-rata estimation to each day of the month based on the number of hours in each time of use. The CRR payments are estimated as the total sum of CRR payments over the hours of the day only for CRRs that were released through both the annual and monthly CRR auction; that is, no CRR payments to allocated CRRs are included. The purpose of this estimate for

net CRR payments is to calculate the net balance for CRR that were auction. For March, there was a persistent negative net CRR payment, indicating that overall the money paid to CRR holders was higher than the money the CAISO collected when releasing such CRRs in the annual and monthly auctions.

Figure 150: Daily net CRR payment to auction CRRs – March 2017



As shown in Figure 151, there is a strong correlation between the level of CRR revenue deficiency and the level of net CRR payments paid to holders of CRRs released in the auction processes. This is not surprising since both metrics reflect to some extent the effect of CRRs released (and priced) in the CRR auction and the capacity released (and priced) in the day-ahead market. A negative value for CRR revenue adequacy represents a shortfall for the CAISO, while a negative value for net CRR payment represents a payment to holders of auction CRRs from the CAISO, meaning the CAISO paid more to auction CRRs than it charged to release CRRs in the auction process.

Figure 151: Comparison of daily net CRR payment with CRR revenue adequacy –March 2017

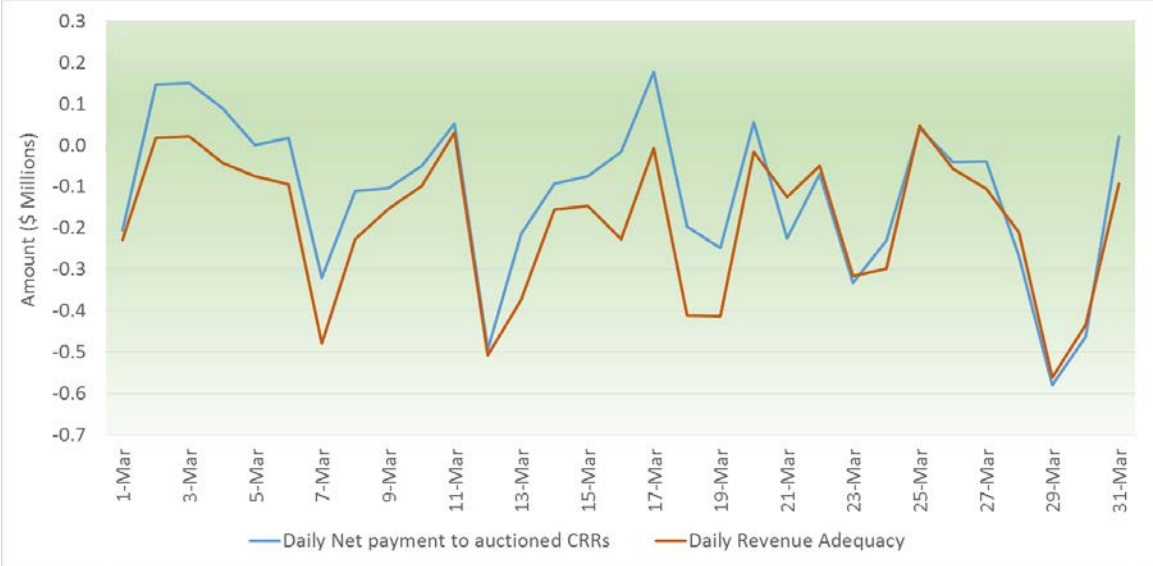
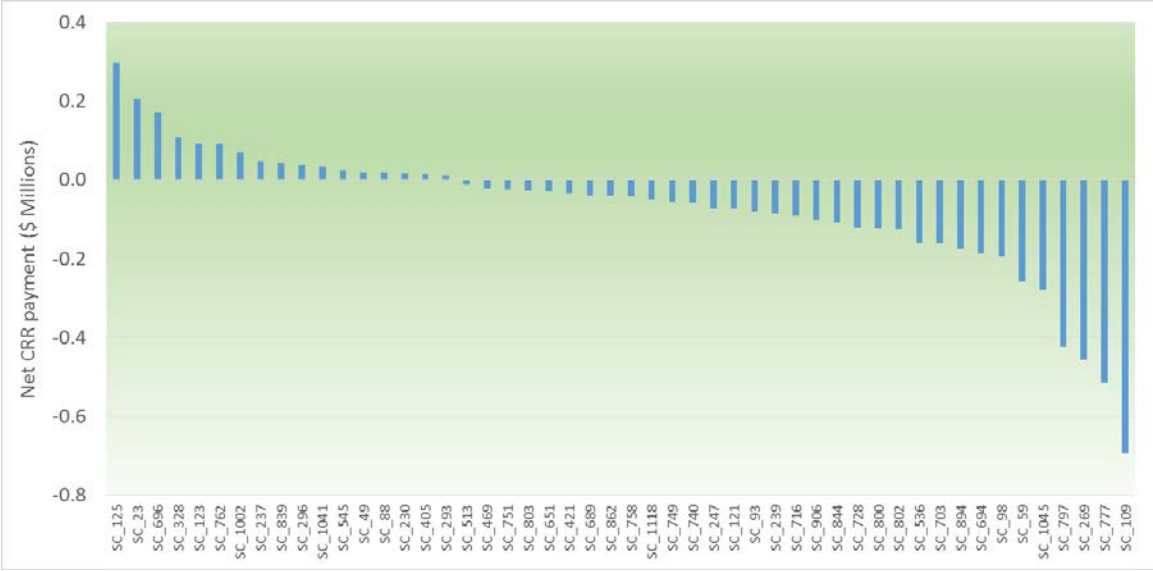


Figure 152 shows the net CRR payments to CRR participants, regardless of the type of participant. This only reflects the payments for CRRs released in both the annual and monthly CRR auctions applicable for the month of March 2017. Since this is from the CAISO's perspective, a negative value means the CAISO disbursed a net CRR payment to the CRR holder (or a net money inflow to the CRR holder). The names of the CRR holders are masked, but the identifier shown in the plot is unique across all the months provided in this analysis. A positive value represents a net inflow for the CAISO since it settled less to CRR holders in the day-ahead market than what it charged to release CRRs in the auction. For March, the majority of holders of auction CRRs saw a net gain from having these positions.

Figure 152: Net CRR payment to auction CRR –March 2017



To better understand the dynamics leading to such an outcome, the CAISO shifted the analysis to the fundamentals of the CRR auction construct by analyzing the CRR auction results at the constraint level. CRRs are released and priced based on the CRR clearing prices; such prices are derived as the relative difference between locational prices between the source and the sink locations. These locational prices originate from the cleared prices when any transmission constraint becomes binding with nonzero pries in the CRR auction, commonly referred as *shadow prices*. The CAISO turned out to analyze what constraints have been binding in the CRR auction process and compared that with the set of constraints that were binding in the day-ahead market. To some extent, one expects that there is a certain level of alignment between the markets.

Figure 153 and Figure 154 show a comparison of net CRR payments. The CRR payments reflect the CRR settlements for CRRs with day-ahead congestion rents, while the CRR auction revenues is the money the CAISO collected from releasing CRRs through the auctions. That is, it reflects the net money participants were charged to acquire CRRs and the money they were paid; in a loose sense, it could be interpreted as profits for holding.

There are four possible permutations to analyze. The first case represents when a CRR payment to CRR holders was made in the day-ahead market settlement, but the CAISO did not collect any revenues from releasing these CRRs from the auctions because the constraint was not binding in the CRR auction. This is shown for both the pro-rata portion of the annual auction for March and for the monthly CRR auction. A negative value indicates that the CAISO had a net CRR payment to CRR holders. The second case is the opposite in which there was no CRR payments when settling CRRs in the day-ahead market but the CAISO collected revenue when releasing these CRRs in the auction process. The third and fourth cases are for CRRs that had a CRR payment in the day-ahead market and the CAISO also charged them in the CRR auctions to release these CRRs. The third case is when the net CRR payment is negative, while the fourth case is when the net CRR payment is positive. This metric reveals any potential misalignment of constrains enforced and binding between the day-ahead market and CRR auctions.

Figure 153: CRR payment versus CRR auction revenues for annual CRR -March 2017

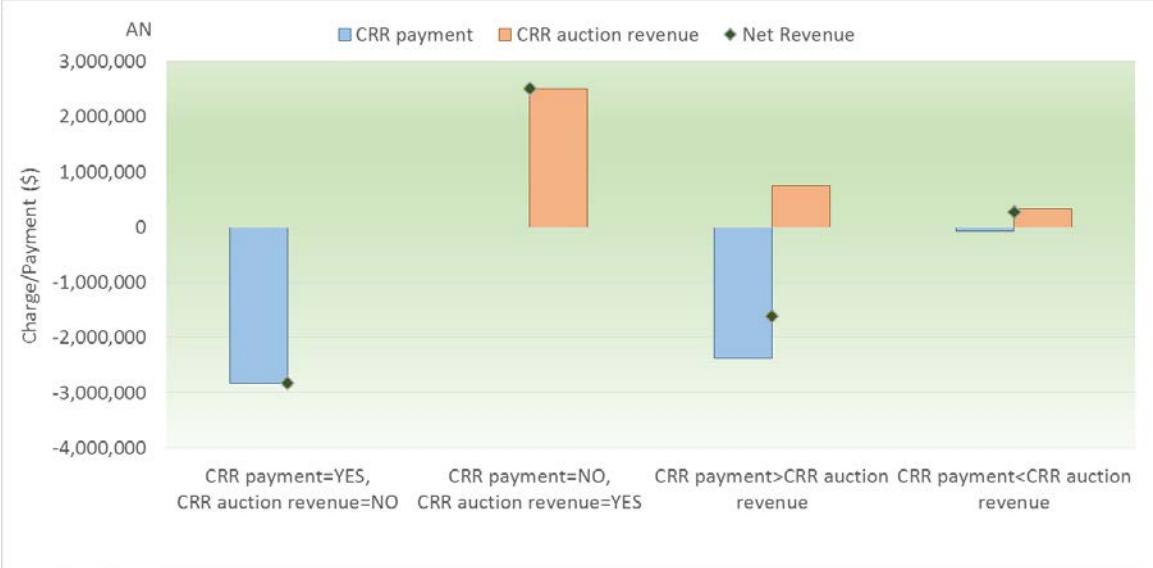


Figure 154: CRR payment versus CRR auction revenues for monthly CRR -March 2017

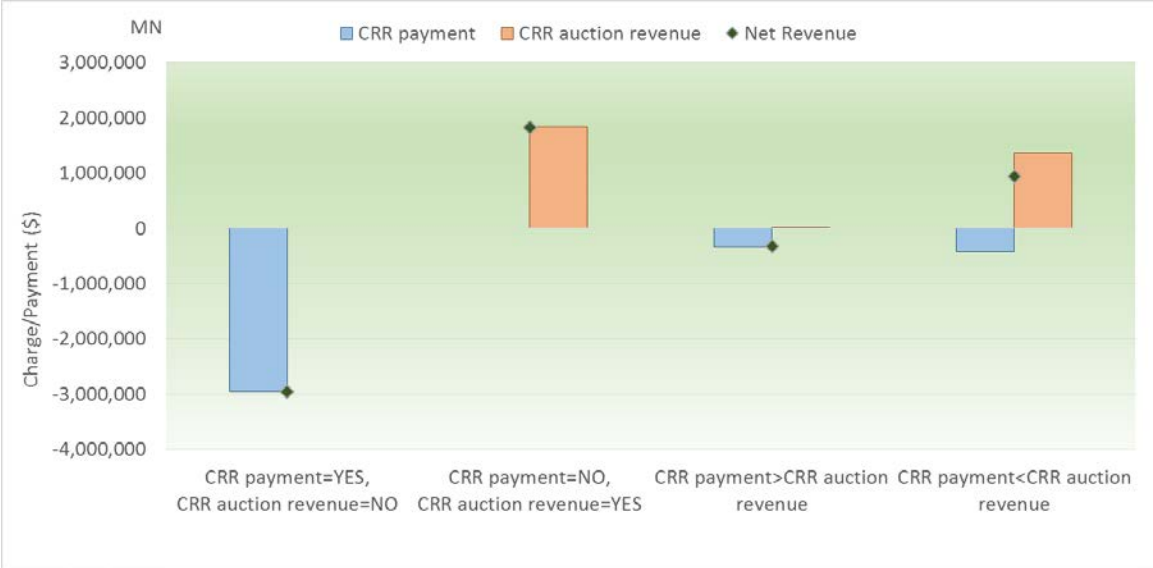


Table 33 provides one level deeper of understanding of such misalignments between markets. This tables shows the top and bottom constraints when sorted by net CRR payments. In the first column it shows the estimated CRR payment to CRR holders accrued in each constraint; the second column shows the revenues collected by the CAISO on that same constraint; the last column shows the net CRR payment, which is the balance between this money outflow (CRR payment) and money inflow (CRR auction revenues) from the CAISO's perspective. Table 34 shows the same information for CRRs released in the monthly auction for March 2017. The top constraints reflect cases where large CRR payments to auction CRRs accrued when the CRR market did not collect any auction revenues when releasing these CRRs.

Table 33: Net CRR payment by constraint - March 2017, Annual auction

Constraints	Total CRR Payment	Total CRR Auction Revenue	Net CRR Payment
7820_TL23040_IV_SPS_NG	-$2,136,802.4	$0.0	-$2,136,802.4
MALIN500	-$1,513,619.8	$707,324.5	-$806,295.3
NOB_ITC	-$728,073.6	$0.0	-$728,073.6
92320_SYCA TP1_230_22832_SYCAMORE_230_BR_1 _1	-$259,171.0	$0.0	-$259,171.0
7820_TL 230S_OVERLOAD_NG	-$98,678.7	$0.0	-$98,678.7
33310_SANMATEO_115_33315_RAVENSWD_115_BR_1 _1	-$90,212.3	$0.0	-$90,212.3
31486_CARIBOU _115_30255_CARBOU M_ 1.0_XF_11	-$65,211.2	$0.0	-$65,211.2
22192_DOUBLTTP_138_22300_FRIARS _138_BR_1 _1	-$59,937.7	$0.0	-$59,937.7
31224_INDIN VL_115_31215_LUCERNJ1_115_BR_1 _1	-$57,071.5	$0.0	-$57,071.5
31336_HPLND JT_60.0_31206_HPLND JT_115_XF_2	-$48,656.6	$15,602.2	-$33,054.3
34874_WHEELER _70.0_34756_WHEELER _115_XF_2	-$29,981.5	$0.0	-$29,981.5
PALOVRDE_ITC	-$71,911.9	$44,813.0	-$27,098.9
OMS_4654659_LBN_S_N	-$17,278.6	$0.0	-$17,278.6
32212_E.NICOLS_115_32214_RIO OSO _115_BR_1 _1	-$11,827.1	$0.0	-$11,827.1
CASCADE_ITC	-$9,704.7	$0.0	-$9,704.7
31566_KESWICK _60.0_31582_STLLWATR_60.0_BR_1 _1	-$5,793.9	$0.0	-$5,793.9
22820_SWEETWTR_69.0_22476_MIGUELTP_69.0_BR_1 _1	-$5,257.8	$0.0	-$5,257.8
32314_SMRTSVLE_60.0_32316_YUBAGOLD_60.0_BR_1 _1	-$4,225.7	$0.0	-$4,225.7
31461_JESSTAP _115_31464_COTWDPGE_115_BR_1 _1	-$3,736.0	$0.0	-$3,736.0
31512_BIG BEN2_115_31516_WYANDJT2_115_BR_1 _2	-$2,080.4	$0.0	-$2,080.4
32950_PITSBURG_115_30527_PITSBRG _230_XF_13	$0.0	$24,766.9	$24,766.9
PATH26_BG	$0.0	$30,293.7	$30,293.7
WSTWGMEAD_ITC	$0.0	$30,631.8	$30,631.8
SYLMAR-AC_ITC	$0.0	$36,099.3	$36,099.3
IID-SDGE_ITC	$0.0	$36,361.9	$36,361.9
BLYTHE_BG	$0.0	$39,337.3	$39,337.3
MSOLAR_XFMR_BG	$0.0	$40,737.5	$40,737.5
30005_ROUND MT_500_30245_ROUND MT_230_XF_1 _P	$0.0	$42,147.0	$42,147.0
30515_WARNERVL_230_30800_WILSON _230_BR_1 _1	$0.0	$48,073.1	$48,073.1
30523_CC SUB _230_30525_C.COSTA _230_BR_1 _1	$0.0	$56,841.8	$56,841.8
22831_SYCAMORE_138_22832_SYCAMORE_230_XF_1	$0.0	$59,051.6	$59,051.6
22456_MIGUEL _69.0_22464_MIGUEL _230_XF_2	$0.0	$74,365.0	$74,365.0
SDGE_CFEIMP_BG	$0.0	$116,280.1	$116,280.1
22828_SYCAMORE_69.0_22756_SCRIPPS _69.0_BR_1 _1	$0.0	$119,585.5	$119,585.5
22464_MIGUEL _230_22504_MISSION _230_BR_1 _1	$0.0	$132,906.7	$132,906.7
22831_SYCAMORE_138_22124_CHCARITA_138_BR_1 _1	$0.0	$133,944.9	$133,944.9
24086_LUGO _500_26105_VICTORVL_500_BR_1 _1	$0.0	$147,060.1	$147,060.1
PATH15_S-N	-$64,603.5	$290,206.3	$225,602.8
30750_MOSSLD _230_30790_PANOCHE _230_BR_1 _1	$0.0	$272,681.9	$272,681.9
24016_BARRE _230_25201_LEWIS _230_BR_1 _1	$0.0	$424,015.3	$424,015.3

Table 34: Net CRR payment by constraint - March 2017, Monthly auction

Constraints	Total CRR Payment	Total CRR Auction Revenue	Net CRR Payment
7820_TL23040_IV_SPS_NG	-$1,309,536.2	$0.0	-$1,309,536.2
31486_CARIBOU _115_30255_CARBOU M_ 1.0_XF_11	-$770,142.0	$0.0	-$770,142.0
92320_SYCA TP1_230_22832_SYCAMORE_230_BR_1 _1	-$555,159.4	$0.0	-$555,159.4
7820_TL 230S_OVERLOAD_NG	-$89,600.1	$0.0	-$89,600.1
34112_EXCHEQUR_115_34116_LE GRAND_115_BR_1 _1	-$83,690.5	$2,048.4	-$81,642.1
22192_DOUBLTTP_138_22300_FRIARS _138_BR_1 _1	-$72,559.8	$46.1	-$72,513.7
33310_SANMATEO_115_33315_RAVENSWD_115_BR_1 _1	-$71,928.3	$0.0	-$71,928.3
IPPDCADLN_ITC	-$27,179.8	$0.0	-$27,179.8
31512_BIG BEN2_115_31516_WYANDJT2_115_BR_1 _2	-$24,957.9	$0.0	-$24,957.9
32228_PLACER _115_32238_BELL PGE_115_BR_1 _1	-$19,269.3	$0.0	-$19,269.3
32212_E.NICOLS_115_32214_RIO OSO _115_BR_1 _1	-$15,337.7	$0.0	-$15,337.7
32314_SMRTSVLE_60.0_32316_YUBAGOLD_60.0_BR_1 _1	-$17,835.4	$2,758.9	-$15,076.4
IPPUTAH_ITC	-$9,694.6	$0.1	-$9,694.4
22820_SWEETWTR_69.0_22476_MIGUELTP_69.0_BR_1 _1	-$9,230.6	$0.0	-$9,230.6
33541_AEC_TP1 _115_33540_TESLA _115_BR_1 _1	-$8,550.3	$0.0	-$8,550.3
OMS_4654659_LBN_S_N	-$8,383.7	$0.0	-$8,383.7
31580_CASCADE _60.0_31581_OREGNTRL_60.0_BR_1 _1	-$6,442.8	$0.0	-$6,442.8
31224_INDIN VL_115_31215_LUCERNJ1_115_BR_1 _1	-$6,208.4	$0.0	-$6,208.4
34548_KETTLEMN_70.0_34552_GATES _70.0_BR_1 _1	-$1,970.4	$0.0	-$1,970.4
CASCADE_ITC	-$1,489.7	$0.0	-$1,489.7
NdGrp_POD_CNTNLA_2_SOLAR1-APND	$0.0	$25,738.5	$25,738.5
WSTWGMEAD_ITC	$0.0	$28,925.6	$28,925.6
COTPISO_ITC	$29,260.2	$1,062.1	$30,322.3
NdGrp_POD_CPVERD_2_SOLAR-APND	$0.0	$34,309.7	$34,309.7
NdGrp_POD_DOUBLC_1_UNITS-APND	$0.0	$38,922.6	$38,922.6
CASCADE_BG	$0.0	$39,778.6	$39,778.6
22828_SYCAMORE_69.0_22756_SCRIPPS _69.0_BR_1 _1	$0.0	$42,036.8	$42,036.8
NdGrp_AGUCALG1_7_B1	$0.0	$42,188.3	$42,188.3
22596_OLD TOWN_230_22504_MISSION _230_BR_1 _1	$0.0	$44,918.7	$44,918.7
NdGrp_POD_IVSLRP_2_SOLAR1-APND	$0.0	$48,263.1	$48,263.1
30750_MOSSLD _230_30790_PANOCHE _230_BR_1 _1	$0.0	$49,640.0	$49,640.0
IID-SCE_BG	$0.0	$53,969.9	$53,969.9
NdGrp_POD_IVWEST_2_SOLAR1-APND	$0.0	$63,447.8	$63,447.8
24016_BARRE _230_25201_LEWIS _230_BR_1 _1	$0.0	$71,753.1	$71,753.1
30040_TESLA _500_30042_METCALF _500_BR_1 _1	$0.0	$84,381.2	$84,381.2
24132_SANBRDNO_230_24804_DEVERS _230_BR_1 _1	$0.0	$89,673.7	$89,673.7
NORTHGILA500_BG	$0.0	$127,911.0	$127,911.0
24086_LUGO _500_26105_VICTORVL_500_BR_1 _1	$0.0	$217,604.1	$217,604.1
NOB_ITC	-$486,329.4	$844,821.9	$358,492.5
PATH15_S-N	$3,272.0	$511,517.2	$514,789.2

These two tables illustrate instances of constraint misalignment between the CRR auctions and the day-ahead market. To understand this mismatch one level deeper, Table 35 lists the subset of constraints that are not binding or not enforced in the CRR monthly auction or that have a significant CRR payment. The portion that were paid only to CRRs from the annual and monthly auctions is also provided. Then it compares the average transmission limit used in the day-ahead market and the limits actually used in both the annual and monthly auctions. These are the constraints that will mostly drive the divergence between the day-ahead and CRR markets. One of the cornerstones of the CRR

market efficiency is for the CRR market to closely reflect the transmission capacity of the day-ahead market. When the transmission capacity released in the CRR market is less than that of the day-ahead market, there may be an exposure of revenue deficiency. This may also have a fair impact on the level of CRR net payments and how transmission capacity is valued in the CRR auction. This occurs because when CRRs are released in the auction process they are priced on the value of the capacity made available, or on the lack of it. A systemic issue identified during the evaluation of the CRR auction efficiency is that multiple transmission constraints are not modelled or enforced in the CRR auctions.

In cases where the constraint was enforced in the day-ahead market but not modelled or enforced in the CRR auctions, the amount of transmission capacity by means of CRRs that may be released on that constraints is effectively unbounded, which indicates that more transmission capacity may be released in the CRR auction than in the day-ahead market. This is a major problem to the efficiency of the CRR market. For the case of March 2017 and relative to other months analyzed, there were relatively few instances of constraints not enforced in the CRR auctions. In such cases the level of congestion rents and CRR payments were relatively modest, such that even with the misalignment, the financial impact was low. In further investigating why these constraints were not modelled/enforced in the CRR auctions, the common factors are related to how outages were considered and when transmission constraints were enforced in the CRR auction.

1. Constraint 7820_TL23040_IV_SPS_NG. This constraint was added to the CRR model but it was called "23040_CROSSTRIP_NG" when it was first set up. It was later changed to "7820_TL23040_IV_SPS_NG" in the April CRR model. There were several outages related to this that lasted less than 24 hours.
2. Constraint 31486_CARIBOU _115_30255_CARBOU M_ 1.0_XF_11. This constraint is normally not enforced in the market and as such it was not enforced in the CRR auctions.
3. Constraint OMS_3861717_Path15. Outage submitted before CRR cutoff date. However, OEs didn't have Path 15 limitation in initial study until PG&E submitted the outage 4710104 for related impact on PG&E RAS on 3/2/17. This outage lasted more than 24 hours but less than 10 days and was submitted in time.

Table 35: Top constraints binding in the day-ahead market not binding in CRR market - March 2017

Constraint	Constraint Type	TOU	Payments to Annual CRR	Payments to Monthly CRR	DAM Limit	Annual CRR Limit	Monthly CRR Limit	Annual CRR Status	Monthly CRR Status	Reason
7820_TL23040_IV_SPS_NG	NOMOGRAM	ON	-$1,927,414.3	-$1,219,119.6	487.2	Unbounded	Unbounded	Not Enforced	Not Enforced	Late Enforcement
92320_SYCA TP1_230_22832_SYCAMORE_230_BR_1 _1	FLOWGATE	ON	-$259,171.0	-$555,159.4	1126.5	866.9	715.2	Not Binding	Not Binding	Auction Economics
31486_CARIBOU _115_30255_CARBOU M_ 1.0_XF_11	FLOWGATE	ON	-$66,125.8	-$475,444.2	93.5	Unbounded	Unbounded	Not Enforced	Not Enforced	Late Enforcement
31486_CARIBOU _115_30255_CARBOU M_ 1.0_XF_11	FLOWGATE	OFF	$914.6	-$294,697.8	93.5	Unbounded	Unbounded	Not Enforced	Not Enforced	Late Enforcement
7820_TL23040_IV_SPS_NG	NOMOGRAM	OFF	-$209,388.1	-$90,416.6	486.8	Unbounded	Unbounded	Not Enforced	Not Enforced	Late Enforcement
7820_TL 230S_OVERLOAD_NG	NOMOGRAM	ON	-$93,986.8	-$85,974.9	350.0	370.7	392.0	Not Binding	Not Binding	Higher Limit
IPPDCADLN_ITC	INTER_TIE	ON	$29,878.8	-$32,741.1	404.0	300.4	526.6	Not Binding	Not Binding	Higher Limit
33310_SANMATEO_115_33315_RAVENSWD_115_BR_1 _1	FLOWGATE	ON	-$90,212.3	-$71,928.3	109.3	Unbounded	97.3	Not Enforced	Not Binding	Auction Economics
34874_WHEELER _70.0_34756_WHEELER _115_XF_2	FLOWGATE	ON	-$26,335.9	$15,101.7	71.9	Unbounded	47.1	Not Enforced	Not Binding	Auction Economics
OMS_3861717_Path15	NOMOGRAM	OFF	$0.0	$0.0	3300.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missed Outage
OMS_3861717_Path15	NOMOGRAM	ON	$0.0	$0.0	3300.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missed Outage
31512_BIG BEN2_115_31516_WYANDJT2_115_BR_1 _2	FLOWGATE	ON	-$2,080.4	-$24,957.9	75.5	75.8	62.5	Not Binding	Not Binding	Auction Economics
IPPDCADLN_ITC	INTER_TIE	OFF	-$8,934.3	$5,561.3	404.0	433.7	526.6	Not Binding	Not Binding	Higher Limit
33541_AEC_TP1 _115_33540_TESLA _115_BR_1 _1	FLOWGATE	OFF	$316.4	$399.3	180.0	184.0	151.8	Not Binding	Not Binding	Auction Economics
31224_INDIN VL_115_31215_LUCERNJ1_115_BR_1 _1	FLOWGATE	ON	-$57,071.5	-$6,208.4	98.6	113.6	93.7	Not Binding	Not Binding	Auction Economics
34112_EXCHEQUR_115_34116_LE GRAND_115_BR_1 _1	FLOWGATE	ON	$2,100.5	-$38,337.8	107.5	97.3	80.3	Not Binding	Not Binding	Auction Economics
32228_PLACER _115_32238_BELL PGE_115_BR_1 _1	FLOWGATE	ON	$5,962.9	-$13,507.6	111.3	113.6	93.7	Not Binding	Not Binding	Auction Economics
22820_SWEETWTR_69.0_22476_MIGUELTP_69.0_BR_1 _1	FLOWGATE	ON	-$5,257.8	-$9,230.6	106.3	Unbounded	76.5	Not Enforced	Not Binding	Auction Economics
32228_PLACER _115_32238_BELL PGE_115_BR_1 _1	FLOWGATE	OFF	$351.2	-$5,761.7	111.6	113.6	93.7	Not Binding	Not Binding	Auction Economics
34874_WHEELER _70.0_34756_WHEELER _115_XF_2	FLOWGATE	OFF	-$3,645.6	-$1,594.5	71.9	Unbounded	47.1	Not Enforced	Not Binding	Auction Economics
33541_AEC_TP1 _115_33540_TESLA _115_BR_1 _1	FLOWGATE	ON	$19,035.6	-$8,949.6	179.9	184.0	151.8	Binding	Not Binding	Auction Economics
MALIN500	INTER_TIE	OFF	-$794,507.0	$28,284.5	2033.1	1926.4	2151.4	Binding	Binding	Higher Limit
NOB_ITC	INTER_TIE	OFF	-$465,649.0	-$51,435.9	1564.0	809.3	1400.0	Binding	Binding	Auction Economics
MALIN500	INTER_TIE	ON	-$719,112.8	-$20,460.8	1919.4	1899.8	2124.8	Binding	Binding	Higher Limit
NOB_ITC	INTER_TIE	ON	-$262,424.6	-$434,893.5	1562.1	743.5	1400.0	Binding	Binding	Auction Economics

April 2017

Table 36 summarizes the main settlements metrics for CRR performance in the month of April 2017. The sign convention is based from the CAISO's perspective; a positive value indicates the CAISO collects or has a surplus of money; a negative value indicates the CAISO pays or has a shortfall. Day-ahead congestion rents will be positive, CRR payments will be negative and auction revenues will be positive.

Table 36: Summary of CRR performance for April 2017

Metric	Amount
DA Congestion Rents	$30,341,196
Perfect Hedge	-$1,347,886
CRR Clawback	$291,971
CRR Payments [Auction + Allocation]	-$33,653,859
CRR Payments to Auction CRRs	-$13,506,767
CRR Payments to Monthly Auction CRRs	- $5,865,739
CRR Payments to Annual Auction CRRs	-$7,641,384
CRR Payments to Allocation CRRs	-$20,147,092
CRR Auction Revenue Monthly	$2,939,837
CRR Auction Revenue Annual	$2,866,818
Revenue Adequacy	-$4,368,578
Revenue Adequacy with Auction Revenues	$1,438,077
Net payment to auction CRR	-$7,700,112

In April, the overall CRR performance was poor since there was a revenue deficiency of over $4 million, which is the difference between all of the proceeds from day-ahead congestion rents, CRR clawback and the payments made to CRR holders. About 40 percent of the CRR payments were to CRRs originated from the annual and monthly auctions. The auction revenues represent the proceeds from selling CRRs through the auction. The revenues arising from the annual auction for each season are estimated pro-rata to each month of the calendar quarter based on the number of hours in each time of use. The net payment to auction CRRs stands for the difference between the money paid to CRR holders less the money charge to CRR holders to acquire that portfolio of CRRs in the auction. This does not take into account any expenses the CRR holders incur associated with their participation in the CRR market and use of money. This is only a net accounting balance from the point of view of the cash inflow and outflow in the CAISO system.

In order to further understand the origin of this poor performance, there is a need to estimate over time and by constraint the CRR settlements. Figure 155 shows the daily congestion rents accrued on each transmission constraint that was binding in the day-ahead market in the month of April. Correspondingly, Figure 156 shows the daily CRR revenue adequacy also broken out by transmission constraint. In April, about $4.3 million of revenue deficiency was accrued on the constraint *6410_CP5_NG*. This constraint alone accounts for over 95 percent of the total deficiency.

Figure 155: Daily Congestion rents -April 2017

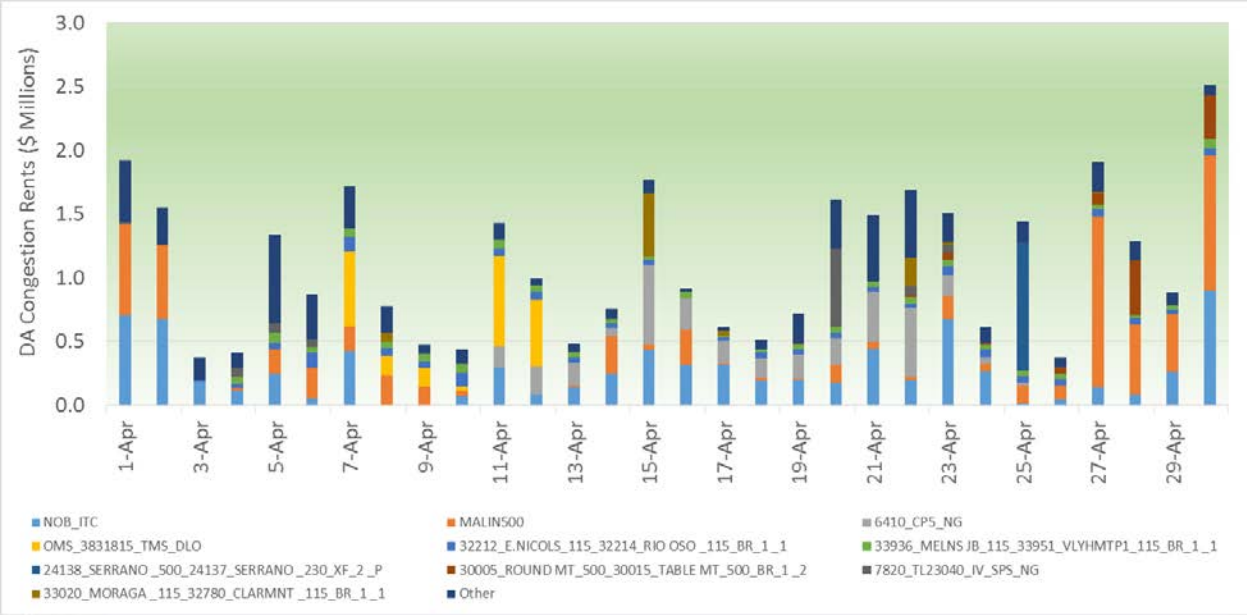


Figure 156: Daily CRR revenue adequacy -April 2017

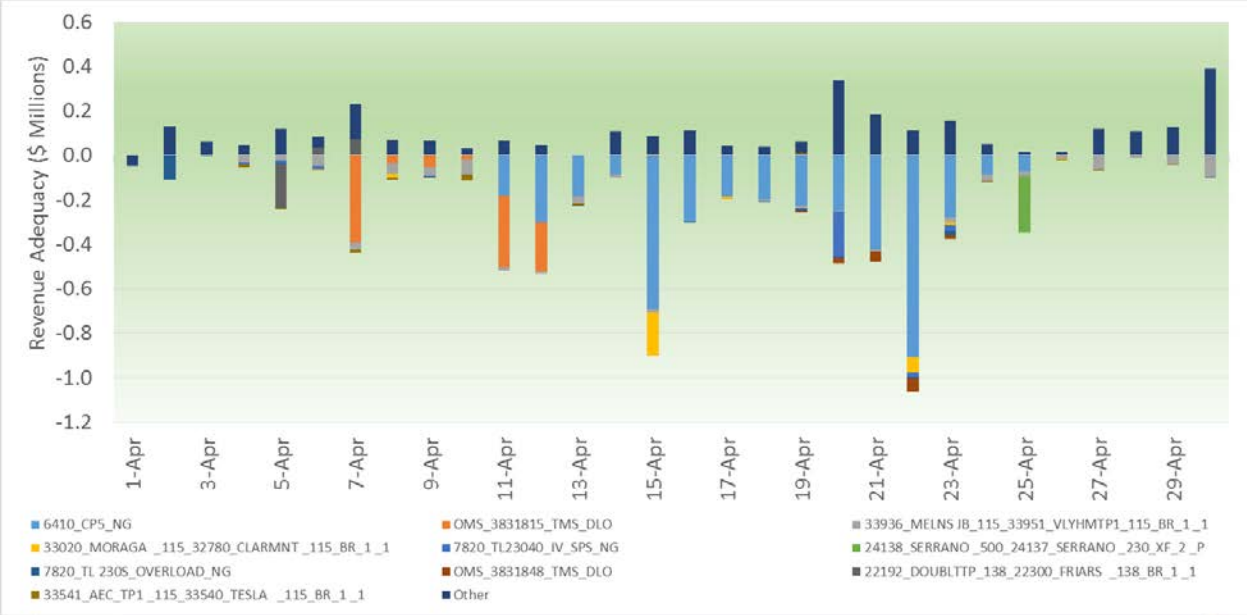
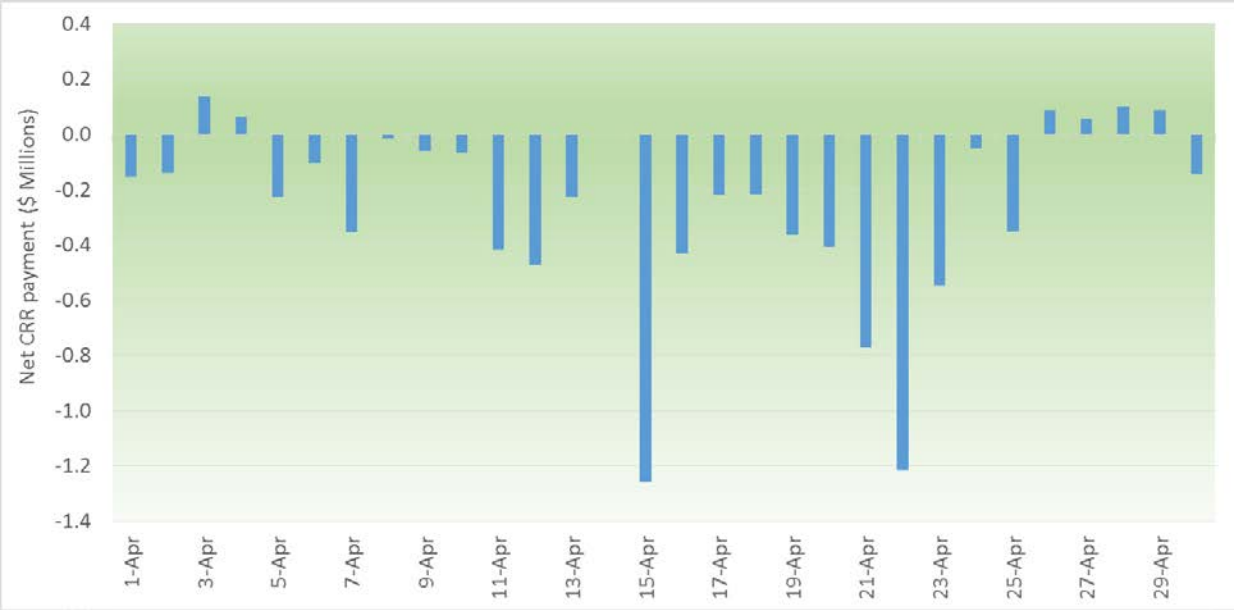


Figure 157 shows the net CRR payment per day. This net revenue is the difference between the CRR payments to CRR holders and the auction revenues collected by the CAISO through the CRR auction process; such revenues become a lump revenue for the auction. For this metric, the annual auction revenues are allocated on a pro-rata estimation to each day of the month based on the number of hours in each time of use. The CRR payments are estimated as the total sum of CRR payments over the hours of the day only for CRRs that were released through both the annual and monthly CRR auction; that is, no CRR payments to allocated CRRs are included. The purpose of this estimate for net CRR payments is to calculate the net balance for CRR that were

auction. For April, there was a persistent negative net CRR payment, indicating that overall the money paid to CRR holders was higher than the money the CAISO collected when releasing such CRRs in the annual and monthly auctions.

Figure 157: Daily net CRR payment to auction CRRs –April 2017



As shown in Figure 158, there is a strong correlation between the level of CRR revenue deficiency and the level of net CRR payments paid to holders of CRRs released in the auction processes. This is not surprising since both metrics reflect to some extent the effect of CRRs released (and priced) in the CRR auction and the capacity released (and priced) in the day-ahead market. A negative value for CRR revenue adequacy represents a shortfall for the CAISO, while a negative value for net CRR payment represents a payment to holders of auction CRRs from the CAISO, meaning the CAISO paid more to auction CRRs than it charged to release CRRs in the auction process.

Figure 158: Comparison of daily net CRR payment with CRR revenue adequacy –April 2017

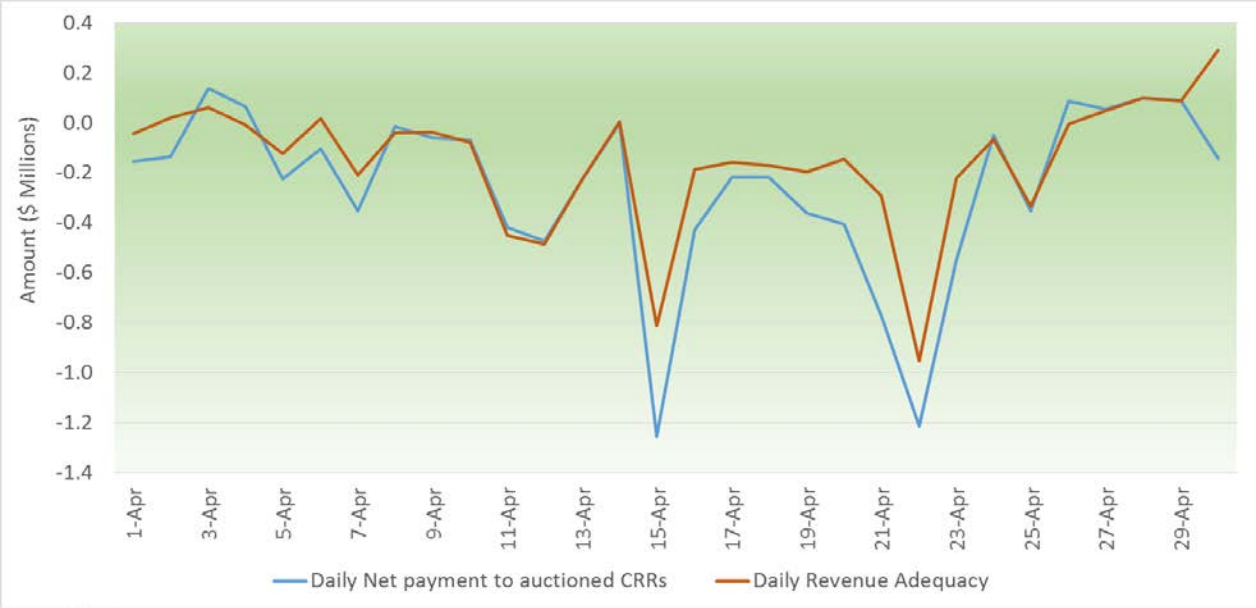
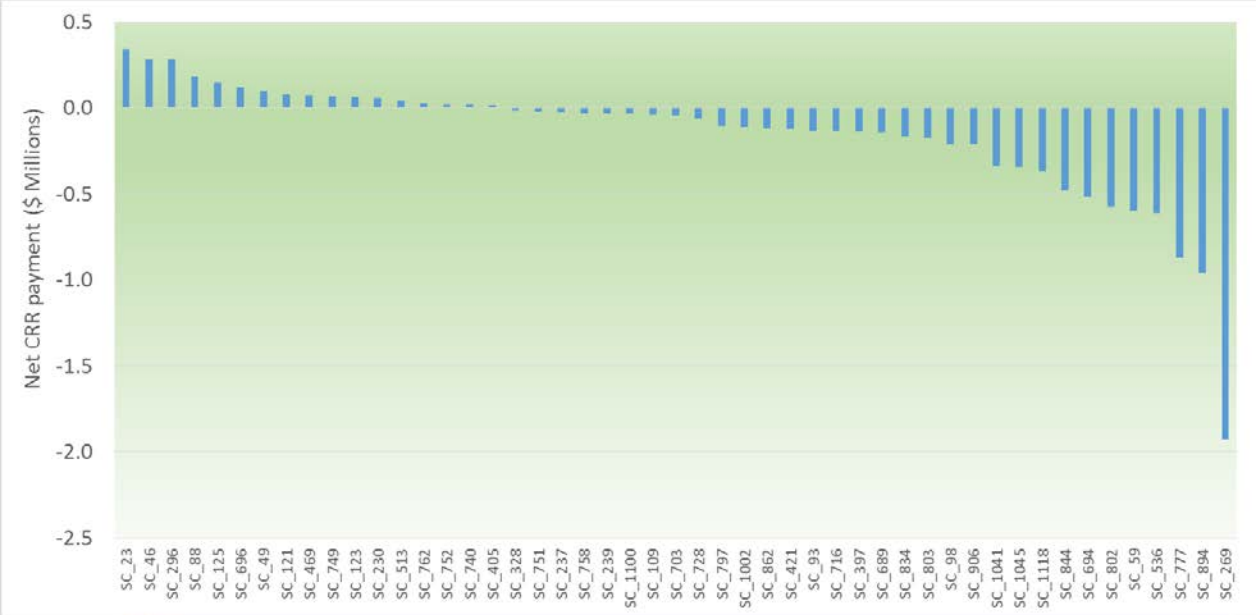


Table 159 shows the net CRR payments to CRR participants, regardless of the type of participant. This only reflects the payments for CRRs released in both the annual and monthly CRR auctions applicable for the month of April 2017. Since this is from the CAISO's perspective, a negative value means the CAISO disbursed a net CRR payment to the CRR holder (or a net money inflow to the CRR holder). The names of the CRR holders are masked, but the identifier shown in the plot is unique across all the months provided in this analysis. A positive value represents a net inflow for the CAISO since it settled less to CRR holders in the day-ahead market than what it charged to release CRRs in the auction. For April, the majority of holders of auction CRRs saw a net gain from having these positions

Figure 159: Net CRR payment to auction CRR –April 2017



To better understand the dynamics leading to such an outcome, the CAISO shifted the analysis to the fundamentals of the CRR auction construct by analyzing the CRR auction results at the constraint level. CRRs are released and priced based on the CRR clearing prices; such prices are derived as the relative difference between locational prices between the source and the sink locations. These locational prices originate from the cleared prices when any transmission constraint becomes binding with nonzero pries in the CRR auction, commonly referred as *shadow prices*. The CAISO turned out to analyze what constraints have been binding in the CRR auction process and compared that with the set of constraints that were binding in the day-ahead market. To some extent, one expects that there is a certain level of alignment between the markets.

Figure 160 and Figure 161 show a comparison of net CRR payments. The CRR payments reflect the CRR settlements for CRRs with day-ahead congestion rents, while the CRR auction revenues is the money the CAISO collected from releasing CRRs through the auctions. That is, it reflects the net money participants were charged to acquire CRRs and the money they were paid; in a loose sense, it could be interpreted as profits for holding.

There are four possible permutations to analyze. The first case represents when a CRR payment to CRR holders was made in the day-ahead market settlement, but the CAISO did not collect any revenues from releasing these CRRs from the auctions because the constraint was not binding in the CRR auction. This is shown for both the pro-rata portion of the annual auction for April and for the monthly CRR auction. A negative value indicates that the CAISO had a net CRR payment to CRR holders. The second case is the opposite in which there was no CRR payments when settling CRRs in the day-ahead market but the CAISO collected revenue when releasing these CRRs in the auction process. The third and fourth cases are for CRRs that had a CRR payment in the day-ahead market and the CAISO also charged them in the CRR auctions to release these CRRs. The third case is when the net CRR payment is negative, while the fourth case is when the net CRR payment is positive. This metric reveals any potential misalignment of constrains enforced and binding between the day-ahead market and CRR auctions.

Figure 160: CRR payment versus CRR auction revenues for annual CRR -April 2017

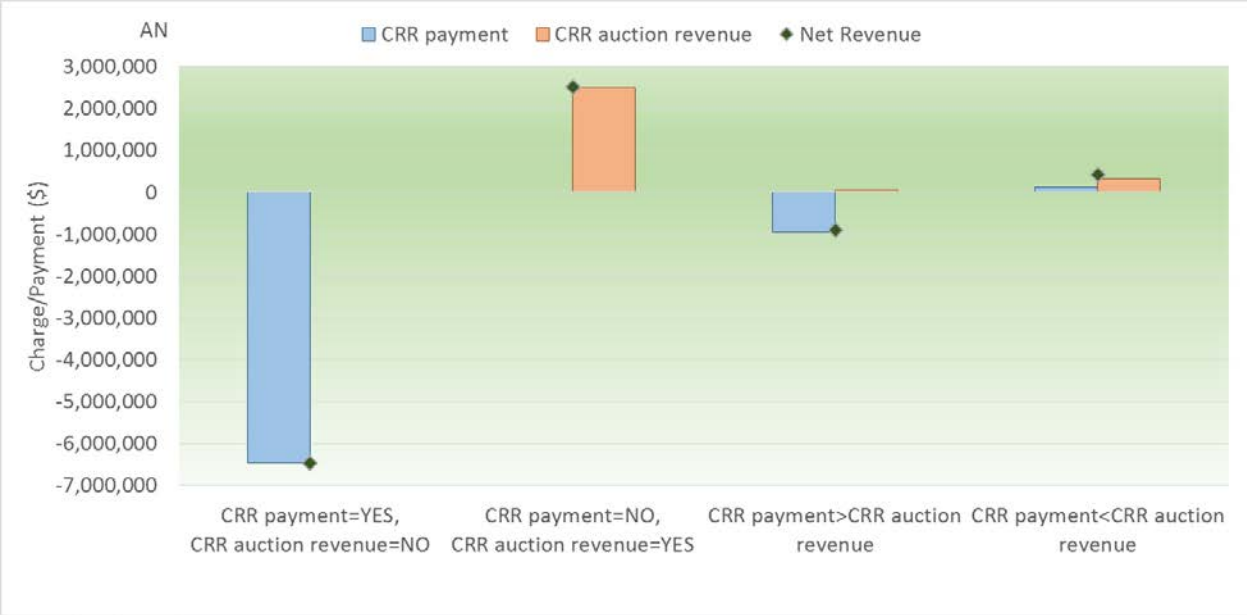


Figure 161: CRR payment versus CRR auction revenues for monthly CRR -April 2017

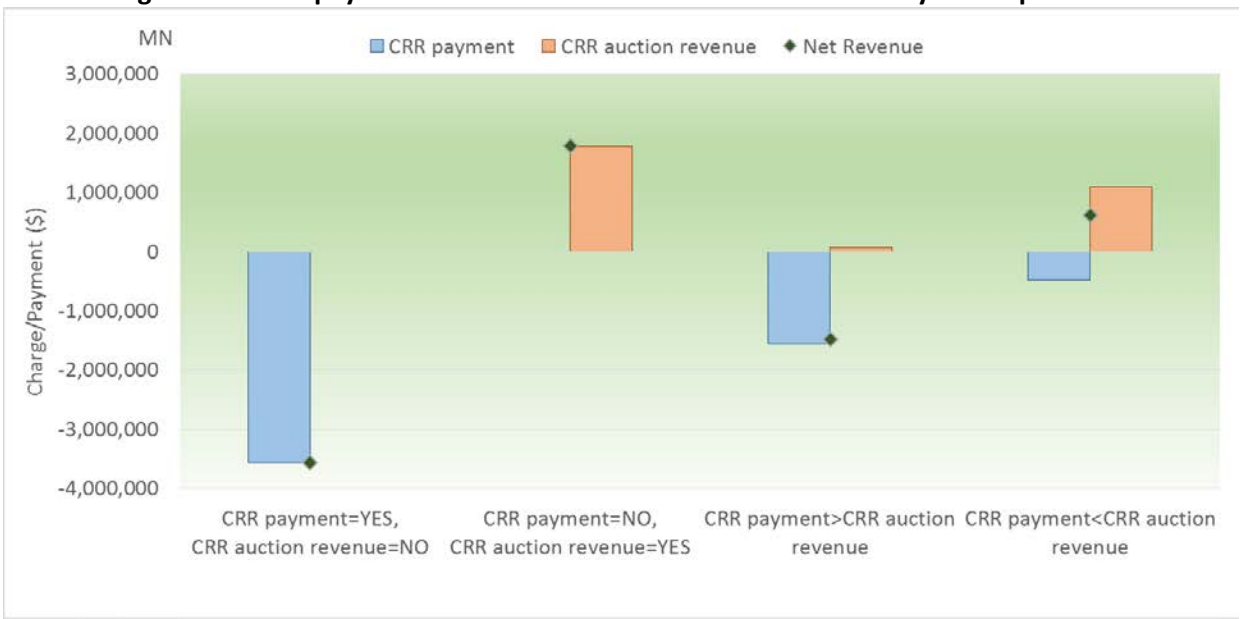


Table 37 provides one level deeper of understanding of such misalignments between markets. This tables shows the top and bottom constraints when sorted by net CRR payments. In the first column it shows the estimated CRR payment to CRR holders accrued in each constraint; the second column shows the revenues collected by the CAISO on that same constraint; the last column shows the net CRR payment, which is the balance between this money outflow (CRR payment) and money inflow (CRR auction revenues) from the CAISO's perspective. Table 38 shows the same information for CRRs released in the monthly auction for April 2017. The top

constraints reflect cases where large CRR payments to auction CRRs accrued when the CRR market did not collect any auction revenues when releasing these CRRs.

Table 37: Net CRR payment by constraint - April 2017, Annual auction

Constraints	Total CRR Payment	Total CRR Auction Revenue	Net CRR Payment
6410_CP5_NG	-$4,292,300.6	$0.0	-$4,292,300.6
32212_E.NICOLS_115_32214_RIO OSO _115_BR_1 _1	-$1,153,925.1	$0.0	-$1,153,925.1
34112_EXCHEQUR_115_34116_LE GRAND_115_BR_1 _1	-$397,891.1	$19,659.1	-$378,232.1
33020_MORAGA _115_32780_CLARMNT _115_BR_1 _1	-$283,926.8	$0.0	-$283,926.8
OMS_3831815_TMS_DLO	-$275,130.6	$0.0	-$275,130.6
33936_MELNS JB_115_33951_VLYHMTP1_115_BR_1 _1	-$217,608.1	$1,019.0	-$216,589.1
NOB_ITC	-$159,380.7	$0.0	-$159,380.7
22192_DOUBLTTP_138_22300_FRIARS _138_BR_1 _1	-$155,303.9	$0.0	-$155,303.9
24138_SERRANO _500_24137_SERRANO _230_XF_2 _P	-$131,885.3	$0.0	-$131,885.3
7820_TL23040_IV_SPS_NG	-$129,933.7	$0.0	-$129,933.7
OMS_3831848_TMS_DLO	-$111,547.8	$0.0	-$111,547.8
32228_PLACER _115_32238_BELL PGE_115_BR_1 _1	-$104,570.6	$0.0	-$104,570.6
30005_ROUND MT_500_30015_TABLE MT_500_BR_1 _2	-$52,039.4	$0.0	-$52,039.4
7820_TL 230S_OVERLOAD_NG	-$50,379.2	$6,257.2	-$44,122.0
32218_DRUM _115_32220_DTCH FL1_115_BR_1 _1	-$39,072.5	$0.0	-$39,072.5
OMS 4673799 Devers_SBus	-$21,786.7	$0.0	-$21,786.7
33020_MORAGA _115_30550_MORAGA _230_XF_3 _P	-$21,449.3	$0.0	-$21,449.3
31336_HPLND JT_60.0_31370_CLVRDLJT_60.0_BR_1 _1	-$19,891.8	$0.1	-$19,891.8
31224_INDIN VL_115_31215_LUCERNJ1_115_BR_1 _1	-$19,780.5	$0.0	-$19,780.5
33932_MELONES _115_33936_MELNS JB_115_BR_1 _1	-$19,518.1	$0.0	-$19,518.1
34116_LE GRAND_115_34134_WILSONAB_115_BR_1 _1	$33,380.2	$909.8	$34,290.0
NdGrp_POD_CHWCHL_1_UNIT-APND	$0.0	$42,955.3	$42,955.3
30106_CARBERRY_230_30245_ROUND MT_230_BR_1 _1	$0.0	$43,871.7	$43,871.7
IPPDCADLN_ITC	$44,005.7	$0.0	$44,005.7
24156_VINCENT _500_24155_VINCENT _230_XF_4 _P	$0.0	$48,013.5	$48,013.5
24086_LUGO _500_24092_MIRALOMA_500_BR_3 _1	$0.0	$48,474.9	$48,474.9
32950_PITSBURG_115_30527_PITSBRG _230_XF_13	$0.0	$50,515.0	$50,515.0
NdGrp_AGUCALG1_7_B1	$0.0	$51,202.4	$51,202.4
24132_SANBRDNO_230_24804_DEVERS _230_BR_1 _1	$0.0	$68,658.5	$68,658.5
33541_AEC_TP1 _115_33540_TESLA _115_BR_1 _1	$75,049.6	$0.0	$75,049.6
22456_MIGUEL _69.0_22464_MIGUEL _230_XF_2	$0.0	$75,165.3	$75,165.3
MALIN500	$66,297.0	$9,917.1	$76,214.2
30523_CC SUB _230_30525_C.COSTA _230_BR_1 _1	$0.0	$86,832.2	$86,832.2
NdGrp_POD_INTKEP_2_UNITS-APND	$0.0	$88,398.7	$88,398.7
22831_SYCAMORE_138_22124_CHCARITA_138_BR_1 _1	$0.0	$90,990.9	$90,990.9
22828_SYCAMORE_69.0_22756_SCRIPPS _69.0_BR_1 _1	$0.0	$102,647.6	$102,647.6
24016_BARRE _230_25201_LEWIS _230_BR_1 _1	-$7,618.1	$153,779.5	$146,161.4
22464_MIGUEL _230_22504_MISSION _230_BR_1 _1	$0.0	$197,517.6	$197,517.6
34548_KETTLEMN_70.0_34552_GATES _70.0_BR_1 _1	$224,140.9	$0.0	$224,140.9
30515_WARNERVL_230_30800_WILSON _230_BR_1 _1	$0.0	$381,657.1	$381,657.1

Table 38: Net CRR payment by constraint - April 2017, Monthly auction

Constraints	Total CRR Payment	Total CRR Auction Revenue	Net CRR Payment
6410_CP5_NG	-$2,473,332.1	$0.0	-$2,473,332.1
32212_E.NICOLS_115_32214_RIO OSO _115_BR_1 _1	-$491,203.7	$20,432.5	-$470,771.1
OMS_3831815_TMS_DLO	-$410,080.2	$0.0	-$410,080.2
34548_KETTLEMN_70.0_34552_GATES _70.0_BR_1 _1	-$384,199.3	$4,312.0	-$379,887.3
33541_AEC_TP1 _115_33540_TESLA _115_BR_1 _1	-$286,384.4	$24,746.5	-$261,637.9
24138_SERRANO _500_24137_SERRANO _230_XF_2 _P	-$219,725.8	$0.0	-$219,725.8
7820_TL 230S_OVERLOAD_NG	-$187,499.0	$0.0	-$187,499.0
34112_EXCHEQUR_115_34116_LE GRAND_115_BR_1 _1	-$136,619.5	$7,984.4	-$128,635.1
OMS_3831848_TMS_DLO	-$127,473.2	$0.0	-$127,473.2
32228_PLACER _115_32238_BELL PGE_115_BR_1 _1	-$103,779.3	$0.0	-$103,779.3
22192_DOUBLTTP_138_22300_FRIARS _138_BR_1 _1	-$92,840.9	$7,832.6	-$85,008.3
MALIN500	-$77,025.3	$0.0	-$77,025.3
30335_ATLANTC _230_30337_GOLDHILL_230_BR_1 _1	-$56,531.6	$0.0	-$56,531.6
30005_ROUND MT_500_30015_TABLE MT_500_BR_1 _2	-$41,172.6	$0.0	-$41,172.6
31990_DAVIS _115_31962_WDLND_BM_115_BR_1 _1	-$27,974.7	$0.0	-$27,974.7
6310_CP6_NG	-$12,222.7	$0.0	-$12,222.7
NdGrp: 34546_AVENAL _70.0_B1	-$11,805.6	$0.0	-$11,805.6
NdGrp: 33506_STANISLS_115_B1	-$10,738.0	$0.0	-$10,738.0
32218_DRUM _115_32220_DTCH FL1_115_BR_1 _1	-$10,679.4	$0.0	-$10,679.4
31224_INDIN VL_115_31215_LUCERNJ1_115_BR_1 _1	-$10,672.7	$0.0	-$10,672.7
NdGrp_POD_CPVERD_2_SOLAR-APND	$0.0	$30,644.3	$30,644.3
24016_BARRE _230_25201_LEWIS _230_BR_1 _1	-$18,724.3	$52,521.9	$33,797.5
24132_SANBRDNO_230_24804_DEVERS _230_BR_1 _1	$0.0	$34,160.2	$34,160.2
33936_MELNS JB_115_33951_VLYHMTP1_115_BR_1 _1	$34,499.7	$0.0	$34,499.7
NdGrp_POD_CNTNLA_2_SOLAR1-APND	$0.0	$35,245.3	$35,245.3
7820_TL23040_IV_SPS_NG	$35,779.6	$0.4	$35,780.0
NdGrp_POD_IVWEST_2_SOLAR1-APND	$0.0	$37,123.8	$37,123.8
34418_KINGSBRG_115_34405_FRWT TAP_115_BR_1 _1	$37,268.1	$0.0	$37,268.1
34410_MANCHSTR_115_34357_AIRWAYJ1_115_BR_1 _1	$40,530.5	$0.0	$40,530.5
NdGrp_POD_IVSLRP_2_SOLAR1-APND	$0.0	$41,442.8	$41,442.8
22592_OLD TOWN_69.0_22596_OLD TOWN_230_XF_2	$0.0	$46,844.3	$46,844.3
IID-SDGE_ITC	$0.0	$47,569.6	$47,569.6
24086_LUGO _500_26105_VICTORVL_500_BR_1 _1	$0.0	$54,326.3	$54,326.3
33020_MORAGA _115_32780_CLARMNT _115_BR_1 _1	$63,454.2	$795.4	$64,249.5
NdGrp_AGUCALG1_7_B1	$0.0	$82,086.3	$82,086.3
CFE_ITC	$0.0	$97,579.6	$97,579.6
NORTHGILA500_BG	$0.0	$121,315.1	$121,315.1
NOB_ITC	-$585,362.1	$752,681.4	$167,319.3
31486_CARIBOU _115_30255_CARBOU M_ 1.0_XF_11	-$19,018.0	$210,076.3	$191,058.4
PATH15_S-N	$0.0	$465,745.5	$465,745.5

These two tables illustrate instances of constraint misalignment between the CRR auctions and the day-ahead market. To understand this mismatch one level deeper, Table 39 lists the subset of constraints that are not binding or not enforced in the CRR monthly auction or that have a significant CRR payment. The portion that were paid only to CRRs from the annual and monthly auctions is also provided. Then it compares the average transmission limit used in the day-ahead market and the limits actually used in both the annual and monthly auctions. These are the constraints that will mostly drive the divergence between the day-ahead and CRR markets. One of the cornerstones of the CRR market efficiency is for the CRR market to closely reflect the transmission capacity of the day-ahead market. When the transmission capacity released in the CRR market is less than that of the day-ahead market, there may be an exposure of revenue deficiency. This may also have a fair impact on the level of CRR net payments and how transmission capacity is valued in the CRR auction. This occurs because when CRRs are released in the auction process they are priced on the value of the capacity made available, or on the lack of it. A systemic issue identified during the evaluation of the CRR auction efficiency is that multiple transmission constraints are not modelled or enforced in the CRR auctions.

In cases where the constraint was enforced in the day-ahead market but not modelled or enforced in the CRR auctions, the amount of transmission capacity by means of CRRs that may be released on that constraints is effectively unbounded, which indicates that more transmission capacity may be released in the CRR auction than in the day-ahead market. This is a major problem to the efficiency of the CRR market. For the case of April 2017 and relative to other months analyzed, there were relatively few instances of constraints not enforced in the CRR auctions. In such cases the level of congestion rents and CRR payments were relatively modest, such that even with the misalignment, the financial impact was low. In further investigating why these constraints were not modelled/enforced in the CRR auctions, the common factors are related to how outages were considered and when transmission constraints were enforced in the CRR auction.

1. Constraint 6410_CP5_NG. For April and May the CRR team was still using the 6310 SOL nomograms and PATH15_S-N and PATH26_BG constraints. The constraint 6410_CP5_NG has the same definition as PATH26_BG but has a lower limit. For April the CRR model enforced the PATH26_BG constraint instead since the nomogram definitions were not defined yet. There were two outages related to this constraint which lasted more than 10 days and were submitted in time.
2. Constraint OMS_3831815_TMS_DLO. This constraint was associated with an outage that was submitted on 03/08/16 for 3 months. It was rescheduled for multiple times with multiple overlapping outages. There were over 58 outage revisions related to this outage and constraint. This outage was modeled in the CRR model for April 2017 with the associated derate's on PACI and COTP_ISO but this specific nomogram was not added to the outage card until after the CRR model was finalized. The CRR model did enforce the normal TMS_DLO_NG constraint. This outage lasted more than 24 hours but less than 10 days.
3. Constraint OMS_3831848_TMS_DLO. This constraint was associated with an outage that was submitted on 03/08/16 for 3 months. It was rescheduled for multiple times with multiple overlapping outages. There are 58 outage revisions changing the COI limits and

Nomograms. This outage was modeled in the CRR model for April 2017 with the associated derate's on PACI and COTP_ISO but this specific nomogram was not added to the outage card until after the CRR model was finalized. The CRR model did enforce the normal TMS_DLO_NG constraint. This outage lasted more than 10 days but was not submitted in time.

4. Constraint OMS 4673799 Devers_SBus. The outage (4673794) was reviewed and added Contingency/Flowgate enforcement in the initial assessment for CRR. Once the outage got closer to scheduled date with more detail study the contingency and flowgate was replaced with the nomogram in the day-ahead market. This outage lasted less than 24 hours.

Table 39: Top constraints binding in the day-ahead market not binding in CRR market - April 2017

Constraint	Constraint Type	TOU	Payments to Annual CRR	Payments to Monthly CRR	DAM Limit	Annual CRR Limit	Monthly CRR Limit	Annual CRR Status	Monthly CRR Status	Reason
6410_CP5_NG	NOMOGRAM	OFF	-$2,597,954.2	-$1,694,229.9	1534.3	Unbounded	Unbounded	Not Enforced	Not Enforced	Missed Enforcement
6410_CP5_NG	NOMOGRAM	ON	-$1,694,346.4	-$779,102.2	1535.9	Unbounded	Unbounded	Not Enforced	Not Enforced	Missed Enforcement
OMS_3831815_TMS_DLO	NOMOGRAM	ON	-$51,112.5	-$210,730.7	291.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missed Outage
OMS_3831815_TMS_DLO	NOMOGRAM	OFF	-$224,018.0	-$199,349.5	291.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missed Outage
24138_SERRANO _500_24137_SERRANO _230_XF_2 _P	FLOWGATE	ON	-$131,885.3	-$219,725.8	1334.8	1064.7	878.4	Not Binding	Not Binding	Auction Economics
OMS_3831848_TMS_DLO	NOMOGRAM	OFF	-$96,273.1	-$77,159.3	298.8	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missed Outage
OMS_3831848_TMS_DLO	NOMOGRAM	ON	-$15,274.6	-$50,313.9	306.4	Unbounded	Unbounded	Not Enforced	Not Enforced	Late/Missed Outage
32228_PLACER _115_32238_BELL PGE_115_BR_1 _1	FLOWGATE	ON	-$69,653.2	-$32,023.2	115.8	113.6	93.7	Not Binding	Not Binding	Auction Economics
32228_PLACER _115_32238_BELL PGE_115_BR_1 _1	FLOWGATE	OFF	-$34,917.5	-$71,756.1	115.8	113.6	93.7	Not Binding	Not Binding	Auction Economics
7820_TL 230S_OVERLOAD_NG	NOMOGRAM	ON	-$9,132.9	-$120,472.1	358.2	354.0	392.0	Not Binding	Not Binding	Higher Limit
7820_TL 230S_OVERLOAD_NG	NOMOGRAM	OFF	-$41,246.3	-$67,026.8	361.3	337.6	392.0	Binding	Not Binding	Higher Limit
30335_ATLANTC _230_30337_GOLDHILL_230_BR_1 _1	FLOWGATE	OFF	-$1,196.4	-$35,402.8	357.2	312.4	257.7	Not Binding	Not Binding	Auction Economics
33020_MORAGA _115_30550_MORAGA _230_XF_3 _P	FLOWGATE	ON	-$21,449.3	-$2,651.6	396.5	378.3	312.1	Not Binding	Not Binding	Auction Economics
30335_ATLANTC _230_30337_GOLDHILL_230_BR_1 _1	FLOWGATE	ON	-$4,628.4	-$21,128.8	370.7	312.4	257.7	Not Binding	Not Binding	Auction Economics
31990_DAVIS _115_31962_WDLND_BM_115_BR_1 _1	FLOWGATE	OFF	$6,960.7	-$25,017.0	113.5	Unbounded	93.7	Not Enforced	Not Binding	Auction Economics
OMS 4673799 Devers_SBus	NOMOGRAM	ON	-$21,786.7	-$4,130.5	351.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Missed Enforcement
22886_SUNCREST_230_92860_SUNC TP1_230_BR_1 _1	FLOWGATE	ON	-$2,473.4	-$7,160.2	1175.4	866.9	715.2	Not Binding	Not Binding	Auction Economics
31224_INDIN VL_115_31215_LUCERNJ1_115_BR_1 _1	FLOWGATE	ON	-$19,780.5	-$10,672.7	98.6	111.3	91.8	Not Binding	Not Binding	Auction Economics
31566_KESWICK _60.0_31582_STLLWATR_60.0_BR_1 _1	FLOWGATE	ON	-$9,909.5	-$809.5	26.5	24.1	19.8	Binding	Not Binding	Auction Economics
33932_MELONES _115_33936_MELNS JB_115_BR_1 _1	FLOWGATE	ON	-$16,671.9	$18,714.1	61.9	53.2	43.9	Not Binding	Not Binding	Auction Economics
31336_HPLND JT_60.0_31206_HPLND JT_115_XF_2	FLOWGATE	ON	-$8,841.7	-$3,176.3	45.0	38.0	31.4	Binding	Not Binding	Auction Economics
32212_E.NICOLS_115_32214_RIO OSO _115_BR_1 _1	FLOWGATE	OFF	-$508,578.4	-$186,440.0	47.5	61.5	50.7	Not Binding	Binding	Higher Limit
32212_E.NICOLS_115_32214_RIO OSO _115_BR_1 _1	FLOWGATE	ON	-$645,346.7	-$304,763.7	48.9	61.5	50.7	Not Binding	Binding	Higher Limit

May 2017

Table 40 summarizes the main settlements metrics for CRR performance in the month of May 2017. The sign convention is based from the CAISO's perspective; a positive value indicates the CAISO collects or has a surplus of money; a negative value indicates the CAISO pays or has a shortfall. Day-ahead congestion rents will be positive, CRR payments will be negative and auction revenues will be positive.

Table 40: Summary of CRR performance for May 2017

Metric	Amount
DA Congestion Rents	$36,479,978
Perfect Hedge	-$1,932,172
Clawback	$675,007
CRR Payments [Auction + Allocation]	-$38,362,619
CRR Payments to Auction CRRs	-$12,159,951
CRR Payments to Monthly Auction CRRs	-$5,895,609
CRR Payments to Annual Auction CRRs	-$6,264,342
CRR Payments to Allocation CRRs	-$26,202,667
CRR Auction Revenue Monthly	$2,547,111
CRR Auction Revenue Annual	$2,907,716
Revenue Adequacy	-$3,139,805
Revenue Adequacy with Auction Revenues	$2,315,022
Net payment to auction CRR	-$6,705,125

In May, the overall CRR performance was poor since there was a revenue deficiency of over $3 million, which is the difference between all of the proceeds from day-ahead congestion rents, CRR clawback and the payments made to CRR holders. About 32 percent of the CRR payments were to CRRs originating from the annual and monthly auctions. The auction revenues represent the proceeds from selling CRRs through the auction. The revenues arising from the annual auction for each season are estimated pro-rata to each month of the calendar quarter based on the number of hours in each time of use. The net payment to auction CRRs stands for the difference between the money paid to CRR holders less the money charge to CRR holders to acquire that portfolio of CRRs in the auction. This does not take into account any expenses the CRR holders incur associated with their participation in the CRR market and use of money. This is only a net accounting balance from the point of view of the cash inflow and outflow in the ISO system.

In order to further understand the origin of this poor performance, there is a need to estimate over time and by constraint the CRR settlements.

Figure 162 shows the daily congestion rents accrued on each transmission constraint that was binding in the day-ahead market in the month of May. Correspondingly, Figure 163 shows the daily CRR revenue adequacy also broken out by transmission constraint. On May 22nd, the total revenue deficiency accounted for about 41% of the entire revenue deficiency for the month.

Figure 162: Daily Congestion rents -May 2017

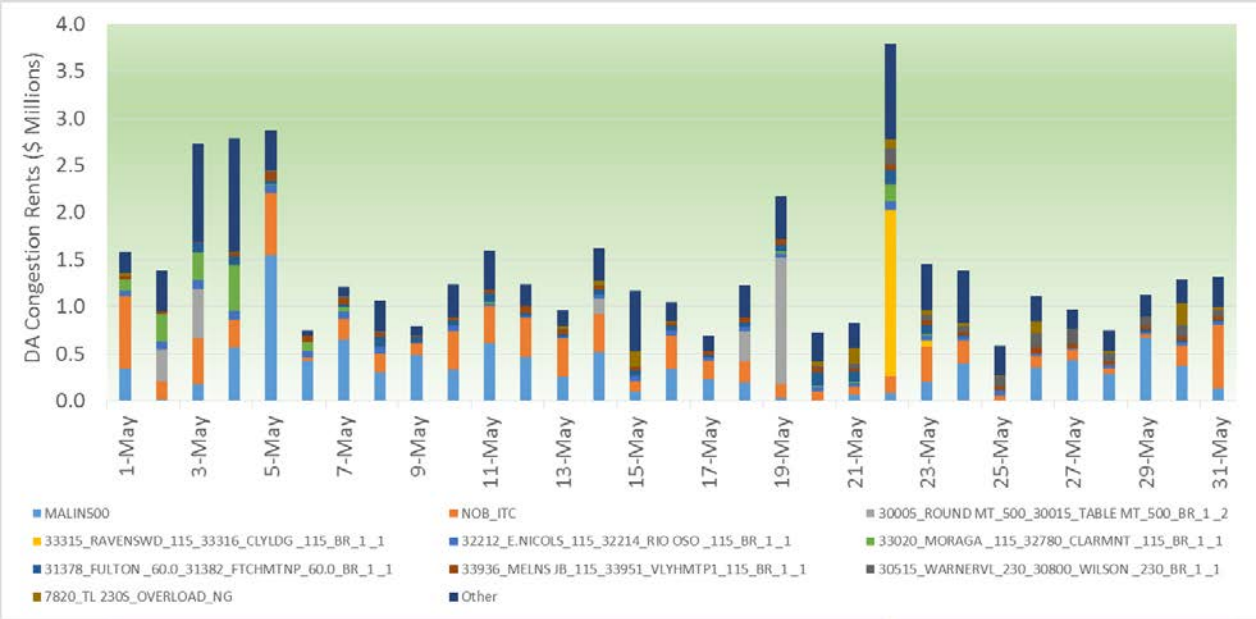


Figure 163: Daily CRR revenue adequacy -May 2017

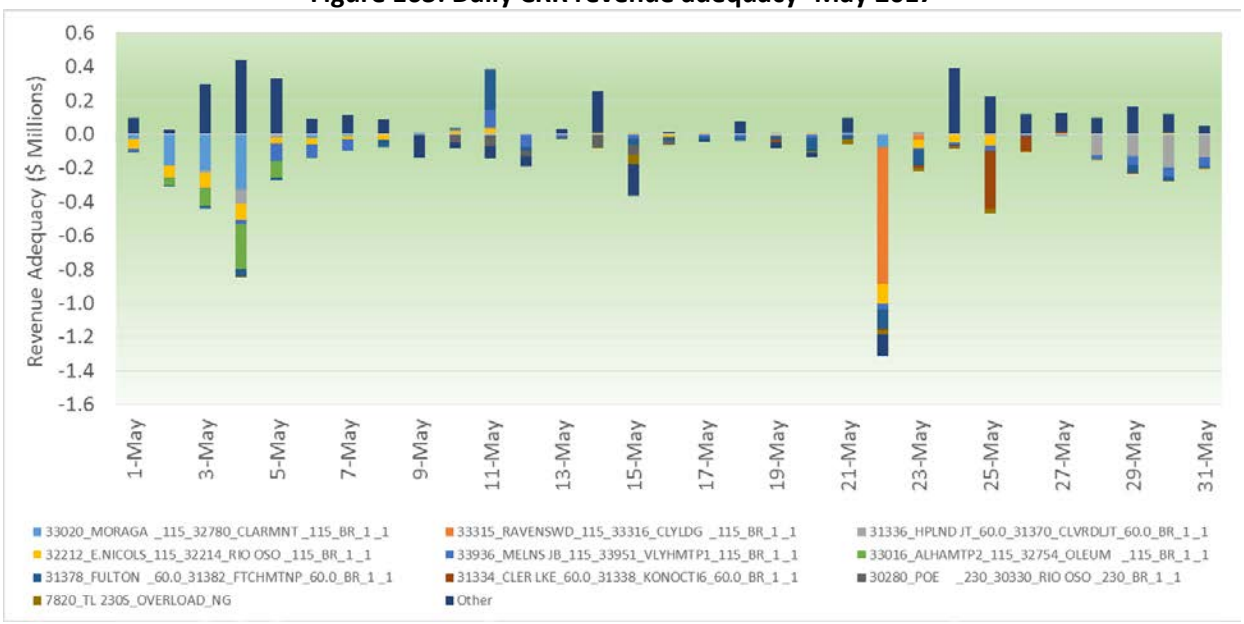
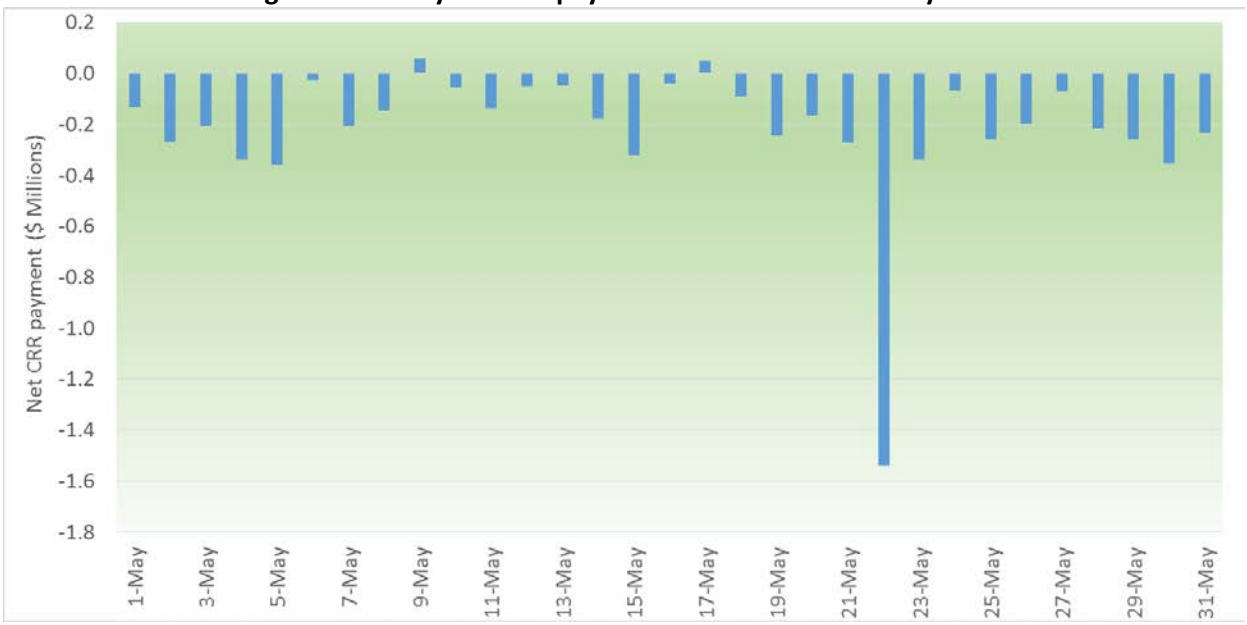


Figure 164 shows the net CRR payment per day. This net revenue is the difference between the CRR payments to CRR holders and the auction revenues collected by the CAISO through the CRR auction process; such revenues become a lump revenue for the auction. For this metric, the annual auction revenues are allocated on a pro-rata estimation to each day of the month based on the number of hours in each time of use. The CRR payments are estimated as the total sum of CRR payments over the hours of the day only for CRRs that were released through both the annual and monthly CRR auction; that is, no CRR payments to allocated CRRs are included. The

purpose of this estimate for net CRR payments is to calculate the net balance for CRR that were auction. For May, there was a persistent negative net CRR payment, indicating that overall the money paid to CRR holders was higher than the money the CAISO collected when releasing such CRRs in the annual and monthly auctions.

Figure 164: Daily net CRR payment to auction CRRs –May 2017



As shown in Figure 165 , there is a strong correlation between the level of CRR revenue deficiency and the level of net CRR payments paid to holders of CRRs released in the auction processes. This is not surprising since both metrics reflect to some extent the effect of CRRs released (and priced) in the CRR auction and the capacity released (and priced) in the day-ahead market. A negative value for CRR revenue adequacy represents a shortfall for the CAISO, while a negative value for net CRR payment represents a payment to holders of auction CRRs from the CAISO, meaning the CAISO paid more to auction CRRs than it charged to release CRRs in the auction process.

Figure 165: Comparison of daily net CRR payment with CRR revenue adequacy –May 2017

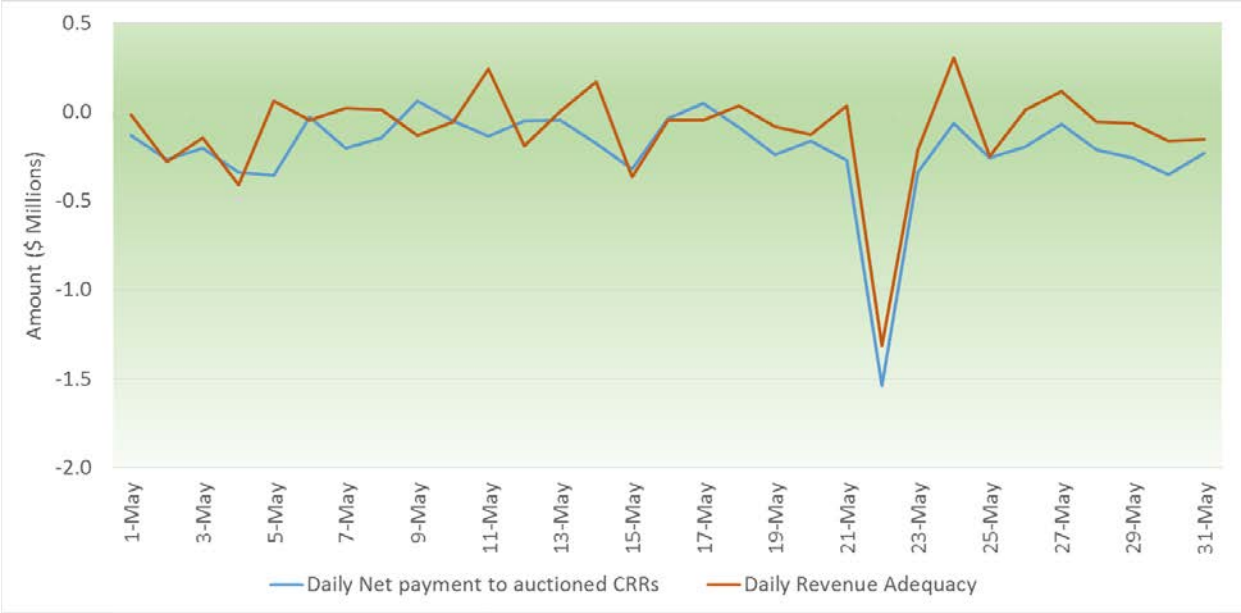
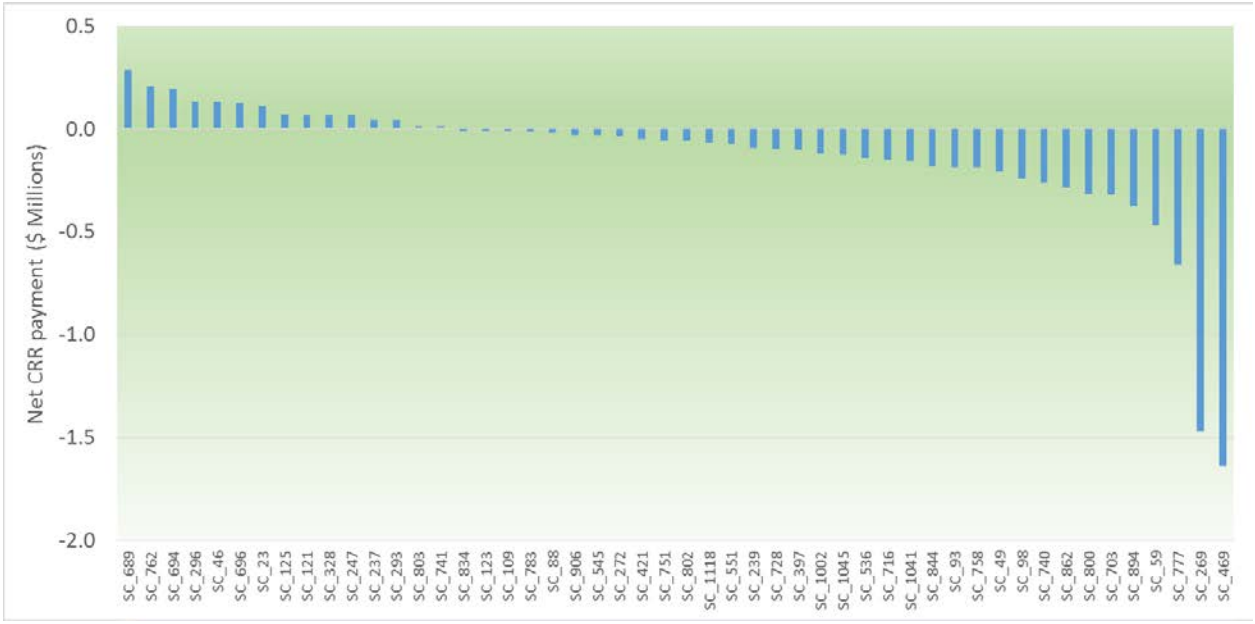


Figure 166 shows the net CRR payments to CRR participants, regardless of the type of participant. This only reflects the payments for CRRs released in both the annual and monthly CRR auctions applicable for the month of May 2017. Since this is from the CAISO's perspective, a negative value means the CAISO disbursed a net CRR payment to the CRR holder (or a net money inflow to the CRR holder). The names of the CRR holders are masked, but the identifier shown in the plot is unique across all the months provided in this analysis. A positive value represents a net inflow for the CAISO since it settled less to CRR holders in the day-ahead market than what it charged to release CRRs in the auction. For May, the majority of holders of auction CRRs saw a net gain from having these positions.

Figure 166: Net CRR payment to auction CRR –May 2017



To better understand the dynamics leading to such an outcome, the CAISO shifted the analysis to the fundamentals of the CRR auction construct by analyzing the CRR auction results at the constraint level. CRRs are released and priced based on the CRR clearing prices; such prices are derived as the relative difference between locational prices between the source and the sink locations. These locational prices originate from the cleared prices when any transmission constraint becomes binding with nonzero pries in the CRR auction, commonly referred as *shadow prices*. The CAISO turned out to analyze what constraints have been binding in the CRR auction process and compared that with the set of constraints that were binding in the day-ahead market. To some extent, one expects that there is a certain level of alignment between the markets.

Figure 167 and Figure 168 show a comparison of net CRR payments. The CRR payments reflect the CRR settlements for CRRs with day-ahead congestion rents, while the CRR auction revenues is the money the CAISO collected from releasing CRRs through the auctions. That is, it reflects the net money participants were charged to acquire CRRs and the money they were paid; in a loose sense, it could be interpreted as profits for holding.

There are four possible permutations to analyze. The first case represents when a CRR payment to CRR holders was made in the day-ahead market settlement, but the CAISO did not collect any revenues from releasing these CRRs from the auctions because the constraint was not binding in the CRR auction. This is shown for both the pro-rata portion of the annual auction for May and for the monthly CRR auction. A negative value indicates that the CAISO had a net CRR payment to CRR holders. The second case is the opposite in which there was no CRR payments when settling CRRs in the day-ahead market but the CAISO collected revenue when releasing these CRRs in the auction process. The third and fourth cases are for CRRs that had a CRR payment in the day-ahead market and the CAISO also charged them in the CRR auctions to release these CRRs. The third case is when the net CRR payment is negative, while the fourth case is when the net CRR payment is positive. This metric reveals any potential misalignment of constrains enforced and binding between the day-ahead market and CRR auctions.

Figure 167: CRR payment versus CRR auction revenues for annual CRR -May 2017

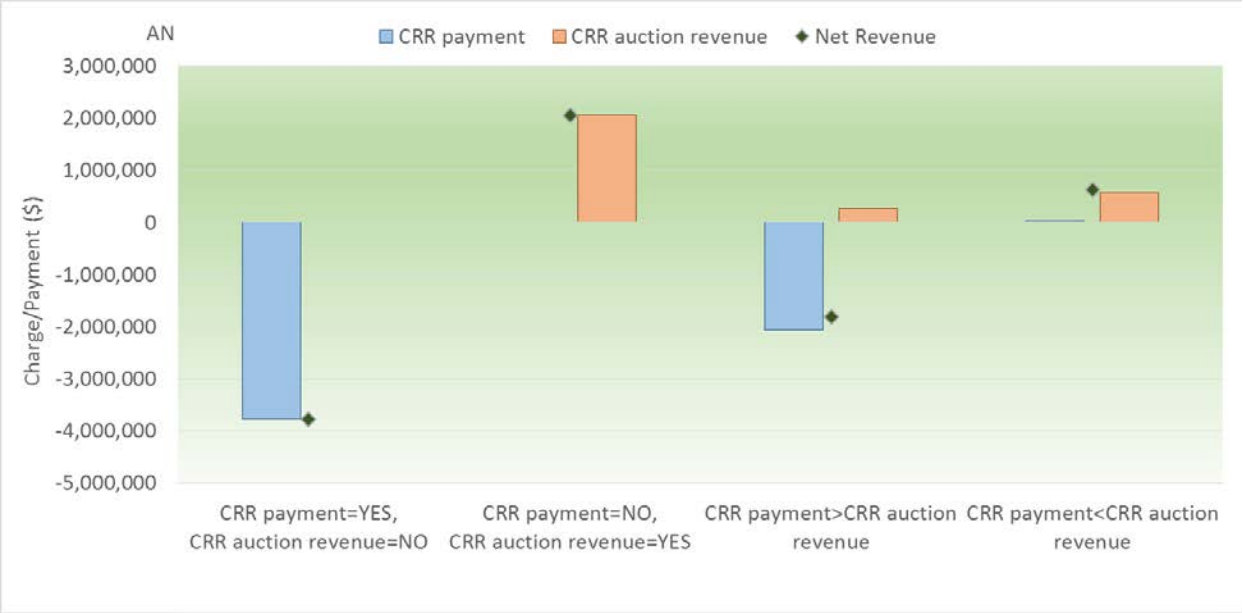


Figure 168: CRR payment versus CRR auction revenues for monthly CRR -May 2017

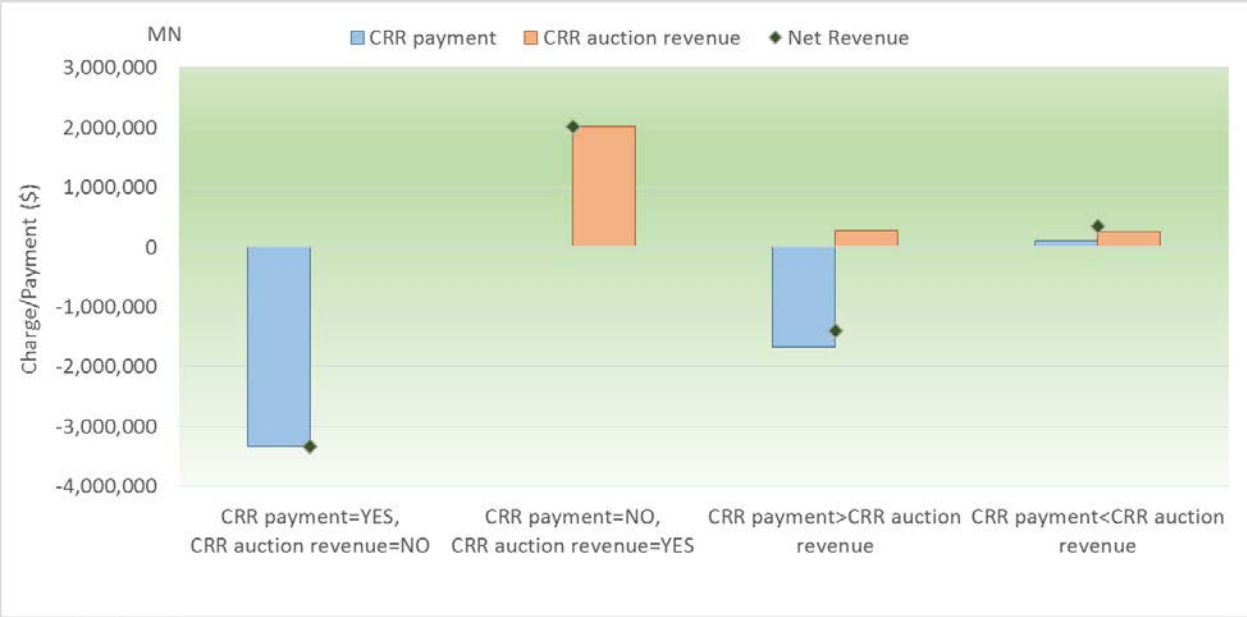


Table 41 provides one level deeper of understanding of such misalignments between markets. This tables shows the top and bottom constraints when sorted by net CRR payments. In the first column it shows the estimated CRR payment to CRR holders accrued in each constraint; the second column shows the revenues collected by the CAISO on that same constraint; the last column shows the net CRR payment, which is the balance between this money outflow (CRR payment) and money inflow (CRR auction revenues) from the CAISO's perspective. Table 42 shows the same information for CRRs released in the monthly auction for May 2017. The top constraints

reflect cases where large CRR payments to auction CRRs accrued when the CRR market did not collect any auction revenues when releasing these CRRs.

Table 41: Net CRR payment by constraint - May 2017, Annual auction

Constraints	Total CRR Payment	Total CRR Auction Revenue	Net CRR Payment
32212_E.NICOLS_115_32214_RIO OSO _115_BR_1 _1	-$1,576,367.7	$0.0	-$1,576,367.7
31378_FULTON _60.0_31382_FTCHMTNP_60.0_BR_1 _1	-$656,966.8	$0.0	-$656,966.8
33315_RAVENSWD_115_33316_CLYLDG _115_BR_1 _1	-$625,600.1	$0.0	-$625,600.1
31336_HPLND JT_60.0_31370_CLVRDLJT_60.0_BR_1 _1	-$546,542.5	$0.1	-$546,542.4
7820_TL 230S_OVERLOAD_NG	-$405,704.9	$6,826.0	-$398,878.9
33020_MORAGA _115_32780_CLARMNT _115_BR_1 _1	-$344,048.7	$0.0	-$344,048.7
34112_EXCHEQUR_115_34116_LE GRAND_115_BR_1 _1	-$318,876.6	$20,046.8	-$298,829.8
6310_CP3_NG	-$260,039.3	$0.0	-$260,039.3
33016_ALHAMTP2_115_32754_OLEUM _115_BR_1 _1	-$250,914.0	$0.0	-$250,914.0
31334_CLER LKE_60.0_31338_KONOCTI6_60.0_BR_1 _1	-$233,407.7	$0.0	-$233,407.7
33936_MELNS JB_115_33951_VLYHMTP1_115_BR_1 _1	-$151,253.9	$1,101.9	-$150,152.0
30005_ROUND MT_500_30015_TABLE MT_500_BR_1 _2	-$131,464.1	$0.0	-$131,464.1
30515_WARNERVL_230_30800_WILSON _230_BR_1 _1	-$498,910.3	$390,055.3	-$108,855.0
31220_EGLE RCK_115_31228_HOMSTKTP_115_BR_1 _1	-$97,305.5	$0.0	-$97,305.5
22480_MIRAMAR _69.0_22756_SCRIPPS _69.0_BR_1 _1	-$97,263.5	$0.0	-$97,263.5
IPPUTAH_ITC	-$108,183.2	$24,909.7	-$83,273.6
MALIN500	-$86,881.0	$10,818.7	-$76,062.3
34427_ATWELL _115_34701_SMYRNA 1_115_BR_1 _1	-$83,941.3	$14,024.2	-$69,917.1
30500_BELLOTA _230_30515_WARNERVL_230_BR_1 _1	-$49,989.3	$0.0	-$49,989.3
22820_SWEETWTR_69.0_22476_MIGUELTP_69.0_BR_1 _1	-$46,454.0	$0.0	-$46,454.0
NdGrp_POD_CHWCHL_1_UNIT-APND	$0.0	$45,427.0	$45,427.0
24086_LUGO _500_24092_MIRALOMA_500_BR_3 _1	$0.0	$48,004.3	$48,004.3
24156_VINCENT _500_24155_VINCENT _230_XF_4 _P	$0.0	$48,818.0	$48,818.0
32950_PITSBURG_115_30527_PITSBRG _230_XF_13	$0.0	$50,252.5	$50,252.5
NdGrp_AGUCALG1_7_B1	$0.0	$50,705.3	$50,705.3
30035_TRACY _500_99006_TAP737 1_500_BR_1 _1	$64,848.3	$0.0	$64,848.3
24132_SANBRDNO_230_24804_DEVERS _230_BR_1 _1	$0.0	$67,991.9	$67,991.9
32766_EL CRRTO_115_33010_SOBRANTE_115_BR_2 _1	$69,581.0	$0.0	$69,581.0
NdGrp: 24702_KRAMER _115_B2	$73,749.2	$0.0	$73,749.2
22456_MIGUEL _69.0_22464_MIGUEL _230_XF_2	$0.0	$75,733.7	$75,733.7
34548_KETTLEMN_70.0_34552_GATES _70.0_BR_1 _1	$88,702.3	$0.0	$88,702.3
22831_SYCAMORE_138_22124_CHCARITA_138_BR_1 _1	$0.0	$90,412.8	$90,412.8
NdGrp_POD_INTKEP_2_UNITS-APND	$0.0	$92,236.3	$92,236.3
22828_SYCAMORE_69.0_22756_SCRIPPS _69.0_BR_1 _1	$0.0	$102,423.2	$102,423.2
NOB_ITC	$113,898.5	$0.0	$113,898.5
OMS 4821903 Tivy Valley CB 42	$120,826.1	$0.0	$120,826.1
30440_TULUCAY _230_30460_VACA-DIX_230_BR_1 _1	$129,884.6	$0.0	$129,884.6
24016_BARRE _230_25201_LEWIS _230_BR_1 _1	-$1,082.9	$154,084.4	$153,001.4
30435_LAKEVILE_230_30460_VACA-DIX_230_BR_1 _1	$190,967.9	$0.0	$190,967.9
22464_MIGUEL _230_22504_MISSION _230_BR_1 _1	$0.0	$196,156.3	$196,156.3

Table 42: Net CRR payment by constraint - May 2017, Monthly auction

Constraints	Total CRR Payment	Total CRR Auction Revenue	Net CRR Payment
32212_E.NICOLS_115_32214_RIO OSO _115_BR_1 _1	-$1,048,283.5	$0.0	-$1,048,283.5
7820_TL 230S_OVERLOAD_NG	-$537,721.9	$0.0	-$537,721.9
31378_FULTON _60.0_31382_FTCHMTNP_60.0_BR_1 _1	-$513,981.8	$0.0	-$513,981.8
33315_RAVENSWD_115_33316_CLYLDG _115_BR_1 _1	-$374,589.4	$0.0	-$374,589.4
30515_WARNERVL_230_30800_WILSON _230_BR_1 _1	-$301,074.1	$21,500.3	-$279,573.8
30280_POE _230_30330_RIO OSO _230_BR_1 _1	-$267,932.0	$3,775.6	-$264,156.5
31336_HPLND JT_60.0_31370_CLVRDLJT_60.0_BR_1 _1	-$247,277.1	$0.0	-$247,277.1
34418_KINGSBRG_115_34405_FRWT TAP_115_BR_1 _1	-$208,035.9	$0.0	-$208,035.9
34158_PANOCHE _115_34350_KAMM _115_BR_1 _1	-$184,407.1	$0.0	-$184,407.1
33936_MELNS JB_115_33951_VLYHMTP1_115_BR_1 _1	-$168,357.1	$0.1	-$168,357.0
33016_ALHAMTP2_115_32754_OLEUM _115_BR_1 _1	-$162,838.6	$0.0	-$162,838.6
33541_AEC_TP1 _115_33540_TESLA _115_BR_1 _1	-$181,270.3	$22,369.1	-$158,901.3
6310_CP3_NG	-$141,713.6	$0.0	-$141,713.6
22192_DOUBLTTP_138_22300_FRIARS _138_BR_1 _1	-$135,827.5	$0.0	-$135,827.5
32766_EL CRRTO_115_33010_SOBRANTE_115_BR_2 _1	-$129,854.9	$0.0	-$129,854.9
NOB_ITC	-$113,891.0	$0.0	-$113,891.0
OMS 4821903 Tivy Valley CB 42	-$83,755.3	$0.0	-$83,755.3
34427_ATWELL _115_34701_SMYRNA 1_115_BR_1 _1	-$75,838.3	$0.0	-$75,838.3
33020_MORAGA _115_32780_CLARMNT _115_BR_1 _1	-$92,962.0	$21,541.2	-$71,420.9
MEAD_ITC	-$47,660.1	$0.0	-$47,660.1
30805_BORDEN _230_30810_GREGG _230_BR_1 _1	$29,878.2	$0.0	$29,878.2
NdGrp_POD_INTKEP_2_UNITS-APND	$0.0	$31,096.5	$31,096.5
IID-SCE_BG	$0.0	$32,184.4	$32,184.4
NdGrp_POD_NAROW2_2_UNIT-APND	$0.0	$35,955.0	$35,955.0
30750_MOSSLD _230_30045_MOSSLAND_500_XF_9	$0.0	$38,825.5	$38,825.5
24132_SANBRDNO_230_24804_DEVERS _230_BR_1 _1	$0.0	$45,164.6	$45,164.6
NdGrp_AGUCALG1_7_B1	$0.0	$45,967.5	$45,967.5
MERCHANT_ITC	$46,704.8	$0.0	$46,704.8
24016_BARRE _230_25201_LEWIS _230_BR_1 _1	-$2,561.1	$50,560.6	$47,999.5
33950_RVRBK TP_115_33934_TULLOCH _115_BR_1 _1	$0.0	$50,797.8	$50,797.8
32200_PEASE _115_32288_E.MRY J1_115_BR_1 _1	-$17,020.3	$75,274.4	$58,254.1
30440_TULUCAY _230_30460_VACA-DIX_230_BR_1 _1	$61,422.0	$0.0	$61,422.0
30035_TRACY _500_99006_TAP737 1_500_BR_1 _1	$66,163.7	$0.0	$66,163.7
MALIN500	$69,167.8	$0.0	$69,167.8
30435_LAKEVILE_230_30460_VACA-DIX_230_BR_1 _1	$81,694.0	$0.0	$81,694.0
24086_LUGO _500_26105_VICTORVL_500_BR_1 _1	$0.0	$94,044.8	$94,044.8
22356_IMPRLVLY_230_21025_ELCENTRO_230_BR_1 _1	$0.0	$96,375.7	$96,375.7
30105_COTTNWD _230_30245_ROUND MT_230_BR_3 _1	-$563.9	$262,112.9	$261,549.0
PATH26_BG	$0.0	$383,814.5	$383,814.5
NdGrp: 24702_KRAMER _115_B2	$421,301.2	$0.0	$421,301.2

These two tables illustrate instances of constraint misalignment between the CRR auctions and the day-ahead market. To understand this mismatch one level deeper, Table 43 lists the subset of constraints that are not binding or not enforced in the CRR monthly auction or that have a significant CRR payment. The portion that were paid only to CRRs from the annual and monthly auctions is also provided. Then it compares the average transmission limit used in the day-ahead market and the limits actually used in both the annual and monthly auctions. These are the constraints that will mostly drive the divergence between the day-ahead and CRR markets. One of the cornerstones of the CRR market efficiency is for the CRR market to closely reflect the transmission capacity of the day-ahead market. When the transmission capacity released in the CRR market is less than that of the day-ahead market, there may be an exposure of revenue deficiency. This may also have a fair impact on the level of CRR net payments and how transmission capacity is valued in the CRR auction. This occurs because when CRRs are released in the auction process they are priced on the value of the capacity made available, or on the lack of it. A systemic issue identified during the evaluation of the CRR auction efficiency is that multiple transmission constraints are not modelled or enforced in the CRR auctions.

In cases where the constraint was enforced in the day-ahead market but not modelled or enforced in the CRR auctions, the amount of transmission capacity by means of CRRs that may be released on that constraints is effectively unbounded, which indicates that more transmission capacity may be released in the CRR auction than in the day-ahead market. This is a major problem to the efficiency of the CRR market. For the case of May 2017 and relative to other months analyzed, there were relatively few instances of constraints not enforced in the CRR auctions. In such cases the level of congestion rents and CRR payments were relatively modest, such that even with the misalignment, the financial impact was low. In further investigating why these constraints were not modelled/enforced in the CRR auctions, the common factors are related to how outages were considered and when transmission constraints were enforced in the CRR auction.

1. Constraint 6310_CP3_NG. This constraint's name was changed from 6310_SOL NG to CP3 NG. SOL NG was modeled in the May CRR auctions. For April and May the CRR auction was still using the 6310 SOL nomograms and PATH15_S-N and PATH26_BG constraints. Specifically the CRR model did enforce 6310_SOL3_NG_SUM for the May CRR model with a limit of 307MW. By the time the modelled was created the nomogram definition did not exist yet.

Table 43: Top constraints binding in the day-ahead market not binding in CRR market - May 2017

Constraint	Constraint Type	TOU	Payments to Annual CRR	Payments to Monthly CRR	DAM Limit	Annual CRR Limit	Monthly CRR Limit	Annual CRR Status	Monthly CRR Status	Reason
33315_RAVENSWD_115_33316_CLYLDG _115_BR_1 _1	FLOWGATE	ON	-$625,600.1	-$374,589.4	137.7	147.7	121.9	Not Binding	Not Binding	Auction Economics
31378_FULTON _60.0_31382_FTCHMTNP_60.0_BR_1 _1	FLOWGATE	ON	-$377,640.5	-$462,051.3	25.6	29.4	24.2	Not Binding	Not Binding	Higher Limit
32212_E.NICOLS_115_32214_RIO OSO _115_BR_1 _1	FLOWGATE	ON	-$916,117.3	-$650,949.2	65.8	61.5	50.7	Not Binding	Not Binding	Auction Economics
7820_TL 230S_OVERLOAD_NG	NOMOGRAM	ON	-$241,146.4	-$374,361.6	368.0	354.0	392.0	Not Binding	Not Binding	Higher Limit
33016_ALHAMTP2_115_32754_OLEUM _115_BR_1 _1	FLOWGATE	ON	-$237,215.7	-$168,759.4	92.7	78.8	65.0	Not Binding	Not Binding	Auction Economics
6310_CP3_NG	NOMOGRAM	OFF	-$260,039.3	-$141,713.6	292.0	Unbounded	Unbounded	Not Enforced	Not Enforced	Late Enforcement
32212_E.NICOLS_115_32214_RIO OSO _115_BR_1 _1	FLOWGATE	OFF	-$660,250.4	-$397,334.3	64.9	61.5	50.7	Not Binding	Not Binding	Auction Economics
31336_HPLND JT_60.0_31370_CLVRDLJT_60.0_BR_1 _1	FLOWGATE	ON	-$226,143.2	-$218,496.1	32.9	29.4	24.2	Binding	Not Binding	Auction Economics
31378_FULTON _60.0_31382_FTCHMTNP_60.0_BR_1 _1	FLOWGATE	OFF	-$279,326.3	-$51,930.5	25.1	29.4	24.2	Not Binding	Not Binding	Higher Limit
31336_HPLND JT_60.0_31370_CLVRDLJT_60.0_BR_1 _1	FLOWGATE	OFF	-$320,399.3	-$28,781.0	32.8	29.4	24.2	Binding	Not Binding	Auction Economics
7820_TL 230S_OVERLOAD_NG	NOMOGRAM	OFF	-$164,558.6	-$163,360.3	368.0	337.6	392.0	Binding	Not Binding	Higher Limit
31334_CLER LKE_60.0_31338_KONOCTI6_60.0_BR_1 _1	FLOWGATE	ON	-$194,384.1	-$34,828.0	35.3	Unbounded	26.9	Not Enforced	Not Binding	Auction Economics
32766_EL CRRTO_115_33010_SOBRANTE_115_BR_2 _1	FLOWGATE	ON	$72,416.0	-$129,526.6	154.8	133.1	109.8	Not Binding	Not Binding	Auction Economics
34418_KINGSBRG_115_34405_FRWT TAP_115_BR_1 _1	FLOWGATE	ON	-$41,145.5	-$176,984.1	77.8	64.9	53.6	Not Binding	Not Binding	Auction Economics
31336_HPLND JT_60.0_31206_HPLND JT_115_XF_2	FLOWGATE	ON	-$54,027.6	-$19,838.1	45.7	38.0	31.4	Binding	Not Binding	Auction Economics
MEAD_ITC	INTER_TIE	ON	$640.6	-$47,660.1	1619.0	977.5	1586.6	Binding	Not Binding	Higher Limit
33932_MELONES _115_33936_MELNS JB_115_BR_1 _1	FLOWGATE	OFF	-$7,706.2	-$41,752.5	57.8	53.2	43.9	Not Binding	Not Binding	Auction Economics
30500_BELLOTA _230_30515_WARNERVL_230_BR_1 _1	FLOWGATE	ON	-$49,989.3	-$37,643.1	312.6	255.6	210.9	Not Binding	Not Binding	Auction Economics
22820_SWEETWTR_69.0_22476_MIGUELTP_69.0_BR_1 _1	FLOWGATE	ON	-$46,454.0	-$14,708.3	100.7	Unbounded	76.5	Not Enforced	Not Binding	Auction Economics
IPPDCADLN_ITC	INTER_TIE	ON	$302.1	-$16,681.5	726.4	299.5	780.0	Not Binding	Not Binding	Higher Limit
31220_EGLE RCK_115_31228_HOMSTKTP_115_BR_1 _1	FLOWGATE	ON	-$38,174.9	-$24,327.4	139.9	119.5	98.6	Not Binding	Not Binding	Auction Economics

Net CRR payments on nodal group constraints

With the detailed analysis performed in this section for a subset of monthly auctions, a trend of auction revenues was created. The nodal group constraints have been consistently binding in the CRR auctions since the introduction of this type of constraint in June 2015, as seen in Figure 169. Since the majority of the time these constraints do not arise in the day-ahead market, the nodal constraints have been a steady money inflow (auction revenues collected in the CRR auctions are greater than the CRR payment to holders of auction CRRs) for the CAISO settlements for net CRR payments. Unlike the CRR auctions, where these constraints are now enforced in every auction, these constraints are generated in the day-ahead market only when there is a difficulty to converge to AC power flows.

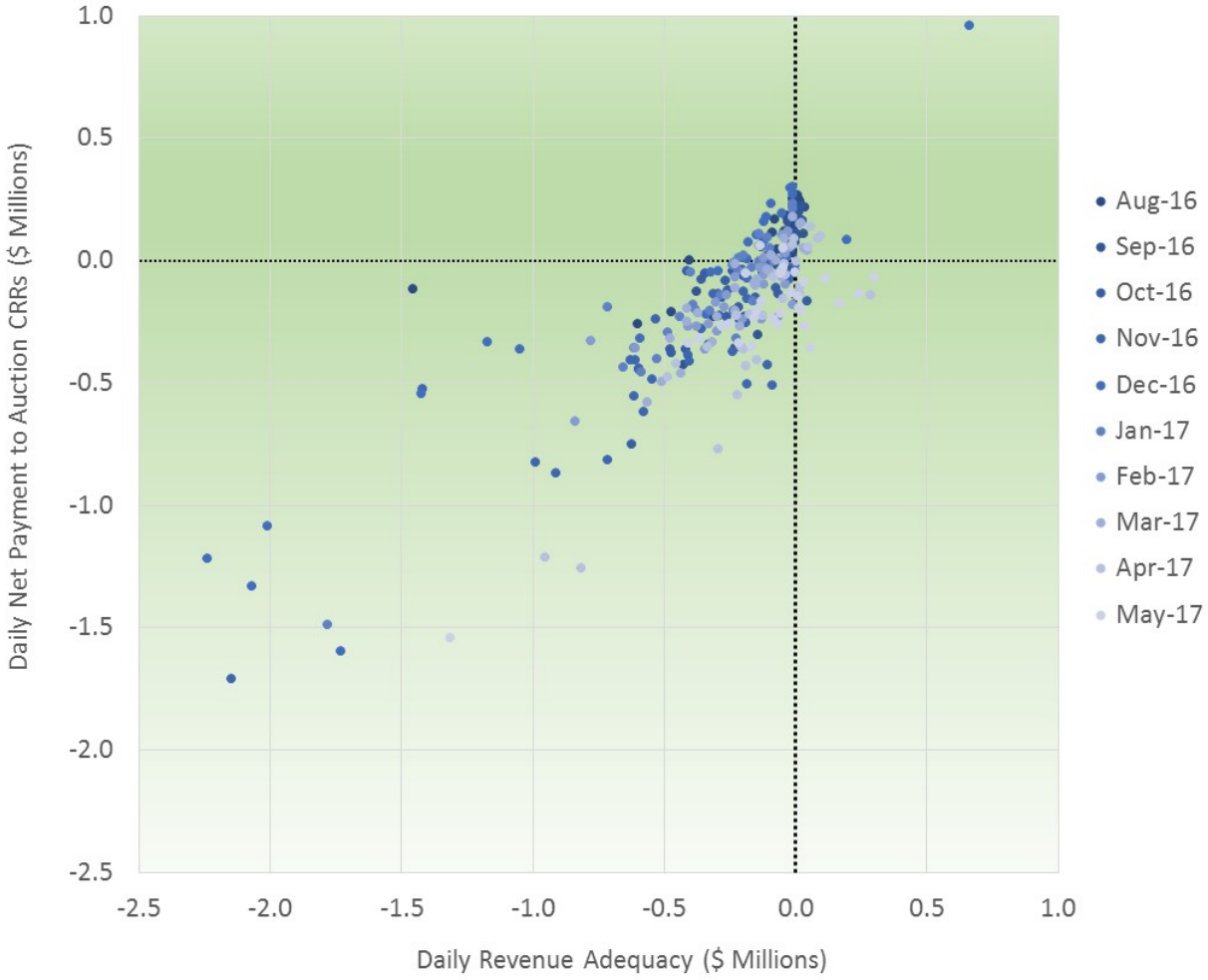
Figure 169: Net CRR payments accrued on nodal group constraints

Net CRR payments and CRR revenue adequacy

As provided in the analysis of each of the months in this section, there is a strong correlation between the net CRR payments and the CRR revenue adequacy.

Figure 170 shows that correlation for the 10 months analyzed. This correlation does not mean that one is the driver of the other; instead, both metrics are impacted largely by some common drivers such as late or missed outages and late enforcement of constraints. For any dot in which both quantities are negative, it means there was a CRR revenue deficiency and holders of auction CRRs were paid more than what they were charged in the auction to acquire these CRRs. Each dot stands for one day of the 10-month period analyzed earlier in this section.

Figure 170: Net CRR payment vs. CRR revenue adequacy



8 Final Remarks

Congestion revenue rights are a key and natural complement to electricity markets based on locational marginal pricing. The purpose of CRRs is to provide a hedging mechanism to entities directly exposed to congestion in the day-ahead market or to those managing risk associated capacity or energy based contracts that could be exposed to congestion. Inherently, CRRs are risk-based instruments and when evaluating the merit or value of the instrument the risk component and its secondary effects cannot be ignored. This risk component is indeed built into the CRR prices and reflected eventually in the auction revenues. There are market design variations among ISO's in regards to how they are released (allocations versus auctions), how often they are released (annual, monthly, sequential), how they are funded (full funding versus partial funding). In the CAISO market, CRRs are allocated in both allocation and auction processes, in annual and monthly cycles and are currently fully funded. Two of the main concerns typically observed about the overall performance of CRRs is regarding revenue sufficiency and net CRR payments. The former is to ensure there are sufficient funds from day-ahead congestion rent to cover all CRR payouts, while the latter is to see how well the CRR auction is discovering the day-ahead market. Convergence between the CRR auction and the day-ahead market will be reflected by means of the relative difference between the money collected as auction revenues when releasing CRRs versus the money paid to the auction CRR holders, namely in this report as net CRR payments.

In this report, the CAISO undertook the analysis of the CRR auctions performance, given the concerns that historically the level of CRR payment to holders of auction CRRs may be too large in comparison to what they paid to acquire these CRRs in the auctions. Different angles of the CRR performance were analyzed and estimated, going from how the participation has evolved over time, the number and volume of CRRs released in the auctions, the prices discovered and formed in the CRR auctions, the level of auction revenues collected, the patterns of the delta between CRR payments and auction revenues to acquire CRRs to isolate if this has its origin in one specific area. There was also some analysis on the type of bids awarded in the CRR markets where the study found that most of the payments for CRRs were defined between supply locations, like from generation location to generation location, as opposed to from a supply to load location. All these metrics are useful to see dynamics and observe bidding patterns; some working hypothesis on the bidding behavior can be constructed; however, to understand how the CRRs were performing the way they were, there was a need to analyze deeper the underlying fundamentals of the market.

While the first part of report focuses on analysis of the auction process including bid-in price/quantity patterns, what is ultimately of interest is the underlying cleared price and quantity which are what make up the auction revenues and become a function of the transmission capacity available in the auction. Similarly, the cleared price and quantity of transmission used in day-ahead market that determines the relationship of the congestion revenue collected which is a function of the transmission available in the day-head market. These prices and quantities, however, are by-product variables of more fundamental variables. The locational marginal prices are by-products of congestion prices on transmission constraints. Thus, to understand the drivers

of the difference between the amount of CRR payments and the money collected as auction revenues, one must understand the drivers causing the differences in the transmission pricing for constraints modeled between CRR auction and the day-ahead market. Therefore, the analysis ultimately focuses on understanding the cause for the differences of transmission available in the CRR market versus the day-ahead market and their pricing.

From that perspective, the CAISO first analyzed the outage information since one critical component in a transmission-based market is to ensure the transmission capacity is properly modelled. The chapter on transmission outages provides some useful information on how frequently outages are submitted on time to be accounted for in the CRR auction processes. Furthermore, this information is then leveraged in the subsequent chapter where the most recent 10 months of CRR auction performance is analyzed. By doing this detailed analysis of auction by auction and constraint by constraint, instead of generic patterns, the CAISO was able to identify critical elements driving the differences between the CRR auctions and the day-ahead market, which can be succinctly summarized as:

i) There have been outages not submitted in time to the CAISO that resulted in missing to include these outages in the CRR auctions.
ii) There were multiple outages that have a short duration that impact the day-ahead congestion prices but even if submitted with plenty of time for their consideration in the CRR auctions, there is no easy and clear way to account for them in the model of the CRR auction.
iii) There were some outages submitted in time but there was a gap in the CAISO process to properly reflect the outages in the CRR auction model.
iv) There were also process gaps in the CAISO processes to enforce and manage transmission constraints between the CRR auction and the day-ahead market that eventually were binding in the day-ahead market even in the absence of any outage.

While through the detailed analysis the significant drivers to the differences were identified, the analysis was not able quantify the relative frequency of each of the four drivers identified. Indeed the dominate drivers often changed from month to month and was situational based rather than creating a pattern where one or some of the drivers are dominate over time.

One of the premises for having a robust CRR market is that there is a high degree of constancy between transmission capacity released in the CRR process with the transmission capacity used in the day-ahead market. All these issues related to transmission constraints and outages not considered or enforced in the CRR auction diminish that fundamental premise.

Furthermore, CRR auctions can be seen as a dynamic interaction of participants who observe results from both CRR auctions and energy markets to define the bidding strategies for the subsequent auctions. The noise introduced when there is a transmission misalignment between markets impacts not only the applicable CRR auction but may also distort the incentives and pricing for subsequent auctions. Once one given auction has been impacted by a model issue, the overall economics of that auction may be distorted since enforcing or not enforcing one specific constraint may ultimately impact the pricing of other transmission constraints since the auction result is based on a simultaneous feasibility test.

Through the analysis, it is shown that there is a strong correlation between CRR revenue adequacy and net CRR payments. This points to the fact that both market performance metrics reflect a common underlying driver, which is the various issues leading to a discrepancy of transmission capacity modelling between the CRR auction and the day-ahead market. The approach implemented by the CAISO is based on full funding; this means that when the congestion rents collected from the day-ahead market are not sufficient to cover all the CRR payments, all CRR payments are still fully paid and the difference (shortfall or surplus) is absorbed by measured demand. In this case, the full funding may actually exacerbate the level of net CRR payments.

Finally, there is an inherent complication to align the CRR auctions with the day-ahead market. Granted, even when knowing all the information about outages and transmission configuration changes in time for the monthly auction, the limiting factor is how to accurately incorporate these into the monthly auctions. For instance, if there is an outage lasting for less than a day, in the monthly auction it is for one single market where the element needs to be on outage or not, or it can be derated. Having the element fully on outage for the monthly auction may be excessively restrictive, but not modelling it at all may fall on the other side of the spectrum. Where to strike the balance when modelling this kind of more granular information than the monthly auction can naturally reflect as an open question. Then the second complication is in the annual auction; this auction runs in the last quarter of the year prior to the binding year of the action, this means that outages or transmission configuration changes impacting the last quarter of the annual auction may be effectively modeled a year apart; by that time there is very limited information of what outages may be really scheduled to happen that far in advance.

Attachment D – Draft Final Proposal Second Addendum

Tariff Amendment to Increase Efficiency of

Congestion Revenue Rights Auctions Track 1B

California Independent System Operator Corporation

Congestion Revenue Rights Auction Efficiency

Track 1B Draft Final Proposal Second Addendum

June 11, 2018

Prepared by: Market and Infrastructure Policy

California Independent System Operator

Table of Contents

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. The CAISO also proposes to reduce 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.

This document also describes two other alternatives the CAISO considered: (1) reducing congestion revenue right quantities each day prior to the day-ahead market so that they reflect available transmission, and (2) 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.

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

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.

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

This section describes the changes the CAISO made to its draft final proposal addendum in this second addendum.

In this second addendum, the CAISO proposes to add a safeguard to mitigate the risk that its constraint-specific proposal could pose to any specific congestion revenue rights. During its June 7, 2018 Market Surveillance Committee meeting, the Market Surveillance Committee expressed the concern that due to the CAISO's large amount of congestion revenue right revenue inadequacy, any specific congestion revenue right's payments had the potential to be significantly de-valued. The Market Surveillance Committee was concerned that this could diminish the value of congestion revenue rights and could particularly adversely affect market participants with smaller congestion revenue right portfolios. Consequently, the Market Surveillance Committee recommended to socialize the revenue inadequacy costs by allocating them to all congestion revenue rights holders in proportion to their congestion revenue right payments.

Stakeholders at the meeting expressed concerns with this approach and, in general, preferred the CAISO's proposed constraint-specific revenue inadequacy cost-allocation approach. They stated that, in valuing congestion revenue rights, they could better estimate the risk of transmission outages than they could estimate their potential share of congestion revenue right revenue inadequacy. Stakeholders also stated that the CAISO's constraint-specific approach would better reduce incentives to obtain congestion revenue rights that have inflated payments due to modeling differences between the auction and the day-ahead market. Finally, they stated allocating revenue inadequacy in proportion to congestion revenue right payments would inequitably affect congestion revenue rights purchased at a higher price relative to their payments more than it would affect congestion revenue rights purchased at a lower price.

Nevertheless, to address the Market Surveillance Committee's concern while still implementing its constraint-specific revenue inadequacy cost allocation approach, the CAISO also proposes to reduce the amount of system capacity released in the annual allocation and auction process to 65%. This additional measure is intended to dampen any extreme congestion revenue rights de-valuations by only releasing congestion revenue rights that are reasonably expected to be feasible. As discussed in prior versions of this proposal, the CAISO found that by limiting the release of system capacity to 65%, it can eliminate 57% of monthly transmission infeasibilities. This measure should decrease the likelihood that a congestion revenue right obtained in the annual process will have its payment reduced below its target payment. Consequently, this measure will likely result in higher auction prices then without it because it will increase each auction participant's confidence that the congestion revenue rights they bid on will be fully funded.

In ***Section 6.2.2***, the CAISO discusses the proposal to reduce the amount of system capacity released in the annual process.

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 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.[2]

[2] 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
6/7/2018	Stakeholder comments to track 1B draft final proposal addendum
6/11/2018	Publish track 1B draft final proposal second addendum
6/13/2018	Stakeholder conference call
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 reflects 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.[3]

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

[3] 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).[4] 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.

[4] 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.[5] 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.[6] 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.[7] 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,

[5] 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.
[6] MRTU Filing, Exh. No. ISO-2 at 22.
[7] 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).[8]

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.

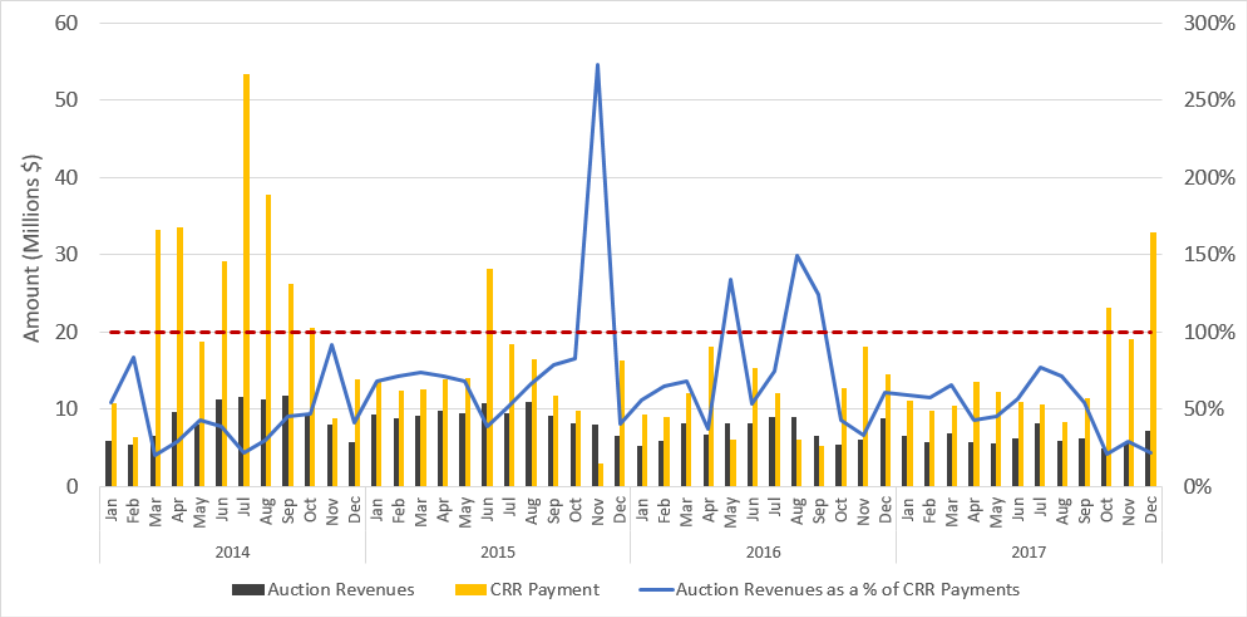


Figure 1: Auction proceeds versus payouts

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.

[8] 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.[9]

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.

[9] 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.

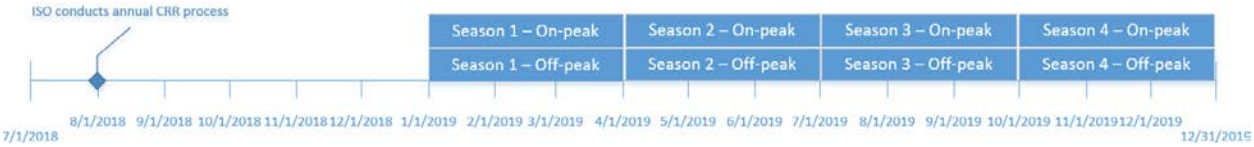


Figure 2: Mid-year annual process awards CRRs for upcoming calendar year

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 intertie capacity for the auction round. If no intertie 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.

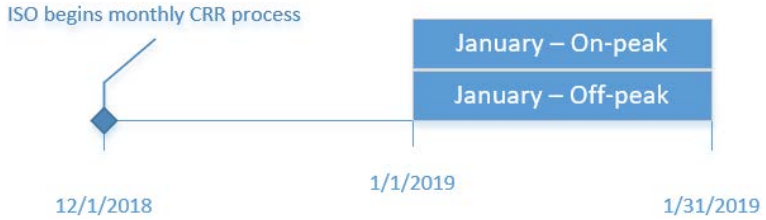


Figure 3: Monthly process awards CRRs for upcoming calendar month

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.

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 ***Section 6.2.2***, the CAISO proposes to lower the percentage of system capacity available in the annual allocation and auction.

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 reduce congestion revenue rights quantities each day prior to the day-ahead market.

- In ***Section 6.3.2***, 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.

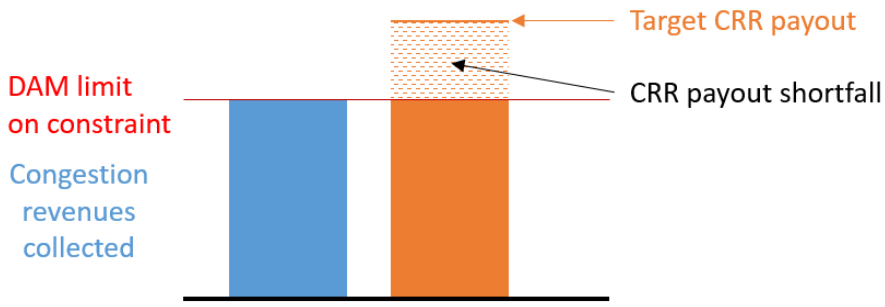


Figure 4: Congestion revenue shortfall between day-ahead market congestion revenues and congestion revenue rights payments per constraint

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 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.[10] This allocation method has similarities to methods employed at other ISO/RTOs. The PJM[11] and MISO[12] 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. [13]

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[10] 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

[11] 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.

[12] See Section 2.9.3 of the MISO Business Practice Manual "BPM 005 – Market Settlements" June 12, 1014 available at: https://www.misoenergy.org/Library/BusinessPracticesManuals/Pages/BusinessPracticesManuals.aspx.

[13] 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."[14] 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

[14] See http://www.caiso.com/Documents/Presentation-CongestionRevenueRightsAuction Efficiency-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.[15]

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.

[15] 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.

6.2.2 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 proposes to release congestion revenue rights for 60% of system capacity into the long-term allocation process going forward.

2. The CAISO proposes to 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 will still be honored.

6.3 Alternatives considered

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

6.3.1 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.

6.3.2 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.[16]

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.[17]

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.

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[16] http://www.caiso.com/Documents/MSCFinalOpinionon CongestionRevenueRightsAuctionEfficiency-Mar15_2018.pdf, at P4

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

7 Next Steps

Stakeholders should attend the stakeholder conference call on June 13, 2018 to provide verbal comments.

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.

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

Where,

N	*number of nodes on the system indexed by* $\boldsymbol{n}$
Q	*number of congestion revenue rights indexed by* $\boldsymbol{q}$
K	*number of preventive contingencies indexed by* $\boldsymbol{k}$[18]
M	*number of monitored elements indexed by* $\boldsymbol{m}$[19]
T	*number of time intervals indexed by* $\boldsymbol{t}$
$CRRMW_q$	*megawatt capacity awarded to* CRR_q
SF	*day ahead market shift factor*
$SF^{src}_{q,k,m,t}$	*day ahead shift factor from CRR* $\boldsymbol{q}$ *source location to constraint* $\boldsymbol{k},\boldsymbol{m}$ *in time interval* $\boldsymbol{t}$
$SF^{snk}_{q,k,m,t}$	*day ahead shift factor from CRR* $\boldsymbol{q}$ *sink location to constraint* $\boldsymbol{k},\boldsymbol{m}$ *in time interval* $\boldsymbol{t}$
$IFMMW_{n,t}$	*net megawatt injection*[20] *at node* $\boldsymbol{n}$ *in time interval* $\boldsymbol{t}$ *of the integrated forward market*
$\propto_{q,k,m,t}$	$CRR\ \boldsymbol{q}'s$ *proportion of the prevailing flow on constraint* $\boldsymbol{k},\boldsymbol{m}$ *in time interval* $\boldsymbol{t}$
$CRRClawbackMW_{q,k,m,t}$	*megawatt representation of revenue clawback on CRR* $\boldsymbol{q}$ *on constraint* $\boldsymbol{k},\boldsymbol{m}$ *in time interval* $\boldsymbol{t}$

Simplify the notation to the product of two terms: congestion revenue right q's ***portion of congestion revenue right settled flow*** ($\propto_{q,k,m,t}$) 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.

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

Where,

$$\propto_{q,k,m,t} = \begin{cases} 0, & CRRMW_q \times \left(SF^{src}_{q,k,m,t} - SF^{snk}_{q,k,m,t}\right) \leq 0 \\ \dfrac{CRRMW_q \times \left(SF^{src}_{q,k,m,t} - SF^{snk}_{q,k,m,t}\right) - CRRClawbackMW_{q,k,m,t}}{\sum_{q=0}^{Q} \max\left[0, CRRMW_q \times \left(SF^{src}_{q,k,m,t} - SF^{snk}_{q,k,m,t}\right) - CRRClawbackMW_{q,k,m,t}\right]}, & otherwise \end{cases}$$

And

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

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.

[18] 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.
[19] The monitored element is oriented in the direction of the $IFMMW_{n,t}$ flow, so the $IFMMW_{n,t}$ flow is always positive.
[20] IFMMW includes ETC/TOR injections and withdrawals

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

$$CRRMW_{q,k,m,t} = CRRMW_q \times \left(SF^{src}_{q,k,m,t} - SF^{snk}_{q,k,m,t}\right)$$

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 ($TargetCRRRevenue_{q,k,m,t}$).

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

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.

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

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.

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

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:

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

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

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

$$\begin{aligned} MonthlyCRRPayment_{q,k,m} &= MonthlyTargetCRRRevenue_{q,k,m} \\ &\quad - MonthlyCRRClawbackRevenue_{q,k,m} \\ &\quad + \min\left(0, MonthlyOffsetRevenue_{q,k,m}\right) \\ MonthlyRemainder_{q,k,m} &= \max\left(0, MonthlyOffsetRevenue_{q,k,m}\right) \end{aligned}$$

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.

Attachment E – Board Memo

Tariff Amendment to Increase Efficiency of

Congestion Revenue Rights Auctions Track 1B

California Independent System Operator Corporation

Memorandum

To: ISO Board of Governors

From: Keith Casey, Vice President, Market & Infrastructure Development

Date: June 14, 2018

Re: **Decision on congestion revenue rights auction efficiency track 1B proposal**

This memorandum requires Board action.

EXECUTIVE SUMMARY

Management seeks Board approval of changes to the ISO's congestion revenue right market rules that will reduce the net payment to a congestion revenue right holder if its payments exceed associated congestion charges collected in the day-ahead market. The ISO currently pays congestion revenue right holders in full even if the congestion revenues collected from the day-ahead market are insufficient to cover the total payments due to congestion revenue right holders. This occurs when more restrictive constraints are enforced in the day-ahead market than were enforced in the congestion revenue rights auction. When this occurs, day-ahead market congestion revenue is insufficient to cover payments to congestion revenue right holders. The ISO currently charges this revenue deficiency to load (more specifically, load and exports).

Management proposes that, instead of charging load for this revenue inadequacy, the ISO will charge congestion revenue right holders in proportion to congestion revenue rights flow over each constraint in the day-ahead market associated with the revenue inadequacy. This change will result in a more equitable allocation of the revenue inadequacy instead of charging it to load.

Management also proposes to decrease the percentage of system capacity released in the annual congestion revenue rights allocation and auction process to 65 percent from 75 percent. This will provide greater assurance that congestion revenue rights obtained in the annual process will be feasible in the monthly process. This will reduce the amount of payment reductions resulting from revenue inadequacy charges.

These changes are part of the ISO's congestion revenue rights auction efficiency initiative designed to decrease the ISO's congestion revenue rights auction revenue shortfall. Since 2014, auction revenues have averaged $99.5 million per year less than payments to congestion revenue rights. The Board approved track 1A of the initiative in

March 2018 and the ISO subsequently submitted these changes to the Federal Energy Regulatory Commission (FERC). Track 1A consisted of changes to the ISO's congestion revenue right market rules designed to decrease the auction revenue shortfall by limiting congestion revenue right sources and sinks and improving outage reporting.

While track 1A targeted decreasing the auction revenue shortfall primarily by increasing congestion revenue right prices, track 1B addresses the auction revenue shortfall by decreasing net congestion revenue right payments to bring them more in line with system conditions modeled in the auction. Management also proposes to offset the revenue inadequacy charged to congestion revenue right holders to the extent there are revenue surpluses collected on the same constraint over the course of a month. This will reduce the amount of revenue taken back from congestion revenue right holders and therefore mitigate incentives to bid lower prices for congestion revenue rights in the auction.

Management proposes the following motion:

> ***Moved, that the ISO Board of Governors approves the proposal to implement the congestion revenue rights auction efficiency track 1B changes described in the memorandum dated June 14, 2018; and***
>
> ***Moved, that the ISO Board of Governors authorizes Management to make all necessary and appropriate filings with the Federal Energy Regulatory Commission to implement this proposal, including any filings that implement the overarching initiative policy but contain discrete revisions to incorporate Commission guidance in any initial ruling on the proposed tariff amendment.***

BACKGROUND

Congestion revenue rights facilitate participation in the ISO's market by providing market participants the ability to hedge congestion costs in the ISO's locational marginal price-based day-ahead market – effectively locking in the cost of day-ahead market transmission service on a forward basis. This ability to hedge congestion cost risk is an important part of the ISO's market design. It results in more efficient bilateral long-term power contracting because suppliers do not have to include congestion cost risk premiums in power contracts. Congestion revenue rights and the congestion revenue rights auction are a standard part of all of the ISO and RTO market designs in the United States.

Congestion revenue rights entitle holders to a payment or charge based on the differences, due to congestion, of the locational marginal prices between two locations in the day-ahead market. 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 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 (the source) to location B (the sink). 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.

Market participants obtain congestion revenue rights in annual and monthly allocation and auction processes. In both the annual and monthly process, the ISO first allocates congestion revenue rights to load-serving entities based on their requests and then auctions the remaining congestion rights to all eligible participants (e.g., generator owners, marketers, financial traders).

Generally, over the long-term, congestion revenue rights auction prices should reflect the value of the hedge provided against day-ahead market congestion charges and consequently should generate auction revenues that are more or less commensurate with the payments congestion revenue rights receive from the day-ahead market. This has not been the case for ISO congestion revenue rights. ISO congestion revenue rights auction revenues have been much less than payments to congestion revenue rights holders. Since 2014, auction revenues have averaged $99.5 million per year less than payments to congestion revenue rights holders. The ISO allocates auction revenues to load and exports.

In March 2018, the Board approved track 1A of the ISO's congestion revenue rights auction efficiency initiative and the ISO subsequently submitted these changes to the FERC. Track 1A consisted of two changes to the ISO's congestion revenue right market rules that were designed to decrease the auction revenue shortfall. The first change was to limit congestion revenue right sources and sinks to only the combinations needed to hedge congestion costs associated with delivering supply. This is intended to increase auction prices by concentrating congestion revenue right bidding to transmission paths involving supply delivery. Track 1A also included an earlier transmission outage reporting requirement so that the ISO can more accurately model outages in the congestion revenue rights auction and allocation process.

In conjunction with these changes, the ISO has implemented various congestion revenue rights process changes also intended to improve the efficiency of the congestion revenue rights auction. These include changes to outage reporting and constraint modeling in the auction and the day-ahead markets that the ISO can implement without tariff changes. These changes are referred to as track 0 of the initiative.

In its March 2018 Board memorandum regarding track 1A, Management described that it was continuing to consider additional congestion revenue right market rule changes that it would propose to the Board at a later date. Management also described that it was seeking earlier action on the initial track 1A changes so that they could be developed and implemented in the ISO systems in time for the 2019 annual congestion revenue right allocation and auction process.

PROPOSAL

The ISO currently makes day-ahead market payments to congestion revenue right holders for the full MW quantity of their congestion revenue rights awarded in the auction. This occurs even if constraints subsequently enforced or tightened in the day-ahead market, such as due to transmission outages, prevent the day-ahead market from scheduling a corresponding amount of power. The lower amount of power scheduled in the day-ahead market over a constraint reduces the associated congestion revenue the day-ahead market collects. When this happens, this full congestion revenue right funding results in congestion revenue being insufficient to cover payments to congestion revenue rights holders. The ISO currently charges load (more specifically, load and exports) to make up for this revenue inadequacy and allocates it any surplus. The CAISO also allocates any surplus in the monthly balancing account to demand.

Full funding of congestion revenue rights also exacerbates congestion revenue rights revenue inadequacy and auction revenue shortfalls. For example, market participants can obtain low-priced congestion revenue rights in the auction that can have high payouts if a constraint not modeled in the auction turns out to be enforced in the day-ahead markets, or vice versa. This results in high payouts that often lead to revenue inadequacy and also contribute to auction revenue deficiencies due to payouts that are inconsistent with the conditions modeled, and resulting prices, in the auction.

To address these issues, Management proposes to modify the market rules to allocate congestion revenue rights revenue inadequacy to congestion revenue right holders. Under this approach, congestion revenue right holders will receive day-ahead market congestion payments for only the transmission capacity that is actually available in the day-ahead market. The proposed changes in track 1B are designed to work in conjunction with the track 1A changes to reduce the auction revenue shortfall.

Management proposes to allocate congestion revenue rights revenue inadequacy to congestion revenue right holders based on each of their congestion revenue rights' modeled flow over market constraints resulting in revenue insufficiency. The ISO will charge each congestion revenue right holder for each of their congestion revenue right's share of each constraint's revenue inadequacy based on each congestion revenue right's proportional share of all congestion revenue rights' modeled flow over the constraint. For example, assume the congestion revenue rights auction modeled congestion revenue rights as having 800 MW of flow over a constraint representing a 1,000 MW line. Assume the ISO subsequently reduces the line's transmission capacity

for one day in a month to 500 MW, and that the line is congested for all hours of the day with congestion charges averaging $10/MWh. Under the current market rules, the congestion revenue rights over the line will be paid the full MW value despite the line's derate in the day-ahead market, with payments on that day totaling $192,000 (800 MW * $10/MWh * 24 hours). However, the day-ahead market for that day will only collect $120,000 in congestion charges associated with the line because only 500 MW can flow over it, resulting in a $72,000 revenue deficiency. The ISO charges load for this revenue deficiency under the current market rules. Under Management's proposal, the ISO will instead charge the $72,000 revenue deficiency to the congestion revenue rights that have flows over the line. For example, if one congestion revenue right in this example has 400 MW of flow over the line and two others each have 200 MW of flow over the line, the ISO will charge the first congestion revenue right $36,000 ($72,000 * 400 MW/800 MW) and will charge each of the other two congestion revenue rights $18,000 each ($72,000 * 200 MW/800 MW).

Management's proposal ensures net revenue adequacy by assigning shortfalls to all congestion revenue right holders, rather than assigning all shortfalls to load as it does today. Management proposes that all congestion revenue rights, whether they are obtained through the allocation or auction processes be treated similarly. Management's proposal is equitable among all categories of market participants because each congestion revenue right holder pays shortfalls associated with their own congestion revenue rights. This means that the load and exports that currently suffer all of the revenue inadequacy shortfalls will only be charged for those shortfalls associated with the congestion revenue rights they hold.

One potential drawback to allocating congestion revenue rights revenue inadequacy to congestion revenue rights rather than to load is that market participants may reduce the amount they are willing to pay for congestion revenue rights in the auction. This could potentially increase, rather than decrease, auction revenue shortfall if auction prices decrease by a large amount.

Management proposes two measures to mitigate that potential. First, Management proposes to offset the charge to congestion revenue rights for revenue inadequacy that is described above with any day-ahead market revenue surpluses associated with the constraint over the month. The day-ahead market will collect a revenue surplus associated with a constraint when the day-ahead market scheduled flow over the constraint is greater than congestion revenue rights entitlements on the constraint.

Second, Management proposes to decrease the percentage of system capacity released in the annual congestion revenue rights allocation and auction process to 65 percent from 75 percent. This will increase auction participants' confidence that a congestion revenue right they are bidding to purchase in the auction will not have its payment reduced because the corresponding transmission capacity may become unavailable.

POSITION OF THE PARTIES

Pacific Gas & Electric, Northern California Power Agency, and Powerex support Management's proposal to allocate congestion revenue shortfalls to congestion revenue rights rather than load, noting it makes important improvements to equitably allocate the cost of congestion revenue right revenue inadequacy.

The Market Surveillance Committee generally supports Management's proposal and emphasizes the importance of the ISO's continued role as a provider of congestion revenue rights through both allocation and auction processes. However, the Market Surveillance Committee also notes that if auction participants view Management's proposed allocation of congestion revenue shortfalls as making congestion revenue rights too risky, then it would potentially decrease auction revenues more than it decreases payouts. Consequently, the Market Surveillance Committee proposed several potential modifications to guard against this. One of these recommendations was to decrease the percentage of system capacity made available in the annual auction to provide increased assurance congestion revenue rights, which Management adopted. Other stakeholders are divided on this measure, those opposing it being concerned it will reduce available congestion revenue rights.

The Department of Market Monitoring, Southern California Edison, Six Cities, and the California Public Utility Commission support Management's proposal as improvements to the current congestion revenue right market rules, but also maintain the ISO should make more fundamental changes to the congestion revenue rights auction. They maintain the ISO should implement a design in which only a "willing counterparty" would fund a congestion revenue right's payments in exchange for a fixed payment instead of the current design in which the ISO market funds congestion revenue right payments, effectively on behalf of load. They maintain the current design is not equitable because the auction revenue received for funding payments to congestion revenue rights has been substantially less than the payments.

Management agrees that the congestion revenue right market rules should minimize this auction revenue shortfall, but believes that the adverse impact to the overall wholesale energy market of discontinuing the congestion revenue right auction's sales of ISO-market backed congestion revenue rights would likely exceed the benefit of eliminating the auction revenue shortfall. Management believes the comprehensive changes in the three tracks of this initiative will significantly reduce the auction revenue shortfall while maintaining the auction's energy market benefits.

Auctioned congestion revenue rights enable all classes of market participants to participate in the ISO market under equivalent conditions by providing them all the same means to efficiently hedge day-ahead market congestion cost risk, particularly that associated with delivering power as part of forward contracts. This enables efficient forward contracting, which enables load to be served at the least cost and protects load

against market power, particularly during tight supply conditions. This is particularly important in today's environment in which generation is retiring and load is migrating to community choice aggregators. Community choice aggregators often must purchase at least a portion of their congestion revenue rights in the auction because the ISO bases congestion revenue right allocations on historical load and their load is increasing. The auction also allows suppliers to have access to the same hedging mechanism that load does so they can participate in the market under equivalent conditions.

The ISO's sales of congestion revenue rights in the auction ensures these benefits are realized. Also, the ISO can provide this hedging mechanism at the lowest cost because the day-ahead market generates the congestion revenue needed to make payments to congestion revenue right holders. In contrast third parties would demand a substantial additional risk premium to be counterparties to congestion revenue rights because they are not hedged by this stream of congestion revenues.

Finally, the proposal for an auction with sales of only congestion revenue rights backed by a "willing counterparty" poses a number of practical implementation challenges because of the large number of potential congestion revenue right source and sink combinations. It is unlikely that all of the source and sink combinations under the current design would be available, even as modified by this initiative's track 1A. This would decrease the overall benefits of congestion revenue rights described above.

Other stakeholders oppose management's track 1B proposal, offering different revenue inadequacy allocation methodologies, including allocating revenue inadequacy costs attributable to transmission outages to transmission owners, or suggesting that the ISO first wait until it sees the effect of the track 0 changes it has already made or the track 1A changes filed with FERC. Six Cities and Calpine offer different cost allocation methodologies that they suggest would reduce the impact to individual congestion revenue right holders. Management believes its proposal is preferable because it addresses incentives to exploit differences between constraints modeled in the congestion revenue rights market and the day-ahead market while being feasible to implement in time for congestion revenue right financial settlement in 2019.

Stakeholder comments relating to technical details of Management's proposal and Management's response, are outlined in a stakeholder comment matrix included as Attachment A. The Market Surveillance Committee provided a formal opinion on Management's proposals and is included as Attachment B.

CONCLUSION

Management requests the ISO Board of Governors approve the changes described above to adjust congestion revenue rights payments to the level supported by transmission capacity that is actually available in the day-ahead market. The proposed changes provide for the equitable allocation of congestion payment shortfalls among all congestion revenue rights holders, thereby reducing the congestion payment shortfall burden currently borne by load. The proposed changes also mitigate incentives to bid for congestion revenue rights that could have inflated payouts relative to their auction prices.

Management believes that the combined track 1A and track 1B proposals will resolve a majority of the observed auction inefficiencies. Management's proposals are extensive and the impact of these changes on auction performance will need to be assessed prior to pursuing further design changes. To allow time for this assessment, Management will continue to explore additional potentially comprehensive rule changes beginning mid-2019 and targeting implementation in time for the 2022 congestion revenue rights auction which takes place fall 2021.

Attachment F – Stakeholder Matrix

Tariff Amendment to Increase Efficiency of

Congestion Revenue Rights Auctions Track 1B

California Independent System Operator Corporation

Attachment A

Stakeholder Process: Congestion Revenue Rights Auction Efficiency

Summary of Submitted Comments and Management Response

Stakeholders provided three rounds of comments to the ISO under the Congestion Revenue Rights Auction Efficiency, Track 1B stakeholder initiative on the following dates:

- Round One (written comments on Track 1B Straw Proposal April 23, 2018), 05/07/18
- Round Two (written comments on Track 1B Draft Final Proposal May 18, 2018 and Addendum May 25, 2018), 06/7/18
- Round Three (verbal comments on Track 1B Second Addendum June 13, 2018), 06/13/18

Stakeholder comments received from:
Boston Energy, Calpine, California Public Utilities Commission (CPUC), CPUC Office of Ratepayer Advocates (ORA), California Department of Water Resources (CDWR), Calpine, DC Energy, Department of Market Monitoring (DMM), Northern California Power Agency (NCPA), NRG, , Pacific Gas and Electric (PG&E), Powerex, Southern California Edison (SCE), San Diego Gas and Electric (SDG&E), Six Cities, Western Power Trading Forum (WPTF)

Stakeholder comments are posted at:
Congestion Revenue Rights Auction Efficiency:
http://www.caiso.com/informed/Pages/StakeholderProcesses/CongestionRevenueRightsAuctionEfficiency.aspx

Other stakeholder efforts include:

Congestion Revenue Rights Auction Efficiency:

- Working group discussion, 04/10/2018
- Conference call, 04/23/2018
- Conference call, 05/18/2018
- Conference call, 06/13/2018

	Charge CRR holders in proportion to their CRRs flow over each constraint in the day-ahead market associated with the revenue inadequacy	Reduce capacity released in annual CRR auction and allocation process to 65%	Management Response
Boston Energy	Opposes, states ISO should instead allocate revenue deficiencies to transmission owners and allocated CRR holders.	Supports	Allocating revenue deficiencies to transmission owners would be a more extensive change than there is time to consider in this track 1B. Management proposes to allocate revenue deficiencies on the same basis to allocated and auction CRR holders as all CRRS represent the same market product.
Calpine	Opposes, stating that CRRs should pool risk of outages and ISO should adopt a methodology that socializes revenue deficiencies to all CRR holders.		Other stakeholders stated they could better estimate the risk of transmission outages than they could estimate their potential share of overall CRR inadequacy. In addition, allocating to all CRR holders would not address incentives to exploit differences between constraints modeled in the congestion revenue rights market and the day-ahead market. Finally, allocating revenue inadequacy to all CRR holders would inequitably affect those with CRRs purchased at a higher price relative to their payments more than it would affect those with CRRs purchased at a lower price.

	Charge CRR holders in proportion to their CRRs flow over each constraint in the day-ahead market associated with the revenue inadequacy	Reduce capacity released in annual CRR auction and allocation process to 65%	Management Response
CDWR	No comment	Reduction may impede their ability to obtain needed CRRs	While reducing the capacity released in the auction may prevent some CRRs that would be revenue sufficient from being released, it will reduce the overall amount of revenue inadequacy.
CPUC	Supports approach as an improvement but ISO should pursue broader auction reforms under which only "willing counterparties" back auctioned CRRs.	No comment	The adverse impact to the overall wholesale energy market of discontinuing the congestion revenue right auction's sales of ISO-market backed congestion revenue rights would likely exceed the perceived benefit of eliminating the auction revenue shortfall.
CPUC-ORA	Supports Management's proposed methodology of allocating revenue deficiencies to CRR holders by market constraint except believes allocation should be based on the bid prices submitted to the auction. ISO should pursue broader auction reforms under which only "willing counterparties" back auctioned CRRs.	No comment	Allocating revenue deficiencies based on bid prices would be a more extensive change than there is time to consider in this track 1B. The adverse impact to the overall wholesale energy market of discontinuing the congestion revenue right auction's sales of ISO-market backed congestion revenue rights would likely exceed the perceived benefit of eliminating the auction revenue shortfall.

	Charge CRR holders in proportion to their CRRs flow over each constraint in the day-ahead market associated with the revenue inadequacy	Reduce capacity released in annual CRR auction and allocation process to 65%	Management Response
DC Energy	Opposes, should instead allocate shortfalls to transmission owners. If ISO does implement Management's proposed methodology, should also reduce payments owed by counterflow CRR holders on constraints with revenue deficiencies and should net surpluses against revenue deficiency charges over the term of seasonal CRRs rather than monthly.	Supports	Reducing payments owned by counterflow CRR holders would exacerbate revenue deficiencies and thereby increase risk to CRRs held to hedge supply deficiencies. Seasonal netting is not feasible under the track 1A change to allow the sale of seasonal CRRs in monthly increments.
DMM	Supports approach as an improvement but ISO should pursue broader auction reforms under which only "willing counterparties" back auctioned CRRs.	No comment	The adverse impact to the overall wholesale energy market of discontinuing the congestion revenue right auction's sales of ISO-market backed congestion revenue rights would likely exceed the perceived benefit of eliminating the auction revenue shortfall.
NCPA	Supports	No comment	Management appreciates the comments.

	Charge CRR holders in proportion to their CRRs flow over each constraint in the day-ahead market associated with the revenue inadequacy	Reduce capacity released in annual CRR auction and allocation process to 65%	Management Response
NRG	Should also reduce payments owed by counterflow CRR holders on constraints with revenue deficiencies and should net surpluses against revenue deficiency charges over the term of seasonal CRRs rather than monthly. ISO should allocate revenue deficiencies to transmission owners and allocated CRR holders. Supports not pursuing willing-counterparty approach.	No comment	Reducing payments owed by counterflow CRR holders would exacerbate revenue deficiencies, increasing risk to CRRs held to hedge supply deficiencies. Seasonal netting is not feasible under the track 1A change to allow the sale of seasonal CRRs in monthly increments. Allocating revenue deficiencies to transmission owners would be a more extensive change than there is time to consider in this track 1B. Management proposes to allocate revenue deficiencies on the same basis to allocated and auction CRR holders as all CRRS represent the same market product.
PG&E	Supports	Reduction may prevent some CRRs that would be revenue sufficient from being released.	While reducing the capacity released in the auction may prevent some CRRs that would be revenue sufficient from being released, it will reduce the overall amount of revenue inadequacy.

	Charge CRR holders in proportion to their CRRs flow over each constraint in the day-ahead market associated with the revenue inadequacy	Reduce capacity released in annual CRR auction and allocation process to 65%	Management Response
Powerex	Supports	Supports	Management appreciates the comments.
SCE	Supports approach as an improvement but ISO should pursue broader auction reforms under which only "willing counterparties" back auctioned CRRs.	No comment	The adverse impact to the overall wholesale energy market of discontinuing the congestion revenue right auction's sales of ISO-market backed congestion revenue rights would likely exceed the perceived benefit of eliminating the auction revenue shortfall.
Six Cities	Supports Management's proposed methodology to allocating revenue deficiencies to CRR holders by market constraint except believes allocation should be based on the bid prices submitted to the auction. ISO should pursue broader auction reforms under which only "willing counterparties" back auctioned CRRs.	No comment	Allocating revenue deficiencies would be a more extensive change than there is time to consider in this track 1B. The adverse impact to the overall wholesale energy market of discontinuing the congestion revenue right auction's sales of ISO-market backed congestion revenue rights would likely exceed the perceived benefit of eliminating the auction revenue shortfall.

	Charge CRR holders in proportion to their CRRs flow over each constraint in the day-ahead market associated with the revenue inadequacy	Reduce capacity released in annual CRR auction and allocation process to 65%	Management Response
WPTF	Opposes. Should instead change CRR auction timing to address shortfalls and maintain fully funded CRRs. Should not be making multiple CRR market rule and procedure changes at the same time. Supports not pursuing willing-counterparty approach. If ISO does implement Management's proposed methodology, should also reduce payments owed by counterflow CRR holders on constraints with revenue deficiencies and should net surpluses against revenue deficiency charges over the term of seasonal CRRs rather than monthly.	No comment	Changing CRR auction timing to address shortfalls would be a more extensive change than there is time to consider in this track 1B. It is important to make immediate comprehensive changes to address the ongoing CRR auction efficiency issue. Reducing payments owed by counterflow CRR holders would exacerbate revenue deficiencies, increasing risk to CRRs held to hedge supply deficiencies. Seasonal netting will not be feasible under the Track 1A change to allow the sale of seasonal CRRs in monthly increments.

Attachment G – MSC Opinion

Tariff Amendment to Increase Efficiency of

Congestion Revenue Rights Auctions Track 1B

California Independent System Operator Corporation

Opinion on
Congestion Revenue Rights Auction Efficiency, Track 1B

by
James Bushnell, Member
Scott M. Harvey, Member
Benjamin F. Hobbs, Chair

Members of the Market Surveillance Committee of the California ISO

FINAL
June 13, 2018

1. Introduction and Summary of Recommendations

1.1 Background

The California Independent System Operator (CAISO) has proposed major revisions to its process for auctioning Congestion Revenue Rights (CRRs) preceding its auction of annual CRRs to be held in July 2018.[1] As we discussed in our Opinion on the Track 1A proposal,[2] the proposal follows a year-long exploration of several concerns with the California CRR system as it is currently constructed. The CAISO and its Department of Market Monitoring (DMM) have highlighted, in particular, the fact that CRRs have, on average, sold at auction prices substantially below the value of the revenue streams associated with them. From 2009 through 2017, payouts to auctioned CRRs have exceeded $1.4 billion while auction revenues for those CRRs was just over $740 million, a difference of close to $700 million.[3]

The DMM and some load-serving entities (LSEs), who are the residual claimants on congestion revenues if they were not sold at auction, have characterized the auctions as unwilling sales of future revenue streams that are fated to be sold below value due to fundamental flaws in the CRR process. At the same time, CRRs have long been held to be useful, if not

[1] Track 1A proposals are documented in: California ISO, "Congestion Revenue Rights Auction Efficiency, Track 1 Draft Final Proposal," February 8, 2018, www.caiso.com/Documents/DraftFinalProposal-CongestionRevenueRightsAuctionEfficiency-Track1.pdf, and its Addendum, March 8, 2018, www.caiso.com/Documents/DraftFinalProposalAddendum-CongestionRevenueRightsAuctionEfficiency-Track1.pdf. Track 1B proposals, which are the focus of this Opinion, are contained in: California ISO, "Congestion Revenue Rights Auction Efficiency, Track 1B Draft Final Proposal", May 11, 2018, www.caiso.com/Documents/DraftFinalProposal-CongestionRevenueRightsAuctionEfficiencyTrack1B.pdf and its Addendum, May 25, 2018, www.caiso.com/Documents/DraftFinalProposalAddendum-CongestionRevenueRightsAuctionEfficiencyTrack1B.pdf.

[2] J. Bushnell, S. Harvey, and B.F. Hobbs, CAISO Market Surveillance Committee, "Opinion on Congestion Revenue Rights Auction Efficiency," March 15, 2018.

[3] "Problems in the performance and design of the congestion revenue right auction," CAISO Department of Market Monitoring, November 27, 2017.

critical, instruments for hedging the risk of congestion prices in transmission networks. The development of the paradigm of financial transmission rights (or CRRs) was a fundamental step in shifting US power markets away from inefficient physical transmission rights as a means of providing open access to transmission systems. If significant value is placed upon CRRs as a hedging tool, especially by parties who do not receive allocated CRRs, then market design changes that eliminate or substantially reduce access to them raise potential concerns about market efficiency and competitiveness.

The CAISO Track 1A and 1B proposals attempt to balance these concerns with those of DMM and the investor-owned utilities who have argued that CRRs sales are costing their ratepayers an average of about $75 million per year. The Track 1A proposal would alter outage reporting and make other process changes, and would also restrict the types of CRRs available for auction by limiting the sources and sinks of the CRRs that would be eligible for sale in the auction. These changes would alter the amounts and types of CRRs that then would be eligible for settlements in the integrated forward market (IFM). The Track 1B proposal instead addresses the CRR settlements. Presently, CRRs are fully funded, in that CRRs are settled for their MW amount times the difference in the congestion component between the sink and source of the CRR, without regard to congestion rent collections. Track 1B would eliminate the assurance of full funding by reducing payments on binding transmission constraints if the target CRR payout for individual constraints exceeds the congestion rents collected in the day-ahead market (i.e., where the net flows implied by the awarded CRRs exceed the net day-ahead market flows on the constraint). This limitation on CRR payouts would guarantee revenue adequacy (congestion revenues being sufficient to cover CRR payouts), and if payouts are reduced more (in dollar terms) than CRR auction revenues, then the gap between CRR payouts and auction revenues will be reduced.

While the Track 1B proposals were originally motivated by an initiative directed at auction revenue shortfalls, it is important to recognize the 1B is addressing related, but distinct issues from those raised with the auction. Stakeholder concerns about the auction center around the perception that existing transmission capacity is being sold at prices lower than its ex-post valuation. In other words, the auction shortfall amounts to selling an asset at a discount. The revenue inadequacy problem equates to selling an asset that doesn't actually exist. While auction revenue shortfalls do not, of themselves, require uplift payments, revenue inadequacy does. Importantly, it is possible that a significant share, possibly a majority, of the revenue inadequacy arises from allocated, rather than auctioned CRRs. Therefore, these issues require attention regardless of the status of the auction.

The CAISO Market Surveillance Committee (MSC) has been asked by the CAISO to provide an Opinion on the Track 1B proposal. Previous to the recent discussions of CRR auction issues, the MSC wrote several opinions on CRR auctions and allocation as a part of the MRTU design process.[4] Recently, the causes of shortfalls in the CAISO's CRR auctions along with possible remedies have been previously discussed at three MSC meetings. These include

[4] See Track 1A Opinion, Footnote 5 for a summary of those opinions.

meetings on Feb. 3, 2017, when the MSC discussed possible analyses to understand the reasons for the revenue shortfalls and to quantify the uses of auctioned CRRs for hedging and trading purposes;[5] and Feb. 2, 2018, when the CAISO's Track 1A proposal was first publicly discussed. During the April 5, 2018 meeting, the CAISO presented its Track 1B proposal, and MSC members discussed several technical, institutional, and legal issues associated with alternative proposals for reform. Examples of those issues included outage modeling, the need in some proposals for exact matches of locations between bids and offers of CRRs, and potentially weak incentives for regulated owners of congestion revenue rights to sell them to market parties who might value them more.

1.2 Summary of Recommendations

In this subsection, we summarize our major conclusions from our previous Opinion on the CAISO's Track 1A proposal together with our recommendations on Track 1B, which are detailed in the following sections of this Opinion.

In our Opinion on the CAISO's Track 1A proposal, we expressed support for continuing the ISO's role as a provider of CRRs backed by congestion revenues through allocation and auction processes. This provision of rights is an important component of the open transmission access that underlies organized electricity markets. We do not support the elimination of the auction of CRRs that are backed by network capability that remains after the free allocation of allowances to load serving entities. We also supported the proposed changes to the CRR auction, stating that we believed that they were likely to reduce the auction revenue shortfall without substantially harming market efficiency. The changes would also provide some evidence of how auction modifications impact the relationship between auction value and CRR payouts. However, we anticipated that further changes will be necessary, such as those considered in Track 1B and, eventually, in Track 2. Whatever further changes are made should continue to support the ability of small and non-LSEs to access a market for ISO-backed CRRs.

In the Opinion on Track 1A, we made four specific suggestions, and we reiterate here our support for them. First, we recommended that a wider range of alternatives for reducing the difference between CRR auction prices and expected day-ahead market payouts be considered. One alternative should include establishing a minimum price or per unit fee for auctioned CRRs. Our second suggestion was that careful analyses be made of potential CRR auction revenues relative to payouts, categorized by source-sink pair, under alternative auction designs for the 2014-2017 period. Third, we recommended that the CAISO analyze the extent to which there is a general under-valuation of hedging CRRs in CAISO markets, rather than simply a low valuation of CRRs that have little value as congestion hedges. The final suggestion was that, as the Track 1 changes are implemented, the CAISO should assess the extent to which these changes have been effective in reducing the payout to CRRs whose shift factors and day-ahead market payouts are inflated by outages, and consider

[5] S. Harvey, Briefing on Analyzing Congestion Revenue Rights Auction Valuation, MSC Meeting, February 3, 2017, www.caiso.com/Documents/BriefingonAnalyzingCongestionRevenueRightsAuctionValuation-MSCHarvey-Feb2017.pdf

whether changes in the way CRRs are settled might contribute to improved outcomes. The Track 1B proposal that we address in this Opinion represents such a change in settlements.

In this Opinion, we first summarize the issues that the CAISO is addressing in the tracks of its CRR initiative (Section 2). Then in Section 3 we summarize the specific objectives of Track 1B's modifications of CRR settlements and possible design options (Section 3.1), and then make recommendations on those options (Section 3.2). In Section 4, we discuss additional CRR auction options that are not the subject of Track 1B, but should be considered in Track 2. In the remainder of this section, we summarize the major recommendations contained in those sections.

First, we acknowledge the goal of shifting the cost consequences of revenue inadequacy away from transmission ratepayers to CRR holders. It is reasonable, and consistent with the policies of some other ISOs, to reduce CRR payments when congestion charges in the day-ahead market are inadequate to fully fund the target payments to CRR holders. Going forward, we recommend that the CAISO explore the option of allocating some of these shortfalls to the owners of the transmission experiencing the outages. We also note that there are important trade-offs to the targeting of payment reductions among CRR holders.

Second, targeting reductions, as the CAISO proposes, to CRRs that hold rights on constraints that become infeasible in market runs will allocate the burden of transmission outages to holders of rights on those specific constraints. We expect this would be relatively more effective at deterring strategies to acquire CRRs designed to receive inflated payments in the day-ahead market than would a policy that would share the CRR payout reductions proportionally across all CRRs. However, the proposed CAISO approach also increases the uncertainty of CRR payouts and would degrade the congestion hedging value of all CRRs distributed via an auction or allocation process. In the absence of simulation analysis of the impacts of the proposed changes on past CRRs, we are unable to determine how significant this degradation could be. The inclusion of guardrails against extreme outcomes would be helpful, but these guardrails would not preclude substantial reductions in the hedging value of CRRs. Stronger guardrail measures would better preserve the hedging value of CRRs but would also undermine the goal of reducing the payouts to CRRs designed to receive inflated payouts in the day-ahead market. We also recommend that the CAISO be prepared to change its CRR shortfall allocation strategy if signs emerge that this approach is significantly degrading the value of all CRRs

Lastly, we continue to recommend that the CAISO explore other options that directly target the auction revenue shortfall, including a minimum sale price for CRRs in the auction and a reduction of the quantity of CRRs sold in the annual and monthly auctions. We therefore support the ISO's proposal[6] to reduce to 65% the amount of system capacity released in the annual allocation and auction process.

[6] CAISO, "Congestion Revenue Rights Auction Efficiency Track 1B Draft Final Proposal Second Addendum", June 11, 2018, www.caiso.com/Documents/DraftFinalProposalSecondAddendum-CongestionRevenueRightsAuctionEfficiencyTrack1B.pdf

2. Summary of Identified Issues with CRRs and the CRR Auction

There are several sets of issues that have been identified by the CAISO as needing attention. These include reporting of outages (addressed in part in Tracks 0 and 1A); design of the CRR auction, such as what network information is made available to bidders and what bus pairs can be bid for (the latter being the focus of Track 1A); settlements of CRRs, including whether they will be fully funded and, if not, how payments will be reduced (the subject of Track 1B); and other issues, such as the possibility of making PTOs explicitly responsible fully or partially for revenue inadequacies (deferred to Track 2). In this section, we first review general issues associated with the purposes of CRRs, the implications of those purposes for full funding of CRRs, and how much and which types should be made available in auctions (Section 2.1). In Section 2.2, we discuss the relationship of the problems of revenue inadequacy (when CRR payouts exceed congestion revenues in the day-ahead market) and auction revenue shortfalls (when those payouts exceed CRR auction revenues); they share some common causes and therefore measures aimed at correcting one may help with the other. The CAISO history of very high revenue inadequacy (well in excess of that experienced at other ISOs, in percentage terms) suggests that addressing the causes of that problem might also help correct the auction revenue shortfall issue.

2.1 General Issues

As we noted in our previous opinion on Congestion Revenue Rights, CRRs were envisioned as a means to provide the financial equivalent of firm transmission service, in the sense that they entitle the holder to use of the transmission network without paying congestion charges.[7] We interpret the principal role of CRRs as providing physical network users with a longer-horizon ability to access an ISO/RTO network at a predetermined cost. However, we do not agree with the position that open access requires all possible source and sink pairs be made available as CRRs. Physical transmission rights were not generally awarded between nodes that were not physically consistent with the supply and consumption of power Physical transmission rights could only be used to support the physical delivery of power from a generator to load. This was intrinsic in the physical nature of these transmission rights.

We also disagree with the view that the short-term nondiscriminatory access provided by ISOs through their day-ahead markets or market-based real-time dispatch is sufficient to provide open access to the transmission grid. Limiting open access to participation in the day-ahead market or real-time market-based dispatch would not provide a mechanism for entities other than the transmission provider to enter into forward contracts that would be hedged against future changes in congestion costs. The reliability, efficiency, and competitiveness of wholesale power markets is dependent upon robust, and ideally liquid, forward trading. Financial transmission rights, such as the CAISO's CRRs, therefore fill an

[7] FERC "Order Conditionally Accepting Tariff and Market Rules…" Docket Nos ER97-1523-000; OA97-470-000 and ER97-4234-000, January 27, 1999 86 FERC ¶61,062, footnote 13, page 6. The FERC's primary concern with TCCs in that order was the absence of rights longer than six months. The NYISO subsequently revised its proposal to include auctions of both 6 month and longer-term TCCs.

important role bridging the gap between the daily open access provided by the CAISO short-term markets and the ability of both load serving entities, and those they contract with, to participate in forward markets and be able to hedge the congestion costs associated with forward contracts. Enabling load serving entities to enter into forward contracts with a wide variety of potential suppliers, not just the transmission provider or the transmission provider's load-serving affiliate, at a variety of trading points is important both for load serving entities to have access to competitive supply options and to be able to hedge the cost of serving their retail load against uncertain future market prices.

Given our belief that (congestion revenue backed) CRRs are important for supporting electricity forward markets, an additional question is whether an auction that limits the capacity backed by congestion revenues to the levels awarded in the allocation phase would be sufficient. This approach has been called the "willing-buyer, willing-seller" (WB-WS) framework.[8] We agree with the CAISO management position that this approach would be overly restrictive for several reasons. First, as we noted in our previous opinion, this approach effectively freezes the set of CRRs for a given period to be those established in the allocation process. However, the allocation process was not designed to be a stand-alone mechanism for distributing congestion revenue-backed CRRs. The allocation process places restrictions on what types of CRRs can be awarded to which firms. One implication of this is that some types of CRRs (such as those that source at generator nodes and sink at trading hubs) cannot be defined in the allocation process. If the sale of CRRs in the auction is limited to those feasible based on the transfer capability of CRRs awarded in the allocation process, a firm cannot willingly sell CRRs that would use transfer capability not assigned in the allocation process because CRRs using that transfer capability could not be designated in the allocation process. Second, even though regulated LSEs that currently receive the bulk of the CRRs awarded in the allocation process may be willing to sell certain CRRs, they may be unable to or discouraged from doing so because of their regulatory oversight, even if the value of those CRRs to others is greater than their value to the regulated LSE. Third, CRRs that could be awarded in the allocation process may not be allocated if LSEs eligible for such an allocation cannot foresee the need of suppliers for particular hedges. Fourth, it cannot be taken for granted that the regulated LSEs who receive the bulk of the CRRs awarded in the allocation process would be willing sellers of CRRs that could be used to facilitate sales to CCAs competing for the retail load of the regulated LSEs. Both DMM and the LSEs have noted the complicated set of incentives created by the regulatory authority that can discourage participation by regulated LSEs in the auction.

There remain difficult tradeoffs between the goal of enabling the sale of CRRs in an auction process in order to support forward trading, and the goal of minimizing the costs that a poorly functioning auction may impose on transmission customers (mostly load within the CAISO) that pay the embedded cost of the transmission system. In our previous opinion, we explained how the CAISO – and indirectly transmission ratepayers who are the ultimate

[8] DMM Proposal, Market Alternatives to the Congestion Revenue Rights Auction, November 27, 2017. www.caiso.com/Documents/DMMWhitePaper- Market_Alternatives_CongestionRevenueRightsAuction-Nov27_2017.pdf; SCE Proposal, www.caiso.com/Documents/SCEComments-CRRAuctionAnalysisReport.pdf, posted on December 11, 2017.

claimants to congestion revenues – are in a unique position to sell CRRs in a way that reduces risk. This is because the CAISO (and transmission ratepayers) are collecting an uncertain stream of congestion payments, and by selling CRRs that are unelected in the allocation process, they can convert uncertain systemwide congestion revenues into a predetermined auction payment. Thus, the selling of unallocated CRRs that do not match the positions of LSEs does not increase risk to ratepayers.[9] If the CRRs awarded in the allocation process and sold in the auction are revenue adequate, then the CAISO (and its ratepayers) are assured that the settlements for those CRRs are consistent with and do not exceed the congestion payments received in settling the day-ahead market. In contrast, financial firms are not in a position to offer the equivalent of CRRs without increasing their risk. This is why we view access to CAISO (e.g., transmission ratepayer backed) CRRs to be important for all market participants. We are not confident that third parties stand ready to provide equivalent instruments at reasonable prices.

However, the ability of an ISO to sell CRRs without taking on additional risk is limited by the feasibility of the network capacity underlying those CRRs. If the set of CRRs that has been distributed has become revenue inadequate, for any of the reasons described below, then the CAISO has taken on an obligation to distribute more congestion revenues than it is actually collecting. This places it in a position similar to other purely financial providers of CRRs. We view the spirit of the current CAISO proposal in this light. The spirit of open access argues for distributing CRRs whose payout can be supported by the congestion rents collected in the day-ahead market, but not for selling CRRs whose payout would require funding from more network capacity than actually exists.

Because of the dynamic nature of the transmission network, it is extremely difficult to anticipate what transfer capability will or will not be feasible months or years in advance. The network and its available transfer capability changes constantly because of, e.g., upgrades, forced outages, maintenance, loopflows, and dynamic ratings in response to weather and modelled contingencies. This variability over time in the available transfer capability forces a trade-off between providing high-quality forward access (via CRRs) and limiting the risk exposure of transmission ratepayers who are currently the residual claimants to those CRR payments. In general, the tradeoff can be resolved either by releasing relatively fewer, high quality (e.g., firm) CRRs, or by releasing relatively more CRRs but followed by ex-post adjustments to their payouts in the event they become infeasible, thereby decreasing the quality of the CRRs.

In addition to the "quantity vs. quality" tradeoff described in the previous paragraph, the CAISO Track 1B proposal raises another question about the role of CRRs: what kinds of

[9] This point applies to CRRs that do not match the physical transactions of LSEs. The allocation process is intended to allow LSEs to elect and acquire those CRRs that match their physical transactions; meanwhile, the auction was intended as a means for distributing capacity that remains unused after the allocation process and as a mechanism for realignment of allocated CRRs. We note that the allocation process itself creates incentives for LSEs to target high-payout CRRs over CRRs that match their physical position and could be contributing to a sub-optimal disposition of CRRs. Concerns such as these motivated the restrictions on the allocation process discussed above. We strongly recommend that a Track 2 process on CRRs take a holistic look at the efficiency of both the allocation and auction process.

risks are they intended to hedge? Should CRRs be designed in a way that provides a hedge only against nodal price fluctuations, or should it also provide some hedge against uncertainty in the transfer capability of the network itself? By proposing in Track 1B to reduce payments to CRRs that hedge congestion on specific constraints, the CAISO is limiting CRRs to provide a hedge only to the extent the congestion charges are hedged by the transfer capability of the available transmission network. The proposal raises questions about the proper disposition of risk in the network itself. As we discuss below, we believe there is an argument for distributing that risk more broadly amongst both CRR holders and the Transmission Owners.

2.2 Revenue Inadequacy

CRR revenue inadequacy, often referred to as congestion rent shortfalls, is a distinct concept from auction revenue shortfalls. Revenue inadequacy concerns whether the congestion rents collected by the CAISO in settling the day-ahead market are sufficient to cover the payments due to CRR holders without drawing upon other sources of revenue to fund the payments. On the other hand, auction revenue shortfalls concern whether auction prices appropriately value the payments made to CRRs sold in the annual and monthly auction process.

While CRR revenue inadequacy and auction revenue shortfalls are distinct concepts, there is a potential for them to be related if some of the factors that contribute to high levels of CRR revenue inadequacy also contribute to auction revenue shortfalls.

Under the assumptions applied in the mathematical formulations of LMP pricing the day-ahead market congestion rents would be sufficient to fully fund payments to CRR holders.[10] In actual electricity markets, however, there are a variety of factors that contribute to congestion rent shortfalls in the day-ahead market. These factors include differences between the CRR auction model and the day-ahead market model relating to the network model,[11] the modeling of transmission outages or deratings, dynamic line ratings as a function of weather, constraints and contingencies that are enforced or modeled, loopflows, load weights used for zonal load modeling, loss flows, and phase angle regulator (PAR) schedules. Congestion rent shortfalls can also arise from the solution methods for the market model, such as shift factor truncation and market solutions that have not fully converged to the actual optimum.[12]

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[10] See for example, W.W. Hogan, "Contract Networks for Electric Power Transmission," *Journal of Regulatory Economics*, September 1992, Vol. 4(3); W.W. Hogan, "Financial Transmission Right Formulations," March 31, 2002.

[11] Including constraints that are not modeled because it is assumed congestion will be managed through line switching but give rise to congestion rent shortfalls when they must be managed through out-of-merit generation dispatch.

[12] See for example, Scott Harvey, "Sources of Congestion Rent Shortfalls in the Day-Ahead Market, California ISO, Market Surveillance Committee, October 15, 2014.California ISO, CRR Auction Analysis Report, NOvember 21, 2017 pp 43-44. Due to the need for timely solutions, a finite "MIP" (mixed integer programming) gap

These are not problems that are unique to CRR systems, as analogies to congestion rent shortfalls exist in traditional physical transmission right systems. In physical systems, factors such as transmission outages, deratings, loopflows, changes in PAR flows and other differences between the grid model used to analyze the award of firm transmission service and real-time flows could lead to the curtailment of firm transmission service by the transmission provider or could require the transmission provider to provide out of market dispatch to support the provision of firm transmission service.

It was anticipated in implementing LMP electricity markets that these congestion rent shortfalls would be a minor factor. This has proved to not necessarily be the case. The level of revenue inadequacy depends in part on the factors contributing to congestion rent shortfalls described above and also in part on the proportion of the transfer capability of the transmission system that is made available to transmission customers through CRR allocation and auction processes.

The proportion of the transfer capability of the transmission system that is made available to transmission customers through CRR allocation and auction processes is to a large degree controlled by the CAISO, through its decisions regarding the flow limits enforced and outages modeled in the allocation and auction simultaneous feasibility test. However, the transfer capability needed to support payments to awarded CRRs is also partially a function of the source and sink nominations in the CRR allocation and auction processes. There is a potential for transmission customers to nominate (in an allocation process) or purchase (in an auction process) CRR source-sink pairs that do not reflect the actual use of the transmission system in the day-ahead market or in real-time operations but are instead designed to create additional entitlements to CRRs on constraints that may bind in the day-ahead market. These designations can magnify the target payout to CRR holders,[13] while not providing congestion hedges for day-ahead market transactions that would be valuable to suppliers, traders or load serving entities.

Congestion rent shortfalls in the California ISOs day-ahead market have been relatively large, averaging a little under $141 million a year over the period 2014 through 2017. Day–ahead congestion rents averaged slightly less than 69% of the target CRR payout over this period, despite the fact that the California ISO releases only 75% of transmission system transfer capability in the annual auction and allocation process, and the available

is necessarily present in the market solution as is incomplete iteration in AC power flow solutions. Finally, a potentially important new source of network changes will arise if dispatching transmission (line switching) is implemented as part of the market scheduling process, as is being considered by some other ISOs. (E.B. Fisher, R.P. O'Neill, and M.C. Ferris, "Optimal transmission switching," *IEEE Transactions on Power Systems*, 23(3), 2008, 1346-1355. At least two ISOs are undertaking tests of the feasibility and benefits of including transmission switching as an option in market software.)

[13] "Target payout" is defined as the payout that would be made if the rights were fully funded.

capacity is capped at 82.5% in the monthly allocation and auction process (with less potentially released depending on what outages are modeled in the monthly auction).[14]

The levels of revenue inadequacy experienced by the CAISO are much higher, at least on a percentage basis, than other ISOs experience. In the New York ISO, in contrast to the CAISO, day-ahead market congestion rents averaged slightly over 88% of the target TCC (CRR) payout over the period 2012-2016, despite the decision of New York transmission owners to generally not model outages in TCC auctions.[15] Day-ahead market congestion rents have been around 100% of the target FTR payout in MISO and PJM in recent years, in part reflecting the conservative assumptions made in making capacity available in their auctions.[16]

It is likely that one reason for the high congestion rent shortfalls in the California ISO has been the failure of the California ISO to model many constraints that bound in the day-ahead market in either the monthly or annual auction and allocation process.[17] If a constraint is not modeled in the auction, there is a potential for the CRR flows on the constraint to exceed the transfer capability that will be available in the day-ahead market, leading to target CRR payouts that exceed congestion rent collections in the day-ahead market.
It is also possible that the high level of congestion rent shortfalls is in part due to the auction of non-delivery CRRs that receive inflated CRR payments in the day-ahead market if the non-delivery CRRs were selected for purchase because they would be impacted by outages that would increase their shift factor on binding constraints in the day-ahead market.

The Track 0 changes proposed by the CAISO will tend to reduce congestion rent shortfalls, and likely improve CRR auction valuation by improving the modeling of transmission outages or deratings, constraints enforced or modeled, and loopflows in the auction model.
The Track 1A changes proposed by the CAISO are also intended to reduce congestion rent shortfalls, and likely improve CRR auction valuation by reducing the award of non-delivery CRR source-sink pairs that magnify payouts to CRR holders relative to the auction valuation and also contribute to congestion rent shortfalls.

We believe that that Track 1B changes will also further reduce congestion revenue shortfalls. In particular, the past high level of congestion rent shortfalls in the CAISO has the implication that the proration of CRR payments proposed by the California ISO in Track 1B

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[14] California ISO, CRR Auction Analysis Report, November 21, 2017 pp. 44-45; California ISO, Congestion Revenue Rights Auction Efficiency, Track 1B Draft Final Proposal Addendum, May 25, 2018 pp. 17-22

[15] See Potomac Economics, "State of the Market Report for the New York ISO Markets, 2016," May 2017, Figure 8, p. 38; ____, "State of the Market Report for the New York ISO Markets, 2014," May 2015, Figure 9, p. 37; and _____, "State of the Market Report for the New York ISO Markets, 2013," May 2014, Figure 10, p. 38.

[16]See Monitoring Analytics, "2016 State of the Market Report for PJM," Table 13-37, p. 561; Potomac Economics, "2016 State of the Market Report for the MISO Electricity Market," June 2017, Figure A83, p. 89.

[17] This can be seen in the discussion in Section 7 of the California ISO's "CRR Auction Analysis Report" (November 21, 2017, Tables 7, 11, 15, 19, 23, 27, 31, 35, 39, 43, www.caiso.com/Documents/CRRAuctionAnalysisReport.pdf). These tables only show the CRR payouts to auctioned CRRs so do not show the impact of payouts to allocated CRRs on constraints that were not enforced in the allocation process.

could materially reduce the value of CRRs as a congestion hedge if the California ISO Track 0 and Track 1A reforms do not materially improve the relationship between the target level of CRR payouts and congestion rent collections. An average 69% funding level implies the potential for some CRR holders to receive an even lower level of payments on the particular CRRs they hold.

Of course, by lowering the value of the hedge, the willingness to pay for those hedges, as expressed by bids in the CRR auction, and in turn auction revenues, would also decrease. Nevertheless, the reduction in payouts resulting from the Track 1B proposal would also likely tend to lower the payout deficit by decreasing payouts more than CRR auction revenues are reduced for CRRs sold at very low auction prices, as the auction revenues from these CRR sales are already relatively small compared to the expected payout. However, if the potential reduction in payouts materially reduces the hedging value of CRRs sold at higher prices in the auction, the auction revenues from the sale of these CRRs might possibly fall more than the reduction in the expected payout. There has not been enough analysis of auction results carried out for us to make an assessment of the likely overall impacts. The proration would also reduce the value of the hedges assigned to load serving entities at zero cost in the allocation process.

3. The CAISO Track 1B Proposal: Overview and Discussion

3.1 Overview

As the Track 1B proposal explains, all other ISOs, except the NYISO and (for CRRs involving a resource node) ERCOT, payments to all CRRs are reduced by the same proportion if there is revenue inadequacy. The NYISO takes a different approach by fully funding CRRs like the CAISO, but allocating revenue shortfalls to transmission owners (PTOs) rather than to CAISO load and exports. As described in Section 3.2, below, allocating a portion of the congestion rent shortfalls to PTOs responsible for outages that cause the shortfalls is believed to provide an incentive to manage transmission outages to minimize congestion costs. In ERCOT, CRRs involving one or more resource nodes have their payments trimmed on a constraint-by-constraint basis, broadly similar to the approach proposed by the CAISO in Track 1B, summarized below. Other ERCOT rights, however, have their payments proportionally reduced, as in most other ISOs.

Thus, in its Track 1B proposal, the CAISO proposes to switch from its present unique system of fully funding CRRs by charging any revenue shortfalls to load, to a system of adjusting payments to all CRRs on a constraint-by-constraint basis, which resembles aspects of ERCOT's system. In particular, the CAISO proposes to reduce payments to CRR holders based on their constraint effectiveness (i.e., flows implied by the CRR source/sink pair using the day-ahead shift factors) for those transmission constraints that are responsible for congestion revenue shortfalls. These are the constraints for which the total flow (net of counterflow) implied by the full set of allocated and auctioned CRRs is more than the constraint for those constraints that were binding and had a nonzero shadow price in the day-ahead solution.

There are several specific design features that have to be decided upon in implementing a CRR settlement system that reduces payouts when there is revenue inadequacy:

1. *To what extent should CRRs be fully or partially funded? If revenue inadequacy is allowed to persist (as would be the case under full funding), should consumers or transmission owners make up the difference?*
2. *Should payouts be reduced on a constraint-by-constraint basis or by the same proportion for all CRRs in the market* (or by the same proportion within each service territory or other zonal definition)? Track 1B, as mentioned, opts for the former.
3. *Should allocated and auctioned rights be treated consistently or differently*, for instance by only subjecting auctioned rights to payment reduction, or calculating payment reductions separately for each class? Track 1B recommends the former.
4. *Over what time period should revenue surpluses and shortfalls be cumulated* so that shortfalls in one subperiod can be compensated by surpluses in others? This could be as short as a settlement interval, the entire day-ahead market, a month (as proposed by the Track 1B draft final proposal), or a much longer period, such as a season or year.
5. *Should reductions in payouts be calculated ex post* (after running the markets, based on the realized LMPs and payouts), *or ex ante* (before running the markets, by reducing CRRs on constraints that are oversubscribed, in terms of CRR net flows relative to the magnitude of the constraint)? In Track 1B, the CAISO recommends that, like all other ISOs, an ex post system be used.
6. *Should rights in the direction of prevailing flow be treated differently than rights in the counterflow direction?* Prevailing flow rights are CRRs whose flows on the day-ahead market transmission grid would exacerbate congestion on a given constraint and result in higher payments, if the constraint is binding and has a non-zero shadow price. Other ISOs generally treat prevailing flow and counterflow rights symmetrically, but the ISO in Track 1B proposes to only prorate payments to prevailing flow CRRs.
7. *If a constraint-by-constraint approach to CRR payment proration is adopted, should constraints be aggregated prior to calculation of curtailments of payouts, and should CRRs be aggregated by CRR holder before that calculation? Should constraints be placed on the overall change in CRR payouts?* Various aggregations of constraints and CRRs could change which CRRs are subject to payout reduction, and lower the magnitude of those reductions. Also, if revised payouts (based on constraint-by-constraint calculations) for particular CRRs are judged unreasonable (e.g., changing a positive payout to a negative payout, or increasing a positive payout beyond the target), they could be subjected to adjustments after the calculation. The proposal does not propose any such aggregation or adjustments of CRR payouts.

In the next subsection, we make recommendations for each of the design features with respect to a number of design objectives. In evaluating alternatives for those design features, the ISO considered the first three of the following objectives. The additional five objectives might also be viewed as important, and are implied by some of the stakeholder comments.

1. *Potential to equitably allocate revenue shortfalls*. By reducing payouts to CRRs with target payouts that exceed the congestion rents collected in the day-ahead market , the ISO hopes to reduce inflated payouts to CRRs that target constraints that are not modeled in the allocation/auction process or with payouts that are inflated by differences between auction and day-ahead market shift factors.[18] In addition, by eliminating the socialization of outage costs across the CAISO transmission system, the Track 1B design may incent the PTOs to better minimize the cost of transmission outages within their service territory. On the other hand, "socialization" of revenue inadequacies by reducing all payouts proportionally would dilute that incentive, and could result in cross-subsidies of some regions or classes of market parties by others. These cross-subsidies could be viewed as an acceptable pooling of the risk of individual transmission outages--or as an unacceptable reward for the acquisition (via auction or allocation) of a particular CRR with high ex post pay outs.
2. *Potential to improve auction efficiency* (reduce the amount by which payouts exceed auction revenues). By reducing payouts, as long as auction revenues are not reduced dollar-for-dollar, auction efficiency with respect to the relationship between CRR auction value and expected payouts may be improved. But alternatives that make returns less predictable, for example because of their complexity, would be expected to reduce CRR bidder willingness to pay (and thus auction revenues) perhaps by more than reduction in CRR payouts. For instance, asymmetric treatment of prevailing flow vs counterflow might result in more unpredictability of payouts to a particular right, and so depress auction prices proportionally more than the diminishment in payouts. As another example, constraint-by-constraint reductions of payouts would likely increase uncertainty of payouts, and thus might reduce auction revenues by an amount greater than the payout reduction for all CRRs.[19]
3. *Implementable in time for 2019 congestion revenue rights settlement.* This objective would preclude implementation of approaches that would prorate payments prior to the day-ahead market, which could instead be considered in Track 2.
4. *Minimization of curtailment of CRRs.* If this is an objective, then complete preservation of counterflow rights (as in the ISO's Track 1B addendum) could result in an ability to accommodate more prevailing flow rights. However, asymmetric settlement of prevailing flow and counterflow CRRs would have the outcome that prevailing flow CRRs would have an expected value that would be less than the expected

[18] This feature of Track 1B supplements the Track 0 and Track 1A changes intended to address these inflated payouts. To the extent that the Track 0 and Track 1A reforms are effective, less proration of CRR payments will be required. However, it may not be feasible to model all day-ahead market constraints on an auction grid with a different configuration. Also, the limitation of CRRs to delivery pairs will likely not completely eliminate the ability of allocation and auction participants to acquire CRRs targeting constraints not modeled in the auction or receiving inflated payments in the day-ahead market due to differences between allocation/auction and day-ahead market shift factors. The Track 1B changes would provide an additional limit on excess payouts due to inflated shift factors or auction flows in excess of the day-ahead market transmission limit.

[19] A proportional reduction in payouts and auction revenues will reduce the payout gap, because the latter are smaller; so it is possible that even if the proportional reduction in auction revenues is greater than in payouts, the gap may be reduced.

cost of the corresponding counterflow CRR, which could drastically reduce or eliminate the sale of pure counterflow CRRs in the auction,[20] and might reduce the willingness of market participants to hold CRRs with any material counterflow impacts on potential day-ahead market constraints. This objective would also potentially be in conflict with the second objective above.

5. *Simplicity of implementation and predictability of payout outcomes.* The constraint-by-constraint approach is less attractive by this objective than the proportional payout (socialization) approach.
6. *Preservation of the hedging value of CRRs.* The constraint-by-constraint approach will likely result in lower and more variable payouts relative to congestion charges than would an approach based on socialization of payout reductions (proportional reduction of all rights). Lower and more variable payouts relative to congestion charges, all else being equal, mean less effective hedges. Because the CAISO has not carried out any simulations of the overall impact of the 1B proration design on CRR settlements, we cannot assess the magnitude of these impacts.
7. *Maximization of liquidity of CRR secondary markets.* This would argue in favor of symmetric treatment of allocated and auctioned rights, so that they could be traded on a 1:1 basis, without uncertainty about their relative payouts. This objective also supports symmetric treatment of prevailing flow and counterflow rights. For instance, with symmetric treatment, A to B rights would have the opposite payout of B to A rights, so that if a market party wanted to zero out a position, it could buy equal amounts of opposing rights and be assured of zero net payout; this would not be the case for asymmetric treatment.
8. *Avoid anomalous changes in CRR payouts.* These could include the following. Because the CAISO has not carried out any simulations of the application of the 1B design to historical auction and allocation rights, we cannot assess the likelihood of these outcomes.

    a. *Avoid increasing payouts to any CRR with a positive payout.* If negative payouts (i.e., payment obligation for a counterflow) are curtailed in a constraint-by-constraint system, it is then possible for the revised net payment to increase beyond the target for some CRRs receiving positive payments. That is, they would be paid more than the congestion component difference times the MW quantity of the right. This is viewed by some stakeholders as a priori undesirable because it increases rather than reduces the hedge and exacerbates revenue inadequacies.[21]

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[20] It is not clear that this should be a material concern given the overall low valuation of CRRs in the CAISO auctions. CAISO data shows that CRR auction valuation is in aggregate well below the CRR payout. Market participants would not offer to buy counterflow CRRs at a price that was materially less than the expected payout. However, it is not known how general the under-valuation of CRRs acquired as hedges is. For example, no analysis has been carried out comparing the value of allocated CRRs at monthly auction prices to the payout on those CRRs.

[21] Appendix, "Comments of Pacific Gas & Electric Company Congestion Revenue Rights Auction Efficiency, Track 1B, Draft Final Proposal," www.caiso.com/Documents/

b. *Avoid reducing payments due from a CRR such that a CRR with a negative target payout receives a positive CRR payment.* This outcome is a possibility if payments due from a CRR providing counterflow were prorated down but the payments received by the CRR on other constraints were not prorated down.
c. *Avoid reducing payments to a CRR with a positive target payout to such an extent that the CRR holder is required to make a payment to the CAISO.* This outcome is a possibility if a CRR had both prevailing flow and counterflow impacts on constraints that bound in the day-ahead market and the payments due to the CRR for the prevailing flow impacts were prorated down while the counterflow charges were not.[22] While the impact of this kind of anomaly would likely average out for the large regulated LSEs holding many CRRs from many sources to the relevant DLAP or CLAP, these impacts might not average out for smaller LSEs holding CRRs on a limited number of paths.

These objectives can be in conflict. The ISO's proposal constraint-by-constraint proposal in which only prevailing flow rights are curtailed can be viewed as emphasizing the first four objectives at the expense of the latter four. On the other hand, some stakeholders who are concerned with predictability, simplicity, preservation of hedging values, and maximization of liquidity tend to prefer simple constant proportion-based proration of payments to all CRRs. Other stakeholders are focused on reducing the gap between payouts and auction revenues, and recommend elimination of the auction of ISO-backed rights altogether.

In the following subsections, we discuss some of our recommendations concerning choices in the design of the Track 1B CRR settlement, based on these objectives. In Section 4, we consider other possible reforms to the CRR process as well, especially assigning responsibility for revenue shortfalls and full funding of CRRs.

Ideally, conclusions concerning the impacts and desirability of design choices would be based on in-depth analysis using multiple years of CRR auction results to explore the effects on hedging value, distribution of impacts among various market parties, and possible

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PG_EComments-CongestionRevenueRightsAuctionEfficiencyDraftFinalProposalTrack1B.pdf. For instance, in a constraint-by-constraint calculation, consider a CRR that on net has a positive target payout which is the net effect of a positive flow on binding constraint and a counterflow on another. It could experience either of the following effects. If, on one hand, the second constraint is oversubscribed, then the counterflow's payment obligation could be reduced, increasing the net payout to the CRR to more than the target. If on the other hand, the first constraint is oversubscribed, then the positive portion of the CRR payout might be reduced so far that the counterflow payment obligation winds up being bigger in magnitude, changing the overall CRR payout from positive to negative.

[22] This is not the same as the situation in which a CRR that is expected to receive a payment has a negative value in the day-ahead market. When the target value of the CRR in the day-ahead market reverses from what the owner of the right expected, the nodal pricing-based charge for the underlying transaction also reverses so there is not impact on entities using the CRR as a hedge. However, in the case considered here in which the payout is changed from the target value, the CRR holder still has to pay congestion charges, but not only is it not hedged against those congestion charges, it has to pay for counterflow impacts of the CRR. There is no analogy to this outcome with physical transmission rights. While the holder of a physical transmission right could have its right curtailed, it would not also be charged for failing to provide the counterflow.

unintended effects. As we recommended in our Opinion on Track 1A, such analyses are also desirable to better understand the impacts of alternative auction designs as well, such as a minimum fee or price on CRRs. Any such simulations would be limited by their inability to represent how bidding behavior in the CRR auction would change, and thus would present an incomplete picture of changes in payouts minus auction revenues. Nevertheless, such simulations would help build understanding of the possible direction and magnitude of effects and the potential for unintended consequences. Thus, our conclusions in this Opinion about the impact of the Track 1B proposal are necessarily limited by our lack of insight into the likelihood or potential magnitude of some of the potential effects.

3.2 Discussion of Design Alternatives

3.2.1 To what extent should CRRs be fully or partially funded? If revenue inadequacy is allowed to persist, should consumers or transmission owners make up the difference?

We support, as an interim measure, eliminating full funding of CRRs in favor of partial funding, consistent with what most ISOs do. The magnitude of revenue inadequacy in the CAISO, as well as the persistent gap between payouts and auction revenues, both need to be reduced. Some MSC members believe that partial funding will go some way towards doing so.

However, eliminating full funding necessarily reduces the value of CRRs as a hedge. Moreover, the application of constraint-by-constraint payment proration has the potential to introduce a great deal of uncertainty into the value of CRRs as congestion hedges. Because the CAISO has not been able to carry out simulations of the impact of the Track 1B design on CRR payouts, we cannot assess the magnitude of the likely reduction in hedging value.

We hope that it will be possible to restore full funding if the fundamental problems can be resolved that have led to the large revenue inadequacies and payout-auction revenue gap. The reforms of Tracks 0 and 1A are intended to address part of those problems. We also believe that a design that makes PTO shareholders and rate payers responsible for congestion revenue shortfalls due to transmission outages the PTO schedules (analogous to the NYISO design), rather than socializing these costs over all CAISO load, will also be helpful, as we discuss below. Finally, use of shift factors for the auction's network model to settle congestion revenue rights, rather than the shift factors from the day-ahead market, could also significantly reduce revenue inadequacy due to network changes, although such a design change would also reduce the hedging value of CRRs.

We now further discuss the possibility of assigning responsibility for congestion revenue inadequacy to PTOs. Even though this is not possible to implement in time for the 2019 CRR auctions, it is a possibility that should begin to be considered now and then considered fully in the Track 2 process. Its implementation would mean that the Track 1B partial funding proposal would represent only a temporary suspension of full funding.

While the CAISO controls the degree to which transmission outages and deratings are modeled in the seasonal and monthly CRR allocation process, the duration and scheduling of

transmission outages and deratings is primarily determined by the responsible transmission owner. There is a potential to reduce congestion rent shortfalls by providing stronger incentives for transmission owners to incur costs in order to carry out transmission maintenance on a faster time line or to be more flexible by adjusting schedules of work on short notice to take advantage of favorable weather and load conditions. This would be a long-range change that could not be implemented in the time frame of the Track 0, 1A or 1B changes. However, it has a potential to somewhat decrease congestion due to outages, thereby reducing hedging risks and improving system efficiency. Furthermore, an added benefit of lowered congestion is that CRR payouts would be reduced, potentially reducing the extent to which payouts exceed auction revenues.

The New York ISO implemented a design in 2004 that allocates congestion rent shortfalls in the day-ahead market to the responsible transmission owner.[23] These outage costs are passed through to transmission customers in the FERC transmission access charge. However, the rate design for retail customers served by the state jurisdictional load serving entities can provide incentives for the transmission owners to attempt to minimize outage costs. The allocation process also identifies the source of large congestion rent shortfalls, potentially allowing the cause to be addressed or the impact reduced in future periods. There is no public data or analysis available to confirm that these incentives have reduced congestion and shortfalls. Nevertheless, there is anecdotal evidence that this is the case in the NYISO, and their stakeholders have been sufficiently satisfied with the results such that there have been no changes made in the design over the past decade.[24]

Any improvement in outage duration or timing would benefit ratepayers. But any such improvements would unlikely to be so large as to eliminate most of the high level of congestion rent shortfalls in the CAISO. Since this transmission outage cost design has been in operation in the New York ISO for almost 15 years, it has proven to be a workable design, but as explained above it would be a long-term change and would not eliminate the need to implement the Track 0 and Track 1A changes. As noted above, a secondary impact of the Track 1B constraint-by-constraint proration of CRR payments would be that it would eliminate the socialization of outage costs across the CAISO transmission grid and tend to assign outage costs to entities serving load within the territory of each PTO, which might incent the PTOs to reduce outage costs.

An alternative approach to full funding of CRRs would be a partial funding system that would have PTOs pay only some portion of the of the congestion revenue shortfalls due to network outages, while curtailing CRRs to make up for the rest. This would then retain incentives (albeit diluted) to the TSO better manage outages, but also would lessen the

[23] See New York ISO March 17, 2006 filing in Docket ER06-769; October 16, 2003 filing in Docket ER04-54; NYISO OATT, Attachment N.

[24] Some changes were made in 2006 in the original design that was implemented in 2004. The 2006 changes in part reflected process improvements developed through the initial application of the design. In addition, the implementation of the design in 2004 led almost immediately to the identification of data base and auction implementation errors that were contributing materially to congestion rent shortfalls in the NYISO settlements and the 2006 filing include tariff changes needed to account for how these errors were handled.

impact of CRR bidders in the auction who are targeting for speculation reasons the acquisition of low-priced CRRs on constraints that may be subject to outages.

3.2.2 Should payouts be reduced on a constraint-by-constraint basis or by the same proportion for all CRRs in the market?

Although we generally support the idea of diminishing incentives for CRR holders to acquire CRRs that target constraints that are not modeled or would receive inflated payments when outages are modeled in the day-ahead market, we are concerned that constraint-by-constraint reduction of payouts could significantly erode the hedging value of CRRs. Absent simulations of the payout consequences of constraint-by-constraint basis, we are unable to assess its impact on the hedging role of CRRs and also may not be able to identify potential unintended effects. Since Track 1B is intended to be potentially interim in nature, pending possible Track 2 reforms, we believe that proportional payout reduction for all CRRs (so-called "socialization") because of its simplicity, would produce less unpredictable but possibly less desirable results. Ideally, changes as complex as the current 1B proposal would be accompanied by substantial quantitative analysis that can provide stakeholders with a more complete picture of the expected impacts. It appears that such analysis will not be possible until Track 2 changes are considered. As we discuss below, the addition of guardrails that limit the magnitude of the clawback paid by any individual CRR is an alternative to socialization to at least partially bound the uncertainty.

3.2.3 Should allocated and auctioned rights be treated consistently or differently?

Without separation of auctioned and allocated rights, the allocated rights could end up subsidizing the shortfall of the auctioned ones under a pure socialization approach, if the auctioned rights are responsible for a disproportionate share of that shortfall. On the other hand, there has been no analysis of the whether the award of allocated CRRs has targeted constraints that are not modeled in the allocation model or CRRs that would have inflated impacts on day-ahead market constraints.

We conclude that transmission access requires a transparent and liquid CRR market, and that creating two classes of rights with different payouts would interfere with that goal. Such a design would diminish the incentive of LSEs to sell unneeded CRRs in the auction as they would become much less valuable as hedges, given present levels of revenue inadequacy. It would also discriminate against small LSEs that want to use forward markets at trading hubs to hedge, as sellers of power at the hubs could not get as good a hedge as the large LSEs getting allocated CRRs from the generator. If the proration is substantial the discrimination would be material and might effectively eliminate hedges at the hubs. Making it impossible or very expensive for small LSEs to hedge their energy costs in high cost hours (e.g., hours 14-22) would not be a good step.

3.2.4 Over what time period should revenue surpluses and shortfalls be cumulated so that shortfalls in one subperiod can be compensated by surpluses in others?

In order to improve the value of CRRs as a hedge, it is reasonable to allow surpluses in some periods to offset congestion revenue shortfalls in others. The ISO has indicated that tracking surpluses and shortages for particular constraints or CRRs over periods longer than a month poses some practical problems of implementation; it is reasonable therefore to start with an averaging period that corresponds with billing cycles, and then lengthen it at some later point to a full season or even a year, if it judged to be worth the trouble. If a month has an overall congestion revenue surplus, it could be carried over to the next month and used to offset later congestion revenue shortfalls. Another possibility is that it could also be used to offset shortfalls in prior months of the CRR year.

On the other hand, any shifting of congestion rents between months of shortfall and months of surplus risks undermining one of the intended impacts of the track 1B changes, in that it would reverse the limit on the payout to constraints in months in which the payout to CRRs is inflated by constraints that were not modeled or whose outages had large impacts.

3.2.5 Should reductions in payouts be calculated ex post or ex ante?

We agree with the ISO that the practical details of implementing ex ante reductions in CRR entitlements mean that it should not be implemented at this time. Further consideration should be given in Track 2 to whether ex ante or ex post is preferable in the long term.

3.2.6 Should rights in the direction of "prevailing flow" be treated differently than rights in the counterflow direction?

As noted above, a constraint-by-constraint discounting of CRRs that only reduces payouts to prevailing flow rights while leaving counterflow rights unchanged would allow more of the CRRs to be preserved, which may enhance their value as hedges. However, this would only be the case to the extent that the asymmetric settlement, and hence asymmetric auction value, does not largely eliminate the award of counterflow CRRs. In addition, by breaking the ability to perfectly offset A to B rights with an equal MW quantity of B to A rights introduces uncertainty in financial exposure and the value of hedges. This would lower market liquidity in part because the net position resulting from a bundle of multiple hedges would become difficult or impossible to assess. The MSC cannot make a confident recommendation at this time in the absence of simulations of the impact of alternative designs based on historical patterns of CRR bidding and awards, and in the absence of analysis of the auction valuation and CRR payout to hedging CRRs such as those awarded in the allocation process.

3.2.6 If a constraint-by-constraint approach is adopted, should constraints be aggregated prior to calculation of curtailments of payouts, and should CRRs be aggregated by party before that calculation? Should constraints be placed on the overall change in CRR payouts?

A fundamental principle of locational marginal pricing is the relationship between nodal price differences, shift factors, and shadow prices on constraints. In particular, in a linearized DC network without losses, the difference in price between two nodes (and thus the value of a CRR obligation between the nodes) equals the sum (across all network constraints) of the product of the relevant shift factors for that pair of nodes with the constraint shadow prices. It is reasonably argued that most load serving entities and suppliers selling power to load serving entities that purchase CRRs as a congestion hedge are interested in hedging differences in prices at different nodes, not in constraint shadow prices per se, which is why financial transmission rights are based on trading point-to-point rights rather than flowgate rights.[25]

Stakeholders have argued that some aggregation of constraints (cancelling out deficits and surpluses of congestion revenues relative to payouts) therefore makes sense if a constraint-by-constraint approach to CRR payment proration is adopted; for instance, aggregating across multiple constraints that result for a transmission element from considering multiple N-1 contingencies.[26] If this is done for a constraint-by-constraint system in which counterflow payments are not adjusted, then such an aggregation cannot lower payouts to CRRs and might increase them. By themselves, such aggregations won't result in violation of revenue adequacy, rather they will generally reduce the revenue surplus that results from constraint-by-constraint curtailment of payouts.

However, this kind of aggregation would have the potential to unwind the impact of the Track 1B reform in reducing payouts on constraints with inflated payouts, which is the point of the 1B changes.

In addition, even if it were reasonable to implement in an interim system if it were not too complex, such a design has the potential to in fact be very complex to implement. The aggregation of additional constraints beyond contingencies poses conceptual problems. In particular, if two or more transmission elements have shortfalls while two or more others have surpluses, and are affected differently by different CRRs, then which sets of constraints are aggregated for settlements will affect the relative payouts.[27] Arbitrary decisions can have significant distributional consequences. Rather than have a complicated set

[25] The "flowgate rights vs. point-to-point rights" debate occurred early in the intellectual development of the financial transmission right idea (see, e.g., R.P. O'Neill, U. Helman, B.F. Hobbs, W.R. Stewart, and M.H. Rothkopf. "A joint energy and transmission rights auction: Proposal and properties," *IEEE Transactions on Power Systems*,17(4), 2002, 1058-1067).

[26] See E. Wolfe," Comments on ISO CRR Auction Efficiency Track 1B Draft Final Proposal," Western Power Trading Forum, June 7, 2018

[27]If in the extreme case all constraints are combined, then the result is the "socialization" policy that we recommended in Section 3.2.2, above.

of rules to aggregate constraints that would no doubt engender extensive stakeholder debate, we would recommend that if some form of aggregation over constraints is implemented, the following interim approach be used: any congestion revenue surplus that results from constraint-by-constraint curtailment of payments would be allocated to CRRs whose payouts have been reduced, in proportion to the amount of reduction. This would probably best be done on a monthly basis. But even aggregating on a monthly basis would tend to unwind the potential benefits of the 1B approach, while likely reducing any adverse impact of 1B on CRR hedging value.

If a constraint-by-constraint design is adopted, as the ISO proposes, it has been argued that aggregation of CRRs on a market party basis would also be fairer, in that someone who owns an equal amount of A to B rights and B to A rights could net them out and be exposed to no reductions in payout or increase in liability. On the other hand, this would mean that a given right would have a different payout depending on who owns it. This could result in unintended consequences concerning CRR bidding incentives and risk hedging, and possibly bestow financial advantages on larger entities who would natural have more rights to offset each other than smaller market parties. Because there has not been an opportunity to analyze these implications with market simulations, we recommend that aggregation by market party not be part of an interim system, if the ISO chooses to go with a constraint-by-constraint system.

However, we are supportive of some "guard rails" on changes in CRR payouts in a constraint-by-constraint system. Some options include:

(1) If a constraint-by-constraint procedure increases the payout of a positive CRR beyond its target value, the payout should be reduced to the target.[28] The resulting revenue surplus could be refunded to rate payers or redistributed among other CRRs whose payouts were reduced.
(2) If a constraint-by-constraint procedure instead reverses the sign of a payout from positive to negative,[29] then instead a payment of zero could be made. This would increase the potential revenue inadequacy problem, but eliminate the risk that the procedure would turn a hedge against positive congestion charges would turn into a liability while those hedged congestion charges would themselves remain a liability.[30]

[28] See Note 22, supra, for an example of how this can happen. This can occur only if only payments by prevailing flows are reduced, without changing counterflows.

[29] Ibid.

[30] It is possible that in the presence of this guardrail that an owner of a CRR from A to B with a net positive payout would be better off (increase their payout) by instead owning separate CRRs (A to C, and C to B). each with positive payouts. This can occur if the A to B payout would remain positive after constraint-by-constraint reduction of payouts, but (for instance) the C to D payout would go negative in the absence of this guardrail. (E.g., the A to B target payout is $10/MWh, but is reduced to $6; A to C's target is $7 and would be unaffected; and finally C to B's target is $3, and would be reduced to $-1 without a guardrail. With a guardrail, C to B would be reduced only to $0, so the actual payoff for holding A to C together with C to B would be

A stronger version of (2) would ensure that payouts are reduced by no more than some percentage. E.g., since auction revenues were historically 69% of payouts to auctioned rights, a floor of 50% (representing roughly double the percentage gap) might be imposed. This would ensure that hedging rights would retain at least some of their value. Such a floor could increase revenue inadequacy, if many CRRs would otherwise be reduced below that level.[31] A concern with this proposal is that like the aggregation of shortfalls over constraints, such a design would have the potential to unwind the impact of the Track 1B reform in reducing payouts on constraints with inflated payouts, which is the major point of the 1B changes.

The MSC supports both (1) and a version of (2), without recommending a particular level of the floor for payouts to CRRs with positive payouts under (2). We anticipate that collaring payouts in this manner would reduce, at least slightly, the uncertainty concerning how payouts would change for CRRs, and make them easier to evaluate.

4. Additional Auction Changes

We interpret the current CAISO proposal as targeting the auction revenue shortfall problem as much as it is the revenue inadequacy issue. To the extent the two issues are distinct, this CAISO approach risks applying a suboptimal solution to both problems by trying to deal with them through one mechanism. We acknowledge that the current CAISO proposal would on its own, be more likely reduce auction revenue shortfall than the alternative we proposed above. This is why we also recommend the adoption of other measures more directly targeted at the auction revenue shortfall, in addition to the proposed changes that would address revenue inadequacy.

4.1 Reduce Capacity Available in the Annual Auction

A first recommendation for phase 1B would be to reduce, slightly, the available capacity sold in the annual auction. This is the most straightforward change that would both reduce the risk of auction revenue shortfalls while maintaining the quality of CRRs that are distributed. The ISO has calculated how much a given reduction in capacity would have reduced shortfalls in the past, under the assumption that bids would not have changed. While not definitive,[32] since bidding behavior is likely to change, such calculations inform where to set a new capacity limit. We suggest that a modest reduction to 65-70% in the annual

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$7+$0, which exceeds the A to B payout of $6.) Without further analyses, it is unclear whether such situations would occur frequently or only very rarely.

[31] A similar constraint could be placed on movement of negative payout CRRs, ensuring that would remain at least some minimum level of obligation to pay for counterflow.

[32] 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.

process and 70-75% overall be considered as a step toward reducing the risk of revenue shortfalls while the impact of the other Track 0, 1A and 1B changes is assessed. At the same time, this reduction would likely lessen the amount by which CRR hedging values would be reduced by the ISO's proposed constraint-by-constraint payout reductions.

We see the reduction in the auctioned capacity as a reasonable compromise between the status quo, and proposals that would effectively set the limit of additional capacity sold in the auction to zero.[33]

4.2 Introduce a Minimum Purchase Price for CRRs

A second recommendation for either Track 1B or later would be to establish a minimum sale price for CRRs sold at auction. The CAISO analysis of the CRR auction has shown that there are both a large number of CRRs that sell for zero or very small prices and that CRRs that sell for zero or low prices are responsible for a non-trivial amount of the auction revenue shortfall. One explanation for these facts is that bidders are taking a large number of low-cost speculative positions on CRRs in the expectation that at least some of them will yield surprisingly high congestion payouts. A minimum sale price would both discourage such strategies and, at a minimum, increase the revenues collected in the event bidding behavior did not change. The minimum sale price approach has the appeal of having little impact on high value CRRs for which bidders are already willing to offer significant prices for, while targeting only the CRRs that current results imply hold less value for market participants.

The minimum sale price also represents a compromise between the status quo and the position of SCE and others who argue that the current auction represents a forced sale of CRRs at unreasonably low prices. We note that the practice of auctioning collectively or publicly owned resources is relatively common. Such mechanisms can be effective when ownership of resources is diffuse or difficult to define, and the value of the resources is contingent up on the bundles or combinations that are purchased. Congestion revenue rights share all these characteristics. Market prices for federal forest and mineral rights are frequently determined in this manner. However, it is also common for such auctions to set a reservation prices to ensure against public resources selling at unreasonably low prices.

A minimum price could be implemented through the auction process itself or simply as a fee imposed on all MWh of CRR sold through the auction. While quantitative analysis of historic bidding could inform the extent to which particular minimum price levels might reduce auction revenue shortfalls, an administrative basis for the fee, such as a fraction of TAC would be a reasonable approach that we believe would be consistent with the principles of open-access.

[33] We also note that the auctioned capacity need not be as great or greater than the capacity made available in the allocation process.

Attachment H – DMM Opinion

Tariff Amendment to Increase Efficiency of

Congestion Revenue Rights Auctions Track 1B

California Independent System Operator Corporation

Memorandum

To: ISO Board of Governors

From: Eric Hildebrandt, Executive Director, Market Monitoring

Date: June 18, 2018

Re: **Department of Market Monitoring comments on congestion revenue rights auction efficiency initiative**

This memorandum does not require Board action.

EXECUTIVE SUMMARY

The ISO's *Congestion Revenue Rights Auction Efficiency Track 1B Draft Final Proposal* proposes to reduce the net payment to a congestion revenue right (CRR) holder if payments to CRRs exceed associated congestion charges collected in the day-ahead market on a targeted constraint-by-constraint basis. This methodology was recommended by the Department of Market Monitoring (DMM) in 2014. In combination with the ISO's Track 1A changes, these additional changes will provide a measure of protection against the risks imposed on transmission ratepayers by the CRR auction and will likely reduce the current level of ratepayer losses. Relative to other potential methods of allocating revenue inadequacy, the Track 1B constraint-specific allocation reduces the incentive for auction participants to target specific modeling discrepancies. Therefore, DMM supports the Track 1B constraint-specific allocation as an improvement over the currently implemented method of allocating revenue inadequacy to measured demand.

Because Management's proposal does not address the fundamental market flaw underlying the CRR auction design, it will not protect transmission ratepayers from further losses from the CRR auction. DMM continues to recommend that the ISO address this issue by modifying the CRR auction into a market for financial hedges based on clearing of bids from willing buyers and sellers. The ISO indicates it has now concluded that the costs of DMM's recommendation would outweigh its benefits, and that the ISO will not give further consideration to this option during Track 2 of this initiative. DMM continues to recommend that the ISO give serious consideration to a market based on willing buyers and sellers during Track 2 of this initiative. This should include the development of a straw proposal based on a market between willing buyers and sellers that could be considered by stakeholders and that has provisions to address the main concerns with willing buyer and seller approaches that the MSC and some stakeholders have expressed, such as the need to modify the CRR allocation process in order to replace the CRR auction with a market based on willing buyers and sellers.

MANAGEMENT'S TRACK 1B PROPOSAL

Background

In 2014, DMM proposed a general methodology that could be used to allocate CRR revenue inadequacy costs back to holders of congestion revenue rights on an interval and constraint specific basis.[1] This allocation approach would limit the total amount of revenues that can be transferred from load-serving entities to congestion revenue rights holders through uplift. Moreover, this allocation method would reduce the incentive for entities purchasing congestion revenue rights to target the modeling differences that create revenue inadequacy costs.[2]

The ISO included modifications to the CRR process in its initial list of potential stakeholder initiatives for 2015. However, the ISO ultimately excluded any initiative on congestion revenue rights due to resource limitations and the ISO assessment that this would involve a complicated stakeholder process.[3] Management is now proposing to adopt this same basic approach as a way to reduce the losses being incurred by transmission ratepayers from CRRs sold in the ISO's auction – which totaled over $100 million in 2017 and over $750 million since 2009.

In combination with the ISO's Track 1A proposal, this will provide a measure of protection against the risks imposed on transmission ratepayers by the CRR auction and will likely reduce the current level of ratepayer losses. Relative to other potential methods of allocating revenue inadequacy, the Track 1B constraint-specific allocation reduces the incentive to target specific modeling discrepancies. Therefore, DMM supports the Track 1B constraint-specific allocation as an improvement over the currently implemented method of allocating revenue inadequacy to measured demand.

MSC Proposal

During its June 7, 2018 meeting, the Market Surveillance Committee (MSC) proposed an allocation method in which revenue inadequacy would be allocated to all CRRs in proportion to their CRR payments.[4] This is similar to the revenue inadequacy method used in PJM. DMM supports the constraint-specific allocation over the less targeted method recommended by the MSC to allocate revenue inadequacy to all congestion revenue rights. The more socialized PJM method of allocating revenue inadequacy to all congestion

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[1] *Allocating CRR Revenue Inadequacy by Constraint to CRR Holders*, Department of Market Monitoring, October 6, 2014. https://www.caiso.com/Documents/AllocatingCRRRevenueInadequacy-Constraint-CRRHolders_DMMWhitePaper.pdf.

[2] *2014 Annual Report on Market Issues and Performance*, Department of Department of Market Monitoring, June 2015, pp. 19-20, 195-196. http://www.caiso.com/Documents/2014AnnualReport_MarketIssues_Performance.pdf

[3] Ibid, pp. 19 and 195.

[4] *CRR Issues and Responses*, James Bushnell, Market Surveillance Committee, June 7, 2018: http://www.caiso.com/Documents/Presenttion-CongestionRevenueRightsAuctionEfficiency1B-June7_2018.pdf

revenue rights would provide significantly less benefits than a constraint-specific allocation because the PJM method leaves intact substantial incentives for financial entities to target specific modeling discrepancies in the congestion revenue rights auction.

Recommended improvements in management proposal

The ISO's May 25 addendum proposed treating flow and counterflow differently in the proposed methodology for allocating revenue inadequacy. This differing treatment would result in different effective prices for the same underlying constraint depending on whether the flow associated with a congestion revenue right over the constraint has a positive or negative megawatt value. DMM is not convinced that having different prices for the same underlying commodity is a good idea.

The ISO argues that this treatment would be consistent with what would happen if they ran another optimization with a simultaneous feasibility test. But the ISO is not actually running another optimization, so it is unclear how this argument supports the different treatment of flow and counterflow. However, DMM believes that the significance of resolving this issue is minor compared to the benefits that a constraint-specific allocation would provide relative to the more socialized approaches of allocating revenue inadequacy to measured demand or to all congestion revenue rights.

TRACK 2 AUCTION DESIGN CHANGES

While Management's 1A and 1B proposals would provide some measure of protection for transmission ratepayers, they still do not address fundamental flaws of the CRR auction.[5] DMM continues to hope and recommend that the ISO address these flaws in the Track 2 comprehensive CRR auction design changes. But in discussing alternatives in the Track 1B proposal, the ISO makes numerous statements which make it clear that the ISO will not give further consideration to moving the auction towards a market for CRRs or other hedging contracts based on trading between willing counterparties. Management's most recent response to DMM's comments on this matter asserts that:

> The adverse impact to the overall wholesale energy market of discontinuing the congestion revenue right auction's sales of ISO-market backed congestion revenue rights would likely exceed the perceived benefit of eliminating the auction revenue shortfall.[6]

Management does not provide or cite any empirical support for this conclusion. In making this conclusion, the ISO appears to rely on arguments by the MSC and entities profiting from the current auction that there are some potential costs of moving to a market between willing

[5] DMM has described these flaws in multiple venues including its *Comments on the CRR Auction Analysis Working Group*, Department of Market Monitoring, January 16, 2018: http://www.caiso.com/Documents/DMMComments-CRRAuctionAnalysisReportWorkingGroup.pdf.

[6] *Stakeholder Process: Congestion Revenue Rights Auction Efficiency Summary of Submitted Comments and Management Response, Attachment A, June 14, 2018, p.4.* *http://www.caiso.com/Documents/DecisiononCongestionRevenueRightsAuctionEfficiencyTrack1BProposal-AttachmentA-Jun2018.pdf*

counterparties. No empirical analysis or evidence has been presented that these costs may be large enough to justify ending the consideration of alternatives to the CRR auction that are based on a market between willing counterparties.

Meanwhile, most load serving entities who actually rely on the wholesale energy market support moving towards a market for CRRs or other hedging contracts based on trading between willing counterparties. This coalition includes the state's major investor owned utilities, as well as a broad range of smaller load serving entities and public power entities. Why would these entities support development of a market for CRRs based on willing buyers and sellers if they thought the costs of this on wholesale energy prices would exceed the benefits from eliminating auction revenue shortfalls?

By prematurely accepting the assertions of the MSC and some stakeholders about the impacts of transitioning to a market between willing counterparties, the ISO precludes any productive discussion about market design changes that will adequately address the auction's fundamental flaws. DMM's comments therefore address concerns cited by the ISO as reasons not to pursue alternatives to the CRR auction based on trading between willing counterparties. Specifically, these comments make the following points:

- Transmission ratepayers are not natural sellers of basis risk hedges, as the MSC contends.
- Neither the ISO, MSC nor any other participant has provided any reasonable theoretical or empirical support to justify using ratepayer auction losses as a subsidy to other market participants who may buy or sell energy contracts.
- The main issue for the ISO to resolve is whether and how the ISO should facilitate the trading of contracts to hedge locational basis risk.

A more detailed discussion of these key issues is provided below. Going forward, DMM believes a more thorough vetting of these issues is necessary for the ISO to seriously consider market alternatives to the CRR auction.

Transmission ratepayers are not "natural sellers" of CRRs

The ISO's MSC argues that because transmission ratepayers receive the "excess" congestion rent not paid to allocated CRRs that they are "natural sellers" of price swaps that hedge congestion risk. The MSC argues that sales of CRRs in the auction by the ISO actually reduces risk for ratepayers.[7] As explained below, these arguments are flawed. Transmission ratepayers are not the natural sellers of swaps to hedge basis risk.

[7] The MSC opinion asserts that "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 oppo site revenue stream." See *Opinion on Congestion Revenue Rights Auction* Efficiency, Market Surveillance Committee, March 13, 2018, p. 4. http://www.caiso.com/Documents/MSCDraftOpinionon CongestionRevenueRightsAuctionEfficiency-Mar15_2018.pdf

The MSC's argument assumes that the only relevant risk is the uncertain stream of day-ahead market congestion rent income that is not paid to allocated CRRs, which the MSC assumes is free to be used to back the CRRs subsequently auctioned by the ISO on behalf of ratepayers. However, this unallocated congestion rent is created directly by the purchases that LSEs make in the day-ahead market for which no LSEs have received allocated CRRs. Therefore, returning this unallocated congestion rent to the ratepayers through the CRR balancing account would hedge the ratepayers for the congestion costs of the day-ahead market energy purchases that are not hedged by any allocated CRRs.

Instead, the current auction design requires ratepayers to sell CRRs under the assumption that the payments to the CRRs will be backed by the unallocated day-ahead market congestion rents. This actually removes the hedge that ratepayers would have on their day-ahead market energy purchases if not for the CRR auction. In other words, when the ISO sells ratepayer-backed CRRs it is not reducing overall risks – it is creating a new, large source of risks for transmission ratepayers.

The argument that the auction design reduces ratepayer risks by replacing an uncertain stream of income with a fixed payment in the auction is also incorrect. If a market participant offers a known payment now to replace an unknown payment, then accepting the known payment would be less risky. But the CRR auction design does not give this type of offer to ratepayers. Instead, the design replaces uncertain day-ahead market payments with a different uncertain auction payment.[8] Just because the auction payment is a single payment does not mean it is not risky. The payment is still uncertain and ratepayers cannot control at what price they will "accept" auction payments in exchange for obligations to make payments at the day-ahead market prices.

Arguments that CRR auction revenue shortfalls are justified because they help to reduce forward contract prices are unsupported and flawed

The ISO, MSC and several stakeholders argue that transmission ratepayer losses in the CRR auction reduce the costs of the auction participants who are buying the CRRs to hedge basis risk related to forward contracting.[9] Participants buying the CRRs as hedges, the argument goes, can then lower their forward contract prices by the amount of ratepayer losses (which are profits for the auction participants). Thus, the ratepayer losses are made

[8] The auction actually gives transmission ratepayers the obligation to pay CRR holders which in theory nets out against the congestion rent income. Ratepayers have to make these payments whether or not there is an offsetting stream of congestion rent income. Obviously, to the extent there is not an offsetting stream of congestion rent income, or to the extent that the stream of income is not negatively correlated with the payments to CRRs, paying CRRs increases the risks faced by ratepayers (assuming no other relevant spot market risks).

[9] For example, the MSC argues that if the ISO did not offer ratepayer-backed CRRs through the auction, "replacement hedges would likely be available only at a much higher prices for market participants", *MSC Opinion from March 13, 2018*, pp. 22-23.

up for by lower forward contracting costs and the market may actually be better off. This argument is not based on any empirical analysis or sound economic reasoning.

First, as a practical matter, most of the ratepayer losses are paid to CRRs that are unlikely to be used for hedging forward contract basis risk.[10] The ratepayer losses on CRRs not hedging forward contract basis risk cannot reduce forward contracting costs in the way described above. If the ISO and the MSC determine that ratepayers should be made to subsidize hedges that reduce the costs of forward energy contracts, then a mechanism should be designed that does not result in the vast majority of ratepayers' money going to financial entities through CRRs that do nothing to reduce the costs of forward energy contracts.

DMM has not seen anyone present an argument on how subsidizing CRRs with ratepayer funds would actually increase the efficiency of the forward energy contract market. Having ratepayers lose money on CRRs to lower the costs of forward contracting is a cross subsidy. Subsidizing factor costs to reduce product costs is not generally assumed to increase market efficiency in the absence of an externality or other market failure. On the contrary, economists are generally concerned that such cross subsidization would distort market prices and decrease market efficiency.

Further, in arguing that the "adverse impact…would likely exceed the perceived benefit" of moving to a market based on willing counterparties, the ISO is assuming that any increase in forward contracting costs would be commensurate with (or exceed) ratepayer auction losses. The effect that subsidizing CRRs has on forward contracting costs depends on the distribution of the subsidy among market participants, and the structure and elasticities of the forward contracting market.

Neither the ISO, MSC, nor any stakeholder has presented evidence to suggest that replacing the current auction design with a CRR market with voluntary counterparties would increase LSE forward contract costs by more than ratepayer losses from the current auction design. On the contrary, the best public evidence on this topic indicates the opposite. In particular, the CPUC, Office of Ratepayer Advocates, and LSEs representing the vast

[10] See *Joint reply commenters' request for leave to submit reply comments and reply comments*, Docket No. ER18-1344, Affadavit of Doug Boccignone, May 25, 2018, p. 7 (p. 40 of filing): https://elibrary.ferc.gov/IDMWS/common/opennat.asp?fileID=14930322

Mr. Boccignone's analysis of 2017 auction CRRs found that "…over ninety percent (90.3%) of the auction CRRs are held by parties that account for less than four percent (3.9%) of the volume of all reported CAISO EQR energy transacted in 2017. More than seventy-two percent (72.4%) of the CAISO auction CRRs are held by entities that, according to the EQRs, had no CAISO energy transactions"

majority of California's transmission ratepayers support the ISO moving to a market based on willing counterparties.

The MSC has incorrectly characterized support for a market based on willing counterparties as being "those of DMM and the investor-owned utilities".[11] In fact, the entities that support the ISO implementing a design that limits transactions to those between willing buyers and willing sellers includes regulators, large and small municipal utilities, CCAs, commercial and industrial loads, and direct access customers. The fact that all different types of LSEs representing the vast majority of California's load supports the ISO adopting a market based on willing counterparties is the most compelling public evidence that DMM has seen that a market between willing buyers and sellers should be expected to lower overall wholesale energy costs for LSEs.

DMM does not believe the intent of the CRR auction was (or should be) to provide subsidies for basis risk hedges. However, even if one believes a subsidy is needed or beneficial, the CRR auction appears to be a non-targeted and very inefficient way to go about administering such a subsidy.

The main issue for the ISO to resolve is whether and how the ISO should facilitate the trading of contracts to hedge basis risk.

The CRR auction design forces ratepayers to offer financial contracts and increases risks borne by ratepayers. The current auction design subsidizes CRRs with ratepayer funds. As explained above, subsidies that lower the price of CRRs can reduce market efficiency. But some may worry that the costs of participating in a market for contracts to hedge locational basis risk would be too high in the absence of the current CRR auction design. That is, the costs of trading would stop otherwise valuable trades from occurring. It might be possible that intervening, potentially with a subsidy, could reduce trading costs.

DMM believes the current CRR auction design is a non-targeted intervention subsidized by transmission ratepayers that creates huge opportunities for financial entities to extract rents from the wholesale market system without any resulting benefits in terms of actual hedging.

Relevant policy questions to address in a stakeholder initiative on CRR auction reform include:

[11] *Opinion on Congestion Revenue Rights Auction Efficiency, Track 1B*, Market Surveillance Committee, June 13, 2018, p. 2. http://www.caiso.com/Documents/MSCOpinionon CongestionRevenueRightsAuctionEfficiencyTrack1B-June13_2018.pdf

- Should the ISO intervene, potentially with subsidies, to help facilitate the trading of basis swaps?
- Or, should the ISO not intervene in the forward markets?
- If intervention is thought to be needed, how best can the ISO design a targeted intervention that will facilitate trading without creating massive rent seeking opportunities?
- If subsidies for hedging are warranted, who should fund these subsidies?

RECOMMENDATION

In combination with the ISO's Track 1A changes, the changes in the ISO's *Congestion Revenue Rights Auction Efficiency Track 1B Draft Final Proposal* will provide a measure of protection against the risks imposed on transmission ratepayers by the CRR auction and will likely reduce the current level of ratepayer losses. Relative to other potential methods of allocating revenue inadequacy, the Track 1B constraint-specific allocation reduces the incentive to target specific modeling discrepancies. Therefore, DMM supports the Track 1B constraint-specific allocation as an improvement over the currently implemented method of allocating revenue inadequacy to measured demand.

While Management's 1A and 1B proposals would provide some measure of protection for transmission ratepayers, they still do not address fundamental flaws of the CRR auction. DMM continues to hope and recommend that the ISO address these flaws in the Track 2 comprehensive CRR auction design changes. But in discussing alternatives in the Track 1B proposal, the ISO makes numerous statements that suggest the ISO will not consider moving the auction towards a market for CRRs or other hedging contracts based on trading between willing counterparties. The ISO cites arguments raised by stakeholders and the MSC against moving to a market between willing counterparties. DMM does not think these points have been sufficiently discussed.

DMM continues to recommend that the ISO to give serious consideration to a market based on willing buyers and sellers during Track 2 of this initiative. This should include the development of a straw proposal based on willing buyers and sellers that could be considered by stakeholders and that attempts to address the main concerns with willing buyer and seller approaches that the MSC and some stakeholders have expressed. The design option developed should include modifications the ISO believes would be needed in the CRR allocation process (such as to address special issues that may be created by Community Choice Aggregators) in order to replace the CRR auction with a market based on willing buyers and sellers. DMM recognizes that this may be a controversial and perhaps protracted process for the ISO, but believes that this issue merits continued focus and serious consideration by the ISO.

Attachment I – Example of Scaling Proposal

Tariff Amendment to Increase Efficiency of

Congestion Revenue Rights Auctions Track 1B

California Independent System Operator Corporation

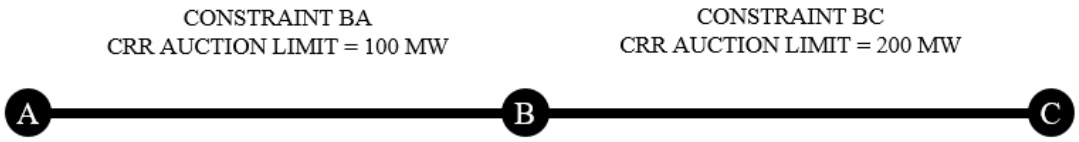
Attachment I

Example of Scaling Proposal

This example demonstrates the CAISO proposal to scale CRR payments while allowing CRR holders to net prevailing and counter flow CRRs against each other, consistent with the Commission's September 20 Order.

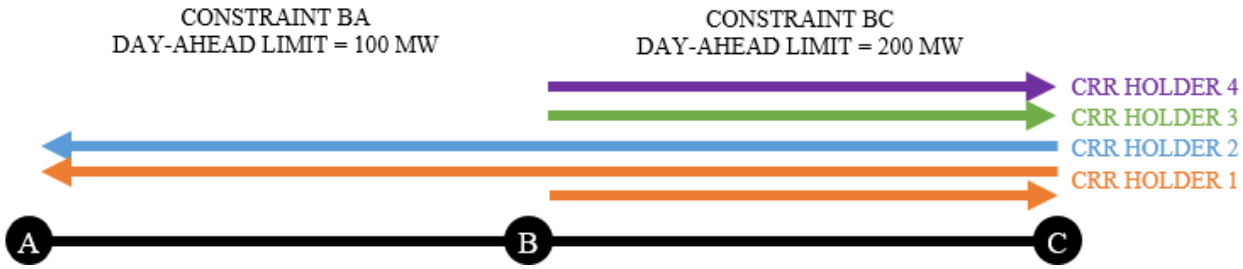
Consider a three-node system with two transmission constraints. The transmission line between A and B is rated at 100 MW meaning it can carry 100 MW in the A to B direction or 100 MW in the B to A direction. The transmission line between B and C is rated at 200 MW meaning it can carry 200 MW in the B to C direction or 200 MW in the C to B direction.

Figure 1: Three-Node System



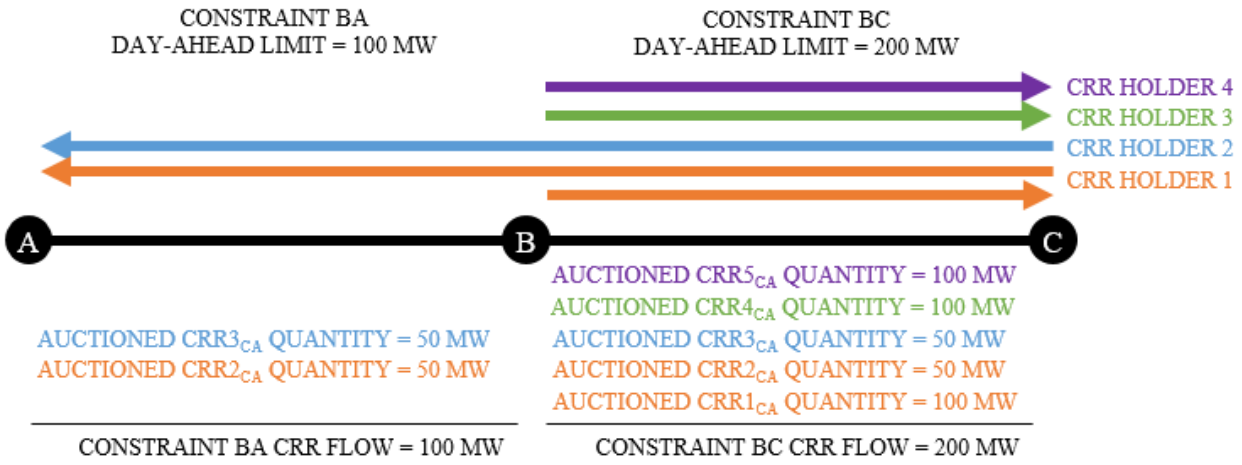
The CAISO released two congestion revenue rights (CRRs) from C to A that each place 50 MW of flow on both constraints and it released three CRRs from B to C that each place 100 MW of flow on constraint B to C. CRR holder 1 owns one of the CRRs from C to A and one of the CRRs from B to C. Three other CRR holders hold each of the remaining three CRRs.

Figure 2: CRRs Held on the Two Constraints



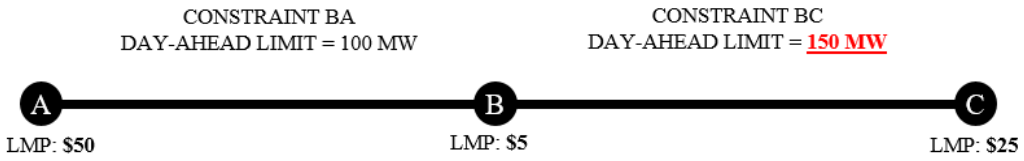
These awards are simultaneously feasible on this system because 100 MW of flow is placed on constraint B to A (which is less than or equal to the auction limit of 100 MW) and a net 200 MW of flow is placed on constraint B to C (a total of 300 MW of CRR prevailing flow on constraint B to C minus a total of 100 MW of CRR counter flow on constraint B to C, which is less than or equal to the auction limit of 200 MW).

Figure 3: Auctioned CRR Quantities on the Constraints



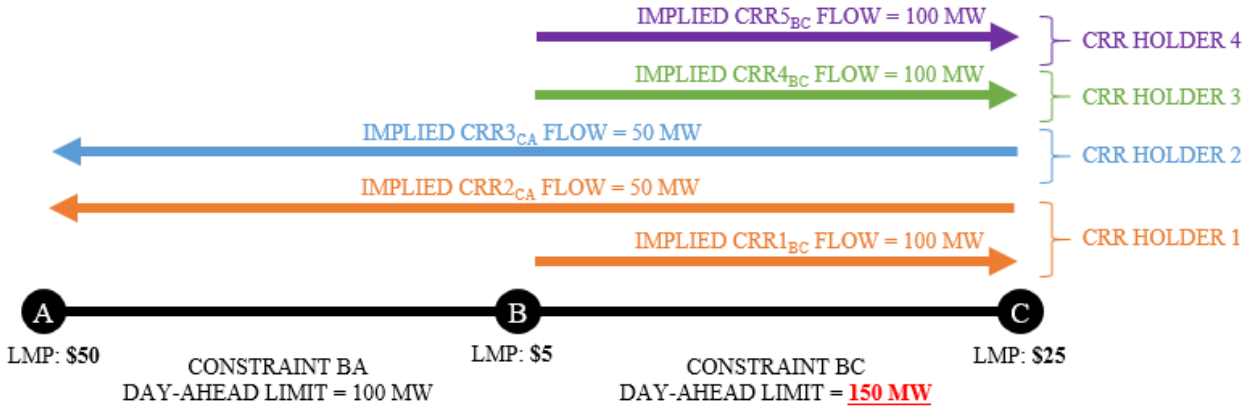
Now consider the case where the CAISO must de-rate constraint B to C by 50 MW from 200 MW to 150 MW in the day-ahead market. Also, consider that the day-ahead market locational marginal price (LMP) at A is $50, the LMP at B is $5, and the LMP at C is $25.

Figure 4: Day-Ahead Market Limits and LMP on the Three-Node System



The CRRs place the same flows on these constraints as they did in the auction. CRRs from C to A have 100 MW of implied flow on both constraints and CRRs from B to C have 300 MW of implied flow on constraint BC.

Figure 5: Day-Ahead Market and Implied Flows on the Three-Node System



Currently, the CAISO settles the full notional value of all five CRRs. The difference in the marginal congestion components (MCC) of the LMPs between C and A is $25, so the CAISO pays each CRR from C to A $1,250 ($25 multiplied by 50 MW). The difference in the MCC of the LMPs between B and C is $20, so the CAISO pays each CRR from B to C $2,000 ($20 multiplied by 100 MW).

Table 1

Notional settlement value				
CRR Index	CRR Holder	CRR Quantity	MCC difference source to sink	Notional CRR Payment
$CRR1_{BC}$	1	100 MW	$20	$2,000
$CRR2_{CA}$	1	50 MW	$25	$1,250
$CRR3_{CA}$	2	50 MW	$25	$1,250
$CRR4_{BC}$	3	100 MW	$20	$2,000
$CRR5_{BC}$	4	100 MW	$20	$2,000

However, constraint B to C is revenue insufficient because the day-ahead market can only collect congestion revenues associated with the 150 MW of available transmission plus 50 MW of additional transmission made available to the day-ahead market by the non-netted counterflow CRRs, while the CRRs place flows greater than the available transmission in the day-ahead market. The CAISO proposes to settle only the portion of each CRR holder's net modeled CRRs that are revenue sufficient.

The CAISO first nets those implied flows per CRR holder per constraint. This netting is shown in column G of Table 2: 100 MW of $CRR1_{BC}$ and -50 MW of $CRR2_{CA}$ are netted on constraint BC.

The netted $CRR1_{BC}$ and $CRR2_{CA}$, $CRR4_{BC}$, and $CRR5_{BC}$ do not receive full notional value because they are only paid up to their congestion-supported implied flow on

constraint B to C in the day-ahead market. Constraint B to A does not limit the implied flow of $CRR3_{CA}$ in any way.

Table 2

Constraint	Constraint shadow price (A)	Day-ahead limit plus non-netted counter flow CRR transmission (B)	Day-ahead congestion revenue (C) =A×B	CRR	CRR holder	CRR quantity (D)	Shift factor to constraint (E)	Implied CRR flow on constraint (F) =D×E	CRR holder's net implied flow on constraint (G) =sum(F) per CRR Holder	Constraint-specific netted notional value (H) =A×F	Percent of implied prevailing CRR flow (I)	Congestion supported constraint-specific settlement value (J) =min(C×I,G)
BA	$45	100 MW	$4,500	$CRR1_{BC}$	1	100 MW	0	0 MW	50 MW	$2,250	50%	$2,250
				$CRR2_{CA}$	1	50 MW	1.00	50 MW				
				$CRR3_{CA}$	2	50 MW	1.00	50 MW	50 MW	$2,250	50%	$2,250
				$CRR4_{BC}$	3	100 MW	0	0 MW	0 MW	$0	0%	$0
				$CRR5_{BC}$	4	100 MW	0	0 MW	0 MW	$0	0%	$0
BC	$20	200 MW[1]	$4,000[2]	$CRR1_{BC}$	1	100 MW	1.00	100 MW	50 MW	$1,000	20%	$800
				$CRR2_{CA}$	1	50 MW	-1.00	-50 MW				
				$CRR3_{CA}$	2	50 MW	-1.00	-50 MW	-50 MW	($1,000)[3]	0%	($1,000)
				$CRR4_{BC}$	3	100 MW	1.00	100 MW	100 MW	$2,000	40%	$1,600
				$CRR5_{BC}$	4	100 MW	1.00	100 MW	100 MW	$2,000	40%	$1,600

[1] The *day-ahead limit plus non-netted counter flow CRR transmission* is 200 MW, or 150 MW available transmission plus 50 MW of non-netted counter flow transmission made available by $CRR3_{CA}$.

[2] The *day-ahead congestion revenue* is $3,000 (150 MW multiplied by the $20 constraint shadow price) plus $1,000 in non-netted counter flow charges (50 MW of non-netted counter flow transmission made available by $CRR3_{CA}$ multiplied by the $20 constraint shadow price).

[3] As described in the previous two footnotes, this value is reflected in the $4,000 of day-ahead congestion revenue available to congestion revenue rights placing prevailing flow on constraint BC.

On constraint B to A, the CAISO collects $4,500 (all from CRRs on the available transmission in the day-ahead market) and distributes $4,500 ($2,250 to the netted $CRR1_{BC}$ and $CRR2_{CA}$, and $2,250 to $CRR3_{CA}$).

On constraint B to C, the CAISO collects $4,000 ($3,000 of congestion revenues on the available transmission in the day-ahead market plus $1,000 of non-netted counter flow congestion revenues) and distributes $4,000 ($800 to the netted $CRR1_{BC}$ and $CRR2_{CA}$, $1,600 to $CRR4_{BC}$, and $1,600 to $CRR5_{BC}$). The netted $CRR1_{BC}$ and $CRR2_{CA}$ receives a payment scaled by $200, $CRR4_{BC}$ receives a payment scaled by $400, and $CRR5_{BC}$ receives a payment scaled by $400.

Table 3 below compares the congestion revenue right notional value with its final settlement value after constraint-specific scaling.

Table 3

Compare notional value with settlement value					
CRR Index	CRR Holder	CRR Quantity	MCC difference source to sink	Notional CRR Payment	Settlement Value
$CRR1_{BC}$	1	100 MW	$20	$2,000	$3,050
$CRR2_{CA}$	1	50 MW	$25	$1,250	
$CRR3_{CA}$	2	50 MW	$25	$1,250	$1,250
$CRR4_{BC}$	3	100 MW	$20	$2,000	$1,600
$CRR5_{BC}$	4	100 MW	$20	$2,000	$1,600