April 11, 2018

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

Re: California Independent System Operator Corporation
ER18-_____-000

Tariff Amendments to Increase Efficiency of Congestion Revenue Rights Auctions

Dear Secretary Bose:

The California Independent System Operator Corporation (CAISO) proposes to revise its tariff to improve the efficiency of its congestion revenue rights (CRRs) auctions.[1] The tariff revisions will require that transmission owners submit an annual transmission outage plan by July 1 each year for outages that could affect power flows in the day-ahead market. The CAISO will use this information to improve the accuracy of the network model it uses for the annual CRR allocation and auction. The CAISO also proposes to limit the source and sink pairs for CRRs that market participants can purchase in the auctions to eliminate the procurement of CRRs that contribute to the inefficiency of the CRR auctions, while ensuring market participants can sufficiently hedge congestion charges associated with supply delivery transactions in the CAISO's day-ahead market. These revisions also establish an express right for CRR holders to sell CRRs back into subsequent auctions.

The CAISO requests that the Commission issue an order accepting the proposed revisions by June 11, 2018 (i.e., 61 days after the date of this filing), with an effective date of July 1, 2018. This effective date will allow the CAISO to implement the revisions prior to its annual CRR allocation and auction process for 2019. These targeted enhancements will improve the CRR auction by addressing the lack of sufficient outage information at the time the CAISO prepares the full network model used in the annual CRR process, and removing the multitude of auctioned CRRs defined at source/sink combinations not tied to supply delivery but that were subject to significant auction revenue shortfalls. The CAISO identified both these issues to be drivers of CRR auction inefficiency.

[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.

The CAISO will continue to explore with its stakeholders ways to improve the efficiency of the CRR auction further.

I. Executive Summary

CRRs are financial instruments the CAISO makes available through an annual and monthly allocation and auction process. 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.

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 expected congestion costs to protect themselves against uncertain congestion costs. In recent years, however, the auction revenues collected from CRR holders in the CAISO's CRR auctions have been significantly lower than CRR revenues based on day-ahead market congestion costs received by CRR holders. The CAISO analyzed the performance of its CRR auctions comprehensively to identify the root causes of the disparity between CRR auction revenues and payouts to holders of auctioned CRRs. This analysis shows that, on average 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 CAISO auctions. The CAISO has been exploring ways to improve the efficiency of its CRR auctions to reduce the magnitude of these auction revenue shortfalls.

This filing includes two sets of separate measures to improve the efficiency of the CRR release process that the CAISO can implement before the upcoming annual CRR allocation and auction process for 2019. The CAISO will continue to work with stakeholders to explore further improvements to its CRR auctions. Future enhancements may include other incremental measures the CAISO can implement for the 2019 CRR allocation and auction and more comprehensive design changes the CAISO would implement in future years.

The first change the CAISO proposes in this filing is a new requirement that transmission owners report annually by July 1 known transmission outages they plan to take in the upcoming year that affect power flows in the day-ahead market and thus CRR revenue adequacy.[2] The CAISO tariff already requires

[2] The CAISO considers two metrics to evaluate the efficiency of the CRR auction processes. The first, discussed above, is "auction revenue shortfall," which is the proportion of the revenue collected in the CRR auction for CRRs relative to the revenues collected from the day-ahead market for those CRRs. The second is CRR "revenue inadequacy," which measures the potential gap between congestion revenue collected from the day-ahead market and the obligations the CAISO has to pay to CRR holders based on CRRs released in the CRR processes.

participating transmission owners to report annually by October 15 known outages they plan to take in the upcoming year. The additional reporting requirement is narrowly tailored to provide the CAISO with outage information on facilities that affect the efficiency of the CRR allocations and auctions. This will enable the CAISO to: (1) align the modeling of system capacity in the CRR allocation and auction better with the transmission that actually will be available; and (2) reflect more accurately expected conditions in the day-ahead market during the periods covered by each annual allocation and auction. The CAISO's analysis of CRR auction efficiency found that many constraints contributing to auction revenue shortfalls were not enforced in the annual and monthly CRR auctions but contributed to congestion in the day-ahead market. Better information regarding planned transmission outages will allow the CAISO to identify additional constraints that it should enforce in the auction model, which will improve auction efficiency. This new deadline is appropriate because the CAISO releases the CRR model to be used for the annual allocation and auction process in late July. Obtaining Commission approval of this new requirement by June 11, 2018, is crucial for the CAISO to obtain the needed outage information in time for the 2019 allocation and auction processes.

Most stakeholders support the new outage reporting requirements. Some transmission owners are concerned that the new outage-reporting requirement will increase the costs of transmission maintenance. However, the new reporting requirement does not impose any changes on how the transmission owners plan for outages. The CAISO expects that, consistent with good utility practice and by necessity, many of the maintenance outages the transmission owners take are planned well in advance of the upcoming year. The CAISO merely proposes to require transmission owners to submit any known planned maintenance outages earlier so that the CAISO can incorporate those outages in the CRR models. Although the new deadline might impose an additional administrative cost on the transmission owners, the CAISO believes that such additional costs, if any, are justified by the expected improvements to the efficiency of the CRR auctions. This earlier reporting requirement is consistent with reporting requirements with other independent system operators that require transmission outage information even further in advance without imposing undue costs on their ratepayers.

Second, the CAISO proposes to discontinue releasing in the auction CRRs that do not source and sink at points used for delivery of supply. For example, the CAISO would no longer auction CRRs that are defined by supply-to-supply points, load-to-supply points, or load-to-load points. This is more consistent with the intended purpose of CRRs as a hedge for supply delivery and will eliminate CRRs that have a high payout potential relative to the price paid for those CRRs, but are likely unrelated to supply delivery. Currently, the auction rules allow bidders to bid for and obtain CRRs with any combination of generator locations, load locations, trading hubs, pricing nodes, and import/export scheduling points. Many of these source-sink pairs, however, have no

relationship to the primary purpose of CRRs, *i.e.,* allowing market participants to hedge congestion costs associated with supply delivery. The CAISO's analysis of the CRR auctions show that these "non-delivery" source and sink CRR pairs contribute greatly to CRR auction revenue shortfalls. Further analysis shows that these non-delivery source and sink CRR pairs do not provide beneficial competitive or counter-flow value in the auctions. Although market participants may use these CRRs to hedge their portfolio of resources, any incremental benefit these options can provide are outweighed by the significant disparity in payouts relative to the CRR auction revenue received for these types of CRRs. This is especially so given that market participants could still obtain CRRs that source and sink from generators to the load aggregation points or trading hubs. These remaining alternatives can continue to provide the equivalent hedge at a more competitive price. The delivery pairs that would remain eligible for auction bids will provide a better hedge because these pairs would pay all the congestion exposure for supply delivery.

These enhancements are supported by the CAISO's Market Surveillance Committee (MSC), which notes that "the number of generator-to-generator hedges being purchased during the year exceeds their possible use for this purpose of adjusting congestion hedges by an order of magnitude."[3] Supply delivery CRRs would also likely be priced more equitably because they would place flows over more constraints consistent with physical use of the grid that will have competitive flows because all the other CRRs are flowing to the same load aggregation points or hubs.

The CAISO therefore proposes to limit CRR auction bids to pairs that source and sink in the following ways: (1) from a generator bus to either a load aggregation point, a trading hub, or scheduling point; or (2) from a trading hub to either a load aggregation point or scheduling point; or (3) from a scheduling point to either a load aggregation point or trading hub. The CAISO anticipates that this change will increase CRR auction prices to a level closer to anticipated CRR revenues, and thereby reduce auction revenue shortfalls.

Although the proposed tariff revisions arise from the same stakeholder initiative, each set of revisions is discrete and stands on its own. From a substantive perspective, the two sets of revisions are separate elements of a multi-part filing that are severable from each other and not interdependent or affected by the Commission's actions on the other element. Thus, the Commission should evaluate the justness and reasonableness of each proposed set of tariff changes based on its individual merits. Nonetheless, contrary determinations with respect to one element could affect the implementation timeline of the other.

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[3] *See* the opinion of the Market Surveillance Committee on CRR Auction Efficiency (MSC Opinion) in Attachment H to this filing at 19.

Commission action on this item by June 11, 2018, will enable the CAISO and market participants to plan for the 2019 annual CRR auction to be held later this year, starting in late October. These changes require software and system changes and will require that market participants change their processes and practices for the 2019 auctions. The CAISO proposes a July 1 effective date for the proposed tariff revisions. However, the CAISO proposes to apply the existing tariff provisions until the 2018 CRR monthly markets are completed to allow participants to clear in the 2018 monthly auctions any CRRs obtained in the 2018 annual allocation and auction.[4]

Finally, because it is restricting auctioned CRR source to sink combinations, the CAISO must enhance the CRR system to allow entities that acquire CRRs in auctions or allocations to sell these CRRs back in subsequent auctions. This added functionality will allow market participants to unwind directly their CRR positions, which currently is achieved by buying counter-flow CRRs. No stakeholder opposes this change.

The Department of Market Monitoring and several other stakeholders advocate for replacing the current CRR auctions with an entirely new trading mechanism where congestion hedges would be available by auction only where one voluntary CRR bid is matched by an equal and opposite counter-flow bid. This extensive overhaul of the CRR framework goes far beyond the targeted scope of this filing. The CAISO will continue to explore this and other proposals in the ongoing stakeholder processes addressing CRR auction efficiency issues, but the CAISO has significant concerns that such a proposal is contrary to fundamental principles of open access and could not be accomplished without significant changes to the CRR allocation processes.

The Market Surveillance Committee supports the CAISO's proposed revisions herein, expecting they will reduce losses to transmission ratepayers caused by current auction revenue shortfalls while maintaining the hedging benefits and flexibility attributes of the existing CRR auction design. The Market Surveillance Committee also has many concerns with proposals to replace the current CRR auctions with a voluntary trading platform.

For the reasons explained in this filing, the Commission should accept the proposed tariff revisions in time to be implemented for the next annual CRR allocation and auction process.

[4] This filing includes an appendix to the tariff that documents the application of existing CRR tariff provisions for CRRs that settle based on congestion that occurs in the CAISO day-ahead market between July 1, 2018, and December 31, 2018.

II. Background

A. Overview of CRRs in the CAISO Markets

The CAISO operates wholesale markets that include a day-ahead market and a real-time market. The day-ahead market consists of two separate processes: the integrated forward market and the residual unit commitment. The integrated forward market co-optimizes energy and ancillary services based on bids for energy supply, energy demand, and ancillary services. The integrated forward market produces locational marginal prices and day-ahead financially binding schedules. The residual unit commitment process clears bids for residual available capacity based on a procurement target, which is largely based on the CAISO's demand forecast.

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 independent system operators (ISOs) and regional transmission organizations (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.[5]

CRRs are financial instruments that market participants can acquire through a CAISO-administered allocation and auction process.[6] All other ISOs and RTOs offer comparable financial transmission rights. 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),[7] multiplied by the megawatt (MW) quantity of the CRRs a

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

[6] 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.

[7] 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.

market participant holds between the two points.[8] 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 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).[9] 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 CAISO releases CRRs to load-serving entities at no cost to those entities through an allocation process. The CAISO also conducts CRR auctions that allow all market participants to obtain CRRs based on cleared bids. The CRR allocation and auction processes occur annually and monthly. 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.[10] Once the CAISO releases CRRs, market participants can also trade them through secondary market transactions.[11]

The primary purpose of CRRs is to hedge day-ahead market congestion costs, allowing market participants to address congestion risk. When transmission demand exceeds capacity, locational marginal prices vary depending on congestion levels. Congestion charges can change dramatically based on system conditions and patterns of supply and demand. As the Commission has repeatedly recognized, CRRs give market participants a level of financial protection against the risks associated with unpredictable congestion charges.[12]

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[8] Tariff sections 11.2.4.2 – 11.2.4.2.2. Each pair of source-sink points is sometimes called a bid pair. Currently, the following types of sources and sinks are eligible for the CRR auction: pricing nodes, scheduling points, trading hubs, load aggregation points, metered subsystem load aggregation points, and sub-load aggregation points. Tariff section 36.13.5.

[9] This example 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.

[10] Tariff sections 36.8-36.11 and 36.13.

[11] Tariff section 36.7.

[12] *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's CRR design provides for full funding of CRRs. The CAISO maintains a CRR clearing account, in which it collects hourly day-ahead market congestion revenues and CRR auction revenues. To the extent funds in the CRR clearing 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 clearing account to measured demand.

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. The CAISO maintains a list of constraints and network topology that is intended to reflect, as closely as possible, similar constraints and network topology expected in the day-ahead market. In determining the available capacity to include in the CRR model used in each allocation and auction process the CAISO considers information regarding maintenance (i.e., planned) outages of transmission facilities that may significantly affect CRR revenue adequacy.[13] The CAISO tariff defines such outages in terms of the type of facility and the planned duration of the outage and requires that facility operators report such outages no fewer than 30 days in advance of the first day of the month in which the outage is proposed to begin.[14] In addition, the CAISO tariff requires each facility operator provide the CAISO with a proposed plan for transmission maintenance outages for the following year by October 15 of each year.[15]

B. Stakeholder Initiative on CRR Auction Efficiency

With an efficient CRR auction, prices of auctioned CRRs should roughly reflect market participants' expectations of congestion exposure in the day-ahead market.[16] In recent years, however, the outcomes of the CRR auctions have not reflected this expectation. The discount in CRR auction prices relative to expected CRR payouts seen in recent years far exceeds any reasonable risk premium.

In early 2017, the CAISO commenced a stakeholder initiative to address concerns with CRR auction efficiency.[17] 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.

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[13] Tariff section 36.4.

[14] Tariff sections 9.3.6.3.2 and 36.4.3.

[15] Tariff section 9.3.6.

[16] Declaration of Guillermo Bautista Alderete, Director, Market Analysis and Forecasting, provided as Attachment C to this filing at 7-8 (Bautista Alderete Declaration).

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

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 focuses on what measures the CAISO can take to address the drivers of the shortfalls identified in the analysis phase

The CAISO divided the policy phase into three tracks. Track 0 focused on CRR auction enhancements that the CAISO can 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 this year. Track 2 will focus on more comprehensive changes to the CRR auction design that CAISO management would present to the CAISO Board of Governors later in 2018.

The CAISO subsequently subdivided Track 1 into Track 1A and Track 1B. Track 1A focused on enhancements the CAISO can implement by this summer, in time to incorporate them into the CRR model for the CAISO's 2019 annual CRR allocation and auction process. The tariff revisions proposed in this filing implement the Track 1A recommendations as documented in the CAISO's CRR Auction Efficiency, Track 1A Draft Final Proposal Addendum dated March 8, 2018, provided as Attachment D to this filing.

The CAISO solicited multiple rounds of stakeholder comments on these issues, beginning after the April 2017 working group to determine the scope of the analysis phase.[18] Most recently, stakeholders submitted comments on February 28, 2018, following publication of a Track 1 Draft Final Proposal and a stakeholder meeting on the proposal. Many stakeholder comments address issues beyond the limited scope of the instant filing. The CAISO will consider in Track 1B proposals raised in Track 1A that it could not resolve in time to make this filing. The CAISO will address longer-term potential changes in Track 2. Recent stakeholder comments received in this initiative also informed the CAISO's decision to narrow the list of enhancements proposed in the instant filing.[19]

On March 22, 2018, the CAISO Board of Governors approved the Track 1A proposals included in this filing. A copy of the memorandum from Keith Casey, Vice President, Market & Infrastructure Development, to the Board of

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[18] 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.

[19] A Summary of Submitted Stakeholder Comments on CRR Auction Efficiency provided to the CAISO Board is provided as Attachment F to this filing. Responses to stakeholder comments are addressed separately below, in Section IV.

Governors on the Track 1A proposals is in Attachment E to this transmittal letter. The Department of Market Monitoring does not support the Track 1A proposals. A copy of the memorandum from Eric Hildebrandt, Executive Director, Market Monitoring, to the Board is in Attachment G to this transmittal letter. The Market Surveillance Committee supports the CAISO's Track 1A proposals. A copy of the MSC Opinion is in Attachment H to this transmittal letter.

Track 1B of the CRR auction efficiency initiative is focusing on additional measures that could improve the efficiency of CRR auctions for 2019. The CAISO plans to bring Track 1B policy recommendations to the Board of Governors for approval in the summer of 2018 and will submit any related filings to the Commission shortly thereafter. Any such further tariff amendments would be incremental to the changes proposed herein and would complement, rather than supersede, this filing. In other words, any proposals would be separate, distinct, and not interdependent with the revisions proposed herein.

1. CRR Auction Analysis

In this initiative's analysis phase, the CAISO analyzed 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 24, 2017.[20]

One way to measure the efficiency of the CRR auction is to compare what bidders pay for CRRs in the auction to the payments a CRR holder receives in the day-ahead market. 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. As Dr. Bautista Alderete explains, 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 $174 million in 2017. 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 $100 million in 2017.[21]

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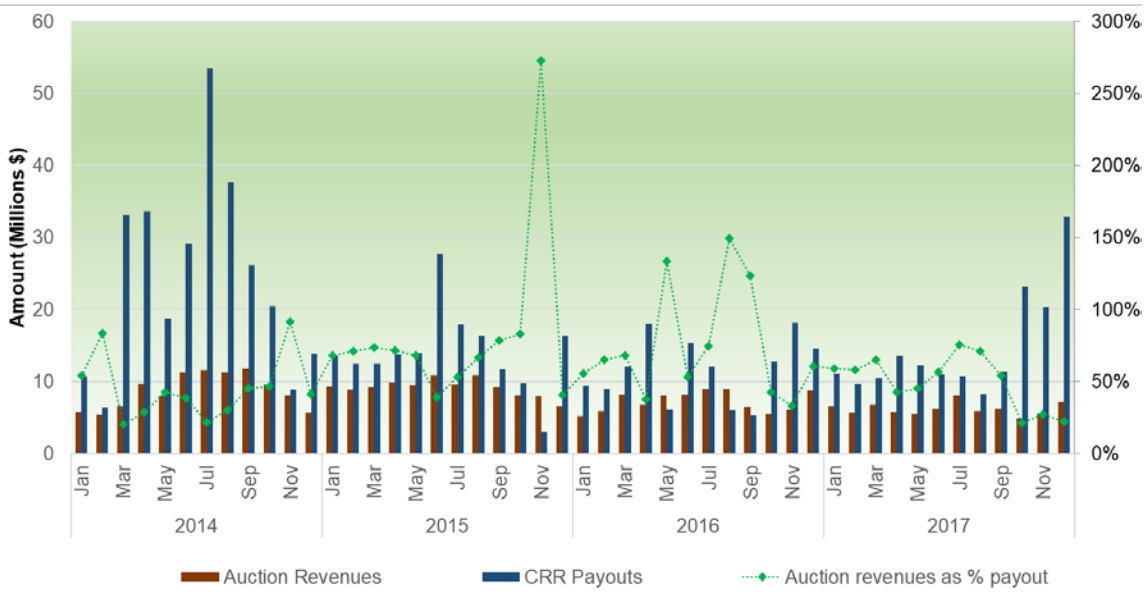
[20] The CRR Auction Analysis Report is provided as Appendix I to the Declaration of Guillermo Bautista Alderete, Director, Market Analysis and Forecasting, provided as Attachment C to this filing. The CRR Auction Analysis Report is also available at http://www.caiso.com/Documents/CRRAuctionAnalysisReport.pdf.

[21] Bautista Alderete Declaration at 9-10.

The following figure provides a more granular illustration of these 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 things, the CRR Auction Analysis Report identified the following issues relevant to this tariff amendment:

- The lack of sufficient information on key transmission outages prior to the CRR auctions causes misalignments in constraint enforcement, contingency enforcement, and topology between the model used for CRR auctions and actual system conditions in the day-ahead market.

- A significant percentage of auction revenue shortfalls are associated with auctioned CRRs for source and sink pairs that do not facilitate the use of CRRs as a hedge for congestion resulting from supply delivery transactions.[22]

The CAISO discusses these matters in more detail below.

[22] The CRR Auction Analysis Report also identified other issues not relevant to these tariff amendments that may be addressed in future filings with the Commission.

a. Lack of Sufficient Information on Transmission Outages

The CRR Auction Analysis Report found that the lack of timely information on transmission maintenance outages contributes to CRR auction-related deficiencies. The report concluded that misalignment of transmission constraints between CRR auctions and the day-ahead market is a systemic issue impacting the overall efficiency of the CRR auctions. Without sufficient advance notice of certain key outages, the CAISO is unable to prepare models effectively to conduct the annual and monthly CRR allocation and auction processes.[23] The auction revenue received for a CRR will be less than the payments to that CRR holder if a constraint frequently binds in the day-ahead market at a high congestion cost but does not bind, or binds at a lower cost, in the CRR auction market.

As reported in the CRR Auction Analysis Report, the CAISO found that the lack of timely outage data was one of the primary reasons for both CRR revenue insufficiencies and auction revenue shortfalls. Even a single constraint that binds in the day-ahead market but that the CAISO is unable to model in an annual or monthly auction may lead to a major revenue shortfall. As Dr. Bautista Alderete explains, in some cases, like January 2017, one constraint alone that was not modeled and for which outage information was not available to the CAISO drove a significant portion of the CRR revenue shortfall for that month.[24]

The tariff does not currently require participating transmission owners to report outages that could significantly affect CRR revenue adequacy in advance of the annual CRR allocation and auction process. They are only required to submit an annual maintenance outage plan by October 15 of each year, but the annual CRR allocation and auction model has been finalized by that time. Some participating transmission owners voluntarily provide information on outages earlier, but there is no mandate to do so, and this practice is not consistent. The existing monthly outage submittal requirements call for CAISO approval of outages that may have a significant effect on CRR revenue adequacy no less than 30 days in advance of the month in which the outage is proposed to begin. Although the tariff defines the types of facilities and outage durations that transmission owners must report as part of this monthly requirement, it does not specify that the outages must be reported because they affect the power flow and therefore may affect the efficiency with which the CAISO auctions CRRs. The CAISO intends to clarify through this filing that the outages the CAISO intends to have reported earlier are those that affect facilities that when out can affect the power flow and therefore both CRR revenue adequacy and the auction

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[23] *See* Draft Final Proposal Addendum at 24-26.

[24] Bautista Alderete Declaration at 14-15; CRR Auction Analysis Report at 9.

revenue shortfalls. This clarification is intended to target specific information so that it is clear that transmission owners do not have to provide outages of certain equipment that otherwise meets the voltage and duration thresholds but do not actually impact the power flow in the CRR DC full network model (*e.g.*, a bypassed breaker in a substation that does not impact the rating of the associated transmission line).

In addition, as reported in the CRR Auction Analysis Report, the CAISO found that many constraints contributing to CRR auction revenue shortfall were not enforced in the annual and monthly auctions but contributed significantly to congestion in the day-ahead market.[25] Planned outages affecting power flows that cause constraints to bind need to be incorporated into the CRR models. Because the CAISO lacked sufficient information on these types of outages, the network model did not include the outage, and the additional constraint was not reflected in the auction.

b. Auction Revenue Shortfalls Resulting from Certain CRR Source-Sink Pairs

Currently, the CAISO permits market participants to source and sink CRR bids at all defined pricing nodes, import/export scheduling points, trading hubs, load locations, and generator locations. The CRR Auction Analysis Report determined that the bulk of the auction revenue shortfall is associated with source-to-sink CRRs acquired in the CRR auctions that do not align with typical supply delivery paths. For instance, auction participants may purchase CRRs that source and sink at two supply locations or that source at a load location and sink at a supply location. These CRRs do not hedge the entire path from supply locations to load locations. Where auction participants desire to hedge a particular supply delivery route, but instead bid for a portfolio of non-delivery CRRs focused on specific uncompetitive constraints, auction outcomes fail to reflect the true value of the intended supply delivery hedge. In contrast, CRRs aligned with typical supply deliveries source at a supply location and sink at a load or export location. These CRRs hedge the entire path from supply locations to load locations. When auction participants bid for the entire intended path, auction participants must compete for all constraints associated with typical supply delivery routes, leading to more efficient auction outcomes.

Dr. Bautista Alderete explains that CRRs with non-delivery source and sinks have accounted for 81 percent of CRR auction revenue shortfalls. The CAISO found that market participants purchased these non-delivery CRRs for 38 cents on the dollar, while market participants purchased CRRs with supply

[25] Bautista Alderete Declaration at 15-17.

delivery source and sinks for 74 cents on the dollar.[26] Non-delivery CRRs theoretically can add value to the auction, but only where they place counter-flows on the system that enable more CRRs to be sold in the auction. Any such potential benefits must be considered against the significant costs such CRR source-sink pairs impose on customers. For example, the CAISO's analysis shows that generation-to-generation CRRs have resulted in $186 million CRR auction revenue shortfalls for the 2014-2017 period of analysis.[27]

Dr. Bautista also explains it is particularly instructive that the bulk of the large payouts made to CRRs in the day-ahead market were procured at very low prices. Figure 2 in his testimony shows the payouts relative to the prices paid illustrating the cumulative profits for non-delivery on-peak CRRs for the period under analysis. Dr. Bautista explains that large auction revenue shortfalls accrued on non-delivery CRRs that are mostly low-valued and cleared at prices very close to $0/MWh.[28]

The CAISO's analysis further shows that CRRs associated with bid pairs unrelated to supply delivery – called non-delivery pairs in this policy effort – do not provide competitive or counter-flow value in auctions and do not further the policy of using CRRs to hedge congestion charges associated with supply delivery. Instead, it appears that market participants purchase such CRRs more often for financial speculation than to hedge congestion charges. This has become a frequent practice. Awards to non-delivery pairs account for over 79 percent of all transmission capacity released as CRRs, and CRR non-delivery pair bids have cost $280 million in auction revenue shortfalls in the period of 2014 through November 2017.

Some stakeholders have argued that non-delivery pair bids benefit the market because they place counter-flows on the system, enabling more delivery pair bids to clear in the auction. The CAISO evaluated this based on an analysis of a representative CRR season, and concluded this is not the case. As explained by Dr. Bautista Alderete, the CAISO compared 2018 Season 3 actual auction results to an auction run without non-delivery pairs. When the CAISO re-ran the CRR auction without any non-delivery pair bids, cleared bids for delivery-pair rights increased by 5,000 MW to 22,000 MW. Without non-delivery pair bids, cleared bids increased from 25 percent to 33 percent, showing that delivery pair bids do not depend on non-delivery pair bids. Bids for non-delivery pairs also prevent bids for CRRs that sink at load-serving entity load aggregation points from clearing. When the CAISO removes all non-delivery pair bids from its 2018 Season 3 actual auction results, 12,700 MW of bids for CRRs sinking at load

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26 *Id.* at 19.

27 *See* Draft Final Proposal Addendum at 28-30 (summarizing CAISO findings).

28 Bautista Alderete Declaration at 19-20.

points clear the auction, an increase of 3,800 MW.[29] Although this analysis is limited to one season, it is indicative that the removal of such CRRs is not at the expense of any meaningful amount of additional capacity otherwise added by these CRR combinations – this scenario actually showed that counter-flow did not enable any additional capacity for supply delivery.

The CAISO conducted an additional analysis comparing the 2017 Season 3 CRR auction with non-delivery CRR source/sink pairs removed and comparing these results with the actual CRR auction results. As Dr. Bautista Alderete explains, in this simulation, auction revenues decreased from $20.12 million to $5.32 million without the non-delivery source/sink CRRs. The estimated day-ahead payouts to holders of auctioned CRRs in excess of auction revenues was also much less, dropping from $10.25 million to $5.71 million. The 2017 Season 3 analysis also shows, however, that total prices paid for CRRs in the simulated Season 3 CRR auction relative to total day-ahead market payouts to holders of the auctioned CRR did not increase.

The CAISO has determined that it cannot estimate the impact on the price paid for CRRs in a meaningful way because it cannot simulate how market participants will adjust their bidding if the CAISO removes the non-delivery pair CRRs from the auction and therefore cannot simulate exactly how the auction revenues will change. The CAISO anticipates that removing the non-delivery CRRs source/sink pairs will increase the efficiency of the auction because in simple terms removing approximately 1.18 million eligible CRR pairs will inevitably increase competition for the remaining 78 thousand pairs.

In conducting the 2017 Season 3 CRR analysis, the CAISO had to use bids that were actually submitted into the Season 3 CRR auction and then disregard the non-delivery CRR bids. In other words, the after-the-fact simulated auction could not reflect the actual conditions that will exist if market participants are unable to submit non-delivery CRR bids. The CAISO cannot simulate how market participants will modify their bids if they are not permitted to submit non-delivery bids. In an auction where market participants cannot submit non-delivery CRR bids, market participants reasonably would be expected to change their behavior and bid for delivery CRRs. If, as asserted by some stakeholders, a portion of the non-delivery CRRs are used to hedge supply portfolios, market participants will seek supply to load CRRs to obtain hedges needed for supply delivery. Market participants that participate in the auction for speculative purposes will also have fewer combinations of locations to bid for CRRs. When auction participants must bid for the entire intended path between supply and demand, auction participants must compete for all constraints associated with typical supply delivery routes, leading to more efficient prices.

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[29] *Id.* at 22-23.

When comparing the actual 2017 Season 3 results with the simulation results, it is likely the auction would have collected more than $5.32M if the simulation could account for changes in bidding behavior. In the 2017 Season 3 analysis, the ISO eliminated 89% of the bid-in megawatt capacity in the auctions. This is a substantially large amount of capacity, and it is likely that market participants would bid at least a portion of that capacity back into the auction at the eligible locations. The simulated auctions cleared similar quantities of supply delivery CRRs as the actual auctions, but with 89% less bid-in megawatt capacity. This indicates that constraints related to supply delivery on the transmission system bind in a way that has a relatively similar supply of transmission regardless of the quantity of bid-in CRRs. If the supply of transmission stays relatively similar with or without non-delivery pairs, it would take a relatively modest amount of auction activity shifting from non-delivery pairs to delivery pairs in the new paradigm to increase the demand for this relatively similar supply of transmission.[30] This will introduce more liquidity and competition in the CRR auction because fewer CRRs will be eligible for the same amount of capacity. As such, prices for those auctioned CRRs should increase, producing auction revenues that are more consistent with market participants' expectations of congestion price exposure in the day-ahead market.[31]

III. Proposed Tariff Revisions

A. Annual Outage Reporting Requirements for the Annual CRR Release Process

As discussed above, insufficient information on transmission maintenance outages misaligned the constraints, contingencies, and topology that the CAISO used in the CRR auction models compared to those actually experienced in the day-ahead market. Simply put, the CRR model assumes the availability of transmission capacity, which ultimately is not available in actual operations due to maintenance outages. Obtaining relevant outage information prior to the annual CRR process will reduce auction revenue shortfalls resulting from this misalignment.

To that end, the CAISO proposes to revise the tariff to create an additional annual transmission outage-reporting deadline, requiring transmission owners to submit by July 1 of each year all known, and planned transmission maintenance outages potentially affecting the CRR model for the following year. This annual outage plan-reporting requirement will only apply to outages of transmission

30 *Id.* at 24-25.

31 *Id.* at 24.

facilities that the tariff defines as affecting CRR revenue adequacy.[32] Just like the information already required for planned outages that transmission owners must submit annually by October 15, the plan will include the following information for each transmission facility: the identification of the facility and location; the nature of the proposed maintenance outage; the preferred start and finish date for each outage; and where there is a possibility of flexibility, the earliest start date and the latest finish date, along with the actual duration of the outage once it commences. Annual outage reporting by July 1 will give the CAISO sufficient advance notice of outages that could affect the annual CRR allocation and auction process, thus decreasing auction payment shortfalls due to over-allocated transmission.

The CAISO tariff already defines the specific facilities and the duration of outages that may affect CRR modeling.[33] The CAISO also proposes to define the types of outages that must be reported for CRR modeling purposes. Specifically, the revised tariff provisions will require transmission owners to report only outages that meet the existing criteria; affect topology changes such as outages that effect equipment that results in a bus outage, a split bus, transmission line outage or de-rate, or a transformer outage or de-rate; and extend beyond a twenty-four (24) hour period.[34] In response to stakeholder comments, the CAISO clarifies that transmission operators must only report known and planned outages by July 1. In addition, in response to stakeholder requests, the CAISO clarifies that the 24-hour exemption to reporting an outage only applies to specific facility outages that commence and are completed within a twenty-four hour period, consistent with the intent of that provision when filed.[35] These changes will ensure that the new annual reporting requirement applies only to those types of outages vital to CRR modeling. Consistent with existing tariff provisions, the CAISO will continue to maintain a list of facilities that satisfy these criteria in CAISO operating procedures so that transmission owners can readily identify the types of outages they must report to comply with the July 1 reporting requirements in proposed section 9.3.6.1 and the 30-day reporting requirements in existing Section 36.4.3.

B. Limit Allowable Source and Sink Paris in the CRR Auction

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[32] Revised tariff sections 9.3.6.1 and 36.4.3.2.

[33] See tariff section 36.4.3.

[34] Revised tariff section 36.4.3.2. The CAISO also eliminates a paragraph in section 36.4 that only applied to the initial CRR allocation and auctions during the first year of the CAISO's nodal market design.

[35] *See* CAISO, Amendment to ISO Tariff and MRTU Tariff and Compliance Filing, Docket No. ER08-1059-000, *et al.*, at 15 (filed May 30, 2008) ("The revised provision, adopted in response to a request by Participating Transmission Owners (''PTOs''), allows the PTOs greater flexibility to reduce the number of planned Outages that must be scheduled under the 30-day rule by allowing the exemption to apply if the Outage is planned to be initiated and completed within a 24-hour period which may consist of portions of two consecutive calendar days.").

The primary purpose of CRRs is to enable market participants to hedge congestion charges associated with supply delivery. Although auction participants may purchase CRRs that have sources and sinks that do not align with typical supply delivery paths, these CRRs do not include, and therefore do not compete for, all constraints associated with typical supply delivery routes. Where auction participants desire to hedge a particular supply delivery route, but instead bid for a portfolio of non-delivery CRRs focused on specific uncompetitive constraints, auction outcomes fail to reflect the true value of the intended supply delivery hedge. Non-delivery pairs do not assist in enabling more delivery pair bids to clear auctions, prevent bids for CRRs that sink at load-serving entity load aggregation points from clearing, and fail to improve average auction prices. The CAISO has determined that a large portion of the auction revenue shortfalls in the CRR markets – totaling $280 million since 2014 – are associated with auctioned CRRs that have sources and sinks unrelated to supply delivery.

To address these issues, the CAISO proposes to revise the tariff to limit the combination of source and sink pairs eligible for future CRR auctions to those pairs associated only with supply delivery.[36] Specifically, the only eligible source and sink pairs will be:

- From a generator bus to either a load aggregation point, a trading hub, or a scheduling point;
- From a trading hub to either a load aggregation point or a scheduling point; and
- From a scheduling point to either a load aggregation point or a trading hub.[37]

The following table breaks down allowable source/sink CRR auction bids.

		SINK			
SOURCE		LAP	GENERATOR	Intertie	Trading Hub
	LAP				
	GENERATOR	VALID		VALID	VALID
	Intertie	VALID			VALID
	Trading Hub	VALID		VALID	

[36] The CAISO's proposal will have no impact on the continued validity of CRRs acquired prior to the effective date of these tariff revisions.

[37] Revised tariff section 36.13.5.

By limiting the number of source and sink pairs in the auction, the CAISO will reduce the potential combinations of source and sink pairs. This will increase competition for CRRs at sources and sinks related to supply delivery, and therefore increase competition for constraints associated with supply delivery and the physical use of the grid. These tariff modifications will refine the CRR product to be consistent with its intended purpose: hedging day-ahead congestion costs associated with transmission supply transactions.

The Market Surveillance Committee supports this proposal because this rule change should lead to a decrease in auction payment shortfalls. The Market Surveillance Committee notes that, "The logic behind this restriction is strong: non-delivery pair CRRs account for the vast majority of the auction revenue shortfall.[38] Limiting CRR combinations therefore "should theoretically concentrate the flows over fewer constraints so they could increase prices relative to payouts."[39] Acknowledging that the exact improvement stemming from limiting source and sink pairs is unclear, the proposal is still "likely to reduce the auction revenue shortfall without substantially harming market efficiency."[40] Therefore, the Market Surveillance Committee states that it is anticipated that this rule change will substantially reduce auction revenue shortfalls.[41]

Further, continuing to allow targeted supply-to-supply transactions that do not align with supply delivery to the settled default load aggregation point price has other negative impacts. At the April 5, 2018, meeting of the Market Surveillance Committee, Dr. Scott Harvey explained that there is an intractable problem associated with model granularity and unrestricted source/sink pair combinations under current CAISO CRR settlement rules. One may think that an ISO must simply model transmission lines as out-of-service in its auction models to reduce overall transfer capability to increase auction efficiency. For example, if a transmission line is scheduled to be out only half the hours in a month, the ISO 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 ISO 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 CRRs that would have high prices in the auction when the outage is modeled, but require minimal CRR payments in the day-ahead market when the outage is not modeled." Allowing

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38 MSC Opinion at 17.

39 *Id.* at 23.

40 *Id.*

41 *Id.* at 17.

auction participants the capability to source and sink at any location on the system enables the behavior Dr. Scott Harvey describes.[42]

Because the CAISO proposes to limit the source/sink combinations allowed in the CRR auction, the CAISO must also enhance the CRR system to include an option to sell an existing CRR. Today, participants desiring to sell CRRs in the CRR auction must do so by purchasing counterflow positions, which financially unwind the CRRs they hold. The CAISO did not previously include a "sell" feature in the auction because of the costs associated with such a software enhancement. However, with the limitations proposed in this filing, market participants will not have the ability to bid at all counterflow locations. Therefore, the CAISO proposes further tariff revisions to allow a market participant that acquires CRRs through the allocation or auction process to sell those CRRs back into a subsequent CRR auction.[43] This change will facilitate such sales in the auction. Given the need to restrict eligible source/sink combinations in the auction, the CAISO believes it is appropriate to introduce this sell feature.

IV. Responses to Stakeholder Comments

Stakeholders submitted multiple rounds of comments in the CRR auction efficiency initiative. Most stakeholder comments to date address potential broader, longer-term design changes that are beyond the scope of this targeted proceeding. In this proceeding, the Commission should only consider whether the targeted near-term CRR auction enhancements proposed by the CAISO are just and reasonable. Once the Commission has made that finding, there is no need to consider alternative changes to the CAISO's CRR allocation or auction provisions. [44] Commission precedent also supports the approval of incremental improvements to market rules while allowing the CAISO to consider stakeholder input on more comprehensive market design changes.[45] Consistent with this

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[42] *See* http://www.caiso.com/Documents/Presentation-CongestionRevenueRightsAuctionEfficiency-HarveyApr5_2018.pdf.

[43] Revised tariff section 36.13.4.

[44] "Pursuant to section 205 of the [Federal Power Act], the Commission limits its evaluation of a utility's proposed tariff revisions to an inquiry into 'whether the rates proposed by a utility are reasonable – and not to extend to determining whether a proposed rate schedule is more or less reasonable to alternative rate designs.'" *Cal. Indep. Sys. Operator Corp.*, 141 FERC ¶ 61,135 at P 44 n.43 (2012), quoting *City of Bethany v. FERC*, 727 F.2d 1131, 1136 (D.C. 1984). Therefore, "[u]pon finding that CAISO's proposal is just and reasonable, [the Commission] need not consider the merits of alternative proposals." 141 FERC ¶ 61,135 at P 44; *see also PJM Interconnection, L.L.C.*, 162 FERC ¶ 61,139, at P 127 (2018). That is the case here.

[45] *See, e.g.*, *Cal. Indep. Sys. Operator Corp.*, 149 FERC ¶ 61,284 at PP 31-32 (2014) (accepting tariff revisions as "an improvement over the existing commitment cost recovery mechanism in CAISO's tariff" while also stating that the Commission "expect[s] CAISO to abide by its commitment to consider longer-term market design changes for commitment cost bids in conjunction with" a separate CAISO stakeholder initiative).

precedent, the Commission should allow the CAISO to consider proposals for more comprehensive changes to the CAISO's CRR release provisions as part of Track 1B and 2 of the ongoing CRR auction efficiency stakeholder initiative.

Several investor-owned utilities, municipal/state load serving entities, and the Department of Market Monitoring (DMM) generally believe the CRR auction could be replaced by bilateral agreements. Other stakeholders, including non-utility load serving entities, suppliers, marketers, and financial participants believe the CRR auctions serve an important purpose and should be retained. The Market Surveillance Committee supports retaining the CRR auctions with the Track 1A changes proposed by the CAISO:

> CRRs are viewed by many, including ourselves, as providing benefits to the operation and efficiency of wholesale markets. While it is extremely difficult to quantify the exact contribution that auctioned CRRs provide to the market, it does not have to be substantial to make a difference.[46]

DMM argues the current CRR auction is not a competitive market between willing buyers and sellers, and therefore the design forces load serving entities and their customers to backstop payments to holders of auctioned CRRs whether or not they are able, or wish, to participate in the auction. DMM proposes to eliminate the CRR auction and replace it with one of three potential alternatives: a decentralized market for locational price swaps, a voluntary centralized swap clearing pool, or a voluntary centralized swap clearing pool where the pool takes on market price risk. Southern California Edison proposes a variant on this approach whereby limits on additional transmission sold in the CRR auction would be set to a net value of zero so that CRR auction bids would only clear to the extent that bids from other parties create an equal but opposite counter-flow.

The Commission has found the CAISO's CRR auction procedures are just and reasonable, and they are well-established in the CAISO tariff.[47] The Commission has noted previously that "[u]nchanged tariff provisions are not

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[46] MSC Opinion at 23. The Market Surveillance Committee suggests that the Track 1A changes could be viewed as provisional or as an incremental step. The CAISO does not intend for these changes to be temporary. The CAISO does intend to analyze the impacts of the Track 1A enhancements on the efficiency of the CRR auctions as it moves forward with the Track 2 stakeholder process.

[47] *Cal. Indep. Sys. Operator Corp.*, 116 FERC ¶ 61,274 (2006) (September 2006 MRTU Order), *order on reh'g*, 119 FERC ¶ 61,076 (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.).

subject to revision as part of [a Federal Power Act] section 205 filing."[48] If any party wishes to remove or fundamentally alter the auction process itself, they would first need to file a complaint with the Commission under section 206 of the Federal Power Act and demonstrate that the existing provisions of the CAISO tariff have become unjust and unreasonable.[49] Although the CAISO acknowledges that certain features of the CRR auctions might benefit from targeted improvements to address inefficiencies, there is no evidence that the fundamental CRR auction design itself is unjust and unreasonable.

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.[50] 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."[51] The CAISO believes that the current market design, which releases CRRs through a combination of allocation and auction procedures, ensures that all market participants, and in particular all load serving entities have an opportunity to obtain hedges for congestion cost risks associated with supply delivery transactions and therefore allows the CAISO to provide open access to its customers. Although in Track 1B the CAISO will consider Southern California Edison's proposal that effectively eliminates the CRR auction, the CAISO must consider whether such proposal is consistent with open access principles absent corresponding changes to the CAISO allocation processes.

The Market Surveillance Committee opines that proposals to replace the current CRR auction structure with a voluntary trading platform could be inconsistent with the Commission's open access principles:

> In particular, [this proposal] would be counter to the open access principles that motivated the creation of congestion revenue rights as a hedge in the first place; replacement hedges would likely be available only at a much higher prices for market participants who do not participate in the free allocation stage of CRR allocation; and caution should be the rule when considering market changes that

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48 *Pepco Holdings, Inc.*, 125 FERC ¶ 61,130 at P 113 (2008).

49 16 U.S.C. § 824e.

50 *Cent. Hudson Gas & Elec. Corp.*, 86 FERC ¶ 61,062, at 61,208 n.13 (1999) (finding that transmission congestion contracts or "TCCs," the equivalent of CRRs, "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.").

51 *Long-Term Firm Transmission Rights in Organized Electricity Markets*, Order No. 681, FERC Stats. & Regs. ¶ 31,226, at P 391 (2006).

> would profoundly affect the availability and cost of transmission hedging services.[52]

As the Market Surveillance Committee notes, proposals to replace the current CRR auction structure with a voluntary trading platform are not favored by some smaller load-serving entities or by load-serving entities serving direct access customers because it would limit flexibility in hedging congestion risks and would prevent market participants from obtaining CRRs that sink at trading hubs, which is where many non-utility load serving entities transact.[53] The CAISO shares the concern that such dramatic changes to the CRR design could adversely affect some market participants.

The rationale underlying these proposals also may be inconsistent with Commission precedent. The Commission has rejected arguments that financial transmission rights such as CRRs should be designed to return all congestion revenues to load. In a recent order addressing financial transmission right cost-shifting issues in PJM, the Commission 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.[54]

For all of these reasons, the CAISO believes that the Commission should reject calls to eliminate the CRR auctions in this proceeding. Although the CAISO does have a number of concerns described above, the CAISO intends to consider and obtain stakeholder input on the DMM and Southern California Edison proposals as part of Track 1B and 2 of the CRR initiative.

Some commenters argue that the proposed new annual outage-reporting requirement could increase transmission maintenance costs ultimately paid by ratepayers because transmission owners could potentially delay critical work as

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[52] MSC Opinion at 22-23. The Market Surveillance Committee does suggest that such proposals could be considered if Track 1 and Track 2 changes are ineffectual at reducing CRR auction revenue shortfalls.

[53] MSC Opinion at 10.

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

to not violate the proposed July 1 reporting deadline, or they could schedule and take on unnecessary work. These concerns are misplaced.

The New York Independent System Operator (NYISO) requires two-year maintenance outage plans.[55] Transmission owners in NYISO comply with these requirements without imposing excessive costs on ratepayers. The Midcontinent Independent System Operator requires that transmission owners report their outages 12 months in advance.[56] The CAISO anticipates that transmission owners already develop long-term outage schedules for many critical facilities as part of their internal planning.[57] Such critical facilities are likely to be those that would affect the CRR model. To the extent there are additional administrative costs, the CAISO submits that such costs are justified by the reduced auction revenue shortfalls resulting from improved CRR modeling. Lastly, the new requirement would not prevent a transmission owner from revising its outage plan after July 1 or scheduling new maintenance outages that were not anticipated at the time the plan was submitted.

One stakeholder insisted that, instead of requiring new annual reporting of outages that could affect the CRR model by July 1, the CAISO should adjust its current processes and incorporate into the annual auction existing transmission outage data submitted by October 15. Although the CAISO requires submittal of an annual maintenance plan by October 15 each year, the submittal of certain information by July 1 will result in more accurate data in the CRR model for the annual allocation and auction process, significantly improving the efficiency of the annual CRR auction. With the four allocation tiers and the annual auction, the CAISO must start the process well before October 15 each year so that the annual process can be completed before starting the monthly process for the subsequent year in December. The CAISO releases the CRR model for the annual CRR allocation and auction in late July each year.

Some stakeholders contend that limiting CRR source and sink pairs and decreasing the available locations for node-pair bidding locations would negatively affect a participant's ability to hedge specific, localized congestion exposure. Although the proposal to narrow allowable bid locations would decrease the number of node-to-node combinations, the CAISO believes there will continue to be ample opportunities for participants to acquire CRRs to hedge

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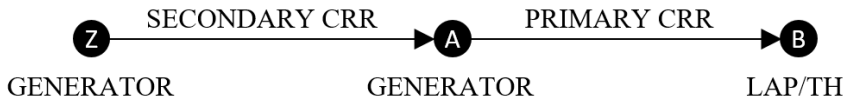
[55] *See* NYISO Manual 29: Outage Scheduling Manual, version 4.8, section 2.2.1, available at http://www.nyiso.com/public/webdocs/markets_operations/documents/Manuals_and_Guides/Manuals/Operations/outage_sched_mnl.pdf.

[56] MISO BPM-008: Outage Operations Business Practices Manual, version 13, section 5.1 and Exhibit 2-3, available at https://www.misoenergy.org/legal/business-practice-manuals/.

[57] The CAISO also notes that transmission owners have been on notice since at least February of this year of the proposed July 1 outage reporting requirement.

delivery of supply with the reduced set of sour to sink CRRs. The delivery CRR will allow market participants many opportunities to hedge congestion, which is the primary purpose of CRRs. Moreover, participants' current ability to purchase CRRs for node-pair bidding combinations that target a single constraint or a limited number of constraints, exposing the CRR to specific, localized congestion is the main cause of the CAISO's current auction revenue shortfall. As shown in Dr. Bautista Alderete's declaration, these CRRs face limited competition over a single or a limited number of constraints. As such, they are likely to be priced low in the auction.[58]

Some stakeholders suggest there could be a legitimate use for supply-to-supply congestion revenue rights to hedge the risk of a physical generator outage. For example, a supplier would first obtain a congestion revenue right from its primary generator location to load aggregation point or trading hub, then would seek to obtain a congestion revenue right from a secondary generator location to its primary generator location. Financially, the congestion revenue right from the secondary generator location to the primary generator location is equivalent to having a hedge from the secondary generator location to the load aggregation point or trading hub. If the market participant's primary generator suffered a forced outage, its secondary generator would still be hedged to the load aggregation point or trading hub through the two congestion revenue rights.



The CAISO evaluated congestion revenue rights purchases from 2014 through 2017 and estimates that the hedge described above accounts for only 0.97% of the total congestion revenue rights volume cleared in the auctions and 1.66% of all supply-to-supply volume. The CAISO determined all congestion revenue rights within each market participant's portfolio that sink at load aggregation points and trading hubs (primary congestion revenue rights). It then determined all supply-to-supply congestion revenue rights within each market participant's portfolio that sink at the sources of the primary congestion revenue rights (secondary congestion revenue rights). The volume of the generator outage hedge actually obtained in the auctions is the portion of the awarded secondary congestion revenue right that is no greater than the volume of the primary congestion revenue right. The CAISO summed the portions of the awarded secondary congestion revenue rights that were no greater than the volume of the primary congestion revenue rights in each month from 2014 through 2017.

[58] Bautista Alderete Declaration at 22.

The CAISO also determined that the congestion revenue rights described above accounted for only 0.36% of payments made to congestion revenue rights holders and 0.70% of supply-to-supply payments from 2014 through 2017.

This analysis indicates that a very small portion of supply-to-supply CRRs are likely to be used to hedge the risk of a physical generator outage in this manner. The CAISO understands that these opportunities will be eliminated under its proposal. However, given the significant cost of releasing these CRRs because they account for the bulk of the auction inefficiency, it is neither just nor reasonable to expect that the CAISO continue to release these CRRs without limitations. Furthermore, under the CAISO's proposed design, market participants that wish to obtain a hedge from secondary generators to supplement a supply delivery contract will still be able to purchase congestion revenue rights from the secondary generator to the load aggregation points or trading hub. The CAISO does not propose to impose any limitations on the supply to load type CRRs market participants can bid into the CRR auction.

Total 2014-2017	**Value**	**% of supply-to-supply CRRs**	**% of all CRRs (2014-2017)**
Secondary CRR supply-to-supply volume	230,146.05 MW	5.08%	2.98%
Secondary CRR supply-to-supply payments	$(8,462,077.63)	2.15%	1.09%
Secondary CRR supply-to-supply MW volume limited by primary hedge CRR volume (quantity as intended hedge)	75,194.02 MW	1.66%	0.97%
Secondary CRR supply-to-supply payments on volume limited by primary hedge CRR volume (value as intended hedge)	$ (2,749,750.50)	0.70%	0.36%
Total auctioned CRR MW volume (2014-2017)	7,721,518.04 MW		
Total auctioned CRR payments (2014-2017)	$(774,146,094.18)		
Total auctioned supply-to-supply volume (2014-2017)	4,531,553.69 MW		
Total auctioned supply-to-supply CRR payments (2014-2017)	$(393,918,138.01)		

Some commenters suggest that eliminating non-delivery pair CRRs will not minimize auction revenue shortfall and instead will lead to less efficient market outcomes and lower realized auction revenues. These comments are based on the flawed premise that the primary purpose of conducting the CRR auction is to maximize bid-based auction revenues. Provided that sufficient CRRs are available to provide a congestion hedge for supply delivery transactions, the objective of the proposed enhancements is to increase the

auction proceeds versus payout efficiency ratio so that market valuations are more consistent with anticipated hedging activity.[59]

In comparable circumstances, the Commission has approved limitations on bidding locations. PJM market rules permit a number of virtual transactions that can be used to arbitrage price differences between the day-ahead market and real-time market and hedge financial exposure to physical positions. These include Up-to-Congestion (UTC) transactions, which involve bids into PJM's day-ahead markets to purchase congestion and losses between two points. A UTC bid consists of a specified source and sink location and a "bid spread" that identifies how much the market participant is willing to pay for a congestion and loss position between the source and the sink. PJM recently proposed to limit the eligible points at which UTC bids can be submitted to improve the efficiency of virtual transactions in the PJM markets. Among other things, the Commission found that:

> PJM's proposal to limit the UTC bid locations to interfaces, zones, and hubs will minimize false arbitrage opportunities for UTCs . . . as the effect of modeling differences between the day-ahead and real-time markets are minimized at these aggregates.[60]

The Commission found that reducing UTC bidding points "may help to align day-ahead and real-time transmission constraint profiles."[61] PJM proposed not to allow UTC bids at Extra High Voltage (EHV) nodes, that are used by PJM to publish prices on the EHV system, but are not generation nodes or load buses. The Commission agreed with PJM that, "EHV nodes are for informational purposes only and no load, generation, or physical settlement occurs at them in the day-ahead or real time markets."[62] The Commission found that the proposal to limit UTC bid locations was just and reasonable even though it prevented some theoretical benefits that could be attained through UTC bidding at a wider range of locations:

> We acknowledge that the instant proposal may greatly reduce the opportunity to utilize UTCs in general, as well as the level of granularity at which UTCs can be utilized. We also acknowledge that the biddable points PJM proposes to delete may provide some value to the market . . . . We are not persuaded by protestors that forgoing some of the theoretical benefits associated with retaining

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59 *See* Draft Final Proposal Addendum at 13-15.

60 *PJM Interconnection, L.L.C.,* 162 FERC ¶ 61,139, at P 94.

61 *Id.* at P 95.

62 *Id.* at P 97.

> the bidding points for UTCs at zone, EHV, or aggregate nodes necessarily renders PJM's proposal unjust and unreasonable.[63]

Similarly, in the instant proceeding, any discussion of the theoretical benefits of retaining the ability to bid for "non-delivery pair" CRRs does not demonstrate that the CAISO's proposal is unjust and unreasonable, particularly in light of the evidence that limiting CRR source-sink pairs will reduce auction revenue shortfalls and align CRR auction prices more closely with expected day-ahead market revenues.

Some stakeholders suggest that, instead of the proposed limitations on CRR source-sink pairs, the CAISO should eliminate CRRs between electrically identical locations as some other independent system operators and regional transmission organizations have done. The Market Surveillance Committee notes that such a change would have little impact on the CRR auction efficiency issues identified to date.[64] Such CRRs accounted for less than 5% of the auction revenue shortfall in 2016 and less that 0.5% in 2017.

V. Effective Date

The CAISO respectfully requests that the Commission issue an order by June 11, 2018 (*i.e.*, 61 days after the date of this filing), accepting the tariff revisions in this filing effective July 1, 2018.

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.

The CAISO will apply the proposed tariff modifications starting in 2018 for CRRs that settle on day-ahead market congestion in 2019 and beyond. The CAISO requests the July 1 effective date, rather than January 1, 2019, because the first parts of the 2019 annual CRR process begin in July 2018. In fact, the CAISO and its market participants will complete the entire 2019 annual CRR process before 2019. Additionally, the monthly auction and allocation processes for the first months of 2019 also will be completed in 2018. An effective date of January 1, 2019, would not grant the CAISO authority to allocate and auction CRRs that settle in 2019 based on the proposed tariff modifications. For CRRs that settle based on congestion that occurs in the CAISO day-ahead market between July 1, 2018, and December 31, 2018, the CAISO will continue to administer the corresponding CRR processes under the existing tariff provisions. To account for this overlap, the CAISO has included in Appendix H to the CAISO

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63 *Id.* at P 99.

64 MSC Opinion at 21.

tariff the current versions of all tariff provisions proposed for modification in this filing. The modifications to Appendix H also have a proposed effective date of July 1, 2018. The provisions in Appendix H will "apply to the CAISO's treatment of CRRs that settle based on congestion that occurs in the Day-Ahead Market in 2018."[65]

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,[66] 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.

[65] Revised tariff Appendix H.

[66] 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	Declaration of Guillermo Bautista Alderete, Director, Market Analysis and Forecasting, including CRR Auction Analysis Report, dated November 21, 2017, as Appendix 1 to that Declaration
Attachment D	CRR Auction Efficiency Track 1A Draft Final Proposal Addendum, dated March 8, 2018
Attachment E	Memorandum of Keith Casey, Vice President, Market & Infrastructure Development, to Board of Governors on CRR Auction Efficiency Proposal, dated March 14, 2018
Attachment F	Summary of Submitted Stakeholder Comments on CRR Auction Efficiency, dated March 14, 2018
Attachment G	Memorandum of Eric Hildebrandt, Department of Market Monitoring, to Board of Governors on CRR Proposal, dated March 14, 2018
Attachment H	Opinion of the Market Surveillance Committee on CRR Auction Efficiency, dated March 15, 2018

IX. Conclusion

For the reasons set forth in this filing, the CAISO respectfully requests that the Commission issue an order by June 11, 2018, accept the tariff revisions contained in this filing effective July 1, 2018.

Respectfully submitted,

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Attachment A –

Clean Tariff Records

CRR Auction Efficiency Track 1A Tariff Amendments

California Independent System Operator Corporation

9.3.6 Maintenance Outage Planning

9.3.6.1 CRR Transmission Maintenance Outage Plan

By July 1 of each year, each Operator shall provide the CAISO with a CRR Transmission Maintenance Outages plan that includes the proposed schedule of any known CRR Transmission Maintenance Outages it plans to take in the following year. The plan shall pertain to the Operator's transmission facilities that comprise the CAISO Controlled Grid. The Participating TOs shall develop the plan in consultation with the UDCs interconnected with that Participating TO's system and the plan shall account for each UDC's planned maintenance requirements. The plan shall include the following information for each transmission facility:

(a) the identification of the facility and location;

(b) the nature of the proposed Maintenance Outage;

(c) the preferred start and finish date for each Maintenance Outage;

(d) where there is a possibility of flexibility, the earliest start date and the latest finish date, along with the actual duration of the Outage once it commences.

Either the CAISO, pursuant to Section 9.3.7, or an Operator, subject to Section 9.3.6.12, may at any time request a change to an Approved Maintenance Outage. An Operator may, as provided in Section 9.3.6.4, schedule with the CAISO a Maintenance Outage on its system, subject to the conditions of Sections 9.3.6.5.1, 9.3.6.9, and 9.3.6.10.

9.3.6.2 Proposed Schedule of Maintenance Outage

By October 15 of each year, each Operator or Scheduling Coordinator shall provide the CAISO with a proposed schedule of all known Maintenance Outages it wishes to undertake in the following year. The proposed schedule shall include all of the Operator's transmission facilities that comprise the CAISO Controlled Grid and Generating Units subject to a Participating Generator Agreement, Net Scheduled PGA, or Pseudo-Tie Participating Generator Agreement (including its Reliability Must-Run Units). In the case of a Participating TO's transmission facilities, that proposed schedule shall be developed in consultation with the UDCs interconnected with that Participating TO's system and shall take account of each UDC's planned maintenance requirements. The nature of the information to be provided and the detailed Maintenance Outage planning procedure shall be established by the CAISO. This information

shall include:

The following information is required for each Generating Unit of a Participating Generator:

(a) the Generating Unit name and Location Code;

(b) the MW capacity unavailable;

(c) the scheduled start and finish date for each Outage; and

(d) where there is a possibility of flexibility, the earliest start date and the latest finish date, along with the actual duration of the Outage once it commences.

The following information is required for each transmission facility:

(a) the identification of the facility and location;

(b) the nature of the proposed Maintenance Outage;

(c) the preferred start and finish date for each Maintenance Outage; and

(d) where there is a possibility of flexibility, the earliest start date and the latest finish date, along with the actual duration of the Outage once it commences.

Either the CAISO, pursuant to Section 9.3.7, or an Operator or Scheduling Coordinator, subject to Section 9.3.6.12, may at any time request a change to an Approved Maintenance Outage. An Operator or Scheduling Coordinator may, as provided in Section 9.3.6.4, schedule with the CAISO a Maintenance Outage on its system, subject to the conditions of Sections 9.3.6.5.1, 9.3.6.9, and 9.3.6.10.

9.3.6.3 Look Ahead Updates

Each Participating Generator and Participating TO shall notify the CAISO through the CAISO's outage management system of any known changes to a Generating Unit or System Unit Outage scheduled to occur within the number of days identified in the Business Practice Manuals as the "Look Ahead Period." A Participating Generator or Participating TO may submit changes to its planned Maintenance Outage schedule at any time. Participating Generators must obtain the approval of the CAISO in accordance with Section 9. Such approval may be withheld only for reasons of System Reliability or security.

9.3.6.4 Timeframe for Scheduling Generation and Transmission Outages

9.3.6.4.1 Resource Maintenance Outages

(a) The Scheduling Coordinator for a Participating Generator, Participating Intermittent Resource, Generating Unit, System Unit, Physical Scheduling Plant, Proxy Demand

Resource, Reliability Demand Response Resource, Non-Generation Resource, Participating Load, or other resource subject to the outage management requirements of Section 9, shall submit a request for a Maintenance Outage or a request to change an Approved Maintenance Outage to the CAISO no less than eight days prior to the start date for the Outage, subject to the provisions of Sections 9.3.6.5.1, 9.3.6.9, and 9.3.6.10. The CAISO timeline for submitting the required advance notice is calculated excluding the day the request is submitted and the day the Outage is scheduled to commence. Submission of a request for a Maintenance Outage or a request to change an Approved Maintenance Outage no less than eight days prior to the start of the Outage does not guarantee that the Reliability Coordinator will complete any separate Outage approval process it may conduct in time for the Outage to commence on the requested date. Additional detail on the relationship between the CAISO Outage approval timeline and the Reliability Coordinator approval timeline is available in the Business Practice Manuals.

(b) The requirement in Section 9.3.6.4.1(a) does not preclude submission of a request for a Forced Outage under Section 9.3.10.3 where immediate corrective action is needed because equipment has failed in service, is in danger of imminent failure, or is urgently needed to protect personnel.

(c) A request for a Maintenance Outage that is submitted seven days or less prior to the start date for the Outage shall be classified as a Forced Outage.

(d) A request to change an Approved Maintenance Outage that is submitted seven days or less prior to the start date for the Outage, if approved, will remain classified as a Maintenance Outage. If the request is not approved, the Scheduling Coordinator for the resource may submit a request for a new Forced Outage for the schedule change.

9.3.6.4.2 Transmission Maintenance Outages

An Operator shall submit a request for a Maintenance Outage or a request to change an Approved Maintenance Outage for transmission facilities on its system in advance of the start date for the Outage, as follows:

1. An Operator shall, upon thirty (30) days notice in advance of the first day of the month the Outage is proposed to be scheduled (or within the notice period in the Operating Procedures posted on the CAISO Website), schedule with the CAISO a CRR Transmission Maintenance Outage for transmission facilities on its system, subject to the conditions of Sections 9.3.6.5.1, 9.3.6.9, 9.3.6.10, and 36.4.3.
2. An Operator shall submit a request for a Planned Transmission Maintenance Outage or a request to change an Approved Maintenance Outage to the CAISO no less than eight days prior to the start date for the Outage, subject to the provisions of Sections 9.3.6.4.2, 9.3.6.5.1, 9.3.6.9, and 9.3.6.10. The CAISO timeline for submitting the required advance notice is calculated excluding the day the request is submitted and the day the Outage is scheduled to commence. Submission of a request for a Planned Transmission Maintenance Outage or a request to change an Approved Maintenance Outage no less than eight days prior to the start of the Outage does not guarantee that the Reliability Coordinator will complete any separate Outage approval process it may conduct in time for the Outage to commence on the requested date. Additional detail on the relationship between the CAISO Outage approval timeline and the Reliability Coordinator approval timeline is available in the Business Practice Manuals. This requirement does not preclude submission of a request for a forced outage under Section 9.3.10.3 where immediate corrective action is needed because equipment has failed in service, is in danger of imminent failure, or is urgently needed to protect personnel.
3. If an Operator submits a request for a Planned Transmission Maintenance Outage or a request to change an Approved Maintenance Outage seven days or less prior to the start date for the Outage, the CAISO may, at its discretion, reject the request as untimely, or approve the request as an Unplanned Transmission Maintenance Outage provided that the CAISO has adequate time to analyze the request before the Outage begins and the analysis determines that: (i) the Outage is necessary for reliability; (ii) system conditions and the overall Outage schedule provide an opportunity to take the facilities out of service without a detrimental effect on the efficient use and reliable operation of the CAISO

Controlled Grid and without disrupting efficient market operations; and (iii) the Outage has not already commenced as a Forced Outage. The CAISO will consider Unplanned Transmission Maintenance Outages in the order the requests are received.

9.3.6.5 Changes to Maintenance Outages

A Participating TO may submit changes to its Maintenance Outage information at any time, provided, however, that if the Participating TO cancels an Approved Maintenance Outage after 5:00 a.m. of the day prior to the day upon which the Outage is scheduled to commence and the CAISO determines that the change was not required to preserve System Reliability, the CAISO may disregard the availability of the affected facilities in determining the availability of transmission capacity in the Day-Ahead Market. The CAISO will, however, notify Market Participants and reflect the availability of transmission capacity in the Real-Time Market as promptly as practicable.

9.3.6.5.1 The CAISO shall evaluate whether the requested Maintenance Outage or change to an Approved Maintenance Outage is likely to have a detrimental effect on the efficient use and reliable operation of the CAISO Controlled Grid or the facilities of a Connected Entity. The CAISO may request additional information or seek clarification from Participating Generators or Participating TOs of the information submitted in relation to a planned Generating Unit and System Unit Outage or a transmission Maintenance Outage. This information may be used to assist the CAISO in prioritizing conflicting requests for Outages.

9.3.6.6 [NOT USED]

9.3.6.6.1 [NOT USED]

9.3.6.7 Withdrawal or Modification of Request

The Operator of a Participating Generator or a Participating TO's Operator may withdraw a request at any time prior to actual commencement of the Outage. The Operator of a Participating Generator or Participating TO's Operator may modify a request at any time prior to receipt of any acceptance or rejection notice from the CAISO or pursuant to Sections 9.3.8.1, and 9.3.8.2, but the CAISO shall have the right to reject such modified request for reasons of System Reliability, system security or market impact, because of the complexity of the modifications proposed, or due to insufficient time to assess the impact of such modifications.

9.3.6.8 Each Participating Generator or Participating TO that has scheduled a Maintenance Outage pursuant to Section 9.3.4 must schedule and receive approval of the Outage from the CAISO prior to initiating the Approved Maintenance Outage. The CAISO will review the Maintenance Outages to determine if any one or a combination of Maintenance Outage requests relating to CAISO Controlled Grid facilities, Generating Units or System Units may cause the CAISO to violate the Applicable Reliability Criteria. This review will take consideration of factors including, but not limited to, the following:

(a) forecast peak Demand conditions;

(b) other Maintenance Outages, previously Approved Maintenance Outages, and anticipated Generating Unit Outages;

(c) potential to cause Congestion;

(d) impacts on the transfer capability of Interconnections; and

(e) impacts on the market.

9.3.6.9 The CAISO shall acknowledge receipt of each request to confirm or approve a Maintenance Outage for a Generating Unit, System Unit, or Physical Scheduling Plant. Where the CAISO reasonably determines that the requested Maintenance Outage or the requested change to an Approved Maintenance Outage, when evaluated together with existing Approved Maintenance Outages, is not likely to have a detrimental effect on the efficient use and reliable operation of the CAISO Controlled Grid, the CAISO shall authorize the Maintenance Outage or change to the Approved Maintenance Outage, and shall so notify the requesting Operator and other entities who may be directly affected.

9.3.6.10 Where, in the reasonable opinion of the CAISO, the requested Maintenance Outage or requested change to an Approved Maintenance Outage is likely to have a detrimental effect on the efficient use and reliable operation of the CAISO Controlled Grid, the CAISO may reject the requested Maintenance Outage or requested change to Approved Maintenance Outage. If in the CAISO's determination, any of the Maintenance Outages would cause the CAISO to violate the Applicable Reliability Criteria, the CAISO will notify the relevant Operator, and the Operator will then revise the proposed Maintenance Outage and inform the CAISO of the proposed changes. The CAISO shall, in a rejection notice, identify the CAISO’s reliability, security and market concerns which prompt the rejection and suggest possible remedies or schedule revisions which might mitigate any such concerns. The

CAISO may provide each Operator in writing with any suggested amendments to those Maintenance Outage requests rejected by the CAISO. Any such suggested amendments will be considered as a CAISO maintenance request and will be approved in accordance with the process set forth in Section 9.3.7. The determination of the CAISO shall be final and binding on the Operator. If, within fourteen (14) days of having made its determination, the Operator requests the CAISO to provide reasons for its determination, it shall do so as soon as is reasonably practicable. The CAISO will give reasons for informational purposes only and without affecting in any way the finality or validity of the determination.

9.3.6.11 Failure to Meet Requirements

Any request to consider maintenance that does not meet the notification requirements contained in Section 9.3.8.2 will be rejected without further consideration, unless Section 9.3.10 applies.

9.3.6.12 Cancellation of Approved Maintenance Outage

In the event an Operator of facilities forming part of the CAISO Controlled Grid cancels an Approved Maintenance Outage after 5:00 a.m. of the day prior to the day upon which the Outage is scheduled to commence and the CAISO determines that the change was not required to preserve System Reliability, the CAISO may disregard the availability of the affected facilities in determining the availability of transmission capacity in the Day-Ahead Market, provided, however, that the CAISO will, as promptly as practicable, notify Market Participants and reflect the availability of the affected facilities in determining the availability of transmission capacity in the Real-Time Market.

* * * * *

9.3.8 CAISO Notice Required Re Maintenance Outages

* * * * *

9.3.8.1 Data Required

The Scheduling Coordinator for a Generating Unit owned or controlled by a Participating Generator shall submit to the CAISO, pursuant to Sections 9.3.4 and 9.3.5.2.1, its request to confirm the schedule of a planned Maintenance Outage or to change the schedule of a planned Maintenance Outage. Such

request must be made to the CAISO by no less than eight days prior to the starting date of the proposed Outage (or as specified on the CAISO Website). Likewise, all Operators or Scheduling Coordinators for transmission facilities shall submit a formal request to confirm or change an Approved Maintenance Outage with respect to any CAISO Controlled Grid facility to the CAISO in accordance with Sections 9.3.6.4.2 and 9.3.8.2. The timeline for submitting the required advance notice is calculated excluding the day the request is submitted and the day the Outage is scheduled to commence.

Such schedule confirmation request shall specify the following:

* * * * *

9.3.8.2 Eight-Day Prior Notification

Any request by a Participating Generator to confirm or change an Approved Maintenance Outage must be submitted no less than eight days prior to the starting date of the Approved Maintenance Outage (or as posted on the CAISO Website). The timeline for submitting the required advance notice is calculated excluding the day the request is submitted and the day the Outage is scheduled to commence. Any request by an Operator or Scheduling Coordinator of transmission facilities to confirm or change an Approved Maintenance Outage seven (7) days or less in advance of the start date for the Outage is subject to Section 9.3.6.4.2.

* * * * *

36.4 FNM for CRR Allocation and CRR Auction

The CAISO shall prepare the CRR FNM that it will use in the CRR Allocation and CRR Auction consistent with the following requirements:

36.4.1 Adjustments to the FNM in Preparing the CRR FNM

When the CAISO conducts its CRR Allocation and CRR Auction, the CAISO shall use the most up-to-date DC FNM, which is based on the AC FNM used in the Day-Ahead Market.

36.4.1.1 Seasonal Available CRR Capacity

The CAISO shall base the Seasonal Available CRR Capacity on the DC FNM, taking into consideration the following, all of which are discussed in the applicable Business Practice Manual:

(i) any long-term scheduled transmission Outages, including planned outages submitted pursuant to Section 9.3.6;

(ii) TTC adjusted for any long-term scheduled derates;

(iii) a downward adjustment due to TOR or ETC as determined by the CAISO; and

(iv) the impact on transmission elements used in the annual CRR Allocation and Auction of:

(a) transmission Outages or derates that are not scheduled at the time the CAISO conducts the Seasonal CRR Allocation or Auction determined through a methodology that calculates the breakeven point for revenue adequacy based on historical Outages and derates; and

(b) known system topology changes, both as further defined in the Business Practice Manuals.

36.4.1.2 Monthly Available CRR Capacity

The CAISO shall base the Monthly Available CRR Capacity on the DC FNM, taking into consideration:

(i) any scheduled transmission Outages known at least thirty (30) days in advance of the start of that month as submitted for approval consistent with the criteria specified in Section 36.4.3;

(ii) adjustments to compensate for the expected impact of Outages that are not required to be scheduled thirty (30) days in advance, including unplanned transmission Outages;

(iii) adjustments to restore Outages or derates that were applied for use in calculating Seasonal Available CRR Capacity but are not applicable for the current month;

(iv) any new transmission facilities added to the CAISO Controlled Grid that were not part of the DC FNM used to determine the prior Seasonal Available CRR Capacity and that have already been placed in-service and energized at the time the CAISO starts the applicable monthly process;

(v) TTC adjusted for any scheduled derates or Outages for that month;

(vi) a downward adjustment due to TOR or ETC as determined by the CAISO; and

(vii) adjustments for possible unscheduled flow at the Interties.

36.4.1.3 Transmission Capacity for CRR Allocation and CRR Auction

With the exception of the Tier LT, the CAISO makes available seventy-five percent (75%) of Seasonal Available CRR Capacity for the annual CRR Allocation and CRR Auction processes, and one hundred percent (100%) of Monthly Available CRR Capacity for the monthly CRR Allocation and CRR Auction processes. The CAISO makes available sixty percent (60%) of Seasonal Available CRR Capacity in the Tier LT. Available capacity at Scheduling Points shall be determined in accordance with Section 36.8.4.2 for the purposes of CRR Allocation and CRR Auction of CRRs that have a CRR Source identified at a Scheduling Point. Before commencing with the annual or monthly CRR Allocation and CRR Auction processes, the CAISO may distribute Merchant Transmission CRRs and will model those as fixed injections and withdrawals on the DC FNM to be used in the allocation and auction. These fixed injections and withdrawals are not modified by the Simultaneous Feasibility Test. Similarly, before commencing the annual or monthly CRR Allocation and CRR Auction processes, the CAISO will model any previously allocated Long Term CRRs as fixed injections and withdrawals on the DC FNM to be used in the CRR Allocation and CRR Auction. These fixed injections and withdrawals are not modified by the Simultaneous Feasibility Test, which will ensure no degradation of previously allocated and outstanding Long Term CRRs due to the CRR Allocation and CRR Auction processes. Maintaining the feasibility of allocated Long Term CRRs over the length of their terms also is accomplished through the transmission planning process in Section 24.1.3.

36.4.2 Simultaneous Feasibility

The annual and monthly CRR Allocation processes release CRRs to fulfill CRR nominations as fully as possible subject to a Simultaneous Feasibility Test. To the extent that nominations are not simultaneously feasible, the nominations are reduced in accordance with the CRR Allocation optimization formulation until simultaneous feasibility is achieved. The CRR Allocation optimization formulation, detailed in the Business Practice Manuals, utilizes a weighted least squares objective function that applies pro-rated reductions in flows on a binding constraint based on squares of the Power Transfer Distribution Factor of each CRR nomination for the binding constraint. In addition to the adjustments in Section 36.4.1.3, the Simultaneous Feasibility Test for each CRR Allocation considers:

(a) CRRs representing ETCs, Converted Rights and any TOR capacity that was not captured in the adjustments described in Section 36.4, which the CAISO deems necessary to prevent the Congestion Settlement of ETCs, Converted Rights, and TORs from causing revenue inadequacy of allocated and auctioned CRRs;

(b) In the case of the monthly CRR Allocation, the CRRs already released for that month in the annual CRR Allocation and Auction; and,

(c) The CRRs allocated in previous CRR Allocation tiers as described in Sections 36.8.3.1 through 36.8.3.6.

* * * * *

36.4.3 Outages that may Affect CRR Revenue; Scheduling Requirements

36.4.3.1 Submission Timelines

Pursuant to Section 9.3.6.4.2, an Operator shall all known submit CRR Transmission Maintenance Outages to the CAISO for approval no less than thirty (30) days in advance of the first day of the month in which the Operator proposes to begin the Outage. Pursuant to Section 9.3.7.1, Operators shall also provide their CRR Transmission Maintenance Outages plan by July 1 of each year, for Outages they plan to take in the following year.

36.4.3.2 CRR Transmission Maintenance Outage

CRR Transmission Maintenance Outages are those Outages that may have a significant effect upon CRR revenue adequacy, which are defined as outages that affect transmission facilities on the CAISO Controlled Grid that:

(a) are rated above 200 kV; or

(b) are part of any defined flow limit as described in a CAISO Operating Procedure; or

(c) were out of service in the last three (3) years and for which the CAISO determined a special flow limit was needed for real-time operation.

CRR Transmission Maintenance Outages consist only of outages that: (1) meet the criteria specified above; (2) involve system configuration changes that affect power flow in the CRR DC FNM; and (3)

initiated and completed within a twenty-four (24) hour period.

The following types of Outages need not be submitted for approval within this thirty-day time frame and will not be designated as Forced Outages if they otherwise comply with the requirements in Section 9.3.6: (1) Outages previously approved by CAISO that are moved within the same calendar month either by the CAISO or by request of the Participating TO; and (2) Outages associated with CAISO-approved allowable transmission maintenance activities during restricted maintenance operations as covered in CAISO Operating Procedures.

36.4.3.3 Operating Procedures

A list of the transmission facilities that satisfy criteria (b) and (c) in Section 36.4.3.2 is provided in the Operating Procedures. The CAISO will review the list annually in collaboration with the Participating TOs or will revise the list as appropriate; provided, however, that the CAISO will ultimately determine the lines that are included in the list.

* * * * *

36.8.4.2.2 Scheduling Points as CRR Sources for LSEs Beyond CRR Year One

In the annual CRR Allocation processes subsequent to CRR Year One, there will be no special provisions regarding CRR Sources at Scheduling Points in tiers 1 and 2 for LSEs. For tier 3 the CAISO will calculate and set aside for the annual CRR Auction fifty percent (50%) of the import capacity at each Scheduling Point that remains after the tier 1 and tier 2 CRR Allocations and after considering any previously allocated Long Term CRRs that are valid for that month as described in Section 36.4.1.3. In the monthly CRR Allocation processes subsequent to CRR Year One there will be no special provisions regarding CRR Sources at Scheduling Points in tier 1 for LSEs. For tier 2 the CAISO will calculate and set aside for the monthly CRR Auction fifty percent (50%) of the import capacity that remains at each Scheduling Point after accounting for the annual CRR Allocation and CRR Auction results for that month, any previously allocated Long Term CRRs that are valid for that month, and the results of tier 1 of the monthly CRR Allocation.

* * * * *

36.13 CRR Auction

The CAISO shall conduct CRR Auctions on an annual and monthly basis subsequent to each annual and monthly CRR Allocation process. Candidate CRR Holders may bid to purchase and may acquire CRR Obligations, and may sell CRRs, through the CAISO's annual and monthly CRR Auctions in accordance with the provisions of this Section 36.13. The CAISO shall settle CRR Auction results as provided in Section 11.2.4.3.

36.13.1 Scope of the CRR Auctions

The CAISO will conduct a CRR Auction corresponding to and subsequent to the completion of each CRR Allocation process, and prior to the start of the period to which the auctioned CRRs will apply. Each CRR Auction will release CRRs having the same seasons, months and time of use specifications as the CRRs released in the corresponding CRR Allocation. Each CRR Auction will utilize the same DC FNM that was utilized in the corresponding CRR Allocation. For each CRR Auction, the CRRs allocated in the corresponding CRR Allocation will be modeled as fixed injections and withdrawals on the DC FNM and will not be adjusted by the SFT in the CRR Auction process. Thus the CRR Auction will release only those CRRs that are feasible given the results of the corresponding CRR Allocation. CRRs released in a CRR Auction will be indistinguishable from CRRs released in the corresponding CRR Allocation for purposes of settlement and secondary trading. The following additional provisions apply. First, participants in the CRR Auctions will have more choices regarding CRR Sources and CRR Sinks than are eligible for nomination in the CRR Allocations, as described in Section 36.13.5. Second, to the extent a Market Participant receives CRRs in both a CRR Allocation and the corresponding CRR Auction, the CRRs obtained in the CRR Auction will not be eligible for nomination in the PNP. Third, in CRR Year One the CRR Auction cannot be used by CRR Holders to offer for sale CRRs they acquired in a prior CRR Allocation, CRR Auction or through the Secondary Registration System. In the annual and monthly CRR Auction processes for years following CRR Year One, CRR Holders may offer for sale any CRRs held by such holders, subject to the limitations on sale and transfer of Long Term CRRs specified in Section 36.7.1.2. Merchant Transmission CRRs that are CRR Options may be offered for sale in the annual and

monthly CRR Auctions for years following CRR Year One, subject to the same temporal limitations that apply to Long Term CRRs as specified in Section 36.7.1.2.

* * * * *

36.13.4 Bids in the CRR Auctions

Market Participants will submit Bids to purchase CRRs in accordance with the requirements set out in this Section 36.13.4 and as further specified in the applicable Business Practice Manuals. Once submitted to the CAISO, CRR bids may not be cancelled or rescinded by the Market Participant after the CRR Auction is closed. Market Participants may bid to buy Point-to-Point CRRs and bid to sell Point-to-Point CRRs that they previously acquired through CRR Allocation or CRR Auction processes. Each bid to buy or sell a Point-to-Point CRR shall specify:

(a) The associated month or season and time of use period;

(b) The associated CRR Source and CRR Sink;

(c) A monotonically non-increasing (in the case of a bid to buy) or non-decreasing (in the case of a bid to sell) piecewise linear bid curve in quantities (denominated in thousandths of a MW) and prices ($/MW).

Bid prices in all CRR bids may be negative.

36.13.5 Eligible Sources and Sinks for CRR Auction

Allowable CRR Sources for CRRs acquired in the CRR Auction will be generator PNodes/APNodes, Scheduling Points and Trading Hubs. Allowable CRR Sinks for CRRs acquired in the CRR Auction will be Scheduling Points, Trading Hubs, LAPs, MSS-LAPs and Sub-LAPs. Eligible Market Participants may only submit CRR bids that have the following CRR Source and Sink combinations: (1) from a generator PNode/APNode to either a LAP, MSS-LAP, Sub-LAP, Trading Hub, or Scheduling Point; or (2) from a Trading Hub to either a LAP, MSS-LAP, Sub-LAP, or Scheduling Point; or (3) from a Scheduling Point to either a LAP, MSS-LAP, Sub-LAP, or Trading Hub.

* * * * *

37.4.2.1 Expected Conduct

A Market Participant shall not undertake an Outage except as approved by the CAISO in accordance with Section 9.3.2, Section 9.3.9, and Section 9.3.6.7. A Market Participant shall not commence any Outage without obtaining final approval from the CAISO Control Center in accordance with Sections 9.3.9 and 9.3.10.

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Appendix H

CONGESTION REVENUE RIGHTS TRANSITION PERIOD

Notwithstanding any other provisions of the CAISO Tariff, the following provisions apply to the CAISO's treatment of CRRs that settle based on congestion that occurs in the Day-Ahead Market in 2018. In all other respects, provisions of the CAISO Tariff not covered by this Appendix H will apply to the CAISO's treatment of CRRs that settle based on congestion that occurs in the Day-Ahead Market in 2018.

9.3.6 Maintenance Outage Planning

Each Operator or Scheduling Coordinator shall, by not later than October 15 each year, provide the CAISO with a proposed schedule of all Maintenance Outages it wishes to undertake in the following year. The proposed schedule shall include all of the Operator's transmission facilities that comprise the CAISO Controlled Grid and Generating Units subject to a Participating Generator Agreement, Net Scheduled PGA, or Pseudo-Tie Participating Generator Agreement (including its Reliability Must-Run Units). In the case of a Participating TO's transmission facilities, that proposed schedule shall be developed in consultation with the UDCs interconnected with that Participating TO's system and shall take account of each UDC's planned maintenance requirements. The nature of the information to be provided and the detailed Maintenance Outage planning procedure shall be established by the CAISO. This information

shall include:

The following information is required for each Generating Unit of a Participating Generator:

(a) the Generating Unit name and Location Code;

(b) the MW capacity unavailable;

(c) the scheduled start and finish date for each Outage; and

(d) where there is a possibility of flexibility, the earliest start date and the latest finish date, along with the actual duration of the Outage once it commences.

The following information is required for each transmission facility:

(a) the identification of the facility and location;

(b) the nature of the proposed Maintenance Outage;

(c) the preferred start and finish date for each Maintenance Outage; and

(d) where there is a possibility of flexibility, the earliest start date and the latest finish date, along with the actual duration of the Outage once it commences.

Either the CAISO, pursuant to Section 9.3.7, or an Operator or Scheduling Coordinator, subject to Section 9.3.6.11, may at any time request a change to an Approved Maintenance Outage. An Operator or Scheduling Coordinator may, as provided in Section 9.3.6.3, schedule with the CAISO a Maintenance Outage on its system, subject to the conditions of Sections 9.3.6.4.1, 9.3.6.8, and 9.3.6.9.

* * * * *

36.4 FNM for CRR Allocation and CRR Auction

When the CAISO conducts its CRR Allocation and CRR Auction, the CAISO shall use the most up-to-date DC FNM, which is based on the AC FNM used in the Day-Ahead Market.

The Seasonal Available CRR Capacity shall be based on the DC FNM, taking into consideration the following, all of which are discussed in the applicable Business Practice Manual: (i) any long-term scheduled transmission Outages; (ii) TTC adjusted for any long-term scheduled derates; (iii) a downward adjustment due to TOR or ETC as determined by the CAISO; and (iv) the impact on transmission elements used in the annual CRR Allocation and Auction of

(a) transmission Outages or derates that are not scheduled at the time the CAISO conducts the Seasonal CRR Allocation or Auction determined through a methodology that calculates the breakeven point for revenue adequacy based on historical Outages and derates, and

(b) known system topology changes, both as further defined in the Business Practice Manuals.

The Monthly Available CRR Capacity shall be based on the DC FNM, taking into consideration: (i)any scheduled transmission Outages known at least thirty (30) days in advance of the start of that month as submitted for approval consistent with the criteria specified in Section 36.4.3; (ii) adjustments to compensate for the expected impact of Outages that are not required to be scheduled thirty (30) days in advance, including unplanned transmission Outages; (iii) adjustments to restore Outages or derates that were applied for use in calculating Seasonal Available CRR Capacity but are not applicable for the current month; (iv) any new transmission facilities added to the CAISO Controlled Grid that were not part of the DC FNM used to determine the prior Seasonal Available CRR Capacity and that have already been placed in-service and energized at the time the CAISO starts the applicable monthly process; (v) TTC adjusted for any scheduled derates or Outages for that month; (vi) a downward adjustment due to TOR or ETC as determined by the CAISO; and (vii) adjustments for possible unscheduled flow at the Interties. For the first monthly CRR Allocation and CRR Auction for CRR Year One, to account for any planned or unplanned Outages that may occur for the first month of CRR Year One, the CAISO will derate all flow limits, including Transmission Interface limits and normal thermal limits, based on statistical factors determined as provided in the Business Practice Manuals.

36.4.1 Transmission Capacity for CRR Allocation and CRR Auction

With the exception of the Tier LT, the CAISO makes available seventy-five percent (75%) of Seasonal Available CRR Capacity for the annual CRR Allocation and CRR Auction processes, and one hundred percent (100%) of Monthly Available CRR Capacity for the monthly CRR Allocation and CRR Auction processes. The CAISO makes available sixty percent (60%) of Seasonal Available CRR Capacity in the Tier LT. Available capacity at Scheduling Points shall be determined in accordance with Section 36.8.4.2 for the purposes of CRR Allocation and CRR Auction of CRRs that have a CRR Source identified at a

Scheduling Point. Before commencing with the annual or monthly CRR Allocation and CRR Auction processes, the CAISO may distribute Merchant Transmission CRRs and will model those as fixed injections and withdrawals on the DC FNM to be used in the allocation and auction. These fixed injections and withdrawals are not modified by the Simultaneous Feasibility Test. Similarly, before commencing the annual or monthly CRR Allocation and CRR Auction processes, the CAISO will model any previously allocated Long Term CRRs as fixed injections and withdrawals on the DC FNM to be used in the CRR Allocation and CRR Auction. These fixed injections and withdrawals are not modified by the Simultaneous Feasibility Test, which will ensure no degradation of previously allocated and outstanding Long Term CRRs due to the CRR Allocation and CRR Auction processes. Maintaining the feasibility of allocated Long Term CRRs over the length of their terms also is accomplished through the transmission planning process in Section 24.1.3.

* * * * *

36.4.3 Outages that may Affect CRR Revenue; Scheduling Requirements

As provided in Section 9.3.6.4.2, Outages that may have a significant effect upon CRR revenue adequacy must be submitted for approval no less than thirty (30) days in advance of the first day of the month in which the Outage is proposed to begin. Outages that may have a significant effect upon CRR revenue adequacy are defined in terms of the type of facility and the planned duration of the Outage. Outages of the types of transmission facilities described below that extend beyond a twenty-four (24) hour period must be submitted for CAISO approval consistent with this 30-day advance submittal requirement. The types of transmission facilities on the CAISO Controlled Grid to which this 30-day advance submittal and approval requirement applies consist of transmission facilities that:

(a) are rated above 200 kV; or

(b) are part of any defined flow limit as described in a CAISO Operating Procedure; or

(c) were out of service in the last three (3) years and for which the CAISO determined a special flow limit was needed for real-time operation.

A list of the transmission facilities that satisfy criteria (b) and (c) above is provided in the Operating

Procedures. The list will be initially created in collaboration with the respective Participating TOs and will be reviewed by the CAISO in collaboration with the Participating TOs on an annual basis and revised as appropriate; provided, however, that the CAISO will ultimately determine the lines that are included in the list. The list will be reviewed by the CAISO on an annual basis and revised as appropriate. The following types of Outages need not be submitted for approval within this thirty-day time frame and will not be designated as Forced Outages if they otherwise comply with the requirements in Section 9.3.6: (1) Outages previously approved by CAISO that are moved within the same calendar month either by the CAISO or by request of the Participating TO; and (2) Outages associated with CAISO-approved allowable transmission maintenance activities during restricted maintenance operations as covered in CAISO Operating Procedures.

* * * * *

36.8.4.2.2 Scheduling Points as CRR Sources for LSEs Beyond CRR Year One

In the annual CRR Allocation processes subsequent to CRR Year One, there will be no special provisions regarding CRR Sources at Scheduling Points in tiers 1 and 2 for LSEs. For tier 3 the CAISO will calculate and set aside for the annual CRR Auction fifty percent (50%) of the import capacity at each Scheduling Point that remains after the tier 1 and tier 2 CRR Allocations and after considering any previously allocated Long Term CRRs that are valid for that month as described in Section 36.4.1. In the monthly CRR Allocation processes subsequent to CRR Year One there will be no special provisions regarding CRR Sources at Scheduling Points in tier 1 for LSEs. For tier 2 the CAISO will calculate and set aside for the monthly CRR Auction fifty percent (50%) of the import capacity that remains at each Scheduling Point after accounting for the annual CRR Allocation and CRR Auction results for that month, any previously allocated Long Term CRRs that are valid for that month, and the results of tier 1 of the monthly CRR Allocation.

* * * * *

36.13 CRR Auction

The CAISO shall conduct CRR Auctions on an annual and monthly basis subsequent to each annual and monthly CRR Allocation process. Candidate CRR Holders may bid to purchase and may acquire CRR Obligations, and may sell CRRs, through the CAISO's annual and monthly CRR Auctions in accordance with the provisions of this Section 36.13. CRR Auction results shall be settled as provided in Section 11.2.4.3.

36.13.1 Scope of the CRR Auctions

The CAISO will conduct a CRR Auction corresponding to and subsequent to the completion of each CRR Allocation process, and prior to the start of the period to which the auctioned CRRs will apply. Each CRR Auction will release CRRs having the same seasons, months and time of use specifications as the CRRs released in the corresponding CRR Allocation. Each CRR Auction will utilize the same DC FNM that was utilized in the corresponding CRR Allocation. For each CRR Auction, the CRRs allocated in the corresponding CRR Allocation will be modeled as fixed injections and withdrawals on the DC FNM and will not be adjusted by the SFT in the CRR Auction process. Thus the CRR Auction will release only those CRRs that are feasible given the results of the corresponding CRR Allocation. CRRs released in a CRR Auction will be indistinguishable from CRRs released in the corresponding CRR Allocation for purposes of settlement and secondary trading. The following additional provisions apply. First, participants in the CRR Auctions will have more choices regarding CRR Sources and CRR Sinks than are eligible for nomination in the CRR Allocations, as described in Section 36.13.5. Second, to the extent a Market Participant receives CRRs in both a CRR Allocation and the corresponding CRR Auction, the CRRs obtained in the CRR Auction will not be eligible for nomination in the PNP. Third, in CRR Year One the CRR Auction cannot be used by CRR Holders to offer for sale CRRs they acquired in a prior CRR Allocation, CRR Auction or through the Secondary Registration System. In the annual and monthly CRR Auction processes for years following CRR Year One, CRR Holders may offer for sale any CRRs held by such holders, subject to the limitations on sale and transfer of Long Term CRRs specified in Section 36.7.1.2. Merchant Transmission CRRs that are CRR Options may be offered for sale in the annual and monthly CRR Auctions for years following CRR Year One, subject to the same temporal limitations that apply to Long Term CRRs as specified in Section 36.7.1.2. As further described in Section 36.13.4, sales

of CRRs in the CRR Auctions are accomplished through the submission of a CRR bid to procure a counterflow CRR of the CRR to be liquidated.

* * * * *

36.13.4 Bids in the CRR Auctions

Bids to purchase CRRs shall be submitted in accordance with the requirements set out in this Section 36.13.4 and as further specified in the applicable Business Practice Manuals. Once submitted to the CAISO, CRR bids may not be cancelled or rescinded by the Market Participant after the CRR Auction is closed. Market Participants may bid for Point-to-Point CRRs. Each bid for a Point-to-Point CRR shall specify:

(a) The associated month or season and time of use period;

(b) The associated CRR Source and CRR Sink;

(c) A monotonically non-increasing piecewise linear bid curve in quantities (denominated in thousandths of a MW) and prices ($/MW).

Bid prices in all CRR bids may be negative. Sales of CRRs in the CRR Auctions are accomplished through the submission of a CRR bid to procure a counterflow CRR of the CRR to be liquidated. If such bids for sale of CRRs are cleared through the CRR Auction, the entitlements rights of the CRR Holder that sold the CRR in this manner are effectively liquidated.

36.13.5 Eligible Sources and Sinks for CRR Auction

Allowable CRR Sources for CRRs acquired/sold in the CRR Auction will be PNodes, Scheduling Points, Trading Hubs, LAPs, MSS-LAPs and Sub-LAPs. Allowable CRR Sinks for CRRs acquired/sold in the CRR Auction will be PNodes, Scheduling Points, Trading Hubs, LAPs, MSS-LAPs and Sub-LAPs.

Attachment B –

Marked Tariff Records

CRR Auction Efficiency Track 1A Tariff Amendments

California Independent System Operator Corporation

9.3.6 Maintenance Outage Planning

9.3.6.1 CRR Transmission Maintenance Outage Plan

By July 1 of each year, each Operator shall provide the CAISO with a CRR Transmission Maintenance Outages plan that includes the proposed schedule of any known CRR Transmission Maintenance Outages it plans to take in the following year. The plan shall pertain to the Operator's transmission facilities that comprise the CAISO Controlled Grid. The Participating TOs shall develop the plan in consultation with the UDCs interconnected with that Participating TO's system and the plan shall account for each UDC's planned maintenance requirements. The plan shall include the following information for each transmission facility:

(a) the identification of the facility and location;

(b) the nature of the proposed Maintenance Outage;

(c) the preferred start and finish date for each Maintenance Outage;

(d) where there is a possibility of flexibility, the earliest start date and the latest finish date, along with the actual duration of the Outage once it commences.

Either the CAISO, pursuant to Section 9.3.7, or an Operator, subject to Section 9.3.6.12, may at any time request a change to an Approved Maintenance Outage. An Operator may, as provided in Section 9.3.6.4, schedule with the CAISO a Maintenance Outage on its system, subject to the conditions of Sections 9.3.6.5.1, 9.3.6.9, and 9.3.6.10.

9.3.6.2 Proposed Schedule of Maintenance Outage

By October 15 of each year, ~~E~~each Operator or Scheduling Coordinator shall~~, by not later than October 15 each year,~~ provide the CAISO with a proposed schedule of all known Maintenance Outages it wishes to undertake in the following year. The proposed schedule shall include all of the Operator's transmission facilities that comprise the CAISO Controlled Grid and Generating Units subject to a Participating Generator Agreement, Net Scheduled PGA, or Pseudo-Tie Participating Generator Agreement (including its Reliability Must-Run Units). In the case of a Participating TO's transmission facilities, that proposed schedule shall be developed in consultation with the UDCs interconnected with that Participating TO's system and shall take account of each UDC's planned maintenance requirements. The nature of the information to be provided and the detailed Maintenance Outage planning procedure shall be established

by the CAISO. This information shall include:

The following information is required for each Generating Unit of a Participating Generator:

(a) the Generating Unit name and Location Code;

(b) the MW capacity unavailable;

(c) the scheduled start and finish date for each Outage; and

(d) where there is a possibility of flexibility, the earliest start date and the latest finish date, along with the actual duration of the Outage once it commences.

The following information is required for each transmission facility:

(a) the identification of the facility and location;

(b) the nature of the proposed Maintenance Outage;

(c) the preferred start and finish date for each Maintenance Outage; and

(d) where there is a possibility of flexibility, the earliest start date and the latest finish date, along with the actual duration of the Outage once it commences.

Either the CAISO, pursuant to Section 9.3.7, or an Operator or Scheduling Coordinator, subject to Section 9.3.6.1~~2~~4, may at any time request a change to an Approved Maintenance Outage. An Operator or Scheduling Coordinator may, as provided in Section 9.3.6.4~~3~~, schedule with the CAISO a Maintenance Outage on its system, subject to the conditions of Sections 9.3.6.5~~4~~.1, 9.3.6.9~~8~~, and 9.3.6.10~~9~~.

~~**9.3.6.1 [Not Used]**~~

~~**9.3.6.1.1** [Not Used]~~

~~**9.3.6.1.2** [Not Used]~~

9.3.6.3~~2~~ Look Ahead Updates

Each Participating Generator and Participating TO shall notify the CAISO through the CAISO's outage management system of any known changes to a Generating Unit or System Unit Outage scheduled to occur within the number of days identified in the Business Practice Manuals as the "Look Ahead Period." A Participating Generator or Participating TO may submit changes to its planned Maintenance Outage schedule at any time. Participating Generators must obtain the approval of the CAISO in accordance with Section 9. Such approval may be withheld only for reasons of System Reliability or security.

9.3.6.43 Timeframe for Scheduling Generation and Transmission Outages

9.3.6.43.1 Resource Maintenance Outages

(a) The Scheduling Coordinator for a Participating Generator, Participating Intermittent Resource, Generating Unit, System Unit, Physical Scheduling Plant, Proxy Demand Resource, Reliability Demand Response Resource, Non-Generation Resource, Participating Load, or other resource subject to the outage management requirements of Section 9, shall submit a request for a Maintenance Outage or a request to change an Approved Maintenance Outage to the CAISO no less than eight days prior to the start date for the Outage, subject to the provisions of Sections 9.3.6.54.1, 9.3.6.98, and 9.3.6.109. The CAISO timeline for submitting the required advance notice is calculated excluding the day the request is submitted and the day the Outage is scheduled to commence. Submission of a request for a Maintenance Outage or a request to change an Approved Maintenance Outage no less than eight days prior to the start of the Outage does not guarantee that the Reliability Coordinator will complete any separate Outage approval process it may conduct in time for the Outage to commence on the requested date. Additional detail on the relationship between the CAISO Outage approval timeline and the Reliability Coordinator approval timeline is available in the Business Practice Manuals.

(b) The requirement in Section 9.3.6.43.1(a) does not preclude submission of a request for a Forced Outage under Section 9.3.10.3 where immediate corrective action is needed because equipment has failed in service, is in danger of imminent failure, or is urgently needed to protect personnel.

(c) A request for a Maintenance Outage that is submitted seven days or less prior to the start date for the Outage shall be classified as a Forced Outage.

(d) A request to change an Approved Maintenance Outage that is submitted seven days or less prior to the start date for the Outage, if approved, will remain classified as a Maintenance Outage. If the request is not approved, the Scheduling Coordinator for the resource may submit a request for a new Forced Outage for the schedule change.

9.3.6.43.2 Transmission Maintenance Outages

An Operator ~~or Scheduling Coordinator~~ shall submit a request for a Maintenance Outage or a request to change an Approved Maintenance Outage for transmission facilities on its system in advance of the start date for the Outage, as follows:

1. An Operator ~~or Scheduling Coordinator~~ shall~~may~~, upon thirty (30) days notice in advance of the first day of the month the Outage is proposed to be scheduled (or within the notice period in the Operating Procedures posted on the CAISO Website), schedule with the CAISO a CRR Transmission Maintenance Outage for transmission facilities on its system, subject to the conditions of Sections 9.3.6.54.1, 9.3.6.98, 9.3.6.109, and 36.4.3.
2. An Operator ~~or Scheduling Coordinator~~ shall submit a request for a Planned Transmission Maintenance Outage or a request to change an Approved Maintenance Outage to the CAISO no less than eight days prior to the start date for the Outage, subject to the provisions of Sections 9.3.6.43.2, 9.3.6.54.1, 9.3.6.98, and 9.3.6.109. The CAISO timeline for submitting the required advance notice is calculated excluding the day the request is submitted and the day the Outage is scheduled to commence. Submission of a request for a Planned Transmission Maintenance Outage or a request to change an Approved Maintenance Outage no less than eight days prior to the start of the Outage does not guarantee that the Reliability Coordinator will complete any separate Outage approval process it may conduct in time for the Outage to commence on the requested date. Additional detail on the relationship between the CAISO Outage approval timeline and the Reliability Coordinator approval timeline is available in the Business Practice Manuals. This requirement does not preclude submission of a request for a forced outage under Section 9.3.10.3 where immediate corrective action is needed because equipment has failed in service, is in danger of imminent failure, or is urgently needed to protect personnel.
3. If an Operator ~~or Scheduling Coordinator~~ submits a request for a Planned Transmission Maintenance Outage or a request to change an Approved Maintenance Outage seven days or less prior to the start date for the Outage, the CAISO may, at its discretion, reject

the request as untimely, or approve the request as an Unplanned Transmission Maintenance Outage provided that the CAISO has adequate time to analyze the request before the Outage begins and the analysis determines that: (i) the Outage is necessary for reliability; (ii) system conditions and the overall Outage schedule provide an opportunity to take the facilities out of service without a detrimental effect on the efficient use and reliable operation of the CAISO Controlled Grid and without disrupting efficient market operations; and (iii) the Outage has not already commenced as a Forced Outage. The CAISO will consider Unplanned Transmission Maintenance Outages in the order the requests are received.

9.3.6.54 Changes to Maintenance Outages

A Participating TO may submit changes to its Maintenance Outage information at any time, provided, however, that if the Participating TO cancels an Approved Maintenance Outage after 5:00 a.m. of the day prior to the day upon which the Outage is scheduled to commence and the CAISO determines that the change was not required to preserve System Reliability, the CAISO may disregard the availability of the affected facilities in determining the availability of transmission capacity in the Day-Ahead Market. The CAISO will, however, notify Market Participants and reflect the availability of transmission capacity in the Real-Time Market as promptly as practicable.

9.3.6.54.1 The CAISO shall evaluate whether the requested Maintenance Outage or change to an Approved Maintenance Outage is likely to have a detrimental effect on the efficient use and reliable operation of the CAISO Controlled Grid or the facilities of a Connected Entity. The CAISO may request additional information or seek clarification from Participating Generators or Participating TOs of the information submitted in relation to a planned Generating Unit and System Unit Outage or a transmission Maintenance Outage. This information may be used to assist the CAISO in prioritizing conflicting requests for Outages.

9.3.6.65 [NOT USED]~~CAISO Analysis of Generating Unit Outage Plans~~

9.3.6.65.1 [NOT USED]

9.3.6.76 Withdrawal or Modification of Request

The Operator of a Participating Generator or a Participating TO's Operator may withdraw a request at any

time prior to actual commencement of the Outage. The Operator of a Participating Generator or Participating TO's Operator may modify a request at any time prior to receipt of any acceptance or rejection notice from the CAISO or pursuant to Sections 9.3.8.1, and 9.3.8.2, ~~and 9.3.8.3,~~ but the CAISO shall have the right to reject such modified request for reasons of System Reliability, system security or market impact, because of the complexity of the modifications proposed, or due to insufficient time to assess the impact of such modifications.

9.3.6.8 ~~7~~ Each Participating Generator or Participating TO that has scheduled a Maintenance Outage pursuant to Section 9.3.4 must schedule and receive approval of the Outage from the CAISO prior to initiating the Approved Maintenance Outage. The CAISO will review the Maintenance Outages to determine if any one or a combination of Maintenance Outage requests relating to CAISO Controlled Grid facilities, Generating Units or System Units may cause the CAISO to violate the Applicable Reliability Criteria. This review will take consideration of factors including, but not limited to, the following:

(a) forecast peak Demand conditions;

(b) other Maintenance Outages, previously Approved Maintenance Outages, and anticipated Generating Unit Outages;

(c) potential to cause Congestion;

(d) impacts on the transfer capability of Interconnections; and

(e) impacts on the market.

9.3.6.9 ~~8~~ The CAISO shall acknowledge receipt of each request to confirm or approve a Maintenance Outage for a Generating Unit, System Unit, or Physical Scheduling Plant. Where the CAISO reasonably determines that the requested Maintenance Outage or the requested change to an Approved Maintenance Outage, when evaluated together with existing Approved Maintenance Outages, is not likely to have a detrimental effect on the efficient use and reliable operation of the CAISO Controlled Grid, the CAISO shall authorize the Maintenance Outage or change to the Approved Maintenance Outage, and shall so notify the requesting Operator and other entities who may be directly affected.

9.3.6.10 ~~9~~ Where, in the reasonable opinion of the CAISO, the requested Maintenance Outage or requested change to an Approved Maintenance Outage is likely to have a detrimental effect on the efficient use and reliable operation of the CAISO Controlled Grid, the CAISO may reject the requested

Maintenance Outage or requested change to Approved Maintenance Outage. If in the CAISO's determination, any of the Maintenance Outages would cause the CAISO to violate the Applicable Reliability Criteria, the CAISO will notify the relevant Operator, and the Operator will then revise the proposed Maintenance Outage and inform the CAISO of the proposed changes. The CAISO shall, in a rejection notice, identify the CAISO's reliability, security and market concerns which prompt the rejection and suggest possible remedies or schedule revisions which might mitigate any such concerns. The CAISO may provide each Operator in writing with any suggested amendments to those Maintenance Outage requests rejected by the CAISO. Any such suggested amendments will be considered as a CAISO maintenance request and will be approved in accordance with the process set forth in Section 9.3.7. The determination of the CAISO shall be final and binding on the Operator. If, within fourteen (14) days of having made its determination, the Operator requests the CAISO to provide reasons for its determination, it shall do so as soon as is reasonably practicable. The CAISO will give reasons for informational purposes only and without affecting in any way the finality or validity of the determination.

9.3.6.1~~0~~1 Failure to Meet Requirements

Any request to consider maintenance that does not meet the notification requirements contained in Section~~s~~ 9.3.8.2 ~~and 9.3.8.3~~ will be rejected without further consideration, unless Section 9.3.10 applies.

9.3.6.1~~1~~2 Cancellation of Approved Maintenance Outage

In the event an Operator of facilities forming part of the CAISO Controlled Grid cancels an Approved Maintenance Outage after 5:00 a.m. of the day prior to the day upon which the Outage is scheduled to commence and the CAISO determines that the change was not required to preserve System Reliability, the CAISO may disregard the availability of the affected facilities in determining the availability of transmission capacity in the Day-Ahead Market, provided, however, that the CAISO will, as promptly as practicable, notify Market Participants and reflect the availability of the affected facilities in determining the availability of transmission capacity in the Real-Time Market.

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9.3.8 CAISO Notice Required Re Maintenance Outages

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9.3.8.1 Data Required

The Scheduling Coordinator for a Generating Unit owned or controlled by a Participating Generator shall submit to the CAISO, pursuant to Sections 9.3.4 and 9.3.5.2.1, its request to confirm the schedule of a planned Maintenance Outage or to change the schedule of a planned Maintenance Outage. Such request must be made to the CAISO by no less than eight days prior to the starting date of the proposed Outage (or as specified on the CAISO Website). Likewise, all Operators or Scheduling Coordinators for transmission facilities shall submit a formal request to confirm or change an Approved Maintenance Outage with respect to any CAISO Controlled Grid facility to the CAISO in accordance with Sections 9.3.6.~~34~~.2 and~~,~~ 9.3.8.2~~, and 9.3.8.3~~. The timeline for submitting the required advance notice is calculated excluding the day the request is submitted and the day the Outage is scheduled to commence.
Such schedule confirmation request shall specify the following:

* * * * *

9.3.8.2 Eight-Day Prior Notification

Any request by a Participating Generator to confirm or change an Approved Maintenance Outage must be submitted no less than eight days prior to the starting date of the Approved Maintenance Outage (or as posted on the CAISO Website). The timeline for submitting the required advance notice is calculated excluding the day the request is submitted and the day the Outage is scheduled to commence. Any request by an Operator or Scheduling Coordinator of transmission facilities to confirm or change an Approved Maintenance Outage seven (7) days or less in advance of the start date for the Outage is subject to Section 9.3.6.~~3~~4.2.

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36.4 FNM for CRR Allocation and CRR Auction

The CAISO shall prepare the CRR FNM that it will use in the CRR Allocation and CRR Auction consistent with the following requirements:

36.4.1 Adjustments to the FNM in Preparing the CRR FNM

When the CAISO conducts its CRR Allocation and CRR Auction, the CAISO shall use the most up-to-date DC FNM, which is based on the AC FNM used in the Day-Ahead Market.

36.4.1.1 Seasonal Available CRR Capacity

The CAISO shall base ~~T~~the Seasonal Available CRR Capacity ~~shall be based~~ on the DC FNM, taking into consideration the following, all of which are discussed in the applicable Business Practice Manual:

(i) any long-term scheduled transmission Outages, including planned outages submitted pursuant to Section 9.3.6;

(ii) TTC adjusted for any long-term scheduled derates;~~,~~

(iii) a downward adjustment due to TOR or ETC as determined by the CAISO;~~,~~ and

(iv) the impact on transmission elements used in the annual CRR Allocation and Auction of:

(a) transmission Outages or derates that are not scheduled at the time the CAISO conducts the Seasonal CRR Allocation or Auction determined through a methodology that calculates the breakeven point for revenue adequacy based on historical Outages and derates;~~,~~ and

(b) known system topology changes, both as further defined in the Business Practice Manuals.

36.4.1.2 Monthly Available CRR Capacity

The CAISO shall base the Monthly Available CRR Capacity ~~shall be based~~ on the DC FNM, taking into consideration:

(i) any scheduled transmission Outages known at least thirty (30) days in advance of the start of that month as submitted for approval consistent with the criteria specified in Section 36.4.3;~~,~~

(ii) adjustments to compensate for the expected impact of Outages that are not required to be scheduled thirty (30) days in advance, including unplanned transmission Outages;~~,~~

(iii) adjustments to restore Outages or derates that were applied for use in calculating Seasonal Available CRR Capacity but are not applicable for the current month;~~,~~

(iv) any new transmission facilities added to the CAISO Controlled Grid that were not part of

the DC FNM used to determine the prior Seasonal Available CRR Capacity and that have already been placed in-service and energized at the time the CAISO starts the applicable monthly process;~~,~~

(v) TTC adjusted for any scheduled derates or Outages for that month;~~,~~

(vi) a downward adjustment due to TOR or ETC as determined by the CAISO; and

(vii) adjustments for possible unscheduled flow at the Interties.

~~For the first monthly CRR Allocation and CRR Auction for CRR Year One, to account for any planned or unplanned Outages that may occur for the first month of CRR Year One, the CAISO will derate all flow limits, including Transmission Interface limits and normal thermal limits, based on statistical factors determined as provided in the Business Practice Manuals.~~

36.4.1.3 Transmission Capacity for CRR Allocation and CRR Auction

With the exception of the Tier LT, the CAISO makes available seventy-five percent (75%) of Seasonal Available CRR Capacity for the annual CRR Allocation and CRR Auction processes, and one hundred percent (100%) of Monthly Available CRR Capacity for the monthly CRR Allocation and CRR Auction processes. The CAISO makes available sixty percent (60%) of Seasonal Available CRR Capacity in the Tier LT. Available capacity at Scheduling Points shall be determined in accordance with Section 36.8.4.2 for the purposes of CRR Allocation and CRR Auction of CRRs that have a CRR Source identified at a Scheduling Point. Before commencing with the annual or monthly CRR Allocation and CRR Auction processes, the CAISO may distribute Merchant Transmission CRRs and will model those as fixed injections and withdrawals on the DC FNM to be used in the allocation and auction. These fixed injections and withdrawals are not modified by the Simultaneous Feasibility Test. Similarly, before commencing the annual or monthly CRR Allocation and CRR Auction processes, the CAISO will model any previously allocated Long Term CRRs as fixed injections and withdrawals on the DC FNM to be used in the CRR Allocation and CRR Auction. These fixed injections and withdrawals are not modified by the Simultaneous Feasibility Test, which will ensure no degradation of previously allocated and outstanding Long Term CRRs due to the CRR Allocation and CRR Auction processes. Maintaining the feasibility of allocated Long Term CRRs over the length of their terms also is accomplished through the transmission planning process in Section 24.1.3.

36.4.2 Simultaneous Feasibility

The annual and monthly CRR Allocation processes release CRRs to fulfill CRR nominations as fully as possible subject to a Simultaneous Feasibility Test. To the extent that nominations are not simultaneously feasible, the nominations are reduced in accordance with the CRR Allocation optimization formulation until simultaneous feasibility is achieved. The CRR Allocation optimization formulation, detailed in the Business Practice Manuals, utilizes a weighted least squares objective function that applies pro-rated reductions in flows on a binding constraint based on squares of the Power Transfer Distribution Factor of each CRR nomination for the binding constraint. In addition to the adjustments in Section 36.4.1.3, the Simultaneous Feasibility Test for each CRR Allocation considers:

(a) CRRs representing ETCs, Converted Rights and any TOR capacity that was not captured in the adjustments described in Section 36.4, which the CAISO deems necessary to prevent the Congestion Settlement of ETCs, Converted Rights, and TORs from causing revenue inadequacy of allocated and auctioned CRRs;

(b) In the case of the monthly CRR Allocation, the CRRs already released for that month in the annual CRR Allocation and Auction; and,

(c) The CRRs allocated in previous CRR Allocation tiers as described in Sections 36.8.3.1 through 36.8.3.6.

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36.4.3 Outages that may Affect CRR Revenue; Scheduling Requirements

36.4.3.1 Submission Timelines

Pursuant to ~~As provided in~~ Section 9.3.6.~~3~~4.2, an Operator shall all known submit CRR Transmission Maintenance Outages to the CAISO ~~that may have a significant effect upon CRR revenue adequacy must be submitted~~ for approval no less than thirty (30) days in advance of the first day of the month in which the Operator proposes to begin the Outage ~~is proposed to begin~~. Pursuant to Section 9.3.7.1, Operators shall also provide their CRR Transmission Maintenance Outages plan by July 1 of each year, for Outages they plan to take in the following year.

36.4.3.2 CRR Transmission Maintenance Outage

CRR Transmission Maintenance Outages are those Outages that may have a significant effect upon CRR revenue adequacy, which are defined as ~~in terms of the type of facility and the planned duration of the Outage. Outages of the types of transmission facilities described below that extend beyond a twenty-four (24) hour period must be submitted for CAISO approval consistent with this 30-day advance submittal requirement. The types of~~ outages that affect transmission facilities on the CAISO Controlled Grid ~~to which this 30-day advance submittal and approval requirement applies consist of transmission facilities~~ that:

(a) are rated above 200 kV; or

(b) are part of any defined flow limit as described in a CAISO Operating Procedure; or

(c) were out of service in the last three (3) years and for which the CAISO determined a special flow limit was needed for real-time operation.

CRR Transmission Maintenance Outages consist only of outages that: (1) meet the criteria specified above; (2) involve system configuration changes that affect power flow in the CRR DC FNM; and (3) initiated and completed within a twenty-four (24) hour period.

~~A list of the transmission facilities that satisfy criteria (b) and (c) above is provided in the Operating Procedures. The list will be initially created in collaboration with the respective Participating TOs and will be reviewed by the CAISO in collaboration with the Participating TOs on an annual basis and revised as appropriate; provided, however, that the CAISO will ultimately determine the lines that are included in the list. The list will be reviewed by the CAISO on an annual basis and revised as appropriate.~~ The following types of Outages need not be submitted for approval within this thirty-day time frame and will not be designated as Forced Outages if they otherwise comply with the requirements in Section 9.3.6: (1) Outages previously approved by CAISO that are moved within the same calendar month either by the CAISO or by request of the Participating TO; and (2) Outages associated with CAISO-approved allowable transmission maintenance activities during restricted maintenance operations as covered in CAISO Operating Procedures.

36.4.3.3 Operating Procedures

A list of the transmission facilities that satisfy criteria (b) and (c) in Section 36.4.3.2 is provided in the Operating Procedures. The CAISO will review the list annually in collaboration with the Participating TOs or will revise the list as appropriate; provided, however, that the CAISO will ultimately determine the lines that are included in the list.

* * * * *

36.8.4.2.2 Scheduling Points as CRR Sources for LSEs Beyond CRR Year One

In the annual CRR Allocation processes subsequent to CRR Year One, there will be no special provisions regarding CRR Sources at Scheduling Points in tiers 1 and 2 for LSEs. For tier 3 the CAISO will calculate and set aside for the annual CRR Auction fifty percent (50%) of the import capacity at each Scheduling Point that remains after the tier 1 and tier 2 CRR Allocations and after considering any previously allocated Long Term CRRs that are valid for that month as described in Section 36.4.1.3. In the monthly CRR Allocation processes subsequent to CRR Year One there will be no special provisions regarding CRR Sources at Scheduling Points in tier 1 for LSEs. For tier 2 the CAISO will calculate and set aside for the monthly CRR Auction fifty percent (50%) of the import capacity that remains at each Scheduling Point after accounting for the annual CRR Allocation and CRR Auction results for that month, any previously allocated Long Term CRRs that are valid for that month, and the results of tier 1 of the monthly CRR Allocation.

* * * * *

36.13 CRR Auction

The CAISO shall conduct CRR Auctions on an annual and monthly basis subsequent to each annual and monthly CRR Allocation process. Candidate CRR Holders may bid to purchase and may acquire CRR Obligations, and may sell CRRs, through the CAISO's annual and monthly CRR Auctions in accordance with the provisions of this Section 36.13. The CAISO shall settle CRR Auction results ~~shall be settled~~ as

provided in Section 11.2.4.3.

36.13.1 Scope of the CRR Auctions

The CAISO will conduct a CRR Auction corresponding to and subsequent to the completion of each CRR Allocation process, and prior to the start of the period to which the auctioned CRRs will apply. Each CRR Auction will release CRRs having the same seasons, months and time of use specifications as the CRRs released in the corresponding CRR Allocation. Each CRR Auction will utilize the same DC FNM that was utilized in the corresponding CRR Allocation. For each CRR Auction, the CRRs allocated in the corresponding CRR Allocation will be modeled as fixed injections and withdrawals on the DC FNM and will not be adjusted by the SFT in the CRR Auction process. Thus the CRR Auction will release only those CRRs that are feasible given the results of the corresponding CRR Allocation. CRRs released in a CRR Auction will be indistinguishable from CRRs released in the corresponding CRR Allocation for purposes of settlement and secondary trading. The following additional provisions apply. First, participants in the CRR Auctions will have more choices regarding CRR Sources and CRR Sinks than are eligible for nomination in the CRR Allocations, as described in Section 36.13.5. Second, to the extent a Market Participant receives CRRs in both a CRR Allocation and the corresponding CRR Auction, the CRRs obtained in the CRR Auction will not be eligible for nomination in the PNP. Third, in CRR Year One the CRR Auction cannot be used by CRR Holders to offer for sale CRRs they acquired in a prior CRR Allocation, CRR Auction or through the Secondary Registration System. In the annual and monthly CRR Auction processes for years following CRR Year One, CRR Holders may offer for sale any CRRs held by such holders, subject to the limitations on sale and transfer of Long Term CRRs specified in Section 36.7.1.2. Merchant Transmission CRRs that are CRR Options may be offered for sale in the annual and monthly CRR Auctions for years following CRR Year One, subject to the same temporal limitations that apply to Long Term CRRs as specified in Section 36.7.1.2. ~~As further described in Section 36.13.4, sales of CRRs in the CRR Auctions are accomplished through the submission of a CRR bid to procure a counterflow CRR of the CRR to be liquidated.~~

* * * * *

36.13.4 Bids in the CRR Auctions

Market Participants will submit Bids to purchase CRRs ~~shall be submitted~~ in accordance with the requirements set out in this Section 36.13.4 and as further specified in the applicable Business Practice Manuals. Once submitted to the CAISO, CRR bids may not be cancelled or rescinded by the Market Participant after the CRR Auction is closed. Market Participants may bid to buy~~for~~ Point-to-Point CRRs and bid to sell Point-to-Point CRRs that they previously acquired through CRR Allocation or CRR Auction processes. Each bid to buy or sell ~~for~~ a Point-to-Point CRR shall specify:

(a) The associated month or season and time of use period;

(b) The associated CRR Source and CRR Sink;

(c) A monotonically non-increasing (in the case of a bid to buy) or non-decreasing (in the case of a bid to sell) piecewise linear bid curve in quantities (denominated in thousandths of a MW) and prices ($/MW).

Bid prices in all CRR bids may be negative. ~~Sales of CRRs in the CRR Auctions are accomplished through the submission of a CRR bid to procure a counterflow CRR of the CRR to be liquidated. If such bids for sale of CRRs are cleared through the CRR Auction, the entitlements rights of the CRR Holder that sold the CRR in this manner are effectively liquidated.~~

36.13.5 Eligible Sources and Sinks for CRR Auction

Allowable CRR Sources for CRRs acquired~~/sold~~ in the CRR Auction will be generator PNodes/APNodes, Scheduling Points~~,~~ and Trading Hubs~~, LAPs, MSS-LAPs and Sub-LAPs~~. Allowable CRR Sinks for CRRs acquired~~/sold~~ in the CRR Auction will be ~~PNodes,~~ Scheduling Points, Trading Hubs, LAPs, MSS-LAPs and Sub-LAPs. Eligible Market Participants may only submit CRR bids that have the following CRR Source and Sink combinations: (1) from a generator PNode/APNode to either a LAP, MSS-LAP, Sub-LAP, Trading Hub, or Scheduling Point; or (2) from a Trading Hub to either a LAP, MSS-LAP, Sub-LAP, or Scheduling Point; or (3) from a Scheduling Point to either a LAP, MSS-LAP, Sub-LAP, or Trading Hub.

* * * * *

37.4.2.1 Expected Conduct

A Market Participant shall not undertake an Outage except as approved by the CAISO in accordance with Section 9.3.2, Section 9.3.9, and Section 9.3.6.7~~6~~. A Market Participant shall not commence any Outage without obtaining final approval from the CAISO Control Center in accordance with Sections 9.3.9 and 9.3.10.

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Appendix H

CONGESTION REVENUE RIGHTS TRANSITION PERIOD

Notwithstanding any other provisions of the CAISO Tariff, the following provisions apply to the CAISO's treatment of CRRs that settle based on congestion that occurs in the Day-Ahead Market in 2018. In all other respects, provisions of the CAISO Tariff not covered by this Appendix H will apply to the CAISO's treatment of CRRs that settle based on congestion that occurs in the Day-Ahead Market in 2018.

9.3.6 Maintenance Outage Planning

Each Operator or Scheduling Coordinator shall, by not later than October 15 each year, provide the CAISO with a proposed schedule of all Maintenance Outages it wishes to undertake in the following year. The proposed schedule shall include all of the Operator's transmission facilities that comprise the CAISO Controlled Grid and Generating Units subject to a Participating Generator Agreement, Net Scheduled PGA, or Pseudo-Tie Participating Generator Agreement (including its Reliability Must-Run Units). In the case of a Participating TO's transmission facilities, that proposed schedule shall be developed in consultation with the UDCs interconnected with that Participating TO's system and shall take account of each UDC's planned maintenance requirements. The nature of the information to be provided and the detailed Maintenance Outage planning procedure shall be established by the CAISO. This information shall include:

The following information is required for each Generating Unit of a Participating Generator:

(a) the Generating Unit name and Location Code;

(b) the MW capacity unavailable;

(c) the scheduled start and finish date for each Outage; and

(d) where there is a possibility of flexibility, the earliest start date and the latest finish date, along with the actual duration of the Outage once it commences.

The following information is required for each transmission facility:

(a) the identification of the facility and location;

(b) the nature of the proposed Maintenance Outage;

(c) the preferred start and finish date for each Maintenance Outage; and

(d) where there is a possibility of flexibility, the earliest start date and the latest finish date, along with the actual duration of the Outage once it commences.

Either the CAISO, pursuant to Section 9.3.7, or an Operator or Scheduling Coordinator, subject to Section 9.3.6.11, may at any time request a change to an Approved Maintenance Outage. An Operator or Scheduling Coordinator may, as provided in Section 9.3.6.3, schedule with the CAISO a Maintenance Outage on its system, subject to the conditions of Sections 9.3.6.4.1, 9.3.6.8, and 9.3.6.9.

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36.4 FNM for CRR Allocation and CRR Auction

When the CAISO conducts its CRR Allocation and CRR Auction, the CAISO shall use the most up-to-date DC FNM, which is based on the AC FNM used in the Day-Ahead Market.

The Seasonal Available CRR Capacity shall be based on the DC FNM, taking into consideration the following, all of which are discussed in the applicable Business Practice Manual: (i) any long-term scheduled transmission Outages; (ii) TTC adjusted for any long-term scheduled derates; (iii) a downward adjustment due to TOR or ETC as determined by the CAISO; and (iv) the impact on transmission elements used in the annual CRR Allocation and Auction of

(a) transmission Outages or derates that are not scheduled at the time the CAISO conducts the Seasonal CRR Allocation or Auction determined through a methodology that

calculates the breakeven point for revenue adequacy based on historical Outages and derates, and

(b) known system topology changes, both as further defined in the Business Practice Manuals.

The Monthly Available CRR Capacity shall be based on the DC FNM, taking into consideration: (i)any scheduled transmission Outages known at least thirty (30) days in advance of the start of that month as submitted for approval consistent with the criteria specified in Section 36.4.3; (ii) adjustments to compensate for the expected impact of Outages that are not required to be scheduled thirty (30) days in advance, including unplanned transmission Outages; (iii) adjustments to restore Outages or derates that were applied for use in calculating Seasonal Available CRR Capacity but are not applicable for the current month; (iv) any new transmission facilities added to the CAISO Controlled Grid that were not part of the DC FNM used to determine the prior Seasonal Available CRR Capacity and that have already been placed in-service and energized at the time the CAISO starts the applicable monthly process; (v) TTC adjusted for any scheduled derates or Outages for that month; (vi) a downward adjustment due to TOR or ETC as determined by the CAISO; and (vii) adjustments for possible unscheduled flow at the Interties. For the first monthly CRR Allocation and CRR Auction for CRR Year One, to account for any planned or unplanned Outages that may occur for the first month of CRR Year One, the CAISO will derate all flow limits, including Transmission Interface limits and normal thermal limits, based on statistical factors determined as provided in the Business Practice Manuals.

36.4.1 Transmission Capacity for CRR Allocation and CRR Auction

With the exception of the Tier LT, the CAISO makes available seventy-five percent (75%) of Seasonal Available CRR Capacity for the annual CRR Allocation and CRR Auction processes, and one hundred percent (100%) of Monthly Available CRR Capacity for the monthly CRR Allocation and CRR Auction processes. The CAISO makes available sixty percent (60%) of Seasonal Available CRR Capacity in the Tier LT. Available capacity at Scheduling Points shall be determined in accordance with Section 36.8.4.2 for the purposes of CRR Allocation and CRR Auction of CRRs that have a CRR Source identified at a Scheduling Point. Before commencing with the annual or monthly CRR Allocation and CRR Auction processes, the CAISO may distribute Merchant Transmission CRRs and will model those as fixed

injections and withdrawals on the DC FNM to be used in the allocation and auction. These fixed injections and withdrawals are not modified by the Simultaneous Feasibility Test. Similarly, before commencing the annual or monthly CRR Allocation and CRR Auction processes, the CAISO will model any previously allocated Long Term CRRs as fixed injections and withdrawals on the DC FNM to be used in the CRR Allocation and CRR Auction. These fixed injections and withdrawals are not modified by the Simultaneous Feasibility Test, which will ensure no degradation of previously allocated and outstanding Long Term CRRs due to the CRR Allocation and CRR Auction processes. Maintaining the feasibility of allocated Long Term CRRs over the length of their terms also is accomplished through the transmission planning process in Section 24.1.3.

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36.4.3 Outages that may Affect CRR Revenue; Scheduling Requirements

As provided in Section 9.3.6.4.2, Outages that may have a significant effect upon CRR revenue adequacy must be submitted for approval no less than thirty (30) days in advance of the first day of the month in which the Outage is proposed to begin. Outages that may have a significant effect upon CRR revenue adequacy are defined in terms of the type of facility and the planned duration of the Outage. Outages of the types of transmission facilities described below that extend beyond a twenty-four (24) hour period must be submitted for CAISO approval consistent with this 30-day advance submittal requirement. The types of transmission facilities on the CAISO Controlled Grid to which this 30-day advance submittal and approval requirement applies consist of transmission facilities that:

(a) are rated above 200 kV; or

(b) are part of any defined flow limit as described in a CAISO Operating Procedure; or

(c) were out of service in the last three (3) years and for which the CAISO determined a special flow limit was needed for real-time operation.

A list of the transmission facilities that satisfy criteria (b) and (c) above is provided in the Operating Procedures. The list will be initially created in collaboration with the respective Participating TOs and will be reviewed by the CAISO in collaboration with the Participating TOs on an annual basis and revised as

appropriate; provided, however, that the CAISO will ultimately determine the lines that are included in the list. The list will be reviewed by the CAISO on an annual basis and revised as appropriate. The following types of Outages need not be submitted for approval within this thirty-day time frame and will not be designated as Forced Outages if they otherwise comply with the requirements in Section 9.3.6: (1) Outages previously approved by CAISO that are moved within the same calendar month either by the CAISO or by request of the Participating TO; and (2) Outages associated with CAISO-approved allowable transmission maintenance activities during restricted maintenance operations as covered in CAISO Operating Procedures.

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36.8.4.2.2 Scheduling Points as CRR Sources for LSEs Beyond CRR Year One

In the annual CRR Allocation processes subsequent to CRR Year One, there will be no special provisions regarding CRR Sources at Scheduling Points in tiers 1 and 2 for LSEs. For tier 3 the CAISO will calculate and set aside for the annual CRR Auction fifty percent (50%) of the import capacity at each Scheduling Point that remains after the tier 1 and tier 2 CRR Allocations and after considering any previously allocated Long Term CRRs that are valid for that month as described in Section 36.4.1. In the monthly CRR Allocation processes subsequent to CRR Year One there will be no special provisions regarding CRR Sources at Scheduling Points in tier 1 for LSEs. For tier 2 the CAISO will calculate and set aside for the monthly CRR Auction fifty percent (50%) of the import capacity that remains at each Scheduling Point after accounting for the annual CRR Allocation and CRR Auction results for that month, any previously allocated Long Term CRRs that are valid for that month, and the results of tier 1 of the monthly CRR Allocation.

* * * * *

36.13 CRR Auction

The CAISO shall conduct CRR Auctions on an annual and monthly basis subsequent to each annual and monthly CRR Allocation process. Candidate CRR Holders may bid to purchase and may acquire CRR

Obligations, and may sell CRRs, through the CAISO's annual and monthly CRR Auctions in accordance with the provisions of this Section 36.13. CRR Auction results shall be settled as provided in Section 11.2.4.3.

36.13.1 Scope of the CRR Auctions

The CAISO will conduct a CRR Auction corresponding to and subsequent to the completion of each CRR Allocation process, and prior to the start of the period to which the auctioned CRRs will apply. Each CRR Auction will release CRRs having the same seasons, months and time of use specifications as the CRRs released in the corresponding CRR Allocation. Each CRR Auction will utilize the same DC FNM that was utilized in the corresponding CRR Allocation. For each CRR Auction, the CRRs allocated in the corresponding CRR Allocation will be modeled as fixed injections and withdrawals on the DC FNM and will not be adjusted by the SFT in the CRR Auction process. Thus the CRR Auction will release only those CRRs that are feasible given the results of the corresponding CRR Allocation. CRRs released in a CRR Auction will be indistinguishable from CRRs released in the corresponding CRR Allocation for purposes of settlement and secondary trading. The following additional provisions apply. First, participants in the CRR Auctions will have more choices regarding CRR Sources and CRR Sinks than are eligible for nomination in the CRR Allocations, as described in Section 36.13.5. Second, to the extent a Market Participant receives CRRs in both a CRR Allocation and the corresponding CRR Auction, the CRRs obtained in the CRR Auction will not be eligible for nomination in the PNP. Third, in CRR Year One the CRR Auction cannot be used by CRR Holders to offer for sale CRRs they acquired in a prior CRR Allocation, CRR Auction or through the Secondary Registration System. In the annual and monthly CRR Auction processes for years following CRR Year One, CRR Holders may offer for sale any CRRs held by such holders, subject to the limitations on sale and transfer of Long Term CRRs specified in Section 36.7.1.2. Merchant Transmission CRRs that are CRR Options may be offered for sale in the annual and monthly CRR Auctions for years following CRR Year One, subject to the same temporal limitations that apply to Long Term CRRs as specified in Section 36.7.1.2. As further described in Section 36.13.4, sales of CRRs in the CRR Auctions are accomplished through the submission of a CRR bid to procure a counterflow CRR of the CRR to be liquidated.

* * * * *

36.13.4 Bids in the CRR Auctions

Bids to purchase CRRs shall be submitted in accordance with the requirements set out in this Section 36.13.4 and as further specified in the applicable Business Practice Manuals. Once submitted to the CAISO, CRR bids may not be cancelled or rescinded by the Market Participant after the CRR Auction is closed. Market Participants may bid for Point-to-Point CRRs. Each bid for a Point-to-Point CRR shall specify:

(a) The associated month or season and time of use period;

(b) The associated CRR Source and CRR Sink;

(c) A monotonically non-increasing piecewise linear bid curve in quantities (denominated in thousandths of a MW) and prices ($/MW).

Bid prices in all CRR bids may be negative. Sales of CRRs in the CRR Auctions are accomplished through the submission of a CRR bid to procure a counterflow CRR of the CRR to be liquidated. If such bids for sale of CRRs are cleared through the CRR Auction, the entitlements rights of the CRR Holder that sold the CRR in this manner are effectively liquidated.

36.13.5 Eligible Sources and Sinks for CRR Auction

Allowable CRR Sources for CRRs acquired/sold in the CRR Auction will be PNodes, Scheduling Points, Trading Hubs, LAPs, MSS-LAPs and Sub-LAPs. Allowable CRR Sinks for CRRs acquired/sold in the CRR Auction will be PNodes, Scheduling Points, Trading Hubs, LAPs, MSS-LAPs and Sub-LAPs.

~~**FOR TRADING DAYS PRIOR TO NOVEMBER 1, 2009**~~

~~**1. Grandfathering of Metering and Settlement Provisions for Trading Days Prior to November 1, 2009.**~~

~~Notwithstanding any other provisions of the CAISO Tariff the following provisions shall apply to transactions conducted prior to November 1, 2009. In all other respects, the CAISO Tariff, including the provisions of Section 10 and Section 11 not covered by this Appendix O, will apply to transactions that occurred prior to November 1, 2009.~~

~~**10.3.6 Timing of Meter Data Submission.**~~

Scheduling Coordinators shall submit either hourly time-stamped Settlement Quality Meter Data for Scheduling Coordinator Metered Entities or profiled cumulative Settlement Quality Meter Data to the CAISO for each Settlement Period in an Operating Day according to the timelines established in the CAISO Payments Calendar and as provided in the applicable Business Practice Manual. Scheduling Coordinators must also submit Settlement Quality Meter Data on demand as provided in the applicable Business Practice Manual.

11.1.4 Calculations of Settlements.

The CAISO shall calculate, account for and settle, based on the Settlement Quality Meter Data it has received, or, if Settlement Quality Meter Data is not available, based on the best available information or estimate it has received, the following charges in accordance with this CAISO Tariff.

11.29 Billing and Payment Process.

The CAISO will calculate for each charge the amounts payable by the relevant Scheduling Coordinator, CRR Holder, Black Start Generator or Participating TO for each Settlement Period of the Trading Day, and the amounts payable to that Scheduling Coordinator, CRR Holder, Black Start Generator or Participating TO for each charge for each Settlement Period of that Trading Day and shall arrive at a net amount payable for each charge by or to that Scheduling Coordinator, CRR Holder, Black Start Generator or Participating TO for each charge for that Trading Day. Each of these amounts will appear in the Initial Settlement Statement T+38BD, Initial Settlement Statement Reissue, Recalculation Settlement Statement and the Recalculation Settlement Statement T+76BD that the CAISO will provide to the relevant Scheduling Coordinator, CRR Holder, Black Start Generator or Participating TO. The components of the Grid Management Charge will be included in the Initial Settlement Statement T+38BD, Initial Settlement Statement Reissue, Recalculation Settlement Statement and the Recalculation Settlement Statement T+76BD with the other types of charges referred to in Section 11, but a separate Invoice for the Grid Management Charge, stating the rate, billing determinant volume, and total charge for each of its components, will be issued by the CAISO to the Scheduling Coordinator.

11.29.1 The billing and payment process shall be based on the issuance of Initial Settlement Statement T+38BD, Initial Settlement Statement Reissue, Recalculation Settlement Statement and the Recalculation Settlement Statement T+76BD for each Settlement Period in each Trading Day.

11.29.2 Payment for the charges referred to in Section 11.1.2 (except for the charges payable under long-term contracts) for each Trading Day in each calendar month shall be made five (5) Business Days after issuance of the Initial Settlement Statement T+38BD for the last day of the relevant calendar month. Payment for adjustments will be made five (5) Business Days after issuance of the Initial Settlement Statement Reissue or Recalculation Settlement Statement for the last day of the relevant month. Payments for FERC Annual Charges will be made in accordance with Section 11.19.

11.29.5 General Principles for Production of Settlement Statements.

11.29.5.1 Basis of Settlement.

The basis of each Settlement Statement shall be the debiting or crediting of an account in the name of the relevant Scheduling Coordinator, CRR Holder, Black Start Generator or Participating TO in the

general ledger set up by the CAISO to reflect all transactions, charges or payments settled by the CAISO.

11.29.5.2 Right to Dispute.

All Scheduling Coordinators, CRR Holders, Black Start Generators or Participating TOs shall have the right to dispute any item or calculation set forth in any Initial Settlement Statement in accordance with this CAISO Tariff.

11.29.7 Settlements Cycle.

11.29.7.1 Timing of the Settlements Process.

11.29.7.1.1 Initial Settlement Statement T+38BD.

The CAISO shall provide to each Scheduling Coordinator, CRR Holder, Black Start Generator or Participating TO for validation an Initial Settlement Statement for each Trading Day within thirty-eight (38) Business Days of the relevant Trading Day, covering all Settlement Periods in that Trading Day. Each Initial Settlement Statement will include a statement of:

(a) the amount payable or receivable by the Scheduling Coordinator, CRR Holder, Black Start Generator or Participating TO for each charge referred to in Section 11 for each Settlement Period in the relevant Trading Day;

(b) the total amount payable or receivable by that Scheduling Coordinator, CRR Holder, Black Start Generator or Participating TO for each charge for all Settlement Periods in that Trading Day after the amounts payable and the amounts receivable under (a) have been netted off pursuant to Section 11.29; and

(c) the components of each charge in each Settlement Period except for information contained in the Imbalance Energy report referred to in this Section 11.29.7.1.1.

Each Initial Settlement Statement shall also be accompanied by a breakdown of the components of the Imbalance Energy Charge (the Imbalance Energy report).

11.29.7.1.2 Each Scheduling Coordinator, CRR Holder, Black Start Generator or Participating TO shall have a period of eight (8) Business Days from the issuance of an Initial Settlement Statement during which it may review the Initial Settlement Statement T+38BD and notify the CAISO of any errors. No later than fifty-one (51) Business Days after the Trading Day to which it relates, the CAISO shall issue an Initial Settlement Statement Reissue or a Recalculation Settlement Statement to each Scheduling Coordinator or CRR Holder for that Trading Day.

11.29.7.1.3 Initial Settlement Statement Reissues and Recalculation Settlement Statements.

The CAISO shall provide to each Scheduling Coordinator, CRR Holder, Black Start Generator or Participating TO an Initial Settlement Statement Reissue or a Recalculation Settlement Statement in accordance with the CAISO Tariff and the CAISO Payments Calendar. The Initial Settlement Statement Reissue or Recalculation Settlement Statement shall be in a format similar to that of the Initial Settlement Statement and shall include the same granularity of information provided in

the Initial Settlement Statement as amended following the validation procedure.

11.29.7.1.4 Each Scheduling Coordinator, CRR Holder, Black Start Generator or Participating TO shall have a period of ten (10) Business Days from the issuance of the Initial Settlement Statement Reissue or Recalculation Settlement Statement during which it may review the Incremental Changes on the Initial Settlement Statement Reissue or Recalculation Settlement Statement and notify the CAISO of any errors. No later than twenty-five (25) Business Days from the date of issuance of the Initial Settlement Statement Reissue or Recalculation Settlement Statement, the CAISO shall issue the 76th Day Recalculation Settlement Statement and shall incorporate any required corrections in a subsequent Initial Settlement Statement.

11.29.7.2 Basis for Billing and Payment.

The Initial Settlement Statement T+38BD, Initial Settlement Statement Reissue, Recalculation Settlement Statement and the Recalculation Settlement Statement T+76BD shall constitute the basis for billing and associated automatic funds transfers in accordance with this CAISO Tariff. The Initial Settlement Statement T+38BD shall constitute the basis for billing and associated automatic funds transfers for all charges in the first instance. The Initial Settlement Statement Reissue and Recalculation Settlement Statement shall constitute the basis for billing and associated automatic funds transfers for adjustments to charges set forth in the Initial Settlement Statement T+38BD. Each Scheduling Coordinator, CRR Holder, Black Start Generator, and Participating TO shall pay any net debit and shall be entitled to receive any net credit shown in an Invoice or Payment Advice on the Payment Date, whether or not there is any dispute regarding the amount of the debit or credit.

11.29.7.2.1 Elimination of Invoices under $10.00.

Preliminary and final Invoices and Payment Advices due to or from any Market Participant for amounts less than $10.00 will be adjusted to $0.00 and no amount will be due to or from that Market Participant for that Invoice or Payment Advice.

11.29.7.3 Settlement Statement Re-runs and Post Final Adjustments.

The CAISO is authorized to perform Settlement Statement Re-runs following approval of the CAISO Governing Board. A request to perform a Settlement Statement Re-run may be made at any time by a Scheduling Coordinator, CRR Holder, Black Start Generator, or Participating TO by notice in writing to the CAISO Governing Board. The CAISO Governing Board shall, in considering whether to approve a request for a Settlement Statement Re-run, determine in its reasonable discretion whether there is good cause to justify the performance of a Settlement Statement Re-run.

11.29.7.3.1 If a Settlement Statement Re-run is ordered by the CAISO Governing Board, the CAISO shall arrange to have the Settlement Statement Re-run carried out as soon as is reasonably practicable following the CAISO Governing Board's order, subject to the availability of staff and computer time, compatible software, appropriate data and other resources.

11.29.7.3.2 The cost of a Settlement Statement Re-run shall be borne by the Scheduling Coordinator, CRR Holder, Black Start Generator, or Participating TO requesting it, unless the Settlement Statement Re-run was needed due to a clerical oversight or error on the part of the CAISO staff.

11.29.7.3.3 Where a Settlement Statement Re-run indicates that the accounts of Scheduling

Coordinators, CRR Holders, Black Start Generators, or Participating TOs should be debited or credited to reflect alterations to Settlements previously made under this CAISO Tariff, for those Scheduling Coordinators, CRR Holders, Black Start Generators, or Participating TOs affected by the statement rerun, the CAISO shall reflect the amounts to be debited or credited in the next subsequent Recalculation Settlement Statement that it issues following the Settlement Statement Re-run to which the provisions of this Section 11 apply.

11.29.7.3.4 Reruns, post closing adjustments and the financial outcomes of CAISO ADR Procedures and any other dispute resolution may be invoiced separately from monthly market activities. The CAISO shall provide a Market Notice at least thirty (30) days prior to such invoicing identifying the components of such Invoice or Payment Advice.

11.29.8 Confirmation and Validation.

11.29.8.1 Confirmation.

It is the responsibility of each Scheduling Coordinator, CRR Holder, Black Start Generator, or Participating TO to notify the CAISO if it fails to receive a Settlement Statement on the date specified for the publication of such Settlement Statement in the CAISO Payments Calendar. Each Scheduling Coordinator, CRR Holder, Black Start Generator, or Participating TO shall be deemed to have received its Settlement Statement on the dates specified, unless it notifies the CAISO to the contrary.

11.29.8.2 Validation.

Each Scheduling Coordinator, CRR Holder, Black Start Generator, or Participating TO shall have the opportunity to review the terms of the Initial Settlement Statement T+38BD that it receives. The Scheduling Coordinator, CRR Holder, Black Start Generator, or Participating TO shall be deemed to have validated each Initial Settlement Statement unless it has raised a dispute or reported an exception within eight (8) Business Days from the date of issuance. Once validated, an Initial Settlement Statement shall be binding on the Scheduling Coordinator, CRR Holder, Black Start Generator or Participating TO to which it relates, unless the CAISO performs a Settlement Statement Re-run pursuant to Section 11.29.7.3.

The notice of dispute, if any, shall state clearly the Trading Day, the issue date of the Initial Settlement Statement, the item disputed, the reasons for the dispute, the amount claimed (if appropriate) and shall be accompanied with all available evidence reasonably required to support the claim.

11.29.8.3 Validation of Initial Settlement Statement Reissue and Recalculation Settlement Statements.

Each Scheduling Coordinator, CRR Holder, Black Start Generator or Participating TO shall have the opportunity to review the Incremental Changes that appear on the Initial Settlement Statement Reissue and Recalculation Settlement Statement that it receives. The Scheduling Coordinator, CRR Holder, Black Start Generator or Participating TO shall be deemed to have validated the Incremental Changes on each Initial Settlement Statement Reissue and Recalculation Settlement Statement unless it has raised a dispute or reported an exception regarding those Incremental Changes within ten (10) Business Days from the date of issuance. Once validated, the Incremental Changes on the Initial Settlement Statement Reissue and Recalculation Settlement Statement shall be binding on the Scheduling Coordinator, CRR Holder, Black Start Generator or Participating TO to which it relates, unless the CAISO performs a Settlement Statement Re-run

pursuant to Section 11.29.7.3. The notice of dispute shall state clearly the Trading Day, the issue date of the Initial Settlement Statement Reissue and Recalculation Settlement Statement, the item disputed, the reasons for the dispute, the amount claimed (if appropriate) and shall be accompanied with all available evidence reasonably required to support the claim. The only Recalculation Settlement Statement that cannot be disputed is the one issued on T+60BD.

11.29.8.4 Recurring Disputes or Exceptions.

A Scheduling Coordinator, CRR Holder, Black Start Generator or Participating TO may request the CAISO to treat as recurring a dispute or exception raised in accordance with Sections 11.29.8.1 and 11.29.8.2 above, if a dispute or exception would apply to subsequent Initial and the Initial Settlement Statement Reissue and Recalculation Settlement Statements. A request for recurring treatment may be made for any valid reason provided that subsequent Initial Settlement Statements T+38BD, Initial Settlement Statement Reissue and Recalculation Settlement Statements would be affected, including but not limited to, that the disputed calculation will recur, or that a disagreement as to policy will affect calculations in subsequent Initial Settlement Statement T+38BD, the Initial Settlement Statement Reissue and Recalculation Settlement Statements. If a Scheduling Coordinator, CRR Holder, Black Start Generator or Participating TO wishes to request that the CAISO treat a dispute as recurring, it shall, in the notice, clearly indicate that it requests such treatment and set forth in detail the reasons that support such treatment. To the extent possible, the Scheduling Coordinator, CRR Holder, Black Start Generator or Participating TO shall state the types of charges and dates to which the dispute will apply, and provide estimates of the amounts that will likely be claimed on each date. The CAISO shall make a determination on such a request within five (5) Business Days of receipt. To preserve its right to dispute an item, a Scheduling Coordinator, CRR Holder, Black Start Generator or Participating TO must continue to raise a dispute or report an exception until it is notified by the CAISO that the CAISO agrees to treat the dispute or exception as recurring. If the CAISO grants a request to treat a dispute or exception as recurring, the dispute raised or exception reported by the Scheduling Coordinator, CRR Holder, Black Start Generator or Participating TO shall be deemed to apply to every subsequent Initial Settlement Statement T+38BD, the Initial Settlement Statement Reissue and Recalculation Settlement Statement provided to the Scheduling Coordinator, CRR Holder, Black Start Generator or Participating TO from the date that the CAISO grants the request for recurrent treatment until: a) ninety (90) days have elapsed, unless the CAISO indicates a different expiration date on its response to the request, in which case the expiration date shall be as stated by the CAISO in its response or b) the dispute or exception is resolved, whichever is shorter. The CAISO may deny a request that the CAISO treat a dispute as recurring for any valid reason, including because the request is not adequately specific as to the basis for recurring treatment or the subsequent calculations that will be affected.

11.29.8.5 Amendment.

Regarding a dispute related to an Initial Settlement Statement, if the CAISO agrees with the amount claimed, it shall incorporate the relevant data into the Initial Settlement Statement Reissue or Recalculation Settlement Statement. Regarding a dispute related to an Incremental Change in an Initial Settlement Statement Reissue or Recalculation Settlement Statement, the CAISO shall make a determination on the dispute no later than twenty-five (25) Business Days from the issuance of the Initial Settlement Statement Reissue or Recalculation Settlement Statement, and, if the CAISO agrees with the amount claimed, shall incorporate the relevant data into the next Recalculation Settlement Statement issued on T+76BD.

11.29.8.6 CAISO Contact.

If the CAISO does not agree with the amount claimed or if it requires additional information, it shall make reasonable efforts (taking into account the time it received the notice of dispute and the complexity of the issue involved) to contact the relevant Scheduling Coordinator, CRR Holder, Black Start Generator or Participating TO to resolve the issue before issuing the Initial Settlement Statement Reissue or Recalculation Settlement Statement. If it is not possible to contact the relevant party, the CAISO shall issue the Initial Settlement Statement Reissue or Recalculation Settlement Statement without taking into account the dispute notice.

11.29.10 Billing and Payment.

The CAISO shall prepare and send to each Scheduling Coordinator, CRR Holder, Black Start Generator or Participating TO two Invoices or Payment Advices for each calendar month. The first Invoice or Payment Advice will be based on the Initial Settlement Statement T+38BD and the second Invoice or Payment Advice will be based on the Initial Settlement Statement Reissue or Recalculation Settlement Statement(s). Each Invoice or Payment Advice will show amounts which are to be paid by or to each Scheduling Coordinator, CRR Holder, Black Start Generator or Participating TO, the Payment Date, being the date on which such amounts are to be paid or received and details of the CAISO Clearing Account to which any amounts owed by Scheduling Coordinators, CRR Holder, Black Start Generator or Participating TO are to be paid.

The Invoices or Payment Advices will also include the total charges for each component of the Grid Management Charge, the total charges associated with any Interest for each relevant Trading Month, the FERC Annual Charges due monthly, as well as any disbursements associated with a shortfall receipt distribution.

A separate Invoice for the FERC Annual Charges due annually will be issued by the CAISO to the Scheduling Coordinator in accordance with Section 11.19.1.2. The CAISO will issue separate Invoices for NERC/WECC Charges as described in Section 11.20.

A separate Invoice for a shortfall allocation will be issued by the CAISO to Scheduling Coordinators in the event of a payment default in accordance with Section 11.29.17.1.

Settlement Statement Reruns, post closing adjustments and the financial outcomes of CAISO ADR Procedures and any other dispute resolution may be invoiced separately from monthly market activities. The CAISO shall provide a Market Notice at least thirty (30) days prior to such invoicing identifying the components of such Invoice or Payment Advice.

11.29.10.1 Emergency Procedures.

11.29.10.2 Use of Estimated Data.

In the event of an emergency or a failure of any of the CAISO software or business systems, the CAISO may use estimated Settlement Statements and Invoices and Payment Advices and may implement any temporary variation of the timing requirements relating to the Settlement and billing process contained in the CAISO Tariff. Details of the variation and the method chosen to produce estimated data, Settlement Statements and Invoices and Payment Advices will be published on the CAISO Website.

11.29.10.3 Payment of Estimated Statements and Invoices.

When estimated Settlement Statements and Invoices or Payment Advices are issued by the CAISO, payments between the CAISO and Market Participants shall be made on an estimated basis and the necessary corrections shall be made by the CAISO as soon as practicable. The corrections will be reflected as soon as practicable in later Settlement Statements and Invoices and Payment Advices issued by the CAISO. Failure to make such estimated payments shall result in the same consequences as a failure to make actual payments.

11.29.10.4 Validation and Correction of Estimated Statements and Invoices.

The CAISO shall use its best efforts to verify the estimated data and to make the necessary corrections as soon as practicable. The corrections will be reflected as soon as practicable in later Settlement Statements and Invoices and Payment Advices issued by the CAISO.

11.29.10.5 Estimated Statements to be Final.

In the event that the CAISO is of the opinion that, despite its best efforts, it is not possible for it to verify the estimated data because actual data is not reasonably expected to become available to the CAISO in the foreseeable future, the CAISO shall consult with the Market Participants in order to develop the most appropriate substitute data including using data provided by Market Participants. Following such determination of substitute data, the CAISO shall send to the relevant Market Participants revised Settlement Statements and Invoices and Payment Advices. The provisions of Section 11.29.8.6 shall apply to payment of revised Invoices issued in accordance with these emergency procedures. Failure to make payments of such revised Invoices shall result in the same consequences as a failure to make actual payments.

11.29.21.2 Evidence of Unpaid Amount.

The CAISO shall, on request, certify in writing the amounts owed by a CAISO Debtor that remain unpaid and the CAISO Creditors to whom such amounts are owed and shall provide certified copies of the relevant Initial Settlement Statement T+38BD and the Initial Settlement Statement Reissue and Recalculation Settlement Statements, Invoices, Payment Advices, and other documentation on which the CAISO's certificate was based to the CAISO Debtor and the relevant CAISO Creditors. A CAISO certificate given under this Section 11.29.21.2 may be used as prima facie evidence of the amount due by a CAISO Debtor to CAISO Creditors in any legal proceedings.

11.29.23 Communications.

The Initial Settlement Statement T+38BD, any Initial Settlement Statement Reissue, the Recalculation Settlement Statements and Invoices, and Payment Advices will be considered issued to CAISO Creditors or CAISO Debtors when released by the CAISO's secure communication system. Communications on a Payment Date relating to payment shall be made by the fastest practical means including by telephone. If there is a failure of a communication system and it is not possible to communicate by electronic means, then the CAISO or CAISO Creditor or CAISO Debtor, as the case may be, shall communicate by facsimile but only if the recipient is first advised by telephone to expect the facsimile. Methods of communication between the CAISO and Market Participants may be varied by the CAISO giving not less than ten (10) days notice to Market Participants on the CAISO's secure communication system.

11.29.24 CAISO Payments Calendar.

11.29.24.1 Preparation.

In September of each year, the CAISO will prepare a draft CAISO Payments Calendar for the following calendar year showing for each Trading Day:

(a) The date by which Scheduling Coordinators are required to provide Settlement Quality Meter Data for all their Scheduling Coordinator Metered Entities for each Settlement Period in the Trading Day;

(b) The date on which the CAISO will issue Initial Settlement Statements and Invoices and Payment Advices to Scheduling Coordinators or CRR Holders, Black Start Generators and Participating TOs for that Trading Day;

(c) The date by which Scheduling Coordinators, CRR Holders, Black Start Generators and Participating TOs are required to notify the CAISO of any disputes in relation to their Initial Settlement Statements pursuant to Section 11.29.8.2;

(d) The date on which the CAISO will issue the Initial Settlement Statement Reissue and Recalculation Settlement Statements for T+51BD, T+60BD and T+76BD, and Invoices and Payment Advices to Scheduling Coordinators, CRR Holders, Black Start Generators and Participating TOs for that Trading Day;

(e) The date and time by which CAISO Debtors are required to have made payments into the CAISO Clearing Account in payment of Invoices for that Trading Day;

(f) The dates and times on which CAISO Creditors will receive payments from the CAISO Clearing Account of amounts owing to them for that Trading Day; and

(g) In relation to Reliability Must-Run Charges and RMR Payments, the details set out in paragraph 3 of Appendix N, Part J.

The CAISO will make a draft of the CAISO Payments Calendar available on the CAISO Website to Scheduling Coordinators, CRR Holders, Black Start Generators, Participating TOs and RMR Owners any of which may submit comments and objections to the CAISO within two weeks of the date of posting of the draft on the CAISO Website. No later than October 31st in each year, the CAISO will publish the final CAISO Payments Calendar for the following calendar year, after considering the comments and objections received from Scheduling Coordinators, CRR Holders, Black Start Generators, Participating TOs and RMR Owners. The final CAISO Payments Calendar will be posted on the CAISO Website, and will show for the period from 1 January to 31 December in the next succeeding year (both dates inclusive), the dates on which Settlement Statements shall be published by the CAISO and the Payment Dates on which the CAISO will pay the Participating TOs the Wheeling revenues allocated to them pursuant to Section 26.1.4.3.

2. Definitions

As used in this Appendix O, the capitalized terms defined below shall have the definitions specified in this Section 2. All other capitalized terms shall have the meaning specified in the Master Definition Supplement in Attachment A.

Incremental Change: The change in dollar value of a specific Charge Code from the Initial Settlement Statement T+33BD to the Initial Settlement Statement Reissue or Recalculation Settlement Statement including any new Charge Codes or Trading Day charges appearing for the first time

on the Initial Settlement Statement, Reissue or Recalculation Settlement Statement.

Initial Settlement Statement T+38BD: A Settlement Statement generated by the CAISO for the calculation of Settlements for a given Trading Day, which is published on the thirty eight Business Day from the relevant Trading Day (T+38BD) and is prior to the Invoice or Payment Advice published for the relevant bill period.

Settlement Statement Re-run: The recalculation of a Settlement Statement in accordance with the provisions of the CAISO Tariff.

Recalculation Settlement Statement: The reissue of an Initial Settlement Statement T+38BD by the CAISO on the fifty-first (51st) Business Day from the relevant Trading Day (T+51BD) if T+51BD falls on a calendar day that is after the day the invoice or Payment Advice for the bill period containing the relevant Trading Day is scheduled to publish.

Recalculation Settlement Statement T+76BD: The reissue of an Initial Settlement Statement Reissue or the Recalculation Settlement Statement by the CAISO on the seventy-sixth (76th) Business Day from the relevant Trading Day (T+76BD).

Settlement Statement: Any one of the following: Initial Settlement Statement T+38BD, Initial Settlement Statement Reissue, Recalculation Settlement Statement and Recalculation Settlement Statement T+76BD.

Attachment C –

Declaration of Guillermo Bautista Alderete, Director, Market Analysis and Forecasting

CRR Auction Efficiency Track 1A Tariff Amendments

California Independent System Operator Corporation

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

California Independent System Operator Corporation	))	**Docket No. ER18-___-000**

DECLARATION OF
GUILLERMO BAUTISTA ALDERETE
ON BEHALF OF THE
CALIFORNIA INDEPENDENT SYSTEM
OPERATOR CORPORATION

Q. Please state your name, title, and business address.

A. My name is Guillermo Bautista Alderete. I am employed as Director of Market Analysis and Forecasting for the California Independent System Operator Corporation (CAISO). My business address is 250 Outcropping Way, Folsom, CA 95630.

Q. Please describe your educational and professional background.

A. I have a bachelor's degree in Electrical Engineering from the Institute of Technology in Mexico, a master's degree in Electrical Engineering with specialization in the Operations of Power Systems from the Polytechnic Institute of Technology in Mexico, and a Doctor of Philosophy in Electrical and Computer Engineering with an emphasis in Financial Transmission Rights and competition in electricity markets from the University of Waterloo, Canada.

Q. What are your responsibilities as Director for Market Analysis and Forecasting?

A. I oversee the Market Validation Analysis and Short Term Forecasting groups that are responsible for analyzing the quality of market outcomes and systems, monitoring and reporting on market performance, validation of market outcomes, determining whether price corrections are needed, analytical support for policy initiatives, calculating fuel indices and default energy bids, producing and developing of short term forecasting for both load and renewable resources in the CAISO's markets.

Q. What is your previous experience at the CAISO?

A. I began working at the CAISO in May 2007 and have worked on a variety of technical areas in the divisions of Operations, Technology, Market Infrastructure and Development, and Market Quality and Renewable Integration. My first assignment at the CAISO in the Operations divisions was with the congestion revenue rights (CRR) team in the Operations and Market Performance groups, where I supported implementation of the CRR functionality that continues to be in place as part of the transition to the CAISO's current nodal market design. I also led implementation of the load migration process that is used to account for the transfer of allocated CRRs from one load serving entity to another as load transfers, and the CRR credit-related initiative. I participated in testing the CRR software currently used to run the CRR allocation and auction processes, and I helped develop the business practice manual for CRRs, including the section of

the outage reporting requirements. In 2008 and 2009, I developed the indices and metrics used to analyze the performance of the CRR products, including the index for convergence between CRRs and day-ahead markets, revenue adequacy, and revenue adequacy by constraint. I designed the methodology of the break-even analysis which is currently used to determine the optimal capacity made available on constraints for the annual CRR release. As one of the leads on the market performance team, I developed the indices, metrics, and reports for our energy markets and CRR products, which the CAISO continues to use today as part of its market performance evaluation. I was also part of the team that implemented the nodal market currently used in the CAISO. I participated in the development and testing of multiple market functionalities in the nodal market including, pricing and scheduling, congestion management, co-optimization of energy and ancillary services, and unit commitment. In 2010, I transferred to the Technology division to help enhance and support the energy market software application, where I also provided 24/7 support to operators in the control room for their operation of the market software application and investigation of the market solutions. During my tenure in Technology, I also participated in the implementation of convergence bidding and multi-stage generator functionalities.

In 2011, I became the manager of the then newly created Market Validation and Quality Analysis team in the Division of Market Infrastructure and Development, whose primary responsibility is market solution quality review, price validation, and root cause analysis of anomalous market outcomes. In this capacity I also

led several policy initiatives, including Administrative Pricing Rules, Multiple Contingency and Multiplicity (degeneracy) of Pricing, and Pricing Enhancements. Since 2014, the group's responsibilities have expanded to support validation, analysis, and tools needed with new market features such as the various commitment costs initiatives, including the development of the in-house calculator of the default energy bids, bidding rules, the Aliso Canyon processes and more recently the opportunity costs calculator for use-limited resources as part of the commitment costs enhancements. In 2015, I became the Manager of Market Analysis and assumed the responsibility of managing an additional team responsible for market analysis and development, whose primary role is to provide analytical support to policy initiatives and monitoring and reporting of the CAISO's markets. In 2016, I became the Director for Market Analysis and Forecasting, which is the position I hold now.

In recent years, under the support of the United States Agency for International Development and the National Association of Regulatory Utility Commissioners, I have offered technical support to the system operators and energy regulatory commission of Mexico and Colombia in their development and implementation of electricity markets.

Q. What is the purpose of your declaration?

A. I will explain the analysis my group conducted to support the CAISO's proposed CRR policy changes. By way of background, I will first provide an overview of

CRRs. I will then discuss the problems we identified through our analyses. Finally, I will discuss the CAISO's proposed solutions to these issues.

I. Background

Q. Please give a brief overview of CRRs.

A. CRRs are financial instruments meant to hedge congestion costs associated with supply delivery in the CAISO markets, as defined by the source and sink points of the individual CRR. The CAISO operates wholesale markets where buyers and sellers transact energy. Within these wholesale markets, congestion occurs when the demand for transmission exceeds the available capacity. In locational marginal pricing-based markets such as the CAISO's, this congestion is a component of the locational marginal price. The holder of a CRR receives revenues associated with the price difference between two points on the CAISO transmission system. Specifically, CRRs settle on the day-ahead market congestion price difference between two locations. CRRs are designed to serve as a financial hedge against the volatility associated with congestion prices. The CAISO allocates and auctions out CRRs through annual and monthly processes. The CRR allocation process is open only to load-serving entities and they are limited to requesting CRRs that source at supply points and sink at load aggregation points. The CRR auction process does not place such restrictions on market participants. My testimony largely relates to the CRR auction process.

Q. Please describe "auction revenue shortfall."

A. An "auction revenue shortfall" occurs when the auction revenue for a defined set of CRRs is lower than the eventual payout to the holders of those CRRs that are based on day-ahead market prices. Auction revenue is the charge allocated to a CRR holder for acquiring a CRR in the auction at the auction-clearing price. A CRR payout is the money, typically, collected by the holder of such CRRs settled at the day-ahead price differential of marginal congestion components. For example, if a market participant paid 75 cents in the auction to acquire a CRR, but based on day-ahead market the CRR is paid a total of $1.00 over the term of that CRR on congestion experienced in the day-ahead market, then the auction revenue shortfall for that one CRR would be 25 cents. The auction revenue shortfall as to a group of CRRs is one of the measures of how efficient the auction is with respect to those CRRs.

Q. Please describe a "revenue inadequacy" in the CRR context.

A. Revenue inadequacy exists when all CRR payouts (both auctioned and allocated CRRs) exceed the overall proceeds from day-ahead congestion rents. The CAISO includes the auction revenues together with the day-ahead congestion revenues to fund the CRR payouts. The CAISO guarantees full funding of CRRs, meaning that if the CRR fund is not sufficient to pay out on all released CRRs for the particular period, the CAISO does not alter the CRR entitlement and settles the CRRs as prescribed. The CAISO distributes any shortfall or excess revenue from the CRR process to measured demand. Revenue

inadequacy, and the extent of such inadequacy, is one measure of the CRR process efficiency.

Q. What is the relationship between CRR revenue inadequacy and auction revenue shortfall from the CRR auction?

A. Taken on their own, auction revenue shortfalls and revenue inadequacy each reflect performance of the CRR process. These two measurements are also related. By design, the CAISO energy market will collect day-ahead congestion rents because it will always collect more congestion payments than it pays to generators. These rents and the CRR auction revenue are dedicated to fund payouts to both auctioned and allocated CRRs. Put another way, day-ahead market congestion rent plus CRR auction revenue stand on one side of the revenue adequacy equation, while CRR auction payouts and CRR allocation payouts stand to the other side. An "auction revenue shortfall" means that CRR auction payouts are relatively larger than auction revenue, which in turn means that the overall CRR revenue equation starts out weighed in favor of revenue inadequacy. This other measure of efficiency is different, but to some degree, correlated to the auction revenue shortfall. Through the analysis carried out for this initiative, the CAISO has determined that factors and conditions impacting the auction revenue shortfall have correspondingly impacted also the CRR revenue adequacy.

Q. Is there any evidence of inefficiencies with the current CRR release process?

A. Yes. Auctioned CRRs, as a whole, consistently have shown an auction revenue shortfall. As a starting point, CRR auction bids should reflect roughly market participants' expectations of congestion exposure in the day-ahead market. Although some participants may have a higher degree of sophistication than others, overall and with symmetrical information, participants bidding for CRRs would base their bids on expected payouts from the day-ahead market. With sufficient competition in bids for CRRs based on expected congestion, the bid prices and, thus, the clearing price in the auction, would rise to closer to the level of expected payout. An individual participant's motivation for securing the CRR will influence how close to the expected payout it is willing to bid in the auction. A market participant bidding on a CRR for purely speculative purposes would need to internalize a profit and risk premium in its bid, and rationally, not bid up to the expected payout or above. Acquiring a CRR implies other additional costs such as the net value of money, and fees and costs incurred to participate in the markets and hold CRRs. A participant bidding on a CRR to hedge congestion risk for supply delivery might even rationally bid above the expected payout as its primary purpose is to secure a form of congestion insurance. Also, different participants will have different projections of the expected payout from a given CRR given the different valuation of risk premium. Finally, participants' collective expectations of CRR payouts will not necessarily match the congestion patterns that actually materialize in the day-ahead market. As a general proposition, an

efficient CRR auction would result in CRR auction revenues that more closely match payouts for auctioned CRRs, and in some circumstances with the uncertainty and changes in conditions, auction revenue shortfall would sometimes even become auction revenue surpluses.

However, in recent years the overall revenues the CAISO has collected from the CRR auction are significantly lower than the amount the CAISO paid out to parties holding auctioned CRRs. That is, taken together as a whole, auctioned CRRs have a total auction revenue shortfall. Over the three and half year period the CAISO studied on a monthly basis, the CAISO observed an auction revenue surplus in four months and observed auction revenue shortfalls in 37 months.

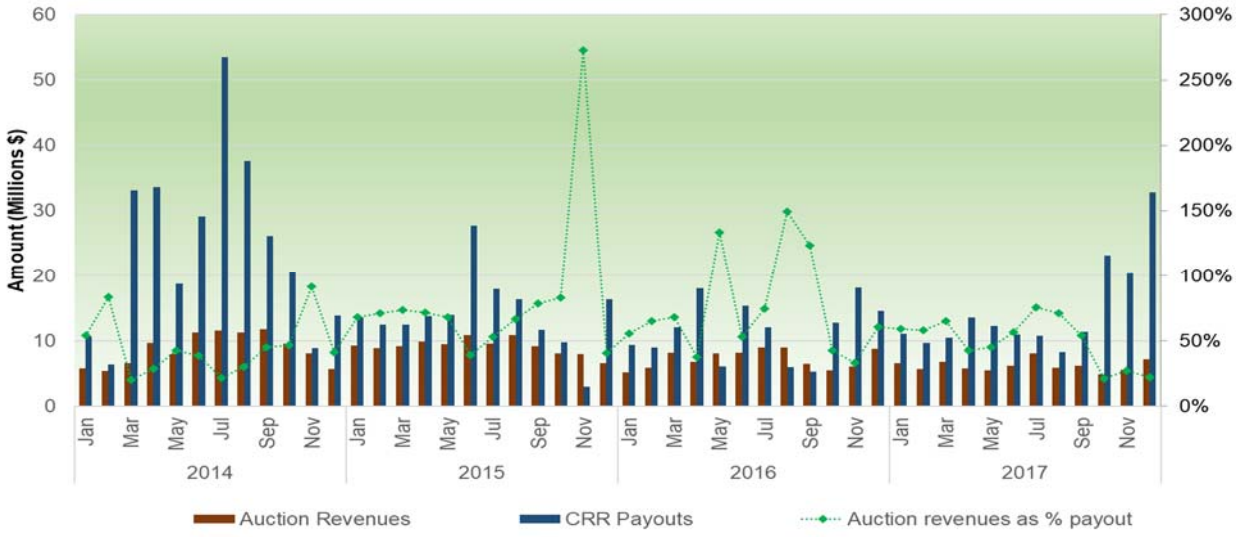
Q. Please describe the analysis the CAISO conducted.

A. In 2017, the CAISO began an initiative to address concerns with persistent CRR auction revenue shortfall. The first stage on this initiative consisted of an in-depth analysis of the efficiency of the CRR auction based on the CRRs released over the period of January 2014 - May 2017. The analysis and conclusions reached in this first stage are contained in the CRR Auction Analysis Report, published on November 21, 2017 and provided as Appendix 1 to my declaration. This CRR Auction Analysis Report suggests that the auction is not producing an efficient outcome for CRRs. For example, the total payouts to auctioned CRRs in 2014 of approximately $292 million were significantly more than auction revenues of about $104 million, resulting in a $187 million auction revenue

shortfall. This means that in 2014, on average, CRR holders paid 36 cents to acquire a CRR at auction that would obtain $1 in CRR payments from the CAISO. The auction revenue shortfall for auctioned CRRs fell to about $60 million in 2015 (based on total auction revenues of $109 million and CRR payouts of about $169 million), implying an auction revenue shortfall of 64 cents on the dollar, and fell even more in 2016 to about $51 million (based on total auction revenues of $87 million and CRR payouts of about $138 million), implying an auction revenue shortfall of 63 cents on the dollar.[1] In 2017, the net auction revenue shortfall was $100 million (based on auction revenues of $74 million and CRR payouts of $174 million), implying an auction revenue shortfall of 42 cents on the dollar. Figure 1 below compares the cost of CRRs at auctions to the eventual payouts, highlighting auction revenue shortfalls over the period from January 2014 December 2017. This is an updated version of a figure included in the CRR Auction Analysis Report and covers all of 2017.

[1] See CRR Auction Analysis Report at 49.

Figure 1



Q. Please summarize the findings of the CAISO's analyses that led to this filing.

A. Following the analysis stage, the CAISO began the policy development phase to consider and implement CRR enhancements aimed to improve CRR auction efficiency. The CAISO's analyses suggest a number of potential ways to improve the CRR product. This filing addresses two proposed improvements based on the analysis findings. First, when the CAISO conducts its CRR allocation and auction processes, the analysis shows that it lacks significant information about transmission maintenance outages that will take place during the period covered by the auction. This lack of information creates significant discrepancies between the network model used in the CRR auctions and the network model used in the day-ahead market; specifically, insufficient information on planned transmission outages creates discrepancies in the constraints, contingencies, and topology the CAISO enforces in the CRR allocation and auction versus those it enforces in the actual day-ahead market.

Second, a significant percentage of auction revenue shortfalls from auctioned CRRs are attributable to CRRs that do not reflect a definition of the delivery of supply; in this context, we refer to such CRRs as delivery CRRs since they enable the primary purpose of CRRs, which is to hedge the risk of congestion costs between supply source and demand sink.

The analysis revealed that about 80 percent of the auction revenue shortfalls accrued on CRRs with non-delivery definitions. In the first round of the policy proposal, the CAISO targets these two issues to improve the efficiency of the CRR auction.

II. Outage Notification and Auction Revenue Shortfalls

Q. How far in advance must participating transmission owners currently report outages?

A. The CAISO has different requirements for annual and monthly transmission outage reporting. Under the CAISO tariff, participating transmission owners are not required to report outages that could significantly affect the feasibility of CRRs prior to start of the annual CRR auction and allocation process. Although some transmission owners report outages voluntarily in advance of the preparation of the CRR model each summer used for the annual CRR allocation and auction, there is no mandate to do so. Transmission owners are required to submit an annual maintenance outage plan for the following year by October 15,

but this is long after the CAISO has finalized the CRR model used for the annual release. In addition, transmission owners must submit for CAISO's approval outages that may have a significant effect on CRR revenue adequacy no less than 30 days in advance of the start of the month in which the participating transmission owner proposes to begin the outage.

Q. How does the CAISO use outage reporting in its CRR processes?

A. The CAISO considers reported outages when modeling system capacity for the CRR auction. For both annual and monthly CRR auctions, the CAISO maintains a default CRR model that includes a list of constraints enforced by default, which includes contingencies, and a default network topology. When setting up the full network model it will use in the CRR allocation and auction processes, the CAISO uses any annual outage information that it has available at that time. In studying available network capacity for monthly CRR allocations and auctions, the CAISO uses the most up-to-date full network model, and takes into account known planned maintenance outages. In the annual processes, the CAISO will take into account any long-term scheduled transmission outages, will make adjustments to the total transmission capacity of a line for any long-term scheduled derates, and will consider the impact of historical outages and derates on specific transmission elements to account for any unscheduled transmission outages or derates. In the monthly processes, the CAISO considers any scheduled transmission outages known at least thirty days in advance of the start

of the applicable month. It also considers adjustments to compensate for the expected impact of outages that are not required to be scheduled thirty days in advance, including unplanned transmission outages, adjustments to restore outages or derates that were applied in the annual process but are no longer applicable for the current month. Lacking information on the planned outages prior to conducting the annual allocation or auction process, the CAISO cannot include in the CRR full network model the impact of outages that then may materialize in the day-ahead market. Consequently, the CRR auction may be considering less constrained capacity than will actually materialize in the day-ahead market; this may also have implications on how appropriately the CRRs may be priced at certain locations compared to how these CRRs would have been priced if the CAISO had modelled the outage as described above. Consequently, CRRs obtained through the auction may receive payouts reflecting the outages that occur in the day-ahead market causing associated congestion to materialize. Such payouts may be disconnected from the auction revenues paid in the CRR auctions.

Q. What findings, if any, did the CRR Auction Analysis Report have with respect to reporting outages?

A. The CRR Auction Analysis Report found that late or unreported outages, which create discrepancies in the model and constraint enforcement used in the network model used for CRR auctions are at times large contributors to both revenue inadequacy and auction revenue shortfalls. Even a single constraint

that is not modelled in an annual or monthly auction can lead to significant auction revenue shortfalls. For example, in January 2017, the CAISO did not model a transmission constraint named "OMS 4622069 TL50003" in the annual and monthly auctions because the associated outage information was not available by the time the CRR auctions were run. However, this constraint bound in the day-ahead market, and caused $1.25 million of auction revenue shortfall in one single day. This single constraint accounted for about 28 percent of the total auction revenue shortfall for that month across all auctioned CRRs.[2]

Q. Was the lack of accurate constraint modeling in the CRR auctions an issue that only arose occasionally?

A. No. The analysis reported in the CRR Auction Analysis Report reveals that the CAISO systematically did not enforce multiple transmission constraints in the CRR markets that later were enforced and bound in the day-ahead market. This discrepancy between the CRR auctions and the day-head market leads to a twofold inefficiency. First, where the CAISO did not model or enforce a constraint in the CRR auction that later materialized in the day-ahead market, the amount of transmission capacity the CAISO could release over the relevant constraint in the CRR auction could be effectively unbounded because the constraint did not exist in the CRR auction. This indicates that more transmission capacity may be released in the CRR auction than the day-ahead market. This impacts directly CRR revenue inadequacy. If more megawatts are released in a

[2] See CRR Auction Analysis Report at 146-47.

given CRR than is feasible based on the capacity actually modeled in the day-ahead market, the CAISO will not collect sufficient revenue from the day-ahead congestion payments to cover the megawatts of CRRs released in the allocation and auction processes. This creates revenue insufficiency. Secondly, when the CAISO does not model or enforce a transmission constraint in the CRR auctions, the auction does not price the constraint and no auction revenues are collected over that constraint. This impacts directly the auction revenue shortfall.

For example, in December 2016, the Crosstrip Constraint was not enforced in either the annual or monthly auctions but it was enforced and bound persistently in the day ahead market. By not enforcing in the CRR auctions, transmission capacity was cleared in excess in the CRR auction with respect to the transmission capacity actually cleared in the day-ahead market. This single constraint, thus, created a CRR revenue inadequacy of about $6.4 million, which is about 60 percent of the total revenue inadequacy for the month. Furthermore, since this constraint was not enforced in the CRR auctions, it could not be priced accordingly; thus, the CRR auctions did not collect any auction revenues on this constraint. However, it was binding frequently in the day-ahead market. This single constraint consequently led to an overall auction revenue deficiency of about $5.7 million, which is more than the net auction revenue deficiency of $4.5 million given the offsetting of some excess auction revenue arising from other transmission constraints.[3]

[3] See CRR Auction Analysis Report at 146.

Q. What were the consequences of the lack of outage reporting?

A. The CAISO concluded that many constraints contributing to auction revenue shortfall were not enforced in the annual and monthly auctions but did contribute to day-ahead market congestion. Because the CAISO lacked accurate information on future outages, its engineering analysis was unable to identify certain constraints that would have more accurately reflected actual conditions in the day-ahead market (in addition to default constraints). An unenforced constraint in the CRR model can lead to inaccurate pricing of transmission in the CRR auction and to the release of excess transmission capacity in the auction. If the CAISO has earlier advance notice of outages that could affect CRRs, the CAISO will be able to use that information to enforce constraints in its CRR models that currently it cannot enforce because it does not have notice of planned maintenance outages that could impact the network model. If the CAISO had notice of such outages, it could model and enforce them in the CRR allocation and auction processes and would release CRRs that are more feasible and consistent with conditions expected in the day-ahead market, thereby improving the efficiency of auction pricing and leading to lower auction revenue shortfalls.

Q. How does the CAISO propose to address this issue?

A. The CAISO proposes to revise its tariff to require that transmission maintenance outages that could impact the CRR model for a given year and that the participating transmission owner plans to take in that year should be submitted in

the CRR Transmission Maintenance Outages plan by July 1 of the prior year. That is, planned transmission maintenance outages that may impact the CRR model would need to be submitted to the CAISO at least six months, and as long as 18 months, before the outage would start.

Q. Why is July 1 an appropriate date for annual outage reporting?

A. July 1 gives the CAISO adequate time to incorporate this information in its models for the annual CRR allocation and auction. The CAISO releases the CRR network model for the annual allocation and auction in late July.

III. Deficiencies Resulting from Certain CRR Source-Sink Pairs

Q. At what locations may market participants source and sink CRR bids under the current auction design?

A. The CAISO currently permits market participants to source and sink auction CRRs at pricing nodes, generator locations, load locations, import/export scheduling points, and trading hubs in any possible combination. This is more flexible than the locations allowed to request CRRs in the allocation process, in which CRRs have to source at a supply location and sink at a load location.

Q. Are all CRRs bids under current market rules consistent with the purpose of CRRs as a hedge against congestion risk for supply delivery transactions?

A. No. Based on historical data for the CRR auctions, CRRs acquired through the CRR auctions for certain sources and sinks do not appear to be related to supply delivery. For example, the majority of CRRs between one generator location and another generator location do not appear to address any congestion costs that would be incurred for the delivery of electricity supply to customers. These CRRs sourcing at a generation location and sinking to a generation location are referenced in the CAISO policy discussion as one type of non-delivery CRRs. Other types of non-delivery CRRs are those sourcing at a load location and sinking to a generation as well as those sourcing at a load location and sinking to a load location.

Q. What effect, if any, do non-delivery CRRs have on CRR auction revenues shortfalls?

A. The auction revenue shortfalls are largely accrued on non-delivery CRRs. For the period under analysis, about 56 percent of all auction revenue shortfalls accrued on CRRs awarded from generation-to-generation locations.[4] For the period under study, non-delivery CRRs have resulted in an overall $280 million auction revenue shortfall, which accounts over 80 percent of all auction revenue shortfall.

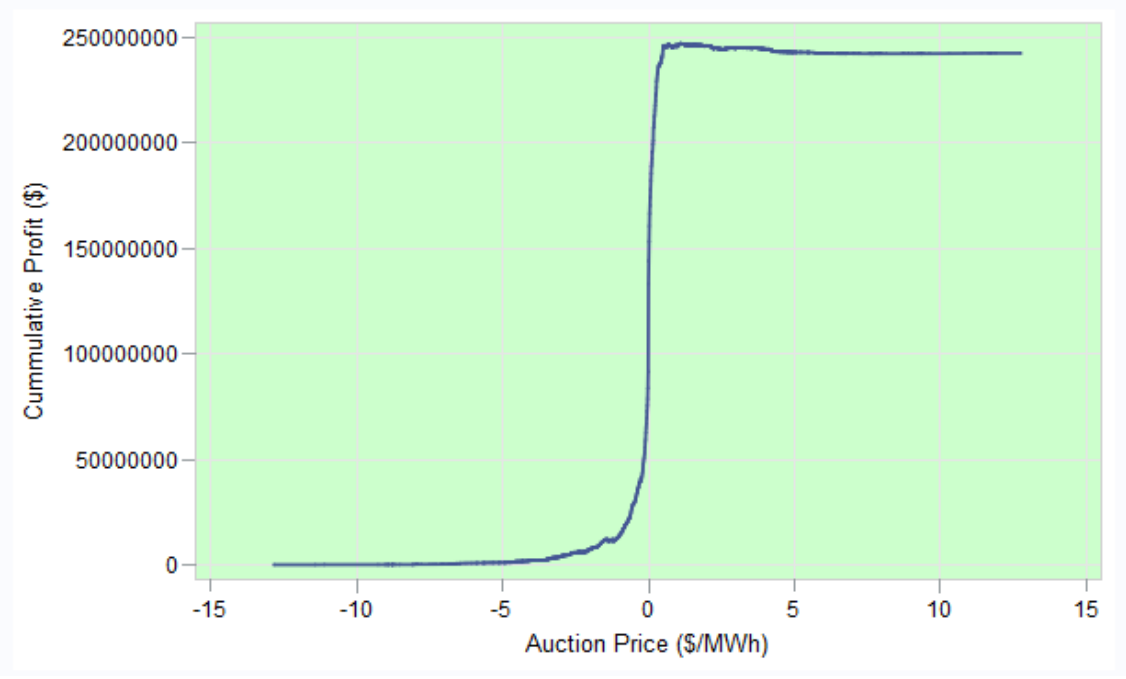
[4] CRR Auction Analysis Report at 6, 54.

Q. Why do such non-delivery CRRs collect the majority of the auction revenue shortfall?

A. Non-delivery CRRs have accounted for over 80 percent of the total auction revenue shortfall. Market participants purchased these CRRs for 38 cents on the dollar, while market participants with CRRs with delivery sources and sinks were purchased for 74 cents on the dollar.

Market participants purchased non-delivery CRRs at very low prices while they collect large payouts in the day-ahead market. Figure 2 below illustrates this interplay by trending the cumulative profits for non-delivery on-peak CRRs for the period under analysis. It shows that large auction revenue shortfalls accrued on non-delivery CRRs that are mostly low-valued and cleared at prices very close to $0/MWh.

Figure 2: Cumulative profits for non-delivery CRRs



Q. What is the CAISO's proposal to address auction revenue shortfalls associated with such non-delivery source/sink CRR pairs?

A. The CAISO proposes only to accept CRR bids in the auction that source and sink in the following ways: (1) from a generator bus to either a load serving entity load aggregation point, a trading hub, or scheduling point; (2) from a trading hub to either a load serving entity load aggregation point or scheduling point; or (3) from a scheduling point to either a load serving entity load aggregation point or a trading hub. These CRR source/sink pairs will allow market participants to hedge congestion risk associated with supply delivery transactions.

Q. Will the removal of non-delivery CRRs from the allowable CRRs to bid in the auction impede participants to acquire CRRs to hedge their positions?

A. Eliminating source and sink combinations from non-delivery pair bids will continue to provide participants hedges for supply delivery. Participants will continue to have the means in the CRR auction to acquire CRRs to hedge the delivery of supply since CRRs going from a supply location to a load location will continue to be allowed in the auction. Furthermore, trading hubs will enable to link supply to demand locations and provide additional flexibility to participants.

Q. Is there any benefit provided by non-delivery CRRs that will be lost by no longer allowing these CRRs in the auction?

A. Conceptually, more participation in the market will tend to drive more competition and liquidity in the marketplace. In the analysis, the CAISO found in contrast that a large volume of non-delivery CRRs faced little competition; with a large number of potential combinations from supply location to supply location, many CRRs had only one bid and award for a given CRR definition. The large number of potential CRRs created with any source and any sink will inherently dilute the bidding space where participants can compete to acquire CRRs. The simultaneous feasibility test will force all CRRs to compete for scarce capacity on transmission constraints instead of a direct competition from location to location. Based on its analysis, the CAISO concluded that there is no such competition in the current auction since low valued CRRs are persistently cleared in the auctions. Instead, the large supply of eligible bid locations is resulting in a more disperse set of non-delivery CRR locations than the current amount of market participants can possibly coincide to bid and compete. Therefore, there is a tendency to spread the demand for CRRs over too numerous locations resulting in little if any competition at any given source-to-sink combination.

Another argument raised in favor for retaining non-delivery CRRs is that such CRRs will provide counter-flow capacity (capacity in the opposite direction to relieve capacity in a given direction) and consequently will enable more volume of delivery CRRs cleared. To gain some empirical insights onto this concept, the

CAISO compared 2018 Season 3 auction results to a simulated 2018 Season 3 auction run without non-delivery CRR source/sink pairs. The removed pairs included all non-delivery locations and were not limited to generator-to-generator CRR bids. The 2018 Season 3 rerun analysis showed that non-delivery pairs are not enabling more supply delivery pairs to clear in the auction. After removing non-delivery pairs, bids for 5,000 MW more of delivery CRRs cleared the auction. Cleared delivery pair bids increased from 25% to 33% of transmission capacity for which market participants submitted bids.

That same analysis suggests that non-delivery pair bids interfere with those bids sinking at load aggregation points from clearing. After removing non-delivery pair bids from the simulation, 12,700 MW of bids for CRRs sinking at load points cleared in the auction, compared to 8,900 MW in the representative season including delivery pair bids. An additional 3,800 MW of CRR bids sinking at load points would have potentially cleared the auction had non-delivery pair bids been removed.

Q. Did the CAISO run any additional studies to evaluate the implications of removing non-delivery CRR source/sink pairs? If so, what were the results?

A. Yes, the CAISO had continued to do analysis to support the policy effort after it posted the analysis report back in November 2017. Some of these results were provided during the policy discussion as they became available. One of these

studies consisted of rerunning 2017 Season 3, removing non-delivery CRR source/sink pairs (including but not limited to generator-to-generator CRR bids) and comparing these results with the actual CRR auction results. The purpose of this rerun was to estimate the effect of removing non-delivery CRRs in the auction on the CRR settlements; *i.e.*, to estimate how the auction revenue shortfall might change. This analysis did not prove to be fully fruitful because the CAISO cannot simulate how market participants would bid in the absence of non-delivery CRRs. Comparing the original settlements of Season 3 2017 with the settlements based on the rerun results revealed that the CRR auction revenue decreased from $20.12 million to $5.32 million without the non-delivery source/sink CRRs. This is because previously, the multitude of CRRs extracted from the non-delivery locations accounted for a large amount of the revenue. In reality, a portion of these bids will be diverted to the eligible locations once the new policy is in place. The estimated day-ahead payouts to holders of auctioned CRRs was also much less, dropping from $30.37 to $11 million. Consequently, the auction revenue shortfall reduced from $10.25 million to $5.71 million. The rerun auction cleared delivery CRRs at 50 cents on the dollar on average.

Although the rerun may shed some light on the effect of disregarding non-delivery CRRs, it is to some extent uncertain how a real auction may clear because bidding behavior will change. In the rerun, a simplistic approach is to disregard the bids for non-delivery CRRs. In practice, however, the CAISO believes that making non-delivery source/sink CRR bids ineligible in the auction

will result in a change in bidding behavior. Market participants would have to reconfigure their CRR bids to reflect their delivery needs. Restricting the number of eligible CRR locations in the auction will create more competition and liquidity for the eligible CRR locations. As such, the CAISO expects prices for those CRRs at eligible source and sink combinations to increase, producing auction revenues that are more consistent with market participants' expectations of congestion price exposure in the day-ahead market.

An important consideration is that prices will tend to increase with this change because the capacity cleared for delivery CRRs is limited by the nature of the delivery definitions of eligible CRRs. Supply-to-load auctioned CRRs, similar to allocated CRRs, tend to exhaust positive-flow transmission capacity and are inherently bounded by the physical transmission capacity. In contracts, supply-to-supply (non-delivery) CRRs naturally may produce counter-flows to each other and thus are not inherently bounded by the physical transmission capacity. By limiting the set of eligible CRRs to be only delivery CRRs, the available transmission capacity will be bounded and in the auction clearing process the demand for CRRs will be more competitive and may tend to shift upward the demand for CRRs with correspondingly higher prices.

Q. Is the CAISO proposing any additional enhancements to its CRR rules? If so, please describe.

A. Yes, the CAISO also proposes to allow a market participant who acquires CRRs through the allocation or auction process to sell those CRRs back into a subsequent CRR auction. Currently, the CRR auction does not have an explicit sell feature for CRRs, and the only way to unwind an existing CRR position is to acquire a counter-flow CRR through the auction. Under current market rules, participants may purchase counter-flow positions using a wide range of source and sink combinations, allowing them to financially unwind the CRRs they hold. With the proposed limits on source and sink CRRs, market participants will not have the ability to bid in the auctions for CRRs at all counter-flow locations. This modification would address that issue, allowing a direct sellback as an alternative means of unwinding CRR positions consistent with the new CRR auction rules.

Q. Thank you. I have no further questions.

I, Guillermo Bautista Alderete, affirm under penalty of perjury that the statements in this declaration are true and correct to the best of my knowledge, information, and belief.

/s/ Guillermo Bautista Alderete

Guillermo Bautista Alderete

Executed this 11th day of April, 2018

Appendix 1 – CRR Auction Analysis Report dated November 21, 2017

to the Declaration of Guillermo Bautista Alderete on behalf of the

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.

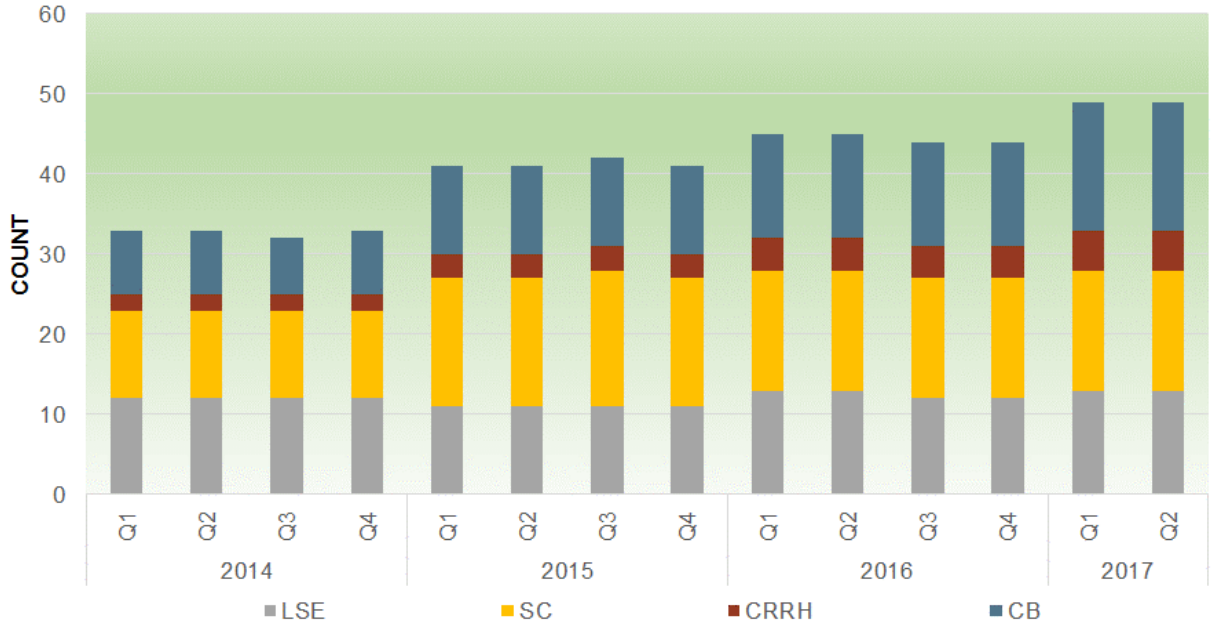
4 Congestion Revenue Right Auctions

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

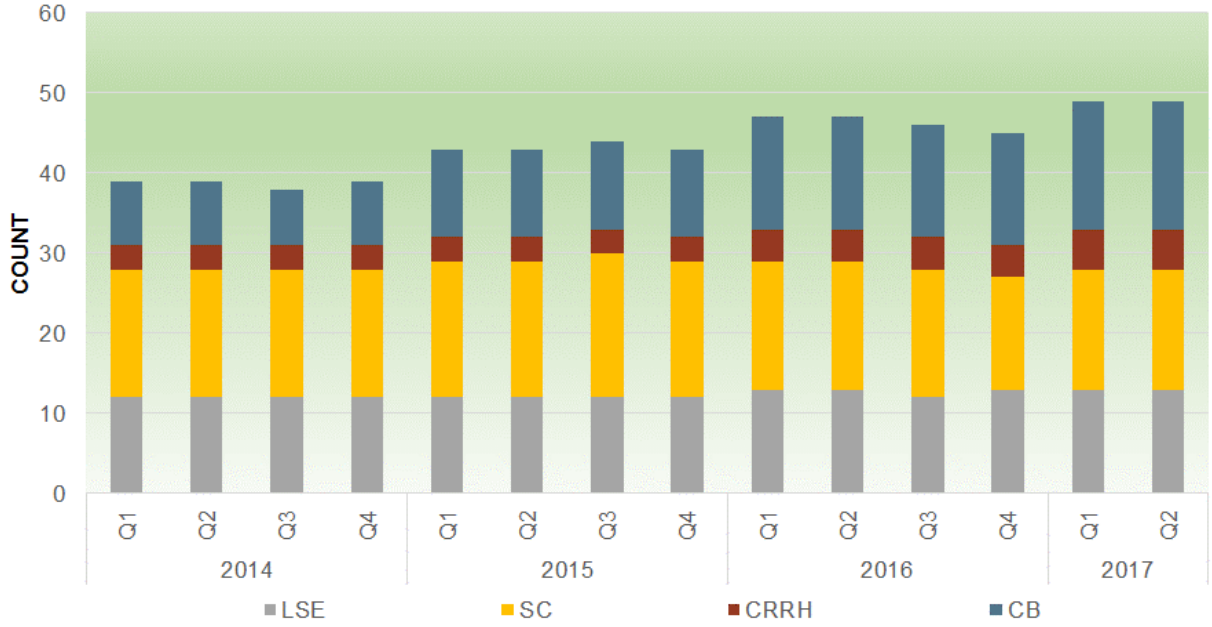


Similarly Figure 2 shows the number of participants in annual auctions by CRR type. The count of participants is by season for On-peak and similar to the Off-peak there is a steady increase in the count of participants from year to year. Since there is a separate annual auction

[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

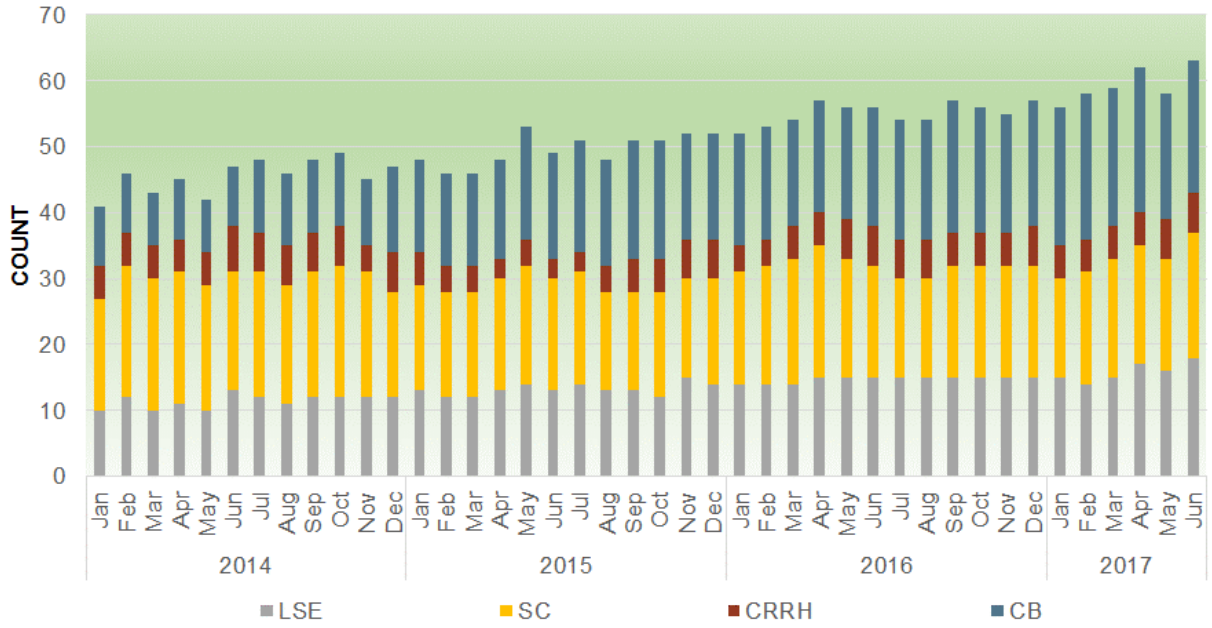
for each time of use, participants have the flexibility to participate in both or any of the two auctions; this is the reason the number of participants is different for each time of use.

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



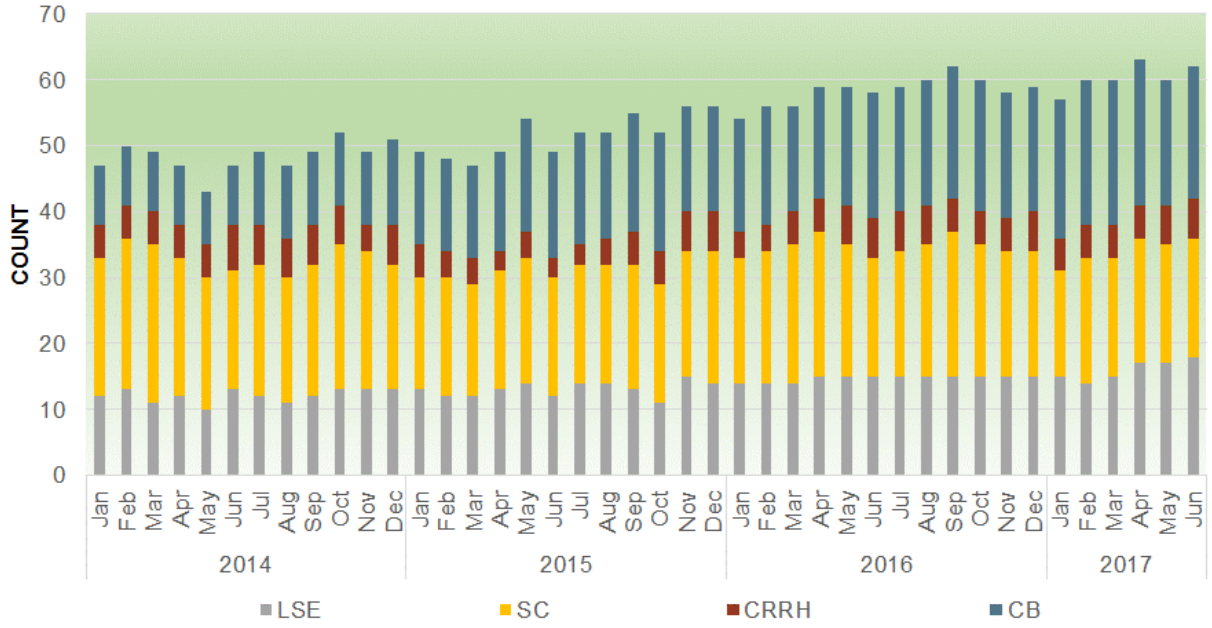
Correspondingly, Figure 3 shows the number of entities participating in the monthly CRR auctions by type of participant for Off-peak. The number of participants has also steadily increased from 41 entities in 2014 to 63 entities in May 2017.

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

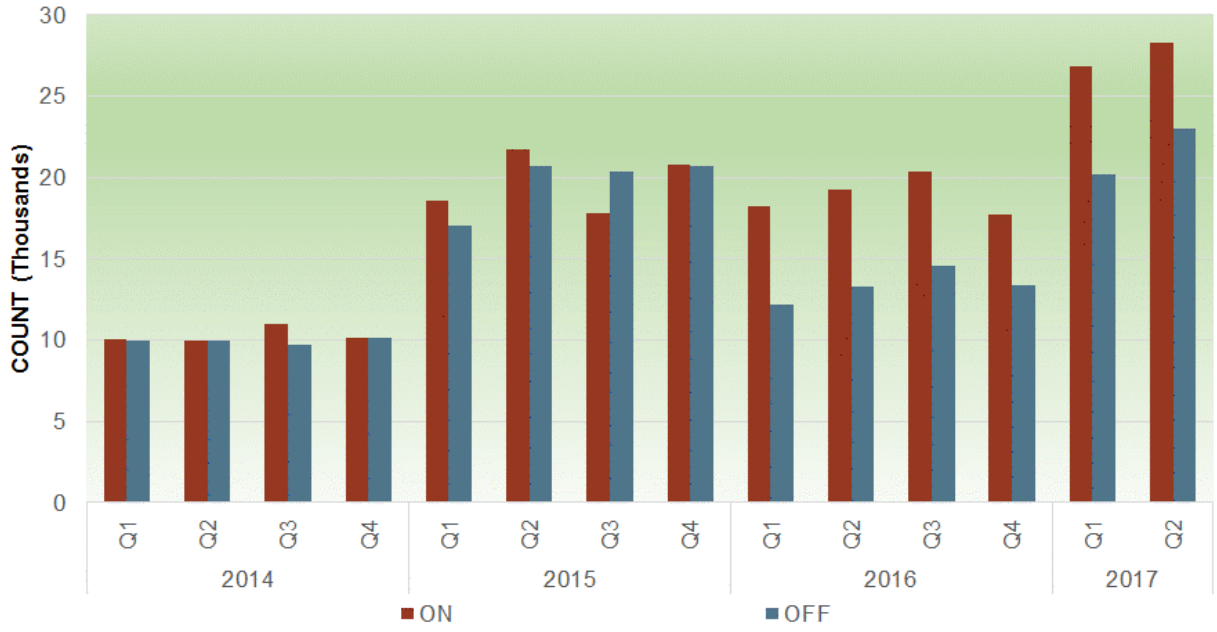
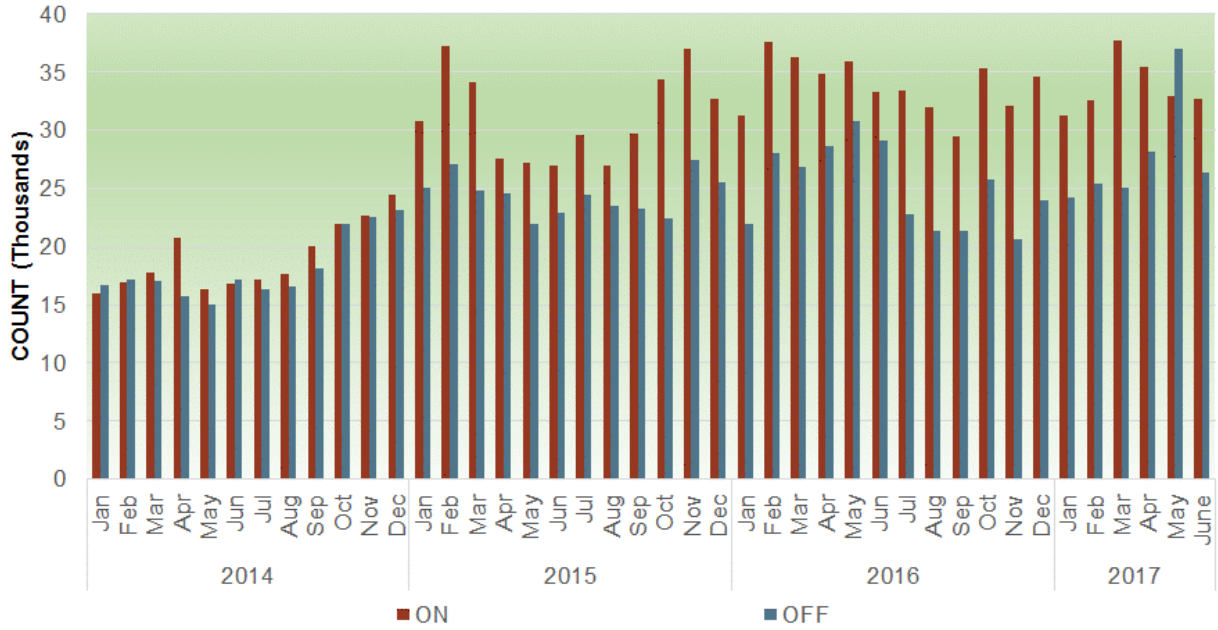


Figure 6 shows the number of the bids in the monthly CRR auctions by month, TOU and year. The number of bids have increased over time, going from about 16,000 bids in early 2014 to as high as almost 33,000 bids in 2017. It is important to note that the number of bids is not a direct metric of CRR awards,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

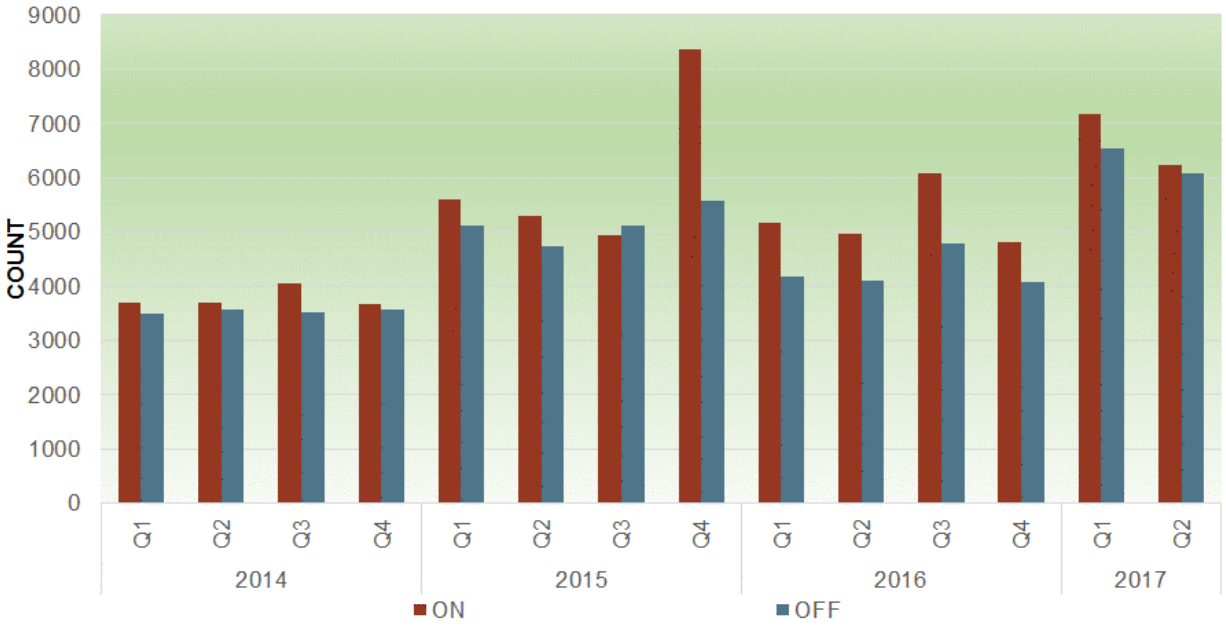


Figure 8: Number of different CRR definitions in monthly auctions

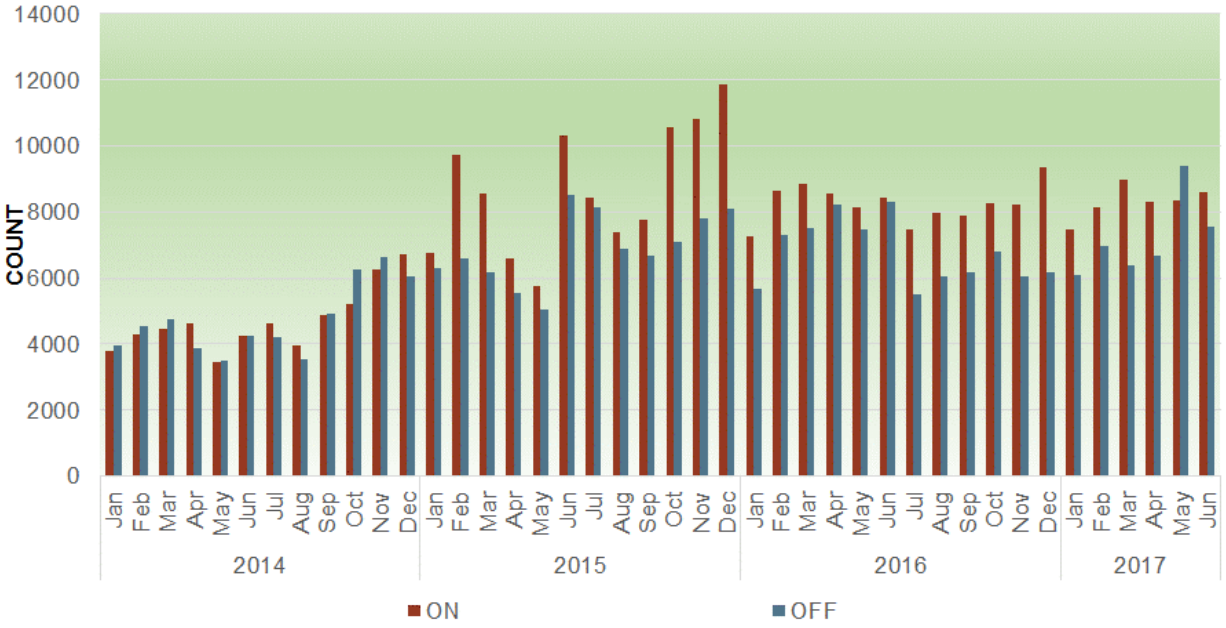


Figure 9 through Figure 12 show the volume of CRRs awards cleared in the annual and monthly auctions by time of use. These volumes are grouped into sets of numbers of awards for each CRR definition. For instance, the bin associated with the label "1" is the estimate of CRR volume with awards for definitions 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

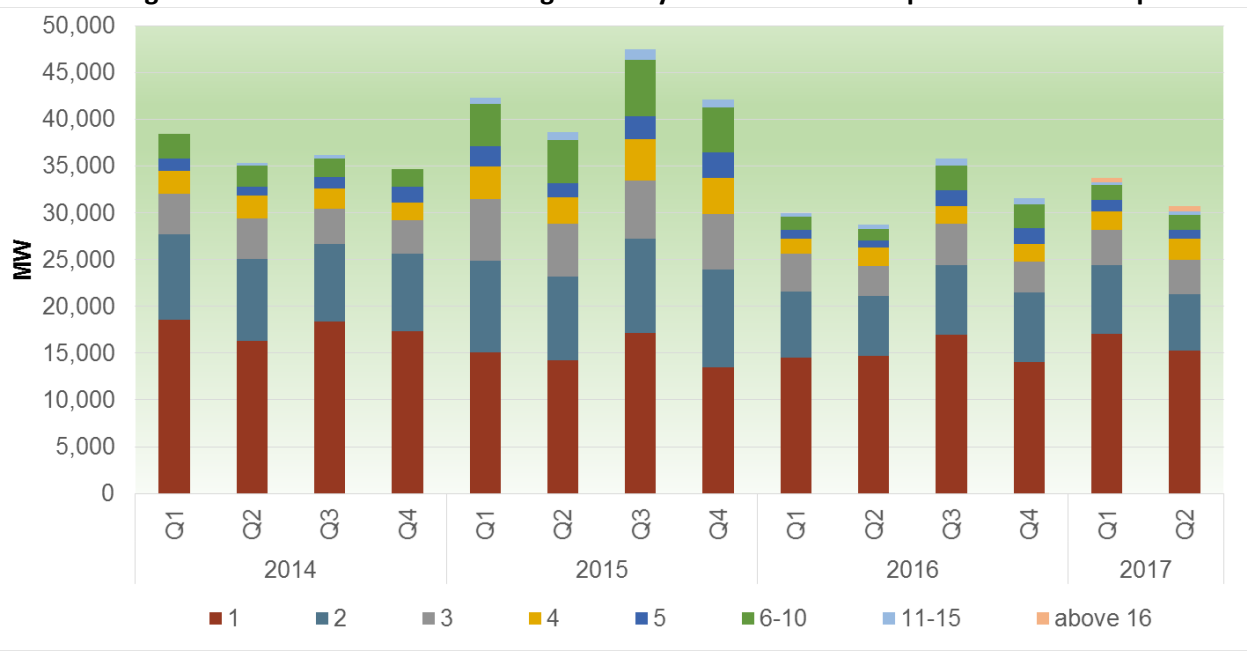


Figure 10: Volume of annual CRR organized by number of awards per definition –Off peak

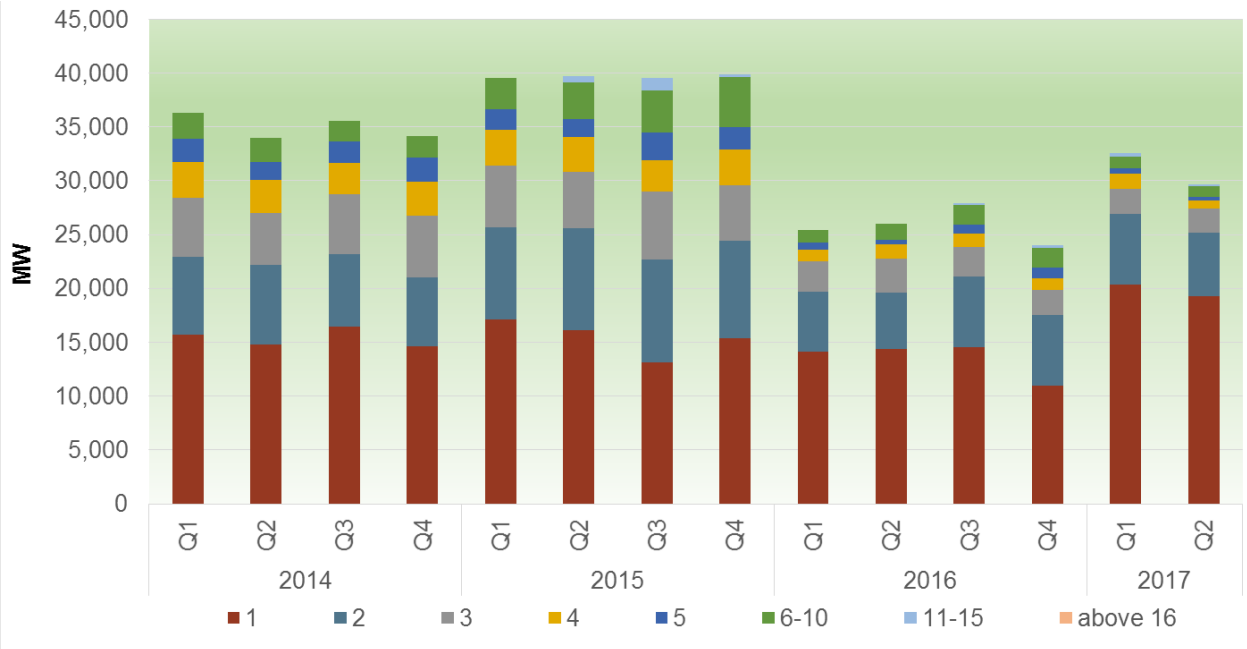


Figure 11: Volume of monthly CRR organized by number of awards per definition –On peak

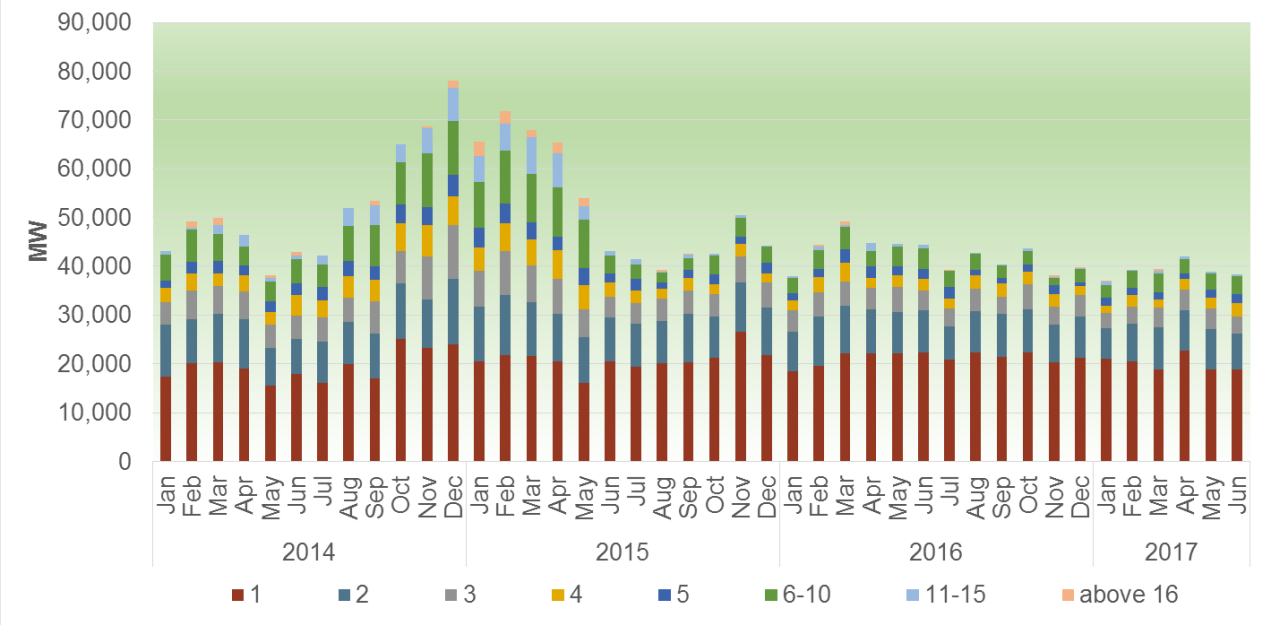
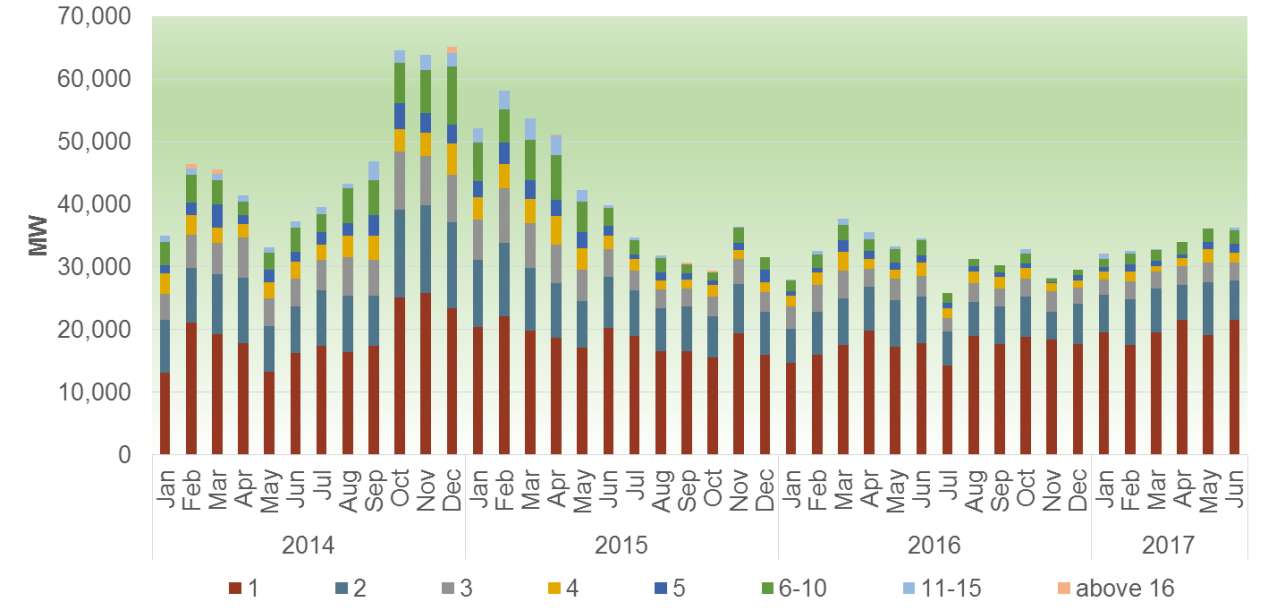


Figure 12: Volume of annual CRR organized by number of awards per definition –On peak



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

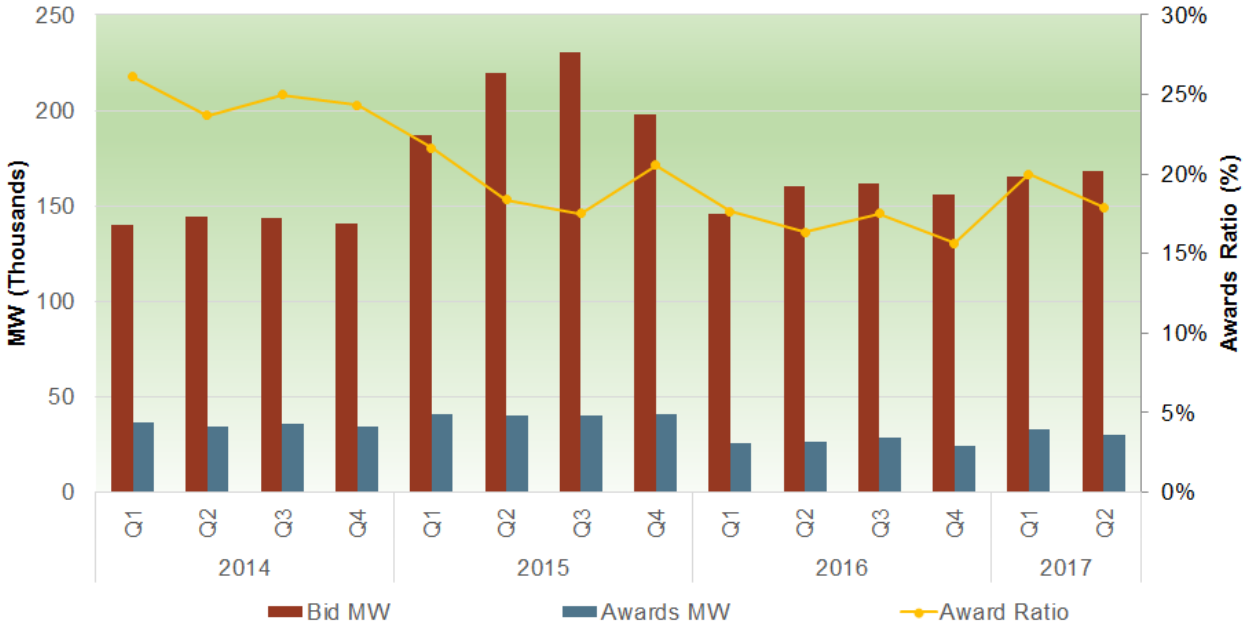


Figure 14: Volume of bids and awards in annual auctions for on peak

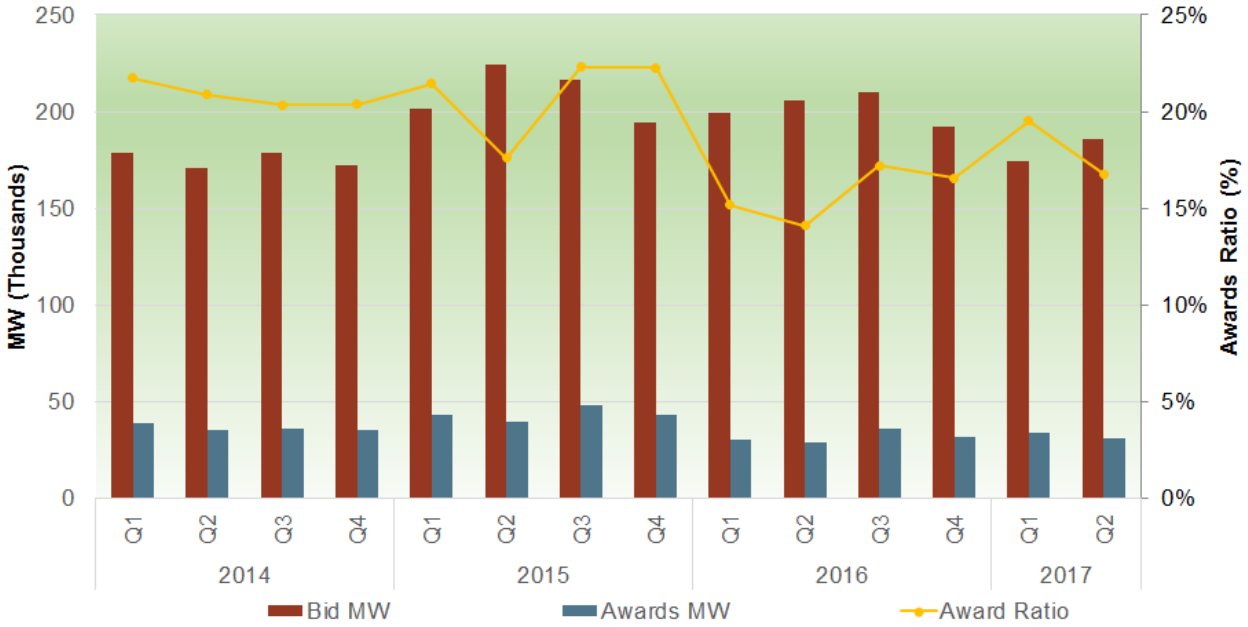


Figure 15 shows the trend of bid-in and award volumes in monthly auctions for the Off-peak period, organized by month and year. The awards for the Off-peak period, have been steady and clearing at about 31,000 to 36,000 MW in the last two years.

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

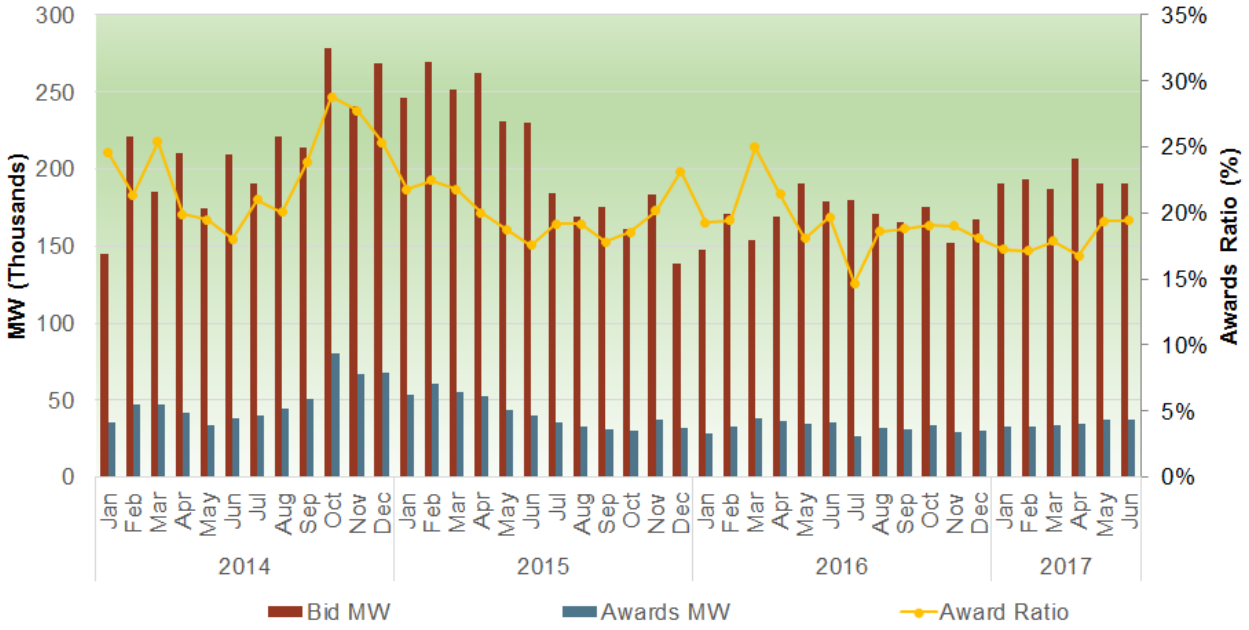
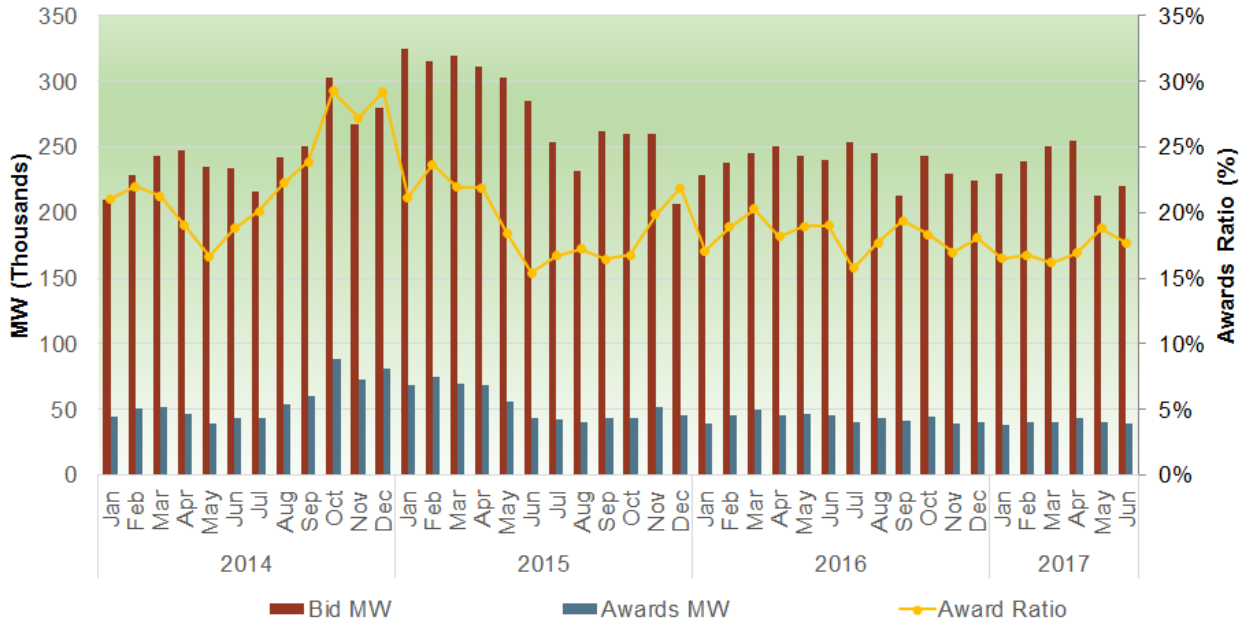


Figure 16 shows the trend of the bid-in volume compared to the volume of awards for monthly auctions for on-peak and shows that bid-in volume has been steady with a slight increase in 2015, ranging from about 220,000 to 320,000 MW. However the award ratio for on-peak period is about 15 to 20 percent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

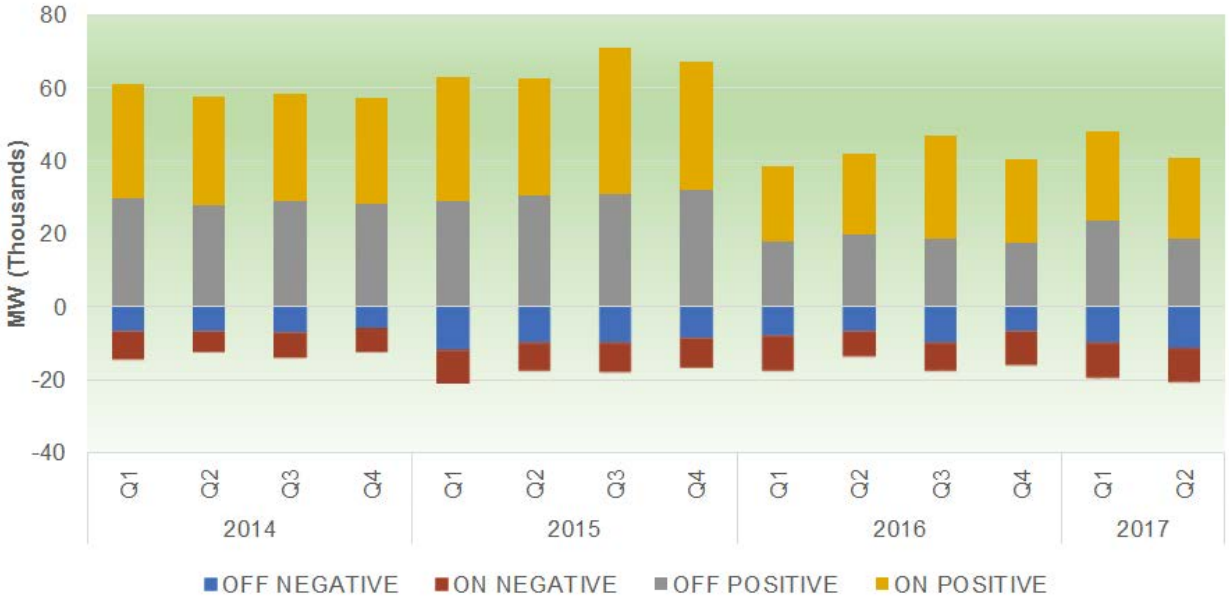
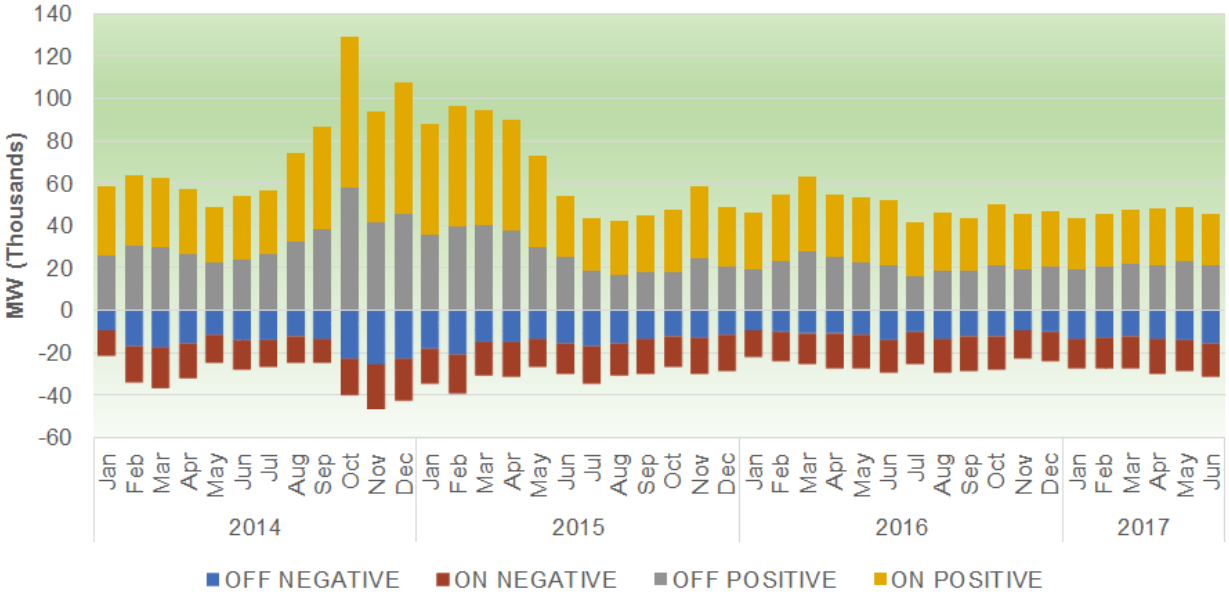


Figure 18: Volume of awards in monthly auctions by TOU



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

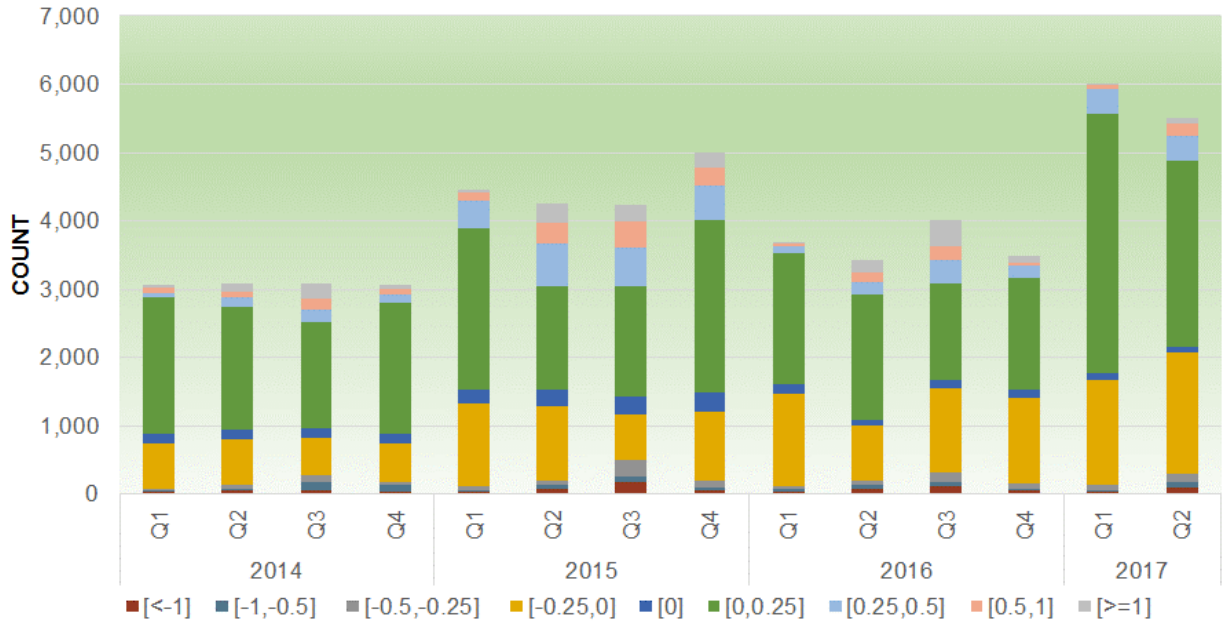
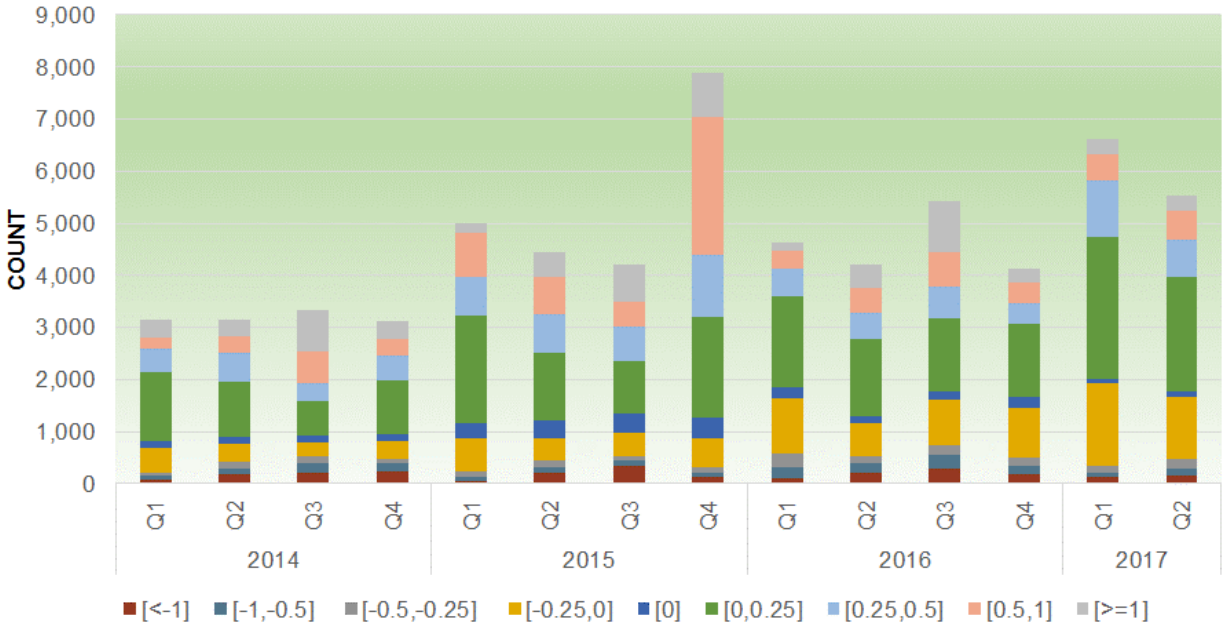


Figure 20: Hourly prices from annual auctions - On peak



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

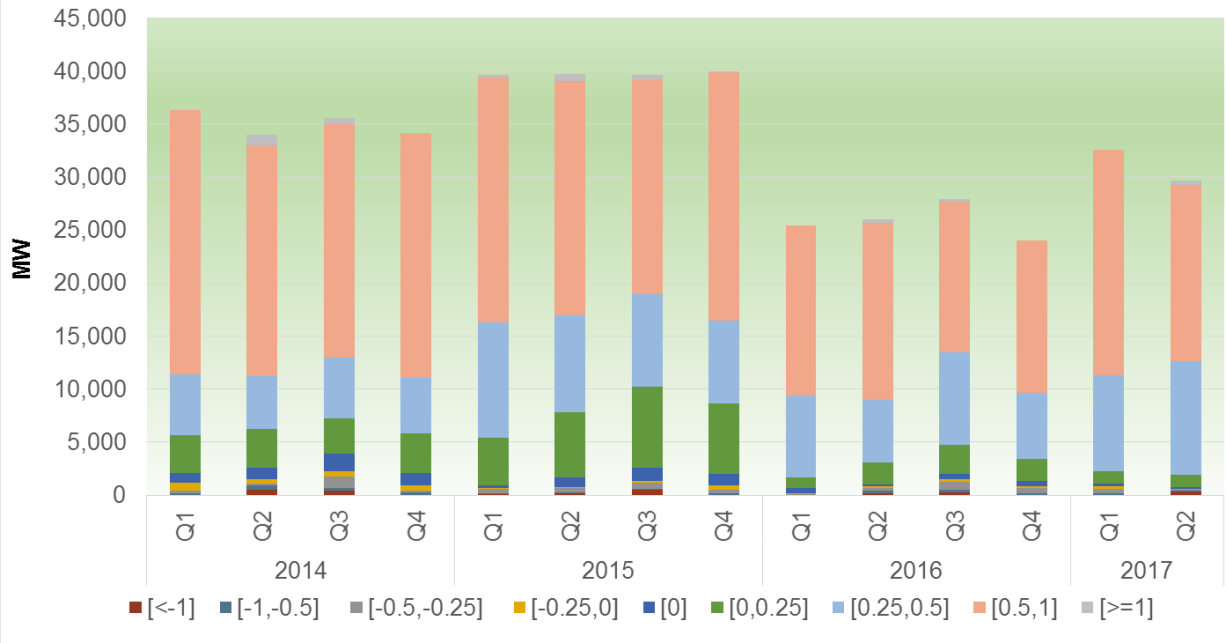


Figure 22: Volume of annual auction CRRs organized by prices from annual auctions - On peak

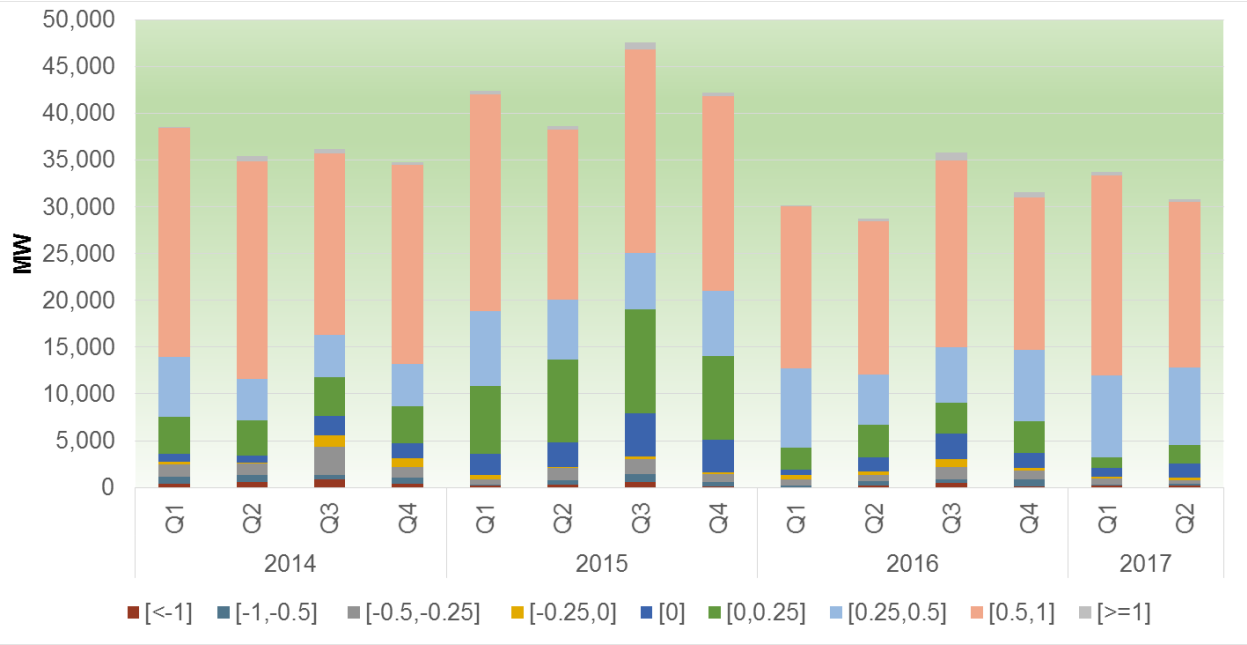


Figure 23 and Figure 24 shows the monthly auction prices organized by price ranges and TOU. Over time, most of the paths cleared in the monthly auctions fell in the price range of -0.25 and 0.25 $/MWh. This trend is indeed more vivid in the Off-peak periods, in which about 92 percent of the paths were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

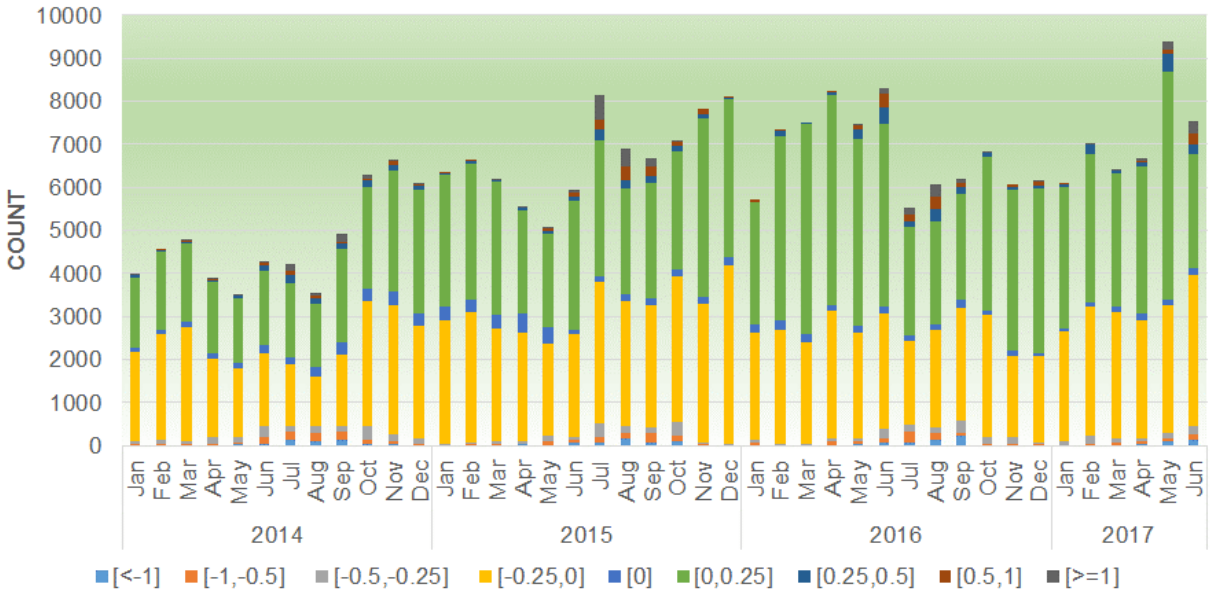
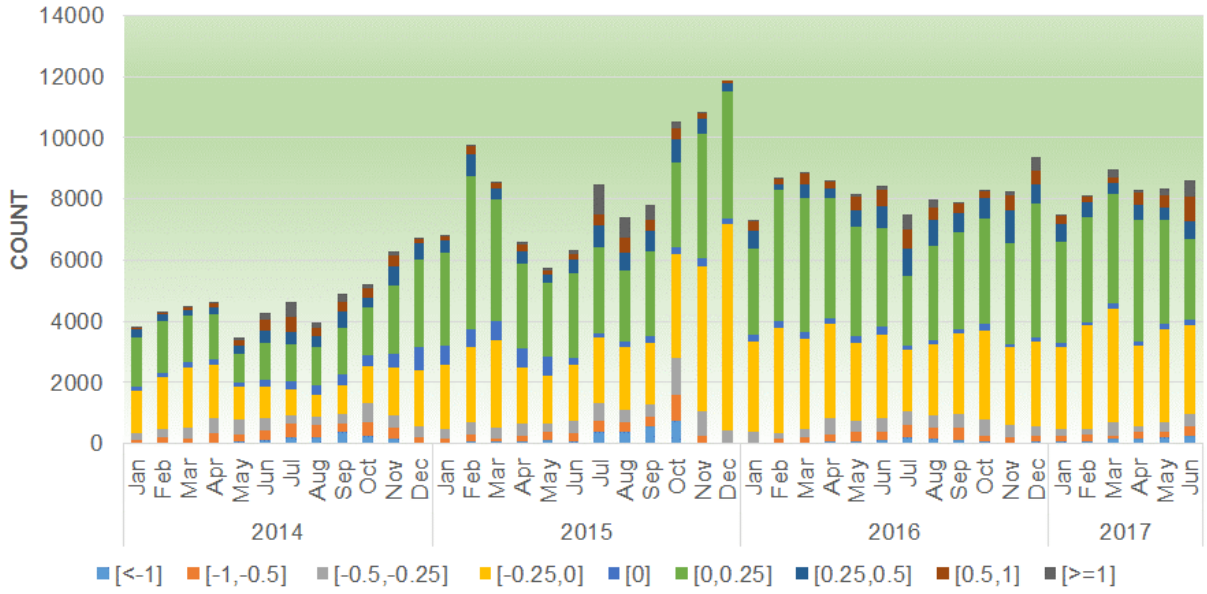


Figure 24: Hourly prices from monthly auctions - On peak



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

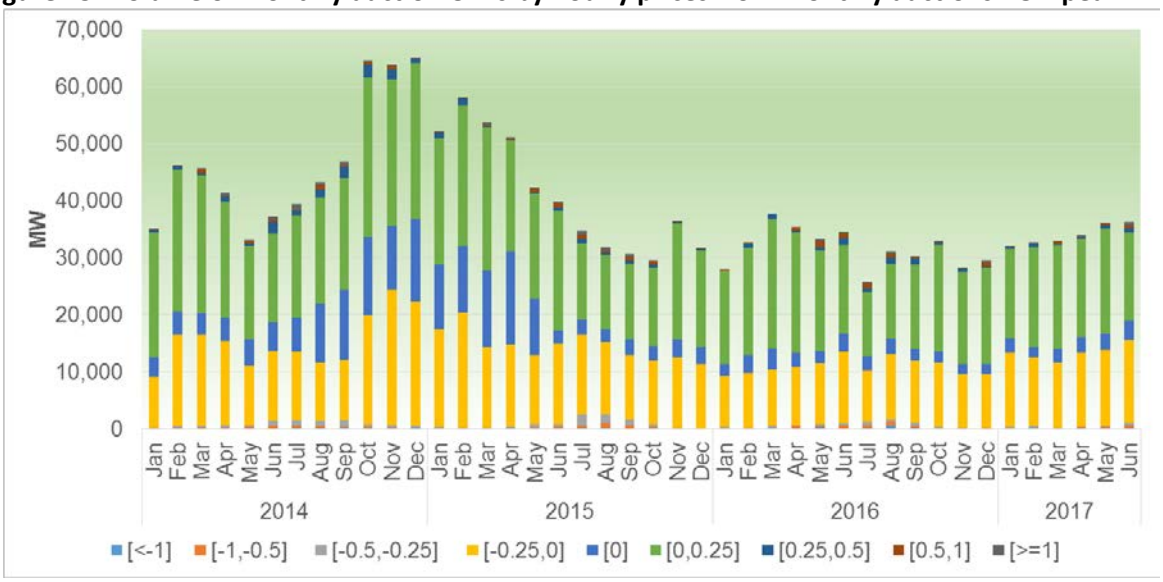
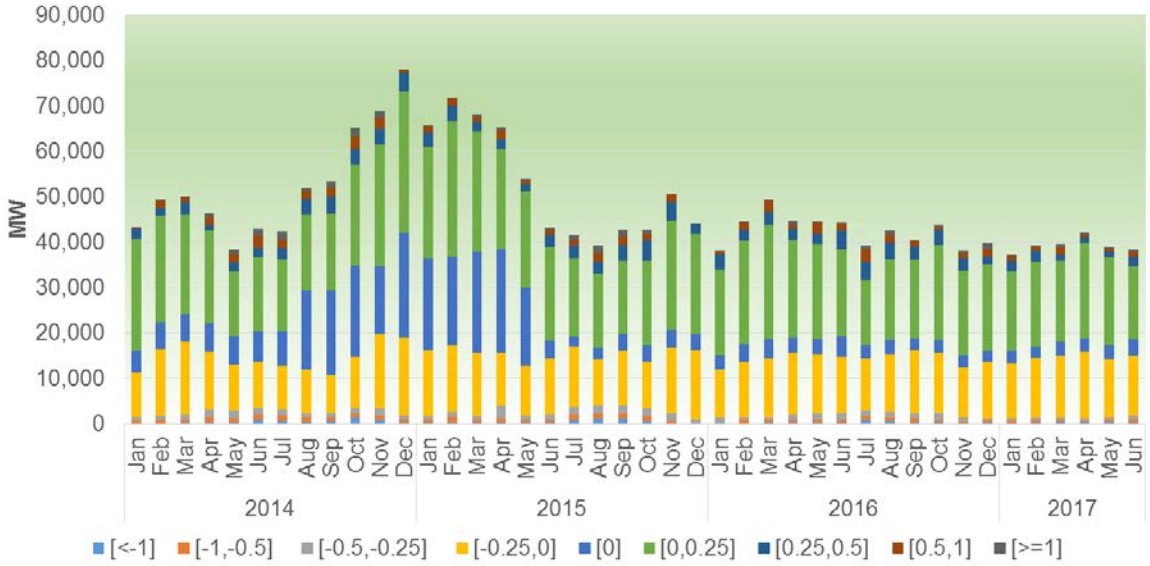


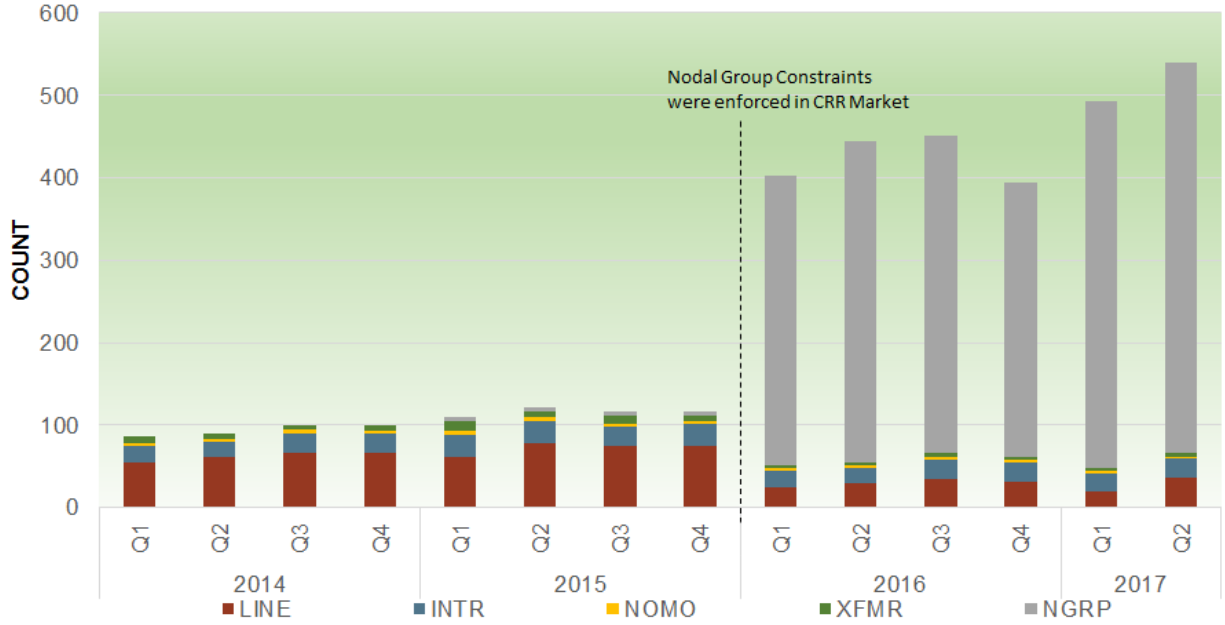
Figure 26: Volume of monthly auction CRRs by hourly prices from monthly auctions - On peak



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

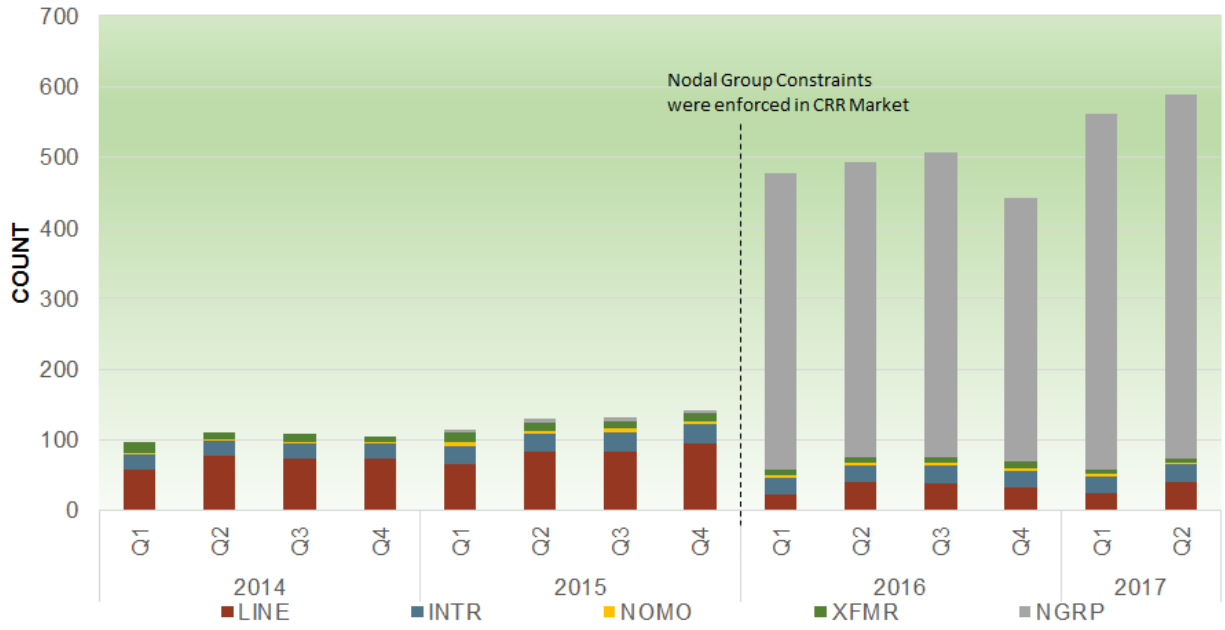


Figure 29 and Figure 30 show the trends of binding constraints in CRR monthly auctions. Similarly, these figures show that in the monthly auctions there was a significant increase in binding constraints for both Off- and On-peak periods due to the introduction of nodal group constraints. Nodal group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

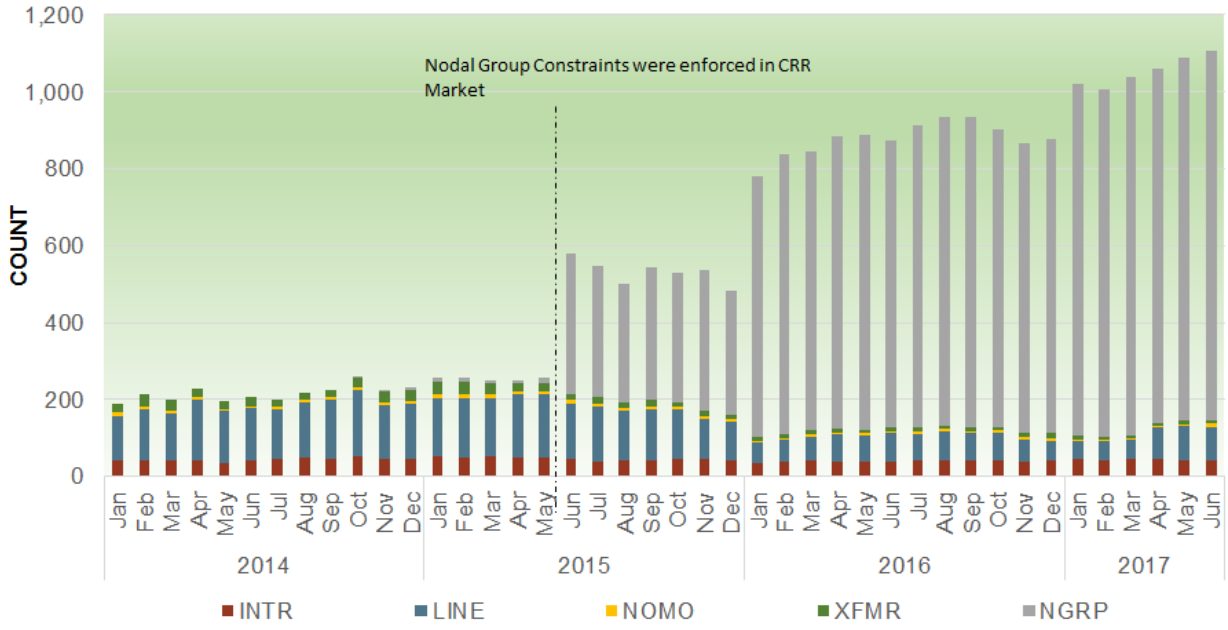
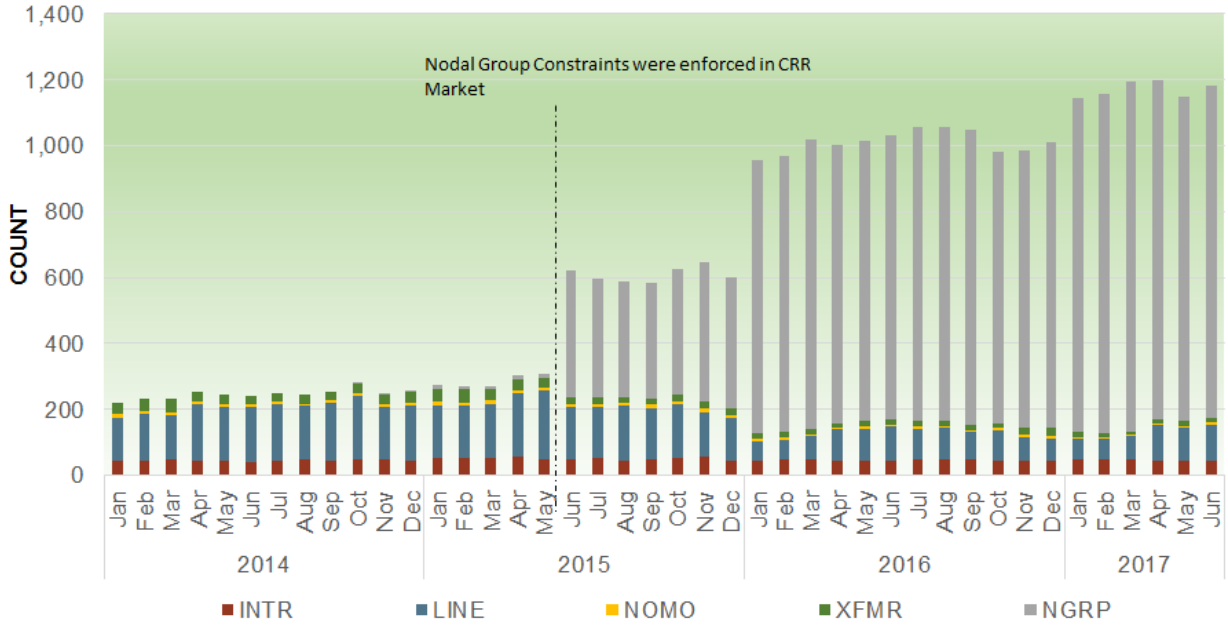


Figure 30: Number of binding constraints in monthly auctions by type -On peak



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

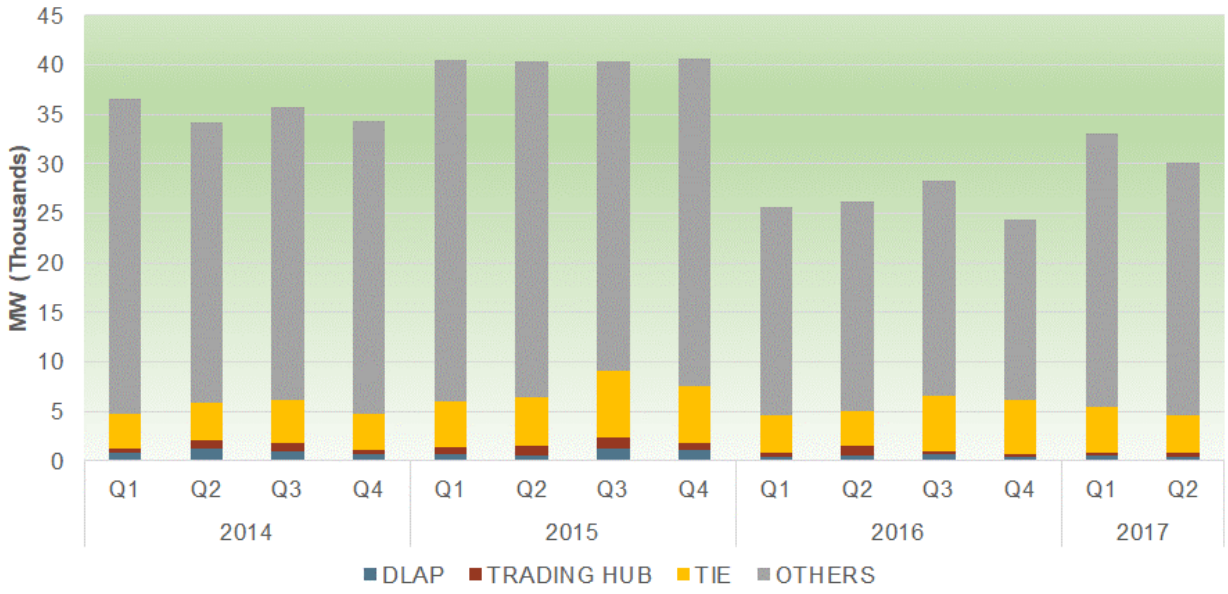
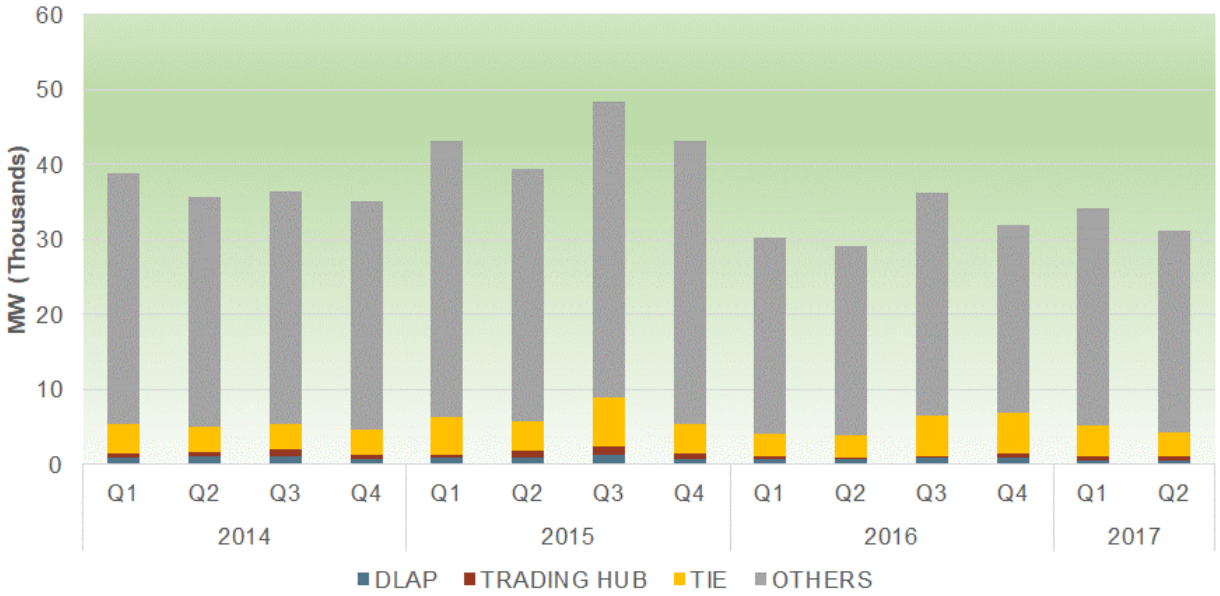


Figure 32: Volume of awards in annual auctions by source type - On peak



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

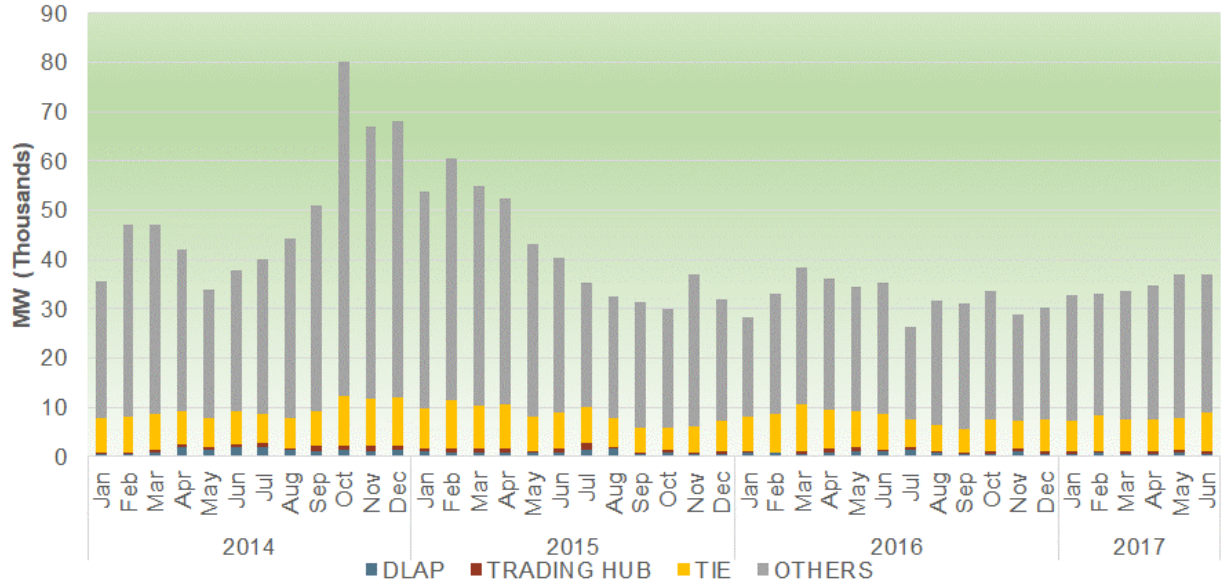
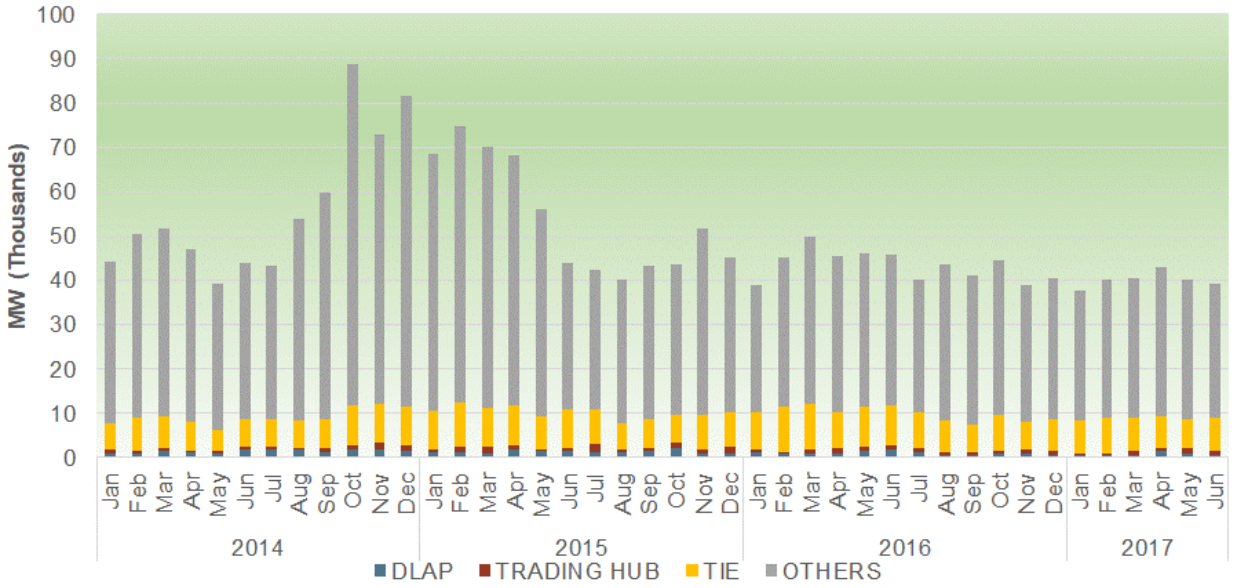


Figure 34: Volume of awards in monthly auctions by source type - On peak



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

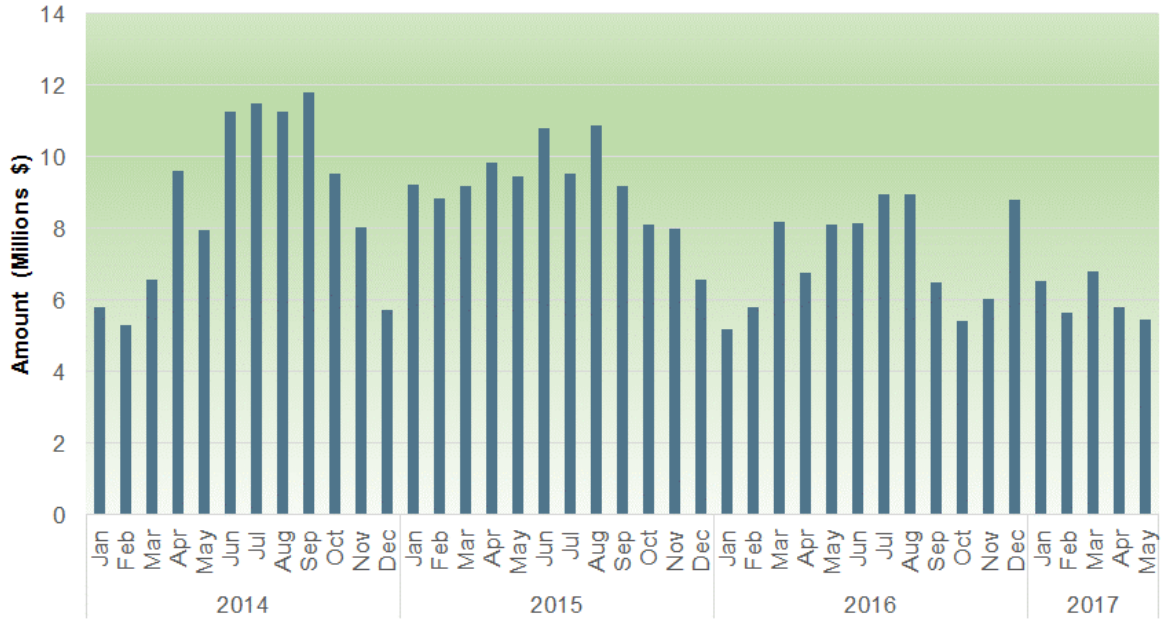
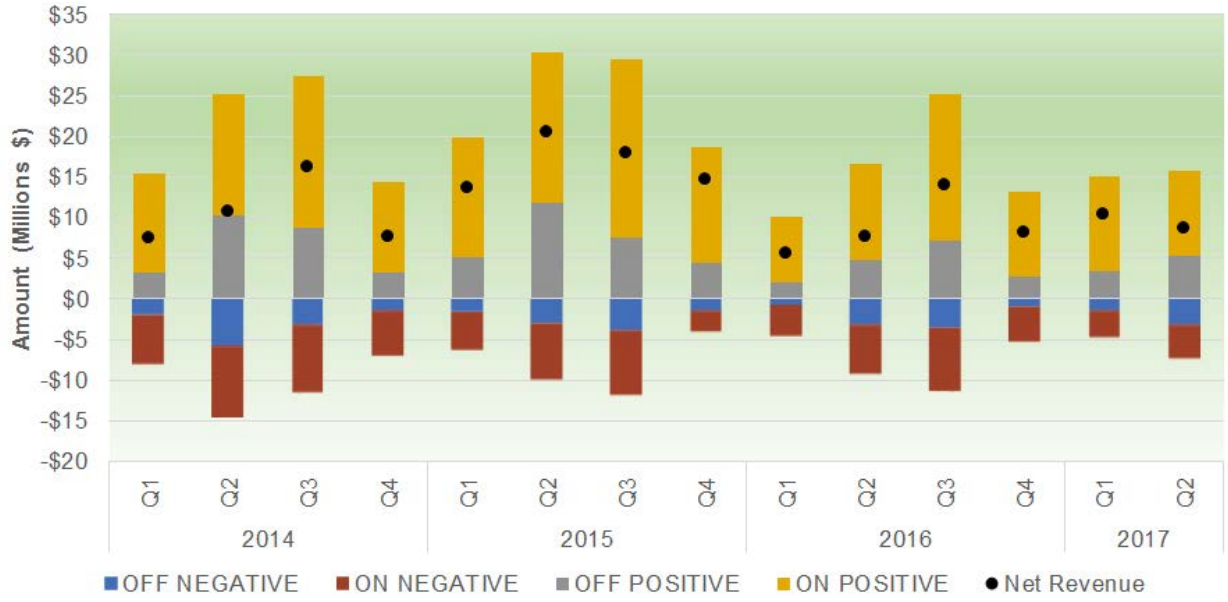


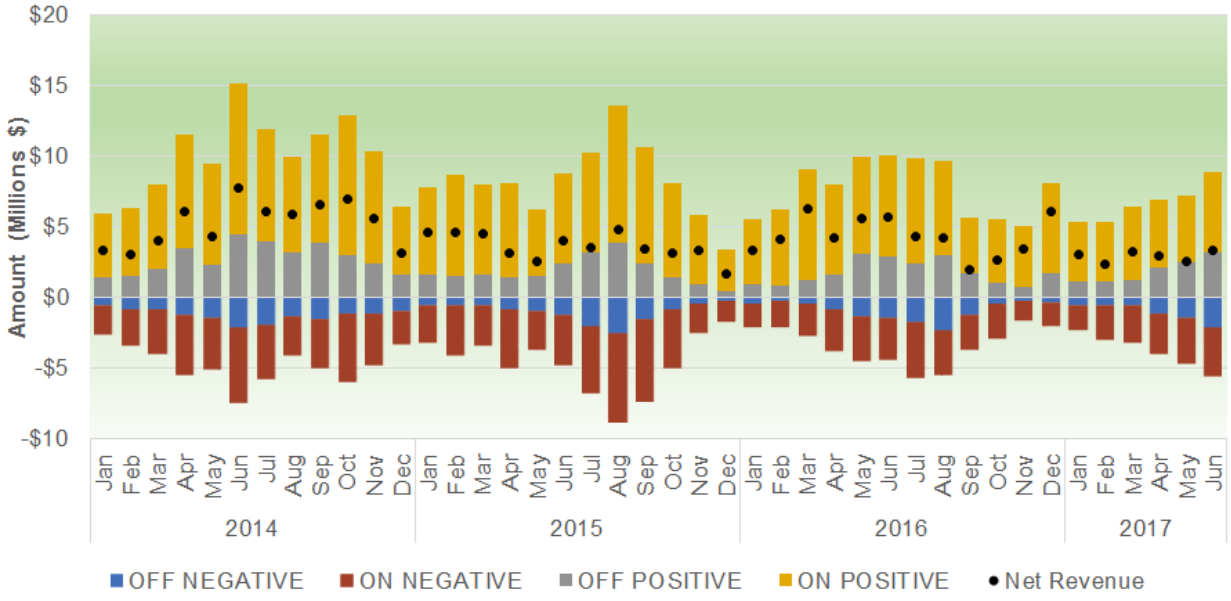
Figure 36 and Figure 37 show the auction revenues organized by positive and negative revenues in each TOU from annual and monthly auctions. These figures also show the net auction revenues collected by the ISO by TOU with a black dot on the chart. This net revenue illustration shows a trend with higher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

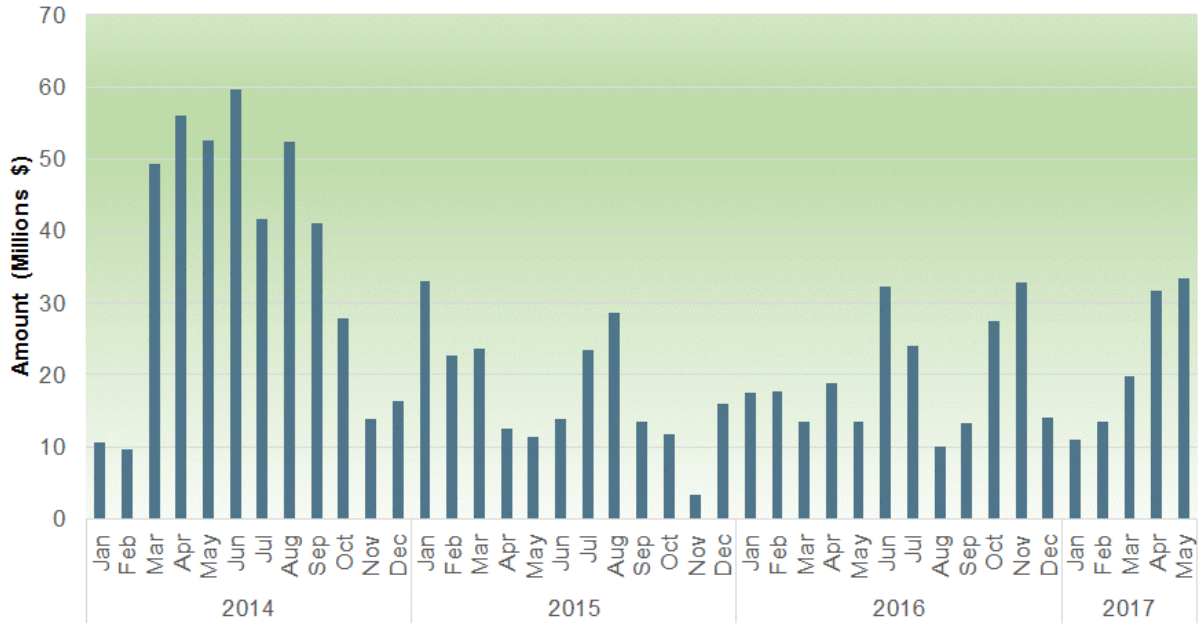
In addition, the revenue stream available from the IFM to fund the CRR payments are reduced by the amount to be paid back to holders of existing rights (TOR, ETC and CVR), as they are fully exempt from congestion charges. This requirement is contractual and is a tariff requirement[3]. The CAISO explicitly 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

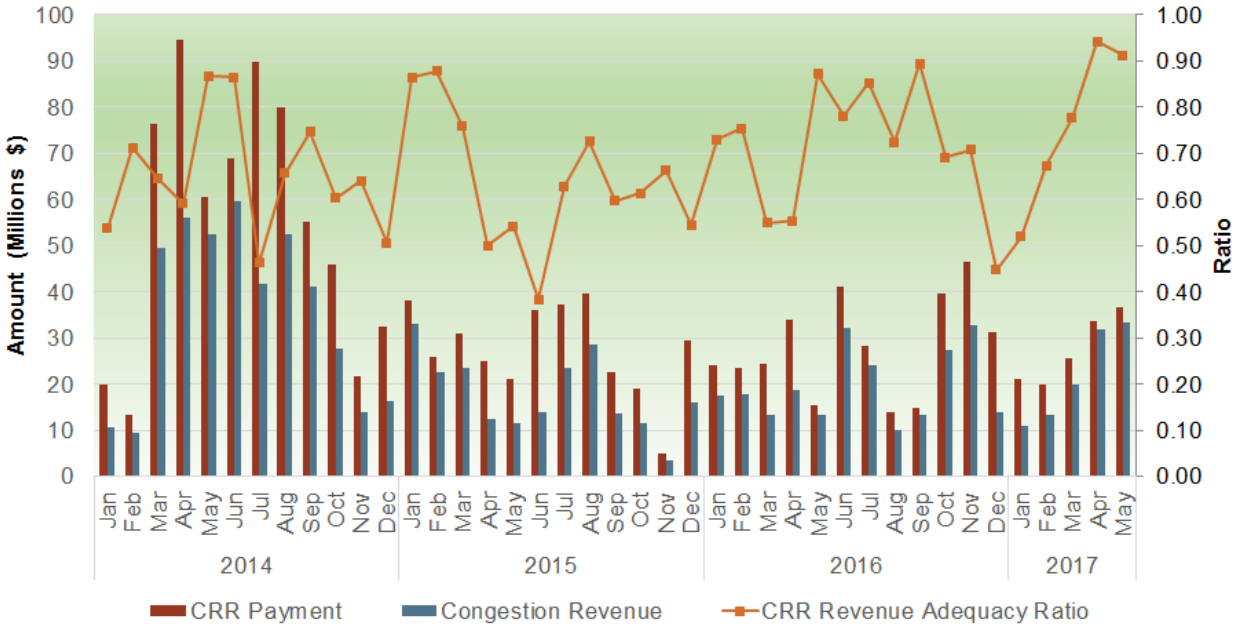


Figure 40 illustrates the monthly congestion revenue adequacy before including the auction revenues. Although auction revenues can be used to offset any CRR revenue deficiency that results from the IFM, the intention of the CAISO's CRR release process is that proceeds from the IFM will be sufficient 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

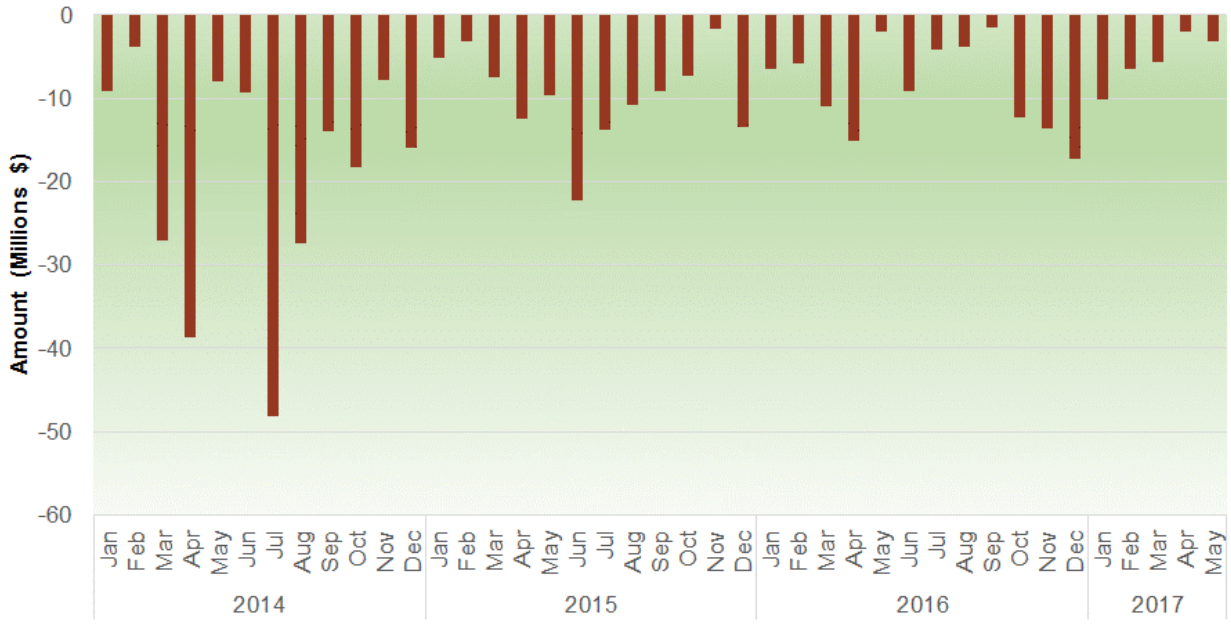


Figure 41: Monthly comparison of congestion rents incl. auction revenue with CRR entitlements

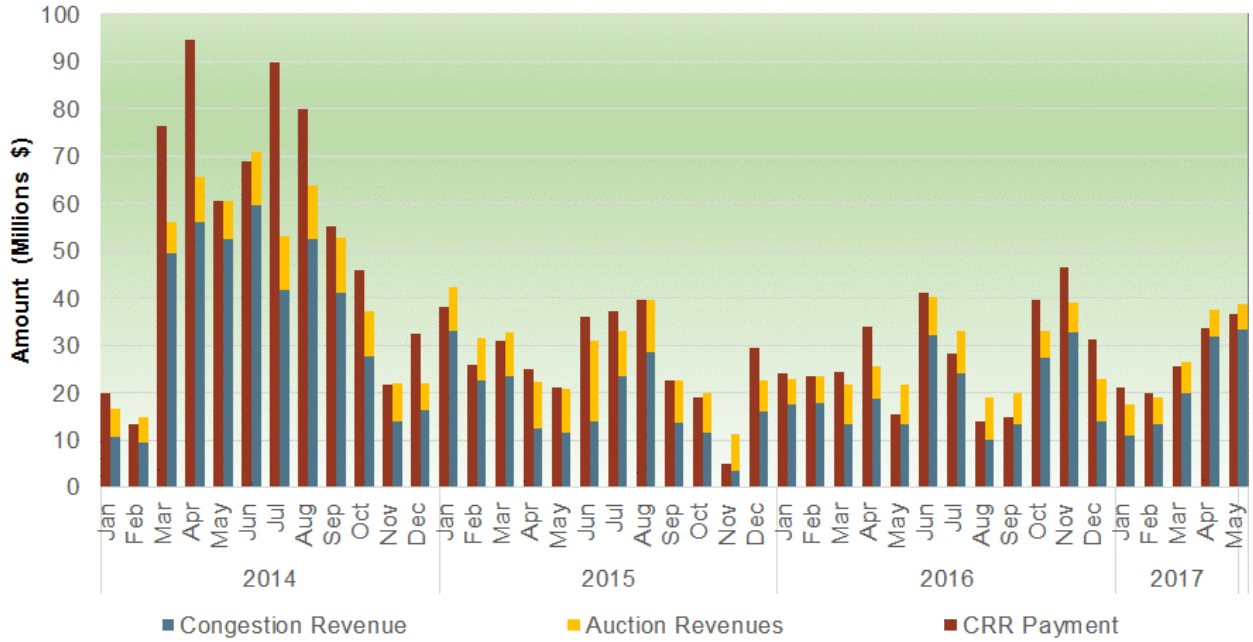


Figure 41 shows the comparison of congestion rents from IFM with CRR payments; this also includes the auction revenues from the monthly and annual CRR auctions. Similarly, Figure 42 shows the difference between congestion rent from IFM and CRR payments including the auction revenue to check if the proceeds 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

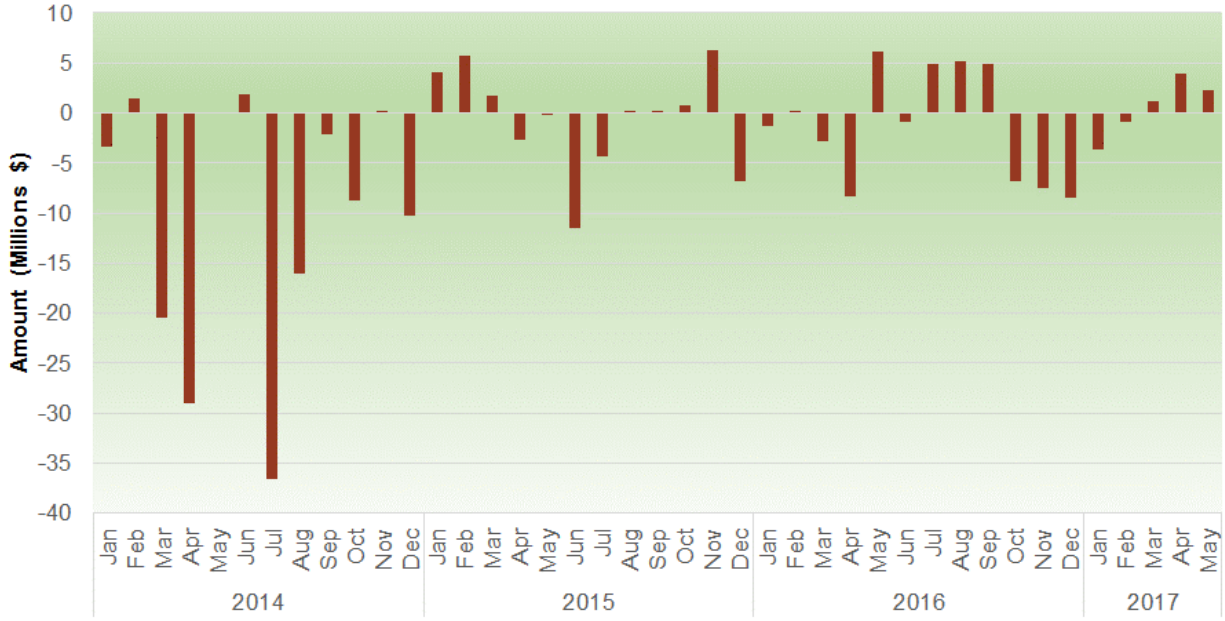
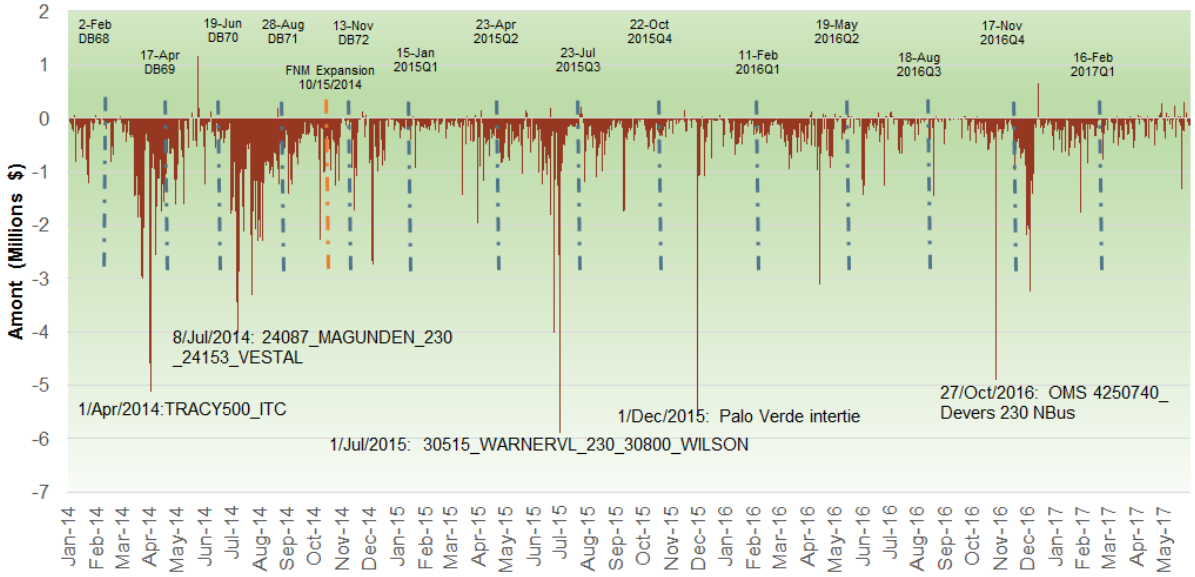


Figure 43: Daily CRR revenue adequacy

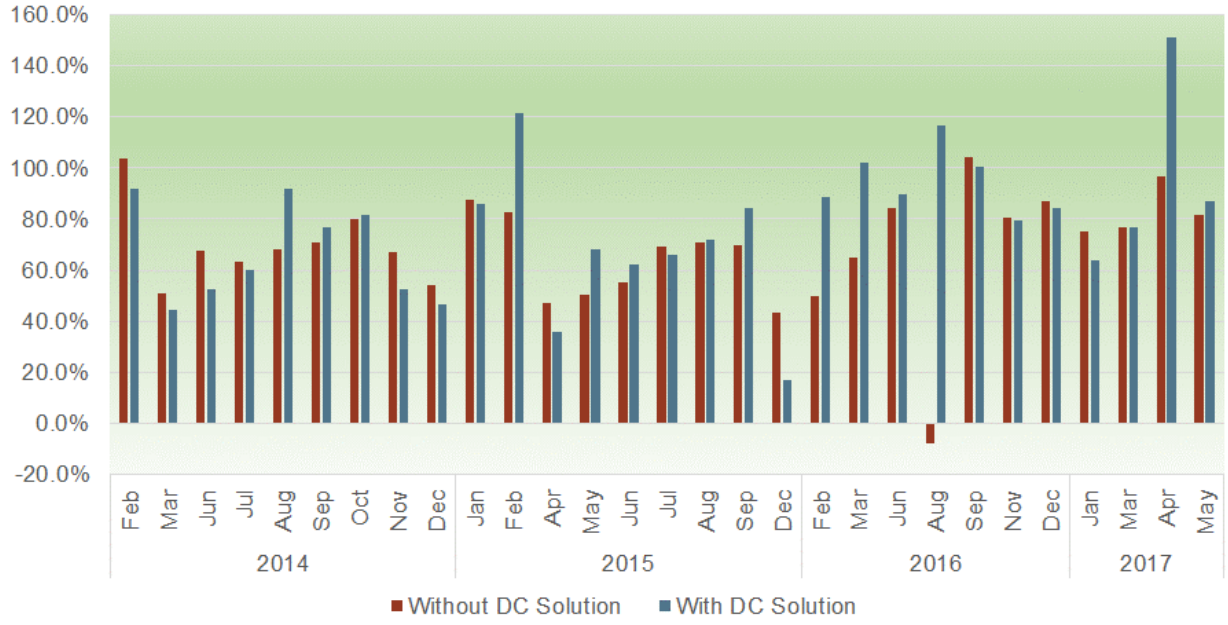


DC solutions and CRR revenue shortfalls

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).

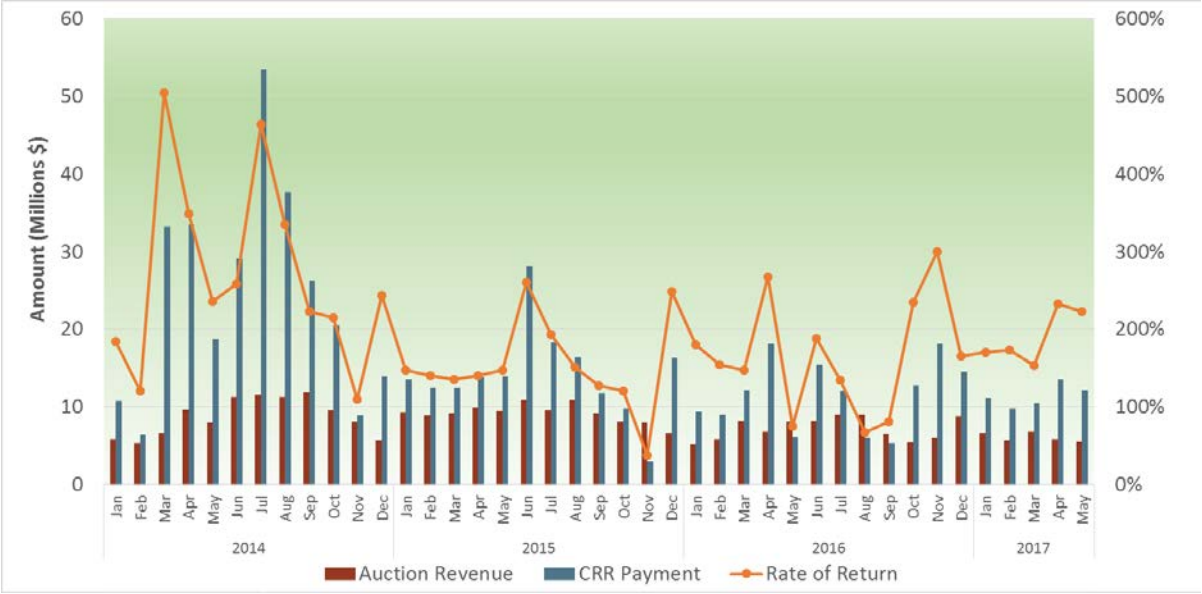
Figure 44: CRR revenue adequacy ratio - for trade dates with DC solution in IFM



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

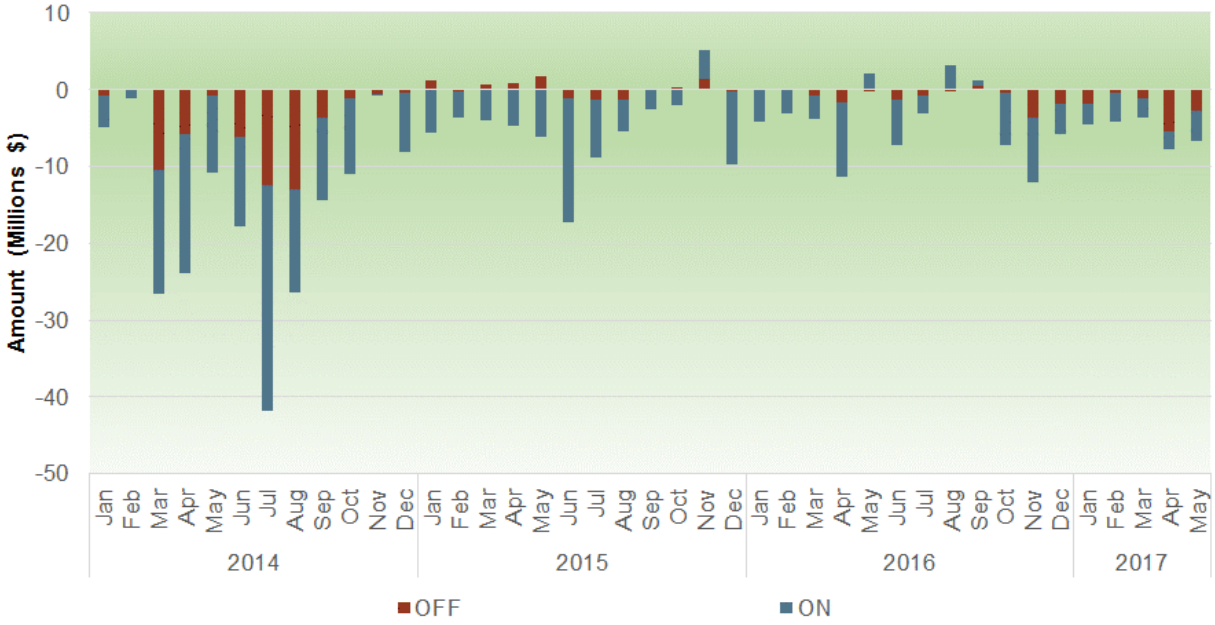
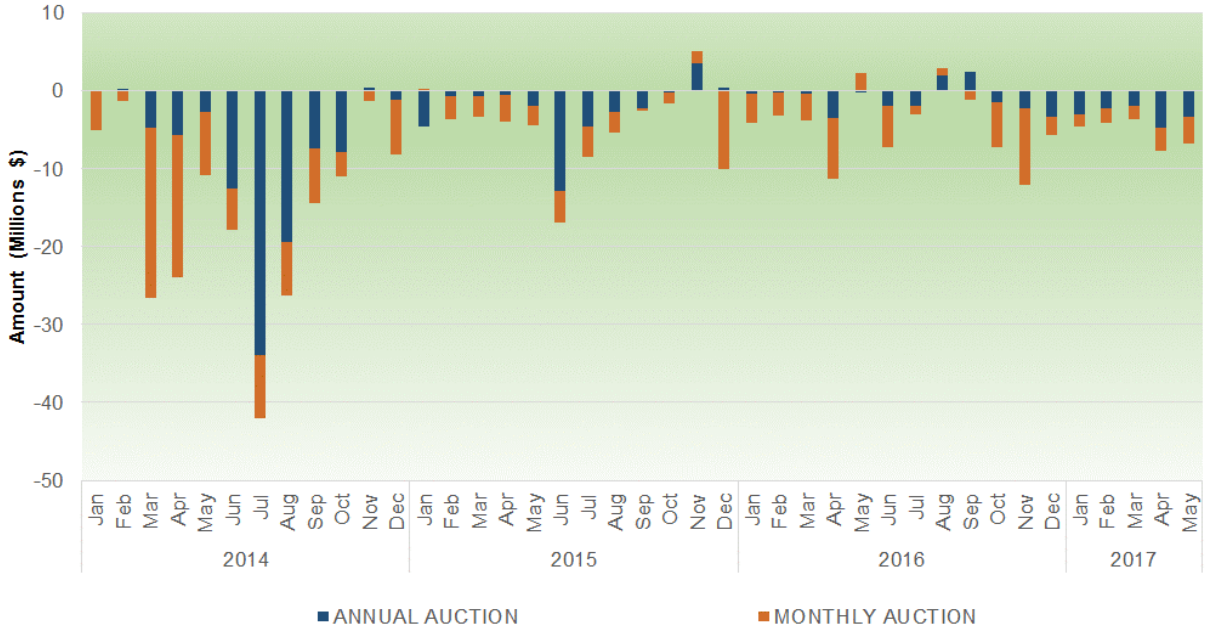


Figure 47 shows the net CRR payments for CRRs organized by annual and monthly auctions. The trend shows that the difference between the payments from the auction CRRs and auction revenues are evenly distributed between the monthly auction market and the annual auction market. The net CRR payments to 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).

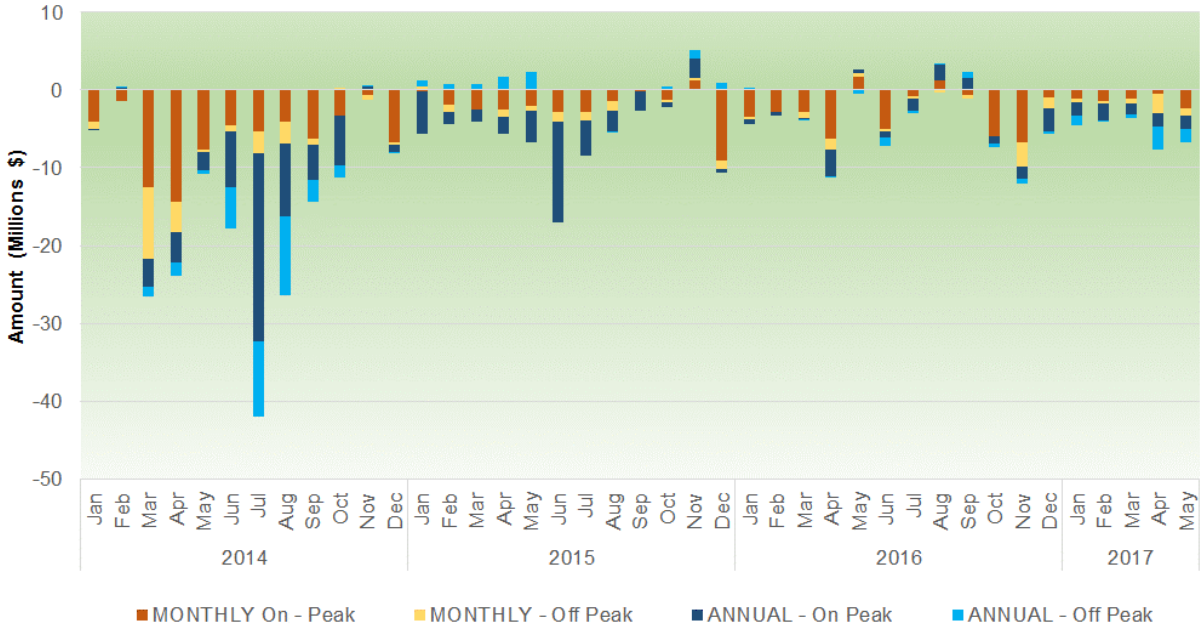
Figure 47: Net CRR payments to CRRs released in the monthly auctions



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

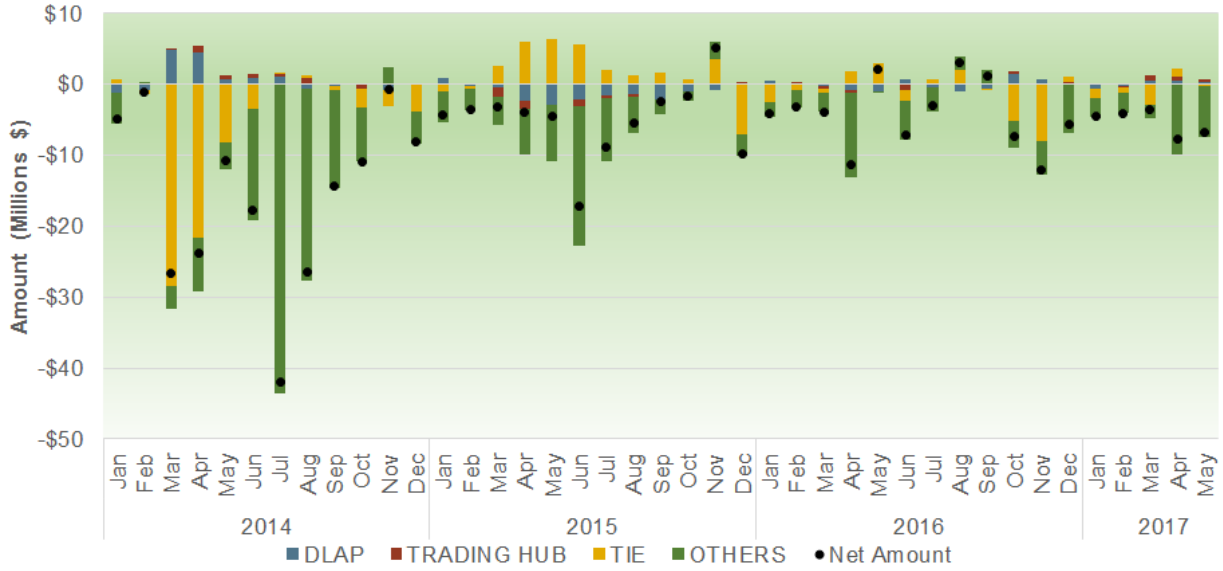
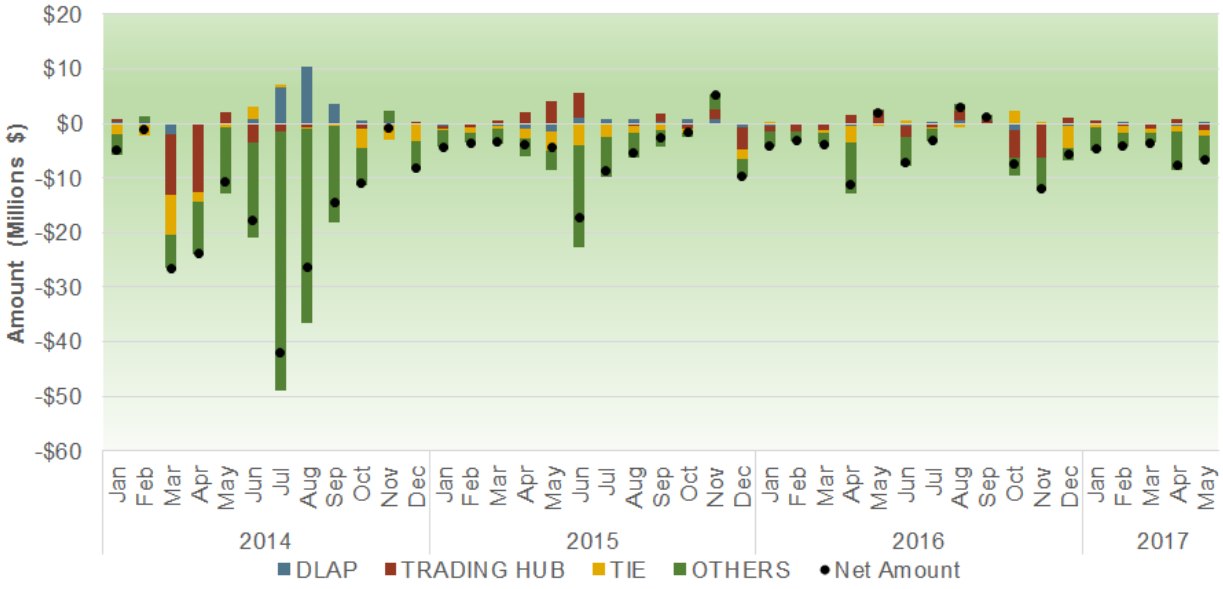


Figure 50 shows a similar metric by grouping the net CRR payments by type of sink location. This trend shows that overtime a particular sink type, namely the *Others*, has been the most lucrative sink for the auction CRR holders.

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

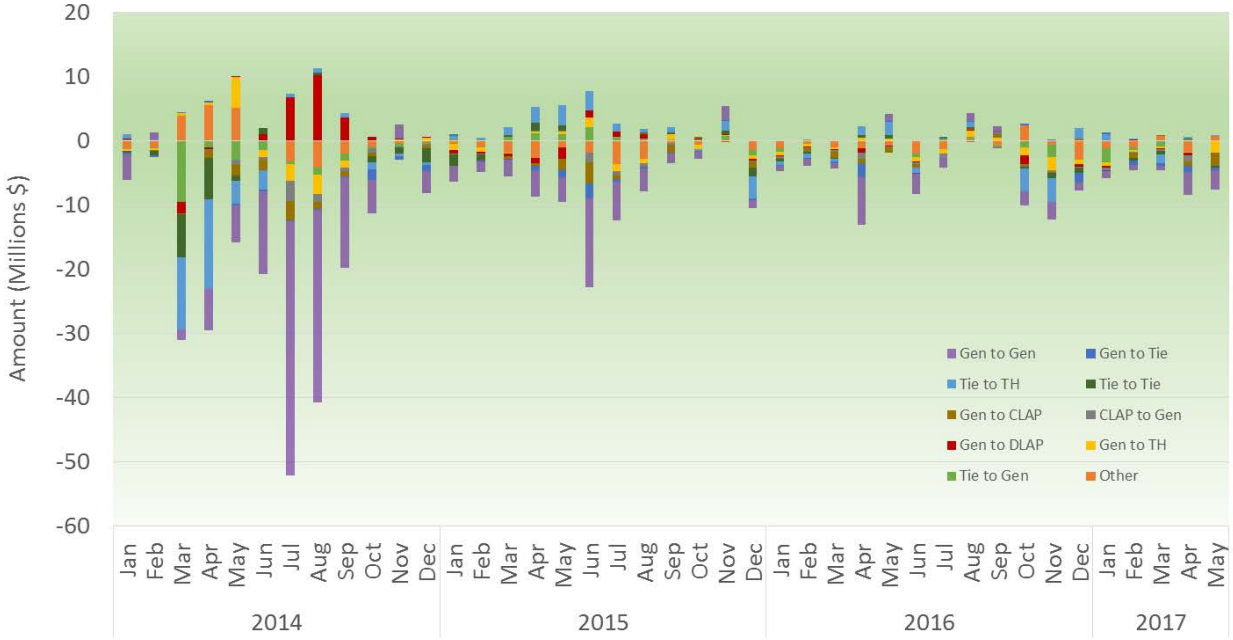


Table 1 summarizes the net CRR payments accrued on all potential combinations of location type to be used as source and sinks in auction CRRs. The summary is broken out by year. The columns list the different types of sinks while the rows shows the different types of sources; the diagonal entries will 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

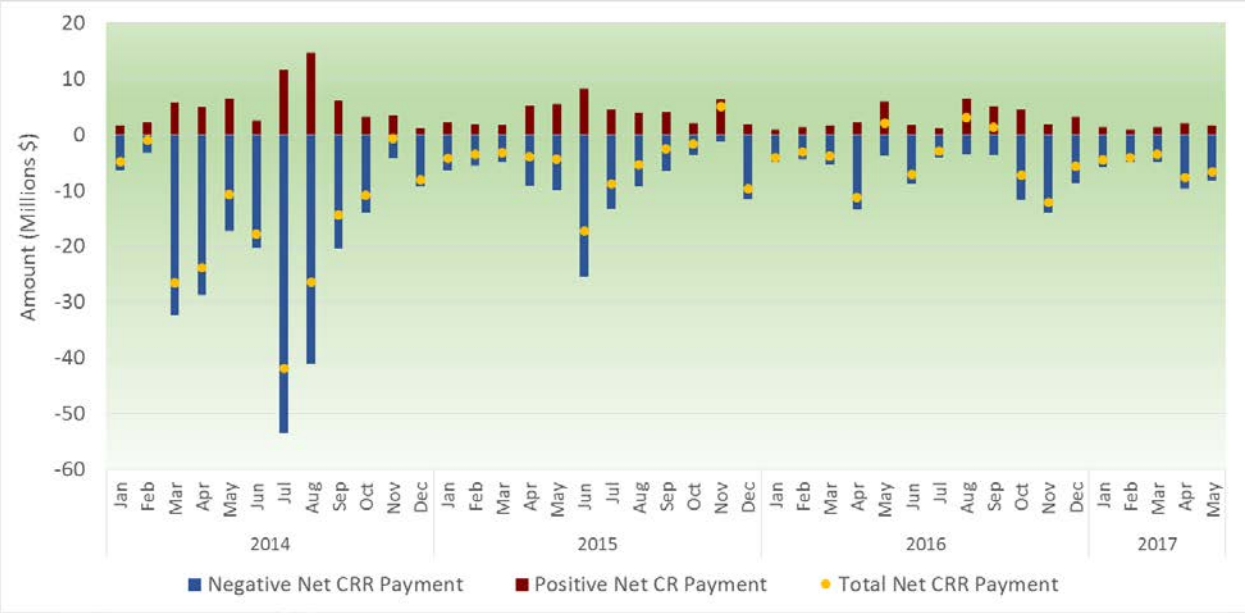


Figure 53 shows the frequency of auction CRRs that have payments less than the money collected through auction revenues. For some cases, a CRR holder might take a counter flow position and it might be a payment to the CRR holders in auction revenues. It shows that about 25 percent of CRRs have less payments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

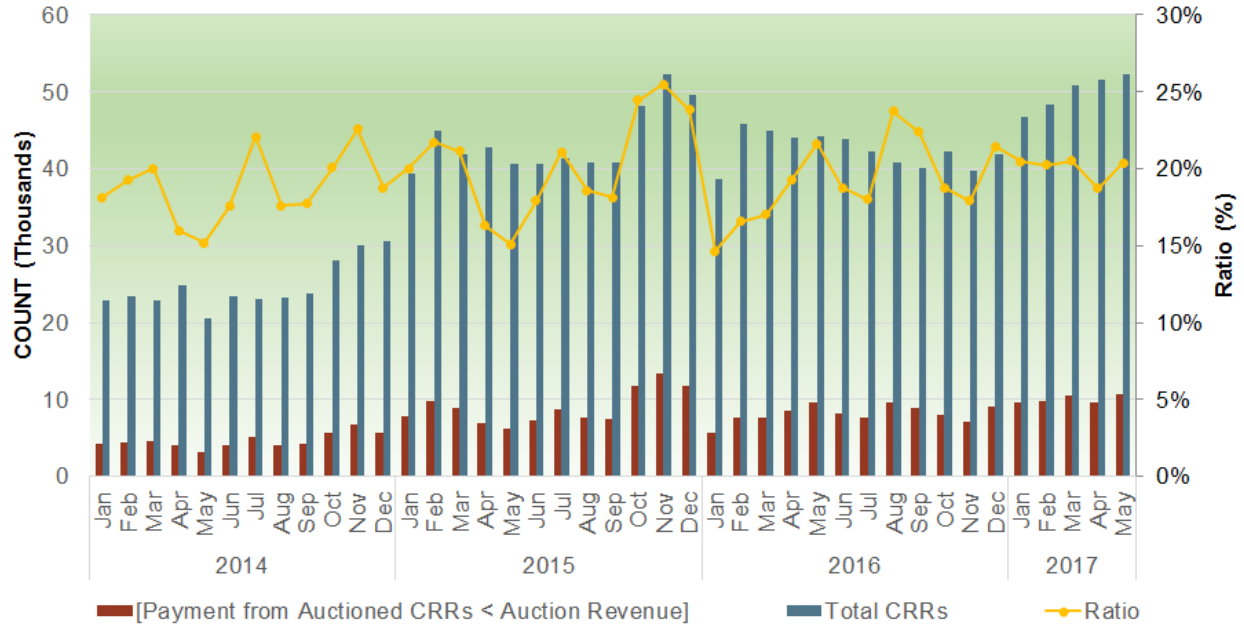
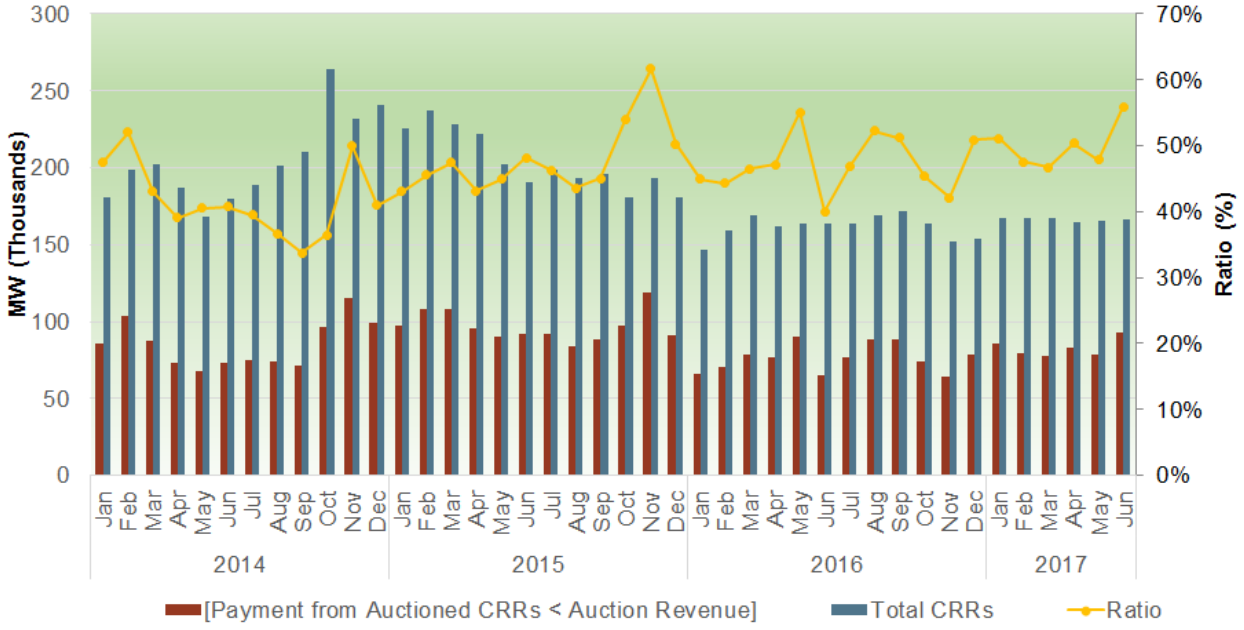


Figure 54: CRR awards with CRR payments less than auction revenues



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.

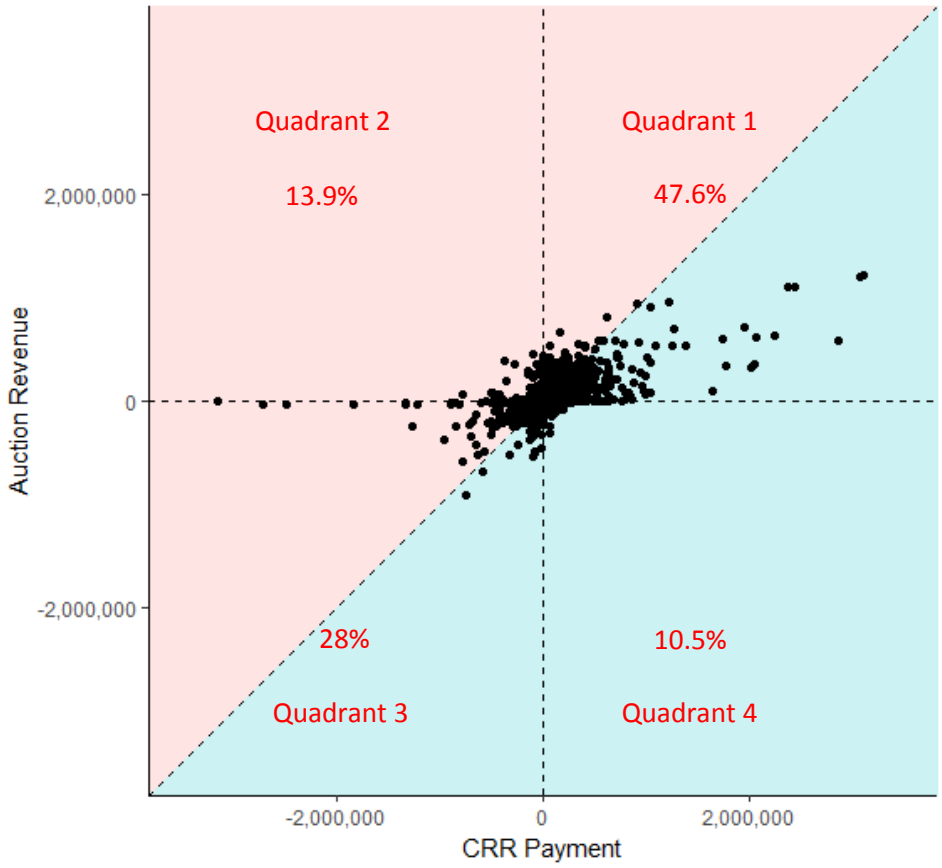
The scatter plot is divided into four quadrants with the following characterizations:

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

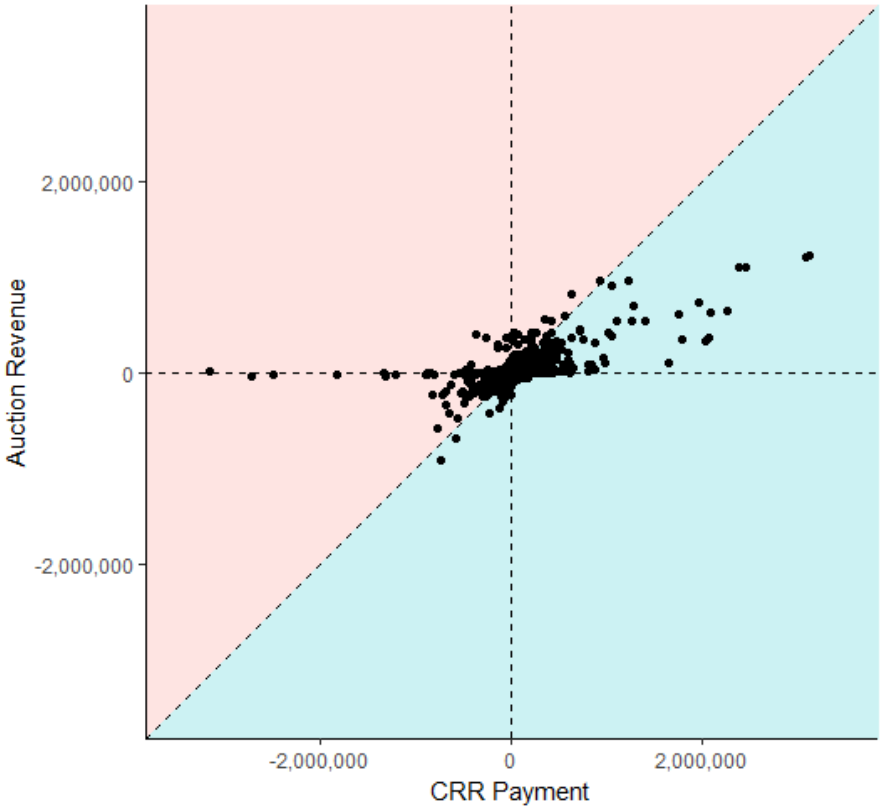


Figure 57: Spread of auction revenues vs CRR entitlements for auction CRRs – 2015

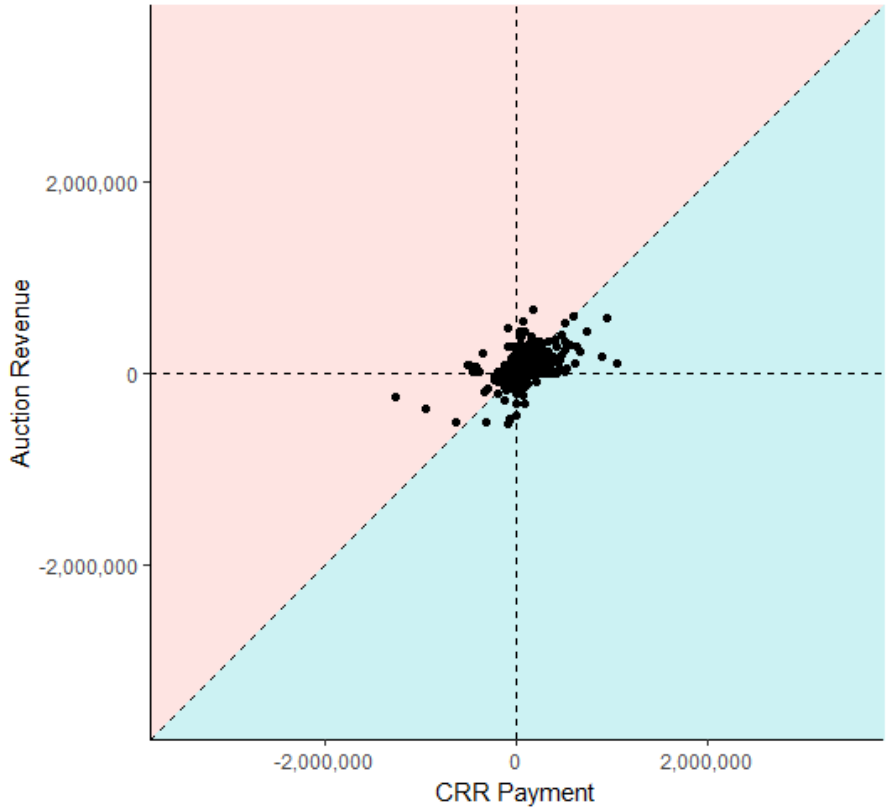


Figure 58: Spread of auction revenues vs CRR entitlements for auction CRRs - 2016

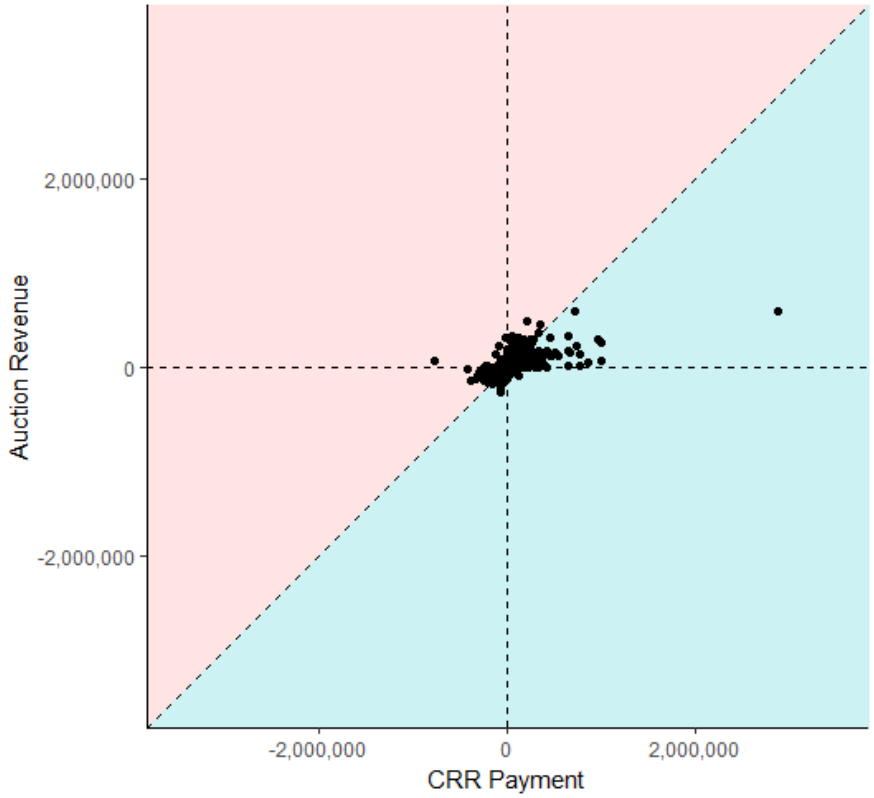


Figure 59: Spread of auction revenues vs CRR entitlements for auction CRRs – 2017

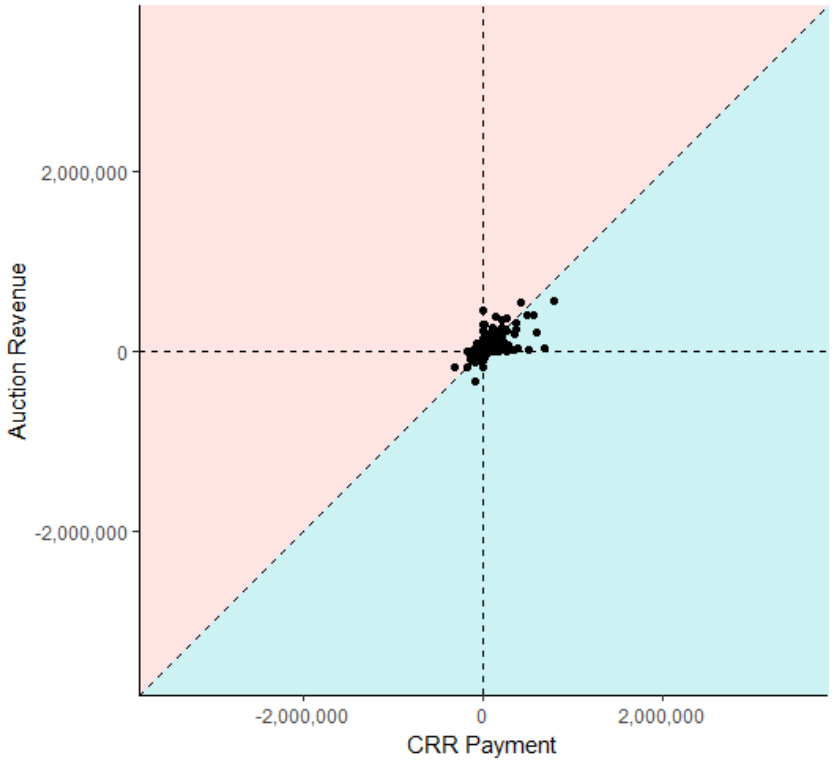


Figure 60 shows the scatter plot comparing the auction revenues and CRR payments organized by CRR holder instead of CRR award. For this metric, all of the auction revenues and payments are summed up for each CRR holder (for all their CRR positions). It shows that there are a few CRR holders that were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

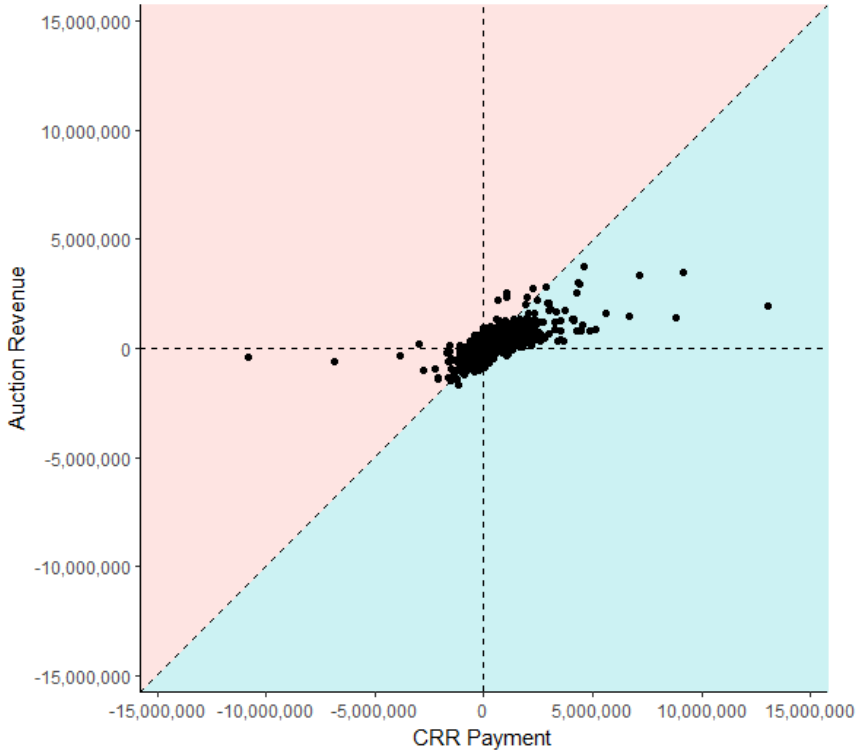


Figure 61: Spread of auction revenues vs CRR payments by CRR holder – 2014

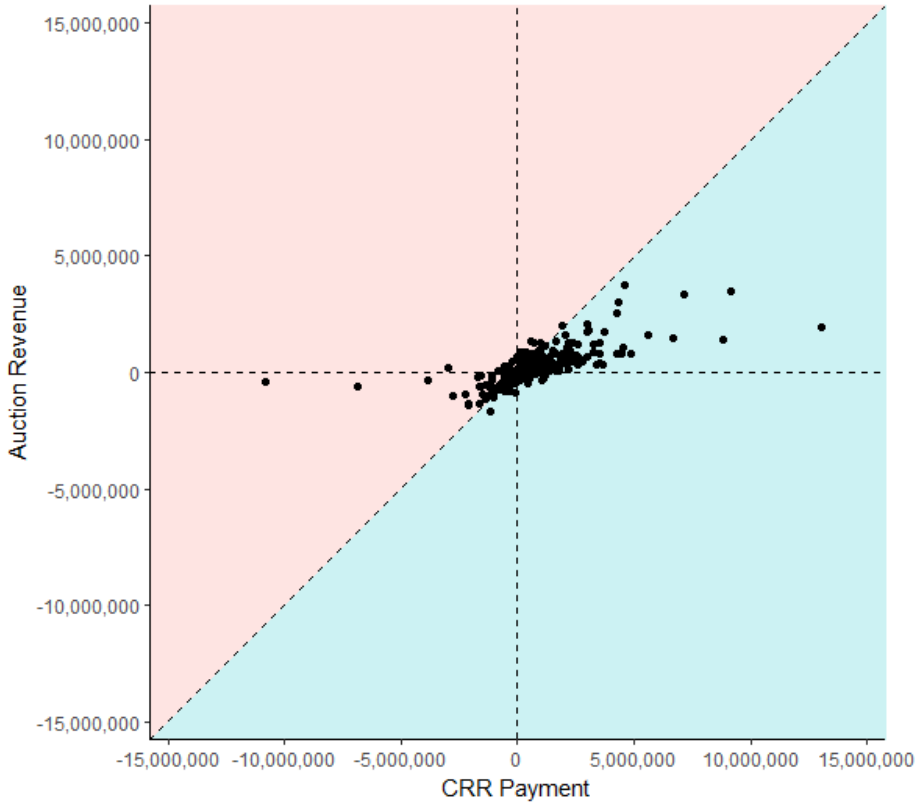


Figure 62: Spread of auction revenues vs CRR payments by CRR holder – 2015

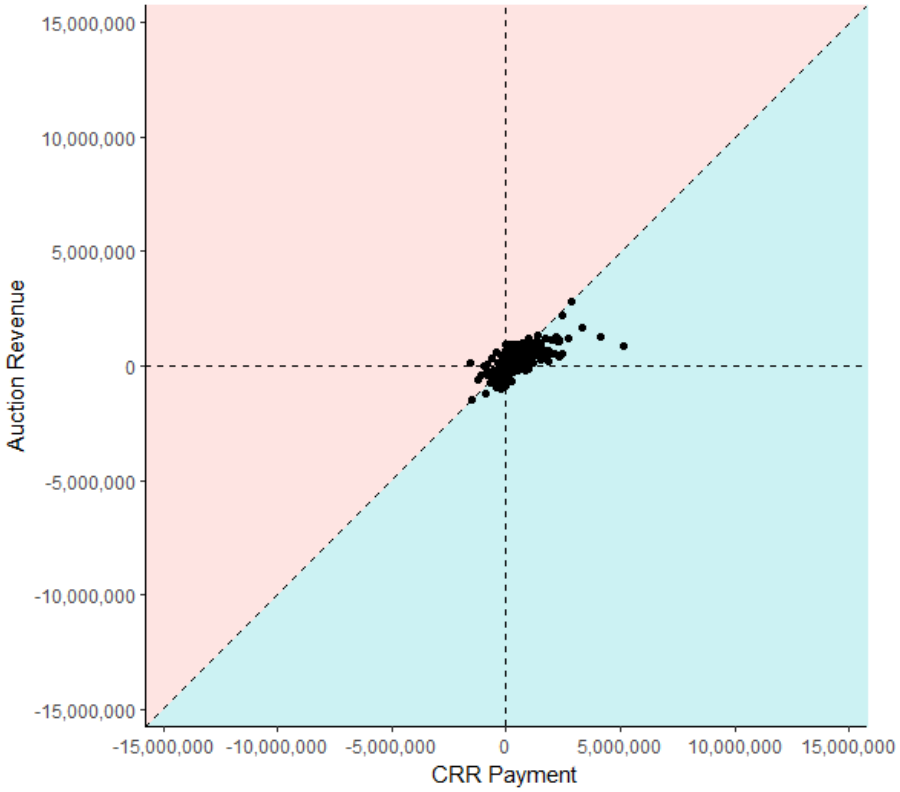


Figure 63: Spread of auction revenues vs CRR payments by CRR holder – 2016

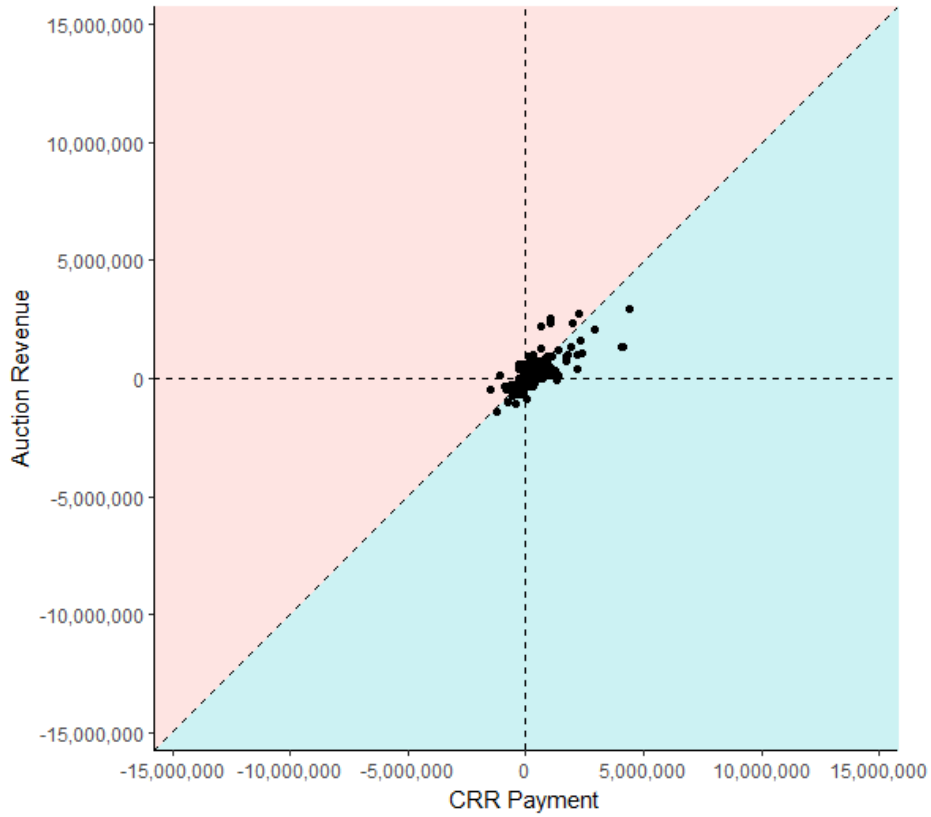
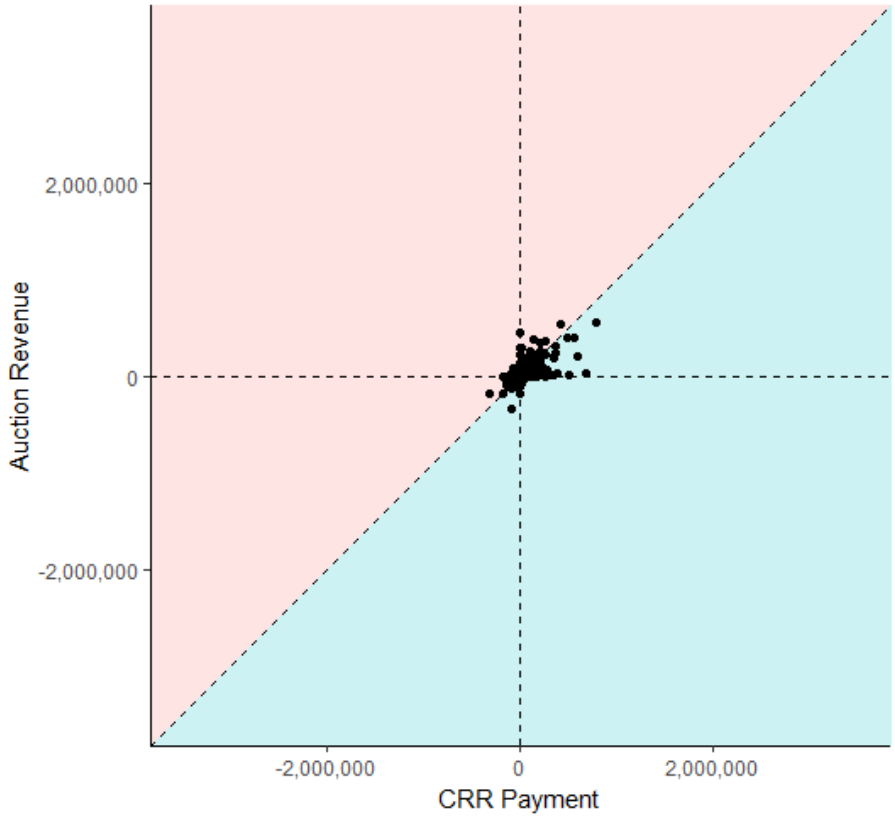


Figure 64: Spread of auction revenues vs CRR payments by CRR holder – 2017



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

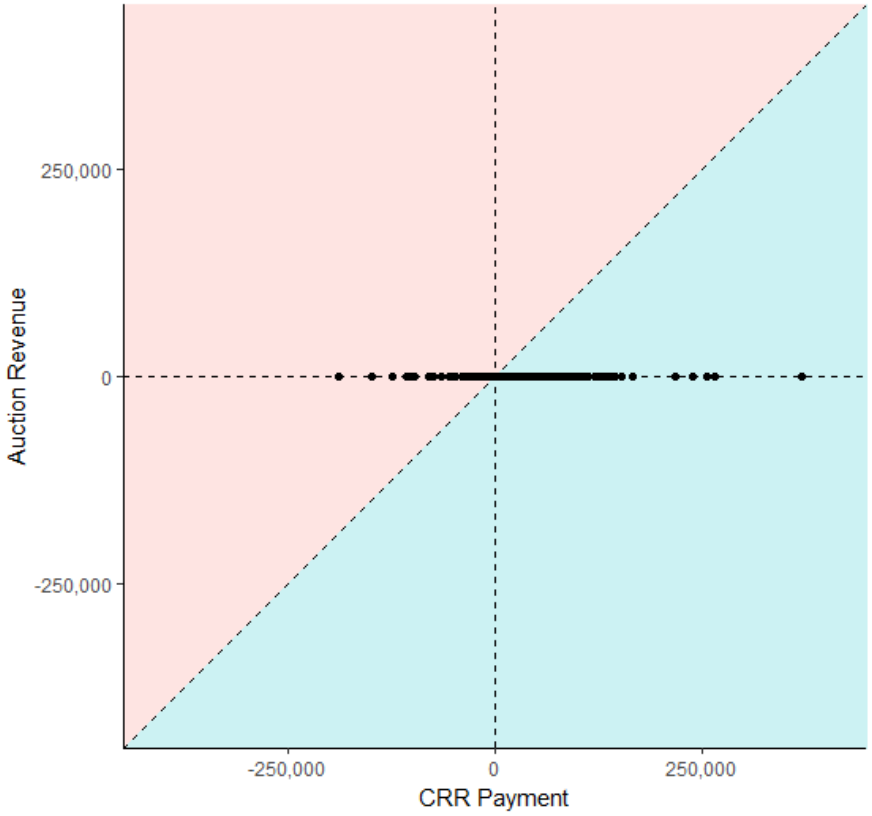


Figure 66: Spread of auction revenues vs. CRR payments for CRRs with zero auction revenue - 2014

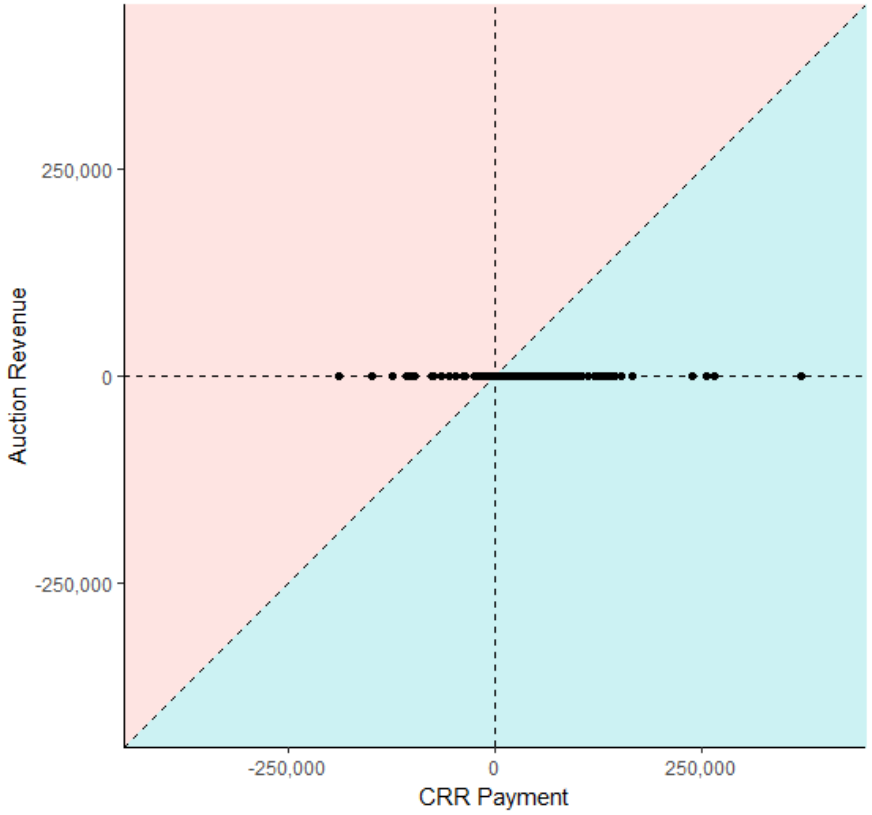


Figure 67: Spread of auction revenues vs. CRR payments for CRRs with zero auction revenue - 2015

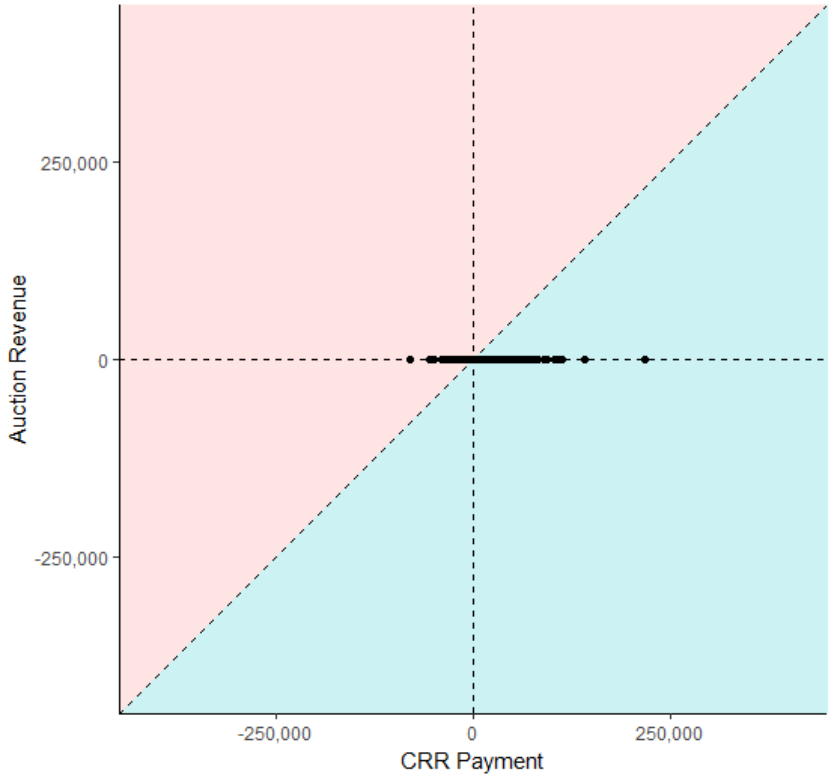


Figure 68: Spread of auction revenues vs. CRR payments for CRRs with zero auction revenue - 2016

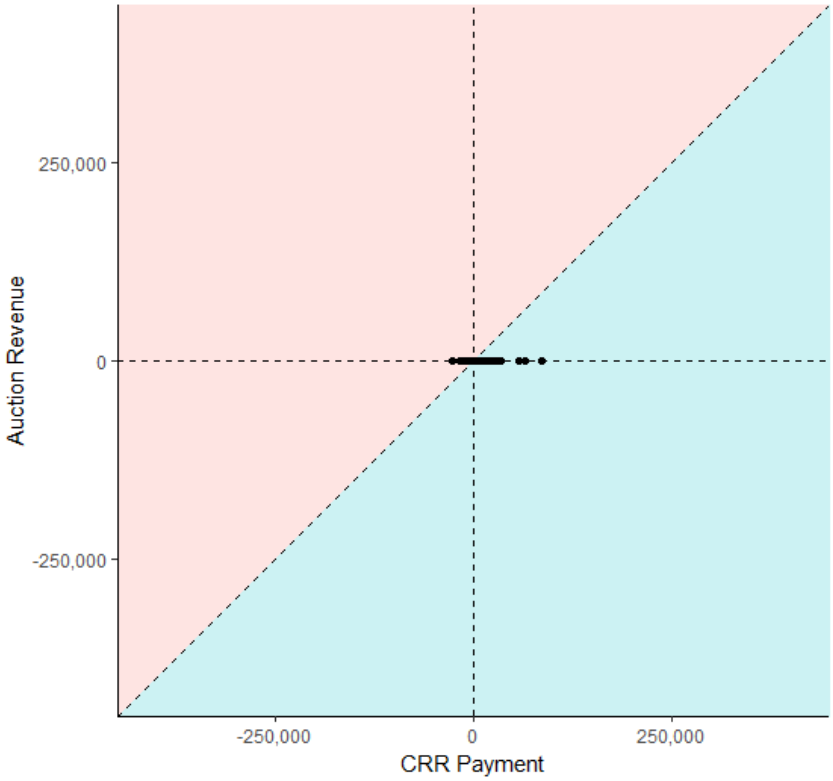


Figure 69: Spread of auction revenues vs. CRR payments for CRRs with zero auction revenue - 2017

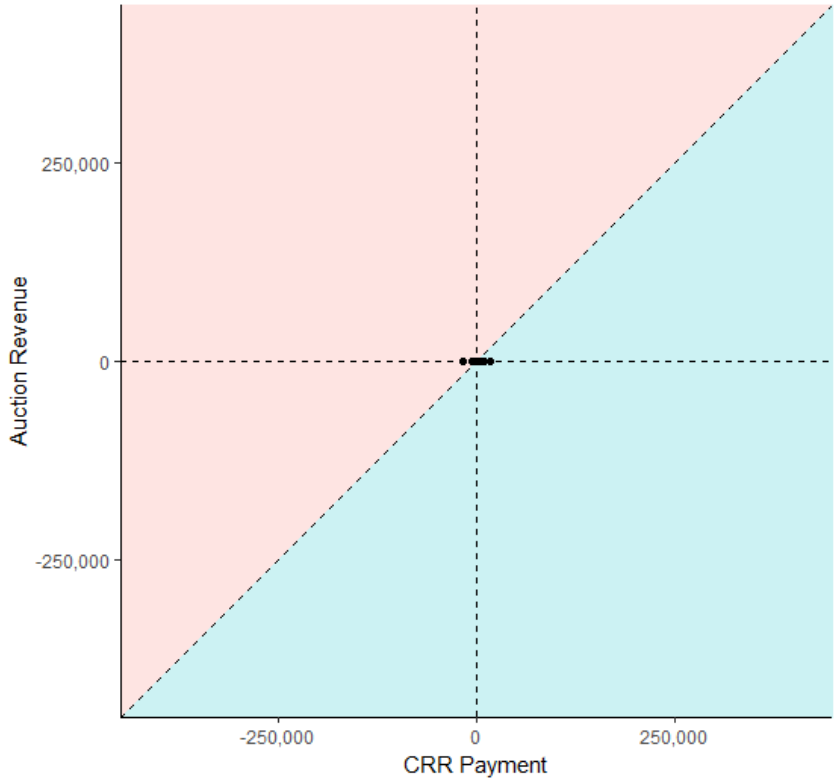


Figure 70: Spread of CRR payments for auction CRRs with zero auction revenue by CRR holder

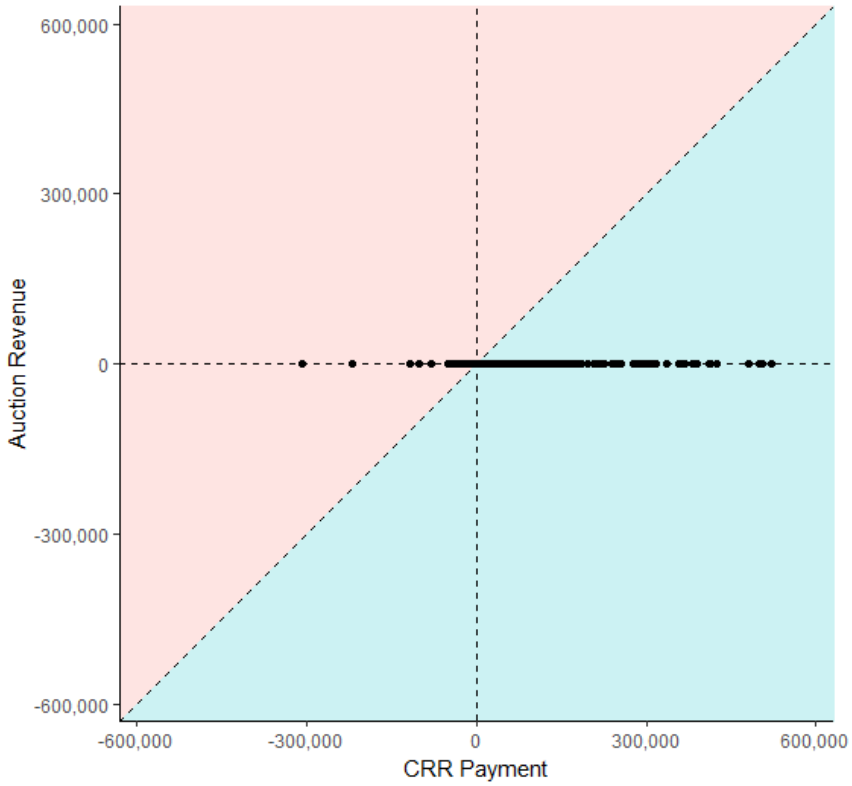


Figure 71: Spread of CRR payments for auction CRRs with zero auction revenue by CRR holder - 2014

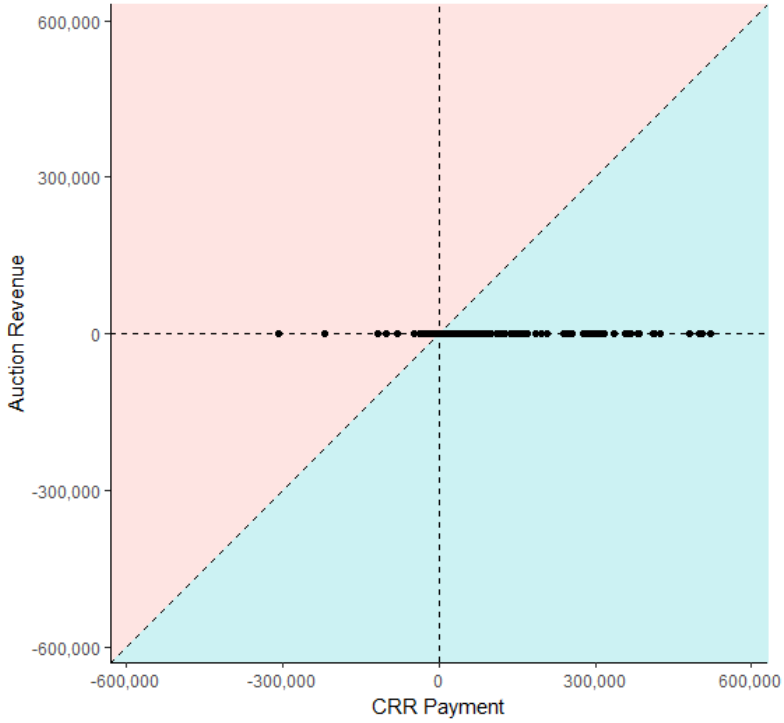


Figure 72: Spread of CRR payments for auction CRRs with zero auction revenue by CRR holder - 2015

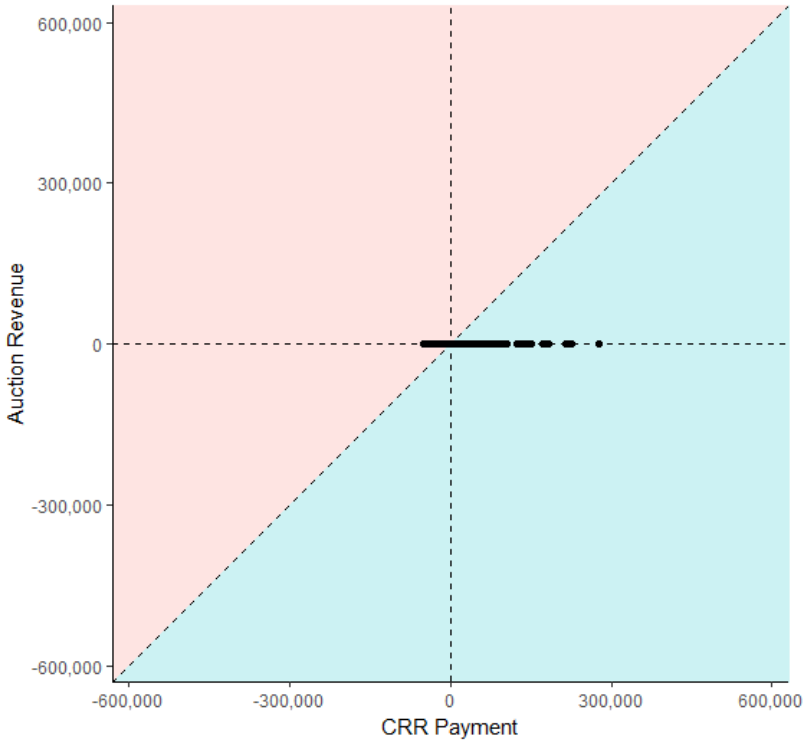


Figure 73: Spread of CRR payments for auction CRRs with zero auction revenue by CRR holder - 2016

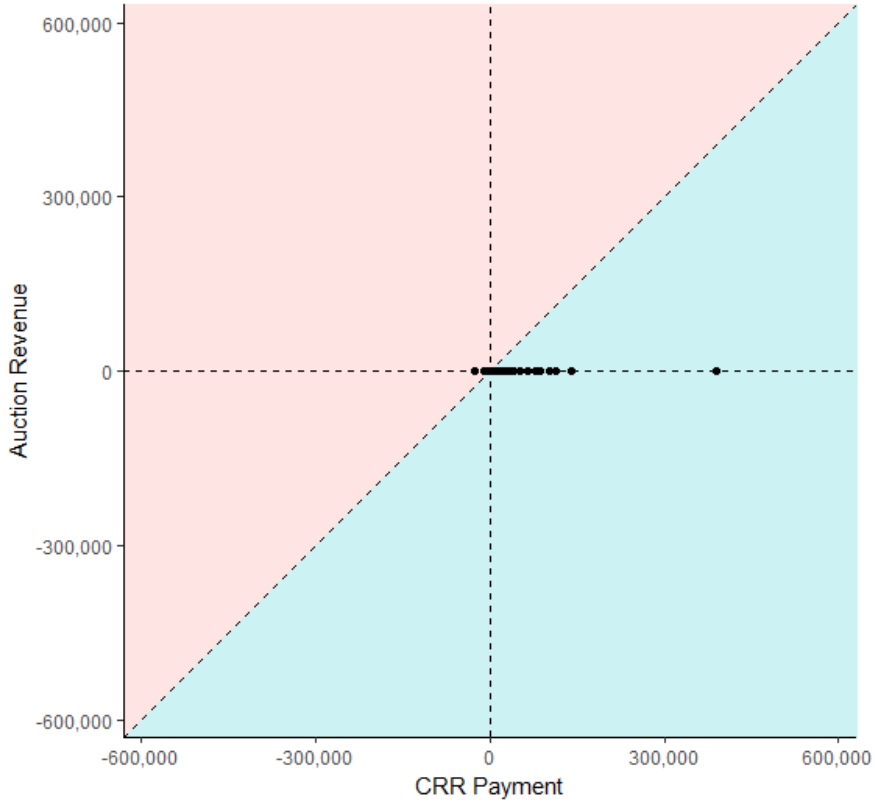
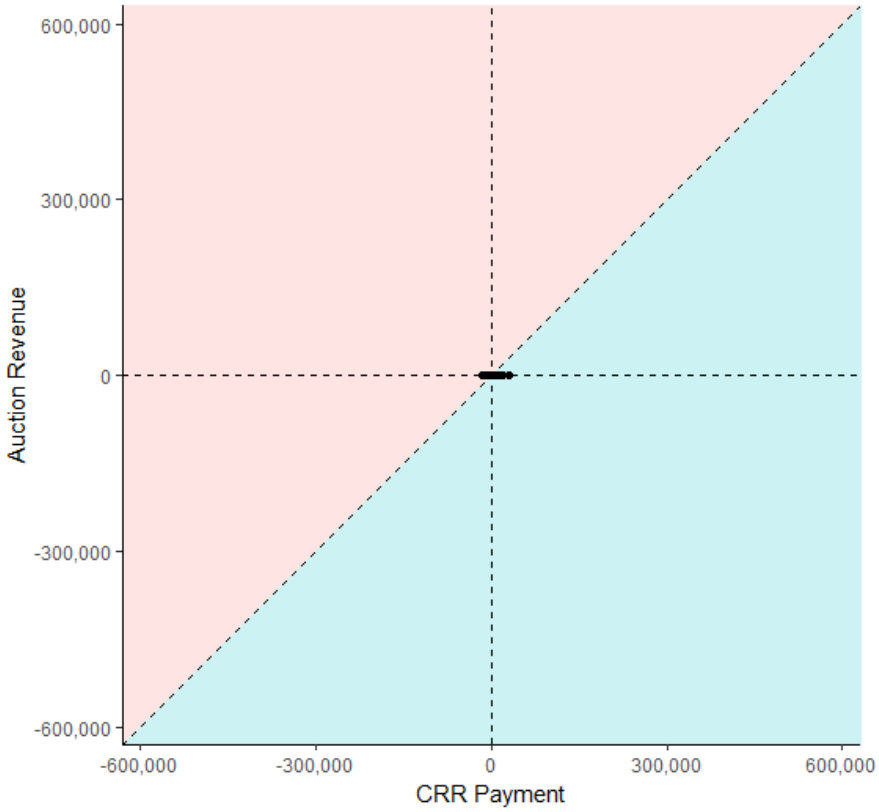


Figure 74: Spread of CRR payments for auction CRRs with zero auction revenue by CRR holder - 2017



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

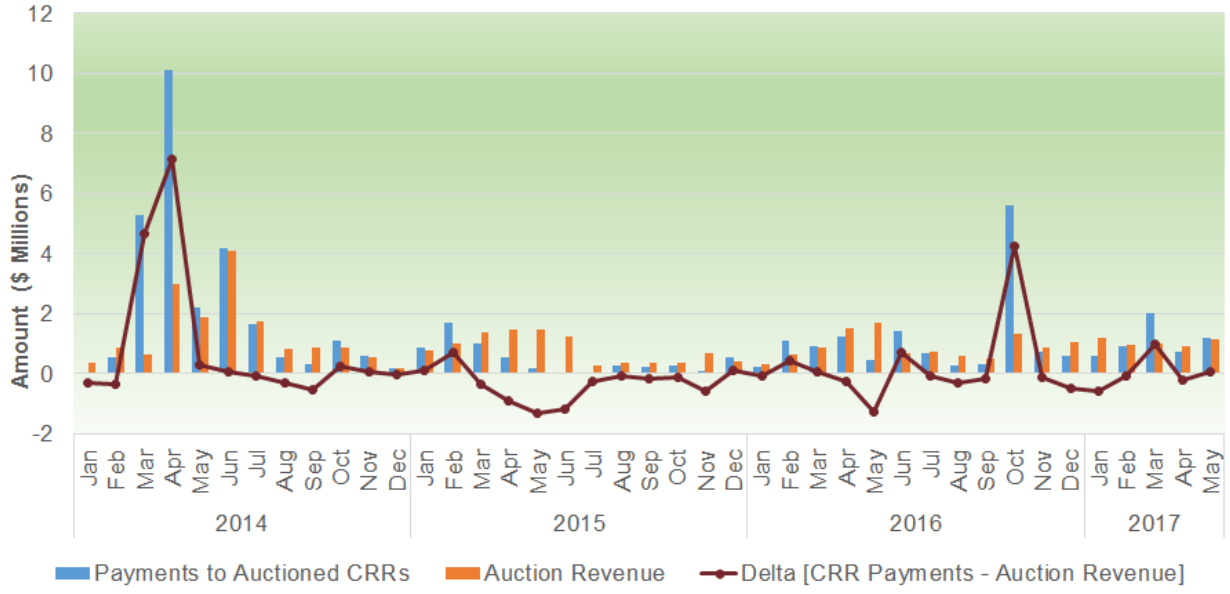


Figure 76: Comparison of CRR payments (auction CRRs) vs auction revenue for - SYLMARDC_2_N501 to TH_NP15_GEN_APND

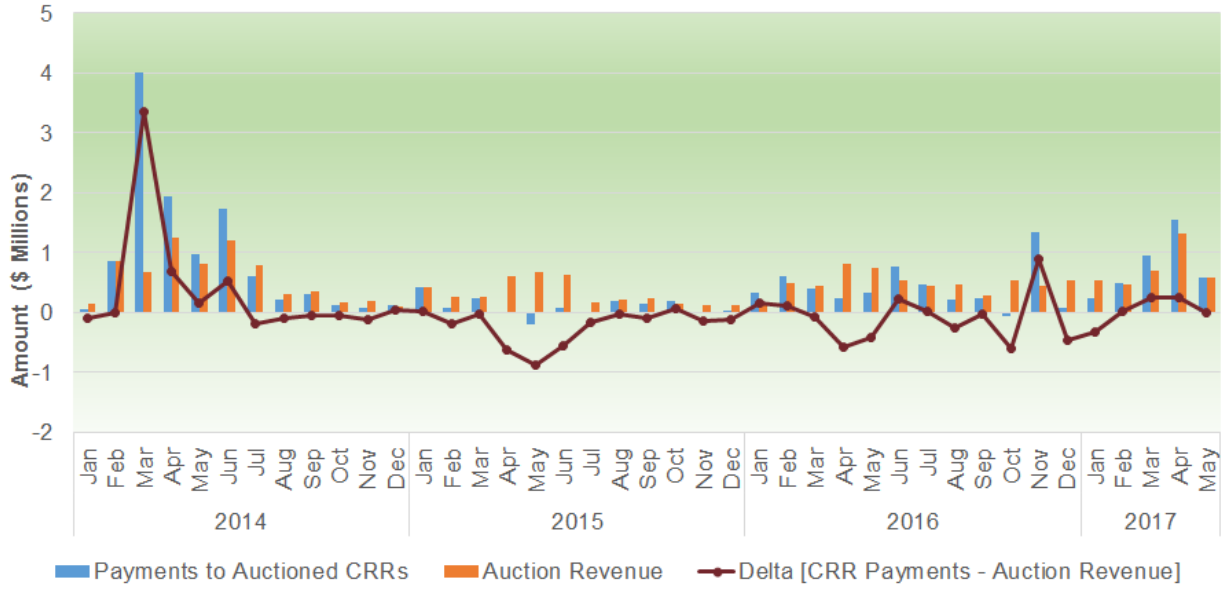


Figure 77: Comparison of CRR payments (auction CRRs) vs auction revenue for - PALOVRDE_ASR_APND to TH_SP15_GEN_APND

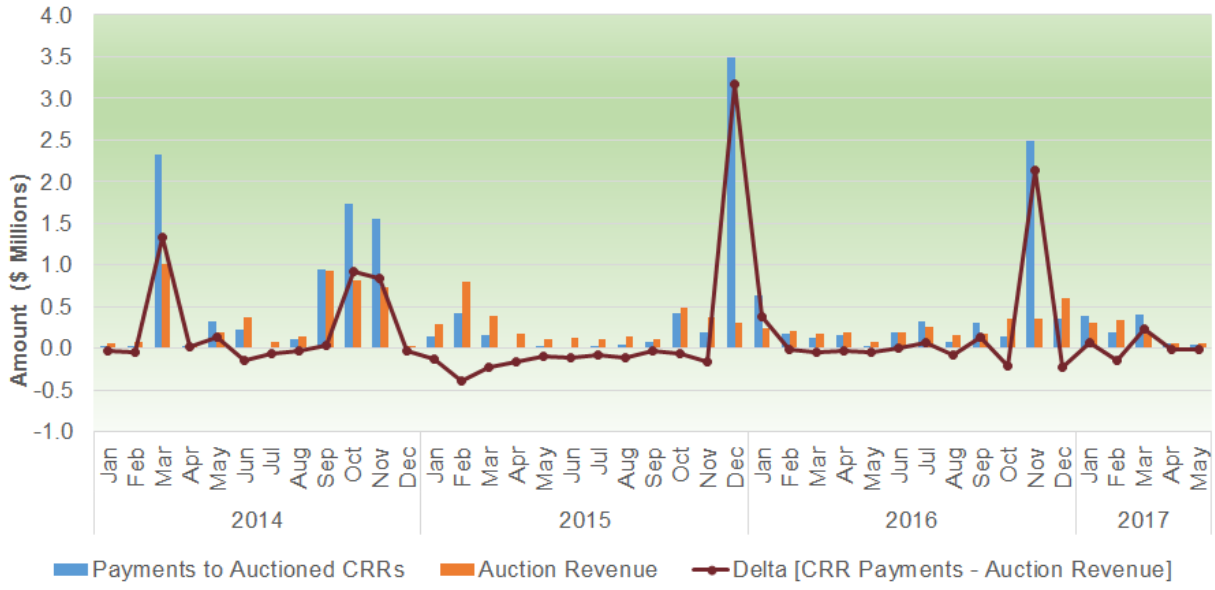


Figure 78 to Figure 80 show the trend of the bottom 3 source-sink pairs from January 2014 to May 2017.

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

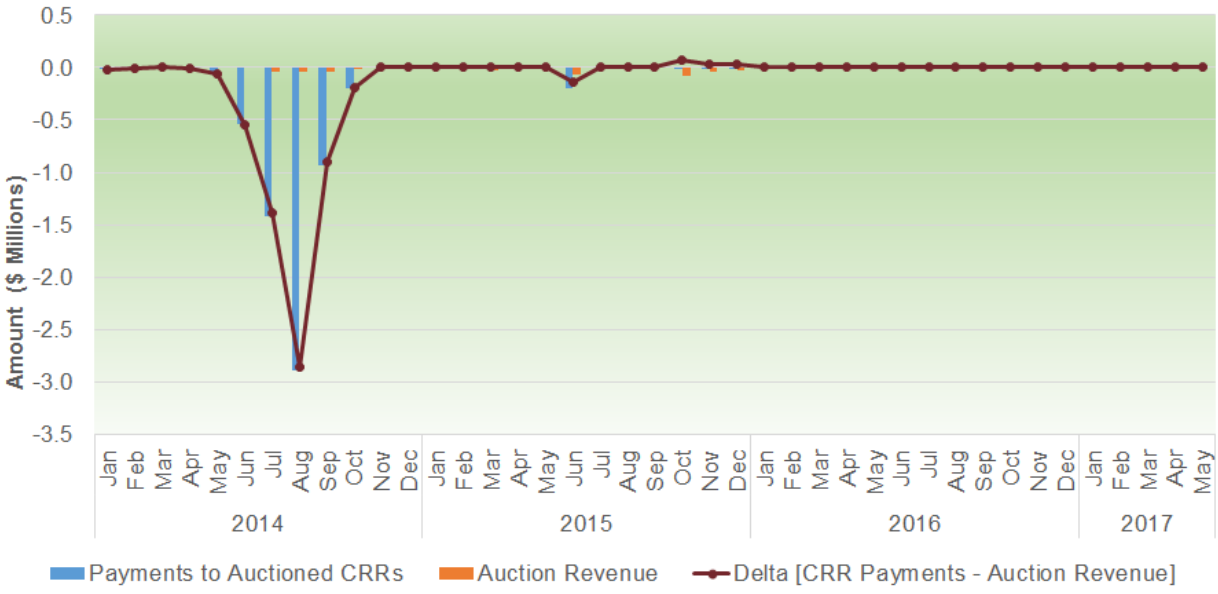


Figure 79: Comparison of CRR payments (auction CRRs) vs auction revenue for - POD_HELMPG_7_UNIT 1-APND to DLAP_PGAE-APND

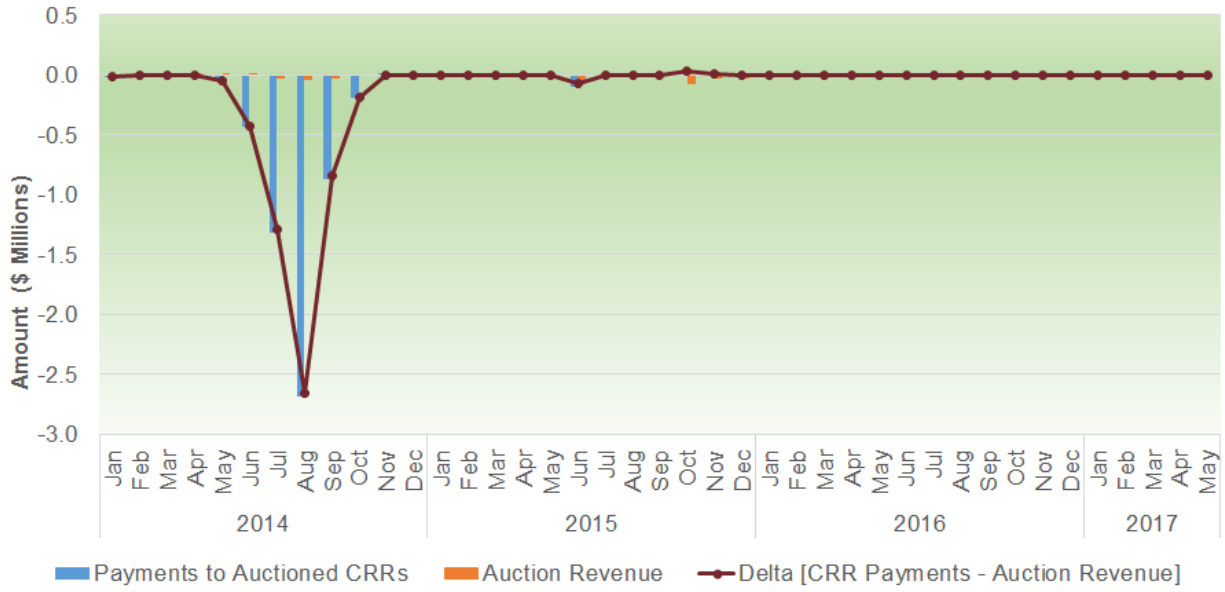
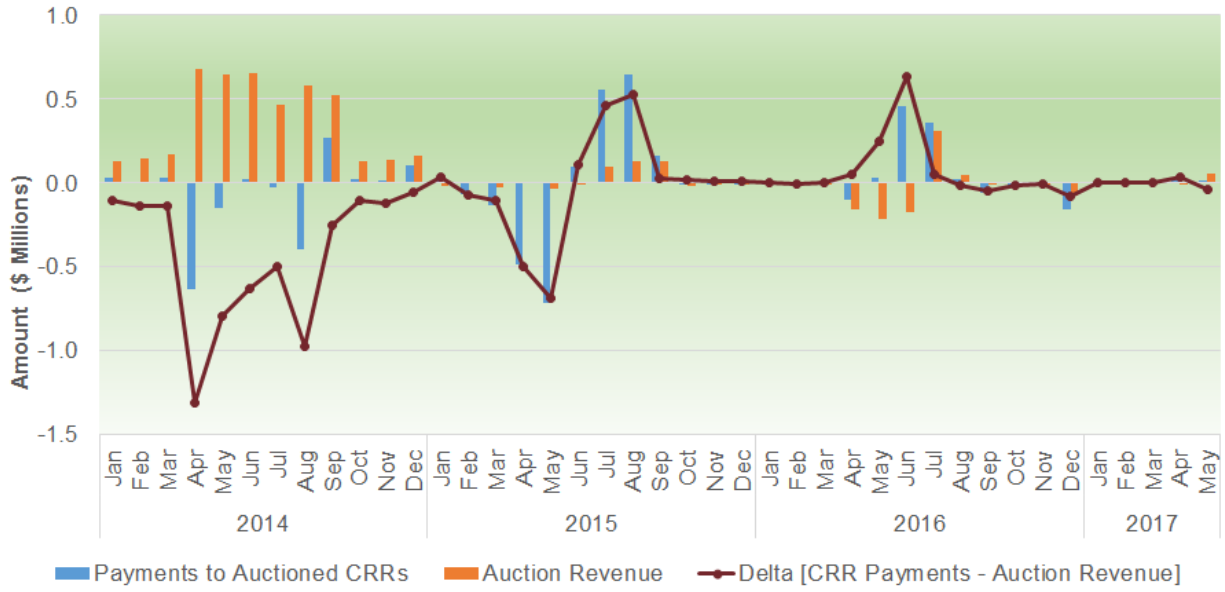


Figure 80: Comparison of CRR payments (auction CRRs) vs auction revenue for - TH_NP15_GEN-APND to TH_SP15_GEN-APND



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

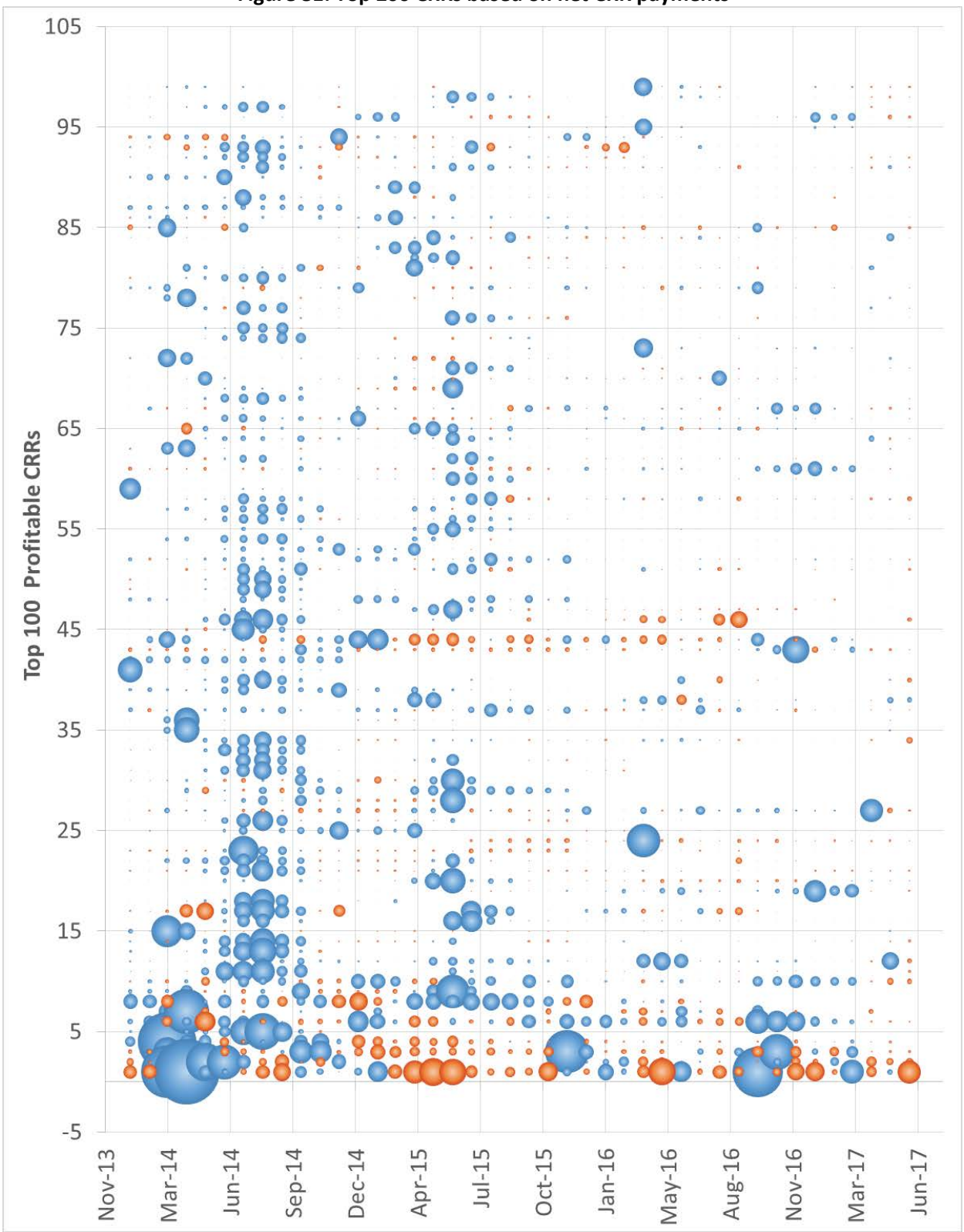


Figure 82: Top 200 CRRs based on net CRR payments

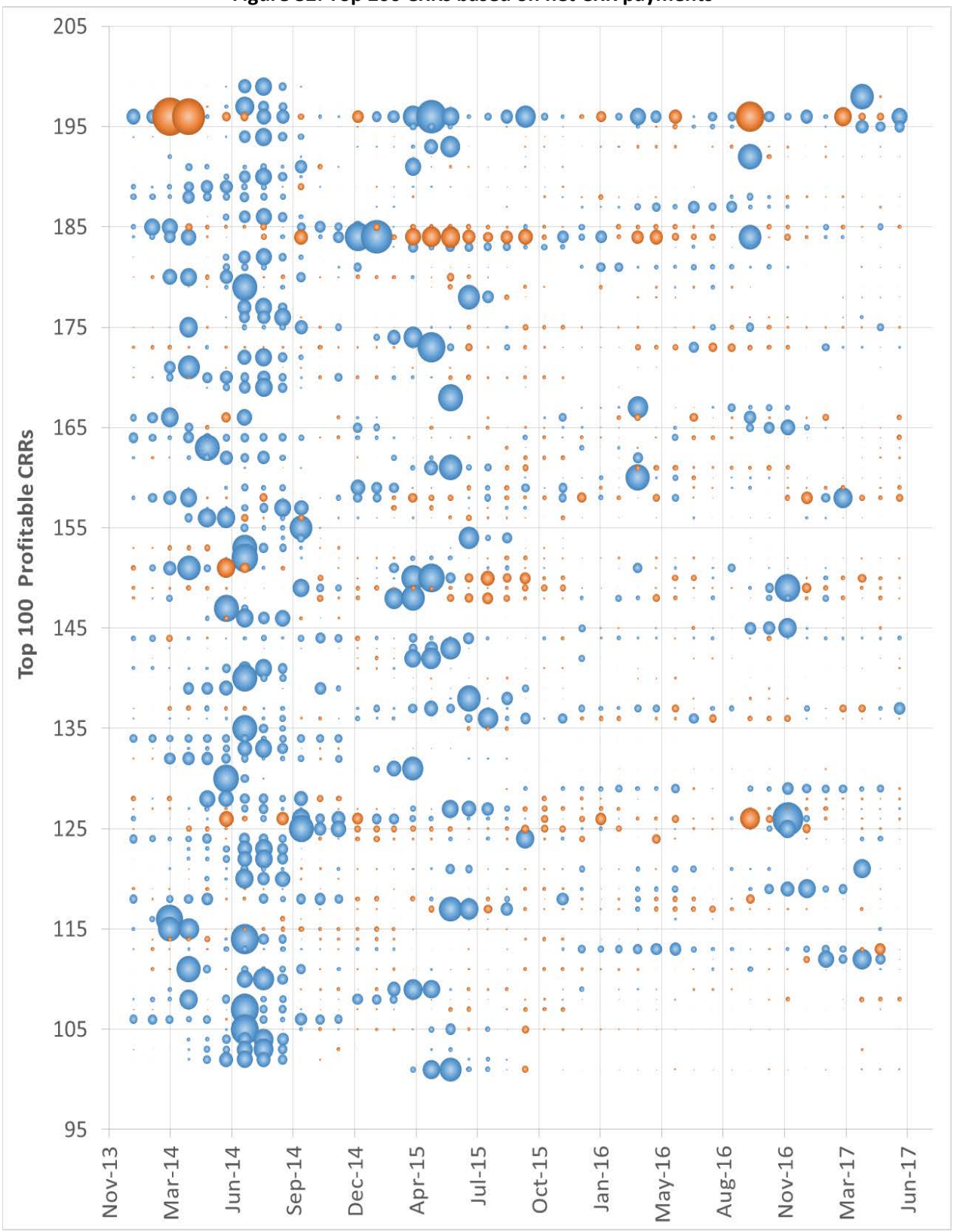


Figure 83: Top 200 CRRs based on consistency of monthly net CRR payments

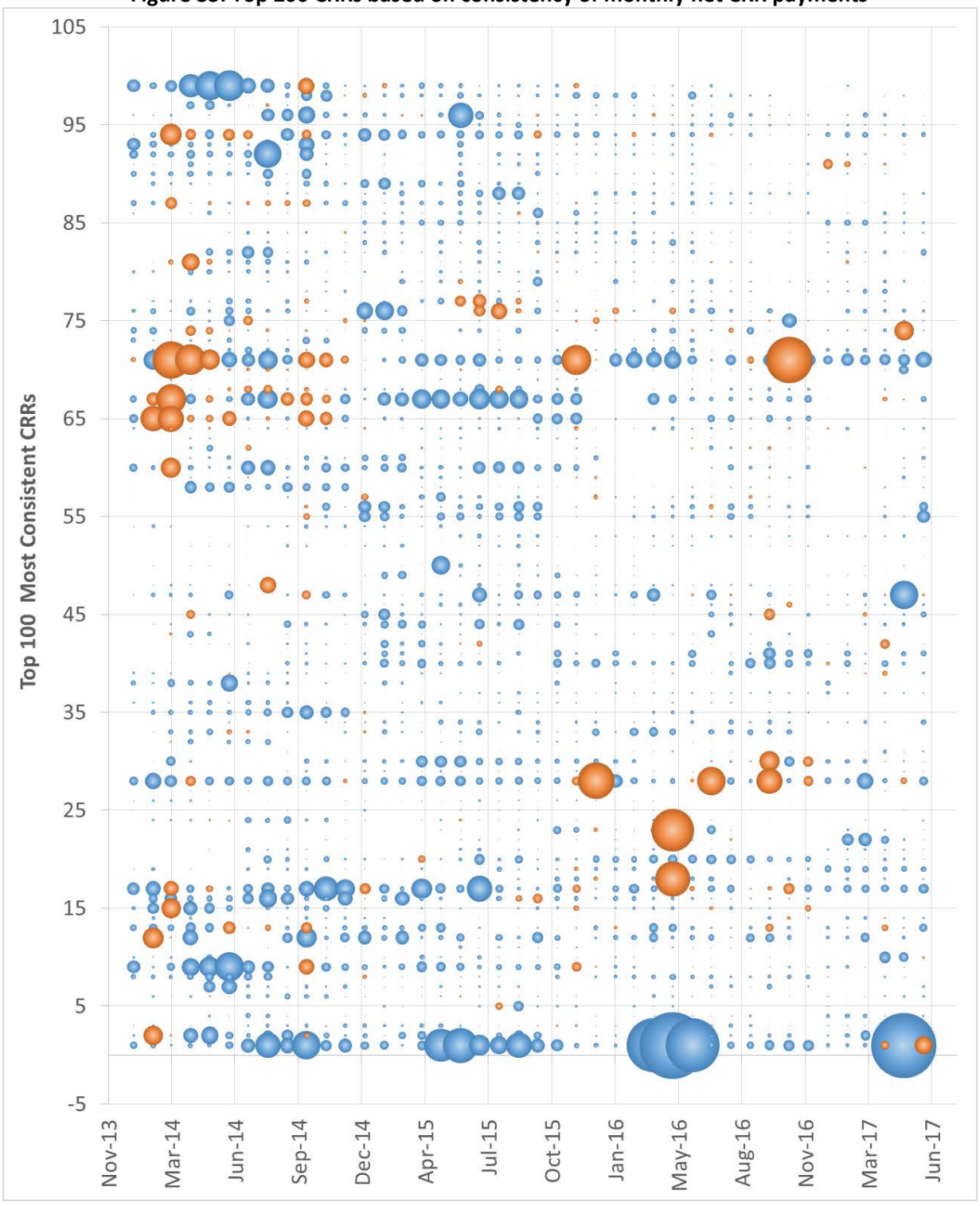
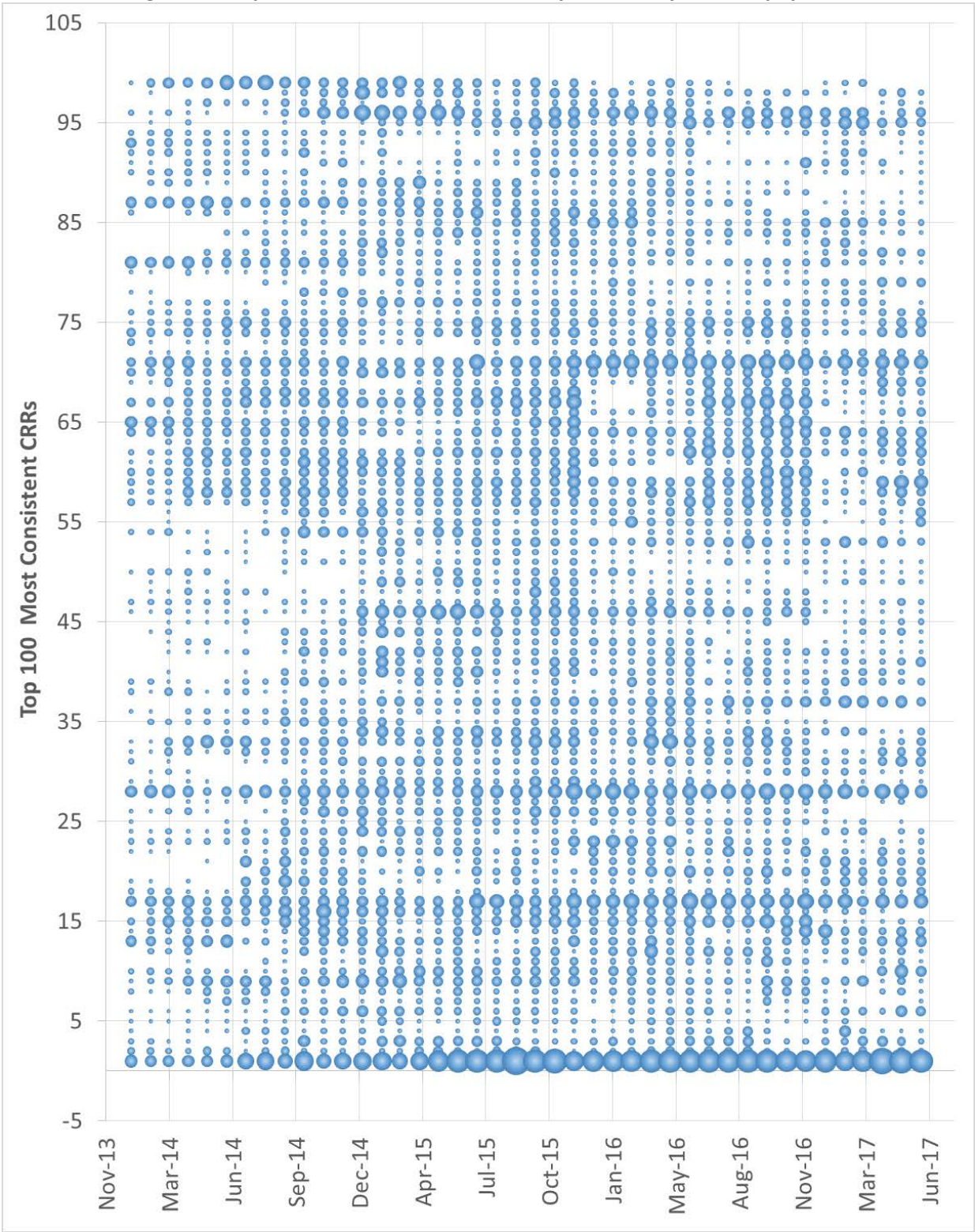


Figure 84: Top 200 CRRs based on consistency of monthly net CRR payments

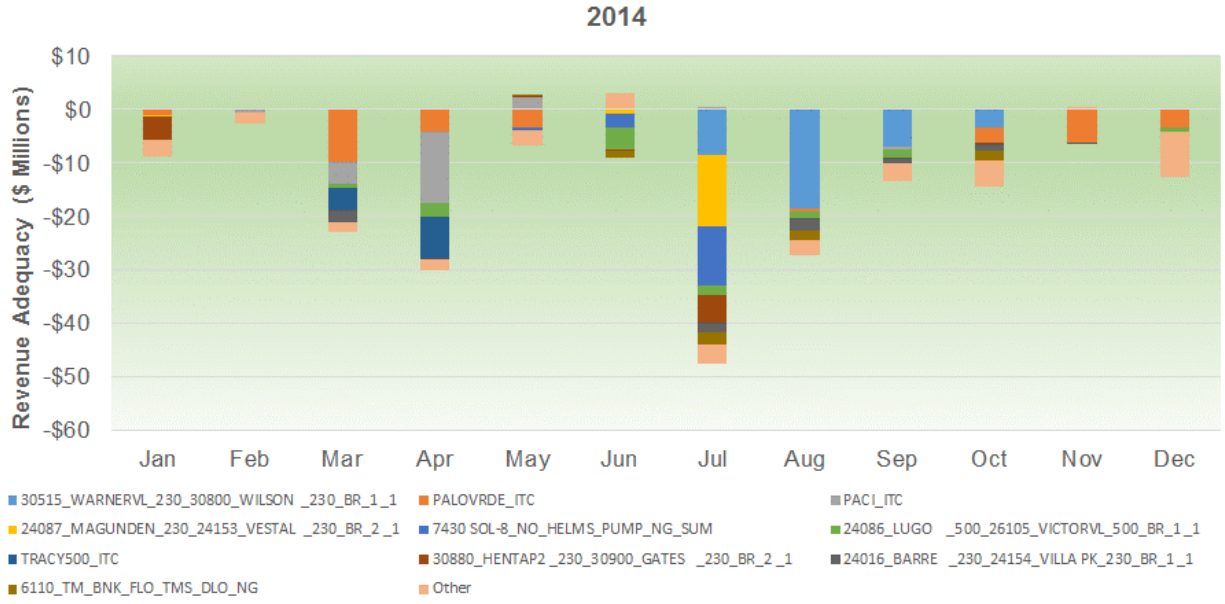


CRR revenue adequacy by transmission element

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

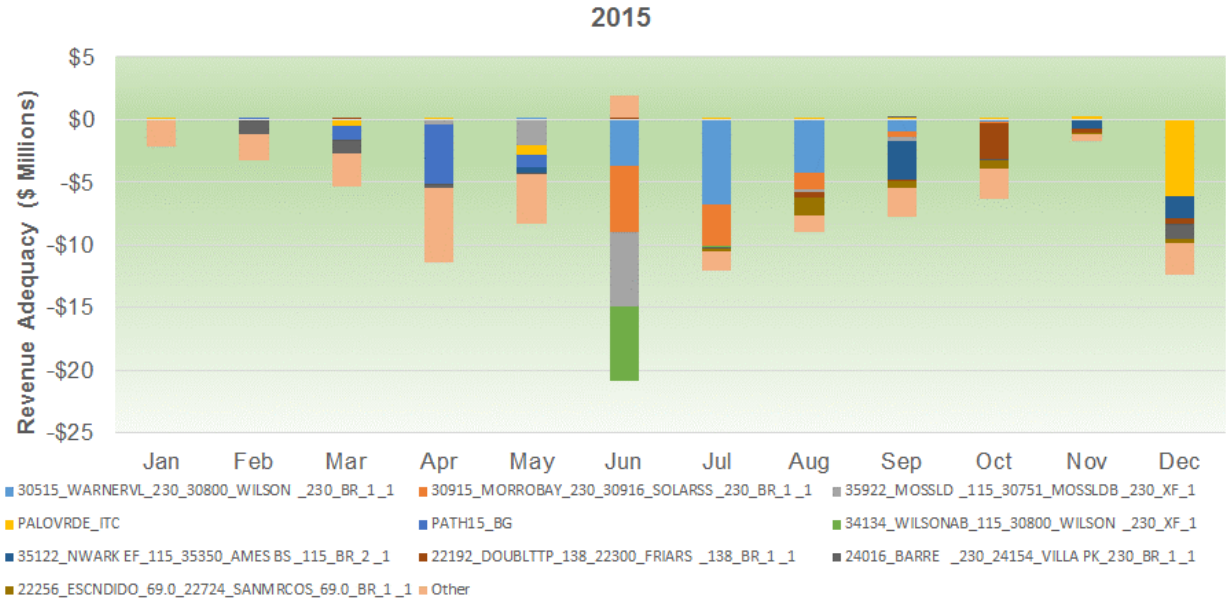


Figure 87: Top 10 CRR revenue inadequate transmission elements

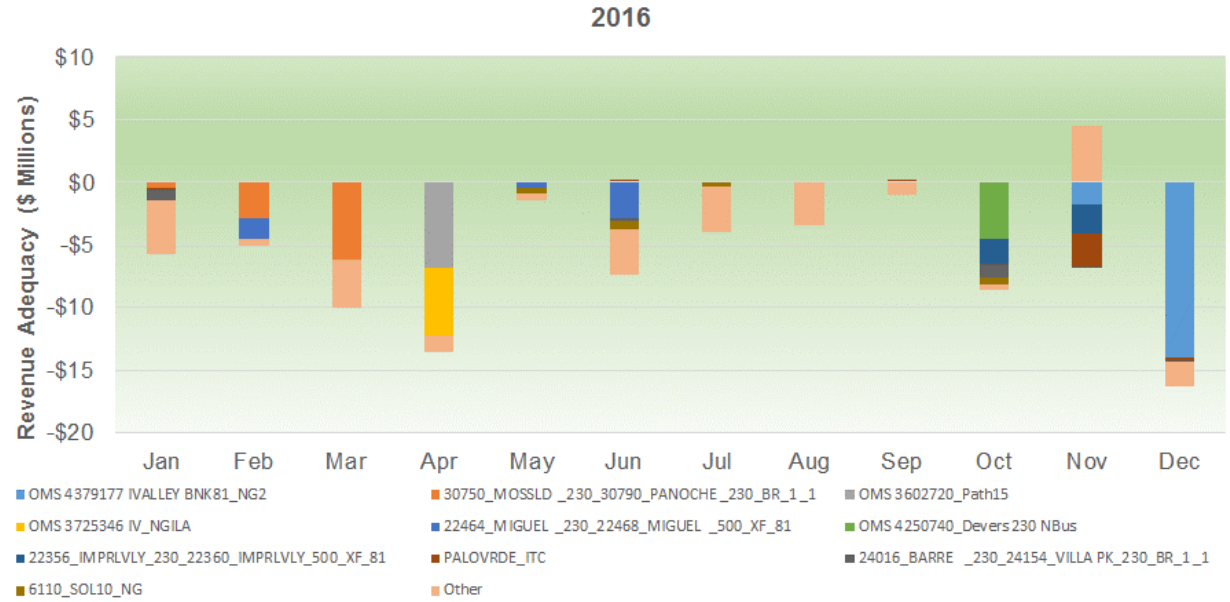
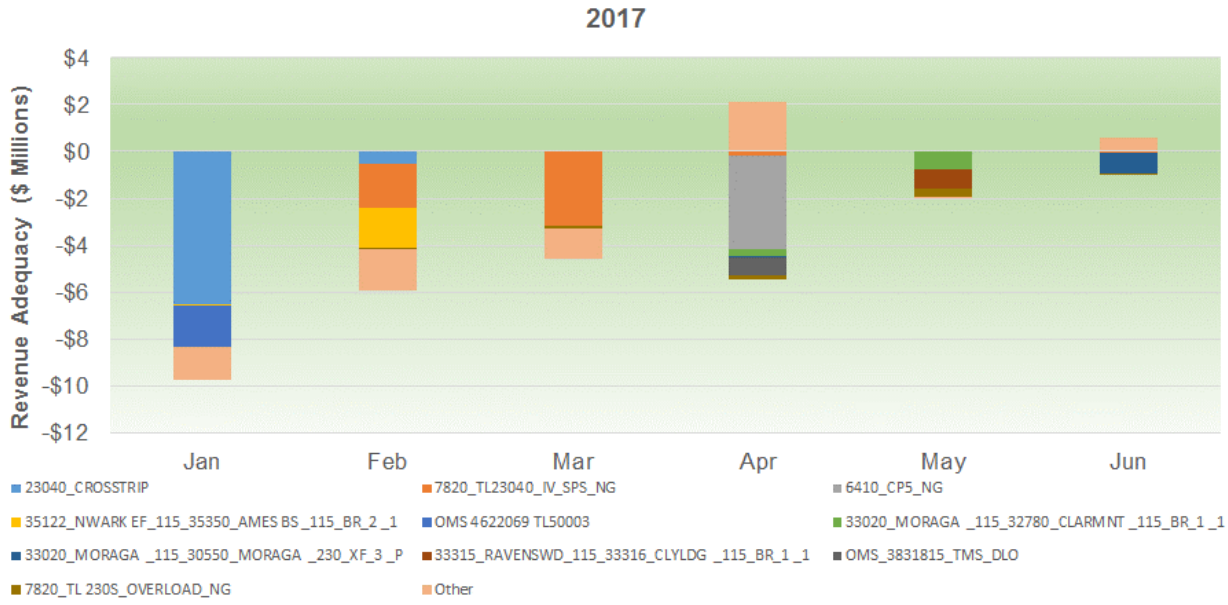


Figure 88: Top 10 CRR revenue inadequate transmission elements



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

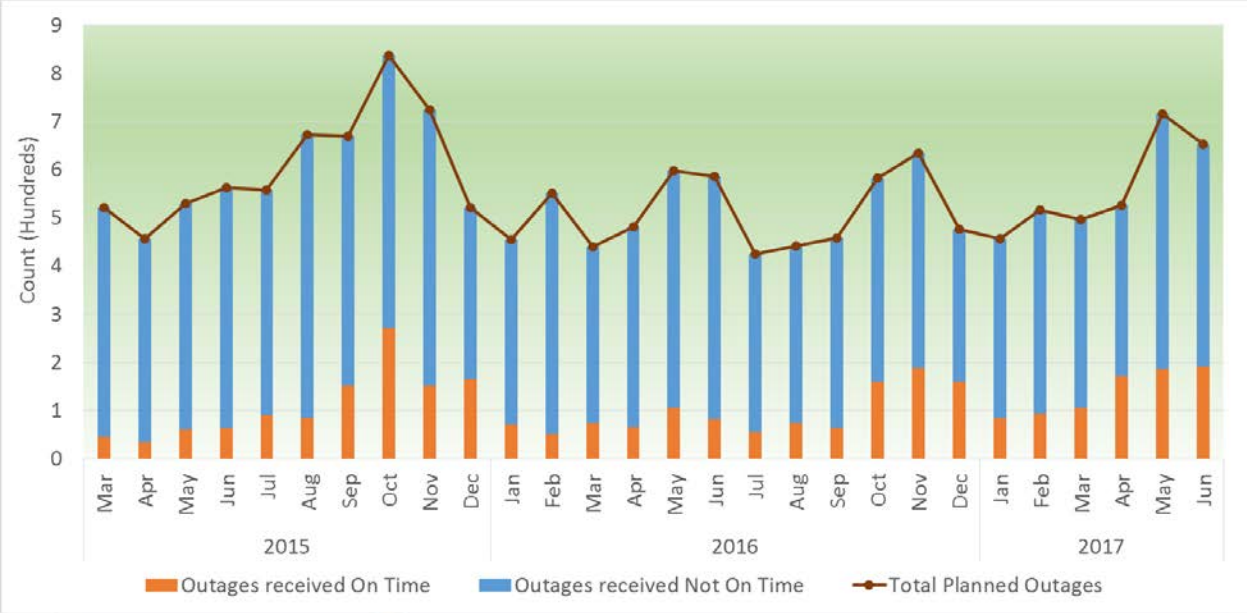


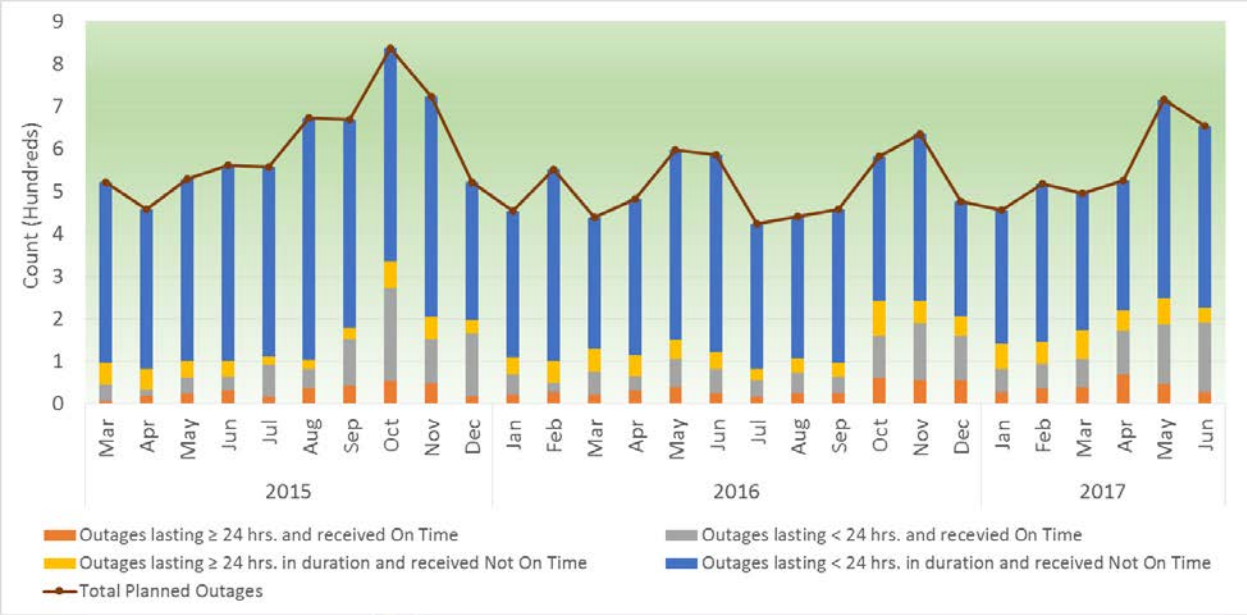
Figure 90 shows the total number of planned transmission outages associated with the number of outages broken out in two main groups; one group to identify if the outages have a duration of at least 24 hours, and the second grouping to identify the portion of outages submitted on time. The majority of 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

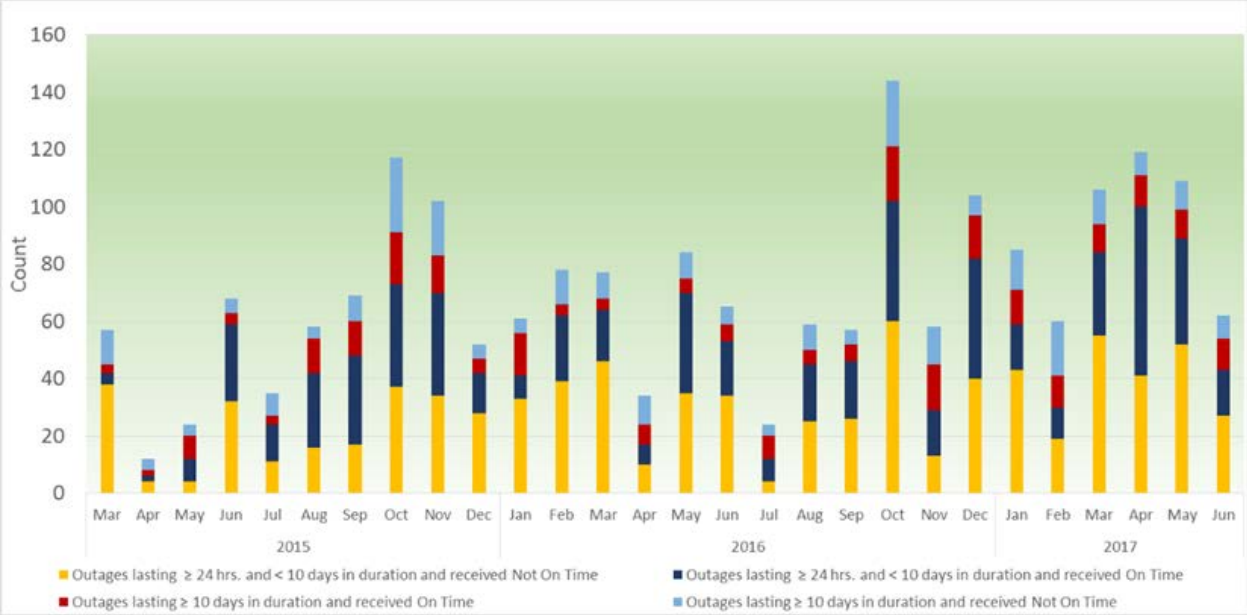
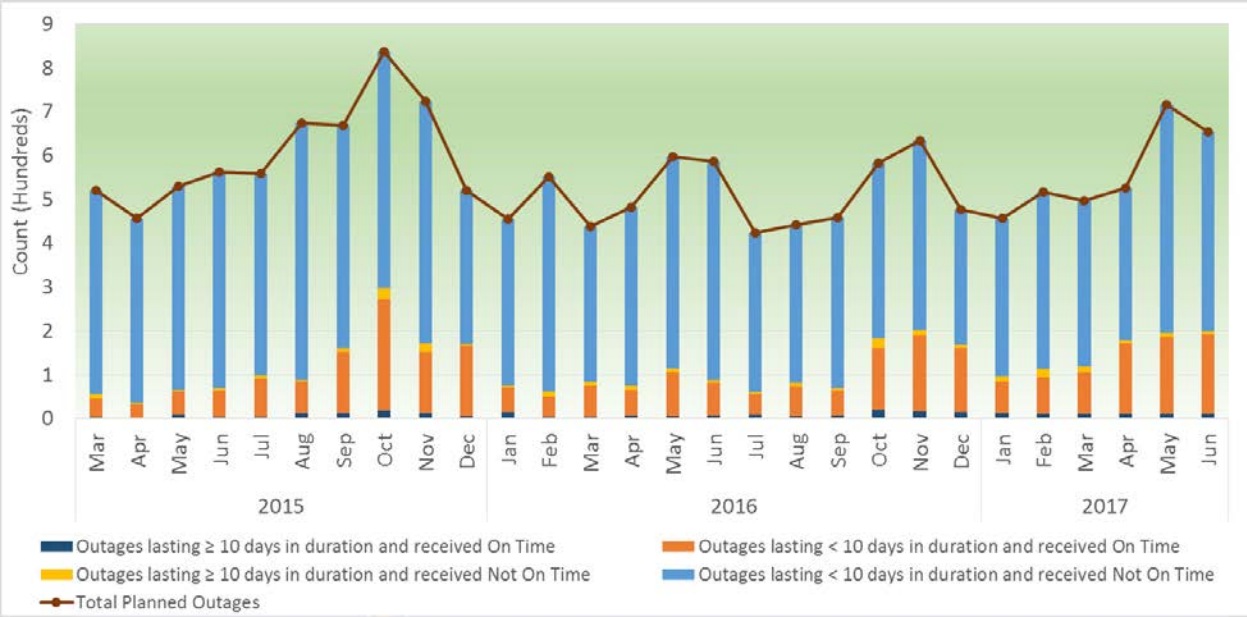


Figure 92: Total number of planned transmission outages organized by 10-day duration



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

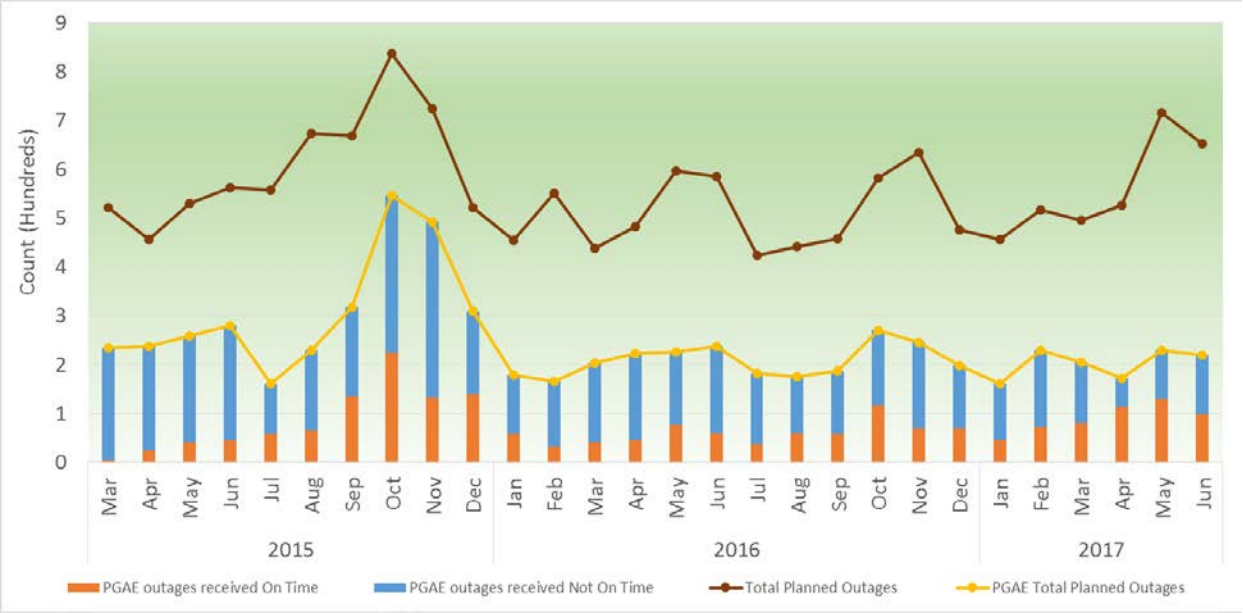


Figure 94: Total number of planned transmission outages subject to submission window for PGAE

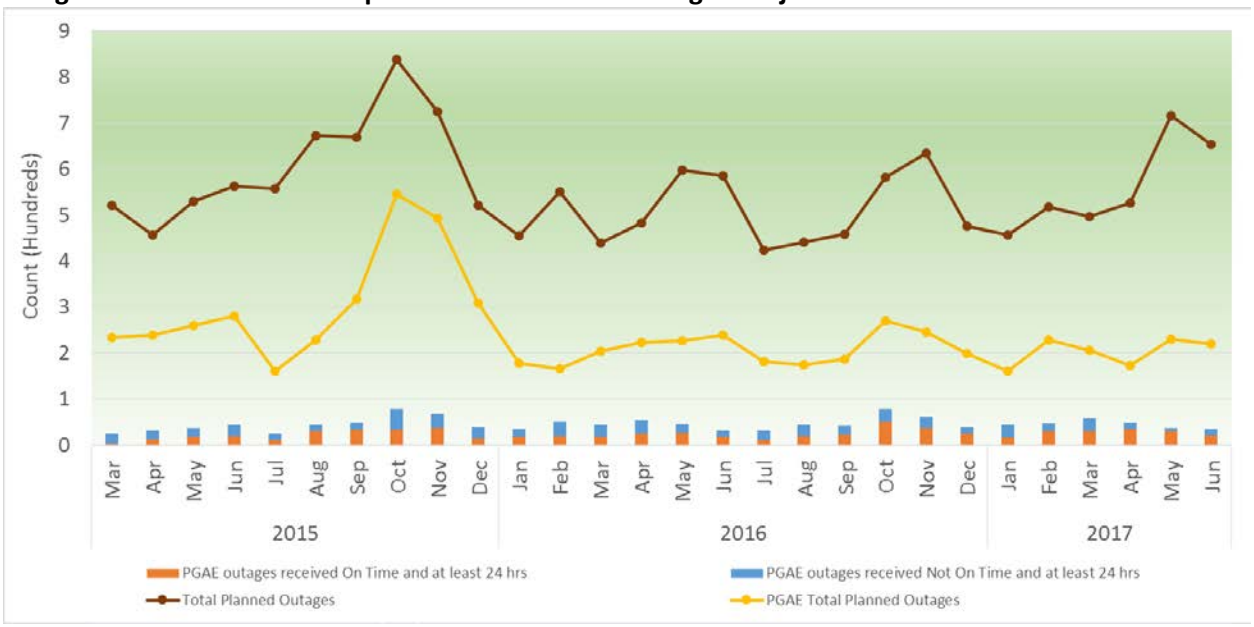


Figure 95 and Figure 96 shows the total number of planned transmission outages that the CAISO analyzed in the sub control area of SCE. This figure is outlined by the timeliness of when the CAISO received the outages. On average, about 65 percent of SCE's system outages subject to the 30-day submission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

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

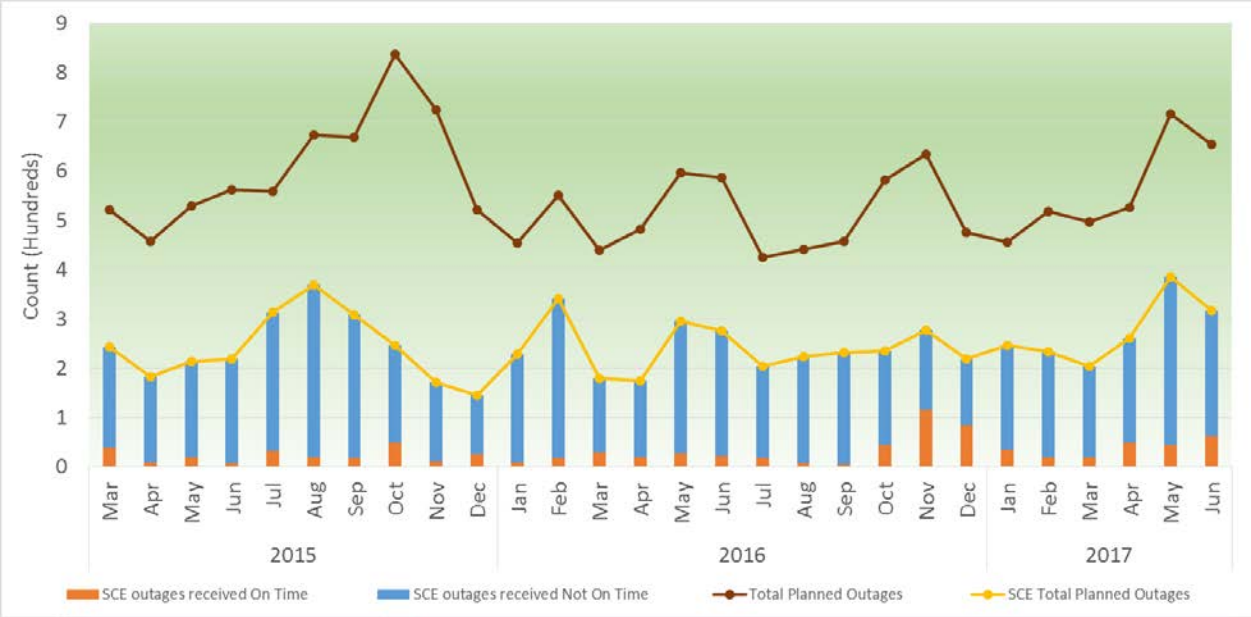


Figure 96: Total number of planned transmission outages subject to submission window for SCE

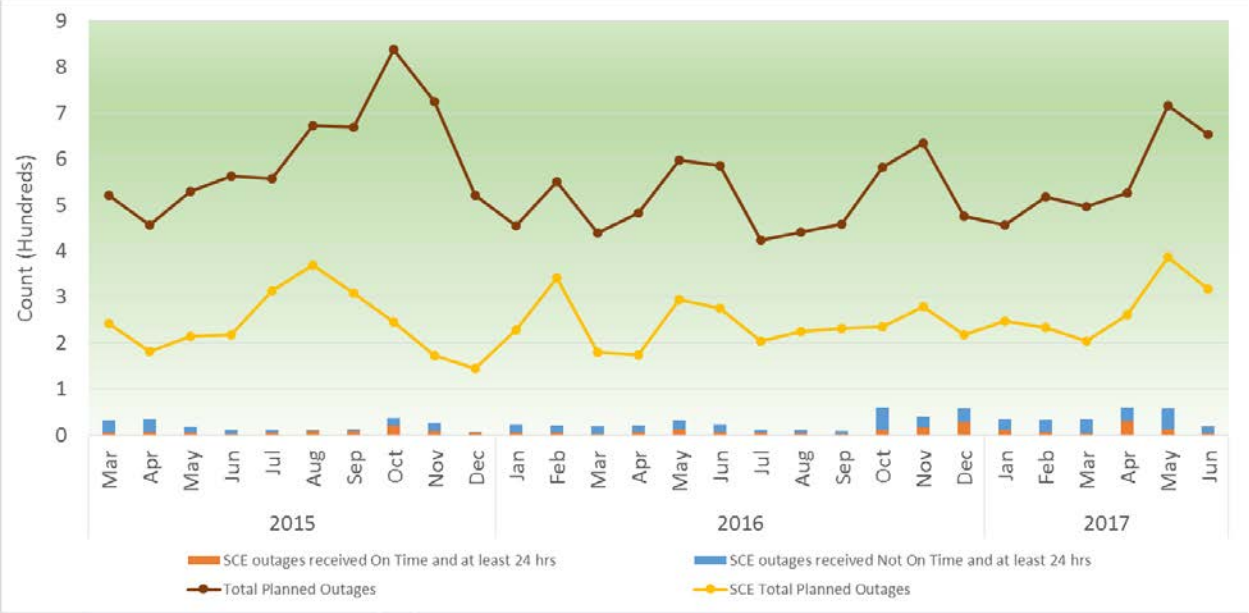


Figure 97 and Figure 98 shows the total number of planned transmission outages that the CAISO analyzed in the sub control area of SDGE. This figure is outlined by the timeliness of when the CAISO received the outages. On average, about 70 percent of SDGE's system outages subject to the 30-day submission 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

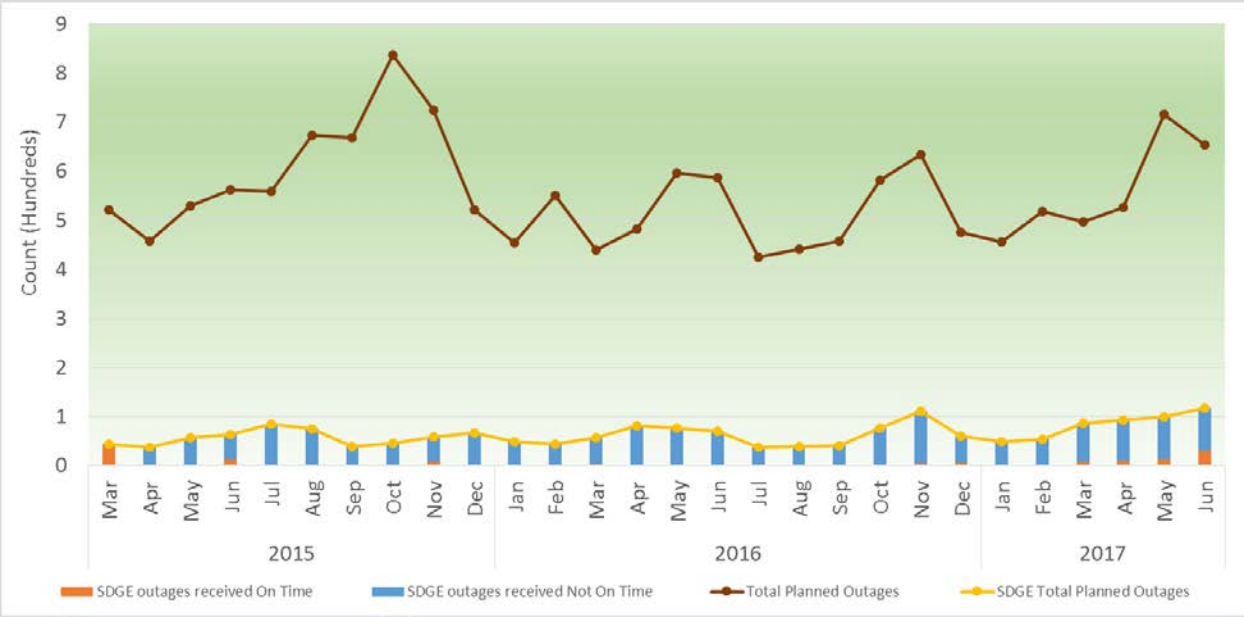
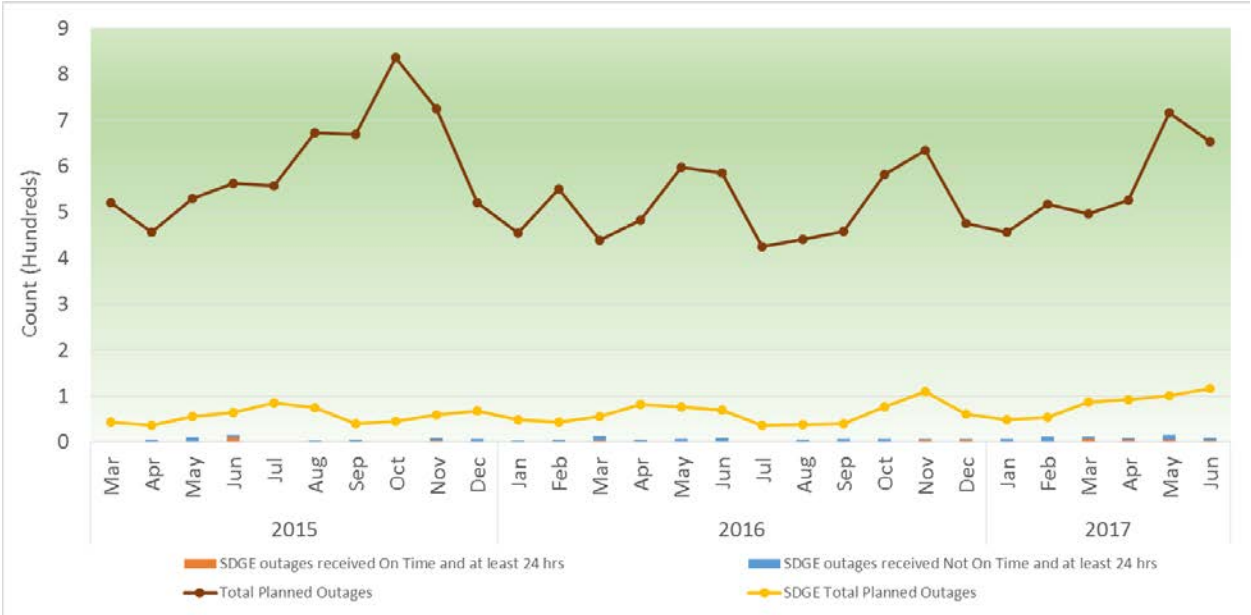


Figure 98: Total number of planned transmission outages subject to submission window for SDGE



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

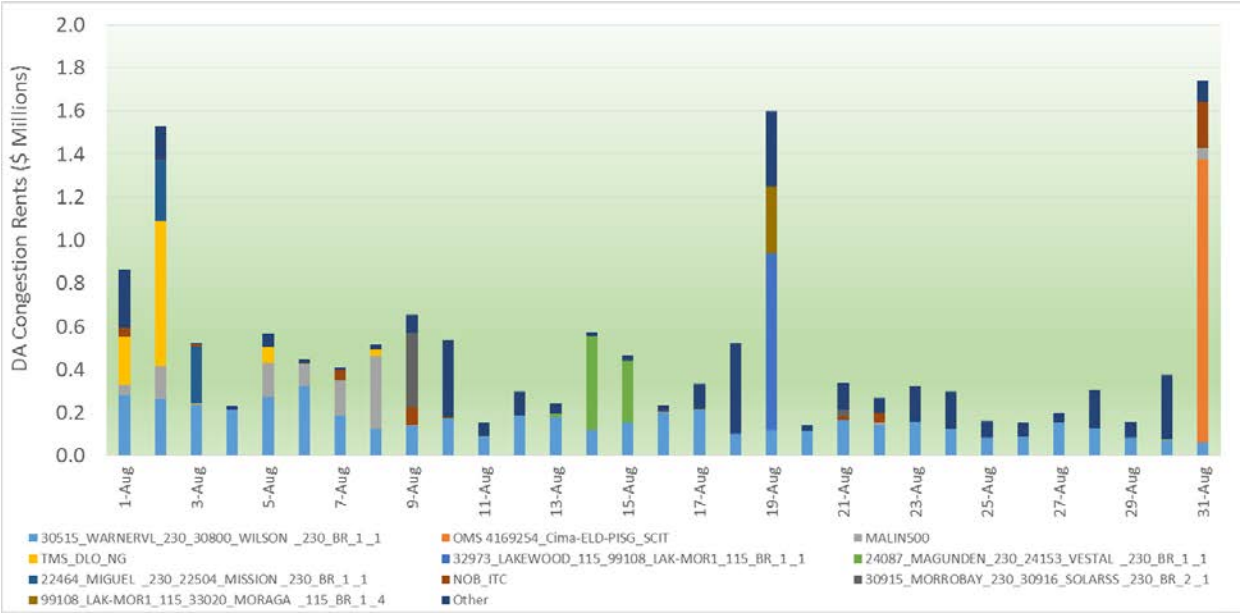


Figure 100: Daily CRR revenue adequacy - August 2016

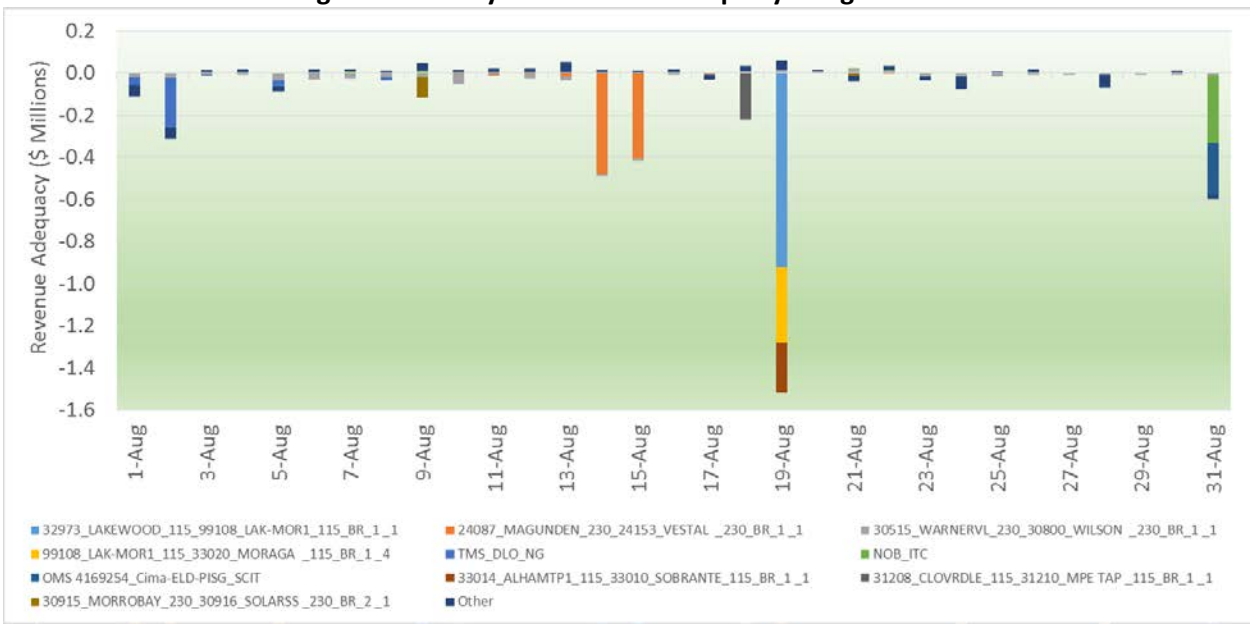


Figure 101 shows the net CRR payment per day. This net payment is the difference between the CRR payments to CRR holders and the auction revenues collected by the CAISO through the CRR auction process; such revenues become a lump revenue for the auction. For this metric, the annual auction revenues are 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

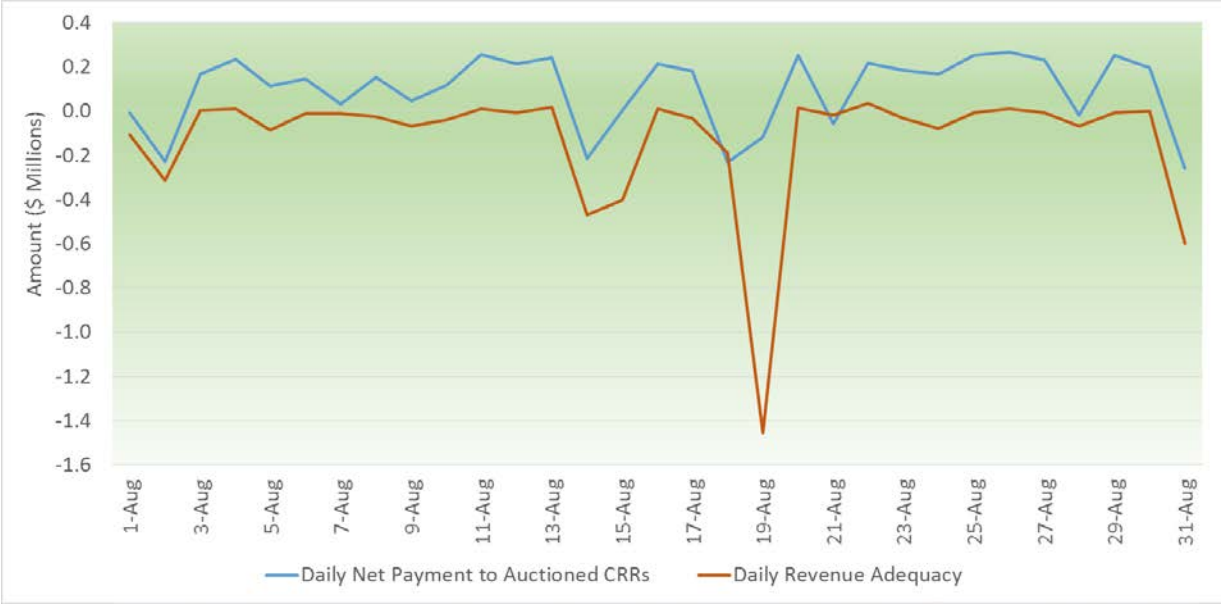
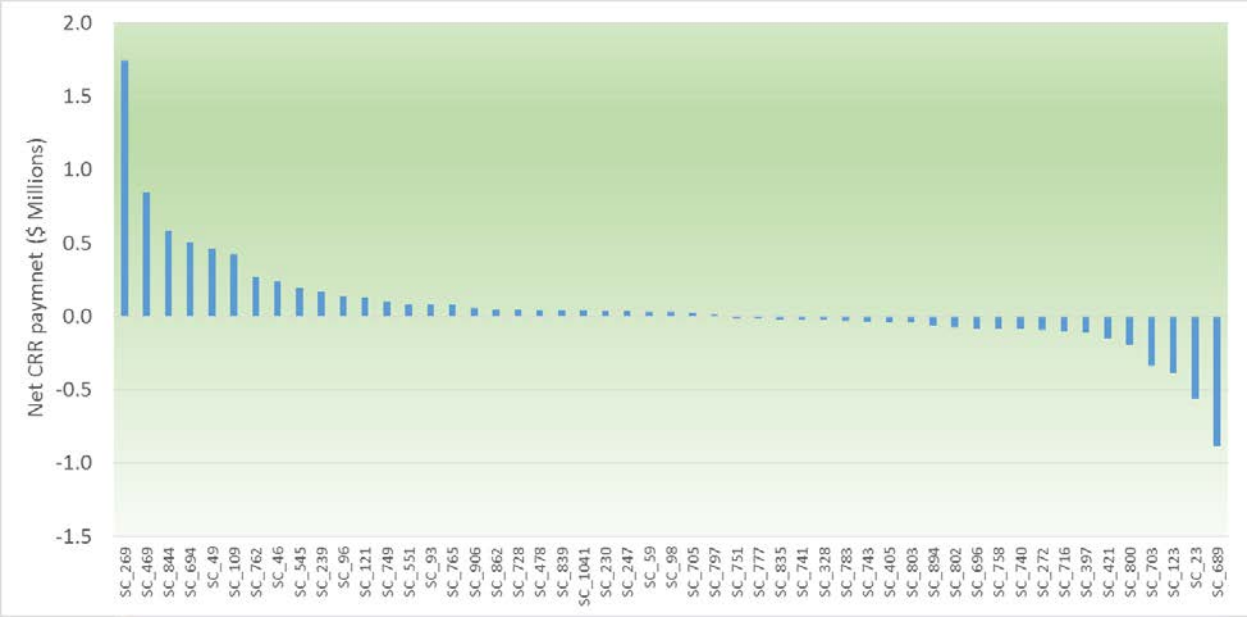


Figure 103 shows the net CRR payments to CRR participants, regardless of the type of participant. This only reflects the payments for CRRs released in both the annual and monthly CRR auctions applicable for the month of August 2016. Since this is from the CAISO's perspective, a negative value means the 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

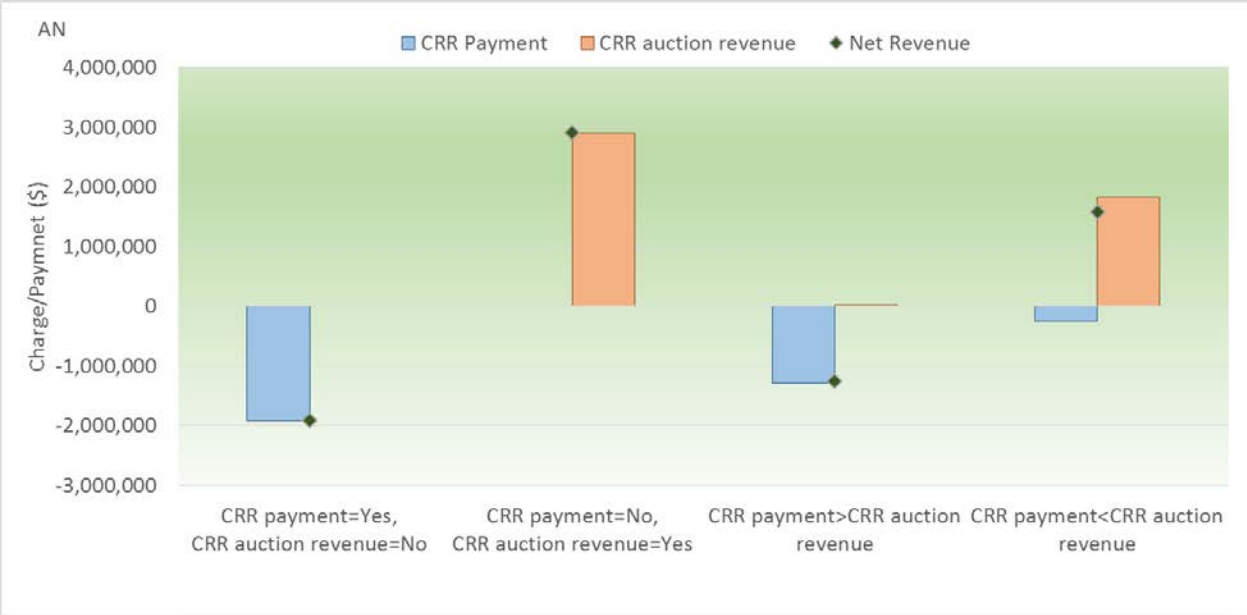


To better understand the dynamics leading to such an outcome, the CAISO shifted the analysis to the fundamentals of the CRR auction construct by analyzing the CRR auction results at the constraint level. CRRs are released and priced based on the CRR clearing prices; such prices are derived as the relative 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

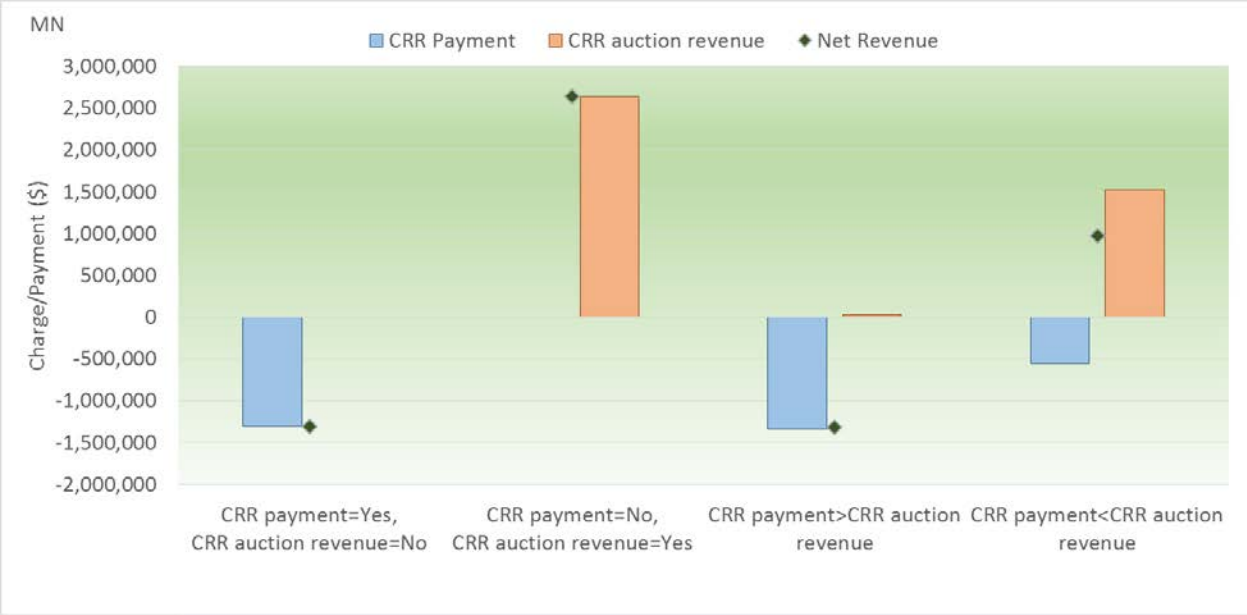


Table 5 provides one level deeper of understanding of such misalignments between markets. This tables show the top and bottom constraints when sorted by net CRR payments. In the first column it shows the estimated CRR payment to CRR holders accrued by each constraint; the second column shows the auction 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

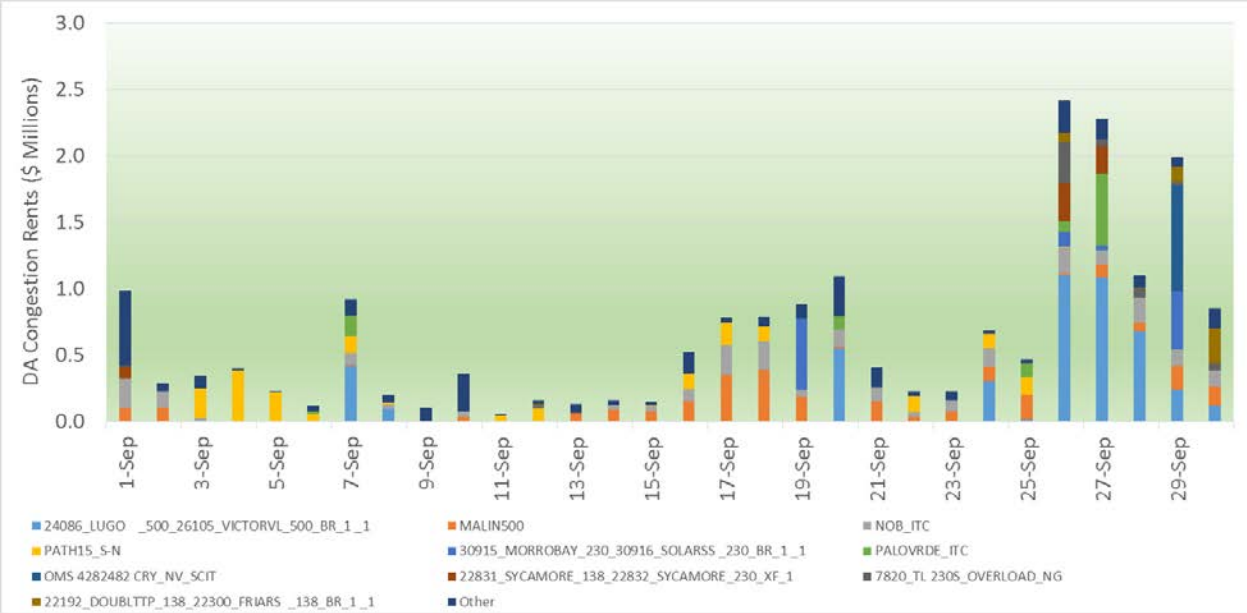


Figure 107: Daily CRR revenue adequacy - September 2016

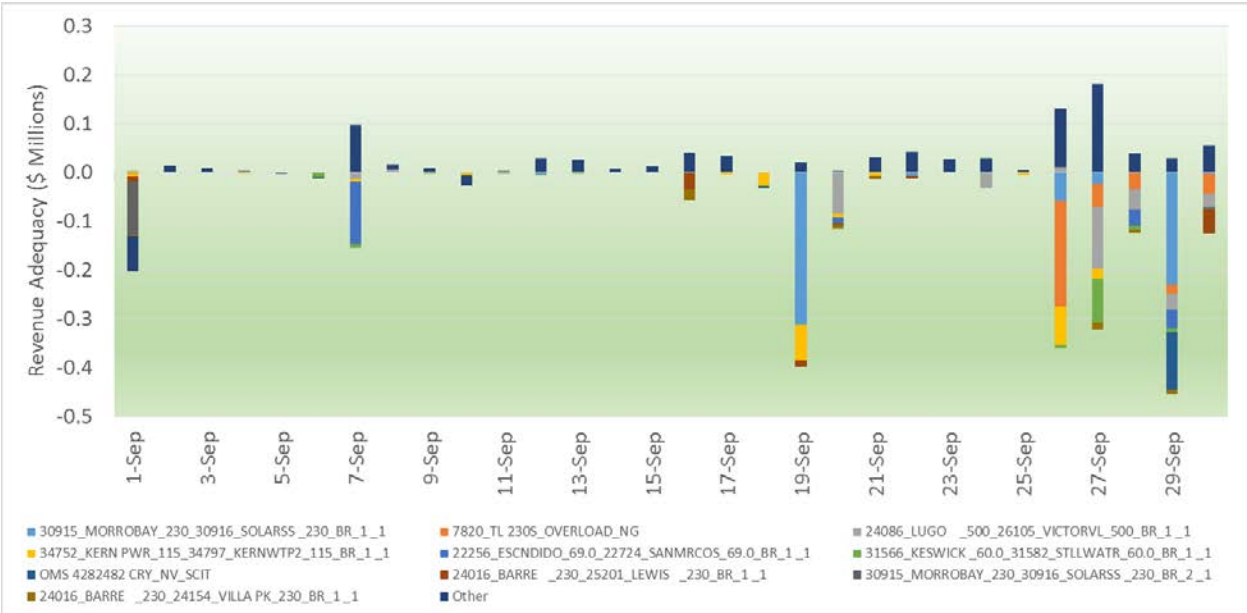


Figure 108 shows the net CRR payment per day. This net payment is the difference between the CRR payments to CRR holders and the auction revenues collected by the CAISO through the CRR auction process; such revenues become a lump revenue for the auction. For this

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

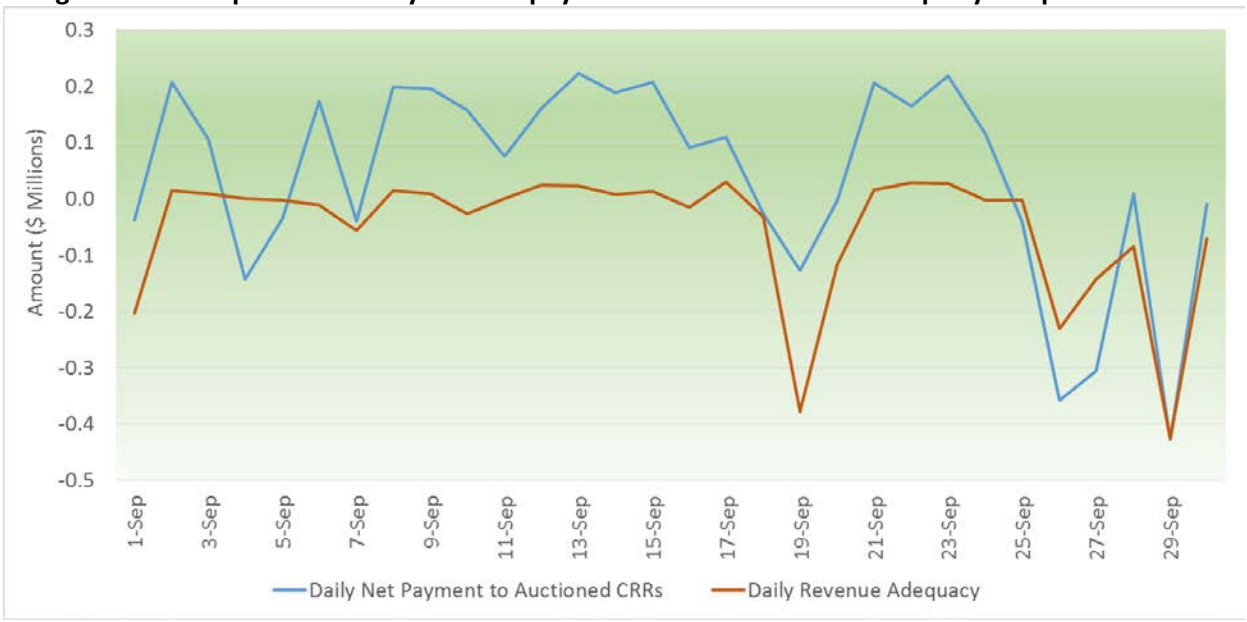
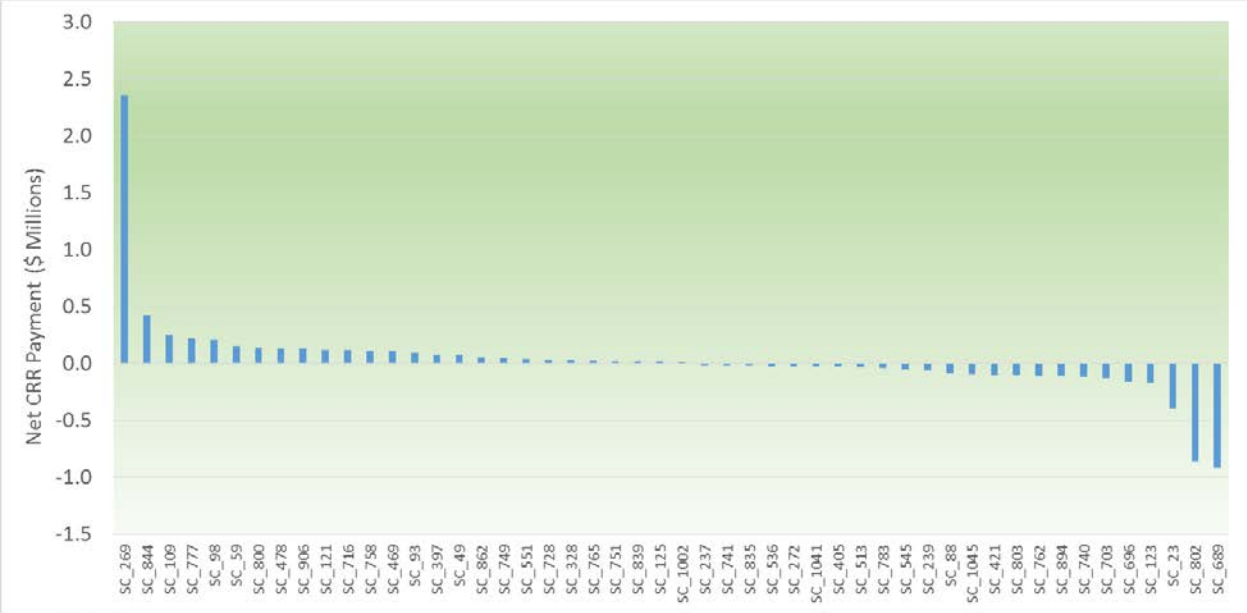


Figure 110 shows the net CRR payments to CRR participants, regardless of the type of participant. This only reflects the payments for CRRs released in both the annual and monthly CRR auctions applicable for the month of September 2016.

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

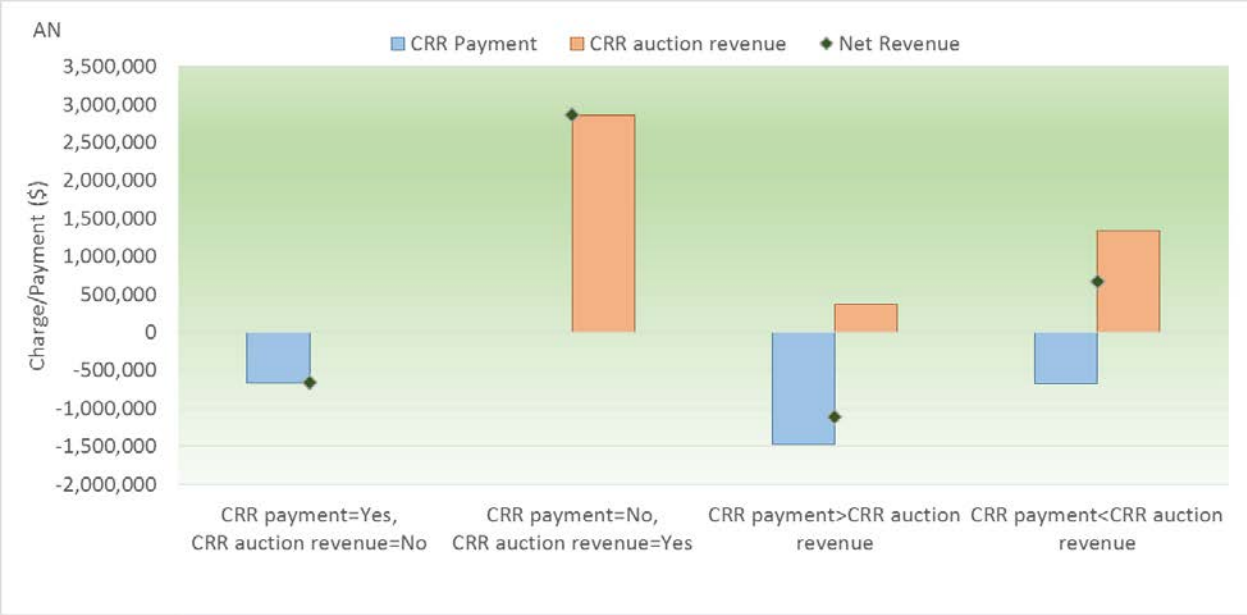


Figure 112: CRR payment versus CRR auction revenues for monthly CRR - September 2016

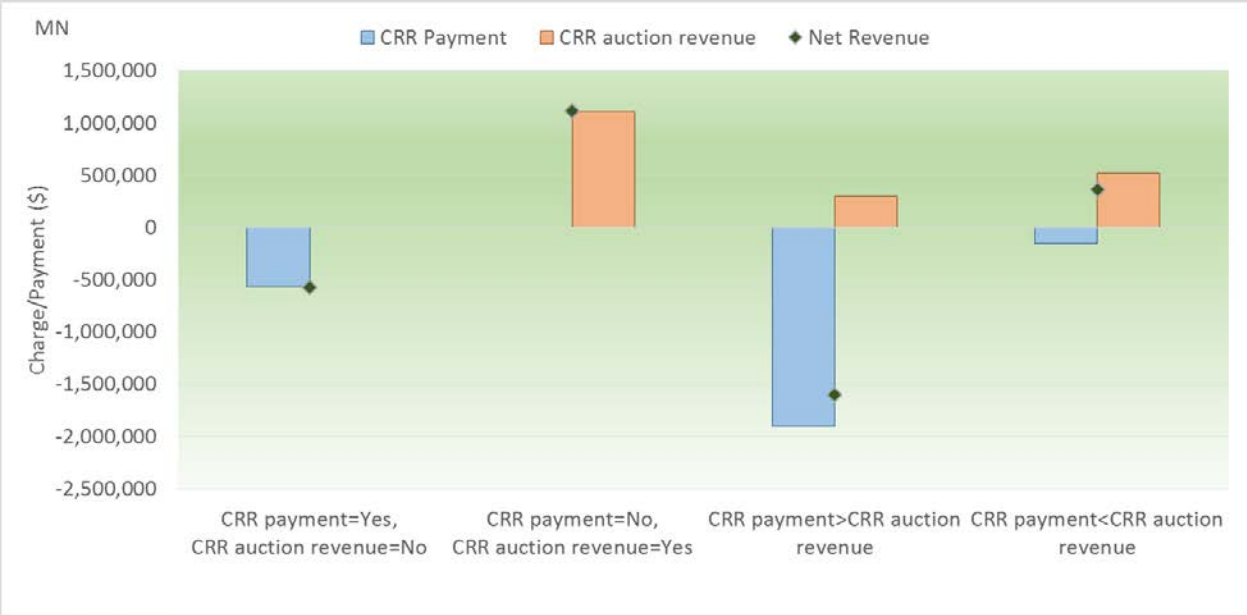


Table 9 provides one level deeper of understanding of such misalignments between markets. This tables show the top and bottom constraints when sorted by net CRR payments. In the first column it shows the estimated CRR payment to CRR holders accrued by each constraint; the second column shows the auction 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

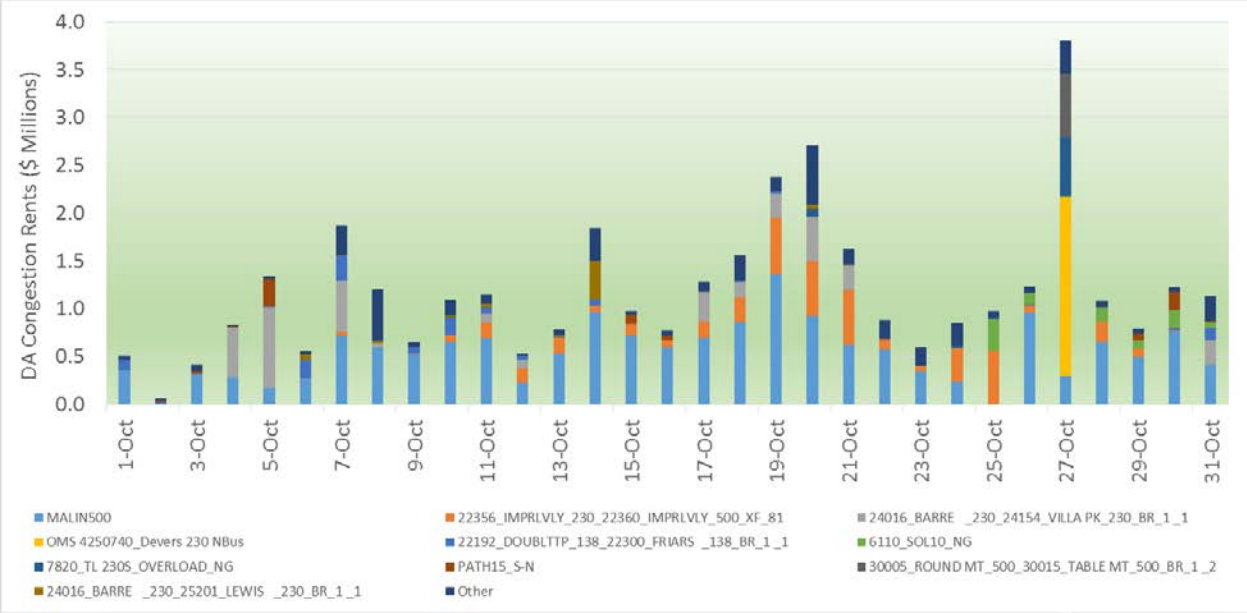


Figure 114: Daily CRR revenue adequacy - October 2016

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

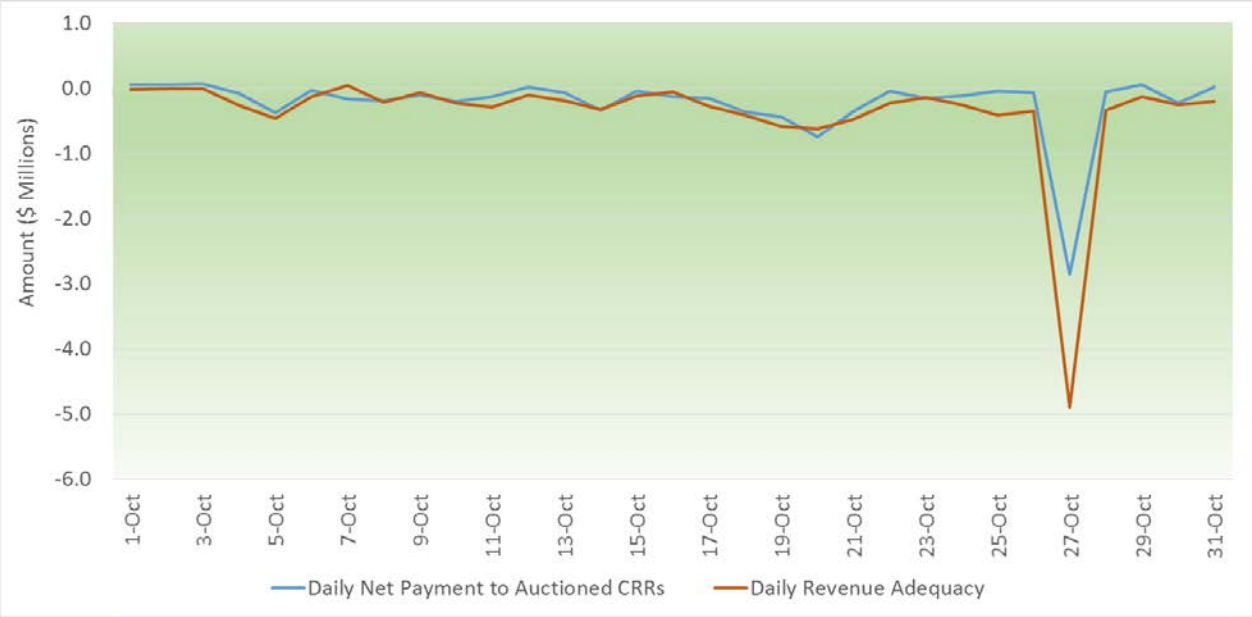


Figure 117 shows the net CRR payments to CRR participants, regardless of the type of participant. This only reflects the payments for CRRs released in both the annual and monthly CRR auctions applicable for the month of October 2016. Since this is from the CAISO's perspective, a negative value means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

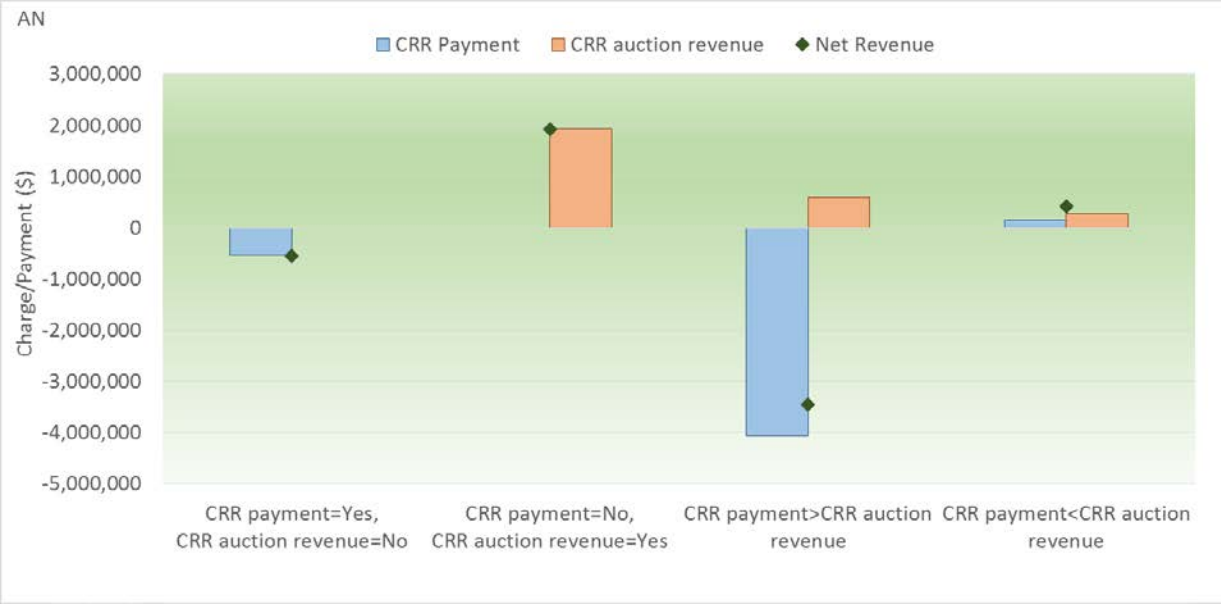


Figure 119: CRR payment versus CRR auction revenues for monthly CRR - October 2016

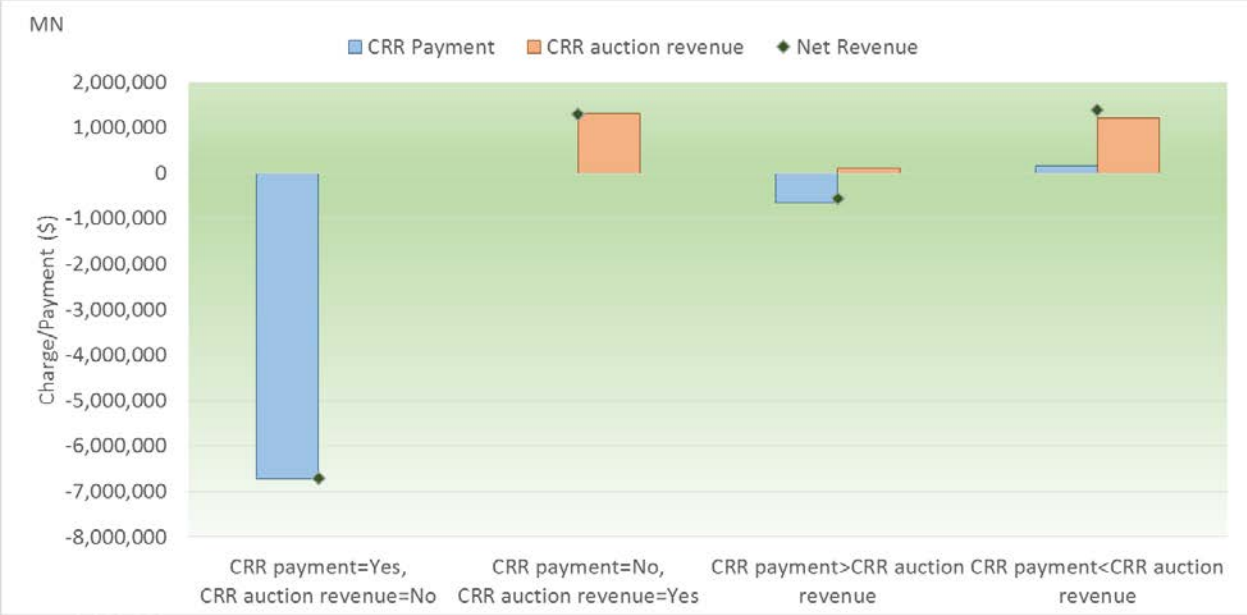


Table 13 provides one level deeper of understanding of such misalignments between markets. This tables shows the top and bottom constraints when sorted by net CRR payments. In the first column it shows the estimated CRR payment to CRR holders accrued in each constraint; the second column shows the revenues 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

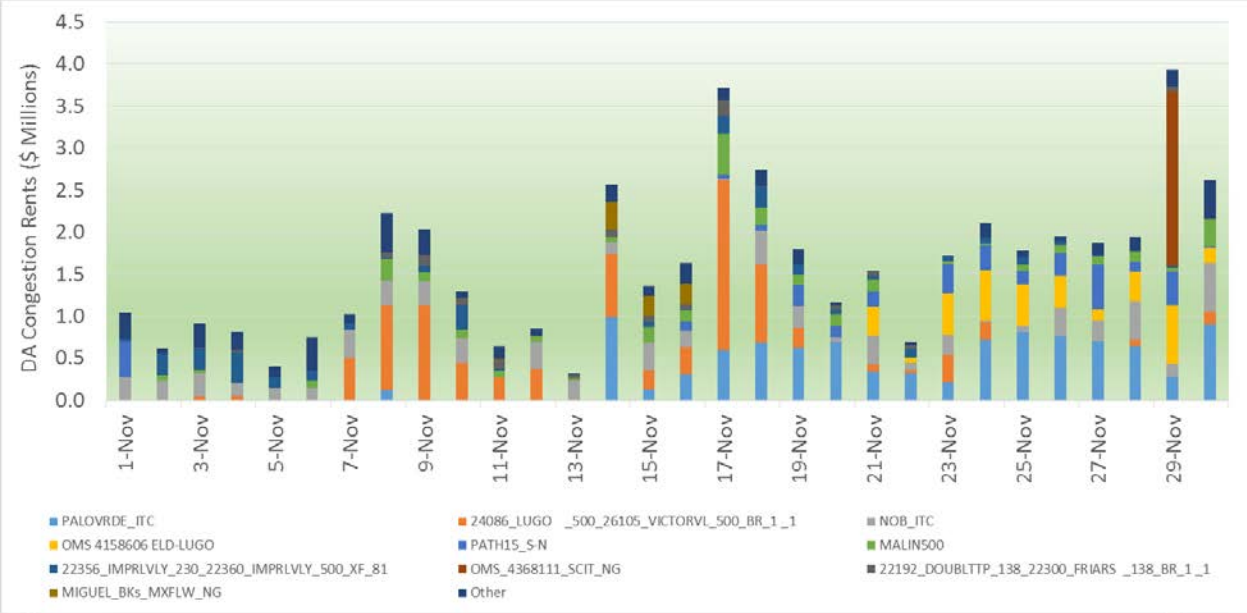


Figure 121: Daily CRR revenue adequacy - November 2016

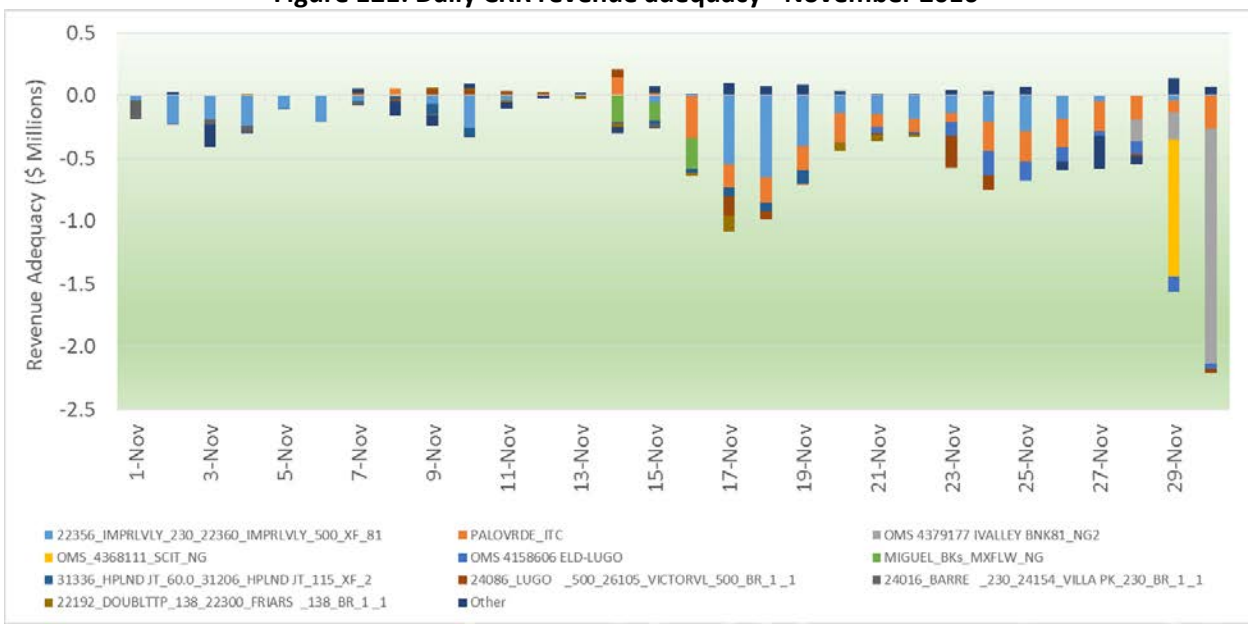
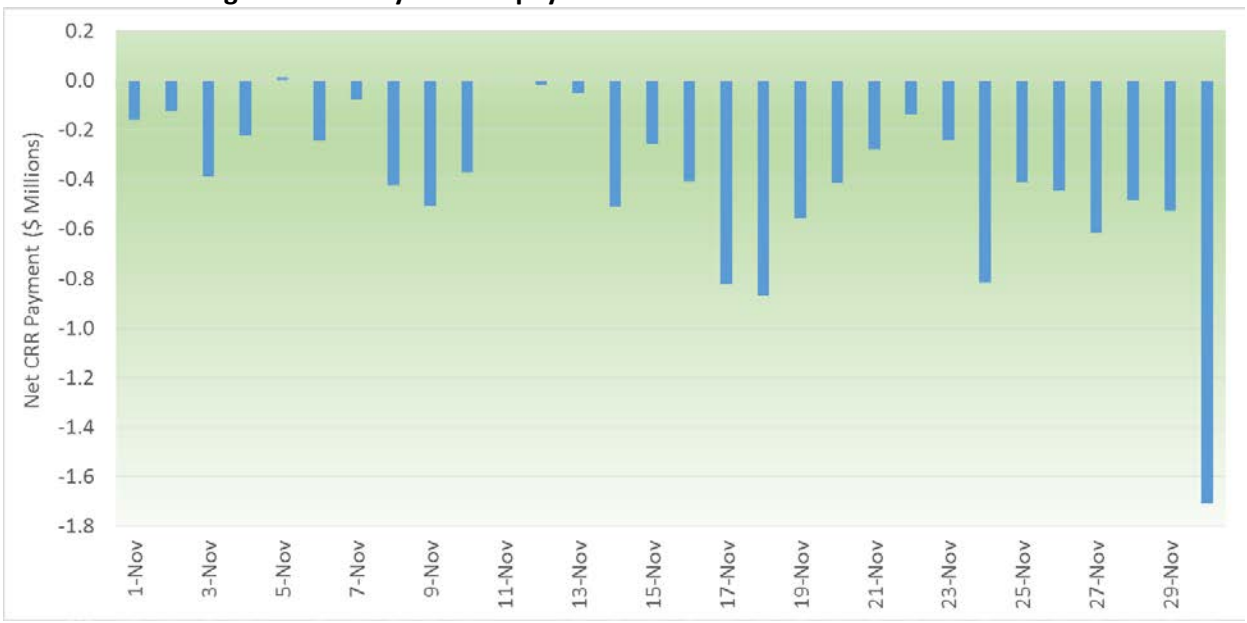


Figure 122 shows the net CRR payment per day. This net revenue is the difference between the CRR payments to CRR holders and the auction revenues collected by the CAISO through the CRR auction process; such revenues become a lump revenue for the auction. For this metric, the annual auction revenues are 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

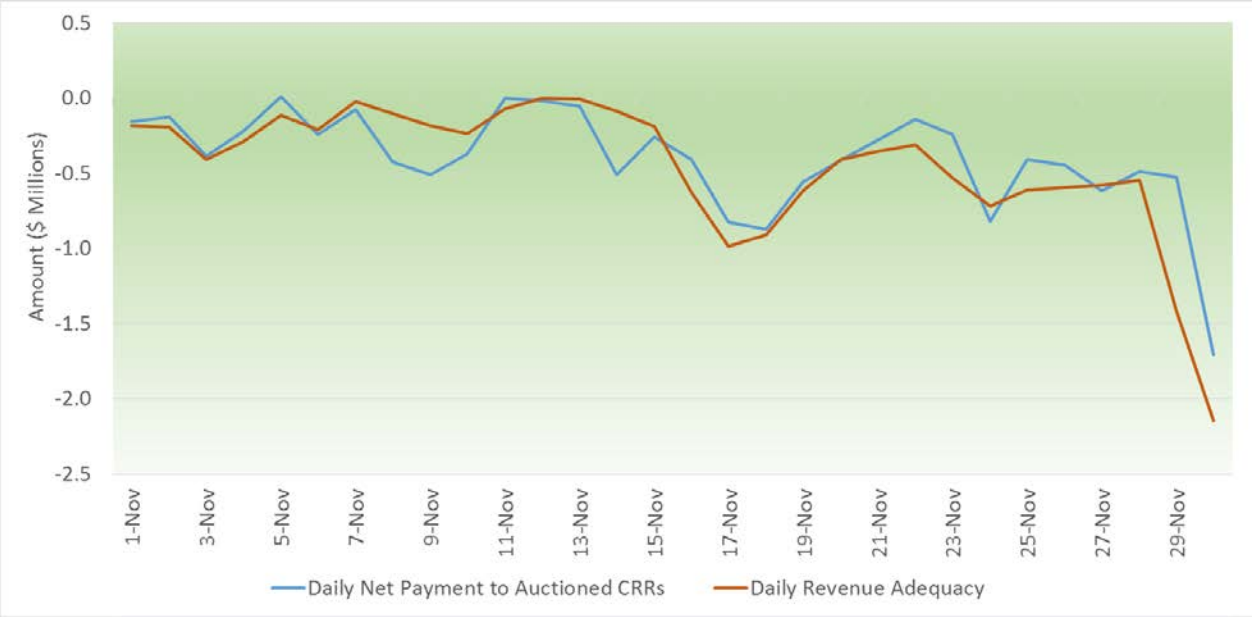


Figure 124 shows the net CRR payments to CRR participants, regardless of the type of participant. This only reflects the payments for CRRs released in both the annual and monthly CRR auctions applicable for the month of November 2016.

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

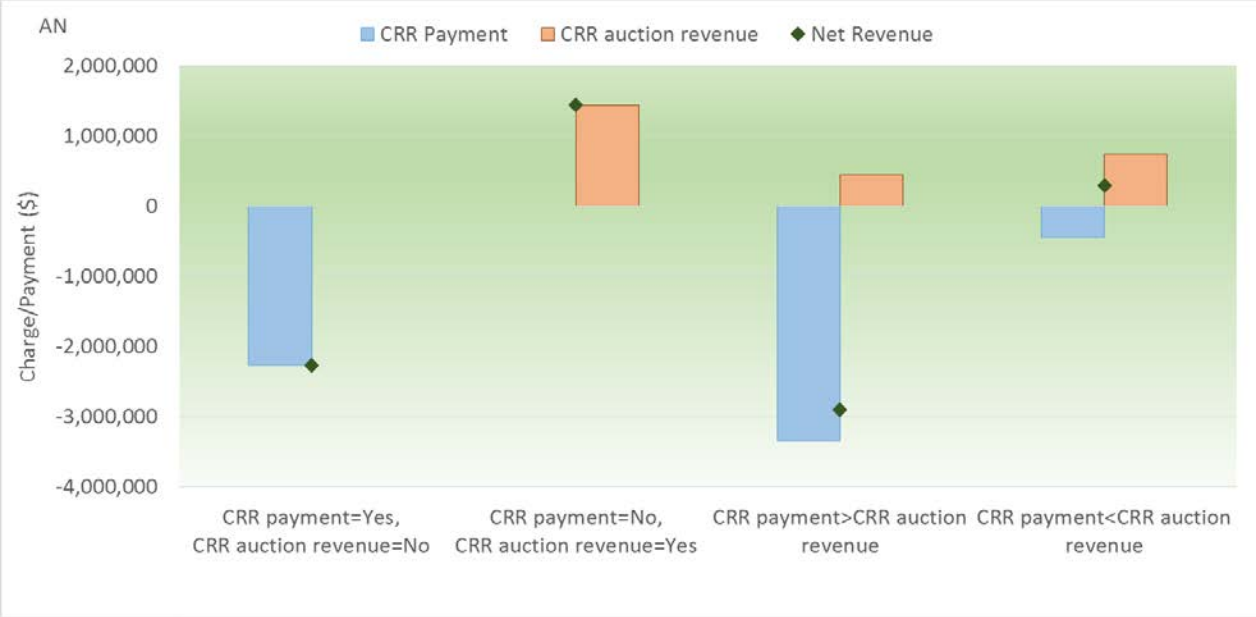


Figure 126: CRR payment versus CRR auction revenues for monthly CRR -November 2016

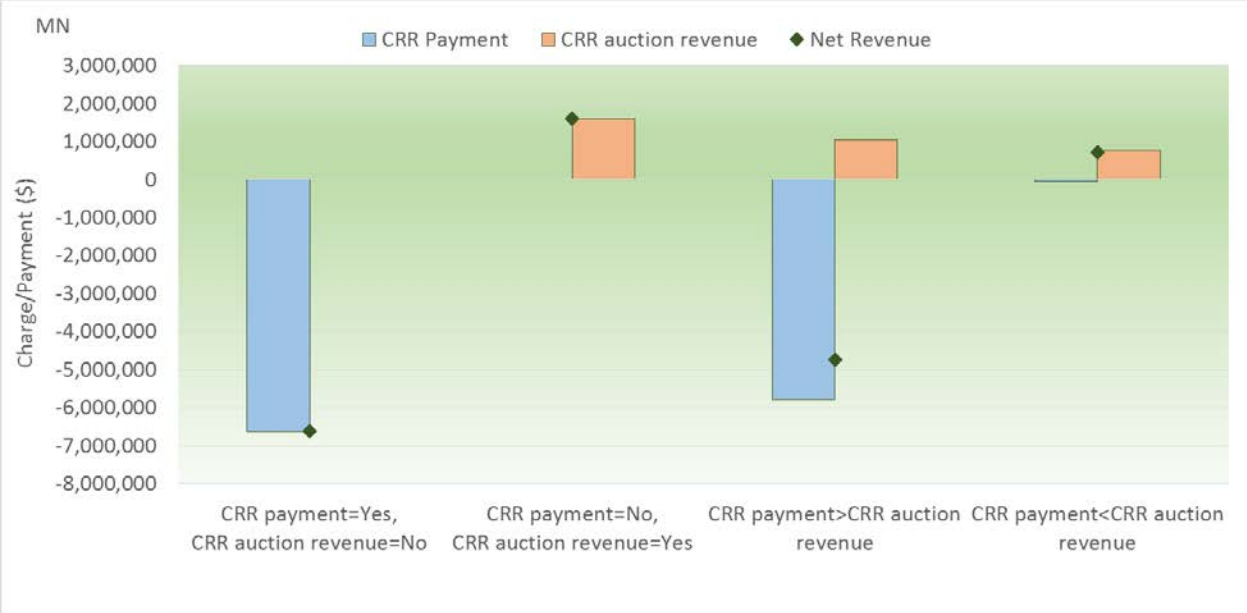


Table 17 provides one level deeper of understanding of such misalignments between markets. This tables shows the top and bottom constraints when sorted by net CRR payments. In the first column it shows the estimated CRR payment to CRR holders accrued in each constraint; the second column shows the revenues 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

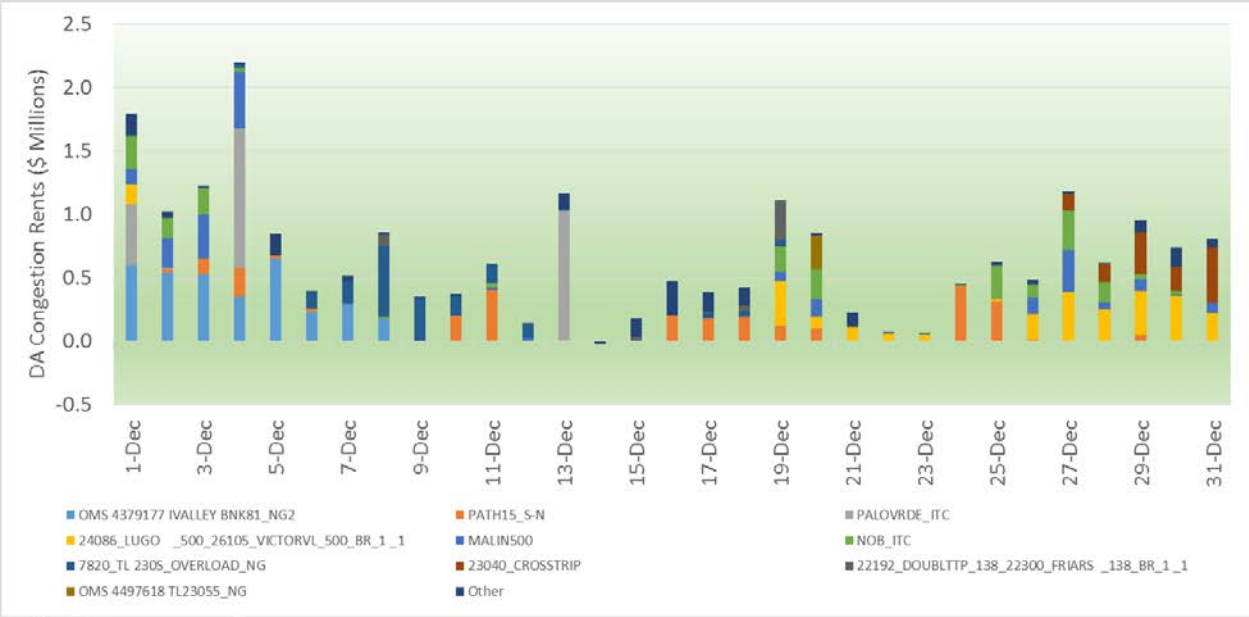
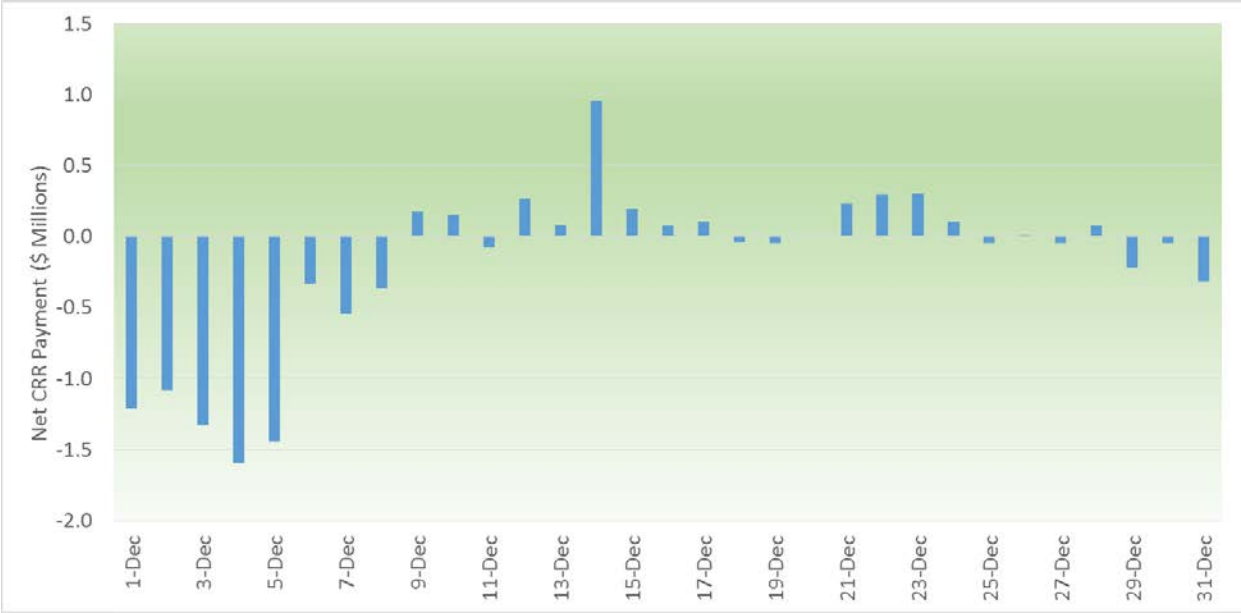


Figure 128: Daily CRR revenue adequacy - December 2016

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

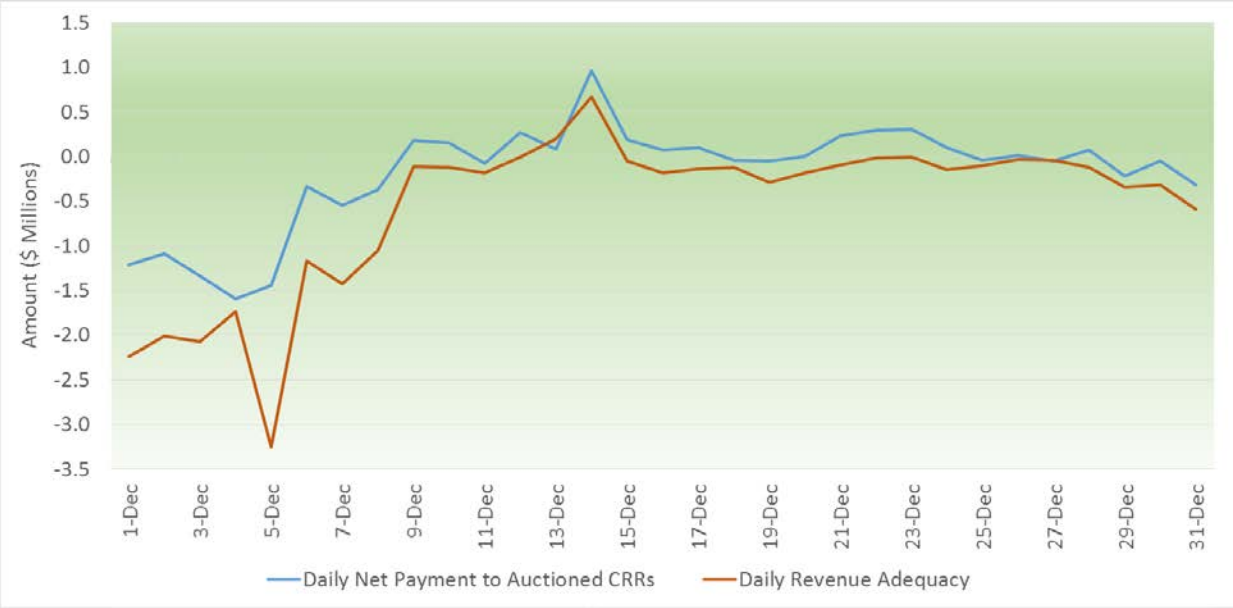
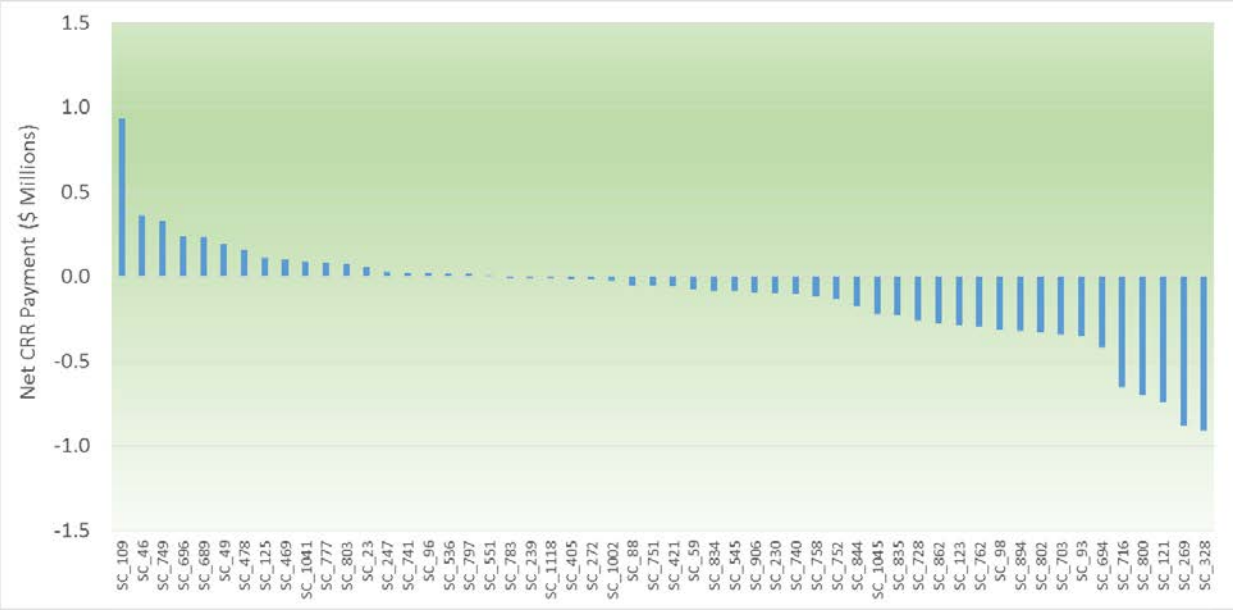


Figure 131 shows the net CRR payments to CRR participants, regardless of the type of participant. This only reflects the payments for CRRs released in both the annual and monthly CRR auctions applicable for the month of December 2016. Since this is from the CAISO's perspective, a negative value means 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

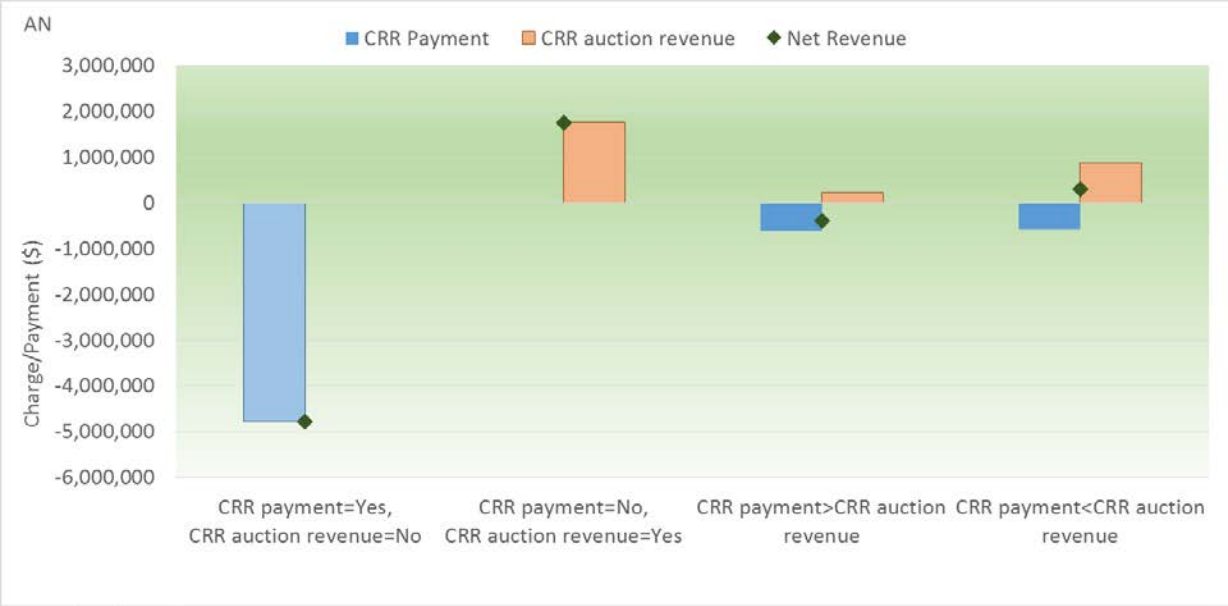


Figure 133: CRR payment versus CRR auction revenues for monthly CRR - December 2016

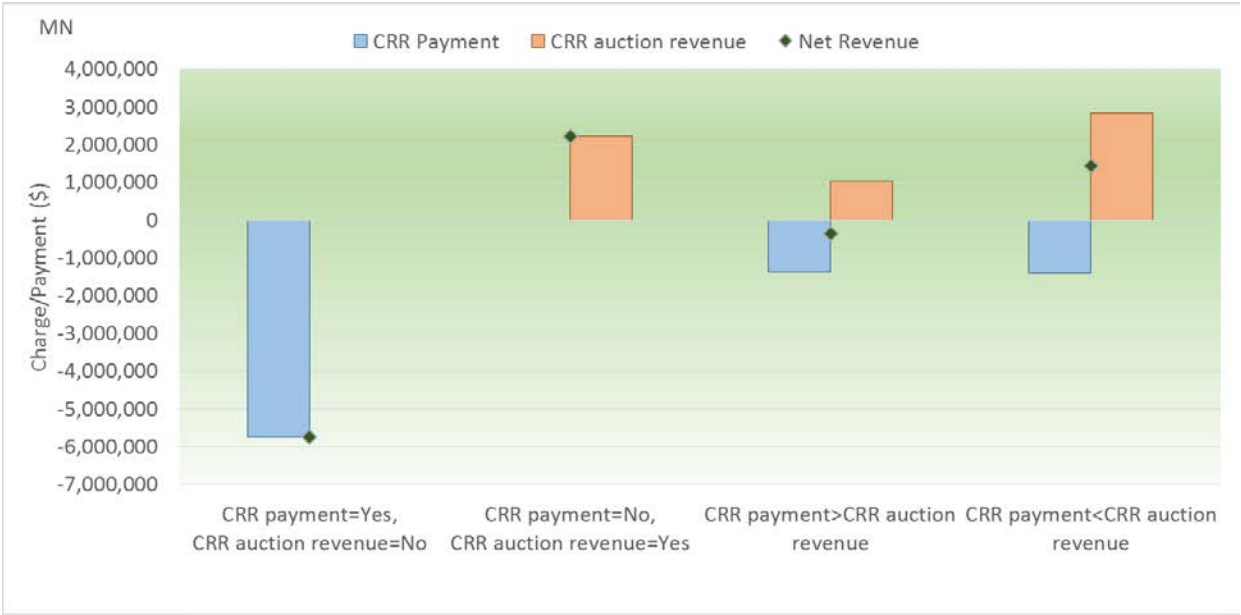


Table 21 provides one level deeper of understanding of such misalignments between markets. This tables shows the top and bottom constraints when sorted by net CRR payments. In the first column it shows the estimated CRR payment to CRR holders accrued in each constraint; the second column shows the revenues 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

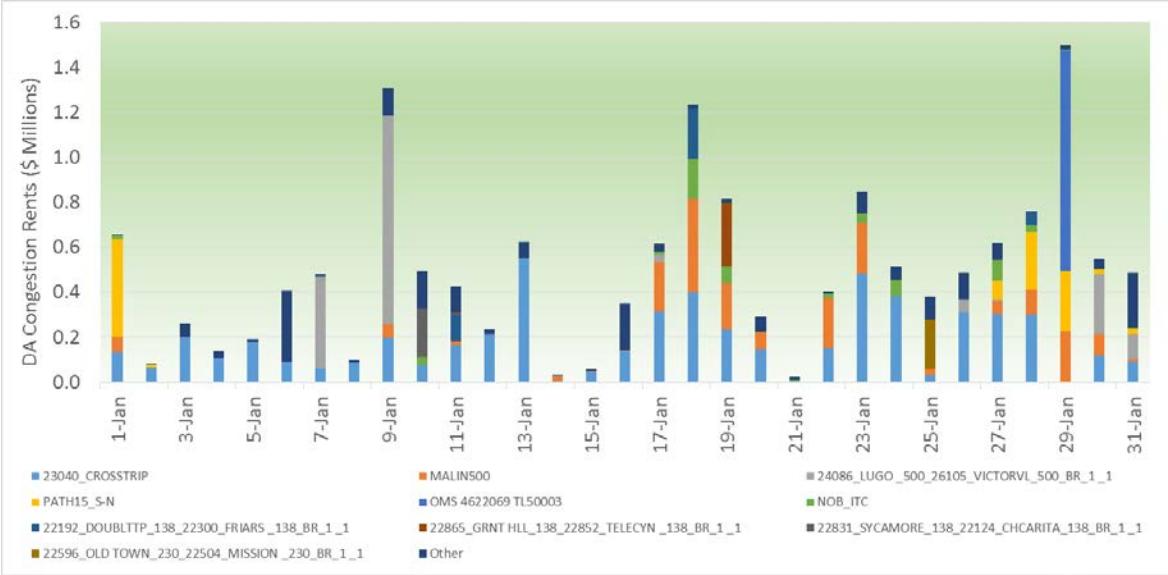


Figure 135: Daily CRR revenue adequacy - January 2017

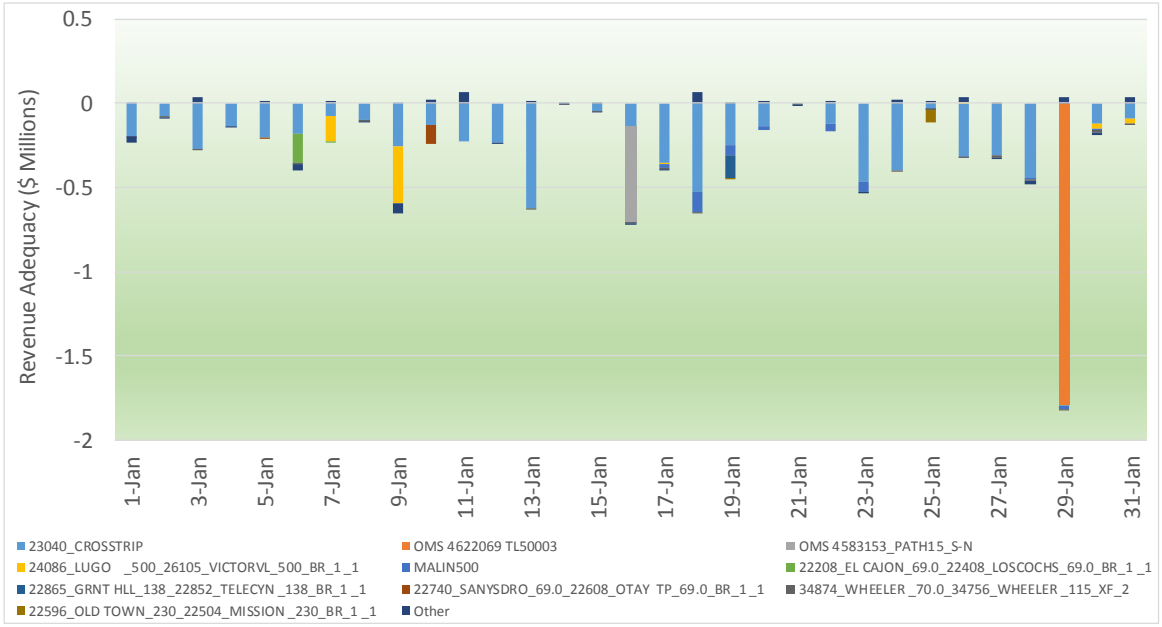
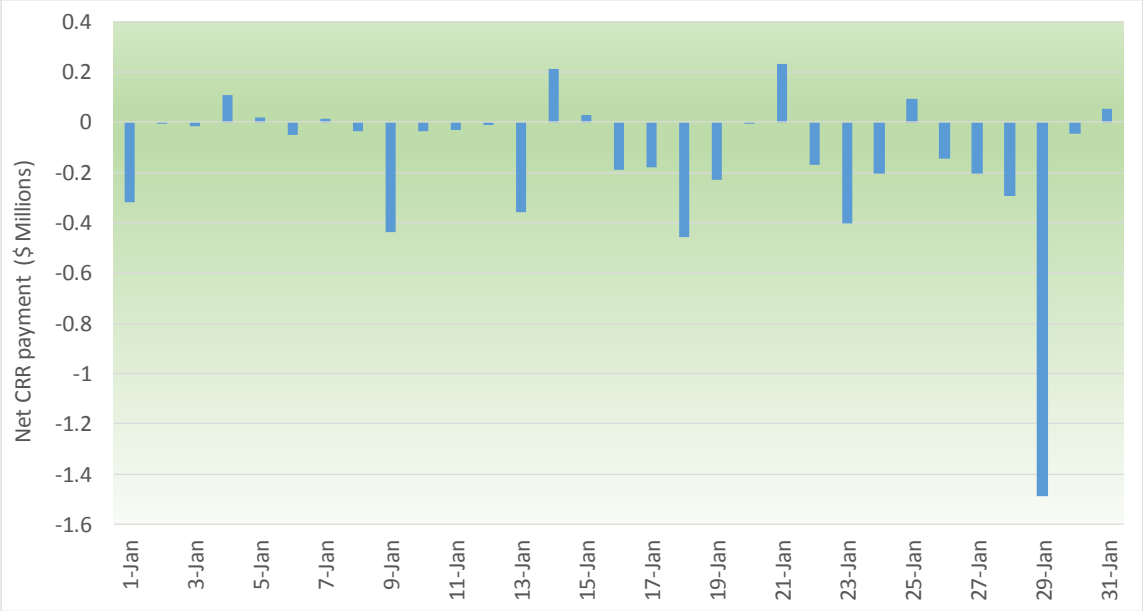


Figure 136 shows the net CRR payment per day. This net revenue is the difference between the CRR payments to CRR holders and the auction revenues collected by the CAISO through the CRR auction process; such revenues become a lump revenue for the auction. For this metric, the annual auction revenues are 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

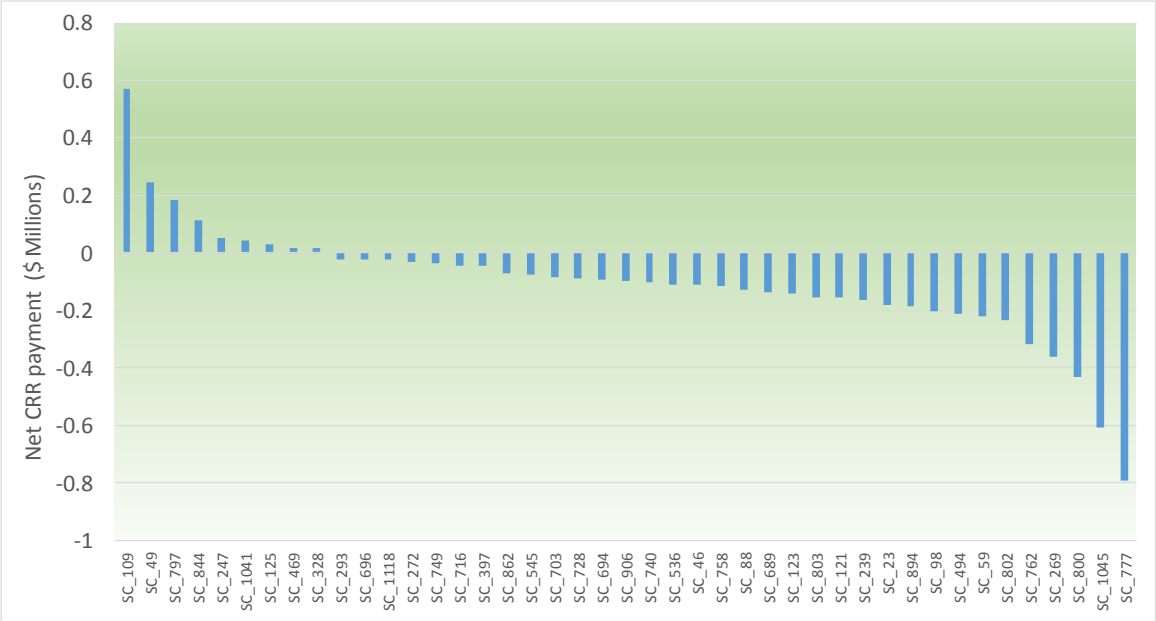


As shown in Figure 137, there is a strong correlation between the level of CRR revenue deficiency and the level of net CRR payments paid to holders of CRRs released in the auction processes. This is not surprising since both metrics reflect to some extent the effect of CRRs released (and priced) in the 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

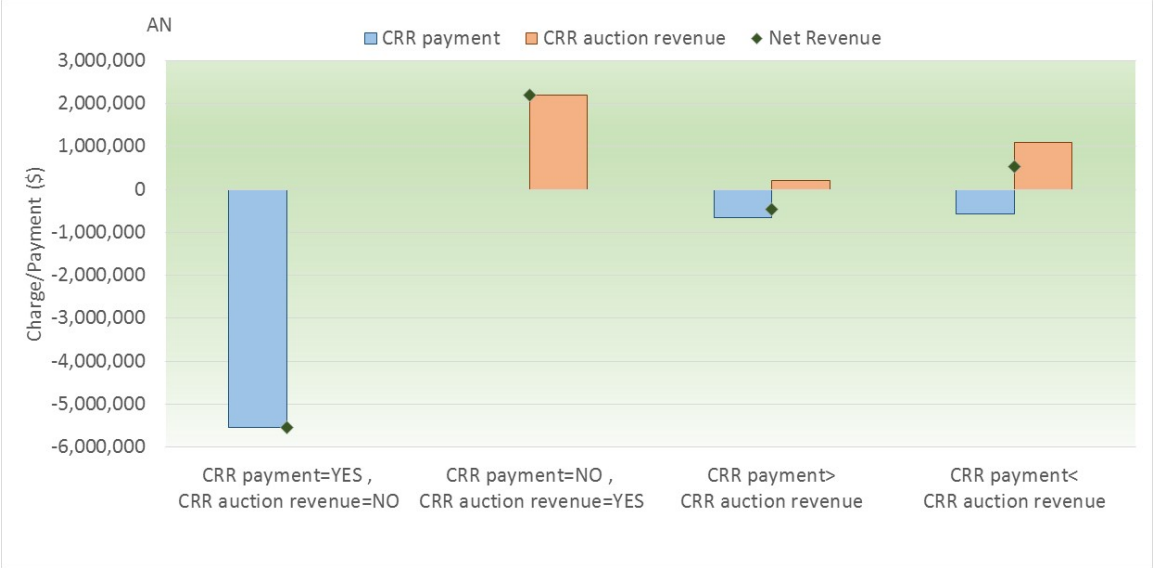


Figure 140: CRR payment versus CRR auction revenues for monthly CRR - January 2017

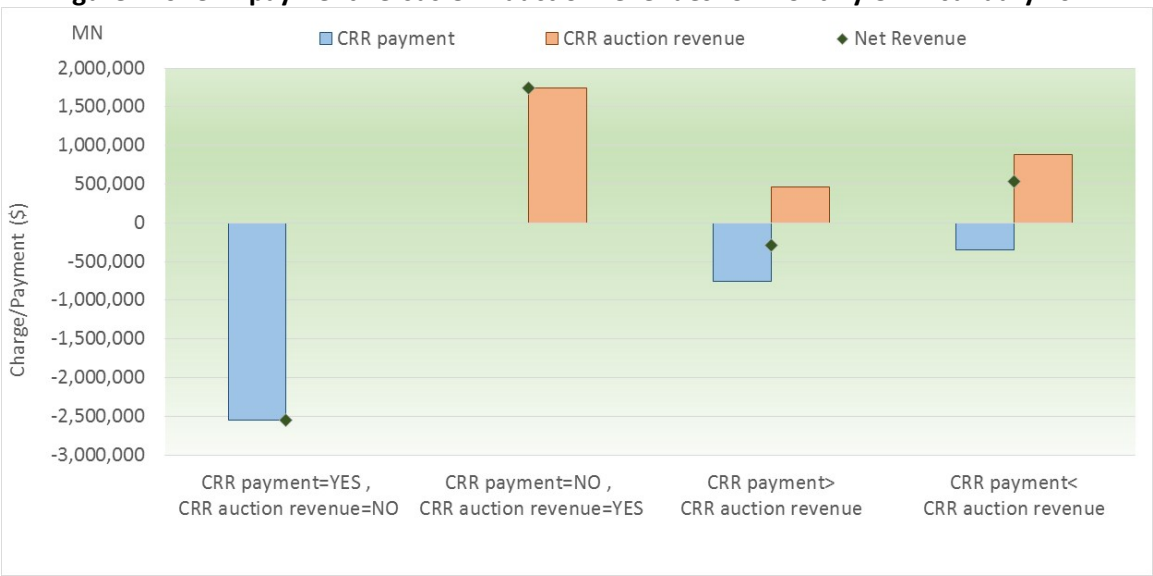


Table 25 provides one level deeper of understanding of such misalignments between markets. This tables shows the top and bottom constraints when sorted by net CRR payments. In the first column it shows the estimated CRR payment to CRR holders accrued in each constraint; the second column shows the revenues 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

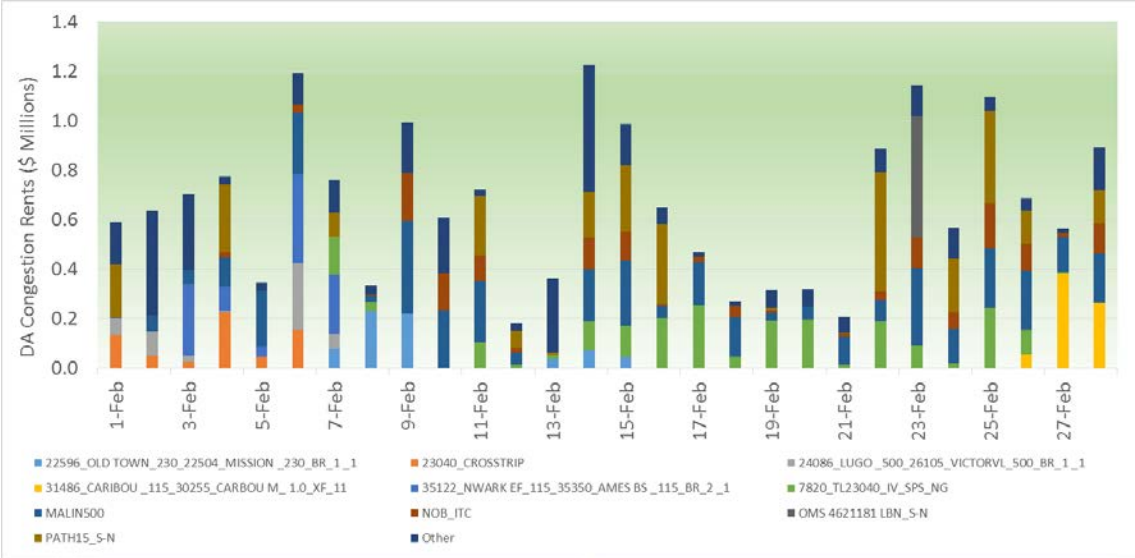


Figure 142: Daily CRR revenue adequacy - February 2017

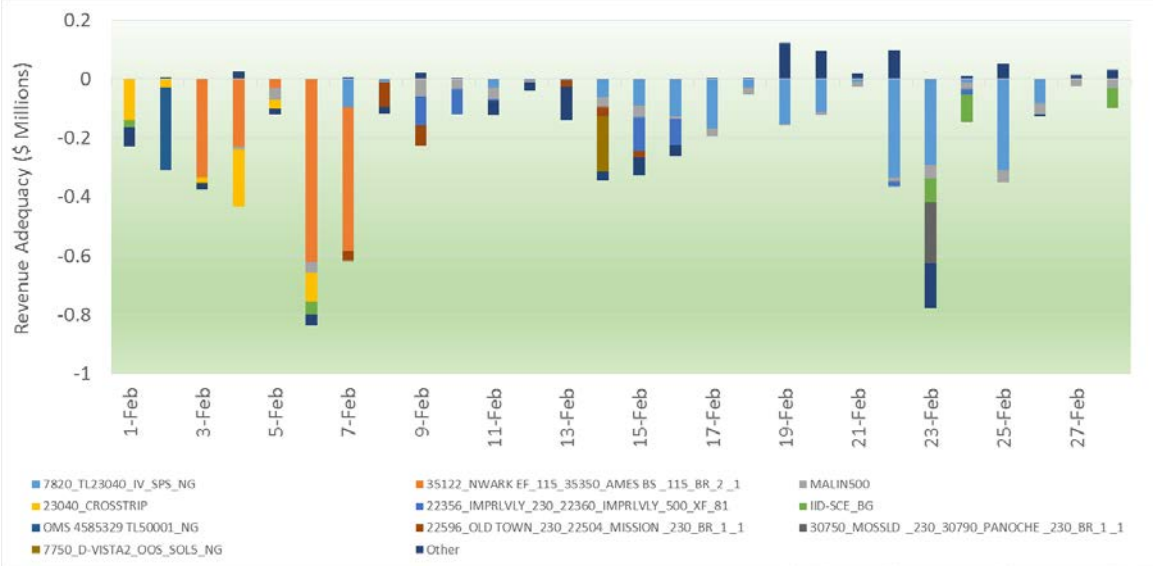


Figure 143 shows the net CRR payment per day. This net revenue is the difference between the CRR payments to CRR holders and the auction revenues collected by the CAISO through the CRR auction process; such revenues become a lump revenue for the auction. For this metric, the annual auction revenues are 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

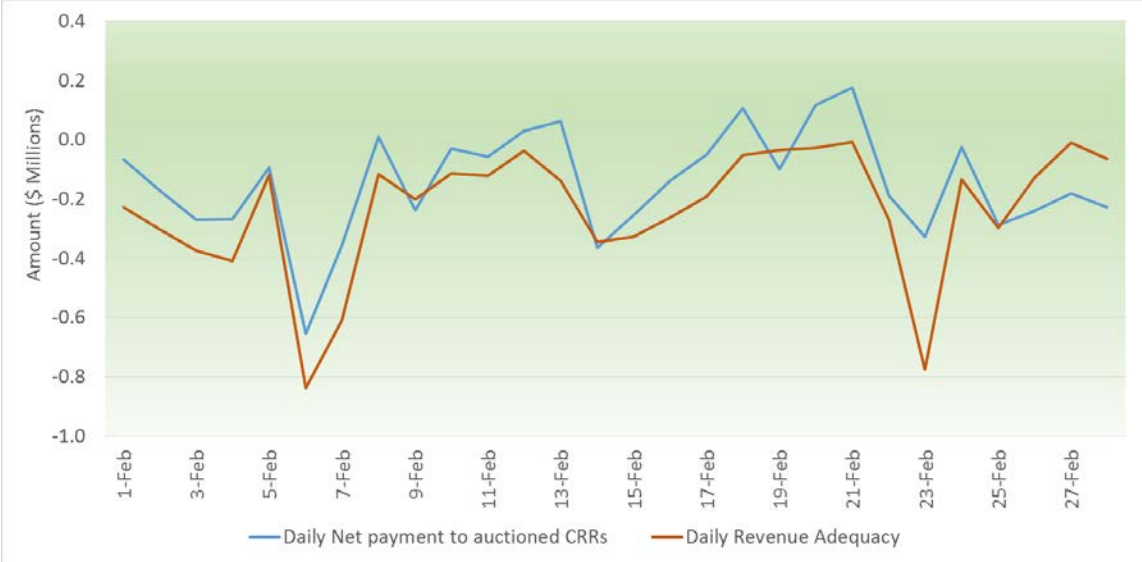
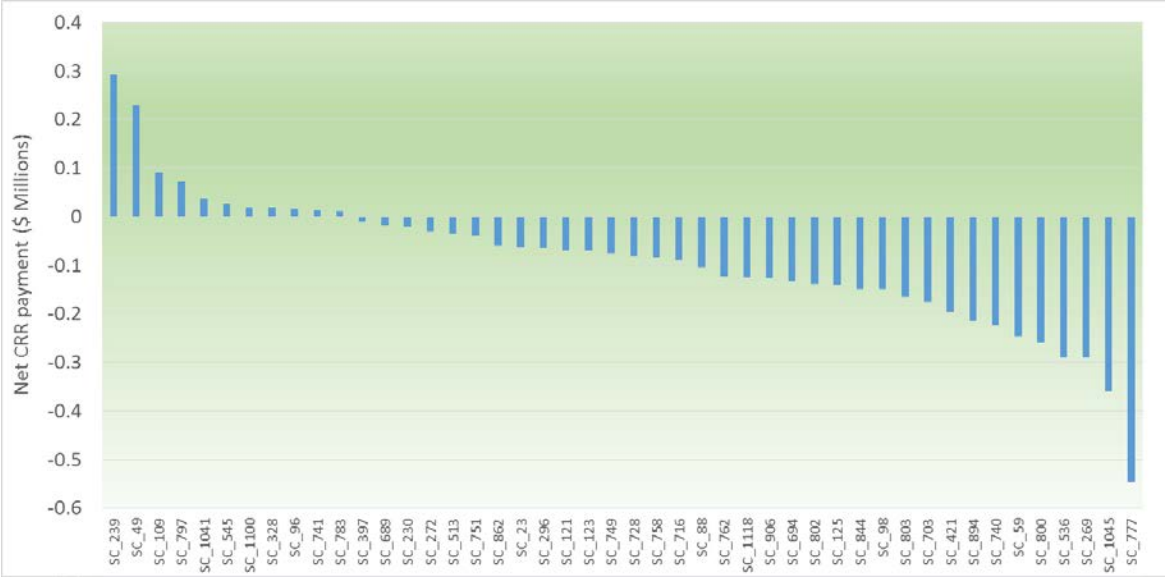


Figure 145 shows the net CRR payments to CRR participants, regardless of the type of participant. This only reflects the payments for CRRs released in both the annual and monthly CRR auctions applicable for the month of February 2017. Since this is from the CAISO's perspective, a negative value means 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

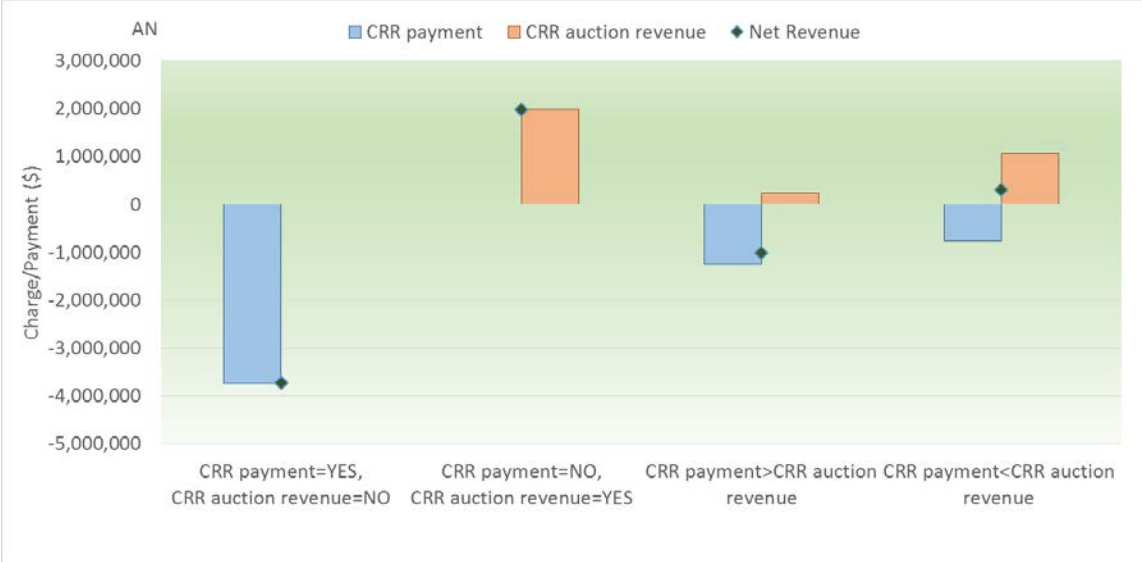


Figure 147: CRR payment versus CRR auction revenues for monthly CRR - February 2017

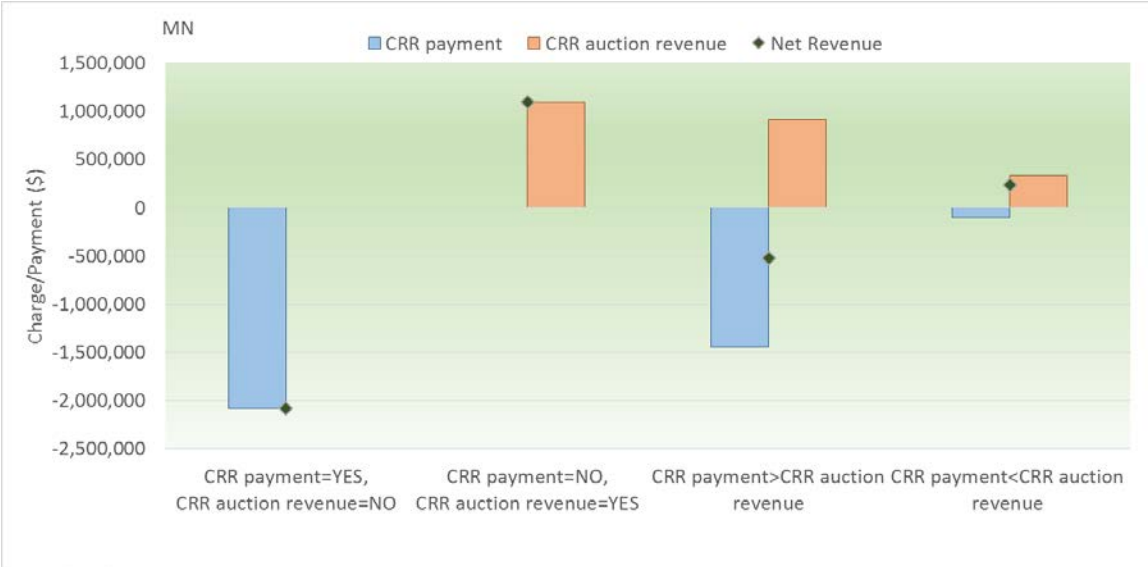


Table 29 provides one level deeper of understanding of such misalignments between markets. This tables shows the top and bottom constraints when sorted by net CRR payments. In the first column it shows the estimated CRR payment to CRR holders accrued in each constraint; the second column shows the revenues 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

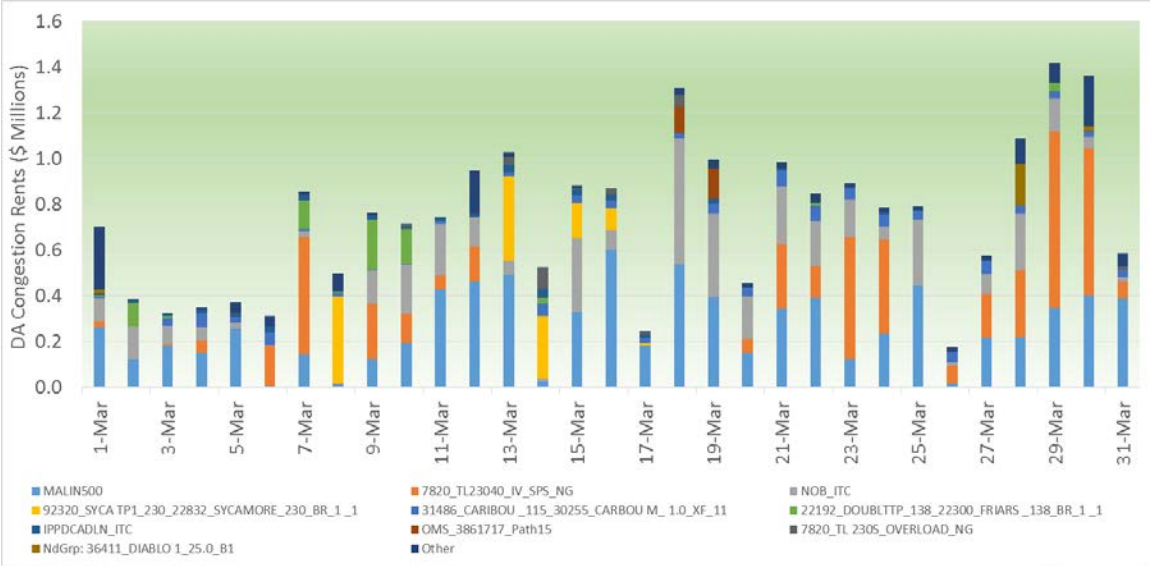


Figure 149: Daily CRR revenue adequacy - March 2017

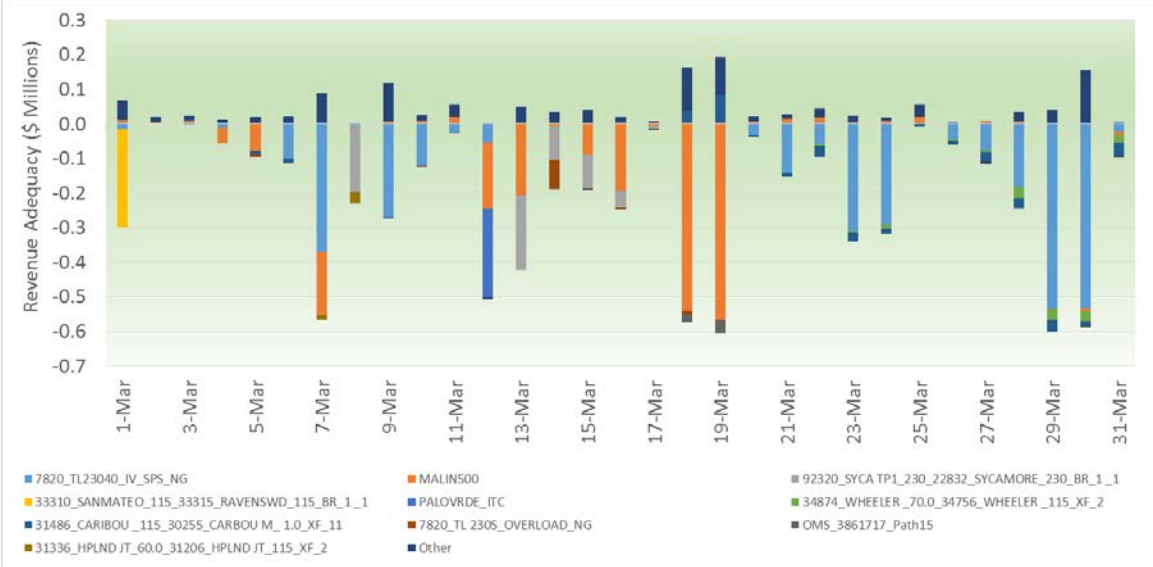
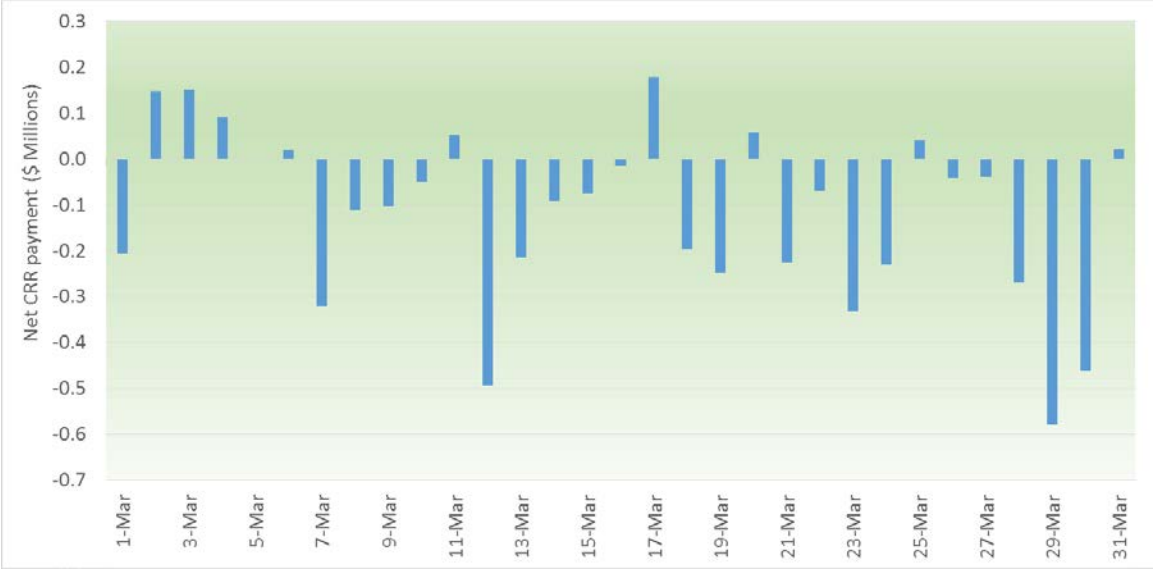


Figure 150 shows the net CRR payment per day. This net revenue is the difference between the CRR payments to CRR holders and the auction revenues collected by the CAISO through the CRR auction process; such revenues become a lump revenue for the auction. For this metric, the annual auction revenues are 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

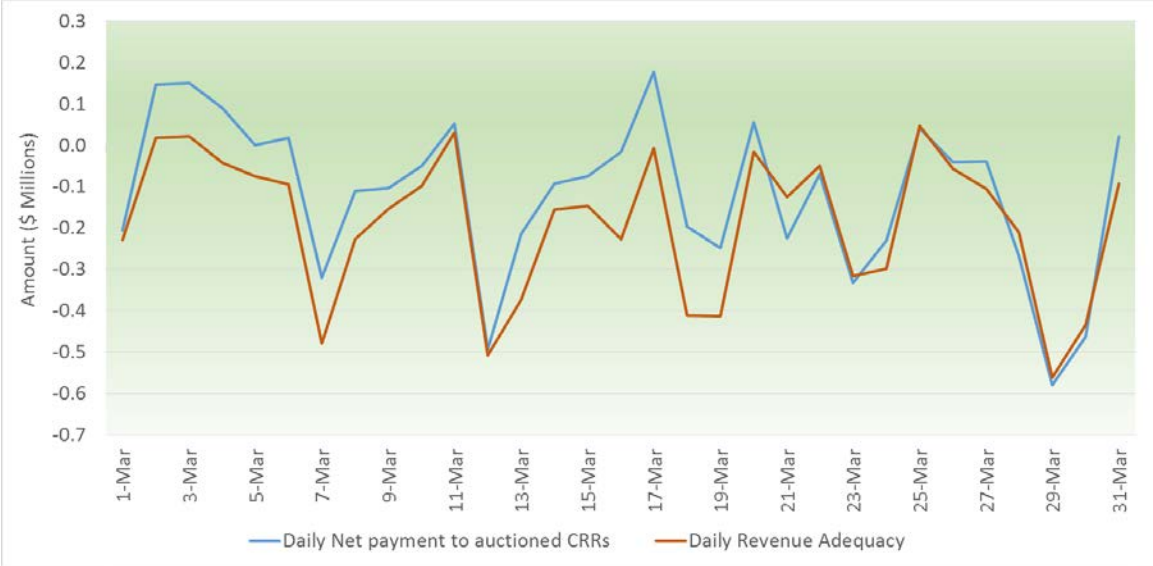
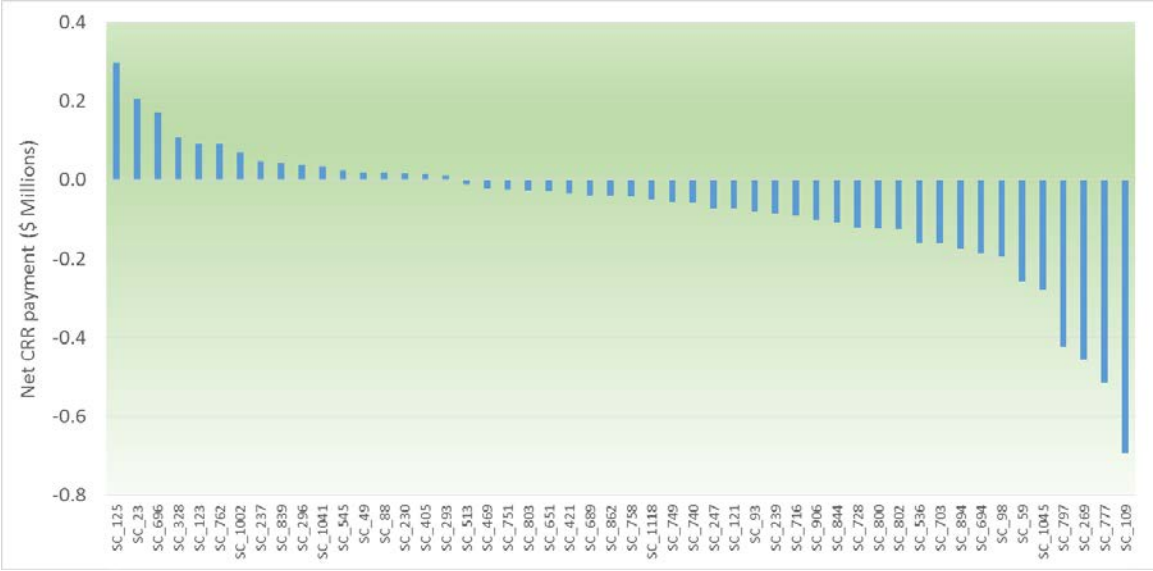


Figure 152 shows the net CRR payments to CRR participants, regardless of the type of participant. This only reflects the payments for CRRs released in both the annual and monthly CRR auctions applicable for the month of March 2017. Since this is from the CAISO's perspective, a negative value means the 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

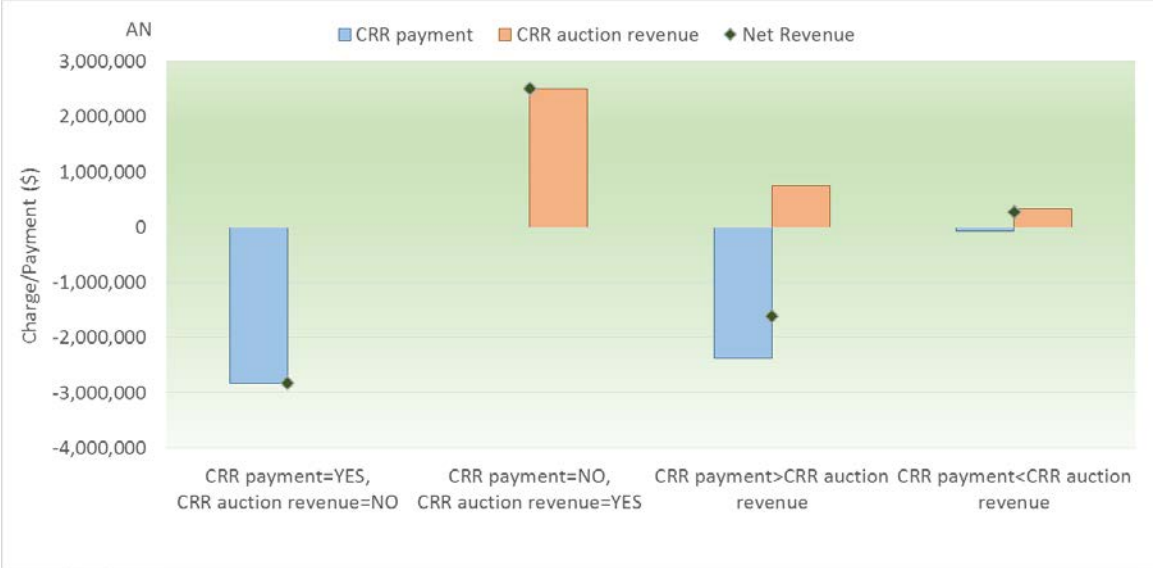


Figure 154: CRR payment versus CRR auction revenues for monthly CRR -March 2017

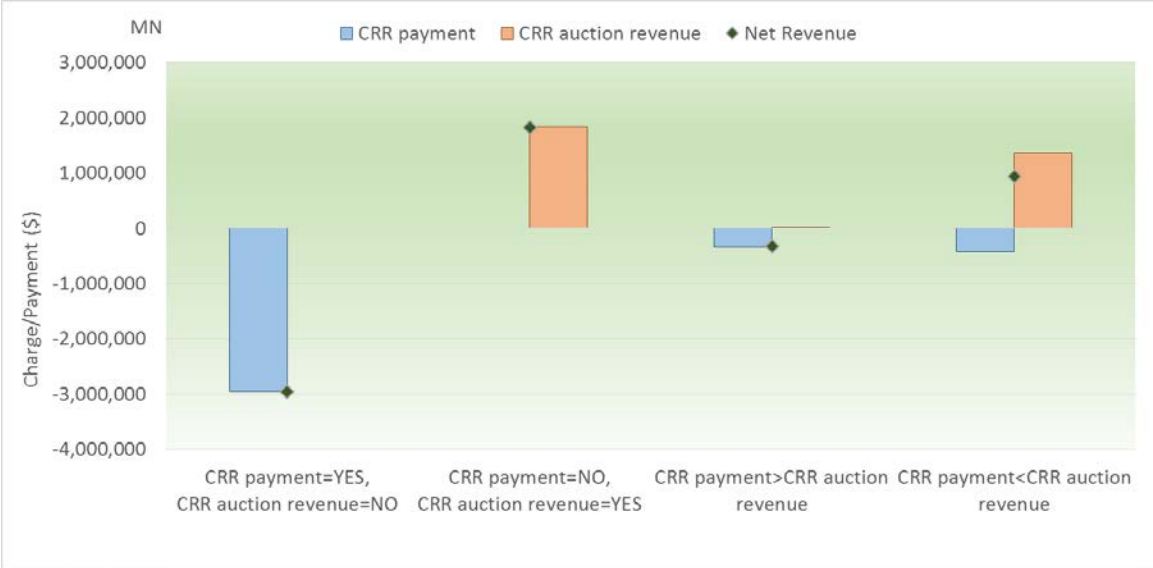


Table 33 provides one level deeper of understanding of such misalignments between markets. This tables shows the top and bottom constraints when sorted by net CRR payments. In the first column it shows the estimated CRR payment to CRR holders accrued in each constraint; the second column shows the revenues 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

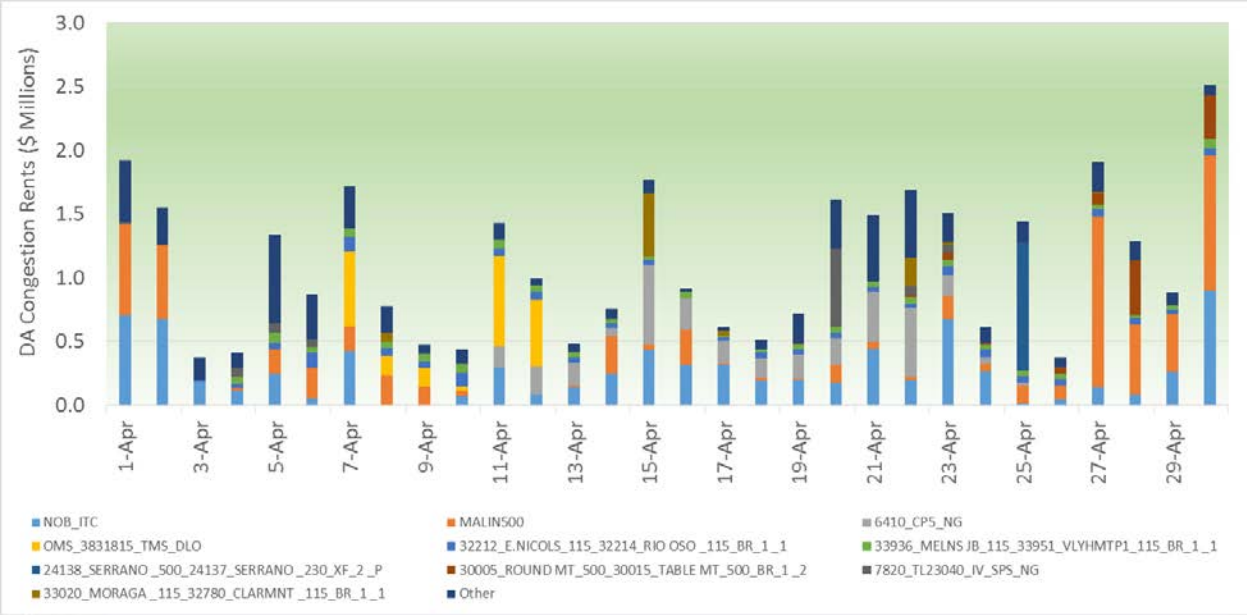


Figure 156: Daily CRR revenue adequacy -April 2017

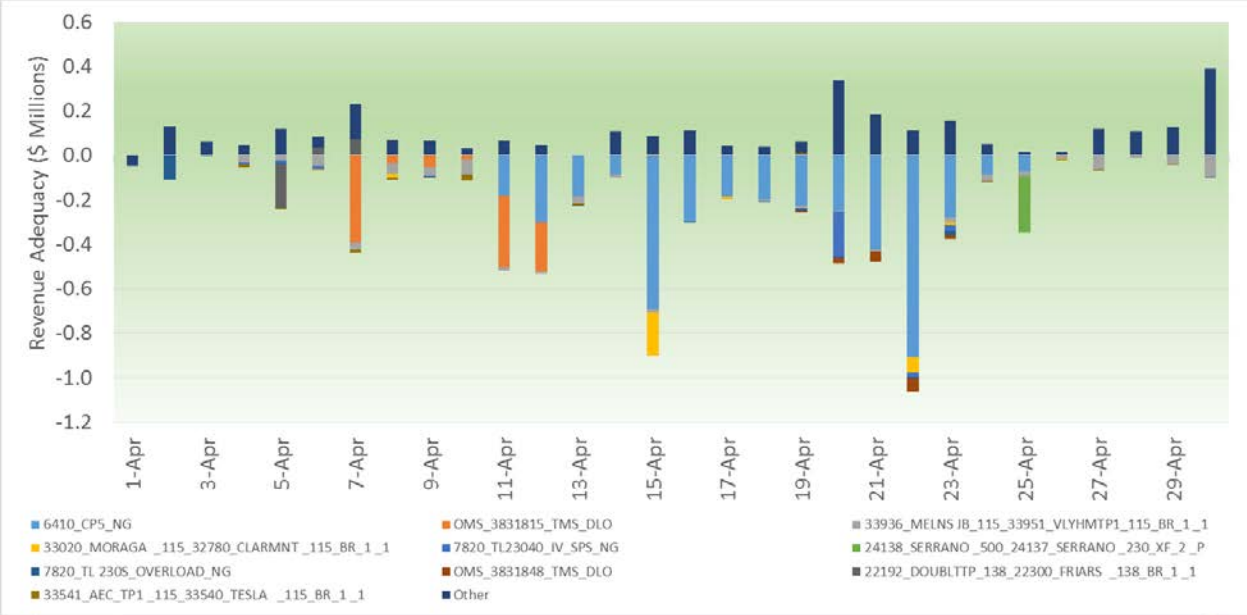
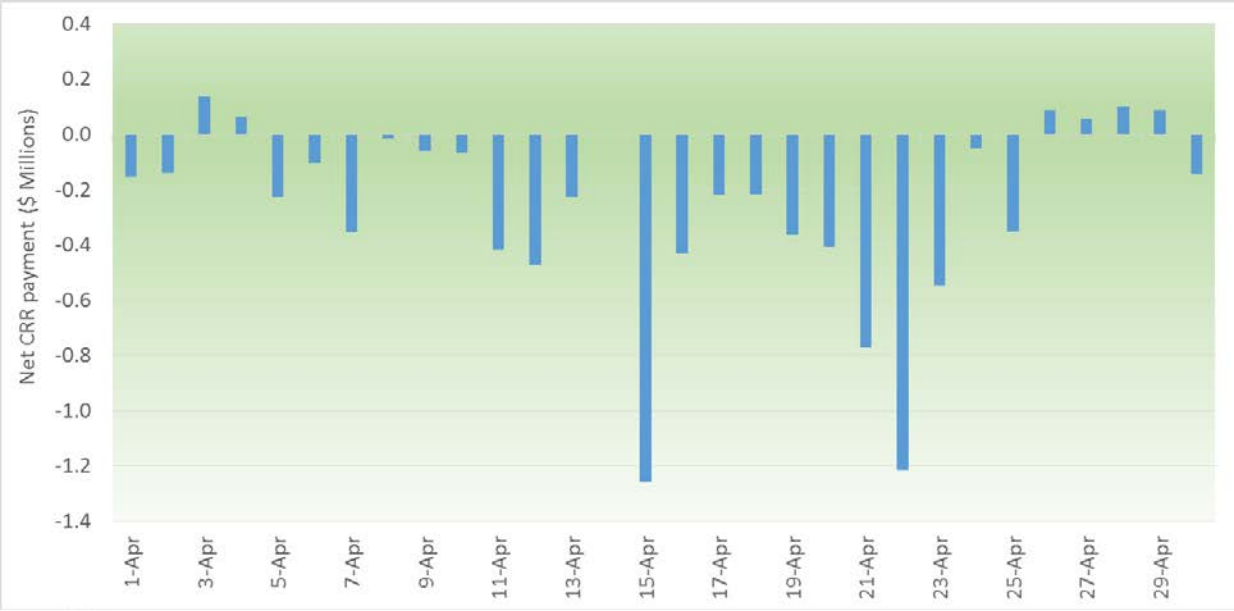


Figure 157 shows the net CRR payment per day. This net revenue is the difference between the CRR payments to CRR holders and the auction revenues collected by the CAISO through the CRR auction process; such revenues become a lump revenue for the auction. For this metric, the annual auction revenues are 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

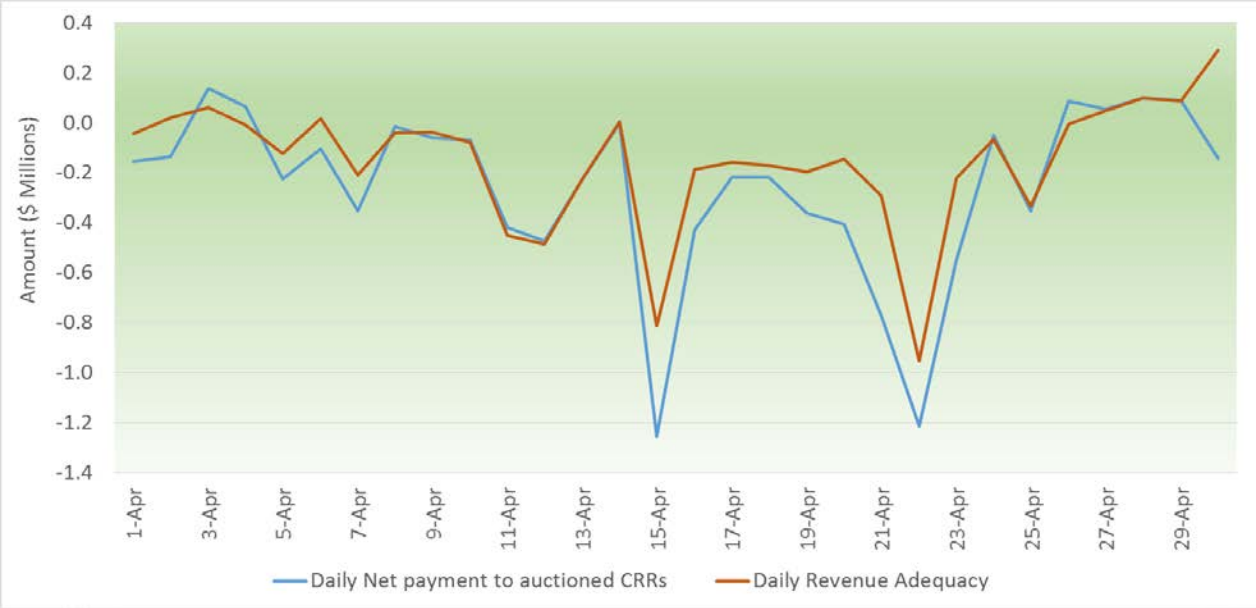
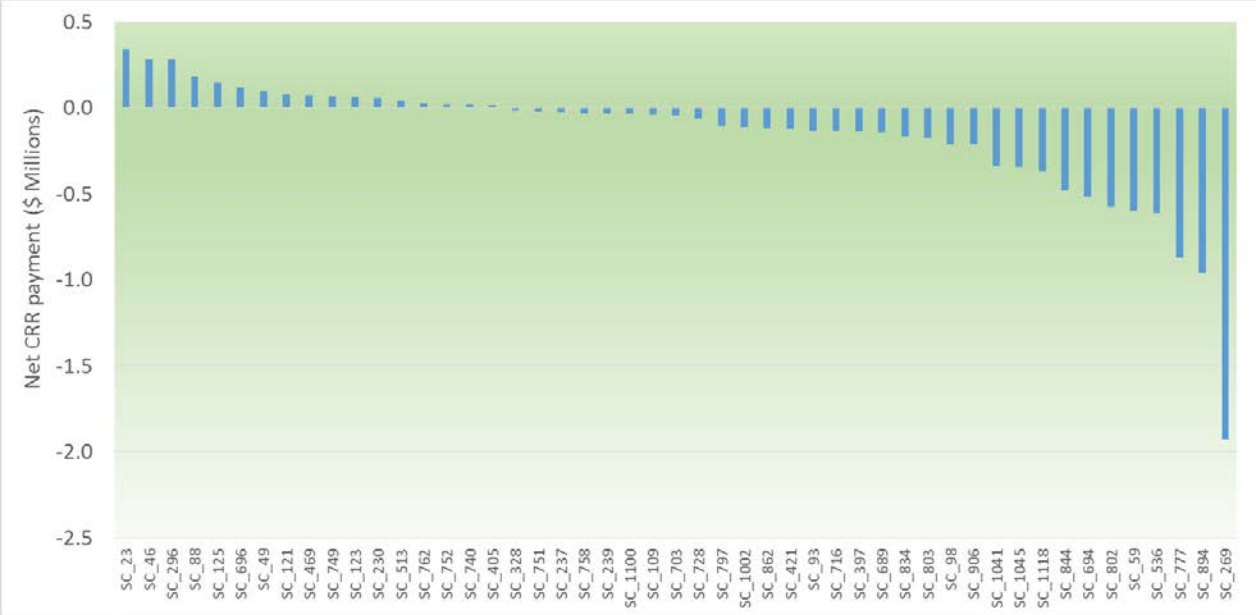


Table 159 shows the net CRR payments to CRR participants, regardless of the type of participant. This only reflects the payments for CRRs released in both the annual and monthly CRR auctions applicable for the month of April 2017. Since this is from the CAISO's perspective, a negative value means the 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

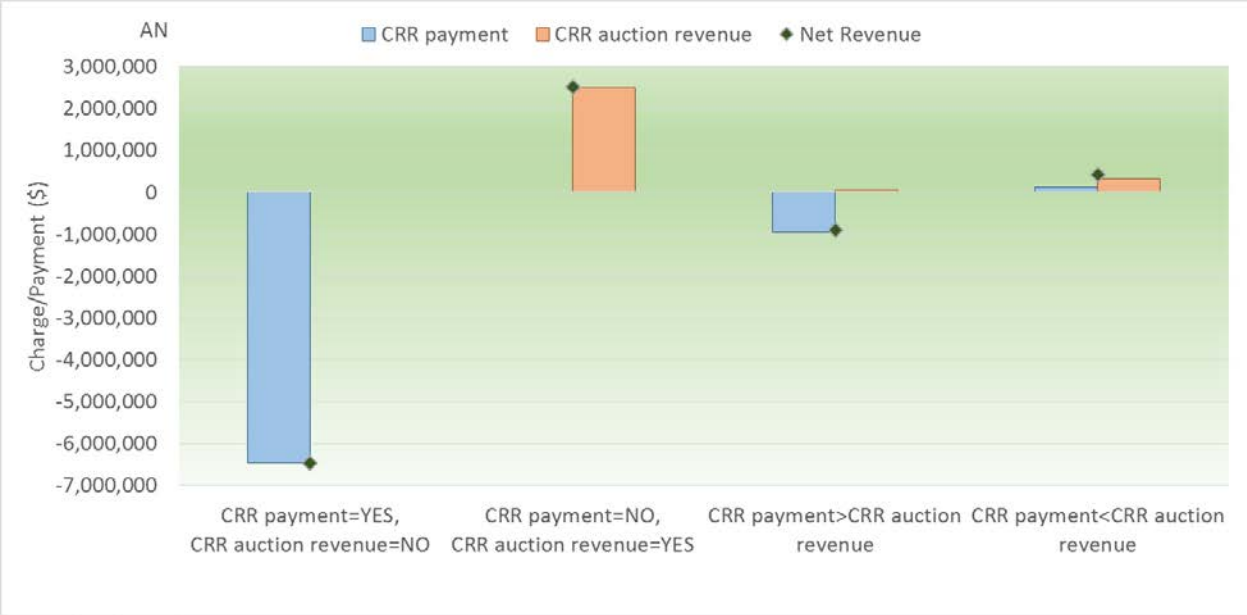


Figure 161: CRR payment versus CRR auction revenues for monthly CRR -April 2017

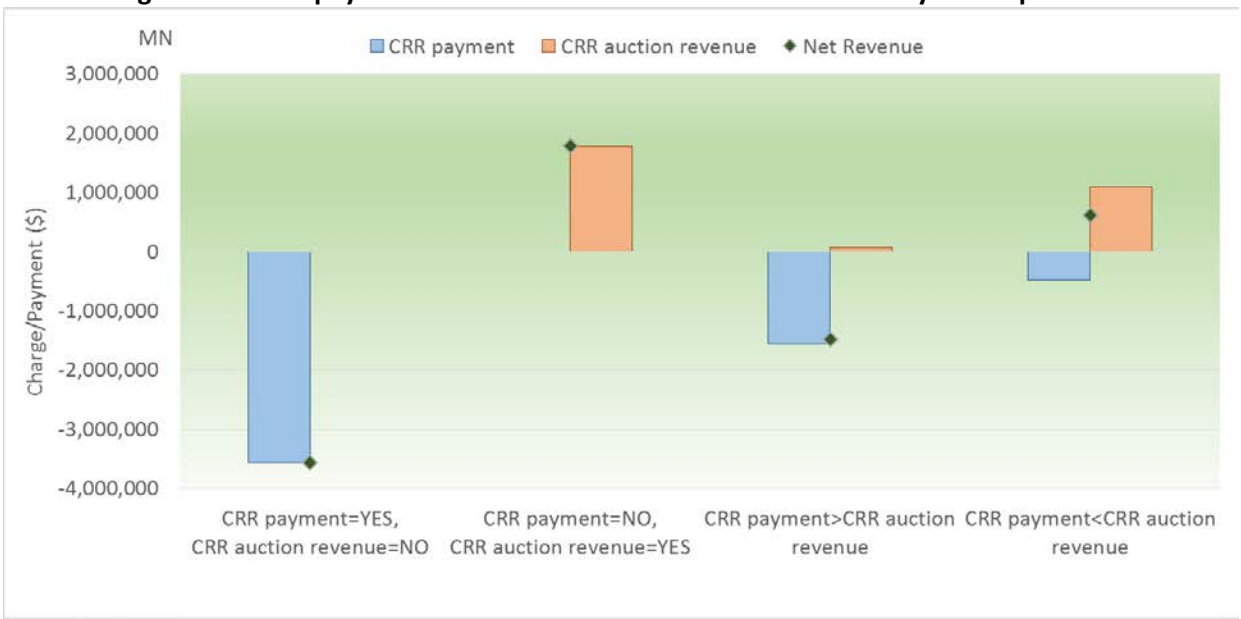


Table 37 provides one level deeper of understanding of such misalignments between markets. This tables shows the top and bottom constraints when sorted by net CRR payments. In the first column it shows the estimated CRR payment to CRR holders accrued in each constraint; the second column shows the revenues 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

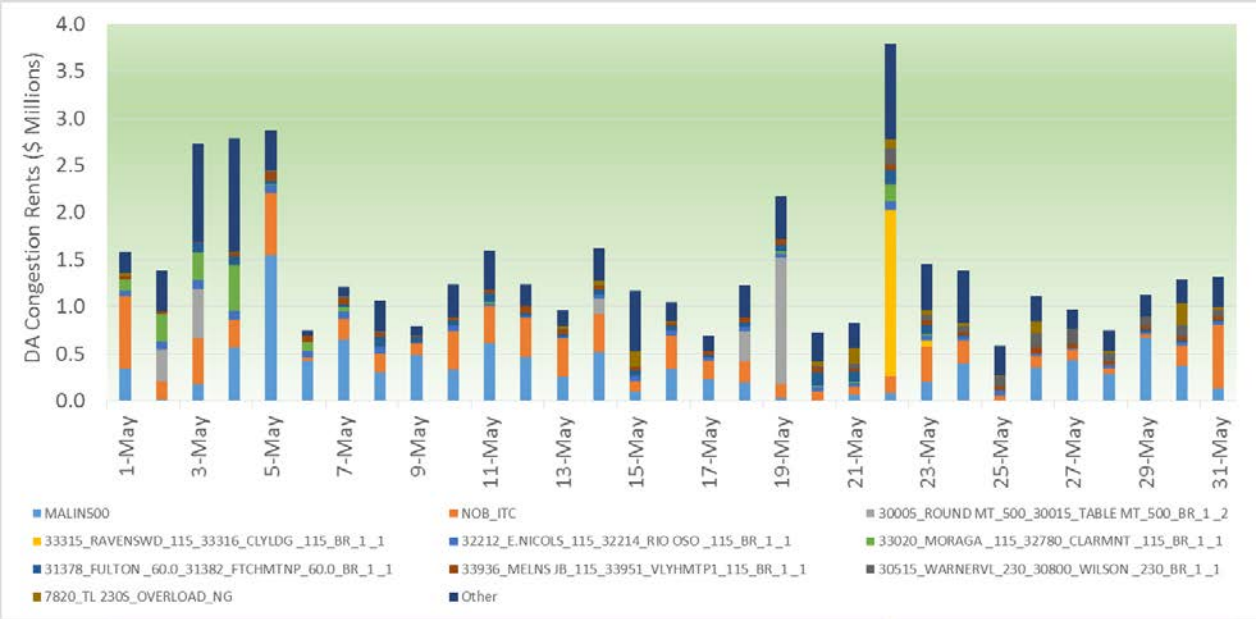


Figure 163: Daily CRR revenue adequacy -May 2017

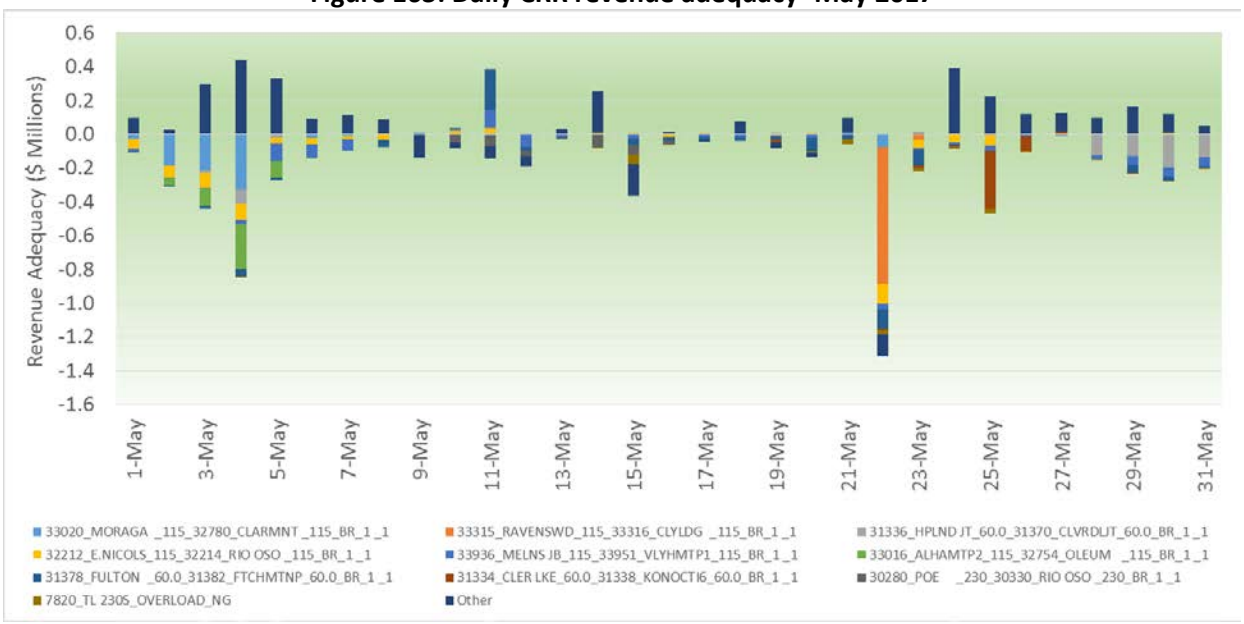
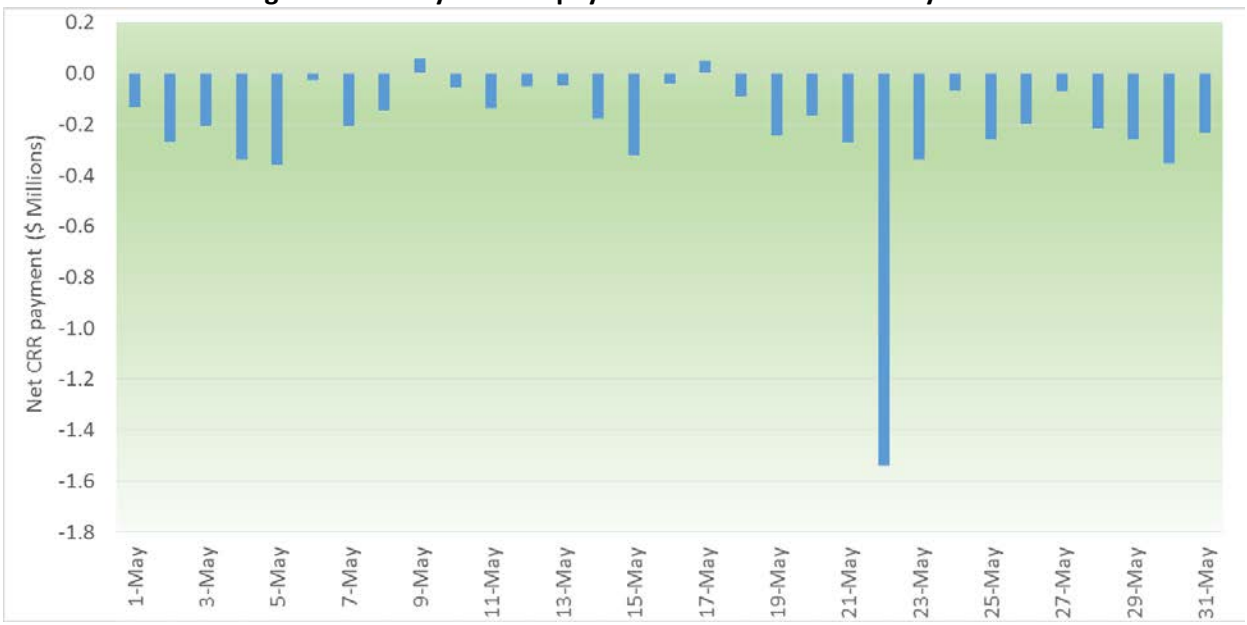


Figure 164 shows the net CRR payment per day. This net revenue is the difference between the CRR payments to CRR holders and the auction revenues collected by the CAISO through the CRR auction process; such revenues become a lump revenue for the auction. For this metric, the annual auction revenues are 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

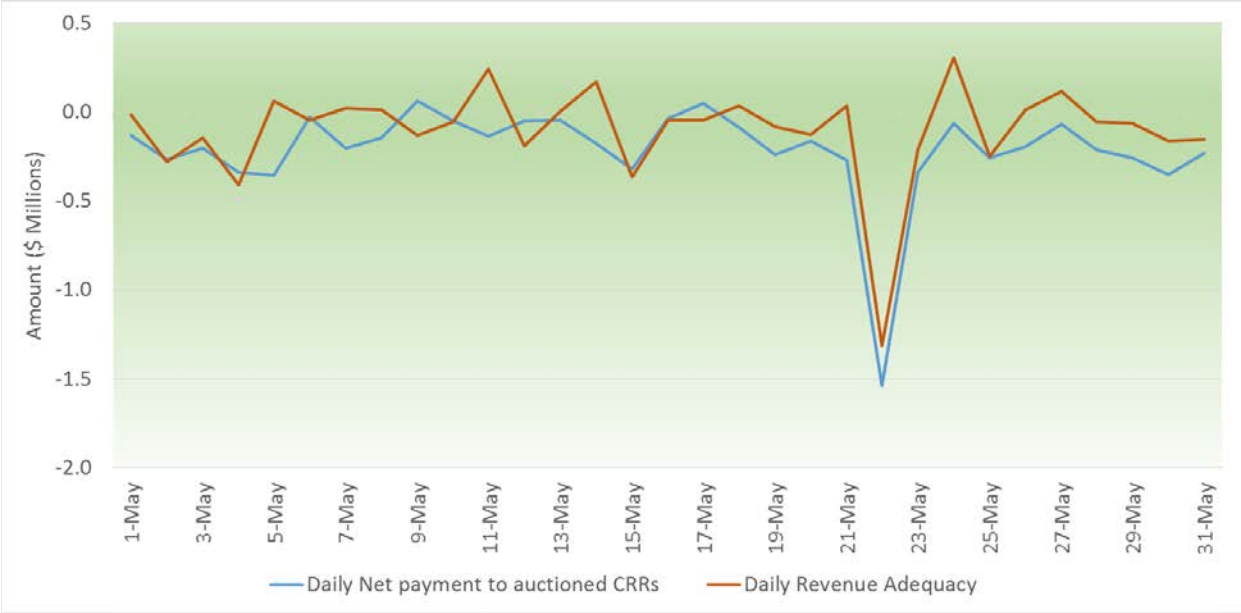
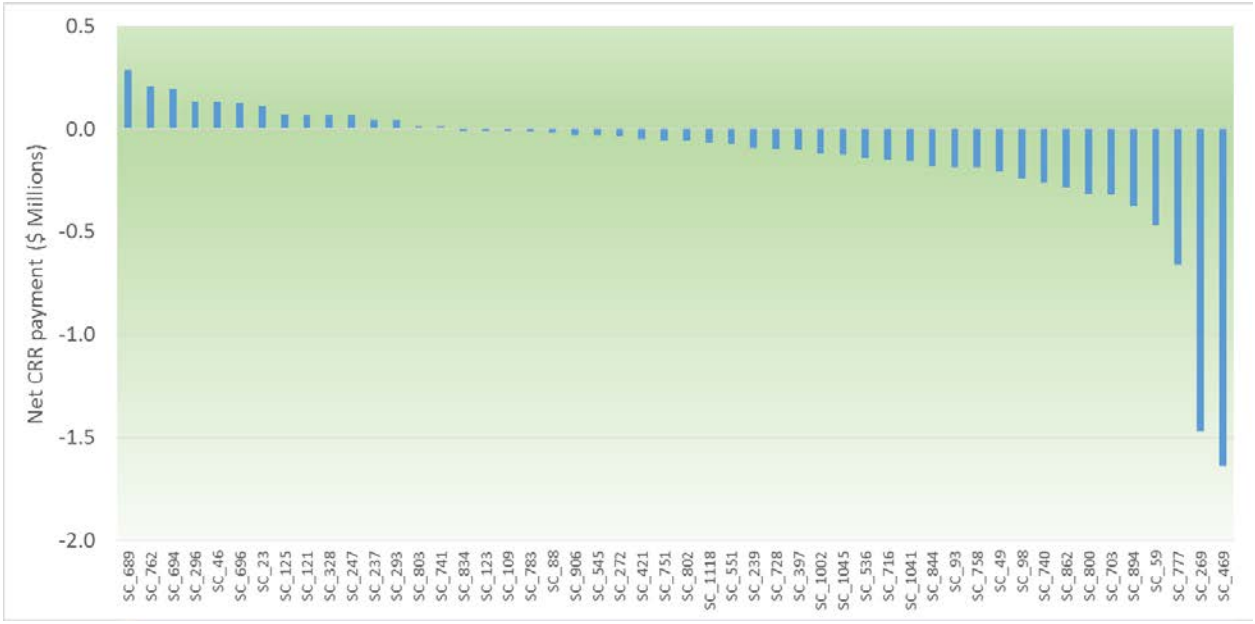


Figure 166 shows the net CRR payments to CRR participants, regardless of the type of participant. This only reflects the payments for CRRs released in both the annual and monthly CRR auctions applicable for the month of May 2017. Since this is from the CAISO's perspective, a negative value means the 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

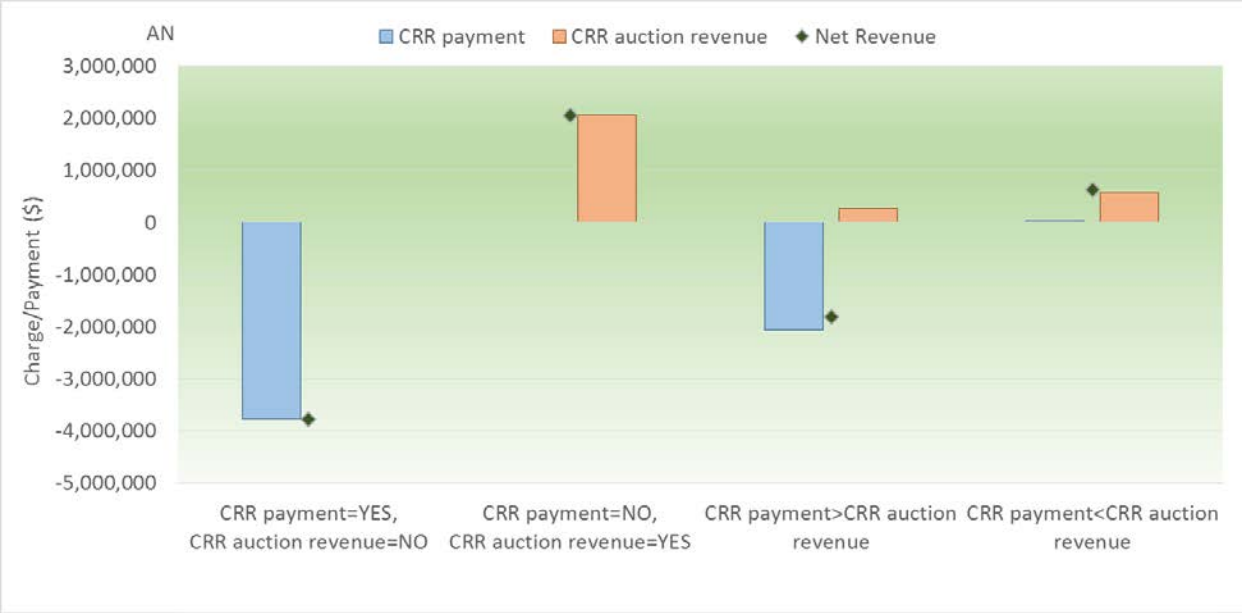


Figure 168: CRR payment versus CRR auction revenues for monthly CRR -May 2017

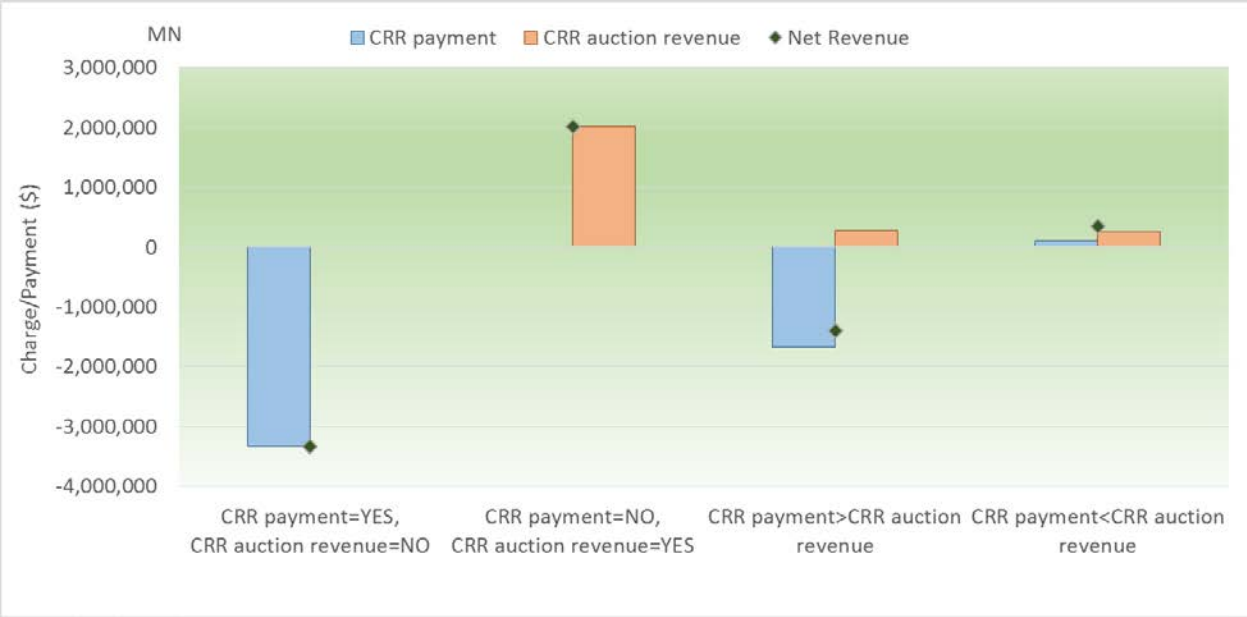


Table 41 provides one level deeper of understanding of such misalignments between markets. This tables shows the top and bottom constraints when sorted by net CRR payments. In the first column it shows the estimated CRR payment to CRR holders accrued in each constraint; the second column shows the revenues 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.

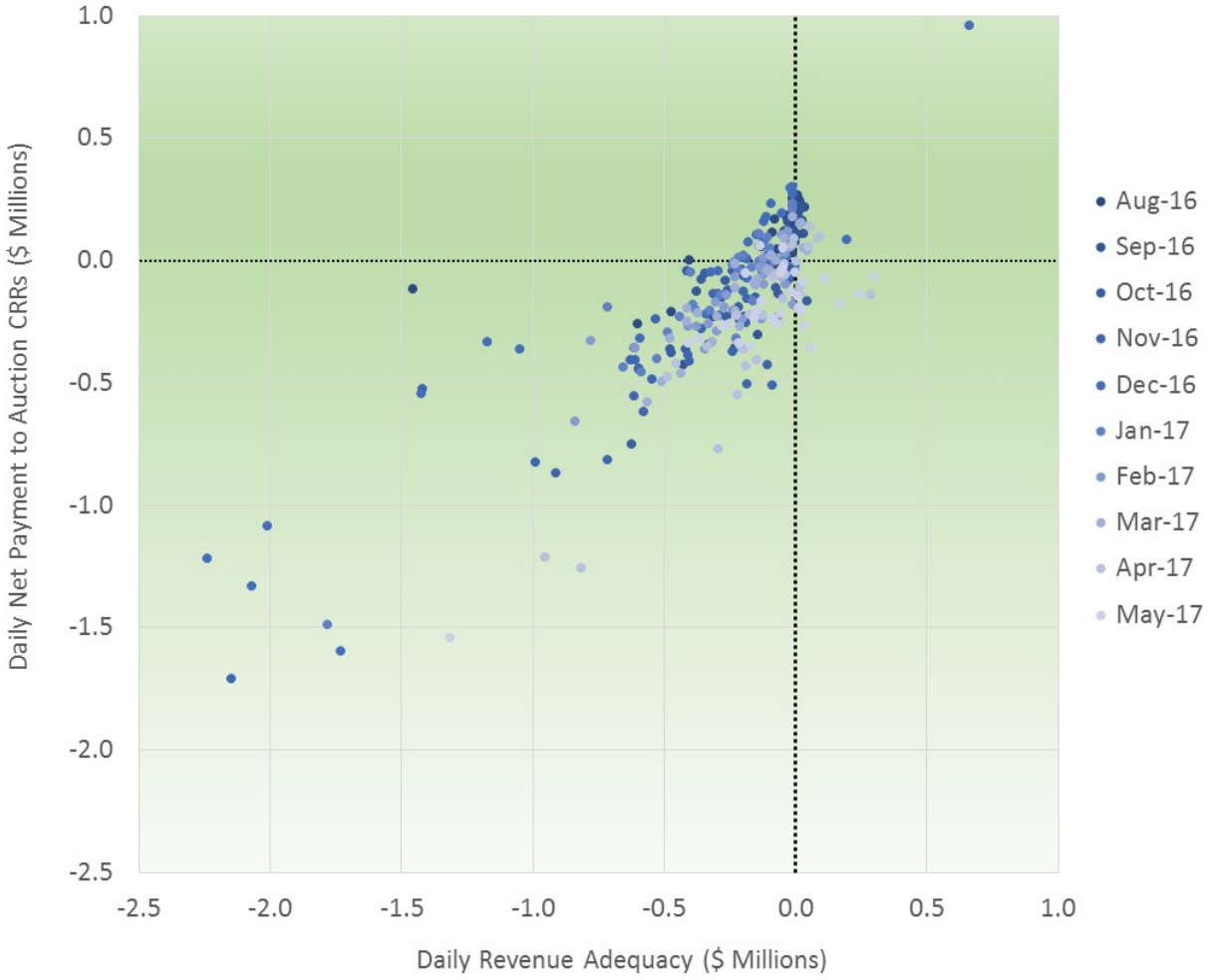
Figure 169: Net CRR payments accrued on nodal group constraints

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 -

CRR Auction Efficiency Track 1A Draft Final Proposal Addendum

CRR Auction Efficiency Track 1A Tariff Amendments

California Independent System Operator Corporation

Congestion Revenue Rights Auction Efficiency

Track 1A Draft Final Proposal Addendum

March 8, 2018

Prepared by: M&IP

California Independent System Operator

Table of Contents

1 Executive Summary

There is evidence that the California ISO's (CAISO's) congestion revenue rights auction produces inefficient outcomes. 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 "net payment deficiency" 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. Auctioned congestion revenue rights are intended for hedging congestion associated with supply delivery in the CAISO's locational marginal price-based day-ahead market. 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 therefore the expected congestion revenue right payments.[1]

The CAISO proposes several rule changes to the annual congestion revenue rights allocation and auction process for which the CAISO will seek Board of Governors' approval at their March 2018 meeting. This will enable the CAISO to seek Federal Energy Regulatory Commission (FERC) approval of certain changes discussed in this draft final proposal in time for the 2019 annual congestion revenue right processes that will start this summer. The CAISO is also considering process changes it can make under current tariff authority as well as more comprehensive rule changes that it will work with stakeholders to develop over a longer time period.

The CAISO believes it is important to make changes that it can implement for this year's annual auction to reduce congestion revenue rights net payment deficiencies. Congestion revenue rights awarded in the annual auction have accounted for about half of the net payment deficiency. Following the February 13 stakeholder meeting and an initial review of stakeholder comments received on the February 8 Draft Final Proposal, we are proposing to refine the scope of the proposal. The CAISO has removed the two policy proposals from the scope as outlined in Section 5 of this paper for the March Board of Governors meeting.

In its congestion revenue rights auction efficiency analysis report, published in November 2017, the CAISO identified issues impacting the congestion revenue rights market that are considered in this Draft Final Proposal Addendum:

- The CAISO being informed of transmission outages after the time that it conducts the congestion revenue right auction causes it to create misalignments in constraint enforcement, contingency enforcement, and topology between the congestion revenue rights market model and the actual day-ahead market models.

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

- A large portion of net payment deficiencies are associated with auctioned congestion revenue rights inconsistent with their purpose of hedging congestion associated with supply delivery.

Consequently, the CAISO proposes the following refined congestion revenue rights rule changes, now identified as Track 1A:

- Create an additional annual outage reporting deadline to be aligned with the annual congestion revenue rights allocation and auction process to improve the congestion revenue rights model used in the annual process.

- Limit allowable source and sink pairs in the auction to align congestion revenue rights with their primary purpose of hedging congestion associated with supply delivery.

The CAISO will pursue Track 1B, in which it will continue to focus on policy affecting 2019 congestion revenue rights and bring these policy items to the CAISO Board of Governors for approval in the summer of 2018.

2 Initiative organization and scope

2.1 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**, the subject of this draft final proposal, 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** 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 or in very short order. The CAISO plans to bring Track 1B policy items to the CAISO Board of Governors for approval in the summer of 2018.
>
> The CAISO is focusing **Track 2** on addressing potential comprehensive design changes in time for CAISO Board of Governors' consideration in late 2018.

2.2 Track 1 scope

The CAISO targets the March 2018 Board of Governors' meeting for policies developed in this proposal. It proposes market design rule changes that can improve congestion revenue rights valuations in the annual and monthly 2019 congestion revenue rights auction and allocation processes. Because the CAISO is following a short timeline for this track, it evaluated potential proposals against the following criteria:

1. Policy has potential to make meaningful impact

2. Policy implementable in time for annual 2019 auction

3 Stakeholder engagement

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, and also to revise the requirements for Participating Transmission Owners in the ISO's balancing authority are to report transmission outages that could affect those auctions and allocations. 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.

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

Date	Event
2/3/2017	Market Surveillance Committee meeting
4/18/2017	Working group meeting
5/1/2017	Stakeholder comments due
5/16/2017	Market Performance and Planning Forum – Analysis Scope
7/18/2017	Market Performance and Planning Forum – Initial analysis report data release
11/21/2017	Publish congestion revenue rights auction efficiency analysis report
12/6/2017	Stakeholder comments due
12/19/2017	Working group meeting
1/12/2018	Stakeholder comments due
2/2/2018	Market Surveillance Committee meeting
2/8/2018	Publish track 1 draft final proposal
2/13/2018	Stakeholder meeting on track 1 draft final proposal
2/28/2018	Stakeholder comments due
3/8/2018	Publish track 1A draft final proposal addendum
3/21/18-3/22/18	March Board of Governors' meeting – Track 1A policy

4 Stakeholder comments

To date, stakeholders submitted three rounds of comments on the issues considered in this initiative. They first submitted comments after the April 2017 working group to determine the scope of the analysis phase. They then submitted comments following the release of the congestion revenue rights auction efficiency analysis report in November 2017. Finally, they submitted comments following the December 2017 working group to discuss the analysis and determine the objectives and scope of the initiative's policy phase.

Stakeholders have generally targeted comments on specific findings of the analysis report and potential comprehensive design changes that would be part of the initiative's Track 2.

Stakeholders have different opinions regarding the value of the congestion revenue rights auction. The investor owned utilities, municipal/state load serving entities and the CAISO Department of Market Monitoring (DMM) generally believe the auction could be replaced by bilateral agreements while non-utility load serving entities, suppliers, marketers, and financial participants on the other hand believe the congestion revenue rights auction conducted by the CAISO serves a critical function.

DMM argues the current congestion revenue rights auction is not a competitive market between willing buyers and sellers, and therefore the design forces load serving entities and their customers to backstop payments to holders of auctioned congestion revenue rights whether or not they are able to or wish to participate in the auction. DMM proposes to eliminate the congestion revenue rights auction and proposes consideration of three potential alternatives: a decentralized market for locational price swaps, a voluntary centralized swap clearing pool, and a voluntary centralized swap clearing pool where the pool takes on market price risk.

As an alternative to the DMM's proposals, Southern California Edison (SCE) proposed that CAISO maintain its auction structure but set auction limits for all transmission constraints to zero. It argues that this will enable the clearing of locational price swaps, but still allow the CAISO to be the clearinghouse. Generally, SCE also supports the DMM's proposals.

Pacific Gas & Electric Company (PG&E) urged the CAISO to quickly pursue reforms to the congestion revenue rights auction and notes that the analysis completed to date provides a basis for at least some major reforms to the congestion revenue rights market design. PG&E also questions the value derived by the CAISO auctioning transmission capacity associated with generator to generator congestion revenue rights as well as rights priced at $0/MW. Generally, PG&E also supports the DMM's proposals.

The Six Cities support the DMM proposals, and also join the CAISO in questioning how much forward contract liquidity or hedging the auctions may be supporting given large volumes of congestion revenue rights awarded to single parties. They also support

prompt implementation of measures that will reduce differences between the models used for the congestion revenue rights auctions and the models used for the day-ahead market and that can be developed quickly and without tariff modifications.

Other stakeholders, such as Calpine Solutions, NRG Energy, Vitol, Inc., Western Power Trading Forum (WPTF), and DC Energy urge the CAISO to focus on competitiveness, liquidity, and better aligning the congestion revenue rights model with the day-ahead market model. Proposals include increasing the frequency of auctions or changing the timing of congestion revenue rights auctions so as to allow market participants to make adjustments to positions and bid prices continuously rather than solely on an annual or monthly basis.

Calpine Solutions states the congestion revenue rights auction provides substantial benefits to consumers. It notes that load serving entities rely on congestion revenue rights auctions to provide consumers with the lowest possible energy cost. It also notes the congestion revenue rights auction process provides load serving entities with the means by which they can hedge congestion costs between specific receipt and delivery points.

Calpine Solutions argues that the divergence in opinion among the various stakeholder classes is almost entirely a function of regulatory and retail pricing constructs rather than any failings inherent in the congestion revenue rights auction process. Calpine Solutions states the entities most in favor of the DMM's proposals are those whose loads are relatively insensitive to energy pricing because they bill their customers using relatively fixed class-based energy rates reflecting the providers' costs of energy aggregated and averaged across long periods of time for the entire customer class. Calpine Solutions also states those entities most in favor of retaining the congestion revenue rights auction are those whose loads are highly sensitive to energy pricing both at the retail and wholesale levels.

DC Energy argues that limiting source and sink pairings to those associated with hedging supply delivery would erode competition and lead to less congestion revenue right auction value. It argues that the perspective that the large volume of paths with a congestion revenue rights awarded to only one auction participant indicates low auction liquidity which results in the auction failing to capture the dynamics of the network topology. DC Energy describes that all congestion revenue rights paths are related to some degree and therefore unique sets of "different awards" may all impact flows on the same transmission constraint. In this way, congestion revenue rights network capacity can be awarded in many configurations, which promotes the overall liquidity of the market. DC Energy supports a potential congestion revenue right auction change that would limit eligible injections/withdrawals on electrically equivalent nodes and notes that the best practice is to programmatically remove bids on electrically equivalent settlement location pairs prior to clearing the congestion revenue rights auction.

Boston Energy Trading and Marketing encourages the CAISO to look for ways to move forward the existing congestion revenue rights auction design, rather than eliminating it

or reducing its importance in the overall market. It suggests the CAISO consider changing the amount of system capacity released in the annual and monthly auctions. It states moving more system capacity to the monthly auctions may provide incremental revenue shortfall improvements as a result of better transmission outage information.

Powerex supports efforts to address inefficiencies in the congestion revenue rights auction framework while preserving the role of congestion revenue rights in providing support for forward contracting arrangements and efficient forward market outcomes. It recommends the CAISO limit its eligible source and sink pairs to only those locations required to efficiently hedge forward contracts for the physical delivery of energy.

WPTF does not support limiting source and sink pairs in any way maintaining it would damage the liquidity of the auction and/or create unintended adverse consequences. It states restricting injection and withdrawal nodes could result in less accurate congestion revenue right auction bidding and further create differences between auction clearing prices and day-ahead market congestion prices.

5 Changes to this proposal

The CAISO removed the following two policy proposals from the scope for the March Board of Governors meeting:

- Elimination of certain information from the congestion revenue rights auction and allocation process model disclosure

- Lowering the percentage of system capacity available in the annual allocation and auction to more accurately model the transmission that will ultimately be available.

The CAISO will pursue a Track 1B in which it will continue to focus on policy affecting 2019 congestion revenue rights. In Track 1B, 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 or in very short order. It may continue to consider these two proposals in Track 1B of this initiative.

The CAISO also added the EIM Governing Body authority classification to ***Section 3***.

6 Background

6.1 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.[2]

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 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.

[2] MRTU Filing, Exh. No. ISO-2 at 24.

6.2 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).[3] 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.

6.3 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.[4] 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,

[3] 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.
[4] 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.

including facilitating long-term contracting by load serving entities and generators.[5] 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.[6] 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 net payment deficiency. 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, further decreasing in 2016 to about $51 million, followed by an increase to $73 million in 2017 (through November).[7]

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.

[5] MRTU Filing, Exh. No. ISO-2 at 22.
[6] 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.
[7] California ISO. November 2017. "Congestion revenue rights auction analysis report." Pg. 49.

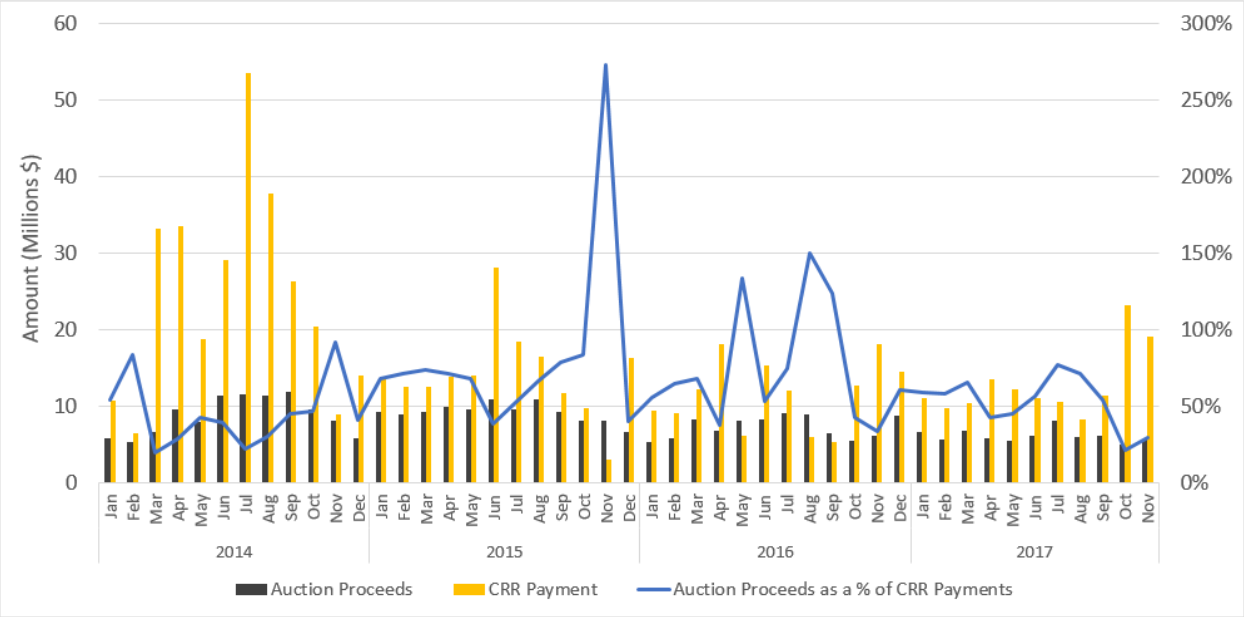


Figure 1: Auction proceeds versus payouts

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.

- 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.[8]

6.4 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

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

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.

6.4.1 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.

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.

6.4.2 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.

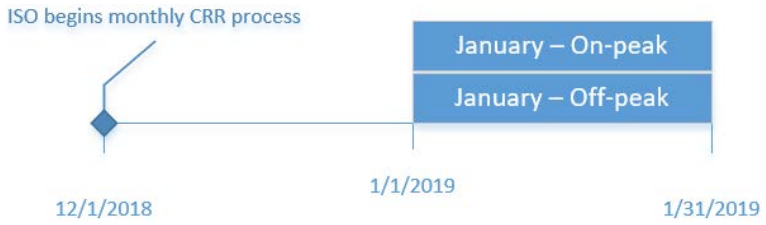


Figure 3: Monthly process awards CRRs for upcoming calendar month

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.

6.5 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	Outage reporting	FTR network model disclosure	Total system capacity released 4 to 16 months forward	Eligible bid-pairs
CAISO	**Facility type:** • All facilities greater than 200 kV • Special list of facilities less than 200 kV **Timing:** • Annual maintenance plan due by October 15 each year for all facilities under ISO control • Outage of facilities meeting the criteria above due 30 days prior to the month the outage begins	Includes facilities modeled as out-of-service, constraint enforcement status, and contingency enforcement status	75%	All biddable pricing points
ERCOT	**Facility type:** • All facilities greater than or equal to 60 kV **Timing:** • 12 month rolling outage plans with continuous updates	Includes facilities modeled as out-of-service, constraint enforcement status, and contingency enforcement status	40-55%	All non-electrically similar pricing points
ISO-NE	**Facility type:** • All facilities greater than or equal to 115 kV • All 69 kV facilities that are not interties **Timing:** • 24 months to 21 days in advance of the outage start with incentives to encourage submittal at least 90 days in advance of the outage.	Includes facilities modeled as out-of-service, constraint enforcement status, and contingency enforcement status	50%	All pricing points
MISO	**Facility type:** • All facilities greater than or equal to 100 kV **Timing:** • 24 month rolling outage plans with continuous updates	Includes facilities modeled as out-of-service, constraint enforcement status, and contingency enforcement status	~60%	All pricing points that are not at the same bus.
NYISO	**Facility type:** • All facilities under ISO control impacting system transfer capability **Timing:** • Two-year annual transmission facilities outage schedules due October 1. • Due 30 days prior to the month the outage begins	Includes facilities modeled as out-of-service, constraint enforcement status, and contingency enforcement status	5-100%	All biddable pricing points

PJM	**Facility type:** • All facilities that can effect ISO monitored elements **Timing:** • Outages of greater than 30 day duration due February prior to planning cycle (up to 16 months in advance) • Outages of greater than 5 day duration due before the first of the month 6 months prior to the month the outage begins • Outages of less than 5 day duration due before the first of the month, one month prior to the month the outage begins	Includes facilities modeled as out-of-service. All in-service constraints assumed enforced. Does not share contingency enforcement status.	100%	All non-electrically similar pricing points
SPP	**Facility type:** • All ISO controlled facilities **Timing:** • Due 10 business days prior to the scheduled model posting date	Y	0-60%	All non-electrically similar pricing points

The CAISO compared its transmission element outage reporting rules to those employed by other ISO/RTOs as related to financial transmission rights. The CAISO requires submittal of an annual maintenance plan by October 15 of each year. Also, it generally requires monthly submittal of outages by 30 days prior to the start of the month of the outage on transmission facilities with voltages greater than 200 kV and that have duration greater than 24 hours. Other ISO/RTOs generally require outage reporting on all facilities under their control. Some require 2-year maintenance plans.

The CAISO compared its rules for disclosing the network model used in the congestion revenue right allocation and auction process to the financial transmission right model disclosure rules employed by other ISO/RTOs. Most ISO/RTOs, including the CAISO, disclose the specific outages they model, the specific constraints they enforce, and the specific contingencies they enforce in their allocation and auction processes. Some ISO/RTOs, such as the Southwest Power Pool and PJM, enforce all constraints on all facilities in their congestion revenue right allocation and auction processes, so they share constraint enforcement status by virtue of sharing the underlying facility information. Notably, PJM does not share contingency enforcement status in their model disclosure.

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 the allowable node-pair bidding locations enforced by other ISO/RTOs in their financial transmission rights auctions. The CAISO currently allows auction participants to bid from any biddable pricing point to any other biddable pricing point. Most other ISO/RTOs limit the allowable node-pairs to those that are not electrically equivalent.

7 Proposals

In this section, the CAISO proposes four changes related to its congestion revenue rights allocation and auction processes that are intended to reduce the congestion revenue right net payment deficiency.

- In ***Section 7.1***, the CAISO proposes to create an annual outage reporting deadline to be aligned with the annual congestion revenue rights allocation and auction process to improve the congestion revenue rights model used in the annual process.

- In ***Section 7.2***, the CAISO proposes to limit the congestion revenue right source and sink combinations that market participants can purchase in the auctions to better align the congestion revenue rights product with the purpose of hedging congestion charges associated with supply delivery in the CAISO's locational marginal price-based day-ahead market.

7.1 Create annual outage reporting deadline for annual congestion revenue rights process

7.1.1 Discussion

In order for the CAISO to accurately maintain its congestion revenue rights model and minimize congestion revenue rights net payment deficiencies, it must receive certain outage information in time for the CAISO to perform the necessary analysis and reflect the outage in the congestion revenue right market model.

For both the annual and monthly auctions, the CAISO maintains a default congestion revenue rights model that includes a list of constraints enforced by default, a list of contingencies enforced by default, and a default network topology.

The CAISO conducts a monthly outage coordination process in which it analyzes known planned maintenance outages to determine (1) which constraints to enforce in the congestion revenue rights market model, (2) which contingencies to enforce in the congestion revenue rights market model, and (3) which outages to model as out-of-service in the congestion revenue rights market model. These determinations are added to the congestion revenue rights model *default* constraints, contingencies, and topology.

The final list of constraints, contingencies, and outages modeled in the each congestion revenue rights auction is a combination of the default information plus supplemental information that depends on planned maintenance outages that will occur during the period for which a particular auction is selling congestion revenue rights.

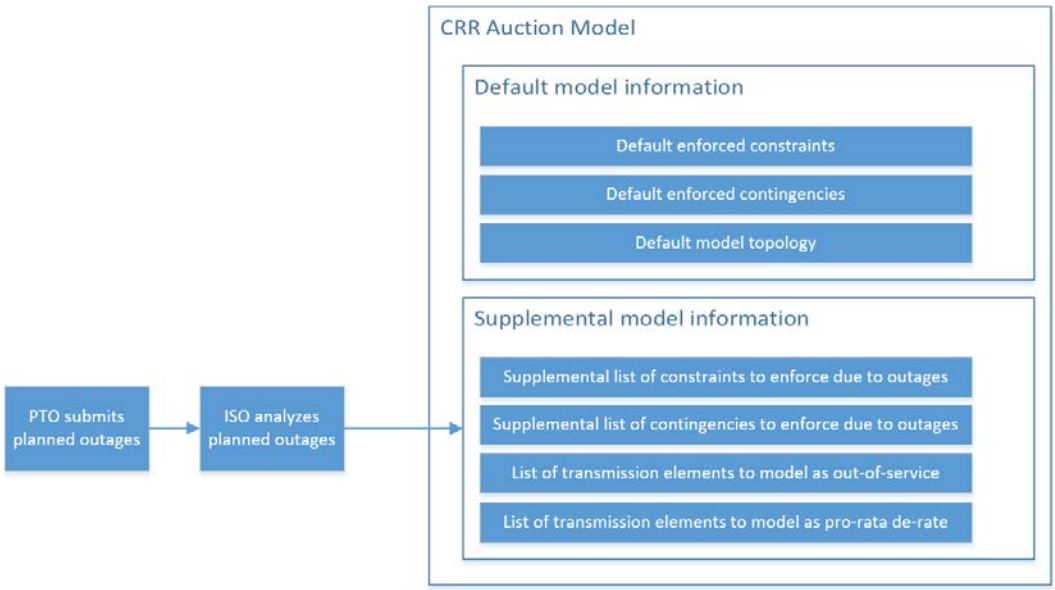


Figure 4: Congestion revenue rights model maintenance

7.1.1.1 Enforced constraints

The *Congestion Revenue Rights Auction Efficiency Analysis Report* (termed "the analysis" in the remainder of this discussion) found that many constraints contributing to net payment deficiency were not enforced in the annual and monthly auctions but did contribute to congestion in the day-ahead market. This means that because the CAISO lacked sufficient information on outages, its engineering analysis did not identify that the constraint should be enforced in the auction in addition to default constraints. A constraint that is not enforced in the congestion revenue rights market model cannot produce auction revenues because the constraint will not bind and thus will not be priced.

7.1.1.2 Enforced contingencies

The congestion revenue right market model represents transmission path capacities as constraints. The analysis found that many constraints contributing to net payment deficiency were enforced but not-binding (i.e. did not result in congestion) in the annual and monthly auctions but did result in congestion in the day-ahead market.

There are two possible reasons that a constraint is enforced but does not bind in the congestion revenue right auction. The first reason is there is not enough flow over the constraint in the congestion revenue right model run in the auction for it to bind. The second reason is the CAISO did not enforce a contingency in the congestion revenue right market model that would limit the allowable flow over the constraint. The CAISO may not have enforced the contingency in the congestion revenue rights market model because its analysis, based on known outage information, did not indicate the contingency would have to be enforced in the day-ahead markets.

7.1.1.3 Modeling of out-of-service equipment

The analysis found that many transmission outages contributing to revenue insufficiency had durations of less than 10 days. By default, the CAISO models all outages with durations of at least 10 days in the congestion revenue rights auction market model. However, it lowers available transmission capacity for outages lasting less than 10 days. The analysis shows that the de-rate methodology may not be sufficient at capturing the impact that the outage has on congestion in the congestion revenue rights auction.

7.1.1.4 Outage reporting

The analysis found that transmission owners do not report over half of outages on transmission equipment of at least 200 kV equipment on-time. This directly impacts the CAISO's operations engineering analysis used to determine supplemental constraints, supplemental contingencies, and network topology used in the congestion revenue rights auction model. The CAISO cannot perform an accurate analysis with less than half of the required information to perform such analysis.

The late reporting contributes to congestion revenue right net payment deficiency because constraints and contingencies not enforced in the congestion revenue right market model, but that are ultimately enforced in the day-ahead market, cannot contribute to congestion revenue right auction prices but result in day-ahead market congestion payments to associated congestion revenue rights. Similarly, network topology differences between the congestion revenue right market model and the day-ahead market can result in day-ahead congestion that is not priced in the congestion revenue right auction.

7.1.1.5 Other ISO/RTOs

The CAISO reviewed outage reporting rules employed by other ISO/RTOs. The CAISO requires submittal of an annual maintenance plan by October 15 of each year. Also, it generally requires monthly submittal of outages on facilities with voltages greater than 200 kV and of duration greater than 24 hours by 30 days prior to the start of the month of the outage. Other ISO/RTOs generally require outage reporting on all facilities under their control. Some require 2-year maintenance plans.

7.1.2 Proposal

The CAISO must receive outage information in time to perform its analysis and incorporate outages in its congestion revenue rights market model so that later reflecting outages in the day-ahead market does not contribute to net payment deficiencies.

While the analysis certainly points to an issue with monthly outage reporting, in track 1 of this initiative, the CAISO is mainly focused on congestion revenue rights with 2019 terms and beyond.

The CAISO currently does not have a requirement for advanced submittal of outages that could potentially impact the congestion revenue rights model on a timeline consistent with the annual congestion revenue rights allocation and auction process. The CAISO proposes to require submittal of planned outages that could potentially impact the congestion revenue rights model by July 1 of each year.

The existing outage reporting requirements related to the monthly outage submittal timelines currently include transmission elements (facilities) that may have no impact on congestion in the congestion revenue rights model. For instance, a single breaker outage that does not remove a transmission line, bus, or transformer from service does not impact the congestion revenue rights model. While the tariff clearly defines the facilities and durations of outages that transmission owners are required to report, it does not specify the specific types of outages.

The CAISO proposes to define which subset of outages are required to be reported for congestion revenue rights purposes. For purposes of creating an accurate congestion revenue rights model, the CAISO proposes to require transmission owners to only report outages of equipment that results in a bus outage, a split bus, transmission line outage, or a transformer outage on equipment as currently defined in the tariff. The CAISO will make this same clarification related to its proposed requirement to submit outages that could potentially impact the congestion revenue rights model by July 1 of each year.

The CAISO proposes to receive outage information in time for its annual congestion revenue rights process and make further clarifications on the types of outages required to be reported.

1. The CAISO will require submittal of outages that could potentially cause congestion revenue inadequacy for the following calendar year by July 1.

2. The CAISO will require this plan to only include outages of transmission facilities impacting the congestion revenue rights model as defined in the CAISO Tariff Section 36.4.3.

3. While the ***facilities*** and ***outage duration*** that are required to be reported for congestion revenue rights modeling purposes are already defined, the CAISO will update the criteria to only include ***outages*** that could potentially cause congestion in the day-ahead market such as a bus outage, a split bus, a transmission line outage, or a transformer outage.

7.2 Limit allowable source and sink pairs in the auction

7.2.1 Discussion

For both the annual and monthly auction processes, the CAISO allows market participants to source and sink their congestion revenue rights bids at generator locations, load locations, trading hubs, pricing nodes, and import/export scheduling points.

As discussed earlier in ***Section 6.1***, the intent of congestion revenue rights is to enable market participants to hedge congestion charges associated with supply delivery. Congestion revenue rights with sources and sinks that are not related to supply delivery do not further this core objective.

One example of a transaction that appears to be unrelated to supply delivery is a congestion revenue right that sources at a generator point and sinks at another generator point. While, these types of transactions theoretically can add value to the auction because they can place counter-flows on the system that may enable more congestion revenue rights to be sold in the auction, we have seen in practice that these transactions have resulted in an overall $186 million congestion revenue right auction net payment deficiency since 2014. This represents over half of the congestion revenue rights net payment deficiency.

In addition, further analysis indicates that these types of transactions do not provide competitive or counter-flow value in the auctions. The CAISO conducted an analysis that found that, in aggregate, generator-to-generator type transactions do not add counter-flow or competitive flow value to the auction. This is because the CAISO's analysis found bids for generator-to-generator congestion revenue rights do not enable more non-generator-to-generator rights to clear in the auction and do not increase average auction prices.

A common argument is that bids for generator-to-generator rights place counter-flows on the system that enable more non-generator-to-generator type bids to clear in the auction. However, the CAISO found otherwise. Generator-to-generator awards account for over 50% of transmission capacity awarded as congestion revenue rights. In a representative season, 46,000 MW of generator-to-generator rights bids cleared in the auction while 37,000 MW of non-generator-to-generator rights bids cleared the auction. The CAISO found that when it re-ran the congestion revenue rights auction while removing generator-to-generator bids from the auction, 50,000 MW of non-generator-to-generator rights bids cleared. This shows that 13,000 MW more of non-generator-to-generator congestion revenue rights bids can clear the auction without the generator-to-generator bids. Without the generator-to-generator bids, cleared non-generator-to-generator bids increased from 25% to 33% of transmission capacity for which bids were submitted.

Not only are bids for generator-to-generator congestion revenue rights hindering bids for non-generator-to-generator congestion revenue rights from clearing in the auction, they are also hindering bids for congestion revenue rights that sink at load serving entity aggregation points from clearing. In the representative season, 8,900 MW of congestion revenue rights sinking at load points clear in the auction. A common argument is that generator-to-generator bids place counter-flows on the system that enable more congestion revenue rights to sink at load serving entity load aggregation points. However, the CAISO found that when it removes generator-to-generator type bids from the auction, bids for 16,000 megawatts of rights sinking at load points clear the auction. This shows that bids for 7,100 more megawatts of congestion revenue rights sinking at load points can clear the auction without the generator-to-generator bids.

In addition to generator-to-generator bids not allowing more non-generator-to-generator bids to clear the auction they also do not help improve auction pricing. In its simulation, the CAISO observed that without the generator-to-generator bids, average auction prices increase from $113/MW to $117/MW suggesting that the generator-to-generator bids are also not placing meaningful transmission flows that improve competition for capacity over constraints for which non-generator-to-generator transactions also place flows. If they were, the average auction prices would have increased without the non-generator-to-generator bids.

The auction can still achieve the potential benefits of the competitive flow or counter-flow that these generator-to-generator bids offer in other ways. For instance, a bid for a congestion revenue right that sinks at a trading hub places counter-flow on the system because the trading hub distributes the sink energy to hundreds of generator nodes across the system. This will inevitably place counter-flow that may enable another congestion revenue right award from a generator to a load aggregation point.

There appears to be little or no competitive benefit from the sale of congestion revenue rights with sources and sinks that are not related to supply delivery. In its analysis, the CAISO showed that roughly half of auctioned congestion revenue rights are between source and sink locations for which the auction awarded congestion revenue rights to only a single purchaser, or that were between two supply points. These also appear to be the types of congestion revenue rights for which there is limited competition in the auction—and hence are sold at low prices—and where even a few hours of high congestion can lead to significant payouts. Narrowing the allowable source and sink pairs in the auction will reduce the potential combinations of source and sink pairs, increasing competition for congestion revenue rights on sources and sinks related to supply delivery.

Finally, sources and sinks that are not related to supply delivery are most typically purchased for financial speculation on future congestion charges, rather than being purchased to hedge congestion charges associated with supply delivery, such as hedging a forward contract. The CAISO's analysis showed that 56% of all transmission

capacity awarded as generator-to-generator congestion revenue rights went to financial intermediaries.

While the purpose of congestion revenue rights is hedge supply delivery including supporting forward contracting for supply to loads, this does not mean that only actual suppliers or load serving entities should be permitted to acquire congestion revenue rights. Indeed, speculative market participants can serve an important role in promoting competitive congestion revenue rights auction outcomes and robust price discovery by increasing demand for under-valued congestion revenue rights on sources and sinks associated with supply delivery.

The CAISO reviewed the allowable node-pair bidding locations enforced by other ISO/RTOs. The CAISO allows auction participants to bid from any scheduling point to any other scheduling point. Most other ISO/RTOs limit the allowable source and sink pairs to those that are not electrically equivalent.

7.2.2 Proposal

The CAISO proposes to continue to support the core purpose of congestion revenue rights as a means to provide hedges for supply delivery. It proposes to not only eliminate generator-to-generator source and sink combinations, but to limit the allowable source and sink pairs to only those associated with supply delivery ("delivery pairs"). This proposal strikes a balance between providing sufficient flexibility for non-participating transmission owner load serving entities, generator owners, and marketers the capability to obtain hedges for supply delivery while not allowing the opportunity for completely strategic bidding aimed at exploiting the congestion revenue rights auction.

The CAISO proposes to only accept congestion revenue right bids sourcing and sinking in the following ways: (1) from a generator bus to a load serving entity load aggregation point, a trading hub, or scheduling point; or (2) from a trading hub to a load serving entity load aggregation point or scheduling point; or (3) from scheduling point to a load serving entity load aggregation point or trading hub. It also proposes to allow market participants that acquire these congestion revenue rights in the allocation or auction processes to sell those rights back into auctions. Currently the congestion revenue rights auction does not have an explicit sell feature for congestion revenue rights (congestion revenue rights are currently "sold" by obtaining a congestion revenue right in the opposite direction) but this will be added as part of the scope of these policy changes.

The CAISO conducted analysis and found that, in aggregate, node pairs not associated with supply delivery ("non-delivery pairs") do not add counter-flow or competitive flow value to the auction, while costing $280 million in net payment deficiencies since 2014, an average of $17.5 million per quarter.

These allowable bid combinations as proposed by the CAISO are reasonable combinations that will allow hedging supply delivery. Some market participants have

argued that allowing bids for other node-pair combinations increase the value of the congestion revenue rights by either (1) providing counter-flow so that more bids for congestion revenue rights corresponding to the supply delivery clear the market, or (2) providing pricing discipline to the market by providing flows over constraints for which they are competing with delivery pair bids. However, as described below, the CAISO believes the non-delivery pair bids do not enable more delivery pair bids to clear and do not provide pricing benefits. Thus no longer allowing non-delivery pair bids will enable congestion revenue right auction participants to obtain hedges for supply delivery while eliminating a significant contributor to the congestion revenue right auction net payment deficiency.

Non-delivery pairs are not enabling more transactions associated with supply delivery to clear in the auction. Non-delivery pair awards account for over 79% of transmission capacity released as congestion revenue rights. In the representative season analyzed by the CAISO, 66,000 MW of bids for non-delivery pair rights cleared the auction while 17,000 MW of bids for delivery-pair rights cleared the auction. A common argument is that non-delivery pair bids place counter-flows on the system that enable more delivery-pair type bids to clear in the auction. However, the CAISO found that when non-delivery pair bids are removed from the auction, bids for 22,000 MW of delivery-pair rights clear. This means that bids for 5,000 MW more delivery-pair congestion revenue rights can clear the auction without the non-delivery pair bids. Without the non-delivery pair bids, cleared delivery pair bids increased from 25% to 33% of transmission capacity for which bids were submitted.

Not only are non-delivery pair bids hindering more delivery pair bids from clearing in the auction, they are also specifically hindering bids that sink at load aggregation points from clearing. In the representative season analyzed by the CAISO, 8,900 MW of congestion revenue rights sinking at load points cleared the auction. A common argument is that non-delivery pair transactions place counter-flows on the system that enable more congestion revenue rights to sink at load serving entity load aggregation points. However, the CAISO found that when it removes non-delivery pair type transactions from the auction, 12,700 MW of bids for congestion revenue rights sinking at load points clear the auction. This shows that an additional 3,800 MW of bids for congestion revenue rights sinking at load points would have cleared the auction without the non-delivery pair bids.

For reference, today 3,800 MW of bids for counter-flow sourcing from the load serving entity load aggregation points cleared the actual annual auction (the fact that the quantity of counter-flow awarded in the auction today and the increased quantity that is awarded in the simulation is the same is just a coincidence). This means that even with the 3,800 MW of counter-flow awarded today, the auction still clears 3,800 MW less congestion revenue rights sinking at load serving entity load aggregation points than an auction without non-delivery pair bids.

The non-delivery pair bids are also not providing pricing discipline to the congestion revenue right market by placing flows over constraints for which they are competing with

delivery-pair bids. When the CAISO removed non-delivery pair bids from its simulation, net auction revenues increased from $113/MW to $147/MW, indicating that, in aggregate, the non-delivery pair transactions are not placing meaningful competitive flows on constraints for which they compete with delivery pair transactions. If they were, average auction prices would have been greater with the non-delivery pair bids.

The CAISO expects the non-delivery pair transaction activity required for hedging for supply delivery to shift to the proposed allowable source and sink pairs, increasing auction competitiveness while providing sufficient opportunity to market participants to obtain hedges. One example of bidding behavior expected to shift to delivery pairs is market participants that currently anticipate it would be too competitive to obtain hedges sinking at a load serving entity load aggregation point that instead opt to sink at another, less competitive, similarly priced location "nearby." Another example are participants that use combinations of source and sink pairs to particularly target constraints between their supply point and the load point rather than compete for a congestion revenue right directly from their supply point to the load point. Under the CAISO proposal, market participants seeking these kinds of hedges would instead bid competitively for the allowable source and sink combinations which will still enable them to obtain a hedge for their supply delivery.

The core purpose of congestion revenue rights can be achieved, and auction competitiveness increased, by refining the allowable source and sink locations of congestion revenue rights obtained in the auction. The CAISO proposes to modify its allowable source and sink pairs for auctions of congestion revenue rights with 2019 terms and beyond, as follows

1. The CAISO will only accept bids sourcing and sinking in the following ways:

    a. From a generator bus to a load serving entity load aggregation point, a trading hub, or a scheduling point; or

    b. From a trading hub to a load serving entity load aggregation point or scheduling point; or

    c. From a scheduling point to a load serving entity load aggregation point or trading hub.

2. After a market participant receives congestion revenue rights, it will be able to sell those awarded rights back into a subsequent congestion revenue rights auction.

8 Next Steps

The CAISO will bring this policy to the March 2018 Board of Governors meeting.

Attachment E -

Memorandum of Keith Casey, Vice President, Market & Infrastructure Development, to Board of Governors on CRR Auction Efficiency Proposal

CRR Auction Efficiency Track 1A Tariff Amendments

California Independent System Operator Corporation

Memorandum

To: ISO Board of Governors

From: Keith Casey, Vice President, Market & Infrastructure Development

Date: March 14, 2018

Re: **Decision on congestion revenue rights auction efficiency proposal**

This memorandum requires Board action.

EXECUTIVE SUMMARY

Management is seeking Board approval of several rule changes to the ISO congestion revenue rights design that will serve as a first step in addressing the observed inefficiencies with the ISO congestion revenue rights auction. As discussed below, Management plans to bring further proposed changes to the Board in early summer, but is seeking action on these proposed changes now so that they can be developed and implemented in time for the 2019 annual congestion revenue right allocation and auction process.

Over recent years, the ISO has sold congestion revenue rights in its auction for substantially less than their payouts based on day-ahead market congestion revenue. Since 2014, these auction congestion revenue right sales have averaged $99.5 million per year less than the payments these entitlements received from the day-ahead market. In an efficiently functioning auction, auction revenues should more closely align with congestion revenue rights payouts.

Last year, the ISO undertook a comprehensive root cause analysis of the systemic problem of congestion revenue right payouts greatly exceeding the prices paid for these rights in the auction. The ISO was able to use the insights obtained from that analysis, completed late last year, to consider various policy changes to address the auction revenue deficiency. Based on the policy work done to date, Management proposes to implement the following changes this summer in time for the 2019 congestion revenue right auction and allocation processes:

- Limit allowable source and sink pairs in the auction to combinations that align with hedging physical deliveries of energy in the ISO market. This will eliminate other congestion revenue rights (i.e., source-sink pairs) that are not aligned with physical deliveries of energy and have historically been a major part of the auction revenue shortfall.

- Create an additional annual transmission outage reporting deadline that is aligned with the annual congestion revenue rights allocation and auction process so that known transmission outages can be incorporated into the congestion revenue rights model used in the annual congestion revenue right process. This will better align the transmission topology in the annual allocation and auction model with the transmission topology used in the day-ahead market, improving the auction's efficiency.

Management continues to work on additional modifications to the 2019 congestion revenue rights auction, which it plans to bring to the Board in early summer, that are designed to further mitigate congestion revenue right payouts in excess of auction revenues. Among the changes being considered are a partial funding approach to congestion revenue rights and reducing the amount of congestion revenue rights released in the annual auction process. Management is also willing to further discuss and seek stakeholder input on a proposal by the Department of Market Monitoring and certain load serving entities to limit the congestion revenue rights auction to capacity brought forward by willing buyers and sellers. However, Management has concerns that such an approach may be inconsistent with FERC policy and could undermine certain benefits that can only be attained though an ISO-run auction process. Management will also continue to explore additional rule changes that will take more time to develop and implement for the 2020 congestion revenue rights auction.

Management proposes the following motion:

> ***Moved, that the ISO Board of Governors approves the proposal to implement the congestion revenue rights auction efficiency proposal described in the memorandum dated March 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 the congestion revenue rights auction efficiency proposal described in the memorandum dated March 14, 2018, including any filings that implement the overarching initiative policy but contain discrete revisions to incorporate Federal Energy Regulatory 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 associated with the supply delivery in the ISO's locational marginal price-based day-ahead market. Allowing market participants to hedge congestion cost risk is an important part of the ISO's market design. Congestion revenue rights provide market efficiency benefits through enabling market participants to hedge their exposure to congestion cost risk, which reflects the cost of redispatch to address congestion on the transmission grid. As a result, market

participants are able to engage in more efficient power contracting because suppliers do not have to include congestion cost risk premiums in their supply contracts or their energy bids. 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 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 (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, and financial traders). Currently, the ISO releases 75 percent of system transmission capacity in the annual allocation and auction process and 100 percent of system capacity in the monthly allocation and auction process. Each congestion revenue right has a source and a sink. Sources and sinks currently can be at generator locations, load locations, trading hubs, pricing nodes, and import/export scheduling points. The auction produces prices based on auction participants' bids for congestion revenue rights and a model of the transmission system. The auction models flows from the sources to the sinks of all congestion revenue right bids. The auction price of a congestion revenue right will be non-zero if it produces flows over transmission constraints for which there is more demand for transmission capacity than available transmission capacity. The auction revenue received for a congestion revenue right will be less than the payments made to the holder if a constraint frequently binds in the day-ahead market at a high congestion cost, but does not bind, or binds at a lower cost, in the auction.

The price of congestion revenue rights used as a hedge to lock in the cost of day-ahead market transmission service on a forward basis should reflect market participants' expectations of congestion price exposure in the day-ahead market plus a premium due to the certainty they provide. Generally, over the long-term, congestion revenue rights 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.

The ISO's congestion revenue rights auction has not been efficient because auction revenues have been much less than congestion revenue right payments, rather than producing prices reflecting congestion revenue rights' value as hedges. Total payments to auctioned congestion revenue rights in 2014 were $187 million more than auction revenues. This shortfall decreased in 2015 to about $60 million, further decreased in 2016 to about $51 million, but has increased in 2017 to $100 million.

PROPOSAL

Management proposes several congestion revenue right auction and allocation process rule changes that it proposes to implement beginning with the upcoming annual auction and allocation process for 2019 that starts in July. Implementing the rule changes in the 2019 annual process should help mitigate the shortfall in annual auction revenue as compared to the payments to the congestion revenue rights. These proposed rule changes are based on Management's extensive analysis of the drivers of the low auction revenues compared to congestion revenue right payments, which it published in a report last November.

Management is pursuing other congestion revenue right rule changes that do not require tariff changes. These include greater transparency on transmission outage reporting performance, process improvements, and a review of current modeling criteria. Management also plans to work with stakeholders on additional measures. It plans to seek the ISO Board of Governors' approval in early summer for some or all of these additional items in time for the upcoming annual auction and allocation process that starts in July.

The initial congestion revenue right auction and allocation process rule changes that Management proposes to implement beginning with the annual auction and allocation process for 2019 are described below.

Limit allowable source and sink pairs in the auction

Management proposes to limit congestion revenue right sources and sinks to only the combinations needed to hedge congestion costs associated with delivering supply. As previously described, congestion revenue right auction participants can currently purchase congestion revenue rights that have sources and sinks at generator locations, load locations, trading hubs, pricing nodes, and import/export scheduling points. This allows auction participants to bid for congestion revenue rights at many different locations, increasing their ability to purchase congestion revenue rights involving constraints that do not bind or bind at a lower cost in the auction, but then bind at relatively high prices in the day-ahead market. This results in congestion revenue rights being purchased at a much lower price in the auction then the payments made based on the day-ahead market.

To mitigate this issue, Management proposes to only accept congestion revenue right bids sourcing and sinking in the following ways: (1) from a generator bus to a load serving entity load aggregation point, a trading hub, or scheduling point; or (2) from a trading hub to a load serving entity load aggregation point or scheduling point; or (3) from scheduling point to a load serving entity load aggregation point or trading hub.

Management's analysis of the congestion revenue rights auction revenue deficiency revealed that congestion revenue rights that do not have these proposed sources and sinks have historically accounted for 81 percent of the congestion revenue right profits. Moreover, market participants purchased these rights for 38 cents on the dollar. In contrast, market participants purchase congestion revenue rights that do have the proposed sources and sinks for 74 cents on the dollar. Thus, no longer allowing non-delivery pair bids will enable congestion revenue right auction participants to obtain hedges for supply delivery while eliminating a significant contributor to the excessive congestion revenue right profits.

Management also proposes to provide a mechanism through which market participants that acquire congestion revenue rights in the allocation or auction processes can sell those rights back into auctions. Currently the congestion revenue rights auction does not have an explicit sell feature for congestion revenue rights.

Create annual outage reporting deadline for annual congestion revenue rights process

Management proposes to create an annual transmission outage reporting deadline in order to receive transmission outages in time to model in the annual congestion revenue rights allocation and auction. Transmission outages have a direct impact on the amount of transmission capacity that can be made available to market participants as congestion revenue rights. The ISO currently releases 75% of transmission capacity in its annual allocation and auction processes to account for potential unknown outage conditions. However, even at this level, Management found that congestion revenue rights awarded in the annual process routinely exceed the amount of capacity available in the monthly processes because of outages identified after the ISO has conducted the annual process. Obtaining transmission outages in time for the annual process is crucial to ameliorating this deficiency because it would allow the ISO to reduce the transmission capacity in the annual process to account for the outage and not release the congestion revenue rights in the first instance.

Transmission outage information affects more than just the network topology that the ISO uses in its allocation and auction process. The ISO relies on the outage information to determine appropriate constraints and contingency conditions to monitor in the allocation and auction. If the conditions considered in the annual process are far different from the actual conditions, auction revenues collected in the annual process will not be enough to cover eventual payouts leading to a higher auction revenue deficiency. Management's analysis shows that almost half of the auction revenue

deficiencies are associated with congestion revenue rights that the ISO awards in the annual process.

To address this inefficiency, Management proposes to require transmission owners to submit outages that could potentially cause congestion revenue inadequacy for the following calendar year by July 1. These consist of the same types of outages that transmission owners are currently required to report thirty days prior to the month in which the outages are to occur. Management also proposes to narrow this requirement to outages that could potentially cause congestion revenue inadequacy to facilities that meet the current voltage and duration requirements as defined in the tariff and result in transmission topology changes. This proposal is consistent with outage reporting rules at other ISOs and RTOs.

POSITIONS OF THE PARTIES

The generation, marketing, and financial communities do not support the proposal to limit the allowable source and sink pairs in the auction because they argue it will hinder a participant's ability to manage its congestion exposure, and thereby increase costs. They also argue that in order for a participant to hedge congestion exposure under the proposed rules, they will have to purchase a larger quantity of less effective congestion revenue rights forcing participants to add higher risk premiums into their offers, further exacerbating the auction efficiency issue. Southern California Edison does not support this proposal because they favor a more substantial change of limiting the congestion revenue rights auction to willing counterparties.

The California Department of Water Resources, Energy Users Forum, Marin Clean Energy, Northern California Power Agency, the Office of Ratepayer Advocates, Pacific Gas & Electric Company, Powerex, and the Six Cities support the proposal to limit the allowable source and sink pairs in the auction because it may provide auction revenue deficiency relief, but mostly see it as a short-term measure on the way to more comprehensive changes.

Most stakeholders support changes to the outage reporting rules. The generation, marketing, and financial communities advocate for stricter outage reporting rules with clear financial accountability assigned to transmission owners. Pacific Gas & Electric Company, and San Diego Gas & Electric do not support the proposal because it would increase the cost of transmission maintenance imposed on ratepayers. Southern California Edison and Silicon Valley Power do not support the proposal because they favor a more substantial change of limiting the congestion revenue rights auction to willing counterparties.

The Market Surveillance Committee supports both proposals.

A stakeholder comment matrix is included as Attachment A. The Market Surveillance Committee provided a formal opinion on Management's proposal and is included as Attachment B.

CONCLUSION

Management requests the ISO Board of Governors approve the changes described above. The proposed changes will improve congestion revenue rights auction competitiveness consistent with the use of congestion revenue rights as a hedge for supply delivery, reduce auction revenue deficiencies, and allow the ISO to more accurately release congestion revenue rights corresponding to transmission that will ultimately be available in the day-ahead market.

Management is continuing to work on additional modifications to the 2019 congestion revenue rights auction that it plans to bring to the Board in early summer that are designed to further mitigate payouts in excess of auction revenues.

Attachment F -

Summary of Submitted Stakeholder Comments on CRR Auction Efficiency

CRR Auction Efficiency Track 1A Tariff Amendments

California Independent System Operator Corporation

California ISO

Attachment A

Stakeholder Process: Congestion Revenue Rights Auction Efficiency

Summary of Submitted Comments

Stakeholders submitted four rounds of written comments to the ISO under the congestion revenue rights auction efficiency stakeholder initiative on the following dates:

- Round One (comments following April 2017 analysis scoping working group), 05/01/17
- Round Two (comments following release of analysis report), 12/14/17
- Round Three (comments following December 2017 working group), 01/12/18
- Round Four (comments on draft final proposal), 02/28/18

Stakeholder comments were received from: Appian Way, Alliance for Retail Energy Markets (AReM), Boston Energy Trading and Marketing (Boston Energy), Calpine Energy Solutions, California Department of Water Resources (CDWR), California Public Utilities Commission (CPUC), DC Energy, Department of Market Monitoring (DMM), Energy Users Forum (EUF), Financial Marketers Coalition (FMC), Load Serving Entities in Support of Market Efficiency and the CRR Auction (LSE-CRR Auction Supporters), Marin Clean Energy (MCE), Northern California Power Agency (NCPA), NRG Energy, Office of Ratepayer Advocates (ORA), Pacific Gas & Electric Company (PG&E), Powerex, Southern California Edison (SCE), San Diego Gas & Electric Company (SDG&E), Six Cities, Silicon Valley Power (SVP), Valley Electric Association (VEA), Vitol, Inc., Western Power Trading Forum (WPTF)

Stakeholder comments are posted at:
http://www.caiso.com/informed/Pages/StakeholderProcesses/CongestionRevenueRightsAuctionEfficiency.aspx

Other stakeholder efforts include:

- Working group, 04/18/17
- Market Performance and Planning Forum analysis update, 05/16/17
- Market Performance and Planning Forum analysis update, 07/18/17
- Working group, 12/19/17
- Stakeholder meeting, 02/13/18

Comments of following Market Participants	Limit allowable source and sink pairs in the auction	Create annual outage reporting deadline for annual congestion revenue rights process
Appian Way	Opposes. Concerned proposed restrictions eliminate the possibility to offer counter-flow congestion revenue rights. Concerned management's proposal will hinder a participant's ability to manage its congestion exposure granularly making it much harder if not impossible for market participants to hedge specific localized congestion risk.	No position.
Alliance for Retail Energy Markets	Opposes. Concerned management's proposal will hinder a participant's ability to manage its congestion exposure granularly making it much harder if not impossible for market participants to hedge specific localized congestion risk.	Supports.
Boston Energy Trading and Marketing	Opposes. Concerned management's proposal will hinder a participant's ability to manage its congestion exposure granularly making it much harder if not impossible for market participants to hedge specific localized congestion risk.	Supports.

Calpine Energy Solutions	Opposes. Concerned management's proposal will hinder a participant's ability to manage its congestion exposure granularly making it much harder if not impossible for market participants to hedge specific localized congestion risk. Concerned management's proposal will decrease the ability of financial market participants to provide a load-serving counterparty with the lowest possible hedge cost.	Supports.
California Department of Water Resources	Supports.	Supports.
Energy Division Staff, California Public Utilities Commission	Opposes. Concerned management's proposal does not result in a congestion revenue rights auction between willing counterparties.	Opposes. Concerned management's proposal does not result in a congestion revenue rights auction between willing counterparties.
DC Energy	Opposes. Concerned management's proposal will hinder a participant's ability to manage its congestion exposure granularly making it much harder if not impossible for market participants to hedge specific localized congestion risk. Concerned management's proposal will increase the cost of hedging for maintenance, forced outages, fuel supply risk, weather deviations, and mid-year forward contract expirations.	Supports.

Department of Market Monitoring	Opposes. Concerned that management's proposal may only have moderate effects on auction revenue shortfall.	No position.
Energy Users Forum	Supports.	Supports.
Financial Marketers Coalition	Opposes. Concerned management's proposal will hinder a participant's ability to manage its congestion exposure granularly making it much harder if not impossible for market participants to hedge specific localized congestion risk. Concerned management's proposal will increase the cost of hedging for maintenance, forced outages, fuel supply risk, weather deviations, and mid-year forward energy contract expirations.	Supports.
Load Serving Entities in Support of Market Efficiency and the CRR Auction	Opposes. Concerned the node pairs the ISO proposes to eliminate from the CRR auction currently allow their generation counterparties to manage risks and therefore provide a potentially lower cost energy supply.	Supports.

Marin Clean Energy	Supports.	Supports.
Northern California Power Agency	Supports.	Supports.
NRG Energy	Opposes. Concerned restricting allowable node pairs will make it more difficult for market participants to hedge congestion delivery risk therefore increasing costs.	Supports.
Office of Ratepayer Advocates	Supports.	Supports.

Pacific Gas & Electric Company	Supports.	Opposes.
Powerex	Supports.	Supports.
Southern California Edison	Opposes. Concerned management's proposal does not result in a congestion revenue rights auction between willing counterparties.	Opposes. Concerned management's proposal does not result in a congestion revenue rights auction between willing counterparties.
San Diego Gas & Electric Company	Opposes. Concerned management's proposal will only minimize the amount of congestion revenue rights auctioned and will not increase auction efficiency, because it does not ensure that constraints that are normally binding in the day-ahead market will be binding in the annual auction.	Opposes. Concerned management's proposal would increase cost of transmission maintenance imposed on ratepayers.
Six Cities	Supports.	Supports.

Silicon Valley Power	Opposes. Concerned management's proposal does not result in a congestion revenue rights auction between willing counterparties.	Opposes. Concerned management's proposal does not result in a congestion revenue rights auction between willing counterparties.
Valley Electric Association	Opposes. Concerned that the node pairs management's proposal would eliminate currently allow their generation counterparties to manage risks and therefore provide a potentially lower cost energy supply.	Supports.
Vitol, Inc.	Opposes. Concerned management's proposal will hinder a participant's ability to manage its congestion exposure granularly making it much harder if not impossible for market participants to hedge specific localized congestion risk. Concerned that the node pairs management's proposal would eliminate currently allow its generation counterparties to manage risks and therefore provide a potentially lower cost energy supply.	Supports.
Western Power Trading Forum	Opposes. Concerned that management's proposal will hinder a participant's ability to manage its congestion exposure granularly making it much harder if not impossible for market participants to hedge specific localized congestion risk. Concerned that the node pairs management's proposal would eliminate currently allow their generation counterparties to manage risks and therefore provide a potentially lower cost energy supply.	Supports.

Management Response	Management proposes to continue to support the core purpose of congestion revenue rights as a means to provide hedges for supply delivery. It proposes to limit the allowable source and sink pairs to only those associated with supply delivery ("delivery pairs"). This proposal strikes a balance between providing sufficient flexibility for nonparticipating transmission owner load serving entities, generator owners, and marketers the capability to obtain hedges for supply delivery while not allowing the opportunity for completely strategic bidding aimed at exploiting the congestion revenue rights auction. Management expects the current non-delivery pair transaction activity required for hedging for supply delivery to shift to the proposed allowable source and sink pairs, increasing auction competitiveness while providing sufficient opportunity to market participants to obtain hedges. Management's proposal allows sufficient opportunity for hedging supply delivery because the allowable pairs source at all types of supply points and sink at the types of nodes that supply market participants deliver supply to. Management understands that market participants may no longer be able to target specific constraints and thereby gain low-cost hedging options, however, the very concern that the proposal addresses is the fact that market participants currently obtain certain congestion revenue rights at significant discounts to eventual payouts. Analysis of the congestion revenue rights auction revenue deficiency revealed that congestion revenue rights that do not have proposed sources and sinks have historically accounted for 81 percent of the congestion revenue right payments that exceed auction revenue. Market participants purchased these rights for 38 cents on the dollar. In contrast, market participants purchase congestion revenue rights that do have the proposed sources and sinks for 74 cents on the dollar.	Transmission outage information affects more than just the network topology that the ISO uses in its allocation and auction process. The ISO relies on the outage information to determine appropriate constraints and contingency conditions to monitor in the allocation and auction. If the conditions considered in the annual process are far different from the actual conditions, auction revenues collected in the annual process will not be enough to cover eventual payouts, leading to higher auction revenue deficiency associated with congestion revenue rights awarded in the annual process. Analysis showed that almost half of the auction revenue deficiencies are associated with congestion revenue rights that the ISO awards in the annual process. By collecting outage information in time for the annual process, the ISO will better align the amount of transmission capacity released as congestion revenue rights in the annual processes with the amount of transmission capacity that will ultimately be available.

Attachment G -

Memorandum of Eric Hildebrandt, Department of Market Monitoring, to

Board of Governors on CRR Proposal

CRR Auction Efficiency Track 1A Tariff Amendments

California Independent System Operator Corporation

Memorandum

To: ISO Board of Governors

From: Eric Hildebrandt, Executive Director, Market Monitoring

Date: March 14, 2018

Re: **Department of Market Monitoring Report Comments on CRR Proposal**

This memorandum does not require Board action.

EXECUTIVE SUMMARY

The Department of Market Monitoring (DMM) does not support the ISO's *Congestion Revenue Rights Auction Efficiency Track 1 Draft Final Proposal*. Under Management's proposal, the ISO would continue to auction off large volumes of CRRs – mostly to purely financial entities – which must be backed by payments from congestion revenues that should instead flow back to ratepayers who pay for the transmission system in full through the Transmission Access Charge (TAC). Ratepayers have already lost over $750 million from the CRR auction, including over $100 million in 2017 and over $27 million in the first two months of 2018. 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.

Since 2016 DMM has been strongly recommending 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. DMM recommends that the Board direct the ISO to develop an auction design based on willing buyers and sellers that addresses the fundamental auction design flaws -- such as the proposal by SCE -- as soon as possible. The approach proposed by SCE is less complex to implement than the changes being proposed by Management and directly addresses the flaw in the CRR auction design. If the ISO believes further refinements in the CRR allocation and auction process would be beneficial, these can be made after the basic flaw in the CRR auction design has been addressed.

Because the ISO plans to extend its CRR structure to the extended day-ahead market, failure to address these auction design flaws now could adversely impact the ISO's regional expansion initiatives. Extending this flawed design to other balancing authority areas will unnecessarily prevent their transmission ratepayers from receiving all congestion rents from the day-ahead market.

BACKGROUND

DMM has described the underlying problems and flaws in the CRR auction design in detail in prior reports and comments.[1] The CRR auction relies on conscripted sellers, has high transaction costs, has poorly defined property rights, and dissipates market liquidity. These are not the characteristics of a competitive market and cause the revenue from CRRs sold in the auction to be systematically lower than the payments which are made to entities purchasing CRRs from congestion revenues collected by the ISO.[2]

These flaws are clearly apparent in the performance of the CRR auction over the last decade in California and other ISOs. The CRR auction has cost California transmission ratepayers an average of over $82 million per year since 2009 – representing a loss of over $750 million.[3] In 2017, these losses totaled over $100 million. As shown in Figure 1, ratepayers receive less than $.50 in auction revenue for each dollar paid out for CRRs from congestion revenues that would otherwise be refunded back to ratepayers.

In just the first two months of 2018, ratepayer losses from auctioned CRRs have already totaled over $27 million (see Figure 2). Over 90 percent of these ratepayer losses continue to result from CRRs bought by purely financial entities that do not schedule load or generation in the ISO system.

For nearly two years, DMM has been recommending that the ISO modify the auction so that load serving entities are not forced to back CRRs sold in the auction with congestion revenues they should receive as the entities paying for the transmission system.[4] Since June 2016 DMM has been strongly recommending that the ISO address this issue by assessing how to convert the CRR auction into a CRR market based on bids voluntarily submitted by various participants willing to buy or sell congestion revenue rights.

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[1] For example see Department of Market Monitoring *Problems in the performance and design of the congestion revenue right auction* November 27, 2017: http://www.caiso.com/Documents/DMMWhitePaper-Problems_Performance_Design_CongestionRevenueRightAuction-Nov27_2017.pdf

[2] *Comments on the CRR Auction Analysis Working Group*, Department of Market Monitoring, January 16, 2018: http://www.caiso.com/Documents/DMMComments-CRRAuctionAnalysisReportWorkingGroup.pdf.

[3] $730 million through 2017 plus $27 million in the first two months of 2018. See: *Q4 2017 Report on Market Issues and Performance*, Department of Market Monitoring, February 14, 2018, p.28. http://www.caiso.com/Documents/2017FourthQuarterReport-MarketIssues-PerformanceFebruary2018.pdf

[4] *2015 Annual Report on Market Issues and Performance*, Department of Market Monitoring, May 2016, pp. 225-226. http://www.caiso.com/Documents/2015AnnualReportonMarketIssuesandPerformance.pdf

Figure 1. Auction revenues and payments to non-load-serving entities (2012-2017)

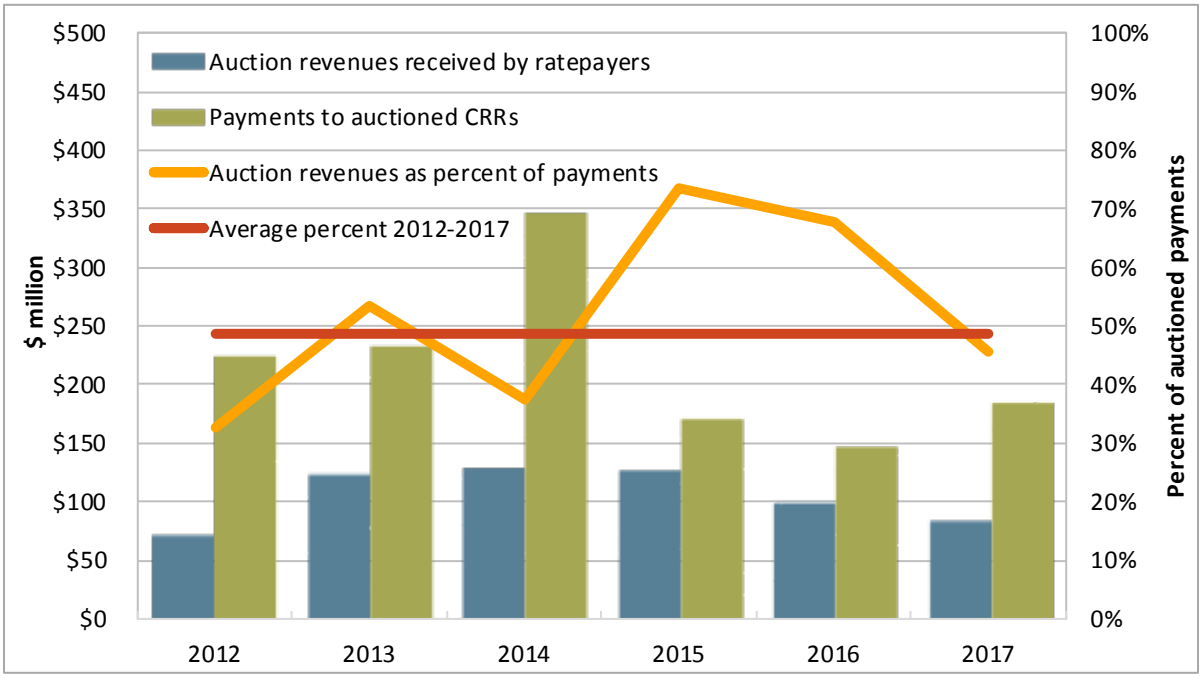
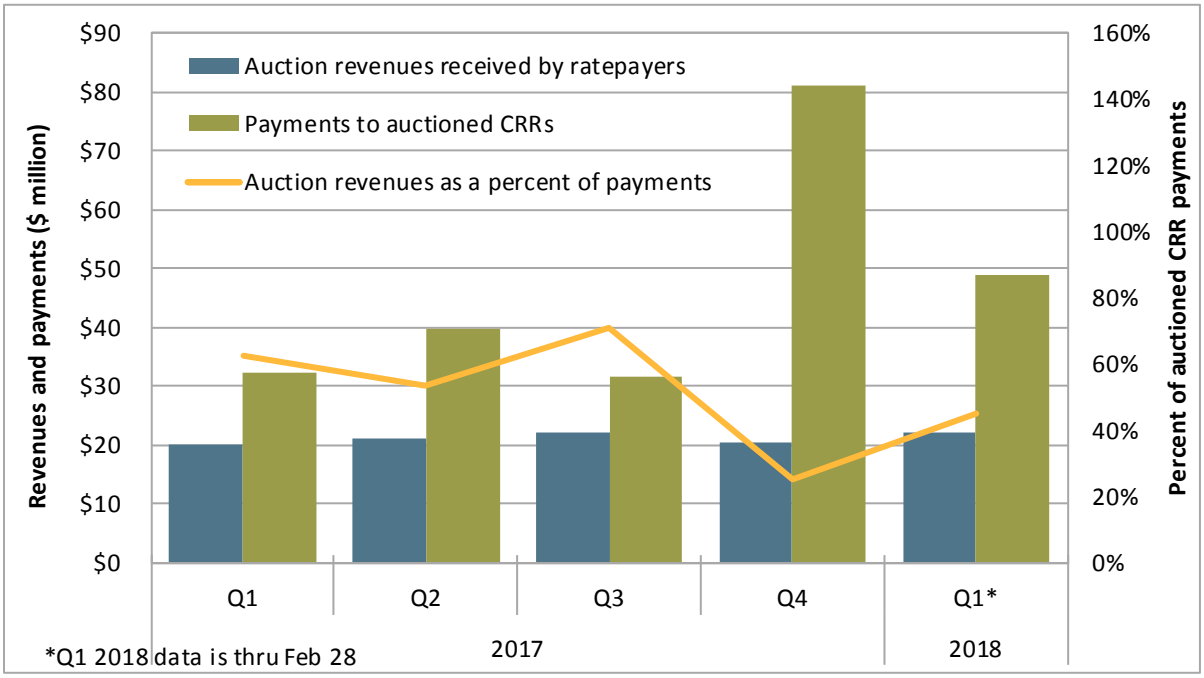


Figure 2. Auction revenues and payments to non-load-serving entities (2017-2018)



As noted in DMM's Q2 2016 report:

> DMM believes replacing the congestion revenue rights *auction* with this type of congestion revenue rights *market* would be more equitable, produce more efficient prices set by willing buyers and sellers, and greatly reduce the loss of congestion revenues for ratepayers by the current congestion revenue rights auction design. DMM believes it is likely that implementing this type of market would not be more complex than the effort needed to implement the current congestion revenues rights auction.[5]

The ISO ultimately agreed to open a stakeholder process on this issue in 2017 and has now been analyzing this issue and options for over a year.[6] Although the ISO now agrees that "there is evidence that the California ISO's congestion revenue rights auction produces inefficient outcomes," the measures proposed by the ISO do not move toward the type of CRR market based on willing buyers and sellers.

The ISO's February 8 draft final proposal incorrectly states that "DMM proposes to eliminate the congestion revenue rights auction" and only consider three other potential market designs for financial price swaps.[7] In fact, DMM's January 17 comments specifically noted that there are numerous "feasible alternatives to the CRR auction that will ensure CRRs are bought and sold only between willing counterparties while allowing market participants to manage basis risk," and that these alternatives include "another easy to implement alternative proposed by SCE." [8]

The approach proposed by SCE allows the ISO to maintain its auction structure but sets auction limits for all transmission constraints (i.e. above levels needed for allocated CRRs) to a net value of zero. This will enable the clearing of bids for offsetting locational price swaps, and still allow the ISO to be the clearinghouse. As noted in our January 2018 comments, "DMM believes the ISO should give serious and timely consideration to SCE's proposed alternative as a very effective option that could be implemented quickly by the ISO."[9] In our most recent comments in response to the ISO's Draft Final Proposal, DMM

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[5] *Q2 2016 Report on Market Issues and Performance*, Department of Market Monitoring, August 22, 2016, p. 56. http://www.caiso.com/Documents/2016SecondQuarterReportMarketIssuesandPerformance.pdf

[6] As noted in the ISO's draft final proposal, the public stakeholder process on this issue started with the Market Surveillance Committee Meeting on February 2, 2017. , *Congestion Revenue Rights Auction Efficiency Track 1 Draft Final Proposal,* February 8, 2018, p.6. http://www.caiso.com/Documents/DraftFinalProposal-CongestionRevenueRightsAuctionEfficiency-Track1.pdf

[7] Draft Final Proposal, p.7.

[8] *Comments on the CRR Auction Analysis Working Group,* Department of Market Monitoring January 16, 2018, http://www.caiso.com/Documents/DMMComments-CRRAuctionAnalysisReportWorkingGroup.pdf

[9] *Comments on the CRR Auction Analysis Working Group,* p. 8.

reaffirmed its recommendation that "the ISO instead propose a design that addresses the fundamental auction design flaws – such as the SCE proposal – as soon as possible."[10]

MANAGEMENT PROPOSAL

Under Management's proposal, the ISO would continue to auction off large volumes of CRRs – primarily to purely financial entities – which must be backed by payments from congestion revenues that should instead flow back to transmission ratepayers who pay for the transmission system. Because Management's proposal does not address the fundamental flaw underlying the CRR auction design, it will not protect transmission ratepayers from further losses from the CRR auction. As discussed below, the proposal may only have moderate effects on ratepayer losses and could potentially make the problems worse.

Limiting source and sink pairs will not eliminate ratepayer losses

The ISO proposes to limit allowable CRR source and sink pairs in the auction. The node pair limits are meant to align the CRR sales with source and sink pairs more likely to be used for hedging forward contract basis risk. The node pair limits are also meant to limit the ability of auction participants to target specific illiquid transmission elements or modeling discrepancies.

Even though the ISO would restrict source and sink pairs, the underlying auction would still use a transmission model offering contracts backed by ratepayers without reservation prices. Auction participants could still create portfolios of CRRs that mimic source and sink pairs that the ISO proposes to not allow. As a result, even with the proposed limits on source and sink pairs, auction participants could still create portfolios of CRRs that give them approximately the same exposures to the illiquid transmission elements and modeling discrepancies that the source-sink limits seek to stop.

Given that the ISO would still be offering contracts backed by ratepayers, reducing competition would work to increase ratepayer losses. The net effect that restricting source and sink pairs would have on ratepayer losses is not clear, but DMM notes that this aspect of the proposal could actually increase ratepayer losses from the auction over time.

Even financial participants currently making large profits from the CRR auction agree this measure will be ineffective at reducing ratepayer losses. As noted by DC Energy, "it is not logical to expect that a highly restrictive filter on allowable bids will somehow create more competition on "delivery pair" transaction or help the CAISO carry out its objective to minimize "net payment deficiency" …. DC Energy submits that the actual outcome of the proposed CRR restrictions would be fewer CRRs awarded and reduced competition across

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[10] *Comments on the Congestion Revenue Rights Auction Efficiency Track 1 Draft Final Proposal,* Department of Market Monitoring, February 28, 2018, p.1. http://www.caiso.com/Documents/DMMComments-CongestionRevenueRightsAuctionEfficiencyTrack1DraftFinalProposal.pdf

the network. This would lead to less overall auction revenue … and would not facilitate the CAISO's objective of minimizing "net payment deficiency".[11]

Lowering annual transmission limits will not significantly cut ratepayer losses

The ISO has indicted it has considered decreasing the percent of expected transmission capacity modeled in the annual allocation and auction processes from 75% to 45%. However, the ISO would continue to auction CRRs in the monthly auctions based on the same transmission ratings it does today.

While the ISO will have better information about day-ahead market transmission models when the ISO runs the monthly auction, the ISO still cannot make the auction model the same as the day-ahead models. Auction participants will also have better information about potential day-ahead transmission modeling in the monthly auction that they can use to take advantage of model differences between the monthly auction model and the day-ahead market models. Therefore, moving more CRR sales from the annual to monthly auction may not improve auction outcomes.

Recent market results support this assessment. Lowering the line ratings in the annual processes may not significantly affect auction results. In 2017 about 60% of total ratepayer losses from the CRR auctions came from annual auction CRRs while 40% came from the monthly auction CRRs. On average, ratepayers were paid 41 cents in the auction for every dollar they had to pay out on annual auctioned CRRs. Ratepayers were paid on average 50 cents per dollar on monthly auctioned CRRs.

Lowering the transmission limits used in the annual model could also limit the allocation of CRRs to load serving entities. DMM would support significantly decreasing the amount of CRRs sold in the annual auction for 2019 if the ISO was committed to implementing a market between willing buyers and sellers – such as the approach proposed by SCE -- in the monthly process as soon as possible in 2018. However, DMM believes the approach proposed by SCE could be implemented in the annual auction for 2019. DMM notes that the annual auction for 2018 was not held until November 28, 2017 to allow the ISO to address a modeling issue that could have caused large losses to transmission ratepayers.

Changing modeling disclosure may exacerbate CRR auction problems

The ISO has considered stopping disclosing the exact modeling used in the CRR auctions in order to make it more difficult for auction participants to find opportunities to extract value from model differences. As discussed in DMM's stakeholder comments, the CRR auction design suffers from a public-private estimation problem.[12] Auction participants who can better estimate how, or have better insights into how, the ISO will model transmission in the

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[11] *Comments on Congestion Revenue Rights Auction (CRR) Auction Efficiency Draft Final Proposal* [sic], DC Energy, February 28, 2018. p.3. http://www.caiso.com/Documents/DCEnergyComments-CongestionRevenueRightsAuctionEfficiencyTrack1DraftFinalProposal.pdf

[12] *Comments on the Congestion Revenue Rights Auction Efficiency Track 1 Draft Final Proposal, p, 2.*

auction will have an advantage over other participants. Because auction participants who are better at estimating the day-ahead models are likely to also be better at estimating how the ISO will create the auction model, the ISO's proposal to not disclose the auction model will likely increase the information advantage of these participants. This will further undermine price based competition and increase the rewards to this non-price competition. As a result, the ISO's proposal may actually increase ratepayer losses from the CRR auction.

SCE PROPOSAL

DMM supports the auction modifications proposed by SCE as a very effective option for creating a market for CRRs between willing buyers and sellers that could be quickly implemented by the ISO. With this approach:

- The ISO would first allocate all CRRs that are feasible based upon the transmission capability to load serving entities based on their CRR nominations. The allocation process would be conducted in the same manner as today, except the ISO would no longer "reserve" CRRs for the auction process.

- The ISO would then utilize the CRR model to conduct a market by clearing only bids to buy and sell CRRs by willing counterparties. To implement this, the ISO simply needs to set the limits on additional transmission sold in the auction to a net value of zero. Thus, CRR bids would only clear to the extent that bids from other parties created an equal and opposite counter-flow. Those wishing to purchase CRRs either to hedge a physical risk or to speculate on value would be able to do so in the auction. Load serving entities could still utilize the auction to essentially sell back any CRRs they were allocated and/or buy additional CRRs.

This approach completely eliminates revenue shortfalls in the auction since payments to one party will be matched by revenues due from its counterparty. This framework could be supplemented with other mechanisms to encourage liquidity, such as a pre-auction bulletin board where auction participants could disclose potential interest in buying or selling specific CRRs. DMM believes this approach is actually simpler to implement than Management's proposed measures.

OTHER ISSUES

Timing of Approval and Implementation of Auction Changes

The ISO has indicated that it feels it must gain approval at the March 2018 Board of Governors' meeting for any changes in the auction to be implemented in the annual and monthly 2019 congestion revenue rights auction and allocation processes. DMM disagrees that the Management proposal is the only feasible option for reducing ratepayer losses from the annual and monthly auctions for 2019.

DMM understands that the overall annual allocation and auction process starts in July with the collection of information for the CRR allocation and development of the full network model. The 2018 annual auction was held October 31-November 2 with the awards posted November 8. Because of a modeling issue that could have caused large losses to transmission ratepayers, the 2017 annual auction was delayed to November 28 with awards posted December 5. A similar delay would be appropriate if needed to implement the SCE proposal.

Moreover, DMM believes that even if the ISO cannot act soon enough to implement the approach proposed by SCE in the annual auction for 2019, these changes can and should be implemented in the monthly auctions in late 2018 or early 2019. As noted above, the annual auction can be delayed and/or the transmission limits used in the annual model could be lowered significantly as an interim measure, while the ISO worked to implement the approach proposed by SCE.

Other Options

Beyond the measures incorporated in Management's proposal, the other main option that has been mentioned by Management as a "longer term option" is the concept of the ISO placing a *reservation price* on CRRs in the auction. DMM notes that this essentially amounts to the ISO placing a positively priced bid to sell in the CRR auction on behalf of transmission ratepayers (instead of the $0 bid currently placed). DMM believes this approach would be very problematic and ineffective. However, if the ISO believes this is a viable option, DMM encourages the ISO to vet this option (and any other potential options) as expeditiously as possible.

Impact of CRR Auction Design on Regional Expansion Initiatives

The ISO has indicated that it plans to create a CRR design for the extended day-ahead market that is "similar to CAISO balancing area".[13] The current CRR auction design has cost California transmission ratepayers an average of over $82 million per year since 2009 – and over $100 million in 2017. If the ISO does not address the fundamental flaws in the

[13] *2018 Policy Initiatives Roadmap*, January 12, 2018, p. 21: http://www.caiso.com/Documents/2018FinalPolicyInitiativesRoadmap.pdf.

CRR auction design, the risk of these transmission ratepayer losses could impact the ISO's regional expansion initiatives.

The ISO auction design in effect forces transmission ratepayers to offer financial swaps. This exposes these ratepayers to potentially large losses that are funded by the congestion rents that these ratepayers would otherwise receive from their transmission assets. Extending this flawed design to other balancing authority areas will unnecessarily prevent their transmission ratepayers from receiving all of their day-ahead market congestion rents.

Therefore, extending the ISO's flawed auction design to other balancing areas would reduce the benefits these areas would receive from the ISO's extended day-ahead market and could adversely impact entities' decisions to join. Developing a CRR auction design that addresses the fundamental flaws would allow the ISO to extend its CRR market design to the extended day-ahead market without adversely impacting regional expansion.

CONCLUSION

Over the last 12 months since the ISO began its stakeholder process on this issue, transmission ratepayers lost another $100 million in the CRR auctions. DMM hopes the ISO will move swiftly to eliminate the costs and risks placed on ratepayers by the current CRR auction design.

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. Under Management's proposal, the ISO would continue to auction off large volumes of CRRs – primarily to purely financial entities – which must be backed by payments from congestion revenues that should instead flow back to transmission ratepayers.

DMM recommends that the Board direct the ISO to develop a design that addresses the fundamental auction design flaws -- such as the proposal by SCE -- as soon as possible. The approach proposed by SCE is less complex to implement than the changes being proposed by Management and directly addresses the flaw in the CRR auction design. If the ISO believes further refinements in the CRR allocation and auction process would be beneficial, these can be made after the basic flaw in the CRR auction design has been addressed. DMM believes that even if the ISO cannot act soon enough to implement the approach proposed by SCE in the annual auction for 2019, these changes can and should be implemented in the monthly auctions in late 2018 or early 2019.

Because the ISO plans to extend its CRR structure to the extended day-ahead market, failure to address these auction design flaws now could adversely impact the ISO's regional expansion initiatives. Extending this flawed design to other balancing authority areas will unnecessarily prevent their transmission ratepayers from receiving all congestion rents from the day-ahead market.

Attachment H -

Opinion of the Market Surveillance Committee on CRR Auction Efficiency

CRR Auction Efficiency Track 1A Tariff Amendments

California Independent System Operator Corporation

Opinion on
Congestion Revenue Rights Auction Efficiency

by
James Bushnell, Member
Scott M. Harvey, Member
Benjamin F. Hobbs, Chair

Members of the Market Surveillance Committee of the California ISO

Final, March 15, 2018

1. Introduction

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] 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.[2] This "auction revenue shortfall" has been declining over time. The CAISO report similarly calculates that the payout to annual CRRs exceeded their auction price by $48 million over the period January 2015 through May 2017, while the payout to monthly CRRs exceeded their auction price by about $92 million over the same period.[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

[1] California ISO, Congestion Revenue Rights Auction Efficiency, Track 1 Draft Final Proposal, February 8, 2018, www.caiso.com/Documents/DraftFinalProposal-CongestionRevenueRightsAuctionEfficiency-Track1.pdf; California ISO, Congestion Revenue Rights Auction Efficiency, Track 1 Draft Final Proposal Addendum, March 8, 2018. www.caiso.com/Documents/DraftFinalProposalAddendum-CongestionRevenueRightsAuctionEfficiency-Track1.pdf.

[2] *Problems in the performance and design of the congestion revenue right auction*, CAISO Department of Market Monitoring, November 27, 2017. Thus, auction revenues have been about half of the value of the congestion revenue payouts. If, however, expressed as a percentage of total congestion revenue, the payout has been a significantly smaller fraction, since day-ahead congestion rents are on the order of $200M to $500M/year (from 2012-2015, according to DMM state of the market reports).

[3] California ISO, CRR Auction Analysis Report, November 21, 2017 pp. 51-52. Note the $92 million figure cited above corrects for a typo in this report where net payments for 2017 January – May were reported as -$11 million but were actually -$19 million.

flaws in the CRR process. At the same time, CRRs have long been held to be useful, if not 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 1 proposal attempts 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, although this number is lower in recent years. In addition to changes in outage reporting and other process changes, the proposal would 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.

The CAISO Market Surveillance Committee (MSC) has been asked by the CAISO to provide an Opinion on the Track 1 proposal. The causes of shortfalls in the CAISO's CRR auctions along with possible remedies have been previous discussed at two MSC meetings. These include 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;[4] and Feb. 2, 2018, when the CAISO's Track 1 proposal (the present proposal) was first publicly discussed. The MSC has also written opinions previously on CRR auction and allocation as a part of the MRTU design process.[5]

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[4] S. Harvey, Briefing on Analyzing Congestion Revenue Rights Auction Valuation, MSC Meeting, February 3, 2017, www.caiso.com/Documents/BriefingonAnalyzingCongestionRevenueRightsAuctionValuation-MSCHarvey-Feb2017.pdf

[5] Prior to the implementation of the Market Redesign and Technology Upgrade (MRTU) in 2007, the MSC issued three opinions that addressed CRR allocation. One focused on long-term rights allocation, supporting the ISO's proposal and full-funding of all CRRs (F. Wolak, J. Bushnell, and B. Hobbs, "Opinion on Long-Term Congestion Revenue Rights Proposal", Jan. 18, 2007, www.caiso.com/Documents/FinalOpinionon LongTermCongestionRevenueRights.pdf).

The other opinions included more comprehensive discussions of CRR allocation. The most recent (F. Wolak, J. Bushnell, and B. Hobbs, "Final Opinion on Recent Changes to the ISO Congestion Revenue Rights Proposal," www.caiso.com/Documents/070418_MSCFinalOpinionon CongestionRevenueRights.pdf) emphasized the importance of giving small LSEs access to long-term CRRs at trading hubs. The Opinion also stated the following two principles "which... will limit the extent to which an allocation mechanism might harm market efficiency. One principle ... is to avoid a direct linkage between future market transactions and the assignment of future rights. Such a linkage could distort the investment decisions of a firm because the cost of locating a plant in a congested area would be at least partially offset by the allocation of CRRs from that location to the firm's load. A second principle is that the allocation of transmission rights, rather than an auction of all rights, helps to guard against the ownership of CRRs enhancing the incentive of market participants to exercise local market power. For this reason, we have consistently supported allocating CRRs to LSEs and have recommended against auctioning the majority of the total CRRs available" (p. 3). The concern was with how rights allocation could magnify market power, a point elaborated upon in another opinion (F. Wolak, B. Barber, J. Bushnell, and B. Hobbs, "Opinion on Aspects of the California ISO's Market Redesign and Technology Upgrade (MRTU) Conceptual Filing", September 30, 2005, www.caiso.com/Documents/OpinionAspects-

In this Opinion, we first provide background in Section 2 on the role of CRRs in restructured electricity markets, the procedures presently used to allocate CRRs, and the Department of Market Monitoring (DMM) / Southern California Edison (SCE) proposals for their reform. Then in Section 3, we discuss several identified issues with CRRs and CRR auctions, before summarizing the CAISO Track 1 proposal in Section 4. In the latter section, we describe and provide comments on the two major features of the proposal, which are changes in outage reporting and restrictions upon the allowed source-sink pairs in the CRR auction. Section 5 presents our conclusions.

2. Background

2.1 *The Historical Role of CRRs in ISO Markets*

Congestion Revenue Rights award to their owner a revenue stream associated with the price difference between two locations in an ISO network.[6] They 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] The transition from physical to financial transmissions rights allowed ISOs to provide market participants non-discriminatory physical access to the grid, while preserving for individual suppliers the financial equivalent of the ability to "deliver" power to customers. In an order conditionally approving market rules of the New York ISO, the FERC concluded that CRRs or "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."[8]

A core element of financial transmission rights is that they are financial instruments, not physical transmission rights. This design is essential in order to avoid use-it-or-lose-it

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CaliforniaISO%E2%80%99sMarketRedesignandTechnologyUpgrade_MRTU_ConceptualFiling.pdf). This opinion argued for a simple allocation process that would give all CRRs to load, and against use of an auction primarily because of concerns that CRRs could be used to magnify generator market power. "The market participant able to cause the most congestion is willing to pay the most for CRRs that refund these congestion charges… there is the danger that firms, upon purchasing or being awarded a financial CRR, would behave less efficiently than if they did not own that CRR" (p. 18). These market power concerns were subsequently mitigated by CAISO rules prohibiting resources from holding certain CRR positions that would magnify market power (e.g., owning rights that sink into a congested load pocket in which the holder also owns generation). In none of the opinions did the MSC address the possibility that auction revenues would consistently fall short of payouts to the auction rights, or the equity implications if that took place.

[6] Excluding loss components.

[7] Hogan, William W. "Contract networks for electric power transmission." *Journal of Regulatory Economics* 4.3 (1992): 211-242.

[8] 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.

incentives that would discourage efficient participation in the economic dispatch. Because these rights are purely financial, they can potentially be acquired by financial participants that do not use them for hedging and would instead value them as purely financial instruments. These financial firms can utilize their purchased CRRs to create secondary hedging instruments they might in turn sell to market participants, or they may be valued purely as risky, but potentially profitable trades.

The CRR paradigm also provides a mechanism for ISOs to redistribute the congestion revenues it collects from its operation of markets with locational marginal prices. Charging efficient congestion prices produces a surplus for the market operator that can be returned to market participants via CRRs or an alternative design. Although financial transmission rights were designed so they would be funded by the congestion rents collected by the system operator, because of the way CRRs are defined in the CAISO, and in other ISO markets as well, payments to CRRs can exceed the congestion revenues collected, a problem known as revenue inadequacy. Revenue inadequacy is a related, but distinct issue from the auction revenue shortfalls that have motivated the current CAISO proposal. Revenue inadequacy creates an operating deficit whereby ongoing congestion payments to CRR holders exceed congestion revenues. Auction revenue shortfalls, in contrast, equate to selling an asset for less than its expected future payout, adjusting for the time value of money. Of course, payments to CRR holders are only one of many possible uses for CAISO collected congestion revenues. When there is a surplus of congestion revenue net of CRR payments, this surplus is applied to reduce the revenue requirement for ratepayers of the transmission system.

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 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. We are not aware of quality data on the availability and cost of CRRs provided by third parties, but we are more

skeptical than DMM about the ability of third parties to fulfill CRR needs in the absence of ISO defined instruments.[9]

For firms and individuals engaged in the generation, marketing, and purchasing of power in ISO markets, hedges of locational price differences (congestion costs) can be highly valuable, and the acquisition of hedges an important cost of doing business. When paired with a physical transaction, CRRs provided a similar economic return as would the physical right to "deliver" power from a generation source location to a customer load sink location.

2.2 The Present Distribution of CRRs in the California ISO Market

In the CAISO market, policies have developed to allow load-serving entities initial and exclusive access to some CRRs through a multi-stage allocation process. These policies were developed with at least two motivations. The first was an early concern that CRRs could be used to leverage market power if suppliers in a constrained area were able to purchase CRRs sinking in the constrained area and thereby increase their profits from withholding output and driving up prices in the day-ahead market.[10] If an individual supplier was able to increase the payout to CRRs by exercising market power, it might be willing to outbid other competitors for those CRRs. Given the effectiveness of local market power mitigation, and the overall competitiveness of the CAISO market in recent years, it is not clear how significant this concern remains.

The second motivation for allocation was the connection made between access to congestion rents and obligations to pay for the physical transmission infrastructure. In the CAISO, the capital costs for transmission assets are recovered through a Transmission Access Charge (TAC) applied to load as well as energy that is exported or wheeled through the system. In this sense, load (and other TAC payers) are the transmission "owners", and it is logical that they would have claim to the congestion rents produced by the assets they helped pay for through their electric rates. These congestion rents could be distributed in several ways: (1) a direct refund of congestion rents in proportion to consumption (or equivalent offsets of other charges to consumers); (2) directly transferring CRRs through allocation, or (3) transferring the revenues raised from CRR auctions.

The first option (proportional refund) would guarantee a balanced refund of congestion revenues to all transmission ratepayers, but it would also eliminate the ability to use congestion revenues to support payments of CRRs. Further, the distribution of the refunded congestion rents could be very different from the distribution of congestion costs as a result of different consumers facing different locational marginal prices (LMPs). Hence, it

[9] Even if quality data on the cost of third party CRR equivalents (sometimes called basis swaps) were available, it is important to note that these products are being sold in the current market environment where conventional CRRs are allocated and auctioned according to current rules. Firms providing basis swaps could very well be using conventional CRRs to balance their risk exposure. Therefore, a sharp reduction or elimination of conventional CRRs could spill over to the pricing of third-party substitute instruments.

[10] Wolak *et al.*, 2005 and 2007, *op. cit*.

would not provide a mechanism for transmission customers to obtain the equivalent of firm transmission service.

Instead, the primary mechanism applied in California, measured in terms of capacity, has been the direct allocation of CRRs to LSEs. Despite paying TAC, export and wheel-through transmission customers are not eligible for CRR allocations. This differential treatment of external load was argued to be acceptable as external load could access ISO-backed CRRs through the auction process.[11] This access would change under proposals by the DMM described below. Currently, the CAISO allocates up to 75% of its modeled transmission capacity through a multi-stage annual allocation process, that includes long-term (10 year) and seasonal year-ahead CRRs. Additional transmission capacity, that the CAISO describes as up to roughly 82% of modelled capacity, is made available in a monthly allocation process. In practice, however, the proportion of congestion rent paid to CRRs awarded in the allocation process has not been in the range of 75-82% but has been only 54.6% over the period January 2015 through May 2017.[12]

If auctions were eliminated, the allocation process could also produce results considered inequitable by some LSEs. It is possible that some LSEs may be able to target and acquire CRRs that are more valuable, in terms of either projected congestion revenues or secondary market value than other LSEs. Neither the CAISO nor DMM has examined the equity of the current allocation process in terms of the relationship between the CRR payments received and congestion charges paid by different categories of load serving entities.

It is only after transmission capacity has been assigned to LSEs in the form of allocated CRRs that any remaining capacity is auctioned in the annual and monthly auctions. The level of overall network capacity made available to the auctions is the same as that made available to the allocations (75% year-ahead and roughly 82% month-ahead). No percentage of network capacity is directly reserved exclusively for sale in the auctions other than ½ of the intertie capacity that is available at the end of the 2nd tier allocation round.[13] The limitation that allocated CRRs must sink at particular locations may indirectly prevent the allocation of certain CRRs that create flows on some constraints.

At first glance, one might therefore interpret the auctions as the disposing of unwanted capacity "leftover" from the CRR allocation process, rather than a "forced sale" of CRRs.

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[11] "(E)xternal LSEs will receive a tremendous benefit from the CAISO and its transmission owners in being allowed to acquire CRRs as needed in the CAISO coordinated CRR auctions without being obligated to pay embedded cost charges on a prospective basis. It is likely that most external LSEs will acquire the CRRs they need to hedge potential wheeling through and out transactions in the CRR auction and only pay embedded cost usage charges to the extent they actually use the system." Prepared Direct Testimony of Scott Harvey and Susan Pope, FERC Docket ER06-615-000. February 2006, pp. 139-140.

[12] We use the May 2017 end date to be consistent with the time period covered by the CAISO November report. Over the period January 2015 through December 2017 the ratio is 57%.

[13] California ISO, Congestion Revenue Rights Auction Efficiency, Track 1 Draft Final Proposal, February 8, 2018, p. 8.

However, there are critical differences between the allocation stage and the auctions. Most importantly, LSEs are restricted to choose from a limited set of source-sink pairs in the current allocation process. Under current market rules, LSEs pay, for energy, a zonal price that is an aggregation of load-node LMPs, or DLAP or CLAP, in their regions. Therefore, most LSEs do not need to hedge LMPs at specific load nodes, and are restricted to selecting CRRs that sink instead at LAPs. As a consequence, each CRR that is selected by an LSE is assumed to impact flows to every load node in its respective LAP region, and therefore impacts a large number of transmission constraints. Therefore, in the allocation process, when only one of these constraints binds at 75% (or 82%) of modelled capacity, no further CRRs sinking at the LAPs are feasible, and hence eligible for allocation, even though the flows associated with allocated CRRs over other constraints on the network may be well below the 75% threshold.[14] This "lumpiness" in the CRR allocation phase is likely a non-trivial source of extra capacity being available in the auction process, where bidders can choose from more precisely targeted CRRs.

The other channel through which additional CRR capacity can be created in the auction is through a willingness by generators or financial participants to take on risk in the form of "counterflow" CRRs.[15] To the extent that generators or financial participants acquire counterflow CRRs that in turn facilitate the sale of additional hedging CRRs, this advances the purpose of the CRR market. No load serving entity is compelled to purchase a CRR supported by the purchase of counterflow CRRs by generators or financial participants. A load serving entity can choose to purchase a CRR supported by counterflow if the price of the CRR is financially attractive. In addition, to the extent that financial participants compete with load serving entities for hedging CRRs, they help converge auction prices and CRR payouts by raising auction prices, so particular load serving entities are not able to buy CRRs at a large discount to the auction price because of a lack of competition for those CRRs from other hedgers.

In addition to allowing financial participants to sell counterflow CRRs and thereby also enable the sale of additional hedging CRRs made feasible by the counterflow CRRs, CRR auctions serve three other roles. First, while the allocation process allows load serving entities to acquire CRRs sourcing at generators and sinking at their DLAP or CLAP, not all load serving entities either own generation or contract for the power of an individual generator. Some load serving entities may instead choose to buy power on a delivered basis, at their CLAP or DLAP, or may choose to buy power at a trading hub.[16] Settling forward contracts

[14] CRRs are restricted to sinking at DLAPS in tiers 1 and 2 of the allocation process but can be designated to sink at the more disaggregated CLAPs in tier 3.

[15] A counterflow CRR is a CRR that is expected to have a negative payout and would sell at a negative price in the CRR auction. In other words, holders would require a payment to take on the obligations associated with the counterflow CRR. The payment to hold such a CRR would be funded by auction participants who are willing to pay for the additional CRRs made feasible by the counterflow CRR.

[16] It can be seen in the 2018 allocation process that a number of smaller load serving entities were allocated CRRs from trading hubs to their load, suggesting that they were seeking to hedge purchases at these trading hubs. These load serving entities were not the large investor owned utilities but smaller load serving entities

at trading hubs is a common practice in most U.S. electricity markets because the common trading point provides more liquidity when the buyer or seller want to buy or sell some of the power covered by the contract.

In order for suppliers to be able to hedge contracts calling for the delivery of power at a CLAP, DLAP or trading hub, the supplier needs to be able to acquire a CRR from its supply source to the point of sale, a CLAP, DLAP or trading hub. The CRRs a supplier would need for this hedging need to be acquired in an auction or from third parties [17](because suppliers are not entitled to participate in the CAISO CRR allocation process), and will be unlikely to correspond to the CRRs allocated to any entity.

Second, the allocation process does not provide a mechanism for load serving entities to sell CRRs that they no longer need for hedging but could be reconfigured in the auction into a CRR that can hedge the congestion charges of another load serving entity or supplier selling to a load serving entity.[18] Third, the auction allows transmission customers that want to sell power out of California or wheel power through California to acquire CRRs that hedge the congestion charges on those transactions.

While more in-depth analysis of the allocation process is required for developing a comprehensive CRR policy in California, there are at least two qualitative implications of the allocation process for the current proposal. First, elimination of an auction would further exclude non-LSE participants from directly purchasing ISO-backed CRRs. It would *not* eliminate all, or even a majority of, CRR capacity, which would remain directly assigned to LSEs. But purchase of those CRRs would require a transaction in which an LSE puts the CRR up for sale. Second, certain types of ISO-backed CRRs simply could not exist if there were not an auction. For example, point-to-point CRRs sinking at trading hubs can only currently be assigned through the auction, given the limitations on the allocation process described above. Also, CRRs sourcing inside the CAISO and sinking at scheduling points for exports can also only be acquired in the CRR auction.

2.3 The DMM and SCE Proposals

Before turning in Section 3 to our discussion of issues associated with revamping the CAISO CRR auction process, we summarize an alternative approach favored by a number of stakeholders.

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such as the city and county of San Francisco, the City of Corona, the Port of Stockton, Sonoma Clean Power Authority and Golden State Water Company.

[17] This would require that a load serving entity have nominated a CRR from the generator's node to the LAP that was not needed to hedge supply contracts of that load serving entity.

[18] This cannot be carried out through bilateral trades unless the buyer wanted to hedge congestion between exactly the same source and sink as the seller, which is unlikely. Auction sales allow the buyer to hedge congestion between a different source and sink that create flows on some of the same binding constraints in the auction as the CRR being sold. However, if the auction is designed to have no spare capacity on any constraint as proposed by DMM and SCE, then like the bilateral situation, any sale of a CRR would have to matched by precisely the same amount of counterflow right in the opposite direction between the same two locations.

While not eliminating the CAISO CRR auctions completely, a proposal by DMM, as well as a related proposal by Southern California Edison,[19] would make significant changes to how the auction is defined and executed. As we understand these proposals, they would limit the transmission capacity available to support the award of CRRs to a level equal to the flows implied by CRRs assigned in the allocation process. In the annual process, at least one-constraint would likely bind at 75% (because that is the maximum available in the allocation process), but others, as described above, could emerge from the allocation well below this threshold. Unlike the current process, under the DMM/SCE design the transmission capacity available on constraints that did not bind in the allocation would no longer be available to support the sale of ISO-backed CRRs to transmission customers. The only way CRRs could be acquired in the auction would be if an LSE (or a third party willing to take on the risk) made available the exact counterflow necessary to enable the new CRR to be awarded without increasing the flows on any transmission element, binding or not, above the flows due to the CRRs awarded in the allocation phase.

Unlike the CAISO proposal described below, this proposal would substantially reduce the capacity of transmission made available to form ISO-backed CRRs, and we also believe would further restrict the types (in terms of source-sink pairs) of ISO-backed CRRs that could be awarded. To the extent that risk-seeking third parties are willing to provide speculative counter-flow, such instruments could be available, but likely at a higher cost than if the CAISO used its available transmission capacity (ATC) to support the award of CRRs. Although the transmission system would have ATC available to support the award of CRRs to suppliers seeking to sell to LSEs at trading hubs, this design would not allow the CAISO to make any CRRs available for sale utilizing this ATC.[20] Nor would it make ATC available to support the sale of CRRs that support exports or wheel-through transactions. Furthermore, no ATC would be made available by the CAISO to support the purchase and sale by load serving entities of ISO-backed CRRs for which the CRR purchased and the CRR sold have differing flows on any transmission element.

The DMM/SCE design would very likely be effective in preventing financial market participants from acquiring CRRs at a discount to the expected payout. However, it would also prevent physical market participants from acquiring CRRs at a discount *or* a premium to the expect payout. In other words, while the proposal would effectively eliminate the purchase of speculative CRRs in the auction, it does so at a cost of sharply reducing access to

[19] 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.

[20] The proposal would allow market-participants such as generators to offer counterflow CRRs at prices that would incorporate the risk associated with offering such CRRs, but the proposal would not allow additional ATC to support the award of additional CRRs. The proposal could therefore be interpreted as withdrawing ATC that supports CAISO-backed CRRs and replacing those CRRs with speculative counterflow CRRs offered at higher prices.

ISO-backed hedging CRRs, and of locking in the rigidities of the current allocation process discussed above.

This design is supported by a number of load serving entities but the supporters do not appear to include most of the smaller load serving entities that acquired CRRs sourcing at trading hubs and sinking at LAPs in the allocation process, such as the city and county of San Francisco, Golden State Water Company, Port of Stockton, Western Power Authority, or City of Corona. It is also strongly opposed by load serving entities serving direct access customers, and some smaller LSEs such as the LSE-CRR Auction Supporters Group. Load serving entities that depend on meeting their load in part by purchasing power at trading hubs, in turn depend on the suppliers they contract with for power being able to sell them power at the trading hubs. However, under the SCE/DMM design there would be no mechanism for suppliers to acquire CRRs sinking at trading hubs and supported by the available ATC of the transmission system to hedge congestion charges on their trading hub sales.

The SCE/DMM design would allocate the available ATC at a zero price to the load serving entities using their owned and contracted generation to meet their load, but the design would prevent the CAISO from making ATC available to support the award of CRRs, at any price, to suppliers selling to LSEs at trading hubs. While the SCE/DMM proposal would allow the resale of CRR source-sink pairs held by an LSE to other market participants, source-sink pairs that a load serving entity did not acquire would not be available for purchase. Moreover, if the vast bulk of the CRRs were allocated to the large load serving entities at each LAP, they would have no obligation to make those CRRs available for sale to any other LSE, or supplier. The DMM has remarked upon the incentive problems and regulatory constraints that limit regulated LSE participation in the auction, yet this proposal relies upon such participation as the only channel through which CAISO-backed rights could be reconfigured, or redistributed to non-LSEs.[21] Further, if the current rules limiting the allocation of CRRs to load serving entities to those sinking at LAPs, there does not appear to be any way that CRRs could be acquired to hedge export or wheel through transactions.

If one accepts the premise articulated by FERC that ISO-backed CRRs are a form of firm-transmission service, then under the DMM/SCE proposal there would be no such firm transmission service offered by the CAISO to support power sales at trading hubs when ATC permitted it. The only way to sell power at trading hubs would be the use of "non-firm transmission" that includes the volatile costs of congestion.

While the DMM/SCE proposal might appear to benefit large California load serving entities by reducing the auction revenue shortfalls, it can also be construed as restricting forward access to the CAISO transmission grid. This can have unpredictable negative consequences to wholesale markets. If an analogous policy were to be permitted by FERC allowing the denial of forward access to the transmission system outside California to California LSEs and those selling to those LSEs, it would be likely to adversely impact California power consumers.

[21] *Problems in the performance and design of the congestion revenue right auction*, CAISO DMM, p. 24.

3. Identified Issues with CRRs and the CRR Auction

In this section we discuss the issues that have been identified with the CRR process, and also areas in which further analysis would be helpful in gaining a better understanding of the underlying causes of these outcomes. The primary issue of concern in this proceeding is what is called the "auction revenue deficiency." As discussed above, this is distinct from, but related to revenue inadequacy. As stated above, the CAISO and the DMM have shown in a number of reports that the average payout to CRRs acquired in CAISO auctions has materially exceeded the auction revenues from the sale of these CRRs.[22] This outcome can a be result of the unpredictability of congestion patterns in any particular month, and it is precisely this variability that is the reason load serving entities and suppliers enter into forward power contracts need CRRs to hedge congestion risk. However, the CAISO and DMM analyses have shown that the payments to CRRs have exceeded the auction revenues on average over a large number of auctions, so the relationship between auction revenues and payouts in these analyses reflects more than just the variability of congestion patterns.[23] The CAISO data shows that the total payments to auctioned CRRs over the period January 2015 to May 2017 was $365.3 million, compared to auction revenues of only $220.1 million, indicating that the CRRs overall sold for only 60.3% of the expected payout (around 54% for the monthly CRRs and 69% for the seasonal CRRs).

As discussed above, the core purpose of financial transmission rights (CRRs, FTRs and TCCs) is to support forward contracting by load serving entities and other market participants by facilitating the parties' ability to hedge potential future congestion charges. We agree with the view that the purpose of a CRR auction is to support this core purpose of facilitating hedging of congestion costs and thereby promote open access to the transmission grid. The goal is *not* to facilitate the selling of financial (or physical) transmission rights that have little or no value as hedges at a large discount to their expected value.

This holds several implications for the interpretation of CRR market results. While some of the CRRs in the auction may be acquired in order to hedge congestion risk and might be valued at a premium to the expected payout, this is not the case overall. Instead, the overall pattern is one of CRRs being valued by buyers as risky financial instruments and purchased at a discount to the expected payout that materially exceeds the time value of money.[24] While the instance of any specific CRR selling for less than its subsequent congestion revenue value is not sufficient evidence that it was sold for less than its expected value (which

[22] See for example, California ISO, CRR Auction Analysis Report, November 21, 2017 pp. 49-56, California ISO Department of Market Monitoring, 2016 Annual Report on Market Issues and Performance, pp. 200-204.

[23] Neither the DMM nor CAISO comparisons of auction revenues and CRR payouts for annual CRRs account for the time value of money difference in the timing of payments for and to annual CRRs.

[24] Because annual/seasonal CRRs are paid for as much as a year before any payout would be received, there is a time value of money benefit from receiving these advance payments. The rates of return for transmission owners are in the range of 10% or less, however, which are too low to account for more than a small portion of the difference between auction revenues and CRR payouts.

can't be observed), the persistent pattern of overall auction revenues falling below overall congestion payouts is evidence that this effect is dominating the aggregate auction outcomes.

One question in understanding auction outcomes is the extent to which there are structural factors contributing to a relatively low demand for CRRs as hedging instruments in CAISO CRR auctions, thereby yielding low auction prices. This could in part be because the focus has to date been on the auction, and the most valuable hedging CRRs are likely acquired in the allocation process. The value and payout of these allocated CRRs is not included in these comparisons. In addition, because the portion of load served by regulated utilities is much higher in California than in regions like NYISO, PJM or ISO New England, there might be less demand for congestion hedges because of elements of CPUC regulation that discourage regulated utilities from acquiring CRRs in auctions [25] or because CPUC regulations do not incent regulated utilities to hedge congestion risk.[26] Since no statistics have been compiled on the valuation of CRRs acquired in the allocation process, we cannot assess whether CRRs in general are not valued as hedges or whether it is particularly the CRRs purchased in CAISO auctions that are not valued at the margin as hedges but as risky financial instruments.[27]

While one possibility is that CRRs are typically sold at a discount to the expected payout because there is a general lack of demand for congestion hedges in CAISO auctions, another possibility is that the low valuation of CRRs is specific to the CRRs sold in the auction and reflects the payout to CRRs that have little value as hedges. CRRs have been structured in California to provide load serving entities a perfect hedge for congestion charges between the CRR source and the CLAP or DLAP at which the load serving entity buys power, without regard to the impact of transmission outages, loopflows or changes in load distribution factors for the CLAPs and DLAPs on the extent to which the transmission grid is able to support the payments to the CRR holder. Because of this CRR design, load serving entities and suppliers selling to load serving entities have no hedging incentive to acquire generator-to-generator CRRs that would have a payout in any of the following circumstances:

(1) when particular outages occur, and the outage causes constraints to bind that were not binding in the CRR auction model or causes the CRR to have an increased shift factor in the day-ahead market over constraints that did bind in the CRR auction,
(2) when there are loopflows modeled in the day-ahead market that change the available transmission, or

[25] This could be the case, for example, if the regulated utility's shareholders were at risk for losses on CRR purchases while profits would be passed through to rate payers.

[26] This might be the situation if, e.g., the regulated utility was able to pass through any congestion charges in its rates, so that rate payers had to bear the congestion risks.

[27] Because all CRRs are priced in auctions, allocated CRRs could be valued at both seasonal and monthly auction prices and this valuation compared to the payout, but neither comparison has been carried out by the CAISO or DMM.

(3) when the distribution of load in the day-ahead market causes different constraints to bind in the day-ahead market than in the allocation or auction.

If CRRs that have little value to load serving entities or their suppliers as congestion hedges are offered in the auction, one would expect they would be valued as risky financial instruments and sold at a discount to the expected payout. It is important to understand that this outcome is not necessarily a result of a lack of competition among the purely financial auction participants. No matter how intense competition is among the financial auction participants, they will not value CRRs at a premium to the expected payout; pure financial players will only be willing to buy positively valued CRRs at a discount to the expected payout. A lack of competition would increase the discount to the expected payout but more competition from financial market participants will not eliminate the discount. Competition between financial market participants and hedgers (because of shared transmission constraints) might result in a higher valuation of CRRs that are valued as hedges, but only by a few load-serving entities or suppliers. However, competition from financial participants cannot eliminate the discount for CRRs that are valued only as financial instruments.

Moreover, the more complex it is to analyze and value CRRs, the more costs financial players must incur to participate, and the larger the difference between the auction price and day-ahead market payout must be in equilibrium to enable those participants to recover their costs. The same is also true for load-serving entities that might value these CRRs as imperfect hedges. The more complex it is to value these CRRs as improving their congestion hedges, the lower the premium will be that the load serving entity would be willing to pay (or the larger the discount it would need to receive) for the CRRs relative to the expected payout.

Finally, to the extent that transmission outages cause differences between the transmission model used in the auction process and that used to determine CRR values in the day-ahead market, there is a potential for auction participants to acquire CRRs that create little if any flows on constraints modeled in the auction, and hence are valued near zero, but create large flows on transmission elements that will bind on the day-ahead market when particular outages occur.[28] Because in the CAISO CRR design the transmission grid model used in the auction differs from the grid model that will determine CRR values in the day-ahead market, the hedging CRRs acquired by load serving entities and suppliers in the allocation and auction may not create very large flows on such constraints in the auction model, and the constraints may not even be enforced in the auction model. If this is the case, these constraints will not bind in the auction so that the price of CRR flows on these constraints in the auction will be zero.

[28] The price of a CRR in the CRR auction is determined by the flow the CRR creates on the constraints that bind in the auction solution, times the shadow price of each auction constraint. If a CRR creates no flows on any constraint that binds in the auction, it would have a zero price. If a CRR can be acquired between any pair of nodes in the transmission model, it might be possible to identify and select CRRs that turn out to create minimal flows on binding constraints and hence sell at a low price.

This outcome was seen for a variety of constraints in the CAISO analyses of the CRR auction outcomes, particularly during the typical maintenance months of October through December.[29] In a number of cases, more than a million dollars of CRR payments were made to CRRs sold in the annual and monthly auctions for constraints that were not modeled in the auctions and hence the constraint could not bind in auction and was valued at zero in determining CRR prices. Indeed, in a number of months more than all of the auction revenue shortfall appears to be accounted for by the payout to CRRs creating flows on constraints that did not bind in the annual and monthly CRR auctions. Sometimes this amount of payout arose from a single constraint that did not bind in the CRR auctions because it was not modeled. [30]

The CRRs sold in the auction that created these flows may have also created flows on other constraints that did bind in the auction so that the CRRs were likely not sold at a zero price. They were, however, potentially sold at a very large discount to the day-ahead market payout.[31] The potential for this kind of outcome in which CRRs that create flows on constraints that bind in the day-ahead market but do not, or cannot, bind on that constraint in the CRR auction (and hence do nothing to improve auction valuation) is increased by rules and policies that require the California ISO to disclose the details of the auction model a number of days prior to the auction, and do not allow the California ISO to change the model to reflect additional outages. This auction structure allows market participants who are not seeking hedges to identify CRRs that will create flows on transmission elements that will bind when outages occur, but create little if any flows on transmission constraints enforced in the auction model. These CRR bids do nothing to improve CRR auction values, they are in fact structured precisely to avoid having that impact.

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[29] California ISO, CRR Auction Analysis Report, November 21, 2017, Tables 13-23.

[30] For example, see the discussion of December 2016 in Section 4.2 below. Similarly, in January 2017 the net payment to auction CRRs in excess of auction revenues was $4.5 million. The CRR payments to a single constraint that was not enforced in the auction 23040 Cross Trip accounted for $5.7 million of payments to auctioned CRRs, and another constraint, OMS4622069 TL50003 accounted for another $1.2 million. In February 2017, the net payout to auctioned CRRs in excess of auction revenues was $4.1 million The constraint 7820 TL23040 IV SPS NG that was not enforced only accounted for $1.6 million of this shortfall but there were a number of constraints that were not enforced that contributed to the overall shortfall. The overall shortfall was $3.6 million for March 2017, with a single constraint that was not enforced, 7820 TL23040 SPS NG, accounting for $3.4 million of this and one other unenforced constraint 31486 Caribou 115 30255 Carbou M 1 XF 11 accounting for another $.8 million. In April 2017 the CRR payout exceeded auction revenues by $7.7 million, and a single constraint that was not enforced, 6410 CPS NG, accounted for a net payout of more than $6.7 million. One other constraint that was not enforced, OMS3831815 TMS DLO accounted for roughly another $.7 million. The CAISO analysis in Section 7 of the November report also shows large payouts on other constraints that were enforced, but did not bind in the auction. This outcome can arise simply because congestion patterns are different from expected but it can also arise because Generator-to-generator CRRs are acquired in the auction that create small flows on the constraint on the auction grid but create large flows and payouts on these constraints on the day-ahead market transmission grid because of outages that were not modeled in the auction.

[31] It would be possible to identify which FTRs created flows on these constraints in the auction and compare the FTR prices to the payouts but this would require rerunning the auction for force these constraints to bind so that shift factors would be calculated.

4. The CAISO Proposal

The changes proposed by the CAISO would be applied to the next auction of annual CRRs where, barring changes, 75% of the system capacity is made available through a sequential process of allocation and auctioning. The CAISO also plans to implement changes to the auctions for monthly 2019 CRRs. As mentioned above, the annual auction has been responsible for $48 million in net auction revenue shortfalls over the period January 2015 through May 2017.[32] These changes are therefore targeted at the annual auction both because of its prominence in auction revenue shortfalls and because the auction will be the first in the next cycle of CRR auction distributions. The CAISO will consider further comprehensive design changes, including those that might impact monthly auctions, in its Track 2 process during the rest of 2018.[33]

There are two components of the changes proposed for Track 1. These include changing the timeline for transmission outage reporting and changes to the allowable source and sink pairs that can be sold in the auction. We discuss each of these components below.

4.1 Timeline for Transmission Outage Reporting

One source of both revenue insufficiency (CRR payments in excess of congestion rents collected) and net auction payment deficiencies (CRR auction prices below the subsequent revenue stream associated with them) has been the mismatch between constraints that are represented in the network model used by the auction and those that are actually incorporated in the network model used to clear the day-ahead market whose prices are used to settle CRRs. This is a fundamental consideration when defining the true capacity of the network. When constraints are not included in the auction model, they cannot bind and therefore cannot impact the availability and prices of CRRs. If those constraints do bind in the daily market, then there is a potential that more transmission capacity has been sold in the form of CRRs, than actually exists. Moreover, if auction participants know that a particular constraint that will bind during an outage is not enforced in the auction model, they can structure their CRR bids to create flows on the transmission element that is not modeled but have little or no impact on modeled constraints. Alternatively, if they know that a particular unmodeled outage would increase the shift factors of particular CRRs on constraints that would bind in the day-ahead market, they can structure their bids to acquire CRRs that have no value as hedges on the auction grid but would be entitled to large payouts during the outage. Either bidding strategy can contribute to both revenue insufficiency and low auction prices relative to payouts for CRRs sold in the auction.

There are several potential options for mitigating these problems, some of which may be

[32] California ISO, CRR Auction Analysis Report, November 21, 2017, p. 52.

[33] CAISO, CRR Auction Efficiency Track 1 Draft Final Proposal, p. 4.

considered during Track 2. For Track 1 the CAISO has highlighted a basic problem with constraint modeling in its annual auction; the fact that auction is held before transmission owners are currently required to notify the CAISO of planned outages for the following year. Currently, the CAISO deadline for submitting comprehensive annual maintenance plans is October 15 of the previous year,[34] whereas its annual CRR process is run in August of the previous year. In order to best capture the known future availability of transmission facilities in time for the annual auction, the CAISO is therefore proposing an additional deadline for outage reporting relevant to the CRR auction of July 1.

Discussion

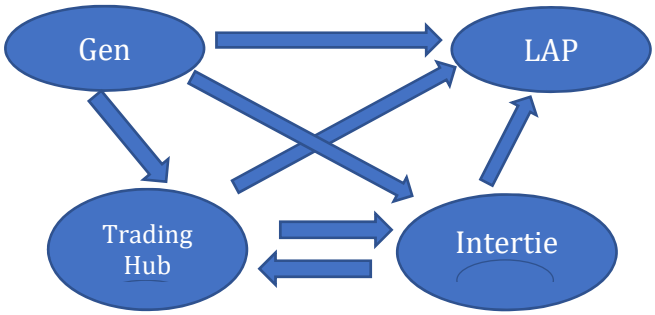
There is an inherent trade-off between earlier reporting deadlines and the quality of information that can be collected in time to meet those deadlines. The main downside of the proposal is that the state of information as of July the year prior to the operating year will be of much lower quality than would be the case closer to the operating month. With respect to the annual auction, even partial or imperfect information about future maintenance plans is likely better than no information at all. However, there are limits to the transmission owners' ability to provide accurate information this far in advance of the outage, as the need for some outages may not be known that far in advance. While earlier notification of known outages strikes us as a common-sense step with regards to the annual auction, the need for some outages would not be known at that point in time and will have to be scheduled closer to the operating month. Hence, a secondary October reporting date will be retained, and the CAISO auction modeling will need to allow for the possibility that other outages will need to be scheduled closer to the operating month.

There is also the question of enforcement. The CAISO has reported that for the monthly process only 43% percent of planned outages were reported by their required reporting date and the CAISO did not have time to evaluate all of these outages for adjustments to the monthly auction model. While this is clearly problematic, significant penalties for missing deadlines could lead to speculative or overly conservative estimates. This would in turn raise the question of enforcing the quality of reported information. It is therefore not clear if the gains of more heavy-handed enforcement of reporting would be substantial.

4.2 Restrictions on Allowable Source and Sink Pairs

The most significant change to the CRR paradigm proposed by the CAISO is to introduce limitations on the types of nodes eligible to be either a source or sink for CRRs sold in the CRR auction. Figure 1 provides an illustration of the source-sink combinations that are proposed to be allowed in this proposal. In contrast, the CAISO currently allows auction participants to bid from any biddable pricing point to any other biddable pricing point.

[34] CAISO *op. cit.,* p. 24.



The proposal would eliminate "non-delivery pair" bids, a term that refers to source-sink pairs that are not related to supply transactions. Among the types of CRR bids that would not be allowed would be "gen-to-gen" CRRs, which both source and sink at supply nodes.[35] This latter category accounts for the largest single source of CRR capacity awarded during the auction phase. The CAISO reports that gen-to-gen transactions "have resulted in an overall $186 million congestion revenue right auction net payment deficiency since 2014."

The CAISO argues that many CRRs between non-delivery pairs would have limited value in hedging resource-to-load transactions. This is because, such CRRs could not, on their own, match or offset the congestion risk associated any physical transaction. The only way that non-delivery CRRs could contribute to hedging is when they are combined with other instruments, either ISO-backed CRRs or purely financial, to form additional hedging products. We discuss the potential hedging uses of these CRRs sourcing and sinking at these other locations below.

Discussion

This is the most substantive and controversial element of the CAISO's proposed changes. The logic behind this restriction is strong: non-delivery pair CRRs account for the vast majority of the auction revenue shortfall.[36] Moreover, allowing sales of CRRs sourcing and sinking at these non-delivery locations likely contributes substantially to the ability of financial market participants to buy CRRs that create flows on transmission elements that bind during outages but are not modeled as constraints in the auction. Further, this allowance can also enable purchases of CRRs that had small shift factors on binding constraints in the auction model, yet had large shift factors on binding constraints in the day-ahead market during transmission outages. It is therefore anticipated that eliminating the auctioning of such CRRs would substantially reduce the auction revenue deficiency.[37] Ideally,

[35] CAISO, CRR Auction Efficiency Track 1 Draft Final Proposal, p. 32.

[35] *Ibid*.

[36] Recent CAISO calculations provided to us indicate that $280 million, or 82%, of the overall auction revenue shortfall since 2014 can be attributed to non-delivery pairs. As noted above, generator-to-generator CRRs alone account for $186 million. See California ISO, Congestion revenue rights auction efficiency, Feb 13, 2018 pp. 8, 10.

[37] These changes are also likely to improve auction revenue adequacy.

such a change would focus bidding on a smaller sub-set of CRRs that will create flows on constraints modeled in the auction and therefore increase competition and, in all likelihood, auction revenues for the remaining eligible pairs.

Total auction *revenue* would very likely decline with the enforcement of these source-sink restrictions in the auction, but it is anticipated that the decline in auction revenues will be smaller than the decrease in CRR payouts. It is anticipated that many fewer CRRs will likely be sold in annual and monthly auctions as a result of this change. The intention of the proposal is for the reduction in the sale of CRRs to then lead to a large reduction in the overall congestion payments to CRRs sold in the auction, thereby bringing the auction revenues more in line with the CRR payout. The degree to which the overall CRR payout will be reduced is uncertain, but there is evidence lending support to the expectation that the reduction in CRR payouts will exceed the reduction in auction revenues. The fundamental drivers of demand for hedging CRRs are different than those for speculative ones. It is reasonable to expect that hedgers would be willing to pay a premium (over expected revenues) for hedging CRRs, while speculators would require a discount over expected value to accept the risk associated with a speculative CRR. In other ISOs, specific CRRs associated with hedging (e.g. delivery) pairs connecting major source and sink hubs have consistently cleared at prices above their subsequent payout.[38]

While the elimination of CRRs sourcing and sinking at Gen nodes could in the abstract materially increase, rather than decrease, differences between auction clearing prices and day-ahead market congestion payouts on the CRRs sold in the auction, the CAISO's analysis has shown that a very large portion of the net payout is to constraints that did not bind in the auction and often were not even enforced. The Gen to Gen CRR bids therefore did nothing to converge auction prices with market payouts with regards to those constraints. For example, Table 23 for December 2016 shows that there were net payouts to monthly and annual CRRs of over $8 million due to the constraint OMS4379177 IVALLEY BNK81 NG2 which was not enforced in the auction. This one constraint accounts for more than all of the difference between auction revenues and CRR payouts in December 2016, which was $5.7 million.[39]

At the same time, selling less CRRs, while reducing revenue shortfalls, might also reduce the various market benefits provided by CRRs that have been discussed above. Several stakeholders have noted the ways that non-delivery pair CRRs can be combined with each-other or delivery-pair CRRs to create new hedges. Such flexibility will be reduced. However, CAISO analysis indicates the perception that the auction itself produces substantial counterflow that directly unlocks ISO-back hedging (delivery-pair) CRRs is not accurate.

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[38] CRRs (or equivalent instruments) associated with the New York ISO Zone G to Zone J, and the PJM western hub to PECO sink have sold in auctions at prices on average higher than payouts over 10 to 15 year periods (S. Harvey, February 2018. "CRR Prices and Pay Outs: Are CRR Auctions Valuing CRRs as Hedges or as Risky Financial Instruments").

[39] California ISO, CRR Auction Analysis Report, November 21, 2017, pp. 135 and 145. See also the note above discussing similar patterns in the CAISO analysis of payouts to non-binding and not enforced constraints in other months.

According to the CAISO's calculations, eliminating generator-to-generator CRRs, the dominant form of non-delivery pair CRRs, allowed for an *increase* in the sale of non-generator-to-generator pair CRRs in a resimulation of the 3rd quarter of 2018. This provides support for the argument that non-delivery point CRRs are not providing direct hedging value through the auction.

While there is reason to expect that the direct impacts of this change will produce the desired effect of reducing auction revenue shortfalls while preserving, or even expanding, the availability of hedging CRRs in the auction, it is much more difficult to predict the indirect impacts of this change. A number of concerns have been expressed with the limitations on source-sink pairs proposed by the CAISO. Some of these concerns appear to be valid, some would require further discussion to understand, while some others appear inconsistent with the data compiled by the CAISO in its detailed analysis of auction outcomes.

First, several market participants have pointed out that the purchase of Generator-to-generator CRRs can be used to effectively change the source of a Generator to LAP or generator to trading hub CRR held by a market participant.[40] Thus, a CRR from node A to the Trading Hub plus a CRR from node B to node A is financially exactly equivalent to a node B to Trading Hub CRR. The purchase of generator-to-generator CRRs is therefore potentially useful to physical market participants in adapting their congestion hedges to changes in generation contracts or outages over the year. However, the number of generator-to-generator hedges being purchased during the year exceeds their possible use for this purpose of adjusting congestion hedges by an order of magnitude. Instead, these generator-to-generator CRRs account for a large portion of the payout in excess of CRR auction values. The CAISO would likely be able to accommodate the sale of smaller amounts of generator-to-generator CRRs in the long run by implementing some restrictions on allowed purchases,[41] but these changes would need to be implemented in future auctions after the short-run changes have been implemented and the current substantial imbalance between auction revenues and CRR payments corrected.

Second, there has been an opinion expressed that generator-to-generator CRRs can be used to reduce exposure to particular nodes in the current trading hub.[42] It is not clear why this is desirable from a hedging perspective for transactions at the trading hub. If there is a need for the development of new trading hubs with somewhat different definitions than the current hubs, that is a discussion the CAISO could have with stakeholders perhaps

[40] See, for example, DC Energy, Comments on Draft Final Proposal, February 28, 2018; Financial Marketers Coalition, Comments on Draft Final Proposal, February 28, 2018; and Appian Way Energy Partners Comments, February 28, 2018.

[41] The CAISO could implement bid validation that would only allow a CRR holder to submit a generator-to-generator CRR bid for a CRR sinking at the source of a generator to a LAP, a generator to a tie or a generator to trading hub CRR held by the market participant submitting the bid. Such a design would allow the purchase of generator-to-generator CRRs to restructure existing CRRs without allowing the use of generator-to-generator CRRs to create flows on constraints not modeled in the auction.

[42] See Comments of Calpine Energy Solutions LLC, February 28, 2018.

followed by implementation additional trading hubs in future auctions. However, that would be a discussion best held after the changes proposed by the CAISO have been implemented.

Third, it has been observed that generator-to-generator CRRs could be used to create so-called "dirty" hedges, i.e. a set of CRRs that do not perfectly hedge congestion between a resource and a LAP or trading hub but provide a partial hedge, if incremental generator to LAP CRRs cannot be awarded.[43] This is possible, but the patterns of CRR flows on unenforced and non-binding constraints portrayed in the CAISO report suggests that the primary focus of these generator-to-generator CRRs is not hedging, and there is no evidence that these CRRs have material value as hedges given that they are sold at a large discount to the expected payout. Once the changes proposed by the CAISO have been implemented and the current substantial imbalance between auction revenues and CRR payments corrected, consideration could be given to whether there is a need to make additional changes that might enable increased hedging.

A fourth concern with the CAISO proposal is that it would prevent market participants from bidding to provide counterflow CRRs, for example from a trading hub to a generator or from a LAP to a generator.[44] This will be the case, but it is a necessary part of the CAISO's design. If the CAISO were to allow the purchase of such counterflow CRRs, market participants could construct generator-to-generator CRRs by purchasing a CRR from a generator to a trading hub and then buying a counterflow CRR from the trading hub to another generator. If both bids cleared, the two CRRs would be completely equivalent to holding a generator-to-generator CRR. While the need to submit separate for the two CRRs would complicate bidding,[45] allowing these bids would give rise to the kind of concerns DMM expressed about bidding strategies that would circumvent the intended restrictions. [46] Since the fundamental characteristic of generator-to-generator CRRs is that the auction price is much less than the CRR payout, there is not much incentive for market participants to buy counterflow CRRs and taken on a position for which they would be paid less than they would pay out. The CAISO's resimulation of a season of CRR auctions found that there were 3800 megawatts of counterflow CRRs but the overall impact of non-delivery CRRs was to reduce the number of CRRs that cleared between the primary locations for supply hedges.[47]

After the CAISO implements these Track 2 reforms and observes the degree of improved convergence between CRR auction prices and day-ahead market payouts, it will be able to

[43] See NRG Energy Inc, Comments on Draft Final Proposal, February 28, 2018.

[44] See, for example, Appian Way Energy Partners Comments, February 28, 2018.

[45] If the bidder submitted two separate price capped bids, one might clear while the other bid not, leaving the bidder with a position it did not intend to take, while if the bidder submitted price taking bids it could end up paying more than it intended for the CRR if the CAISO enforced a constraint that the bidder did not expect.

[46] See CAISO Department of Market Monitoring, Comments on the Congestion Revenue Rights Auction Efficiency Track 1 Draft Final Proposal, February 28, 2018.

[47] "Congestion Revenue Rights Auction Efficiency, Track 1 Draft Final Proposal," February 8, 2018, p. 35.

consider refinements in bidding rules that could be implemented on a longer time frame that could allow the submission of some counterflow CRR bid without unraveling the effects of the source-sink restrictions.

Other commenters have pointed to the source-sink restrictions proposed by the CAISO will make it more difficult or costly to hedge unspecified congestion exposures.[48] It is anticipated that the source-sink restrictions proposed by the CAISO will make it more difficult for CRR purchasers to hedge congestion on particular transmission elements (such as those that are not modeled in the auction). However, that inability does not prevent market participants from bidding for CRRs that hedge the congestion risks that either physical market participants or those selling them financial hedges would incur.

Commenters have also suggested that generator-to-generator CRRs helps CRR auction prices reflect constraint costs but the CAISO data in Section 7 shows that much of the CRR payout is to constraints that are not enforced in auction, so generator-to-generator bids cannot cause them to bind and impact prices, but they do increase the CRR payout. In addition, the CAISO analysis in Section 7 of the November CRR Auction Analysis Report shows that many of the other constraints that accounted for large payouts did not bind in the auction, so the ability of auction participants to submit generator-to-generator CRR bids did not cause the expected payout to these constraints to be reflected in constraint prices.

A number of commenters suggest that instead of imposing the source-sink restrictions proposed by the CAISO, the CAISO should limit the auction changes to eliminating the sale of CRRs between essentially identical locations.[49] While such changes should be made, the CAISO's analysis has shown that their impact on the difference between auction revenues and CRRs payouts would have been relatively limited.[50]

To summarize, CAISO analysis indicates that the majority of the auction revenue shortfalls are presently attributable to the types of CRRs that would be eliminated under this proposal. Several stakeholders have raised concerns that this reduction in the allowed sources and sinks for CRRs could lead to unintended consequences through changes to bidding behavior and to financial transactions outside of CAISO markets. There may be some secondary impacts from these changes, but the CAISO analysis shows that whatever the benefits that may be foregone because of these unintended consequences, there is a very large intended consequence of taking a first step towards reducing and eventually eliminating the discrepancy between auction revenues and CRR payouts. Moreover, we note that this change is a less dramatic change to the landscape of auctioned CRRs than the solutions supported by DMM and the investor-owned utilities.

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[48] See, for example, Comments of Boston Energy Trading and Marketing, February 28, 2016.

[49] See for example, Appian Way Energy Partners Comments, February 28, 2018, NRG Energy Inc, Comments on Draft Final Proposal February 28, 2018; DC Energy, Comments on Draft Final Proposal February 28, 2018; Comments of Financial Marketers Coalition, February 28, 2018.

[50] We understand from the CAISO that while these CRRs accounted for around 12% of the auction revenue shortfall in 2015, they accounted for less than 5% in 2016 and less than 0.5% in 2017.

Conversely, the magnitude of the reduction in the difference between auction revenues and CRR payouts and the increase in congestion rents flowing to transmission rate payers that will be achieved by the CAISO design is also uncertain as it depends in part on how CRR auction participants change their behavior in future auctions. Therefore, while the full effects of this change cannot be understood with *ex ante* simulation alone, we support this measure as targeting the CRRs that are the least likely to provide market benefits and the most likely to induce auction revenue shortfalls. As with all of the measures currently proposed by CAISO, we support an in-depth evaluation of their impacts and pursuit of further, or even reversal of these, changes as warranted by the analysis. The impact of the DMM/SCE proposal and the congestion rents flowing to transmission rate payers is also uncertain because this depends not only on auction revenues and CRR payouts but also on the congestion rents collected in the day-ahead market. Changes which hinder the ability of external suppliers to hedge forward sales at CAISO trading hubs will likely impact forward sales patterns as well as CRR purchases and by reducing imports could both reduce congestion rent collections and raise day-ahead market prices.

5. Conclusions

At this stage, there are three broad policy directions that the CAISO could take:

1) Continue the status quo with only minor modifications to the auction,
2) Eliminate the auction in its current form, leaving it as only a trading platform for "voluntary" transactions (as in the DMM / SCE) proposal, or
3) Make substantial revisions to the auction structure that try to maintain its hedging benefits while significantly reducing losses to transmission ratepayers. These revisions could either be intended to be permanent, or could instead be provisional, intended to reduce losses while the CAISO further analyzes possible changes and develops a more finely tuned proposal that may include further restrictions on auction sales in some respects, but allow more auction participation in other respects.

The CAISO proposal falls in the third category. The changes to the auction are far more than minor adjustments. However, they preserve the ability of non-LSEs to directly access the ISO-backed CRR market in order to hedge sales to load serving entities at LAPs or trading hubs by purchasing CRRs sourcing at generators or the ties and sinking at LAPs and trading hubs. They also maintain some of the other flexibility attributes provided by the current auction process, such as exporting, wheeling, and even non-contracted merchant generation. The changes can also be viewed as provisional, and could be supplanted or supplemented by changes as part of Track 2 of the CRR auction reforms or subsequent proposals. We support this proposal for the detailed reasons provided above, which are summarized below.

At this time, we do not support the DMM / SCE proposal for the reasons provided in Section 2.3. In particular, it would be counter to the open access principles that motivated the creation of congestion revenue rights as a hedge in the first place; replacement hedges would

likely be available only at a much higher prices for market participants who do not participate in the free allocation stage of CRR allocation; and caution should be the rule when considering market changes that would profoundly affect the availability and cost of transmission hedging services. If the Track 1 and 2 changes prove to be ineffectual in reducing CRR auction losses, then the DMM / SCE proposal is one alternative that could be considered.

The auction, as it is currently implemented, has produced a revenue shortfall that has ranged from 50 – 75 $million over the last three years. Total congestion revenues during this period have been several times as large. At the same time, CRRs are viewed by many, including ourselves, as providing benefits to the operation and efficiency of wholesale markets. While it is extremely difficult to quantify the exact contribution that auctioned CRRs provide to the market, it does not have to be substantial to make a difference. The total wholesale cost of serving load, as calculated by DMM, ranged from 7.5 to 12.1 $billion annually between 2014 and 2016. The CAISO's CRR auctions need to contribute less than one percent to wholesale market efficiency to offset the entire auction revenue shortfall, thereby actually producing a net benefit to ratepayers, and would be able to provide a larger net benefit when the auction revenue shortfall is reduced by the CAISO Tracks 1 and 2 proposals.

While it is extremely difficult to quantify the impacts of the changes proposed by the CAISO in Track 1, we note that qualitatively, they are consistent with the goal of preserving access to congestion hedging instruments for all load serving entities, including the smaller load serving entities that appear to be more likely to purchase power at trading hubs, while minimizing ratepayer losses. Most plausible hedging transactions require rights consistent with the physical flow of power or with financial supply deliverability at trading hubs, and those instruments will be preserved under the proposal. While it is possible that other types of CRRs play some role in supporting hedging, as well as speculation, we know of no reliable way to quantify the contributions these types of CRRs make to the hedging function. The CAISO auction analysis does show us, however, that these rights have been responsible for the largest net revenue shortfalls over the last several years. By contrast, an earlier proposal to reduce overall capacity available in the annual auction targets all types of CRRs, and strikes us as more likely to have limited the availability of hedging as well as speculative instruments in timeframes relevant to some forward contracts. Furthermore, limiting the combinations of CRRs should theoretically concentrate the flows over fewer constraints so they could increase prices relative to payouts.

While the proposal is qualitatively a step in the right direction, the exact quantitative impacts are uncertain. It is unclear to us how effective the source-sink restrictions will be in limiting the sale of CRRs that have little value as hedges and are sold in the auction at low prices relative to the expected payout. By how much the source-sink restrictions will improve the balance between auction prices and CRR payouts is uncertain. Nevertheless, these changes are, we believe, likely to reduce the auction revenue shortfall without substantially harming market efficiency, and the CAISO can undertake additional analysis to guide additional changes over the coming weeks. While the annual auctions for 2019 will begin this summer, the largest differences between auction revenues and CRR payouts are

in the monthly auctions and additional design changes could be implemented in those auctions prior to the annual auctions for 2020.

Even if the CAISO Track 1 proposal is effective in reducing purchases of CRRs at large discounts to the expected payout by financial market participants, it still may not eliminate all or even most of the difference between auction prices and CRR payouts. The market structure of retail supply in California, combined with the aggregation of demand node pricing to load aggregation points, could be contributing to relatively low demand for hedging instruments, at least by LSEs. To the extent that low auction prices, and auction revenue shortfalls are due to low hedging demand, the CAISO changes will not change these outcomes as they are not a result of the CAISO's auction design.

We note that this proposal is only a first step in a longer process of evaluation of the CRR auction and its broader market impacts. Analysis of the effects of the proposed changes, some of which have not been experienced in US markets before, will provide valuable insight toward whether further changes are necessary, or if elements of the proposal should be revisited. As an interim step, therefore, we believe that this option makes considerable sense as a way to reduce the sale of undervalued CRRs in the short-run and provide some evidence of how some kind of auction modifications impact the relationship between auction value and CRR payouts. Therefore, we support the CAISO proposal as a reasonable incremental step, that stands a good chance of limiting auction revenue shortfalls while still preserving the main underlying function of the CRR auction. These changes, together with any Track 2 changes that are implemented, will need to be given some reasonable period of time to be in place before their success is evaluated. As part of the Track 2 stakeholder process, we strongly suggest that, first, that a wider range of alternatives for reducing auction losses be considered.

One alternative should include establishing a minimum price or per unit fee for auctioned CRRs. Data provided to us by ISO staff indicate that 7% of the auction losses in the past four years were comprised of payments made to CRRs that sold at a zero price.[51] Another would be to look at the structure for funding the auction revenue shortfall. We note that the problem that is the focus in this initiative--the auction revenue shortfall--is fundamentally a transfer payment issue from one set of market participants to another, in contrast, the proposals to address this transfer could have additional negative impacts on the efficiency of the market. While there are reasons to believe that the efficiency impacts associated with the CAISO proposal would be acceptable, those associated with the DMM/SCE proposal could be more substantial. If the source of the problem constitutes an unacceptable transfer from one group to another, the solution could involve another transfer or fee that would offset these losses without significantly compromising the CRR market.

Our second suggestion is 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. This would best be done by running historical bids through implementations of alternative auctions (including elimination of certain source-sink pairs,

reductions in annual auction quantities awarded, and minimum price or bid fees). This should be done for the entire four year period in order to minimize the impact of sample error upon the conclusions. We note that the results of such analyses should be interpreted carefully, because bidding behavior may change as a result of reforming the auction, so that the anticipated reductions in losses might not be realized. Nevertheless, these simulations of the performance of alternative auction designs using historical bids will provide a better indication of the potential reduction in losses than the analyses that are presently available.

A third suggestion is that the CAISO analyze the extent to which there is a general undervaluation of hedging CRRs in CAISO markets, rather than simply a low valuation of CRRs that have little value as congestion hedges.

Fourth, 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 whether changes in the way CRRs are settled might contribute to improved outcomes.

To summarize, we support the CAISO proposal, but anticipate that further changes will be necessary to either supplement or supplant those proposed here. Whatever changes are made should continue to support the ability of small and non-LSEs to access a market for ISO-backed CRRs. We suggest several analyses that can quantify the impact of these and other potential changes, and advise these be undertaken as part of the Track 2 process.