Summary of Testimony of Eric Hildebrandt, PhD
Director, Department of Market Monitoring
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Ratepayers of load serving utilities pay for the full cost of the transmission system through Transmission Access Charges – and also through higher prices when congestion occurs. All congestion revenues collected by ISOs from use of the transmission system should therefore be allocated back to transmission ratepayers. However, all ISO's auction financial instruments commonly called Financial Transmission Rights ("FTRs"). Revenues collected from auctioned FTRs are consistently much lower that what the ISOs pay out to entities purchasing these FTRs. This directly reduces the congestion revenues that would otherwise be refunded back to transmission ratepayers.

Based on data reported by ISOs, we estimate transmission ratepayers nationwide are losing over $400 million per year from auctioned FTRs. Almost all profits from auctioned FTRs are going to purely financial entities and trading companies – with a very small portion of FTRs purchased by electric generators as potential hedges against congestion costs. ISOs do not need to auction FTRs for electricity suppliers to gain access to physical transmission or to hedge price risks associated with wholesale energy contracts and trading. If policy makers believe ISO's should facilitate financial hedging, ISO's should do this through a market for FTRs that is cleared and settled based on bids and offers from willing buyers and sellers. Transmission ratepayers should not be exposed to the losses and risks that they are currently suffering as a result of FTR auctions being run by ISOs.

Testimony of Eric Hildebrandt, Ph.D.
Director, Department of Market Monitoring
California Independent System Operator Corporation

Committee on Energy and Commerce
Subcommittee on Energy
United States House of Representatives
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My name is Eric Hildebrandt. I am the Director of Market Monitoring at the California Independent System Operator (ISO). The Department of Market Monitoring serves as the independent market monitor for the California ISO. Under FERC regulations, each Commission-approved ISO must have an independent market monitor, whose mission includes "the protection of consumers and market participants by the identification and reporting of market design flaws and market power abuses."[1]

My testimony today focuses on a major market design flaw that exists in all FERC jurisdictional ISOs which is costing transmission ratepayers over $400 million each year. This flaw involves the auctioning of purely financial instruments most commonly called Financial Transmission Rights ("FTRs"). The California ISO calls these Congestion Revenue Rights (or "CRRs").

Ratepayers of load serving utilities pay for the full cost of the transmission system through Transmission Access Charges – and also through higher prices when congestion occurs. All congestion revenues collected by ISOs should therefore be allocated back to transmission ratepayers. In fact, FTRs were initially developed as a

[1] Final Rule, Order No. 719 (Issued October 17, 2008) §35.28 Part 35 3(i) (f) P.314. https://www.ferc.gov/whats-new/comm-meet/2008/101608/E-1.pdf

way to fairly allocate congestion revenues back to participants who pay for the transmission system.

All ISOs currently allocate FTRs to load serving entities based on their projected use of the transmission system. We support continued use of FTRs in this way as a means for providing load serving entities with a hedge that offsets congestion charges they incur. In addition, all of the additional congestion revenues that remain after settlement of these allocated FTRs should also be refunded to transmission ratepayers.

However, after allocating FTRs to load serving entities, all ISOs then auction off additional FTRs. These financial instruments are essentially *price swap* contracts. But unlike price swaps for other commodities, FTRs sold in the ISO auction are not cleared and settled based on bids from willing buyers and sellers. Instead, ISOs auction off FTRs -- and then paid off these FTRs using congestion revenues that would otherwise be refunded to transmission ratepayers.

Unfortunately, revenues that ISOs collect from auctioned FTRs are consistently much lower that what the ISOs pay out to entities purchasing these FTRs. This makes FTRs highly profitable for financial entities, but these profits directly reduce the congestion revenues that would otherwise be refunded back to transmission ratepayers.

Based on data reported by ISOs, we estimate transmission ratepayers nationwide are losing over $400 million per year from FTRs sold at auction in various ISOs. Almost all of these profits are going to purely financial entities and trading companies – with a very small portion of FTRs purchased by electric generators as potential hedges against congestion costs.

In the California ISO, ratepayers have lost over $680 million since 2009 – or about $75 million per year. Transmission ratepayers receive only 52 cents in auction revenues for each dollar the ISO pays out to these FTRs. That represents a profit of nearly 100 percent for entities purchasing these FTRs.

In the PJM Interconnection, data indicate that transmission ratepayers have lost about $1.2 billion in FTR auctions to financial entities since 2011 – or about $170 million per year.[2] As a result, PJM's independent market monitor and the Organization of PJM States have called for changes to PJM's FTR process to ensure all congestion revenues are returned to load serving entities.[3]

In the New York ISO, recent analysis at Stanford University shows that non-load serving entities received FTR profits over $900 million since 1999 – or about $60 million per year.[4] As explained in a 2014 expose in the *New York Times,* FTRs were originally designed to help "protect the electricity producers, utilities and industries that need to buy power" by helping them "hedge against sharp price swings …. but Wall Street

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[2] Monitoring Analytics, 2016 *State of the Market Report for PJM* p. 553: http://www.monitoringanalytics.com/reports/PJM_State_of_the_Market/2016/2016-som-pjm-sec13.pdf
Monitoring Analytics, 2017 *Quarterly State of the Market Report for PJM: January through December* p. 599: http://www.monitoringanalytics.com/reports/PJM_State_of_the_Market/2017/2017q3-som-pjm-sec13.pdf

[3] Organization of PJM States, Inc (OPSI), *OPSI Resolution 2016-4 Concerning Financial Transmission Rights*, Approved August 18, 2016. https://www.pjm.com/~/media/about-pjm/who-we-are/public-disclosures/20160826-opsi-letter-and-resolution-regarding-ftr-construct.ashx

[4] Leslie, Gordon, "Why do transmission congestion contract auctions cost ratepayers money? Evidence from New York," November 14, 2017, pp. 23-24, downloaded 11/17/2017: http://www.web.stanford.edu/~gwleslie/index_new_files/Leslie_JMP20171114.pdf.

banks and other investors have stepped in, siphoning off much of the money," according to the *Times*.[5]

In the Midwest ISO, transmission ratepayers have received less than 80 percent of day-ahead congestion rent, representing a loss of at least $100 million per year from the MISO's FTR auction. [6]

ISOs do not need to auction FTRs for generation owners or energy traders to gain access to physical transmission or to hedge price risks associated with wholesale energy contracts and trading. As with other commodities, market participants and financial entities are free to develop and trade price swap contracts. In fact, this type of free market – with trades between willing buyers and sellers – is what is needed to price such price swaps most efficiently and fairly.

If policy makers believe it is beneficial to wholesale electricity markets and consumers for ISO's to facilitate such financial price swaps, then ISO's should do this through a market for FTRs that is cleared and settled based on bids and offers from willing buyers and sellers.

Transmission ratepayers should not be exposed to the losses and risks that they are currently suffering as a result of FTR auctions being run by ISOs. If ISOs do not

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[5] "Traders Profit as Power Grid is Overworked" *The New York Times* August 14, 2014: https://www.nytimes.com/2014/08/15/business/energy-environment/traders-profit-as-power-grid-is-overworked.html

[6] *Problems in the performance and design of the congestion revenue right auction*, Department of Market Monitoring, California Independent System Operator, November 27, 2017, pp. 18-19. http://www.caiso.com/Documents/DMMWhitePaper-Problems_Performance_Design_CongestionRevenueRightAuction-Nov27_2017.pdf

take action to address this issue, FERC will need to take action to protect the nation's transmission ratepayers.

Additional details of our analysis, along with a detailed discussion of the fundamental economic flaws underlying the auctioning of FTRs, are provided in an attached report by the California ISO Department of Market Monitoring.[7] Another report posted on our website provides a discussion of market-based options through which energy generators, traders and financial entities can buy and sell financial instruments that allow hedging of congestion costs.[8]

Thank you for the opportunity to appear before you today. I look forward to answering your questions on this important issue.

[7] *Problems in the performance and design of the congestion revenue right auction*, Department of Market Monitoring, California Independent System Operator, November 27, 2017. http://www.caiso.com/Documents/DMMWhitePaper-Problems_Performance_Design_CongestionRevenueRightAuction-Nov27_2017.pdf

[8] *Market alternatives to the congestion revenue rights auction,* Department of Market Monitoring, California Independent System Operator, November 27, 2017. http://www.caiso.com/Documents/Market_Alternatives_CongestionRevenueRightsAuction-Nov27_2017.pdf

California Independent System Operator Corporation

California ISO

Problems in the performance and design of the congestion revenue right auction

November 27, 2017

Department of Market Monitoring

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Summary

In markets based on locational marginal pricing, binding transmission constraints cause locational prices to differ. Prices are higher in areas where transmission limits constrain the ability of lower cost generation to meet demand and higher cost generation must be used. Prices are lower in areas where transmission limits constrain the market from using otherwise available lower cost generation. These price differences cause the total amount paid by buyers to exceed the amount paid to suppliers over the entire system. This creates a source of revenue known as *congestion rent* since it results from higher prices reflecting congestion on transmission constraints.

Most congestion rents are allocated back to transmission ratepayers because they pay for most of the transmission system through the transmission access charge (TAC). The TAC is collected based on each participant's demand (i.e. load or exports). The TAC is set at a fixed rate ($/MWh) designed to cover the full capital costs and rate of return for transmission assets. Any revenues collected above the level required to cover these transmission costs, such as congestion rent, should therefore be refunded to the TAC ratepayers.

Allocated CRRs are part of a system that distributes congestion rent to load serving entities on behalf of retail ratepayers and to other TAC ratepayers. This paper does not concern the congestion rent allocation or propose any changes to the current CRR allocation process.

Auctioned CRRs, on the other hand, are purely financial instruments that obligate the ISO's transmission ratepayers to pay entities purchasing these CRRs the difference in day-ahead market prices between two locations. An auctioned CRR is a forward price swap. Payments in the auction are exchanged for payments based on differences in day-ahead market prices.

California ISO transmission ratepayers lost over $680 million in the congestion revenue right (CRR) auction from 2009 through 2017. For every dollar ratepayers paid to entities purchasing CRRs in the auction, ratepayers received only 52 cents in auction revenues. This consistent underpricing of CRRs calls into question a fundamental assumption of the CRR auction design that competition will drive auction prices to equal the CRR's expected value.

As described in this paper, the CRR auction differs from a competitive market—and other forward financial markets—in several ways. These differences create opportunities for purely financial entities to purchase CRRs at prices systematically lower than the payments that ratepayers are obligated to pay the auction participants. DMM has recommended that the ISO takes steps to eliminate the current framework by which the ISO auctions CRRs, and consider if the ISO should instead play a role in facilitating trading of CRRs or similar price swaps between willing buyers and sellers through a market based only on bids and offers.

Auctioned CRRs are not needed for transmission access or to ship power between nodes. An LMP market is a centrally cleared market. Power is sold or bought through the central market at the market price. Market participants do not ship power from one location to another. The LMP at each location is the appropriate market price for that location. A CRR is not needed to ship power between locations because power is not shipped between locations.

A CRR is not a day-ahead market transmission right. All day-ahead market bidders have access to the transmission system regardless of whether or not they hold a CRR. Instead, an auctioned CRR is simply a

forward contract. This forward contract allows auction participants to hedge financial exposure to–or speculate on—uncertain day-ahead price differences between two locations.

The demand for a financial hedge against day-ahead market locational price differences primarily comes from forward contracts that settle on pre-agreed upon reference power prices in the spot market. This forward contracting takes place outside the ISO markets. A supplier may sell a forward power contract at a location different than its generator's location. When this occurs, the day-ahead price on which the forward contract settles will be different than the day-ahead price the generator receives for selling power into the day-ahead market. Different settlement locations cause the supplier to face an uncertain day-ahead price difference that will not be hedged by the forward power contract. To hedge this uncertainty, a supplier may be willing to buy a forward contract for the difference between the day-ahead prices at the two locations.

Financial forward contracts on locational price differences can be purchased in the CRR auction. Unlike most other forward contract markets, the CRR auction allows participants to take positions without a counterparty offering to take the opposite position. Market participants can buy forward contracts in the CRR auction without trading with a willing seller. This is because the auction makes the ISO's transmission ratepayers the counterparty to contracts bought from the CRR auction without being an explicit willing seller.

CRR forward contracts are essentially price swaps offered for sale in the auction at offer prices of $0 by the ISO on behalf transmission ratepayers. To avoid being a counterparty to the forward contracts offered under the current CRR auction design, ratepayers would need to participate in the auction to buy contracts from themselves. This is the opposite of most other forward markets where sellers must willingly offer to enter a forward contract.

While ratepayers may want to buy CRRs to avoid forward contract obligations, they cannot readily buy them. Technical, economic and regulatory hurdles restrict ratepayer participation in the auction. Ratepayers cannot easily avoid being a counterparty to the forward contracts they did not offer to enter. An auction participant can therefore buy a CRR from ratepayers for a price at which ratepayers would not willingly sell.

The CRR auction also differs from other forward markets, and competitive markets generally, in another significant way. Competitive markets trade a well-defined product or property right. For example, a forward contract for a bushel of wheat is defined as a bushel of wheat in both the forward and spot markets. A natural gas forward basis contract between Henry Hub and Chicago is defined as the price difference between Henry Hub and Chicago in both the forward and spot markets. A CRR is not consistently defined between the auction and day-ahead market.

CRRs are auctioned as a bundle of forward contracts on specific transmission constraints. However, CRRs are not settled as the same bundle of forward contracts at day-ahead market prices. Instead, the CRRs are settled at the day-ahead market locational price differences between two locations. A CRR will only be consistently defined if the bundle in the auction is the same as the implied bundle from the day-ahead market price differences. When the transmission models are different in the auction and day-ahead market, the bundles will not be the same. The CRR will be a different product when bought than when settled at day-ahead market prices.

CRRs are unlikely to be consistently defined because the CRR auction relies on a single estimated network model to estimate a series of different hourly day-ahead network models that are ultimately used in the market over the entire settlement month or quarter. This settlement is like allowing auction

participants to purchase premium gasoline at prices for regular gasoline with ratepayers making up the difference. Profit maximizing auction participants would bid to obtain CRRs that the auction models as being of a lower (regular) value but which they anticipate to be a higher value (premium) product.

The peculiarities and complexities of the CRR auction can create opportunities for participants to routinely extract payments from ratepayers. The majority of these payments are from ratepayers to purely financial entities seeking to profit from participation in the auction, rather than suppliers that may be seeking to hedge risks related to day-ahead market schedules.

There is no clear rationale for the ISO to offer forward price swaps. Market participants can freely contract and trade forward price swaps outside the ISO. If the ISO continues to facilitate the trading of forward price swaps, the auction design should be changed so that only willing counterparties will enter forward contract obligations.

1 CRRs are financial forward contracts

Ratepayers pay for and own most congestion rent

Nodal markets are designed to promote efficient use of the scarce transmission system. The transmission system both facilitates and limits the ability to reliably trade energy. The limited transmission available in the day-ahead market constrains the choice of optimal energy schedules. This creates locational price differences which in turn creates congestion rent.[1]

Most congestion rents are allocated back to transmission ratepayers because they pay for most of the transmission system through the transmission access charge (TAC.[2] Ratepayers pay for the capital costs and rate of return on transmission assets through TAC that is imposed on all load schedules. Any revenues that these transmission assets earn in excess of the rate of return included in the TAC should therefore be credited or refunded to transmission the ratepayers.

The ISO currently distributes congestion rent to the TAC ratepayers through an allocation process that includes the CRR allocation process. This allocation process is designed so that congestion rents are refunded back to different groups of transmission ratepayers in approximately the same proportion as these groups pay congestion. This paper does not concern the congestion rent allocation. Instead the focus of this paper is on the CRR auction.

Network models define the transmission right products

As described in the following subsections, auctioned CRRs are not rights to physical transmission, nor are auctioned CRRs even the rights to day-ahead market congestion rents. A CRR is a forward contract that is settled base on the difference in day-ahead market prices between two locations. Although a CRR settles on the day-ahead market congestion price differences, the ISO auctions CRRs as bundles of forward contracts to specific transmission constraints. Using the term *congestion rights* to refer to CRRs is inaccurate and misleading. In practice, congestions rents collected can be higher or lower than CRR payments, and payment of CRRS is made independent of congestion rents actually collected. Therefore, for the rest of this paper, we refer to CRRs as *forward contracts*.

The CRR auction clears by maximizing total bid value constrained by the transmission network model. Forward contracts sold in the auction are defined by a network model, which includes specific nodes (locations), transmission constraints and shift factors. A *shift factor* describes how many forward contracts on a constraint are bought or sold from a one megawatt injection at a specific location. A CRR bids as an injection at a source location balanced by a withdrawal at a sink location. The forward contracts a CRR buys or sells on a particular constraint is the source shift factor minus the sink shift factor multiplied by the cleared CRR megawatts. The auction price for each increment of forward contract for that one constraint is the CRR auction's shadow price on the constraint.

[1] A good analogy is that transmission use is an externality of scheduling power and the transmission price is an externality tax, as explained on pg. 26 of Oren, Shmuel S., Pablo T. Spiller, Pravin Varaiya, and Felix Wu. 1995. "Nodal Prices and Transmission Rights: A Critical Appraisal." *Electricity Journal*,p. 32: http://www.ieor.berkeley.edu/~oren/pubs/nodal.pdf.

[2] Exceptions to this are rights owned by merchant transmission and long-term rights holders. However, these are very minor in the CAISO system.

If a CRR's net shift factor (source shift factor minus sink shift factor) is positive, the CRR purchases forward contracts for the constraint's price. If a CRR's net shift factor is negative, the CRR sells forward contracts. The total forward contracts purchased by participants bidding in the auction do not need to equal the forward contracts sold by participants bidding into the auction. Instead, the forward contracts bought minus the forward contracts sold must be less than the forward contracts made available in the auction through each constraint's transmission limit.

Equation 1 shows a CRR auction transmission constraint called *k.* Individual CRRs are indexed by *i.*

Equation 1. CRR market constraints define forward contracts auctioned

$$\sum_i MW_i^{CRR}\left(ShiftFactor_{i,source}^k - ShiftFactor_{i,sink}^k\right) \leq Limit^k$$

$$Contracts\ Bought\ -\ Contracts\ Sold\ \leq\ Contracts\ offered\ by\ auction$$

Auction participants can buy more forward contracts than are sold by other participants bidding in the CRR auction. More forward contracts can be bought than sold because the ISO makes forward contracts available through its auction's transmission model. The ISO sells these forward contracts on behalf of transmission ratepayers. The CRR buyers pay ratepayers the auction revenues. The ratepayers then pay the buyers the day-ahead prices for these forward contracts. The ISO offers forward contracts on the ratepayers' behalf (through the limits on transmission elements in the CRR auction) with zero offer prices.

CRRs are considered *revenue adequate* when revenues from congestion rents are greater than or equal to the payments to CRRs. CRRs will be revenue adequate if the transmission limits and network models (shift factors) are the same[3] in both the auction and day-ahead market.[4] When the auction limits or network models are different, the CRRs may not be revenue adequate.

Revenue adequacy is not a concern in forward markets for other commodities.[5] In forward markets for other commodities buyers and sellers are matched and revenue adequacy is assured. Revenue adequacy does not matter for CRRs either. Revenue adequacy does not matter because the CRR auction actually does match buyers and sellers. Ratepayers will always be the counterparties to contracts not matched between the buyers and willing sellers who bid into the auction.

As discussed in detail in the next three sub-sections, CRRs can be better understood by interpreting CRRs from the perspective of the transactions between the buyers and sellers of CRRs, rather than from the perspective of revenue adequacy. The underlying transactions are the exchange of a fixed payment in the auction for floating payments at the uncertain day-ahead market prices. The transactions that matter to ratepayers are the auction revenues they receive compared to the payments they are obligated to make to CRR holders.

[3] More precisely, the difference between shift factors has to be the same between all 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.

[5] This assumes away default risk, which is different than the revenue adequacy referred to here.

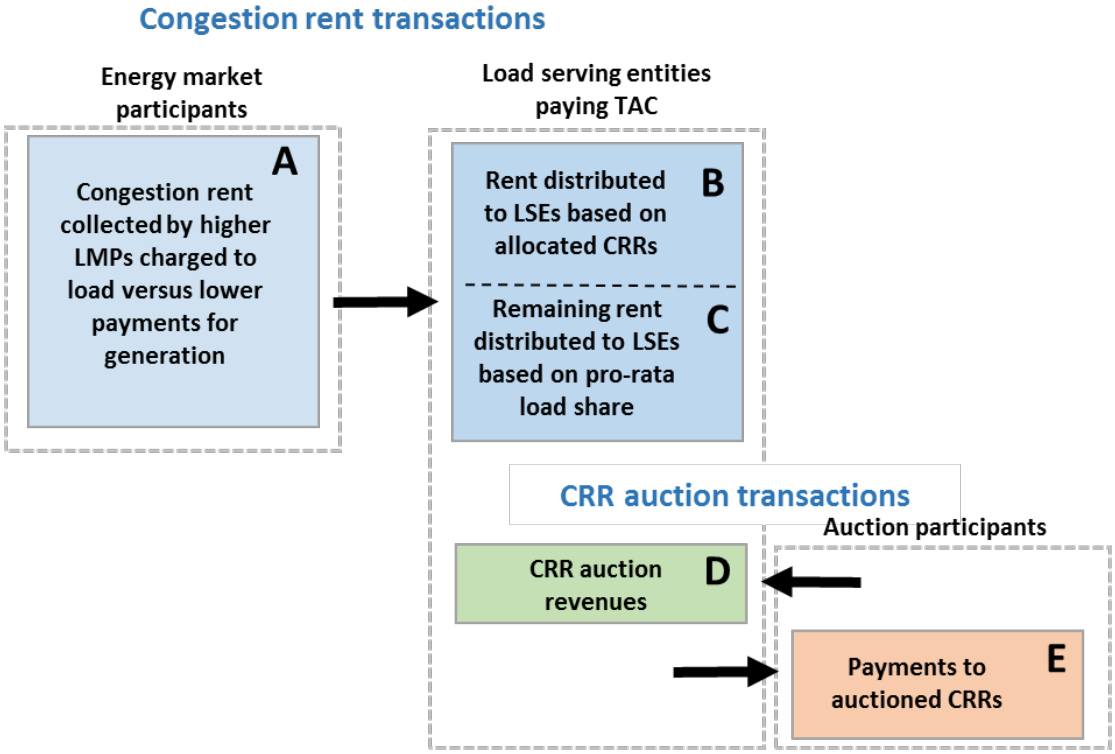
Accounting for ratepayer gains or losses from CRRs sold in the auction

The congestion revenue rights balancing account is a settlement mechanism. This settlement mechanism ensures that the final *net* payments and charges to the day-ahead market and to CRR auction participants are correct. The CRR balancing account processes two underlying transaction types. To understand the actual day-ahead market and CRR auction trades, we should consider the underlying transactions, rather than the net sum of the CRR balancing account.

Figure 1 shows the two transaction types from the ratepayer's perspective. In the first type of transaction (box A), entities with energy schedules clearing the day-ahead market pay congestion rents. As discussed, transmission ratepayers should receive these congestion rents since they have paid for the transmission system through the TAC. Therefore, the ISO distributes some of the congestion rents to transmission ratepayers by CRRS allocated to load serving entities (box B). Any congestion rents remaining after the allocation process are distributed to participants who pay the TAC based on their *pro-rata* share of demand schedules, i.e. loads and exports (box C). Load serving entities, who are the largest transmission ratepayers, then pass the congestion rents back to transmission ratepayers.

In the second type of transaction (shown in boxes D and E), CRR auction participants and ratepayers (who do not participate in the auction) trade financial forward contracts through auctioned CRRs. Auction participants pay the forward price (the auction price) to ratepayers (box D). In exchange, ratepayers take on the obligation to pay the spot price (the difference between the source and sink day-ahead market prices) to auction participants (box E). The exchange of forward CRR auction revenues for spot market payments to auctioned CRRs at day-ahead market prices is the ratepayers' overall net forward contract trade.

Figure 1. Different transaction types settled through the CRR balancing account



If no CRRs were sold at auction, all remaining congestion revenues after payments made to allocated CRRs would be refunded to ratepayers of load serving entities who pay the TAC based on their *pro-rata* share of demand (box C). Thus, whenever auction revenues are less than payments made by the ISO to CRRs, the difference is a direct loss for transmission ratepayers.

Congestion revenue rights are not actually rights to congestion rents

When the CRR auction transmission model and day-ahead market transmission model are the same, we can view a CRR as a forward contract, a point-to-point transmission right, or a right to a share of congestion rent.[6] All three views are financially equivalent.

However, the CRR auction and day-ahead market transmission models are inevitably different. When the models are different, paying CRRs the day-ahead market settlement price is not the same as paying a share of the congestion rent. For example, if 100 MWs of transmission is sold to entities with schedules clearing the day-ahead market, the ISO cannot pay CRRs for rights to 115 megawatts worth of congestion rent. The CRRs clearly do not represent the rights to the congestion rents. Instead, ratepayers receive the congestion rents for the 100 megawatts of transmission sold to day-ahead market schedules (see Transaction 1 in Figure 1). Separately, ratepayers must pay day-ahead market locational price differences to settle the 115 megawatts of CRR forward contracts that the ISO auctioned off on the ratepayers' behalf (see Transaction 2 in Figure 1).

Even if the transmission models are the same, the CRR contracts sold for a constraint can be greater than the transmission limit because auction participants can sell additional forward contracts. If the constraint limit is 10 MWs and some participants sell an additional 50 MWs of forward contracts through CRR bids, a total of 60 MWs of forward contracts can be purchased by other CRR auction participants. 60 MWs of rights to congestion rent do not exist. The ISO does not arbitrarily decide that a particular 10 MWs of CRRs is rights to congestion while the other 50 are something else. Instead, all 60 MWs are forward contract purchases with 50 MWs sold by parties bidding into the auction and 10 MWs sold on behalf of transmission ratepayers.

CRR profitability is the relevant measure of CRR auction performance

CRR revenue inadequacy has traditionally received a lot of attention. Concerns over whether there will be sufficient congestion rent to pay the CRRs are rooted in the prevalent and incorrect view that CRRs are rights to the day-ahead market congestion rent. But once we recognize that CRRs are simply forward contracts, and not rights to congestion rent, it becomes clearer that focusing on revenue adequacy incorrectly frames the problem as a need for the ISO to make the "correct" amount of forward contracts available in the auction on behalf of ratepayers.

The relevant question for ratepayers is *not* how total payments to CRRs compare to total day-ahead congestion rent (i.e. it is not a question of revenue adequacy). The relevant question for ratepayers is how the payments ratepayers are obligated to make to auctioned CRR holders compare to the CRR auction revenues ratepayers receive. If ratepayers pay auctioned CRR holders more than the auction revenues ratepayers receive, then ratepayers will lose money on their CRR forward contracts.

[6] Harvey, Scott M, William W Hogan, and Susan L Pope. 1997. *Transmission Capacity Reservations and Transmission Congestion Contracts.* Cambridge, MA: Harvard University, p. 62 of the version at: http://www.hks.harvard.edu/fs/whogan/tccoptr3.pdf.

The auction revenues ratepayers receive depends on how well the CRR auction prices CRRs. A well-functioning competitive auction would price CRRs near their expected value. The CRR auction revenues ratepayers receive would roughly equal the ratepayers' expected payments to non-LSE CRR holders. The CRRs purchased from ratepayers by non-LSE auction participants would not be highly profitable. If the CRR auction is not a well-functioning competitive market, non-LSE auction participants can consistently profit from ratepayers' losses without driving up CRR auction prices.

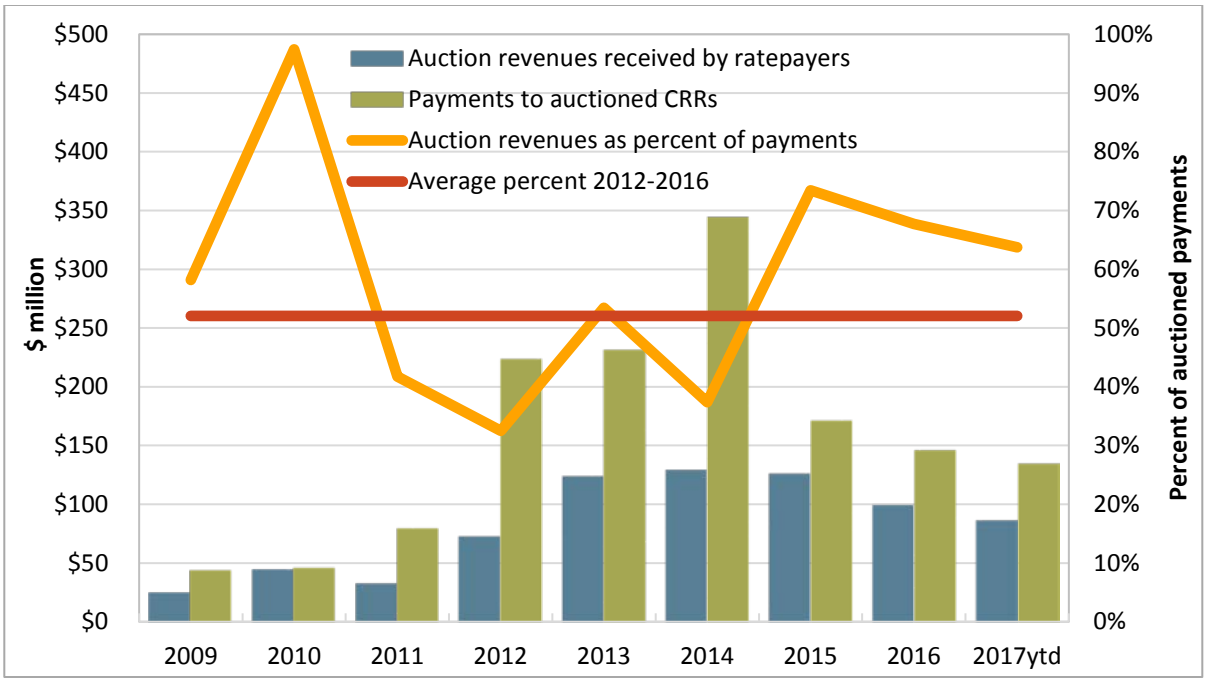
2 CRR auction results

The section provides analysis of the ISO's CRR auction since 2009. The section also provides a review of analysis and studies that have been performed for other ISO's. This analysis shows that auction revenues have been systematically much lower than CRR payments made to non-load serving entities. These results are not consistent with a well-functioning competitive market. Data from other ISO's indicate that these trends occur in other ISO's as well.

CRRs are auctioned for only half the value of CRR payments

As shown in Figure 2, ratepayers have consistently lost money in the CRR auction each year since the ISO's LMP market began in 2009. Ratepayers have lost over $680 million from the CRR auction from 2009 through 2017, or an average of $75 million per year. Ratepayers paid over $1.4 billion to non-LSE CRR holders but received only $742 million in auction revenues. For every dollar paid to non-LSE CRR holders, ratepayers received just 52 cents. This represents more than a 90 percent annual rate of return for non-LSE entities purchasing CRRs in the auction. This clearly reflects a systematic bias and distortion in the CRR auction.

Figure 2. Auction revenues and auctioned CRR payments excluding LSEs



As shown in Table 1, most profits from CRRS purchased in the auction go to financial entities that do not operate or schedule physical generation assets in the ISO system – and do not purchase CRRS to hedge power contracts. Since 2009, non-LSEs and non-physical generation entities (financial entities and marketers) received about $598 million in profits from the CRR auction, paying 52 cents per dollar

received – representing a profit of almost 100 percent. Physical generators received $86 in profits paying 45 cents per dollar.

Table 1. CRR auction profits ($ millions) – Physical generators

Year	Auction Revenues	CRR Payments	Profits
2009	$2	$2	**$0**
2010	$0	$1	**$1**
2011	($1)	$3	**$4**
2012	$9	$25	**$16**
2013	$14	$31	**$16**
2014	$14	$48	**$34**
2015	$17	$24	**$7**
2016	$9	$14	**$5**
2017*	$7	$11	**$3**
Total	**$71**	**$157**	**$86**

*2017 is year-to-date through October 31.

Table 2. CRR auction profits ($ millions) – Financial traders and marketers (excludes load serving entities and physical generators)

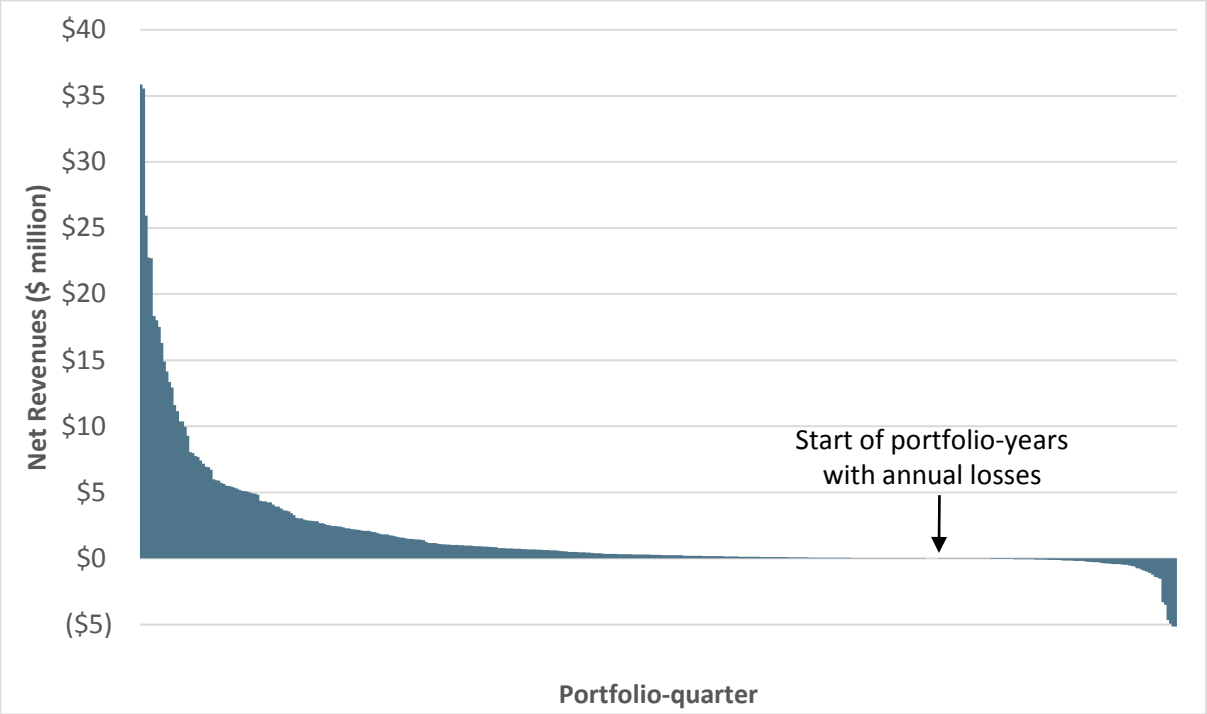
Year	Auction Revenues	CRR Payments	Profits
2009	$24	$43	**$19**
2010	$45	$46	**$0**
2011	$35	$78	**$43**
2012	$64	$200	**$136**
2013	$110	$201	**$91**
2014	$115	$297	**$182**
2015	$109	$148	**$39**
2016	$91	$133	**$43**
2017*	$79	$125	**$46**
Total	**$671**	**$1,269**	**$598**

*2017 is year-to-date through October 31.

Figure 3 provides a more detailed analysis of how CRRs have been consistently profitable over time for virtually all non-TAC ratepayer (non-LSE) CRR auction participants. Figure 3 shows the distribution of total annual profits and losses for all annual portfolios of CRRs purchased by non-LSEs over the 2009 through Q3 2017 period. These data illustrate that the portfolios of CRRs purchased by different non-LSEs in the auction were systematically profitable and extremely skewed, with very limited risk of potential losses.

Over the 2009 through Q3 2017 period shown in Figure 3, non-LSE portfolios that were profitable were paid about $728 million dollars. Non-LSE portfolios that were not profitable lost only about $50 million. The losses were about 7% the amount of gains. This is not indicative of a well-functioning market. The $677 million difference in profitable versus unprofitable CRR portfolios purchased in the auction was paid from revenue that would otherwise have been refunded to transmission ratepayers to partially offset TAC payments charged to load serving entities.

Figure 3. Annual profits on auctioned CRRs by entity (excluding LSEs) 2009-Q3, 2017



Figures 4 through 6 summarizes a more detailed analysis of how systematically profitable portfolios of CRRs purchased in the auction have been for different types on non-LSEs. These figures compare the amount paid by individual participants for portfolios of monthly and seasonal CRRs each quarter to the revenues received for these portfolios. Observations below the 45 degree line are quarterly CRR portfolios that were profitable. Observations above the 45 degree line are quarterly portfolios that were unprofitable.[7]

[7] These charts also show CRR portfolio data from Q1 2014 through Q2 2017 calculated on a quarterly basis corresponding to the term of seasonal CRRs (rather than on a monthly basis).

Figure 4. All non-Load serving entities' quarterly auction revenues versus CRR payments by portfolio (2014-Q2 2017)

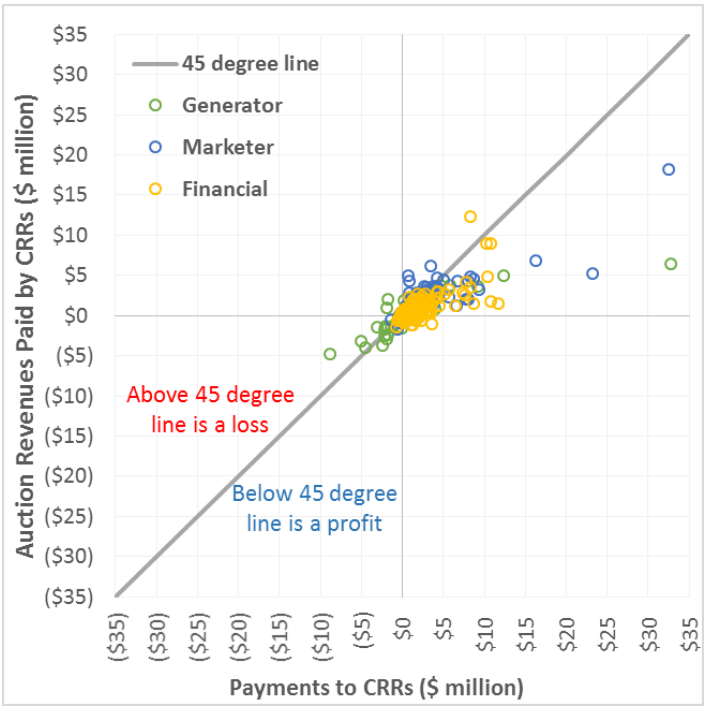


Figure 5. Financial entities' quarterly auction revenues versus CRR payments by portfolio, 2014 to Q2 2017 (axes truncated at $10 million)

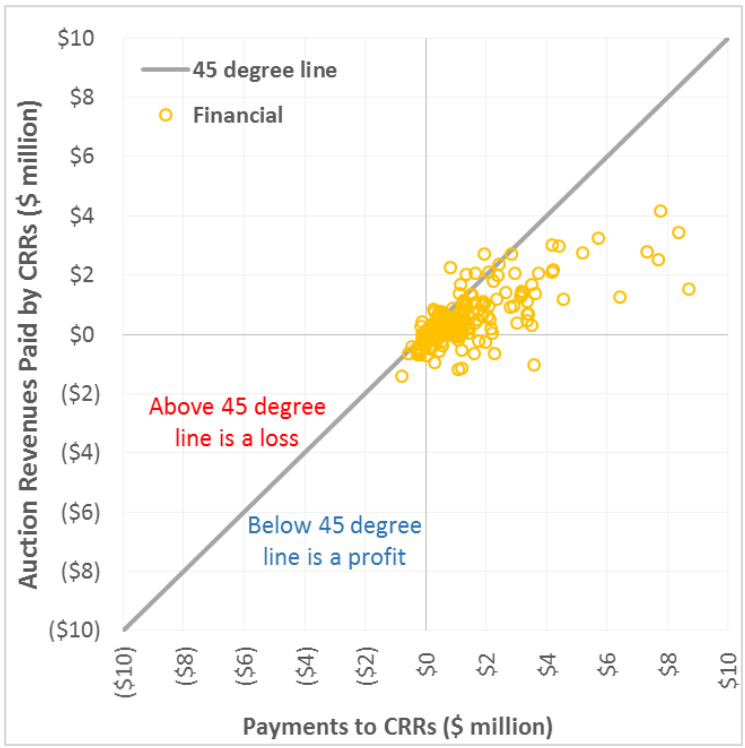


Figure 6. Marketers' quarterly auction revenues versus CRR payments by portfolio (2014 to Q2 2017 - axes truncated at $10 million)

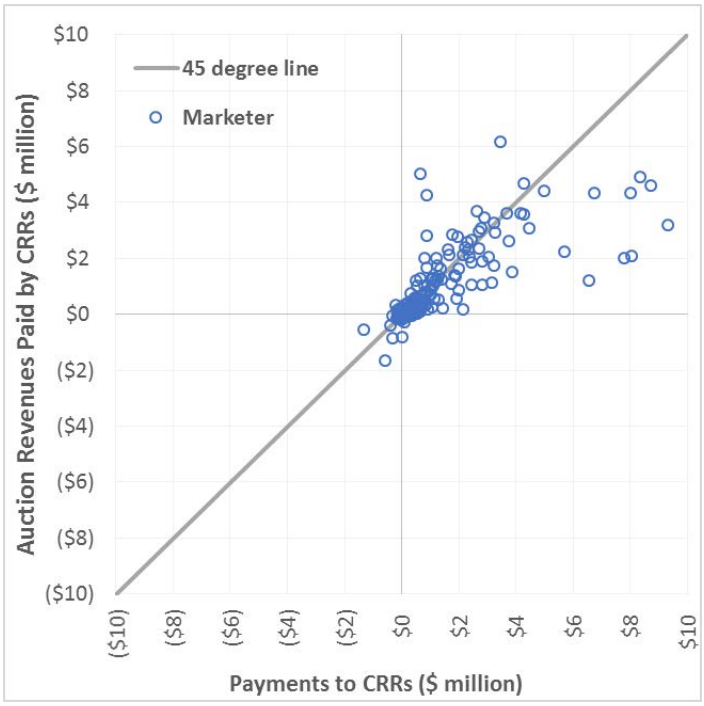
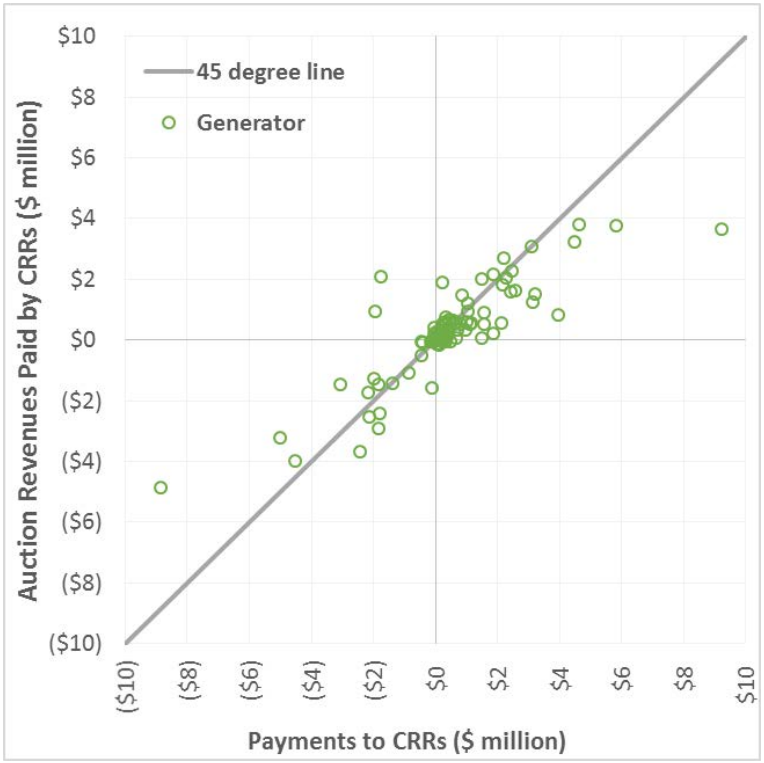


Figure 7. Generators' quarterly auction revenues versus CRR payments by portfolio, 2014-Q2 2017 (axes truncated at $10 million)



The risk and time value of money associated with CRRS does not explain abnormally high profits

Auction participants may be risk adverse. Risk aversion may cause the CRR auction prices to not equal the expected day-ahead payments. Auction participants may be increasing or decreasing their risk by procuring a CRR. Participants increasing their risk would be willing to pay less than the expected value. Participants decreasing their risk would be willing to pay more than the expected value as an *insurance premium*. Therefore we cannot presume that risk aversion will decrease or increase auction prices relative to the expected value.

This analysis does not discount the auction revenue and CRR payment flows for the time value of money. However, most of the monthly CRR payments occur less than a month after purchase. Only the payments to annual CRRs in late November and December occur more than a year after the CRRs are purchased. Given the short time periods, discounting the cash flows would not appreciably affect the values. The effects of risk aversion and the time value of money cannot account for pricing CRR's sold in the auction at only 53 cents for each dollar of congestion payments.

Ratepayers losses occur from CRR/FTR auctions in other ISOs/RTOs

The California ISO is not the only ISO/RTO where transmission ratepayers have been losing money in auctions for Financial Transmission Rights (the term for CRRs in these markets). [8] Data reported by different ISOs/RTOs is not always reported in a manner that clearly shows the impact of these auctions on transmission ratepayers. However, there are clear indications FTR auctions are highly profitable for the auction participants in multiple markets. Based on DMM's review, auctions clearly result in losses of several hundred millions dollars per year nationwide. A 2017 analysis at Stanford University estimates that losses to ratepayers total about $600 million per year in the countries four main ISOs. [9]

PJM

In the PJM Interconnection (PJM), data reported by PJM's Independent Market Monitor indicate that transmission ratepayers have lost over $1.18 billion in FTR auctions from 2011 to September 2017. Financial entities have received about $170 million per year in FTR profits (see Table 3).[10] As noted by PJM's Independent Market Monitor:

> In an LMP system, the only way to ensure that load receives the benefits associated with the use of the transmission system to deliver low cost energy is to use FTRs to pay back to load the difference between the total load payments and the total generation revenues, which equals total congestion revenues.

[8] CRRs in other ISOs/RTOs are also known as financial transmission rights (FTRs), transmission congestion contracts (TCCs), and transmission congestion rights (TCRs).

[9] "Traders Profit as Power Grid is Overworked" *The New York Times* August 14, 2014: https://www.nytimes.com/2014/08/15/business/energy-environment/traders-profit-as-power-grid-is-overworked.html

[10] Monitoring Analytics, 2016 *State of the Market Report for PJM* p. 553: http://www.monitoringanalytics.com/reports/PJM_State_of_the_Market/2016/2016-som-pjm-sec13.pdf
Monitoring Analytics, 2017 *Quarterly State of the Market Report for PJM: January through December* p. 599: http://www.monitoringanalytics.com/reports/PJM_State_of_the_Market/2017/2017q3-som-pjm-sec13.pdf

PJM's Market Monitor has recommended changes to PJM's FTR process to ensure all congestion revenues are returned to load serving entities, noting that:

> The current ARR/FTR design does not serve as an efficient way to ensure that load receives all the congestion revenues or has the ability to receive the auction revenues associated with all the potential congestion revenues.

In 2016, the Organization of PJM States (OPSI) passed a resolution citing the PJM Market Monitors findings and recommendations calling upon PJM to propose a redesign of the PJM's FTR market "that will ensure that all congestion revenues are returned to consumers." [11] As noted in the OPSI resolution, "[c]onsumers pay for all congestion in the system, so anything short of the prospect for realizing a full return of those congestion revenues [to consumers] would indicate a failure in achieving the objective of the ARR/FTR construct."

Table 3. PJM financial entity FTR auction profits ($ millions)

Year	Financial Entity Profits
2011	$126
2012	$79
2013	$177
2014	$544
2015	$182
2016	$48
2017*	$34
Total	**$1,190**

*2017 ytd thru September.

NYISO

In 2014 the *New York Times* reported on the very large FTR auction profits in the New York ISO (NYSO).[12] As explained in the Times article, FTRs were originally designed to help "protect the electricity producers, utilities and industries that need to buy power," by helping them "hedge against sharp price swings caused by competition as well as the weather, plant failures or equipment problems." Those lower costs reduce consumers' bills, "but Wall Street banks and other investors have stepped in, siphoning off much of the money".

The New York Times article provides valuable insights into the barriers to competition in what it calls a "murky corner" of the energy market.

> Like top Wall Street banks, DC Energy [a major financial trader of FTRs] stocks its trading desk with graduates of elite universities. Most have backgrounds in science and engineering — a doctorate in chemical physics from Harvard, for example, or a master's degree in artificial intelligence from

[11] Organization of PJM States, Inc (OPSI), OPSI Resolution 2016-4 Concerning Financial Transmission Rights, Approved August 18, 2016. https://www.pjm.com/~/media/about-pjm/who-we-are/public-disclosures/20160826-opsi-letter-and-resolution-regarding-ftr-construct.ashx

[12] "Traders Profit as Power Grid is Overworked" *The New York Times* August 14, 2014: https://www.nytimes.com/2014/08/15/business/energy-environment/traders-profit-as-power-grid-is-overworked.html

> Stanford — rather than in finance. Their job is to develop computer-driven trading models to predict what will happen to electricity prices in different parts of the nation.

As explained in the *New York Times*:

> … in places like upstate New York or Long Island, the market is so small, and the participants for certain contracts so few, that knowledgeable traders can collect rich rewards. Frank A. Wolak, an economics professor at Stanford who studies commodities, said the congestion markets created perverse incentives because profits rise when grid congestion becomes worse. "If traders are making money, then consumers are paying more," Mr. Wolak said. "The money that these guys are making has to come from somewhere."

A recent research paper from Stanford University estimates that that in the New York ISO non-retail (non-LSE) entities received FTR profits totaling $938 million over the 1999-2016 period, almost $60 million per year.[13] As noted in this research:

> … these derivatives have proven controversial because financial traders have consistently earned trading profits of $600m a year from holding these derivatives across the four largest U.S. electricity markets. These products are typically issued via regular auctions, with payouts of the issued derivatives funded by ratepayers, who in turn receive the auction revenues … financial traders typically purchase many derivatives in small quantities between locations that physical firms do not tend to buy. Financial traders earn profits when they are the first to buy a previously illiquid product, where they effectively receive a transfer from ratepayers for this service.[14]

MISO

In the Midcontinent ISO (MISO) for the 2010-2011 through 2016-2017 planning periods, on average only about 80% of the day-ahead market congestion rent was received by transmission ratepayers.[15] As explained in earlier DMM reports, this implies that transmission ratepayer losses in the FTR auction were equal to about 20% of day-ahead congestion rents for the period.[16] Day-ahead congestion rent averaged about $790 million from 2011 through 2016.[17] This data indicates that transmission ratepayers in MISO have consistently suffered large losses from the FTR auctions, between $100 million and $200 million per year.

[13] Leslie, Gordon "Why do transmission congestion contract auctions cost ratepayers money? Evidence from New York" November 14, 2017, pp23-24, downloaded 11/17/2017: http://www.web.stanford.edu/~gwleslie/index_new_files/Leslie_JMP20171114.pdf.

[14] Ibid, p.1

[15] Midcontinent ISO *ARR/FTR Transmission Customer Metric May 11, 2017*: https://www.misoenergy.org/Library/Repository/Meeting%20Material/Stakeholder/MSC/2017/20170511/20170511%20MSC%20Item%20XX%20ARR%20FTR%20Transmission%20Customer%20Metric%20April%202017%20Update.pdf

[16] Department of Market Monitoring *Shortcomings in the Congestion Revenue Right Auction Design* p.6: https://www.caiso.com/Documents/DMM-WhitePaper-Shortcomings-CongestionRevenueRightAuctionDesign.pdf

[17] MISO day-ahead congestion rent data from Potomac Economics *2016 State of the Market Report for the MISO Electricity Market* p.50; Potomac Economics *2014 State of the Market Report for the MISO Electricity Market* p.52; Potomac Economics *2012 State of the Market Report for the MISO Electricity Market* p.46. Reports available at: https://www.misoenergy.org/MARKETSOPERATIONS/INDEPENDENTMARKETMONITOR/Pages/IndependentMarketMonitor.aspx

Table 4 shows the percent of day-ahead market congestion rent received by MISO ratepayers across the planning years since 2010. Table 4 also shows the annual day-ahead congestion rent by calendar year. We estimate losses to ratepayers from the auction multiplying the percentage of day-ahead congestion rent that was *not* returned to ratepayers each year by the reported congestion rent for that year.

The planning period and calendar years used by the MISO are not align. Therefore, the range of auction losses is estimated first by multiplying the percentage of day-ahead congestion rent that was not returned to ratepayers by the congestion rent where the start year of the planning period and calendar year are the same. We also estimated auction losses based on congestion rents where the end year of planning period and calendar year are the same. These two approaches indicate a range of losses to MISO transmission ratepayers from FTRs sold in the auction of $165 million to $207 million.

Table 4. MISO percent of day-ahead market congestion rent received by ratepayers and estimated potential range of ratepayer FTR auction losses ($ millions)

Planning Period	Percent of DAM Rent Returned	Calendar Year	Annual DAM Rent	Estimated Auction Losses	
				Start Year Percent	End Year Percent
06/10 - 05/11	72%	2010	$498	$139	
06/11 - 05/12	75%	2011	$503	$126	$141
06/12 - 05/13	79%	2012	$778	$163	$194
06/13 - 05/14	64%	2013	$842	$303	$177
06/14 - 05/15	89%	2014	$1,444	$159	$520
06/15 - 05/16	83%	2015	$751	$128	$83
06/16 - 04/17	81%	2016	$737	$140	$125
Average	**78%**		**$793**	**$165**	**$207**

3 Market barriers and flaws in CRR auction design

This section explains several factors that are likely to help explain the very poor performance of the CRR auction from the perspective of ratepayers. These include:

- CRRs are not consistently defined products in both the auction and day-ahead market.
- CRR auction participants can profit from better information on difference in the way CRRs are defined in the auction versus the day-ahead market – without increasing efficiency or adding any value to ratepayers or other market participants.
- Ratepayers face significant limitations to bidding in auctions
- Buyers do not have an incentive to bid auctioned CRRs up to their expected value

These represent fundamental flaws that cannot be eliminated under the current market design. The last section of this paper discusses how these flaws could be addressed through a voluntary market for price swaps between willing buyers and sellers. However, this option should only be pursued if policymakers believe that the benefits of facilitating price swaps warrant or require intervention by the ISO, rather than allowing price swaps to occur through private mechanisms as occurs with other commodities.

CRRs are not consistently defined products in both the auction and day-ahead market.

In the monthly CRR auction, the ISO uses a transmission model developed at least several weeks, and as much as a month, prior to the relevant day-ahead market hour. The ISO conducts the seasonal CRR auctions at the end of the year prior to the settlement year. Many outages "…cannot be known until real-time operations…" and these outages can "…change the system configuration and result in different shift factors…" than used in the auction.[18] Different limits and network configurations are possible and likely. "Therefore, it might be that the assignment [of CRRs] is not, in all circumstances and under all conditions, actually feasible."[19]

When CRRS are auctioned based on a network model that is not feasible given the model actually used in the day-ahead market, this can cause revenue inadequacy. However, the use of different network models in the CRR auction and day-ahead market creates a more basic issue than revenue inadequacy. Different models mean the CRR product is defined differently in the CRR auction than in the day-ahead market. A CRR holder buys a specific bundle of forward contracts in the auction. But the CRR holder can be paid the day-ahead prices for a different bundle of forward contracts. The product purchased in the CRR auction is not the same product settled in the day-ahead market. Because the day-ahead market network model is not and cannot be known when the auction is run, it is uncertain what transmission constraint prices the CRR will settle on in the day-ahead market.

Consider a case where the ISO introduces a completely new constraint (Constraint A) into the day-ahead market. When Constraint A is binding in the day-ahead market, it increases payments to a CRR. When

[18] Bautista Alderete, Guillermo. "FTRs and Revenue Adequacy" in Financial Transmission Rights: Analysis, Experience and Prospects. Springer 2013. Edited by Juan Rosellón and Tarjei Kristiansen, p. 253.

[19] Harvey, Scott M, William W Hogan, and Susan L Pope. 1997. *Transmission Capacity Reservations and Transmission Congestion Contracts.* Cambridge, MA: Harvard University, p. 62 of the version at: http://www.hks.harvard.edu/fs/whogan/tccoptr3.pdf.

the ISO pays the CRR holder for the entire difference in day-ahead market congestion prices between the source and sink nodes, the ISO pays the CRR holder for a forward contract to the Constraint A which was not even modeled in the auction. The CRR holder is paid for this forward contract even though a forward contract to Constraint A was not purchased, or even offered, in the auction.

Under this scenario the ISO does not explicitly offer a forward contract for Constraint A in the auction, yet a forward contract for congestion on Constraint A is actually available. The CRR will be settled on the entire day-ahead market source-sink price difference, which includes the day-ahead market transmission price for Constraint A. This CRR is a different bundle of forward contracts in the auction than it is in the day-ahead market. At the time the CRR auction is held, it is not clear what constraints will be enforced in the day-ahead market. Therefore, it is not clear what forward transmission right contracts are actually available in the CRR auction.

Similar problems occur when the ISO models a constraint differently between the CRR auction and day-ahead market. Consider a 100 megawatt CRR whose source and sink locations both have .10 shift factors to another transmission constraint (Constraint B). The holder of this CRR would purchase zero net megawatts of forward contracts to Constraint B. If in the day-ahead market model the sink shift factor to Constraint changes to 0.05, while the source shift factor remains .10, the CRR holder would be paid for 5 megawatts of forward contracts to Constraint B at the day-ahead market price. Again the CRR holder never purchased forward contract for Constraint B. Different transmission models, as defined by different shift factors in the CRR model and day-ahead market model, can create the same or similar problems as non-modeled constraints.

CRR auction participants profit from better information on modeling differences without adding any efficiency or value to the market

Paying auctioned CRRs based on the full day-ahead market congestion price differences between the source and sink nodes is like allowing buyers to purchase regular gasoline now to sell at premium prices later. The network model in the auction is public information to the CRR auction participants. Auction participants can compare the public CRR auction model to their private estimates of the multiple network models over the month or season in which the auctioned CRRs will settle. An auction participant may find CRRs modeled in the auction as lower value, "regular," that the participant models as higher value, "premium." Profit maximizing participants will bid to obtain CRRs modeled in the auction as regular but which they anticipate to be premium.

Similar use of superior private information to bid into auctions has been studied in construction contract, government procurement, timber, and online advertisement auctions.[20] These studies show that the use of superior private information in auctions with inconsistently defined products can result in decreased auction revenues relative to the value of the product actually being auctioned.[21]

[20] As examples see:

Athey, Susan, and Jonathan Levin. 2001. "Information and competition in US Forest Service timber auctions." *Journal of Political Economy*: http://web.stanford.edu/~jdlevin/Papers/Skewing.pdf.

Agarwal, Nikhil, Susan Athay, and David Yang. 2009. "Skewed Bidding in Pay Per Action Auctions for Online Advertising" *The American Economic Review*: http://economics.mit.edu/files/10630.

[21] For procurement auctions it can result in increased payments to the auction participant relative to the value of the product or service procured.

A simple example CRR auction illustrates how a CRR auction participant can profit from having better estimates of the actual day-ahead market shift factors. The example auction has one constraint (Constraint X) with a 10 MW limit. Table 4 shows the auction bids, auction shift factors, actual day-ahead shift factors and actual day-ahead shadow value for Constraint X. Two auction participants (Company Y and Company Z) expect a $30/MW shadow value for Constraint X which equals the actual day-ahead market shadow price.

Table 5. Example of CRR auction with shift factors different than day-ahead market

Bidder	CRR Name	CRR Bid		Cleared CRR MW	Net Shift Factor		Bid Price Per MW		DA Mkt S.V.
		Price	MW		Auction	DA Mkt	Auction	Actual	
Company Y	A-C	$3.00	150	0	0.10	0.10	$30.00	$30.00	$30.00
Company Z	B-C	$3.10	150	100	0.10	0.15	$31.00	$20.67	$30.00

Company Y does not have better estimates of the day-ahead shift factors than the auction. Company Y wants a CRR between locations A and C, and bids the expected price difference between A and C of $3.00/MW. This equals the $30/MW value of the forward contract for Constraint X.

Company Z has better estimates of the day-ahead market shift factors. Company Z expects the actual day-ahead market net shift factor difference between locations B and C will be .15 and not the .10 modeled in the auction. Company Z bids $3.10/MW for CRRs between B and C. Company's bid appears to be $31/MW for forward contracts on Constraint X in the auction. Because $31/MW is greater than $30/MW Company Z is awarded all 10 MW of forward contracts on Constraint X (100 CRR MWs multiplied by the .10 shift factor). Company B pays ratepayers $310 in auction revenues (10 MWs multiplied by $31/MW).

But Company Z did not actually buy 10 MW of forward contracts on Constraint X. Because the actual net shift factor is .15, Company Z really bought 15 MW of forward contracts on Constraint X. Company Z's CRR is not a "regular" CRR with a 10 MW forward contract. Company Z's CRR is a "premium" CRR with a 15 MW forward contract. Ratepayers pay Company Z $450 in the day-ahead market (15 MW multiplied by the $30/MW day-ahead shadow value for Constraint X). Company Z's profits are $140 ($450 minus $310). Ratepayers lose $140 because they received $310 in auction revenues but paid Company Z $450 when settling the forward contract.

Company Z actually bids only $20.67/MW of Constraint X forward contracts ($310 divided by 15 MW). Company Z's bid appears to be $31/MW because the auction used the wrong shift factors and it appeared Company Z was only buying 10 MW. But Company Y is actually the highest bidder. Company Y's $30/MW bid is higher than Company Z's $20.67/MW bid. If the correct net shift factor for Constraint X had been used, Company Y would have won all the Constraint X forward contracts in the auction. Because the CRR auction uses different shift factors than the day-ahead market, the actual highest bidder does not win the forward transmission right contracts in this example CRR auction.

Ratepayers face significant limitations to bidding in auctions

The ISO determines the initial set of CRR forward contracts that ratepayers must offer at a $0 reservation price through the transmission limits set by the ISO in the CRR auction. If ratepayers wanted to auction off less CRR forward contracts than the quantity implied by the auction's transmission limits, ratepayers would have to bid into the CRR auction to buy the forward contracts. Ratepayers could in theory set reserve prices for the CRR forward contracts. They could set reserve prices by submitting price sensitive demand bids to buy CRRs. However, ratepayers face significant limitations to transacting in the CRR auction.

The costs for individual ratepayers to enter the auction obviously outweigh the benefits. Load serving entities therefore participate in ISO markets on the ratepayers' behalf. But load serving entities do not have a direct monetary incentive to manage the ratepayers' CRR forward contracts in the auction. One reason for this is that load serving entities directly pass through to ratepayers any profits or losses from these CRRs that are passively auctioned off by the ISO on the ratepayers' behalf.

Load serving entities also face regulatory hurdles from managing these CRR forward contracts. For example, see the procurement plan passage below:

> As the Commission determined in Resolutions E-4135 and E-4122, [The LSE] uses CRRs and LT-CRRs to hedge against congestion costs (expected and anticipated). [The LSE] does not use CRRs and LT-CRRs for financial speculation.[22]

The above passage reflects the prevalent misunderstanding of the current CRR auction design. Under the current CRR auction design, if load serving entities do not participate in the auction at all, ratepayers will be engaging in risky financial speculation. This is because running a CRR auction with non-zero transmission limits forces ratepayers to offer to sell risky CRR forward contracts at a $0 reservation price.

Regulations such as those cited in the passage above result in load serving entities not being able to purchase CRR forward contracts at auction. As a result, load serving entities cannot use explicit CRR purchases to help ratepayers avoid being forced to sell risky CRR forward contracts. Load serving entities can only bid for CRR forward contracts if they expect to use these CRR contracts to offset specific expected congestion costs as approved by the utility commission. Load serving entity procurement plans contain similar passages for all three investor owned load serving entities in the ISO.[23]

To purchase or set reserve prices on the CRR forward contracts offered by the ISO at $0 reservation prices, load serving entities would also need to determine what CRR forward contracts are actually being offered. As previously described, because CRRs are inconsistently defined products between the auction and day-ahead markets, LSEs cannot easily determine the set of CRR forward contracts being offered in the CRR auction. Load serving entities would likely find it difficult to purchase or set reserve prices on the CRR forward contracts if they do not know what forward contracts are actually available.

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[22] *Pacific Gas and Electric Company Conformed Long Term Procurement Plan, Attachment A, Clean Public Version*, 2012, p.158: https://pgeregulation.blob.core.windows.net/pge-com-regulation-docs/BundledProcurementPlan-Public.pdf.

[23] *Southern California Edison 2015 General Rate Case Generation Volume 4 – Power Procurement* p.2: http://www3.sce.com/sscc/law/dis/dbattach5e.nsf/0/6A7265B21497F49F88257C210080D7A9/$FILE/SCE-02+Vol.+04.pdf
San Diego Gas and Electric Company's 2006 Long Term Procurement Plan, p.17: https://www.sdge.com/sites/default/files/regulatory/2006LTPP-Redacted.pdf.

Financial entities cannot be relied upon to bid auctioned CRRs up to their expected value

Ratepayers face significant economic, regulatory and technical hurdles restricting them from effectively bidding in the CRR auction. Therefore, ratepayers cannot effectively raise the reservation prices of CRR forward contracts auctioned by the ISO from zero up to ratepayers' willingness to sell.

However, CRR buyers competing for profitable CRRs might bid up the CRR prices. Because ratepayers are paid the auction revenue, they would receive the value of higher priced CRRs. If these CRR buyers compete by non-price methods, or transaction costs lower the buyers' willingness to pay, the auction prices they pay to ratepayers for the CRR forward contracts may not rise to expected CRR values.

Non-price competition for CRRs is any action to obtain profitable CRRs other than raising the prices paid for CRRs. For example, by creating better transmission modeling and forecasting tools CRR buyers can find CRRs that are undervalued or modeled differently in the CRR auction than in the day-ahead market.

Further, CRR auction participation is a complex undertaking:

> "…a typical FTR [a.k.a. CRR] desk has to deal not only with standard roles of trading financial products, but also the technical ones of power analytics. Building and operating a successful FTR business is a complex enterprise, with multiple factors to consider. Additionally, the still exotic nature of the product makes standard solutions from the trading industry difficult to use."[24]

To trade in the complex CRR auction many CRR buyers employ PhDs in electrical engineering. The complexity of CRR trading indicates that transaction costs are high. Transaction costs are the costs, other than actual CRR prices, of transacting in the CRR auction. Transaction costs are not only faced by the actual buyers in the auction but also potential buyers who did not enter the auction. Potential transaction costs for CRR auction participation may include:

- Obtaining technical knowledge of power flow analysis, finance, and CRR markets
- Obtaining knowledge specific to the ISO transmission system, outages, and operations
- Collateral requirements limiting total trades[25]
- Company risk management policies, particularly for companies whose main business is not CRRs
- Time and effort spent searching for modeling differences
- Opportunity cost of participating in other markets

CRR auction prices will likely fall as non-price competition and transaction costs increase. CRR buyers can also take advantage of having better and more flexible models of the day-ahead market models than the single model used in the CRR auction. With better models and better information, buyers can bid for CRRs they believe to be high value but which are modeled in the auction as low value. This is described in Section 4 above.

Any one of these or other factors may be preventing buyers from bidding CRR auction prices up to their expected value. The non-ratepayer CRR profits from CRRs are clearly large and consistent. Returns of over 100 percent are not consistent with a competitive auction.

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[24] Arce, Jose. "Trading FTRs: Real Life Challenges" in Financial Transmission Rights: Analysis, Experience and Prospects. Springer 2013. Edited by Juan Rosellón and Tarjei Kristiansen, p.271.

[25] Market participants must hold collateral for each megawatt of CRRs held as shown in *Business Practice Manual for Congestion Revenue Rights Appendix H. Credit Requirement* at: https://bpmcm.caiso.com/Pages/BPMDetails.aspx?BPM=Congestion%20Revenue%20Rights

4 Alternatives to the CRR auction

The ISO's day-ahead market is a centrally cleared market. In a centrally cleared market, power is not traded directly between market participants. It is sold *to the market* at the market price. Similarly power is bought *from the market* at the market price. The market price at any location is the locational marginal price. It follows that power is not shipped from one location to another. A CRR is not needed in order to have the ability or right to ship power between locations or for transmission access.

The demand for a hedge against locational price difference primarily comes from forward contracting on power prices. Suppliers, load serving entities marketers and financial entities trade these forward power contracts outside the ISO markets. A supplier may sell a forward power contact at a location different than the locations of any generation assets it controls. When this happens, the day-ahead settlement prices for the forward power contract and the generator's energy schedule will be different. The supplier will face an uncertain day-ahead price difference not hedged by the forward power contract. A supplier may be willing to buy a forward contract for the day-ahead price difference to hedge this uncertainty.

One alternative to auctioned CRRs would simply be a bilateral or exchange market for forward contracts for price differences between pairs of nodes. Forward contracts for price differences already exist in many markets today. They are called locational basis price swaps. A swap contract is relatively straight forward. The buyer of the swap pays the seller a price in the forward market. In return, the seller of the swap pays the buyer the spot price difference between two locations. Oren, Spiller, Varaiya and Wu detailed how pairs of forward contracts -- one contract at the "source" location and one at the "sink" location -- could be bought and sold to create a hedge on locational price differences with the same effect as a locational basis price swap.

Price swaps could be traded between willing counterparties either through an exchange or bi-laterally. Generators with forward power contracts at locations different than their generation assets would naturally benefit from decreased price differences between their power contract location and their generator location. The generators would be natural buyers of a locational basis price swaps.

Load serving entities with forward power contracts --and who own the day-ahead congestion rents -- would benefit from increased price differences between the power contract location and the generator location. Thus, a load serving entities could be a natural seller of a locational basis price swap. The same parties that benefit from trading forward power contracts could also benefit from trading forward contracts for price differences. Unlike a CRR forward contract, a price swap would be consistently defined in the forward market and day-ahead market. The buyer of the price swap purchases the right to be paid the day-ahead price difference between two locations by the seller. In the day-ahead market, the price swap seller pays the buyer this price difference. This is in contrast to a CRR which can be an inconsistently defined product because it can be a different bundle of forward contracts in the CRR auction than in the day-ahead market.

In a separate paper, DMM outlines several potential contract structures that can allow energy suppliers to hedge basis risk between the supplier location and trade hub reference prices using simple price swaps. Trade hubs give market participants a common reference price to settle forward contracts against and can increase the total potential trading partners available to energy suppliers and load

serving entities. Simple price swaps can be used to allow suppliers to hedge basis risk while contracting at trade hubs.[26]

There is no clear rationale for the ISO to offer forward price swaps. However, policy makers may determine that there are benefits to having the ISO provide a market for price swaps. Financial swap exchange markets external to the ISO or facilitated by the ISO would result in *markets* connecting willing buyers and sellers. Alternative markets should produce prices reflecting participants' willingness to trade. This is in contrast to the current CRR auction – which allows entities to buy forward contracts from ratepayers even though these ratepayers (or their load serving entities) have not offered to sell such contracts into the auction. A market based only on trades between willing participants would also greatly reduce the potential for large wealth transfers from ratepayers to other participants. With these alternative markets any generator, marketer, financial entity, or load-serving entity could buy or sell forward contacts to hedge or speculate on locational price differences.

[26] Department of Market Monitoring "Market alternatives to the congestion revenue right auction" November 27, 2017: http://www.caiso.com/Documents/Market_Alternatives_CongestionRevenueRightsAuction-Nov27_2017.pdf