CRR Prices and Pay Outs: Are CRR Auctions Valuing CRRs as Hedges or as Risky Financial instruments?

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Briefing on Analyzing Congestion Revenue Rights Auction Valuation

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TOPICS

- Valuation of Financial Transmission Rights
- Empirical Analysis
- Potential Sources of Low CRR Auction Valuation
- Identifying Causes of Low CRR Valuation

VALUATION OF FINANCIAL TRANSMISSION RIGHTS

If positively priced financial transmission rights are held at the margin by load serving entities, generators or traders that use the financial transmission rights to hedge congestion charges they could incur in covering forward financial contracts, or in covering physical or financial load serving obligations, then we expect financial transmission rights auction prices to exceed by at least a little the expected payment to the financial transmission right holder, taking account of time value of money costs and other costs imposed on financial transmission right holders.

Conversely, if positively priced financial transmission rights are held at the margin by financial market participants that do not use them to hedge other positions, the financial transmission rights will be valued to provide a return to holding them, i.e. as risky financial instruments, and the auction price will reflect a discount to the expected day-ahead market pay out.

VALUATION OF FINANCIAL TRANSMISSION RIGHTS

In order for market participants to be willing to hold negatively priced, counter flow financial transmission rights, those financial transmission rights must be priced such that the auction price, taking account of the time value of money and other charges imposed on financial transmission right holders, exceeds the expected day-ahead market congestion charges.

- This is an efficient outcome and consistent with a risk shifting role for financial transmission rights, as long as the entities holding the negatively priced financial transmission rights have sufficient financial resources to cover their potential liabilities. [1]

1. The purpose of financial transmission right collateral policies is to ensure that potentially negatively valued financial transmission rights are held by entities that have sufficiently financial resources to cover their potential liabilities. Excessive collateral policies will, however, reduce auction prices on positively priced financial transmission rights requiring collateral and could raise the prices of some negatively priced financial transmission rights.

EMPIRICAL ANALYSIS

Assessing whether positively priced financial transmission rights are being valued in auctions as risky financial instruments rather than as hedges is not straight forward.

- We do not observe the expected payment to financial transmission right holders, we observe the actual payment, which reflects the impact of uncertainty.
  - Day-ahead market payouts on a given financial transmission right can vary radically from month to month, reflecting the highly variable congestion they hedge.
  - Day-ahead market payouts are also unpredictable, so that the relationship between the auction price and day-ahead market payout can vary greatly from month to month.
- In addition, depending on ISO payment terms and charges for financial transmission rights, there may be time value of money costs and other charges to take into account in making such comparisons.

EMPIRICAL ANALYSIS

Because CRR prices are set by auction constraint shadow prices, all possible CRR source sink pairs (FTRs and TCCs) are priced in every auction.

- Hence, even if no one purchases a CRR between a particular source and sink in a particular auction, its price is determined in the auction based on its flow impact on binding constraints, so one can calculate a historical time series of auction prices for any hypothetical CRR source and sink.

- One can also calculate the historical day-ahead market payout to any hypothetical CRR source sink pair.

- This allows one to calculate a time series of auction prices and payouts for any hypothetical CRR source sink pair.

EMPIRICAL ANALYSIS

I have from time to time updated a time series of auction prices and day-ahead market payouts for benchmark CRRs in New York ISO and PJM.

- 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 these particular TCCs and FTRs being valued as hedges, priced at a premium to the expected payout, even without accounting for charges imposed on FTR and TCC holders.

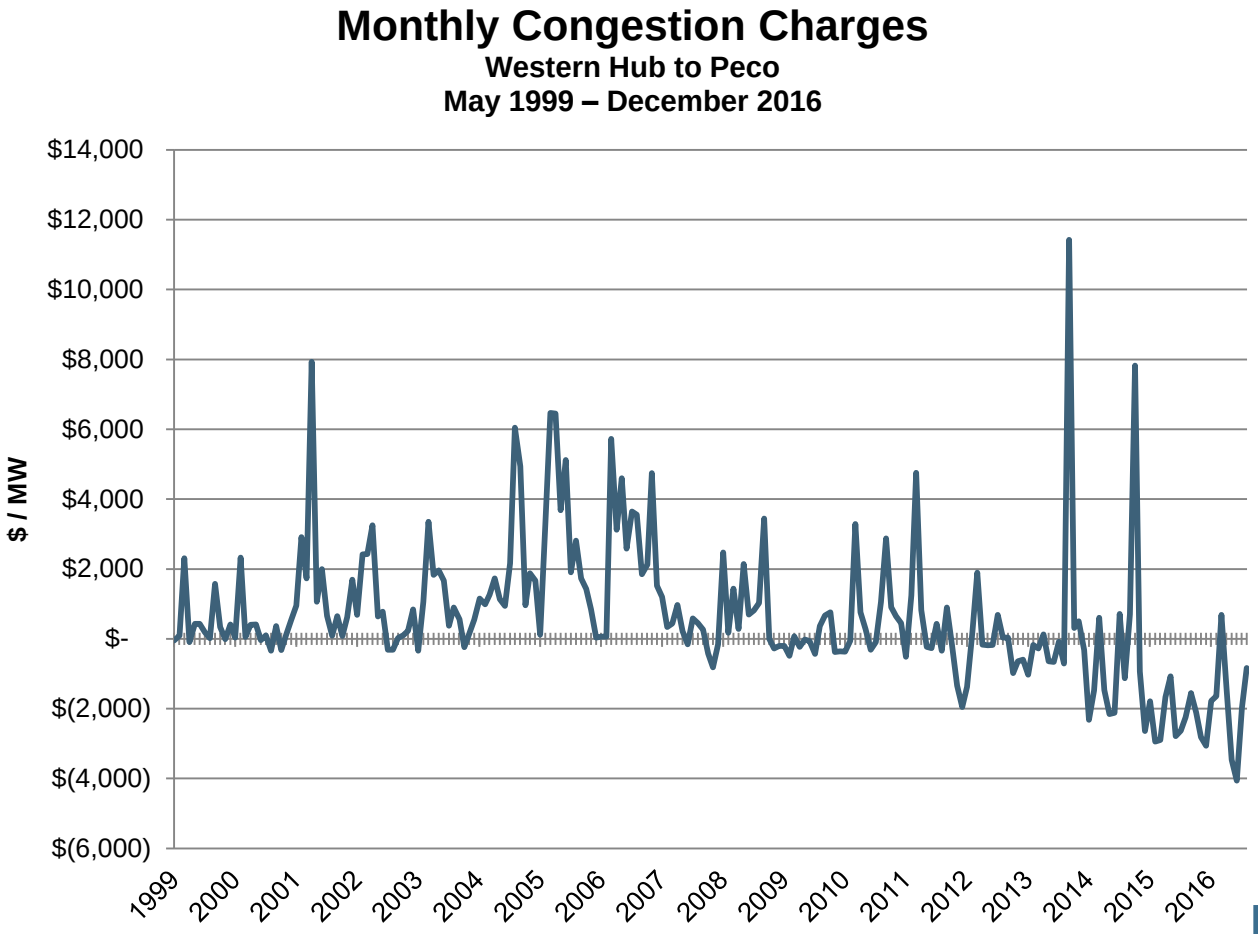
EMPIRICAL ANALYSIS

- The monthly auction price of a New York ISO Zone G to Zone J TCC has averaged 115.5% of the day-ahead market payout over the period January 2012 through December 2016.
- The monthly auction price plus schedule 1 TCC charges of a New York ISO Zone G to Zone J TCC have averaged 117.7% of the day-ahead market payout over the period January 2012 through December 2016.

These valuations do not imply that all TCCs and FTRs are being valued as hedges in auctions, but they provide clear evidence that some TCCs and FTRs are being valued as hedges.

EMPIRICAL ANALYSIS

Historical PJM data illustrate the variability of day-ahead market congestion charges and day-ahead market FTR payments. This variability is the reason load serving entities often want to hold congestion hedges.



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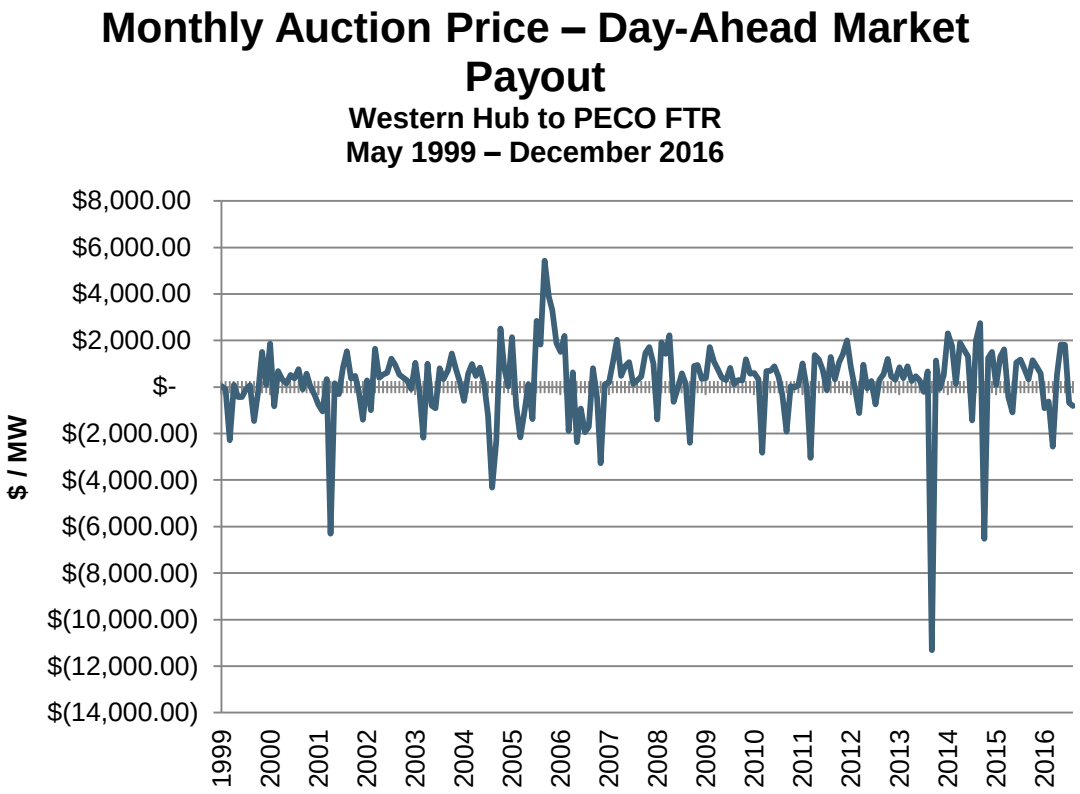
EMPIRICAL ANALYSIS

Historical PJM data also illustrate the unpredictability of day-ahead market payments. The monthly auction price can turn out to be much higher or lower than the actual day-ahead market payout.



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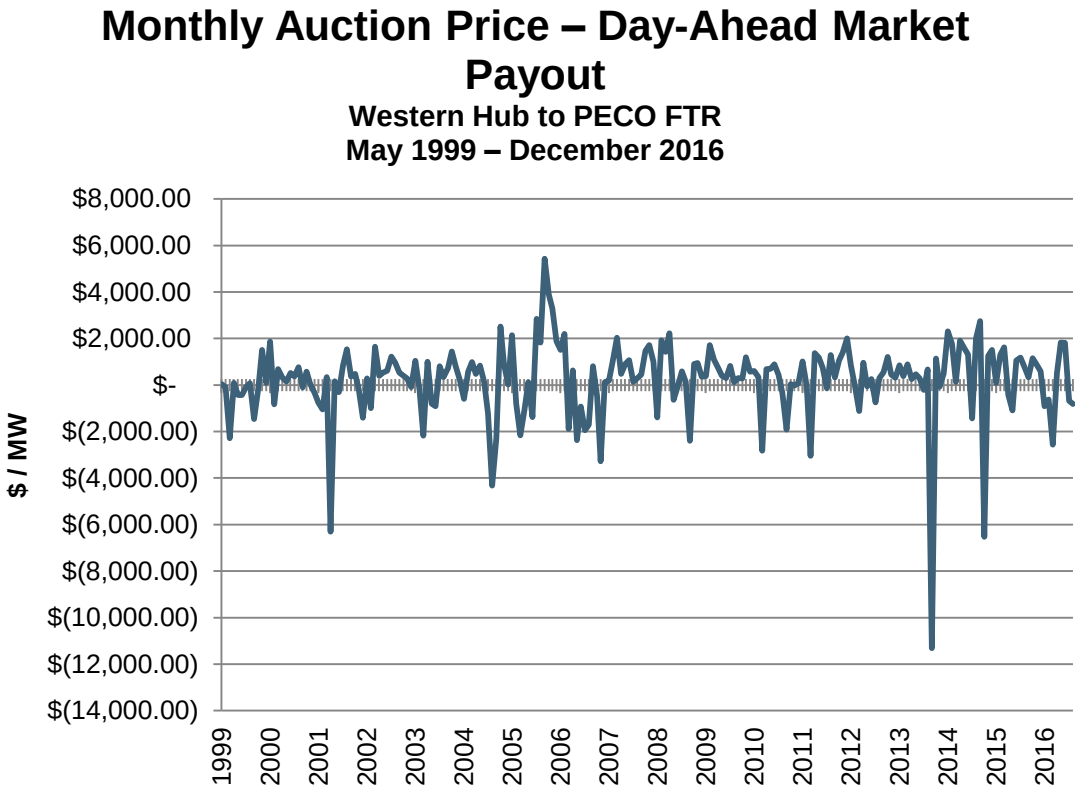
EMPIRICAL ANALYSIS

In light of the unpredictable variability of congestion charges, comparisons of past auction revenues and day-ahead market payouts need to be carried out over a sufficiently long period of time to allow valid conclusions to be drawn regarding the underlying relationship, given the historic variability in auction prices and day-ahead market payouts.



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EMPIRICAL ANALYSIS

These kinds of historical tabulations of auction prices and day-ahead market payouts for financial transmission rights between significant trading and load serving locations provide insight into the auction valuation of particular financial transmission rights that are likely to be used for hedging.

They do not assess the overall relationship between auction values and day-ahead market payouts.

EMPIRICAL ANALYSIS

Because all possible CRR source sink pairs (FTRs and TCCs) are priced in every auction, even if no one purchases a CRR between that source and sink in the monthly auction, one can also value the CRR source sink pairs sold in seasonal auctions at monthly auction prices and compare the monthly auction value of all CRRs to the total day-ahead market payout.

- Basing a comparison on monthly auction prices minimizes the impact of time value of money costs on auction prices and increases the number of independent data points.
- As observed above, the average relationship between auction prices and day-ahead market payouts is impacted by the considerable month to month variability in the auction payout, even if the comparison is based on monthly auction prices.

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EMPIRICAL ANALYSIS

The impact of the variability and unpredictability of day-ahead market payouts on the observed relationship between auction prices and day-ahead market payouts can be accounted for by examining the relationship over a sufficiently long period of time that the actual returns should converge around the expected return.

- This convergence will be much greater using monthly than seasonal or annual auction data.

- One can estimate statistical models of the relationship between monthly CRR auction revenues and day-ahead market payouts over a multi-year period and assess the probability that any observed difference between auction revenues and day-ahead market payouts is consistent with the variability of day-ahead market payouts relative to monthly auction prices.

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EMPIRICAL ANALYSIS

Hence, the question: Are the CRRs cleared by the California ISO in monthly and seasonal auctions sold at prices reflecting a risk premium consistent with their use by load serving entities, generators and traders to hedge risk or do their prices reflect a risk discount, implying that at the margin CRR buyers require a return to hold the CRRs?

- The California ISO Department of Market Monitoring has carried out several comparisons of CRR auction revenues and day-ahead market payouts.[1]
- While these comparisons are impacted by time value of money costs because not all CRRs are valued using monthly auction prices[2] and they do not account for charges on CRR holders,[3] the comparisons suggest that at least some CRRs are being valued at the margin as risky financial instruments.

1. California ISO, Department of Market Monitoring, 2015 Annual Report on Market Issues & Performance, pp. 177-190.
2. If it turned out that the difference between the monthly and seasonal auction valuation was too large relative to the time value of money benefit to rate payers, this would suggest a need to focus on the structure and settlement terms of the seasonal auctions.
3. The CRR Services Charge (section 11.22.2.5.3) and the much smaller Bid Segment Fee and CRR Transaction Fee (sections 11.22.5 and 11.22.6).

CRR VALUATION ISSUES

Why might some or all CRRs be purchased at prices indicating that the CRRs are being valued as risky financial instruments rather than as hedges?

- Lack of hedging demand for some or all CRRs sold in the auctions?
- Lack of competition in hedging demand for CRRs sold in auctions?
- Auction modeling issues?

CRR VALUATION ISSUES

While CRRs hedging source sink pairs with risky, unpredictable congestion charges may be purchased by hedgers at a premium to the expected day-ahead market payout, some potential hedgers in California ISO markets may lack incentive to buy CRRs on paths with little congestion or very predictable congestion.

- Absent sufficient hedging demand, CRRs creating flows on constraints on these paths would be valued as risky financial instruments and priced at a discount to the day-ahead market payout.
- If a significant proportion of the load serving entities in the market are not risk averse because they can pass through congestion charges to their rate payers, the marginal CRR buyer could be a financial market participant that would value CRRs as risky financial instruments.
- If a significant proportion of the load serving entities in the auction are regulated entities able to pass through congestion charges but exposed to regulatory risk on CRR purchases, CRRs may at the margin be purchased and valued as risky financial instruments rather than as hedges.

CRR VALUATION ISSUES

Lack of hedging demand for some or all CRRs in the auction?

- The design of CRRs serves to hedge CRR holders against congestion even when particular CRRs are infeasible on the day-ahead market grid.
- This design provides load serving entities with a better congestion hedge but can eliminate the need of hedgers to buy CRRs between some sources and sinks that have positive expected day-ahead market payouts (the CRRs create flows on constraints that bind when there are transmission outages), because these CRRs individually do not hedge load serving entity congestion costs.
- If the potential return was large enough, these CRRs would be purchased by other market participants who would value them as risky financial instruments on which they would expect to earn a return for taking on that risk.

CRR VALUATION ISSUES

Lack of competition in hedging demand in the auction?

- If the number of entities seeking or able to buy congestion hedges that create flows on particular constraints is small, they may be able to buy CRRs at a discount to the actual day-ahead market payout.
- If some entities have superior information regarding transmission flows or outages, they may be able to buy CRRs at a discount to the actual day-ahead market payout.

Such a lack of competition can be endogenous on some constraints. External entities entering into delivered price contracts may not do so if they cannot hedge the associated congestion charges so day-ahead market flows and congestion charges could be lower if the CRR holder was not able to hedge the contract with CRRs.

CRR VALUATION ISSUES

Are there auction modeling issues involving constraints that do not bind at the level of hedging flows that clear on the auction grid because of modeling issues, but that bind in the day ahead market, resulting in low auction prices for CRRs with significant day-ahead market payouts.

- Constraints not modeled or enforced on the auction grid?
- Differences in grid configuration between auction model and day-ahead market?
- Differences in modeled loss flows between the auction model and day-ahead market?

CRR VALUATION ISSUES

A factor that needs to be kept in mind in assessing the relationship between the hedging activity of market participants and the marginal valuation of FTRs based on net auction revenues is that an increase in FTR payout in an auction can have two sources:

- A market participant could acquire an FTR that will receive a net payment in the day-ahead market creating additional FTR flows on a constraint that was not binding in the auction;
- A market participant could sell an FTR that would have required a net payment by the market participant in the day-ahead market, reducing FTR counterflows on a constraint that was not binding

In some cases, a material portion of the overall difference between FTR auction value and FTR payments is due to negatively valued FTRs being sold, i.e. counterflow bought back, at a discount to the day-ahead market payments.

VALUATION OF FINANCIAL TRANSMISSION RIGHTS

If empirical analysis indicates that CRRs in aggregate are currently valued at the margin as risky financial instruments, rather than as hedges, this raises a number of questions:

- Is this the case for all CRRs sold in auctions or is it generally the case only for certain types of CRRs?
- What are the reasons for this low valuation?
- Is there a reason this low valuation is an appropriate outcome?
- If the low valuation it is not an appropriate outcome, what changes should be implemented in the CRR auction or market design?

The discussion which follows focuses on how to gain insight into the answers to the first and second questions.

IDENTIFYING VALUATION ISSUES

While the kind of time series comparisons of overall auction revenues and day-ahead market payouts described above are useful in assessing whether CRRs in aggregate are valued at the margin as hedges or as risky financial instruments, they do not provide insight into whether there are particular types of CRRs that are valued as risky financial instruments nor shed light on why expected day-ahead market payouts might be higher than the auction price.

IDENTIFYING VALUATION ISSUES

A threshold issue is whether low CRR auction values may reflect a lack of load serving entity hedging incentives or the presence of regulatory risks for load serving entities acquiring CRRs in auctions. Insight into the impact of load serving entity behavior on CRR valuation can be gained by examining the auction value and day-ahead market revenues for CRRs awarded in the allocation process:

- Calculate the value of allocated CRRs at monthly auction prices plus CRR holding charges;
- Calculate the day-ahead market payout on allocated CRRs;
- Are allocated CRRs awarded to load serving entities valued at the margin in monthly auctions as hedges or as risky financial instruments?

IDENTIFYING VALUATION ISSUES

The next analytical step is to assess whether there are particular constraints that appear to be the source of low auction revenues relative to day-ahead market payouts.

IDENTIFYING VALUATION ISSUES

The auction shadow price and day-ahead market payout are known for all constraints and can be compiled and compared.

- It is slightly more complex to calculate the priced CRR flow on the auction grid and the priced CRR flow on the day-ahead market grid but this can also be done.
- The priced CRR flow is the flow calculated using the generation shift factors for the source and sink on the transmission constraint, it does not include the loss flow in the AC model, which is not priced.
- This analysis should include nodal constraints, as well as conventional transmission constraints.
- If the CRR auction is cleared using an AC model, it is helpful to also compile the auction AC CRR flow and auction limit for each constraint.

IDENTIFYING VALUATION ISSUES

With the constraint shadow prices compiled and priced CRR flows calculated, one can then compare for each constraint that bound in the day-ahead market:

[1] monthly auction shadow price constraint i
– Σ day-ahead market shadow price constraint i

Or [2] monthly auction shadow price constraint i
* CRR flow auction grid constraint i
– Σ day-ahead market shadow price constraint i
* CRR flow day-ahead market grid constraint i

IDENTIFYING VALUATION ISSUES

With such a constraint by constraint comparison of auction prices and payouts, one can readily identify any constraints that are consistently under valued in the monthly auction.

- An initial focus would be on identifying constraints that did not bind in the auction, and hence had an auction shadow price of zero and generated no auction revenues.
- A constraint could have a zero shadow price because the constraint was not modeled in the auction, because it was modeled but not enforced, or possibly because the limit was materially overstated.
- Nodal constraints might be a category of constraint that bound in the day-ahead market but were not enforced in the auction.

These kinds of omissions in the auction model can be readily corrected once they are identified.

IDENTIFYING VALUATION ISSUES

For the constraints with day-ahead market payouts materially in excess of the auction revenues, it would also be desirable to examine differences in priced CRR constraint flows in the auction model and day-ahead market model in hours with large payouts.

- Differences in priced constraint flows could reflect changes in grid configuration due to outages in the day-ahead market;
- Differences in priced constraint flows could also reflect explicit or implicit differences in the modeling of loss flows between the auction and the day-ahead market.

Such modeling differences could result in CRRs that generate payouts in the day-ahead market but have no value as a hedge for load serving entities and hence would be valued as risky financial instruments. The equilibrium auction prices of such CRRs would be further depressed to the extent that costly analysis was required to identify them.

IDENTIFYING VALUATION ISSUES

The CAISO could also break down the day-ahead market payouts and CRR flows by hours with an AC solution in the day-ahead market and hours with a DC solution in the day-ahead market.

Large differences in constraint flows and day-ahead market payouts between hours with AC and DC solutions in the day head market would be an indicator that the high payouts might be related to differences in loss modeling between the auction and day-ahead market.

IDENTIFYING VALUATION ISSUES

A constraint could have a zero shadow price in the auction yet be at the limit in the auction if there is a parallel line which also bound with a non-zero shadow price.

- These situations can often be analyzed by examining whether the OPF CRR flows in the auction were equal to the auction limit, with the auction shadow price equal to zero because a parallel constraint also bound.

- In this situation, the assessment of constraint valuation needs to take account of the auction price and day-ahead market payout to both constraints.

IDENTIFYING VALUATION ISSUES

It is also possible that a constraint could not bind in the auction yet bind in the day-ahead market because of:

- Unexpected generation or load patterns in the day-ahead market,
- Transmission outages that cause different constraints to bind in the day-ahead market than in the auction.
- Limits on sources or sink that can be used in the auction that prevent auction participants from buying CRRs that create flows on particular constraints. [1]
- Limits on the ability of regulated load serving entities ability to buy CRRs from sources that create flows on that constraint.

1. Limits on the sources or sinks that can be used in the allocation process can also reduce demand in the auction if some load serving entities are constrained from fully participating in the auction.

IDENTIFYING VALUATION ISSUES

Another topic for examination would be the extent to which constraints with persistent differences between the auction valuation and the payout are either constraints on tie lines or constraints that are materially impacted by imports or exports on the ties.

- Are large day-ahead market payouts associated with transmission line outages scheduled by the balancing authority area operator?

- Are the CRRs sourcing or sinking at proxy buses hedging sales for which there may be a limited number of interested parties and limited competition to buy CRRs over some paths?

- Are there limits on the ability of regulated load serving entities to acquire CRRs sourcing at these proxy buses in either the allocation or auction processes?

IDENTIFYING VALUATION ISSUES

It is also possible to identify all CRRs creating flows in excess of a threshold level on undervalued constraints and calculate the CRR price, CRR payout, CRR auction flow, and CRR holder for each such CRR.

- Is the constraint undervalued but the CRRs creating flows on the constraint properly valued because they bound on other constraints in the auction that bound at lower shadow prices in the day-ahead market?
- Are the undervalued CRRs held by a physical market participant that is likely using the CRRs for hedging but may not face competition from other physical market participants seeking CRRs that would create flows on the constraint?
- Are CRRs creating flows on a constraint and sinking at LAPs undervalued, suggesting that LSEs lack an incentive to hedge or face regulatory disincentives to purchase CRRs in the auction?
- Are the CRRs creating flows on the constraints sinking at LAPS appropriately valued but there are other CRRs that do not sink at LAPS or SubLaps and do not cause material flows on any other constraints that consistently sell at a substantial discount to the average day-ahead market payout.

IDENTIFYING VALUATION ISSUES

There is a potential for constraints to bind in the day-ahead market but not in the auction because of differences between the auction and the day-ahead market in the nodal load weights used for CRRs sinking in LAPs, sub LAPs, and other aggregates of nodal buses.

- If the differences in nodal load weights are large enough and predictable enough, there could be a potential for market participants to acquire portfolios of CRRs that create little or no flow on a constraint in the auction but create flows on the constraint, and hence day-ahead market payouts, at day-ahead market load weights when that constraint binds.
- Analysis of CRR portfolios impacting profitable constraints would enable the CAISO to identify portfolios of CRRs that create little auction flow on constraints with large payouts.
- The day-ahead market payout of these CRR portfolios attributable to the constraint of interest could then be calculated.

IDENTIFYING VALUATION ISSUES

These analyses might:

- Suggest changes in the California ISO CRR allocation or auction process or modeling;
- Suggest further more detailed analysis of the modeling of particular constraints or CRRs in the auction;
- Suggest more detailed analysis of the modeling of CRR flows in the allocation and auction model.

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