



CRR Market Design in Nodal Markets

CAISO Working Group Meeting Addressing DMM Proposal on CRR Auction Design

Abram W Klein

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Appian Way Energy Partners

- Appian Way Energy Partners is a financial marketer trading CRRs, convergence bids and futures in ISO markets
- CAISO market participant -- began trading in December 2016
- Currently trades in six of the US ISO/RTO markets
- Active in market design discussions at ISOs and FERC with respect to price formation, competitive markets, transmission rights, convergence bidding and cost allocation issues
- Questions about this presentation? Feel free to reach out!

Abram Klein
Managing Partner
Appian Way Energy Partners
25 Mount Auburn Street
Cambridge MA, 02138
aklein@appianwayenergy.com
617-899-5022



Discussion Topics

- Background

- CRRs in LMP market design

- Remember Uniform/Zonal pricing vs. Nodal pricing?
 - CRR open access, liquidity and transparency plays a critical role in reducing the risk of contracting and making futures markets more efficient, benefiting consumers

- CRR liquidity and transparency important for Community Choice and retail access

- Consumers benefit from the ISO facilitating the development and operation of market mechanisms to manage congestion (for suppliers, marketers and LSEs)
 - Is there a metric for evaluating competitiveness of futures and retail markets? In well-designed markets, consumers may be better off with liquid markets for congestion management, regardless of CRR profitability. Congestion represents a very small share of wholesale power costs, but the ability to manage nodal pricing risk has a significant impact on the risk premium demanded for forward contracts

- Scoping

- Revenue Adequacy / CRR overallocation

- If more rights are allocated and auctioned than actual transfer capability, the artificial increase in supply would depresses the value of CRRs at auction. What is the scale of overallocation of CRRs? Other ISO markets have design elements to ensure financial rights sold do not exceed physical capacity of the grid

- Network model consistency

- More accurate CRR modelling would lead to a more efficient auction market result. To what extent are day-ahead contingencies and nomograms not modelled in the CRR auction? Can this be improved?

- Event-driven reasons for CRR profitability (drought, unexpected San Onofre outage, etc). Spot market CRR realized returns can reflect occurrence of low probability events which may be properly reflected in ex ante CRR market prices



Redesign of CRR Construct DMM Proposal

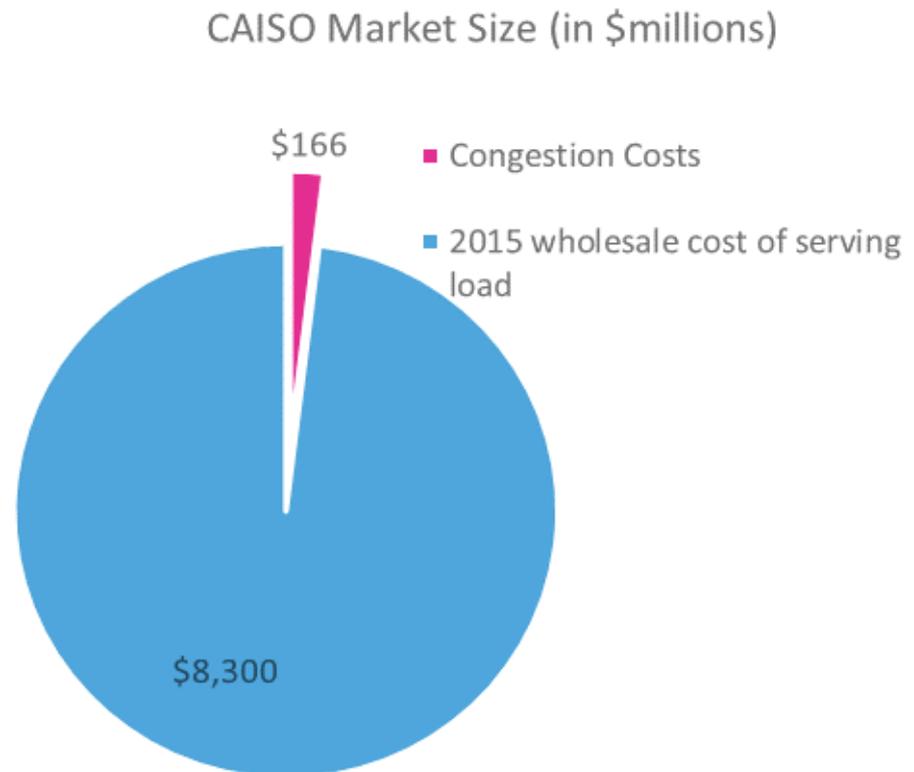
- DMM rationale:
 - CRR market is flawed because CRR market participants, in aggregate, are too profitable. If buyers of CRRs are making money, consumers must be losing that money – it's a zero sum game
 - Those who pay for the grid (i.e. consumers, mostly) are entitled to the value of the financial right to move physical power from low-priced to high-priced locations on the electric grid
 - CRR market should be redesigned to ensure that those who pay for the grid get all the money from congestion
- DMM propose allocating congestion rents directly to load instead of auctioning system transfer capacity to the highest bidders in the form of CRRs
- DMM proposal assumes that basis can be managed instead through a voluntary market of willing buyers and sellers of forward contracts. (Would withholding CRRs compromise liquidity and transparency in basis markets?)
- Bilateral markets already exist for market participants to directly trade basis hedges but these are illiquid other than NP15 and SP15, and do not facilitate competition at other locations
- Would loss of liquidity and transparency from CRR auctions ultimately harm consumers and the CAISO electricity market?



Regulatory Design

Congestion is a Small Part of Larger Electricity Market Structure, but CRRs are a Crucial Piece

- Congestion is a small part (2%) of the overall energy market
- Nevertheless, “getting the prices right” is essential for sending efficient market signals:
 - Short-term least-cost dispatch and efficient use of the transmission grid (ISOs report hundreds of millions in dispatch cost savings)
 - Proper long-term entry and exit decisions, demand response and transmission investments, contracting
 - Competitive market where consumers no longer wear the risk of genco investment decisions
- The ISO model with nodal pricing is the **ONLY** market design that accomplishes this and CRRs are a crucial aspect of this model



Purpose of Competitive Electricity Markets

Why do we have LMP/Nodal Pricing and CRRs?

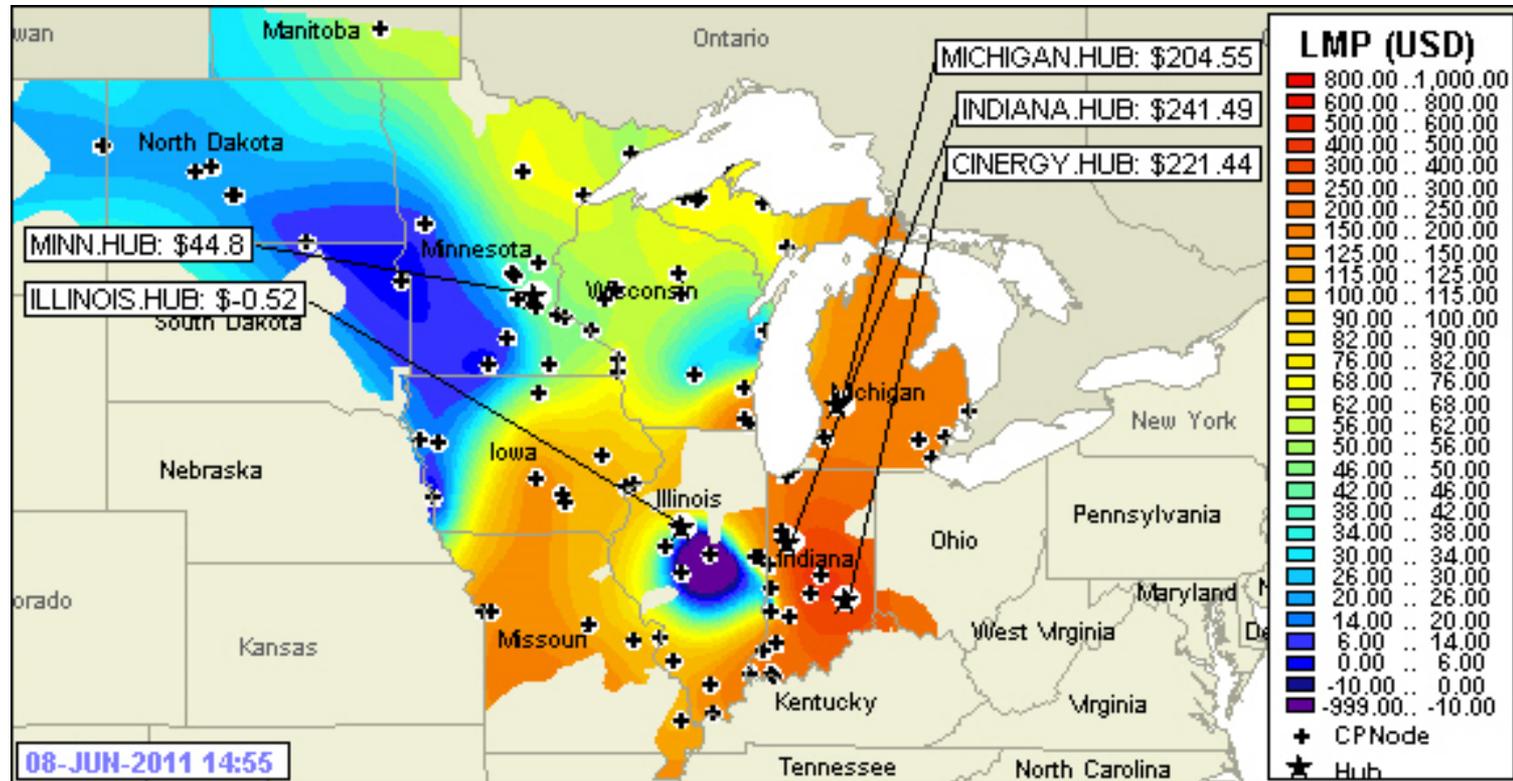
- A spot market in electricity has two principal functions:
 - **Maintain Efficient Short-Term Operations and Dispatch** – Least-cost and reliable dispatch to meet load given available resources in the hour/day; efficient usage of transmission capacity; largely independent of longer-term contract arrangements
 - **Facilitate Longer-Term Contracting and Competitive Entry** – Spot market reduces the risks of contracting; Allows contracting parties to sell “overs and unders” to meet their obligations at least cost/highest profits, facilitates entry by undiversified competitors, each of which can compete in the specific activity it does best without needing to be a self-contained, full-service producer; sends price signals regarding when and where new generation or transmission is needed
- Market design needs to get the first one right, not only in terms of efficient, least-cost dispatch and transmission usage, but also in creating the right signals to support the second function

ISO markets provide low transaction cost access to the spot market, efficient dispatch and efficient use of transmission. Transparent, reliable spot pricing creates a straightforward index against which to settle futures and contracts for differences



The 1st Market Design Debate: Nodal vs. Zonal vs. Uniform Pricing

Nodal “Too Complex” For Supporting Liquidity in Long-term Contracting?

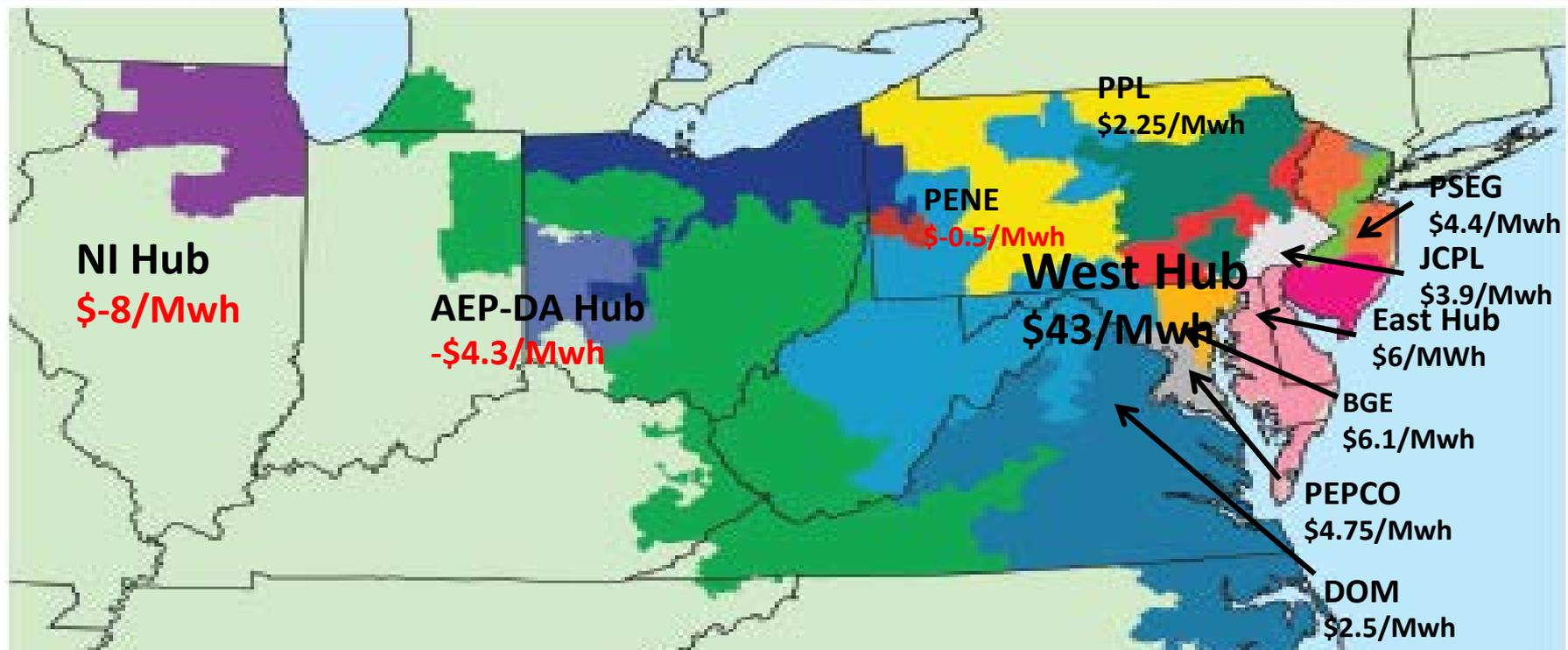


“CRRs” provide an answer that is a crucial market design element for competitive wholesale markets using locational pricing



Nodal Complexity Simplified With Traded Hubs & Zones; Augmented by CRR Markets

CRR market provides a “contestable market” for bilateral futures, enhancing competition, and reducing cost to consumers in retail markets



Nodal prices drive market expectations for CRR markets, and forward trading at zones and hubs. These forward prices become the basis for pricing in customer load auctions, and forward hedging. With high transparency, and increasing sophistication, customers who serve load become comfortable using CRR markets and the futures markets, in combination, to manage basis risk.



Retail Access and Community Choice

- If California expands community choice, aggregators will need a mechanism to manage the risk associated with their location. CRRs' ex post spot market profitability may not be the best measure of market design
 - The spot market assessment of value fails to account for the importance of CRRs in facilitating longer-term contracting and risk management. When LSEs meet their load obligations through forward contracts, we do not look back at the lower ex post prices and argue that they should not have hedged (in fact this type of flawed thinking was a primary cause of the 2000 California Energy Crisis, when California utilities were precluded from hedging)
 - The CRR auctions may yield a fair risk-adjusted expected value for congestion contracts at the time of the auction, but specific circumstances may result in the actual spot prices being different from expected values. For instance:
 - The "Polar Vortex" in 2014 impacted FTR (CRR) profitability in PJM. Based solely on CRR spot profits, auctioning CRRs was a horrendous choice. Yet the Polar Vortex was a great example of success for restructured electricity markets. Forward contracts and sophisticated risk management protected consumers and the availability of CRRs was an essential component
 - Likewise, unusual or unexpected hydro years or nuclear outages in California may have resulted in higher congestion revenues than expected at the time of the auction in the DMM Whitepaper study period. This could be an issue for the working group to analyze – it seems 2015-present have had more moderate CRR profitability



LMP Market Design

CRRs as a Market Mechanism for Managing Congestion

- Good Market Design with respect to CRRs:
 - A function of the collection of congestion rents in the nodal market (i.e. ISOs collect more \$\$ from load than is paid to suppliers). Locational prices ensure efficient transmission usage and proper short-run and long-run price signals
 - Allocates the financial right to physical transfer capacity on the electric grid to those who paid for it
 - Provides a market mechanism for managing congestion
 - PJM's white paper on options to address CRR revenue inadequacy states that PJM has an "**obligation** to ensure the development and operation of market mechanisms to manage congestion"
 - Especially in the Nodal Market, this is a crucial design element allowing market participants to hedge and creating the liquidity and transparency that are crucial to a well-functioning market
 - Supports open-access by:
 - Allocating the financial rights to those who value them the most while maximizing the revenue to those who paid for the grid
 - Establishing a well-defined settlement obligation that minimizes uncertainty
 - Is non-discriminatory
 - Allocating any shortfalls consistent with cost-causation



Background: Given Retail Competition, How Does the Competitive Market Manage Basis Risk?

- A well-functioning, efficient, liquid and transparent market for congestion management reduces risk to competitors, and costs for consumers!

State-Sponsored Competitive Full Requirements Service

Competitive Retail Providers



- Who values the congestion hedge most?
 - The LSE?
 - The competitive supplier?
 - The bank counterparty to the competitive supplier providing a basis hedge?
- What is the “correct” thing to do with allocated CRRs?
 - Keep them?
 - Keep the auction revenue instead?
 - Reconfigure to a different set of CRRs that better correspond to commercial needs?
 - Offer them to a financial intermediary in exchange for a fixed rate?
- How did the NJ market survive the Polar Vortex?

Background: Given Retail Competition, How Does the Competitive Market Manage Basis Risk?

- **CRRs facilitate lower cost to consumers (and suppliers) in forward-traded markets for congestion management!**

State-Sponsored Competitive Full Requirements Service

Competitive Retail Providers

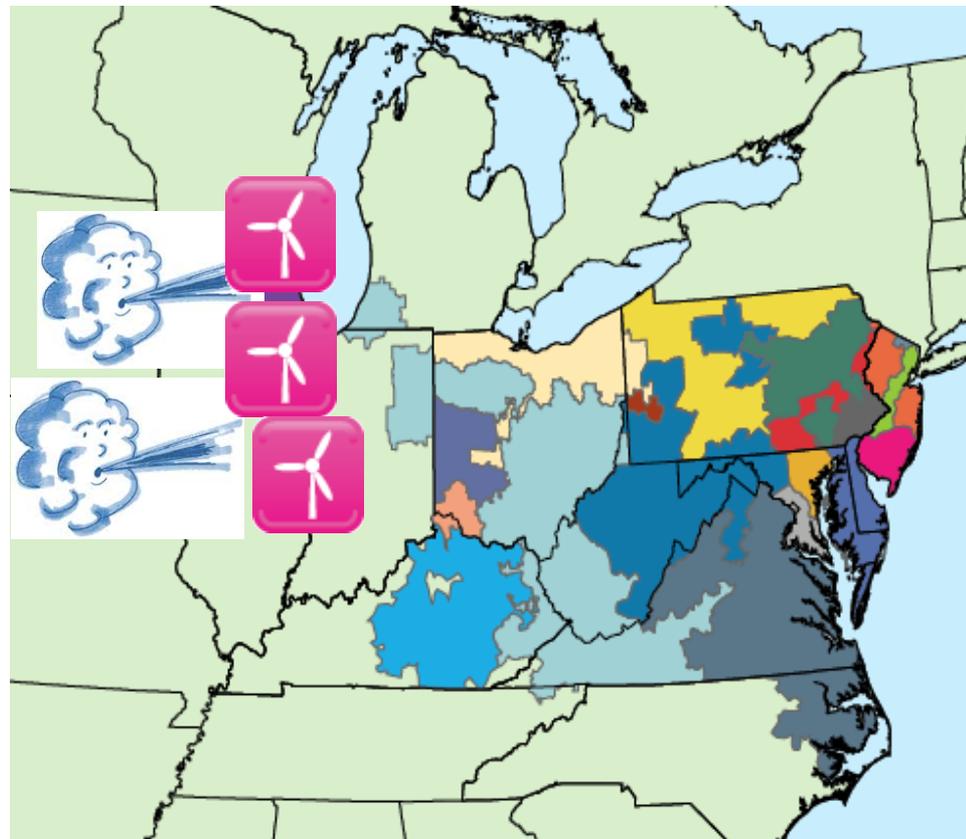


- What happens if congestion revenues are assigned directly to load with no CRR auction, or if the CRR product's integrity as a financial instrument is compromised?
 - Cost and risk premia for supplying illiquid locations go up
 - Generators' options for managing risk compromised
 - Market less robust weathering a polar vortex event or unexpected outage into a load pocket
 - Futures markets at congested zones more volatile and costly
 - With higher "risk," the competitive market price goes up, increasing cost to consumers and suppliers

A Thought Experiment On Transmission Rights Entitlement: CRRs as Critical Resource for Renewables

Consider the following hypothetical:

- Start with a system with limited congestion
- Add renewable generation in a wind/solar rich area of the grid, lowering prices for consumers
- Why should transmission customer be entitled to the resulting congestion rent which is not only caused by but also harming the beneficial renewable generation?
- Answer: Because we want efficient short-run price signals to send proper long-run incentives for investment
- The congestion rent is actually a windfall for load and a derivative of the nodal pricing mechanism
- But the ability to purchase the congestion hedge in the form of a CRR is extremely important to the renewable resource



ERCOT Looking to Expand the CRR Auction to Include a 3rd Year

- In contrast to the DMM proposal, ERCOT's Wholesale Market Subcommittee endorsed a proposal to add a third year to its CRR market (Megawatt Daily 1/12/17, p.5):
 - ...Eric Goff, Citi Energy director of regulatory affairs, said that adding the third year "is very important to allow for congestion hedging."
 - "We have long-term deals that are what makes this market function as it does, and being able to mitigate that risk to a greater degree is very important," Goff said. "It ... allows a market participant to enter or exit from a CRR position as a situation progresses. ... It provides price transparency with very low risk."
- Ability to manage basis is critical for financing and investment for new builds that may face congestion. CRRs provide a risk management mechanism for those offering a hedge to the new build or existing generators
- The mere existence of the market for CRRs allows market participants to know the tools exist for basis management and lowers risk premiums for forward contracting, as well as improving liquidity and transparency in the futures market. CRRs thus offer a "contestable market," that spills over to improve the competitiveness of the futures market



Scoping: Avoid Overselling CRRs

First Principles: Physical = Financial

Goal of allocation/auction that CRRs not exceed physical system capacity

- There is actually something magical about the optimal CRR auction quantity: it matches financial rights with physical quantity. Allocating less is withholding. Allocating more is overselling.
- Revenue Adequacy Theorem
 - As long as financial rights do not exceed the physical capacity of the system, then the ISO will always collect enough “congestion rents” from the operation of the spot market to fund the financial rights
 - Sources of revenue inadequacy:
 - Overselling the system / overallocation of congestion rights (perhaps due to long-term allocated CRRs)
 - Transmission outages or loop flows that reduce physical capacity on the system below the amount allocated
- CAISO market design appropriately funds CRR obligations fully
 - Certainty in the integrity of financial instruments supports the ISO’s role in ensuring the development and operation of market mechanisms to manage congestion
 - CRRs are more valuable as dependable financial instruments that can be relied upon to be worth their intended value (congestion differential between source and sink)
 - If CRRs are overallocated, this will depress CRR auction values and could be a source of market inefficiency and undo CRR profitability
 - An alternative approach is to auction only feasible CRRs. Infeasible CRRs could be prorated away (PJM), or compensated through an infeasible CRR uplift (MISO).
- Scoping questions: Are any infeasible CRRs allocated? What quantity? What is the dollar value at auction? What is impact on auction prices if infeasible CRRs were not sold? What impact if less transfer capacity offered in annual auction and more held back for the monthly auction?



Scoping: Model Consistency

Auction Model vs. Day-Ahead Model?

- A big contributor to CRR profitability may be CAISO's use of different day-ahead models and limits (especially ad hoc nomograms) than used in the CRR model
 - Operations engineers may create short-term constraints for controlling the day-ahead market (such as nomograms) in response to near-term system conditions and outages. If these constraints are not modelled in the auction, mispricing and revenue inadequacy (overselling transfer capacity) can result. Perhaps CAISO can develop a more systematic approach to match day-ahead market and auction constraints, reducing the lag between new DAM constraints and their inclusion in the CRR auction model
 - Market efficiency would be improved if the CRR model better incorporated the DA constraints
- Scoping question: Are there constraints that are not modeled or modelled differently in the CRR auction? How much CRR profitability is coming from these model differences? If differences result in revenue inadequacy, what are the policy options?



Scoping: Event-driven Congestion

- The CRR auctions may yield a fair risk-adjusted expected value for congestion contracts at the time of the auction, but specific circumstances may result in the actual spot prices being different from expected values. For instance:
 - Unusual or unexpected hydro years or nuclear outages in California may have resulted in higher congestion revenues than expected at the time of the auction in 2012-2014
 - Overall CRR profitability looked more reasonable in 2015 (\$45 million) or 23%. We believe the profitability was still lower in 2016 and the trend continues in 2017, but this data was not part of the DMM study period
 - Scoping questions:
 - What does the more recent data look like in 2016 and Q1 2017?
 - Were there particular reasons/events for the high level of CRR profitability in 2012-2014?
 - Can we see if forward market prices also failed to predict spot prices in 2012-2014
 - Can we measure whether withholding CRRs from the auction might have an impact on increasing the risk premia for basis hedges? Even a small increase would vastly outweigh the alleged benefit to load of withholding auction transfer capacity

