



Electricity Market Monitoring

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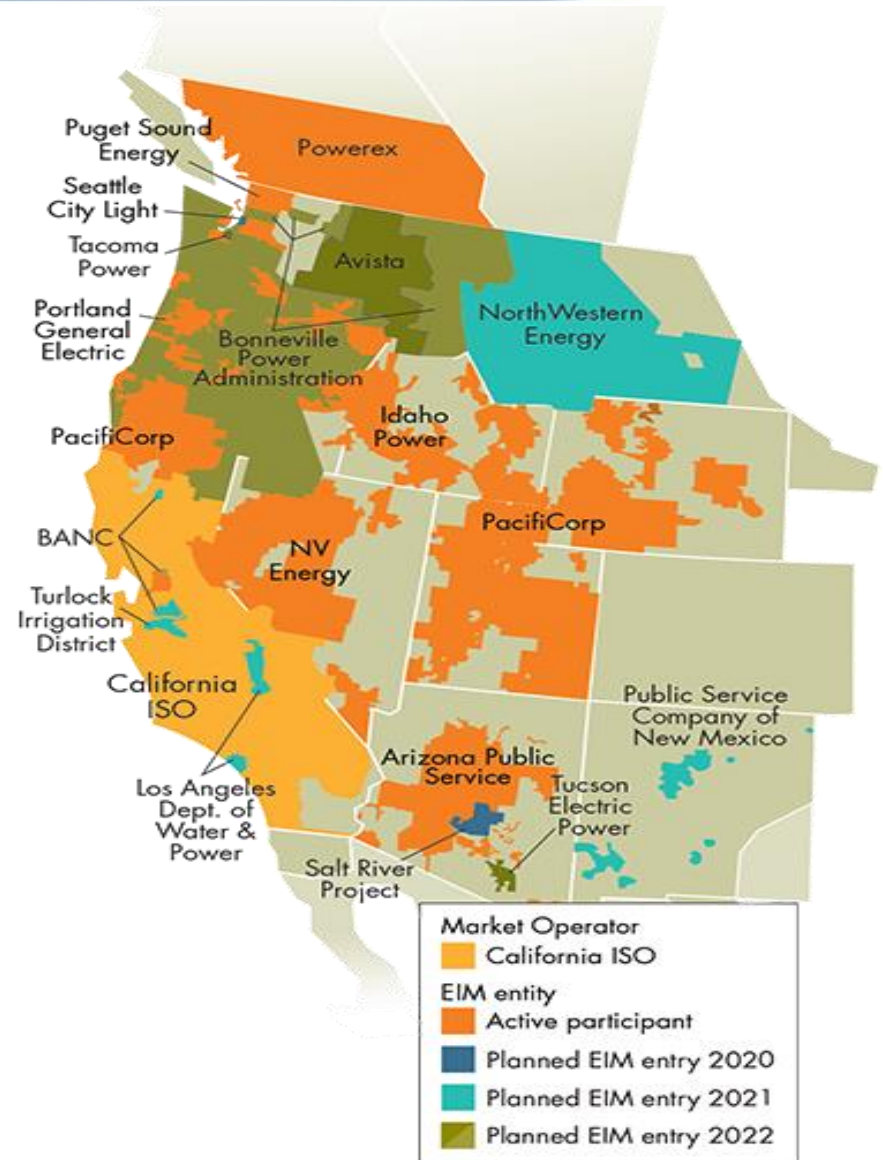
Eric Hildebrandt, Ph.D.
Executive Director, Department of Market Monitoring
California Independent System Operator (CAISO)

California ISO (CAISO)

- Resource adequacy capacity requirements (year-ahead, month ahead)
- Congestion revenue rights auction
- Day-ahead and real-time energy
- Day-ahead and real-time ancillary services markets
- ~ 45,000 MW

Western Energy Imbalance Market (WEIM)

- Real-time energy market only
- ~ 90,000 MW in 2019 (w/CAISO)
- ~125,000 MW by 2022



Role and organization of independent market monitor

- All ISOs under jurisdiction of the U.S. Federal Energy Regulatory Commission (FERC) are required to have an Independent Market Monitor (IMM)
- The formal mission of all FERC jurisdictional IMMs is:
 - *To provide independent oversight and analysis of the ISO Markets for the protection of consumers and market participants by the identification and reporting of market design flaws, potential market rule violations, and market power abuses*
- IMMs provide regulators and market participants with:
 - Greater transparency on market performance
 - Level playing field for all participants
 - Confidence that the ISO market is operating fairly and efficiently.
 - Better understanding of the impact of market rules and proposed changes

Core functions of independent market monitors

1. Review and report on the performance of wholesale markets, including quarterly and annual reports
2. Evaluate existing and proposed market rules, and provide recommendations
3. Notify Federal regulators when:
 - A market participant has engaged in conduct that may require investigation and sanction
 - The ISO have not have followed approved market rules or engaged in other questionable behavior
4. May develop/review cost-based bids used in market power mitigation, but otherwise shall not be responsible for operation of market or application of mitigation

IMMs have no authority to make or approve market rules or impose sanctions.

Ensuring the independence and effectiveness of the market monitor

- IMM is independent from:
 - Market participants
 - ISO management/Board
 - Regulatory entities
- Role and responsibilities of IMM specifically defined in ISO rules:
 - Formal process for providing recommendations and referring issues to the ISO and regulators
 - IMM retains discretion to focus its resources on issues of most importance
- IMM must be provided adequate resources:
 - Budget to hire/retain highly qualified staff
 - Access to market/operational data and information
 - Build and maintain monitoring infrastructure (data, software, metrics)
 - Continuity is important (people, knowledge, monitoring system, etc)

Ensuring the independence, credibility and accountability of the independent market monitor

- All IMM's are overseen administratively by ISO Boards, but are charged with providing independent analysis and recommendations to the ISO, regulators and stakeholders
- All ISOs are required by Federal regulators to maintain IMM's independence and provide IMM with needed resources and information
- ISO Board or management selects IMM, but the IMM rarely changes after being selected
- Federal regulators provide ongoing oversight of the independence of IMM and ISO interactions
- Some ISO's have an external market advisor or committee that also provides review and recommendations on market issues
- Stakeholders also provide informal oversight of IMM and may submit complaints to ISO and/or regulator

IMM role in market design review and recommendations

- Participates in some internal ISO teams/meetings in order to (1) better understand issues/proposals and (2) provide informal input early in market design process
- Provides informal and formal verbal and written comments and recommendations as part of the public stakeholder process
- IMM is often the only entity (besides ISO) that can provide detailed quantitative analysis of market issues and proposed rule changes
- Discusses market design issues with ISO and regulators in non-public meetings
- Submits formal comments and recommendations to ISO Board and regulators on ISO management's final proposals
- May submit formal referrals of major market design flaws not being addressed by ISO to regulators (may be *public* or *non-public*)

Building and maintaining an effective monitoring system

- IMM should have access to all data that the system operator has
 - Frequently used data should be automatically stored in special data system designed for market monitoring and analysis
 - Other data may be need to be provided on special request and/or in non-standard format
- Manual actions taken by system operator are very important to record and provide on routine basis
- IMM needs access to ISO staff to obtain detailed information and explanations of market software, operating practices, etc
- IMM should have access to version of actual market software that can be used to “re-run” the market with different inputs

Building and maintaining an effective monitoring infrastructure requires time (years) and requires a combination of skilled staff, data, software and market/operational knowledge

IMM needs authority to require submission of any potentially relevant data from market participants

- Some data specifically required in advance by ISO:
 - Generating resource characteristics (heat rates, operating characteristics, marginal operating costs, etc.)
- Other data required upon request of IMM:
 - *IMM “may request that Market Participants ... submit any information or data determined by [the IMM] to be potentially relevant. This data will be subject to due safeguards to protect confidential and commercially sensitive data.”*
- Failures to provide required data subject to sanction:
 - Financial penalties (per day of non-compliance)
 - Reporting the failure to the Federal regulator (FERC)
 - Possible exclusion from the ISO markets
- Submission of false or misleading information is referred to Federal regulators

http://www.caiso.com/Documents/AppendixP_CAISODepartmentOfMarketMonitoring_asof_Apr1_2017.pdf

Market monitoring structures

- External to ISO (PJM, MISO, NYISO)
 - Multi-year contract to serve as IMM is awarded to private company
 - Contract awarded/renewed by ISO on 3 to 4 year cycles
 - MISO/NYISO have fixed price budget for core monitoring (with additional work requested/authorized by ISO paid based on hourly consulting fees)
 - PJM has approved cost-based budget based directly on staffing, etc.
- Internal to ISO (CAISO, ISO-NE, SPP)
 - Administratively overseen by ISO Board oversight committee (2 to 3 members)
 - Cost-based budget (based on staffing levels) approved annually by ISO Board
 - Major IMM leadership positions (director, managers) require approval of ISO Board's oversight committee
 - IMM staff adhere to ISO company standards unless exception is warranted (compensation, human resources, code of conduct, etc.)

Potential pros/cons of different monitoring structures

- External and internal IMM both ultimately depend on ISO for budget and staff compensation (subject to oversight from regulator)
- Internal IMM may have more access and closer relationship with ISO leadership/staff – but this can create perception of less independence
- Internal IMM depend on ISO more for information technology support -- but this is generally much more efficient and cost-effective
- Most ISOs with internal IMM also have external market advisors which also provide review and recommendations on market rules and performance
- Internal IMM are subject to audit by regulatory agency and the ISO's own internal audit/compliance unit

Other organizational approaches have been effectively employed in other countries (e.g. separate monitoring units set up by governments)

Keys to effective IMM organizational structure

- IMM that are either external and internal to the ISO can be highly independent and effective with appropriate rules, processes and oversight
- Formal and informal oversight of IMM by multiple entities can help ensure the independence, credibility and effectiveness of the IMM
 - regulators, market advisory committees, stakeholders, etc.
- The IMM is only as independent as its leadership
- Continuity of IMM staff is very important for to building up/maintain the informational infrastructure, knowledge and skills needed for effective market monitoring
- Succession issues – how can IMM leadership change over time as needed while maintaining continuity of IMM staff and organization?

Market power, manipulation and gaming

Market power (vs manipulation)

- Market power involves conduct designed to raise prices by using dominant or pivotal position:
 - in overall energy market or
 - a reliability requirement/constraint
- Market power usually exercised by
 - high priced supply bids
 - limiting supply offered (directly or indirectly)
- Market power is best mitigated through clear *ex ante* market rules
- IMM plays important role in identifying market power and designing effective rules

Market manipulation often involves ...

- False or misleading information
 - False outages or supply limits
 - Inaccurate resource characteristics (e.g. unit start-up or minimum run times)
 - Infeasible supply bids (supply that cannot be delivered)
 - False market information (e.g. supply limits or costs)
- Multiple actions
 - Bidding/scheduling to take advantage of false information
 - Changing bids after ISOs reliability unit commitment process is completed
- Multiple markets
 - Unprofitable trades in one market to profit in different market

Examples of market manipulation

- Increasing bid cost recovery (uplift) payments by increasing unit minimum operating levels and minimum run hours
- Infeasible schedules or bids
 - Schedule/sell excessive energy from resources/locations which ISO must “buy back” at low prices
- Publicizing false supply limitations to increase bilateral futures prices
- Cross market manipulation
 - Increasing or decreasing ISO market prices at a loss in order to profit from bilateral market trades tied to ISO prices
 - May involve bilateral trades for current day or futures prices
- Financial congestion revenue rights
 - Creating or eliminating congestion to increase profit from congestion revenue rights

Preventing and sanctioning market manipulation

- Establishing clear *ex ante* market rules and expectations can help to deter and sanction manipulation
 - Physical supply limitations vs market bids/offers
 - Feasibility of schedules/bids
 - Rules for changing bids
 - Taking advantage of software gaps/errors
- General rules prohibiting manipulation/gaming also important
 - Potential manipulation should be referred by IMM to regulatory/legal entities for detailed investigation/sanctions
- Bilateral market information is often important to identify manipulation

Gaming of market rules

- Often involves taking advantage of a gap or flaw in market or settlement rules to profit in a way that was not intended
 - Not beneficial to market efficiency or reliability
 - Often imposes extra costs on other participants
- May be very similar to manipulation, but difficult to prove or sanction as manipulation
 - e.g. may not involve clear element of false or misleading information
- Usually best addressed by expeditious rule change
- Once detected, participants often stop once contacted by market monitor and advised that behavior is considered detrimental and potential manipulation

Market power mitigation

Automated market power mitigation (energy bids)

- Procedures for limiting (lowering) energy bids when potential market power exists built into ISO market software
 - Test automatically applied to identify potential for market power for time interval (e.g. hourly or 15 and 5-minute interval)
 - When test indicates potential market power, energy bids mitigated *before* final run of market software
- Two main different approaches to market power mitigation used in US ISOs
 - Dynamic mitigation by constraint (CAISO, PJM)
 - Conduct and impact test (MISO, NYISO, ISO-NE, SPP)

Dynamic market power mitigation (CAISO, PJM)

- Market power mitigation (MPM) run of market software performed with unmitigated bids
- Constraints that are congested (binding) in MPM run tested for structural market power
 - 3 pivotal supplier test: *could congestion on the constraint be eliminated without supply of “counterflow” from the 3 largest suppliers?*
- In congested constraint is structurally uncompetitive, resources which can relieve congestion are subject to bid mitigation:
 - Market bids may be lowered to estimate of marginal cost + 10%

Testing for structural market power on congested constraints

- CAISO uses 3 pivotal supplier test (without any price screen)
- Without the largest three suppliers, can congestion on a constraint still be relieved with the *residual supply* of counterflow?
- Demand for counterflow on each constraint calculated using MPM results (scheduled MW x shift factors)
- Residual supply of counterflow calculated for each constraint based on total potential supply of counterflow without largest three suppliers

$$\text{Residual Supply Index (RSI)} = \frac{\text{residual supply of counterflow}}{\text{total demand for counterflow}}$$

- If $\text{RSI} < 1$ constraint is structurally non-competitive

Limitations of dynamic constraint mitigation

- Only applied to constraints within CAISO system
 - Does not mitigate market power on overall system level
 - CAISO considering options for system market power
- Based on structural test vs. impact
 - May trigger mitigation when significant market power actually being exercised
 - However, bids not mitigated below estimated marginal cost plus 10%
- No dynamic mitigation of commitments cost bids
 - Start-up and minimum load bids subject to static cap at 125% of estimated costs

Conduct and impact test (MISO, NYISO, ISO-NE, SPP)

- *Reference level bids* for each unit supposed to represent estimated marginal cost (including opportunity costs)
- *Conduct test* – based on increase in bid over reference level
- *Impact test* – based on increase in LMP due to bids over reference level
- Thresholds used in conduct/impact tests:
 - \$100 per MWh for constraints that are not frequently constrained (500 hours of congestion in prior 12 months)
 - \$10 to \$100/MWh for frequently constrained areas
 - \$25 per MWh for offers resulting in uplift (out-of-market energy, startup and minimum load bids)

Limitations of conduct and impact test

- Does not mitigate market power on overall system level (unless applied system wide)
- Conduct test thresholds set to be triggered only by “a substantial deviation from a competitive offer price.”
 - Suppliers can bid right up to threshold without triggering mitigation
- Impact test only triggered if price impact is also very substantial (e.g. +\$100/MWh for entire area or system)
- Areas with “chronic” congestion defined statically *ex ante* (e.g. 500 hours of congestion in prior 12 months)
 - Congestion can occur less frequently but still involve high level of market power and price impact
- Commitment cost bids (startup and minimum load) only mitigated as part of after-the-fact settlement process if fail conduct/impact tests
 - Does not mitigate price impact of resources that are economically withheld (not committed due to high start-up/minimum load bids)

Congestion Revenue Rights (CRRs)

* also known as Financial
Transmission Rights (FTRs)

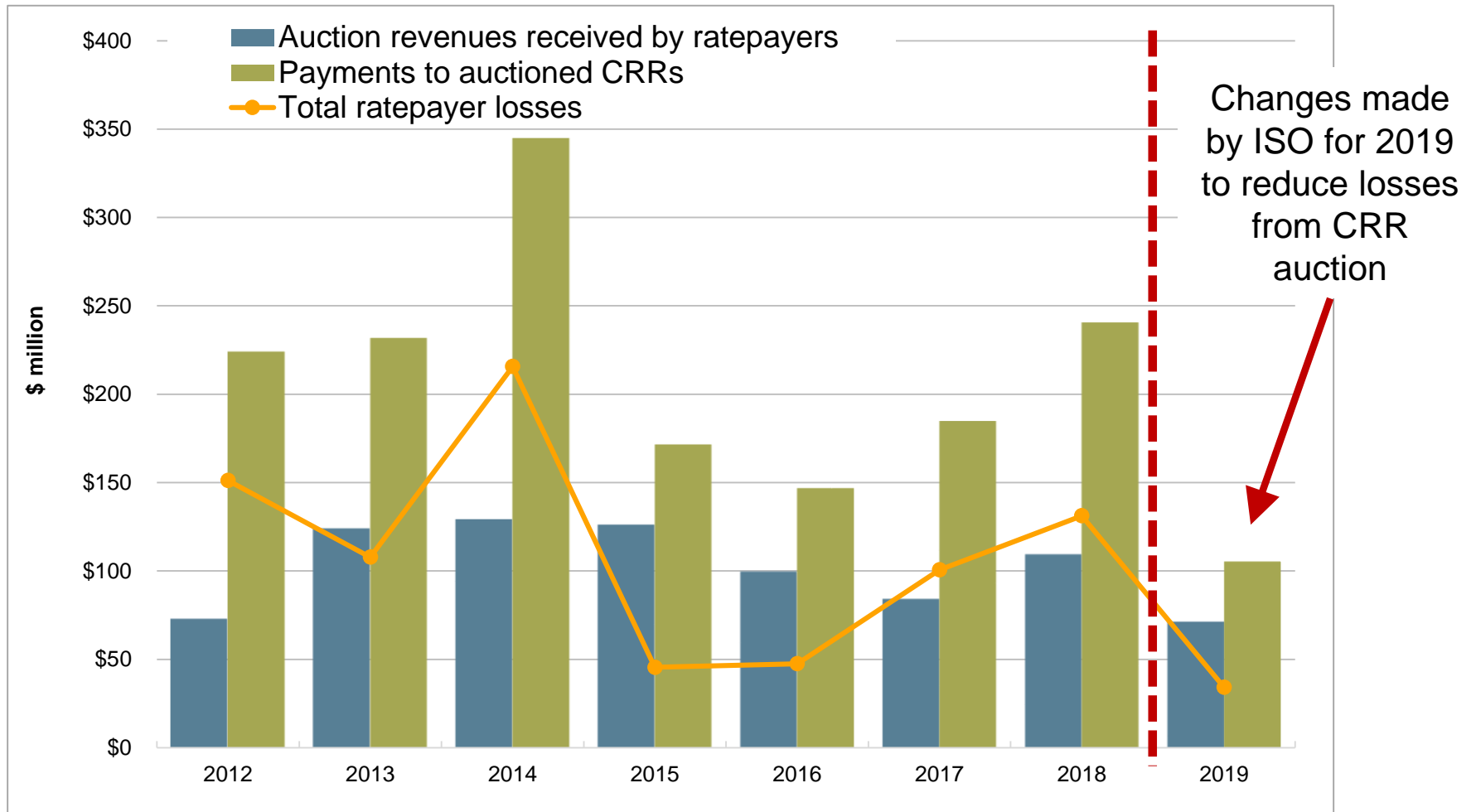
Background on CRRs

- ISO collects Transmission Access Charge (TAC) on all load served to recover 100% of fixed cost of transmission system
- Markets based on Locational Marginal Pricing (LMP) create congestion revenues since LMPs paid by load tend to be greater than LMPs paid to generators
- Since load customers pay TAC and higher LMPs creating congestion revenues, all congestion revenues should be re-allocated back to load customers
 - *Under ISO settlement rules, if ISO did not sell any CRRs, all congestion revenues are allocated back to Load Serving Entities based on MWh*
- CRRs were initially created as means for distributing congestion charges back to load customers in a way that provides financial hedge against congestion costs paid by load customers
- ISO's began auctioning additional CRRs to allow hedging by suppliers
 - *Auctioned CRRs are essentially financial swap contracts that are sold by ISO (without any reservation price) and are backed by congestion revenues that would otherwise be refunded to load customers*

How do Congestion Revenue Rights work?

- After allocating CRRs to Load Serving Entities, the ISO auctions off additional CRRs to other entities (mostly financial traders)
- CRRs are allocated or sold by the ISO for different time periods (annual, monthly, etc.)
- Each CRR has a *source* node and a *sink node*
- The owner of an CRR with a *source* of Node A and *sink* of Node B is paid the difference in LMPs between these nodes ($LMP_B - LMP_A$)
- CRRs are paid out of an ISO settlement account that includes all congestion revenues plus any revenues from CRRs sold by the ISO in the auction
- Auction revenues from CRRs sold by the ISO are consistently less than the payments to buyers of these CRRs in U.S. ISOs
 - *The difference in these CRR payments and CRR auction revenues directly decreases the congestion revenues that would otherwise be refunded to Load Serving Entities*

Auction revenues compared to payments to auctioned congestion revenue rights (2012-2019)



Losses to transmission ratepayers from CRR auction

- From 2009 to 2018, the CAISO's CRR auction resulted in a net loss of over \$800 million for transmission ratepayers (~\$80 million per year)
 - Over this ten year period, revenues collected in the auction equaled only 50 cents per dollar paid to auctioned CRRs
- Changes implemented by ISO in 2019 include:
 - Only sell CRRs with source/sinks between nodes with actual generation and load (“delivery pairs”)
 - Limiting payments to CRRs by amount of congestion revenue actually collected on each constraint
- CRR losses down to \$34 million in 2019 due to changes and lower congestion
 - Losses down from 20% of total congestion revenue to 10%
- IMM continues to recommend that:
 - Sales of CRRs by the ISO are unnecessary
 - If ISO wants to promote hedging, this should be done through a market based on CRR prices offered by willing sellers of financial hedges

Manipulation of CRRs

- Most CRRs bought by financial entities (not as hedges)
- CRRs create incentive for cross-market manipulation:
 - Traders/marketers schedule energy to create congestion
 - If loss on energy trades $<$ increase in CRR payments, then CRR holder profits by creating/increasing congestion
 - Can also profit by reducing/eliminating congestion for “counterflow” CRRs for which the CRR holder losses when congestion occurs
- Monitoring for manipulation of congestion effecting CRRs
 - Requires complex automated metrics and on-going monitoring
 - Can be partially mitigated by settlement rules that automatically rescind CRR payments when energy schedules contribute to congestion

References on CRRs

- *Problems in the performance and design of the congestion revenue right auction*, Department of Market Monitoring, November 2017:
http://www.caiso.com/Documents/DMMWhitePaperProblems_Performance_Design_CongestionRevenueRightAuction-Nov27_2017.pdf
- Testimony of Eric Hildebrandt, PhD, submitted to Committee on Energy and Commerce Subcommittee on Energy United States House of Representatives, November 29, 2017:
http://www.caiso.com/Documents/TestimonyofEricHildebrandt_Nov29.pdf
- Response to Additional Question for the Records, Eric Hildebrandt, PhD, submitted to Committee on Energy and Commerce Subcommittee on Energy United States House of Representatives, January 9, 2018
<http://www.caiso.com/Documents/ResponsestoAdditionalQuestionsreTestimonyofEricHildebrandt-Jan92018.pdf>
- *Comments on the CRR Auction Analysis Working Group*, Department of Market Monitoring January 16, 2018. <http://www.caiso.com/Documents/DMMComments-CRRAuctionAnalysisReportWorkingGroup.pdf>
- *Report on results of 2019 congestion revenue rights auction*, January 27, 2020.
<http://www.caiso.com/Documents/ReportonResultsof2019CongestionRevenueRightsAuction-Jan272020.pdf>

For more information:
Eric Hildebrandt
ehildebrandt@caiso.com