

Virtual Bidding in Forward Power Markets

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Topics

Virtual Bidding and Financial Trading

- The Good
- The Bad
- The Ugly

What are the potential benefits from enabling virtual bidding by financial market participants in day-ahead electricity markets?

- Compensate for strategic underbidding by load serving entities, better converging day-ahead market prices and schedules with expected real-time prices and schedules;
- Compensate for under offers by suppliers, particularly intermittent resources with contracts that insulate them from real-time prices, better converging day-ahead market prices and schedules with expected real-time prices and schedules;

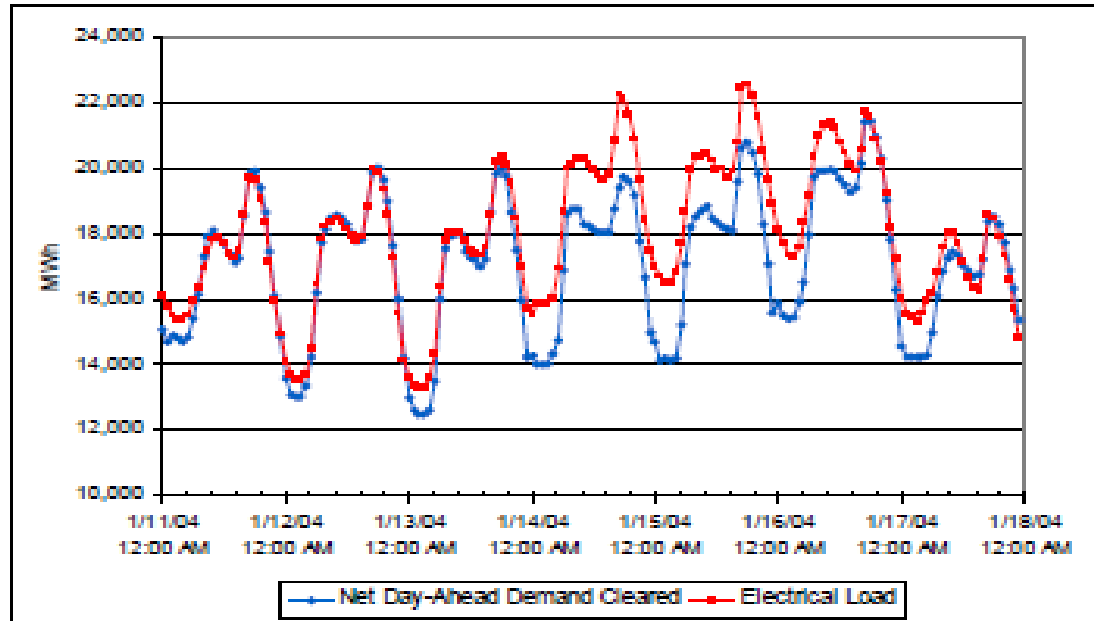
- Enable physical and financial participants to cover financial contractual obligations in the day-ahead market;
- Reflect the output of capacity expected to be committed out of merit by the ISO to manage voltage or other constraints but not scheduled in the day-ahead market, better converging day-ahead market prices and schedules with expected real-time prices and schedules;
- Reflect transmission flows not modeled by the ISO in the day-ahead market, better converging day-ahead market prices and schedules with expected real-time prices and schedules;
- Nodal virtual bids can be used to compensate for predictable errors in nodal load zone weights in the day-ahead market if physical loads submit zonal bids and the ISO determines nodal weights.

Compensate for strategic underbidding by load serving entities, better converging day-ahead market prices and schedules with expected real-time prices and schedules;

The Good

Underbidding by LSES

Net Day-Ahead Demand Cleared and Real-Time Load, January 11-17, 2004



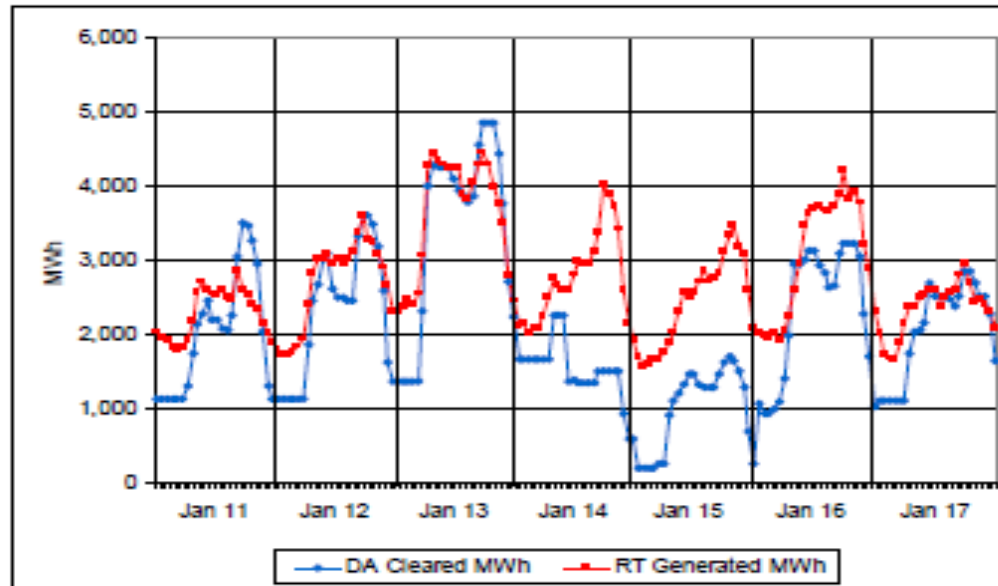
Source: ISO New England Inc, Market Monitoring Department, "Final Report on Electricity Supply Conditions in New England During the January 14-16, 2004 'Cold Snap', October 12, 2004 Figure 21, p115.

Load serving entities in New England appear to have engaged in strategic underbidding on cold winter days for many years.

The Good

Under bidding by LSES

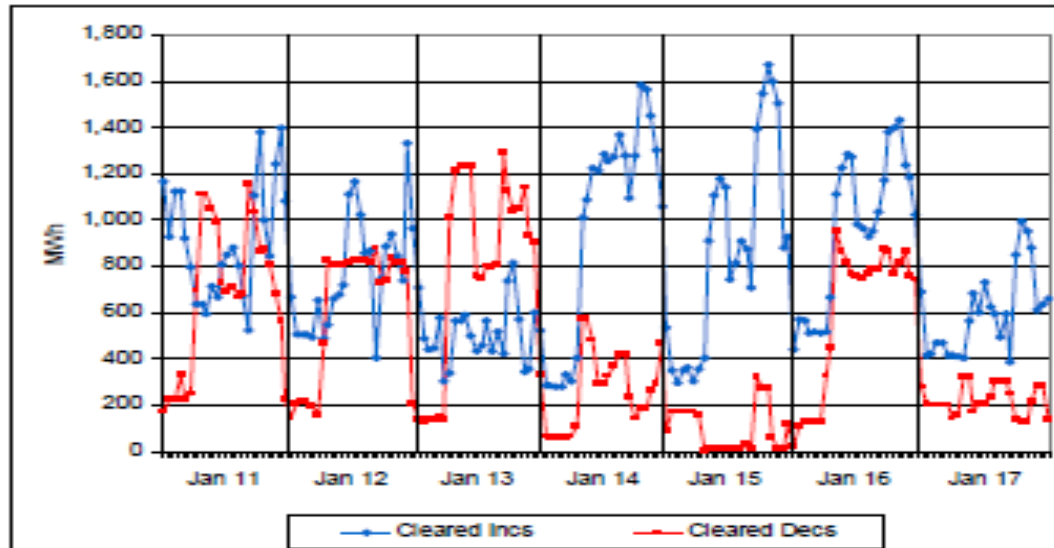
Day-Ahead Gas-Only MWh Cleared in the Day-Ahead market and Actual Gas-Only MWh Generated in the Real-Time Market, January 11-17, 2004



Source: ISO New England Inc, Market Monitoring Department, "Final Report on Electricity Supply Conditions in New England During the January 14-16, 2004 'Cold Snap', October 12, 2004 Figure 24, p121.

Strategic underlying by load serving entities on these days has meant that too little gas fired generation gets day-ahead schedules, too little gas is bought and scheduled on pipelines, adversely impacting reliability.

Cleared Increment Offers and Decrement Bids, January 11-17, 2004



Source: ISO New England Inc, Market Monitoring Department, "Final Report on Electricity Supply Conditions in New England During the January 14-16, 2004 'Cold Snap', October 12, 2004 Figure 25, p122.

Absent virtual bidding, the supply situation would have been even worse in New England because virtual demand bids caused additional generation to get day-ahead market schedules, enabling the resources to purchase and schedule gas.

The Good

Underbidding by LSEs

Underbidding by load serving entities during cold weather has not been limited to 2004, it has been a chronic feature during stressed winter conditions in New England.

January 15, 23, 24, 25, 2011¹

January 22, 23, 24, 2013²

Unfortunately, the internal independent market monitor has not provided similar detailed analysis of the impact of underbidding on the scheduling on gas fired generation and the impact of virtual bidding during more recent cold weather events.

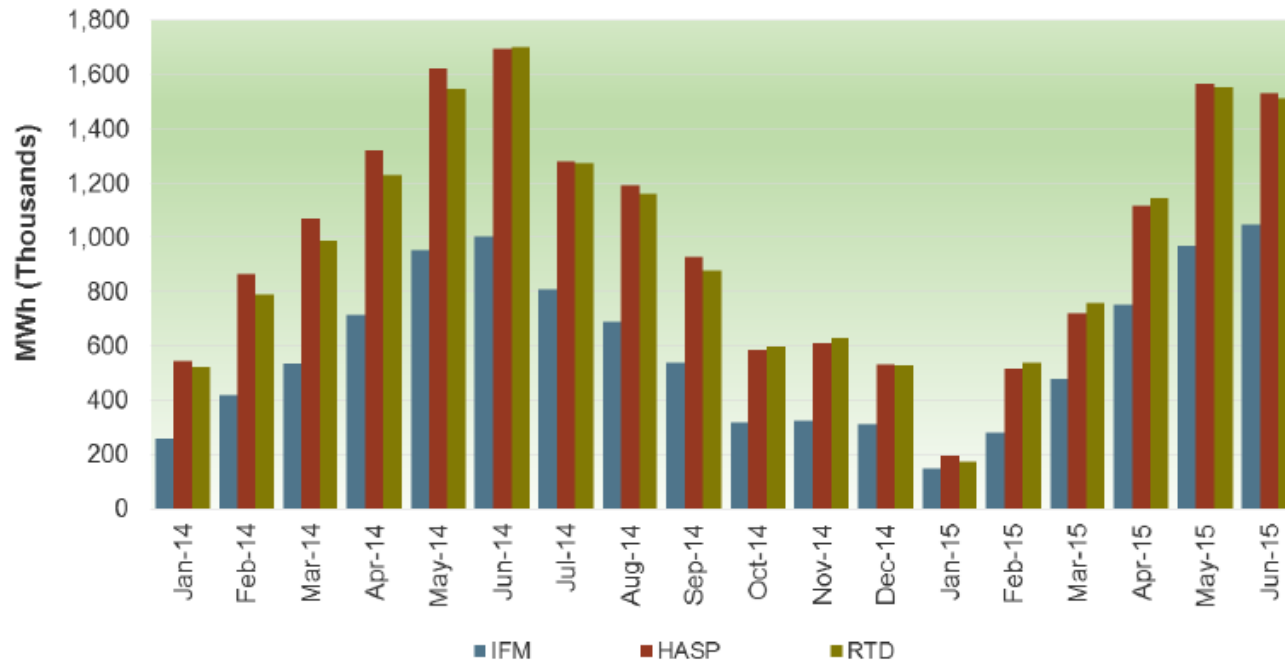
1. NEPOOL Participants Committee Report, February 2011, pp. 6-8.
2. NEPOOL Participants Committee Report, February 2013, p 14.

Compensate for under offers by suppliers, particularly intermittent resources with contracts that insulate them from real-time prices, better converging day-ahead market prices and schedules with expected real-time prices and schedules.

Intermittent resources often sell their output under contracts which insulate them from day-ahead and real-time spot market prices and they are also typically not subject to must offer obligations in the day-ahead market, so they do not schedule their expected output in day-ahead markets.

- If other market participants could not submit virtual supply bids to reflect the real-time output of the intermittent resources that do not offer in the day-ahead market, day-ahead market prices would be artificially inflated.
- Underbidding by load serving entities is not a good substitute for virtual supply bids because the unbid intermittent resources are generally not at the same location as load.

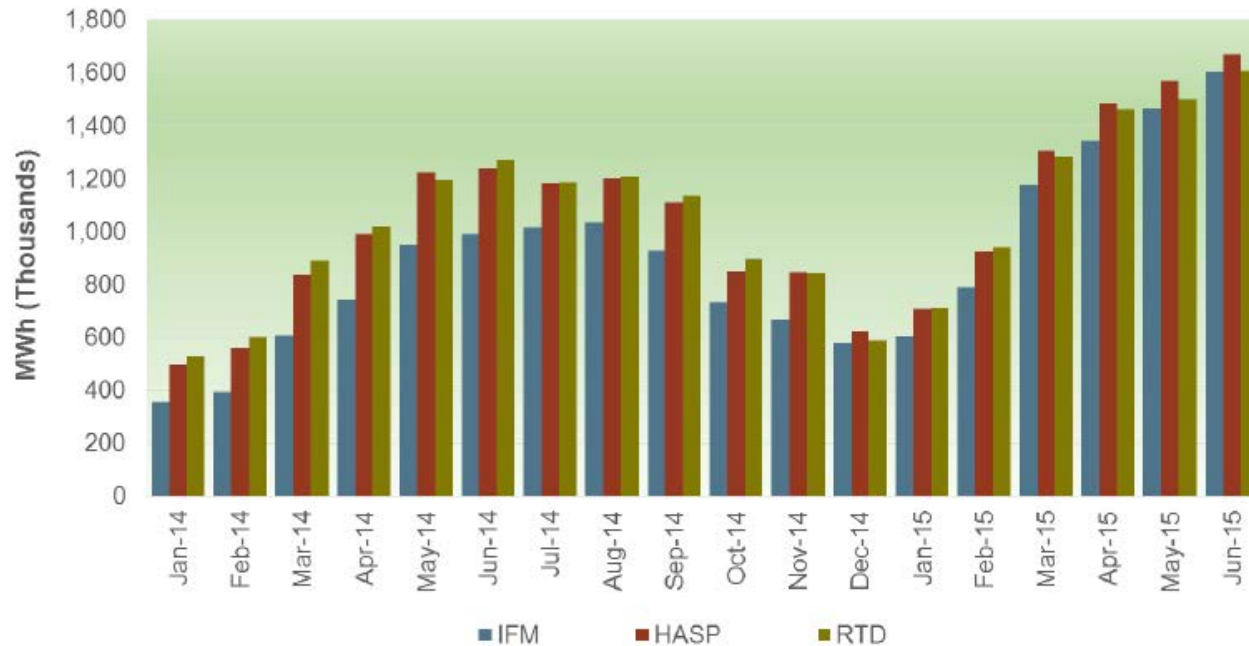
IFM under-scheduling of wind generation continued in May and June



Source: California ISO, Market Performance and Planning Forum, July 21, 2015 p. 23

Wind Generation has consistently been underbid in the CAISO day-ahead market (IFM).

Day-Ahead solar scheduled outputs improved in May and June



Source: California ISO, Market Performance and Planning Forum, July 21, 2015 p. 22

Solar Generation has also been somewhat underbid in the CAISO day-ahead market (IFM).

Although we do not know what factors incent individual virtual bids:

- In the California ISO, load serving entities submitted an average of 2 megawatts of virtual demand bids and 267 megawatts of virtual supply bids during 2014.¹
- These virtual supply bids may have been an effort to reflect the expected real-time output of unbid intermittent resources, perhaps even intermittent resources under contract to the individual load serving entities.
- The virtual supply bids by the load serving entities depress day-ahead market prices, benefitting the load serving entities physical position in the market, but these bids were on average independently profitable, earning \$3.4 million before the allocation of uplift charges.¹

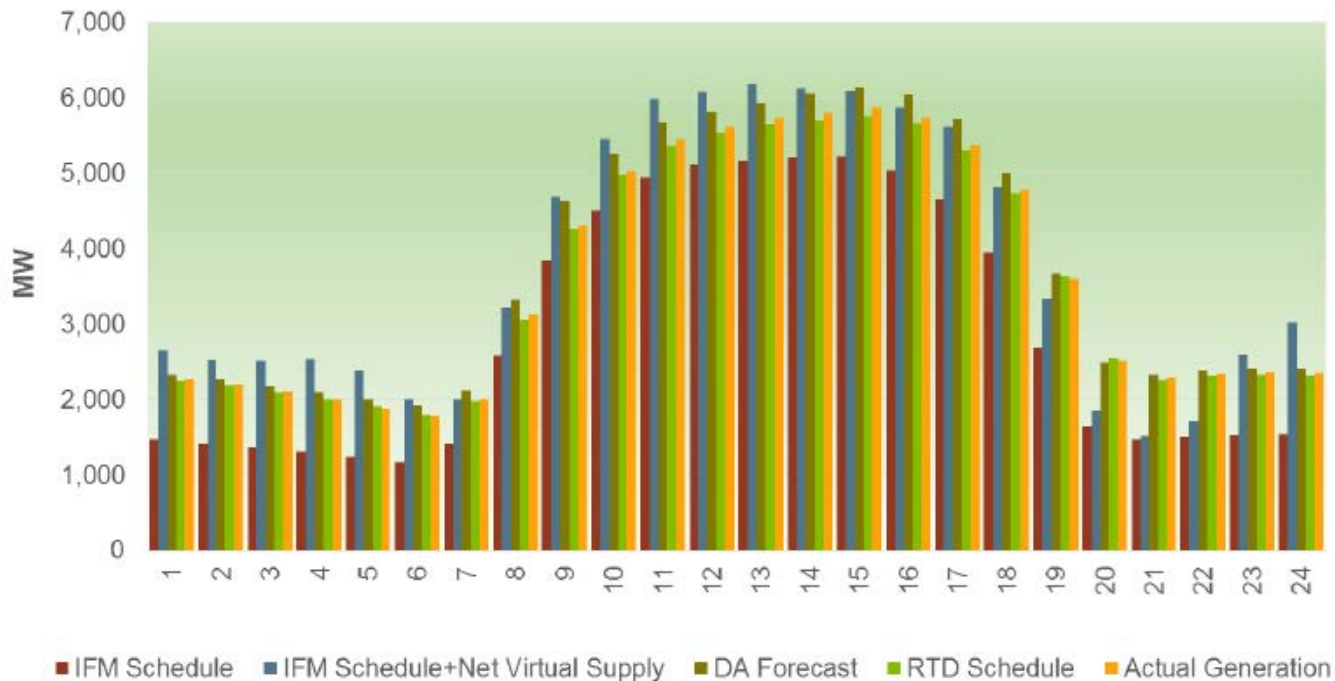
1. California ISO, Department of Market Monitoring, 2014 Annual Report on Market Issues & Performance, Table 4.1 p. 104.

Marketers and physical generators also submitted virtual supply bids that exceeded their virtual demand bids by an average of another 146 megawatts an hour during 2014.¹

- These virtual supply bids lowered day-ahead prices and better converged day-ahead prices and generation schedules with real-time prices and generation schedules.

1. California ISO, Department of Market Monitoring, 2014 Annual Report on Market Issues & Performance, Table 4.1 p. 104.

Renewable (VERS) schedules and forecast in May - June



Source: California ISO, Market Performance and Planning Forum, July 21, 2015 p. 21

Although not all virtual supply may be intended to compensate for under offered intermittent generation, the sum of offered intermittent generation and net virtual supply is much closer to actual real-time intermittent generation output.

The Good

Intermittent Resources

The California ISO Department of Marketing Monitoring noted in its 2014 Report that:

“One reason the state’s main load-serving entities are authorized by the California Public Utilities Commission (CPUC) to engage in virtual bidding is to offset renewable energy that is not scheduled in the day-ahead market for contractual reasons. However, the total amount of net virtual supply clearing in the day-ahead market still fell short of the total amount of renewable and other generation not scheduled in the day-ahead market.”¹

1. California ISO, Department of Market Monitoring, 2014 Annual Report on Market Issues & Performance, pp 7-8.

Enable physical and financial participants to cover financial contractual obligations in the day-ahead market.

Any financial contract settling against real-time load or generation obligations can require one or both of the parties to be able to submit virtual bids in order for them to hedge themselves against real-time congestion costs.

- Unless the parties to a contract are located at the same node, the point of delivery for the contract will not be at physical location of at least one of the parties.

Suppose a generator located at A has a financial obligation to deliver 100 megawatts of power at the Western Hub in real-time. Absent the ability to submit virtual bids at the Western Hub, the generator could:

- Offer power at A in the day-ahead market and buy power at the Western Hub price in real-time to cover its contract;
- Offer power at A in the real-time market and buy power at the Western Hub in real-time.

Either bidding strategy exposes the generator to real-time price volatility. This exposure can be avoided by submitting a generator offer at A and a virtual demand bid at the Western Hub in the day-ahead market.

Offer in DAM No Virtuals

- Generating cost
- + DAM price at A
- RT price at W Hub
- + Contract price

Offer in RT No Virtuals

- Generating Cost
- + RT price at A
- RT price at W Hub
- + Contract price

Offer in DAM With Virtuals

- Generating Cost
- + DAM price at A
- DAM price at W Hub
- + Contract price

Suppose a load serving entity located at B has a financial obligation to buy 100 megawatts of power at the Western Hub in real-time. Absent the ability to submit virtual bids at the Western Hub, the load serving entity could:

- Buy power at B in the day-ahead market and sell power at the Western Hub price in real-time.
- Buy power at B in the real-time market and sell power at the Western Hub in real-time.

Either bidding strategy exposes the load serving entity to real-time price volatility. This exposure can be avoided by submitting a load bid at B and a virtual supply offer at the Western Hub in the day-ahead market.

Buy in DAM No Virtuals

- + RT price W Hub
- RT price at B
- Contract price

Buy in RT No Virtuals

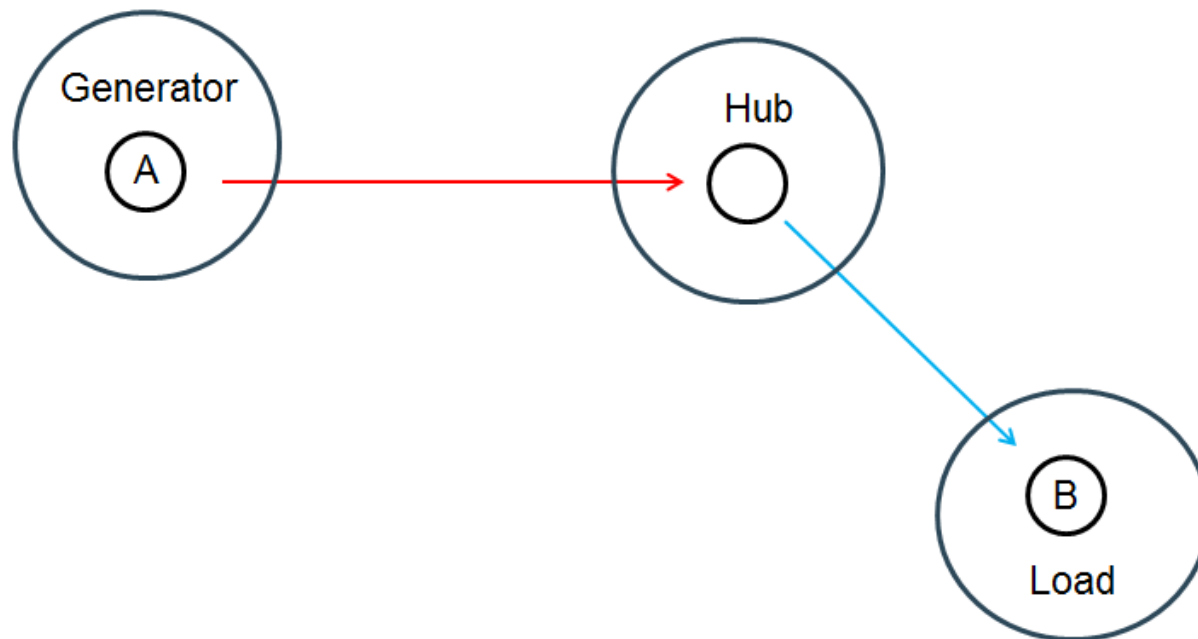
- + RT price at W Hub
- RT price at B
- Contract price

Buy in DAM With Virtuals

- + DAM price at W Hub
- DAM price at B
- Contract price

The virtual demand and virtual supply bids of parties to a bilateral financial contract settling at the Western Hub would net to zero in the day-ahead market solution but the parties to the contract would be hedged on congestion between the physical generation and load and the Western Hub settlement point.

If this were a physical contract between the load serving entity and the generator, they could use a day-ahead market financial bilateral (e schedule in PJM, bilateral netting in NYISO), to structure the transaction without the need for virtual bids.



Suppose, however, that the hedge is an exchange traded contract settled through the exchange.

- Then the generator wants to be able to submit an supply offer at its location, and a virtual demand bid at the Western Hub in the day-ahead market to hedge its congestion costs;
- The load serving entity wants to be able to submit a physical load bid at its location, and a virtual supply bid at the Western Hub in the day-ahead market to similarly hedge its congestion costs.

Exchange traded forward contracts have trended towards contracts for differences that settle against the day-ahead market price, which eliminates the need for the parties to submit virtual bids in the day-ahead market to realize the hedge, but other financial contracts to hedge physical load costs settle at real-time prices.

- Marketers and traders with POLR contracts either need to be able to submit virtual bids or need to be allowed to submit bids as if they were a physical load.

- Reflect the output of capacity expected to be committed out of merit by the ISO to manage voltage or other constraints but not scheduled in the day-ahead market, better converging day day-ahead market prices and schedules with expected real-time prices and schedules.
- Reflect transmission flows not modeled by the ISO in the day-ahead market, better converging day-ahead market prices and schedules with expected real-time prices and schedules.
- Nodal virtual bids can be used to compensate for predictable errors in nodal load zone weights in the day-ahead market if physical loads submit zonal bids and the ISO determines nodal weights.

Virtual bidding only converges day-ahead prices and schedules *closer* to what they would be in an efficient market.

- The extent to which the activities of virtual bidders better converge day-ahead and real-time prices will be limited by their need to recover their costs and a return for the risk they incur;
- Virtual bidders incur costs to analyze the market, to participate in the market, to post collateral for their positions, and in some markets are allocated uplift costs that do not have the slightest relationship to their activities.
- The more extraneous costs are allocated to virtual bidders, the less price and schedule convergence they will find it profitable to provide.

Virtual Bidding can also be used in an effort to move day-ahead prices away from expected real-time prices. Virtual bids could be unprofitable on their own but benefit other physical or financial positions by causing day-ahead market prices to diverge from expected real-time prices.

- The “other position” most commonly at issue are FTR holdings (CRRs, TCCs), but it could be other kinds of positions, including physical positions such as unhedged merchant generation or unhedged load serving obligations.

The potential for virtual bidding to be used in an effort to move day-ahead prices away from expected real-time prices is greatest at electrically isolated locations with price insensitive physical positions that are not hedged by FTRs.

- Prices at electrically isolated positions will be less constrained by the price sensitive offers of other virtual traders or physical market participants.
- The more price elastic are supply and demand (physical and virtual) in the day-ahead market, the larger the unprofitable virtual position that would be required to impact day-ahead market prices.

Physical traders may submit price insensitive bids in the day-ahead market for a number of reasons:

- because they are small unsophisticated market participants;
- because the market design makes it difficult for them to respond to local distortions in prices (e.g. a load serving entity that must buy power at a zonal price while virtual bids may distort the price at an individual node); or
- Because they have financial contracts that insulate them from day-ahead market prices.

Liquidity in forward markets, including ISO and RTO day-ahead markets, is not necessarily deep in the short-run at every location, all the time. Traders incur costs to provide this liquidity and the amount they provide will depend on the expected returns.

- It is limited liquidity that makes manipulation of forward markets possible.
- This has the implication that successful manipulation is more likely in the circumstances in which there is the least liquidity: in the short-run, at isolated locations, with inelastic physical positions.

The Bad

Virtual bids are not manipulative simply if they impact the value of other positions, such as FTRs. They are manipulative only if they cause day-ahead market prices and congestion to diverge from expected real-time prices and congestion, i.e. are unprofitable.

- Even recognition of the impact does not make bids manipulative if they are profitable and better converge market prices and congestion.
- California ISO load serving entities undoubtedly recognize that submitting virtual supply bids to reflect unbid wind and solar output will benefit their unhedged physical load serving obligations, but this does not make their virtual supply bids manipulative.

The Bad

Similarly, vertically integrated load serving entities are likely to hold FTRs sourcing at their generation and sinking at their loads, and likely to submit generation offers at the FTR source and load bids at the FTR sinks.

- These physical generation and load bids are not manipulative simply because they may impact FTR payments.
- If the load and generation bids better converge day-ahead market prices and schedules with expected real-time prices and schedules their impact is procompetitive and efficiency enhancing.

The Bad

Similarly, entities with financial contracts are likely to hold FTRs sourcing at their generation and sinking at the delivery point for their financial contract, and likely to submit generation offers at the FTR sources and virtual load bids at the FTR sinks.

- These physical generation and virtual load bids are not manipulative simply because they may impact FTR payments.
- If the load and generation bids better converge day-ahead market prices and schedules with expected real-time prices and schedules their impact is procompetitive and efficiency enhancing.

The Bad

A financial market participant with a CFD in place with a load serving entity has a financial interest in the day-ahead market not clearing above expected real-time prices.

- It is not manipulative for such a participant to submit a virtual supply offer reflecting expected real-time prices, reflecting the price level at which it would schedule physical imports in real-time, or reflecting the price level at which it would exercise a real-time call contract.

The Bad

CRR recapture rules and other rules addressing the potential for price manipulation need to be applied over time on an expected value basis.

- Virtual bids that are expected to be profitable will turn out to be unprofitable during individual hours when conditions are different than expected. This does not make them manipulative.
- The virtual supply bids of a load serving entity that are profitable over the week and month are not manipulative simply because they turn out to be unprofitable during a few hours when solar or wind output turns out to be lower than normal.

The Bad

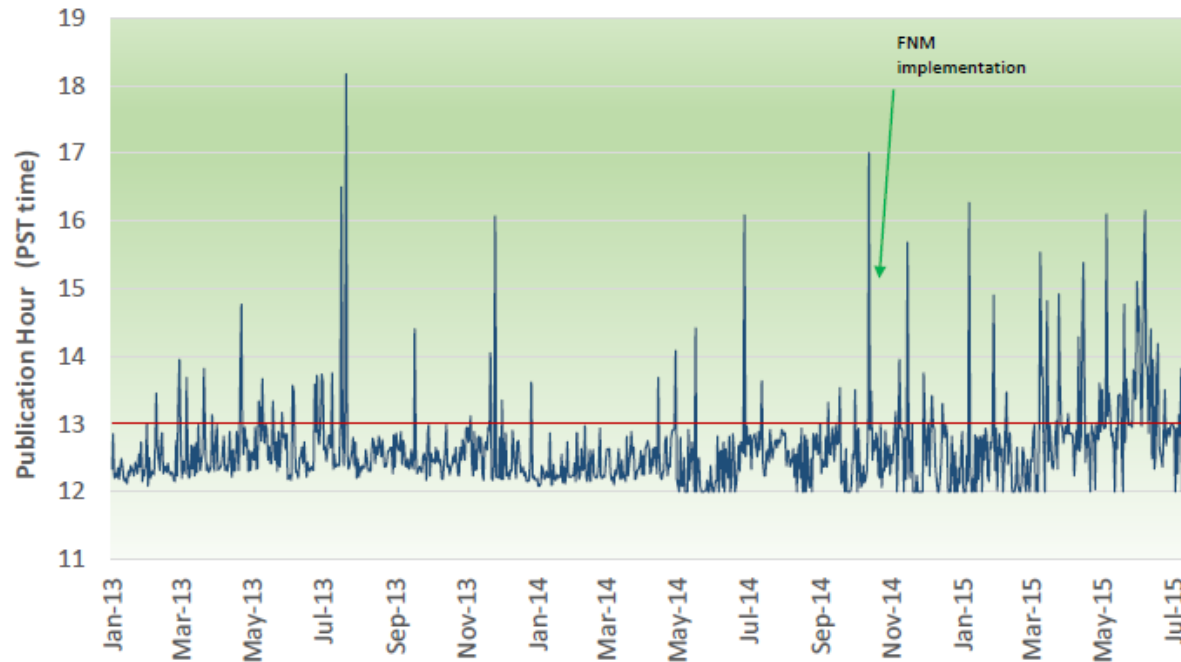
Applying CRR recapture rules or other penalties to virtual trades that are profitable and converge day-ahead market prices and schedules with expected real-time prices and schedules is a form of market manipulation that benefits particular market participants by preserving divergence between day-ahead and real-time prices and reduces market efficiency.

The Ugly

Virtual bidding can also have some negative impacts that do not arise from misconduct by market participants but simply reflect real world trade offs and model limitations.

- High levels of virtual bids can adversely impact day-ahead market solution time and quality;
- Virtual bids can sometimes lead to income transfers without converging day-ahead and real-time prices or schedules.

Daily publication time of DAM results



Source: California ISO, Market Performance and Planning Forum, July 21, 2015 p. 31

Large numbers of virtual bids can contribute to long solution times in the day-ahead market, delaying postings or precluding the system operator from adding functionality (such as improved combined cycle modeling).

The solution time impact of large numbers of virtual bids can in part be managed by assigning an appropriate charge for the submission of virtual bids.

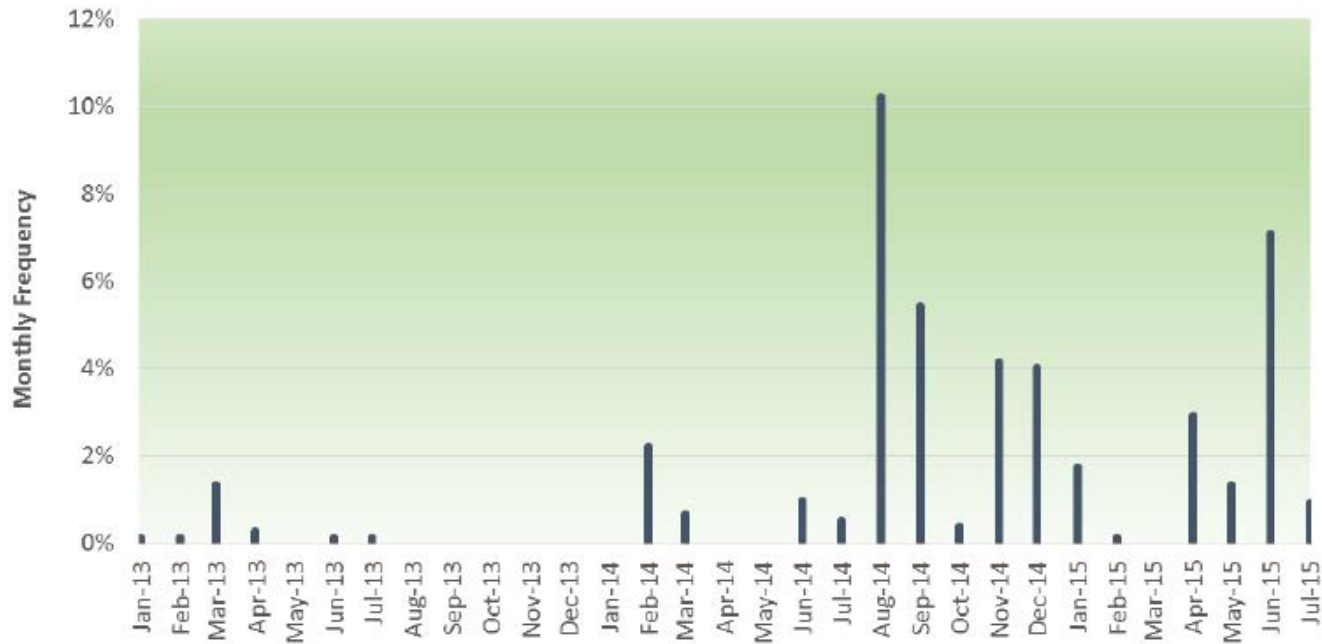
- If accommodating high levels of virtual bids requires more hardware, it is appropriate to assign a charge reflecting these costs;
- If high levels of virtual bids creates trade offs with other elements of the market such as DAM posting time, ability to include all transmission constraints in the DAM, or other DAM functionality, then the charge needs to reflect these opportunity costs.

The Ugly

DAM SOLUTIONS

A tariff charge for the submission of virtual bids that reflects the expected opportunity costs will not always be an ideal way to account for DAM solution time impacts because these solution time impacts may be small under some conditions but become large with changes in market conditions that impact the number or nature of binding constraints.

Frequency of DC solutions in the day-ahead market



Source: California ISO, Market Performance and Planning Forum, July 21, 2015. p. 37.

Some patterns of virtual bids can contribute to problems in obtaining valid powerflow solutions in AC or quasi AC models, reducing the efficiency of the day-ahead market solution.

The Ugly

Non-Convergence

Not all virtual bidding serves to converge day-ahead prices and schedules closer to what they would be in an efficient market.

- Virtual bids will not converge day-ahead prices and schedules with real-time prices and schedules if the transmission constraint that binds in real-time is not modeled in the day-ahead market or if there is some element of the market design or ISO operating policies that prevent convergence.
- The virtual bids are still profitable in this situation, and do not reflect manipulation, but they do not contribute to more efficient day-ahead market outcomes, they simply transfer income.

The Ugly

Non-Convergence

Why would transmission constraints not be modeled in the day-ahead market?

- ISO modeling errors, hopefully sporadic and unpredictable;
- Adverse impact of enforcing all transmission constraints on solution time causes ISO to omit constraints that are not expected to bind;
- The conditions that cause a transmission constraint to bind are external to the factors modeled in the day-ahead market;
- ISO intends to artificially depress prices in a particular region by not enforcing transmission constraints.

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