

WESTERN ENERGY IMBALANCE MARKET

Explaining a main benefit of virtual bids when adding a day-ahead market

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A main benefit of virtual bids that this talk will attempt to explain

- A liquid, competitive pool of virtual bids can help to reduce differences between day-ahead and real-time market prices.
- The expectation of better convergence of day-ahead prices with real-time prices helps incentivize physical generation and load to participate more economically in the day-ahead market.
- Competitive day-ahead market bids reflecting true marginal cost of generation and load increases combined efficiency of day-ahead scheduling and real-time dispatch.

Assumption 1: It is beneficial to run a day-ahead market before the real-time market

- Real-time optimization
 - Limited supply commitment/dispatch options and time horizon
- Day-ahead optimization
 - Much broader set of supply options to optimize with
 - 24 hour time horizon
 - Provides good overall estimate of real-time system conditions
- Key takeaway:
 - Day-ahead market sets up the real-time market to determine a much more optimal final dispatch than if there were only a real-time market

Assumption 2: Day-ahead optimization should use economic load bids and generation offers for energy awards and prices

- Market bids are usually more efficient than using ISO estimates of generation costs (in absence of market power) and self-scheduled load forecasts
- ISO estimates of generator costs are imperfect
- Solving to load forecasts would not allow load serving entities to reflect other supply options and load reduction options

Financial day-ahead energy market requires back-up commitment process to ensure reliability on some days

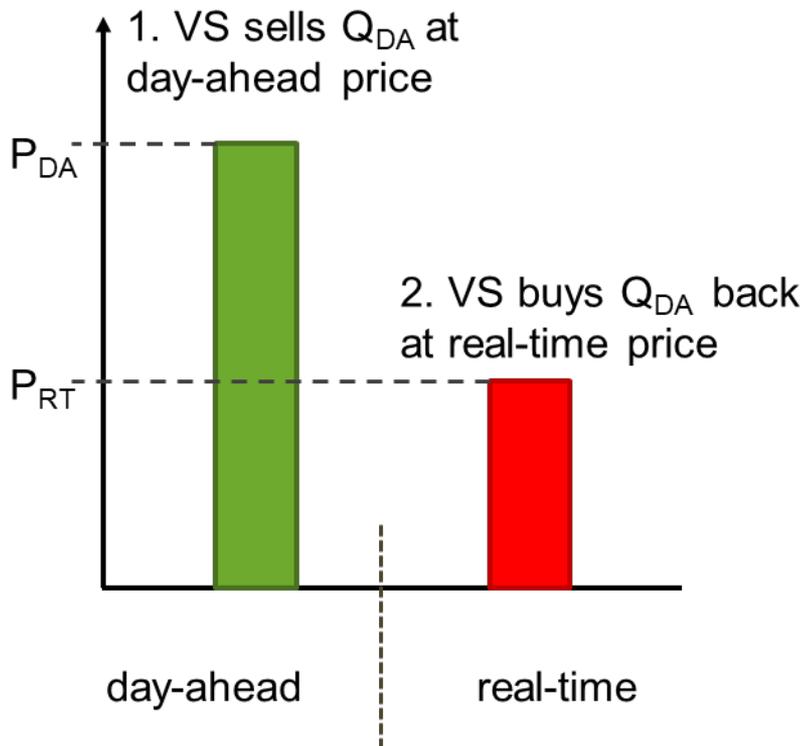
- CAISO currently uses a post-day-ahead market process called Residual Unit Commitment (RUC)

How are virtual bids different than physical bids

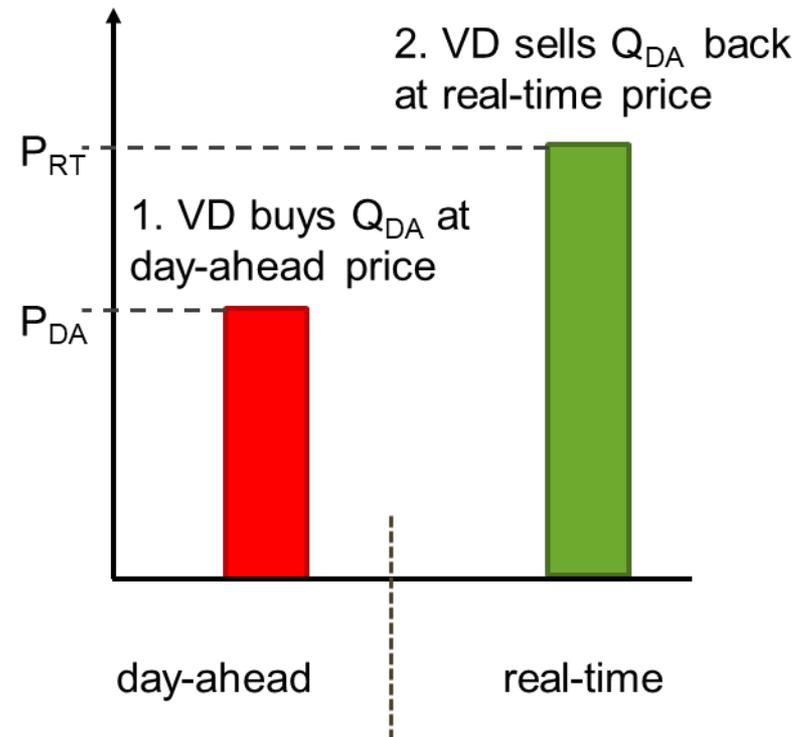
- Virtual bids and awards modeled and settled like physical bids in day-ahead market
 - Post-market reliability processes exclude virtuals
- Virtual and physical awards from day-ahead treated the same financially in real-time
 - *Day-ahead* virtual/physical supply schedules bought back at RT price
 - *Day-ahead* virtual/physical demand schedules sold back at RT price
- Difference: physical supply sells/physical demand buys *real-time* schedules at real-time price
 - Virtuals cannot have real-time schedules

Virtual awards receive difference between day-ahead and real-time price

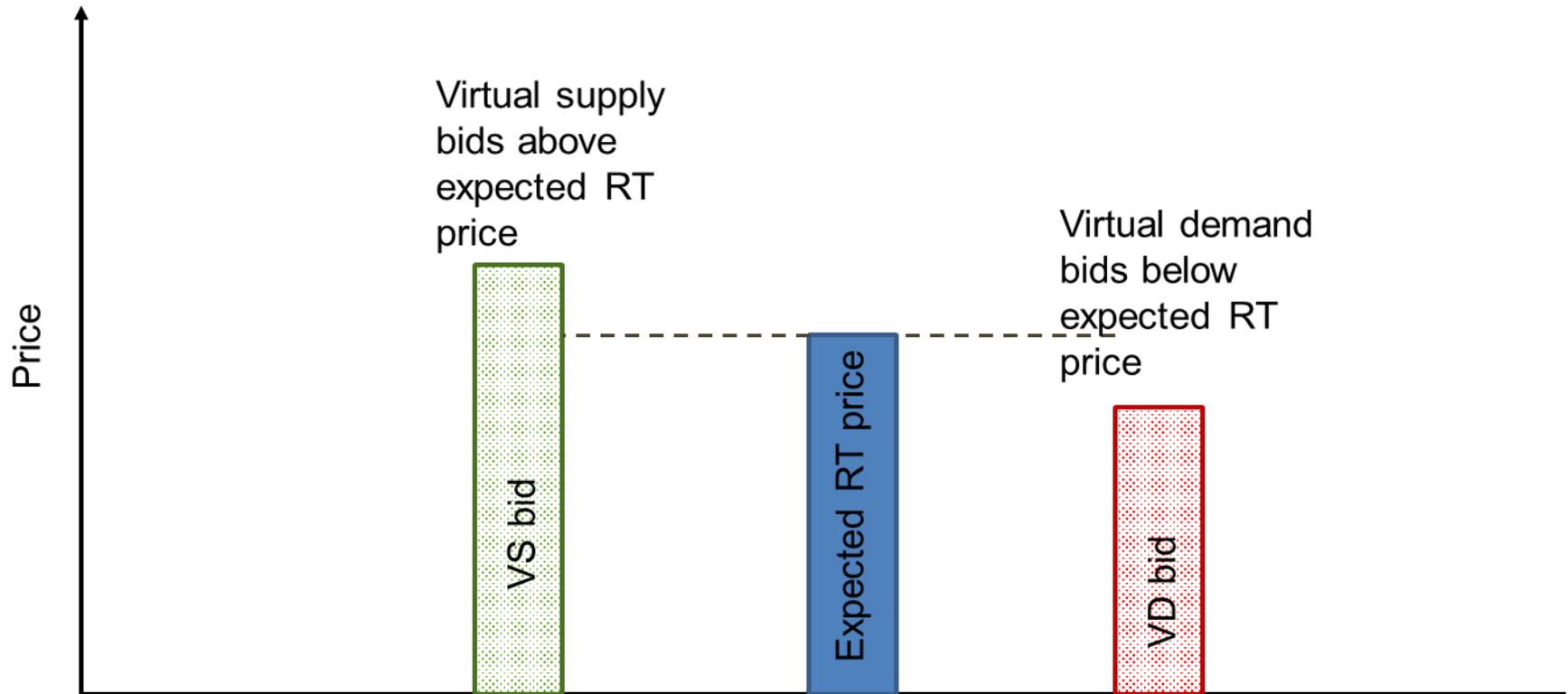
Virtual Supply



Virtual Demand

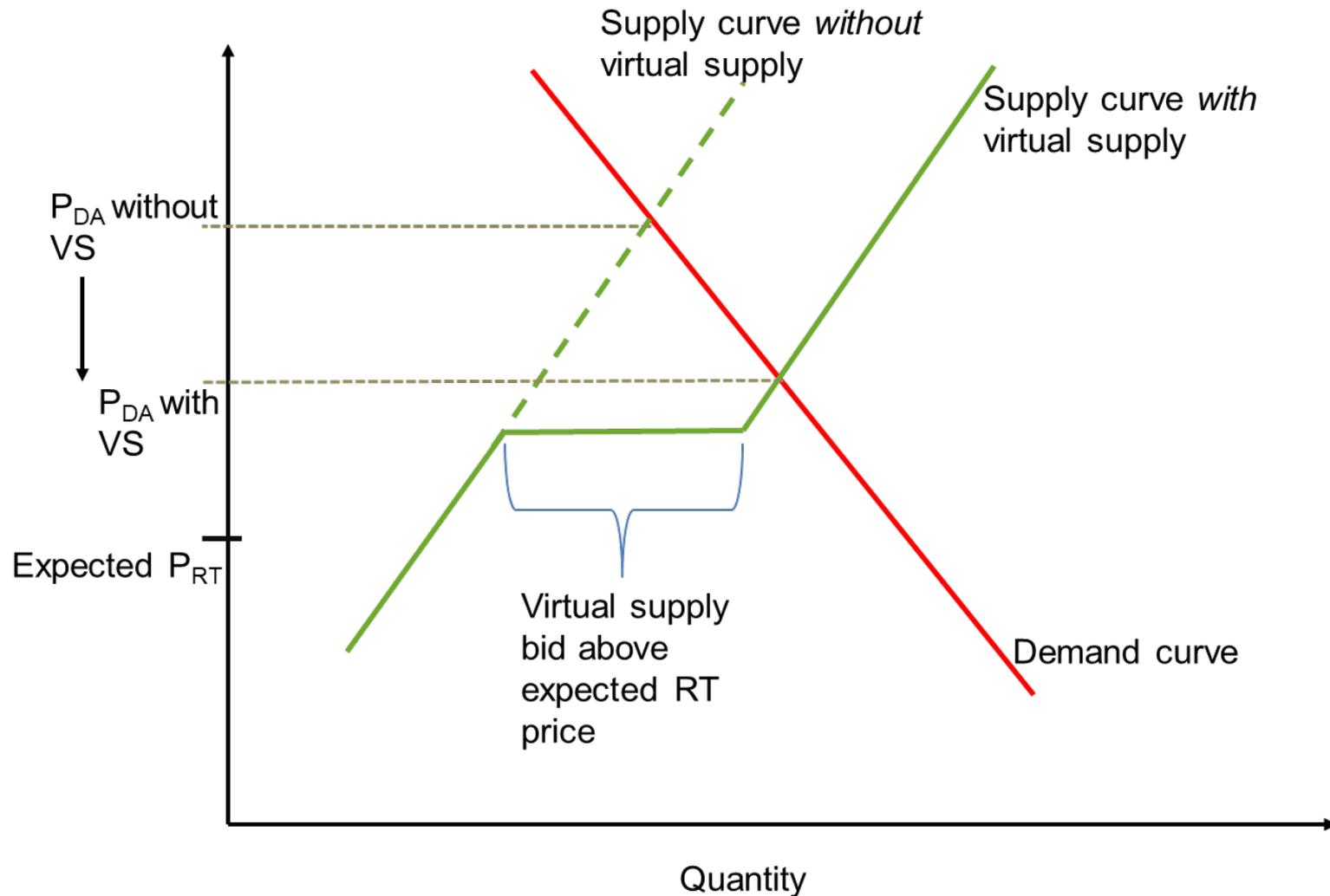


Virtual bids use expected real-time price to formulate bid price

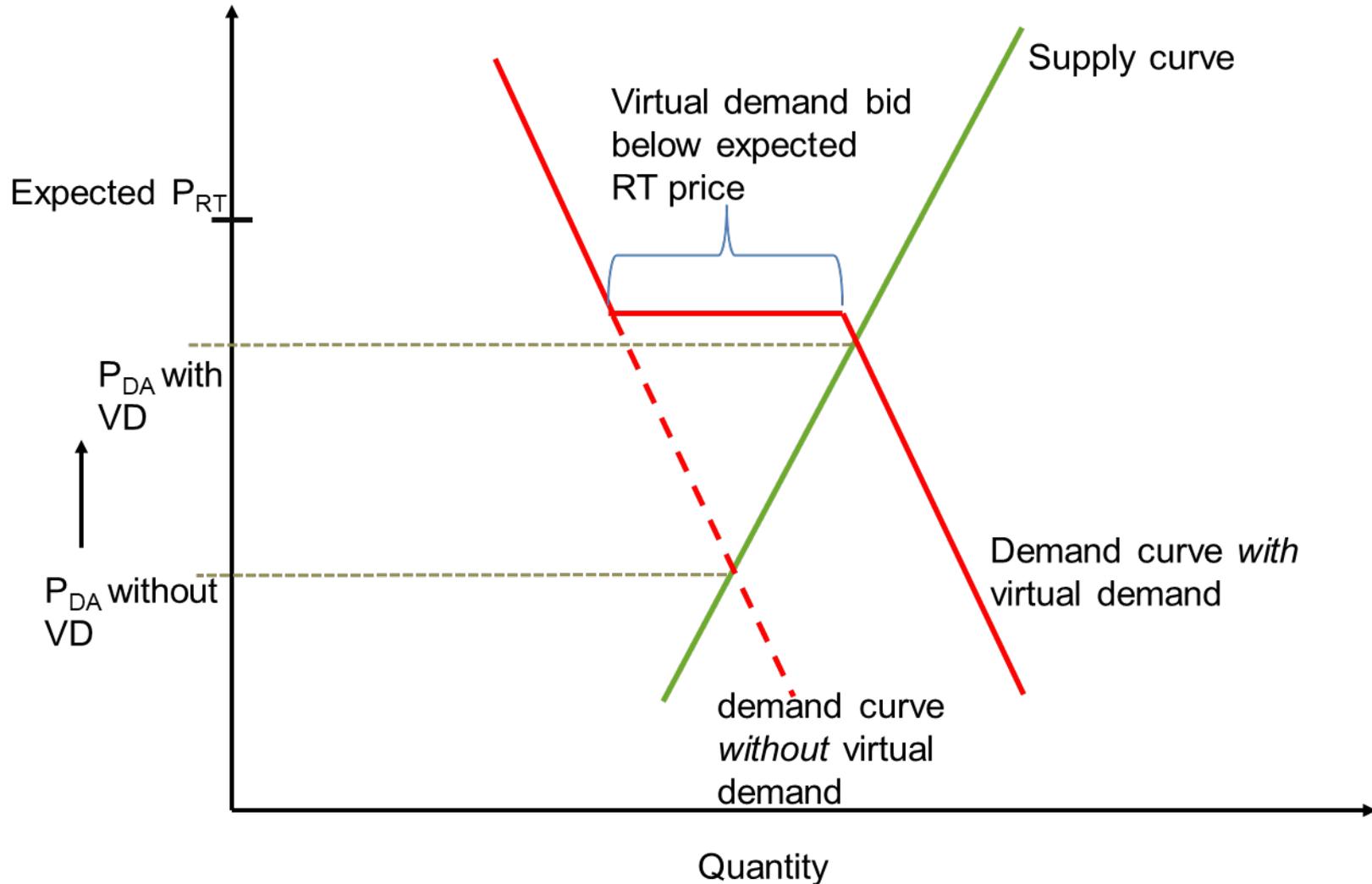


- Virtual supply bids only clear if day-ahead price \geq bid price
- Virtual demand bids only clear if day-ahead price \leq bid price

Virtual supply shifts supply curve out and pulls high day-ahead price down toward expected real-time price



Virtual demand shifts demand curve out and pulls low day-ahead price up toward expected real-time price



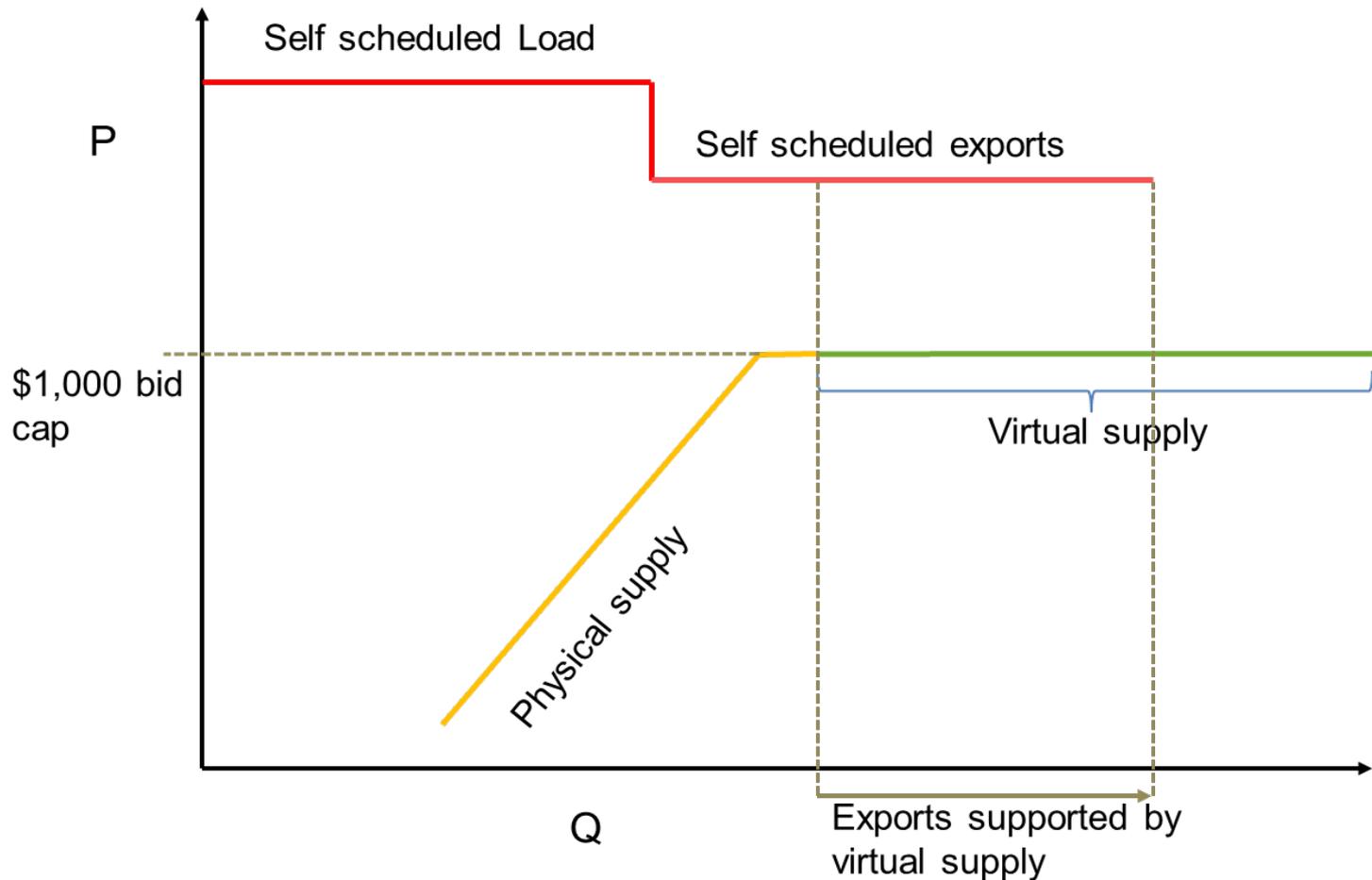
Some causes of day-ahead/real-time price divergence

- Contractual disincentives from day-ahead market participation (e.g. variable energy resources paid contract price for actual real-time production)
- Post day-ahead market manual operator actions
- Supply side market power – physical or economic withholding
- Demand side market power
- Inaccurate load or renewable forecasts
- Modeling differences between day-ahead and real-time markets

A liquid, competitive pool of virtual bids can help to converge day-ahead market prices to real-time market prices

- Expecting day-ahead prices to converge to real-time prices helps to incentivize physical generation and load to participate economically in day-ahead market
- Competitive day-ahead market bids reflecting generation and load's true marginal costs and valuations increases efficiency of ultimate real-time dispatch

On rare occasions, ISO may need to temporarily suspend virtual bidding



- Unexpected design/implementation issues with post-day-ahead market back-up reliability processes (e.g. RUC)

For questions, comments, or more information:

- Department of Market Monitoring website:
 - <http://www.caiso.com/market/Pages/MarketMonitoring/Default.aspx>
- DMM quarterly and annual reports
 - <http://www.caiso.com/market/Pages/MarketMonitoring/AnnualQuarterlyReports/Default.aspx>
- DMM comments on 2020 market design initiatives
 - <http://www.caiso.com/Pages/documentsbygroup.aspx?GroupID=E0E702C8-DC83-4625-98E2-36230535B44A>
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