Convergence Bidding

Alan G. Isemonger
CAISO Market and Product Development
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Objective: Introduce Virtual Bidding

- Introductory Remarks
- Two Settlement System
- Convergence and Types of VB
  – Implicit VB vs. Explicit VB
- Example of how VB Works
Clarifications

- "Virtual Bidding" and "Convergence Bidding" will be used interchangeably in this presentation
Introduction

- Defined broadly as the ability to engage in purely financial transactions **VB is common in commodity markets which are continuous settlement markets**
- VB in electricity markets first introduced in PJM on June 1st 2000, and in the NYISO on November 1st 2001
- Virtual Bidding has become a standard part of multi-settlement electricity markets in the eastern ISOs
- Subsequent implementations in ISO-NE and MISO
Two Settlement System

- CAISO currently has a single energy settlement, but multi-settlement AS and Congestion markets (DA and HA)
- With the PX California had a three settlement system (DA/HA/RT)
- With the demise of the PX CAISO was left with a single energy settlement
- Virtual bidding is premised on multi-settlement (No multi-settlement = No VB)
MRTU Markets

- **MRTU introduces a** transparent, bid-based day-ahead energy market (DAM) and an updated real-time balancing market (RTM)

- **Multi-settlement markets** also allow LSEs to schedule energy in both DAM and RTM, thus reducing their exposure to any one market
  - Risk mitigation is one of the main reasons for multi-settlement

- **Most LSEs will likely secure their energy bilaterally and both the DAM and RTM will essentially be residual markets**
LSE DA Deferred Procurement

- Under MRTU LSEs will bid load into the DAM so they can control how much of their load is settled at DA and how much at RT prices
LSE DA Deferred Procurement
MRTU Markets

**DAY-AHEAD MARKET**
- Price Taking Demand: $P_{DA}$
- Estimated Real-Time Demand: $S_{DA}$
- Price-Taking Supply: $D_{DA}$

**REAL-TIME MARKET**
- Actual Real-Time Demand: $D_{DA}$
- $S_{RT1}$
- $S_{RT2}$

$$Q_{DA} \approx Q_{ERT}$$
Convergence

- Prices should converge to the extent that they are the same product or substitutes for one another
- DA and RT products are perceived to be similar by market participants
  - DA energy and RT energy can substitute for one another
  - Differences between products is small, dispatch interval in DA is 1 hour, but is 12x5min in real time
- The same resource can supply both and, absent other barriers, will price them similarly
- Main difference is merely the time of transaction
Degree of Convergence

- Price difference between DA and RT prices can be separated into two categories, namely predictable price differences and unpredictable (or stochastic) price differences.
- Unpredictable price differences cannot be arbitrated away.
- Actual price differences between DA and RT will persist, but the extent of divergence, on average, will be lessened.
- Premised on no administratively imposed cost differences between DA and RT.
Why VB

- **Price Arbitrage**
  - If you predict price differential correctly you make money and converge the prices
  - If your trades incorrectly predict price differences you lose money

- **Physical Arbitrage**
  - Physical suppliers can hedge their production uncertainties
  - Using a virtual demand bid physical suppliers can schedule DA, but expose their output to the RT price
Types of VB

- Implicit VB and Explicit VB
- Both attempt the same thing, namely profit seeking arbitrage
  - Explicit VB is labeled as such and does not intermingle with Physical products
    - Grid operators can assess grid reliability without worrying about virtuals
- Explicit Virtual Bidding requires a design, software changes, and cost allocation rules
IVB is different

- IVB is the exaggeration of physical schedules to perform the same arbitrage
  - IVB piggybacks on the physical functionality and intermingles virtual bids with physical schedules

- If an LSE believes generation in the DAM is cheap it can over-schedule load (buy cheap generation DA) and just under consume in RT and be paid out at the RT price

- Similarly imports and exports can be used for the same purpose
  - The ISO has no visibility into neighboring control areas so SCs can schedule imports and exports they don’t have, and just cancel them in HASP before RT, and be paid out at the HASP/RT price
IVB is different

- Over-scheduling was an Enron strategy (Fatboy) as was under scheduling (SlimMan or ThinMan)
  - Degrades the reliability of DAM results because grid operators are not sure which results are physical and which virtual
  - Does not allow physical hedging

- IVB is a compromised variant of EVB with less functionality

- The implementation of EVB can reduce IVB significantly
Suppression of IVB

- Suppression via the MMIP could be difficult
- CAISO has no visibility into adjacent control areas so IVB via imports would pose a problem
- SCs always change their schedules due to outages and load conditions
- Trying to work out whether a schedule change was legitimate or not would be difficult
- DMM would have to second guess decisions made under tight time constraints
- Process would be difficult and unpopular
Behavioral Changes

- If virtual bidding is suppressed it is likely that market participants will alter their bidding behavior.
- If demand collectively decides to under-schedule in the DA market then certain suppliers will bid the expected Real-Time price into the DAM.
- This shifts DA supply curve upward so that the DAM once again clears at the expected $P_{RT}$.
- More demand will be met in the RT market, which will no longer be simply a balancing market.
Behavioral Changes

**DAY-AHEAD MARKET**

**EXPECTED REAL-TIME MARKET**
Example of Virtual Demand Bidding

- Purchase of energy in the DAM for sale in the RTM
- Schedule Coordinator A believes that the DAM NP15 trading hub price on Monday (for Tuesday) will be lower than the actual NP15 real-time trading hub price on Tuesday
- In particular SC A expects that the RT NP15 trading hub price on Tuesday will be $50 MWh, but that the DA NP15 trading hub price (on Monday for Tuesday delivery) will be significantly less than $50
- SC A will attempt to buy low on Monday and sell high on Tuesday
VD – Bid Submission

![Bar chart showing bid prices and expected real-time prices for different MW values. The chart displays bid prices in the range from $0 to $60 per MWh, with MW values ranging from 10 to 30. The expected real-time price is represented as a horizontal line at a constant value.]
VD – DAM Run

![Graph showing bid price and actual DA price](image-url)
Only the first bid pair of 10MW @ $40 is cleared at $34

SC A has thus bought supply at $34 in the DAM

There is no further bid submission

– Transaction is flagged as virtual so it is automatically liquidated in RTM at the RTM price where it is a price taker
VD – RTM Result

![Graph showing VD – RTM Result with axes for MW and $/MWh, and data points for Cleared Bid Price, Profit, Actual_DA_Price, and Actual_RT_Price.](image)
VD – RTM Result

- RT market clears at $55, leaving a profit margin of ($55 - $34) * 10MW = $210
- If RT market had cleared below $34 then SC A would have lost money
- Virtual Supply Bidding
  - Sale of energy in the DAM for re-purchase in the RTM
  - Sell high and buy low strategy
  - Similar conceptually to VD bidding, just the other way around
Conclusion

- Substantive predictable differences between prices for similar products are difficult to sustain
- EVB can reduce the incentive to engage in IVB and improve reliability
Questions?