Fixed / Price Sensitive Demand Bids, Load Response, Virtual Bidding & Pump Storage Optimizer in the Day Ahead Market

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Special MIC: Electric Storage Resource Participation Model

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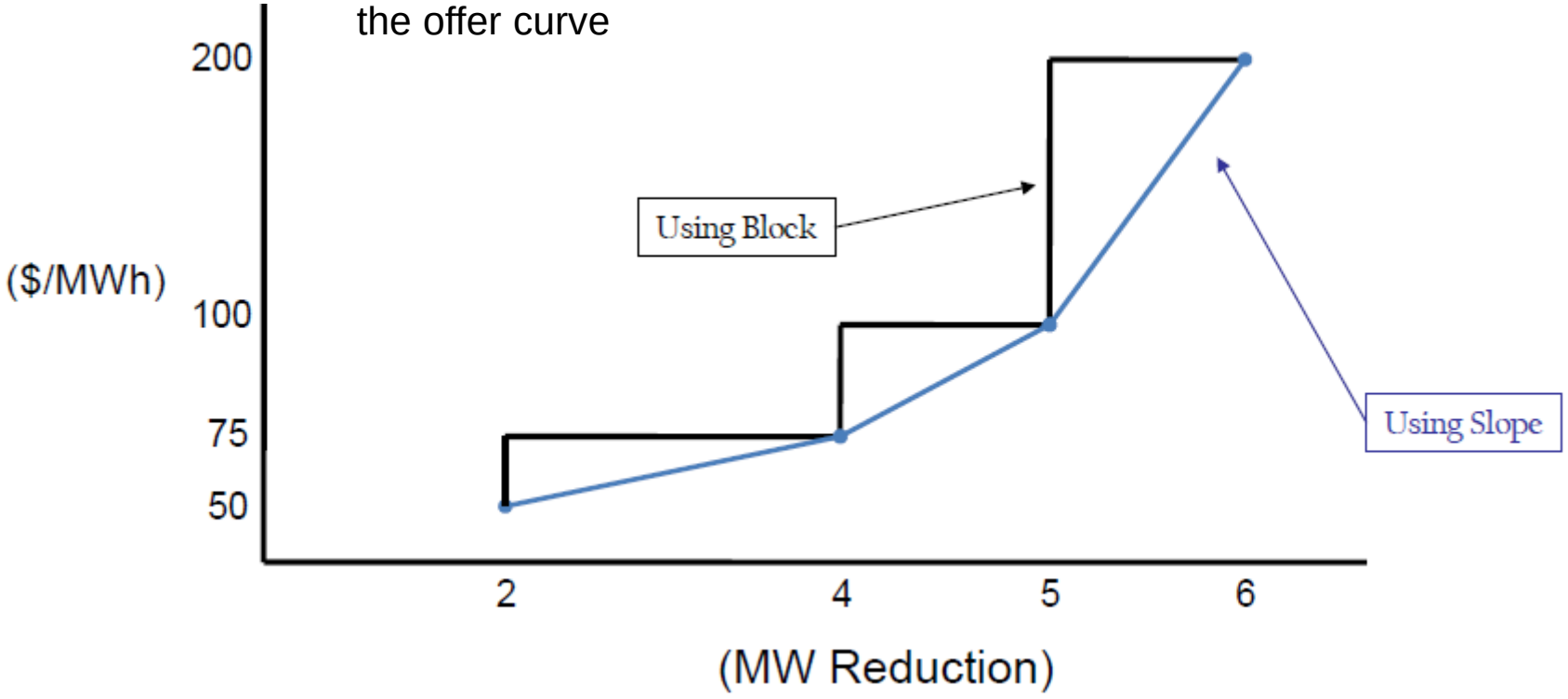
Demand Side Response (DSR)

Consumer's ability to reduce electricity consumption at their location when wholesale prices are high or the reliability of the grid is threatened.

- End-use customers participate in DSR via Curtailment Service Providers (CSP)
- Meter data required to establish Baseline (CBL)
- Offer curves are required for Energy Market participation (offers submitted via Markets Gateway)
- Only one offer curve can be made available on a daily basis
  - Market Type participation can be Day Ahead, Balancing or Both and is associated with a schedule that can be changed daily by the CSP
  - *DA Market* – If hour clears in DA market then DR should respond with associated MWs. PJM will not dispatch in RT for hours that clear in DA market.
  - *Balancing Market* – DR should follow RT dispatch signal
  - *Both* – If hour does not clear then hour is eligible to be dispatched in RT

Slope vs. Block Offer

- Markets Gateway allows for the selection of either Slope of Block
- Offer curves consist of MW-Price pair segments. Up to ten (10) segments can be defined for each offer curve
- Resource will be cleared / dispatched economically in accordance with the offer curve



Fixed / Price-Sensitive Demand Bids

Hourly demand quantities for which a participant commits to purchase energy at Day-Ahead prices for consumption in the next Operating Day. Bid must specify MW quantity and location (aggregate or bus)

- Fixed Demand → Location, MW Price-Sensitive Demand → Location, MW & Price
- Price-Sensitive Demand bids are accepted in single bid-blocks only (up to 9 segments may be submitted per market participant at a specific location)
- If a Market Buyer submits no Day Ahead bid information, then a 0 MW quantity is assumed
- The total MW quantity of Fixed and Price-Sensitive demand bids submitted by an LSE for a given Operating Day must not exceed the LSE's Daily Demand Bid Limit

Increment Offers & Decrement Bids (Virtual Bidding)

- Increment (Inc) offer
  - Looks like a spot market sale or dispatchable resource
  - “virtual generator” (injects MW)
  - If LMP goes above offer price, Inc will be cleared

- Decrement (Dec) bid
  - Looks like a spot market purchase or price-sensitive demand
  - “virtual load” (withdraws MW)
  - If LMP goes below bid price, Dec will be cleared

How are Virtual Bids Treated?

- INCs & DECs are part of the Day-Ahead Supply curve
- Inc offers/Dec bids can be placed at any eligible trading point where either generation, load, or interchange transactions are settled, or at trading hubs where forward positions can be taken
- Treated just like generation to clear the market
- Can displace more expensive generators and set clearing price in the Day-Ahead Market

How Do Virtual Bids Make Money?

INC Offer

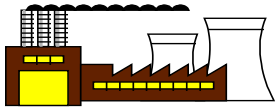
- Sells MW into Day Ahead Market at High Price
- Buys replacement MW from Real-Time Market at Lower Price
- Profits when Day-Ahead Prices are Higher than Real-Time Prices

DEC Bid

- Buys MW from Day Ahead Market at Low Price
- Sells those MW in Real-Time Market at Higher Price
- Profits when Day-Ahead Prices are Lower than Real-Time Prices

Example #1 – Increment Offer

Day-Ahead



Participant offers 100 MW at $30

Assume Day-Ahead LMP= $35

Day-Ahead Settlement = 100 MW * $35 = $3,500 credit

Day-Ahead Position = $3,500

Real-Time

Assume Real-Time LMP = $20

Deviation from DA schedule = -100 MW

Balancing Settlement = -100 MW * $20 = $2,000 charge

Balancing Position = -$2,000

Net position = $3,500 - $2,000
= $1,500 credit

Example #2 – Decrement Bid

Day-Ahead

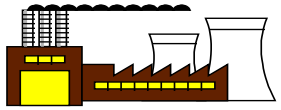
Participant bids 100 MW at $20

Assume Day-Ahead LMP= $15

Day-Ahead Settlement = 100 MW * $15 = $1,500 charge

Day-Ahead Position = -$1,500

Real-Time



Assume Real-Time LMP = $25

Deviation from DA schedule = 100 MW

Balancing Settlement = 100 MW * $25 = $2,500 credit

Balancing Position = $2,500

Net position = -$1,500 + $2,500
= $1,000 credit

Pump Storage Optimizer Input Parameters

- Initial Storage
- Final Storage
- Maximum Storage
- Minimum Storage
- Pump Efficiency

- Economic Minimum (Gen)
- Economic Maximum (Gen)
- Economic Minimum (Pump)
- Economic Maximum (Pump)
- Minimum Run Time
- Maximum Run Time
- Minimum Down Time

} Gen

Pump Storage Optimizer

- No offers are modeled in objective function for optimized pump storage hydro units
- Optimized Pump Storage hydro units can’t set price
- Typically follow Day-Ahead Schedule in Real-Time
- Charged deviation if deviate from Day Ahead schedule