# Hourly Offers:
# Load and Generator Settlement Examples

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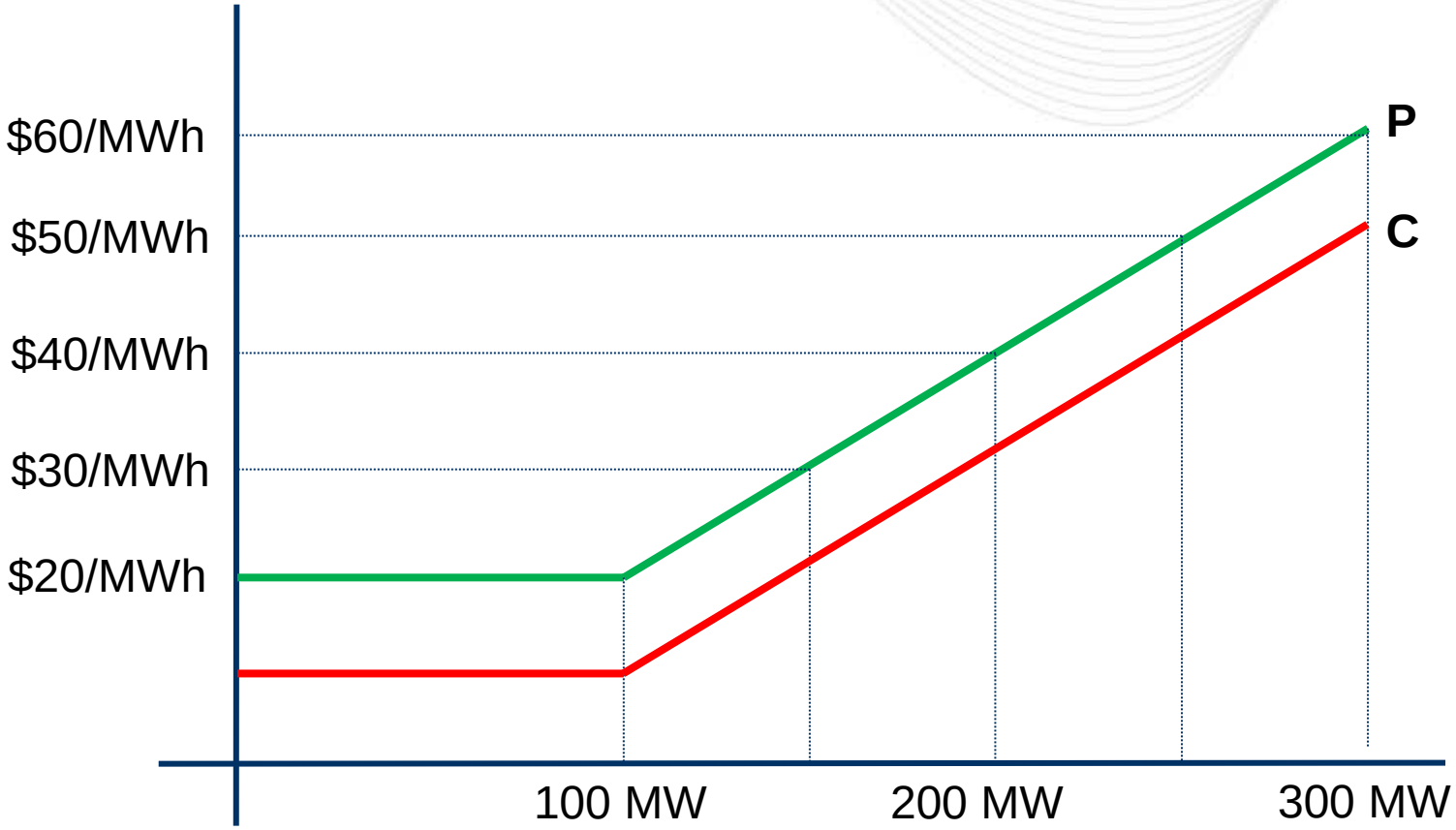
September 18, 2015

# Example Purpose

- Show the generator settlement from start to finish
  - Potential impacts from raising an offer
  - Potential impacts of lowering an offer

- Show load settlement in the same example
  - Load that has hedged day-ahead
  - Load that has not hedged day-ahead
  - Allocation of uplift

# Generator: Pinehurst




**Price curve is GREEN**

**Cost curve is RED**

Markup ~ $10/MWh

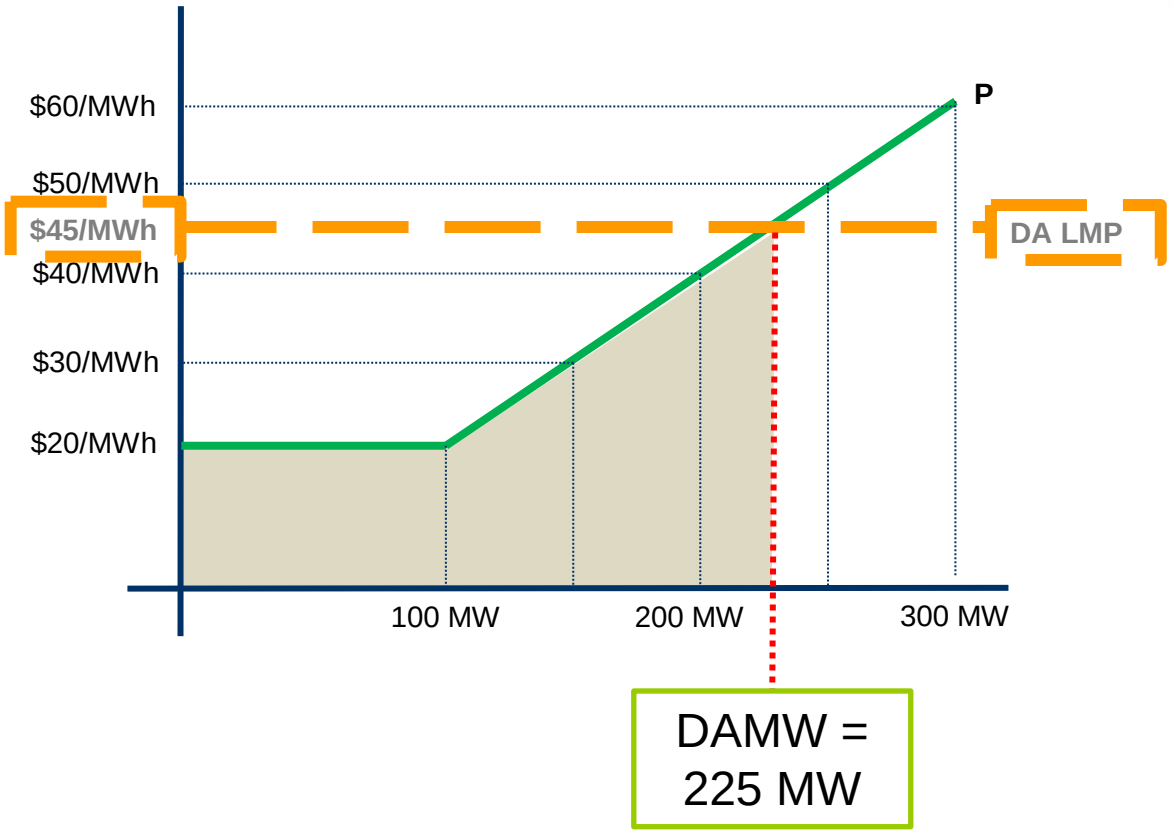
EcoMax = 300 MW

EcoMin = 100 MW

No Load = $0/hr

Startup = $0

# Day-Ahead Market: Generator Clearing




DA Hour Ending 1000

Generator clears on price offer.

DALMP = $45/MWh

DAMW = 225 MW

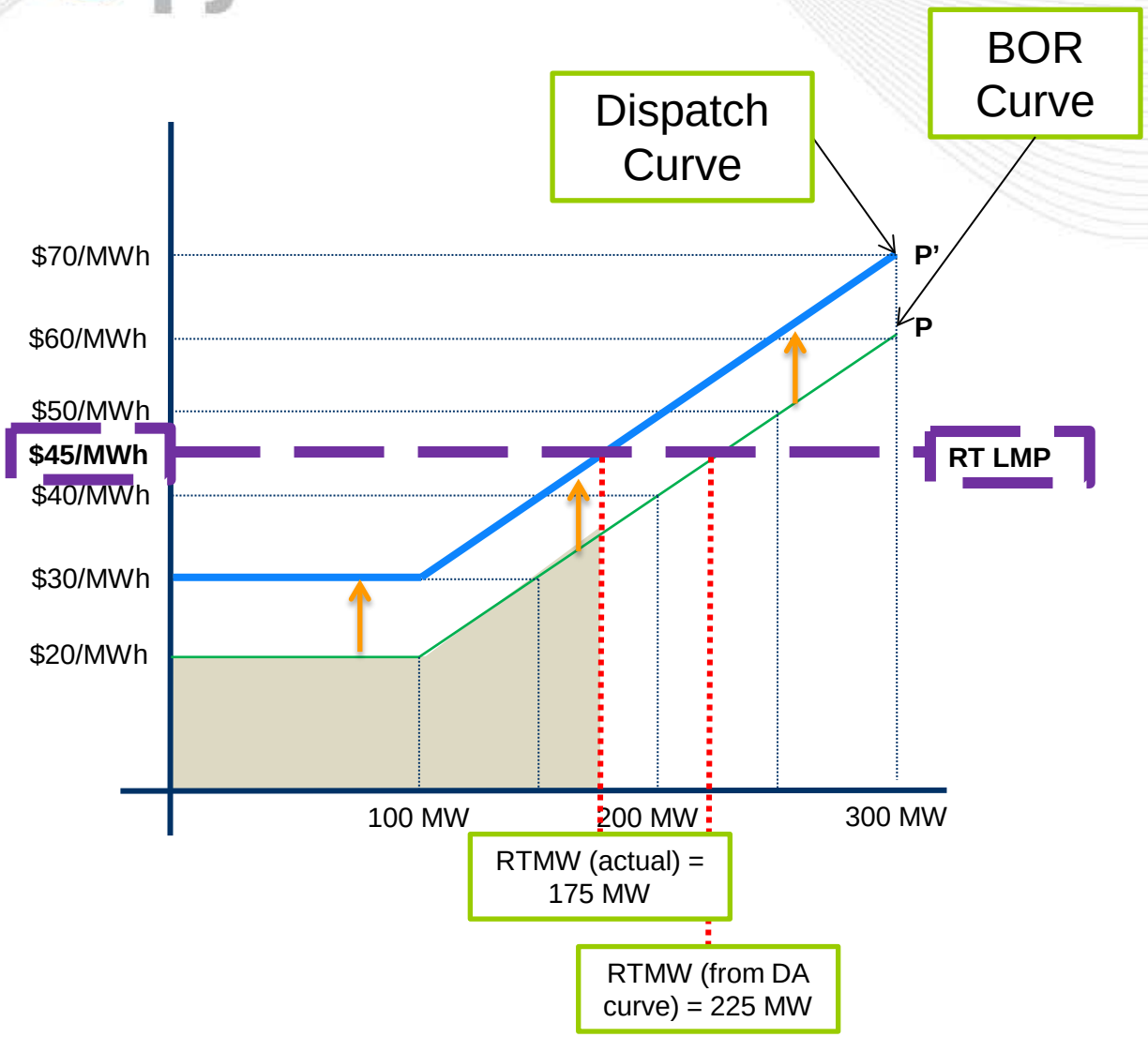
DA Value = $10,125 (DALMP * DAMW)

DA Offer = $6,062.5 (area under curve at DAMW + startup + no load)

DA Uplift = $0 (DA Offer – DA Value)

DA Margin = $4,062.5 (DA Value – DA Offer)

# Real-Time #1: Generator Offer Increase & RTLMP = DALMP




RT Hour Ending 1000

Generator increases price offer by $10/MWh (P' curve).

Assume Deviation Rate = $1.00/MWh

RTLMP = $45/MWh

RTMW = 175 MW

BAL Value Actual = -$2,250 (RTMW (actual) – DAMW) * RTLMP

BAL Value Used = $0 (RTMW (from DA Curve) - DAMW) * RTLMP

BOR Offer = $4,437.5 (area under curve at RTMW + startup + no load)

- **This calculation uses the lesser of the DA and final RT curves**

Schedule Deviation Charge =

| 225 MW – 175 MW| * $1.00/MWh = $50

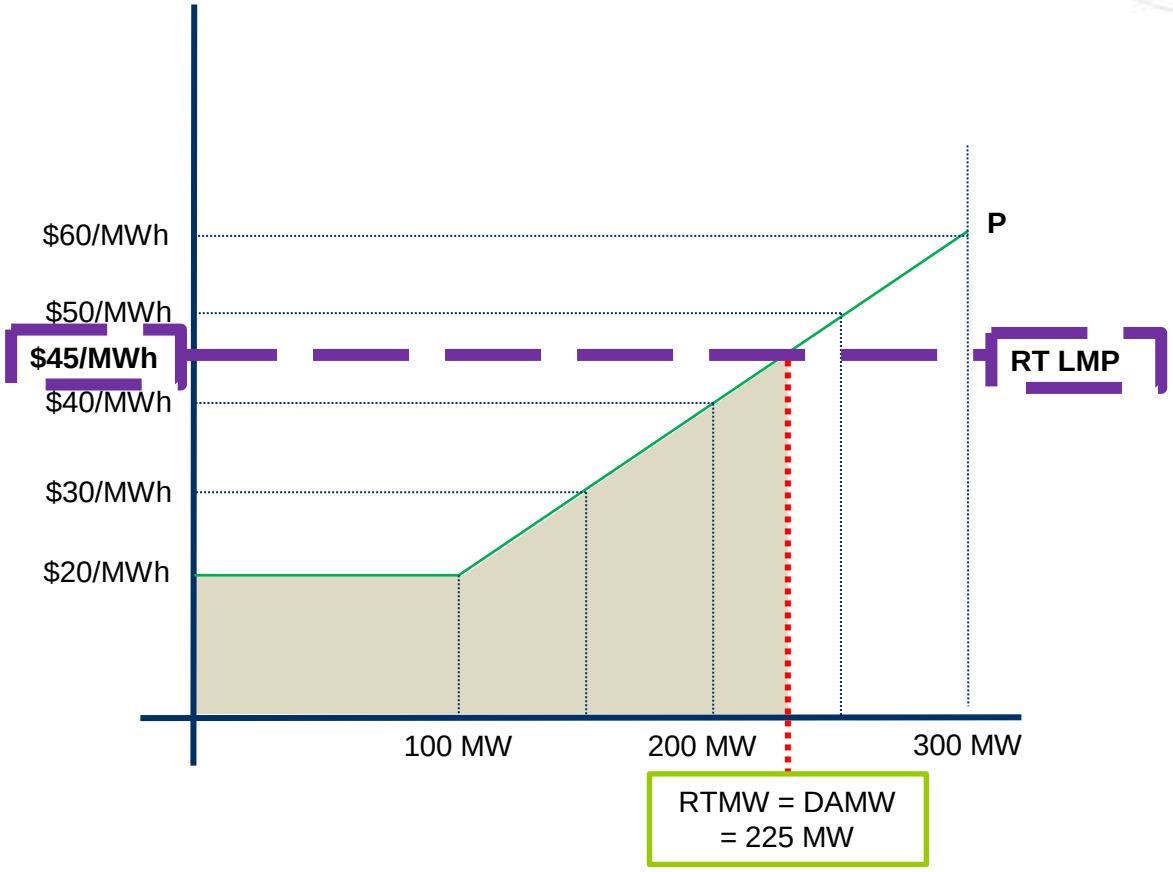
# Real-Time #1: Outcome

- Generation resource increased its offer in real-time
- When RTLMP = DALMP
  - The resource is dispatched to a lower output in RT
  - The resource buys out of the DA commitment at a net loss (Negative Balancing Value)
  - The resource is charged a schedule deviation penalty

BOR Credit = Max($0, BOR Offer – DA Value – BAL Value Used

= Max($0, $4,437.5 - $10,125 – $0) = **$0**

# Real-Time #2: No Offer Change & RTLMP = DALMP




RT Hour Ending 1000

RTLMP = $45/MWh

RTMW = 225 MW

BAL Value Actual = $0 (RTMW (actual) – DAMW) * RTLMP

BAL Value Used = $0 (RTMW (from DA Curve) - DAMW) * RTLMP

BOR Offer = $6,062.5 (area under curve at RTMW + startup + no load)

- **This calculation uses the lesser of the DA and final RT curves**
- **Since the offer was not changed, the DA offer is used**

Schedule Deviation Charge = N/A

# Real-Time #2: Outcome

- Generation resource does not change its offer
- When RTLMP = DALMP
  - The resource is dispatched identically
  - The Balancing Value is $0 due to no MW differences
  - No schedule change penalty

BOR Credit = Max($0, BOR Offer – DA Value – BAL Value Used

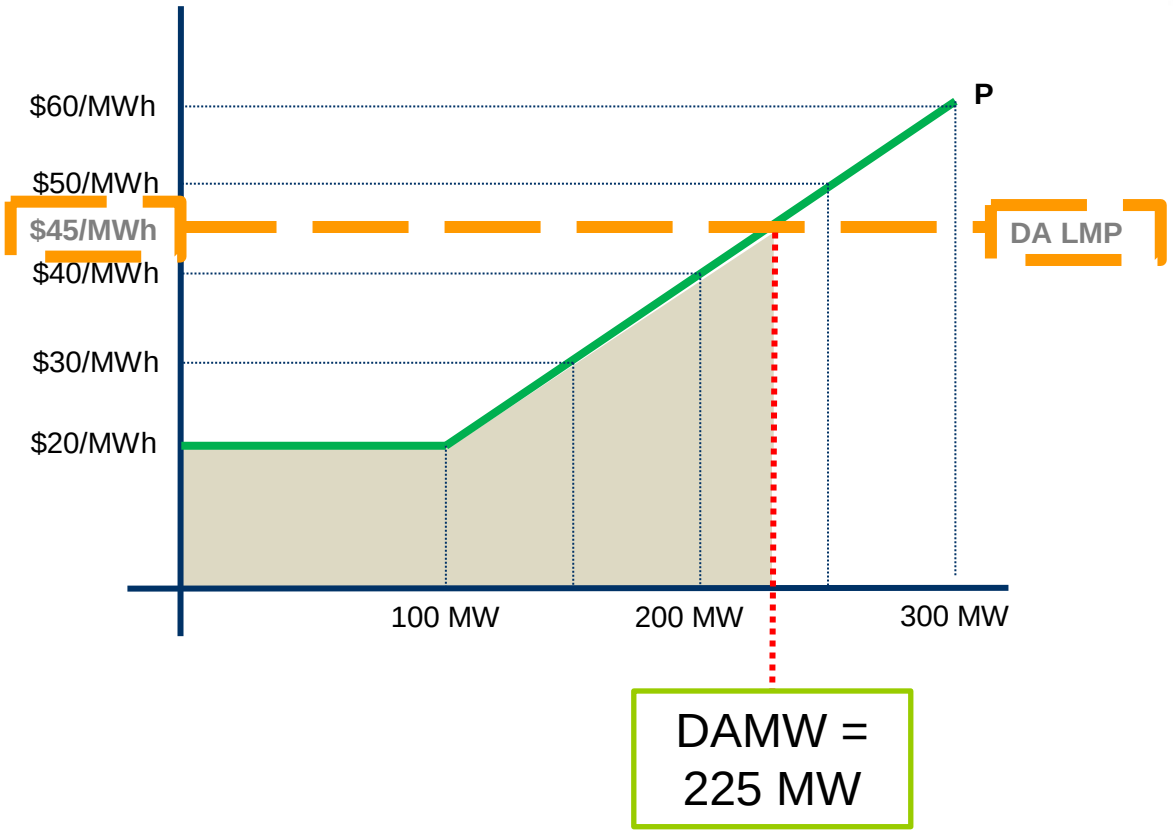
= Max($0, $6,062.5 - $10,125 – $0) = **$0**

# What's the Difference?

| | Offer Changed | No Offer Change |
|---|---|---|
| DA Value | $10,125 | $10,125 |
| BAL Value *Actual* | -$2,250 | $0 |
| BAL Value *Used* | $0 | $0 |
| RT Cost | -$4,437.5 | -$6,062.5 |
| BOR Credit | $0 | $0 |
| Schedule Deviation | -$50 | $0 |
| **Net Settlement** | **$3,387.5** | **$4,062.5** |

- In this example, the cost to buy out of the DA commitment exceeds the cost of generating to meet it
- The generation owner nets ~ $700 less by increasing their offer in real-time and being dispatched lower

# Day-Ahead Market: Generator Clearing




DA Hour Ending 1000

Generator clears on price offer.

DALMP = $45/MWh

DAMW = 225 MW

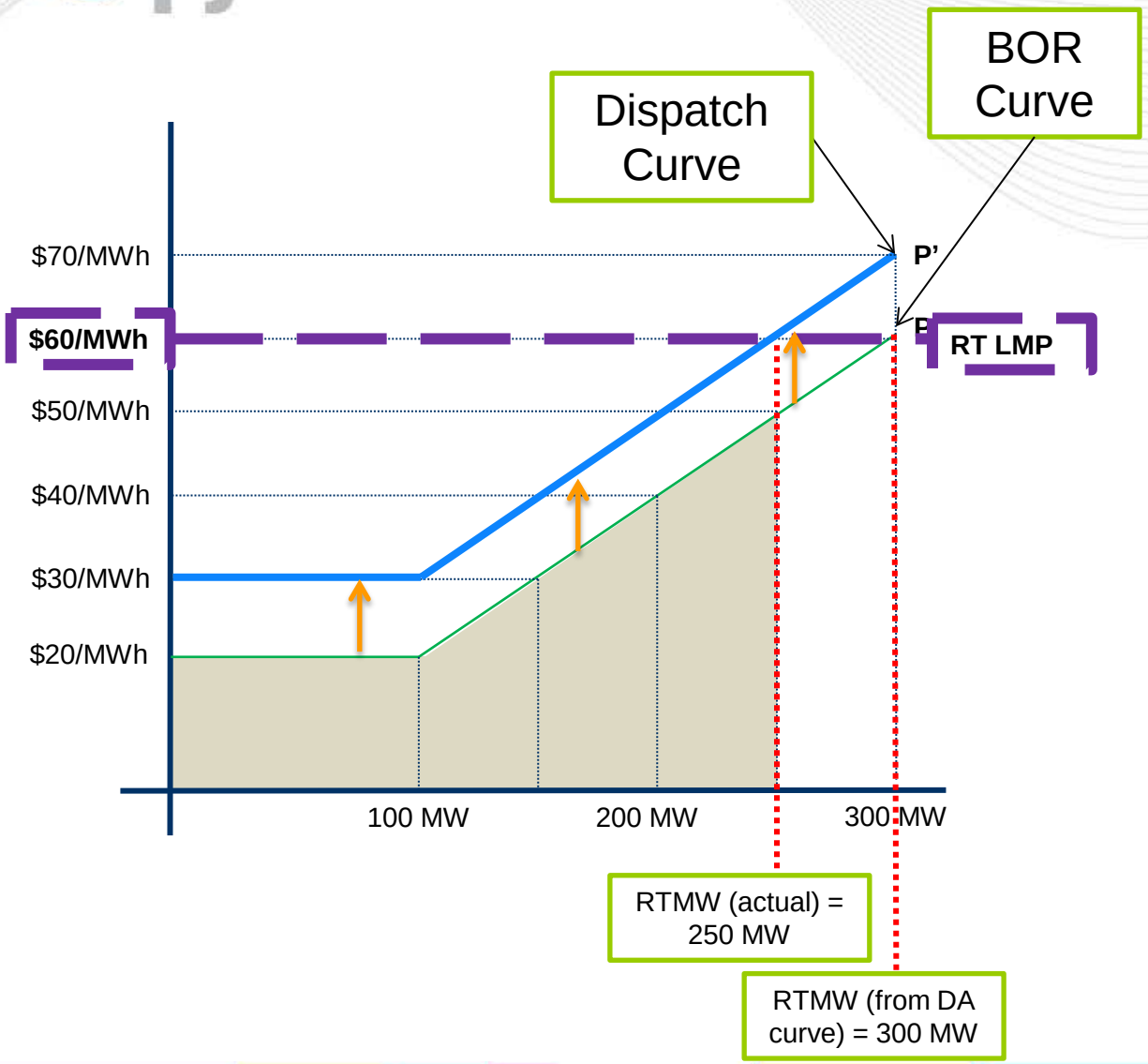
DA Value = $10,125 (DALMP * DAMW)

DA Offer = $6,062.5 (area under curve at DAMW + startup + no load)

DA Uplift = $0 (DA Offer – DA Value)

DA Margin = $4,062.5 (DA Value – DA Offer)

# Real-Time #3: Generator Offer Increase & RTLMP > DALMP




RT Hour Ending 1000

Generator increases price offer by $10/MWh (P' curve).

Assume Deviation Rate = $1.00/MWh

RTLMP = $60/MWh

RTMW = 250 MW

BAL Value Actual = +$1,500 (RTMW (actual) – DAMW) * RTLMP

BOR Offer = $6,125 (area under curve at RTMW + startup + no load)

- **This calculation uses the lesser of the DA and final RT curves**

Schedule Deviation Charge =

| 300 MW – 250 MW| * $1.00/MWh = $50

# Real-Time #3: Outcome

- Generation resource increases its offer
- When RTLMP > DALMP
  - The resource is dispatched below where it would be on its DA curve
  - The Actual Balancing Value is lower as a result ($1,500 vs. $4,500)
  - The unit receives a schedule change penalty

BOR Credit = Max($0, BOR Offer – DA Value – BAL Value

= Max($0, $6,125 - $10,125 – $1,500) = **$0**

# Example #3

| | Offer Changed | No Offer Change |
|---|---|---|
| DA Value | $10,125 | $10,125 |
| BAL Value *Actual* | $1,500 | $4,500 |
| RT Cost | -$6,125 | -$8,000 |
| BOR Credit | $0 | $0 |
| Schedule Deviation | -$50 | $0 |
| **Net Settlement** | **$5,450** | **$6,625** |

- In this example, the reduced MW output in real-time due to the increase in offer decreases the revenues the resource would have collected by exceeding its DA commitment
- The generation owner nets ~ $1,200 less by increasing their offer in real-time and being dispatched lower

# Real-Time Offer Reductions

- The opposite behavior would be to lower offers in real-time as compared to day-ahead
- This would result in lower LMPs in real-time (all other things held equal) and a positive balancing value for the generator
  - Presuming it outperforms the DA commitment and RTLMP > $0
- The individual generation resource's uplift payment would reduce but the addition of low-priced MW would lower LMPs and potentially increase uplift market-wide

# Load Settlement and Allocation of Uplift

- PJM is not proposing any change to the settlement of loads in day-ahead and real-time

- PJM is not proposing any change to how uplift is allocated to loads

# General Load Settlement Rules

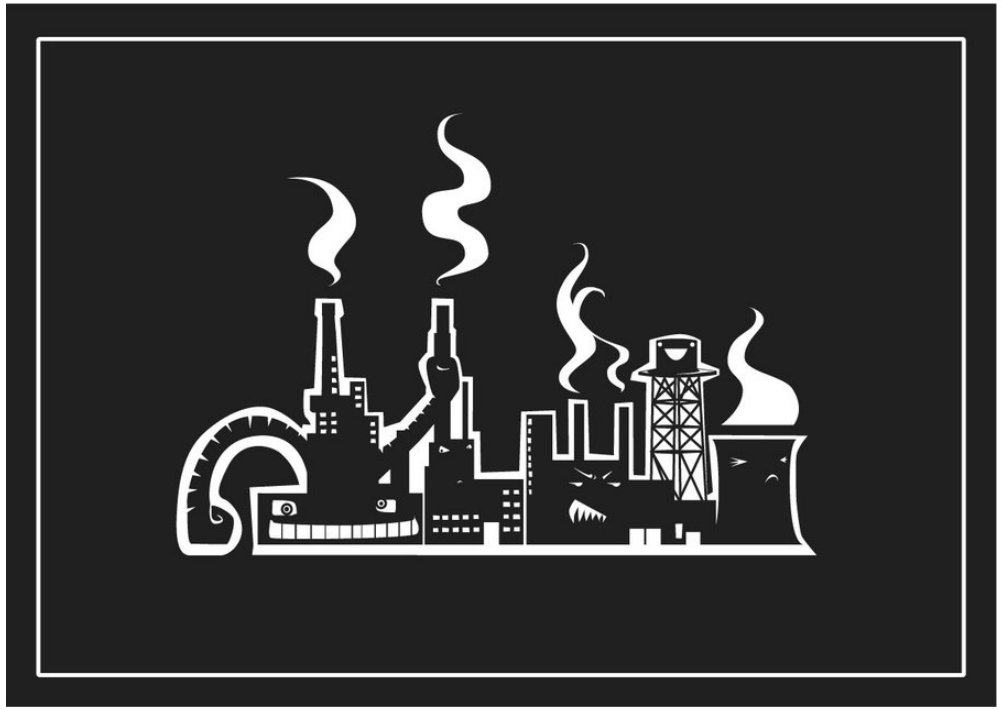
- Loads cleared in the Day-Ahead Market
  - Pay the corresponding LMP
  - Are allocated a share of day-ahead uplift

- Loads schedule deviations from the Day-Ahead Market
  - Pay the corresponding real-time LMP
  - Are allocated a share of real-time uplift for resources not scheduled for conservative operations

# Conservative Operations and Hourly Offers

- The cost of resources committed for conservative operations are generally allocated to load
- These resources, like all others
  - Will receive a DA uplift payment to the DA offer if DA revenues do not cover the cost
  - Will receive a BOR payment to the lesser of the committed or final offer if the real-time operating costs are not recovered
- The BOR payment to these resources cannot be increased by increases in offers in real-time
  - BOR is limited to the lesser of the committed or final offer

# Load Settlement Example for LSE A in Day-Ahead



DA Hour Ending 1000

Load clears 1,000 MW in day-ahead

Ratio share for uplift allocation is 1%

Total Day-Ahead Uplift = $200,000

DALMP = $45/MWh

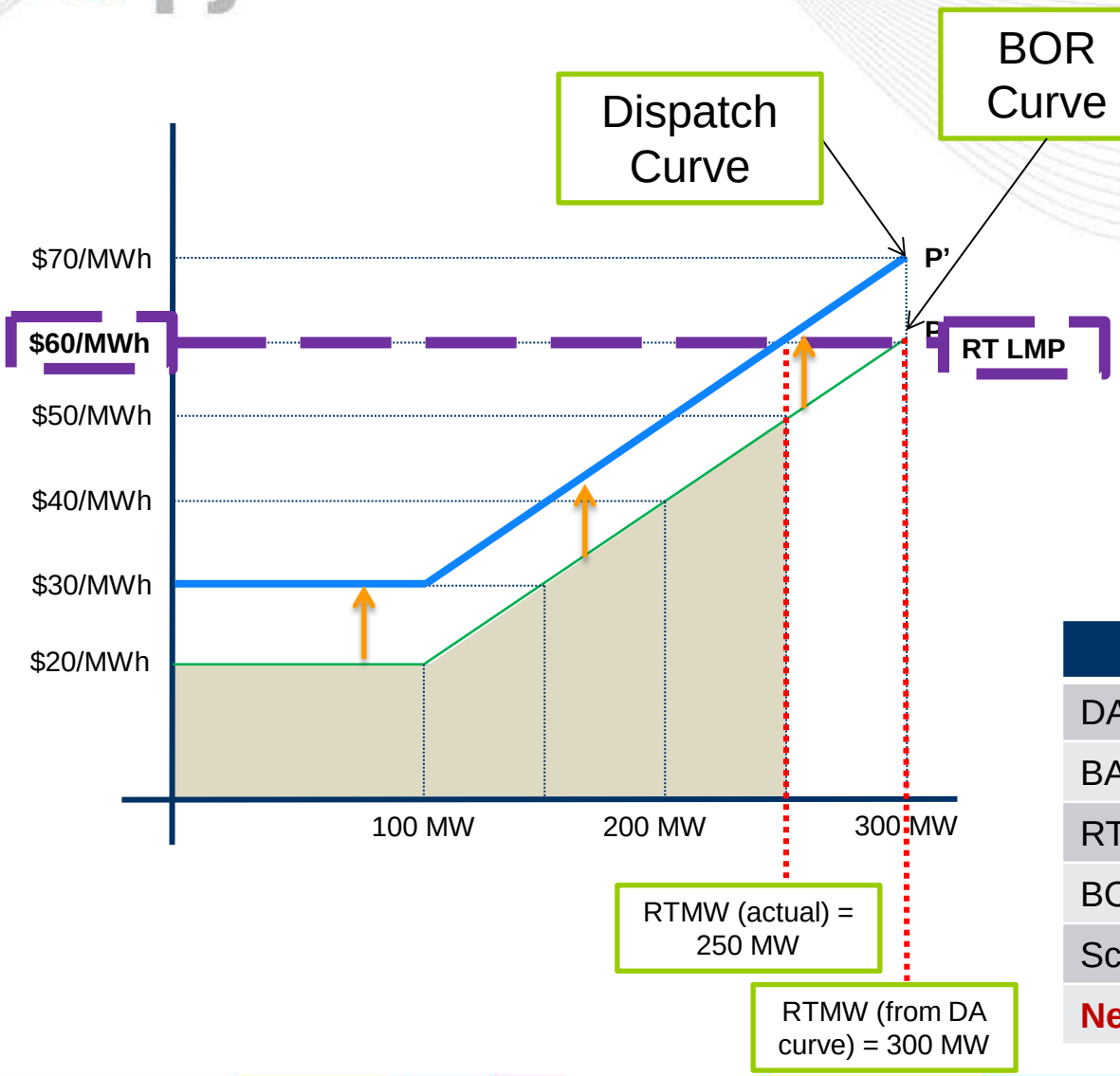
DAMW = 1,000 MW

Day-Ahead Energy Charge = $45,000

Day-Ahead Uplift Charge = $2,000

Total Day-Ahead Settlement = $47,000

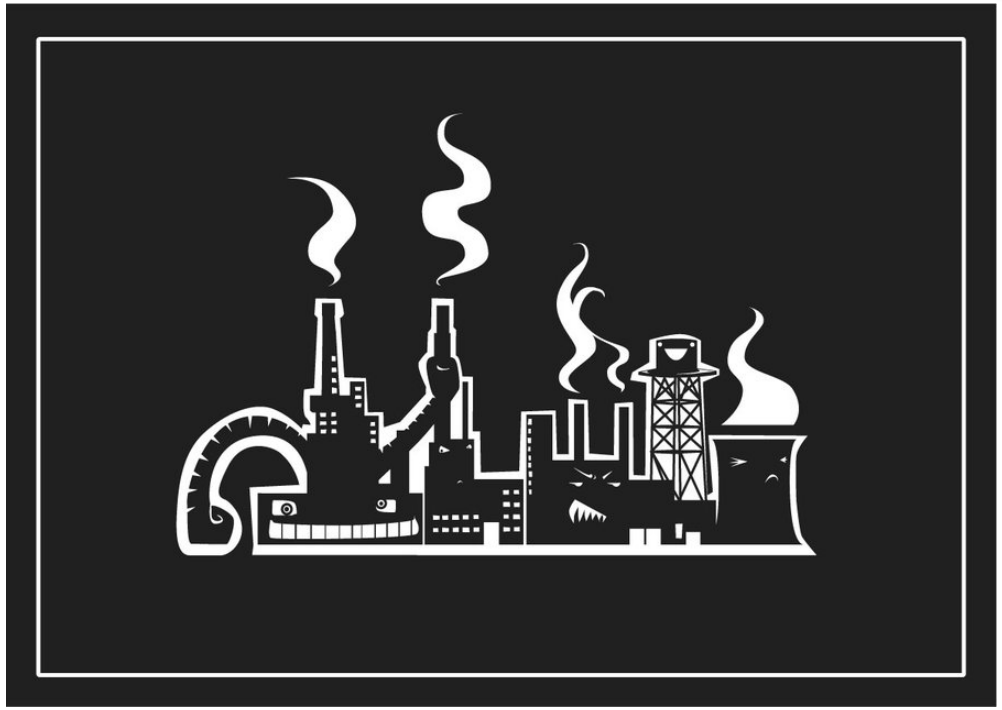
# Gen-Side: Generator Offer Increase & RTLMP > DALMP




- Generator offer increased in real-time
  - Resource only made whole up to committed offer
- LMP increase in real-time
- Potential overall reduction in BOR due to higher LMP

| | Offer Changed | No Offer Change |
|---|---|---|
| DA Value | $10,125 | $10,125 |
| BAL Value *Actual* | $1,500 | $4,500 |
| RT Cost | -$6,125 | -$8,000 |
| BOR Credit | $0 | $0 |
| Schedule Deviation | -$50 | $0 |
| **Net Settlement** | **$5,450** | **$6,625** |

# Load Settlement Example for LSE A in Real-Time



RT Hour Ending 1000

Real-Time load is 1,112 MW

Load is deviating by 112 MW

Assume deviation rate is $1.00/MWh

RTLMP = $60/MWh

RTMW = 1,112 MW

Balancing Energy Charge = $6,720

BOR Charge = $112

Total Charges to LSE A = $53,832

# Load Implications

- Deviating schedules from DA will likely have been paid less uplift due to higher RT LMPs
  - Deviation rate is lower due to less uplift to allocate
- Resource that has increased its offer has made less money than it otherwise would have
  - No increase in its uplift due to offer increase
- Exposure for loads is to the real-time LMP as it is today
- Best way to avoid impacts of offer changes in real-time is to hedge day-ahead

# Hourly Offers and Load Settlement

- Hourly offers will impact the LMP calculation and uplift quantities
  - Direction and magnitude are difficult to determine
  - No studies available from entities with hourly offers already

- All other things being equal,
  - Increases in offer prices in real-time will result in a(n)
    - Increase in the RT LMP compared to DA LMP
    - Decrease in the uplift allocation to deviations due to higher RT LMPs
  - Decreases in offer prices in real-time will result in a(n)
    - Decrease to the RT LMP as compared to DA LMP
    - Increase in the uplift allocation to deviations due to lower RT LMPs