Real-Time Market Operations:
Real-Time LMP

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What is LMP?

- Pricing method PJM uses to ...
  - price energy purchases and sales in the PJM Market
  - price transmission congestion costs to move energy within the PJM Control Area
  - price losses on the bulk power grid
- Physical, flow-based pricing system
  - how energy actually flows, NOT contract paths

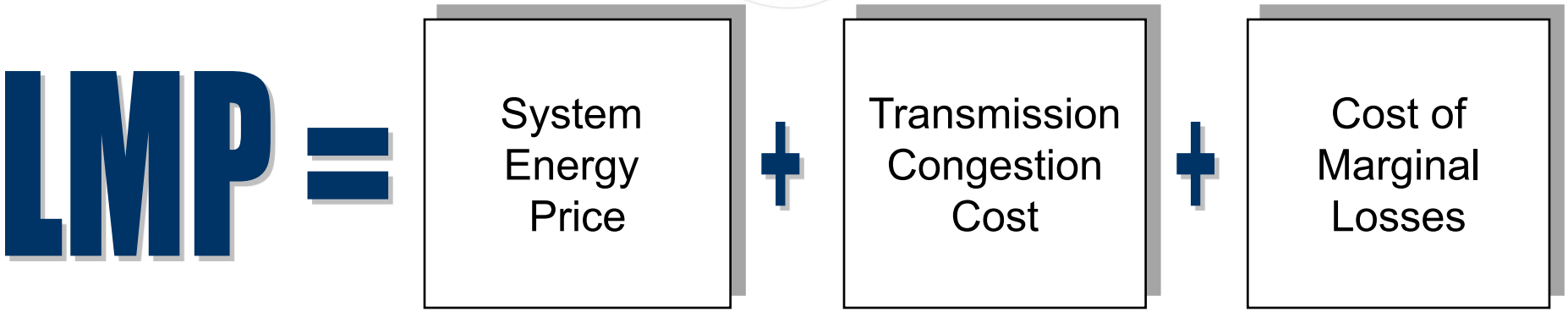
LMP Characteristics

- Based on...
  - actual flow of energy
  - actual system operating conditions
- LMPs…
  - are equal, ONLY in a min gen situation when every price on the system is 0
  - vary by location, when transmission system is constrained or unconstrained because of marginal losses

How is LMP Used?

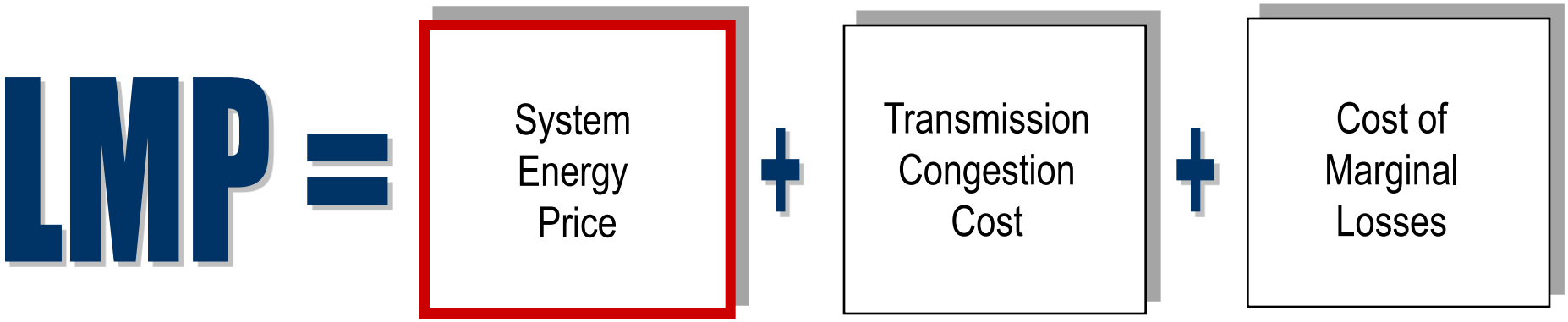
- Generators get paid at generation bus LMP
- Loads pay at load bus LMP
- Transactions pay differential in source and sink LMP

LOCATIONAL MARGINAL PRICING

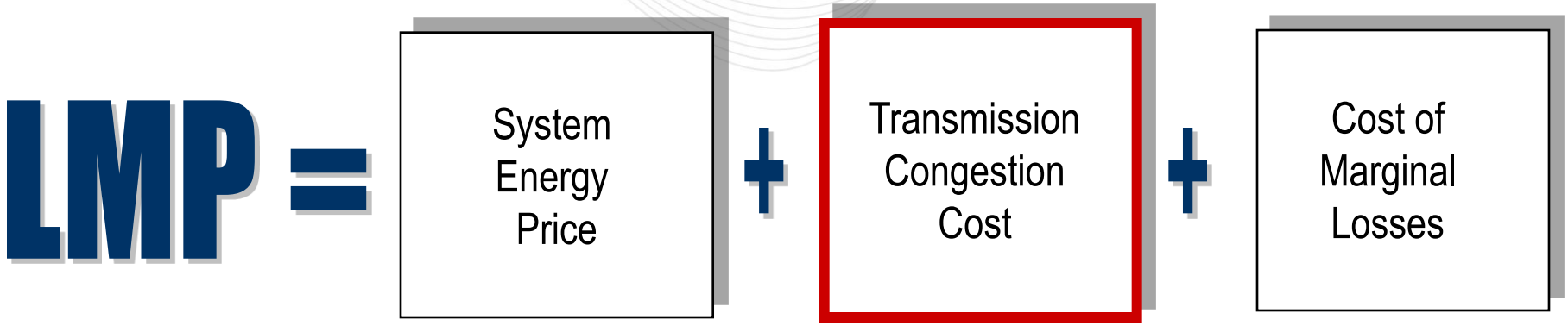


Cost to serve the next MW of load at a specific location, using the lowest production cost of all available generation, while observing all transmission limits

LOCATIONAL MARGINAL PRICING

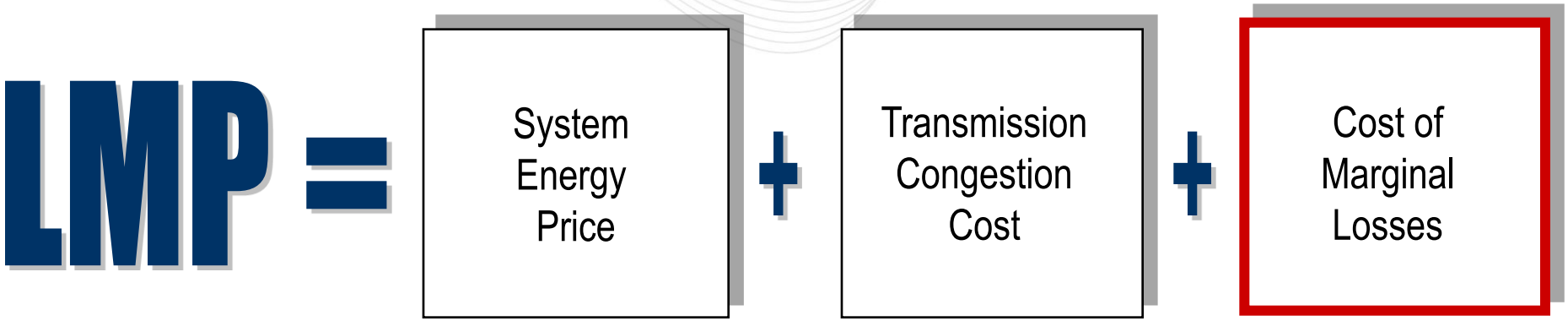


- ☑ System Energy Price
  - Represents optimal dispatch ignoring congestion and losses
  - Same price for every bus in PJM



☑ Congestion Price

- Represents price of congestion for binding constraints
  - Calculated using cost of marginal units controlling constraints and sensitivity factors on each bus
  - No change in this calculation
- Will be zero if no constraints
  - Will vary by location if system is constrained

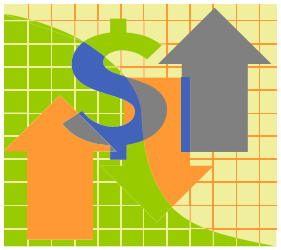


- ☑ Loss Price
  - Represents price of marginal losses
    - Calculated using penalty factors as previously described
  - Will vary by location

LMP and Economic Dispatch

Dispatch Rate → Directive → Where PJM wants the units to be loaded economically

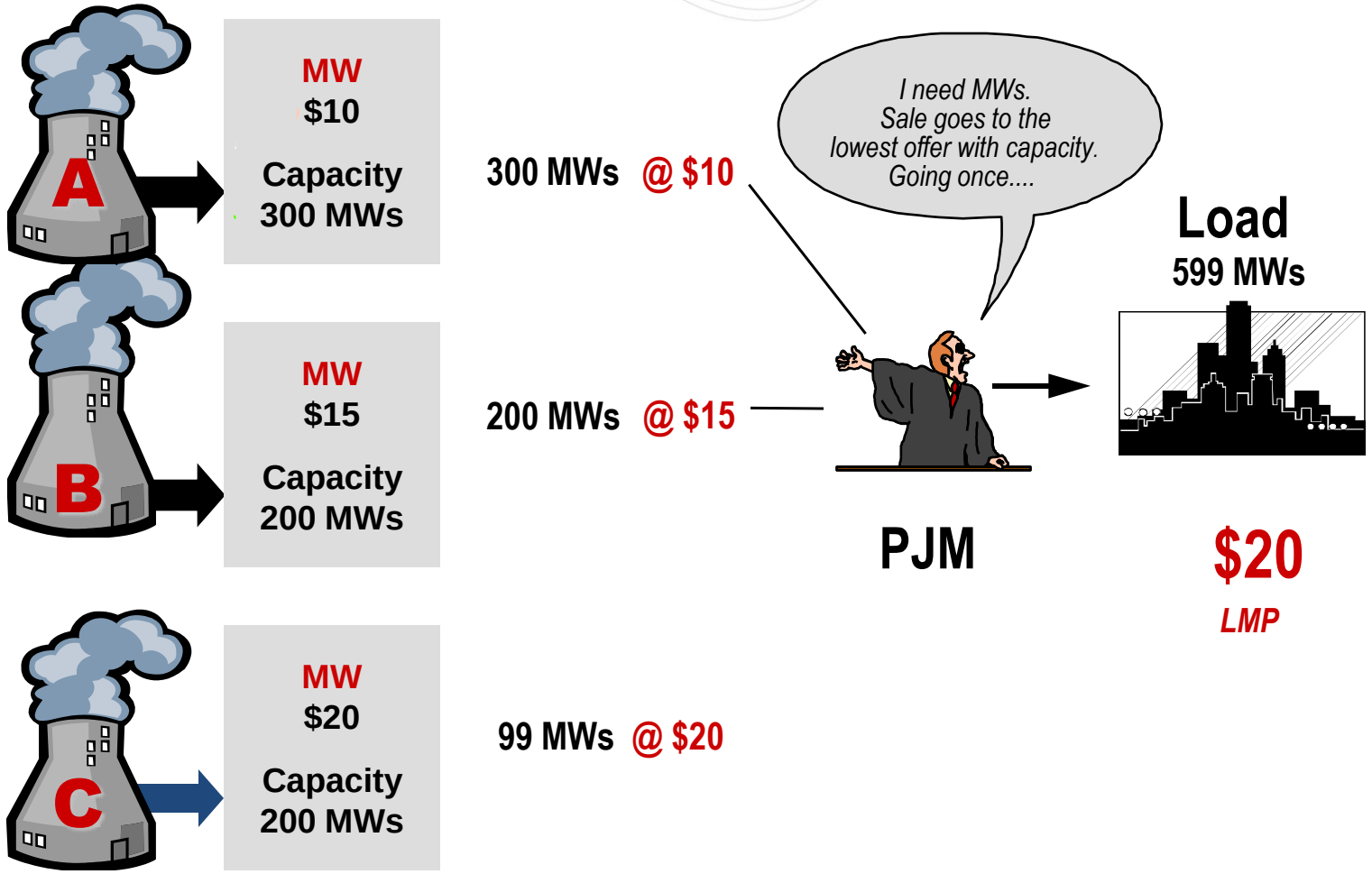
LMP → Result → Based on actual loading of each unit



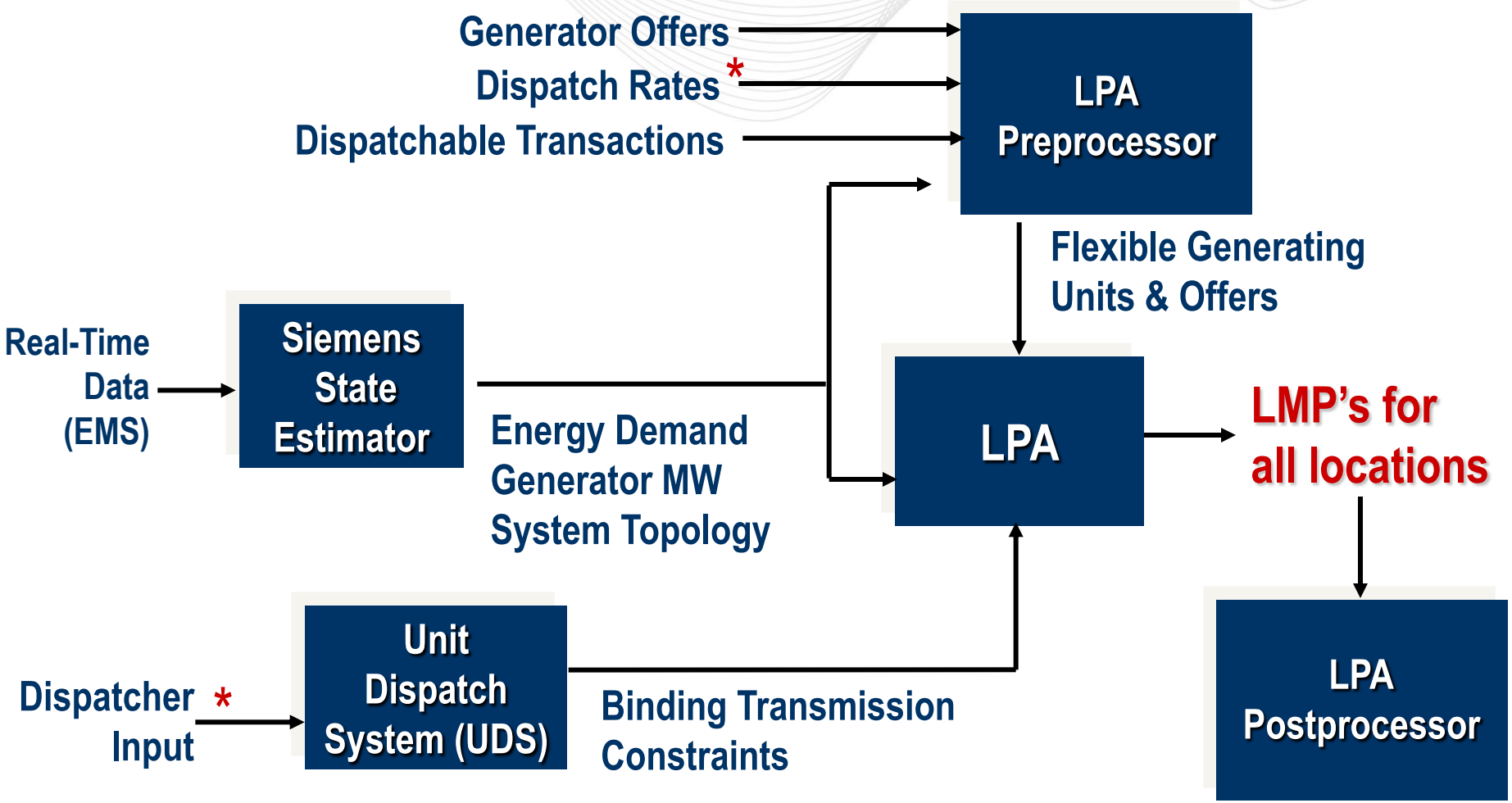
If unit's don't move to follow dispatch rate, LMP will not change!

LMPs are a Result of the Economic Dispatch Problem

Generator Providing Next MW of Load Sets LMP



LMP MODEL



* *Manual Dispatcher Input*

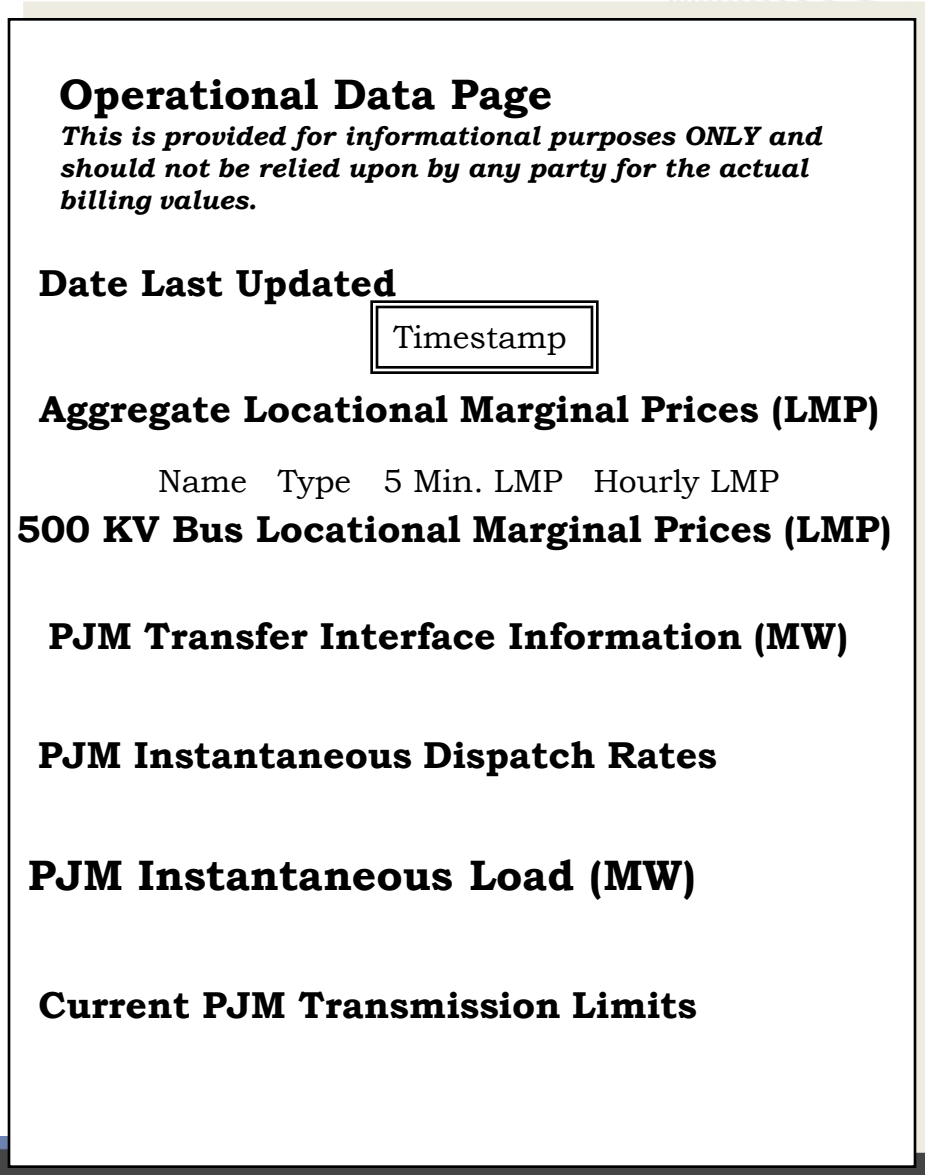
LPA = Locational Pricing Algorithm

LOCATIONAL PRICING ALGORITHM (LPA)

- 3 Components to the LPA
  - Pre-processor
    - screens for and determines eligible units
  - LPA Engine or Processor
    - calculates the LMPs at each generator, load, tie, EHV, and external bus in the model
  - Post-processor
    - comprised of several different programs

Real-time LMPs

- Calculated and posted on the Operational Data page and eData at 5-minute intervals
  - Based on actual operating conditions, as described by State Estimator
- Integrated at end of each hour
  - Hourly integrated values posted on the Operational Data page
- Accounting settlements performed based on hourly integrated LMPs
  - Settlements performed after LMP Verification Process is complete



Operational Data Page

This is provided for informational purposes ONLY and should not be relied upon by any party for the actual billing values.

Date Last Updated

Timestamp

Aggregate Locational Marginal Prices (LMP)

Name Type 5 Min. LMP Hourly LMP

500 KV Bus Locational Marginal Prices (LMP)

PJM Transfer Interface Information (MW)

PJM Instantaneous Dispatch Rates

PJM Instantaneous Load (MW)

Current PJM Transmission Limits

Current 5-minute & hourly integrated LMP values

Values posted:

- PJM & Transmission Zones
- 12 PJM Trading Hubs
- 168 Aggregates
- 16 Interfaces into PJM
- 104 500 kV or higher busses