# Applicability of Energy Market Opportunity Cost and Non-Regulatory Opportunity Cost Calculations and the Forward Looking Energy and Ancillary Service Offset

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# Purpose

- Review Energy Market Opportunity Cost calculations
- Discuss potential applicability to forward looking energy and ancillary service offset

# History

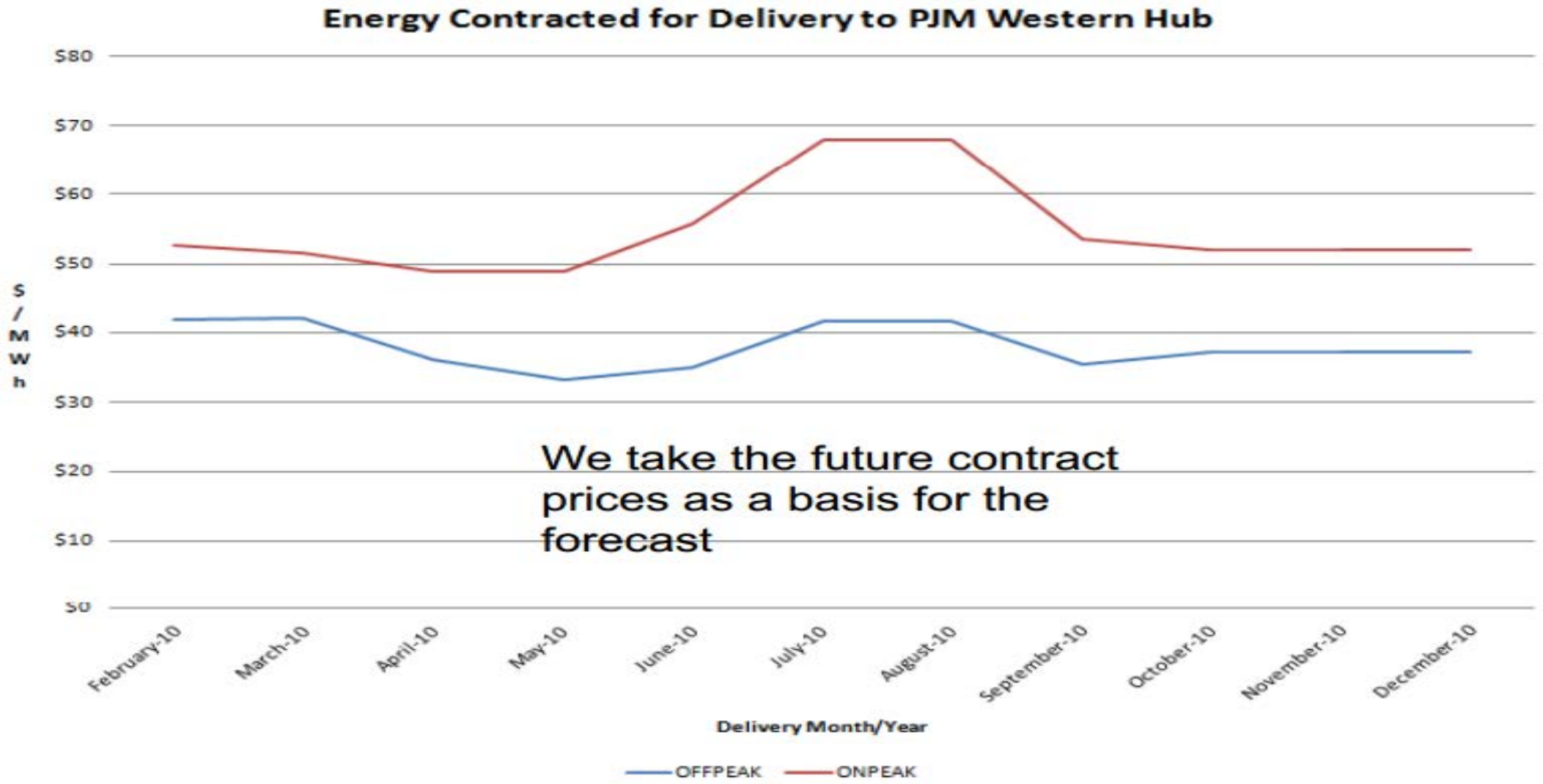
- On May 16, 2008, the Commission granted a complaint in part and eliminated market rule provisions that exempted certain generation resources from energy offer price mitigation.
- The Commission found, under section 206 of the Federal Power Act (FPA), that PJM's mitigation procedures were unjust and unreasonable insofar as they failed to include opportunity costs in the determination of mitigated offer prices.
- PJM had to file before July 31, 2009, that proposed an approach for addressing the incorporation of opportunity costs in mitigated offers.

# Who can use this method currently?

- The unit has an externally imposed environmental limit on run hours within a certain compliance period (EMOC)
- The unit has a force majeure fuel limitation and is limited in run hours for a particular definable period (NROC)
- The unit has a physical equipment limitation on run hours due to Original Equipment Manufacturing (OEM) recommendations or insurance carrier restrictions (NROC)

- Step 1: Forecast LMPs
- Step 2: Forecast Dispatch Cost
- Step 3: Margin = LMP – Dispatch Cost
  - Taken from future contract prices
- Step for Forward looking E&AS Offset… sum net margin

# Step 1a: Future Contract Prices



# Step 1b: LMP Adjustments

- But all generators aren't at PJM Western Hub…
  - 3 years basis
  - Historical Bus LMP divided by PJM Western Hub
  - LMP hourly averaged on and off peak to get ratios to deliver the LMP forecast to my bus deliver the LMP forecast to the zone or bus

# Equation for the Engineers

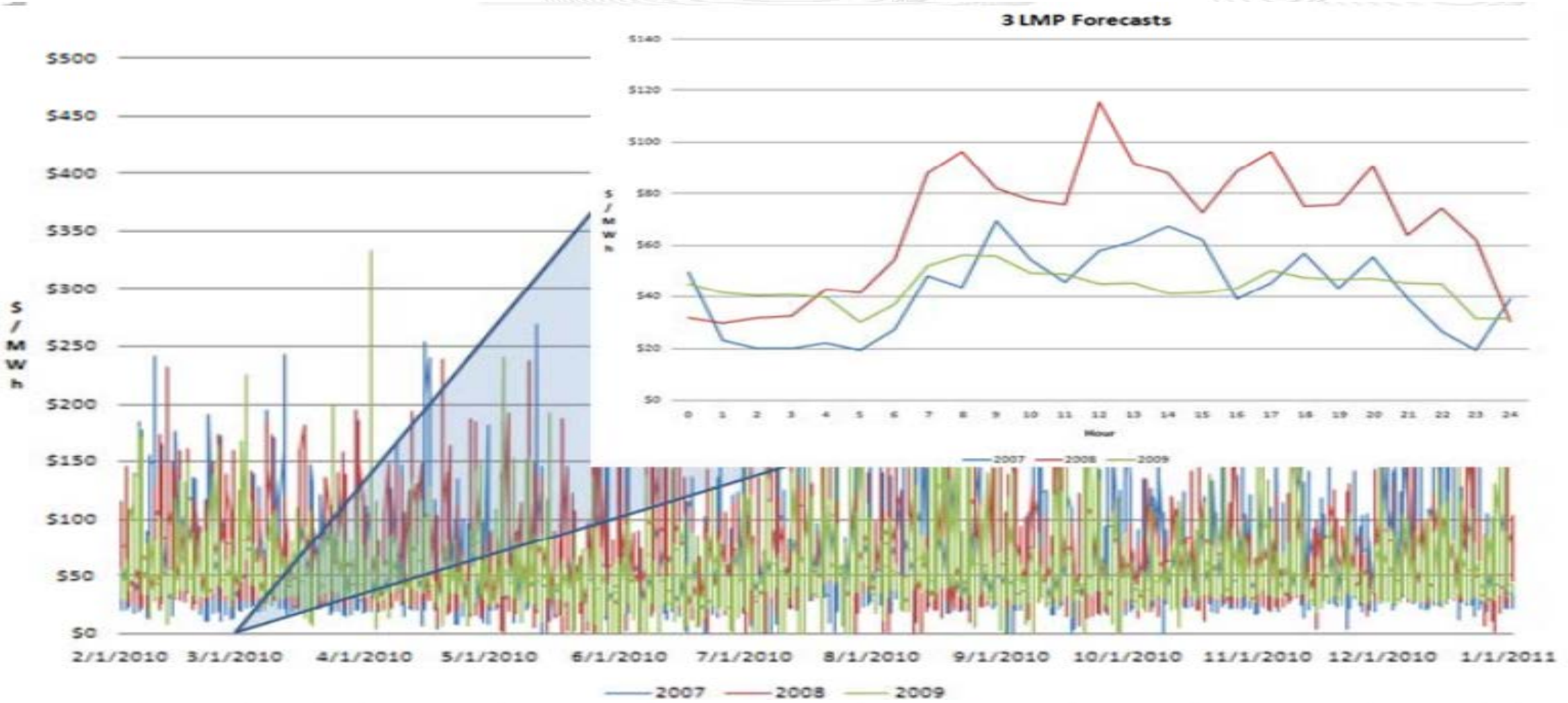
$$\text{ForecastedBUSLMP}^{\text{peak}}_{y,m,d,h} = \text{HourlyVolatilityScalar}^{\text{peak}}_{y,m,d,h} * \text{ForecastedMonthlyBusPrice}^{\text{peak}}_{fy,m}$$

$$\text{HourlyVolatilityScalar}^{\text{peak}}_{y,m,d,h} = \frac{\text{BUSLMP}^{\text{peak}}_{y,m,d,h}}{\text{MonthlyAverageBusLMP}^{\text{peak}}_{y,m}}$$

$$\text{Forecasted Monthly Bus Price}^{\text{peak}}_{fy,m} = \left[ \text{PJMWestern Hub}^{\text{peak}}_{fy,m} * \text{MonthlyPeakBasisRatio}^{\text{peak}}_{y,m} \right]$$

** Explained in detail in Manual 15

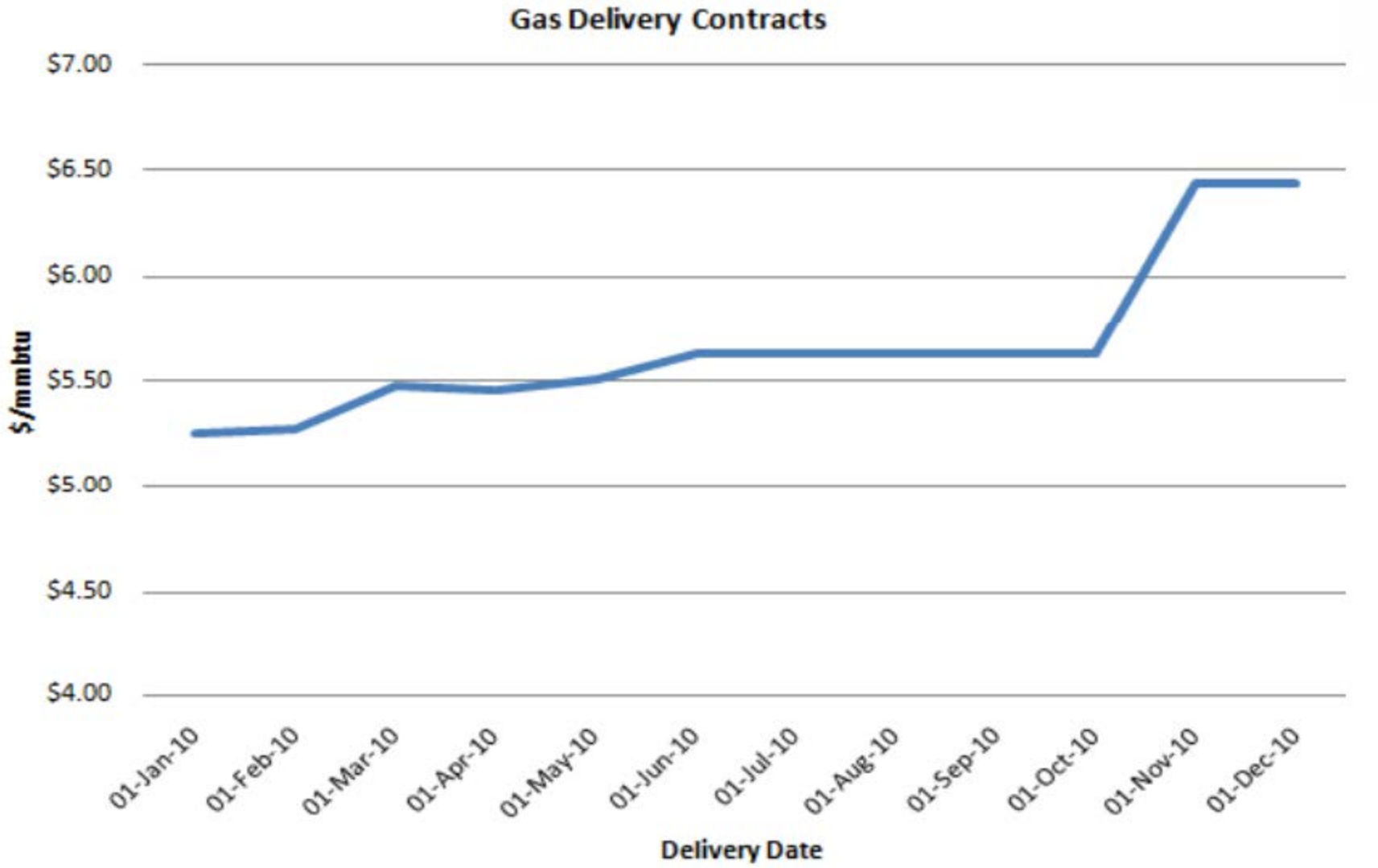
# Step 1c: 3 hourly Shapes



# Step 2 Forecast Dispatch Cost

- Components of the cost based offer are outlined in PJM Manual 15: Cost Development Guidelines
- Fuel Makes up ~90%

# Future Fuel Costs



# Again for the Engineers…

$$\text{UnitCost}_{fy,m,d}^{\text{base year}} =$$

$$\left\{\left[\text{UnitHeatRate}\left(\frac{\text{mBTU}}{\text{mwh}}\right) * \text{DailyDeliveredFuelForecast}\left(\frac{\$}{\text{mBTU}}\right)_{\text{Future y,m,d}}^{\text{base year}}\right] +\right.$$

$$\left[\text{UnitHeatRate}\left(\frac{\text{mBTU}}{\text{mwh}}\right) * \text{UnitNOxEmissionRate}\left(\frac{\text{lbs}}{\text{mBTU}}\right) * \text{Cost of NOx}\left(\frac{\$}{\text{lb}}\right)\right] +$$

$$\left[\text{UnitHeatRate}\left(\frac{\text{mBTU}}{\text{mwh}}\right) * \text{Unit}SO_2\text{EmissionRate}\left(\frac{\text{lbs}}{\text{mBTU}}\right) * \text{Cost of } SO_2\left(\frac{\$}{\text{lb}}\right)\right] +$$

$$\left.\left[\text{UnitHeatRate}\left(\frac{\text{mBTU}}{\text{mwh}}\right) * \text{Unit}CO_2\text{EmissionRate}\left(\frac{\text{lbs}}{\text{mBTU}}\right) * \text{Cost of } CO_2\left(\frac{\$}{\text{lb}}\right)\right] + \text{VOM} +\right\}$$

$$+ \text{ either a } \begin{cases} \text{10\% margin} \\ \text{FMU adder} \end{cases} \text{or}$$

# The method

- The calculator uses a simple dispatch model with start and minimum runtime to dispatch a unit against future LMPs.
- Margins for each blocks are calculated and ranked so the unit is dispatched appropriately to maximize profit.
- The margins are then ranked and used to calculate an opportunity cost adder for the cost based offer.

$$\text{TotalMarginBlock}_{\substack{t=block+MRT-1 \\ block}}^{\text{base year}} = \sum_{t=block} \left( \text{ForecastedBusLMP}_{y(t),m(t),d(t),h(t)}^{\text{base year}} - \text{UnitDispatchCost}_{\text{future y,m,d}}^{\text{base year}} \right)$$

# Pros and Cons of the Method

- PROS
  - Forward Looking
  - Based on Market Data
  - Takes both fuel and electric expectations into account

- CONS
  - Moves Outliers Forward
  - Based on Market Data
  - Complicated