The Coal Bailout Nobody is Talking About

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Joseph Daniel
Sr. Energy Analyst
Union of Concerned Scientists
Science for a healthy planet and safer world.
ENERGY MARKETS ARE DESIGNED TO OPTIMIZE DISPATCH:

LOW VARIABLE COST RESOURCES SHOULD HAVE PRIORITY OVER HIGH VARIABLE COST RESOURCES
MERCHANT VS. RATE REGULATED

- Vertical axis is actual value (CF %)
- Horizontal axis is expected value (% of hours above marginal cost)

Originally presented in: United States Association For Energy Economists Paper
## RESULTS FOR FINANCIAL BURDEN

<table>
<thead>
<tr>
<th></th>
<th>PJM</th>
<th>MISO</th>
<th>ERCOT</th>
<th>SPP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Regulated</td>
<td>Merchant</td>
<td>Regulated</td>
<td>Merchant</td>
</tr>
<tr>
<td>2015</td>
<td>-$259 Million</td>
<td>-$333 Million</td>
<td>-$681 Million</td>
<td>-$18 Million</td>
</tr>
<tr>
<td>2016</td>
<td>-$86 Million</td>
<td>-$335 Million</td>
<td>-$566 Million</td>
<td>-$13 Million</td>
</tr>
<tr>
<td>2017</td>
<td>-$354 Million</td>
<td>-$695 Million</td>
<td>-$270 Million</td>
<td>-$5 Million</td>
</tr>
<tr>
<td>Total</td>
<td>-$699 Million</td>
<td>-$1,362 Million</td>
<td>-$1,518 Million</td>
<td>-$36 Million</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Regulated</th>
<th>Merchant</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>-$36 Million</td>
<td>$n/a</td>
</tr>
<tr>
<td>2016</td>
<td>-$39 Million</td>
<td>$n/a</td>
</tr>
<tr>
<td>2017</td>
<td>-$79 Million</td>
<td>$n/a</td>
</tr>
<tr>
<td>Total</td>
<td>-$154 Million</td>
<td>$n/a</td>
</tr>
</tbody>
</table>

Over $4.6 billion in market losses over three years

NOTE: These numbers are gross, not net; values don’t account for impacts of merit order on LMP and new clearing price of replacement energy.
NOTE: Each bar represents one coal unit, width of bars are not proportional to size capacity of that unit. Ex: ERCOT had fewest units, so the width of the bars are greatest.

Merchant Generators

Rate

Regulated

RESULTS: CUMULATIVE GROSS LOSSES, 3-YEARS
<table>
<thead>
<tr>
<th>Top 15 Worst Actors (all over $100 million over 3 years)</th>
<th>3-year Cumulative Market Losses</th>
<th>Market</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elm Road Generating Station</td>
<td>$ 425 Million</td>
<td>MISO</td>
</tr>
<tr>
<td>Dolet Hills</td>
<td>$ 407 Million</td>
<td>MISO/SPP</td>
</tr>
<tr>
<td>Mount Carmel Cogeneration</td>
<td>$ 290 Million</td>
<td>PJM</td>
</tr>
<tr>
<td>Pirkey</td>
<td>$ 228 Million</td>
<td>SPP</td>
</tr>
<tr>
<td>Northeastern Power Cogen Facility</td>
<td>$ 192 Million</td>
<td>PJM</td>
</tr>
<tr>
<td>Westwood Generating Station</td>
<td>$ 173 Million</td>
<td>PJM</td>
</tr>
<tr>
<td>John E. Amos</td>
<td>$ 159 Million</td>
<td>PJM</td>
</tr>
<tr>
<td>Whitewater Valley</td>
<td>$ 143 Million</td>
<td>PJM</td>
</tr>
<tr>
<td>Big Cajun 2</td>
<td>$ 137 Million</td>
<td>MISO</td>
</tr>
<tr>
<td>Conesville</td>
<td>$ 136 Million</td>
<td>PJM</td>
</tr>
<tr>
<td>Montour</td>
<td>$ 129 Million</td>
<td>PJM</td>
</tr>
<tr>
<td>San Miguel</td>
<td>$ 127 Million</td>
<td>ERCOT</td>
</tr>
<tr>
<td>J. Sherman Cooper</td>
<td>$ 120 Million</td>
<td>PJM</td>
</tr>
<tr>
<td>Sioux</td>
<td>$ 115 Million</td>
<td>MISO</td>
</tr>
<tr>
<td>Indian River</td>
<td>$ 115 Million</td>
<td>PJM</td>
</tr>
</tbody>
</table>
THE MOST INSULTING RESPONSE: 
YOU JUST DON’T UNDERSTAND HOW THIS WORKS.

Yes, wholesale and retail are different.

If there is an opportunity to buy electricity on the wholesale market at a price below a utility production costs it should.
THE SILLIEST RESPONSE: WE HAVE THE RIGHT TO “SELF-SUPPLY.”

“Self-supply” and “over-charge” are two different things.
THE MOST COMMON RESPONSE:
THESE PLANTS ARE NEEDED FOR RELIABILITY?

#1: This research was not designed to indicate or evaluate reliability and makes no judgment about the “need” for any of these plants for reliability purposes.

#2: Markets are designed to maintain a reliable grid. If lower costs resources are clearing the market, then you may or may not be needed for reliability.
THE MOST TECHNICAL EXCUSE: FUEL COSTS ARE FIXED COSTS

Accounting practices are questionable

Contracts can be renegotiated
CONCLUSIONS AND IMPLICATIONS

• All markets impacted
• Assumption of rational actors in organized markets with rate-regulated assets may be flawed
• Calls into question the extent of consumer benefits associated with markets
• LMP not a good proxy for avoided costs
APPENDIX SLIDES
Future Research Questions?

- Why are merchant units behaving this way?
- Are affiliate transactions distorting the market?
- Is guaranteed cost recovery distorting the market?
- How much of the out-of-merit dispatch can be excused by system constraints?
- What is the impact on LMP and other generators?
- Are plants that are refusing to turn off creating congestion? Negative LMPs?
- Should regulators PUCs disallow costs associated with uneconomic dispatch?
## Game Theory Behind Energy Markets

**Energy Production Cost = $30.00**

<table>
<thead>
<tr>
<th>Offer Price ($/MWh)</th>
<th>Market Clearing Price ($/MWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$25.00 (under bid)</td>
<td>$26.00</td>
</tr>
<tr>
<td>$30.00 (logical bid)</td>
<td>$31.00</td>
</tr>
<tr>
<td>$35.00 (over bid)</td>
<td>$36.00</td>
</tr>
</tbody>
</table>

This illustration depicts what happens if power plant underbids market. This is the prevailing theory that should dictate logical dispatch. But not all units provide market offers, instead they self-select to operate/dispatch.
Module 1: Screening Analysis, Methodology

- $C^p = C^f + C^v + C^e$
  - Where expressed in $$/MWh
    - $C^p$: marginal cost of production
    - $C^f$: fuel cost
    - $C^v$: variable O&M costs
    - $C^e$: emissions costs

- $DS_i = C^m_i - C^p_i$
  - Where
    - $DS_i$: Dark Spread, the profit margin per unit output in a given hour
    - $C^m_i$: cost of market purchase in that hour, at that node locational marginal price
    - $C^p_i$: production cost in that hour

- **Expected CF** = \# hours $DS_i > 0 / \# hours 8,760

- **Actual CF** = \( \frac{G^g_i}{\text{Capacity} \times 8,760} \)
MODULE 2: CASH FLOW ANALYSIS, METHODOLOGY

- \[ C^p = C^f + C^v + C^e \]
  - Where expressed in $/MWh
    - \( C^p \): marginal cost of production
    - \( C^f \): fuel cost
    - \( C^v \): variable O&M costs
    - \( C^e \): emissions costs

- \[ G_i^n = G_i^g \times \frac{G_a^n}{C_a^g} \]
  - Where
    - \( G_i^n \): net generation in hour \( i \)
    - \( G_i^g \): gross generation in hour \( i \)
    - \( G_a^n \): annual net generation
    - \( G_a^g \): annual gross generation
    - \( G_i^n = G_i^g \) assumed for units not reporting

- \[ DS_i = C_i^m - C_i^p \]
  - Where
    - \( DS_i \): The profit margin per unit output in a given hour, “Darkest Spread” more robust than Dark Spread
    - \( C_i^m \): cost of market purchase in that hour, defined as the LMP
    - \( C_i^p \): production cost in that hour

- \[ \beta_a = \sum_{i=1}^{8760} G_i^n \times DS_i \]
  - Where
    - \( \beta_a \) represent the annual economic margin in total dollars
DEFINITIONS, CAVEATS, ASSUMPTIONS

- Units excluded:
  - Not all EGU’s report hourly data, those units are omitted
    - Primarily impacts units less than 25MW
  - Only includes units are units whose primary fuel group is listed as coal
    - Includes waste coal, pet coke, lignite, bit., and sub bit.
    - Units that have converted to dual fuel, or co-fire biomass, or list coal as secondary or tertiary fuel are excluded
  - Units that retired prior to June 2018 were excluded
  - Merchant owners don’t report fuel cost data to EIA, S&P data used as back fill
  - Units that joined RTO during study period only included costs and revenues after join date
  - Units that dispatch into multiple RTOs were analyzed only in “primary” RTO
DATA SOURCES, AND REFERENCES

- Energy Information Agency Form 860
- Federal Energy Regulatory Commission Form 1
- Environmental Protection Agency Air Markets Program Database
- S&P Global Market Intelligence
WHAT IS “OUT-OF-MERIT GENERATION”

• When operator of an energy resource (typically an inflexible one) chooses to generate when it does not make economic sense to do so in that time period (hour, day, month, year).

• Is a comparison of production cost (short run marginal costs) versus energy market revenues (typically in day-ahead market).

• When the production cost to generate a MW in a given hour exceeds the market price paid to that generator in that hour
### WHY IS THIS IMPORTANT?

**IT NEGATIVELY IMPACTS THE...**

<table>
<thead>
<tr>
<th>Category</th>
<th>Impact Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market</td>
<td>Reduces wholesale price which discourages new resources and reduces competition.</td>
</tr>
<tr>
<td>Customer</td>
<td>Customers still pay for all the costs of operating expensive plants.</td>
</tr>
<tr>
<td>Grid</td>
<td>Props up inflexible resources / crowds out flexible and variable resources.</td>
</tr>
<tr>
<td>Environmental</td>
<td>Less efficient resources (typically dirtier resources) end up crowding out more efficient (typically cleaner) resources.</td>
</tr>
</tbody>
</table>
Operational constraints may legitimize operations that appear irrational on an hourly level.

- Hourly granularity is overly granular.

- Need to account for magnitude of gains and loses.


IS THIS UNECONOMIC DISPATCH