Out-of-merit Generation of Regulated Coal Plants in Organized Energy Markets

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USAEE United States Association for Energy Economics

IAEE International Association for Energy Economics www.iaee.org

NCAC U.S. Association for Energy Economics National Capital Area Chapter

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*

- $DS_i = C_i^m - C_i^p$
  - Where
    - DS_i: *Dark Spread, the profit margin per unit output in a given hour*
    - C_i^m: *cost of market purchase in that hour, at that node (locational marginal price)*
    - C_i^p: *produciton cost in that hour*

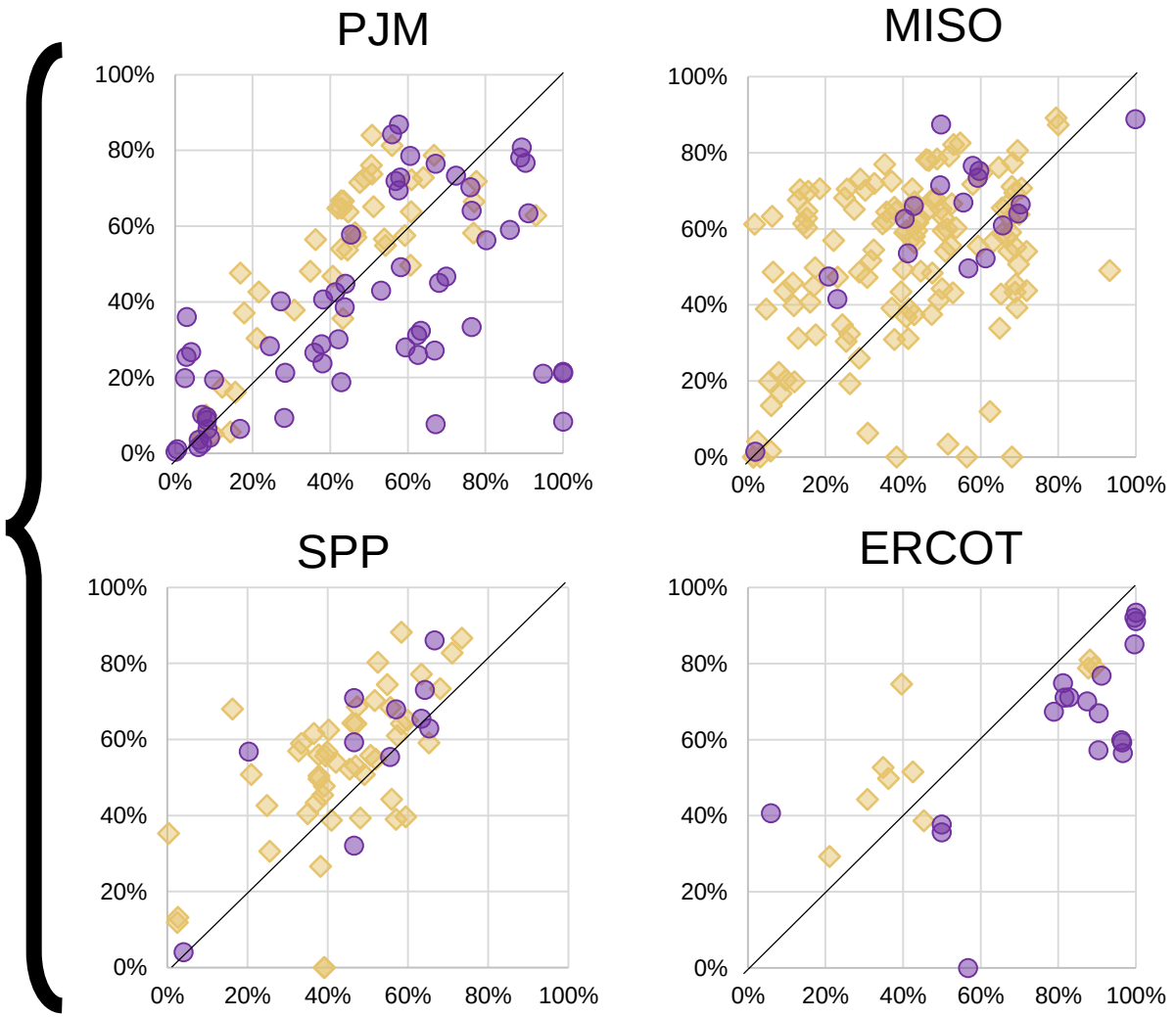
- **Expected CF** = # hours $DS_i > 0$ / # hours (8,760)
- **Actual CF** = $\frac{G_i^g}{\text{Capacity} \times 8{,}760}$

Module 1: Screening analysis, Results for 2017

- Vertical axis is actual value:
- Horizontal axis is expected value:
- Would expect outcomes to fall on or near diagonal line (y=x)
- Predominantly rate regulated coal plants that operate above expected value

Merchant Generators

Rate Regulated (incl. municipality and coops)



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*
- $G_i^n = G_i^g \times \frac{G_a^n}{G_a^g}$
  - *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* G_a^n
- $DS_i = C_i^m - C_i^p$
  - 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: *produciton 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

β Results: Net, 3-years

Rate Regulated

Merchant Generators

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.

β Results: Gross, 3-years

Rate Regulated

Merchant Generators

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.

Top 15 Worst Actors (all over 100 million over 3 years)	3-year Cumulative Monthly Losses	RTO/ISO
Elm Road Generating Station	$ (425) Million	MISO
Dolet Hills	$ (407) Million	MISO/SPP
Mount Carmel Cogeneration	$ (290) Million	PJM
Pirkey	$ (228) Million	SPP
Northeastern Power Cogen Facility	$ (192) Million	PJM
Westwood Generating Station	$ (173) Million	PJM
John E. Amos	$ (159) Million	PJM
Whitewater Valley	$ (143) Million	PJM
Big Cajun 2	$ (137) Million	MISO
Conesville	$ (136) Million	PJM
Montour	$ (129) Million	PJM
San Miguel	$ (127) Million	ERCOT
J. Sherman Cooper	$ (120) Million	PJM
Sioux	$ (115) Million	MISO
Indian River	$ (115) Million	PJM

Results for β (Monthly Granularity)

Represents only the sum of all months where Beta was negative.

PJM	Regulated	Merchant
2015	-$259 Million	-$333 Million
2016	-$86 Million	-$335 Million
2017	-$354 Million	-$695 Million
Total	-$699 Million	-$1,362 Million

MISO	Regulated	Merchant
2015	-$681 Million	-$18 Million
2016	-$566 Million	-$13 Million
2017	-$270 Million	-$5 Million
Total	-$1,518 Million	-$36 Million

SPP	Regulated	Merchant
2015	-$258 Million	-$21 Million
2016	-$163 Million	-$7 Million
2017	-$443 Million	-$15 Million
Total	-$865 Million	-$43 Million

ERCOT	Regulated	Merchant
2015	-$36 Million	$n/a
2016	-$39 Million	$n/a
2017	-$79 Million	$n/a
Total	-$154 Million	$n/a

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.

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?

Conclusions and Implications

- Not isolated to SPP, 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

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
- Daniel, J. (2017): Backdoor Subsidies for Coal in the Southwest Power Pool: Are Utilities in SPP Forcing Captive Customers to Subsidize Uneconomic Coal and Simultaneously Distorting the Market?, Sierra Club. Washington, D.C.
- Nelson, W., Liu, S. (2018) Half of U.S. Coal Fleet on Shaky Economic Footing: Coal Plant Operating Margins Nationwide. Bloomberg New Energy Finance. New York, NY.
- Bloomberg New Energy Finance. (2017). Trends in US power, gas, and renewable economics. DLA Energy World Wide Energy Conference. New York, NY.