The Coal Bailout Nobody is Talking About

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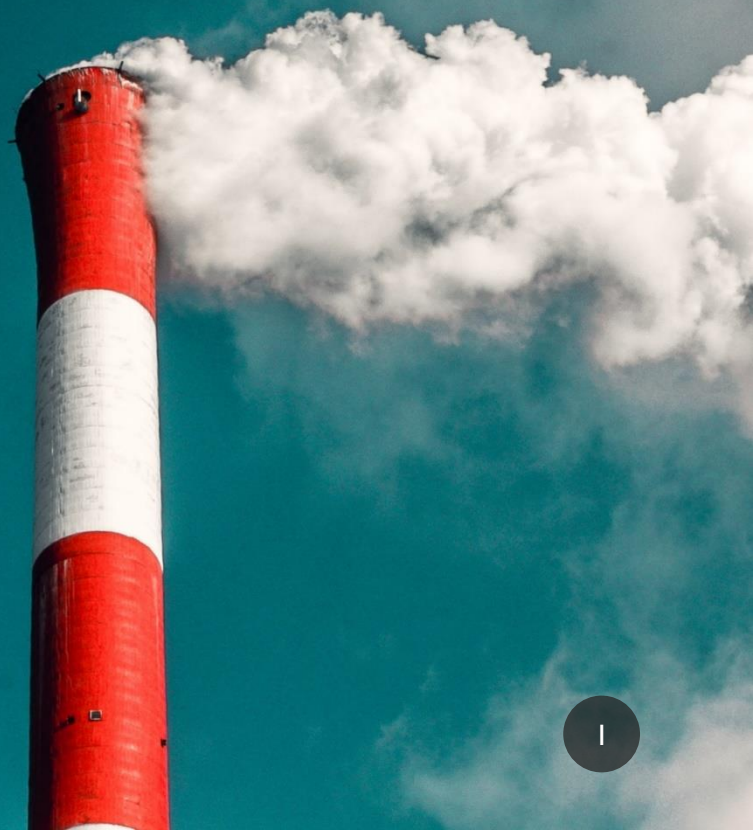

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QUICK ROAD MAP

About UCS
Energy Markets
Analysis Results
Utility Responses
What's Next


Science
and
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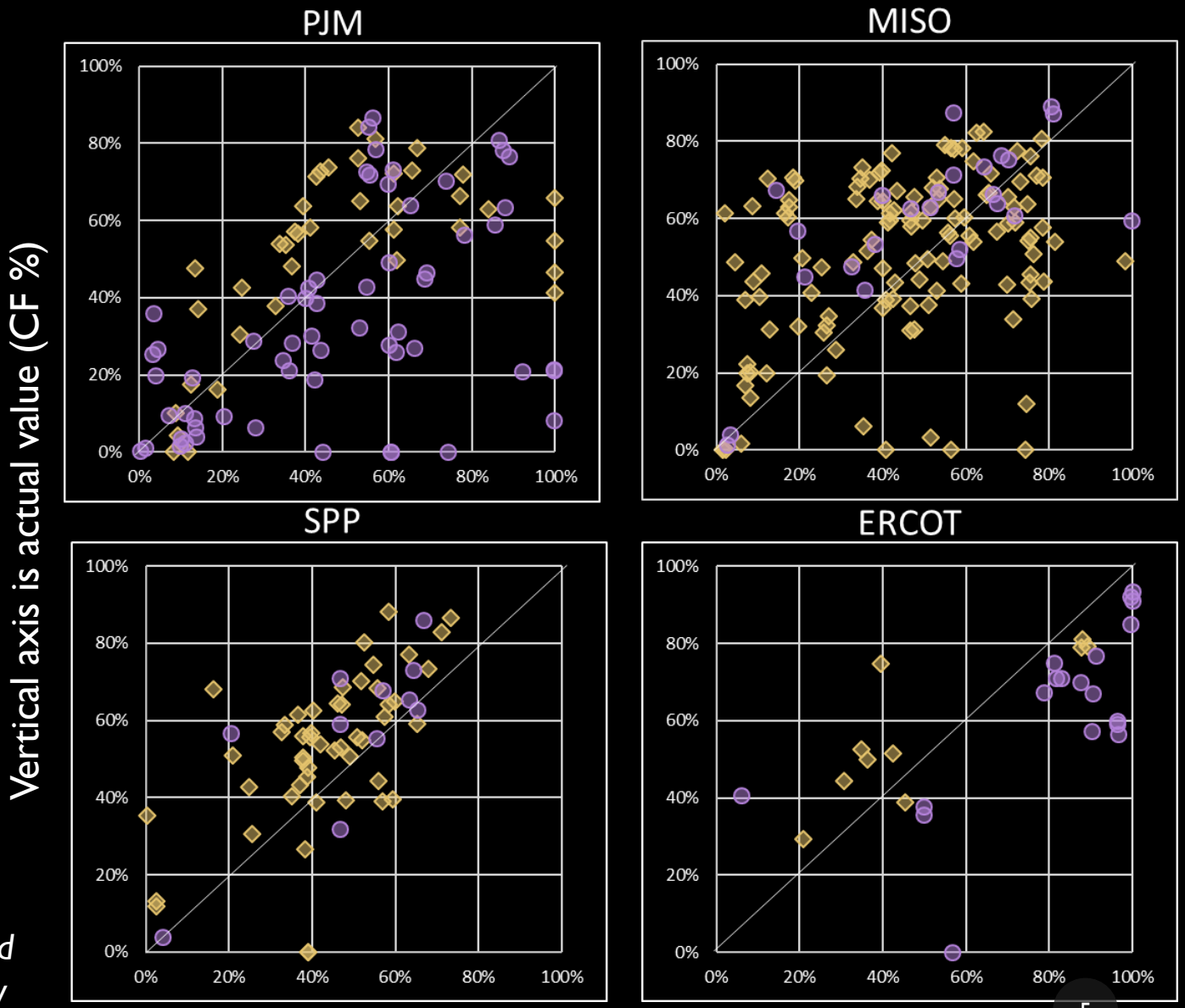
ENERGY MARKETS ARE DESIGNED TO OPTIMIZE DISPATCH:

LOW VARIABLE COST RESOURCES SHOULD HAVE PRIORITY OVER HIGH VARIABLE COST RESOURCES

MERCHANT VS. RATE REGULATED

Merchant Generators

Rate Regulated



Originally presented in: United States Association For Energy Economists Paper

RESULTS FOR FINANCIAL BURDEN

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**

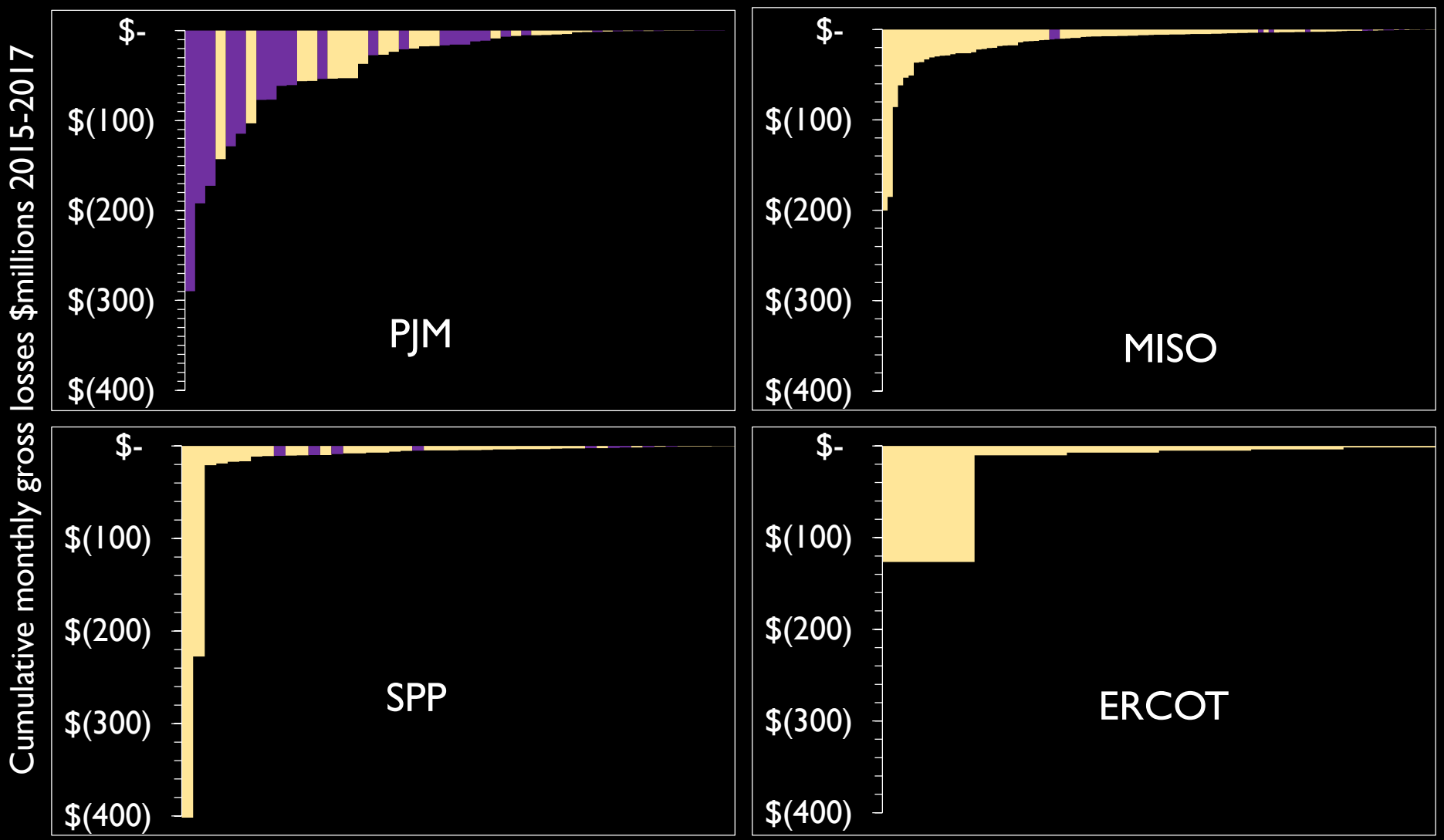
SPP	Regulated	Merchant
2015	-$258 Million	-$21 Million
2016	-$163 Million	-$7 Million
2017	-$443 Million	-$15 Million
Total	**-$865 Million**	**-$43 Million**

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.

RESULTS: CUMULATIVE GROSS LOSSES, 3-YEARS

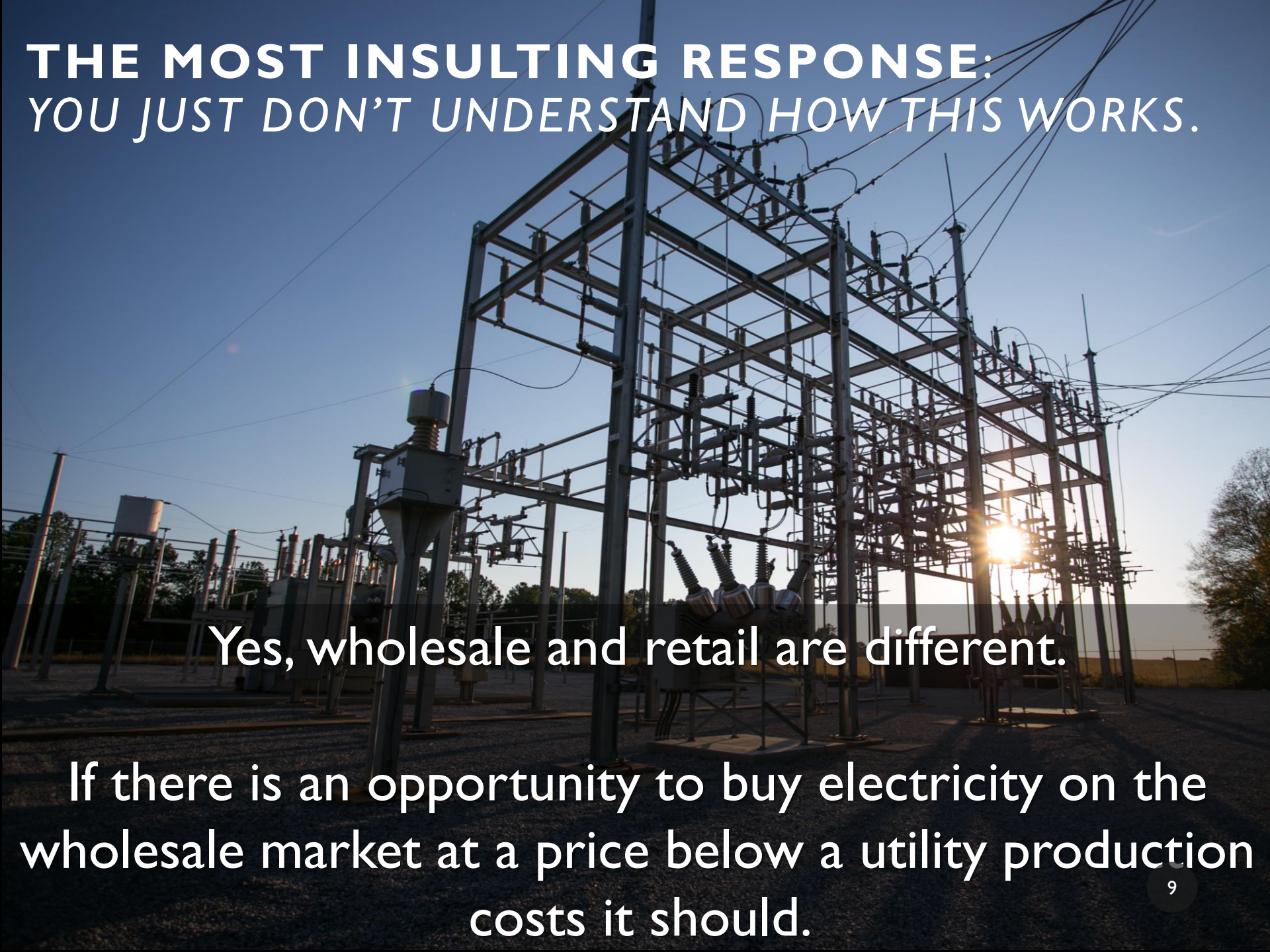


NOTE: Each bar represents one coal unit, width of bars are not proportional to size capacity of that unit. Ex: ERCOT had fewest units, so the width of the bars are greatest.

Merchant Generators

Rate Regulated

Top 15 Worst Actors (all over $100 million over 3 years)	3-year Cumulative Market Losses	Market
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



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

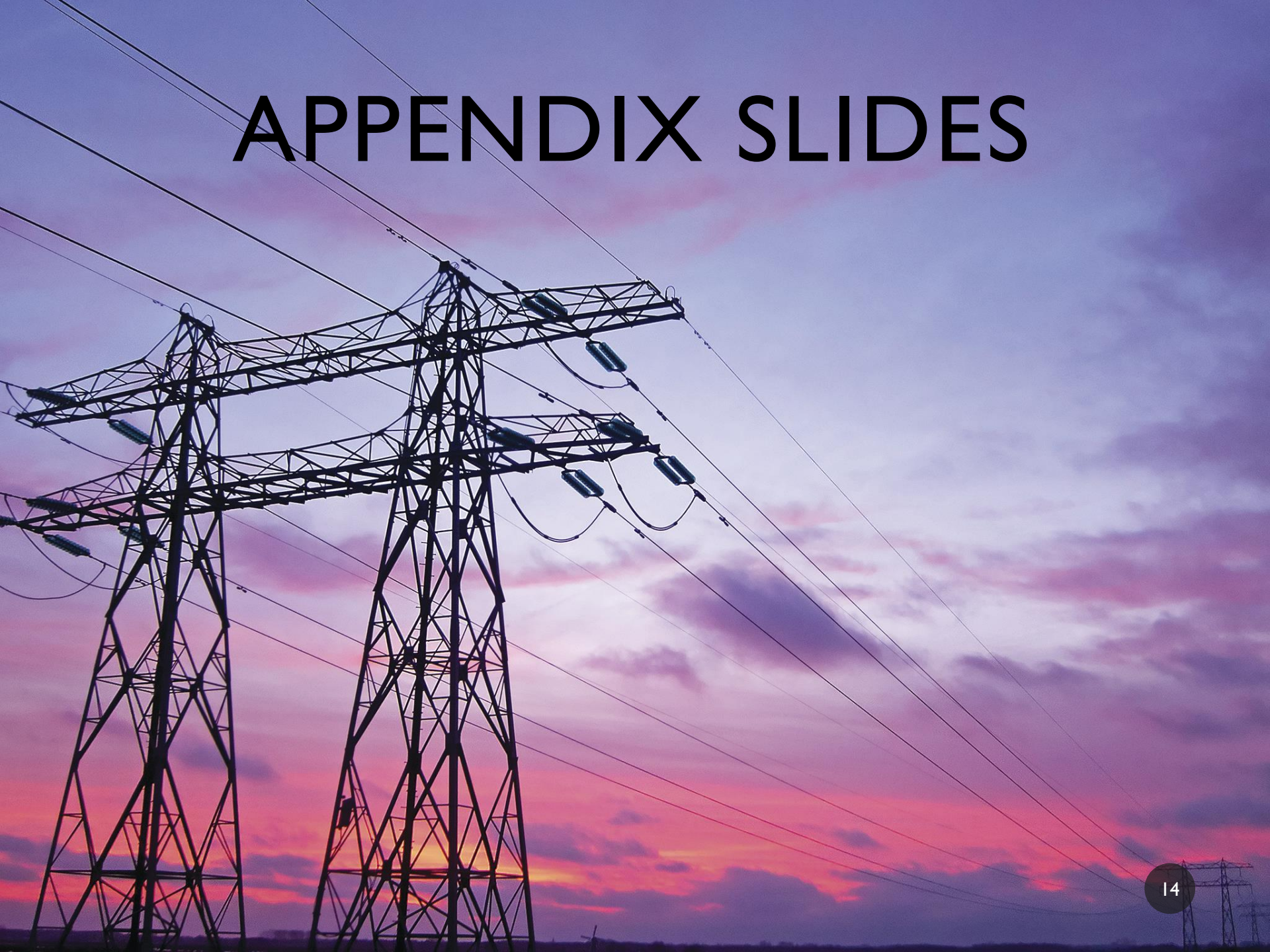
Accounting practices are questionable

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 = $30.00		Market Clearing Price ($/MWh)		
		$26.00	$31.00	$36.00
Offer Price ($/MWh)	$25.00 (under bid)	$(4.00)	$1.00	$6.00
	$30.00 (logical bid)	n/a	$1.00	$6.00
	$35.00 (over bid)	n/a	n/a	$6.00

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*

- $DS_i = C_i^m - C_i^p$
  - 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** = $\dfrac{G_i^g}{\text{Capacity} \times 8{,}760}$

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*
- $G_i^n = G_i^g \times \frac{G_a^n}{G_a^g}$
  - *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*
    - $\frac{G_i^n}{G_a^n} = G_i^g$ *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: *produciton cost in that hour*
- $\beta_a = \sum_{i=1}^{8760} G_i^n \times DS_i$
  - Where
    - β_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
- 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.

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?

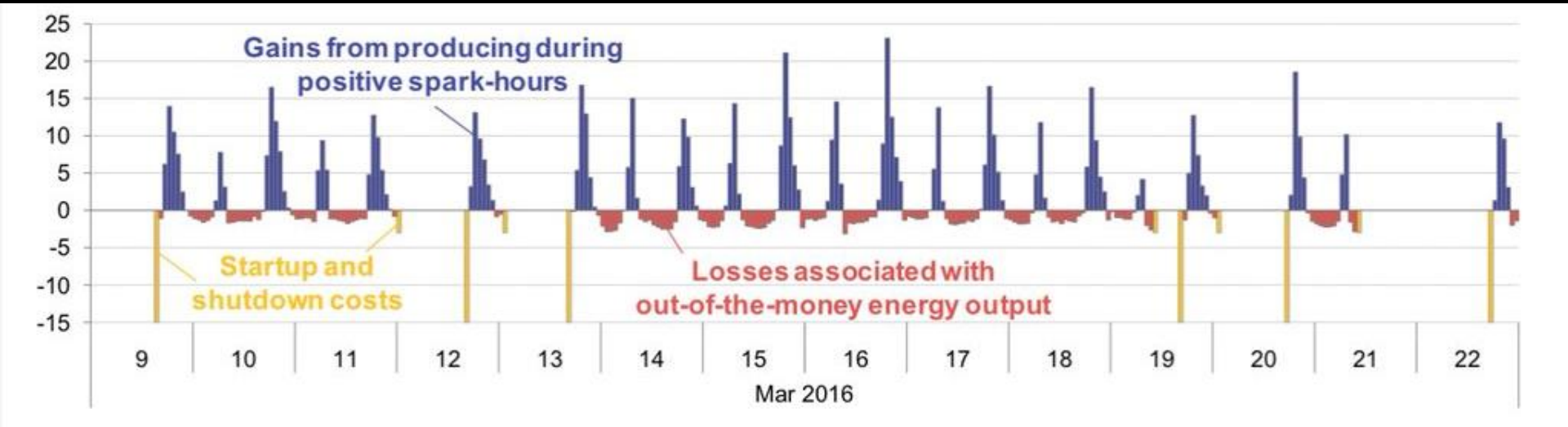
IT NEGATIVELY IMPACTS THE…

Market	Reduces wholesale price which discourages new resources and reduces competition.
Customer	Customers still pay for all the costs of operating expensive plants.
Grid	Props up inflexible resources / crowds out flexible and variable resources.
Environmental	Less efficient resources (typically dirtier resources) end up crowding out more efficient (typically cleaner) resources.

IS THIS UNECONOMIC DISPATCH

- Operational constraints may legitimize operations that are appear irrational on an hourly level

- Hourly granularity is overly granular



- Need to account for magnitude of gains and loses

- Sweet spot? Daily? Weekly? Monthly? Annual?