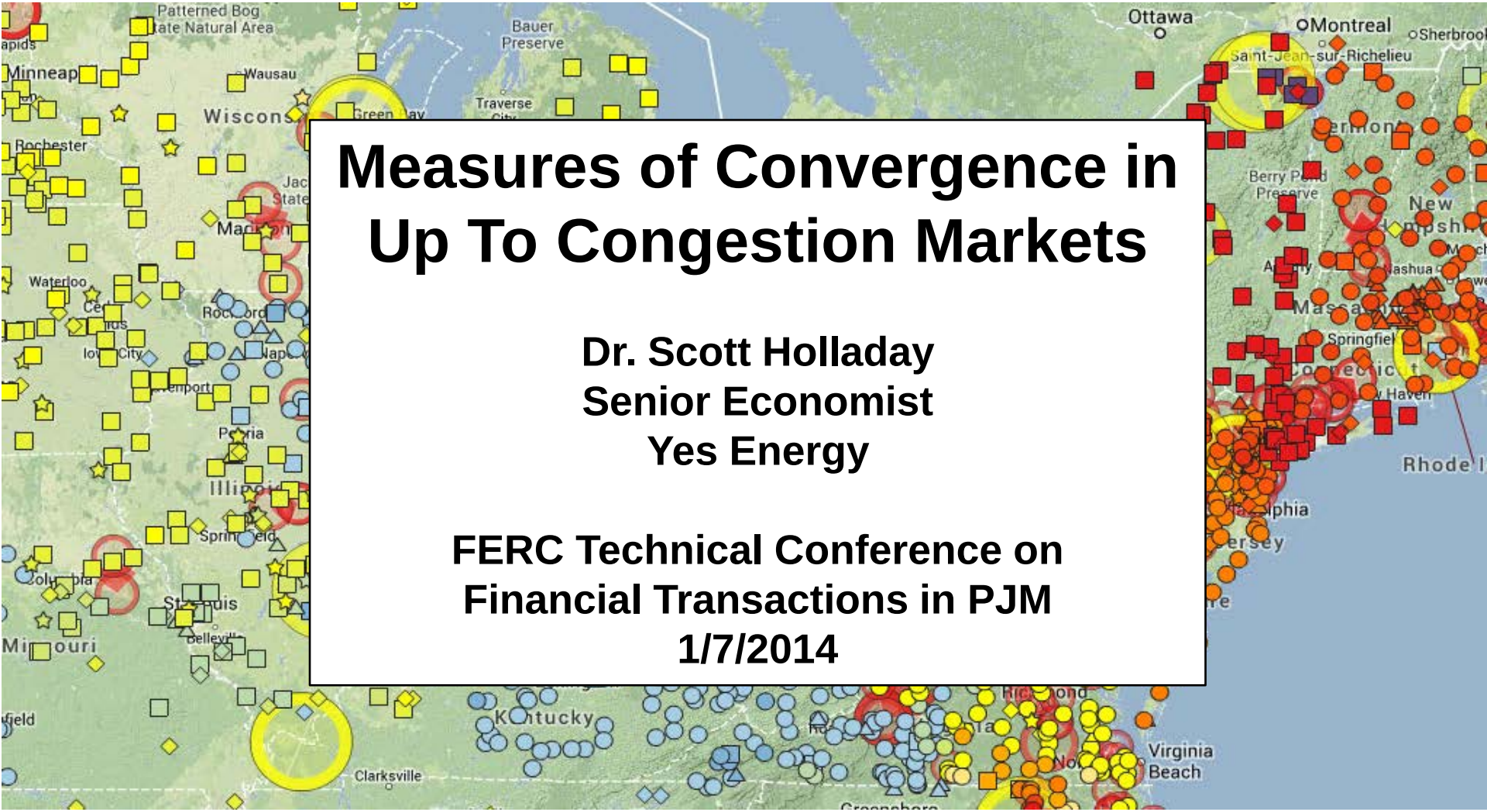
YES ENERGY



Measures of Convergence in Up To Congestion Markets

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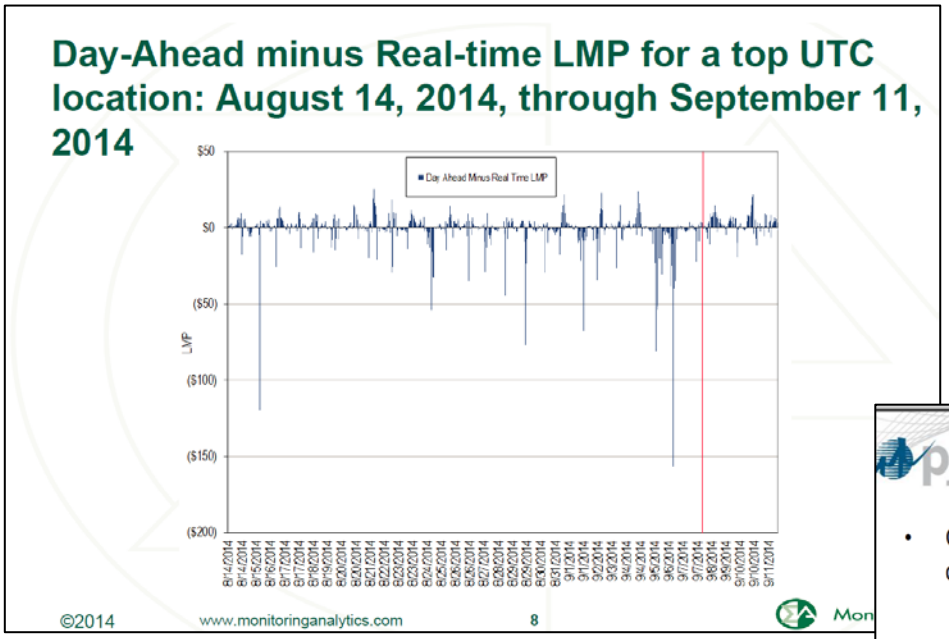
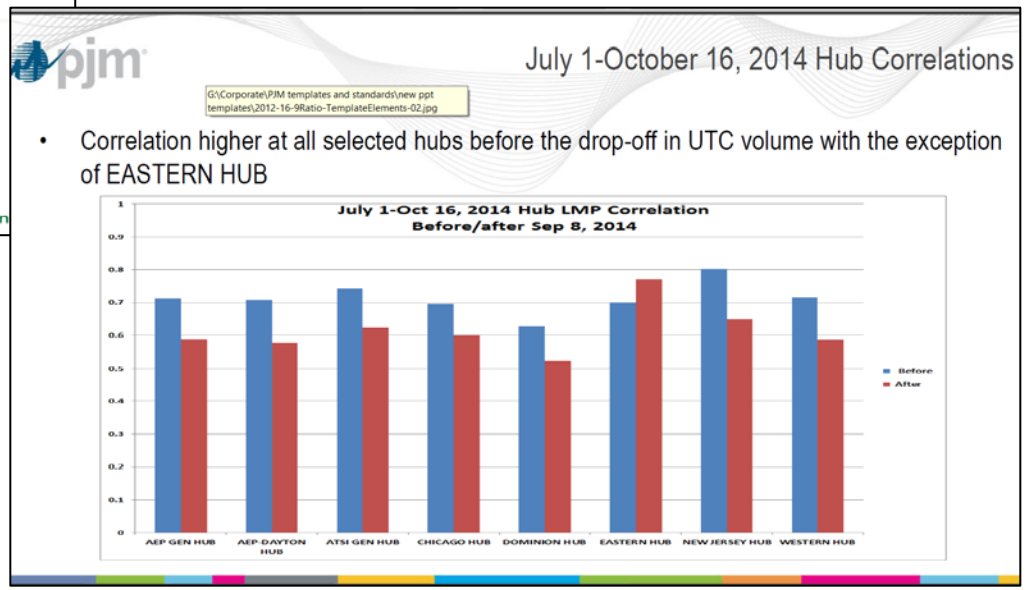
FERC Technical Conference on Financial Transactions in PJM
1/7/2014

The FERC 206 Order and Market Convergence

- Early analysis: Reaction to the order caused *improved convergence*
- Others used "Before/After" methods and presented similar findings:

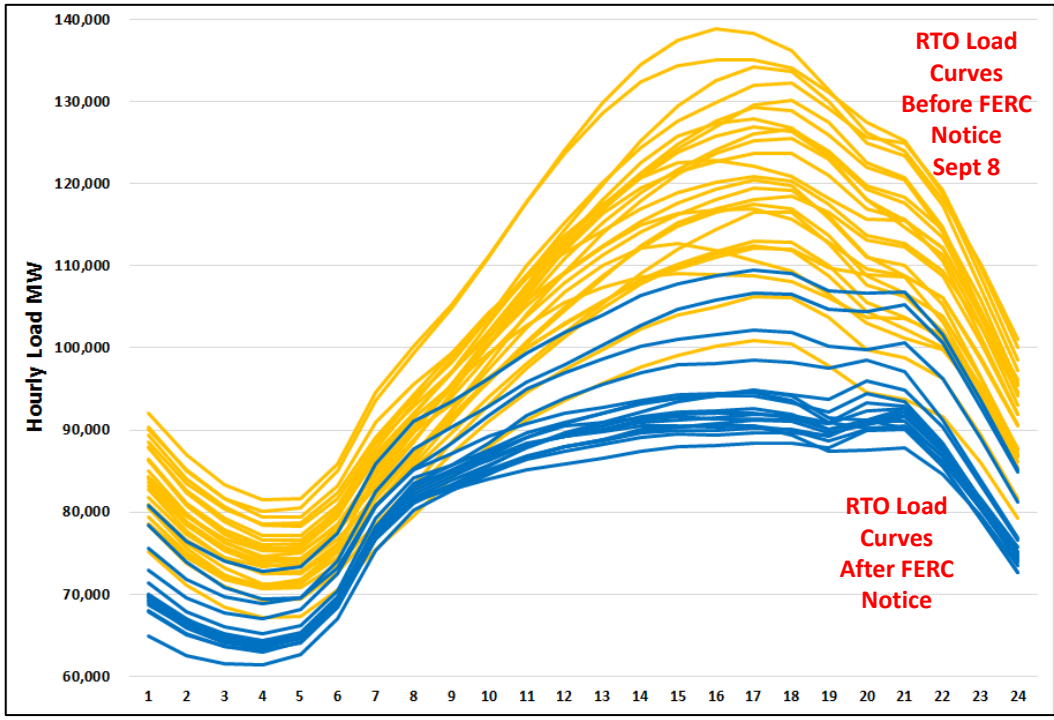




Before/After = Apples/Oranges

- Before/After is simple, intuitive, and incomplete
- Note: other factors beyond the word of FERC impact power markets
- Accounting for other factors is not easy, but necessary and doable

Comparing	Before	After
MidAtl Avg Load	35,903	29,264
MidAtl Peak Load	43,884	33,662
Avg Temp - Philly	76	67
Avg Daily Gen Outage MWs	453	24,304
# 345kV+ Trans Outages	224	403
Tetco M3 Gas $/MMBtu	$ 2.36	$ 1.97
Avg Abs DART Return	$ 7.88	$ 4.94



Difference-in-Difference ("Diff-in-Diff") Method

$$[DART_{POST} - DART_{PRE}] - [DART_{POST} - DART_{PRE}]$$

2014 2013 (or other years)

Key Questions:

- Is convergence better/worse, before/after *similar timeframes*
  - in other years?
  - when normalizing for key drivers?
- Is this convergence relationship the same for
  - all zones?
  - all PJM nodes or just the UTC eligible nodes?

Diff-in-Diff: Post-FERC Order → Worse Convergence

Absolute Dart Return

	Model	Model w/ Controls
Post-Order	-1.657***	-0.751***
	(-28.99)	(-12.09)
2014	0.442***	0.839***
	(13.45)	(34.92)
Diff-in-Diff	0.147	1.520***
	(1.95)	(33.09)
Constant	7.536***	67.16***
	(364.75)	(93.26)
Observations	2,144,348	1,921,863

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Controls omitted for space

	Change in Convergence Pre-Post Order w/Controls
2013	**Convergence increased by $0.751/MWh**
2014	**Convergence decreased by $0.769/MWh**
Net Difference	**Convergence decreased by *$1.52/MWh***

Diff-in-Diff: Post-FERC Order → Higher OPRES

Operating Reserve Charges for RT Deviations

	Diff-in-Diff	UTC Volume
Post-Order	1.271***	
	(1785.46)	
2014	-0.709***	
	(-1466.00)	
Diff-in-Diff	0.0960***	
	(98.48)	
UTC Volume		-0.000000159***
		(-95.84)
Constant	8.401***	14.41***
	(677.68)	(421.58)
Observations	1,547,913	1,173,634
R^2	0.440	0.419

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Controls omitted for space

	Change in OPRES Pre-Post Order w/Controls
2013	**OPRES increased by $1.271/MWh**
2014	**OPRES decreased by $1.367/MWh**
Net Difference	**OPRES increased by *$0.10/MWh***

The Results are Robust

Results remain consistent across nearly 2 million observations and 10 different model specifications across 17 controls including:

- UTC volume
- Post/pre order
- Year
- Gas price
- Maximum temperature
- Minimum temperature
- Average temperature
- Standard deviation of temperature
- Max load
- Max load squared
- Day of the week
- Month of the year

Conclusions

- Higher UTC Volume increases convergence and decreases OPRES
- “Before/After” analysis suggests the reaction to the FERC order improved convergence…
- But full analysis suggests the reaction to the FERC order (using Difference-in-Difference) has made convergence worse