



E&AS Offset Proposal Example

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- Develop a forward looking E&AS methodology
 - 3 year historical can be distorted by anomalous events
 - 3 year historical not consistent with how new units view entry decisions or existing unit view exit decisions
 - 3 year historical 4-6 years out of date by the delivery year



Data for Examples

- Calculated historical E&AS using the current methodology
 - 2011 to 2013
- Use of NYMEX/CME Henry Hub Gas Forward
 - For other gas trading points develop forward curves relative to historic basis with HH
 - Use historic basis to develop “synthetic” forwards where forward basis contracts do not exist
- Use of NYMEX/CME Western Hub Forward
 - In the example, we did not use forward curves from other points



ISO-NE Brattle Recommendation

2018/19 E&AS Margin

$$= \text{Historical E\&AS Margin} * \frac{\text{2018/2019 Mass Hub On-Peak Prices}}{\text{Historical Mass Hub On-Peak Prices}}$$

- Very simplistic adjustment that takes forward energy prices to adjust E&AS margins
- Does not account for changes in fuel costs that may not move in lock step with energy prices



ISO-NE Brattle Recommendation (\$/MW-yr)

Year	Historic Method	ISO-NE Method
2011	\$25,439.31	\$27,681.62
2012	\$20,049.35	\$28,001.53
2013	\$15,183.84	\$19,784.13
3 Yr Avg.	\$20,224.17	\$25,155.76

- Historic Method uses peak-hour dispatch method defined in the tariff
- ISO-NE Method uses PJM Western Hub historic prices (2011, 2012, 2013) and calendar year 2018 forward prices from June 20, 2014.



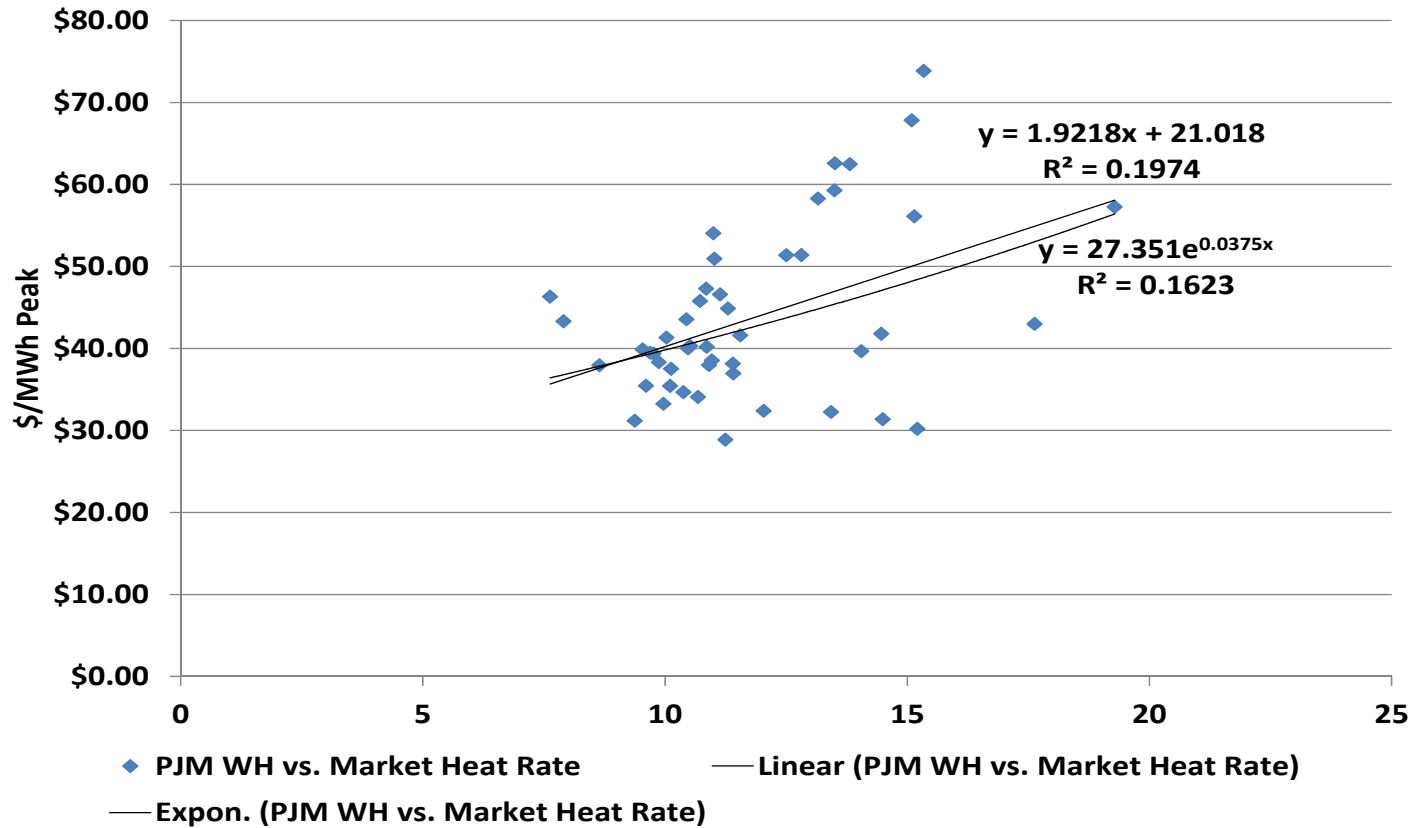
ISO-NE Brattle Recommendation: Underlying Energy Prices (\$/MWh)

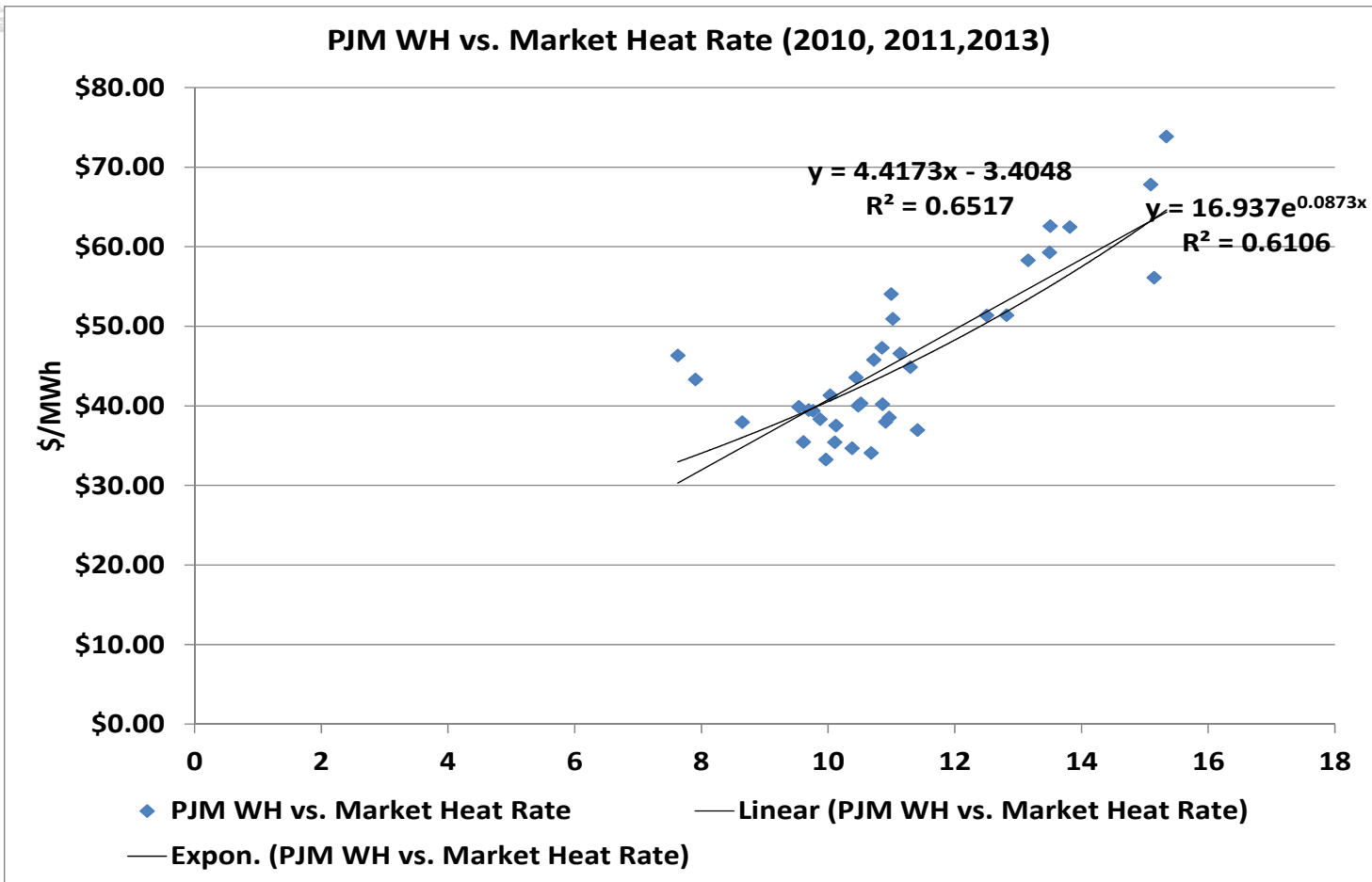
Year	Historic Method	ISO-NE Method (2018 forward)	Ratio: Forward to Historic
2011	\$47.88	\$52.10	1.088143469
2012	\$37.30	\$52.10	1.396630417
2013	\$39.99	\$52.10	1.302972658

- Historic prices are from Western Hub
- ISO-NE Method uses PJM Western Hub historic prices (2011, 2012, 2013) and calendar year 2018 forward prices from June 20, 2014.



PJM WH vs. Market Heat Rate (2010-2013)







PJM Proposal Outline

- Still requires the need to model historic revenues that will be adjusted for the forward looking aspect
 - Still gets a sense of volatility without developing hourly price shapes for energy or daily price shapes for gas
- Builds on the simplicity of what Brattle has proposed for ISO-NE in looking forward
- Incorporates gas prices both historically and in the forward curves
- Looking at this monthly over the year
 - Forward market heat rate by month
 - Historic market heat rate by month



PJM Proposal— Historic Monthly Market Heat Rate

$$\text{Historic Monthly Market Heat Rate} = \frac{\text{Monthly Western Hub Onpeak Average}}{\text{Monthly Henry Hub Average}}$$

$$\text{January 2014 Market Heat Rate} = \frac{\$137.45 \text{ \$/MWh}}{\$4.82 \text{ \$/mmbtu}} = 28.51 \text{ mmbtu/MWh}$$



PJM Proposal— Future Monthly Market Heat Rate

$$\text{Future Monthly Market Heat Rate} = \frac{\text{Future Monthly Western Hub Onpeak Average}}{\text{Future Monthly Henry Hub Average}}$$

$$\text{January 2018 Market Heat Rate} = \frac{\$52.83 \text{ \$/MWh}}{\$4.50 \text{ \$/mmbtu}} = 11.74 \text{ mmbtu/MWh}$$



PJM Proposal—Example for January

$$\begin{aligned} \text{January 2018 E\&AS offset} &= \\ \sum_{y=1}^1 \left(\sum_{m=1}^1 \text{HE\&ASO}_{y,m} * \frac{\text{FMHR}_m}{\text{HMHR}_{y,m}} \right) &= \\ \$1,265 * \frac{11.74}{28.51} &= \$521 \end{aligned}$$



PJM Straw Proposal—Putting it All Together

$$\text{Future E\&AS offset} = \sum_{y=1}^3 \left(\sum_{m=1}^{12} \text{HE\&ASO}_{y,m} * \frac{\text{FMHR}_m}{\text{HMHR}_{y,m}} \right)$$

HE&ASO = Historic Energy and Ancillary Service Offset

FMHR = future market heat rate

HMHR = Historic market heat rate

y = year

m = month



PJM Proposal (\$/MW-yr) in RTO

Year	Historic Method	PJM Proposal
2011	\$25,439.31	\$24,107.53
2012	\$20,049.35	\$15,535.59
2013	\$15,183.84	\$15,267.96
3 Yr. Avg	\$20,224.17	\$18,303.69

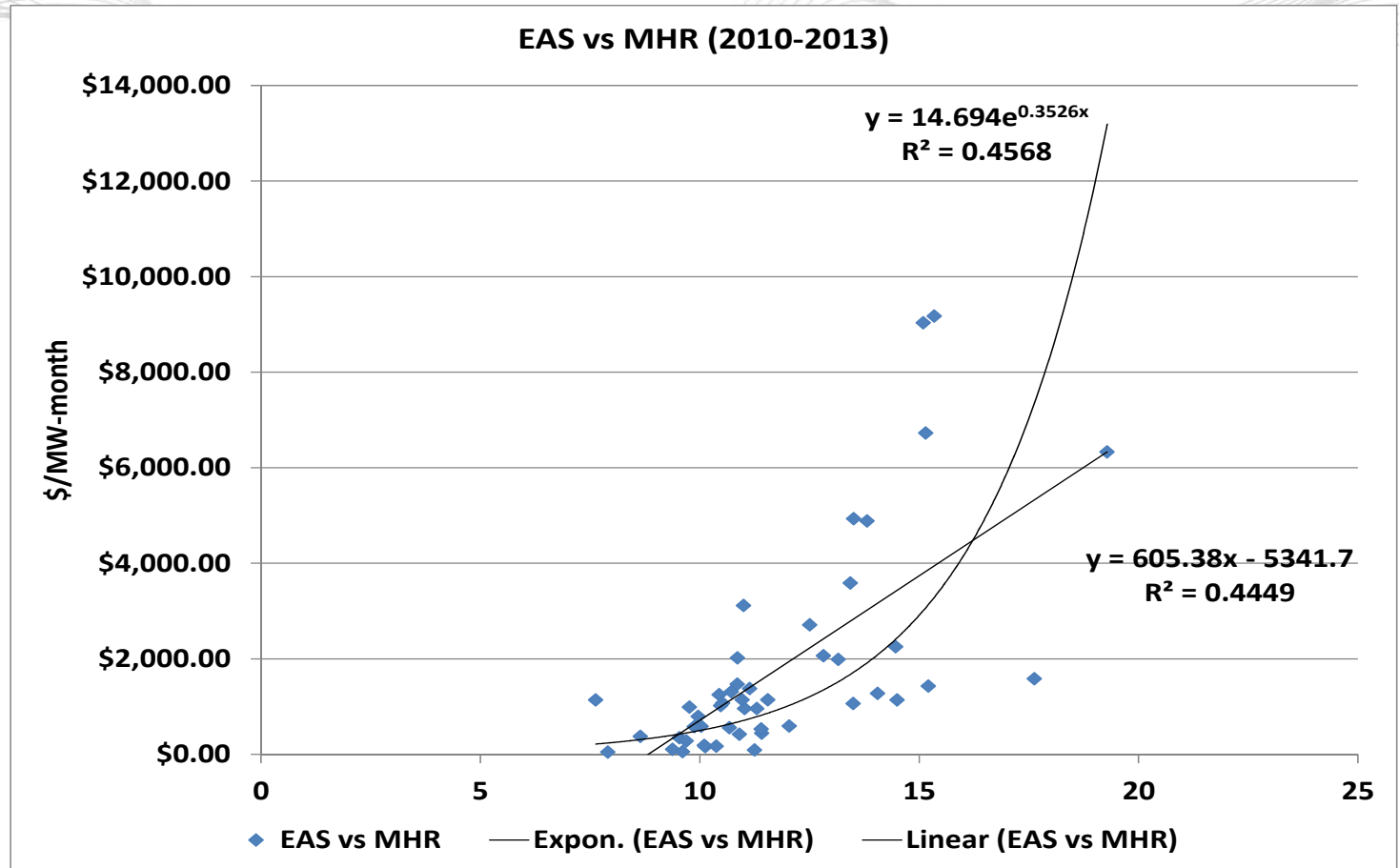
- Historic Method uses peak-hour dispatch method defined in the tariff
- PJM Method uses PJM Western Hub historic prices (2011, 2012, 2013) and calendar year 2018 forward prices from June 20, 2014.
- PJM Method in this example uses Columbia Gas TCO synthetic forward prices based on historic basis differential with Henry Hub.



PJM Proposal Market Heat Rates (\$/mmBtu)

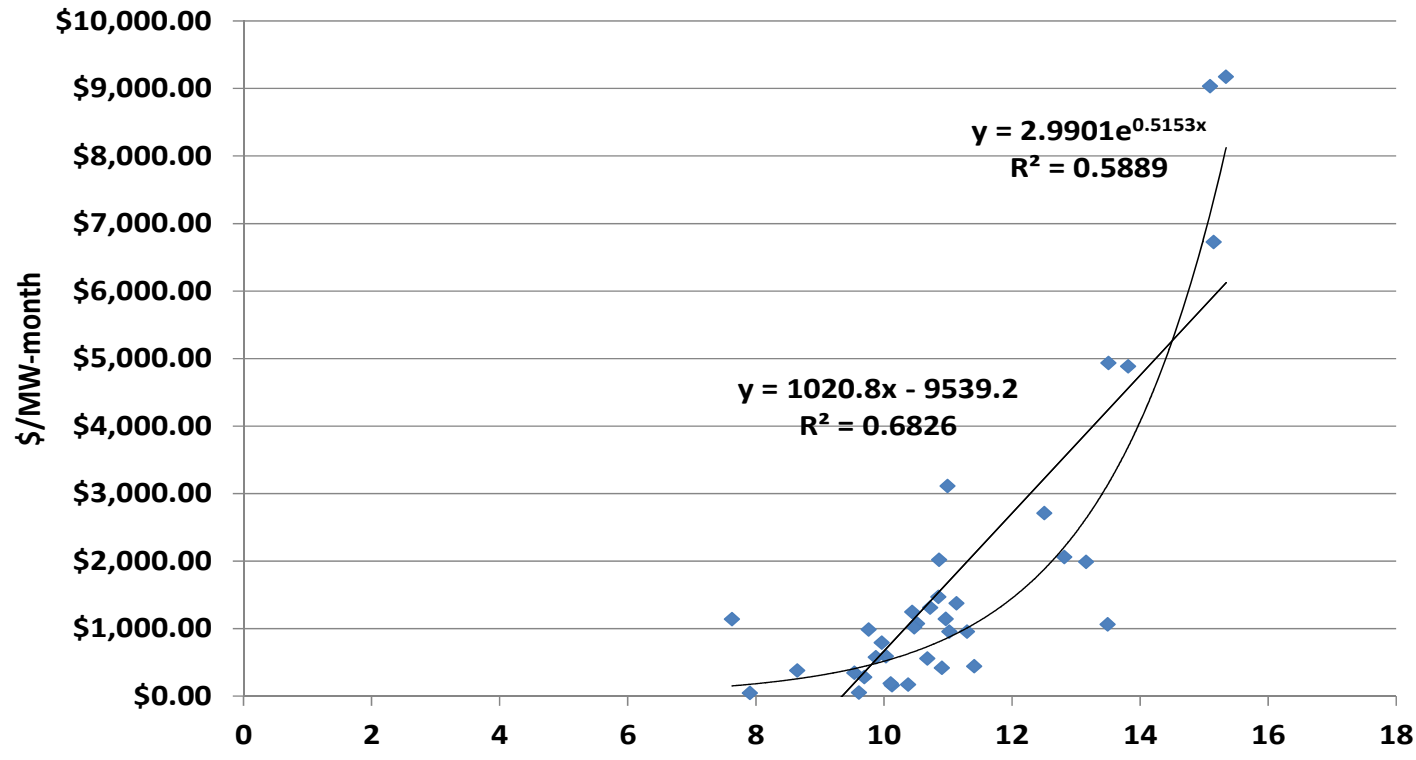
Year	Historic	2018 Forward	Ratio: Forward to Historic
2011	11.65542975	11.16621691	0.964973505
2012	13.68263337	11.16621691	0.837922361
2013	10.70023649	11.16621691	1.046452947

- Historic Method uses peak-hour dispatch method defined in the tariff
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EAS vs HMHR (2010, 2011, 2013)



- ◆ EAS vs HMHR (2010, 2011, 2013)
- Linear (EAS vs HMHR (2010, 2011, 2013))
- Linear (EAS vs HMHR (2010, 2011, 2013))
- Expon. (EAS vs HMHR (2010, 2011, 2013))



Alternate Stakeholder Proposal

- Do a very simple dispatch against the forward curve energy prices using forward curve gas prices by month
 - No daily or hourly volatility...just month to month changes
 - But does not require running dispatch model on historic prices



Alternative Stakeholder Proposal

\$20,364.82
(\$/MW-yr)

Contract Year-Month	Off-Peak	Peak	Columbia Gas TCO pool	Heat Rate	Dispatch Cost	Hourly Peak Margin	Hourly Off-peak Margin	Monthly peak margins	Monthly Off-peak Margins
2018-01	\$52.85	\$69.36	\$4.99	10.297	\$54.34	\$15.02	\$0.00	\$4,807.67	\$0.00
2018-02	\$52.85	\$69.51	\$4.98	10.297	\$54.32	\$15.19	\$0.00	\$4,861.85	\$0.00
2018-03	\$36.97	\$46.26	\$4.67	10.297	\$51.10	\$0.00	\$0.00	\$0.00	\$0.00
2018-04	\$36.97	\$46.31	\$4.57	10.297	\$50.03	\$0.00	\$0.00	\$0.00	\$0.00
2018-05	\$28.93	\$44.45	\$4.88	10.297	\$53.24	\$0.00	\$0.00	\$0.00	\$0.00
2018-06	\$29.13	\$47.67	\$4.73	10.297	\$51.68	\$0.00	\$0.00	\$0.00	\$0.00
2018-07	\$33.74	\$64.38	\$4.45	10.297	\$48.78	\$15.60	\$0.00	\$4,991.54	\$0.00
2018-08	\$33.74	\$64.43	\$4.23	10.297	\$46.61	\$17.82	\$0.00	\$5,703.76	\$0.00
2018-09	\$30.52	\$45.90	\$4.34	10.297	\$47.69	\$0.00	\$0.00	\$0.00	\$0.00
2018-10	\$32.75	\$42.28	\$4.81	10.297	\$52.57	\$0.00	\$0.00	\$0.00	\$0.00
2018-11	\$32.75	\$42.33	\$4.57	10.297	\$50.02	\$0.00	\$0.00	\$0.00	\$0.00
2018-12	\$32.75	\$42.33	\$4.94	10.297	\$53.82	\$0.00	\$0.00	\$0.00	\$0.00

- Examine this for other historic years and other LDAs/zones
- Compare to using daily and hourly load shapes and then using a dispatch model for comparison
 - Question about whether or not to use a “representative year” for price shapes or use the most recent three years.
 - A “representative year” could be derived from as many as 10 years of historic data to further smooth out anomalous years and events