

# Interface Pricing

PJM

- Purpose

- Present PJM's analysis efforts, recommendations and update stakeholders on RTOs recent efforts to update FERC staff on JCM initiatives

- Key Takeaways

- PJM's concerns in adopting MISO IMM's solution remain the same
- A DA simulation conducted by PJM revealed an increase in PJM DA bid production cost if PJM adopts MISO IMM's solution over the common interface solution
- A transaction incentive analysis conducted by PJM revealed PJM's common interface method will not result in transaction incentives in the wrong direction
- A statistical analysis conducted by PJM revealed PJM's method is less volatile than MISO IMM's method
- PJM recommends that for M2M purposes RTOs move forward with the common interface solution
- RTOs provided a status update on this issue and other JCM issues during a recent FERC staff meeting and plan to meet with FERC staff in the future to report any further progress

- ✓ Back ground – proposed solutions
- ✓ Recap PJM's concerns discussed during Feb, 2015 JCM
- ✓ PJM's DA impact simulation
- ✓ Transaction incentive analysis
- ✓ Statistical study
  - ✓ Incentive Volatility
  - ✓ Future sample confidence interval analysis
  - ✓ Shadow Price Volatility
- ✓ PJM Recommendations

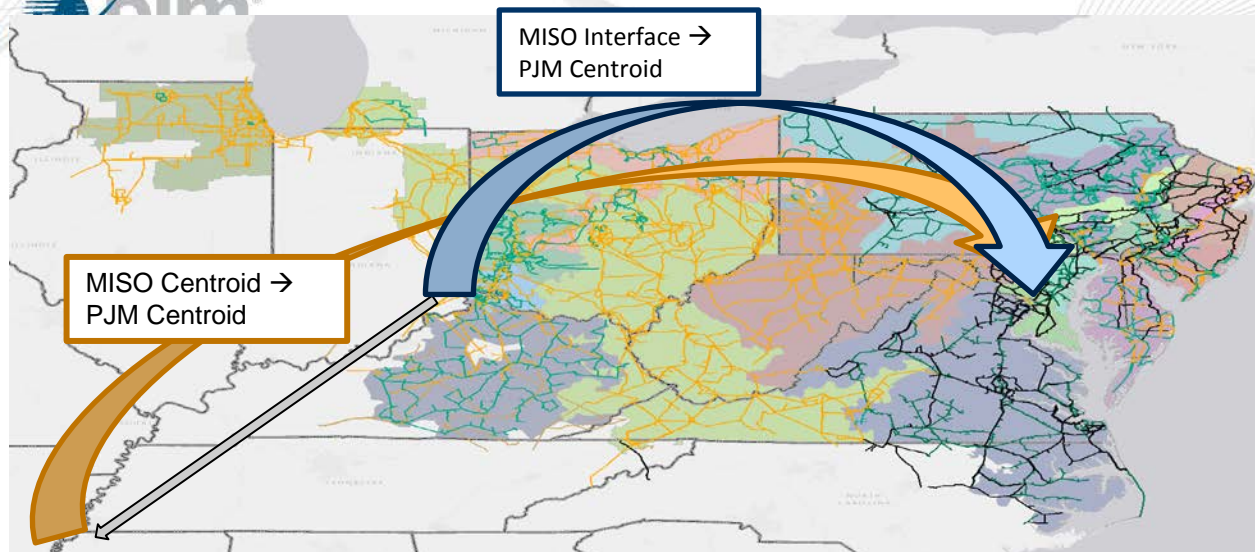


Component	PJM Solution (Common Interface)	MISO IMM Solution (Centroid-to-Centroid)
Interface Definition	Both MRTO and NMRTO adopt a common interface that is based on majority of RTOs' historical tie line energy transfers	<ol style="list-style-type: none"><li>1) MRTO calculate entire M2M congestion by moving the interface definition to the NMRTO's load center;</li><li>2) NMRTO remove the congestion component from LMP calculation and flow impact calculation</li></ol>
Market Flow	Align M2M with Real-Time Settled Market Flow (Commercial Market Flow)	Status Quo

**PJM has concerns with both components associated with MISO IMM solution**

# 1) Recap : Non-M2M IROL Interface Impacts & 2014 MISO Flowgate Congestion Impact Analysis

# Interface Pricing – Moving Reference to MISO Center



- MISO IMM proposes that PJM move the interchange injection reference from the currently defined PJM MISO Interface to MISO's load weighted reference bus.
- PJM Believes this will misrepresent the impact of interchange on internal PJM constraints.

Interface	Com Interface	MISO Centroid	Delta
5004/5005 I/o Conemaugh-Keystone	5.47%	2.82%	2.65%
Western Interface	11.15%	5.73%	5.42%
Central Interface	14.30%	3.66%	10.64%
Eastern Interface	10.34%	2.65%	7.69%
AEP-DOM FLO Baker-Broadford 765kV	3.03%	-4.89%	7.92%

2014	Day-ahead Impact	Balancing Impact	Net Impact	RT Impact
Total	\$ 79M	(\$ 19M)	\$ 60M	\$ 21 M
Average Before June	\$ 13M	(\$ 3.7M)	\$ 9 M	\$ 4 M
Average After June	\$ 2M	(\$ 50K)	\$ 1.8M	\$ 200K

- The ~\$80 million in DA “impact” does NOT represent potential PJM congestion savings
  - The flow relief from the interface activity would need to be replaced in the DA market with expensive resources
- *Balancing Congestion impact was negative; PJM would collect less balancing congestion under MISO IMM proposal*
- PJM interface definition change in June was beneficial; Current interface definition is a good, average approximation of transaction impact

## 2) Day Ahead Impact Simulation



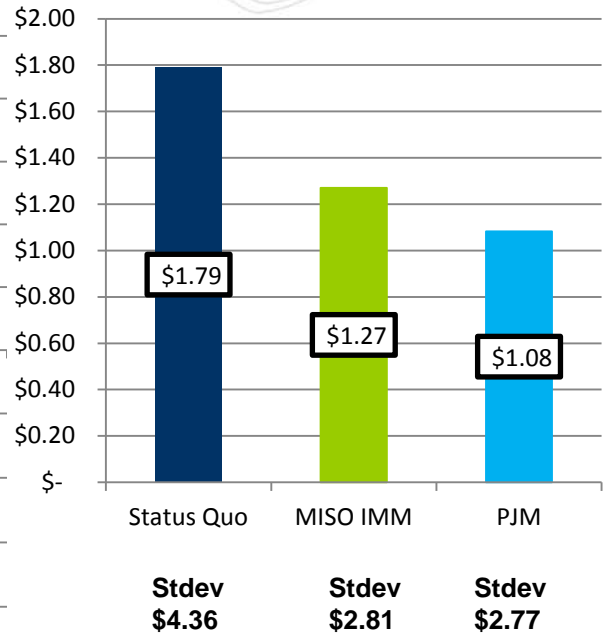
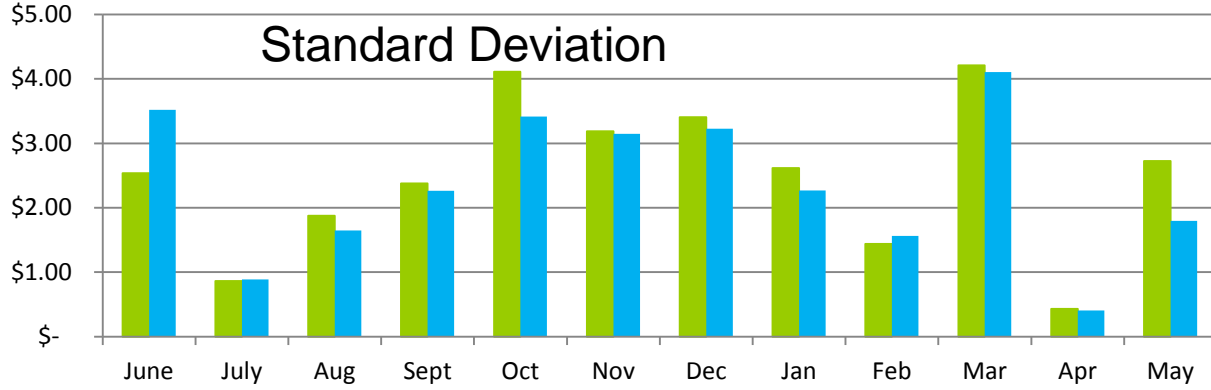
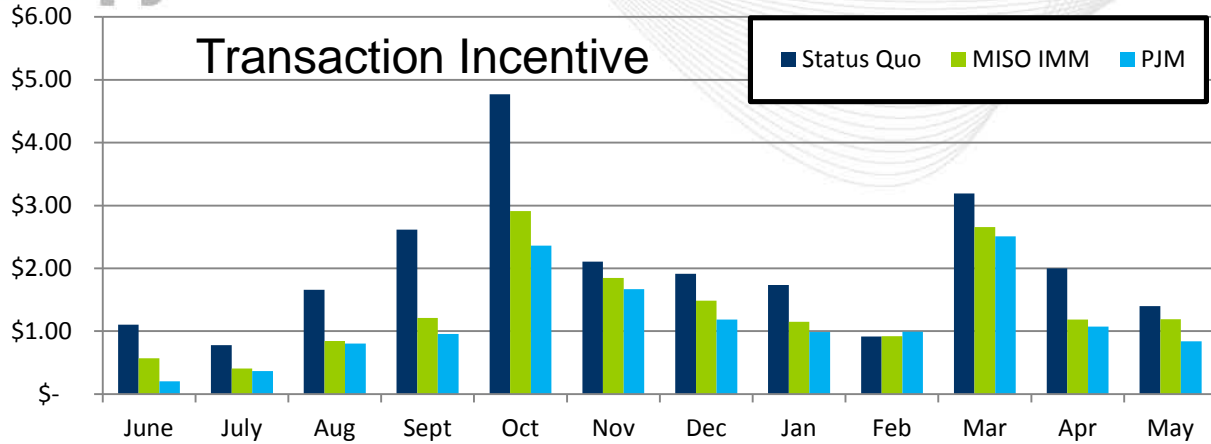
- PJM studied Day Ahead impacts associated with the Breed-Wheatland 345kV FLO Jefferson-Rockport 765kV on 8/11/2015 for Hour 7 using 2 methods
  - What happens when transaction impacts are removed in DA for MISO IMM's approach and transaction impacts are included for PJM's approach?
- Method 1 – Understand DA impacts associated with the two solutions
  - To be conservative PJM utilized the same FFE value for both solutions, although PJM's method is prone to increase FFE value
- Method 2 – Understand DA impacts associated with two solutions minus commercial flow
  - Adjusted DA status quo FFE by the transaction amount to compensate for excluding commercial flow construct

<b>Approach</b>	<b>% SP Increase for MISO IMM</b>	<b>% Net Exports Decrease For MISO IMM</b>	<b>BPC Increase for MISO IMM</b>
1	100%	57%	\$1,578
2	2.2%	57%	\$58

Conclusion – As described in slide 7, For both methods, MISO IMM's method by definition will introduce higher production cost values to the NMRTO when securing Flowgates. Therefore no savings is realized from MISO IMM's method.

### 3) Transaction Incentive Since June 1, 2014

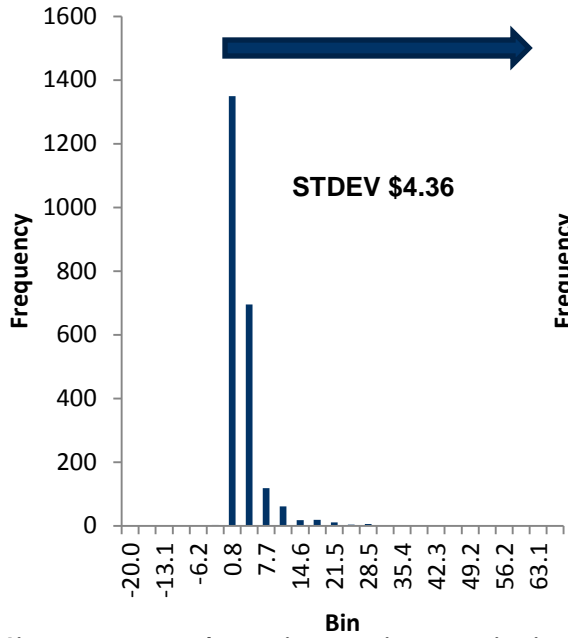
- One concern MISO IMM has raised with adopting PJM's approach is that it will impact reliability by introducing transaction incentives in the opposite direction to the MISO IMM's centroid to centroid shift factor incentives
- PJM analyzed average monthly transaction incentive (for PJM exports) associated with MISO Flowgates since June, 1 2014
  - 35 Flowgates over 2295 hours
  - PJM calculated transaction incentive by subtracting PJM's MISO Interface CLMP from MISO's PJM Interface CLMP (Incentive = MISO PJM CLMP – PJM MISO CLMP)
    - Utilizing Status Quo data
    - Utilizing MISO IMM's recommended load centroid to load centroid shift factor method (MISO SP Only)
    - Utilizing PJM's recommended common interface method (MISO SP and PJM SP)



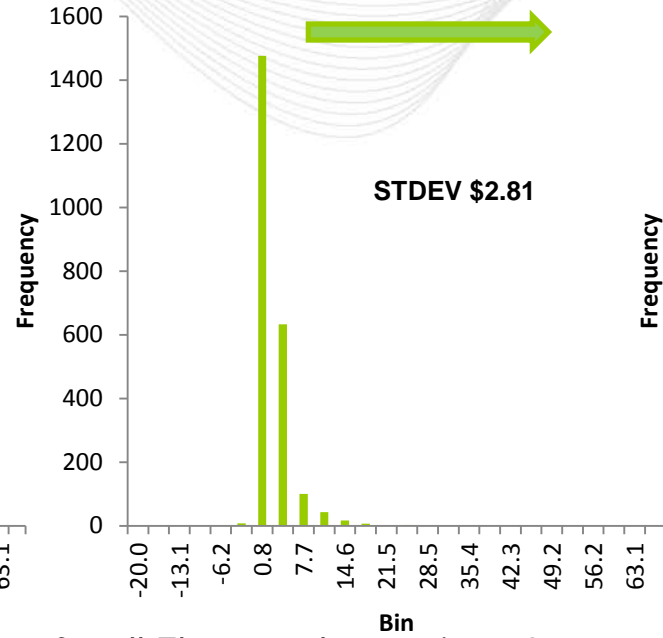
- Based on the transaction incentive analysis it is evident all three methods are producing an average incentive to transact from PJM to MISO
  - PJM's method does not introduce an incentive in the opposite direction
- It is also important to note that MISO IMM's method generated higher incentive than PJM's method
  - MISO IMM recommends only to use MRTO SP
  - PJM recommends to use both MRTO and NMRT0 SP
  - NMRT0 SP is capped at MRTO SP and is generally less than MRTO SP

## 4) Statistical Analysis for Transaction Incentive & Shadow Price Since June 1, 2014

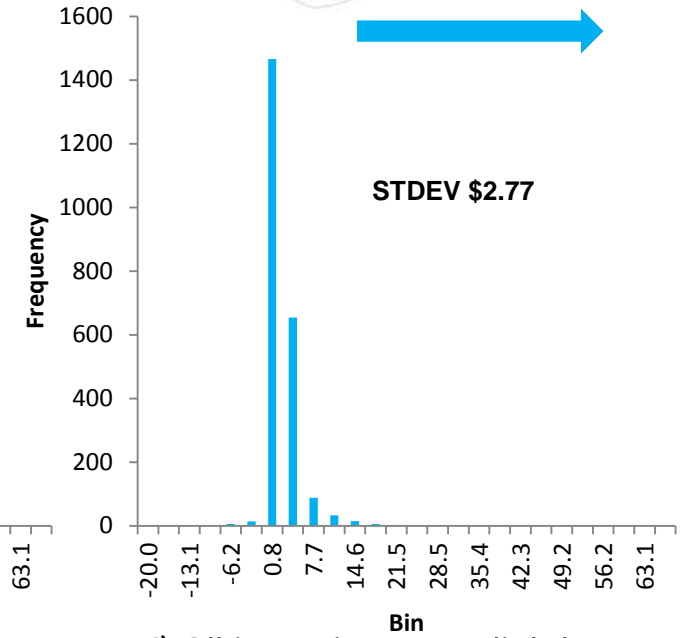
## Histogram-Status Quo



## Histogram -MISO IMM



## Histogram- PJM



Histograms show incentive variation for all Flowgate-hours since June, 1 2014. I) All incentives are slightly right skewed II) No method seems to be drastically volatile than the other III) Status quo has relatively higher variance in incentives IV) *PJM method is less volatile than MISO IMM method*



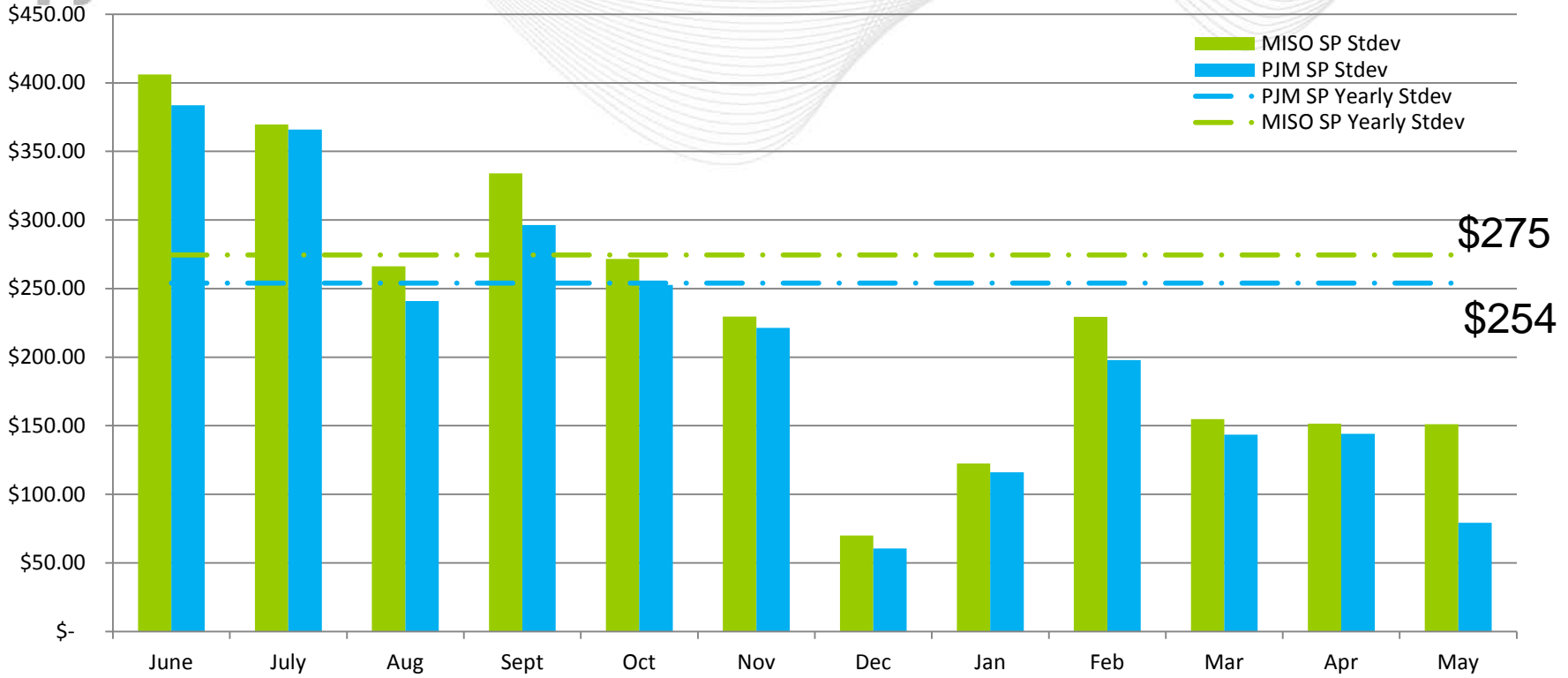
Average	Status Quo	MISO IMM	PJM
Upper Bound	\$2.03	\$1.42	\$1.23
Average	\$1.79	\$1.27	\$1.08
Lower Bound	\$1.56	\$1.12	\$0.93
Marginal Error/Variance	\$0.23	\$0.15	\$0.15

Confidence Interval study demonstrates that average value of any future transaction incentive sample set's will fall within \$0.23 for Status Quo, \$0.15 for MISO IMM and PJM with 99% confidence level and they all are in the same direction

Bottom line - 99% of the time both MISO IMM and PJM future average transaction incentives will be in the same direction with the same variance!

- Incentive Equations
  - $\text{MISO IMM} = (\text{MISO's PJM SF} * \text{MISO SP}) - (\text{PJM's MISO SF} * \text{MISO SP})$
  - $\text{PJM} = (\text{MISO's PJM SF} * \text{MISO SP}) - (\text{PJM's MISO SF} * \text{PJM SP})$
  - So in both equations MISO's PJM SF \* MISO SP, which is the first term is common
  - Therefore the relative volatility must be caused by the uncommon terms :
    - (PJM's MISO SF \* MISO SP) vs (PJM's MISO SF \* PJM SP)
  - But PJM's MISO SF is common between these uncommon terms
- Therefore the driver for relative volatility is caused by the terms MISO SP and PJM SP, hence the RTOs Shadow Price volatility is the Key Driver for volatility

# Shadow Price Volatility – Standard Deviation



**In an average, MISO's Shadow Price is 8% more volatile than PJM's Shadow Price**

- Based on the transaction incentive statistical analysis it is evident all three methods are producing incentives in the PJM to MISO direction
  - MISO IMM's method and PJM's method guarantee with 99% certainty that any future sample sets will produce an average incentive in the PJM to MISO direction
- MISO IMM's method is more volatile
  - MISO IMM's method introduces a higher standard deviation for incentive
  - MISO IMM's method introduces a higher standard deviation for shadow price

- PJM's concerns with moving its interface to the center of MISO load remain
- PJM does not concur with the recommendation to eliminate the congestion impact of monitoring RTO constraints on interface prices
  - NMRTO Shadow Price matters
- PJM recommends:
  - For M2M Flowgates adoption of the common interface definition at the RTO border
  - Implementation of the commercial flow approach to accounting for interchange transactions in Market Flows
  - Continuing to analyze the drivers of PJM and MISO shadow price differences in both DA and RT
  - For non-M2M Flowgates RTOs may use a different interface definition

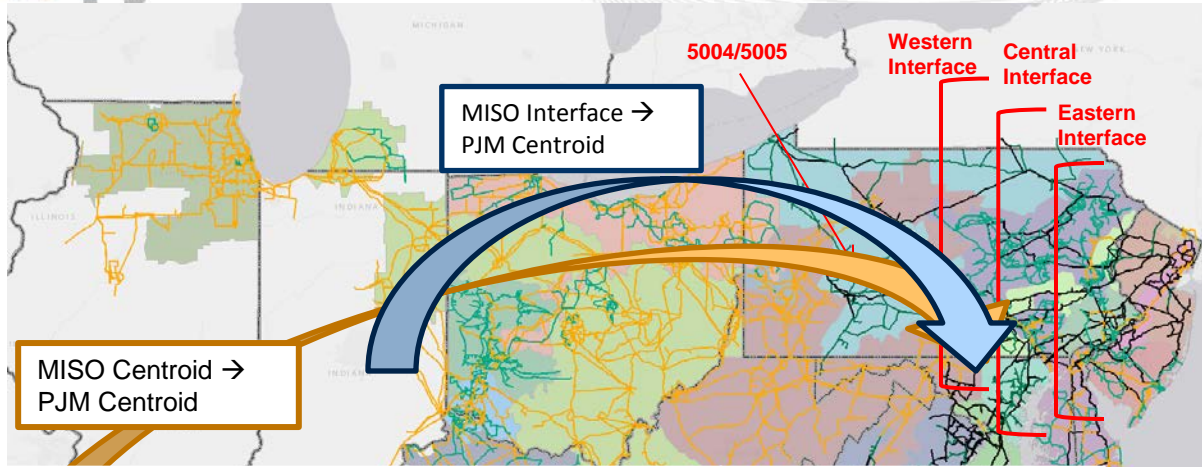
## FERC Staff Meeting Update

- PJM and MISO met with FERC staff on 7/21/2015 to discuss RTOs' joint efforts and progress to date on the following JCM topics
  - Interface Pricing
  - Commercial Market Flow
  - Freeze Date
- PJM and MISO staff found that this FERC staff meeting was beneficial and are interested in holding another FERC staff meeting some time in Fall, 2015
  - RTOs decided to hold the submittal of a coordinated CTS filing to allow RTOs to further discuss these JCM efforts with FERC staff

# Appendix



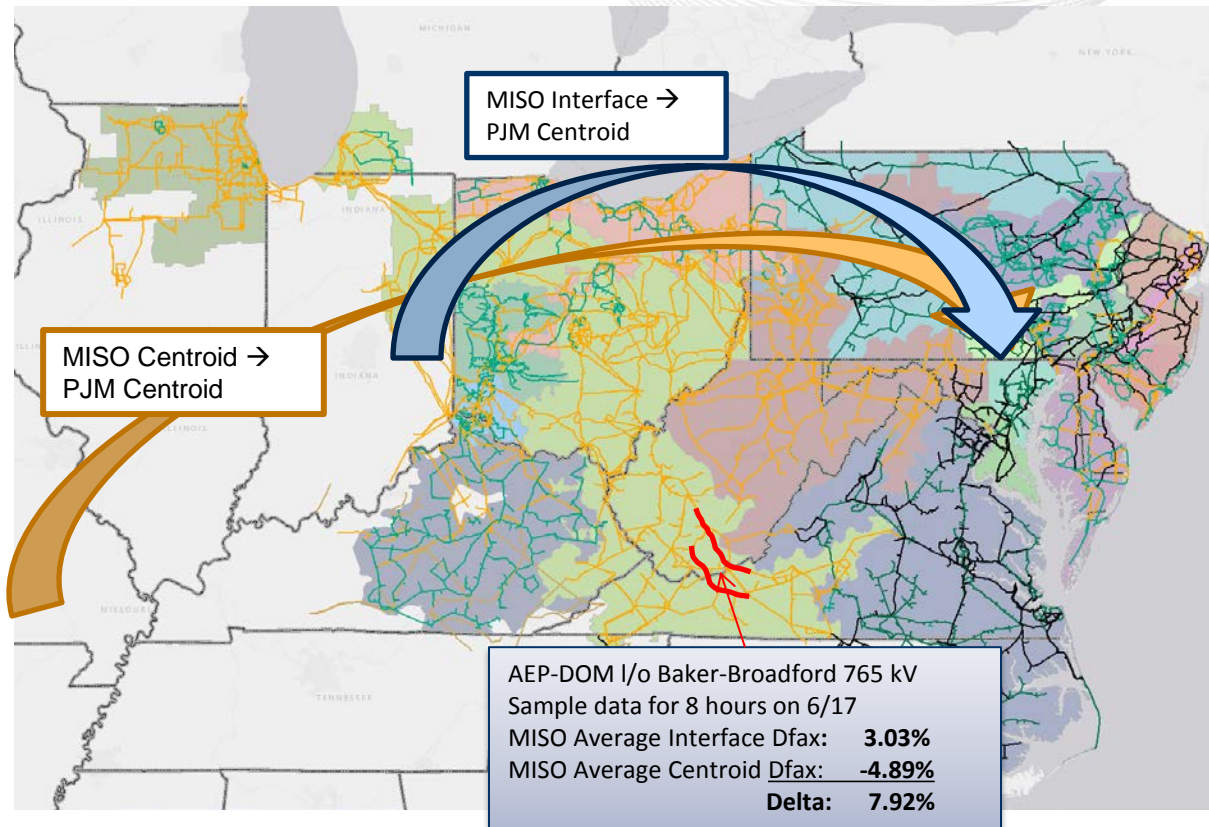
<u>Month</u>	<u>Day-ahead Impact</u>	<u>Balancing Impact</u>	<u>Net Impact</u>	<u>RT Impact</u>
1	\$11,191,620.43	\$ (6,783,841.95)	\$ 4,407,778.48	\$ (2,599,711.99)
2	\$10,557,335.81	\$ (2,819,256.00)	\$ 7,738,079.80	\$ 7,103,174.23
3	\$24,389,932.56	\$ (1,887,143.58)	\$ 22,502,788.98	\$ 12,735,179.89
4	\$10,254,412.16	\$ (1,814,264.46)	\$ 8,440,147.70	\$ 3,015,092.58
5	\$9,150,099.78	\$ (5,398,184.00)	\$ 3,751,915.78	\$ (235,712.08)
6	\$5,366,831.12	\$ (375,596.48)	\$ 4,991,234.64	\$ 243,562.35
7	\$2,095,469.49	\$ (176,552.46)	\$ 1,918,917.03	\$ 126,039.56
8	\$287,457.55	\$ 374,647.41	\$ 662,104.96	\$ 6,285.79
9	\$1,929,674.24	\$ (232,097.77)	\$ 1,697,576.48	\$ 618,812.89
10	\$1,643,582.26	\$ 85,616.01	\$ 1,729,198.27	\$ 460,973.72
11	\$1,599,142.76	\$ (62,173.66)	\$ 1,536,969.09	\$ 134,721.15
12	\$650,652.95	\$ 2,241.58	\$ 652,894.53	\$ 63,322.06
<b>Total</b>	<b>\$79,116,211.09</b>	<b>\$ (19,086,605.35)</b>	<b>\$ 60,029,605.74</b>	<b>\$ 21,671,740.15</b>
<b>Average before June</b>	<b>\$13,108,680.14</b>	<b>\$ (3,740,538.00)</b>	<b>\$ 9,368,142.15</b>	<b>\$ 4,003,604.53</b>
<b>Average after June</b>	<b>\$1,938,972.91</b>	<b>\$ (54,845.05)</b>	<b>\$ 1,884,127.86</b>	<b>\$ 236,245.36</b>



## Impact on internal PJM interfaces:

- Clear reduction of interchange impact on internal constraints
- This reduction is reflected in pricing only, actual impact is unchanged
- This results with an interface price that is insensitive to internal constraints

Interface	MISO Interface	MISO Centroid	Delta
5004/5005 I/o Conemaugh-Keystone	5.47%	2.82%	2.65%
Western Interface	11.15%	5.73%	5.42%
Central Interface	14.30%	3.66%	10.64%
Eastern Interface	10.34%	2.65%	7.69%



- Evidence of this effect extends to reversing the impact of interchange from a hurt to a help on the AEP-DOM Interface

Note - PJM performed a multiple hour average shift factor comparison exercise (results are included in the table)



# Average Transaction Incentive Summary

Month	Status Quo	MISO IMM	PJM
June	\$ 1.10	\$ 0.57	\$ 0.20
July	\$ 0.78	\$ 0.41	\$ 0.37
Aug	\$ 1.66	\$ 0.84	\$ 0.80
Sept	\$ 2.62	\$ 1.21	\$ 0.96
Oct	\$ 4.77	\$ 2.91	\$ 2.36
Nov	\$ 2.11	\$ 1.85	\$ 1.67
Dec	\$ 1.91	\$ 1.49	\$ 1.19
Jan	\$ 1.74	\$ 1.15	\$ 0.98
Feb	\$ 0.92	\$ 0.92	\$ 0.99
Mar	\$ 3.19	\$ 2.66	\$ 2.51
Apr	\$ 2.00	\$ 1.19	\$ 1.07
May	\$ 1.40	\$ 1.19	\$ 0.84
<b>Total Avg</b>	<b>\$ 1.79</b>	<b>\$ 1.27</b>	<b>\$ 1.08</b>

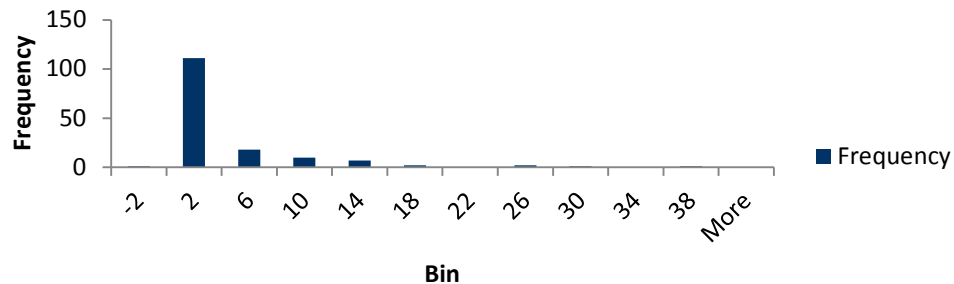
Breed-Wheatland FLO Jefferson-Rockport	Status Quo	MISO IMM	PJM
<b>Upper Bound</b>	5.72	2.54	1.58
<b>Average</b>	4.36	1.90	1.11
<b>Lower Bound</b>	3.00	1.25	0.63
<b>Marginal Error/Variance</b>	1.36	0.64	0.47

Confidence Interval study demonstrates that average value of any future transaction incentive sample set's for Breed-Wheatland Flowgate will fall within \$1.36 for Status Quo, \$0.67 for MISO IMM and \$0.47 for PJM with 99% confidence level and they all are in the same direction

MISO IMM method produces a higher marginal error than PJM method, therefore MISO IMM method produces a higher variance for future sample sets!

Month	IMM/PJM Sign Reversal	Hours
Jun	21%	62
Jul	4%	8
Aug	8%	3
Sep	14%	29
Oct	7%	6
Nov	5%	8
Dec	6%	9
Jan	1%	4
Feb	1%	2
Mar	0%	1
Apr	0%	0
May	11%	21
<b>Total</b>	<b>7%</b>	<b>153</b>

## Price Delta between IMM and PJM during hours of sign reversal



73% of reversal hours were in a +/- \$2.00 difference between methods

Only 1.8% of total hours does PJM and IMM have a sign reversal with a delta > \$2.00