Efficient Interface Pricing for PJM and MISO

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Joint and Common Market Meeting

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Introduction: Interface Pricing

- Interface pricing is essential because:
  - ✓ It is the sole means to facilitate efficient power flows between RTOs.
  - ✓ Poor interface pricing can lead to significant uplift costs and other inefficiency.
  - ✓ They are an essential basis for "coordinated transaction scheduling" or "CTS" to maximize the utilization of the interface.
- One of the key components of the interface price is the congestion component, which reflects the estimated effect of transactions on any constraint in an RTO's market that is binding.
- M2M processes create interface pricing issues because they cause both RTO's to model the *same* constraint.
  - ✓ Hence, the interface prices must be coordinated to avoid duplicative settlements with the transactions.
  - ✓ This is illustrated in the following 2 slides.

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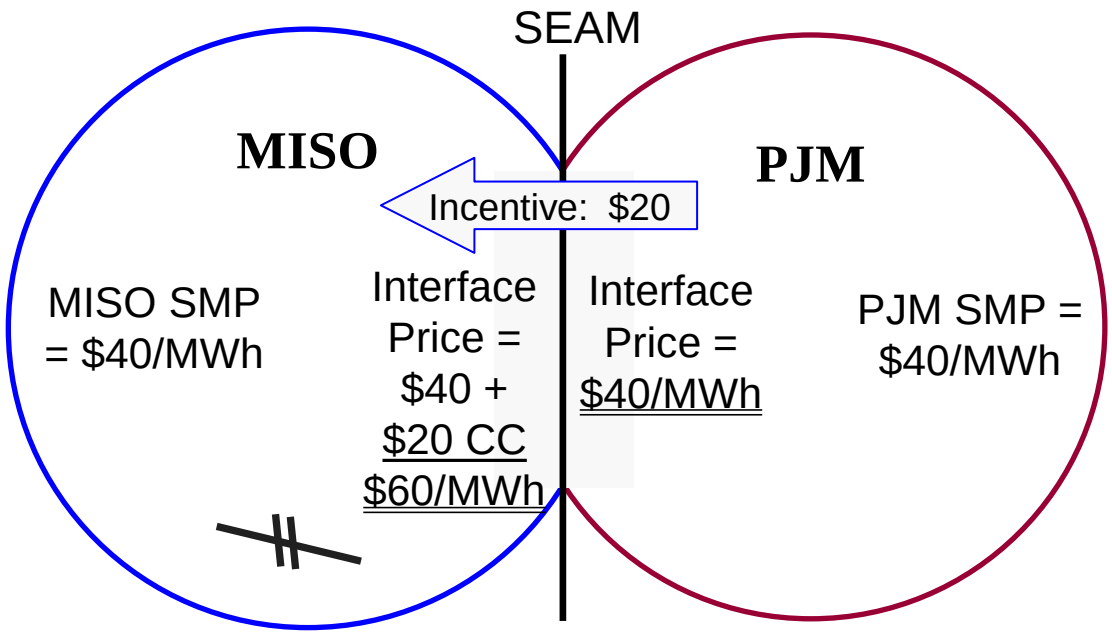
Interface Pricing *without* Market-to-Market (or TLR)



- Assume the binding constraint is *relieved* by an import from PJM.
  - ✓ Without M2M, MISO will estimate the value of the relief ($20 in this example) and the interface price will include a congestion component to incent participants to schedule the transaction.
  - ✓ PJM's interface price would not include a congestion component for this because it is an MISO constraint.

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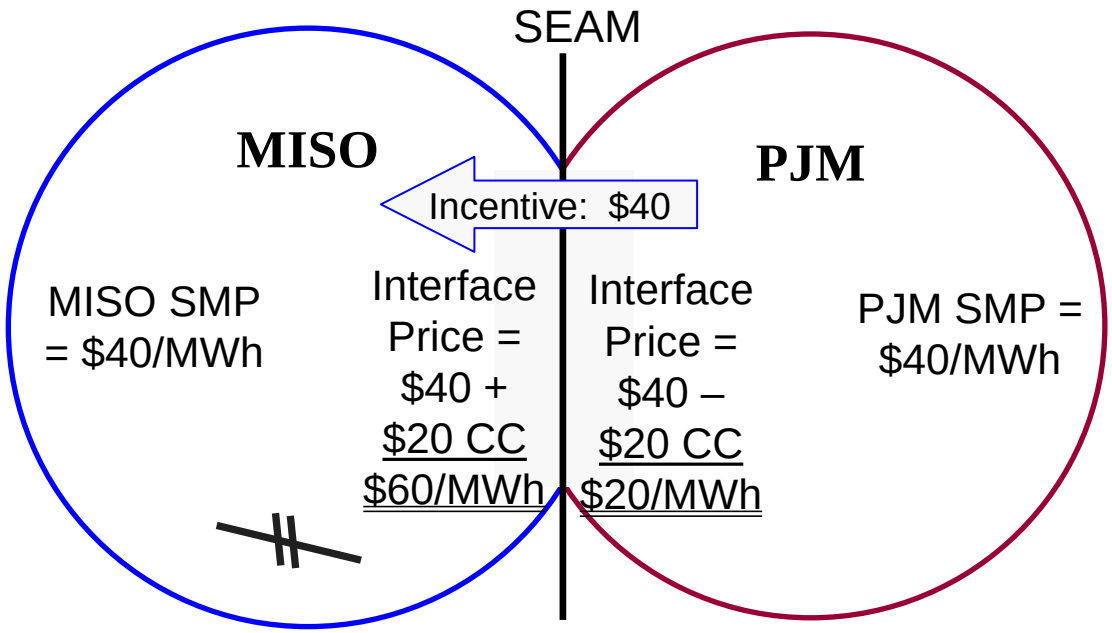
Interface Pricing with Market-to-Market



- Once M2M is initiated, this constraint will appear in both RTOs' dispatch and both will estimate the relief the transaction will provide.
- MISO's settlement is unchanged, but PJM now includes the $20 congestion component in its interface price also, doubling the incentive provided to participants to schedule the transaction ($60-$20).
- PJM's $20 payment will be uplifted to its customers.

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Calculating the Congestion Component at the Interface

- The issue in this case involves the congestion included in the interface price, which is reflected in the congestion component of the LMP.
- The congestion component is calculated by:
  - ✓ Estimating a "shift factor" that indicates the incremental change in flow over a constraint associated with a transaction.
  - ✓ The shift factor is multiplied by the marginal value of the constraint (i.e., the shadow price) to determine the congestion component.
  - ✓ Hence, if the shift factor = 10% and the shadow price = $150, the congestion component will equal $15 per MWh.
- The shift factor is estimated by assuming a source in the neighboring control area (referred to as the "interface definition") and a sink at the "reference bus" in the RTO's own area.

Alternatives for Eliminating Duplicative Settlements

- Two alternatives have been discussed for eliminating the duplicative settlements with PJM:

  1. The monitoring RTO reflects the congestion in its interface price

     ✓ This matches the settlements for non-M2M constraints.

     ✓ The non-monitoring RTO would not include the monitoring RTO's constraints in its interface price.

  2. Both RTO's implement a common interface bus at the seam.

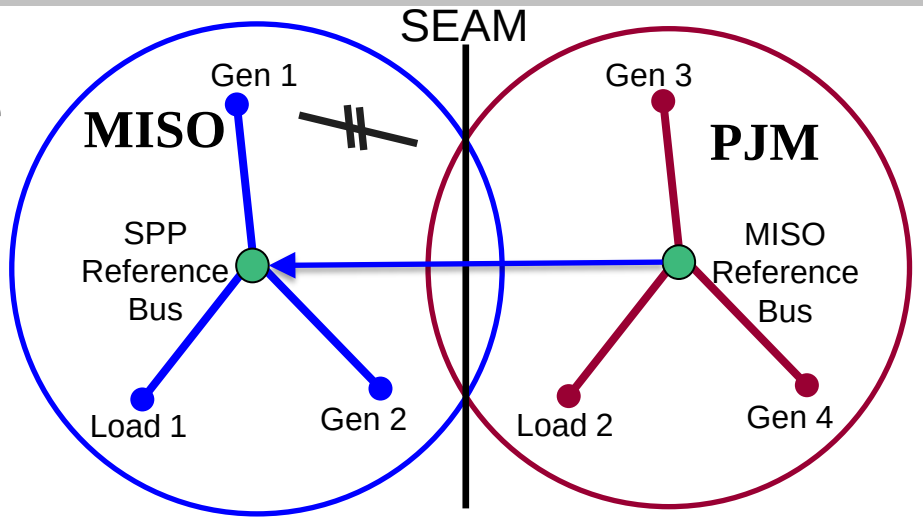
     ✓ Theoretically, this would cause the two shift factors to sum to the value the monitoring RTO would have gotten on its own.

     ✓ Hence, if both RTO's calculate the same shadow costs, their two congestion components should sum to create an efficient settlement.

Interface Pricing Alternatives under Market-to-Market

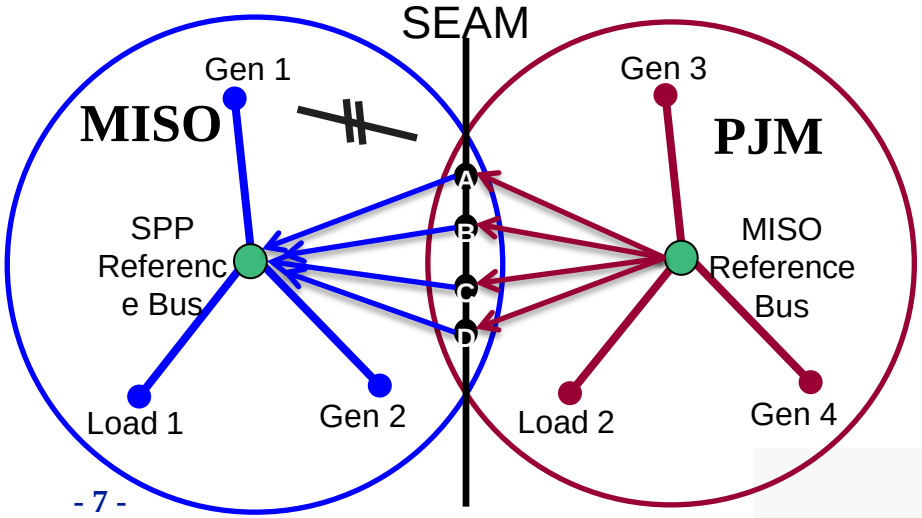
Alternative #1:

- Monitoring RTO prices the entire path from the NMRTO area.
- No payments made by NMRTO.
- No need for settlement adjustments through the JOA to account NMRTO payments.
- Gen and load LMPs



Alternative #2:

- Each RTO sets its interface price relative to a common set of interface points.
- JOA must account for the payments and receipts of the NMRTO.



Interface Pricing Alternatives: Examples

- The following examples show how both Alternatives can produce an efficient settlement with the transaction.
  - ✓ Examples assume a 1 MW export from PJM to MISO that relieves a binding MISO M2M constraint.
- While the net settlement is efficient, The inflated offsetting payments leaves MISO with a shortfall to be uplifted (balancing congestion).

Example 1- Alternative #1

	MISO	PJM	Balancing Congestion/FTR Underfunding
Shadow Cost	$500	0	
Shift Factor	-10%	0	
Congestion Payment	$50	0	None
Total Payment	**$50**		**Payment is efficient**

Example 2- Alternative #2 with Equal Shadow Prices

	MISO	PJM	Balancing Congestion/FTR Underfunding
Shadow Cost	500	500	
Shift Factor	-20%	10%	
Congestion Payment	$100	($50)	MISO= $50 shortfall, PJM= $50 surplus
Total Payment	**$50**		**Payment is efficient**

Interface Pricing Alternatives: Examples

- The following examples shows that when shadow prices do not converge, the incentive to schedule may be understated, overstated or in the wrong direction.

Example 3- Alternative #2 with Non-Convergent Shadow Prices

	MISO	PJM	Balancing Congestion/FTR Underfunding
Shadow Cost	500	100	
Shift Factor	-20%	10%	
Congestion Payment	$100	($10)	MISO= $50 shortfall, PJM= $10 surplus
Total Payment	**$90**		**Transaction overpaid**

Example 4- Alternative #2 with Non-Convergent Shadow Prices

	MISO	PJM	Balancing Congestion/FTR Underfunding
Shadow Cost	100	500	
Shift Factor	-20%	10%	
Congestion Payment	$20	($50)	MISO= $20 surplus, PJM= $50 shortfall
Total Payment	**($30)**		**Transaction Paid to Flow in the Wrong Direction**

Interface Pricing Alternatives: Non-M2M Constraints

- Alternative #2 can distort settlements on non-M2M constraints because there is no offsetting settlement from the neighboring RTO.

Example 5- Alternative #2 for Non-M2M Constraints

	MISO	Balancing Congestion/FTR Underfunding
Shadow Cost	500	
Shift Factor	-20%	
Congestion Payment	$100	MISO= $50 shortfall
Total Payment	**$100**	**Transaction significantly overpaid**

- We analyzed MISO's non-M2M constraints and found that 143 constraints of these would be substantially distorted:
  - ✓ For almost **one quarter** of the constraints, the incentive to schedule imports or exports would reverse direction.
  - ✓ For 60% of the constraints, the absolute value of the change in the shift factor was more than 200 percent of the original value.
- These are sizable distortions that will provide inefficient incentives to schedule transactions between MISO and PJM.

Cook-Palisades Example: February 23rd at 11 pm

- To illustrate these issues and evaluate alternative solutions, we use an example based on one M2M constraint in MISO: Cook-Palisades.
  - ✓ This constraint is in Michigan and was the most active M2M constraint last winter.
- This example illustrate two important issues:
  - ✓ Different interface definitions produce very different shift factors.
  - ✓ Non-convergent shadow prices raise serious pricing concerns with many common interface definitions (including PJM's).
- In the Cook-Palisades example, 20 percent of the hours exhibited PJM shadow prices that were less than 50 percent of MISO's shadow price.
- For illustration, we've select one hour in which PJM's shadow price was roughly half of MISO's.
- The following table shows how the settlement incentives would vary in this hour based on PJM's common interface proposal.

Cook-Palisades Example: February 23rd at 11 pm

		MISO	PJM	Total	Direction
Alternative #1	Shadow Price	$ 797	$ 399		
	Ref-to-Ref Shift Factor	-0.9%			PJM to MISO
	Congestion Payment based on MISO Shadow Price			**$ 7.17**	PJM to MISO
Alternative #2	PJM New Interface Shift Factor	4.2%	-5.1%		
	Congestion Payment ($/MWh)	$(33.47)	$ 20.35	**$(13.13)**	**MISO to PJM**
Actual Results	Actual Interfaces in Feb 2014	-1.1%	-8.3%		
	Congestion Payment ($/MWh)	$ 8.77	$ 33.04	**$ 41.81**	PJM to MISO

- Alternative #1 is the only alternative that provides an efficient incentive.
- Alternative #2 provides an incentive to schedule in the wrong direction.
- The actual pricing in February inflated the scheduling incentives by 600%.
  - ✓ PJM's new interface would have lowered this to a 400-500 percent overstatement.

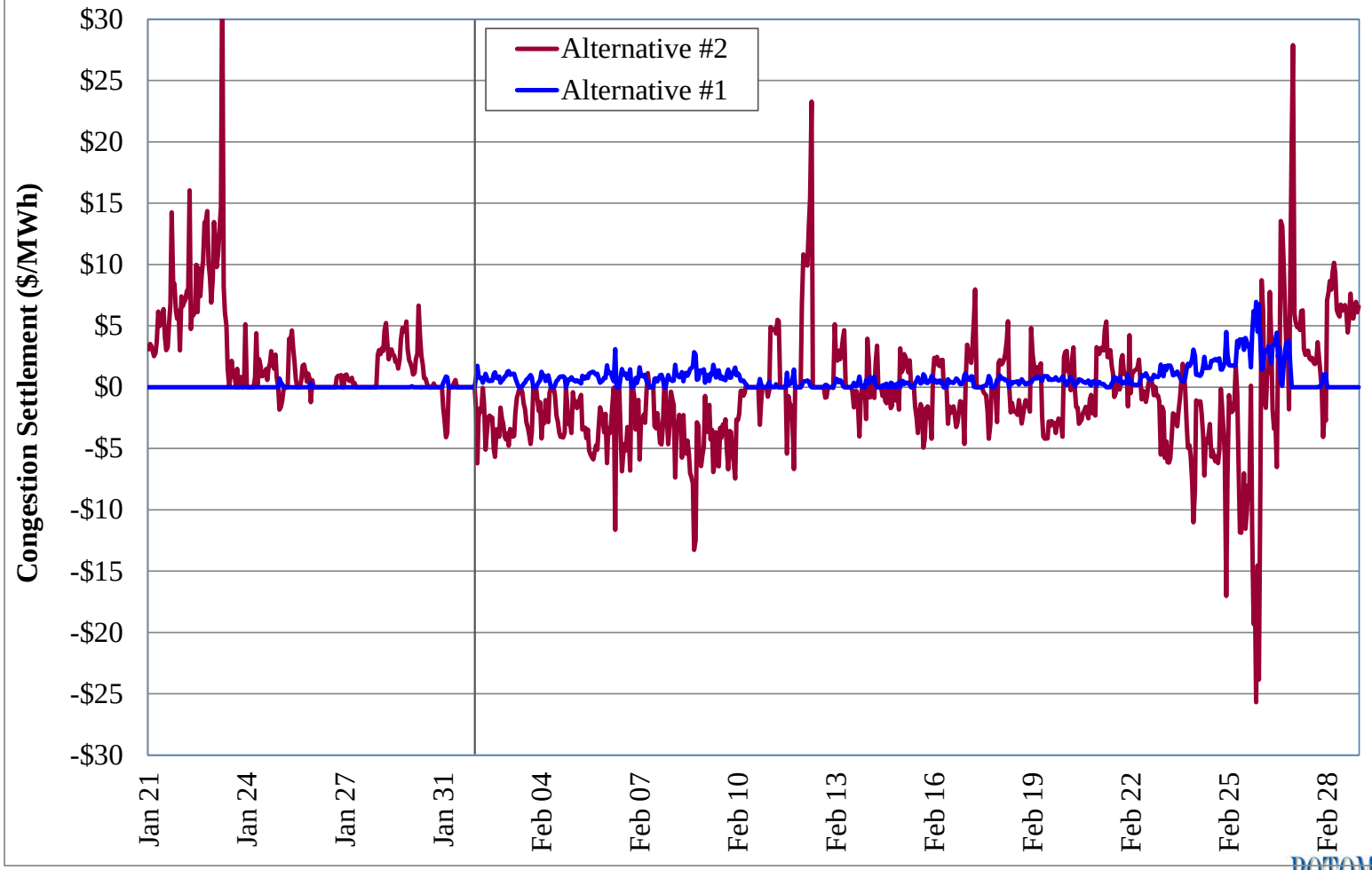
Implications of Divergent Shadow Prices

- When the shadow costs don't converge, the incentive to schedule is distorted and can be in the wrong direction.
  - ✓ In real-time, participants respond to prices with a 20-30 minute lag.
  - ✓ We've previously shown how this lag and the M2M coordination happening each 5 minutes can result prices and incentives to schedule that are unstable.
- *This inefficiency is likely the largest in the day-ahead market where there is no mechanism to cause the shadow prices to converge.*
  - ✓ Most settlements take place through the day-ahead market.
- We've studied the day-ahead results for the Cook Palisades constraints that we have been examining in the real-time market.
  - ✓ The results on the following slide show the interface price effects of these constraints in January and February related to these constraints.

Day-Ahead Interface Pricing for Cook Palisades

- In January and February of 2014, the Cook-Palisades constraints were binding in MISO or PJM in 82 percent of all hours.
- We estimated the incentive to schedule related to these constraints (the difference in the 2 RTO's congestion components) under the PJM common interface versus allowing MISO to price the constraint, and found:
  - ✓ In **36%** of the hours, the incentive reverses direction;
  - ✓ In **8%** of the hours, the common interface more than doubles the incentive to schedule from PJM to MISO; and
  - ✓ In only **3%** of these hours is the incentive to schedule within 100 percent of being efficient (positive and less than double).
  - ✓ The following figure shows these hourly differences from January 21 to February 28, 2014.
- Importantly…poor day-ahead scheduling leads to poor commitment, higher costs and more FTR underfunding.

Day-Ahead Interface Pricing for Cook Palisades



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Conclusions

- We have been analyzing these issues and alternative solutions for roughly two years and have the following conclusions:
- Alternative #1 (MISO IMM Proposal):
  - ✓ Ensures efficient interface pricing under all conditions.
  - ✓ Eliminates balancing congestion/FTR underfunding.
  - ✓ No potential unintended consequences have been identified.
  - ✓ There is no inconsistency for the NMRTO to price the M2M constraint at gen/load locations, but not at the interface.
- Alternative #2 (PJM Proposal):
  - ✓ When the shadow costs don't converge, the incentive to schedule is distorted and can be in the wrong direction.
  - ✓ Can be extremely inaccurate for non M2M constraints since there is no companion settlement from the NMRTO.
  - ✓ Requires inter-RTO settlements to account for the NMRTO payments and collections, which can result revenue inadequacies and uplift.

Conclusions

- We have validated the conclusions regarding these alternatives with empirical data on actual MISO and PJM M2M constraints.
- Making the MRTO responsible for pricing its own constraints at the interface (Alternative 1) has significant benefits and no costs in comparison to:
  - ✓ Dividing responsibility by adopting a "common interface" at the seam (Alternative 2), or
  - ✓ Allowing the RTO's to engage in duplicative settlements at the interface (no common interface).
- We are strong supporters of coordinated interchange (CTS), but efficient CTS requires efficient interchange prices.
- We continue to recommend the RTOs begin implementing Alternative #1, and develop any necessary changes in the JOA to conform to this solution.