POTOMAC ECONOMICS

COMMENTS BY THE
MISO INDEPENDENT MARKET MONITOR
ON
MISO-PJM JOINT AND COMMON MARKET STAKEHOLDER MEETING

August 2, 2012

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I. Overview of Comments

As the Independent Market Monitor (IMM) for MISO, Potomac Economics respectfully submits the following comments regarding the Joint and Common Market Stakeholder Meeting held July 16, 2012 in Rosemont, Illinois.

We have been encouraged by the JCM process and believe it is a useful venue for developing plans to address critical market issues and create substantial benefits for both markets. The recent meetings of the stakeholders provided valuable background and summary of the coordination issues facing the RTOs. We agree with the comments of some that the priorities should be guided by expected benefits, although the benefits of some of the items may be difficult to quantify or long-term in nature. With this as a guiding principle, we recommend the RTOs assign high priorities to just four items:

1. Interchange Optimization -- Dispatchable Interchange Transactions
2. Capacity Deliverability – Joint deliverability analysis
3. Day-Ahead Coordination of FFE and Topology
4. Calculation of Interface Prices

We believe that most of the other items that have been assigned a "High" priority have not been studied from a benefit perspective and will not likely produce significant benefits. For example, the initiative to align scheduling deadlines and ramp limitations will do little to address the underlying causes of the sub-optimal scheduling of the interface between PJM and MISO and the sizable economic inefficiencies it produces. These inefficiencies and reliability effects can be attributed to a) the lag in response of physical schedules to changes in prices, and b) the lack of coordination between participants of their schedule adjustments (i.e., the aggregate magnitude of the interchange adjustments by participants in response to inter-RTO price differences is generally too large or too small). Since the business rule alignment initiatives would not address these underlying causes, there is no reason to believe that they would improve the interface scheduling or produce significant benefits.

II. Interchange Optimization

We have estimated the benefits of optimizing the interchange between PJM and MISO, and between the other RTOs around Lake Erie, and found substantial available efficiency benefits. In total, we found production cost savings of $309 million per year, $59 million of which was attributable to optimizing the interchange between PJM and MISO. We believe these values to be understated because the study period of November 2008 to October 2009 was a period of low load and low fuel prices, which decreases the economic savings of optimizing the interchange.

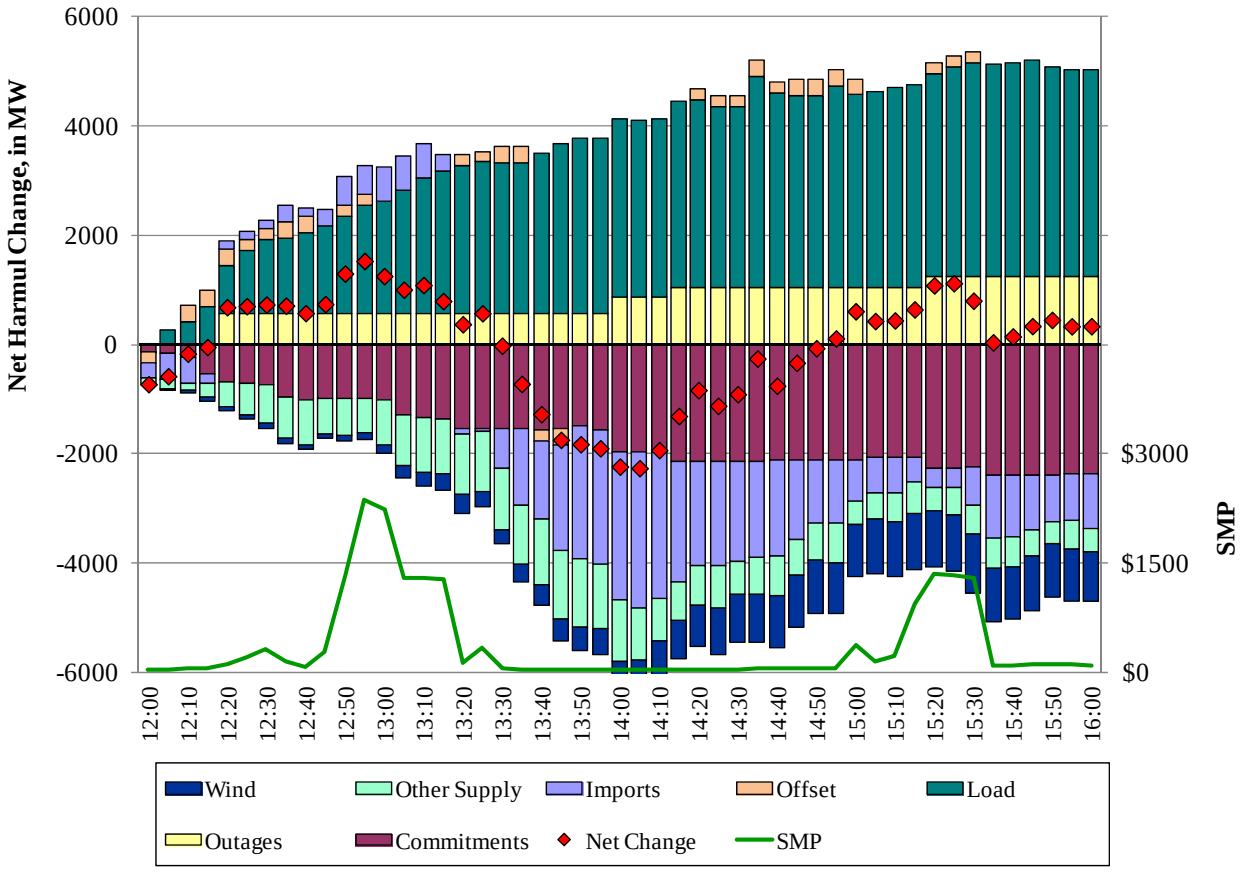
The benefits of optimizing the interchange between the two areas are intuitive. Differences in prices between the markets indicates the potential for economic efficiencies as inter-regional trades will allow lower cost resources in one area to displace higher-cost resources in the other area. Under the current markets, these benefits are captured as participants respond to observed price differences and schedule interchange transactions. However, participants' ability to capture these benefits by effectively arbitraging interregional price differences is undermined by the fact that participants must forecast the price difference that will prevail 30 minutes or more in advance of when the transactions are scheduled. Additionally, the lack of coordination among participants leads to substantial errors in the aggregate quantities of interregional transactions. These barriers to efficient trading would be addressed by allowing participants to submit intra-hour transactions that would clear every 5 or 15 minutes based on the RTO's predicted inter-market price difference.

In addition to the economic benefits this would provide, it would also improve reliability. Both the economic and reliability benefits of improved interchange can be illustrated by MISO's experience on July 6, 2012. On this day, the current scheduling processes contributed to a substantial shortage and compelled MISO to take costly actions to maintain reliability.

The chart below shows the results for July 6. It shows the 5 minute dispatch results, indicating the real-time factors that directly impact capacity levels and energy prices for the hours from noon to 4 PM. Factors that increase net demand (i.e., reduce the supply surplus and reduce operating reserves) are shown as positive values in the figure and factors that reduce net demand

and increase operating reserve are shown as negative values. The figure shows the cumulative impact of each of the supply and demand factors that affect the net capacity balance relative to the interval prior to the period shown. The aggregate effect of all factors is shown as the "net change". The factors shown in the figure include the changes in:

- Real-time market load (prior to the application of any operator offset);
- Operator load offset;
- Real-time Net Scheduled Interchange (changes in net imports);
- Real-time wind output;
- MISO commitments (for capacity or congestion);
- Other Supply (e.g. additional ramping capability from resources dispatched up in the prior interval, increased output from non-dispatchable resources, or self-commitments).
- Significant outages (real-time forced unit outages greater than 60 MW).



This figure shows the following changes over the course of the four hours from noon to 4 pm.

12:00 – 12:50: Net demand increased nearly 1.3 GWs due to rapid increases in load and declining imports leading to an operating reserve shortage at the end of this time period.

- Load increases 1.7 GWs during this time period.
- A 580 MW unit tripped at 12:20.
- Net imports *fall* by 530 MW by 12:50 as prices in PJM average $160 per MWh.
- The increased net demand of 1.3 GW is not fully offset by increased supply.
  - MISO commits 1 GW of capacity; and
  - Other supply rises by 670 MW; and
  - Increasing wind output adds 100 MW during this time period.

12:55 – 13:15: Reserve shortage produces prices peaking at almost $2400 per MWh.

- Load increases another 1 GW.
- MISO commits additional 540 MW.
- Other supply change grows another 430 MW.
- Wind output increases another 200 MW.
- Net Imports decline up to 800 MW and contributed to the operating reserve shortage, but these schedules were submitted prior to 12:45 before prices rise in MISO.
- At the very end of the time period imports begin to increase, ultimately increasing by 600 MW.

13:15 – 15:10: imports surge more than 2.9 GW in response to the shortage pricing. The excess response leads to energy prices averaging $40/MWh, causing net imports to fall rapidly as load continues rising (almost another 1 GW by 15:10).

15:15 – 15:35: Load is growing slowly, falling net imports and a forced unit outage lead to a second reserve shortage that produces peak prices of $1350. Shortage ends as load decreases and as net imports rebound.

This detailed examination of July 6 shows that the current scheduling rules for interchange between PJM and MISO lead to substantial market dysfunction, producing both substantial economic and reliability costs. In summary, net imports:

- Contributed to the shortage initially;
- Responded too slowly to allow MISO to avoid having to commit more than 2 GW of high-cost units and incur $1.4 million in uplift cost on this day;
- Over-responded to the high prices, leading to depressed prices and inflated uplift costs;
- Fell sharply and contributed to the second operating reserve shortage.

Additionally, our 2011 State of the Market Report showed that external scheduling between MISO and PJM was poor. Only about 45 percent of transactions with PJM that were scheduled in the efficient direction (from the low-priced market to the high-priced market) and the majority of hours continue to exhibit significant price differences when the interface is unconstrained. Since aligning the business rules will not address the underlying causes of these scheduling inefficiencies, we recommend the RTOs reduce the priority of these initiatives and increase the priority of the interchange optimization initiative to "High".

III. Capacity Deliverability

Efficient capacity trading between the RTO areas is essential because it affects capacity prices in both markets and, therefore, affects the long-term economic signals produced by both markets. As we have emphasized in the past, there are a number of inefficient barriers to trading capacity between MISO and PJM that RTOs should collaboratively work to address. These barriers fall in three main areas: (1) factors that reduce the availability of transmission capability into PJM; (2) rules governing the reservation and use of existing transmission rights; and (3) obligations on external capacity suppliers.

A. Available Transfer Capability and Deliverability

External capacity that is deemed deliverable should be based on the total firm transfer capability between MISO and PJM since capacity transactions are ultimately executed by the dispatches of

the two RTOs (i.e., one RTO ramps up and the other down), regardless of the location of the external capacity resource.

Substantial question exist regarding the level of firm transfer capability into PJM from MISO to support capacity transactions. A recent report by the Brattle Group provides estimates of the total transfer capability from MISO to PJM using a variety of modeling methodologies.[1] These estimates range from 5300 MW to 6300 MW. These values are consistent with a recent study by PJM that estimated 6,000 MW of cumulative import capability from MISO to PJM.[2] For the year 2013-14, market participants hold about 1200 MW of firm capability into PJM, which should leave approximately 4800 MW available, but the available import capability for 2013-14 is posted as zero. PJM and MISO should collaborate on their deliverability and ATC methodologies to maximize the available transmission capability.

B. Reservation and Use of Existing Long-Term Firm Transmission

Of the 1200 MW of long-term firm transmission rights are held by participants, less than one-half of that amount (570 MW) were used to support capacity sales into the PJM RPM market. Given that use of firm transmission likely has a higher economic value in supporting capacity transactions from MISO to PJM currently, the failure to utilize the interface capability to support capacity transactions raises significant concerns regarding how firm transmission capability is reserved and scheduled. The RTOs should work together to develop better means for reserving the firm transmission capability between the two markets. One means to better allocate the long-term firm transmission capacity into PJM would be to award the transmission capability to external capacity suppliers that clear in the RPM.

C. Resource Obligations and RTO Uncertainty

As with any RTO, PJM and MISO impose certain requirements and obligations on external resources that sell capacity into PJM. However, these obligations have been unclear and, in

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1 Brattle Group, *Preliminary Issue Description: MISO-PJM Capacity Market Seam*, December 2011.

2 NERC Probabilistic Assessment, PJM RTO Region Pilot Study, October 25, 2011, at P 21.

some cases, inefficiently costly.[3] Both of these issues will serve as economic barriers that can hinder efficient capacity trading. PJM and MISO should work together to rationalize and clarify the obligation of external capacity suppliers. Likewise, the RTOs should develop operating procedures governing the delivery of external capacity to ensure that the purchasing RTO has a comparable degree of confidence in the delivery of the external capacity as they do in the delivery of capacity from resources in their own control area.

IV. Day-Ahead Coordination

The findings of the JOA Baseline Reviews were discussed at the first JCM meeting. No specific projects were identified for potential prioritization related to Day-Ahead (DA) coordination other than "review of the current JOA provisions for elimination or modification". Under the current JOA each RTO has the option to request additional FFE on Market-to-Market constraints and to compensate the responding RTO based on the responding RTO's DA shadow price. As noted in our 2012 State-of-the Market Report, this is a valuable provision because a constraint binding in the day-ahead market at the FFE can be costly and inefficient for constraints that are not expected to bind in real-time or bind at levels that would enable an RTO to exceed its FFE in real-time at a very low cost. Neither PJM nor MISO has ever requested additional FFE in the day-ahead market.

Since the start of Market-to-Market coordination, PJM has consistently been over its FFE in the real-time on a large number of Reciprocal Coordinated Flowgates (RCFs) and consequently has paid MISO for use of additional FFE in real-time based on real-time shadow prices. Under the JOA, PJM's payments would likely be reduced if the additional FFE were to be requested in the day-ahead market when MISO would have more ability to efficiently commit (or decommit) resources to manage the additional flows on MISO RCFs. This would reduce MISO's real-time congestion costs and likely reduce PJM's M2M payments.

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[3] Both MISO market participants and the MISO IMM have received conflicting information regarding PJM's operational requirements for external resources that sell into the RPM. In particular, it remains unclear how an external supplier would satisfy its day-ahead must-offer requirements and what the implications are for the real-time dispatch of the resource.

While Section 4.1 of the JOA provides a basic procedure for implementing day-ahead coordination, we recommend that the RTOs work together to develop more detailed procedures. The RTOs should include data exchange related to day-ahead results in order to facilitate the ability to monitor and audit this process. This exchange could readily be added to the on-going exchange recently implemented in response to the JOA Baseline Review. While we would not prioritize this as highly as Interchange Optimization or Capacity Deliverability, we would still make it a "High" priority.

V. Interface Pricing

The final area that we believe warrants a high priority is interface pricing. Interface pricing is important because it facilitates the external transactions into, out of, and through each RTO. When interface prices are set inefficiently, one must expect that the resulting pattern of external transactions will likewise be inefficient.

There are two issues that we would recommend the RTOs evaluate. First, the RTOs should coordinate and make necessary revisions to their interface pricing methodologies in order to reflect the operation of the phase angle regulators (PARs) that have been placed in service at the Ontario – Michigan interface. Efficient interface prices will always reflect the *expected* physical power flows that will result from a transaction. Normally, one can establish an expected power flow associated with the transaction based solely on its source and sink. However, this is not true when the transaction affects the operation of a PAR.[4] For example, the incremental power flows one would expect associated with the transaction from New York to MISO would be different if the transaction is scheduled through Ontario than if it is scheduled through PJM. Efficiency would dictate, therefore, that MISO establish two prices for transactions sourcing in New York that would differ based on the scheduled path. We understand that the PARs will not perfectly control the actual power flows and will not eliminate all Lake Erie loop flows associated with the transactions, but the interface prices could reflect an average observed level of control (e.g.,

[4] The purpose of a PAR device is to incrementally increase or decrease the power flows along a particular path. The Michigan-Ontario PARs are intended to be operated to conform the physical flows through the interface to the scheduled flows (i.e., to minimize unscheduled flows or "loop" flows).

MISO's New York prices could assume that 80 percent of the schedule will flow along the scheduled path rather than 100 percent).

Second, we recommend the RTOs investigate whether the interface prices may be double-counting congestion on market-to-market constraints. Assume, for example, that a market-to-market constraints binds that is relieved when power is scheduled from PJM to MISO. Because this constraint will be activated in both RTOs' real-time markets and reflected in both RTOs' LMPs, it will lower the PJM interface price for MISO and raise the MISO interface price for PJM. Each of these effects will equal the marginal value of the relief expected from the transaction. If this is correct, the settlement will compensate the participant twice for the congestion benefit of the scheduled transaction.

The RTO's have proposed a high priority for enhancing the interface price calculation. We agree with this prioritization to the extent that these enhancements will address the two concerns described above.