Virtual Transactions in the Midwest ISO Markets

23 July 2008

Midwest ISO
Energizing the Heartland
Virtual Transactions in the Midwest ISO Markets

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The Role of RTOs

• Monitor flow of power over the grid
• Schedule transmission service
• Perform transmission security analysis for the Reliability Area footprint
• Manage power congestion through LMPs
• Approve transmission & coordinate generation maintenance outages
• Perform long term planning & analysis for region
• Operate Real-Time & Day-Ahead Markets
Midwest ISO Energy Markets

• The critical design elements included in these Markets are:
  ➢ Real-Time Centralized Dispatch
  ➢ Integrated Energy and Congestion Management Day-Ahead Market
  ➢ Locational Marginal Pricing (LMP)
  ➢ Financial Transmission Rights
  ➢ Reliability Assessment Commitment (RAC)
  ➢ Self-Schedules and Bilateral Schedules
  ➢ Use Limited and Demand Response Resources
  ➢ Load Aggregation and Trading Hubs
  ➢ Market Timeline
  ➢ Market Power Mitigation
  ➢ Security Constrained Unit Commitment (SCUC)
  ➢ Resource Adequacy
  ➢ Pre-OATT Contracts (grand fathered agreements)
  ➢ Ancillary Service Procurement
  ➢ Control Area Activities
  ➢ Market Settlements
Midwest ISO Energy Markets

- Day-Ahead Energy Market
  - What it is
  - Why it exists
  - Seller options
  - Buyer options
  - Virtual participants
  - Timing requirements
  - MISO role
  - Settlements
Day-Ahead Market

What it is:

- A financial day-ahead market, settled hourly, where market participants can buy or sell energy, schedule transactions or hedge congestion costs at financially binding locational marginal prices (LMPs).
- While the day-ahead market is purely financial, the Midwest ISO clears this market using a network topology that ensures that the day ahead solution is physically feasible (i.e., day-ahead scheduled injections and leakages could actually flow across the Midwest ISO grid).
Day-Ahead Market

Why it exists:

- Allows market participants to hedge congestion costs and schedule transmission usage
- Allows market participants that are long or short to alter their positions
- Shifting market activities from real-time to day-ahead improves grid reliability
Day-Ahead Market

**Seller options:**
- Resource types
  - Capacity resources (must offer)
  - Other resources
  - Demand response resources
- Self schedule (price taker)
- Bilateral schedule
  - Financial
  - Physical (imports)
- Supply offers
  - One-part or three-part
  - Physical parameters (start time, ramp rate, ...)
  - Set aside for reserves
  - Offer caps & floors
Day-Ahead Market

Buyer options:
- No mandatory requirement on % of load that must be bid
- Demand bids
  - Self schedule
  - Price responsive demand bids
- Load aggregation pricing points: choice
  - LSEs in the Midwest ISO voluntarily define their load zones based on the actual metered withdrawal points of their customers.
  - Most other ISOs/RTOs establish broader pricing zones across multiple LSEs
    - This serves to mute the price signal these MPs face, and therefore, inhibit demand response.
Day-Ahead Market

Virtual participants:
- Virtual transactions allowed in the day-ahead market
  - Day-ahead transactions that have no physical backing and will never actually flow in real-time, by definition
- Virtual supply offers and demand bids allowed
- Individual market participant benefits
  - Hedge physical supply availability
  - Hedge load uncertainty
- Market benefits
  - Enhanced liquidity
  - Improved day-ahead/real-time price conversion

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**Midwest ISO role:**

- Solve the Day-Ahead Market simultaneously for all hours of the next operating day to:
  - clear Supply Offers and Demand Bids for each Hour of the Operating Day to yield Day-Ahead Schedules
  - efficiently allocate transmission capacity to Day-Ahead Schedules by resolving transmission congestion
  - commit unscheduled Resources at least-cost to meet the Energy requirements throughout the Operating Day.
Timing & process requirements:

- Market closes at 11:00 am EST (offers/bids/schedules due)
- Post results by 5:00 pm EST
- Market monitoring
- Perform security constrained economic dispatch (minimize as-offered overall costs of energy procurement)
- Represent network topology, line limits, AFC constraints and resource outages as close as possible to real-time conditions
- Represent loop flow assumptions as accurate as possible
- Handle shortage and surplus conditions
Settlements:
- LMPs calculated at each pricing node
- Day-Ahead credits applied to
  - Cleared supply offers
  - MISO-committed units
  - FTR rights holders
- Day-Ahead charges applied to
  - Cleared demand bids
  - Bilateral schedules (congestion and loss charges)
  - Unrecovered commitment costs (RSG)
  - FTR rights holders (negative congestion)
Virtual Transactions

• Two types of virtual transactions:
  – Virtual Supply Offers
  – Virtual Demand Bids
• Definition:
  – Offers to supply Energy or Bids to purchase Energy at any CPNode in the Day-Ahead Energy Market that have no physical backing.
• Two main purposes of Virtual Transactions:
  – Virtual Transactions allow Market Participants to hedge Day-Ahead positions or speculate on locational price differences between the Day-Ahead and Real-Time Markets.
  – Virtual Transactions add liquidity to the Market. Typically, virtuals transactions account for about 8% of Midwest ISO’s Day-Ahead cleared generation and demand MWh volumes.
Virtual Transactions

• Who is qualified to submit virtual transactions?
  • Market Participants need not be a Generation or a Load owner to be eligible to submit virtual transactions into the Midwest ISO Market.
  • To be eligible to submit virtual transactions, the entity must be a registered, valid Market Participant, and all Midwest ISO credit requirements must be met (including Daily MW Limit and credit limits).
Virtual Transactions

• Rules:
  – Virtual transactions may be submitted to the Midwest ISO (through the portal or programmatic interface) no earlier than seven days before the operating day and up until 11AM EST the day before the operating day.
  – Virtual transactions may be submitted for any of the approximately 1,300 Commercial Pricing Nodes within the Midwest ISO Footprint (generation node, load zone/node, interface node, or hub). There are no restrictions on which CPNode can be used.
  – A Market Participant may submit up to 10 price/quantity pairs per hour per Commercial Pricing Node.
  – The number of virtual transactions a Market Participant may submit can be limited.
    • The Market Participant must not have exceeded either its Daily Virtual MW limit or its credit limit (as set by MISO’s Credit Department).
Virtual Transactions

- Minimum transaction amount is 0.1 MW
- Virtual Transactions are considered as actual injections and withdrawals at the applicable commercial pricing node for the Day-Ahead market execution. Virtual transactions are not considered in the Real-Time market execution.
- Virtual Transactions are not cumulative and do not carry over from day to day
- Virtual transactions can set price and are considered as any other supply or demand component of the Day-Ahead Market in price setting
- Virtual Transactions can clear partial MWs
- Virtual Supply Offers and Virtual Demand Bids have a floor at -$500/MWh and a cap at $1,000/MWh
Virtual Transactions

• Settlement:
  – Cleared virtual transactions take a position at a CPNode in the Day-Ahead and are settled at Day-Ahead Prices at that node.
  – In the Real-Time, the cleared Day-Ahead position is automatically reversed and settled at the Real-Time price at the node.
  – Essentially, cleared Virtual Bids and Offers will pay or be paid the difference between the Day-Ahead and Real-time prices multiplied by the number of MW cleared in the Day-Ahead at the relevant Commercial Pricing Node.
  – Participants can make or lose money on any transaction.
Virtual Transactions

• Revenue Sufficiency Guarantee Charges:
  – Cleared Net Virtual Demand on a locational basis is used (along with other allocators) to distribute Day-Ahead Revenue Sufficiency Guarantee Charges
  – Cleared Net Virtual Supply on a locational basis is used (along with other allocators) to distribute Real-Time Revenue Sufficiency Guarantee Charges

  – Asset Owners that bid and offer virtual schedules in the Day-Ahead Energy Market are charged the Transaction Administration Rate on the total number of hourly schedules submitted.
  – The Transaction Administration Rate is based in part upon cleared Virtual transaction volumes.
Virtual Transactions

• Market Monitor:
  – The Independent Market Monitor (IMM) monitors the use of Virtual Transactions through conduct and impact tests:
    • If the following two criteria are met:
      – The Average Hourly Deviation between Day-Ahead and Real-Time LMPs is > 10% or < –10%
      – Virtual Bidding practices contribute to an unwarranted divergence between Hourly Day-Ahead LMPs and Hourly Real-Time Ex-Post LMPs
    • Then
      – Impose Virtual Bidding Measures that limit hourly quantities of Virtual Transactions at specific locations and/or restrict Virtual Bidding to Aggregate Nodes or Hubs
Virtual Transactions

From the IMM’s 2007 State of the Market Report:

“[The IMM] continually monitors for large foreseeable losses on virtual transactions because they can indicate an attempt by a participant to manipulate the day-ahead market prices.

For example, a participant may submit a high-priced virtual bid at a constrained location that causes artificial congestion in the day ahead market. The participant will buy in the day-ahead at the high, congested price and sell the energy back at a lower, uncongested price in the real time market.

Although the virtual transaction would be foreseeably unprofitable, the participant could earn net profits if it increases its FTR payments or the value of a financial position.

Virtual losses that warrant further investigation have been rare, and none have warranted a referral to the Commission.”

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High Level Market Summary

• The following chart illustrates monthly average cleared virtual demand and supply volumes since market start.

• On average, cleared virtual demand has exceeded cleared virtual supply by approximately 770 megawatts. In practice, this tendency to clear more virtual demand than virtual supply offsets under-scheduling of load in the Day-Ahead Market.

• Virtual trading volumes were high in 2005. The FERC issued an Order in April 2006 requiring the allocation of RT RSG costs to virtual supply. Afterwards, virtual trading volumes dropped to about half of their pre-FERC Order levels.
High Level Market Summary
Monthly Average Cleared Virtual Supply and Demand Volumes

-12,500 MW
-10,000 MW
-7,500 MW
-5,000 MW
-2,500 MW
0 MW
2,500 MW
5,000 MW
7,500 MW
10,000 MW
12,500 MW
15,000 MW

Virtuals began to be allocated
Real-Time RSG: 4/25/06
High Level Market Summary

- The following charts provide descriptive statistics explaining the Midwest ISO’s experience with virtual transactions since market start.
- After the April 2006 FERC Order, virtual demand volumes accounted for about 8% of total Day-Ahead cleared demand volumes.
- The number of Market Participants submitting virtual transactions into Midwest ISO markets has gradually risen since market start (from 79 MPs in Apr-05, to 109 MPs in Jun-08)
- The number of IOUs serving load within the MISO market footprint that submitted virtual transactions has gradually declined. (from 14 MPs peak in Sep-05, to 7 MPs in Jun-08)
High Level Market Summary

Monthly Average DA Cleared Demand Since Market Start

- Avg Virtual Cleared Demand
- Avg Cleared Fixed Demand
- % of DA Demand that is Virtual

Virtuals began to be allocated
Real-Time RSG: 4/25/06
Cleared hourly virtual and physical volumes for the 1st week of Jun-08

Midwest ISO
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Cleared vs. offered virtual and price-sensitive demand volumes for the 1st week of Jun-08
Monthly Count of MPs Submitting Virtuals

Total number of Midwest ISO MPs in June 2008 was 264
IOUs are restricted to Investor Owned Utilities serving load within the Midwest ISO Market Footprint.
Virtual Profitability

- Virtual activity allows Market Participants to hedge their Day-Ahead positions or statistically arbitrage price differences between Day-Ahead and Real-Time, adding financial trading to the market.

- The virtual profitability metric provides insights into market competitive performance and can also be used to help identify instances where Midwest ISO internal market operations create statistical arbitrage opportunities arising from changes in market conditions between the Day-Ahead and Real-Time.
  - The metric threshold is $0.41/MWh net market profitability based on the monthly average of the profit indices for 2007.
    - Defined as the sum of profits and losses to all cleared virtual transactions divided by the volume (MWh) of total cleared transactions.
    - This empirical threshold is used to evaluate administrative performance and not competitive outcomes relative to a theoretical optimum.
Virtual market activity increased substantially beginning in May 2008 when measured in terms of the total number of cleared monthly virtual transactions.
Monthly price differences were estimated by first taking the hourly average of all MISO CPNodes for Day-Ahead and Real-Time. These were then each averaged on a monthly basis. Then, Monthly average RT LMP was subtracted from Monthly average DA LMP. When Day Ahead LMPs are greater than Real Time LMPs, Virtual Supply Transactions are profitable. When Real Time LMPs are greater than Day Ahead LMPs, Virtual Demand Transactions are profitable.
The overall virtual market profitability index was close to $0/mWh. This generally reflected profitability of virtual supply offers offset by losses of virtual demand offers.
Additional Comments regarding Profitability of Virtual Transactions from IMM’s 2007 SOM Report

“For virtual transactions, the average gross profit per MWh cleared decreased slightly from $0.69 per MWh in 2006 to $0.43 per MWh in 2007.

However after RSG allocations were deducted, the average net profit was negative during 2007.”

This naturally leads to a discussion of MISO’s Real-Time RSG Allocation.
Virtual Transactions and Allocation of Real-Time RSG charges

• One issue that has been the subject of great debate is the appropriate amount of Real-Time RSG to allocate to Virtual volumes.

• Since cleared virtual transactions do not result in the actual injection or withdrawal of energy, is it appropriate to allocate Revenue Sufficiency Guarantee Payments to cleared virtual supply volumes?

• As mentioned earlier, virtual volumes are also used to allocate Day-Ahead RSG (in this case, Virtual Demand* is used, not Virtual Supply). However, DA RSG accounted for only 7% of total RSG over the last year. So most of RSG is allocated through the Real-Time RSG Distribution.

• The following slides summarize the history of FERC Orders and Midwest ISO filings related to RT RSG Redesign. 

*The Day-Ahead RSG is also allocated based upon cleared Day-Ahead fixed demand bids, cleared price sensitive demand bids, and cleared Day-Ahead exports.
History of MISO RT RSG Filings

October 5th, 2005 MISO Filing
The Midwest ISO filed revisions to Section 40.3.3 of the EMT in order to:

• Remove references to virtual supply within the calculation of RSG Charges.
• Clarify allocation of RSG charges among eligible categories of Market Participants.
• Clarify the eligibility of resources not following dispatch instructions for RSG payments.
• Remove the requirement to actually withdraw energy in order to be assessed RT RSG Charges.
History of MISO RT RSG Filings

February 24th, 2006 MISO Filing
The Midwest ISO filed its response to the deficiency letter issued by the Commission concerning RSG. The Midwest ISO sought Confidential treatment of this filing.

April 25th, 2006 FERC Order
- FERC Order conditionally accepting certain parts of Midwest ISO’s proposed tariff changes, rejected other parts.
- Order required Midwest ISO to recalculate, refund, or credit certain RSG payments.
- Order clarified that “the charge, per the terms of the TEMT, is only applied to market participants withdrawing energy in real-time.”
History of MISO RT RSG Filings

May 11th, 2006 MISO Filing
The Midwest ISO filed its Motion to Stay and Request for Expedited Treatment regarding the implementation of the refund and crediting directives including those related to virtual transactions and Carved Out GFAs set forth in the Commission's April 25 Order on RSG.

May 25th, 2006 MISO Filing
The Midwest ISO submits a request for rehearing and/or clarification, request for a technical conference, and expedited treatment of the Commission's April 25, 2006 Order concerning Revenue Sufficiency Guarantee.
History of MISO RT RSG Filings

October 26th, 2006 FERC Order
Order on Rehearing

November 27th, 2006 MISO Filing
The Midwest ISO filed revisions to the EMT in compliance with the Commission's October 26 Order on Rehearing and April 25, 2006 Order regarding Revenue Sufficiency Guarantees. This was a 30 Day Compliance Filing.
History of MISO RT RSG Filings

December 26th, 2006 MISO Filing
The Midwest ISO filed proposed revisions to the EMT, concerning Revenue Sufficiency Guarantee, in compliance with the Commission’s Orders dated October 26, 2006 and April 25, 2006. 60 Day Compliance. Filing included an analysis of virtual transactions, along with proposed Tariff revisions, allocating a share of the RSG costs to such transactions.

March 15th 2007 FERC Orders
• Order on Rehearing. Importantly, the Order states that the current cost allocation in Section 40.3.3.a.ii “remains in effect until a Section 206 investigation determines the current provision is unjust and unreasonable.”
• Order accepting in part and rejecting in part compliance filing
History of MISO RT RSG Filings

March 15th 2007 FERC Orders
• Order on Rehearing. Importantly, the Order states that the current cost allocation in Section 40.3.3.a.ii “remains in effect until a Section 206 investigation determines the current provision is unjust an unreasonable.”
• Order accepting in part and rejecting in part compliance filing

April 16th, 2007 MISO Filing
The Midwest ISO submitted its compliance filing concerning Revenue Sufficiency Guarantee (“RSG”). Among other things, the Filing reinstated Tariff language stating that RSG charges can be imposed on virtual transactions only of Market Participants physically withdrawing energy.
History of MISO RT RSG Filings

April 10th, 17th, 24th, 2007 MISO Filing
The Midwest ISO submitted three Complaints requesting that the Commission to find that Section 40.3.3.a.ii of the EMT is unjust and unreasonable insofar as it can be construed to assess RSG charges on Market Participants physically withdrawing energy from the Real-Time Energy Market.

May 23th, 2007 MISO Filing
The Midwest ISO filed its Answer to the protests and comments filed regarding the Midwest ISO April 17, 2007 compliance filing on RSG
History of MISO RT RSG Filings

September 14, 2007 MISO Filing
The Midwest ISO filed its ASM proposal, which included certain changes to the current EMT’s RSG provisions. Importantly, the RSG Redesign Proposal was not integrated with the ASM proposal at this time.

November 5th, 2007 FERC Orders
- The Commission issued its Order on Rehearing regarding the March 15, 2007 Orders on RSG Compliance and the RSG Second Rehearing Order.
- The Commission issued its Order regarding the April 17, 2007 RSG Compliance Filing.
History of MISO RT RSG Filings

November 28th, 2007 FERC Order

• Consolidated the majority of the RSG complaints
• Finding that the Midwest ISO’s existing RSG cost allocation methodology may be unjust, unreasonable, unduly discriminatory or preferential.
• Instituted paper hearing procedures to review evidence on what would be just and unreasonable RSG cost allocation methodology.
• Directed MISO to make informational filing on February 1st 2008, reporting on the results of RSG related stakeholder discussions.
• Established a potential refund effective date, no earlier than August 10, 2007, while clarifying that the setting of a refund date “does not constitute a determination that refunds will be ordered or how such refund amounts and refund period will be determined.”
History of MISO RT RSG Filings

December 12th, 2007 MISO Filing
The Midwest ISO submitted its compliance filing pursuant to the Commission's November 5, 2007 Order regarding Revenue Sufficiency Guarantee.

February 1st, 2008 MISO filing
The Midwest ISO filed an informational filing, describing the proposed alternative RSG cost allocation framework and undertaking to file the corresponding Tariff language on or about March 3rd, 2008.
History of MISO RT RSG Filings

February 25th, 2008 FERC Order
The Commission issued an order conditionally accepting the Midwest ISO’s ASM proposal, including its RSG-related Tariff revisions.

March 3rd, 2008 MISO filing
The Midwest ISO filed indicative tariff language, reflecting expected revisions necessary to proceed with the RSG Redesign proposal.
Rationale for RT RSG Redesign

• Existing Real-Time RSG charge allocation methodology distributes RSG costs to Market Participants in two passes.
  – First Pass, RSG cost is allocated to market participants that actually withdraw energy based upon the absolute megawatt-hour volume change between Real-Time and Day-Ahead markets for Asset and physical bilateral transaction (“PBT”) schedules, as well as Day-Ahead net virtual supply.
  – Any residual RSG left over from the First Pass is allocated using the Second Pass allocation, which is distributed based upon load ratio share.

• Existing RSG Charge Allocation ignores the locational aspects of schedule deviations. In actual practice, when a unit is committed to manage a transmission constraint, schedule deviations closer to the constraint bear a greater responsibility for the unit commitment than deviations at remote locations.

• Existing RSG Allocation does not distinguish between schedule changes where the Midwest ISO has been notified with sufficient time to reflect the change in the RAC, and those which are not and may result in additional unit commitment.
Guiding Principles of RSG Redesign

The following principles have guided redevelopment of this RSG cost allocation process:

• This RT RSG market redesign is limited to design changes associated with distribution of RSG charges.
  – RSG charges may be reduced through more appropriate LMP calculation - but this is a longer term effort.
  – RSG charges may be reduced by redesigning the RAC process - but this is a longer term effort.
  – The RSG market redesign should allow the Midwest ISO to commit the capacity it deems necessary to reliably operate the grid at the least commitment cost;
  – The RSG market redesign should be part of a transparent and equitable implementation process, in order that AOs can better hedge potential RSG charges as part of their transaction decisions;
  – The RSG market redesign distributes RSG charges on a cost causation basis; and
  – The RSG market redesign should be incentive compatible with the Midwest ISO’s Day-Ahead and Real-Time Energy Markets, as well as with adjacent markets when possible.
Three Commitment Reasons

Following extended discussions with MISO stakeholders and MISO Operations and Settlements staff, the following three commitment reasons were identified:

• Constraint Management: Resources committed by MISO after the execution of the Day-Ahead Market in order to relieve flow on a transmission constraint. Commitment could occur in either forward RAC or in Intra-Day RAC.

• Intra-Hour Demand Change: Resources committed by MISO after execution of the Day-Ahead Market that provide ramp or headroom capability. Ramp capability is needed when the rate of change of aggregate Real-Time MISO demand is greater than expected. Real Time Headroom is the amount of capacity held on online resources in between dispatch point and economic maximum limits – MISO operators try to keep RT Headroom at 750 MW to ensure system reliability.

• Day-Ahead Schedule Deviations: Certain classes of DA schedule deviations contribute to the need to commit additional units in Real-Time. These deviations include Real-Time changes to unit limits, increases in Demand or Exports relative to DA cleared volumes, decreases in Imports relative cleared DA volumes, or net Virtual Supplies.
Real-Time RSG allocation under Redesign Proposal

• Bucket 1: Constraint Management Charge
  – This applies to RT RSG dollars associated with resources committed to manage transmission constraints
  – Allocation sequence
    • Step 1: First, allocate a portion to Second Pass directly, to account for the impact of loop flow and topology change between DA and RT on the constraint limit.
    • Step 2: Then, allocate residual RSG based upon the flow increase on the constraint caused by deviations from DA Schedules.
    • Step 3: Any residual RSG after Step 2 will flow into the next bucket – the Intra Hour Demand Change Charge.
Real-Time RSG allocation under Redesign Proposal

• Bucket 2: Intra-Hour Demand Change Charge
  - RT RSG dollars associated with resources committed for ramp and/or head room requirements will be allocated under this bucket. Also, any left over RT RSG dollars from Constraint Management bucket will also be allocated first under the Intra-Hour Demand Change Charge.
  • RT RSG dollars allocated to this bucket will be based upon Real-Time Headroom requirements.
  • In hours where Real-Time Headroom requirements are high (low), all (none) of the applicable RSG dollars will be allocated through this bucket.
  • RT RSG dollars allocated to this bucket will go to Second Pass directly
    - Residual RSG (if any) will go to next bucket
Real-Time RSG allocation under Redesign Proposal

• **Bucket 3: Day-Ahead Schedule Deviation Charge**
  – All residual RT RSG dollars left over from the Intra-Hour Demand Change Charge will be allocated first through the Day-Ahead Schedule Deviation Charge
  – In this bucket, RSG is allocated to MPs based upon uninstructed deviations of their resources from Day-Ahead schedules. These include
    • Changes to RT Economic limits that violate DA schedules
    • Increases in Demand or Export above cleared DA volumes.
    • Decreases in Imports below cleared DA volumes
    • Net Virtual Supplies
    • Decreases from Target Resource Dispatch.
  – Residual RSG (if any) will go to Second Pass. RSG allocation under Second Pass is based upon load ratio share.
Conclusion

- Virtual transactions in the Day-Ahead Market serve to:
  - Help ensure Day-Ahead Market results are efficient,
  - Facilitate convergence between the Day-Ahead and Real-Time market prices,
  - Add liquidity to the market,
  - Mitigate market power in the Day-Ahead Market.
- Virtual transactions should be allocated a portion of RSG charges.
Questions?
Addendum
RSG Allocation under the current EMT

Prepared for the RSG Task Force - June 4th 2008
Summary of RSG Allocations

RSG First Pass Distributions are allocated to Deviations in several categories with the pre-qualification that a Market Participant Actually withdraws Energy

Historical RSG Allocations ($ Millions)

<table>
<thead>
<tr>
<th>Year</th>
<th>Total RSG</th>
<th>RSG First Pass</th>
<th>Percent</th>
<th>RSG Second Pass</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>$ 469.1 M</td>
<td>$ 173.3 M</td>
<td>37.0 %</td>
<td>$ 295.8 M</td>
</tr>
<tr>
<td>2006</td>
<td>$ 238.4 M</td>
<td>$ 118.7 M</td>
<td>49.8 %</td>
<td>$ 119.7 M</td>
</tr>
<tr>
<td>2007</td>
<td>$ 330.8 M</td>
<td>$ 155.3 M</td>
<td>47.0 %</td>
<td>$ 175.4 M</td>
</tr>
<tr>
<td>2008 YTD</td>
<td>$ 106.8 M</td>
<td>$ 48.7 M</td>
<td>45.6 %</td>
<td>$ 58.1 M</td>
</tr>
</tbody>
</table>
Deviations by Transaction Type

The following data shows how deviations are spread across the different transaction types. This data does not account for those deviations that did not ultimately receive charges due to Actual Withdrawal of Energy.

The results are from 2007 analysis and are approximations of actual data used for settlements.

Although not impacting the allocation, the direction (increased supply), was derived for informational purposes.
# Deviations by Transaction Type

<table>
<thead>
<tr>
<th>Deviation Type</th>
<th>Transaction</th>
<th>Load</th>
<th>Physical Schedule</th>
<th>Virtual</th>
<th>Generation Schedule</th>
<th>Generation Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume (MW X 1000)</td>
<td>Increase</td>
<td>12,293</td>
<td>Increase</td>
<td>9,518</td>
<td>Supply</td>
<td>43,179</td>
</tr>
<tr>
<td></td>
<td>Decrease</td>
<td>12,838</td>
<td>Decrease</td>
<td>7,381</td>
<td>Derate</td>
<td>9,469</td>
</tr>
<tr>
<td>Percent of All Deviations</td>
<td>Increase</td>
<td>12.1%</td>
<td>Increase</td>
<td>9.4%</td>
<td>Supply</td>
<td>42.5%</td>
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<tr>
<td></td>
<td>Decrease</td>
<td>12.6%</td>
<td>Decrease</td>
<td>7.3%</td>
<td>Derate</td>
<td>9.3%</td>
</tr>
<tr>
<td>Percent of All Physical</td>
<td>Increase</td>
<td>21.0%</td>
<td>Increase</td>
<td>16.3%</td>
<td>N/A</td>
<td>5.7%</td>
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<tr>
<td></td>
<td>Decrease</td>
<td>21.9%</td>
<td>Decrease</td>
<td>12.6%</td>
<td>N/A</td>
<td>3.1%</td>
</tr>
</tbody>
</table>
MISO Analysis of the Drivers of RT RSG

The Midwest ISO conducted an analysis of RSG charges for thirty-six (36) days in calendar year 2007, for nine days each in February/March, June, September and December. Each selected month included three days when RSG charges were high, three when the charges were of nominal value, and three when such charges were low. These days were selected in the following manner: An ordered data set was formed by ranking each day in 2007 by the dollar amount of RSG charges. Once ranked, the data was sorted into three equal parts. The first section provided the set of days with low RSG charges. The third section provided the set of days with high RSG charges. The middle section provided the set of days with RSG charges of nominal value. For each aforementioned month, three days were selected randomly from the first, middle and third sections to arrive at the sample of days used to perform the data analysis.
### MISO Analysis of the Drivers of RT RSG

#### Average Daily MWh for RSG Drivers: Nominal, High, and Low RT RSG Days

<table>
<thead>
<tr>
<th>Magnitude of RT RSG (1)</th>
<th>Average RTRSG (2)</th>
<th>Standard Deviation of RTRSG (3)</th>
<th>DA NSI minus RT NSI (4)</th>
<th>VSO minus VDB (5)</th>
<th>EconMax eligible for RT MWP (6)</th>
<th>EconMax eligible for RTMWP &amp; committed for a Constraint (7)</th>
<th>MTLF minus DA Physical Generation (8)</th>
<th>Intra-Hour Demand Change (9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>units</td>
<td>$ / day</td>
<td>$ / day</td>
<td>MWh / day</td>
<td>MWh / day</td>
<td>MWh / day</td>
<td>MWh / day</td>
<td>MWh / day</td>
<td>MWh / day</td>
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<tr>
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- Column 1: designation of the high, low, and nominal value RSG rows.
- Column 2: sample mean in $/day for the twelve (12) days (three in each month) selected. For the middle section, RSG charges averaged over $0.78 m per day, for the selected days. RSG charges in the third section (high RSG) were more than five (5) times the RSG charges in the first section (low RSG), for the sample set.
- Column 3: standard deviation surrounding the sample mean.
- Column 4: DA NSI minus RT NSI: for each hour, max (Σmiso DANSI - ΣmisoRTNSI, 0) then summed across the hours in the day. Imports are positive, exports are negative. DA NSI is Day-Ahead Net Scheduled Interchange. RT NSI is Real-Time Net Scheduled Interchange. Non-negative values only were used to avoid the muting effect that would occur when summing positive and negative values across the hours in the day. Higher net import positions in the Day-Ahead versus Real-Time Markets are associated with low RSG days.
## MISO Analysis of the Drivers of RT RSG

### Average Daily MWh for RSG Drivers: Nominal, High, and Low RT RSG Days

<table>
<thead>
<tr>
<th>Magnitude of RT RSG (1)</th>
<th>Average RTRSG (2)</th>
<th>Standard Deviation of RTRSG (3)</th>
<th>DA NSI minus RT NSI (4)</th>
<th>VSO minus VDB (5)</th>
<th>EconMax eligible for RT MWP (6)</th>
<th>EconMax eligible for RTMWP &amp; committed for a Constraint (7)</th>
<th>MTLF minus DA Physical Generation (8)</th>
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<tr>
<td>units</td>
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- **Column 5**: VSO minus VDB: for each hour, max (Σmiso VSO - Σmiso VDB, 0), then summed across the hours in the day. VSO is cleared virtual supply offers; VDB is cleared virtual demand bids. Non-negative values only were used to avoid the muting effect that would occur when summing positive and negative values across the hours in the day. High RSG days clearly are associated with the largest amount of cleared net virtual supply.

- **Column 6**: EconMax eligible for RT MWP: for each hour, Σmiso EconMax of Resources eligible for RTMWP, summed across the hours in the day. RT MWP is Real-Time make whole payments. This represents the amount of Capacity economically available that has been committed by the Midwest ISO in its RAC processes. High RSG days clearly are associated with the largest amount of Capacity committed.

- **Column 7**: EconMax eligible for RT MWP and Committed for a Constraint: for each hour, Σmiso EconMax then summed across the hours in the day, where resources are eligible for RTMWP and the resource has been committed after the close of the Day-Ahead Energy Market to manage a transmission constraint. High RSG days clearly are associated with the largest amount of Capacity committed to manage constraints.
## MISO Analysis of the Drivers of RT RSG

### Average Daily MWh for RSG Drivers: Nominal, High, and Low RT RSG Days

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- **Column 8**: MTLF minus DA Physical Generation: For each peak hour, \( \Sigma_{\text{miso}} \) MTLF - \( \Sigma_{\text{miso}} \) ClearedPhysicalGen. MTLF refers to the load forecast used by the Midwest ISO during the RAC process. DA Physical Generation refers to physical resources (not virtual supply) that clears as a result of the Day-Ahead Energy Market. The difference represents an indication of the additional Capacity necessary to meet the energy balance during the peak hour. High RSG days clearly are associated with the largest differences between the Load Forecast and cleared generation.

- **Column 9**: Intra-Hour Demand Change: Absolute \(((\Sigma_{\text{misoDem}})_{\text{hrN+1}} - \Sigma_{\text{miso Dem}})_{\text{hrN}}) / 2\). The absolute value of ½ of the hourly change in demand in the Midwest ISO market is calculated to avoid the muting effect that would occur when summing positive and negative values across the hours in the day. Higher Intra-Hour Demand Change is associated with higher RSG days.