Markets Report

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MC Webinar
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PJM Wholesale Cost for March, 2016 was $47.66/MWh, down from full-year 2015 costs of $56.57/MWh. The bulk of the decrease is made up of Energy costs down nearly $10/MWh from 2015. (Slides 5 & 6)

Operating Reserve cost contribution to wholesale energy costs are at their lowest level in the 2011-2016 time period. (Slide 6)

Total Uplift charges remain at their lowest level in the last two years. (Slides 8 & 9)

Load-weighted average LMP for 2016 YTD is $26.69/MWh: (Slide 18)
  – March 2016 was $23/MWh, which is significantly lower than March 2015 ($42) or March 2014 ($75).

In March, both Energy and the sum of Heating and Cooling Degree Days were below their historic averages. (Slides 16-17)
• After a significant increase in July through September, the MWs registered in PJM’s Economic Demand Response leveled off in October, remained relatively level through March. (Slide 23)
• Total cleared MWh of virtual bids (INCs and DECs) have remained essentially flat from their October 2014 levels. Total cleared MWh of UTC transactions increased 46% in January from December 2015 but have been trending back down since. (Slide 27, 29, 31 and data appendix)
• FTR revenue adequacy for the month of March is 96%. The 2015-2016 Planning Year to-date revenue adequacy remains fully funded. (Slides 33-36)
• The biggest contributors to congestion are north to south transfers between MAAC, EMACC and SWMAAC, reflecting market and pipeline constraints. (Slide 37)
• Regulation and Synchronized Reserve market costs have generally tracked with energy prices over time. (Slides 49-51)
Markets Report
Operating Reserve
Monthly Uplift - $/MWh Load

- Day-Ahead Operating Reserve
- Balancing Operating Reserve
- Reactive
- Blackstart
- Lost Opportunity Cost

$/MWh

MAR14 - MAR16
Percent of Total CC, CT and Steam Hours with LMP < Offer

- CC
- CT
- STEAM
• Beginning in December 2008, the daily Balancing Operating Reserves (BOR) rate was replaced with six different BOR rates: RTO BOR for Reliability Rate, RTO BOR for Deviations Rate, East BOR for Reliability Rate, East BOR for Deviations Rate, West BOR for Reliability Rate, West BOR for Deviations Rate.

• Reliability rates are charged to all real-time load and exports, whereas deviation rates, as before, are charged only to real-time deviations. RTO rates are charged to the whole footprint, whereas East and West rate adders are charged based on location.
Energy Market
LMP Summary
• The weather parameter shown in the following slide is a monthly sum of daily Heating Degree Days (HDD) and Cooling Degree Days (CDD).

• Degree days represent a deviation from a baseline temperature, in this case 60 degrees for HDD and 65 degrees for CDD. As temperatures get more extreme, colder or hotter, either HDDs or CDDs, respectively, will increase.

• Typically, winter months will only record HDDs, while summer months will only record CDDs. Shoulder months may have both HDDs and CDDs.

• Degree Days are calculated using a daily load weighting that weights values from stations in each TO zone according to the zonal contribution to the RTO peak on that day.

• Average values use data from 1998 to the most recent complete year, in this case, 2013. Averages include load data for all of TO zones in the current RTO footprint.
Historic Average Weather and Energy versus Current Month

- **Current Month Total Energy**
- **Current Month HDD+CDD**
- **Average Monthly Total Energy**
- **Average Monthly HDD + CDD**

TWh

Heating Degree Days + Cooling Degree Days


0  20  40  60  80  100  120  140  160  180  200  220  240
Fuel Cost Adjusted LMP (Referenced to 1999 Fuel Prices)

$/MWh

- Fuel Cost Adjusted LMP
- Load Weighted LMP

Year:
- 1998
- 2000
- 2002
- 2004
- 2006
- 2008
- 2010
- 2012
- 2014
- 2016
In September 2014 the method for calculating LMP re-run intervals was changed to only include intervals that actually impacted LMP.
Energy Market
Demand Response Summary
Demand Side Response Estimated Revenue

Capacity revenue prior to RPM implementation on 6-01-2007 estimated based on average daily ALM capacity credits and weighted average daily PJM capacity market clearing price.
Economic Demand Response Activity

*Data for the last few months are subject to significant change due to the settlement window.
Total Registered MW in PJM's Economic Demand Response
Energy Market
Virtual Activity Summary
The following six charts depict trends in submitted and cleared virtual and up-to-congestion transactions, in terms of number and volume, into the PJM Energy Market. The first two of these charts show the submitted and cleared increment and decrement bids (virtual transactions or virtuals) and they are the same as what was previously being presented in this report. The two charts after them display the trends in submitted and cleared up-to-congestion transactions into the PJM Energy Market. The last two of these six charts combine the virtual and up-to-congestion transactions and show the sum of these two categories.

To clarify what a bid or transaction is, please consider the following example: An offer (increment, decrement or up-to-congestion) of 10 MW, valid for eight hours for a given day, is captured in the charts as eight submitted bids/transactions and 80 submitted MWh. If this offer fully clears for three of the hours it was submitted for, it shows in the charts as three cleared bids/transactions and 30 cleared MWh.
Virtual Bids (INCs & DECs) - Total Number

- Submitted Bids
- Cleared Bids

Number of Bids ( Millions )
Up-To-Congestion Transactions - Total Number

Number of Transactions (Millions)

- **Submitted Transactions**
- **Cleared Transactions**

Timeline:
- **MAR14**
- **APR14**
- **MAY14**
- **JUN14**
- **JUL14**
- **AUG14**
- **SEP14**
- **OCT14**
- **NOV14**
- **DEC14**
- **JAN15**
- **FEB15**
- **MAR15**
- **APR15**
- **MAY15**
- **JUN15**
- **JUL15**
- **AUG15**
- **SEP15**
- **OCT15**
- **NOV15**
- **DEC15**
- **JAN16**
- **FEB16**
- **MAR16**
Up-To-Congestion Transactions - Total Volume

MWh (Millions)

- Submitted MWh
- Cleared MWh

<table>
<thead>
<tr>
<th>Month</th>
<th>MWh</th>
<th>MWh</th>
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<td>10</td>
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<td>MAR16</td>
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INCs, DECs and Up-To-Congestion Transactions - Total Number

Number of Transactions (Millions)

- Submitted Transactions
- Cleared Transactions

- Data for each month from MAR14 to MAR16 is shown, with the number of transactions increasing over time.
INCs, DECs and Up-To-Congestion Transactions - Total Volume

- **Submitted MWh**
- **Cleared MWh**

MWh (Millions)

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<td>200</td>
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Energy Market
Congestion and FTR Summary
FTR Revenue vs. FTR Target Allocation

- Total FTR Revenues
- Total FTR Targets
<table>
<thead>
<tr>
<th>Period</th>
<th>Surplus / Underfunding</th>
<th>Payout Ratio</th>
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<tr>
<td>March, 2016</td>
<td>$-3,578,846</td>
<td>96%</td>
</tr>
<tr>
<td>2016</td>
<td>$8,395,701</td>
<td>100%</td>
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<tr>
<td>2015/2016</td>
<td>$56,272,183</td>
<td>100%</td>
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Planning Period FTR Payout

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<tbody>
<tr>
<td>Ratio</td>
<td>100%</td>
<td>100%</td>
<td>90%</td>
<td>90%</td>
<td>90%</td>
<td>90%</td>
<td>90%</td>
<td>80%</td>
<td>70%</td>
<td>60%</td>
<td>50%</td>
<td>40%</td>
<td>30%</td>
<td>20%</td>
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</tbody>
</table>
### Ten Most Heavily Congested Transmission Facilities - Overall, March

<table>
<thead>
<tr>
<th>Facility</th>
<th>Total</th>
<th>Day-ahead</th>
<th>Balancing</th>
<th>Market-to-market</th>
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<tbody>
<tr>
<td>Bagley-Graceton 230 (BGE)</td>
<td>$22,000,000</td>
<td>$2,000,000</td>
<td>$10,000,000</td>
<td>$9,000,000</td>
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<tr>
<td>Conastone-Peach Bottom 500 (EHV)</td>
<td>$19,000,000</td>
<td>$2,000,000</td>
<td>$12,000,000</td>
<td>$5,000,000</td>
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<tr>
<td>Cherry Valley 345/138 TR82 (COMED)</td>
<td>$18,000,000</td>
<td>$1,000,000</td>
<td>$15,000,000</td>
<td>$2,000,000</td>
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<tr>
<td>Conastone-Northwest 230 2 (BGE)</td>
<td>$16,000,000</td>
<td>$2,000,000</td>
<td>$14,000,000</td>
<td>$0</td>
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<tr>
<td>Mercer IP-Galesburg 161 (MISO)</td>
<td>$15,000,000</td>
<td>$1,000,000</td>
<td>$14,000,000</td>
<td>$0</td>
</tr>
<tr>
<td>Mardela-Vienna 69 (DPL)</td>
<td>$14,000,000</td>
<td>$1,000,000</td>
<td>$13,000,000</td>
<td>$0</td>
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<tr>
<td>Graceton 230/115 T1 (BGE)</td>
<td>$13,000,000</td>
<td>$1,000,000</td>
<td>$12,000,000</td>
<td>$0</td>
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<tr>
<td>Bremo 230/115 TX9 (DOM)</td>
<td>$12,000,000</td>
<td>$1,000,000</td>
<td>$11,000,000</td>
<td>$0</td>
</tr>
<tr>
<td>Kammer 345/138 TR303 (AEP)</td>
<td>$11,000,000</td>
<td>$1,000,000</td>
<td>$10,000,000</td>
<td>$0</td>
</tr>
<tr>
<td>Richmond-Waneeta 230 (PECO)</td>
<td>$10,000,000</td>
<td>$1,000,000</td>
<td>$9,000,000</td>
<td>$0</td>
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</tbody>
</table>
Energy Market
Interchange/Seams Summary
Monthly Average MISO Interface Pricing

$/MWh

PJM MISO Price (RT)
MISO PJM Price (RT)
PJM MISO Price (DA)
MISO PJM Price (DA)
Hourly Difference Between PJM and MISO Real-Time Prices

Positive values represent hours when the PJM price was higher. Negative values represent hours when the PJM price was lower.

Average price difference for March = $0.32
Percent of hours in which the direction of flow is consistent with price differentials = 53.63%
Hourly Difference Between PJM and MISO Day-Ahead Prices

Positive values represent hours when the PJM price was higher. Negative values represent hours when the PJM price was lower.

Average price difference for March = $1.66
Positive values represent hours when the PJM price was higher. Negative values represent hours when the PJM price was lower.
Hourly Difference Between PJM and NYISO Day-Ahead Prices

Positive values represent hours when the PJM price was higher. Negative values represent hours when the PJM price was lower.

Average price difference for March = $1.76
Negative M2M Credit represents PJM payment to MISO
Negative M2M Credit represents PJM payment to NYISO.
Ancillary Service Market Summary
Regulation Costs

$ Millions

MAY14, APR14, MAY14, JUN14, JUL14, AUG14, SEP14, OCT14, NOV14, DEC14, JAN15, FEB15, MAR15, APR15, MAY15, JUN15, JUL15, AUG15, SEP15, OCT15, NOV15, DEC15, JAN16, FEB16, MAR16

MAR14, $40
APR14, $20
MAY14, $15
JUN14, $10
JUL14, $10
AUG14, $10
SEP14, $10
OCT14, $10
NOV14, $10
DEC14, $10
JAN15, $0
FEB15, $30
MAR15, $20
APR15, $20
MAY15, $20
JUN15, $20
JUL15, $20
AUG15, $20
SEP15, $20
OCT15, $20
NOV15, $20
DEC15, $20
JAN16, $20
FEB16, $20
MAR16, $20
Synchronized Reserve and Synchronous Condenser Costs

Average Synchronous Condenser Payments equals the 36-month rolling average plus 1 standard deviation.
Load-Adjusted Synchronized Reserve and Synchronous Condenser Costs

Average Synchronous Condenser Payments equals the 36-month rolling average plus 1 standard deviation.