Markets Report

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Executive Summary

- PJM Wholesale Cost through October, 2016 was $47.76/MWh, down from full-year 2015 costs of $55.89/MWh. The bulk of the decrease is made up of Energy costs down $7/MWh from 2015. (Slides 5 & 6)
- Operating Reserve cost contribution to wholesale energy costs is at its lowest level in the 2011-2016 time period. (Slide 6)
- Load-weighted average LMP for 2016 YTD is $29.23/MWh: (Slide 18)
  - October 2016 was $28.1/MWh, which is seasonally in line with October 2015 ($28.2) and considerably lower than October 2014 ($36.6).
- In October, both energy and the sum of Heating and Cooling Degree Days were below their historic averages. (Slides 16-17)
• The large decrease in the MWs registered in PJM’s Economic Demand Response, starting in June and continuing through October, is due to a combination of economic reasons and updated, per-site estimates of reductions achieved from mass-market programs. (Slide 23)

• Total cleared MWh of virtual bids (INCs and DECs) have been slowly increasing since July 2015. After increases in December 2015 and January 2016, total cleared MWh of UTC transactions have been fluctuating around a new, higher level in 2016. (Slides 27-32 and data appendix)

• FTR revenue adequacy for the month of October is 94%. The 2016-2017 Planning Year is fully funded. (Slides 33-36)

• Regulation and Synchronized Reserve market costs have generally tracked with energy prices over time. (Slides 48-50)
Markets Report
Operating Reserve
Percent of Total CC, CT and Steam Hours with LMP < Offer
• 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.
Reliability Balancing Operating Reserve Rates

$/MWh

OCT14  DEC14  APR15  JUL15  OCT15  DEC15  APR16  JUL16  OCT16

RTO
East
West
Energy Market

LMP Summary
Load-Weighted Average LMP

<table>
<thead>
<tr>
<th>Month</th>
<th>Price per MWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>OCT14</td>
<td>$37</td>
</tr>
<tr>
<td>NOV14</td>
<td>$38</td>
</tr>
<tr>
<td>DEC14</td>
<td>$33</td>
</tr>
<tr>
<td>JAN15</td>
<td>$38</td>
</tr>
<tr>
<td>FEB15</td>
<td>$72</td>
</tr>
<tr>
<td>MAR15</td>
<td>$42</td>
</tr>
<tr>
<td>APR15</td>
<td>$30</td>
</tr>
<tr>
<td>MAY15</td>
<td>$34</td>
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<td>JUN15</td>
<td>$32</td>
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<td>JUL15</td>
<td>$35</td>
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<tr>
<td>AUG15</td>
<td>$30</td>
</tr>
<tr>
<td>SEP15</td>
<td>$33</td>
</tr>
<tr>
<td>OCT15</td>
<td>$28</td>
</tr>
<tr>
<td>NOV15</td>
<td>$27</td>
</tr>
<tr>
<td>DEC15</td>
<td>$25</td>
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<tr>
<td>JAN16</td>
<td>$30</td>
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<tr>
<td>FEB16</td>
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<td>MAR16</td>
<td>$23</td>
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<td>$31</td>
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<tr>
<td>SEP16</td>
<td>$28</td>
</tr>
<tr>
<td>OCT16</td>
<td>$28</td>
</tr>
</tbody>
</table>
• 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, 2015. 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

Fuel Cost Adjusted LMP (Referenced to 1999 Fuel Prices)
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

MW

OCT14 DEC14 APR15 JUL15 OCT15 DEC15 APR16 JUL16 OCT16

2000 2200 2400 2600 2800 3000 3200 3400 3600

3600 3400 3200 3000 2800 2600 2400 2200 2000
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

Number of Bids (Millions)

- Submitted Bids
- Cleared Bids

- OCT14
- NOV14
- DEC14
- JAN15
- FEB15
- MAR15
- APR15
- MAY15
- JUN15
- JUL15
- AUG15
- SEP15
- OCT15
- NOV15
- DEC15
- JAN16
- FEB16
- MAR16
- APR16
- MAY16
- JUN16
- JUL16
- AUG16
- SEP16
- OCT16
Virtual Bids (INC & DECs) - Total Volume

- Submitted MWh
- Cleared MWh

MWh (Millions)

| OCT14 | NOV14 | DEC14 | JAN15 | FEB15 | MAR15 | APR15 | MAY15 | JUN15 | JUL15 | AUG15 | SEP15 | OCT15 | NOV15 | DEC15 | JAN16 | FEB16 | MAR16 | APR16 | MAY16 | JUN16 | JUL16 | AUG16 | SEP16 | OCT16 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|       |       |       |       |       |       | 10    | 10    | 10    | 10    | 10    | 10    | 10    | 10    | 10    | 10    | 10    | 10    | 10    | 10    | 10    | 10    | 10    | 10    | 10    | 10    | 10    | 10    |
Up-To-Congestion Transactions - Total Number

- Submitted Transactions
- Cleared Transactions

Number of Transactions ( Millions )

| OCT14 | NOV14 | DEC14 | JAN15 | FEB15 | MAR15 | APR15 | MAY15 | JUN15 | JUL15 | AUG15 | SEP15 | OCT15 | NOV15 | DEC15 | JAN16 | FEB16 | MAR16 | APR16 | MAY16 | JUN16 | JUL16 | AUG16 | SEP16 | OCT16 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|       |       |       |       |       |       | 0.0   | 0.5   | 1.0   | 1.5   | 2.0   | 2.5   | 3.0   | 3.5   | 4.0   | 4.5   | 5.0   | 5.5   | 6.0   | 6.5   | 7.0   | 7.5   | 8.0   | 8.5   | 9.0   | 9.5   | 10.0  |
Up-To-Congestion Transactions - Total Volume

- Submitted MWh
- Cleared MWh

MWh (Millions)

| OCT14 | NOV14 | DEC14 | JAN15 | FEB15 | MAR15 | APR15 | MAY15 | JUN15 | JUL15 | AUG15 | SEP15 | OCT15 | NOV15 | DEC15 | JAN16 | FEB16 | MAR16 | APR16 | MAY16 | JUN16 | JUL16 | AUG16 | SEP16 | OCT16 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
INCs, DECs and Up-To-Congestion Transactions - Total Number

- **Submitted Transactions**
- **Cleared Transactions**
Energy Market

Congestion and FTR Summary
<table>
<thead>
<tr>
<th>Period</th>
<th>Surplus / Underfunding</th>
<th>Payout Ratio</th>
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</thead>
<tbody>
<tr>
<td>October, 2016</td>
<td>-$6,195,063</td>
<td>94%</td>
</tr>
<tr>
<td>2016</td>
<td>$43,120,745</td>
<td>100%</td>
</tr>
<tr>
<td>2016/2017</td>
<td>$48,361,185</td>
<td>100%</td>
</tr>
</tbody>
</table>
Planning Period FTR Payout
Ten Most Heavily Congested Transmission Facilities - Overall, October
Energy Market

Interchange/Seams Summary
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 October = $-2.02
Percent of hours in which the direction of flow is consistent with price differentials = 72.31%
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 October = $-1.95
Hourly Difference Between PJM and NYISO 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 October = $-0.51
Percent of hours in which the direction of flow is consistent with price differentials = 56.59%
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 October = $1.30
Negative M2M Credit represents PJM payment to MISO
PJM-NYISO Market-to-Market Coordination Settlement

Negative M2M Credit represents PJM payment to NYISO.
Ancillary Service Market

Summary
Average Synchronous Condenser Payments equals the 36-month rolling average plus one standard deviation.
Average Synchronous Condenser Payments equals the 36-month rolling average plus one standard deviation.
DR Participation in PJM Regulation Markets

- Total Payments ($ Millions)
- MWh Cleared (MWh)

OCT14 - OCT16
$0.0 - $0.3
MWh
3,000 - 9,000
DR Participation in PJM Synchronized Reserve Markets

![Graph showing total payments and MWh cleared over time.]