Markets Report

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Executive Summary

• PJM Wholesale Cost the first month of 2018 was $102.18/MWh, up from full-year 2017 costs of $49.64/MWh. (Slides 5 & 6)
  – To contrast, Wholesale cost for January 2014, the month of the Polar Vortex, was $149.24

• Operating Reserve cost contribution to wholesale energy costs ($0.79) increased in January due to the cold weather, but still remains far lower than levels seen during the Polar Vortex ($7.86). (Slide 6)

• In January, uplift exceeded $800,000 on fifteen days; January 1\textsuperscript{st} through the 8\textsuperscript{th}, the 13\textsuperscript{th} through the 18\textsuperscript{th} and the 31\textsuperscript{st}. (slides 10 & 11)

• Load-weighted average LMP for January, 2018 is $84/MWh. This is the first time LMP has been over $42 since February 2015, the month of PJM’s all-time winter peak. (Slide 17)
  – This is high in comparison to recent Januarys where LMPs have ranged in the $30-$40 range.
  – To contrast, the load-weighted average LMP for January 2014 was $126.7 and February 2015 experienced a load-weighted average LMP of $72.
Executive Summary

• In January, temperatures averaged nearly two degrees below normal and the sum of Heating Degree Days was about 6.5% higher than an average January.
  – To contrast, January 2014 was nearly seven degrees colder than an average January and February 2015 was approximately 11 degrees colder than an average February.

• In January, total load was nearly 7% higher than an average January.
  – To contrast, January 2014 experienced loads that were nearly 12% above an average January and February 2015 saw loads that were over 14% higher than an average February.

• FTR revenue adequacy for the month of January is 100% and the 2017-2018 Planning Year remains fully funded. (Slides 35-38)

• FTR revenues for January 2018 are $520 million. (Slide 35)
  – This is approximately 72% of total FTR revenues for all of 2017.
  – To contrast, FTR revenues were $815 million in January 2014 and $424 million in February 2015.
Markets Report
PJM Wholesale Cost

<table>
<thead>
<tr>
<th>Year</th>
<th>Energy</th>
<th>Reliability Capacity</th>
<th>Transmission</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>$53.13</td>
<td>$8.91</td>
<td>$6.93</td>
<td>$5.75</td>
<td>$70.37</td>
</tr>
<tr>
<td>2015</td>
<td>$36.25</td>
<td>$11.14</td>
<td>$6.93</td>
<td>$6.32</td>
<td>$55.89</td>
</tr>
<tr>
<td>2016</td>
<td>$29.27</td>
<td>$9.39</td>
<td>$7.63</td>
<td>$6.70</td>
<td>$47.49</td>
</tr>
<tr>
<td>2017</td>
<td>$31.06</td>
<td>$8.73</td>
<td>$8.58</td>
<td>$7.29</td>
<td>$49.64</td>
</tr>
<tr>
<td>2018</td>
<td>$83.63</td>
<td>$8.27</td>
<td>$8.01</td>
<td>$7.84</td>
<td>$102.18</td>
</tr>
</tbody>
</table>
Operating Reserve
• In January, uplift exceeded $800,000 on fifteen days; January 1st through the 8th, the 13th through the 18th and the 31st.

• Contributing factors to uplift were:
  o Extended cold weather throughout the PJM footprint
  o High loads with volatile LMPs and forecasting error
  o Overall system conditions
    o Internal transfer interfaces
    o External interchange flows
    o Emergency Outages
Percent of Total CC, CT and Steam Hours with LMP < Offer

- CT
- CC
- Steam

JAN17 FEB17 MAR17 APR17 MAY17 JUN17 JUL17 AUG17 SEP17 OCT17 NOV17 DEC17 JAN18

0% 10% 20% 30% 40% 50%
• 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

- RTO
- East
- West
Deviations Balancing Operating Reserve Rates

$/MWh

JAN16  APR16  JUL16  OCT16  DEC16  APR17  JUL17  OCT17  JAN18

RTO
East
West
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, 2017. Averages include load data for all of TO zones in the current RTO footprint.
Historic Average Weather and Energy versus Current Month
Fuel Cost Adjusted LMP (Referenced to 1999 Fuel Prices)
LMP Price Posting Suspensions and Reruns

- Percentage of Intervals Price Posting Suspended
- Percentage of Intervals Rerun prior to Final LMP Posting

Percentage of 5-Minute Intervals

- JAN16
- FEB16
- MAR16
- APR16
- MAY16
- JUN16
- JUL16
- AUG16
- SEP16
- OCT16
- NOV16
- DEC16
- JAN17
- FEB17
- MAR17
- APR17
- MAY17
- JUN17
- JUL17
- AUG17
- SEP17
- OCT17
- NOV17
- DEC17
- JAN18
Energy Market

Demand Response Summary
Demand Side Response Estimated Revenue

- Capacity
- Ancillary Services
- Emergency Energy
- Economic Energy
- Economic Energy Incentives

$ Millions


$0 $100 $200 $300 $400 $500 $600 $700 $800 $900
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 (INC & DECs) - Total Volume

- Submitted MWh
- Cleared MWh

MWh (Millions)

|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
Up-To-Congestion Transactions - Total Volume

MWh ( Millions )

- Submitted MWh
- Cleared MWh

JAN16, FEB16, MAR16, APR16, MAY16, JUN16, JUL16, AUG16, SEP16, OCT16, NOV16, DEC16, JAN17, FEB17, MAR17, APR17, MAY17, JUN17, JUL17, AUG17, SEP17, OCT17, NOV17, DEC17, JAN18
INCs, DECs and Up-To-Congestion Transactions - Total Volume

- Submitted MWh
- Cleared MWh

MWh (Millions)

- JAN16
- FEB16
- MAR16
- APR16
- MAY16
- JUN16
- JUL16
- AUG16
- SEP16
- OCT16
- NOV16
- DEC16
- JAN17
- FEB17
- MAR17
- APR17
- MAY17
- JUN17
- JUL17
- AUG17
- SEP17
- OCT17
- NOV17
- DEC17
- JAN18
Energy Market

Congestion and FTR Summary
FTR Revenue vs. FTR Target Allocation

- Total FTR Revenues
- Total FTR Targets

$ Millions

JAN16, FEB16, MAR16, APR16, MAY16, JUN16, JUL16, AUG16, SEP16, OCT16, NOV16, DEC16, JAN17, FEB17, MAR17, APR17, MAY17, JUN17, JUL17, AUG17, SEP17, OCT17, NOV17, DEC17, JAN18
<table>
<thead>
<tr>
<th>Period</th>
<th>Surplus / Underfunding</th>
<th>Payout Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>January, 2018</td>
<td>$250,810,403</td>
<td>100%</td>
</tr>
<tr>
<td>2018</td>
<td>$250,810,403</td>
<td>100%</td>
</tr>
<tr>
<td>2017/2018</td>
<td>$325,412,499</td>
<td>100%</td>
</tr>
</tbody>
</table>
Planning Period FTR Payout
### Ten Most Heavily Congested Transmission Facilities - Overall, January

<table>
<thead>
<tr>
<th>Facility Name</th>
<th>Total Congestion (MM$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AEP-DOM Interface (EHV)</td>
<td>$120,000,000</td>
</tr>
<tr>
<td>Cloverdale 765/345 .10 (AEP)</td>
<td>$100,000,000</td>
</tr>
<tr>
<td>Miami Fort-Tanners Creek 345 (AEP IM-DEOK)</td>
<td>$70,000,000</td>
</tr>
<tr>
<td>50045005 Interface (EHV)</td>
<td>$60,000,000</td>
</tr>
<tr>
<td>Bedington-Black Oak Interface (EHV)</td>
<td>$50,000,000</td>
</tr>
<tr>
<td>Batesville-Hubble 138 (MISO)</td>
<td>$40,000,000</td>
</tr>
<tr>
<td>Capitol Hill-Chemical 138 (AEP-AP)</td>
<td>$30,000,000</td>
</tr>
<tr>
<td>Greenfield-Lakeview 138 (ATSI)</td>
<td>$20,000,000</td>
</tr>
<tr>
<td>APSOUTH Interface (EHV)</td>
<td>$10,000,000</td>
</tr>
<tr>
<td>Albion-Northport 138 (AEP IM)</td>
<td>$5,000,000</td>
</tr>
</tbody>
</table>

*Note: The chart above shows the total congestion for each facility in millions of dollars (MM$). The chart includes data for day-ahead, balancing, and M2M congestion.*
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)

JAN16 APR16 JUL16 OCT16 DEC16 APR17 JUL17 OCT17 JAN18
Monthly Average NYISO Interface Pricing
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 January = $3.63
Percent of hours in which the direction of flow is consistent with price differentials = 56.99%
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 January = $1.29
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 January = $3.28
Percent of hours in which the direction of flow is consistent with price differentials = 50.40%
Positive values represent hours when the PJM price was higher. Negative values represent hours when the PJM price was lower.
PJM-MISO Market-to-Market Coordination Settlement

Negative M2M Credit represents PJM payment to MISO
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.
Load-Adjusted Synchronized Reserve and Synchronous Condenser Costs

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)**

$ Millions

- JAN16
- FEB16
- MAR16
- APR16
- MAY16
- JUN16
- JUL16
- AUG16
- SEP16
- OCT16
- NOV16
- DEC16
- JAN17
- FEB17
- MAR17
- APR17
- MAY17
- JUN17
- JUL17
- AUG17
- SEP17
- OCT17
- NOV17
- DEC17
- JAN18

MWh

- 0
- 3,000
- 6,000
- 9,000
DR Participation in PJM Synchronized Reserve Markets

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

$ Millions:
- $0.0
- $0.2
- $0.4
- $0.6
- $0.8
- $1.0

MWh:
- 0
- 25,000
- 50,000
- 75,000
- 100,000
- 125,000

Month:
- JAN16
- FEB16
- MAR16
- APR16
- MAY16
- JUN16
- JUL16
- AUG16
- SEP16
- OCT16
- NOV16
- DEC16
- JAN17
- FEB17
- MAR17
- APR17
- MAY17
- JUN17
- JUL17
- AUG17
- SEP17
- OCT17
- NOV17
- DEC17
- JAN18