Markets Report

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May 16, 2018
• PJM Wholesale Cost through April 2018 was $66.35/MWh, up from full-year 2017 costs of $49.64/MWh. (Slides 5 & 6)

• In April, uplift exceeded $800,000 on only one day – April 30th. (Slide 10)

• Load-weighted average LMP through April 2018 is $46.30/MWh: (Slide 16)
  – April 2018 was $35.20/MWh, which is higher than both April 2017 ($28.50/MWh) and April 2016 ($29.10/MWh).

• In April, due to cooler than average weather most of the month, the sum of Heating and Cooling Degree Days was above its historic average.

• Energy use was slightly above its historic average. (Slides 17-19)
• In June 2017, the calculation of FTR surplus was changed to no longer include Balancing congestion and Market to Market payments. (Slide 35)

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

• Congestion remained at relatively low levels in April. (Slide 35)

• Regulation and Synchronized Reserve market costs have generally tracked with energy prices over time. (Slides 50-52)
Markets Report
Operating Reserve
Monthly Uplift

$ Millions

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

$0 - $75

months:

- APR16
- MAY16
- JUN16
- JUL16
- AUG16
- SEP16
- OCT16
- NOV16
- DEC16
- JAN17
- FEB17
- MAR17
- APR17
- MAY17
- JUN17
- JUL17
- AUG17
- SEP17
- OCT17
- NOV17
- DEC17
- JAN18
- FEB18
- MAR18
- APR18

PJM©2018
Monthly Uplift - $/MWh Load

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

$/MWh

APR16  MAY16  JUN16  JUL16  AUG16  SEP16  OCT16  NOV16  DEC16  JAN17  FEB17  MAR17  APR17  MAY17  JUN17  AUG17  SEP17  OCT17  NOV17  DEC17  JAN18  FEB18  MAR18  APR18
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

- RTO
- East
- West

APR16 JUL16 SEP16 DEC16 APR17 JUL17 SEP17 DEC17 APR18
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

- Daily Energy as a Percent of the Daily Average for this Month
- Daily HDD + CDD as a Percent of the Daily Average for this Month
Fuel Cost Adjusted LMP (Referenced to 1999 Fuel Prices)
Energy Market

Demand Response Summary
Demand Side Response Estimated Revenue

$ Millions

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

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 & DEC) - Total Number

- Submitted Bids
- Cleared Bids

Number of Bids (Millions)

APR16, MAY16, JUN16, JUL16, AUG16, SEP16, OCT16, NOV16, DEC16, JAN17, FEB17, MAR17, APR17, MAY17, JUN17, JUL17, AUG17, SEP17, OCT17, NOV17, DEC17, JAN18, FEB18, MAR18, APR18
Virtual Bids (INCs & DECs) - Total Volume

- Submitted MWh
- Cleared MWh

MWh ( Millions )

APR16, MAY16, JUN16, JUL16, AUG16, SEP16, OCT16, NOV16, DEC16, JAN17, FEB17, MAR17, APR17, MAY17, JUN17, JUL17, AUG17, SEP17, OCT17, NOV17, DEC17, JAN18, FEB18, MAR18, APR18
Up-To-Congestion Transactions - Total Number

Number of Transactions (Millions)

- Submitted Transactions
- Cleared Transactions
INCs, DECs and Up-To-Congestion Transactions - Total Number

- Submitted Transactions
- Cleared Transactions

Number of Transactions (Millions)

- APR16
- MAY16
- JUN16
- JUL16
- AUG16
- SEP16
- OCT16
- NOV16
- DEC16
- JAN17
- FEB17
- MAR17
- APR17
- MAY17
- JUN17
- JUL17
- AUG17
- SEP17
- OCT17
- NOV17
- DEC17
- JAN18
- FEB18
- MAR18
- APR18
Energy Market

Congestion and FTR Summary
<table>
<thead>
<tr>
<th>Period</th>
<th>Surplus / Underfunding</th>
<th>Payout Ratio</th>
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<tbody>
<tr>
<td>April, 2018</td>
<td>$6,678,807</td>
<td>100%</td>
</tr>
<tr>
<td>2018</td>
<td>$271,688,498</td>
<td>100%</td>
</tr>
<tr>
<td>2017/2018</td>
<td>$346,290,593</td>
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Planning Period FTR Payout

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<tbody>
<tr>
<td>Value</td>
<td>100%</td>
<td>90%</td>
<td>80%</td>
<td>70%</td>
<td>60%</td>
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<td>0%</td>
<td>90%</td>
<td>80%</td>
<td>70%</td>
<td>60%</td>
<td>50%</td>
</tr>
</tbody>
</table>
Ten Most Heavily Congested Transmission Facilities - Overall, April

- Graceton-Safe Harbor 230 (BGE)
- Olive 345/138 2 (AEP IM)
- Crescent-Mt Nebo 138 (DQE)
- Greenfield-Lakeview 138 (ATSI)
- N Salisbury-Pemberton 69 (DPL S)
- Lincoln-Robison Park 138 (AEP IM)
- Emerald-Kenton 138 (AEP OH-LGE)
- Jackson-Maple 138 (ATSI)
- Facerock Serial Device 69 (PPL)
- Terminal 345/138 11 (DEOK)
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)

APR16 JUL16 SEP16 DEC16 APR17 JUL17 SEP17 DEC17 APR18
Monthly Average NYISO Interface Pricing

- PJM NYISO Price (RT)
- NYISO PJM Price (RT)
- PJM NYISO Price (DA)
- NYISO 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 April = $0.55
Percent of hours in which the direction of flow is consistent with price differentials = 49.58%
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 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 April = $0.53
Percent of hours in which the direction of flow is consistent with price differentials = 54.86%
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 April = $2.21
PJM-MISO Market-to-Market Coordination Settlement

Negative M2M Credit represents PJM payment to MISO

<table>
<thead>
<tr>
<th>Month</th>
<th>Net M2M Credit ~ MISO ($ Millions)</th>
<th>Net M2M Credit ~ MISO/Total FTR Targets (%)</th>
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<tbody>
<tr>
<td>APR16</td>
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<td>MAY16</td>
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<td>$-10</td>
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<td>OCT16</td>
<td>$-15</td>
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<td>NOV16</td>
<td>$-5</td>
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<tr>
<td>JAN17</td>
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</tr>
<tr>
<td>APR18</td>
<td>$-10</td>
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</table>
Ancillary Service Market
Summary
Regulation Costs

$ Millions

| Year | APR16 | MAY16 | JUN16 | JUL16 | AUG16 | SEP16 | OCT16 | NOV16 | DEC16 | JAN17 | FEB17 | MAR17 | APR17 | MAY17 | JUN17 | JUL17 | AUG17 | SEP17 | OCT17 | NOV17 | DEC17 | JAN18 | FEB18 | MAR18 | APR18 |
|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| Cost | $7   | $6    | $5    | $4    | $3    | $2    | $1    | $0    | $0    | $0    | $0    | $0    | $0    | $0    | $0    | $0    | $0    | $0    | $0    | $0    | $0    | $0    | $0    | $0    | $0    | $0    | $0    |

Note: The chart shows the regulation costs from April 2016 to April 2018.
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 Synchronized Reserve Markets

![Graph showing DR participation in PJM Synchronized Reserve Markets with data from April 2016 to April 2018. The graph includes bars representing Total Payments ($ Millions) and a line graph for MWh Cleared (MWh).](image-url)
Synchronized Reserve Market Daily Prices and Charges

- Total Daily Synchronized Reserve Charges ($ Millions)
- Minimum Hourly Price ($/MWh)
- Average Hourly Price ($/MWh)
- Maximum Hourly Price ($/MWh)