Markets Report

MC Webinar
May 26, 2020
• PJM Wholesale Cost through April 2020 is $41.60/MWh, down from full-year 2019 costs of $48.98/MWh. (Slides 5 & 6)

• Slides pertaining to weather conditions, in addition to slides showing average fuel prices, generation on-line fuel mixes, and System Marginal Prices have been combined into a Market Conditions section. (Slides 7-18)

• In April, temperatures were somewhat below average for most of the month. Thus, the sum of Heating and Cooling Degree Days was above its historic average. (Slides 8-10)

• Despite cooler than average temperatures, because of Corona Virus shelter-in-place impacts, Energy use was below the historic average. (Slides 8-10)

• Load forecast error was higher this April than what is typically observed in April. This is primarily due to over forecasting due to the Corona Virus in the first half of the month. (Slides 13 & 14)
• In April, uplift did not exceed $800,000 on any days. (Slides 24 & 25)
• Load-weighted average LMP through April 2020 is $19.37/MWh: (Slides 31 & 32)
  – April 2020 was $17.60/MWh, which is significantly lower than both April 2019 ($26.40/MWh) and April 2018 ($35.20/MWh).
• FTR revenue adequacy for the month of April is 100% and the 2019-2020 Planning Year is currently fully funded. (Slides 47-50)
• Congestion remains low and lower than the values observed last April. (Slide 48)
• Regulation and Synchronized Reserve market costs have generally tracked with energy prices over time. (Slides 63-65)
Markets Report
Market Conditions
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, 2019. 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**

The graph shows the comparison of historic average weather and energy consumption against the current month. The data is depicted for each month from April 2019 to April 2020, with TWh (Terawatt-hours) on the y-axis and Heating Degree Days (Cooling Degree Days) on the x-axis.
Historic Average Weather and Energy versus Current Month - Daily

- Daily Energy as a Percent of the Historic Average for April
- Daily HDD + CDD as a Percent of the Historic Average for April
- Daily Temperature as a Percent of the Historic Average for April

Percent of Daily Average

0% 50% 100% 150% 200% 250%

01 Apr 2020 - 30 Apr 2020
Average Fuel Prices - Daily

% Deviation from Monthly Average Fuel Price

Fuel Price Source: S&P Global Platts

- Average Gas - $1.53
- Average Coal - $1.53
- Average Oil - $4.91
- Average LMP - $17.57
Daily Difference Between Day-Ahead and Real-Time System Marginal Prices

Positive values represent days when the DA daily average price was higher than RT. Negative values represent days when the DA price was lower.

Average price difference for April = $-0.48
PJM prepares a day-ahead load forecast at 10:00 am for use by our members.

This forecast is not used to clear the day-ahead market and is not utilized for the reliability tools that run subsequent to the day-ahead market.

The following days had load forecast error exceeding 3%:

- 4/6/2020 – COVID-19, warmer than expected temps
- 4/7/2020 – COVID-19, warmer than expected temps
- 4/10/2020 – COVID-19
- 4/12/2020 – COVID-19
- *4/13/2020 – COVID-19, unexpected morning peak in MidAtl, overcorrection for models that were improving
- 4/24/2020 – COVID-19, cooler than expected temps
- 4/30/2020 – COVID-19, model error (esp in AEP)
Monthly Generation by Fuel, Other

'Mother' includes Flywheels, Multiple Fuels, Storage, and Other Renewables
Daily Generation by Fuel - April

'Mother' includes Hydro, Oil, Solar, Wind, and Other
Daily Generation by Fuel, Other - April

'Mother' includes Flywheels, Multiple Fuels, Storage, and Other Renewables
Operating Reserve
(Uplift)
• In April, uplift did not exceed $800,000 on any days.

More information on Uplift can be found on PJM’s website at [Drivers of Uplift](#)
Percent of Total CT, CC and Steam Hours with LMP < Offer

[Bar chart showing the percent of total CT, CC and steam hours with LMP < offer from April 2018 to April 2020. The chart displays two categories: CT and CC & 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.
Reliability Balancing Operating Reserve Rates

$/MWh

APR18 JUL18 SEP18 DEC18 APR19 JUL19 OCT19 DEC19 APR20

RTO
East
West
Deviations Balancing Operating Reserve Rates

$/MWh

RTO
East
West

APR18  JUL18  SEP18  DEC18  APR19  JUL19  OCT19  DEC19  APR20
Energy Market

LMP Summary
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

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Energy Market

Demand Response Summary
Economic Demand Response Activity

*Data for the last few months are subject to significant change due to the settlement window.
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

Month:
APR18, MAY18, JUN18, JUL18, AUG18, SEP18, OCT18, NOV18, DEC18, JAN19, FEB19, MAR19, APR19, MAY19, JUN19, JUL19, AUG19, SEP19, OCT19, NOV19, DEC19, JAN20, FEB20, MAR20, APR20
Virtual Bids (INCs & DECs) - Total Volume

MWh ( Millions )

Jan19
Feb19
Mar19
Apr19
May19
Jun19
Jul19
Aug19
Sep19
Oct19
Nov19
Dec19
Jan20
Feb20
Mar20
Apr20

Submitted MWh
Cleared MWh
Up-To-Congestion Transactions - Total Number

Number of Transactions (Millions)

- Submitted Transactions
- Cleared Transactions

| Month  | APR18 | MAY18 | JUN18 | JUL18 | AUG18 | SEP18 | OCT18 | NOV18 | DEC18 | JAN19 | FEB19 | MAR19 | APR19 | MAY19 | JUN19 | JUL19 | AUG19 | SEP19 | OCT19 | NOV19 | DEC19 | JAN20 | FEB20 | MAR20 | APR20 |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
Up-To-Congestion Transactions - Total Volume

- MWh (Millions)
- Submitted MWh
- Cleared MWh
INCs, DECs and Up-To-Congestion Transactions - Total Number

The bar chart shows the total number of transactions for each month from April 2018 to April 2020. The transactions are categorized into two types: Submitted Transactions (dark blue) and Cleared Transactions (light green). The chart highlights the variations in transaction numbers across different months.
INCs, DECs and Up-To-Congestion Transactions - Total Volume

- Submitted MWh
- Cleared MWh
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>April, 2020</td>
<td>$10,869,473</td>
<td>100%</td>
</tr>
<tr>
<td>2020</td>
<td>$63,434,966</td>
<td>100%</td>
</tr>
<tr>
<td>2019/2020</td>
<td>$129,286,679</td>
<td>100%</td>
</tr>
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</table>
Monthly FTR Payout

| Month   | APR18 | MAY18 | JUN18 | JUL18 | AUG18 | SEP18 | OCT18 | NOV18 | DEC18 | JAN19 | FEB19 | MAR19 | APR19 | MAY19 | JUN19 | JUL19 | AUG19 | SEP19 | OCT19 | NOV19 | DEC19 | JAN20 | FEB20 | MAR20 | APR20 |
|---------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Month   |       |       |       |       |       |       | 100%  |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
The ten most heavily congested facilities account for 67% of total congestion for April.
The ten most heavily congested facilities account for 53% of total congestion for 2020.
Energy Market

Interchange/Seams Summary
Monthly Average MISO Interface Pricing

- PJM MISO Price (RT)
- MISO PJM Price (RT)
- PJM MISO Price (DA)
- MISO PJM Price (DA)
Monthly Average NYISO Interface Pricing

- PJM NYISO Price (RT)
- NYISO PJM Price (RT)
- PJM NYISO Price (DA)
- NYISO PJM Price (DA)

$/MWh

- APR18
- JUL18
- SEP18
- DEC18
- APR19
- JUL19
- OCT19
- DEC19
- APR20
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 = $-2.46
Percent of hours in which the direction of flow is consistent with price differentials = 72.50%
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 = $3.69
Percent of hours in which the direction of flow is consistent with price differentials = 46.25%
Positive values represent hours when the PJM price was higher. Negative values represent hours when the PJM price was lower.
Negative M2M Credit represents PJM payment to MISO.
Negative M2M Credit represents PJM payment to NYISO
Ancillary Service Market
Summary
Synchronized Reserve and Synchronous Condenser Costs

$ Millions

- Synchronized Reserve Market Payments
- Synchronous Condenser Payments

<table>
<thead>
<tr>
<th>Month</th>
<th>APR18</th>
<th>MAY18</th>
<th>JUN18</th>
<th>JUL18</th>
<th>AUG18</th>
<th>SEP18</th>
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Load-Adjusted Synchronized Reserve and Synchronous Condenser Costs

Cents/MWh

- Synchronized Reserve Market Payments / MWh
- Synchronous Condenser Payments / MWh

Month:
- APR18
- MAY18
- JUN18
- JUL18
- AUG18
- SEP18
- OCT18
- NOV18
- DEC18
- JAN19
- FEB19
- MAR19
- APR19
- MAY19
- JUN19
- JUL19
- AUG19
- SEP19
- OCT19
- NOV19
- DEC19
- JAN20
- FEB20
- MAR20
- APR20
DR Participation in PJM Synchronized Reserve Markets

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

Graph showing monthly data from April 2018 to April 2020.
Regulation Market Daily Prices and Charges

- Total Daily Regulation Charges ($ Millions)
- Minimum Interval Price ($/MWh)
- Average Interval Price ($/MWh)
- Maximum Interval Price ($/MWh)
Synchronized Reserve Market Daily Prices and Charges

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