Markets Report

MC Webinar
June 15, 2020
• PJM Wholesale Cost through May 2020 is $41.96/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 May, 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 than the two-year average error, but not as high as what was observed in April of this year. (Slides 13 & 14)
• In May, uplift did not exceed $800,000 on any days. (Slides 24 & 25)
• Load-weighted average LMP through May 2020 is $19.17/MWh: (Slides 31 & 32)
  – May 2020 was $18.30/MWh, which is significantly lower than both May 2019 ($24.20/MWh) and May 2018 ($38.30/MWh).
• FTR revenue adequacy for the month of May is 100% and the 2019-2020 Planning Year is currently fully funded. (Slides 47-50)
• Congestion remains low, however, values observed in May were the highest of 2020 to date. (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

TWh

Heating Degree Days + Cooling Degree Days

May19  Jun19  Jul19  Aug19  Sep19  Oct19  Nov19  Dec19  Jan20  Feb20  Mar20  Apr20  May20

0  250  500  750  1,000  1,250

0  20  40  60  80  100
Historic Average Weather and Energy versus Current Month - Daily

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

Chart showing the percent of daily average from May 1 to May 31, 2020.
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 May = $-0.46

- Average Difference
- Average + 1 Standard Deviation
- Average - 1 Standard Deviation
Load Forecast Error – Monthly Absolute Error, 10:00 Forecast

[Bar chart showing load forecast error for different months and years, with categories for All Hours, Peak Hours Only, Winter, and Summer. The chart includes 25-month average lines.]

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Load Forecast Error – May Daily Peaks, 10:00 Forecast

[Bar chart showing daily load forecast errors with categories for peak hours and weekend/holiday periods.]
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%:

- 5/3 – COVID and warmer than expected
- 5/4 – COVID
- 5/9 – COVID and unusually cool weather
- 5/10 – COVID
- 5/19 – COVID and cool, rainy weather out west
- *5/23 – COVID, some of our first hot weather of the season, warmer than forecasted in some areas, and uncertainty leading into holiday weekend
- 5/24 – Hot weather out west, hotter than forecasted in some areas, and uncertainty due to COVID and holiday weekend
- 5/26 – COVID, continued hot weather, including in the east, warmer than forecasted in some areas
Monthly Generation by Fuel

'MOther' includes Hydro, Oil, Solar, Wind, and Other
Monthly Generation by Fuel, Other

'More than includes Flywheels, Multiple Fuels, Storage, and Other Renewables'
'Other' includes Hydro, Oil, Solar, Wind, and Other
Daily Generation by Fuel, Other - May

'Mother' includes Flywheels, Multiple Fuels, Storage, and Other Renewables
Operating Reserve

(Uplift)
Monthly Uplift - $/MWh Load

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

$/MWh
Zonal Uplift - May

$ Millions

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

AECO    AEP    APS    ATSI    BGE    COMED    DAY    DEOK    DOM    DPL    DUQ    EKPC    JCPL    METED    PECO    PELEC    PEPCO    PPL    PSEG
• In May, 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
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

MAY18 JAN19 MAY19 JUL19 OCT19 JAN20 MAY20
Deviations Balancing Operating Reserve Rates

$/MWh

- RTO
- East
- West

MAY18 | JUL18 | OCT18 | JAN19 | MAY19 | JUL19 | OCT19 | JAN20 | MAY20

$0.0 | $0.1 | $0.2 | $0.3 | $0.4 | $0.5 | $0.6 | $0.7 | $0.8

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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
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.
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

Number of Bids (Millions)

- Submitted Bids
- Cleared Bids

Data for various months from MAY 18 to MAY 20.
Up-To-Congestion Transactions - Total Number

Number of Transactions (Millions)

- Submitted Transactions
- Cleared Transactions

MAY18, JUN18, JUL18, AUG18, SEP18, OCT18, NOV18, DEC18, JAN19, FEB19, MAR19, APR19, MAY19, JUN19, JUL19, AUG19, SEP19, OCT19, NOV19, DEC19, JAN20, FEB20, MAR20, APR20, MAY20
INCs, DECs and Up-To-Congestion Transactions - Total Number
INCs, DECs and Up-To-Congestion Transactions - Total Volume
Energy Market

Congestion and FTR Summary
### FTR Funding

<table>
<thead>
<tr>
<th>Period</th>
<th>Surplus / Underfunding</th>
<th>Payout Ratio</th>
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<tbody>
<tr>
<td>May, 2020</td>
<td>$3,472,523</td>
<td>100%</td>
</tr>
<tr>
<td>2020</td>
<td>$66,907,489</td>
<td>100%</td>
</tr>
<tr>
<td>2019/2020</td>
<td>$132,759,202</td>
<td>100%</td>
</tr>
</tbody>
</table>
FTR Revenue vs. FTR Target Allocation

- **Total FTR Revenues**
- **Total FTR Targets**

$ Millions

- MAY18
- JUN18
- JUL18
- AUG18
- SEP18
- OCT18
- NOV18
- DEC18
- JAN19
- FEB19
- MAR19
- APR19
- MAY19
- JUN19
- JUL19
- AUG19
- SEP19
- OCT19
- NOV19
- DEC19
- JAN20
- FEB20
- MAR20
- APR20
- MAY20
The ten most heavily congested facilities account for 80% of total congestion for May.
Ten Most Heavily Congested Transmission Facilities - Overall, 2020

The ten most heavily congested facilities account for 51% of total congestion for 2020.
Energy Market

Interchange/Seams Summary
Monthly Average MISO Interface Pricing

|$/MWh|

MAY18 | JUL18 | OCT18 | JAN19 | MAY19 | JUL19 | OCT19 | JAN20 | MAY20

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

$/MWh

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

Time Period:
- MAY18 to MAY20

Graph showing the monthly average NYISO Interface Pricing from May 2018 to May 2020.
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 May = $-2.38
Percent of hours in which the direction of flow is consistent with price differentials = 70.56%
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 May = $-2.28
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 May = $1.06
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

- **Synchronized Reserve Market Payments**
- **Synchronous Condenser Payments**

![Bar chart showing synchronized reserve and synchronous condenser costs by month from May 2018 to May 2020.](chart.png)
Load-Adjusted Synchronized Reserve and Synchronous Condenser Costs

Synchronized Reserve Market Payments / MWh
Synchronous Condenser Payments / MWh

Cents/MWh
DR Participation in PJM Synchronized Reserve Markets

$ Millions

MWh

Total Payments ($ Millions)
MWh Cleared (MWh)

MAY18  JUN18  JUL18  AUG18  SEP18  OCT18  NOV18  DEC18  JAN19  FEB19  MAR19  APR19  MAY19  JUN19  JUL19  AUG19  SEP19  OCT19  NOV19  DEC19  JAN20  FEB20  MAR20  APR20  MAY20
Regulation Market Daily Prices and Charges

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

$ Millions

$0.0 $0.2 $0.4 $0.6 $0.8 $600

$/MWh

$0 $150 $300 $450 $600

01MAY20 02MAY20 03MAY20 04MAY20 05MAY20 06MAY20 07MAY20 08MAY20 09MAY20 10MAY20 11MAY20 12MAY20 13MAY20 14MAY20 15MAY20 16MAY20 17MAY20 18MAY20 19MAY20 20MAY20 21MAY20 22MAY20 23MAY20 24MAY20 25MAY20 26MAY20 27MAY20 28MAY20 29MAY20 30MAY20 31MAY20
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)**

The chart shows the daily prices and charges from May 1, 2020, to May 31, 2020.