Markets Report

MC Webinar
July 20, 2020
PJM Wholesale Cost through June 2020 is $41.87/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 June, temperatures were above average for most of the month. Thus, the sum of Heating and Cooling Degree Days was above its historic average. (Slides 8-10)

Because of continued Corona Virus impacts, Energy use remained below the historic average. (Slides 8-10)
Executive Summary

• In June, uplift exceeded $800,000 on three days. (Slides 24 & 25)

• Load-weighted average LMP through June 2020 is $19.40/MWh: (Slides 31 & 32)
  – June 2020 was $20.50/MWh, which is in line with June 2019 ($23.10/MWh) but considerably lower than June 2018 ($31.30/MWh).

• FTR revenue adequacy for the month of June is 100% and the 2020-2021 Planning Year is currently fully funded. (Slides 47-50)

• Congestion remains low, however, it was higher than the values observed last June. (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
Historic Average Weather and Energy versus Current Month - Daily

- Daily Energy as a Percent of the Historic Average for June
- Daily HDD + CDD as a Percent of the Historic Average for June
- Daily Temperature as a Percent of the Historic Average for June
Average Fuel Prices - Daily

Fuel Price Source: S&P Global Platts

- Average Gas: $1.45
- Average Coal: $1.43
- Average Oil: $7.20
- Average LMP: $20.13
Positive values represent days when the DA daily average price was higher than RT. Negative values represent days when the DA price was lower.
Load Forecast Error – Monthly Absolute Error, 10:00 Forecast

- All Hours
- Peak Hours Only
- Winter
- Summer
- 25-month Average
- 25-month Average

The chart shows the monthly absolute error in load forecasts for different periods (All Hours, Peak Hours Only, Winter, Summer) over the years 2018, 2019, and 2020. The error is measured as a percentage and compared against 25-month averages.
Load Forecast Error – June Daily Peaks, 10:00 Forecast
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%:

- 6/2 – Temps much warmer than expected, esp in the West
- 6/6 – Temps much warmer than expected
- 6/10 – Temps warmer than expected
- *6/11 – Storms in Mid-Atl, and operator over-correction for previous day’s under-forecasting
- 6/22 – Afternoon storms in Dominion, FE-West
- 6/23 – Temps a bit cooler than expected, storms in AEP
- 6/24 – Mostly model error (load forecast models were too high). COVID-related changes in load sensitivity to temp may be at fault.
- 6/26 – Storms in ComEd, FE-West
- 6/27 – Temps cooler than expected/storms, model error (over-forecasting) in Mid-Atl (see 6/24 note)
Monthly Generation by Fuel

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

‘Other’ includes Flywheels, Multiple Fuels, Storage, and Other Renewables
Daily Generation by Fuel - June

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

'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
- Pink - Lost Opportunity Cost

$/MWh

$0.0

$0.1

$0.2

$0.3

$0.4

$0.5

JUN18
JUL18
AUG18
SEP18
OCT18
NOV18
DEC18
JAN19
FEB19
MAR19
APR19
MAY19
JUN19
JUL19
AUG19
SEP19
OCT19
NOV19
DEC19
JAN20
FEB20
MAR20
APR20
MAY20
JUN20
In June, uplift exceeded $800,000 on the following days.

• 6/3 - related to load forecast error that resulted in LOC
• 6/10 - related to load forecast error, high loads and localized congestion
• 6/29 - high load day and regional congestion

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

- **RTO**
- **East**
- **West**

$\text{$/MWh}$

- **June 2018**
- **August 2018**
- **November 2018**
- **March 2019**
- **June 2019**
- **August 2019**
- **December 2019**
- **March 2020**
- **June 2020**
Deviations Balancing Operating Reserve Rates

$/MWh

- RTO
- East
- West
Energy Market

LMP Summary
Load-Weighted Average LMP

$/MWh

<table>
<thead>
<tr>
<th>Month</th>
<th>Price</th>
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</thead>
<tbody>
<tr>
<td>JUN18</td>
<td>$31</td>
</tr>
<tr>
<td>JUL18</td>
<td>$33</td>
</tr>
<tr>
<td>AUG18</td>
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<td>$26</td>
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<tr>
<td>MAY20</td>
<td>$18</td>
</tr>
<tr>
<td>JUN20</td>
<td>$20</td>
</tr>
</tbody>
</table>
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
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

| Month  | JUN18 | JUL18 | AUG18 | SEP18 | OCT18 | NOV18 | DEC18 | JAN19 | FEB19 | MAR19 | APR19 | MAY19 | JUN19 | JUL19 | AUG19 | SEP19 | OCT19 | NOV19 | DEC19 | JAN20 | FEB20 | MAR20 | APR20 | MAY20 | JUN20 |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|        | 0.06  | 0.06  | 0.13  | 0.20  | 0.15  | 0.31  | 0.50  | 0.54  | 0.61  | 0.63  | 0.64  | 0.56  | 0.52  | 0.79  | 0.87  | 0.85  | 0.76  | 0.69  | 0.70  | 0.71  | 0.71  | 0.72  | 0.72  | 0.70  | 0.69  | 0.66  |
Virtual Bids (INCs & DECs) - Total Volume

MWh (Millions)

- Submitted MWh
- Cleared MWh

- JUN18
- JUL18
- AUG18
- SEP18
- OCT18
- NOV18
- DEC18
- JAN19
- FEB19
- MAR19
- APR19
- MAY19
- JUN19
- JUL19
- AUG19
- SEP19
- OCT19
- NOV19
- DEC19
- JAN20
- FEB20
- MAR20
- APR20
- MAY20
- JUN20
Up-To-Congestion Transactions - Total Volume

MWh (Millions)

Submitted MWh
Cleared MWh

JUN18 | JUL18 | AUG18 | SEP18 | OCT18 | NOV18 | DEC18 | JAN19 | FEB19 | MAR19 | APR19 | MAY19 | JUN19 | JUL19 | AUG19 | SEP19 | OCT19 | NOV19 | DEC19 | JAN20 | FEB20 | MAR20 | APR20 | MAY20 | JUN20
INCs, DECs and Up-To-Congestion Transactions - Total Volume

[Bar chart showing MWh (Millions) for various months from June 2018 to June 2020.]

- Submitted MWh
- Cleared MWh

[Month labels: JUN18, JUL18, AUG18, SEP18, OCT18, NOV18, DEC18, JAN19, FEB19, MAR19, APR19, MAY19, JUN19, JUL19, AUG19, SEP19, OCT19, NOV19, DEC19, JAN20, FEB20, MAR20, APR20, MAY20, JUN20]
Energy Market

Congestion and FTR Summary
### FTR Funding

<table>
<thead>
<tr>
<th>Period</th>
<th>Surplus / Underfunding</th>
<th>Payout Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>June, 2020</td>
<td>$894,088</td>
<td>100%</td>
</tr>
<tr>
<td>2020</td>
<td>$67,801,577</td>
<td>100%</td>
</tr>
<tr>
<td>2020/2021</td>
<td>$894,088</td>
<td>100%</td>
</tr>
</tbody>
</table>
FTR Revenue vs. FTR Target Allocation

$ Millions

- Total FTR Revenues
- Total FTR Targets

JUN18 | JUL18 | AUG18 | SEP18 | OCT18 | NOV18 | DEC18 | JAN19 | FEB19 | MAR19 | APR19 | MAY19 | JUN19 | JUL19 | AUG19 | SEP19 | OCT19 | NOV19 | DEC19 | JAN20 | FEB20 | MAR20 | APR20 | MAY20 | JUN20

$0 | $50 | $100 | $150 | $200

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Planning Period FTR Payout
The ten most heavily congested facilities account for 60% of total congestion for June.
Overall, 2020

The ten most heavily congested facilities account for 47% of total congestion for 2020.
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)
Monthly Average NYISO Interface Pricing

$/MWh

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

JUN18  AUG18  NOV18  MAR19  JUN19  AUG19  DEC19  MAR20  JUN20
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 June = $-0.58
Percent of hours in which the direction of flow is consistent with price differentials = 60.97%
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 June = $-1.99
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 June = $-0.78
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
Load-Adjusted Synchronized Reserve and Synchronous Condenser Costs
DR Participation in PJM Synchronized Reserve Markets

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

$ Millions

MWh

- JUN18
- JUL18
- AUG18
- SEP18
- OCT18
- NOV18
- DEC18
- JAN19
- FEB19
- MAR19
- APR19
- MAY19
- JUN19
- JUL19
- AUG19
- SEP19
- OCT19
- NOV19
- DEC19
- JAN20
- FEB20
- MAR20
- APR20
- MAY20
- JUN20

0
30,000
60,000
90,000
120,000
150,000
0
$0.0
$0.2
$0.4
$0.6
$0.8
$1.0

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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)