Markets Report

MC Webinar
April 19, 2021
• PJM Wholesale Cost for 2021 is $52.28/MWh, up from full-year 2020 costs of $43.41/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 8-19)

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

• Energy use was also below its historic average for March. (Slides 8-10)
In March, uplift exceeded $800,000 on three days – March 6th, 8th and 25th. (Slides 24 & 25)

Load-weighted average LMP for 2021 is $30.84/MWh: (Slides 31 & 32)
- March 2021 was $26.30/MWh, which is higher than March 2020 ($17.90/MWh) and lower than March 2019 ($29.90/MWh).

There were three 5-minute intervals that experienced shortage pricing in March. (Slide 31 & 32)

FTR revenue adequacy for the month of March is 90% and the 2020-2021 Planning Year is currently funded at 98%. (Slides 49-52)

Congestion remains low, however, higher than values observed last March. (Slide 50)

Regulation and Synchronized Reserve market costs have generally tracked with energy prices over time. (Slides 65-67)
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, 2020. 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 between various energy-related data points for the current month and the average monthly data for HDD (Heating Degree Days) and CDD (Cooling Degree Days) for the months of March 20 (Mar20) to March 21 (Mar21). The Y-axis represents TWh (Terawatt-hours), while the X-axis represents the months from March 20 to March 21.
Historic Average Weather and Energy versus Current Month - Daily

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

- **Average Gas**: $2.27
- **Average Coal**: $1.88
- **Average Oil**: $12.15
- **Average LMP**: $26.09

Fuel Price Source: S&P Global Platts
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 March = -$1.35
Load Forecast Error – March 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.

• Load forecast accuracy was generally high in March, as weather conditions in PJM turned mild. On March 18 and 19, stormy weather conditions and falling temperatures caused load forecast models to under-forecast the peaks.
'Other' includes Hydro, Oil, Solar, Wind, and Other
'Other' includes Flywheels, Multiple Fuels, Storage, and Other Renewables
Daily Generation by Fuel - March

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

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

(Uplift)
Monthly Uplift

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

$ Millions

- MAR19
- APR19
- MAY19
- JUN19
- JUL19
- AUG19
- SEP19
- OCT19
- NOV19
- DEC19
- JAN20
- FEB20
- MAR20
- APR20
- MAY20
- JUN20
- JUL20
- AUG20
- SEP20
- OCT20
- NOV20
- DEC20
- JAN21
- FEB21
- MAR21
Monthly Uplift - $/MWh Load

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

$/MWh

MAR19  APR19  MAY19  JUN19  JUL19  AUG19  SEP19  OCT19  NOV19  DEC19  JAN20  FEB20  MAR20  APR20  MAY20  JUN20  JUL20  AUG20  SEP20  OCT20  NOV20  DEC20  JAN21  FEB21  MAR21
In March, uplift exceeded $800,000 on three days – March 6\textsuperscript{th}, 8\textsuperscript{th} and 25\textsuperscript{th}. Contributing factors to uplift were:

- Uplift on all three days was a result of localized congestion in the DPL zone.

More information on Uplift can be found on PJM’s website at \textcolor{blue}{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.
Energy Market

LMP Summary
• A 5-minute shortage pricing interval occurred on March 17th between 10:10 and 10:15.

• PJM experienced the following reserve penalty factors:
  – 1st step penalty for Primary Reserve deficiencies in the RTO and MAD
  – 2nd step penalty for Synchronized Reserve deficiencies in the RTO and MAD

• System Marginal Price (SMP) for the 5-minute interval was $3,653.98, and the hourly integrated SMP was $343.70.
Two 5-minute shortage pricing intervals occurred on March 22\textsuperscript{nd} between 19:45 and 19:55.

PJM experienced the following reserve penalty factors:

- 19:45-19:50 interval
  - 2\textsuperscript{nd} step penalty for Primary Reserve deficiencies in the RTO and MAD
  - 2\textsuperscript{nd} step penalty for Synchronized Reserve deficiencies in the RTO and MAD

- 19:50-19:55 interval
  - 1\textsuperscript{st} step penalty for Primary Reserve deficiencies in the RTO and MAD
  - 2\textsuperscript{nd} step penalty for Synchronized Reserve deficiencies in the RTO and MAD

SMPs for the 5-minute intervals were $3,688.68 and $2,431.68, respectively and the hourly integrated SMP was $542.37.
Fuel Cost Adjusted LMP (Referenced to 1999 Fuel Prices)

$/MWh


Fuel Cost Adjusted LMP
Load Weighted LMP
LMP Price Posting Suspensions and Reruns

This is likely bad data.
Energy Market

Demand Response Summary
Demand Side Response Estimated Revenue

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

$ Millions

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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

- Submitted Bids
- Cleared Bids

Number of Bids ( Millions )

Month: MAR19, APR19, MAY19, JUN19, JUL19, AUG19, SEP19, OCT19, NOV19, DEC19, JAN20, FEB20, MAR20, APR20, MAY20, JUN20, JUL20, AUG20, SEP20, OCT20, NOV20, DEC20, JAN21, FEB21, MAR21
Virtual Bids (INCs & DECs) - Total Volume

- Submitted MWh
- Cleared MWh

MWh (Millions)
Up-To-Congestion Transactions - Total Volume

MWh (Millions)

- Submitted MWh
- Cleared MWh

[Bar chart showing monthly data from March 2019 to March 2021]
INCs, DECs and Up-To-Congestion Transactions - Total Number

Number of Transactions (Millions)

- Submitted Transactions
- Cleared Transactions

| Month | MAR19 | APR19 | MAY19 | JUN19 | JUL19 | AUG19 | SEP19 | OCT19 | NOV19 | DEC19 | JAN20 | FEB20 | MAR20 | APR20 | MAY20 | JUN20 | JUL20 | AUG20 | SEP20 | OCT20 | NOV20 | DEC20 | JAN21 | FEB21 | MAR21 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
INCs, DECs and Up-To-Congestion Transactions - Total Volume

- Submitted MWh
- Cleared MWh
Energy Market

Congestion and FTR Summary
<table>
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<tr>
<th>Period</th>
<th>Surplus / Underfunding</th>
<th>Payout Ratio</th>
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<td>March, 2021</td>
<td>-$11,167,382</td>
<td>90%</td>
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<tr>
<td>2021</td>
<td>-$1,166,903</td>
<td>100%</td>
</tr>
<tr>
<td>2020/2021</td>
<td>-$13,339,062</td>
<td>98%</td>
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</table>
The ten most heavily congested facilities account for 77% of total congestion for March.
The ten most heavily congested facilities account for 54% of total congestion for 2021.
Energy Market

Interchange/Seams Summary
Negative M2M Credit represents PJM payment to MISO.

Net M2M Credit ~ MISO ($ Millions)
Net M2M Credit ~ MISO/Total FTR Targets (%)
PJM-NYISO Market-to-Market Coordination Settlement

Net M2M Credit ~ NYISO ($ Millions)
Net M2M Credit ~ NYISO/Total FTR Targets (%)

Negative M2M Credit represents PJM payment to NYISO
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 March** = $-1.65
- **Percent of hours in which the direction of flow is consistent with price differentials** = 73.39%
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 March = $-0.44
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 March = $2.76
Percent of hours in which the direction of flow is consistent with price differentials = 53.36%
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 March = $3.01
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

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

Cents/MWh

- MAR19
- APR19
- MAY19
- JUN19
- JUL19
- AUG19
- SEP19
- OCT19
- NOV19
- DEC19
- JAN20
- FEB20
- MAR20
- APR20
- MAY20
- JUN20
- JUL20
- AUG20
- SEP20
- OCT20
- NOV20
- DEC20
- JAN21
- FEB21
- MAR21
DR Participation in PJM Regulation Markets

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

Chart showing the trend of total payments and MWh cleared over the months from March 2019 to March 2021.
DR Participation in PJM Synchronized Reserve Markets

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

Graph showing the trend of total payments and MWh cleared over time from March 2019 to March 2021.
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 $0.1 $0.2 $0.3 $0.4 $0.5 $0.6 $0.7 $0.8 $0.9 $900

$MWh

$0.0 $0.1 $0.2 $0.3 $0.4 $0.5 $0.6 $0.7 $0.8 $0.9 $1.0

01MAR21 02MAR21 03MAR21 04MAR21 05MAR21 06MAR21 07MAR21 08MAR21 09MAR21 10MAR21 11MAR21 12MAR21 13MAR21 14MAR21 15MAR21 16MAR21 17MAR21 18MAR21 19MAR21 20MAR21 21MAR21 22MAR21 23MAR21 24MAR21 25MAR21 26MAR21 27MAR21 28MAR21 29MAR21 30MAR21 31MAR21
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