Markets Report

Tim Horger
Director, Market Operations
Members Committee
May 3, 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)
Executive Summary

• 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 47-50)
• Congestion remains low, however, higher than values observed last March. (Slide 48)
• Regulation and Synchronized Reserve market costs have generally tracked with energy prices over time. (Slides 59-61)
Markets Report
PJM Wholesale Cost

Energy  Reliability Capacity  Transmission  Other

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<th>Year</th>
<th>Energy</th>
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$/MWh
PJM Wholesale Cost - Other

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<th>Regulation</th>
<th>Operating Reserve</th>
<th>PJM Cost</th>
<th>Reactive</th>
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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**
- **Average Monthly Total Energy**
- **Current Month HDD+CDD**
- **Average Monthly HDD + CDD**

The graph compares historic average energy usage (in TWh) and weather conditions (in Heating Degree Days + Cooling Degree Days) against current month data for the months of March 2020 to March 2021. The data shows fluctuations throughout the year with notable peaks and troughs.
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 – Monthly Absolute Error, 10:00 Forecast

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

Graph showing monthly absolute error from 2019 to 2021.
Load Forecast Error – March Daily Peaks, 10:00 Forecast

[Bar chart showing error percentages for each day of March, with categories for Error at Peak Hour and Weekend / Holiday]
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.
Monthly Generation by Fuel

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

(Uplift)
In March, uplift exceeded $800,000 on three days – March 6th, 8th and 25th. 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 [Drivers of Uplift](#)
• 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.
Deviations Balancing Operating Reserve Rates

$/MWh

- RTO
- East
- West

Dates: MAR19, MAY19, AUG19, NOV19, FEB20, MAY20, AUG20, NOV20, MAR21
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)
This is likely bad data.
Energy Market

Demand Response Summary
Demand Side Response Estimated Revenue

$ Millions

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

2008: $150
2009: $300
2010: $500
2011: $450
2012: $400
2013: $350
2014: $300
2015: $700
2016: $650
2017: $600
2018: $550
2019: $500
2020: $450
2021: $100
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 & DECs) - Total Number

Number of Bids (Millions)

- Submitted Bids
- Cleared Bids
Virtual Bids (INCs & DECs) - Total Volume

- Submitted MWh
- Cleared MWh

MWh (Millions)

- JAN
- FEB
- MAR
- APR
- MAY
- JUN
- JUL
- AUG
- SEP
- OCT
- NOV
- DEC
- JAN
- FEB
- MAR
Up-To-Congestion Transactions - Total Number

- **Submitted Transactions**
- **Cleared Transactions**
Up-To-Congestion Transactions - Total Volume

MWh (Millions)

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

Number of Transactions (Millions)

- Submitted Transactions
- Cleared Transactions

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INCs, DECs and Up-To-Congestion Transactions - Total Volume

MWh (Millions)

Submitted MWh
Cleared 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
Energy Market

Congestion and FTR Summary
## FTR Funding

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<td>March, 2021</td>
<td>$-11,167,382</td>
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<td>$-1,166,903</td>
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<td>2020/2021</td>
<td>$-13,339,062</td>
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FTR Revenue vs. FTR Target Allocation

$ Millions

Total FTR Revenues
Total FTR Targets

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
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
Negative M2M Credit represents PJM payment to NYISO
• The Hourly Difference Between PJM and MISO and PJM and NYISO Real-Time and Day Ahead Prices slides (4) are unavailable this month.
Regulation Costs
Synchronized Reserve and Synchronous Condenser Costs

![Chart showing synchronized reserve and synchronous condenser costs.](chart.png)
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)**

The chart shows the trend of total payments and MWh cleared from March 2019 to March 2021. The payments fluctuate throughout the year, with peaks in some months and troughs in others. Similarly, the MWh cleared also shows variability, with peaks and troughs at different times.
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 $0.3 $0.6 $0.9

$/MWh

$0 $300 $600 $900

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