Markets Report

MC Webinar
May 22, 2023
Executive Summary

- PJM Wholesale Cost in 2023 is $50.62/MWh, down from full-year 2022 costs of $102.56/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 8-22)

- In April, temperatures were above average 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 April. (Slides 8-10)

- In April, uplift exceeded $800,000 on four days. (Slides 25 & 26)
Executive Summary

• Load-weighted average LMP for 2023 is $30.06/MWh: (Slides 35-37)
  – April 2023 was $29.30/MWh, which is lower than April 2022 ($63.90/MWh) but in-line with April 2021 ($26.70/MWh).

• There were no 5-minute intervals that experienced shortage pricing in April. (Slides 33-34)

• FTR revenue adequacy for the month of April is 100% and the 2022-2023 Planning Year is currently funded at 100%. (Slides 52-55)

• Congestion values were trending upwards in 2022. However, 2023 has seen a return to lower monthly values. (Slide 53)

• Regulation and Synchronized Reserve market costs have generally tracked with energy prices over time. (Slides 69-71)
Markets Report
PJM Wholesale Cost - Other

- Regulation
- Operating Reserve
- PJM Cost
- Reactive
- Transmission Owner Control
- Synchronized Reserve
- Black Start

$/MWh

2019: $1.26
2020: $1.28
2021: $1.51
2022: $1.89
2023: $1.39
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
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
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.
Load Forecast Error - Monthly Absolute Error, 10:00 Forecast

The chart illustrates the load forecast error for different months from 2021 to 2023, with data split by All Hours and Peak Hours Only. The graph shows the percentage error, categorized by seasons (Winter, Summer) and includes a 25-month average for comparison.

- **All Hours** and **Peak Hours Only** are represented by colored bars.
- **Winter** and **Summer** are distinct sections within the months.
- The 25-month Average is indicated by dashed lines.

The months show varying degrees of error, with some periods demonstrating higher inaccuracies, particularly in certain seasons and hours.

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**Notes:**
- The data is sourced from PJM's public load forecast documentation.
- The chart is designed to visually compare forecast errors across different periods and conditions.
Load Forecast Error - April Daily Peaks, 10:00 Forecast

Series 1
Weekend / Holiday

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Load Forecast Error

- 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.

- On April 9, peak load was under-forecasted due to temperatures coming in colder than forecast and a low biased holiday impact as loads in Easter’s of the past few years have come in much lower than forecast.
- On April 14, peak load was over-forecasted due to temperature error and cloud forecast error as high amounts of cloud cover kept temperatures cooler within an unusual early season warm spell.
- On April 28, the peak load was under-forecasted due to extensive cloud cover and temperatures that came in cooler than forecast in the eastern RTO.
'Other' includes Hydro, Oil, Solar, Wind, and Other
'Other' 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)
Daily Uplift - April

$ Millions

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

$0.0 - $2.0

01 APR 2023 to 30 APR 2023

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• In April, uplift exceeded $800,000 on four days -
• Contributing factors to uplift were:
  • Outages coupled with localized congestion

• More information on Uplift can be found on the PJM website at [Drivers of Uplift](#)
Uplift as a Percent of Energy Costs

- The graph shows the uplift as a percent of energy costs from April 2021 to April 2023.
- The uplift values fluctuate over time, with some periods showing a higher percent uplift than others.
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

APR21 JUL21 SEP21 DEC21 APR22 JUL22 SEP22 DEC22 APR23
Energy Market

LMP Summary
Shortage Pricing Intervals

- MAD Primary Reserves
- MAD Synchronized Reserves
- RTO Primary Reserves
- RTO Synchronized Reserves

Count of Shortage Intervals

MAY22  JUN22  JUL22  AUG22  SEP22  OCT22  NOV22  DEC22  JAN23  FEB23  MAR23  APR23
Information on constraints and shadow prices can be found here:

http://dataminer2.pjm.com/feed/rt_marginal_value
Monthly Load-Weighted Average Real-time LMP

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Daily Load-Weighted Average DA & RT LMP

- Load-Weighted DA LMP
- Load-Weighted RT LMP

($/MWh)
Fuel Cost Adjusted LMP (Referenced to 1999 Fuel Prices)
Spike seen in April 2021 is incorrect and due to a software bug which has since been fixed.
Energy Market

Demand Response Summary
*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

MW

APR21  JUL21  SEP21  DEC21  APR22  JUL22  SEP22  DEC22  APR23
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 Volume

- **Submitted MWh**
- **Cleared MWh**

**MWh (Millions)**

| Month | APR21 | MAY21 | JUN21 | JUL21 | AUG21 | SEP21 | OCT21 | NOV21 | DEC21 | JAN22 | FEB22 | MAR22 | APR22 | MAY22 | JUN22 | JUL22 | AUG22 | SEP22 | OCT22 | NOV22 | DEC22 | JAN23 | FEB23 | MAR23 | APR23 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|       | 5     | 5     | 5     | 5     | 5     | 5     | 5     | 5     | 5     | 5     | 5     | 5     | 5     | 5     | 5     | 5     | 5     | 5     | 5     | 5     | 5     | 5     | 5     | 5     | 5     | 5     | 5     |

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Up-To-Congestion Transactions - Total Number

Number of Transactions (Millions)

- Submitted Transactions
- Cleared Transactions

APR21 | MAY21 | JUN21 | JUL21 | AUG21 | SEP21 | OCT21 | NOV21 | DEC21 | JAN22 | FEB22 | MAR22 | APR22 | MAY22 | JUN22 | JUL22 | AUG22 | SEP22 | OCT22 | NOV22 | DEC22 | JAN23 | FEB23 | MAR23 | APR23
Up-To-Congestion Transactions - Total Volume

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

- Submitted MWh
- Cleared MWh

MWh (Millions)

APR21  MAY21  JUN21  JUL21  AUG21  SEP21  OCT21  NOV21  DEC21  JAN22  FEB22  MAR22  APR22  MAY22  JUN22  JUL22  AUG22  SEP22  OCT22  NOV22  DEC22  JAN23  FEB23  MAR23  APR23
Energy Market

Congestion and FTR Summary
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Monthly FTR Payout

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Planning Period FTR Payout Ratio

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The ten most heavily congested facilities account for 98% of total congestion for April.
Ten Most Heavily Congested Transmission Facilities - Overall, 2023

The ten most heavily congested facilities account for 60% of total congestion for 2023.
Energy Market

Interchange/Seams Summary
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 = $-1.33
Percent of hours in which the direction of flow is consistent with price differentials = 55.83%
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 April = $-1.18
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 = $-1.82
Percent of hours in which the direction of flow is consistent with price differentials = 58.61%
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 April = $-0.28
PJM-MISO Market-to-Market Coordination Settlement

Negative M2M Credit represents PJM payment to MISO
PJM-NYISO Market-to-Market Coordination Settlement

Negative M2M Credit represents PJM payment to NYISO
Ancillary Service Market

Summary
Load-Adjusted Synchronized Reserve and Synchronous Condenser Costs

[CCHART: Synchronized Reserve Market Payments / MWh]

[CCHART: Synchronous Condenser Payments / MWh]
DR Participation in PJM Regulation Markets

$ Millions

$1.5

$1.2

$0.9

$0.6

$0.3

$0.0

MWh

25,000

20,000

15,000

10,000

5,000

0

MAY21
JUN21
JUL21
AUG21
SEP21
OCT21
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FEB23
MAR23
APR23

Total Payments ($ Millions)

MWh Cleared (MWh)
DR Participation in PJM Synchronized Reserve Markets

- Total Payments ($ Millions)
- MWh Cleared (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)
Jennifer Warner-Freeman
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(866) 400 – 8980
custsvc@pjm.com