Markets Report

MC Webinar
December 18, 2023
• PJM Wholesale Cost in 2023 is $50.60/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 November, temperatures fluctuated above and below average for most of the month. The sum of Heating and Cooling Degree Days was slightly below its historic average. (Slides 8-10)
• Energy use was slightly above its historic average for November. (Slides 8-10)
• In November, uplift exceeded $800,000 on six days. (Slides 26 & 27)
Executive Summary

- Load-weighted average LMP for 2023 is $31.38/MWh: (Slides 35-37)
  - November 2023 was $33.00/MWh, which is much lower than November 2022 ($52.90/MWh) and November 2021 ($63.00/MWh).
- There were no 5-minute intervals that experienced shortage pricing in November. (Slides 34, Report Appendix)
- FTR revenue adequacy for the month of November is 98% and the 2023-2024 Planning Year is currently funded at 100%. (Slides 52-55)
- Congestion values have been trending lower in 2023 as compared to 2022. (Slide 53)
- Regulation and Synchronized Reserve market costs have generally tracked with energy prices over time. (Slides 69-71)
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 historic and current weather and energy data for each month from November 2022 to November 2023. The x-axis represents the months, while the y-axis shows the total energy in TWh. The graph includes two sets of degree day lines and bars indicating heating and cooling degree days.
Historic Average Weather and Energy versus Current Month - Daily

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

Percent of Daily Average

0% 100% 200% 300% 400%

Average Fuel Prices - Monthly

Monthly Average Fuel Price ($/MMBtu)

- Average Natural Gas
- Average Coal
- Average Real-time LMP

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 November = $0.37

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
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 was initially under forecast on 11/1, 11/21, and 11/28 due to temperatures coming in colder across the RTO, leading to higher loads. Also, cloud cover played a role in the middle of the day, as more energy was pulled from the grid instead of the behind-the-meter solar.
- On 11/23, Thanksgiving, over-forecasting occurred due to forecast uncertainty around holiday impact and model performance given the holiday.
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 - November

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

'Other' includes Flywheels, Multiple Fuels, Storage, and Other Renewables
Percent of Renewable and Clean Generation

'Renewable' includes Wind, Solar, Hydro, and Other Renewables. 'Clean' includes Renewable and Nuclear.
Operating Reserve
(Uplift)
Monthly Uplift

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

$ Millions

|------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
Monthly Uplift - $/MWh Load

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

The chart shows the monthly uplift costs for different categories of operating reserves from November 2021 to November 2023. The costs vary across different months, with some months having significantly higher costs than others.
Zonal Uplift - November

$ Millions

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<th>Balancing Operating Reserve</th>
<th>Reactive</th>
<th>Blackstart</th>
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In November, uplift exceeded $800,000 on six days - Contributing factors to uplift were:

- Localized congestion and support to North/South flows due to outages

More information on Uplift can be found on the PJM website at Drivers of Uplift
Uplift as a Percent of Energy Costs
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.
Deviations Balancing Operating Reserve Rates
Energy Market

LMP Summary
Information on constraints and shadow prices can be found here.
Monthly Load-Weighted Average Real-time LMP
Daily Load-Weighted Average DA & RT LMP

(\$/MWh)

0 25 50 75 100


Load-Weighted DA LMP
Load-Weighted RT LMP
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

- NOV21
- DEC21
- JAN22
- FEB22
- MAR22
- APR22
- MAY22
- JUN22
- JUL22
- AUG22
- SEP22
- OCT22
- NOV22
- DEC22
- JAN23
- FEB23
- MAR23
- APR23
- MAY23
- JUN23
- JUL23
- AUG23
- SEP23
- OCT23
- NOV23
Energy Market
Demand Response Summary
Demand Side Response Estimated Revenue

$ 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.*
Total Registered MW in PJM's Economic Demand Response

MW

NOV21 JAN22 MAY22 AUG22 NOV22 JAN23 MAY23 AUG23 NOV23

1,000 1,500 2,000 2,500 3,000
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 (INC & DECs) - Total Volume

- Submitted MWh
- Cleared MWh

MWh (Millions)

- NOV 21
- DEC 21
- JAN 22
- FEB 22
- MAR 22
- APR 22
- MAY 22
- JUN 22
- JUL 22
- AUG 22
- SEP 22
- OCT 22
- NOV 22
- DEC 22
- JAN 23
- FEB 23
- MAR 23
- APR 23
- MAY 23
- JUN 23
- JUL 23
- AUG 23
- SEP 23
- OCT 23
- NOV 23
Up-To-Congestion Transactions - Total Volume

MWh (Millions)

Submitted MWh
Cleared MWh

Month:
- NOV21
- DEC21
- JAN22
- FEB22
- MAR22
- APR22
- MAY22
- JUN22
- JUL22
- AUG22
- SEP22
- OCT22
- NOV22
- DEC22
- JAN23
- FEB23
- MAR23
- APR23
- MAY23
- JUN23
- JUL23
- AUG23
- SEP23
- OCT23
- NOV23
INCs, DECs and Up-To-Congestion Transactions - Total Number
INCs, DECs and Up-To-Congestion Transactions - Total Volume

- Submitted MWh
- Cleared MWh

MWh (Millions)

|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
Energy Market

Congestion and FTR Summary
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<th>Surplus / Underfunding</th>
<th>Payout Ratio</th>
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<td>November 2023</td>
<td>$-3,916,289</td>
<td>98%</td>
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<tr>
<td>2023</td>
<td>$128,546,792</td>
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<tr>
<td>2023/2024</td>
<td>$28,785,209</td>
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FTR Revenue vs. FTR Target Allocation
Monthly FTR Payout Ratio

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

NOV21 DEC21 JAN22 FEB22 MAR22 APR22 MAY22 JUN22 JUL22 AUG22 SEP22 OCT22 NOV22 DEC22 JAN23 FEB23 MAR23 APR23 MAY23 JUN23 JUL23 AUG23 SEP23 OCT23 NOV23
The ten most heavily congested facilities account for 72% of total congestion for November.
Ten Most Heavily Congested Transmission Facilities - Overall, 2023

The ten most heavily congested facilities account for 54% of total congestion for 2023.
Balancing Congestion Charge Revenues (BLI 2215)
Energy Market

Interchange/Seams Summary
Monthly Average MISO Interface Pricing
Monthly Average NYISO Interface Pricing

$/MWh

- PJM NYISO Price (RT)
- NYISO PJM Price (RT)
- PJM NYISO Price (DA)
- NYISO PJM Price (DA)
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 November = $-2.26
Percent of hours in which the direction of flow is consistent with price differentials = 64.58%
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 November = $-2.32
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 November = $1.19
Percent of hours in which the direction of flow is consistent with price differentials = 53.75%
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 November = $-1.47
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
Synchronized Reserve and Synchronous Condenser Costs

- Synchronized Reserve Market Payments
- Synchronous Condenser Payments

$ Millions

|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
Load-Adjusted Synchronized Reserve and Synchronous Condenser Costs

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

Cents/MWh

- NOV21
- DEC21
- JAN22
- FEB22
- MAR22
- APR22
- MAY22
- JUN22
- JUL22
- AUG22
- SEP22
- OCT22
- NOV22
- DEC22
- JAN23
- FEB23
- MAR23
- APR23
- MAY23
- JUN23
- JUL23
- AUG23
- SEP23
- OCT23
- NOV23
DR Participation in PJM Regulation Markets

![Bar and Line Chart]

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

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- **$1.5 Maximum $ Millions**
- **35,000 Peak MWh**

Regulation Market Daily Prices and Charges

- Total Daily Regulation Charges ($ Millions)
- Minimum Interval Price ($/MWh)
- Average Interval Price ($/MWh)
- Maximum Interval Price ($/MWh)
Jennifer Warner-Freeman
Jennifer.Freeman@pjm.com

Member Hotline
(610) 666 – 8980
(866) 400 – 8980
custsvc@pjm.com
PROTECT THE POWER GRID
THINK BEFORE YOU CLICK!

Be alert to malicious phishing emails.

Report suspicious email activity to PJM.
(610) 666-2244 / it_ops_ctr_shift@pjm.com