Markets Report

MC Webinar
January 22, 2023
PJM Wholesale Cost in 2023 is $50.18/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 December, temperatures were above average for most of the month. The sum of Heating and Cooling Degree Days was well below its historic average. (Slides 8-10)

Energy use was also below its historic average for December. (Slides 8-10)

In December, uplift exceeded $800,000 on three days. (Slides 26 & 27)
Executive Summary

- Load-weighted average LMP for 2023 is $31.09/MWh: (Slides 35-37)
  - December 2023 was $28.00/MWh, which is much lower than December 2022 ($142.20/MWh) and also lower than December 2021 ($38.90/MWh).

- There were two 5-minute intervals that experienced shortage pricing in December. (Slides 34, Report Appendix)

- FTR revenue adequacy for the month of December 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
PJM Wholesale Cost - Other

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

$/MWh

2019: $1.26
- Regulation: $0.44
- Operating Reserve: $0.38
- PJM Cost: $0.38
- Reactive: $0.23
- Transmission Owner Control: $0.18
- Synchronized Reserve: $0.09
- Black Start: $0.00

2020: $1.28
- Regulation: $0.47
- Operating Reserve: $0.47
- PJM Cost: $0.38
- Reactive: $0.37
- Transmission Owner Control: $0.21
- Synchronized Reserve: $0.17
- Black Start: $0.00

2021: $1.51
- Regulation: $0.47
- Operating Reserve: $0.47
- PJM Cost: $0.38
- Reactive: $0.37
- Transmission Owner Control: $0.21
- Synchronized Reserve: $0.17
- Black Start: $0.00

2022: $1.89
- Regulation: $0.48
- Operating Reserve: $0.40
- PJM Cost: $0.40
- Reactive: $0.37
- Transmission Owner Control: $0.21
- Synchronized Reserve: $0.17
- Black Start: $0.00

2023: $1.45
- Regulation: $0.50
- Operating Reserve: $0.40
- PJM Cost: $0.40
- Reactive: $0.37
- Transmission Owner Control: $0.21
- Synchronized Reserve: $0.17
- Black Start: $0.00
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, 2022. 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

TWh vs. Heating Degree Days + Cooling Degree Days

- Dec22: 40
- Jan23: 60
- Feb23: 50
- Mar23: 70
- Apr23: 80
- May23: 90
- Jun23: 100
- Jul23: 110
- Aug23: 120
- Sep23: 130
- Oct23: 140
- Nov23: 150
- Dec23: 160
Historic Average Weather and Energy versus Current Month - Daily

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

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.
Load Forecast Error - Monthly Absolute Error, 10:00 Forecast
Load Forecast Error - December 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.

• On Sunday, 12/3, the peak load was under-forecasted due to temperatures coming in ~3 degrees lower than forecasted. In the week that followed, some less significant weather forecast error continued, and led to a pattern on under-forecasting by a small margin before correcting.
• On Sunday, 12/24, the peak load was over-forecasted due to holiday impacts. The forecast otherwise performed well throughout the holiday period.
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, Other - December

'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 - $/MWh Load

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

$/MWh

DEC21  JAN22  FEB22  MAR22  APR22  MAY22  JUN22  JUL22  AUG22  SEP22  OCT22  NOV22  DEC22  JAN23  FEB23  MAR23  APR23  MAY23  JUN23  JUL23  AUG23  SEP23  OCT23  NOV23  DEC23
In December, uplift exceeded $800,000 on three days -

Contributing factors to uplift were: *Localized congestion*

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

Uplift $/Energy $
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

DEC21 | MAR22 | JUN22 | AUG22 | DEC22 | MAR23 | JUN23 | AUG23 | DEC23
Deviations Balancing Operating Reserve Rates

$/MWh

- RTO
- East
- West

DEC21  MAR22  JUN22  AUG22  DEC22  MAR23  JUN23  AUG23  DEC23
Energy Market

LMP Summary
Shortage Pricing Intervals

Information on constraints and shadow prices can be found here
Monthly Load-Weighted Average Real-time LMP

$/MWh

Daily Load-Weighted Average DA & RT LMP

($/MWh)

Load-Weighted DA LMP
Load-Weighted RT LMP
Fuel Cost Adjusted LMP (Referenced to 1999 Fuel Prices)
Spikes seen in March and April 2021 are incorrect and due to a software bug which has since been fixed.
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 (INC & DEC) - Total Volume

- Submitted MWh
- Cleared MWh

Monthly MWh (Millions)
Up-To-Congestion Transactions - Total Number

- Submitted Transactions
- Cleared Transactions

Number of Transactions (Millions)

- DEC21
- JAN22
- FEB22
- MAR22
- APR22
- MAY22
- JUN22
- JUL22
- AUG22
- SEP22
- OCT22
- NOV22
- DEC22
- JAN23
- FEB23
- MAR23
- APR23
- MAY23
- JUN23
- JUL23
- AUG23
- SEP23
- OCT23
- NOV23
- DEC23
Up-To-Congestion Transactions - Total Volume

- Submitted MWh
- Cleared MWh

MWh (Millions)

DEC21  JAN22  FEB22  MAR22  APR22  MAY22  JUN22  JUL22  AUG22  SEP22  OCT22  NOV22  DEC22  JAN23  FEB23  MAR23  APR23  MAY23  JUN23  JUL23  AUG23  SEP23  OCT23  NOV23  DEC23
INCs, DECs and Up-To-Congestion Transactions - Total Number
INCs, DECs and Up-To-Congestion Transactions - Total Volume

MWh (Millions)

- Submitted MWh
- Cleared MWh

- DEC21
- JAN22
- FEB22
- MAR22
- APR22
- MAY22
- JUN22
- JUL22
- AUG22
- SEP22
- OCT22
- NOV22
- DEC22
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- FEB23
- MAR23
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- JUN23
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- SEP23
- OCT23
- NOV23
- DEC23
Energy Market

Congestion and FTR Summary
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<th>Period</th>
<th>Surplus / Underfunding</th>
<th>Payout Ratio</th>
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<tr>
<td>December 2023</td>
<td>-$2,429,011</td>
<td>98%</td>
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<tr>
<td>2023</td>
<td>$126,117,781</td>
<td>100%</td>
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<tr>
<td>2023/2024</td>
<td>$26,356,198</td>
<td>100%</td>
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FTR Revenue vs. FTR Target Allocation

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<th>Total FTR Targets</th>
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Planning Period FTR Payout
Ten Most Heavily Congested Transmission Facilities - Overall, December

The ten most heavily congested facilities account for 72% of total congestion for December.
Ten Most Heavily Congested Transmission Facilities - Overall, 2023

The ten most heavily congested facilities account for 53% of total congestion for 2023.
Balancing Congestion Charge Revenues (BLI 2215)
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)

DEC21  MAR22  JUN22  AUG22  DEC22  MAR23  JUN23  AUG23  DEC23
Monthly Average NYISO Interface Pricing

The chart illustrates the monthly average NYISO Interface Pricing from December 2021 to December 2023. The price data includes PJM NYISO Price (RT) and NYISO PJM Price (RT), PJM NYISO Price (DA), and NYISO PJM Price (DA). The prices show fluctuations throughout the year with peak periods occurring in December 2022 and August 2023.
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 December = $0.09
Percent of hours in which the direction of flow is consistent with price differentials = 61.02%
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 December = $-1.06
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 December = $1.45
Percent of hours in which the direction of flow is consistent with price differentials = 61.96%
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 December = $-3.62
PJM-MISO Market-to-Market Coordination Settlement

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

- Synchronized Reserve Market Payments
- Synchronous Condenser Payments

$ Millions

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<th>Month</th>
<th>DEC21</th>
<th>JAN22</th>
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Load-Adjusted Synchronized Reserve and Synchronous Condenser Costs
DR Participation in PJM Synchronized Reserve Markets

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

- $0.0
- $0.5
- $1.0
- $1.5
- $2.0
- $2.5
- $3.0
- $3.5

- 0
- 50,000
- 100,000
- 150,000
- 200,000
- 250,000
- 300,000
- 350,000

- DEC21
- JAN22
- FEB22
- MAR22
- APR22
- MAY22
- JUN22
- JUL22
- AUG22
- SEP22
- OCT22
- NOV22
- DEC22
- JAN23
- FEB23
- MAR23
- APR23
- MAY23
- JUN23
- JUL23
- AUG23
- SEP23
- OCT23
- NOV23
- DEC23
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 $0.2 $0.4 $0.6 $0.8 $1.0 $1.2

$ Millions

$0 $100 $200 $300 $400 $500 $600

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(866) 400 – 8980
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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