Markets Report

MC Webinar
February 20, 2024
• PJM Wholesale Cost in 2024 is $60.72/MWh, up from full-year 2023 costs of $50.18/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 January, temperatures fluctuated above and below average for most of the month. The sum of Heating and Cooling Degree Days was below its historic average. (Slides 8-10)

• Energy use was above its historic average for January. (Slides 8-10)

• In January, uplift exceeded $800,000 on eight days. (Slides 26 & 27)
Executive Summary

• Load-weighted average LMP for 2024 is $42.77/MWh: (Slides 35-37)
  – January 2024 was $42.77/MWh, which is higher than January 2023 ($35.80/MWh) but considerably lower than January 2022 ($69.10/MWh).

• There were ten 5-minute intervals that experienced shortage pricing in January. (Slides 34, Report Appendix)

• FTR revenue adequacy for the month of January is 100% and the 2023-2024 Planning Year is currently funded at 100%. (Slides 52-55)

• Congestion values in January are up when compared to 2023. (Slide 53)

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

Energy
Reliability Capacity
Transmission
Other

$120.00
$100.00
$80.00
$60.00
$40.00
$20.00
$0.00

$120.00
$100.00
$80.00
$60.00
$40.00
$20.00
$0.00

2020
2021
2022
2023
2024

$43.41
$11.03
$8.45
$21.65

$64.07
$11.72
$11.04
$39.79

$102.56
$12.50
$8.00
$80.17

$50.18
$13.75
$31.09
$42.77

$60.72
$13.34

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PJM Wholesale Cost - Other

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

$/MWh

Year: 2020, 2021, 2022, 2023, 2024

- 2020: $1.28
- 2021: $1.51
- 2022: $1.39
- 2023: $1.45
- 2024: $2.04

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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
Average Fuel Prices - Monthly

Fuel Price Source: S&P Global Platts

- Average Natural Gas
- Average Coal
- Average Real-time LMP
Average Fuel Prices - Daily

Fuel Price Source: S&P Global Platts

- Average Gas - $4.74
- Average Coal - $2.45
- Average Oil - $17.17
- Average LMP - $41.03
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 January = $5.33
Load Forecast Error - Monthly Absolute Error, 10:00 Forecast
Load Forecast Error - January Daily Peaks, 10:00 Forecast

- Error at Peak Hour
- Weekend / Holiday
• PJM prepares a day-ahead load forecast at 10:00 am for use by our members.
  • 1/2 (Tuesday): forecast was underforecast due to temperatures which came in cooler than forecast, leading to higher load than expected by load models.
  • 1/3 (Wednesday): forecast was underforecast due to temperatures which came in cooler than forecast, leading to higher load than expected by load models.
  • 1/9 (Tuesday): day was under-forecast due to impacts from widespread, moderate rainfall across entire footprint. Increased lighting load combined with lack of BTM generation led to higher than forecast error. “Peak” actually occurred at 11AM, so error comes off higher than typical.
  • 1/12 (Friday): Under-forecast due to temperature forecast error; temperatures came in 2-3F cooler than forecast for larger regions, leading to higher load overnight and at morning peak. Missed overnight and morning peak, but forecast was more reasonable for remainder of day.

• 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.
Monthly Generation by Fuel

'Mother' includes Hydro, Oil, Solar, Wind, and Other
Monthly Generation by Fuel, Other

'Other' includes Flywheels, Multiple Fuels, Storage, and Other Renewables
Daily Generation by Fuel, Other - January

'Mother' 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

Chart showing monthly uplift in $/MWh from January 2022 to January 2024.
Daily Uplift - January

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

$ Millions

In January, uplift exceeded $800,000 on eight days -

Contributing factors to uplift were:
Severe weather experienced during Winter Storm Gerri

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

- CT
- CC & Steam
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
Energy Market
LMP Summary
Information on constraints and shadow prices can be found here.
Fuel Cost Adjusted LMP (Referenced to 1999 Fuel Prices)
LMP Price Posting Suspensions and Reruns

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
Demand Side Response Estimated Revenue

$ Millions

- Capacity
- Ancillary Services
- Emergency Energy
- Economic Energy
- Economic Energy Incentives
- Capacity Bonus Payment
- Test Emergency Energy


$0 $300 $600 $900 $1,200
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.
Up-To-Congestion Transactions - Total Number

Number of Transactions (Millions)

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

Submitted Transactions
Cleared Transactions

Number of Transactions (Millions)

JAN22  FEB22  MAR22  APR22  MAY22  JUN22  JUL22  AUG22  SEP22  OCT22  NOV22  DEC22  JAN23  FEB23  MAR23  APR23  MAY23  JUN23  JUL23  AUG23  SEP23  OCT23  NOV23  DEC23  JAN24
INCs, DECs and Up-To-Congestion Transactions - Total Volume

Submitted MWh

Cleared MWh

MWh (Millions)

JAN22  FEB22  MAR22  APR22  MAY22  JUN22  JUL22  AUG22  SEP22  OCT22  NOV22  DEC22  JAN23  FEB23  MAR23  APR23  MAY23  JUN23  JUL23  AUG23  SEP23  OCT23  NOV23  DEC23  JAN24
Energy Market

Congestion and FTR Summary
<table>
<thead>
<tr>
<th>Period</th>
<th>Surplus / Underfunding</th>
<th>Payout Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 2024</td>
<td>$62,895,085</td>
<td>100%</td>
</tr>
<tr>
<td>2024</td>
<td>$62,895,085</td>
<td>100%</td>
</tr>
<tr>
<td>2023/2024</td>
<td>$89,251,283</td>
<td>100%</td>
</tr>
</tbody>
</table>
FTR Revenue vs. FTR Target Allocation
Ten Most Heavily Congested Transmission Facilities - Overall, January

The ten most heavily congested facilities account for 80% of total congestion for January.

- APSOUTH Interface (EHV)
- Braidwood-East Frankfort 2001 345 (COMED)
- Lenox-N Meshoppen 115 (PN)
- Nottingham Reactor 230 (PECO)
- Juniata 500/230 T2 (PPL)
- Mazon-0108 2 138 (COMED)
- E Towanda-Hillside 115 (PN)
- AEP-DOM Interface (EHV)
- BED-BLA Interface (EHV)
- Carson-Chapparal (DOM C)
The ten most heavily congested facilities account for 80% of total congestion for 2024.
Balancing Congestion Charge Revenues (BLI 2215)
Energy Market

Interchange/Seams Summary
Monthly Average MISO Interface Pricing

- PJM MISO Price (RT)
- MISO PJM Price (RT)
- PJM MISO Price (DA)
- MISO PJM Price (DA)
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 January = $-0.66
Percent of hours in which the direction of flow is consistent with price differentials = 55.91%
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 January = $-3.39
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 January = $-2.12
Percent of hours in which the direction of flow is consistent with price differentials = 66.67%
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.
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
Regulation Costs
Synchronized Reserve and Synchronous Condenser Costs

- Synchronized Reserve Market Payments
- Synchronous Condenser Payments

$ Millions

- JAN22
- FEB22
- MAR22
- APR22
- MAY22
- JUN22
- JUL22
- AUG22
- SEP22
- OCT22
- NOV22
- DEC22
- JAN23
- FEB23
- MAR23
- APR23
- MAY23
- JUN23
- JUL23
- AUG23
- SEP23
- OCT23
- NOV23
- DEC23
- JAN24
Load-Adjusted Synchronized Reserve and Synchronous Condenser Costs

- Synchronized Reserve Market Payments / MWh
- Synchronous Condenser Payments / MWh
DR Participation in PJM Regulation Markets

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

Graph showing the trend of total payments and MWh cleared from January 2022 to December 2023.
DR Participation in PJM Synchronized Reserve Markets

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

$ Millions

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

MWh

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

JAN22 FEB22 MAR22 APR22 MAY22 JUN22 JUL22 AUG22 SEP22 OCT22 NOV22 DEC22 JAN23 FEB23 MAR23 APR23 MAY23 JUN23 JUL23 AUG23 SEP23 OCT23 NOV23 DEC23 JAN24
Regulation Market Daily Prices and Charges

- Total Daily Regulation Charges ($ Millions)
- Minimum Interval Price ($/MWh)
- Average Interval Price ($/MWh)
- Maximum Interval Price ($/MWh)

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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)
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