Markets Report

MC Webinar
November 14, 2022
• PJM Wholesale Cost 2022 is $98.80/MWh, up from full-year 2021 costs of $64.07/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 October, temperatures were slightly above average for most of the month. Thus, the sum of Heating and Cooling Degree Days was just below its historic average. (Slides 8-10)

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

• In October, uplift exceeded $800,000 on five days. (Slides 25 & 26)
Executive Summary

- Load-weighted average LMP for 2022 is $75.94/MWh: (Slides 35-37)
  - October 2022 was $55.90/MWh, which is lower than October 2021 ($58.40/MWh) but higher than October 2020 ($22.20/MWh).

- There was one 5-minute intervals that experienced shortage pricing in October. (Slides 33-34)

- FTR revenue adequacy for the month of October is 86% and the 2022-2023 Planning Year is currently funded at 100%. (Slides 52-55)

- Congestion values have been trending upwards. However, October’s value is lower than recent history. (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**

### Chart Details
- **Y-axis**: TWh (Terawatt-hours)
- **X-axis**: Months from Oct21 to Oct22
- **Z-axis**: Heating Degree Days + Cooling Degree Days

### Key Observations
- January 2022 had the highest TWh energy usage.
- April 2022 had the highest HDD+CDD days.
- The graph shows a comparison between the current month and the average monthly energy usage, highlighting differences in energy consumption and weather conditions.
Historic Average Weather and Energy versus Current Month - Daily

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

Fuel Price Source: S&P Global Platts
Average Fuel Prices - Daily

- **Average Gas** - $4.83
- **Average Coal** - $7.34
- **Average Oil** - $24.89
- **Average LMP** - $55.63

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 - October 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.

Overall, the load forecast performed well in October, which is typical this time of year due to the mild temperatures. There was some notable forecast error on Saturday, October 22, where the models did not forecast a high enough morning peak throughout the RTO despite having accurate temperature forecasts. On Tuesday, October 25, temperatures came in cooler than forecasted, resulting in over-forecasting by ~ 3%.
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 - October

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

'Mother' includes Flywheels, Multiple Fuels, Storage, and Other Renewables
Operating Reserve
(Uplift)
Monthly Uplift - $/MWh Load

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

Bar chart showing monthly uplift costs for different months and categories.
In October, uplift exceeded $800,000 on five days -

Contributing factors to uplift were:

Volatility of localized congestion, some of which was outage driven, was the biggest driver of BOR and LOC.

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

![Graph showing uplift as a percent of energy costs from Oct 20 to Oct 22.]

- X-axis: Months from Oct 20 to Oct 22
- Y-axis: Uplift $/Energy $ (ranging from 0.0% to 2.0%)

The graph indicates fluctuations in uplift as a percent of energy costs throughout the period, with peaks and troughs visible.
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.
Energy Market
LMP Summary
<table>
<thead>
<tr>
<th>Date</th>
<th>5-Minute Interval</th>
<th>Reserve Penalty Factors</th>
<th>5-Minute Interval SMP</th>
<th>Hourly Integrated SMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wednesday, October 12, 2022</td>
<td>14:05 - 14:10</td>
<td>RTO Synchronized Reserves; MAD Synchronized Reserves</td>
<td>$668.09</td>
<td>$138.11</td>
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</tbody>
</table>

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

$/MWh

<table>
<thead>
<tr>
<th>Month</th>
<th>$/MWh</th>
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<tbody>
<tr>
<td>OCT20</td>
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<tr>
<td>NOV20</td>
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<td>DEC20</td>
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<td>JAN21</td>
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<td>FEB21</td>
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<td>MAR21</td>
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<td>JUL22</td>
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<tr>
<td>AUG22</td>
<td>$78</td>
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<tr>
<td>SEP22</td>
<td>$56</td>
</tr>
<tr>
<td>OCT22</td>
<td>$56</td>
</tr>
</tbody>
</table>
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
Demand Side Response Estimated Revenue

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

$ Millions

- 2008
- 2009
- 2010
- 2011
- 2012
- 2013
- 2014
- 2015
- 2016
- 2017
- 2018
- 2019
- 2020
- 2021
- 2022
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 (INCs & DECs) - Total Volume

MWh (Millions)

- Submitted MWh
- Cleared MWh

OCT20 | NOV20 | DEC20 | JAN21 | FEB21 | MAR21 | APR21 | MAY21 | JUN21 | JUL21 | AUG21 | SEP21 | OCT21 | NOV21 | DEC21 | JAN22 | FEB22 | MAR22 | APR22 | MAY22 | JUN22 | JUL22 | AUG22 | SEP22 | OCT22
INCs, DECs and Up-To-Congestion Transactions - Total Number
INCs, DECs and Up-To-Congestion Transactions - Total Volume

MWh (Millions)

<table>
<thead>
<tr>
<th>Month</th>
<th>Submitted MWh</th>
<th>Cleared MWh</th>
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<tr>
<td>APR21</td>
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</tr>
<tr>
<td>OCT22</td>
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Energy Market

Congestion and FTR Summary
<table>
<thead>
<tr>
<th>Period</th>
<th>Surplus / Underfunding</th>
<th>Payout Ratio</th>
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</thead>
<tbody>
<tr>
<td>October 2022</td>
<td>-$28,354,960</td>
<td>86%</td>
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<tr>
<td>2022</td>
<td>$156,171,062</td>
<td>100%</td>
</tr>
<tr>
<td>2022/2023</td>
<td>$62,065,041</td>
<td>100%</td>
</tr>
</tbody>
</table>
FTR Revenue vs. FTR Target Allocation

- **Total FTR Revenues**
- **Total FTR Targets**

$ Millions

- OCT20
- NOV20
- DEC20
- JAN21
- FEB21
- MAR21
- APR21
- MAY21
- JUN21
- JUL21
- AUG21
- SEP21
- OCT21
- NOV21
- DEC21
- JAN22
- FEB22
- MAR22
- APR22
- MAY22
- JUN22
- JUL22
- AUG22
- SEP22
- OCT22
Monthly FTR Payout Ratio

Year/Month:
- OCT20
- NOV20
- DEC20
- JAN21
- FEB21
- MAR21
- APR21
- MAY21
- JUN21
- JUL21
- AUG21
- SEP21
- OCT21
- NOV21
- DEC21
- JAN22
- FEB22
- MAR22
- APR22
- MAY22
- JUN22
- JUL22
- AUG22
- SEP22
- OCT22

PJM©2022
Ten Most Heavily Congested Transmission Facilities - Overall, October

The ten most heavily congested facilities account for 63% of total congestion for October.
Ten Most Heavily Congested Transmission Facilities - Overall, 2022

The ten most heavily congested facilities account for 48% of total congestion for 2022.
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)

$/MW/h

- OCT20
- DEC20
- APR21
- JUL21
- OCT21
- DEC21
- APR22
- JUL22
- OCT22
Monthly Average NYISO Interface Pricing

$/MW/h

- 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 October = $-2.26
Percent of hours in which the direction of flow is consistent with price differentials = 47.31%
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 October = $-0.29
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 October = $2.13
Percent of hours in which the direction of flow is consistent with price differentials = 55.91%
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 October = $0.67
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
Regulation Costs

$ Millions

- OCT20
- NOV20
- DEC20
- JAN21
- FEB21
- MAR21
- APR21
- MAY21
- JUN21
- JUL21
- AUG21
- SEP21
- OCT21
- NOV21
- DEC21
- JAN22
- FEB22
- MAR22
- APR22
- MAY22
- JUN22
- JUL22
- AUG22
- SEP22
- OCT22
Synchronized Reserve and Synchronous Condenser Costs

- Synchronized Reserve Market Payments
- Synchronous Condenser Payments

$ Millions

- OCT20
- NOV20
- DEC20
- JAN21
- FEB21
- MAR21
- APR21
- MAY21
- JUN21
- JUL21
- AUG21
- SEP21
- OCT21
- NOV21
- DEC21
- JAN22
- FEB22
- MAR22
- APR22
- MAY22
- JUN22
- JUL22
- AUG22
- SEP22
- OCT22
Load-Adjusted Synchronized Reserve and Synchronous Condenser Costs
DR Participation in PJM Regulation Markets

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

Graph showing the trend of Total Payments and MWh Cleared from OCT20 to SEP22, with a significant increase in AUG22.
DR Participation in PJM Synchronized Reserve Markets
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)
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