Markets Report

MC Webinar
September 19, 2022
• PJM Wholesale Cost 2022 is $100.98/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 8-20)

• In August, temperatures were above average for most of the month. Thus, the sum of Heating and Cooling Degree Days was also above its historic average. (Slides 8-10)

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

• In August, uplift exceeded $800,000 on all but 13 days. (Slides 25 & 26)
• Load-weighted average LMP for 2021 is $77.78/MWh: (Slides 34-36)
  – August 2022 was $113.80/MWh, which is higher than August 2021 ($47.40/MWh) and August 2020 ($25.20/MWh).
• There were no 5-minute intervals that experienced shortage pricing in August. (Slides 32-33)
• FTR revenue adequacy for the month of August is 100% and the 2022-2023 Planning Year is currently funded at 100%. (Slides 51-54)
• Congestion values have been trending upwards with August’s value being higher than June or July’s. (Slide 52)
• Regulation and Synchronized Reserve market costs have generally tracked with energy prices over time. (Slides 67-69)
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, 2021. 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

Heating Degree Days + Cooling Degree Days


0  20  40  60  80  100

0  250  500  750  1,000  1,250
Historic Average Weather and Energy versus Current Month - Daily

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

Percent of Daily Average

0% 50% 100% 150% 200%

Average Fuel Prices - Daily

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 August = $-6.05
Load Forecast Error - Monthly Absolute Error, 10:00 Forecast
Load Forecast Error - August 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.

*During the week of the 22\textsuperscript{nd}, we started with a couple days that had significant model error during the afternoon and missed temperature forecasts that only made things worse. After the miss on Monday the 22\textsuperscript{nd}, we were able to mitigate some of the model error on Tuesday. While we still missed our mark on the 23\textsuperscript{rd}, we did reduce the error coming out of our primary ensemble model by over half a percent. Unfortunately, that trend reversed later in the week, with both positive model and temperature forecast error on Thursday the 25\textsuperscript{th}. This seemed to be at least partly driven by some drastic changes in humidity.*
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 - August

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

'Other' includes Flywheels, Multiple Fuels, Storage, and Other Renewables
Operating Reserve

(Uplift)
• In August, uplift exceeded $800,000 on 18 days -

• Contributing factors to uplift were:
  
  Our reliability needs compounded by the hot weather and forecast error continue to be the biggest drivers of uplift. For BOR, the volatility of localized congestion continue to require us to run more expensive CTs longer. For DA OR, the localized congestion limiting our north to south flows on smaller scale have continue to drive the need for the additional steam. As for LOC, if and when congestion materializing in Real Time is the biggest driver but there have also been days where our reliability needs have been a factor.

• More information on Uplift can be found on the PJM website at [Drivers of Uplift](#)
• 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

Graph showing the $/MWh for RTO, East, and West regions from AUG20 to AUG22.
Deviations Balancing Operating Reserve Rates

$/MWh

RTO
East
West

AUG20 OCT20 JAN21 MAY21 AUG21 OCT21 JAN22 MAY22 AUG22
Energy Market

LMP Summary
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

The chart displays the monthly load-weighted average real-time LMP prices from August 2020 (AUG20) to August 2022 (AUG22). The prices range from $0 to $125 per MWh, with the highest price observed in August 2022 at $114 per MWh. The prices vary significantly across months, with some months having lower prices and others considerably higher.
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

$ Millions

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

Years: 2008 to 2022

Values: $0 to $900 Million
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\&s & DEC\&s) - Total Volume

MWh (Millions)

- Submitted MWh
- Cleared MWh

- AUG20
- SEP20
- OCT20
- NOV20
- DEC20
- JAN21
- FEB21
- MAR21
- APR21
- MAY21
- JUN21
- JUL21
- AUG21
- SEP21
- OCT21
- NOV21
- DEC21
- JAN22
- FEB22
- MAR22
- APR22
- MAY22
- JUN22
- JUL22
- AUG22
Up-To-Congestion Transactions - Total Number

Number of Transactions (Millions)

- Submitted Transactions
- Cleared Transactions

Month: AUG20, SEP20, OCT20, NOV20, DEC20, JAN21, FEB21, MAR21, APR21, MAY21, JUN21, JUL21, AUG21, SEP21, OCT21, NOV21, DEC21, JAN22, FEB22, MAR22, APR22, MAY22, JUN22, JUL22, AUG22
Up-To-Congestion Transactions - Total Volume

MWh (Millions)

- Submitted MWh
- Cleared MWh

Month: AUG20, SEP20, OCT20, NOV20, DEC20, JAN21, FEB21, MAR21, APR21, MAY21, JUN21, JUL21, AUG21, SEP21, OCT21, NOV21, DEC21, JAN22, FEB22, MAR22, APR22, MAY22, JUN22, JUL22, AUG22
INCs, DECs and Up-To-Congestion Transactions - Total Number
INCs, DECs and Up-To-Congestion Transactions - Total Volume

MWh ( Millions)

Submitted MWh
Cleared MWh

AUG20  SEP20  OCT20  NOV20  DEC20  JAN21  FEB21  MAR21  APR21  MAY21  JUN21  JUL21  AUG21  SEP21  OCT21  NOV21  DEC21  JAN22  FEB22  MAR22  APR22  MAY22  JUN22  JUL22  AUG22
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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<td>August 2022</td>
<td>$59,925,069</td>
<td>100%</td>
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<tr>
<td>2022</td>
<td>$171,027,764</td>
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<tr>
<td>2022/2023</td>
<td>$76,921,744</td>
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FTR Revenue vs. FTR Target Allocation
The ten most heavily congested facilities account for 74% of total congestion for August.
Ten Most Heavily Congested Transmission Facilities - Overall, 2022

The ten most heavily congested facilities account for 51% of total congestion for 2022.
Energy Market

Interchange/Seams Summary
Monthly Average MISO Interface Pricing

$/MW/h

PJM MISO Price (RT)
MISO PJM Price (RT)
PJM MISO Price (DA)
MISO PJM Price (DA)

AUG20 OCT20 JAN21 MAY21 AUG21 OCT21 JAN22 MAY22 AUG22
Positive values represent hours when the PJM price was higher. Negative values represent hours when the PJM price was lower.

Average price difference for August = $-4.75
Percent of hours in which the direction of flow is consistent with price differentials = 53.09%
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 August = $-2.25
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 August = $-1.57
Percent of hours in which the direction of flow is consistent with price differentials = 63.17%
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 August = $-2.73
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

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<th>Value</th>
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Synchronized Reserve and Synchronous Condenser Costs

- Synchronized Reserve Market Payments
- Synchronous Condenser Payments

$ Millions

- AUG20:
- SEP20:
- OCT20:
- NOV20:
- DEC20:
- JAN21:
- FEB21:
- MAR21:
- APR21:
- MAY21:
- JUN21:
- JUL21:
- AUG21:
- SEP21:
- OCT21:
- NOV21:
- DEC21:
- JAN22:
- FEB22:
- MAR22:
- APR22:
- MAY22:
- JUN22:
- JUL22:
- AUG22:
Load-Adjusted Synchronized Reserve and Synchronous Condenser Costs

Synchronized Reserve Market Payments / MWh
Synchronous Condenser Payments / MWh

Cents/MWh

AUG20 SEP20 OCT20 NOV20 DEC20 JAN21 FEB21 MAR21 APR21 MAY21 JUN21 JUL21 AUG21 SEP21 OCT21 NOV21 DEC21 JAN22 FEB22 MAR22 APR22 MAY22 JUN22 JUL22 AUG22
DR Participation in PJM Synchronized Reserve Markets

$ Millions

MWh

Total Payments ($ Millions)

MWh Cleared (MWh)

AUG20  SEP20  OCT20  NOV20  DEC20  JAN21  FEB21  MAR21  APR21  MAY21  JUN21  JUL21  AUG21  SEP21  OCT21  NOV21  DEC21  JAN22  FEB22  MAR22  APR22  MAY22  JUN22  JUL22  AUG22

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

0  50,000  100,000  150,000  200,000  250,000  300,000
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)**

The chart shows the daily charges for synchronized reserve market from August 1st to August 31st, 2022, with variations in millions of dollars and cents per megawatt-hour ($/MWh).
Markets Report
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