Markets Report

MC Webinar
October 26, 2020
PJM Wholesale Cost through September 2020 is $42.62/MWh, down from full-year 2019 costs of $48.98/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 8-19)

In September, temperatures were milder than average for most of the month. Thus, the sum of Heating and Cooling Degree Days was below its historic average. (Slides 8-10)

Because of mild weather and continued Corona Virus impacts, Energy use remained below the historic average. (Slides 8-10)
• In September, uplift did not exceed $800,000 on any days. (Slides 24 & 25)
• Load-weighted average LMP through September 2020 is $21.22/MWh: (Slides 31 & 32)
  – September 2020 was $19.70/MWh, which is lower than September 2019 ($29.40/MWh) and September 2018 ($35.10/MWh).
• FTR revenue adequacy for the month of September is 95% and the 2020-2021 Planning Year is currently fully funded. (Slides 47-50)
• Congestion remains low and very similar to the values observed last September. (Slide 48)
• Regulation and Synchronized Reserve market costs have generally tracked with energy prices over time. (Slides 63-65)
Markets Report
PJM Wholesale Cost - Other

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

|$MWh|
2016: $1.20
- Regulation: $0.13
- Operating Reserve: $0.16
- PJM Cost: $0.32
- Reactive: $0.39
- Transmission Owner Control: $0.36
- Synchronized Reserve: $0.17
- Black Start: $0.32

2017: $1.31
- Regulation: $0.18
- Operating Reserve: $0.16
- PJM Cost: $0.36
- Reactive: $0.42
- Transmission Owner Control: $0.25
- Synchronized Reserve: $0.36
- Black Start: $0.32

2018: $1.44
- Regulation: $0.18
- Operating Reserve: $0.25
- PJM Cost: $0.36
- Reactive: $0.41
- Transmission Owner Control: $0.38
- Synchronized Reserve: $0.36
- Black Start: $0.36

2019: $1.26
- Regulation: $0.18
- Operating Reserve: $0.25
- PJM Cost: $0.38
- Reactive: $0.44
- Transmission Owner Control: $0.38
- Synchronized Reserve: $0.38
- Black Start: $0.38

2020: $1.23
- Regulation: $0.18
- Operating Reserve: $0.25
- PJM Cost: $0.38
- Reactive: $0.46
- Transmission Owner Control: $0.38
- Synchronized Reserve: $0.38
- Black Start: $0.38
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, 2019. 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

- Sep19
- Oct19
- Nov19
- Dec19
- Jan20
- Feb20
- Mar20
- Apr20
- May20
- Jun20
- Jul20
- Aug20
- Sep20
Historic Average Weather and Energy versus Current Month - Daily

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

Percent of Daily Average

- 250%
- 200%
- 150%
- 100%
- 50%
- 0%
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 September = $0.22
Load Forecast Error – September 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.

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.

The following days had load forecast error exceeding 3%:

- 9/2/20 – Temp forecast error
- 9/14/20 – Model error
- 9/15/20 – Temp forecast error
- 9/16/20 – Temp forecast error
- 9/24/20 – Temp forecast error
- 9/26/20 – Temp forecast error
Monthly Generation by Fuel

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

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

'Mother' includes Flywheels, Multiple Fuels, Storage, and Other Renewables
Operating Reserve
(Uplift)
Monthly Uplift

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

$ Millions

- SEP18
- OCT18
- NOV18
- DEC18
- JAN19
- FEB19
- MAR19
- APR19
- MAY19
- JUN19
- JUL19
- AUG19
- SEP19
- OCT19
- NOV19
- DEC19
- JAN20
- FEB20
- MAR20
- APR20
- MAY20
- JUN20
- JUL20
- AUG20
- SEP20
Daily Uplift - September

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

$ Millions

$0.0

$0.5

$1.0

$1.5

$2.0

01SEP2020
02SEP2020
03SEP2020
04SEP2020
05SEP2020
06SEP2020
07SEP2020
08SEP2020
09SEP2020
10SEP2020
11SEP2020
12SEP2020
13SEP2020
14SEP2020
15SEP2020
16SEP2020
17SEP2020
18SEP2020
19SEP2020
20SEP2020
21SEP2020
22SEP2020
23SEP2020
24SEP2020
25SEP2020
26SEP2020
27SEP2020
28SEP2020
29SEP2020
30SEP2020
In September, uplift did not exceed $800,000 on any days.

More information on Uplift can be found on PJM’s website at [Drivers of Uplift](https://www.pjm.com).
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

SEP18  DEC18  MAR19  JUN19  SEP19  DEC19  MAR20  JUN20  SEP20
Deviations Balancing Operating Reserve Rates

$/MWh

- RTO
- East
- West

SEP18  | DEC18  | MAR19  | JUN19  | SEP19  | DEC19  | MAR20  | JUN20  | SEP20
Energy Market

LMP Summary
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

Bar chart showing the percentage of 5-minute intervals with suspensions and reruns from SEP18 to JUL20.
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
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 Number

Number of Bids (Millions)

- Submitted Bids
- Cleared Bids
Virtual Bids (INCs & DECs) - Total Volume

MWh (Millions)

Submitted MWh
Cleared MWh

SEP18  OCT18  NOV18  DEC18  JAN19  FEB19  MAR19  APR19  MAY19  JUN19  JUL19  AUG19  SEP19  OCT19  Nov19  DEC19  JAN20  FEB20  MAR20  APR20  MAY20  JUN20  JUL20  AUG20  SEP20
Up-To-Congestion Transactions - Total Number

Number of Transactions (Millions)

- Submitted Transactions
- Cleared Transactions
Up-To-Congestion Transactions - Total Volume

MWh (Millions)

Submitted MWh
Cleared MWh

SEP18
OCT18
NOV18
DEC18
JAN19
FEB19
MAR19
APR19
MAY19
JUN19
JUL19
AUG19
SEP19
OCT19
NOV19
DEC19
JAN20
FEB20
MAR20
APR20
MAY20
JUN20
JUL20
AUG20
SEP20
INCs, DECs and Up-To-Congestion Transactions - Total Number

Number of Transactions (Millions)

- Submitted Transactions
- Cleared Transactions

| Month | SEP18 | OCT18 | NOV18 | DEC18 | JAN19 | FEB19 | MAR19 | APR19 | MAY19 | JUN19 | JUL19 | AUG19 | SEP19 | OCT19 | NOV19 | DEC19 | JAN20 | FEB20 | MAR20 | APR20 | MAY20 | JUN20 | JUL20 | AUG20 | SEP20 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
INCs, DECs and Up-To-Congestion Transactions - Total Volume

- **Submitted MWh**
- **Cleared MWh**
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>September, 2020</td>
<td>-$4,909,158</td>
<td>95%</td>
</tr>
<tr>
<td>2020</td>
<td>$69,129,142</td>
<td>100%</td>
</tr>
<tr>
<td>2020/2021</td>
<td>$2,221,653</td>
<td>100%</td>
</tr>
</tbody>
</table>
FTR Revenue vs. FTR Target Allocation

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

$ Millions

|    | SEP18 | OCT18 | NOV18 | DEC18 | JAN19 | FEB19 | MAR19 | APR19 | MAY19 | JUN19 | JUL19 | AUG19 | SEP19 | OCT19 | NOV19 | DEC19 | JAN20 | FEB20 | MAR20 | APR20 | MAY20 | JUN20 | JUL20 | AUG20 | SEP20 |
|----|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| **$0** |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
Ten Most Heavily Congested Transmission Facilities - Overall, September

The ten most heavily congested facilities account for 69% of total congestion for September.

- Bagley-Graceton 230 2304 (BGE)
- Braidwood-East Frankfort 2003 345 (COMED)
- Prunytown 500/138 T2 (APS)
- Ashburn-Cochrane Mills 227A 230 (DOM)
- Conastone-Peach Bottom 500 (EHV)
- Conastone-Graceton 230 (BGE)
- TMI 500/230 1 (METED)
- Smithton-Yukon 138 2 (APS)
- Harmony Village-Whitestone 65A 115 (DOM)
- Cedar Sub-Roseland 230 Y (PSEG)
Ten Most Heavily Congested Transmission Facilities - Overall, 2020

The ten most heavily congested facilities account for 47% of total congestion for 2020.
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)
Monthly Average NYISO Interface Pricing

$/MWh

- PJM NYISO Price (RT)
- NYISO PJM Price (RT)
- PJM NYISO Price (DA)
- NYISO PJM Price (DA)

SEP18  DEC18  MAR19  JUN19  SEP19  DEC19  MAR20  JUN20  SEP20
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 September = $-0.43
Percent of hours in which the direction of flow is consistent with price differentials = 63.19%
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.
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 September = $0.59
Percent of hours in which the direction of flow is consistent with price differentials = 60.00%
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 September = $-0.73
PJM-MISO Market-to-Market Coordination Settlement

Negative M2M Credit represents PJM payment to MISO

Net M2M Credit ~ MISO ($ Millions)
Net M2M Credit ~ MISO/Total FTR Targets (%)
PJM-NYISO Market-to-Market Coordination Settlement

Negative M2M Credit represents PJM payment to NYISO

Net M2M Credit ~ NYISO ($ Millions)
Net M2M Credit ~ NYISO/Total FTR Targets (%)
Ancillary Service Market

Summary
Synchronized Reserve and Synchronous Condenser Costs

The chart shows the synchronized reserve market payments and synchronous condenser payments from September 2018 to September 2020. The payments are measured in millions of dollars. The payments vary significantly across the months, with peaks in October 2018, September 2019, and October 2019. The payments are generally lower from January 2019 to June 2019 and from January 2020 to June 2020.
Load-Adjusted Synchronized Reserve and Synchronous Condenser Costs

Cents/MWh

Synchronized Reserve Market Payments / MWh
Synchronous Condenser Payments / MWh

SEP18 OCT18 NOV18 DEC18 JAN19 FEB19 MAR19 APR19 MAY19 JUN19 JUL19 AUG19 SEP19 OCT19 Nov19 DEC19 JAN20 FEB20 MAR20 APR20 MAY20 JUN20 JUL20 AUG20 SEP20
DR Participation in PJM Synchronized Reserve Markets

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

Graph showing data from SEP18 to SEP20.
Regulation Market Daily Prices and Charges

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