Markets Report

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MC Webinar
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PJM Wholesale Cost through May 2019 is $48.56/MWh, down from full-year 2018 costs of $59.96/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 7-16)

In May, temperatures were at or below average at the start of the month, but above average for the second half of the month. Thus, the sum of Heating and Cooling Degree Days was only slightly above its historic average. (Slides 8-10)

Because temperatures were slightly above average, but still very mild, Energy use was slightly below its historic average. (Slides 8-10)

In May uplift exceeded $800,000 on one day – May 23rd. (Slides 21 & 22)
Executive Summary

• Load-weighted average LMP through May 2019 is $30.16/MWh: (Slides 28-29)
  – May 2019 was $24.20/MWh, which is considerably lower than both May 2018 ($38.30/MWh) and May 2017 ($31.50/MWh).
  – Since January 2011, only two months have a lower LMP: March 2016 and May 2016.

• In June 2017, the calculation of FTR surplus was changed to no longer include Balancing congestion and Market to Market payments. (Slide 45)

• FTR revenue adequacy for the month of May is 100% and the 2018-2019 Planning Year is currently fully funded. (Slides 44-47)

• Congestion remained at relatively low levels in May. (Slide 45)

• Regulation and Synchronized Reserve market costs have generally tracked with energy prices over time. (Slides 60-62)
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, 2018. 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**

The chart displays the comparison of total energy, HDD, and CDD for current and average months from May 2018 to May 2019. The x-axis represents the months, while the y-axis shows the TWh (terawatt-hours) and Heating Degree Days + Cooling Degree Days.
Average Fuel Prices - Daily

Fuel Price Source: S&P Global Platts

- Average Gas: $2.29
- Average Coal: $2.08
- Average Oil: $13.53
- Average LMP: $24.05
Positive values represent days when the DA daily average price was higher than RT. Negative values represent days when the DA price was lower.
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 - May

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

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

(Uplift)
In May uplift exceeded $800,000 on one day; May 23rd.

Contributing factors to uplift were:
  – LMP volatility

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

MAY17 JUL17 OCT17 JAN18 MAY18 JUL18 OCT18 JAN19 MAY19
Deviations Balancing Operating Reserve Rates

- RTO
- East
- West

$/MWh

MAY17 JUL17 OCT17 JAN18 MAY18 JUL18 OCT18 JAN19 MAY19
Energy Market
LMP Summary
Load-Weighted Average LMP

Monthly Average LMP in $/MWh

- MAY 17: $32
- JUN 17: $28
- JUL 17: $33
- AUG 17: $28
- SEP 17: $34
- OCT 17: $28
- NOV 17: $29
- DEC 17: $41
- JAN 18: $84
- FEB 18: $26
- MAR 18: $33
- APR 18: $35
- MAY 18: $38
- JUN 18: $31
- JUL 18: $33
- AUG 18: $34
- SEP 18: $35
- OCT 18: $34
- NOV 18: $33
- DEC 18: $31
- JAN 19: $32
- FEB 19: $28
- MAR 19: $30
- APR 19: $26
- MAY 19: $24
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
Energy Market

Demand Response Summary
Demand Side Response Estimated Revenue

$ Millions

<table>
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<tr>
<th>Year</th>
<th>Capacity</th>
<th>Ancillary Services</th>
<th>Emergency Energy</th>
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<td>2019</td>
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*Data for the last few months are subject to significant change due to the settlement window.
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 & DECs) - Total Number

Number of Bids (Millions)

- **Submitted Bids**
- **Cleared Bids**

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<tr>
<th>Month</th>
<th>Submitted Bids</th>
<th>Cleared Bids</th>
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Virtual Bids (INC & DEC) - Total Volume

![Bar Chart Showing Total Volume of Virtual Bids by Month]

- **Submitted MWh**
- **Cleared MWh**

Months: MAY17, JUN17, JUL17, AUG17, SEP17, OCT17, NOV17, DEC17, JAN18, FEB18, MAR18, APR18, MAY18, JUN18, JUL18, AUG18, SEP18, OCT18, NOV18, DEC18, JAN19, FEB19, MAR19, APR19, MAY19

*Legend:* Submitted MWh vs Cleared MWh
Up-To-Congestion Transactions - Total Number
Up-To-Congestion Transactions - Total Volume

MWh (Millions)

- Submitted MWh
- Cleared MWh

[Graph showing monthly submitted and cleared MWh from May 2017 to May 2019]
INCs, DECs and Up-To-Congestion Transactions - Total Number
Energy Market

Congestion and FTR Summary
## FTR Funding

<table>
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<tr>
<th>Period</th>
<th>Surplus / Underfunding</th>
<th>Payout Ratio</th>
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<tr>
<td>May, 2019</td>
<td>$16,905,354</td>
<td>100%</td>
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<tr>
<td>2019</td>
<td>$79,799,837</td>
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<tr>
<td>2018/2019</td>
<td>$111,676,817</td>
<td>100%</td>
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FTR Revenue vs. FTR Target Allocation

$ Millions

- Total FTR Revenues
- Total FTR Targets

MAY17 | JUN17 | JUL17 | AUG17 | SEP17 | OCT17 | NOV17 | DEC17 | JAN18 | FEB18 | MAR18 | APR18 | MAY18 | JUN18 | JUL18 | AUG18 | SEP18 | OCT18 | NOV18 | DEC18 | JAN19 | FEB19 | MAR19 | APR19 | MAY19

$0 | $100 | $200 | $300 | $400 | $500 | $600
Monthly FTR Payout Ratio
Ten Most Heavily Congested Transmission Facilities - Overall, May

The ten most heavily congested facilities account for 71% of total congestion for May.
Ten Most Heavily Congested Transmission Facilities - Overall, 2019

The ten most heavily congested facilities account for 49% of total congestion for 2019.

- Conastone-Peach Bottom 500 (EHV)
- Siegfried 230/115 T5 (PPL)
- APSOUTH Interface (EHV)
- EAST Interface (EHV)
- CPL-DOM Interface (EHV)
- Argenta-Palisades 345 (MISO)
- Ashburn-Pleasant View 230 274D (DOM)
- Miami Fort-Tanners Creek 345 (AEP IM-DEOK)
- Graceton-Safe Harbor 230 (BGE)
- Facerock Serial Device 69 (PPL)
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)

MAY17 JUL17 OCT17 JAN18 MAY18 JUL18 OCT18 JAN19 MAY19
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 May = $-1.73
Percent of hours in which the direction of flow is consistent with price differentials = 72.18%
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 May = $-1.15
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 May = $2.55
Percent of hours in which the direction of flow is consistent with price differentials = 35.35%
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

- Net M2M Credit ~ MISO (Millions)
- Net M2M Credit ~ MISO/Total FTR Targets (%)
Ancillary Service Market

Summary
Synchronized Reserve and Synchronous Condenser Costs

$ Millions

MAY17  JUN17  JUL17  AUG17  SEP17  OCT17  NOV17  DEC17  JAN18  FEB18  MAR18  APR18  MAY18  JUN18  JUL18  AUG18  SEP18  OCT18  NOV18  DEC18  JAN19  FEB19  MAR19  APR19  MAY19

Synchronized Reserve Market Payments
Synchronous Condenser Payments
Load-Adjusted Synchronized Reserve and Synchronous Condenser Costs

- Synchronized Reserve Market Payments / MWh
- Synchronous Condenser Payments / MWh

Chart shows the costs in cents per MWh for various months from May 2017 to May 2019.
DR Participation in PJM Regulation Markets

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

- Y-axis: $ Millions
- X-axis: Months (MAY17 to MAY19)
- Data ranges from $0.0 to $0.6 for Total Payments and 0 to 15,000 for MWh Cleared.
DR Participation in PJM Synchronized Reserve Markets

![Graph showing Total Payments ($ Millions) and MWh Cleared (MWh) from May 2017 to May 2019.](image-url)
Regulation Market Daily Prices and Charges

- **Total Daily Regulation Charges ($ Millions)**
- **Minimum Hourly Price ($/MWh)**
- **Average Hourly Price ($/MWh)**
- **Maximum Hourly Price ($/MWh)**
Synchronized Reserve Market Daily Prices and Charges

- Total Daily Synchronized Reserve Charges ($ Millions)
- Minimum Hourly Price ($/MWh)
- Average Hourly Price ($/MWh)
- Maximum Hourly Price ($/MWh)