Markets Report

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Executive Summary

- PJM Wholesale Cost for 2019 is $48.98/MWh, down from full-year 2018 costs of $60.00/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 December, temperatures were mild for most of the month. Thus, the sum of Heating and Cooling Degree Days was below its historic average. (Slides 8-10)
- Because temperatures were mild, Energy use was also below the historic average. (Slides 8-10)
- In December, uplift did not exceed $800,000 on any days. (Slides 21 & 22)
Executive Summary

• Load-weighted average LMP for 2019 is $27.15/MWh: (Slides 28-29)
  – December 2019 was $22.50/MWh, which is considerably lower than both December 2018 ($31.00/MWh) and December 2017 ($40.80/MWh).

• FTR revenue adequacy for the month of December is 100% and the 2019-2020 Planning Year is currently fully funded. (Slides 44-47)

• Congestion remains low and is in-line with values seen last December. (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

Heating Degree Days + Cooling Degree Days

TWh

Dec18 | Jan19 | Feb19 | Mar19 | Apr19 | May19 | Jun19 | Jul19 | Aug19 | Sep19 | Oct19 | Nov19 | Dec19

0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0
Historic Average Weather and Energy versus Current Month - Daily

Percent of Daily Average

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

0% - 200%
Average Fuel Prices - Daily

Fuel Price Source: S&P Global Platts

- Average Gas – $2.13
- Average Coal – $1.77
- Average Oil – $13.52
- Average LMP – $23.33
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 December = $0.07
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 - December

'MOther' includes Hydro, Oil, Solar, Wind, and Other
‘Other’ includes Flywheels, Multiple Fuels, Storage, and Other Renewables
Operating Reserve
(Uplift)
Daily Uplift - December

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

$ Millions

$0.0

$0.5

$1.0

$1.5

$2.0

01DEC2019
02DEC2019
03DEC2019
04DEC2019
05DEC2019
06DEC2019
07DEC2019
08DEC2019
09DEC2019
10DEC2019
11DEC2019
12DEC2019
13DEC2019
14DEC2019
15DEC2019
16DEC2019
17DEC2019
18DEC2019
19DEC2019
20DEC2019
21DEC2019
22DEC2019
23DEC2019
24DEC2019
25DEC2019
26DEC2019
27DEC2019
28DEC2019
29DEC2019
30DEC2019
31DEC2019
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.
Deviations Balancing Operating Reserve Rates
Energy Market

LMP Summary
Load-Weighted Average LMP

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<tr>
<th>Month</th>
<th>$/MWh</th>
</tr>
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<tbody>
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<tr>
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<td>NOV19</td>
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</tr>
<tr>
<td>DEC19</td>
<td>$23</td>
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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

Percentage of 5-Minute Intervals

Graph showing the percentage of intervals with price posting suspensions and reruns for each month from DEC17 to DEC19.
Energy Market

Demand Response Summary
*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 Volume

- MWh ( Millions)
- Submitted MWh
- Cleared MWh

Month: DEC17, JAN18, FEB18, MAR18, APR18, MAY18, JUN18, JUL18, AUG18, SEP18, OCT18, NOV18, DEC18, JAN19, FEB19, MAR19, APR19, MAY19, JUN19, JUL19, AUG19, SEP19, OCT19, NOV19, DEC19

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Up-To-Congestion Transactions - Total Number

Number of Transactions (Millions)

- Submitted Transactions
- Cleared Transactions

<table>
<thead>
<tr>
<th>Month</th>
<th>DEC17</th>
<th>JAN18</th>
<th>FEB18</th>
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Up-To-Congestion Transactions - Total Volume

MWh (Millions)

- Submitted MWh
- Cleared MWh

| Month  | DEC17 | JAN18 | FEB18 | MAR18 | APR18 | MAY18 | JUN18 | JUL18 | AUG18 | SEP18 | OCT18 | NOV18 | DEC18 | JAN19 | FEB19 | MAR19 | APR19 | MAY19 | JUN19 | JUL19 | AUG19 | SEP19 | OCT19 | NOV19 | DEC19 |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
INCs, DECs and Up-To-Congestion Transactions - Total Number

Number of Transactions (Millions)

- **Submitted Transactions**
- **Cleared Transactions**

<table>
<thead>
<tr>
<th>Month</th>
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INCs, DECs and Up-To-Congestion Transactions - Total Volume

MWh (Millions)

- Submitted MWh
- Cleared MWh

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Energy Market

Congestion and FTR Summary
### FTR Funding

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<tr>
<th>Period</th>
<th>Surplus / Underfunding</th>
<th>Payout Ratio</th>
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</thead>
<tbody>
<tr>
<td>December, 2019</td>
<td>$5,657,313</td>
<td>100%</td>
</tr>
<tr>
<td>2019</td>
<td>$145,651,550</td>
<td>100%</td>
</tr>
<tr>
<td>2019/2020</td>
<td>$65,851,713</td>
<td>100%</td>
</tr>
</tbody>
</table>
FTR Revenue vs. FTR Target Allocation

- Total FTR Revenues
- Total FTR Targets

$ Millions

- DEC17
- JAN18
- FEB18
- MAR18
- APR18
- MAY18
- JUN18
- JUL18
- AUG18
- SEP18
- OCT18
- NOV18
- DEC18
- JAN19
- FEB19
- MAR19
- APR19
- MAY19
- JUN19
- JUL19
- AUG19
- SEP19
- OCT19
- NOV19
- DEC19

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Ten Most Heavily Congested Transmission Facilities - Overall, December

The ten most heavily congested facilities account for 61% of total congestion for December.

- Wescosville 500/138 T3 (PPL)
- PA-CENT Interface (PPL)
- Nottingham Reactor 230 (PECO)
- Miami Fort–Tanners Creek 345 (AEP IM–DEOK)
- Facercrock Serial Device 69 (PPL)
- Argenta–Palisades 345 (MISO)
- Marblehead 161/138 (MISO)
- Champ–Mohomet 138 (MISO)
- Cedar Creek–Clayton 138 (DPL S)
- Harwood–Susquehanna 230 (PPL)

Overall, December

The ten most heavily congested facilities account for 61% of total congestion for December.
The ten most heavily congested facilities account for 43% of total congestion for 2019.
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)

$/MWh

- DEC17
- MAR18
- JUN18
- AUG18
- DEC18
- MAR19
- JUN19
- AUG19
- DEC19
Monthly Average NYISO Interface Pricing

$/MWh

DEC17 MAR18 JUN18 AUG18 DEC18 MAR19 JUN19 AUG19 DEC19

- PJM NYISO Price (RT)
- NYISO PJM Price (RT)
- PJM NYISO Price (DA)
- NYISO PJM Price (DA)
Positive values represent hours when the PJM price was higher. Negative values represent hours when the PJM price was lower.

Average price difference for December = $-0.64
Percent of hours in which the direction of flow is consistent with price differentials = 71.64%
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 December = $-1.34
Percent of hours in which the direction of flow is consistent with price differentials = 61.56%
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 December = $-0.38
Negative M2M Credit represents PJM payment to MISO.
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

$ Millions

- Synchronized Reserve Market Payments
- Synchronous Condenser Payments

DEC17 | JAN18 | FEB18 | MAR18 | APR18 | MAY18 | JUN18 | JUL18 | AUG18 | SEP18 | OCT18 | NOV18 | DEC18 | JAN19 | FEB19 | MAR19 | APR19 | MAY19 | JUN19 | JUL19 | AUG19 | SEP19 | OCT19 | NOV19 | DEC19

$0 | $12 | $4 | $4 | $4 | $4 | $4 | $4 | $4 | $4 | $4 | $4 | $4 | $4 | $4 | $4 | $4 | $4 | $4 | $4 | $4 | $4 | $4 | $4 | $4 | $4
Load-Adjusted Synchronized Reserve and Synchronous Condenser Costs
DR Participation in PJM Regulation Markets

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

Bar and line chart showing trends from December 2017 to December 2019.
DR Participation in PJM Synchronized Reserve Markets

$ Millions

MWh

Total Payments ($ Millions)
MWh Cleared (MWh)