Transmission Expansion Advisory Committee Meeting

2012 Market Efficiency Analysis
Input Assumptions

March 15, 2012
Market Simulation Input Data

- Study years: 2012, 2015, 2018, 2021, 2026
- PROMOD IV model from Ventyx
- Underlying input data contained in PROMOD Powerbase (February 2012 update)
  - Release contains updates to generation, emissions and fuels
- Powerflow Cases
  - 2012 power flow case to represent today’s “as-is” system
    - ERAG MMWG 2011 Series for 2012 Summer Peak
  - 2016 RTEP power flow case to represent future system
Key Input Parameters

- Fuel prices
- Load and energy
- Demand Response
- Future generation scenario
- Emissions prices
- Transmission topology
- Carrying charge rate and discount rate
Figure 1 - Fuel Price Assumptions

- Coal
- Gas
- OIL-H
- OIL-L

Chart showing projected fuel prices from 2012 to 2026 for different types of fuel.
Load & Energy Input Data

• PJM zonal peak and zonal energy forecast from PJM 2012 Load Forecast Report

Table 1 – Forecast PJM Peak Load and Energy\(^1\)

<table>
<thead>
<tr>
<th>Load</th>
<th>2012</th>
<th>2015</th>
<th>2018</th>
<th>2021</th>
<th>2026</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak (MW)</td>
<td>153,201</td>
<td>162,364</td>
<td>168,228</td>
<td>173,834</td>
<td>182,708</td>
</tr>
<tr>
<td>Energy (GWh)</td>
<td>816,696</td>
<td>863,593</td>
<td>898,358</td>
<td>929,899</td>
<td>979,482</td>
</tr>
</tbody>
</table>

\(^1\) Values reduced by Cleared Energy Efficiency (EE) form RPM.
Demand Response Input Data

- Model zonal demand response consistent with Table B-7 of the 2012 Load Forecast Report.

**Table 2 – Forecast PJM Demand Response**

<table>
<thead>
<tr>
<th>Forecast Year</th>
<th>2012</th>
<th>2015</th>
<th>2018</th>
<th>2021</th>
<th>2026</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand Response (MW)</td>
<td>8,556</td>
<td>14,165</td>
<td>14,165</td>
<td>14,165</td>
<td>14,165</td>
</tr>
</tbody>
</table>
Future Generation Scenarios

• Generation model includes all existing in-service generation plus actively queued generation with an executed ISA less planned generator deactivations [1]
• Installed reserve requirement is met through 2018 study year
• To meet the installed reserve requirement for study years 2021 and 2026, 2,200 MW and 12,400 MW of additional generation will be added to model, respectively
• For study years 2021 and 2026 - new generation will be added in proportion to the regional location and generation type of active generation projects without signed ISAs through Generation Interconnection Queue X

[1] Modeled deactivations include those received on or before of 2/29/2012. (http://www.pjm.com/planning/generation-retirements/~/media/planning/gen-retire/pending-deactivation-requests.ashx)
Figure 2 - PJM Market Efficiency Reserve Margin

- **Forecasted Summer Peak Net Internal Demand**
- **Reserve Requirement**
- **Existing + Expected New Generation - Retirement**

Year: 2012 to 2026

MW:
- 2012: 130,000 MW
- 2026: 210,000 MW

MW Changes:
- 2012 to 2022: 2,200 MW
- 2022 to 2026: 12,400 MW
## Table 3 – Location and Generator Type to Maintain Reserve Margin

<table>
<thead>
<tr>
<th>Region</th>
<th>Nuclear</th>
<th>Coal</th>
<th>Gas</th>
<th>Oil</th>
<th>Wind</th>
<th>Other Renewables</th>
<th>Total Region</th>
</tr>
</thead>
<tbody>
<tr>
<td>AECO/DPL/JCPL/PECO/PSEG</td>
<td>0.8%</td>
<td>0.2%</td>
<td>18.1%</td>
<td>0.0%</td>
<td>0.6%</td>
<td>1.1%</td>
<td>20.7%</td>
</tr>
<tr>
<td>AEP/APS/COM/DAY/DUQ/ATSI/DOEK</td>
<td>1.0%</td>
<td>4.2%</td>
<td>18.7%</td>
<td>0.0%</td>
<td>11.2%</td>
<td>2.6%</td>
<td>37.6%</td>
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<tr>
<td>BGE/PEP</td>
<td>3.4%</td>
<td>0.0%</td>
<td>13.4%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>16.8%</td>
</tr>
<tr>
<td>DOM</td>
<td>0.0%</td>
<td>0.0%</td>
<td>13.4%</td>
<td>0.0%</td>
<td>0.3%</td>
<td>0.1%</td>
<td>10.1%</td>
</tr>
<tr>
<td>ME/PN/PPL</td>
<td>0.0%</td>
<td>0.1%</td>
<td>13.8%</td>
<td>0.0%</td>
<td>0.6%</td>
<td>0.3%</td>
<td>14.8%</td>
</tr>
<tr>
<td>All Regions</td>
<td>5.2%</td>
<td>4.4%</td>
<td>77.3%</td>
<td>0.0%</td>
<td>12.6%</td>
<td>4.1%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>
CO2 emission price assumptions set to zero for all study years
- Reflects the stalled federal legislation regarding greenhouse gases and CO2

SO2 & NOx emission price
- Forecasts reflect the Cross State Air Pollution Rule which replaced the Federal Clean Air Transportation Rule (CATR) and Clean Air Interstate Rule (CAIR).
- CSAPR results in more stringent emissions reduction requirements than the CATR rule and consequently much higher prices through the compliance years.
- Ventyx original forecast for SO2 and Annual NOx is reflected through the 2017 Study Year, however the prices are set to 0 after this period as allowances are presumed to no longer be scarce due to unit environmental retrofits and unit retirements resulting in emissions compliance targets being met.
- Ventyx forecast of Seasonal NOx prices is used for the whole study period (2012-2026) reflecting continued demand for allowances in the summer season.
SO2 Emission Prices

Figure 2 - SO2 Emission Allowance Price Assumptions

$/Allowance vs. Year

Year: 2012 to 2026

The graph illustrates the assumed price for SO2 emission allowances from 2012 to 2026, showing a peak around 2014 followed by a decline in subsequent years.
Figure 3 - NOx Emission Allowance Price Assumptions

- Annual NOx
- Seasonal NOx
Transmission Topology and Constraints

- **Power flow Cases**
  - 2012 power flow case to represent today’s “as-is” system
  - 2016 RTEP power flow case to represent future system

- **Thermal Constraints**
  - NERC Book of Flowgates
  - Planning study results for monitored facilities and monitored/contingency pair facilities
  - Historical PJM congestion events

- **Voltage Constraints**
  - PJM reactive interface limits
  - MW limits based on historical values for “as-is” case adjusted for future upgrade impacts in RTEP case years
## Market Efficiency Model Inputs

### Backbone Line Upgrades

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Market Efficiency Model Year</td>
<td>Not Modeled</td>
<td>2015 and beyond</td>
<td>2018 and beyond</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Carrying Charge Rate and Discount Rate

- Discount rate and levelized carrying charge rate developed using information contained in TO Formula Rate sheets (Attachment H) [1]
- Discount rate based on weighted average after-tax embedded cost of capital [2]
  
  Discount rate = 7.7%

- Levelized annual carrying charge rate based on weighted average net plant carrying charge levelized over an assumed 45 year life of project [3]
  
  Levelized Annual Carrying Charge Rate = 17.8%

[2] Average weighted by TO total capitalization
[3] Average weighted by Total Transmission Plant In service included in PJM Tariff
Next Steps

- Determine Reactive Interface Ratings
- PJM Board approval of input assumptions in April
- Begin analysis with regular updates to TEAC