Transmission Expansion Advisory Committee Meeting

2011 Market Efficiency Analysis
Preliminary Input Assumptions

March 10, 2011
Market Simulation Input Data

- PROMOD IV model from Ventyx
- Underlying input data contained in PROMOD Powerbase (February 2011 update)
  - Release contains updates to generation, emissions and fuels
- Powerflow Cases
  - 2011 power flow case to represent today’s “as-is” system
    - (ERAG MMWG 2010 Series for 2011 Peak)
  - 2015 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
  – Duke Energy Ohio and Duke Energy Kentucky included in PJM
• Carrying charge rate and discount rate
Figure 1 - Fuel Price Assumptions

- **Coal**
- **Gas**
- **OIL-H**
- **OIL-L**
• PJM zonal peak and zonal energy forecast from PJM 2011 Load Forecast Report
• Historical zonal hourly loads used to develop zonal hourly load shape

<table>
<thead>
<tr>
<th></th>
<th>2011</th>
<th>2014</th>
<th>2017</th>
<th>2020</th>
<th>2025</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak (MW)</td>
<td>154,213</td>
<td>164,209</td>
<td>168,880</td>
<td>173,895</td>
<td>180,880</td>
</tr>
<tr>
<td>Energy (GWh)</td>
<td>818,639</td>
<td>869,212</td>
<td>894,481</td>
<td>923,339</td>
<td>957,304</td>
</tr>
</tbody>
</table>

*ATSI & DEOK Load included in all years and values reduced by cleared Energy Efficiency from RPM
Demand Response Input Data

- Model zonal demand response consistent with Table B-7 of the 2011 Load Forecast Report with the addition of any cleared FRR resources

<table>
<thead>
<tr>
<th>Demand Response (MW)</th>
<th>2011</th>
<th>2014</th>
<th>2017</th>
<th>2020</th>
<th>2025</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7,238</td>
<td>9,452</td>
<td>9,452</td>
<td>9,452</td>
<td>9,452</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
- Installed reserve requirement is met through study year 2019
- To meet installed reserve requirement for study years 2020 and 2025, 900 MW and 9,000 MW of new generation will be added to model, respectively
- New generation will be added to PJM regions in proportion to the regional location and regional generation type of planned generation projects in Generation Interconnection Queues through Queue W
Figure 2 - PJM Market Efficiency Reserve Margin

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

Year: 2011-2025
MW: 130,000-210,000

900 MW
9,000 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>1.30%</td>
<td>0.19%</td>
<td>27.49%</td>
<td>0.06%</td>
<td>0.81%</td>
<td>3.32%</td>
<td>33.16%</td>
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<tr>
<td>AEP/APS/COM/DAY/DUQ/ATSI/DOEK</td>
<td>1.57%</td>
<td>5.44%</td>
<td>14.46%</td>
<td>0.00%</td>
<td>16.38%</td>
<td>3.14%</td>
<td>40.98%</td>
</tr>
<tr>
<td>BGE/PEP</td>
<td>5.09%</td>
<td>0.00%</td>
<td>7.63%</td>
<td>0.02%</td>
<td>0.00%</td>
<td>0.03%</td>
<td>12.77%</td>
</tr>
<tr>
<td>DOM</td>
<td>0.00%</td>
<td>0.00%</td>
<td>3.09%</td>
<td>0.00%</td>
<td>0.69%</td>
<td>0.35%</td>
<td>4.13%</td>
</tr>
<tr>
<td>ME/PN/PPL</td>
<td>4.97%</td>
<td>0.16%</td>
<td>2.07%</td>
<td>0.01%</td>
<td>1.13%</td>
<td>0.63%</td>
<td>8.96%</td>
</tr>
<tr>
<td>Total Region</td>
<td>12.93%</td>
<td>5.78%</td>
<td>54.74%</td>
<td>0.08%</td>
<td>19.01%</td>
<td>7.46%</td>
<td>100.00%</td>
</tr>
</tbody>
</table>
Emission Prices

• NOx emission price allowance assumptions will be set to zero for all study years.
  – Forecasts reflect the Federal Clean Air Transportation Rule (CATR) and not the Federal Clean Air Interstate Rule (CAIR) due to courts vacating CAIR and EPAs response of CATR
  – Higher NOx emission targets using CATR resulted in targets already being met and thus there is no emission penalty.
  – Ventyx original data had a small NOx value for year 2011 which was set to zero so data is consistent throughout study years.

• CO2 emission price assumptions set to zero for all study years
  – Reflects the stalled federal legislation regarding greenhouse gases and CO2

• SO2 emission price
  – Forecasts reflect the Federal Clean Air Transportation Rule (CATR) and not the Federal Clean Air Interstate Rule (CAIR) due to courts vacating CAIR and EPAs response of CATR
Figure 2 - SO2 Emission Allowance Price Assumptions

The graph illustrates the projected SO2 emission allowance price over the years from 2011 to 2025. The price starts at $0 in 2011 and increases gradually each year, reaching approximately $600 in 2025.
Transmission Topology and Constraints

- **Powerflow Cases**
  - 2011 power flow case to represent today’s “as-is” system
  - 2015 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
Carrying Charge Rate and Discount Rate

- Discount rate and levelized carrying charge rate developed using information contained in TO Formula Rate sheets posted on PJM web site
- Discount rate based on weighted average after-tax embedded cost of capital (average weighted by TO total capitalization)
  \[
  \text{Discount rate} = 7.7\%
  \]
- Levelized annual carrying charge rate based on weighted average net plant carrying charge (average weighted by TO total capitalization) levelized over an assumed 45 year life of project
  \[
  \text{Levelized Annual Carrying Charge Rate} = 17.9\%
  \]
Next Steps

- Finalize Input assumptions
- PJM Board approval of input assumptions in June
- Begin analysis with regular updates to TEAC