Market Efficiency
Economic component of PJM RTEP Process

- Determine which reliability upgrades, if any, have an economic benefit if accelerated or modified.
- Identify new transmission upgrades that may result in economic benefits.
- Identify economic benefits associated with “hybrid” transmission upgrades. Such hybrid upgrades resolve reliability issues but are intentionally designed in a more robust manner to provide economic benefits in addition to resolving those reliability issues.
Market Efficiency Process

- Develop input assumptions and model
- Setup case
- Benchmark as-is congestion results to actual congestion
- Determine congestion for all study years
  - Post congestion results
- Determine solution options
  - Accept member proposals
- Evaluate solution options
  - Perform benefit/cost test
  - Review results with members
- Recommend project(s)
  - Final review with stakeholders and approval from PJM board
<table>
<thead>
<tr>
<th>Year 0</th>
<th>Year 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>Jan</td>
</tr>
<tr>
<td>Feb</td>
<td>Feb</td>
</tr>
<tr>
<td>Mar</td>
<td>Mar</td>
</tr>
<tr>
<td>Apr</td>
<td>Apr</td>
</tr>
<tr>
<td>May</td>
<td>May</td>
</tr>
<tr>
<td>Jun</td>
<td>Jun</td>
</tr>
<tr>
<td>Jul</td>
<td>Jul</td>
</tr>
<tr>
<td>Aug</td>
<td>Aug</td>
</tr>
<tr>
<td>Sep</td>
<td>Sep</td>
</tr>
<tr>
<td>Oct</td>
<td>Oct</td>
</tr>
<tr>
<td>Nov</td>
<td>Nov</td>
</tr>
<tr>
<td>Dec</td>
<td>Dec</td>
</tr>
</tbody>
</table>

**Market Efficiency 24 Month and 12 month Proposed Cycles**

**Develop Assumptions (Y1, Y5)**

**Market Efficiency Analysis (Y1, Y5)** (Accelerations and Modifications)

**Identify and evaluate Solution Options (Accelerations and Modifications)**

**Final Review with TEAC and approval by Board**

---

**Develop Assumptions (Y5, Y8, Y11, Y15)**

**Market Efficiency Criteria Analysis (Y5, Y8, Y11, Y15)**

**Market Efficiency Analysis (Y5, Y8, Y11, Y15)**

**Identify proposed solutions**

**Update significant assumptions (Y4, Y7, Y10, Y14)**

**Analysis of market solutions and support of benefits of reliability solutions (Y4, Y7, Y10, Y14)**

**Independent Consultant reviews of buildability**

**Adjustments to solution options by PJM on analysis**

---

**Develop Assumptions (Y1, Y5)**

**Market Efficiency Analysis (Y1, Y5)** (Accelerations and Modifications)

**Identify and evaluate Solution Options (Accelerations and Modifications)**

**Final Review with TEAC and approval by Board**
12-Month Cycle

• **Process and Results**
  • 6 month window for analysis of Market Efficiency needs after development of input assumptions
  • Year 1-5 acceleration and modifications
  • Dedicated to accelerations and modifications to RTEP approved projects only
  • Final review with TEAC and board approval at end of each year
24-Month Cycle

- Process and Results
  - 6 month window for analysis of Market Efficiency needs after development of input assumptions
  - Year 5-15 new enhancements
  - 4 month proposal window
  - 8 months of analysis on proposed solutions and adjustments to solution options
    - Updates to input assumptions
    - Independent consultant review of ability to build
    - Review appropriate reliability projects for economic benefits
  - Solutions approved at end of 24-month cycle would need to be in service in 3 ½ years or longer
  - Projects identified for year 5 may be delayed to year 6 if necessary
  - Final review with TEAC and Board approval at end of 24-month cycle
Market Efficiency Tools

- **Powerbase**: Database used to maintain energy market data and transmission representation
- **PROMOD**: Simulation engine which performs hourly unit commitment and dispatch
- **PAT**: Analysis tool that supports PROMOD
Market Efficiency Data inputs

<table>
<thead>
<tr>
<th>Input</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel prices</td>
<td>Ventyx, Stakeholders, PJM Chief Economist</td>
</tr>
<tr>
<td>Emission Prices</td>
<td>Ventyx, Stakeholders, PJM Chief Economist</td>
</tr>
<tr>
<td>Annual PJM Peak Load and Energy</td>
<td>PJM Load Forecast Report</td>
</tr>
<tr>
<td>Model -Topology</td>
<td>PJM Actual and planned RTEP</td>
</tr>
<tr>
<td>Demand Response</td>
<td>RPM</td>
</tr>
<tr>
<td>Generation</td>
<td>Existing and Future planned in-service</td>
</tr>
<tr>
<td>Carry Charge</td>
<td>Transmission Owners</td>
</tr>
<tr>
<td>Discount Rate</td>
<td>Transmission Owners</td>
</tr>
</tbody>
</table>
Case setup – major components

• Internal reactive interfaces ratings
  ➢ Perform PV analysis and historical benchmark

• Thermal ratings
  ➢ Model summer and winter ratings

• External flow contributions on PJM system
  ➢ Activate appropriate areas
  ➢ Scale external areas if necessary
  ➢ Benchmark to historical
Cost/Benefit Analysis

• Present value of annual project benefit for first 15 years of project life compared to present value of annual project cost for first 15 years of project life

• Project is considered economic and included in RTEP if B/C ratio exceeds 1.25:1
Total Annual Enhancement Project Benefit = Energy Market Benefit + Reliability Pricing Model Benefit

- Energy Market Benefit = 70%*(Change total production cost) + 30%*(Change in load energy payment)

- Reliability Pricing model Benefit = 70%*(Change total system capacity cost) + 30%*(Change in load capacity payment)

*Load energy payment reduced for cleared transmission or capacity rights
**For lower voltage facilities only include zones with a decrease in load energy or capacity payment
Market Efficiency Cost Allocation
Market Efficiency Cost allocation divided into two categories.

– Regional Facilities and Necessary Lower Voltage Facilities
  • 500 KV and above
  • Below 500 KV facilities that are necessary as a result of higher voltage regional facility
  • Allocation Method same as Reliability Facilities
    – Load Ratio Share

– Lower Voltage Facilities
  • Below 500 KV that are not necessary as a result of higher voltage regional facility
    – Allocation method determined from zones who benefit from project through decreases in net load payments
## Market Efficiency Lower Voltage Facility Cost Allocation example

Project Upgrade Cost = $5 Million

<table>
<thead>
<tr>
<th>Zone</th>
<th>Net Load Payment Before Upgrade ($millions)</th>
<th>Net Load Payment After Upgrade ($millions)</th>
<th>Delta in Net Load Payment ($ millions)</th>
<th>% of Net Load Payment Reduction</th>
<th>Cost ($millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone 1</td>
<td>10</td>
<td>8</td>
<td>-2</td>
<td>11.76%</td>
<td>$0.59</td>
</tr>
<tr>
<td>Zone 2</td>
<td>12</td>
<td>4</td>
<td>-8</td>
<td>47.06%</td>
<td>$2.35</td>
</tr>
<tr>
<td>Zone 3</td>
<td>14</td>
<td>16</td>
<td>2</td>
<td>0%</td>
<td>$0</td>
</tr>
<tr>
<td>Zone 4</td>
<td>5</td>
<td>8</td>
<td>3</td>
<td>0%</td>
<td>$0</td>
</tr>
<tr>
<td>Zone 5</td>
<td>13</td>
<td>12</td>
<td>-1</td>
<td>5.88%</td>
<td>$0.29</td>
</tr>
<tr>
<td>Zone 6</td>
<td>8</td>
<td>14</td>
<td>6</td>
<td>0 %</td>
<td>$0</td>
</tr>
<tr>
<td>Zone 7</td>
<td>11</td>
<td>10</td>
<td>-1</td>
<td>5.88%</td>
<td>$0.29</td>
</tr>
<tr>
<td>Zone 8</td>
<td>14</td>
<td>9</td>
<td>-5</td>
<td>29.41%</td>
<td>$1.47</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>Total</strong></td>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
<td><strong>$5.00</strong></td>
</tr>
</tbody>
</table>

*Net Load Payment equals Gross Load Payment minus FTR Credits derived from the Net Present Value for 15 years of project*
Miscellaneous Studies

- Interregional analysis
- Regulatory requests
- Internal studies
- Expansion studies