Long-Term Regional Transmission Planning (LTRTP) Update

PJM Staff
Long-Term Regional Transmission Planning Workshop
Nov 9, 2023
Review LTRTP workshop feedback
Review LTRTP Framework Revisions
Manual Update
Stakeholder Feedback on workshop 4 content
Next Steps
LTRTP Workshop Feedback
• Three LTRTP workshops held so far (7/21, 8/22 and 9/21)
  – Long Term planning discussions also occurred in 2022

• PJM received valuable feedback on how to approach public policies in LTRTP scenarios
  – Concerns raised on whether it is appropriate to model, plan and cost allocate all public policy requirements as reliability projects in the LTRTP framework

• PJM considered this feedback and revised the LTRTP scenarios to distinguish between (1) transmission needs related to core reliability and (2) additional transmission solutions that states may voluntarily sponsor
LTRTP Framework
(1) Scenario based Reliability Planning

(2) Resource mix assumption updates

(3) Projected loads (electrification / data center)

(4) Capacity expansion process to develop resource mix for scenarios

(5) Broad set of economic benefits
Scenarios

Analysis

Solutions

Scenarios

Needs

Capacity Expansion

LTRTP Framework
Long-Term Scenario Development

- Scenarios must be plausible
- Scenarios and sensitivities capture realistic ranges of selected inputs
- Scenario assumptions and methods are transparent
• First, PJM categorized Public Policy Requirements (PPR) into 5 buckets
  1. Load PPRs: BTM, Electrification, etc.
  2. Federal retirement PPRs: EPA
  3. State retirement PPRs: IL CEJA, NJ CO₂ rule
  4. Federal new generation PPRs: IRA
  5. State new generation PPRs: RPS, OSW, etc.
• Next, PJM allocated these PPRs to the three LTRTP scenarios and relabeled them
  – Base Scenario will address reliability needs and consider PPRs 1-4, and some level of state new generation PPRs to meet the 1-in-10 reliability target
  – Medium and High Scenarios have additional PPRs and allow states to voluntarily sponsor additional transmission needs and solutions through SAA
LTRTP Scenarios (Previous Framework)

- **Near Term – RTEP**
  - Year 5
- **Planning Horizon**
  - Year 8
  - Year 15

- **High**
  - (e.g. Goals, High Electrification)
- **Primary**
  - (All Statutory Policies)
- **Low**
  - (e.g. Low Offshore Wind, Data Centers)
LTRTP Scenarios (Revised Framework)

- **Planning Horizon**
  - **Year 5**
  - **Year 8**
  - **Year 15**

- **Near Term – RTEP**

- **High – State Voluntary, SAA**
  - (e.g. High Electrification)

- **Medium – State Voluntary, SAA**
  - (All Statutory Policies)

- **Base – Required for Reliability**
  - (Load, Retirements, Queue to 1-in-10)

- PJM can consider performing sensitivities, e.g. for lower data center load
Use of Scenarios

• **Base Scenario**
  - Identifies Intermediate and Long-Term Reliability needs and informs Near-Term solutions

• **Medium and High Scenarios**
  - Identify needs that states may voluntarily sponsor via SAA
  - Inform PJM reliability actions (including low scenarios or sensitivities)
    • Identify robust solutions (e.g. to more EV growth or fewer data centers)
    • Postpone posting of needs
    • Accelerate needs and solutions if needs appear across multiple scenarios and sensitivities
Approach to New LTRTP Scenarios and Cost Allocation

**PROJECT CATEGORY**

**LTRTP Reliability Projects**
(PJM Must-Build)
- Base

**LTRTP Policy Projects**
(Build if Selected by States)
- Medium
- High

**Cost Allocation**

- Current Reliability CA
- State Agreement Approach
- LTRTP Portfolio of Reliability and SAA Projects
- States Do Not Agree and No Selection
- LTRTP Reliability Projects Only

*Only Manual Changes Required*
### Matrix – Policies by LTRTP Scenario

<table>
<thead>
<tr>
<th>Policies</th>
<th>Base</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load Policies* (e.g. Electrification, BTM)</td>
<td>![Not Included]</td>
<td>![Included]</td>
<td>High</td>
</tr>
<tr>
<td>Federal Policy Retirements (e.g. EPA)</td>
<td>![Included]</td>
<td>![Included]</td>
<td>![Included]</td>
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<tr>
<td>State Policy Retirements (e.g. CO₂, CEJA)</td>
<td>![Included]</td>
<td>![Included]</td>
<td>![Included]</td>
</tr>
<tr>
<td>Inflation Reduction Act</td>
<td>![Included]</td>
<td>![Included]</td>
<td>![Included]</td>
</tr>
<tr>
<td>Replacements/Generation Policies (e.g. RPS, Offshore wind)</td>
<td>Use queue to meet 1-in-10</td>
<td>Statutory</td>
<td>Statutory**</td>
</tr>
<tr>
<td>Clean Energy Objectives ***</td>
<td>![X]</td>
<td>Statutory</td>
<td>Statutory**</td>
</tr>
</tbody>
</table>

**Legend**
- PJM’s annual load forecast
- Not Included
- Included

**Notes:** Sensitivity for econ. at-risk units; * Includes Data Centers; ** Sensitivities for goals and future PPR; *** As possible; will work with states on modeling
Background
- Existing generation is mainly thermal
- 98% of pre-ISA MW is renewables or storage

Generation Replacement Approach

Medium Scenario Replacements
- Use queue data and state-identified locations
- Select projects with capacity expansion to meet load given retirements and policies

Base Scenario
- Keep only queue projects
- Add/remove/scale projects until 1-in-10 based on economics
LTRTP Analysis Pillar - Reliability Model Building & Analysis

- Reliability analysis is the primary focus
Long-Term Planning Process

• Extend two year cycle to three year cycle to account for additional scenarios, sensitivities and transmission needs

• Supplement 8 year power flows with 15 year power flows
  – 8 year power flow model will be used to perform both thermal and voltage analysis and will replace the 10 year model used for voltage analysis
  – 15 year model will be used to perform thermal analysis and limited voltage analysis
    • Medium/High/Base scenarios
  – Linear interpolation using year 5, 8 and 15 thermal analysis to determine required in-service dates
Recommended Enhancements To Long-Term Planning Process

1. Develop assumptions and build Year 5 & 8 cases
2. Reliability criteria analysis for Years 5-8
3. Identify and evaluate solution options for Years 5-8
4. Review with TEAC & PJM Board
5. Develop assumptions for Years 6-15 & build Year 15 cases
6. Develop Year 6-15 Assumptions
7. Reliability criteria analysis for Years 9-15
8. Identify and evaluate solution options for Years 6-15
9. Review with TEAC & PJM Board

* Seek transmission solutions for less complex needs in the near-term 18-month cycle window, and address remaining more complex needs in the long-term 36-month cycle window.
• The LTRTP process will begin every three years in January
• During the first year of the three year cycle a set of assumptions for years 6-15 will be developed and intermediate-term (year 8) and long-term (year 15) power flow models will be built
  – Develop year 8 and 15 cases in parallel with year 5 cases after capacity expansion developed
  – Seek transmission solutions for less complex needs in the near-term 18-month cycle window, and seek remaining more complex needs in the long-term 36-month cycle window
• PJM will determine on a case by case basis which needs will be considered complex based largely on the concentration, magnitude and voltage level of reliability violations in a particular area of the system
Reliability Criteria Analysis For Years 8 & 15

• N-1, generator & load deliverability (years 8 & 15)
  – Monitor 230 kV+ in years 8 and 15; monitor lower kV in year 8 for use as necessary to inform years 5-8
  – Ignore terminal equipment limitations
  – Contingencies
    • Singles & Towers (Year 8 and 15)
    • Stuck breakers and bus faults (Year 8 only)
  – Voltage analysis focusing on 230 kV+ in Year 8 and 500 kV+ in Year 15 as needed

• N-1-1 (year 8 only)
  – Thermal & voltage analysis focusing on 230 kV+
Required In-Service Date For Years 6-15

- Replace DFAX extrapolation with linear interpolation of thermal results from year 5, 8 and 15 analyses to determine required in-service dates
  - Use year 5 and year 8 thermal loadings from generator deliverability, load deliverability and N-1-1 to determine year 5-8 required in-service dates
  - Use year 8 and year 15 thermal loadings from generator and load deliverability to determine year 8-15 required in-service date

<table>
<thead>
<tr>
<th>Line</th>
<th>Rating (MVA)</th>
<th>Yr 5</th>
<th>Yr 6</th>
<th>Yr 7</th>
<th>Yr 8</th>
<th>Yr 9</th>
<th>Yr 10</th>
<th>Yr 11</th>
<th>Yr 12</th>
<th>Yr 13</th>
<th>Yr 14</th>
<th>Yr 15</th>
</tr>
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<tbody>
<tr>
<td>A-B</td>
<td>3500</td>
<td><strong>98.0%</strong></td>
<td>98.3%</td>
<td>98.6%</td>
<td><strong>98.9%</strong></td>
<td>99.2%</td>
<td>99.5%</td>
<td>99.8%</td>
<td>100.1%</td>
<td>100.4%</td>
<td>100.7%</td>
<td><strong>101.0%</strong></td>
</tr>
</tbody>
</table>
LTRTP Needs Identification

• Once the reliability analysis has been completed on each scenario, PJM will categorize the potential long-lead time transmission needs into reliability and SAA needs, and either post into the near-term RTEP window or into the long-term LTRTP window, depending on the nature of the identified transmission needs.

• For years 6-15, PJM will request window participants to address transmission needs that have transmission solutions with a lead time beyond 5 years.
Solution Identification and Approval

- Transmission solutions must address reliability and SAA needs
- Secondary benefits inform project selection and portfolio savings
Long-Term Planning Projects

• Long-lead ( > 5 years from need identification, typically 230kV and Up)

• Address reliability needs or SAA needs
  – Projects addressing SAA needs are provided to sponsoring states for consideration

• Reliability projects can be accelerated if sufficiently large benefits
1. Projects must address reliability or SAA needs
2. Feasibility assessment – cost and constructability analyses
3. Do-no-harm analysis
4. Secondary benefits to select among alternative projects
5. Other M-14 F Considerations
6. Support states in the identification of solutions for SAA needs
Considerations that Inform Decisions Include:
Cost Containment Commitment
Cost Estimate Review
Evaluation of Impacts on Other Projects
Grid Resiliency/Performance (Includes CSPA)
Net Load Payments
Production Costs
Project Execution Risk
Project Schedule & Timing
Reliability Margin
Scope/Constructability/Diversity of Route
Sensitivity Analysis
Total System Congestion
• Benefit metrics identify long-lead transmission solutions that maintain reliability at the lowest possible system cost

<table>
<thead>
<tr>
<th>System Cost</th>
<th>Benefit Metrics</th>
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<tbody>
<tr>
<td>Energy Market Benefits</td>
<td>1. Production Cost Savings</td>
</tr>
<tr>
<td>Capital Investment Benefits</td>
<td>2. Avoided Generation Investments</td>
</tr>
<tr>
<td>Enhanced Reliability Benefits</td>
<td>3. Avoided Transmission Investments</td>
</tr>
<tr>
<td>Δ Load Payments = Δ System Costs + Δ Profits</td>
<td></td>
</tr>
</tbody>
</table>

• Alternative benefit metrics are comprehensive load payments + enhanced reliability benefits
**Benefit Metrics – Approach**

- **Latest Approved Near-Term RTEP**
- **Latest Approved Long-Term RTEP**

**Capacity Expansion, Reliability, Production Cost Models**

**System Cost + Enhanced Reliability**

**Δ Benefits**

- **Latest Approved Near-Term RTEP**
- **Latest Approved Long-Term RTEP**

**Current Cycle Long-Term RTEP**

**Capacity Expansion, Reliability, Production Cost Models**

**System Cost + Enhanced Reliability**

**Benefits are calculated for Reliability and SAA Solutions**

**PJM Will consider calculating zonal benefits (But may be easier with load payments)**
Once the window closes:

- PJM staff reviews project proposals
- PJM reports progress to TEAC and produces LTRTP reports for selected projects (1st and 2nd reads)
- LTRTP projects are brought to PJM’s Board for approval
  - State-sponsored projects subject to acceptance by sponsoring state(s), *per* SAA
Long-Term Regional Transmission Planning (LTRTP) Review of Manuals
• PJM has performed an initial review of existing manual language to identify sections that may require update based on the LTRTP framework discussed at these workshops

• M14B – PJM Region Transmission Planning Process
  – Includes specifics on Assumptions, Analysis and Timelines

• M14F – Competitive Planning Process
  – Details specifics around proposal window process
LTRTP Concepts Requiring Update

• Timeline 2 Year process → 3 year process
• Development of additional LT powerflow cases for years 8 and 15
• Update LT analysis procedures
  – DFAX extrapolation to linear interpolation
  – Expansion of analysis to include limited N-1-1 and voltage studies
• Update language that defines qualifications for LT needs
• Additional content in establishing assumptions (e.g. capacity expansion, public policy, etc.)
• Outline process for collecting state policy data
• Acceleration of LT projects/Informing NT Projects
• 1.3 Planning Assumptions and Model Development
  – Seeking input and establishing assumptions
• 2.1 Transmission Planning
  – LT Scenario Analysis
  – Reliability Planning (2.1.2) – 3 Year process
• 2.2 RTEP Process Drivers
  – Addition of LTRTP
• 2.3.14 Long Term Reliability Review
• 2.3.15 Stakeholder Review of and input to Reliability Planning
• Attachment B – Scope of 15 year plan, Scenario Planning Procedure
• Attachment C – Long Term Deliverability Analysis and Upgrades
• 1.1 Proposal Window Type and Duration
  – Timing of LT proposal window
  – 3 year process
  – Update Exhibit 1
• 24-Month Reliability Planning Cycle

• 6.1 Proposal Requirements
  – Add requirements specific to LT projects
Stakeholder Feedback on Workshop 4 Content
Next Steps

• Review any additional feedback and framework updates

• Manual Revisions to follow the normal stakeholder process
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Long Term Regional Transmission Planning Update

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APPENDIX
• The primary goal of LTRTP is reliability, to ensure a reliable energy transition.
• PJM recognizes the importance of economic efficiencies and accounts for them to a large extent in LTRTP by:
  – Planning for an efficient generation fleet via approximating outcome of an efficient market.
  – Addressing reliability needs to enable the efficient fleet will also create economic efficiencies.
  – Utilizing economic benefits to identify reliability solutions that may be accelerated to maximize social welfare.
  – No Market Efficiency Bright Line test.
• PJM Market Efficiency RTEP Planning Process
  – Existing Order 1000 Competitive Windows Market Efficiency process remains Status Quo
    • It includes Bright Line test (B/C Ratio > 1.25).
    • Addresses congestion drivers as needed for longer term horizon (5-8 years).
  – Annual Acceleration and Reevaluation analyses.
  – Targeted Market Efficiency (TMEP) analysis.
Loss of Load Calculation

• PJM thinks an enhanced reliability metric is needed
  – Other benefits assessed under normal operating conditions
  – More robust transmission helps maintain reliability during extreme events
  – Evaluation must be comprehensive to identify solutions with largest social value

• FERC discussed extreme weather scenario in NOPR and could require it

• FERC order 896 - NERC to develop new or modified Reliability Standard concerning extreme weather

• PJM aims to adequately model extreme events
  – PJM will calculate loss of load
  – Monetization may be considered in the future as PJM continues improving extreme weather events’ modeling