Long-Term Regional Transmission Planning (LTRTP) Update

PJM Staff

Long-Term Regional Transmission Planning Workshop

Nov 9, 2023

Agenda

- Review LTRTP workshop feedback
- Review LTRTP Framework Revisions
- Manual Update
- Stakeholder Feedback on workshop 4 content
- Next Steps

LTRTP Workshop Feedback

Modeling Public Policies

- 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

Workshop Focus

(1) Scenario based Reliability Planning

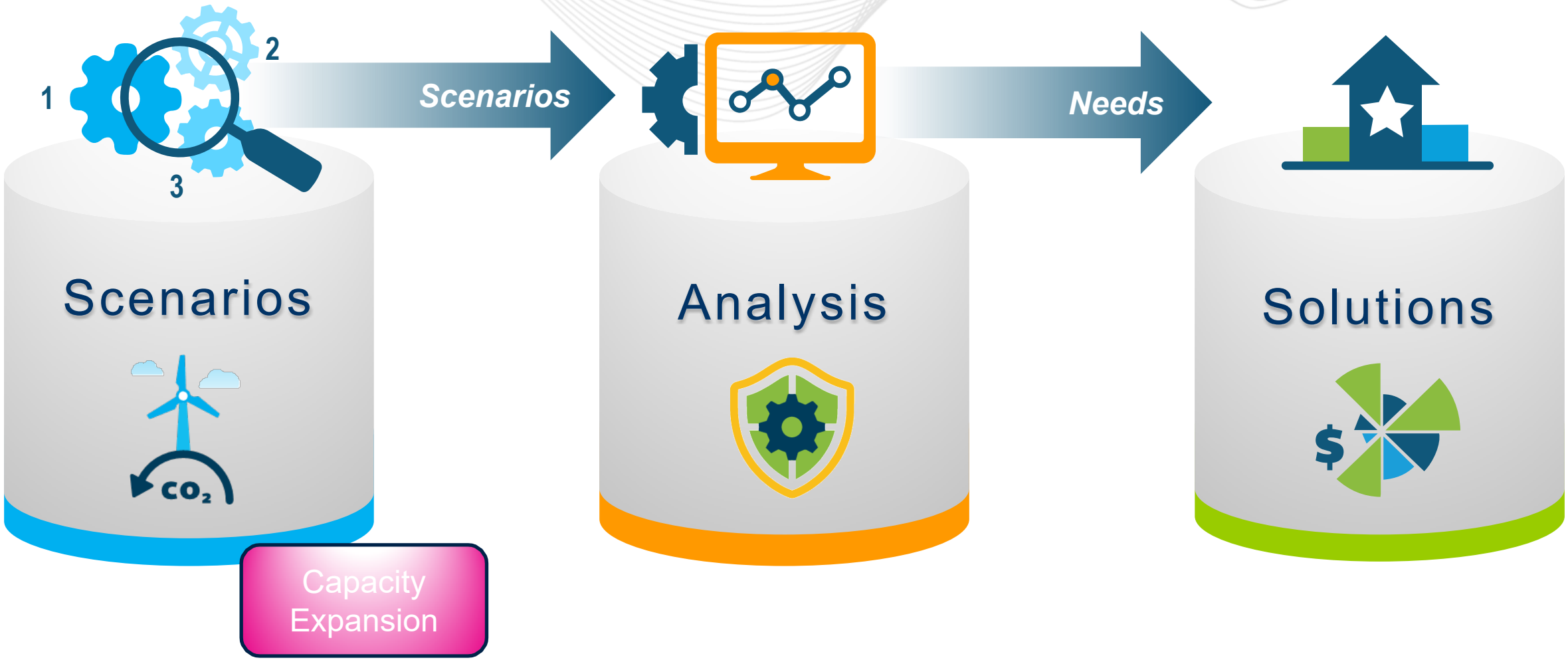
(2) Resource mix assumption updates

(3) Projected loads (electrification / data center)

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

(5) Broad set of economic benefits

LTRTP Framework



Long-Term Scenario Development

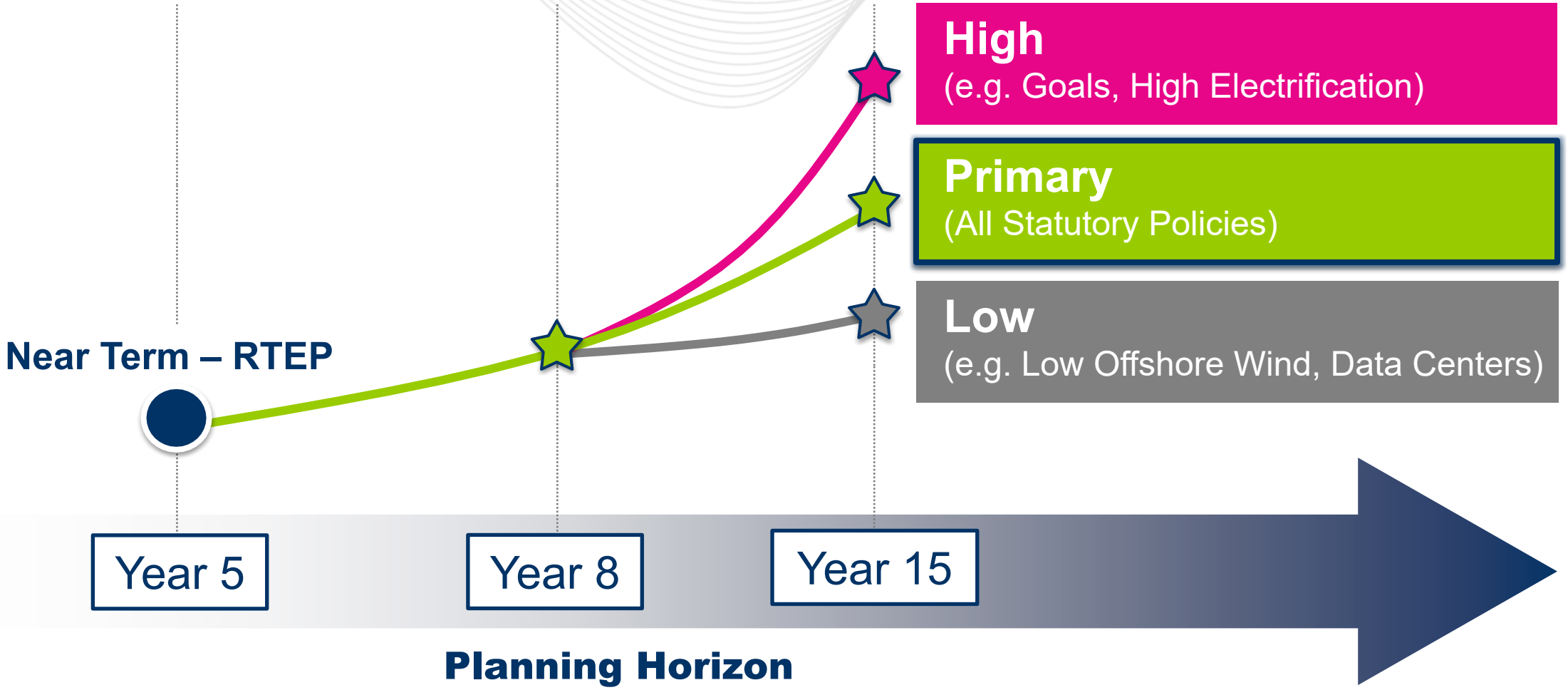
Scenarios

- *Scenarios must be plausible*
- *Scenarios and sensitivities capture realistic ranges of selected inputs*
- *Scenario assumptions and methods are transparent*

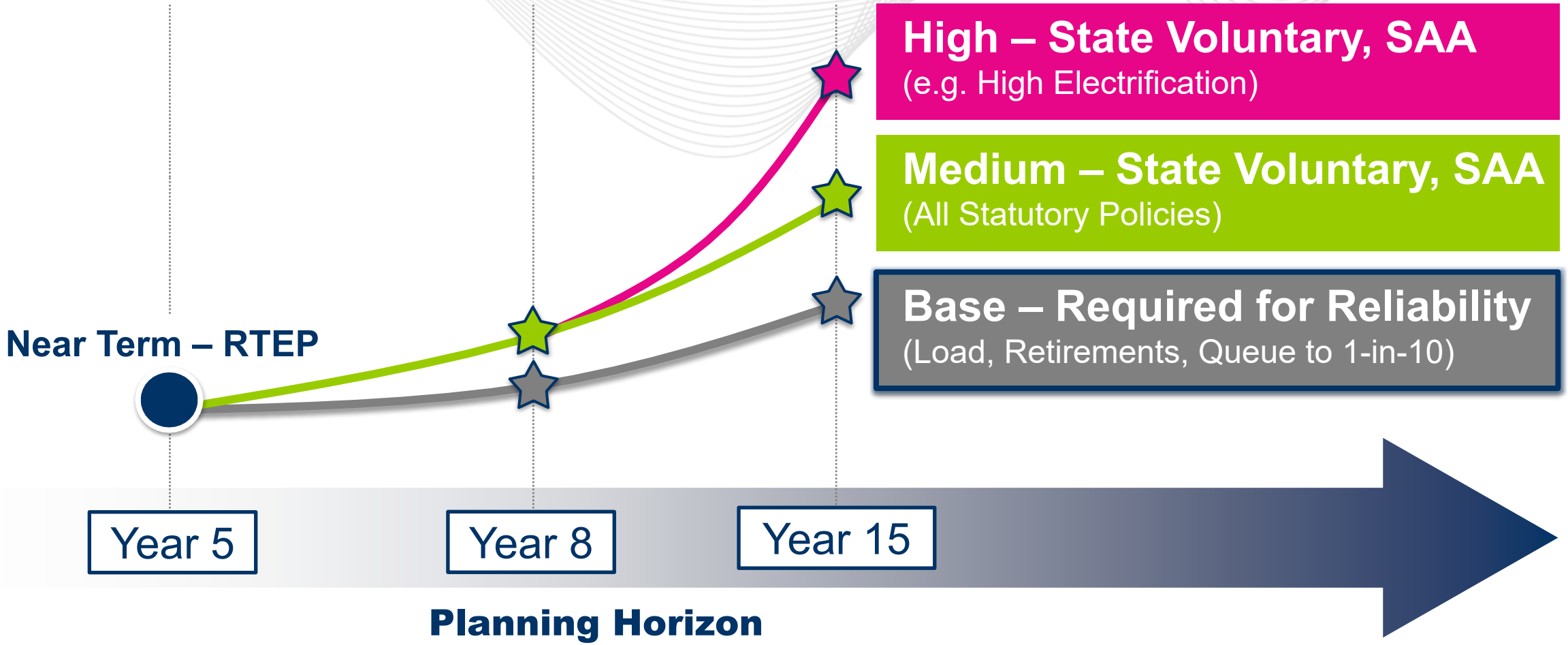
PJM's Construct – PPR modeling

- 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 CO_2 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)



LTRTP Scenarios (Revised Framework)

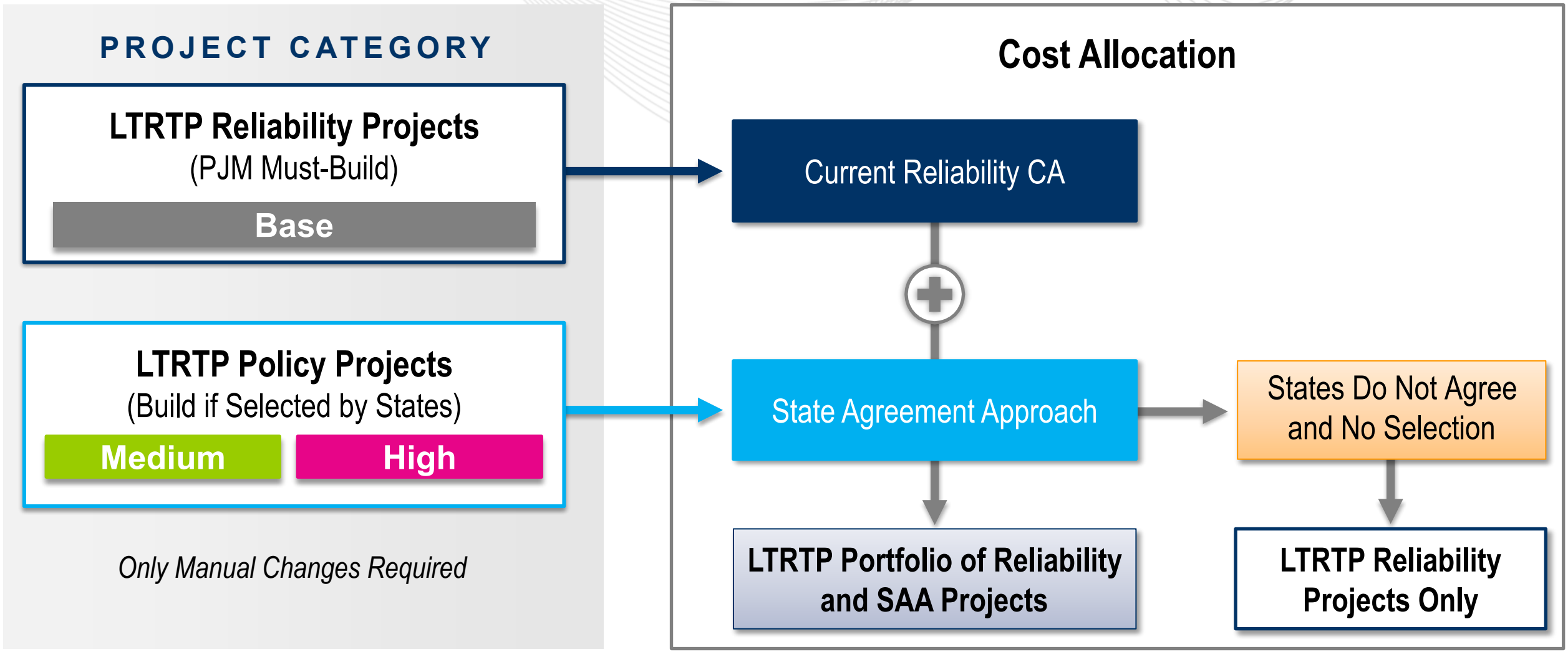


- PJM can consider performing sensitivities, e.g. for lower data center load

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



Matrix – Policies by LTRTP Scenario

Legend
PJM's annual load forecast
Not Included Included

Policies ⊛	Base	Medium	High
Load Policies*(e.g. Electrification, BTM)	PJM's annual load forecast	PJM's annual load forecast	High
Federal Policy Retirements (e.g. EPA)	Included	Included	Included
State Policy Retirements (e.g. CO_2, CEJA)	Included	Included	Included
Inflation Reduction Act	Included	Included	Included
Replacements/Generation Policies (e.g. RPS, Offshore wind)	Use queue to meet 1-in-10	Statutory	Statutory**
Clean Energy Objectives ***	Not Included	Statutory	Statutory**

Notes: ⊛ *Sensitivity for econ. at-risk units; * Includes Data Centers; ** Sensitivities for goals and future PPR; *** As possible; will work with states on modeling*

Replacement Generation Illustration

Background

- Existing generation is mainly thermal
- 98% of pre-ISA MW is renewables or storage

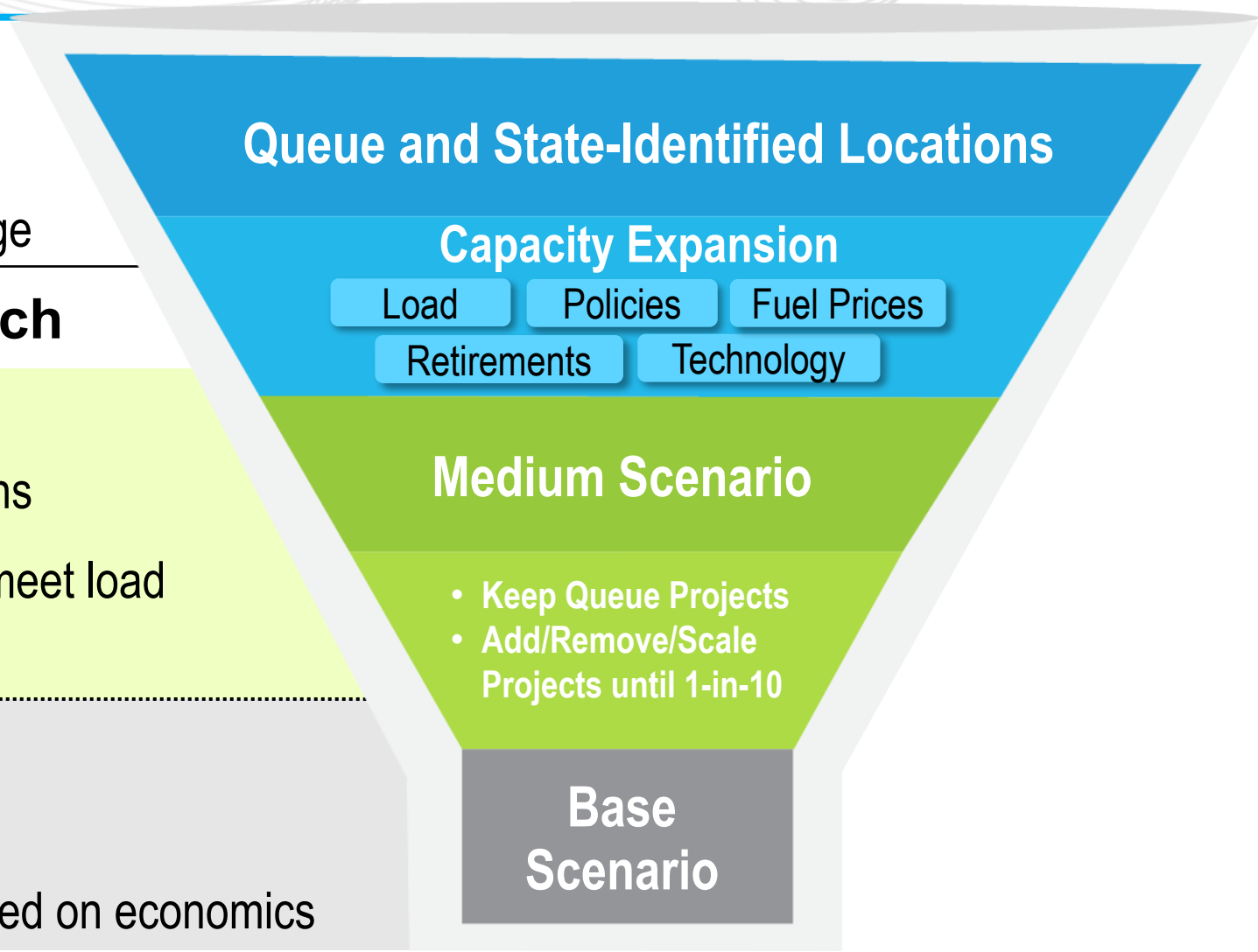
Generation Replacement Approach

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

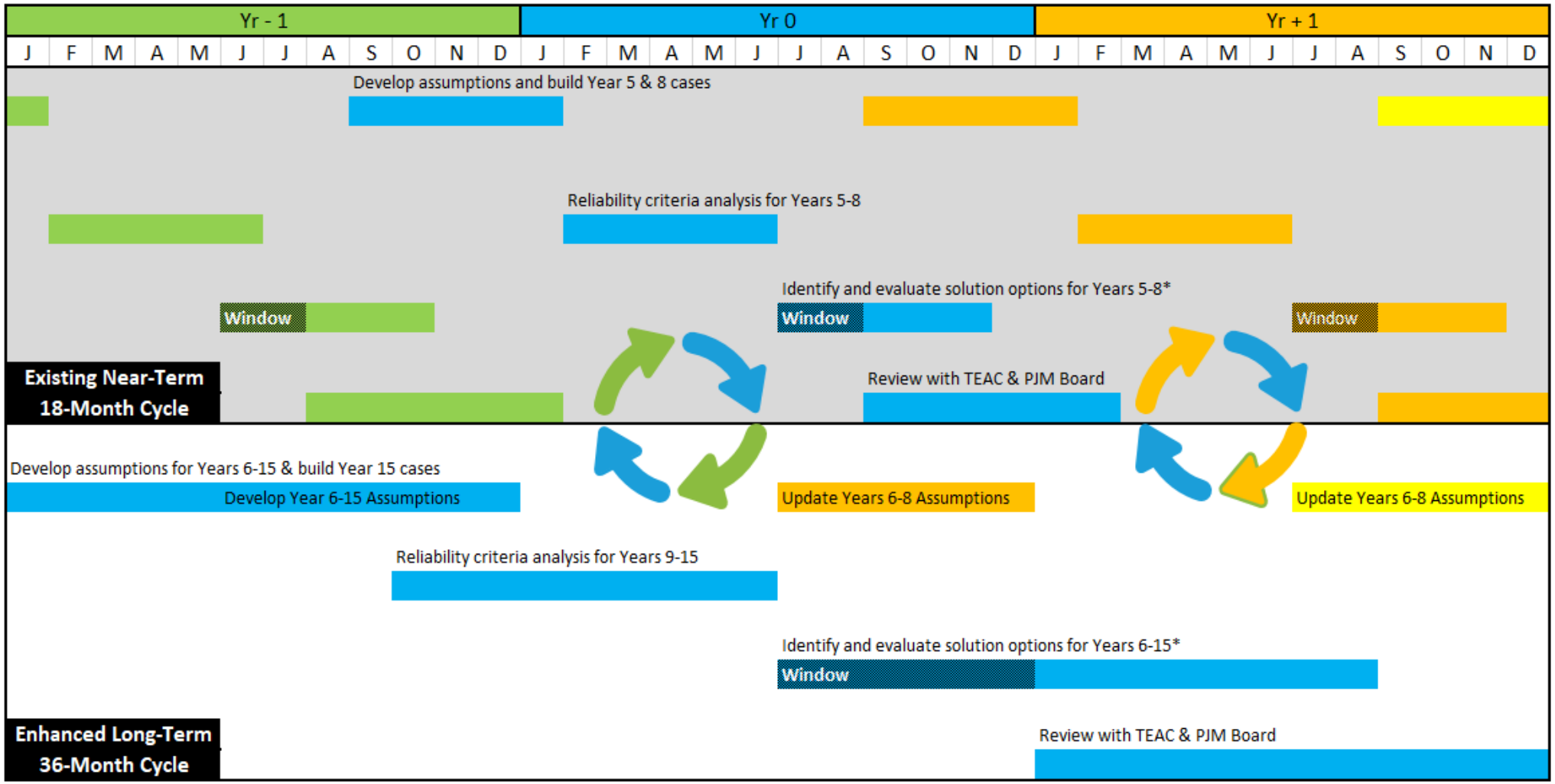
Analysis

••*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



* 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

Reliability Model Building

- 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-term18-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

Line A-B loading increase from Years 5 through Year 15 using linear interpolation of Year 5, 8 and 15 loadings

Line	Rating (MVA)	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Yr 11	Yr 12	Yr 13	Yr 14	Yr 15
A-B	3500	**98.0%**	98.3%	98.6%	**98.9%**	99.2%	99.5%	99.8%	100.1%	100.4%	100.7%	**101.0%**

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

Solutions

- *Transmission solutions must address reliability and SAA needs*
- *Secondary benefits inform project selection and portfolio savings*

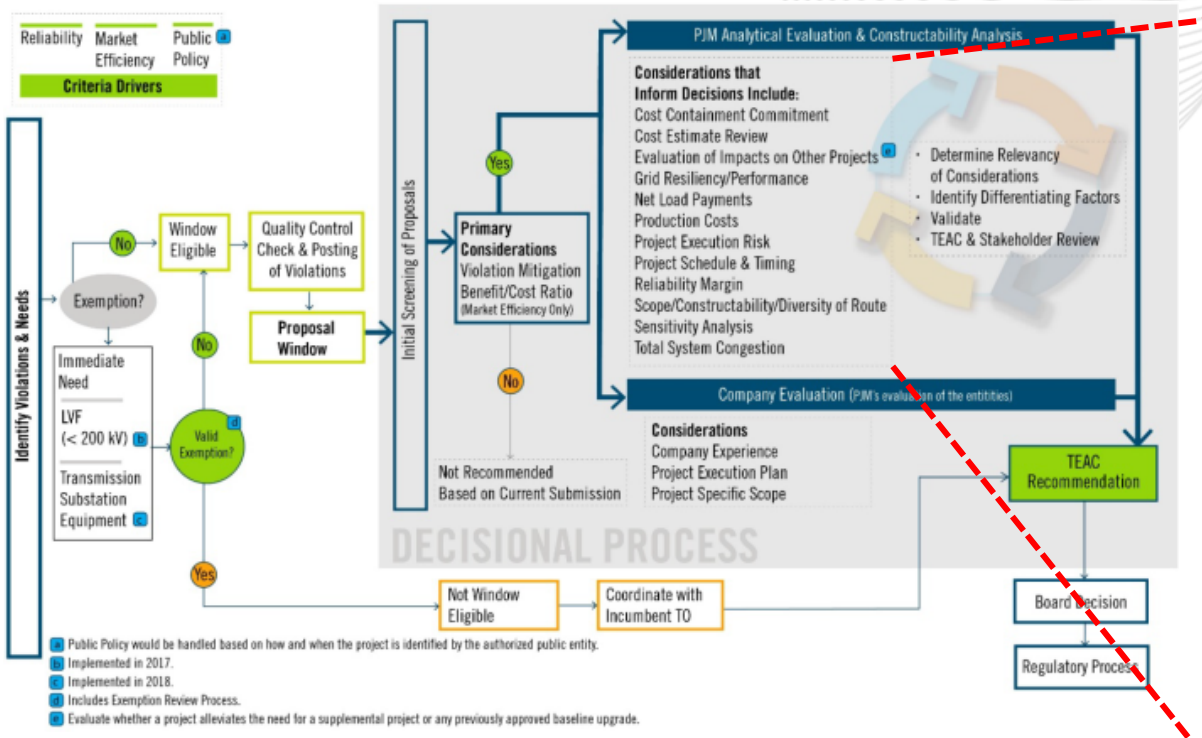
Long-Term Planning Projects

- 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

Project Selection Process

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

Project Selection Process – M-14F



Considerations that Inform Decisions Include:

Cost Containment Commitment
Cost Estimate Review
Evaluation of Impacts on Other Projects (e)
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

- Benefit metrics identify long-lead transmission solutions that maintain reliability at the lowest possible *system* cost

	Benefit Metrics	
System Cost	**Energy Market Benefits**	**1.** Production Cost Savings
	Capital Investment Benefits	**2.** Avoided Generation Investments
		3. Avoided Transmission Investments
	Enhanced Reliability Benefits	**4.** Reduced Loss of Load

- Alternative benefit metrics are *comprehensive* load payments + enhanced reliability benefits

$$\Delta \text{ Load Payments} = \Delta \text{ System Costs} + \Delta \text{ Profits}$$

Benefit Metrics – Approach

Latest Approved Near-Term RTEP

Latest Approved Long-Term RTEP

Capacity Expansion, Reliability, Production Cost Models

System Cost + Enhanced Reliability

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

Δ Benefits

Benefits are calculated for Reliability and SAA Solutions

PJM Will consider calculating zonal benefits (But may be easier with load payments)

TEAC Discussions and Board Approval

- 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 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

M14B Sections

- 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

M14F Sections

- 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

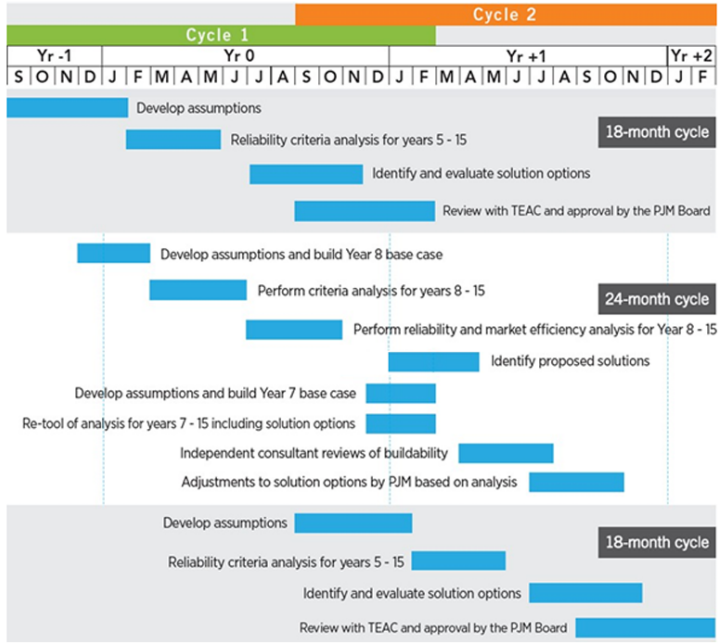


Exhibit 1: 24-Month Reliability Planning Cycle

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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APPENDIX

PJM Planning - Market Efficiency Considerations

- 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