Long-Term Regional Transmission Planning

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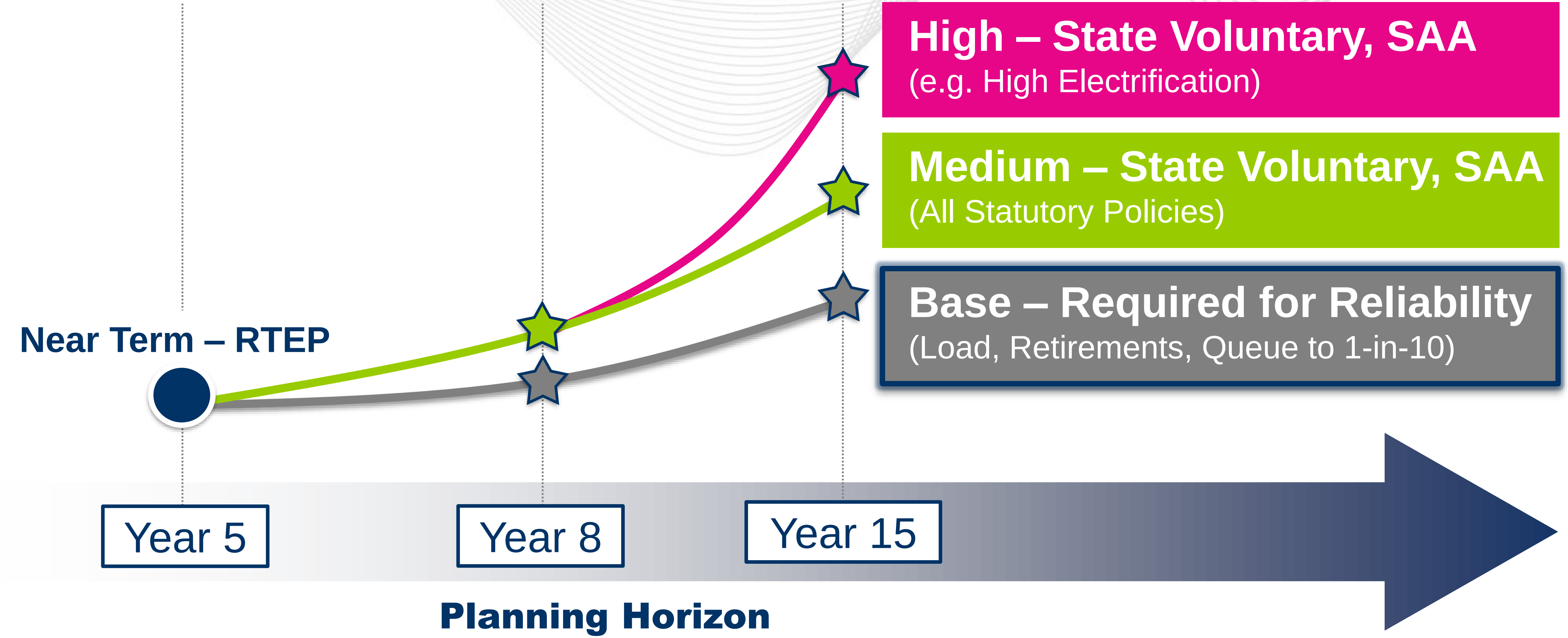
Agenda

- LTRTP replacement generation methodology
- Market efficiency analysis
- LTRTP Analysis pillar

LTRTP Replacement Generation Methodology



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

Matrix – Policies by LTRTP Scenario

Legend
PJM's annual load forecast
Not Included   ✓ Included

Policies	**Base**	**Medium**	**High**
Load Policies*(e.g. Electrification, BTM)			High
Federal Policy Retirements (e.g. EPA)	✓	✓	✓
State Policy Retirements (e.g. CO_2, CEJA)	✓	✓	✓
Inflation Reduction Act	✓	✓	✓
Replacements/Generation Policies (e.g. RPS, Offshore wind)	Use queue to meet 1-in-10	Statutory	Statutory/ Objectives

Notes: *Initial position on assumptions to be included in each scenario that will be further discussed in the assumption meetings; Sensitivities for econ. at-risk units and state policy retirements; * Includes Data Centers;*

Replacement Generation Illustration

Background

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

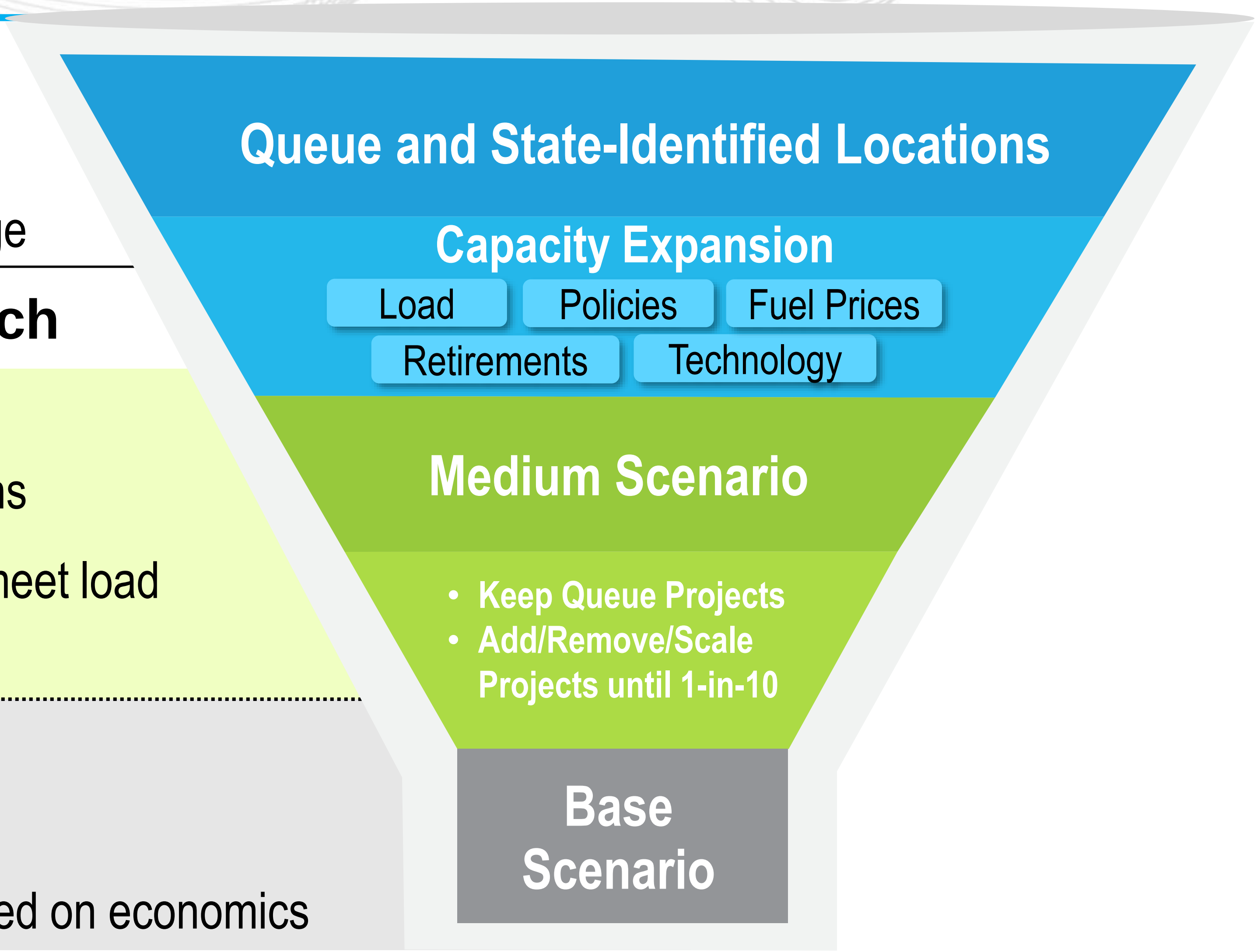
Generation Replacement Approach

Medium Scenario Replacements

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

Base Scenario

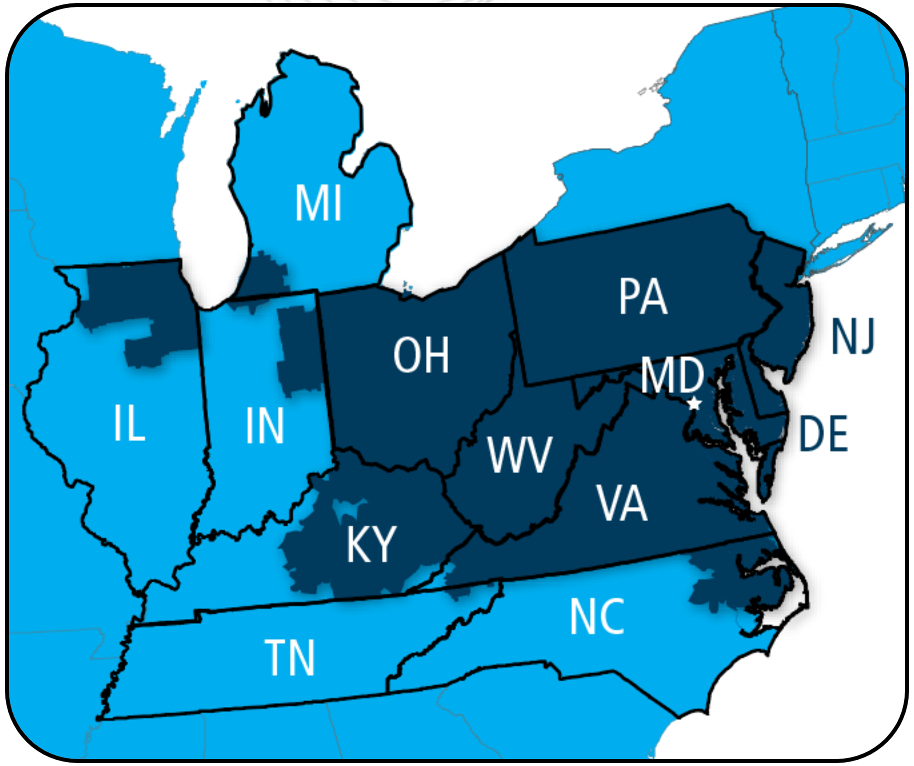
- Keep only queue projects
- Add/remove/scale projects until 1-in-10 based on economics



Market Efficiency Analysis

The PJM Market Efficiency process simulates the electric market using production costing software to:

- Understand internal and interregional congestion
- Assess future market congestion
- Approve economic-based transmission upgrades



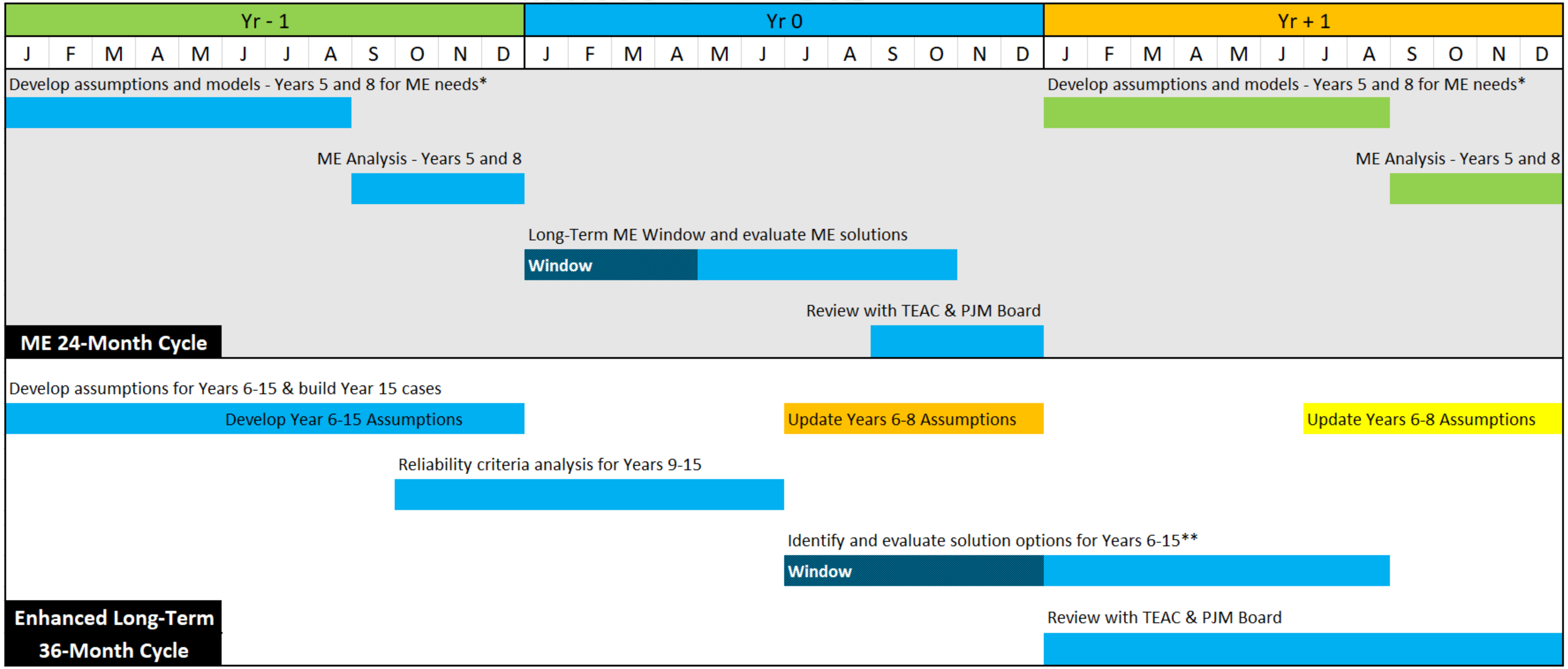
Congestion is a measure of the extent to which marginal generating units are dispatched to serve load due to transmission constraints.

Congestion occurs when available, least-cost energy cannot be delivered due to transmission constraints. As a result, higher-cost units must be dispatched to meet load.

Market Efficiency Analysis Objectives

- **Long-Term Window**
  Identify new transmission projects that address target congestion drivers
- **Re-evaluation Analysis**
  Review cost and benefits of economic-based transmission projects included in the RTEP to assure that they continue to be cost beneficial
- **Acceleration Analysis**
  Determine which reliability-based transmission projects, if any, have an economic benefit if accelerated or modified

Recommended Enhancements To Long-Term Planning Process – ME vs LTRTP Cycles



* Years 5 and 8 models are developed to determine ME needs, additional years are developed for solution evaluation.

** 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

LTRTP Benefit Metrics

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

System Cost

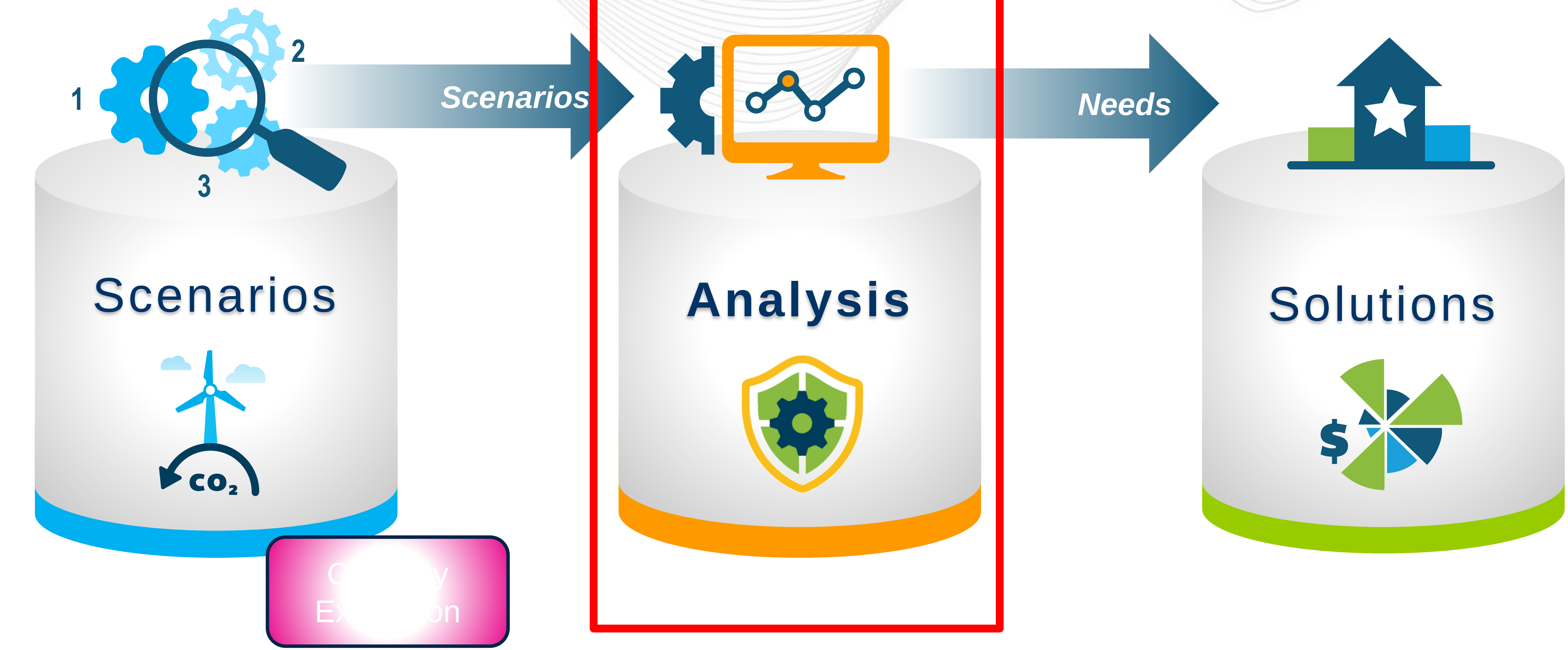
Benefit Metrics	
Energy Market Benefits	**1.** Production Cost Savings
Capital Investment Benefits	**2.** Avoided Generation Investments
	3. Avoided Transmission Investments
Enhanced Reliability Benefits	**4.** Reduced Loss of Load

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

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

LTRTP Analysis Pillar

LTRTP Framework



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

Reliability Criteria Analysis For Years 8 & 15

- N-1, generator & load deliverability (years 8 & 15)
  - Thermal analysis monitored facility (ignore terminal limits) and contingency kV levels
    - Year 8: Same as year 5
    - Year 15: 230 kV+
  - Voltage analysis monitored facility and contingency kV levels
    - Year 8: 230 kV+
    - Year 15: 500 kV+
  - Contingency Types
    - Singles & Towers (Year 8 and 15)
    - Stuck breakers and bus faults (Year 8 only)
- N-1-1 (year 8 only)
  - Thermal & voltage analysis focusing on 230 kV+ monitored facilities and contingencies

Next Steps

- First read of LTRTP manual language expected to occur at Jan. 9 Planning Committee

Contact

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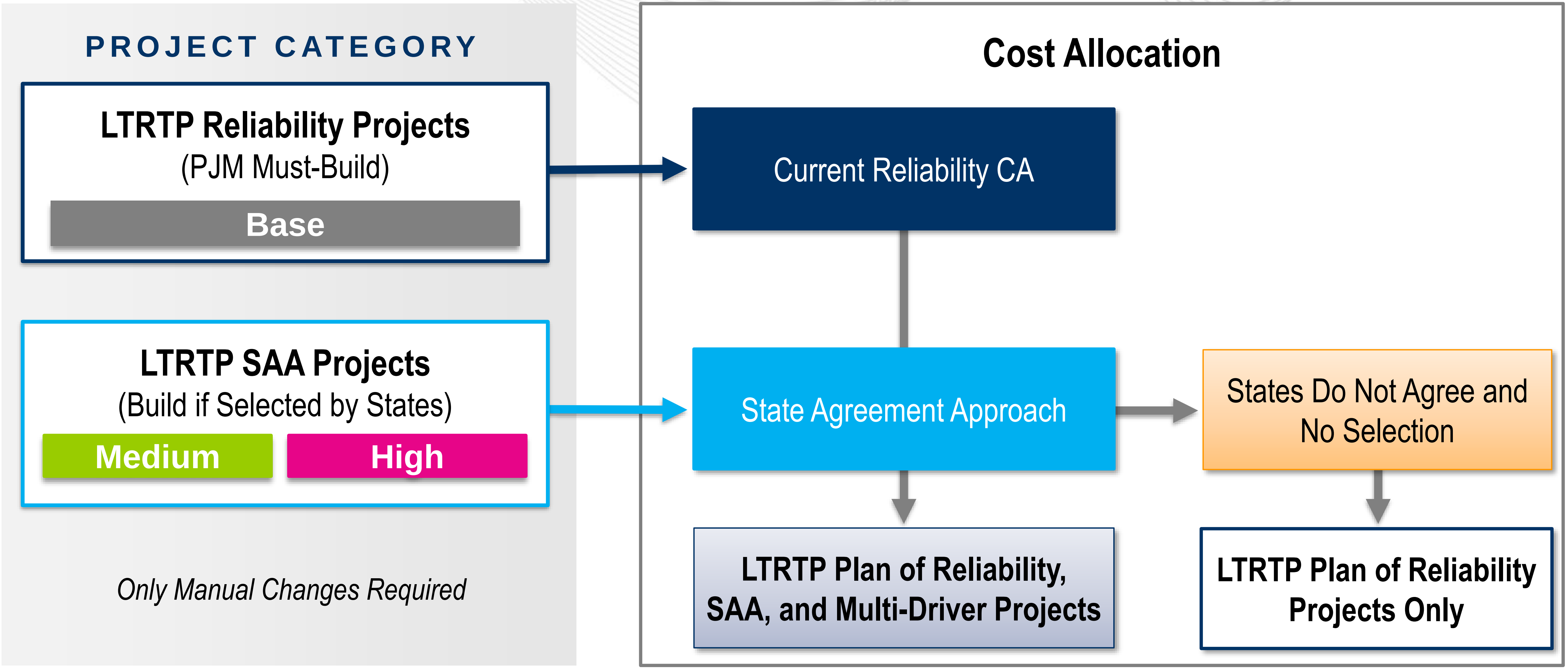
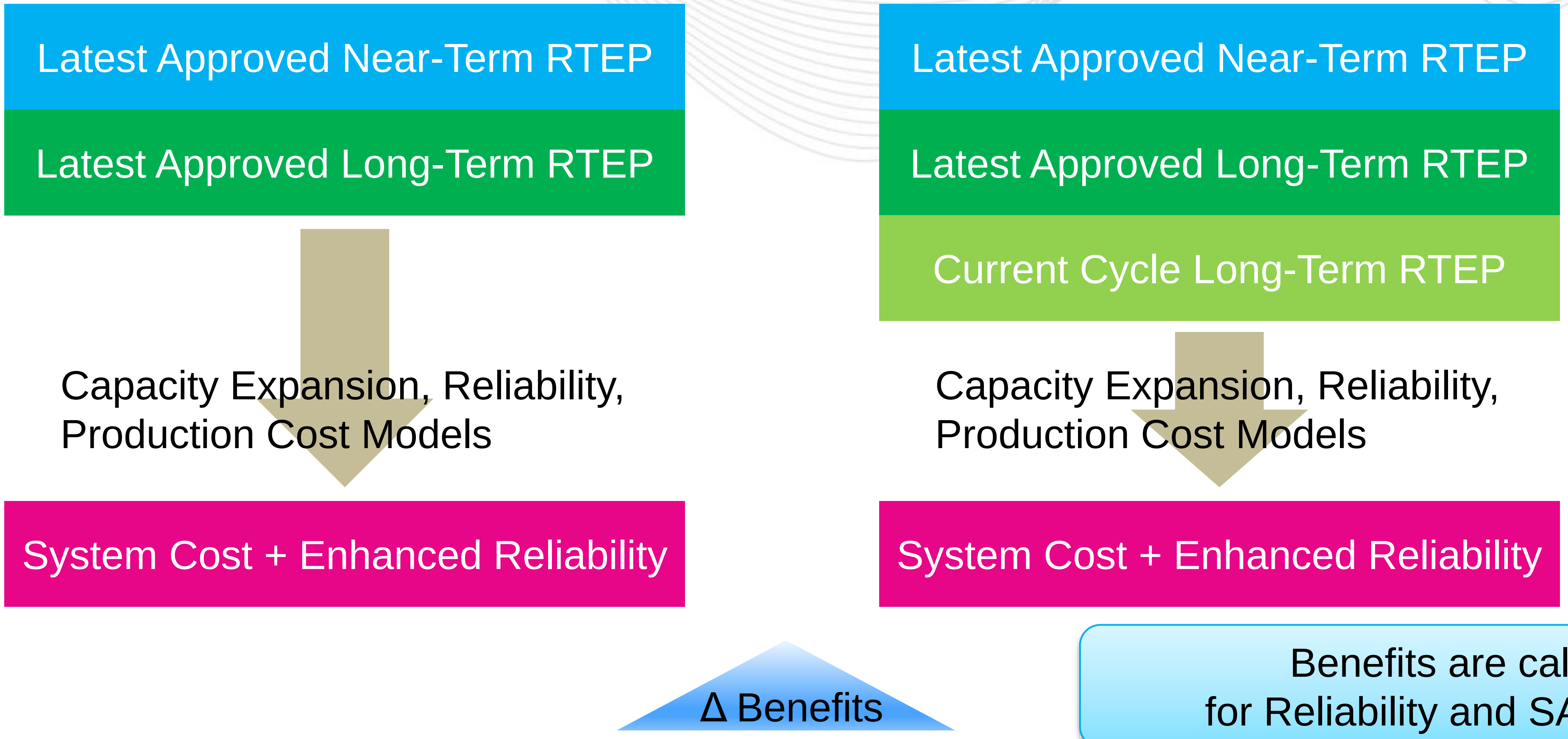
Appendix

Approach to LTRTP Scenarios and Cost Allocation



Benefit Metrics – Approach



Benefits are calculated
for Reliability and SAA Solutions

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

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

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%**