Long-Term Regional Transmission Planning (LTRTP) Update

PJM Staff

Long-Term Regional Transmission Planning Workshop

Aug 22, 2023

Agenda

- Recap of workshop 1 LTRTP Framework Material
- Feedback on workshop 1 content
- Continue to discuss LTRTP Framework
- Feedback on workshop 2 content
- Next Steps

Workshop 1 Recap

Goal and Actions

Goal: Analyze Long-Term Scenarios to **(1)** identify transmission needs driven by the changing *resource mix* and load growth and **(2)** implement reliable, efficient and proactive transmission solutions

Long-Term Planning Action:
Identify and implement long-lead transmission solutions

Near-Term Planning Action:
Better inform near-term planning processes through robust transmission solutions

Workshop Focus

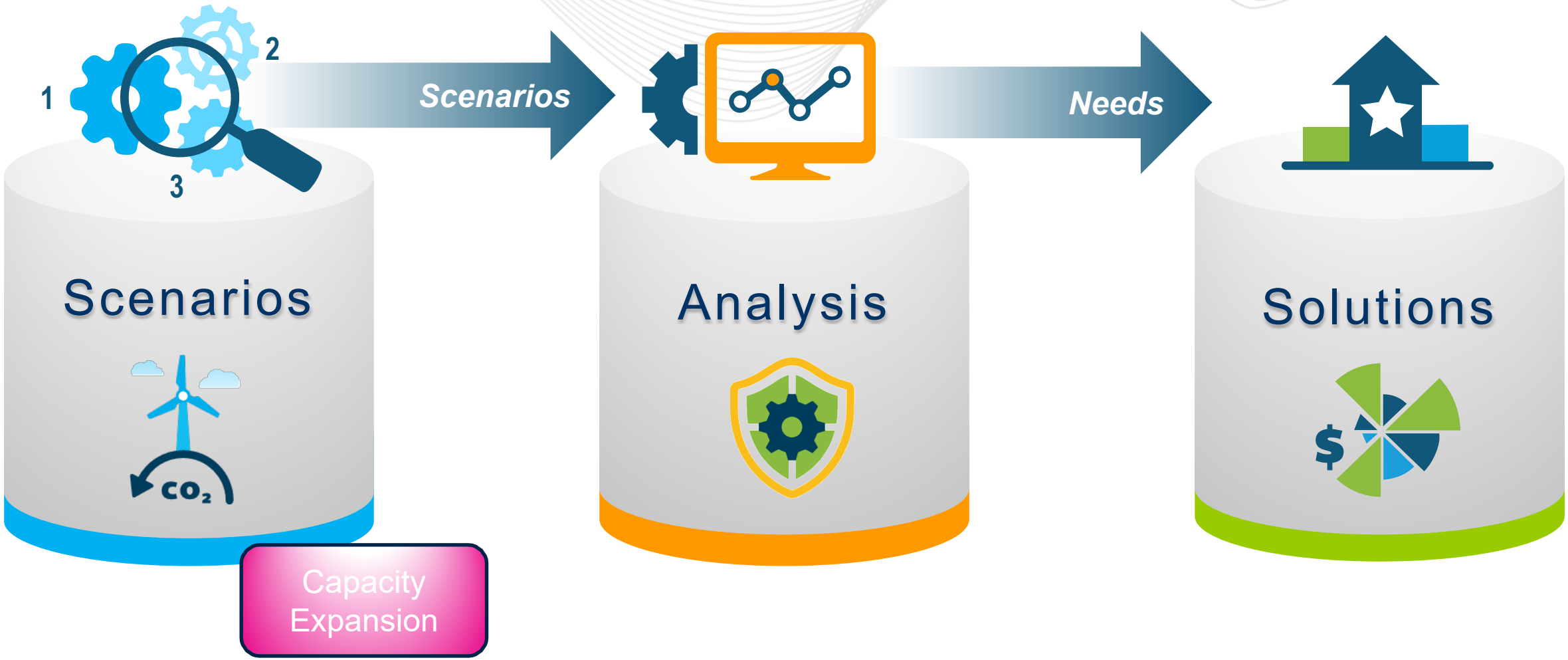
(1) Scenario based Reliability Planning

(2) Resource mix assumption updates

(3) Projected loads (electrification / data center)

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

LTRTP Framework



Principles

Scenarios

- *Scenarios must be plausible*
- *Sensitivities capture realistic ranges for selected inputs (New)*
- *Scenario assumptions and methods are transparent*

Analysis

- *Reliability analysis is the primary focus*

Solutions

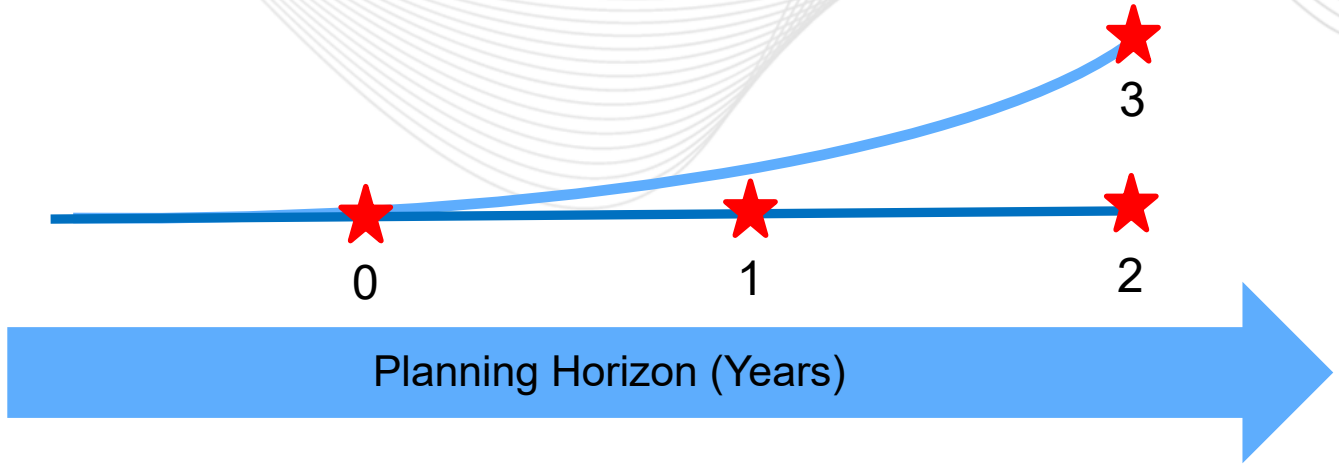
- *Transmission solutions must address reliability needs*
- *Secondary benefits inform project selection and portfolio savings*

Long-Term Scenario Development (Recap)

Scenarios

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

Scenarios



0: *Near-Term* (5 Year RTEP)

1: *Intermediate-Term* (8 Year; for Near-Term solutions and timing of Long-Term needs)

2: *Long-Term, Primary* (15 Year; identify Long-Term needs)

3: *Long-Term, Accelerated* (20 Year)

Sensitivities

- PJM will also consider sensitivities covering plausible ranges of critical inputs to be determined in each long-term planning cycle

- Number of sensitivities should be limited depending on analysis' complexity

Scenario Building, Main Inputs

1. **Load and Electrification** (Data centers, Heating, EVs)

2. **Policies** (Federal and States policies affecting retirements and new builds)

3. **Renewables' capacity factors**

4. **Fuel Prices**

5. **Discount Factor** (for NPV)

6. **Power system's initial state**

7. **Generation and storage candidates** **(**Sites, assets characteristics and costs)

8. **Resource Adequacy** (Reliability Target and ELCC)

Scenario Building, Methods

- Capacity Expansion model
- Siting:
  - Use queue primarily and green field candidate sites as needed
  - Account for siting restrictions (e.g. local ordinances)
  - Prioritize sites based on
    - Interconnection headroom
    - Economics (e.g. fuel availability, renewables' potential)

Stakeholder Feedback on Workshop 1 Content

LTRTP Analysis Pillar - Reliability Model Building & Analysis

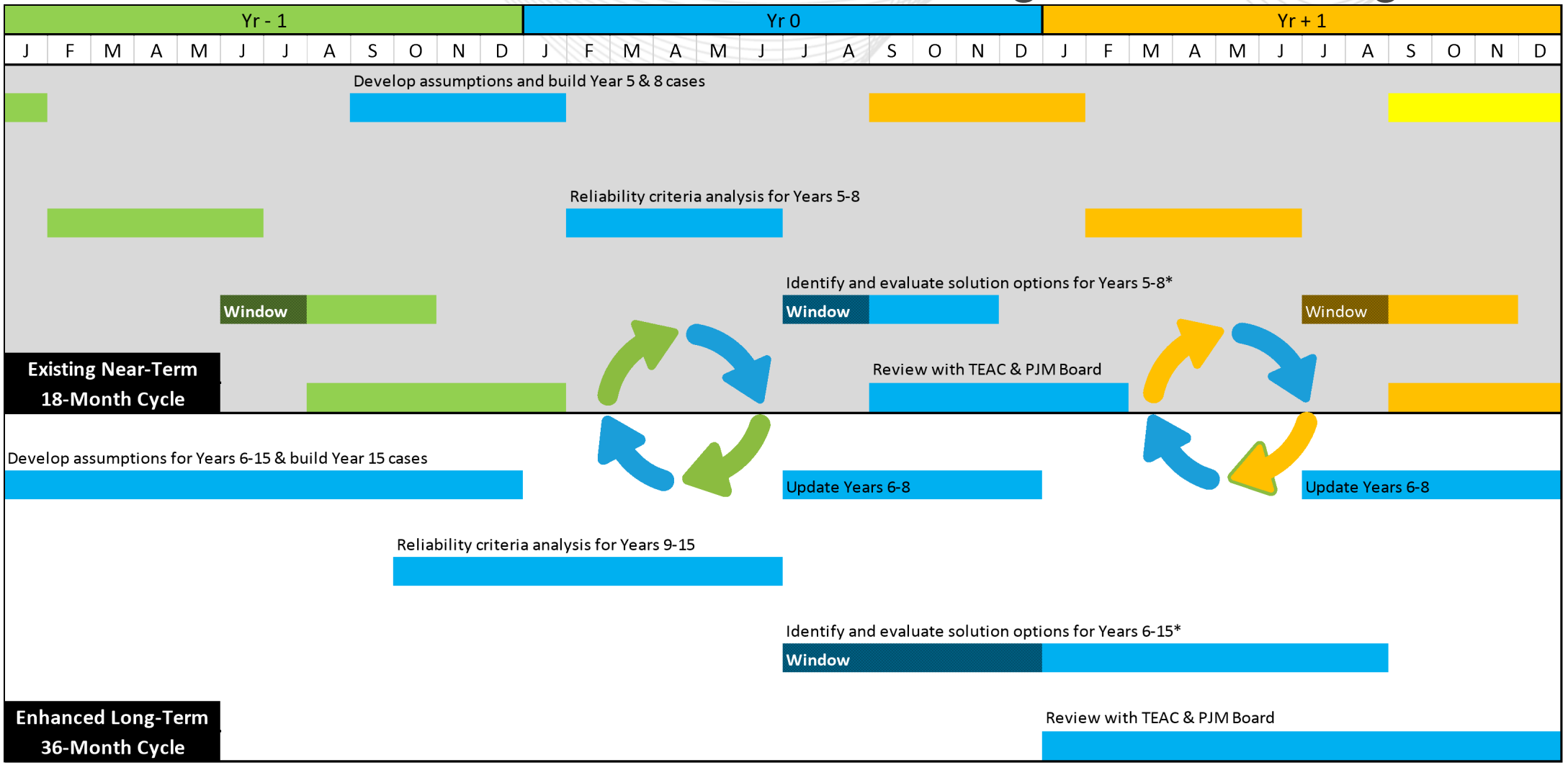
Analysis

••*Reliability analysis is the primary focus*

Key Updates To 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 flow models with 15 year power flow models
  - 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 only
    - Primary scenario
    - Accelerated scenario (assume year 20 conditions occur in year 15)
  - Linear interpolation using year 5, 8 and 15 year 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 assumptions developed
  - Seek transmission solutions for less complex needs in the near-term18-month cycle window, and address remaining more complex needs in the long-term 36-month cycle window

Reliability Model Building

- Three sets of base cases will be created:
  - Year 8 Intermediate-Term: Purpose is to assist in determining required in-service dates of each component of LTRTP and to identify other intermediate-term (years 5-8) reliability needs including both thermal and voltage
  - Year 15 Long-Term
    - Primary: Purpose is to address long-term needs by identifying long-term solutions
    - Accelerated: Purpose is to help size the solutions driven by the primary scenario with consideration of possible acceleration of assumptions in years 9-15
- Three seasonal cases will be created:
  - Summer peak
  - Winter peak
  - Light load

Reliability Criteria Analysis For Years 6-15

- After the models are built, reliability studies will be performed in preparation for a competitive transmission solution window
  - Perform year 8 & 15 analysis
  - Determine required in-service dates using linear interpolation of year 5, 8 and 15 analysis results

Reliability Criteria Analysis For Years 8 & 15

- N-1, generator & load deliverability (years 8 & 15)
  - Monitor same facilities considered in year 5 analysis
  - Ignore terminal equipment limitations
  - Contingencies
    - Singles & Towers (Year 8 and 15)
    - Stuck breakers and bus faults (Year 8 only)
  - Voltage analysis (Year 8 only)
- N-1-1 (year 8 only)
  - Thermal & voltage analysis focusing primarily 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, the potential long-lead time transmission needs will either be submitted 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.

Mid-Cycle Updates

- PJM will refresh the capacity expansion assumptions for the year 8 case annually in time to be input to the near-term cycle case building process

- There will be no mid-cycle update for the year 15 case

Solution Identification and Approval

Solutions

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

Long-Term Planning Actionable Projects

- Long-lead 230kV and Up (> 5 years from need identification)
- Address reliability needs
- Action is needed to meet required in-service date
- … Or sufficiently large benefits to warrant acceleration

Project Selection Steps

1. Projects must address reliability needs
2. Feasibility assessment – cost and constructability analyses
3. Do-no-harm analysis
4. Secondary benefits to select among alternative reliability projects
   - Benefits are comprehensive
   - Robustness to other scenarios and sensitivities is also considered

Benefit Metrics

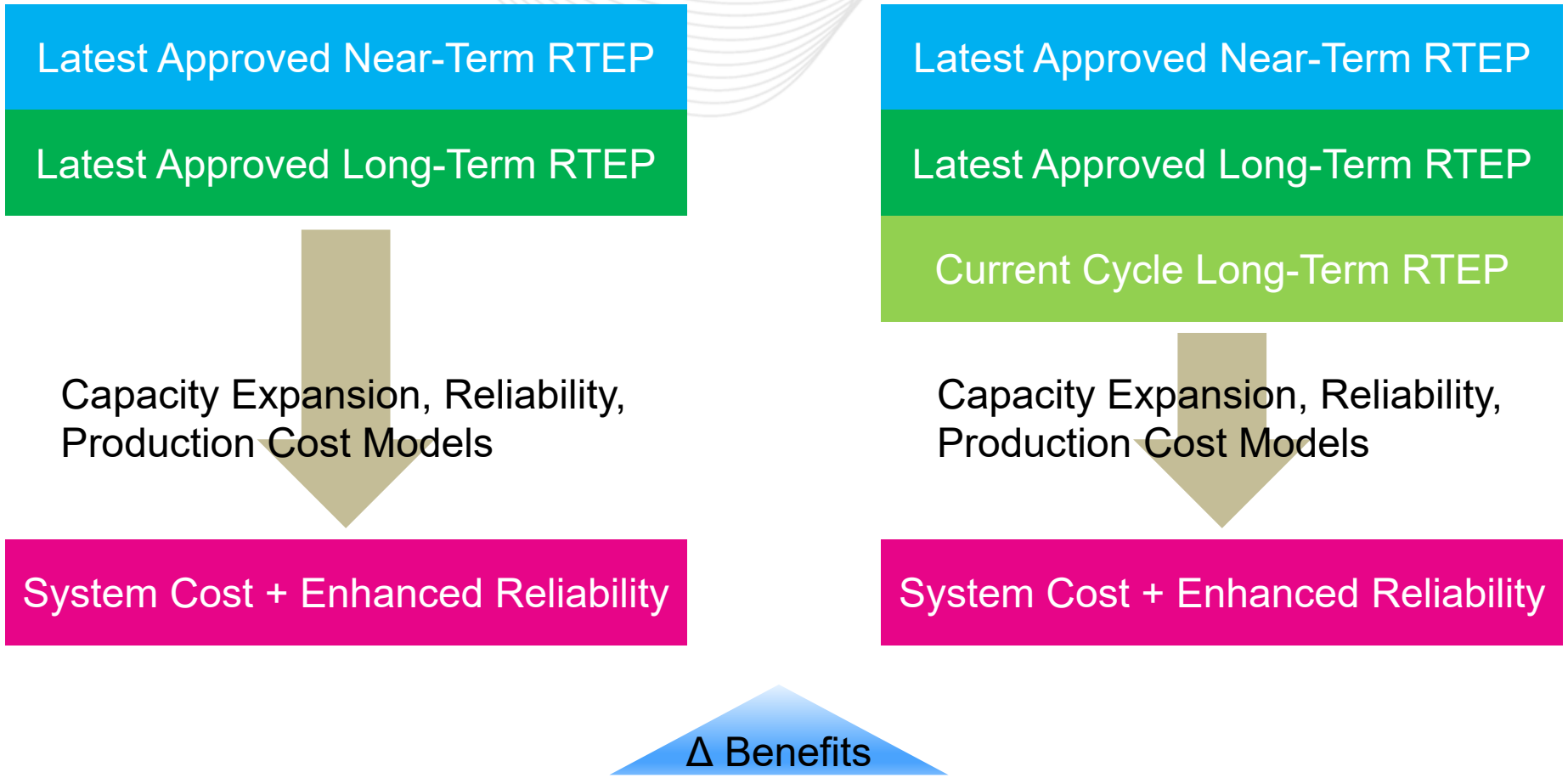
- Benefit metrics identify long-lead transmission solutions that maintain reliability at the lowest possible *system* cost

	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



TEAC Discussions and Board Approval (As Now)

- 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)
  - Actionable projects are brought to PJM's Board for approval

Stakeholder Feedback on Workshop 2 Content

Next Step

- Recap LTRTP materials
- Solicit feedback
- Discuss areas for manual changes

Contact Information

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Long Term Regional Transmission Planning Update

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Appendix

Why PJM is updating LTRTP

- Primary motivation is ensuring a reliable transition
  - Large-scale changes in the resource mix and load are expected in the coming decades. PJM needs to strengthen modeling assumptions and scenario building to identify and implement long-term transmission solutions and preserve reliability at the lowest possible system cost

- FERC is proposing Long Term Planning Rulemaking
  - Improved modeling assumptions and scenario building would be helpful for a possible compliance filing

Revision History

Version No.	Date	Description
1	8/17/2023	• Original slides posted

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