Integration of Economic and Reliability Tools and Data

ESIG

ENERGY SYSTEMS INTEGRATION GROUP

Panelists

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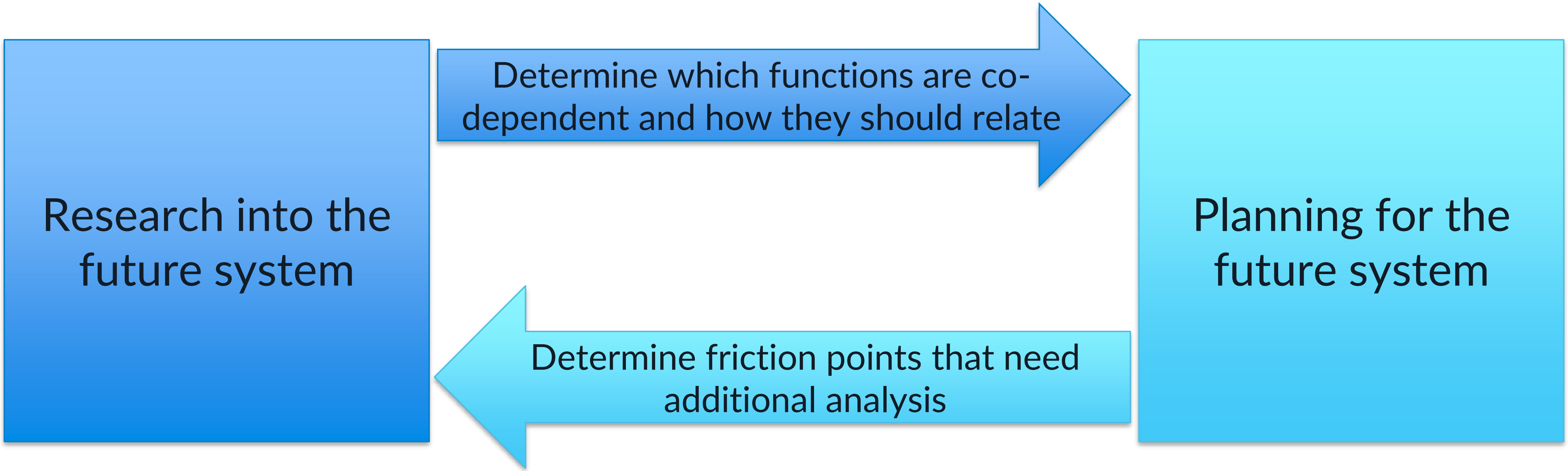
Moving Toward Integrated Planning

Jordan Bakke (MISO)
ESIG
October 21, 2024

Integrated planning is complicated and shouldn't be pursued across all functions. Timely evaluation is needed to determine which functions should be integrated and how that integration can be simplified.

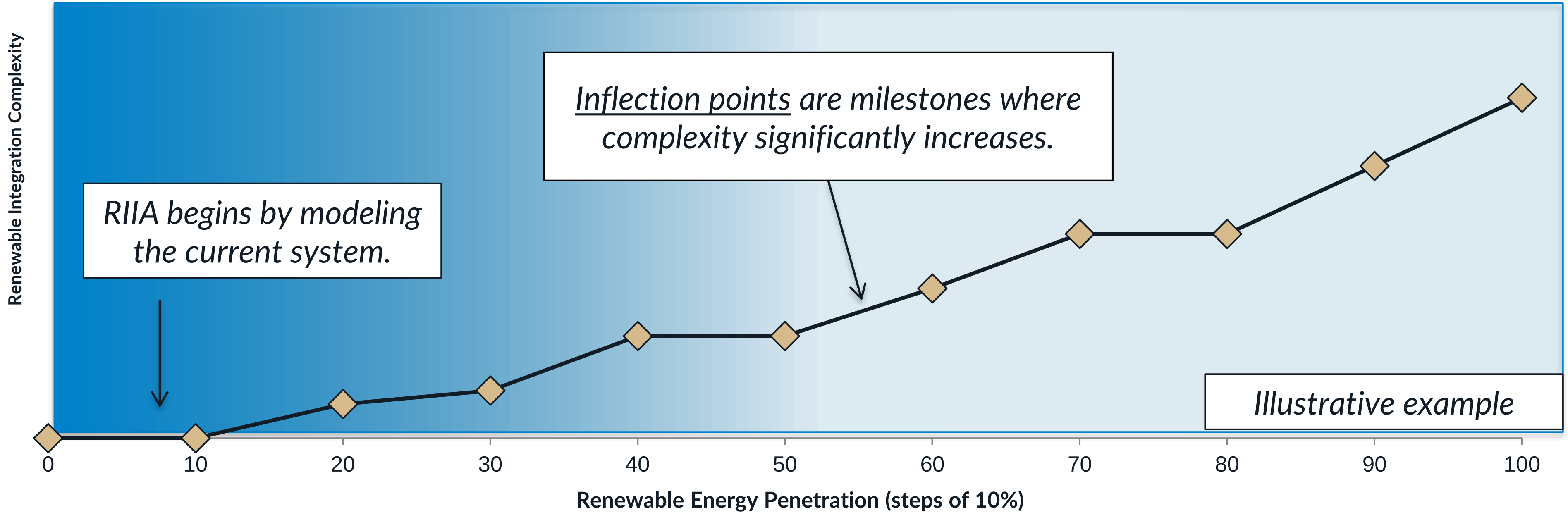


Example: Renewable Integration Impact Assessment

Example: Long Range Transmission Planning

What is the right balance of reliability and economic evaluation?

MISO's Renewable Integration Impact Assessment (RIIA) found inflection points of renewable integration complexity



Focus Areas

Resource Adequacy

Having the sufficient capacity of resources to reliably serve peak demand

Energy Adequacy

Ability to provide energy in all operating hours throughout the year

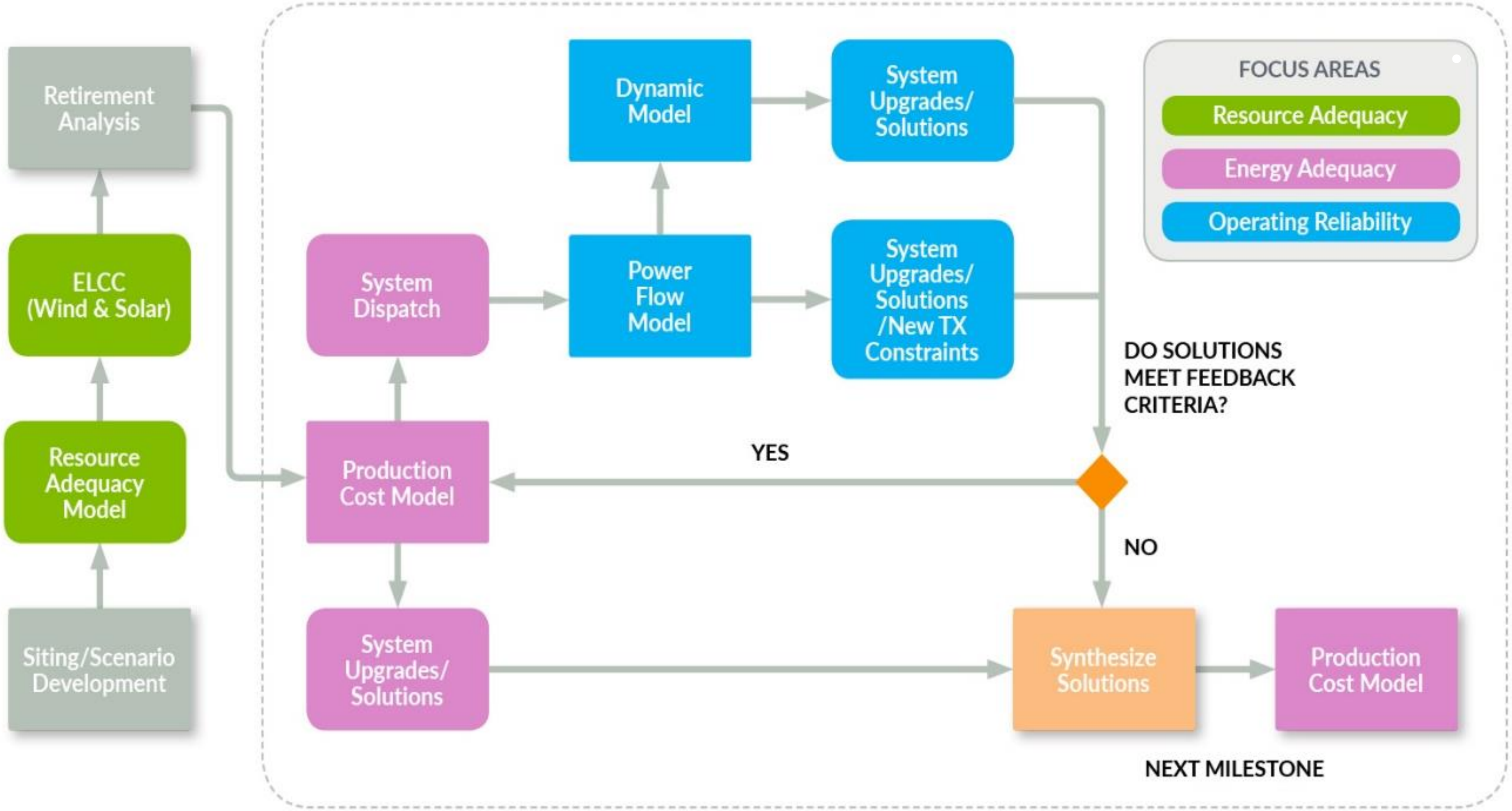
Operating Reliability

Ability to withstand unanticipated component losses or disturbances

https://cdn.misoenergy.org/RIIA%20Summary%20Report520051.pdf

MISO

MISO developed a robust process to understand how the seams between power system disciplines evolved as renewable penetration increased

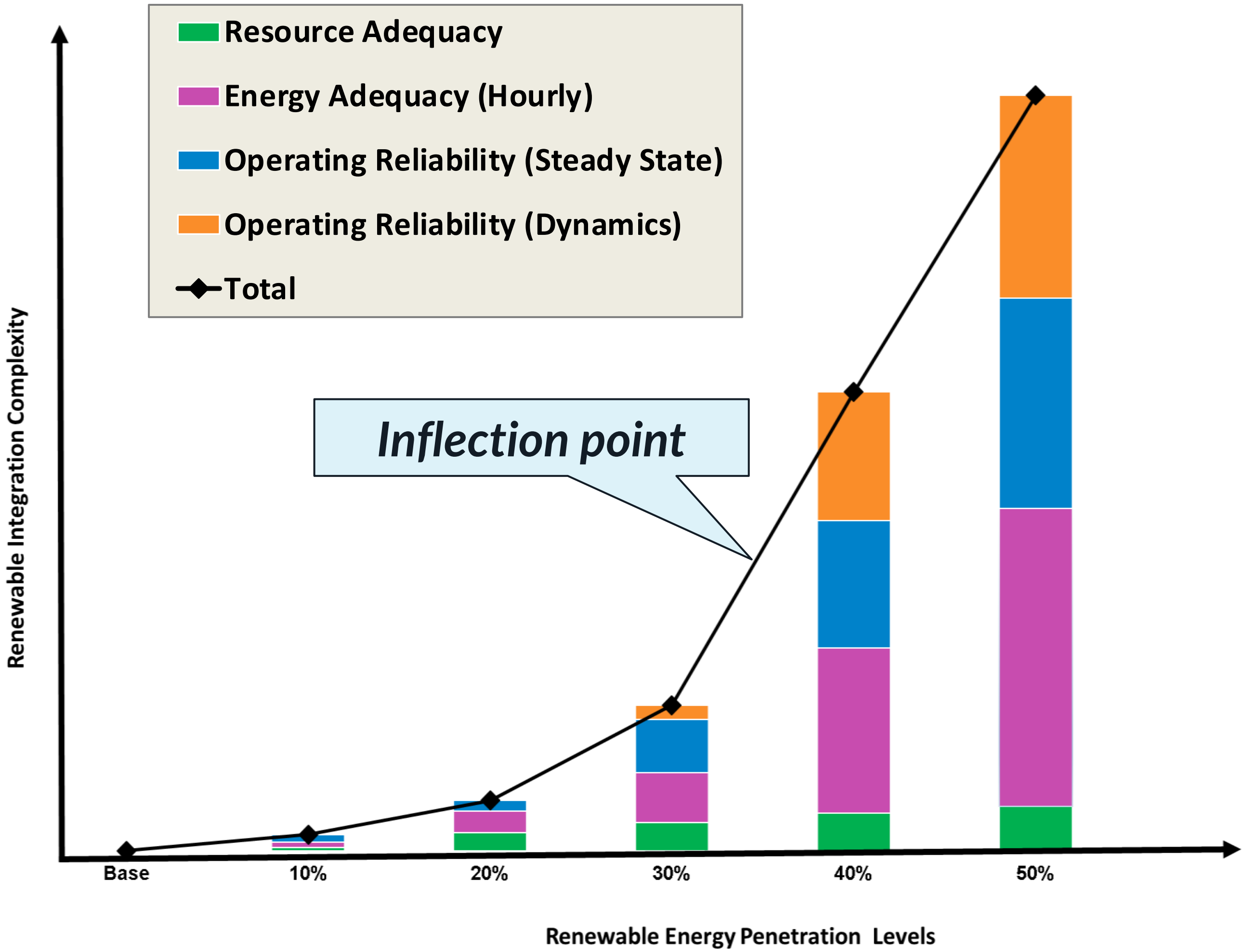


System dispatch results passed along from Energy Adequacy while keeping the retirement assumptions developed based on data received from Resource Adequacy;

Operating Reliability analyzed the dispatch, identify thermal, voltage and dynamic issues;

System upgrades/solutions are developed for reliability issues identified in each milestone in Operating Reliability, including but not limit to reconductor, new circuit, adding dynamic devices, etc.

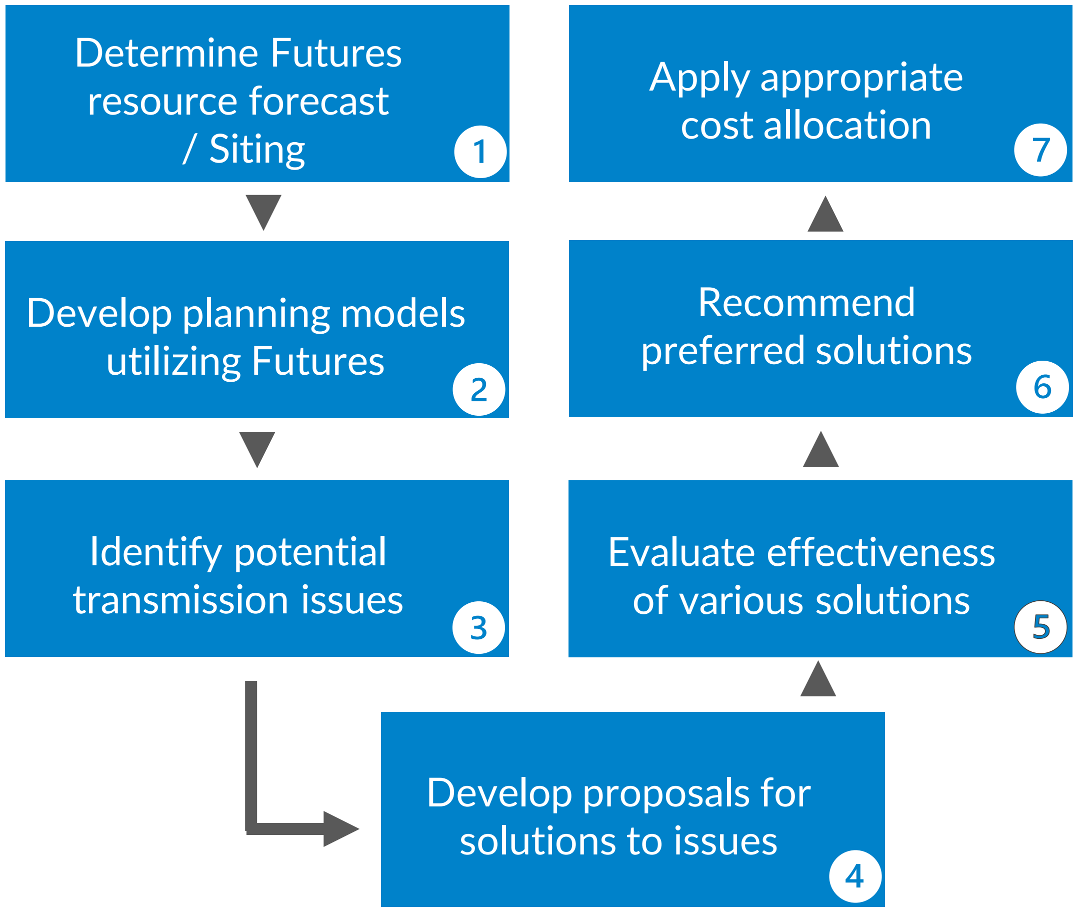
MISO's Renewable Integration Impact Assessment (RIIA) indicates integration complexity increasing sharply beyond 30% renewable penetration



1. Risk of losing load compresses into a small number of hours and shifts into the evening
2. Existing infrastructure becomes inadequate for fully accessing the diverse resources across the MISO footprint
3. Regional energy transfer increases in magnitude and becomes more variable leading to a need for increased extra- high-voltage line thermal capabilities
4. Power delivery from low short circuit areas may need transmission technologies equipped with dynamic support capabilities
5. Frequency response is stable up to 60% instantaneous renewable penetration, but may require additional planned headroom beyond
6. Grid-technology-needs evolve as renewable penetration increases, leading to an increased need for integrated planning
7. Diversity of technologies and geography improves the ability of renewables to serve load

Long Range Transmission Planning (LRTP) is developed through a comprehensive planning process, to deliver a robust, least-regrets, regional solution that reliably and efficiently enable the goals and objectives of its members and states

7-Step Process



- Recognize member and state goals across the entire footprint
- Define a forward-looking resource expansion which conforms to member goals
- Identify a least-regrets transmission buildout that hedges uncertainty
- Focus on regional transmission solutions, rather than localized issues

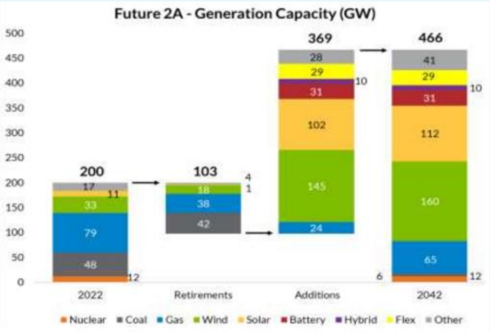
https://www.misoenergy.org/planning/long-range-transmission-planning/

This process began with the creation of Futures — critical planning scenarios to adequately bookend future uncertainties

Initial Model-Build/Resource Expansion

July 2022 – January 2023

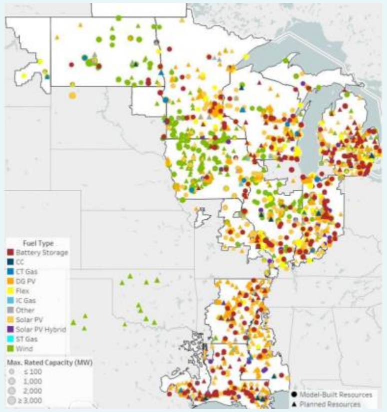
- Apply Futures assumptions
- Incorporate member plans – clean energy goals, resource additions, retirements
- Perform resource expansion to economically determine type, magnitude and timing of new resources



Siting

January – April 2023

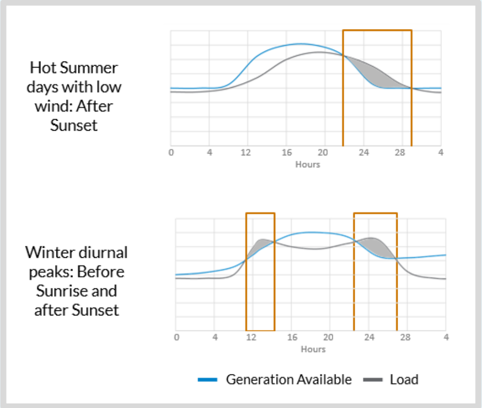
- Determine location to place each new resource in the transmission system
- Incorporate stakeholder feedback (500+ revisions) and update Siting



Energy Adequacy

January – April 2023

- Ensure all hours meet energy requirements
- Site 29 GW of resulting Flexible Attribute Unit capacity

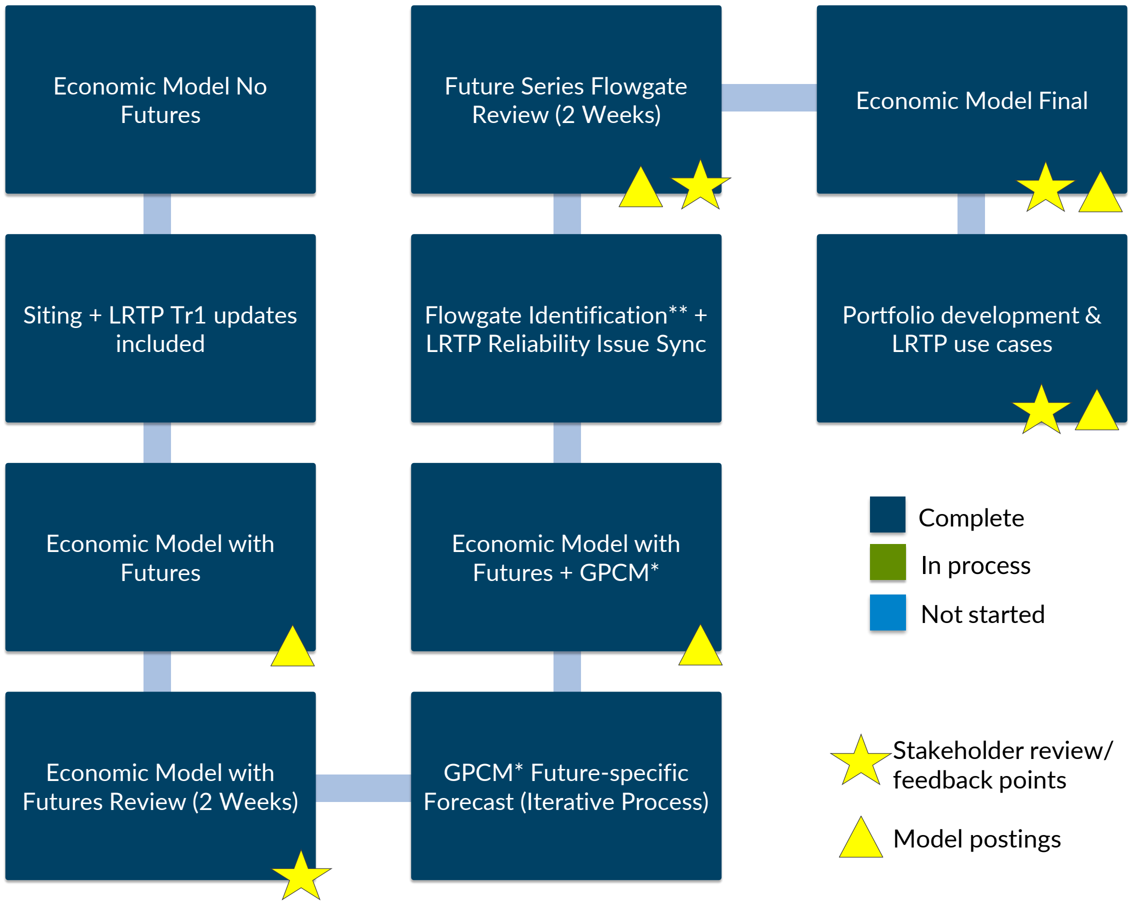


Futures help account for resource gaps and highlight focus areas for planning throughout MISO

Long-term planning analyses require sufficient resources throughout the study period, which can exceed what's currently known or publicly planned by members

Resource Expansion and Siting graphics: examples only (Series 1A).

The economic production cost models included Series 1A Future 2A assumptions, consisting of three study years



Economic Model Development Overview

- MISO's production cost models utilize PROMOD
  - Provides hourly (8760) chronological security constrained unit commitment and economic dispatch – adhering to a wide variety of operating constraints
- Three study years (2032, 2037, 2042)
- Future and year-specific gas prices
- Future and year-specific flowgates
- Used to develop the portfolio development and in business case analysis

*Mar '23 LRTP Workshop - Gas Pipeline Competition Model (GPCM)
**Dec '23 LRTP Workshop - Flowgate Identification

The reliability analysis included core models representing key future resource and load supplemented with transfer scenarios, dynamic stability and safe loading limits

2032

10-year out models

- Core models
- Potential solutions

→ Summer peak, Winter peak, Light load, Average load

2042

20-year out models

- Core models
- Potential solutions

→ Summer peak, Winter peak, Light load, Average load

Stability 2042

20-year out models

- Core models
- Potential solutions

→ Summer peak, Average load

Transfer scenarios 2042

20-year out models

- Core models
- Potential solutions

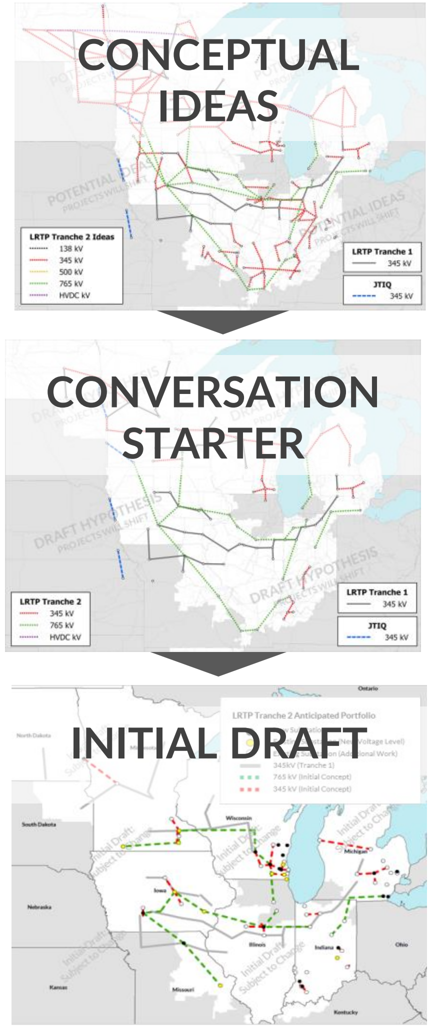
→ Twilight summer, Winter low renewable, Average East to West, Avg lowers to uppers

Contingencies: P0, P1, P2, P4, P5, and P7 – generally system intact, single element and single right of way outages P3 and P6 (within close proximity) – generally multiple outages in parallel

Safe Loading Limits (>345 KV, > 50 mi)

Monitored facilities: MISO Bulk Electric System (BES) elements including tie-lines to neighboring systems & First Tier non-MISO

This analysis drove transmission plans, building from conceptual ideas to an initial draft



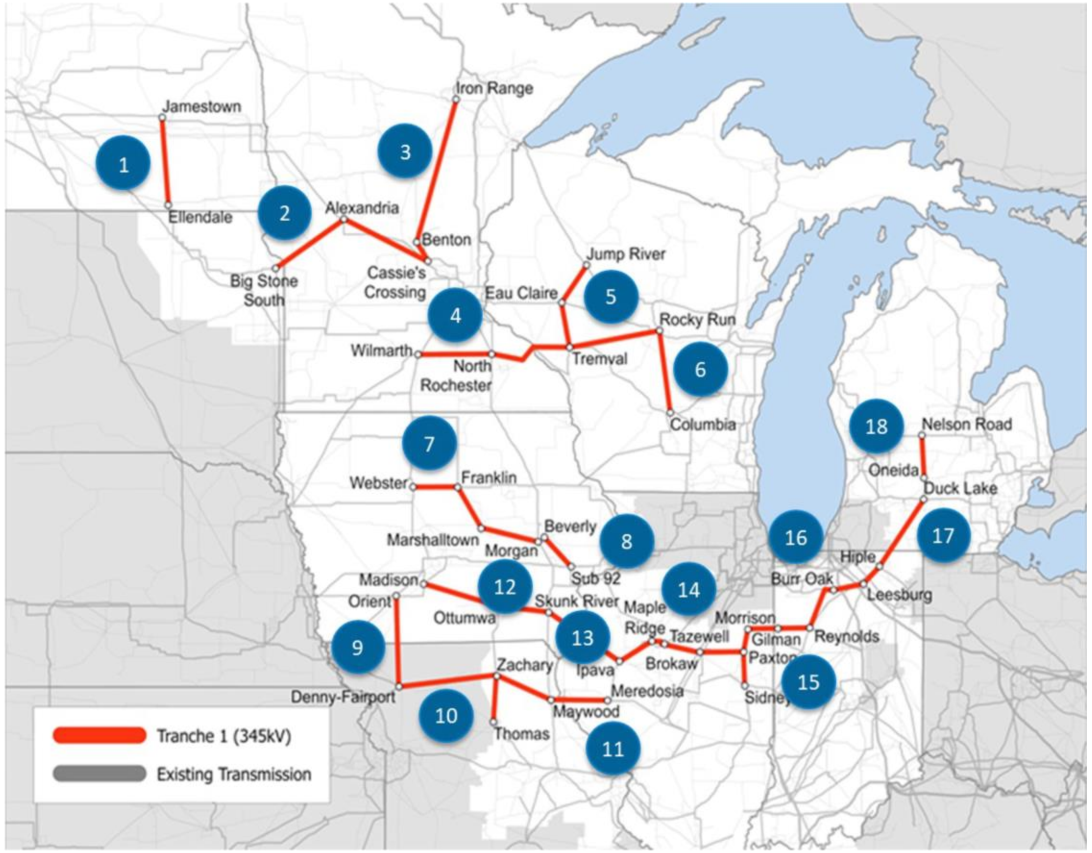
- How do assumptions impact the future resource mix?
- Under what conditions do lines provide value?
- What blend of 345 kV, 765 kV and HVDC* is best?
- Will the projects in the Tranche 2.1 provide robust solutions?
- Does the portfolio provide benefits consistent with the Tariff?
- What are the impacts of other late-stage transmission projects?

* HVDC – High Voltage Direct Current

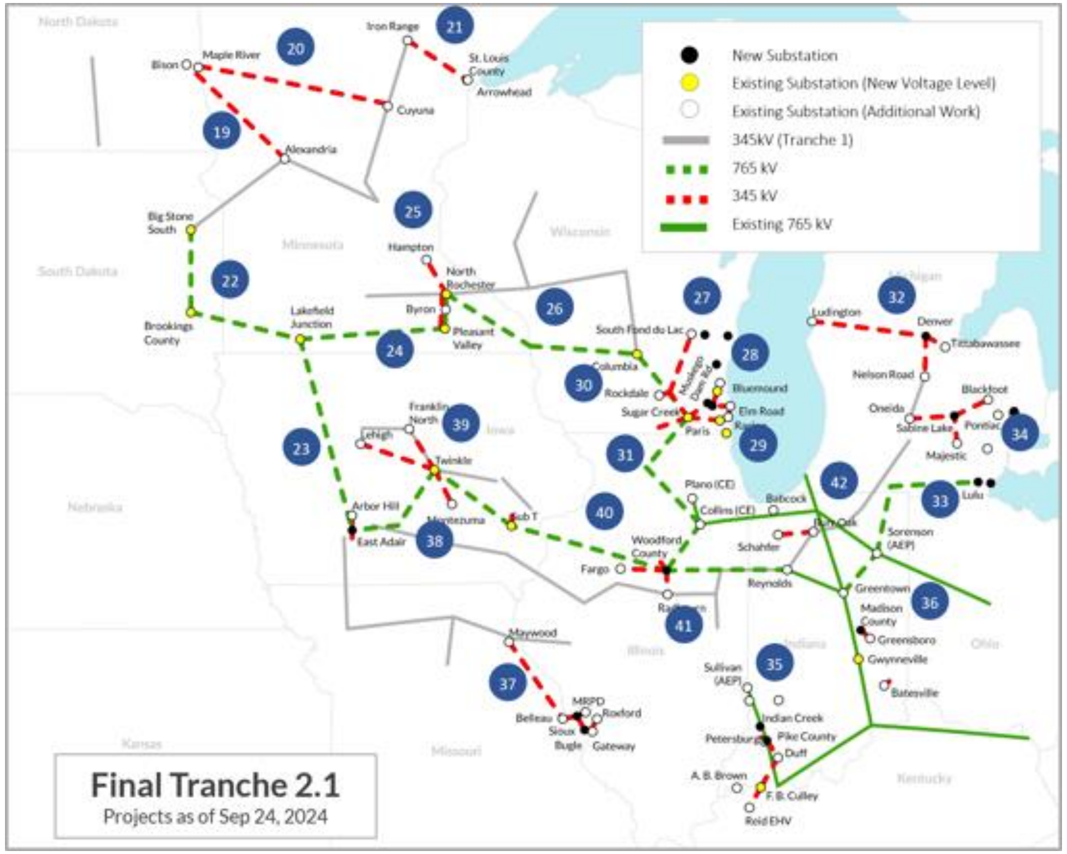
MISO

Two phases on new backbone transmission have been designed to enable the evolution of the system and mitigate against the risks previously explored

Final LRTP Tranche 1 Design



Final LRTP Tranche 2.1 Design



Introductory remarks from all panelists

What types of investments does your organization plan for?

How is your organization evaluating economic and reliability impacts when planning transmission investments?

What types of modeling and analytical studies do you run to value the economic and reliability impacts of transmission investments?

GRID PLANNING - NEEDS AND SOLUTIONS

ENERGINET

Separation of system needs and solutions for technology neutral and socio-economic efficient solutions

Assumtions for energy system development, Danish Energy Agency (2050, annually)

NEEDS (SoS criteria)

- Electric system characteristics
- Needs (methodology and models)
- Definition of needs

SOLUTIONS (cost effective) — Challenges (examples)

Connection agreements
- How to define requirements?
- Only apply for new connections?

DSO and TSO agreements
- DSO: complex regulation
- Cross border TSO: establish cooperation and regulatory approval

Energinet grid components
- Integrate in grid, system planning and models
- Establish/change control systems to manage components (SynCon, HVDC, SVC, STATCOM)

Market products
- Fulfill conditions for efficient market: competition, liquidity and reliability

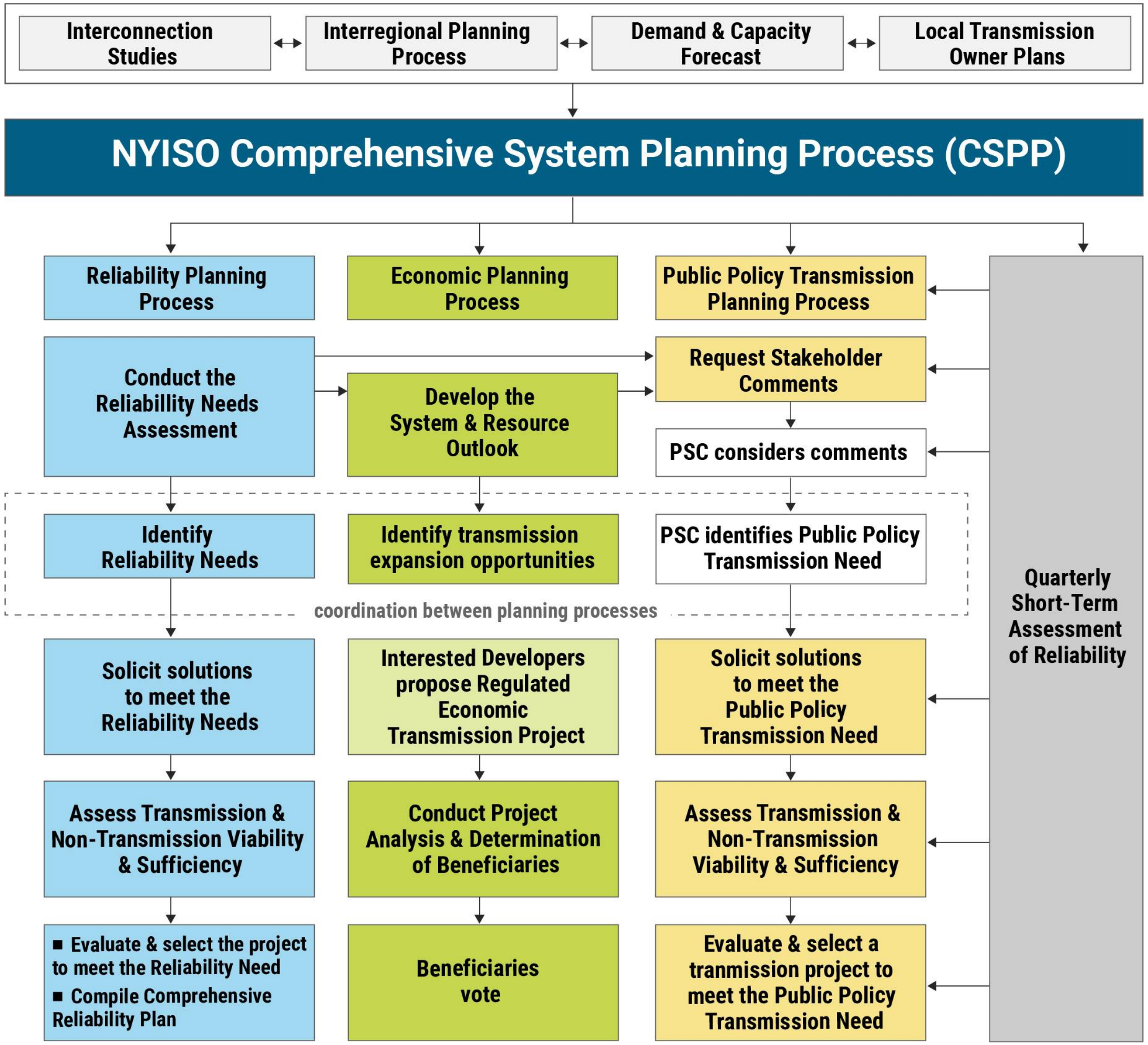
Forced delivery (cost+)
- Intermediate solution

Only to be used by emergency situations or no bids on markets

TSO ANALYSIS (not exhaustive)

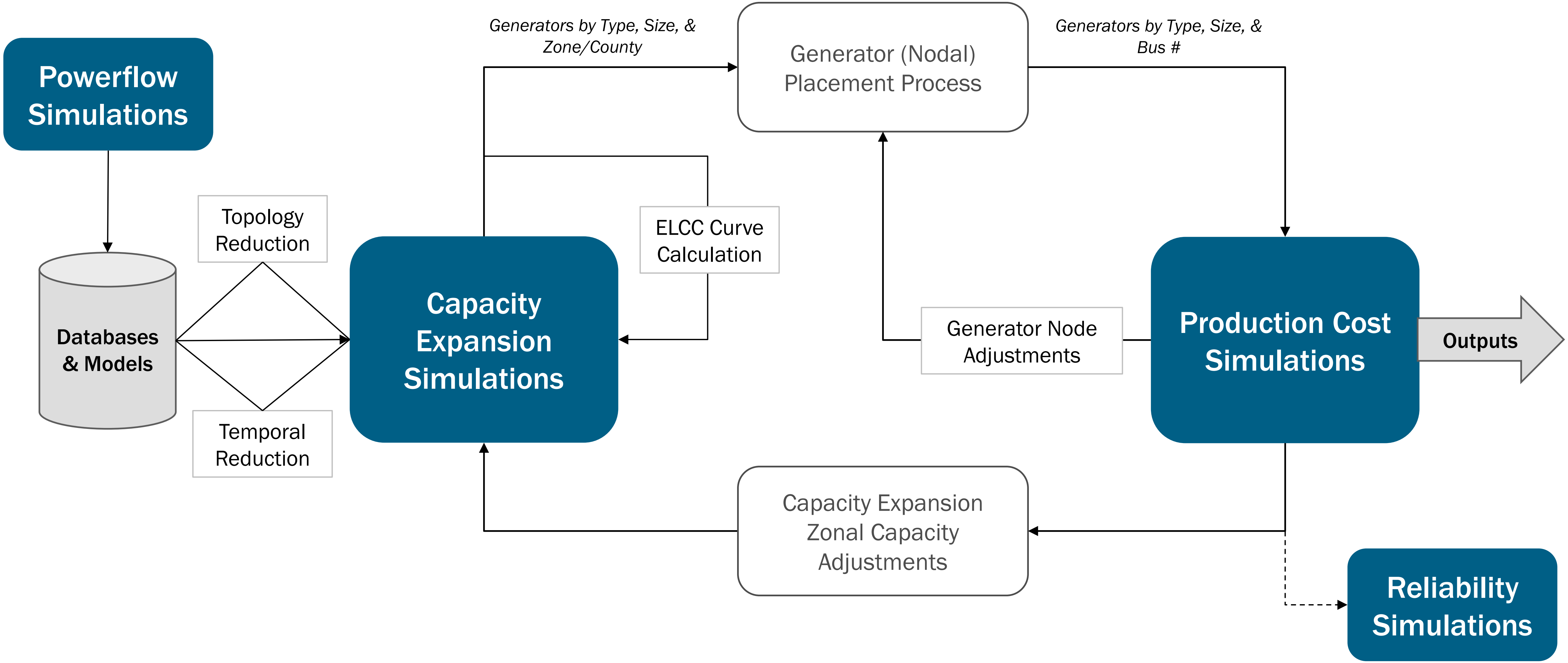
- Long term development plan (to 2050, bi-annual)
- Security of supply analysis (10 years, annually)
- Ancillary service outlook (10 years annually)
- Grid plan, 10 years, (bi-annually/annually)
- *IT-OT/system strategy*
- *System strength strategy*
- *Nordic/European coordination*
- *Grid technology strategy*

Business cases (socio economic)


Interconnection Studies
Interregional Planning Process
Demand & Capacity Forecast
Local Transmission Owner Plans
NYISO Comprehensive System Planning Process (CSPP)
Reliability Planning Process
Economic Planning Process
Public Policy Transmission Planning Process
Conduct the Reliabillity Needs Assessment
Develop the System & Resource Outlook
Request Stakeholder Comments
PSC considers comments
Identify Reliability Needs
Identify transmission expansion opportunities
PSC identifies Public Policy Transmission Need
coordination between planning processes
Quarterly Short-Term Assessment of Reliability
Solicit solutions to meet the Reliability Needs
Interested Developers propose Regulated Economic Transmission Project
Solicit solutions to meet the Public Policy Transmission Need
Assess Transmission & Non-Transmission Viability & Sufficiency
Conduct Project Analysis & Determination of Beneficiaries
Assess Transmission & Non-Transmission Viability & Sufficiency
■ Evaluate & select the project to meet the Reliability Need
■ Compile Comprehensive Reliability Plan
Beneficiaries vote
Evaluate & select a tranmission project to meet the Public Policy Transmission Need

New York ISO

Planning Simulation Framework



GB Transmission Investment Planning

What are the steps of our current transmission network planning approach?

FES	ETYS	NOA		
Pathways Develop pathways to net zero through our FES and the SSEP.	**1. Requirements** Identify future requirements as well as longer-term trends.	**2. Options** Provide a range of options from wider parties to meet identified needs.	**3. Assessment** Options are evaluated and selected against assessment criteria.	**4. Roadmap** Consult on and present an endorsed plan of future investments.
Resource Adequacy CfD, Capacity Market Plexos	**System requirements to meet planning and operation standard**	**Transmission solution Vs Market solution**	**CBA: Plexos Constrain Vs investment**	**Network roadmap**
	Stability and voltage markets			Detailed design and delivery

CSNP framework

SPP TRANSMISSION EXPANSION PLANNING (STEP)

Regional Planning

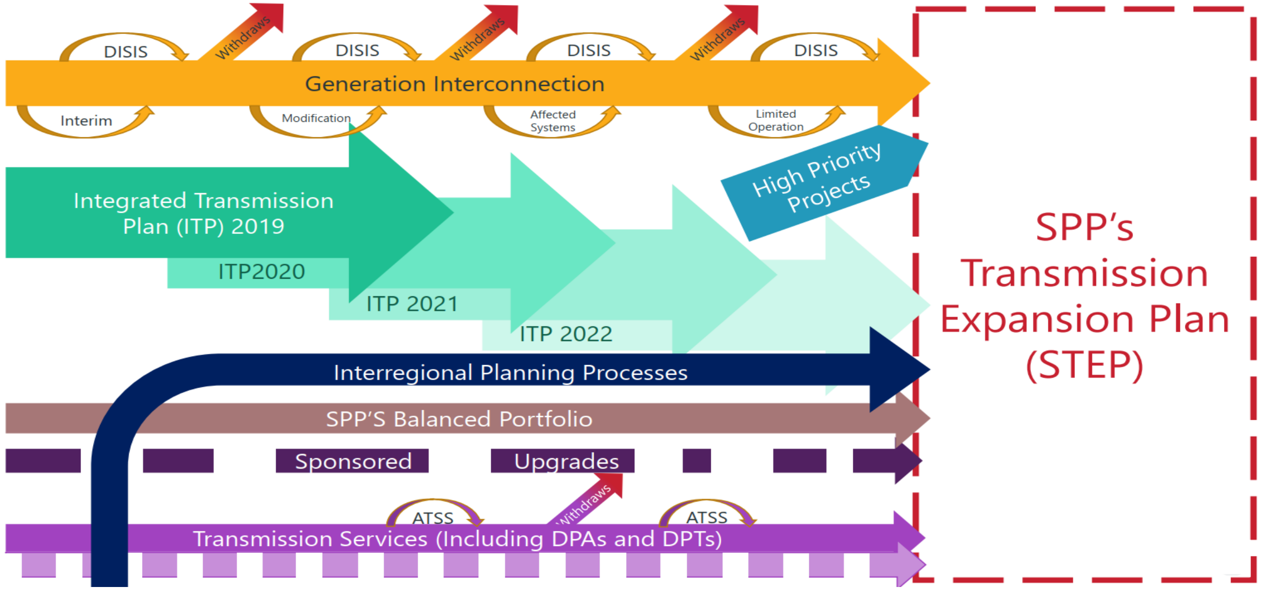
- Integrated Transmission Planning (ITP)
  - Compliance, Reliability, Economic, Scenario Planning
- High Priority Studies

Interregional Planning

Generator Interconnection

Load Interconnection

Transmission Services



ITP Assessment

Scoping and Model Build

- Study scope, including futures, resiliency scenarios, and other study assumptions
- Powerflow and economic model build

Assessments

- Constraint Assessment
- Transmission Needs Assessments (reliability, economic, operational, and public policy)
- Target Areas, Resiliency

Transmission Portfolio Development

- Stakeholder Detailed Project Proposal (DPP) Submission Window
- Solution Evaluation/Selection
- Portfolio Development

Reporting and Final Assessments

- Benefit Metrics
- Customer Rate Impacts
- Final Reliability Assessment

Benefit Metrics

- **Adjusted Production Cost**
- **Reduction of Emission Rates and Values**
- **Savings due to Lower Ancillary Service Needs and Production Costs**
- **Capacity Cost Savings due to Reduced On-Peak Transmission Losses**
- **Avoided or Delayed Reliability Projects**
- **Assumed Benefit of Mandated Reliability Projects**
- **Mitigation of Transmission Outage Costs**
- **Marginal Energy Losses**
- **Increased Wheeling Through and Out Revenues**
- **Benefit of Meeting Public Policy Goals**

Panel discussion

What are the main challenges to quantifying the tradeoffs between the economic and reliability impacts of transmission investments?

Panel discussion

How do you ensure data compatibility between your economic and reliability studies?

Panel discussion

How do you enable the coordination between the economic and reliability planning processes and/or teams?

Panel discussion

How do you collaborate with other system operators and other organizations, including planning software vendors, to advance your integrated planning processes?

Open Q&A

Please share your questions with the panel or individual panelists.