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Utilities and states face new and compounding planning uncertainties: surging data center demand, growth of inverter-based resources, extreme weather, and supply chain constraints, all while cyber and physical risks rise. Traditional resource adequacy and reliability studies struggle to keep pace or translate risk into optimized investment decisions.

Those limitations underscore the urgent need for a new generation of tools and standards for reliability assessment and implementation. These tools and standards must account for resource variability and vulnerability, dependencies on bulk-distribution systems, and uncertain large loads—all while promoting financially feasible investments.

The future of reliability assurance resources for cost-optimized, risk- informed, integrated grid planning

The Framework for Optimizing Reliable Energy Systems and Infrastructure Given High-Uncertainty Trajectories (FORESIGHT) initiative will develop a first-of-its-kind operational and near-term grid planning framework to systematically account for evolving probabilities of weather extremes, uncertainties in technologies and policies, and the potential financial challenges of investors.

The integrated analytics will support cost-optimized, risk-informed grid investment and operational strategy. Reliability assurance datasets, computational methods, dissemination tools, and best practices will be available to the following:

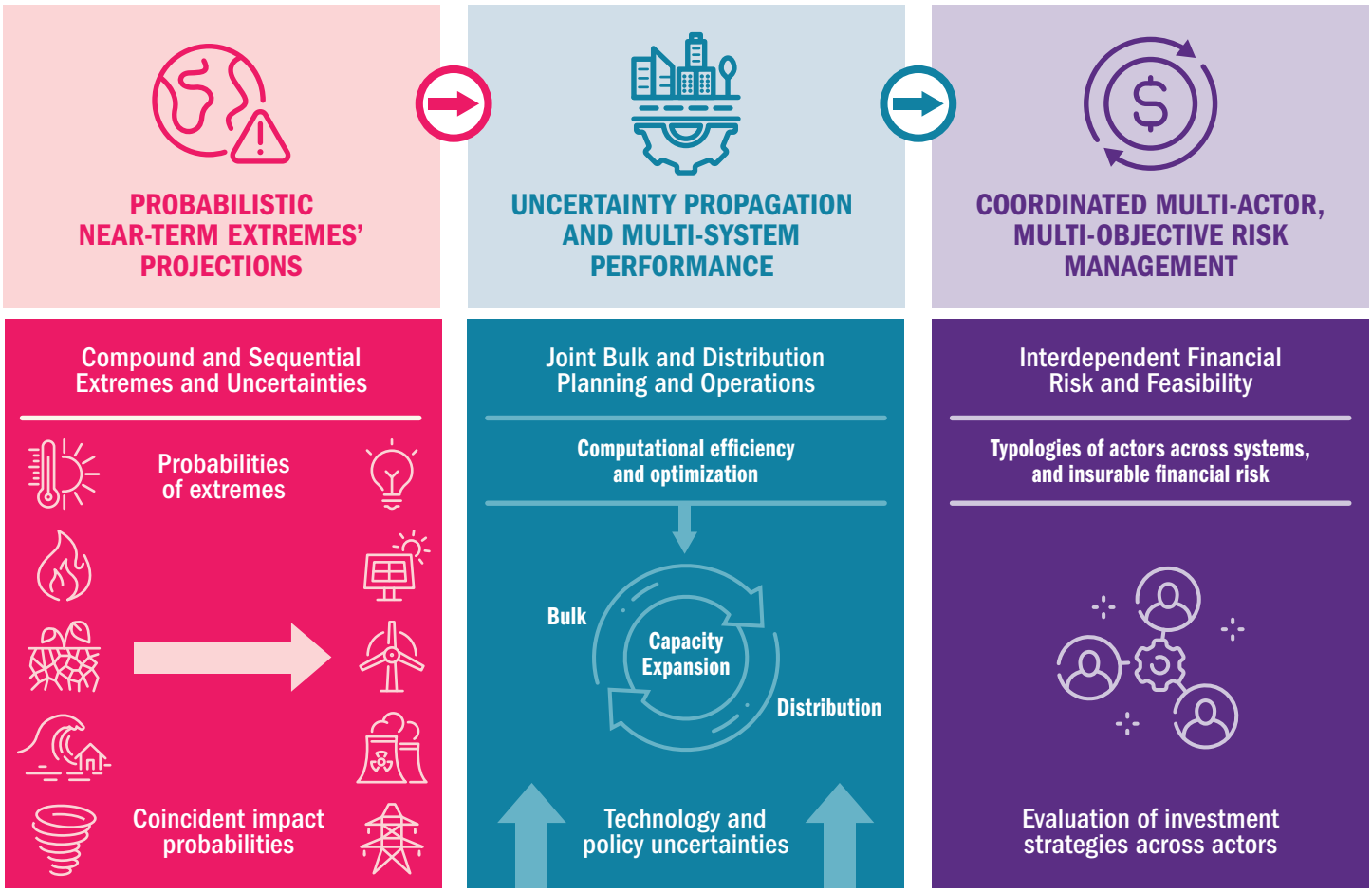
- Regulatory entities to develop reliability standards with the intended robustness and performance targets
- Utilities to develop their compliance plans and meet their mandate of adequacy, reliability, and affordability
- Investors to consider system-wide, risk-informed, cost-optimized investment strategies and supporting resources as part of their decision-support framework.

Technical Objectives

Establish best practices and develop resources to design robust and financially responsible reliability standards for extreme weather events.

Pioneer multi-system electricity infrastructure planning amid uncertainties using computationally efficient algorithms to represent the interdependence between bulk and distribution systems.

Innovate in financial evaluation of infrastructure needs, accounting for uncertainties, financial risk, and the many investors in the bulk and distribution systems.



Core Capabilities

- Artificial intelligence–based weather and hydrology extreme-event emulators for probabilistic near-term planning
- Weather-to-grid deterministic and probabilistic impact models
- Innovative dissemination tool and access to libraries of extreme events and associated power-system-ready datasets
- Advanced algorithms for cross-system planning under compound risk
- Artificial intelligence–based modeling of interacting investor decisions under uncertainty to realize future infrastructure portfolios.

Users Include

System Operators

Evaluate financially feasible resource adequacy needs under uncertainties in weather extremes; determine allocation to bulk and distribution systems for user-provided load growth scenarios.

Utilities

Obtain guidance in selecting extreme-event scenarios for reliability standards compliance efforts; access associated power-system-ready datasets and portfolios of potential investors.

Investors

Evaluate uncertainties for potential investments—and risks across other investors—to support investment decision-making.

Regulatory Entities

Gain access to educational material for defining power system–relevant extreme events for use in developing reliability standards; assess financial risks across investors for use in evaluating rates and incentives.

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For more information, scan the QR or visit **pnnl.gov/projects/foresight**

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