Grid Planning for a Changing Climate

Transmission Challenges with Extreme Weather

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Sr. Principal Technical Leader

October 17, 2023
NASEO Annual Meeting
Portland, OR

Explore EPRI's research across the Nuclear, Generation, and Power Delivery and Utilization sectors ranging from decarbonization to grid modernization to low carbon resources.

COLLABORATION

EPRI's collaborative platform is unrivaled. Our R&D:

- Leverages your research dollars
- Connects you to a global network of peers
- Accelerates deployment of technology
- Mitigates the risk and uncertainty of going it alone
- Positions you as a leader in addressing industrywide challenges

CREDIBILITY

EPRI's independent research is guided by our mission to benefit the public. We offer:

- Objective solutions
- A proven track record
- Scientifically based research you can trust

EXPERTISE

For more than 50 years, EPRI has been applying R&D to help solve real challenges. With EPRI, you can:

- Reduce expenses and increase productivity
- Be more resilient today and better prepared for tomorrow
- Access an industry repository of collective experiences, technical expertise, and training resources
- Extend your staff and make your teams more robust and more confident
- Benchmark, learn and share best practices
- Increase your awareness of challenges that others are facing and alternate solutions to challenges you might be facing
- Save time and money troubleshooting problems EPRI and its stakeholders have seen before

Who We Are

Founded in 1972, the Electric Power Research Institute (EPRI) is the world's preeminent independent, non-profit energy research and development organization, with offices around the world.

Our Experts

EPRI's trusted experts collaborate with more than 450 companies in 45 countries, driving innovation to ensure the public has clean, safe, reliable, affordable, and equitable access to electricity across the globe.

EPRI Climate Resilience and Adaptation Initiative (READi)

CLIMATE READi
RESILIENCE AND ADAPTATION INITIATIVE

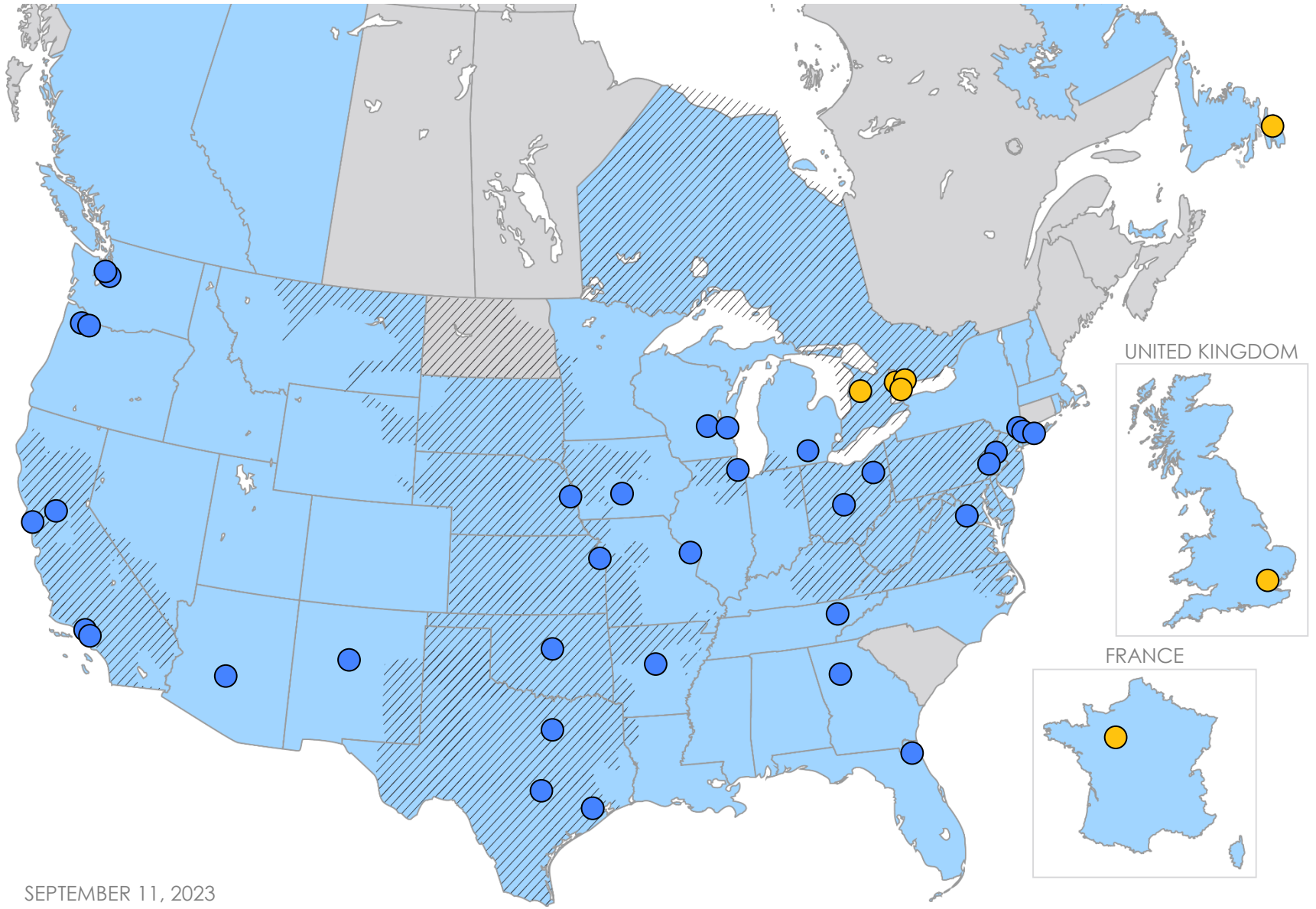
- **COMPREHENSIVE:** Develop a *Common Framework* addressing the entirety of the power system, planning through operations
- **CONSISTENT:** Provide an informed approach to climate risk assessment and strategic resilience planning that can be replicated
- **COLLABORATIVE:** Drive stakeholder alignment on adaptation strategies for efficient and effective investment

Workstream 1	Workstream 2	Workstream 3
Physical Climate Data & Guidance	**Energy System & Asset Vulnerability Assessment**	**Resilience / Adaptation Planning & Prioritization**
• Identify climate hazards and data required for different applications • Evaluate data availability, suitability, and methods for downscaling & localizing climate information • Address data gaps	• Evaluate vulnerability at the component, system, and market levels from planning to operations • Identify mitigation options from system to customer level • Enhance criteria for planning and operations to account for event probability and uncertainty	• Assess power system and societal impacts: resilience metrics and value measures • Create guidance for optimal investment priorities • Develop cost-benefit analysis, risk mitigation, and adaptation strategies

Deliverables: Common Framework "Guidebooks"

- Climate data assessment and application guidance
- Vulnerability assessment
- Risk mitigation investment
- Recovery planning
- Hardening technologies
- Adaptation strategies
- Research priorities

Climate READi Members

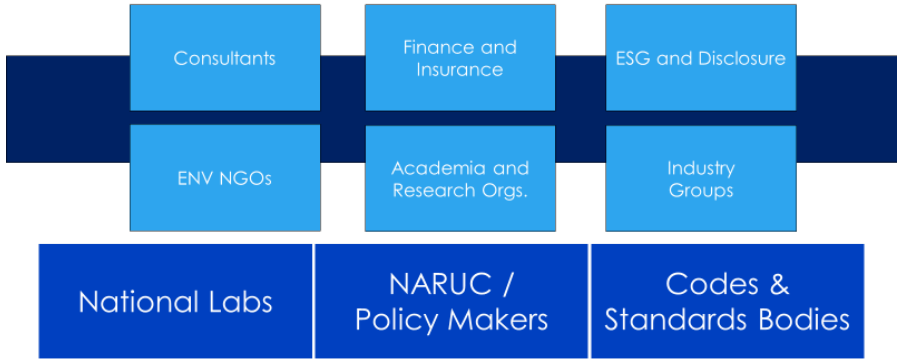


SEPTEMBER 11, 2023

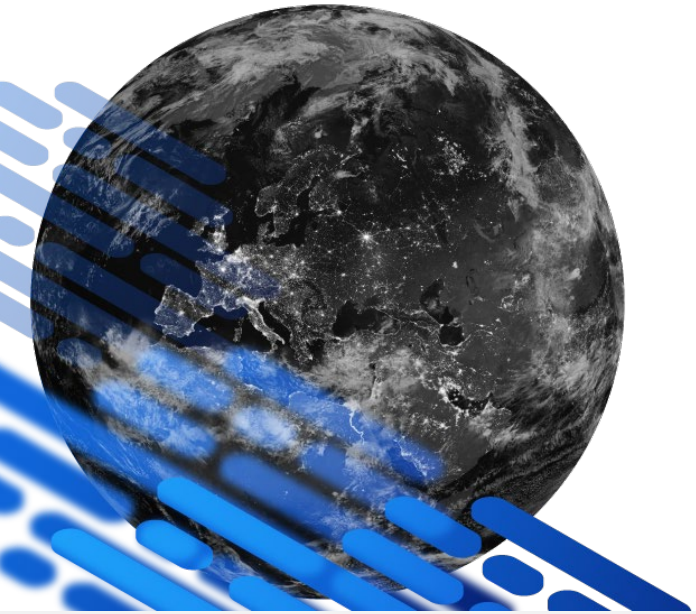
○ Member Headquarters ▭ Member Operating States/Provinces ▨ ISO Service Territories *(only HQ location shown for IPPs)*

aes Indiana · exelon · PG&E
aes Ohio · FirstEnergy · pjm
Alliant Energy · FORTIS · PNM
Ameren · hydro one
American Electric Power · ieso · ppl
Berkshire Hathaway Energy · JEA · PSE Puget Sound Energy
Bonneville Power Administration · LA DWP Los Angeles Department of Water & Power · Rte
BrucePower · LIPA Long Island Power Authority · SRP
California ISO · nationalgrid · Seattle City Light
CenterPoint Energy · NY Power Authority · Southern California Edison
Consumers Energy · OG&E · Southern Company
conEdison · OPPD Omaha Public Power District · SPP Southwest Power Pool
ercot · Ontario Power Generation · TVA Tennessee Valley Authority
evergy · VISTRA
WEC Energy Group

Climate READi Affinity Group (CRAG)



Embracing a 'Big-Tent' Approach to Framework Development



- Accenture
- ADEX
- Alison Silverstein (Consultant)
- Andre Dessler (Consultant)
- Applied Weather Associates
- Argonne National Laboratory
- Baringa
- Battelle
- Black & Veatch
- Brookhaven National Laboratory
- CAMPUT
- Canadian Climate Institute
- CANDU Owners Group
- CarbonPlan
- CDP North America
- Center for Climate & Energy Solutions
- Chemonics
- Clark Miller (Consultant)
- Clean Air Task Force
- Climate Risk Institute
- Columbia University
- Copperleaf Technologies
- CSA Group
- Desert Research Institute
- Disaster Tech
- Eagle Rock Analytics
- Eaton
- Electricity Canada
- Energy Systems Integration Group
- Energy Networks Association
- Enline Transmission
- Exponent
- Grid Lab
- Grid2.0
- Guidehouse
- Houston Advanced Research Center
- ICF
- IEEE
- Imperial College London
- King Abdullah Petroleum Studies and Research Center
- Institute of Nuclear Power Operations
- Jacobs Engineering
- Khalifa University
- King Abdullah University of Science and Technology
- King's College London
- Lawrence Berkeley National Laboratory
- Lawrence Livermore National Laboratory
- McCormick Taylor
- Midwest Climate Collaborative
- Model World Consulting
- National Association of Regulatory Utility Commissioners
- National Association of State Energy Officials
- National Center for Atmospheric Research
- National Oceanic and Atmospheric Administration
- National Renewable Energy Laboratory
- North American Electric Reliability Corporation
- North American Transmission Forum
- Nuclear Energy Institute
- Nuclear Electric Insurance Limited
- National Renewable Energy Laboratory
- Oak Ridge National Laboratory
- Oregon State University
- Pacific Northwest National Laboratory
- Pacific Northwest Utilities Conference Committee
- Power Systems Engineering Research Center
- Quanta Services
- RAND Corporation
- Resources for the Future
- RS Poles
- RUNWITHIT Synthetics
- Sharply Focused
- SLR Consulting
- Storm Impact
- Sunairio
- Union of Concerned Scientists
- Universidad Pontificia
- University of Albany
- University of Illinois
- University of Michigan
- University of Nottingham
- University of Reading
- University of Saskatchewan
- Verdantas

Workstream 3 Objective

Investment prioritization for resilience that accounts for climate risks, asset vulnerability, and impacts on society and communities

To identify and prioritize investments, we need to:

Account for what the system might look like in response to climate and technology development

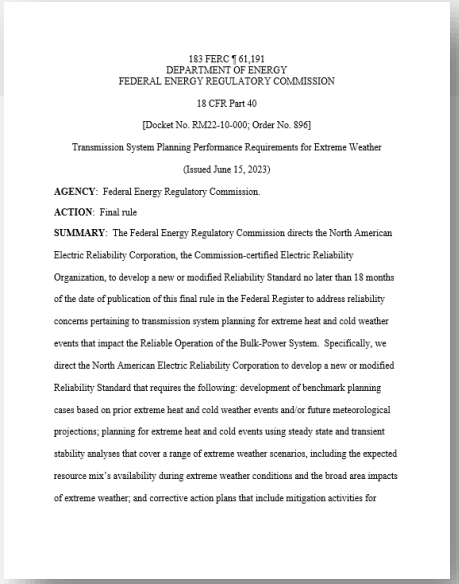
Understand how existing assets and infrastructure will be vulnerable to climate

Identify what are the new adaptations that we want to invest in to ensure resilience

How these adaptations impact communities, equity, and justice

A Changing Regulatory Landscape

A Push for Interregional Transmission



183 FERC ¶ 61,191
DEPARTMENT OF ENERGY
FEDERAL ENERGY REGULATORY COMMISSION

18 CFR Part 40

[Docket No. RM22-10-000; Order No. 896]

Transmission System Planning Performance Requirements for Extreme Weather

(Issued June 15, 2023)

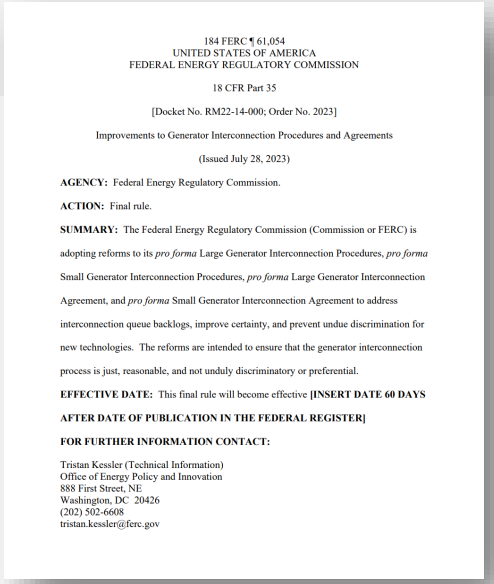
AGENCY: Federal Energy Regulatory Commission.

ACTION: Final rule

SUMMARY: The Federal Energy Regulatory Commission directs the North American Electric Reliability Corporation, the Commission-certified Electric Reliability Organization, to develop a new or modified Reliability Standard no later than 18 months of the date of publication of this final rule in the Federal Register to address reliability concerns pertaining to transmission system planning for extreme heat and cold weather events that impact the Reliable Operation of the Bulk-Power System. Specifically, we direct the North American Electric Reliability Corporation to develop a new or modified Reliability Standard that requires the following: development of benchmark planning cases based on prior extreme heat and cold weather events and/or future meteorological projections; planning for extreme heat and cold events using steady state and transient stability analyses that cover a range of extreme weather scenarios, including the expected resource mix's availability during extreme weather conditions and the broad area impacts of extreme weather; and corrective action plans that include mitigation activities for

FERC Order 896

Updates the NERC transmission planning standard (TPL-001-5.1) and asks planning entities to identify corrective actions for reliability impacts driven by extreme heat or extreme cold events



184 FERC ¶ 61,054
UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

18 CFR Part 35

[Docket No. RM22-14-000; Order No. 2023]

Improvements to Generator Interconnection Procedures and Agreements

(Issued July 28, 2023)

AGENCY: Federal Energy Regulatory Commission.

ACTION: Final rule.

SUMMARY: The Federal Energy Regulatory Commission (Commission or FERC) is adopting reforms to its *pro forma* Large Generator Interconnection Procedures, *pro forma* Small Generator Interconnection Procedures, *pro forma* Large Generator Interconnection Agreement, and *pro forma* Small Generator Interconnection Agreement to address interconnection queue backlogs, improve certainty, and prevent undue discrimination for new technologies. The reforms are intended to ensure that the generator interconnection process is just, reasonable, and not unduly discriminatory or preferential.

EFFECTIVE DATE: This final rule will become effective **[INSERT DATE 60 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**

FOR FURTHER INFORMATION CONTACT:

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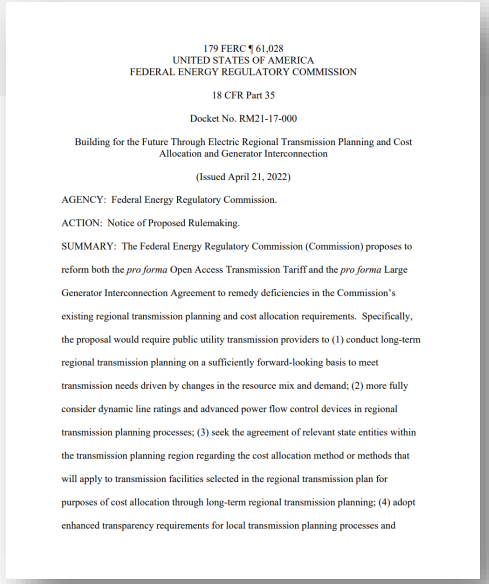
FERC Order 2023

Reforms the generation interconnection study process and address cost allocation with transmission reinforcement for generation interconnection



179 FERC ¶ 61,028
UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

18 CFR Part 35

Docket No. RM21-17-000

Building for the Future Through Electric Regional Transmission Planning and Cost Allocation and Generator Interconnection

(Issued April 21, 2022)

AGENCY: Federal Energy Regulatory Commission.

ACTION: Notice of Proposed Rulemaking.

SUMMARY: The Federal Energy Regulatory Commission (Commission) proposes to reform both the *pro forma* Open Access Transmission Tariff and the *pro forma* Large Generator Interconnection Agreement to remedy deficiencies in the Commission's existing regional transmission planning and cost allocation requirements. Specifically, the proposal would require public utility transmission providers to (1) conduct long-term regional transmission planning on a sufficiently forward-looking basis to meet transmission needs driven by changes in the resource mix and demand; (2) more fully consider dynamic line ratings and advanced power flow control devices in regional transmission planning processes; (3) seek the agreement of relevant state entities within the transmission planning region regarding the cost allocation method or methods that will apply to transmission facilities selected in the regional transmission plan for purposes of cost allocation through long-term regional transmission planning; (4) adopt enhanced transparency requirements for local transmission planning processes and

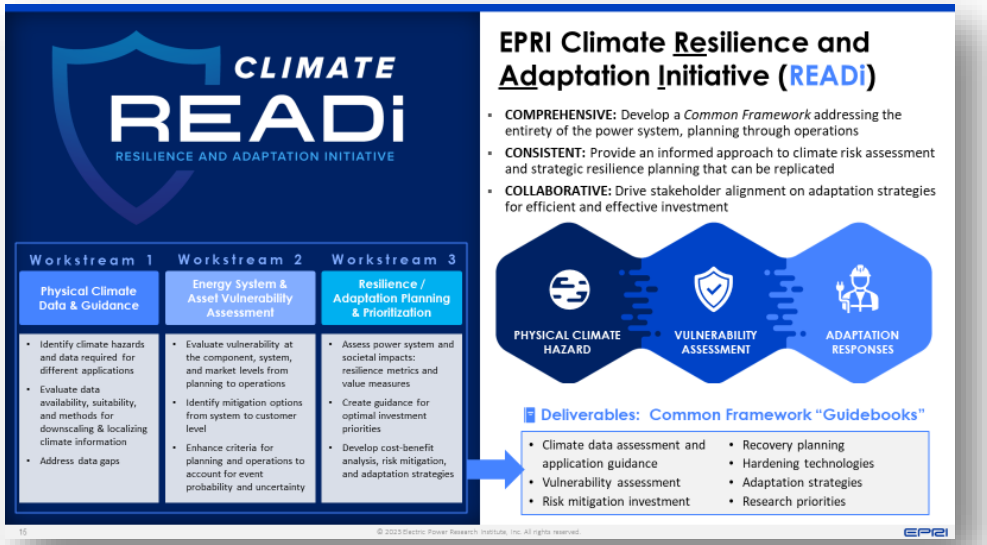
NOPR RM21-17-000

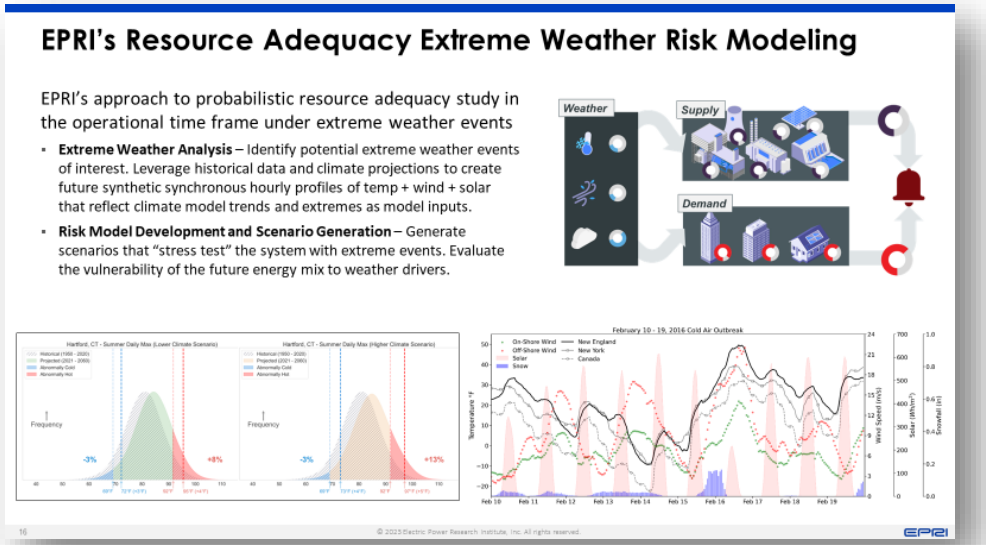
Establishes a longer horizon for transmission planning (20-years) and seeks to remedy the cost-allocation required for the construction of interregional transmission, essentially updating Order 1000

How EPRI research is supporting industry's needs?

- Developing collaborative research-based framework to support industry and facilitate decision making
- EPRI working to identify the challenges and changes that will be required in the CBA process to value reliability, resilience, and value to customers and communities
- Work across EPRI is focused on the integrated planning processes required to address extreme weather challenges in power system planning assessments

Climate READi





RA Initiative and Base Research Projects