Climate Adaptation and Resilience

Energy System Resilience Initiatives

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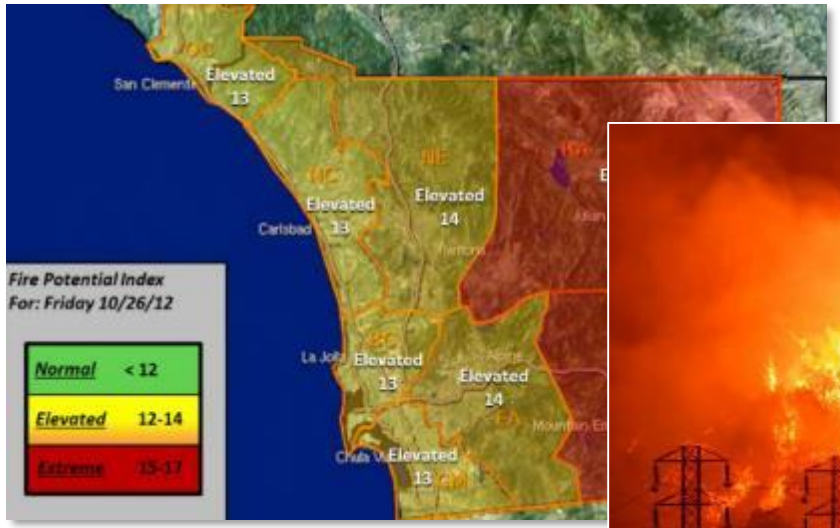
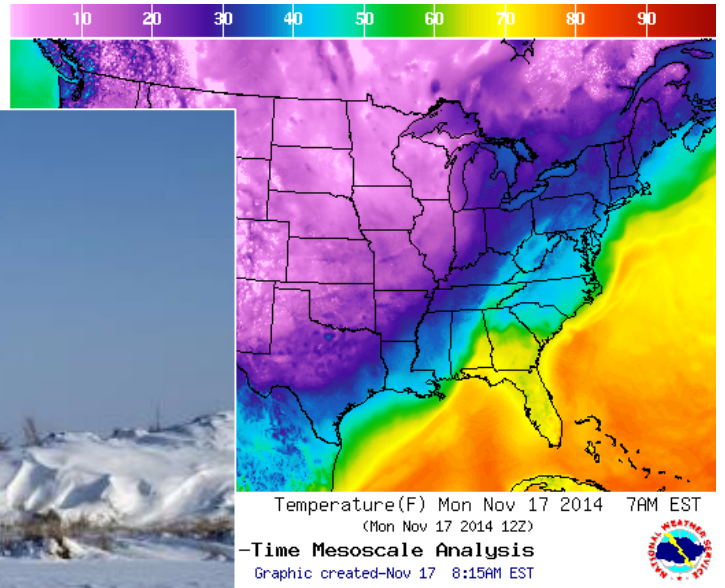
Extreme Weather Events; Electric Sector Adaptation and Resilience





Climate change requires updating the technical basis for designing, planning, and operating the grid.

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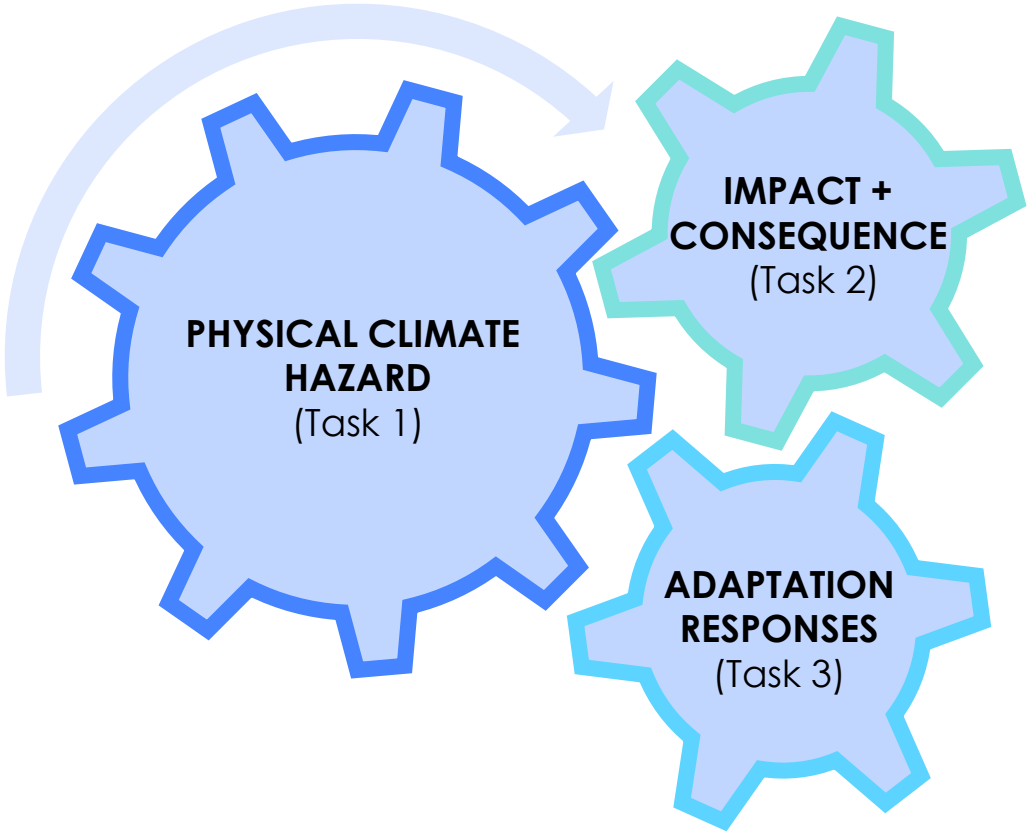
EPRI Climate Adaptation and Resilience Initiative

Integrated approach to localized climate risk assessment & strategic resilience planning

TASK 1: Physical Climate Data and Analysis

- Identify data needs
- Evaluate and provide data
- Assess scientific understanding
- Develop risk framework
- Convene with experts and stakeholders

Foundation for physical risk assessment standard



TASK 2: Energy System Impact and Vulnerability

- Assess impacts and vulnerability at the component, system, and market levels
- Enhanced design basis

TASK 3: Adaptation Response Prioritization and Planning

- Prioritize investments
- Resilience metrics
- Benefit-cost analysis
- Adaptation strategies

Deliverables: Standardized Guidance ("Guidebooks")

- Climate data and scenario guidance
- Research priorities
- Hardening technologies
- Advanced design basis
- Resilient operations
- Adaptation planning process

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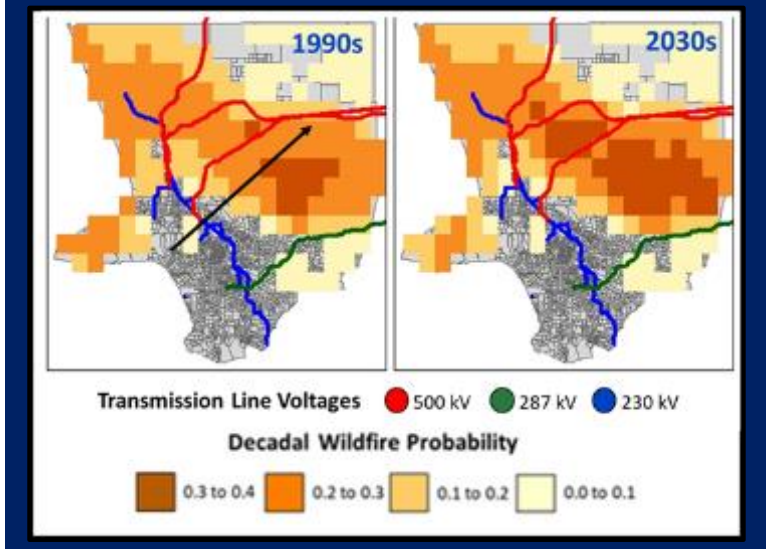
Limited Example: Transmission Climate Resiliency Risk Assessment

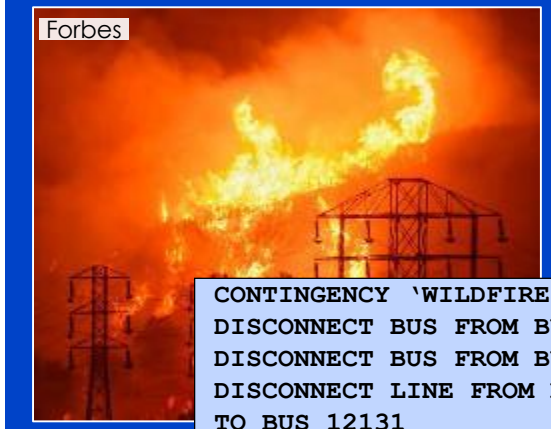
Step 1: Map Climate Impacts Geographically to Utility Assets

Apply future climate data to assess locational climate risk *(wildfire, sea rise, extreme temperatures, etc.)*



Step 2: Assess Grid Impacts and Define Extreme Contingencies

Define future grid impacts: demand changes, generation, and transmission outages

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CONTINGENCY 'WILDFIRE OUTAGES'
DISCONNECT BUS FROM BUS 12345
DISCONNECT BUS FROM BUS 34567
DISCONNECT LINE FROM BUS 91011
TO BUS 12131
DISCONNECT GEN FROM BUS 57890
DISCONNECT PV FROM BUS 123456
DISCONNECT PV FROM BUS 789101
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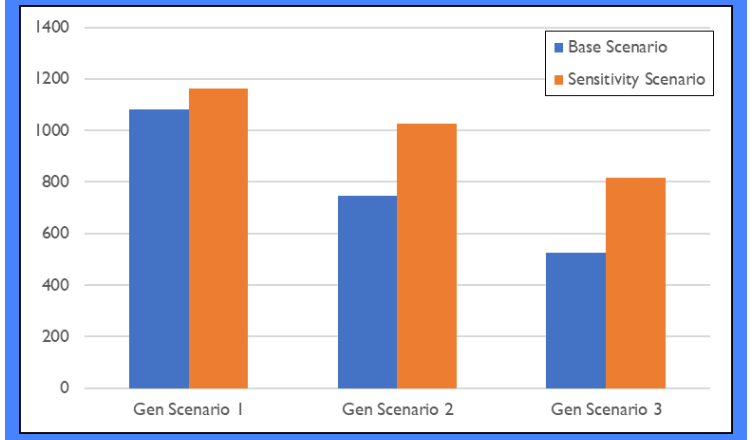
Step 3: Assess Grid Risk and Evaluate Mitigation Options Risk Hedge

Use system resilience analysis to quantify risk while considering system mitigation options

Load Loss Risk Impacts



Full framework must consider societal impacts and mitigation option cost benefit.

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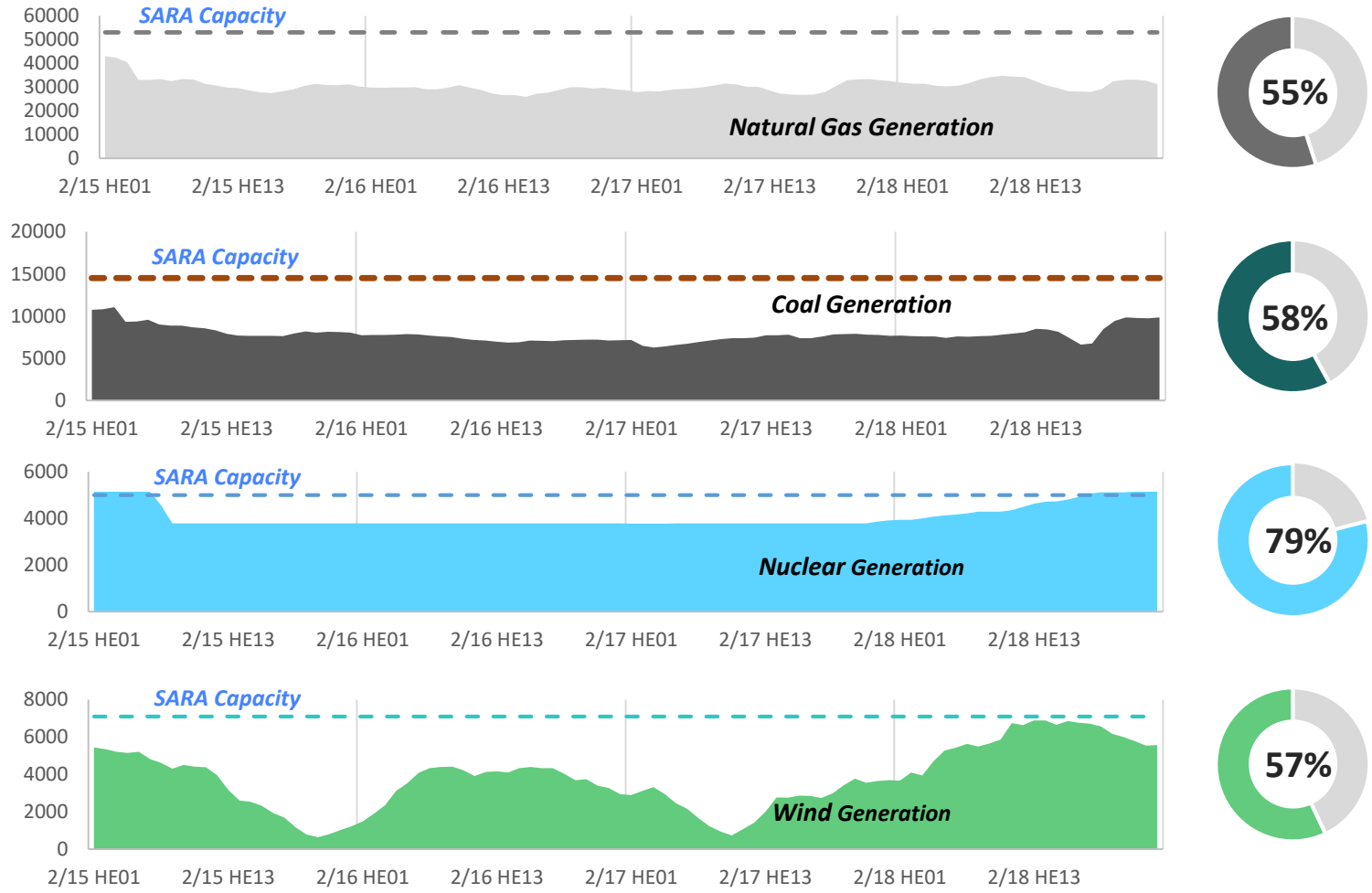
February 2020 Polar Vortex: Resource Adequacy Lessons

- Scenario planning includes future trends (climate, etc.)
- Metrics reflect magnitude and duration of events
- Design criteria reflect future system consequences
- Resource performance in future context considered
- Interdependent systems considered

ERCOT Generation vs. Seasonal Expected Availability (Feb. 15-18)

Seasonal Assessment of Resource Adequacy* (SARA) vs. Actual Generation	Performance vs. SARA



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EPRI Resource Adequacy Initiative

Scope and Deliverables

RA Process

- Recommended Metrics and Criteria
- Future Scenario Database and Tool

Models and Data

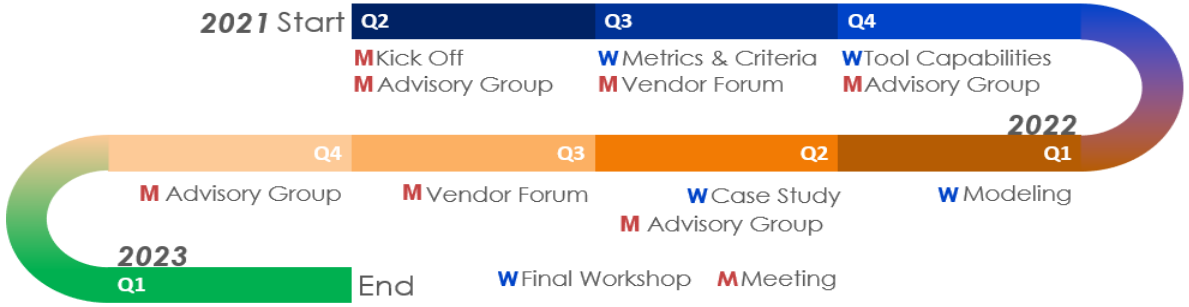
- Emerging Resource & Demand Side Models
- Model Data Development Tools

Analysis Tools

- Existing RA Tool Capabilities
- New Algorithms and open-source code

Case Studies — Evaluation of existing and development of new capabilities based on 4-6 regional RA case studies covering differing RA issues and tools.

Tech Transfer — Reports and workshops to be conducted to disseminate results and to promote broad adoption in commercial tools.



25+ Participants

Collaboration and Partners

External Advisory: NARUC, RROs, DOE, ESIG, ENTSO-E, EEI, ISO/RTOs, G-PST, et. al.

R&D Partners: Vendors, Nat. Labs, Consultants, Universities

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