U.S. Department of Energy's Partnership for Energy Sector Climate Resilience

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Vulnerabilities

- All regions/energy subsectors are vulnerable to extreme weather and climate stress
- Vulnerabilities vary by region, depending upon energy infrastructure present
- Network interdependencies and energy supply chains can extend vulnerabilities across regions

Climate Stress
Increasing temperatures and heat waves
Increasing heavy downpours
Increasing sea level rise and storm surge
Increasing frequency of intense hurricanes

Partnership for Energy Sector Climate Resilience

- Announced in April 2015 in response to industry requests

- Provides a mechanism for sustained engagement between DOE and energy companies, starting with a focus on electric utilities, to address the risks associated with extreme weather and climate

- Collaborate to:
  - ✓ Exchange information and best practices
  - ✓ Provide user-friendly extreme weather and climate data and decision tools;
  - ✓ Assess incentives and disincentives associated with regulations and policies;
  - ✓ Assess cost and benefits of resilience actions;
  - ✓ Identify metrics for measuring success in enhancing resilience and use them to assess progress;
  - ✓ Identify key gaps and opportunities related to the development and deployment of resilient energy technologies, practices and policies.

- Creates a forum where companies pursuing action on extreme weather and climate resilience can receive recognition

Partnership for Energy Sector Climate Resilience: Members

- Membership includes 17 power companies and growing:
  - Represents approximately 20% of U.S. generating capacity, serving approximately 25% of U.S. customers
  - Includes broad array of companies geographically dispersed across the Nation:

Investor-Owned
- AVANGRID
- Consolidated Edison of New York
- Entergy
- Exelon Corporation
- National Grid
- Pacific Gas and Electric
- Pepco Holdings Inc.
- Public Service Electric and Gas
- San Diego Gas and Electric/ Sempra
- Southern California Edison
- Xcel Energy

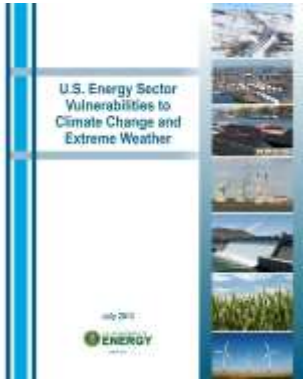
State/Municipal
- Austin Energy
- New York Power Authority
- Seattle City Light
- Sacramento Municipal Utility District

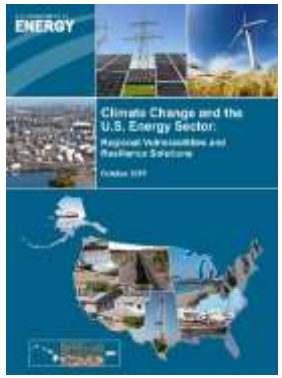
Federal
- TVA

Cooperative
- Great River Energy

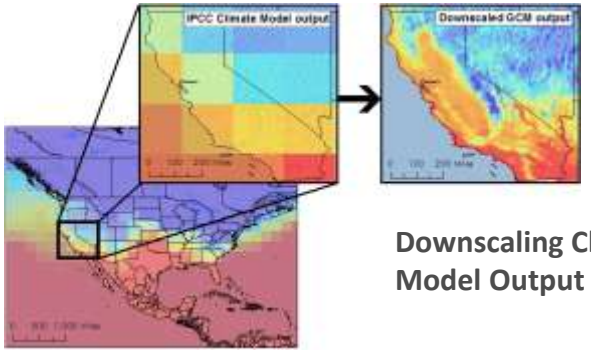
Work Streams: Assess risks from extreme weather and other natural hazards, and develop cost/benefit methodologies

- Conduct analysis and publish reports to help Partners and other stakeholders understand national and regional risks





- Collaborate with Federal Partners (NOAA, NASA, DHS, and others) to provide down-scaled climate model output for assessing current and potential future vulnerabilities

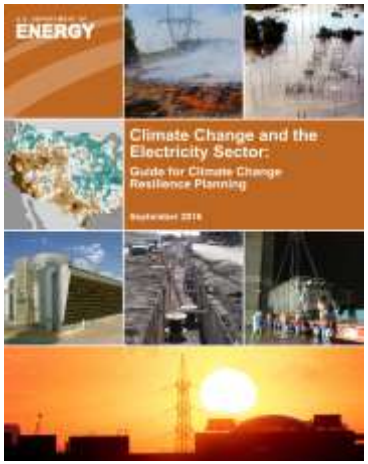


Downscaling Climate Model Output

- Develop uniform methods for economic analysis of costs and benefits of resilience investments.

Work Streams - Conduct Analysis and Provide Guidance and Best Practices to Inform Future Planning

- Provide general guidance for stakeholders to conduct robust vulnerability assessments and develop resilience plans



- Support Partners in conduct of a vulnerability assessment and develop resilience solutions
  - Partner Vulnerability Assessments Summary
  - Partner Resilience Solutions Summary

Energy Sector Strategies to Increase Resilience to Storms (Examples)

- The Energy Sector is investing billions to "build back better"
- Investments include making physical and structural improvements to "harden" the system components as well as planning and modifying operations to enhance resilience
- Solutions with co-benefits (e.g., those that decrease costs, help meet energy efficiency or clean energy targets, or improve reliability independent of climate events) are the most commonly implemented

Flood Protection	Building/strengthening berms, levees, and floodwalls
	Elevating substations/control rooms/pump stations
Wind Protection	Upgrading damaged poles and structures
	Burying power lines underground
Modernization	Deploying sensors and control technology
	Installing asset databases/tools, including SCADA system redundancies
General Readiness	Conducting hurricane preparedness planning and training
	Managing vegetation/ tree trimming
	Participating in mutual assistance groups
	Purchasing or leasing mobile transformers and substations
	Energy Storage, Microgrid Infrastructure (DER, islanding capabilities)
	GIS analysis to help identify vulnerabilities, plan for new builds and relocations
Storm-Specific Readiness	Coordinating priority restoration and waivers
	Securing emergency fuel contracts

Ongoing EPSA Resilience Activities

- **Sponsor Partnership Resilience Workshop**

  Collaborating with Partner utilities and state regulators to sponsor a workshop focusing on effective approaches and best practices for making the business case for resilience investments

- **Develop Model Framework for defining a Resilient Electric Utility**

  Developing white paper that characterizes the operational and design characteristics of a resilient electric utility to guide future resilience planning and infrastructure investment

- **Characterize Energy System Vulnerabilities**

  Collaborating with other DOE programs and the United States Global Climate Research Program to provide a national, regional and local perspective on impacts of climate and extreme weather on the Nation's energy system

- **Advance information, methodologies and tools to manage risks**

  Co-leading a pilot program with NOAA regional resilience centers to provide current and historic extreme weather observations and downscaled projections for utility resilience planning

For Additional Information

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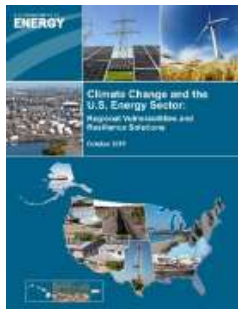

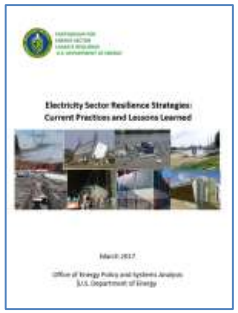

- Reports
  - ***Climate Change and the Electricity Sector: Guide for Climate Change Resilience Planning:*** http://www.energy.gov/epsa/downloads/climate-change-and-electricity-sector-guide-climate-change-resilience-planning
  - ***"Climate Change and the Electricity Sector: Guide for Assessing Vulnerabilities and Developing Resilience Solutions to Sea Level Rise" https://www.energy.gov/epsa/downloads/climate-change-and-electricity-sector-guide-assessing-vulnerabilities-and-developing***
  - ***Climate Change and the U.S. Energy Sector: Regional Vulnerabilities and Resilience Solutions;*** http://www.energy.gov/epsa/downloads/climate-change-and-us-energy-sector-regional-vulnerabilities-and-resilience-solutions
  - ***A Review of Climate Change Vulnerability Assessments: Current Practices and Lessons Learned from DOEs Partnership for Energy Sector Climate Resilience;*** http://www.energy.gov/epsa/downloads/review-climate-change-vulnerability-assessments-current-practices-and-lessons-learned
  - ***Electricity Sector Resilience Strategies: Current Practices and Lessons;*** http://www.energy.gov/epsa/downloads/review-climate-change-vulnerability-assessments-current-practices-and-lessons-learned (Coming Soon!)