U.S. DEPARTMENT OF
ENERGY

CPUC/CEC Workshop on Climate Adaptation in the Energy Sector

July 27, 2015

National Approach to Adaptation

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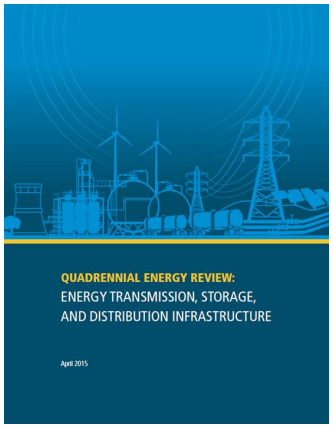
DOE Drivers Related to Energy Sector Climate Mitigation and Resilience

- **Supporting the President's Climate Action Plan and Policies**
  - **Focus on both Climate Mitigation and Climate Resilience**
  - **Scope includes Domestic and International**
  - **Enabling Executive Orders:**
    - EO 13653 *Preparing the United States for the Impacts of Climate Change*
    - EO 13667 *Climate-Resilient International Development*

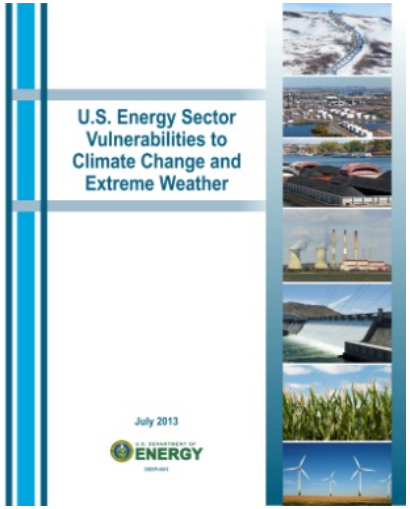
- **Supporting recommendations of the Quadrennial Energy Review; and the State, Local and Tribal Leaders Task Force on Climate Preparedness**



Why a focus on Impacts of Climate Change and Extreme Weather to the Energy Sector ?

Decreasing water availability

- Reduce available thermoelectric generation capacity
- Reduce available hydropower generation
- Impact oil and gas production
- Impede barge transport of crude oil, petroleum products, and coal
- Decrease bioenergy production in some regions



Increasing temperatures

- Increase electricity demand for cooling
- Reduce efficiency of thermoelectric power generation
- Reduce transmission system efficiency
- Thawing permafrost damage energy infrastructure

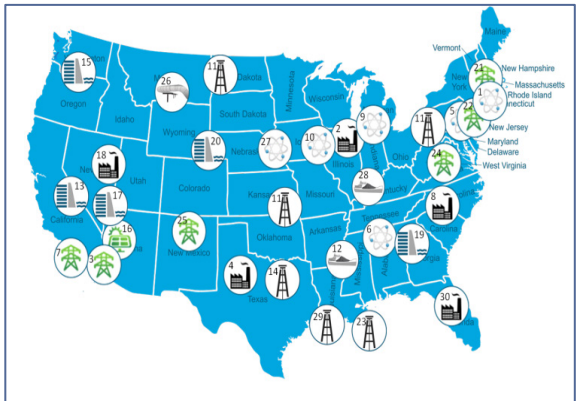


Figure 1. Selected events over the last decade illustrate the U.S. energy sector's vulnerabilities to climatic conditions

Increasing sea level rise and intensity and frequency of storms and flooding

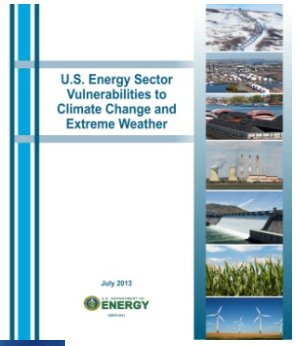
- Damage or disrupt coastal and offshore oil and gas facilities
- Damage to electric transmission and distribution lines
- Risk to inland and coastal thermoelectric facilities
- Risk to rail and barge transport of crude oil, petroleum products, and coal

Four Pillars of DOE's Climate Resilience Framework

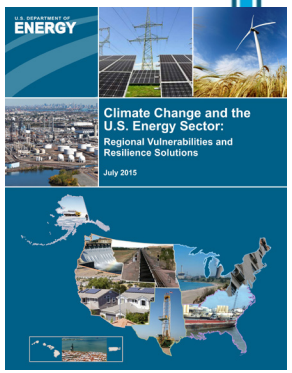
- **Enhance research, development, demonstration and deployment of climate-resilient energy technologies**
- **Foster enabling policies to remove market barriers and encourage building climate resilience into energy systems**
- **Provide technical information, assistance and decision-support tools**
- **Convene and partner with federal agencies, private sector and other stakeholders**

Provide technical information and assistance

- **Issue DOE Reports:**
  - ✓ *U.S. Energy Sector Vulnerabilities to Climate Change and Extreme Weather – July 2013*
    http://www.energy.gov/downloads/us-energy-sector-vulnerabilities-climate-change-and-extreme-weather

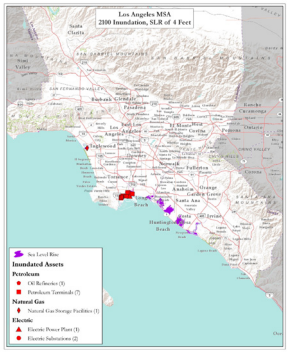


  - ✓ *Climate Change and the U.S. Energy Sector: Regional Vulnerabilities and Resilience Solutions – July 2015*



- **Develop information and tools: 'energy theme' of the U.S. Climate Resilience Toolkit** http://www.data.gov/climate/energy-infrastructure

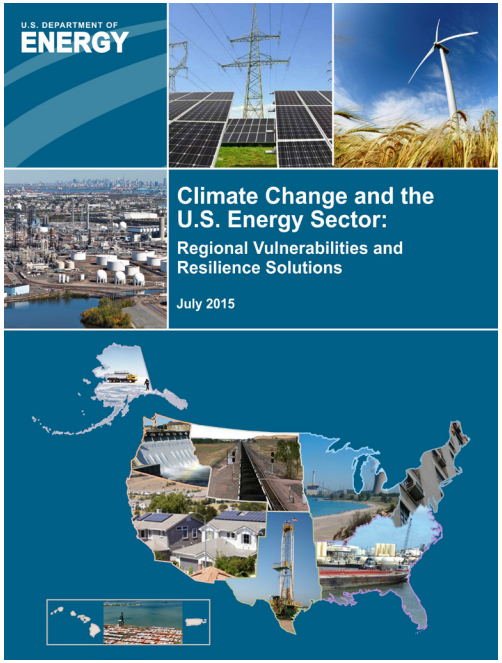
- **Develop methodologies and conducting modeling and cost-benefit analysis (e.g., studies on sea-level rise and storm surge effects on coastal energy infrastructure)**



Climate Change and the U.S. Energy Sector: Regional Vulnerabilities and Resilience Solutions

Purpose of Report

- Enhance energy sector resilience to regional climate change
- Objectively assess energy sector vulnerabilities by region
- Characterize resilience solutions and challenges to address regional vulnerabilities



Audience

- Private-sector decision makers
- Local, state, and regional stakeholders (e.g., Climate Action Champions, State Energy Assurance Planning; Place-based initiatives)

Value Added

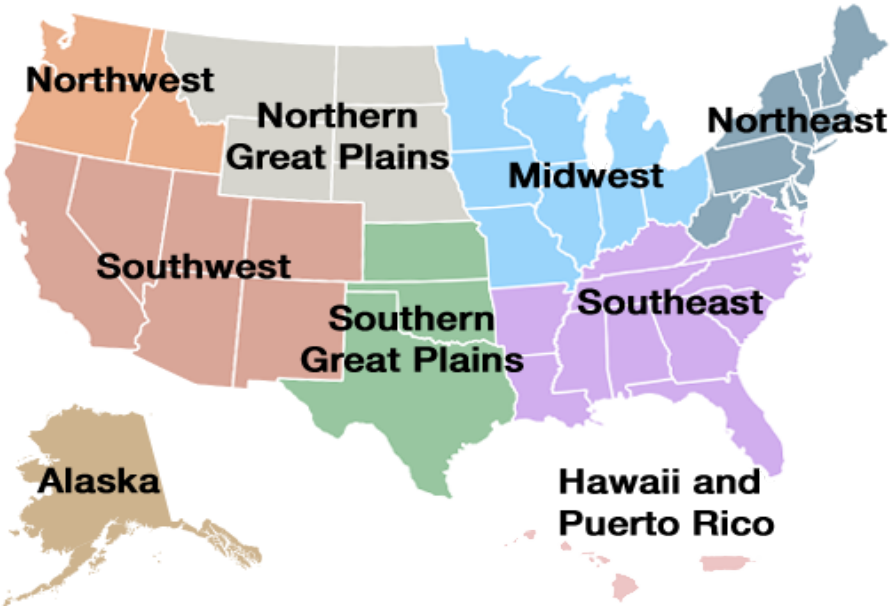
- Provides regional/local technical information to:
  - Further characterize potential climate change impacts on specific energy assets
  - Develop strategies to cost-effectively increase local, regional, and national energy system resilience

Image sources: NIH, BPA, USGCRP, DOE

Scope and Approach of "Regional Vulnerabilities" Report

Method

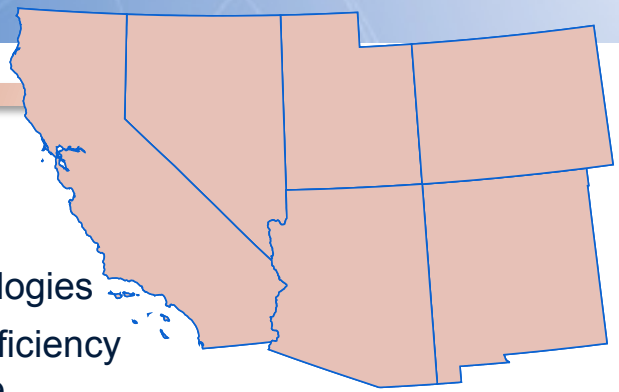
- Characterize energy production, generation, delivery, and end-use by region – (EIA data)
- Examine projected regional climate change (2014 National Climate Assessment, NOAA Technical Data)
- Identify regional climate vulnerabilities and resilience strategies (e.g., QER, DOE and company reports, regulatory filings, adaptation planning documents, etc.)



Energy Subsectors

- Oil and gas exploration and production
- Thermoelectric power generation
- Hydroelectric power generation
- Renewable power and bioenergy
- Fuel transport and storage
- Electric grid
- Energy demand

Important Regional Vulnerabilities and Resilience Solutions – Southwest Region



Vulnerabilities:

- Higher temperatures increase air conditioning penetration and energy demand in the region's largest demand center (California), and increases use throughout region
- Higher temperatures reduce efficiency and capacity of thermoelectric power plants and electric grid, especially during heat waves and periods of peak demand
- Changes to precipitation and snowmelt threaten to shift California's peak hydropower production earlier into the spring (away from periods of peak demand); projected reductions in Colorado River Watershed precipitation could further challenge hydropower assets already facing constrained water supply and drought
- Projected increases in the risk of wildfires and sea level rise threatens critical energy assets

Resilience strategies:

- New capacity additions and resilient designs and technologies
- Deployment of increased efficiency standards and Demand Side Management programs
- Turbine upgrades at existing hydropower facilities to increase capacity at low water levels
- Improved vegetation management, as well as physical upgrades to protect transmission lines from fire and tree-strikes

Illustrative Examples of Resilience Solutions by Sector

(Sampling from Appendix A of *"Climate Change and the U.S. Energy Sector: Regional Vulnerabilities and Resilience Solutions"*)

Sector	Increasing temperatures and heat waves	Decreasing water availability	Increasing wildfire	Increasing sea level rise and storm surge
Electric Grid– Physical Hardening	• Limit customers affected by outages by installing additional substations, breakaway equipment, sectionalizing fuses, and developing island-able "microgrids" • Install smartgrid devices to speed identification of faults and service restoration • Increase or install additional transmission capacity • Upgrade transformers or cooling systems		• Increase redundancy in transmission system • Limit customers affected by outages by sectionalizing or islanding circuits • Replace wood poles and support structures with fire-resistant materials (e.g., steel or concrete) • Install smartgrid devices to speed identification of faults and service restoration	• Install sea walls, riprap, and natural barriers such as vegetation • Limit customers affected by outages by sectionalizing or islanding circuits • Replace wood poles with stronger materials • Elevate or relocate critical equipment • Install smartgrid devices to speed identification of faults and service restoration
Electric Grid– Planning and Operations	• Develop best operating practices for equipment at high temperatures • Include extreme temperature scenarios in future grid planning • Deploy future equipment and lines with higher design temperatures		• Site equipment in areas less prone to wildfire • Enhanced vegetation management (e.g., tree trimming, forest thinning, and prescribed burning) • Develop fire response plans and tools; coordinate with local partners • Develop firefighting compounds safe to use near active power lines	• Site equipment in areas less prone to coastal flooding • Install water level monitoring systems and communications equipment inside vulnerable substations • Update siting and operations plans to account for SLR
Thermo-electric Power Generation– Physical Hardening	• Increase or install additional generation capacity	• Install water-saving cooling technology (e.g., closed-loop cooling, hybrid wet-dry cooling, dry cooling) • Install equipment capable of using alternate water sources		• Install sea walls, riprap, and natural barriers such as vegetation • Install waterproofing measures • Elevate critical equipment

Illustrative Examples of Resilience Solutions by Sector

Sector	Increasing temperatures and heat waves	Decreasing water availability	Increasing wildfire	Increasing sea level rise and storm surge
Thermo-electric Power Generation– Planning and Operations	• Update integrated resource plans to account for reduced available generation capacity from higher temperatures	• Secure back-up water supply in case of low flow conditions • Install monitoring systems on source water supplies • Develop operating procedures for low water conditions		• Update design, siting, and operations plans to account for SLR
Hydro-electric Power Generation– Physical Hardening		• Increase storage capacity of reservoirs • Increase turbine efficiency and minimize leaks at existing dams		
Hydro-electric Power Generation– Planning and Operations	• Update integrated resource plans to account for reduced available generation capacity • Incorporate thermal predictive models into reservoir level forecasts	• Develop integrated water management plan • Manage reservoir capacity • Install monitoring systems on rivers • Develop operating procedures for low water conditions • Improve forecasts of snowmelt timing		
Bioenergy and Renewable Power Generation– Physical Hardening	• Increase or install additional generating capacity	• Use alternative water supplies at biorefineries (e.g., degraded water or wastewater) • Employ sustainable agriculture methods including crop diversification, crop rotation		• Install sea walls, riprap, and natural barriers such as vegetation • Elevate critical equipment or enclose equipment in submersible casings
Bioenergy and Renewable Power Generation– Planning and Operations	• Update design plans for increasing temperatures	• Update plans for securing water considering decreasing water availability	• Account for increased wildfire risk when siting facilities • Incorporate increased wildfire risk into forest management practices	• Update design, siting, and operations plans to account for SLR

Examples of Climate Trends and Resilience Solutions

Increasing average and extreme temperatures; longer, more severe heat waves

- **Florida Power and Light (FPL):** Offers customers monthly credits for participation in the *On Call* program, which allows FPL to switch certain appliances off during periods of peak demand. Rebates offered for efficient air conditioners and A/C duct repair, and free in-home assessments
- **Entergy:** Adding capacity in response to increasing temperatures, in addition to investing in energy efficiency and demand side management, and providing weatherization incentives to low-income customers

Decreasing water availability; shifting streamflow timing

- **Seattle City Light:** Working to assess climate change impacts on hydropower generation by characterizing present and future glacier contribution to summer streamflows, and by updating streamflow projections with multiple climate scenarios
- **Arizona Public Service:** Long-term agreement to treat and use municipal wastewater from Glendale, Mesa, Phoenix, Scottsdale and Tempe, AZ for cooling at Palo Verde Nuclear Generating Station
- **NRG Energy's** solar thermal power plant using using dry cooling technology to provide power to PG&E and Southern California Edison

Examples of Climate Trends and Resilience Solutions

Increasing size and frequency of wildfires

- **California Public Utilities Commission:** Adopted regulations to reduce fire hazards resulting from overhead power lines and target important transmission lines. Requirements include development of fire prevention plans, fire-threat maps, more frequent inspections

- **San Diego Gas & Electric (SDG&E):** Implemented greater minimum clearances for vegetation, hardened critical portions of its lines, and installed advanced line closers to protect lines in case of emergency. Expanded transmission capacity (e.g., activating the Sunrise Powerlink, connecting San Diego to the Imperial Valley to improve reliability).

Rising sea levels and more intense hurricanes

- **Consolidated Edison (ConEd)**: Addressed immediate impacts of Superstorm Sandy and the increased risks of coastal flooding in New York City by upgrading substations and hundreds of submersible transformers and network protectors across its network.

- **DOE, NJ Board of Public Utilities, City of Hoboken and Public Service Electric & Gas Company (PSE&G)** developing first-ever transit system microgrid spanning rail lines and critical stations and maintenance facilities across New Jersey Transit's busy northeastern corridor (serving nearly 900,000 passengers daily) between Newark and New York City, to ensure trains keep running even if the centralized grid goes down.

- **AEP:** Equipped the town of Presidio, Texas with a large-scale energy storage system and Fault Location, Isolation, and Service Restoration (FLISR) system in order to allow uninterrupted service if the town's single 69 kV transmission line is knocked out.

Convene and partner with businesses and other stakeholders – Illustrative Examples

- **Build robust partnerships to deploy innovative technologies and practices to increase energy system climate resilience**
  - ✓ **Establish *Partnership for Energy Sector Climate Resilience***
    http://www.energy.gov/epsa/partnership-energy-sector-climate-resilience

    Support *Climate Action Champions* program
    http://www.energy.gov/epsa/climate-action-champions

    Support States/Communities on Energy Assurance Plans

Partnership for Energy Sector Climate Resilience: Goals and Objectives

- **Provides a mechanism for sustained engagement between DOE and energy companies, starting with a focus on electric utilities**

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

- **Creates a forum where companies pursuing action on climate resilience can receive recognition for their achievements.**

Progress to Date

- **Partnership for Energy Sector Climate Resilience announced on April 21, 2015 by Vice President Biden and Energy Secretary Moniz as part of the release of the Quadrennial Energy Review Report**
  - ✓ http://energy.gov/sites/prod/files/2015/04/f22/QER%20SUMMARY%20FACT%20SHEET%20final.pdf

- **17 power companies have officially joined the Partnership**
  - ✓ Represents approximately 20% of U.S. Generating Capacity
  - ✓ Serve approximately 25% of U.S. customers
  - ✓ Includes broad array of investor-owned , federal, state, municipal and cooperatives
  - ✓ Represents a geographically dispersed set of power companies

Partnership for Energy Sector Climate Resilience: Founding Members

U.S Department of Energy

Investor-Owned

- Consolidated Edison of New York
- Dominion/Virginia Power
- Entergy
- Exelon Corporation
- Iberdrola USA
- National Grid
- **Pacific Gas and Electric**
- Pepco Holdings Inc.
- Public Service Electric and Gas
- **San Diego Gas and Electric/ Sempra**
- Xcel Energy

Cooperative

- Great River Energy
- Hoosier Energy

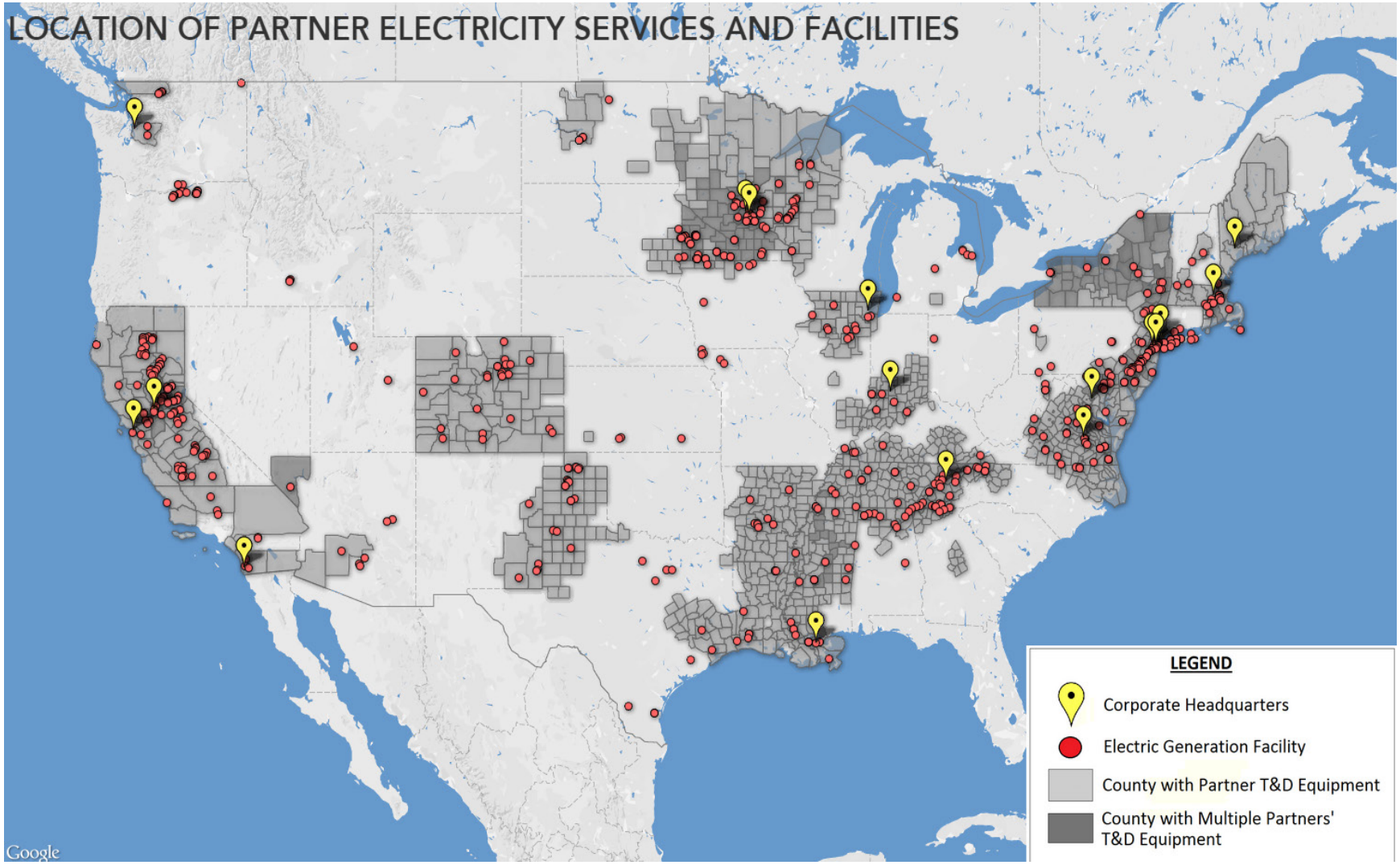
State/Municipal

- New York Power Authority
- Seattle City Light
- **Sacramento Municipal Utility District**

Federal

- TVA

Partnership for Energy Sector Climate Resilience: Founding Member Locations



Actions Underway and Path Forward

- **Conduct outreach to other potential partners to expand upon the initial 17 Partners**
- **Conduct Series of Partnership webinars, meetings, workshops**
  - Discuss company approaches to assessing climate change and energy system vulnerabilities; and developing and justifying resilience strategies to manage risks
  - Discuss Federal Resources (e.g., information, tools, etc.,) available to power companies
- **Identify and address near term priority work streams**
  - Developing guidance, methodologies, tools, best practices and other relevant information for conducting risk/vulnerability assessments
  - Developing general methodologies for assessing costs of impacts to the energy sector, and costs and benefits of climate resilience investments. Pilot methodologies for different regions/climate risks

For Additional Information

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Additional Slides

Climate Mitigation and Resilience Nexus: Leveraging Synergies and Co-Benefits To Justify Investments

MITIGATION

Enhance Energy Efficiency (e.g. Buildings, Appliances)

Expand Use of Renewable Energy Sources

Deploy Electric Vehicles

Deploy Carbon Capture and Storage

NEXUS

Smart Grid & MircoGrids

Distributed power generation from renewable sources

Energy and Water Efficiency

Battery Storage

RESILIENCE

Storm Harden Energy Infrastructure

Reduce energy demand and potential for grid overload

Diversify energy sources that are less vulnerable to decreased water availability- increased temperature –

Partnership for Energy Sector Climate Resilience: Members (as of July 2015)

U.S Department of Energy

Investor-Owned

- Consolidated Edison of New York
- Dominion/Virginia Power
- Entergy
- Exelon Corporation
- Iberdrola USA
- 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

Cooperative

- Great River Energy
- Hoosier Energy

State/Municipal

- New York Power Authority
- Seattle City Light
- **Sacramento Municipal Utility District**

Federal

- TVA