Barriers and Opportunities for Future Investment – U.S. Perspective

RD&D Needs for Energy System Climate Preparedness and Resilience
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Craig Zamuda, Ph.D.
Senior Policy Advisor for Climate and Environmental Analysis
Office of Energy Policy and Systems Analysis
U.S. Department of Energy

Overview

- What is a Climate Resilient Energy Sector?
- Resilience Efforts Underway in U.S.
- Key Barriers
- Technology Opportunities
- International Cooperation

What is a "Climate Resilient" Energy Infrastructure

Capability to anticipate and prepare

- Vulnerability assessments conducted with resilience options identified
- Methodologies in place for prioritizing resilience measures
- Climate preparedness and resilience incorporated into company risk management frameworks
- Sharing of best practices

Capability to respond and recover

- Power plants able to meet demand given constraints on water temperature and availability
- Electric grid able to withstand increases in storm intensity and wildfires
- Coastal energy infrastructure able to withstand sea level rise and enhanced storm surge

Resilience Efforts Underway in the U.S.

❖Develop and Deploy Climate Resilient Energy Technologies and Practices

- Water capture/reuse, nontraditional cooling waters and dry cooling for thermoelectric power plants
- Storm hardening for energy infrastructure
- Backup Generation, Distributed Generation and Microgrids

❖Develop Tools and Resources

- Improved data, tools, and models for characterizing vulnerabilities
  - ✓ Updated National Climate Assessment and regional projections: http://ncadac.globalchange.gov/
  - ✓ The Federal Support Water Toolbox: www.WaterToolbox.us
  - ✓ Sea Level Planning Tool: http://www.corpsclimate.us/Sandy/

❖Conduct Federal Vulnerability Assessments

- Effects of Climate Change on Federal Hydropower: Report to Congress
- Hurricane Sandy Rebuilding Strategy
- Economic Benefits of Increasing Electric Grid Resilience to Weather Outages

❖Establish Enabling Policy Framework to Enhance Pace, Scale and Scope of Efforts

- Facilitate the integration of climate impacts in policies, plans and programs of government agencies and the private sector

Barriers Inhibiting Greater Climate Resilience

Technology
Lack of Commercially Available Technologies
Early Mover Risk
Business Interruption Costs

Policy
Lack of Policies That Internalize Social Benefits/Costs
Moral Hazard
Policy Uncertainty
Competing Policy Goals

Informational/Behavioral
Lack of Relevant Information
Lack of Trained Workforce
Bounded Rationality
Climate Change Skepticism

Institutional
Lack of Knowledge Sharing Platforms
Competing Objectives of Different Stakeholders

Technology Barriers

Lack of Commercially Available Technologies

Lack of adaptation technologies with acceptable capital, operation and maintenance costs

Early Mover Risk

Unproven performance of first-of-a-kind technological solutions

Business Interruption Costs

Downtime associated with implementing adaptive measures at existing operations

Illustrative examples

A water-constrained thermoelectric power plant that relies on recirculating cooling decides not to switch to dry cooling as a resilience measure due to reduced generation capacity and higher costs.

Gulf coast refinery seeking to raise low-lying pumps and boilers scraps the project due to potential for lost revenue during construction

Policy Barriers

Lack of Policies That Internalize Social Benefits/Costs
Moral Hazard Reliance on implicit guarantee that society will compensate for catastrophic losses
Policy Uncertainty Uncertainty in future policy affecting adaptation investment decisions
Competing Policy Goals Competition between resilience and other policy goals (e.g., GHG mitigation and low-cost energy)

Illustrative example

A utility company that evaluated resilience options finds that their regulator (e.g. public utility commission) does not support proposed grid resilience upgrades due to insufficient justification of benefits based on historic. data.

Informational/Behavioral and Institutional Barriers

Info/Behavior

Lack of Relevant Information

Insufficient information to identify vulnerabilities and make informed decisions on adaptation

Lack of Trained Workforce

Bounded Rationality

Irrational decisions on adaptation even when sufficient information is available

Climate Change Skepticism

Institutional

Lack of Knowledge Sharing Platforms

Competing Objectives of Different Stakeholders

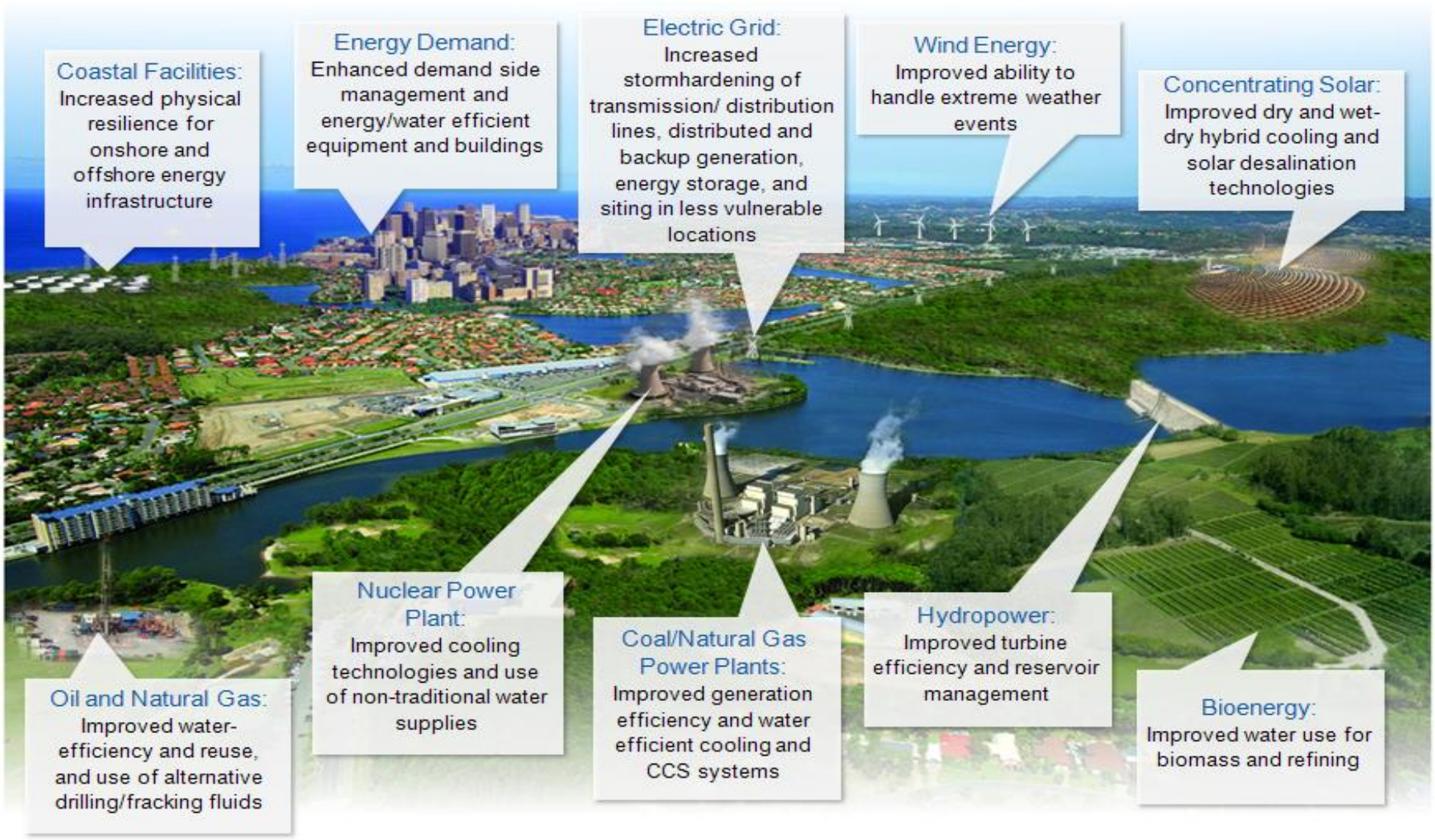
Differing incentives leading to conflicting objectives

Illustrative example

LNG export facility planning to build in low-lying coastal area prone to SLR and tropical storm impacts does not have level of info to facilitate adaptation decision making

Companies are reluctant to proceed with response actions until "actionable, local scale" climate science data is available

Technology Opportunities: Building a Resilient Energy System



Source*: Zamuda et al., 2013. U.S. Energy Sector Vulnerabilities to Climate Change and Extreme Weather*

Opportunities for International Cooperation

- Sustained engagement, information exchange, and energy technology R&D collaboration between governments and institutions
- Development of knowledge sharing platforms for climate projections, vulnerabilities, resilience strategies
- Collaboration on developing resilience policies

For Additional Information

Contact :

Craig Zamuda, Ph.D.
Senior Policy Advisor
Office of Energy Policy and System Analysis
U.S. Department of Energy
202 586-9038
craig.zamuda@hq.doe.gov