

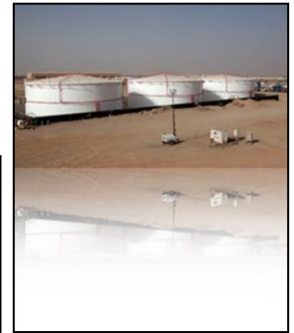
Infrastructure Interdependencies Lessons Learned for Energy and Regional Resilience

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Interdependencies—Fundamental to Energy Assurance and Regional Resilience

- Are instrumental in how well States, Localities, utilities, and the broader stakeholder community prepare for, respond to, and recover from disasters
- Connect and affect all infrastructures and service providers, plus people and community institutions
- To be understood require:
 - Unprecedented information sharing, coordination, and collaboration
 - Analytic and decision support systems that enable service providers and government decision-makers to assess and prioritize mitigation and recovery actions
- Can provide the best incentives for stakeholder investment in improving energy and broader infrastructure resilience



Emergence of Resilience as a National Priority

- The 2013 U.S. Presidential Decision Directive on Critical Infrastructure Security and Resilience (PDD-21) defines resilience as:
The ability to prepare for and adapt to changing conditions and withstand and recover rapidly from disruptions, including deliberate attacks, accidents, or naturally occurring threats and incidents
- PDD-21 also specifies that U.S. efforts address infrastructure security “in an integrated, holistic manner” to reflect infrastructures’ interconnectedness and interdependency
- The directive also identifies energy and communications systems as “uniquely critical due to the enabling functions they provide across all critical infrastructure sectors”

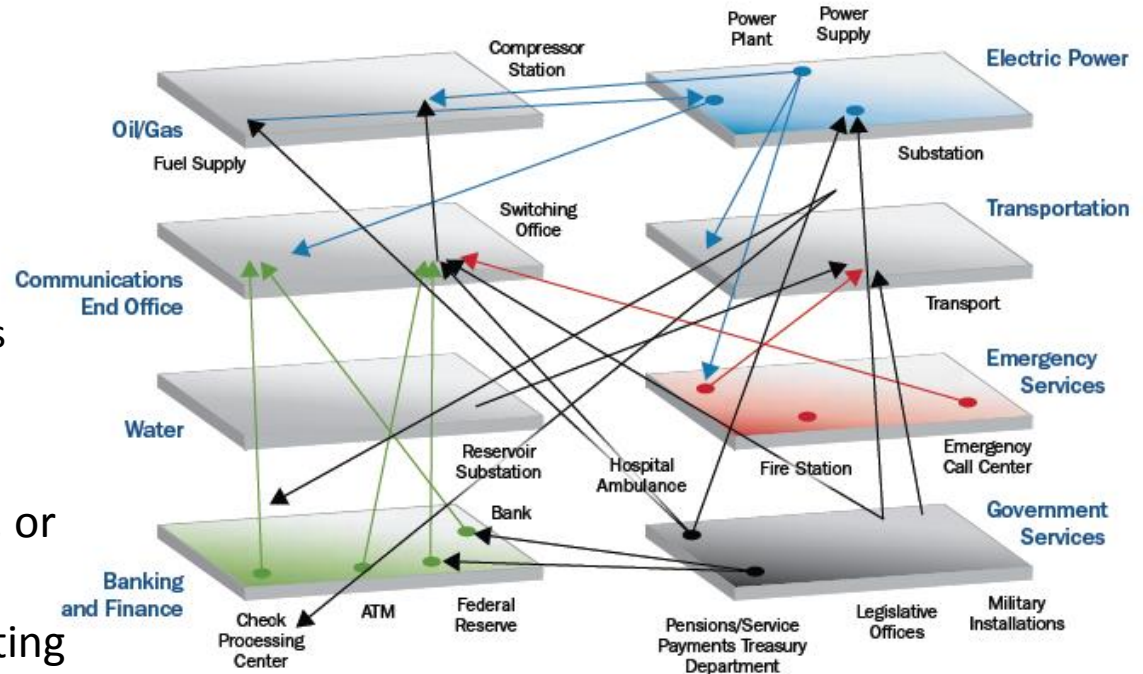
Critical Infrastructures and Service Providers that Underpin Health/Safety, the Economy, and Societal Well-Being

- Energy
- Transportation Systems
- Financial Services
- Chemical
- Food and Agriculture
- Nuclear Reactors, Materials, and Waste
- Dams
- Water and Wastewater Systems
- Healthcare and Public Health
- Emergency Services
- Defense Industrial Base
- Information Technology
- Communications
- Critical Manufacturing
- Government Facilities
- Commercial Facilities
- Community Institutions *
- People *

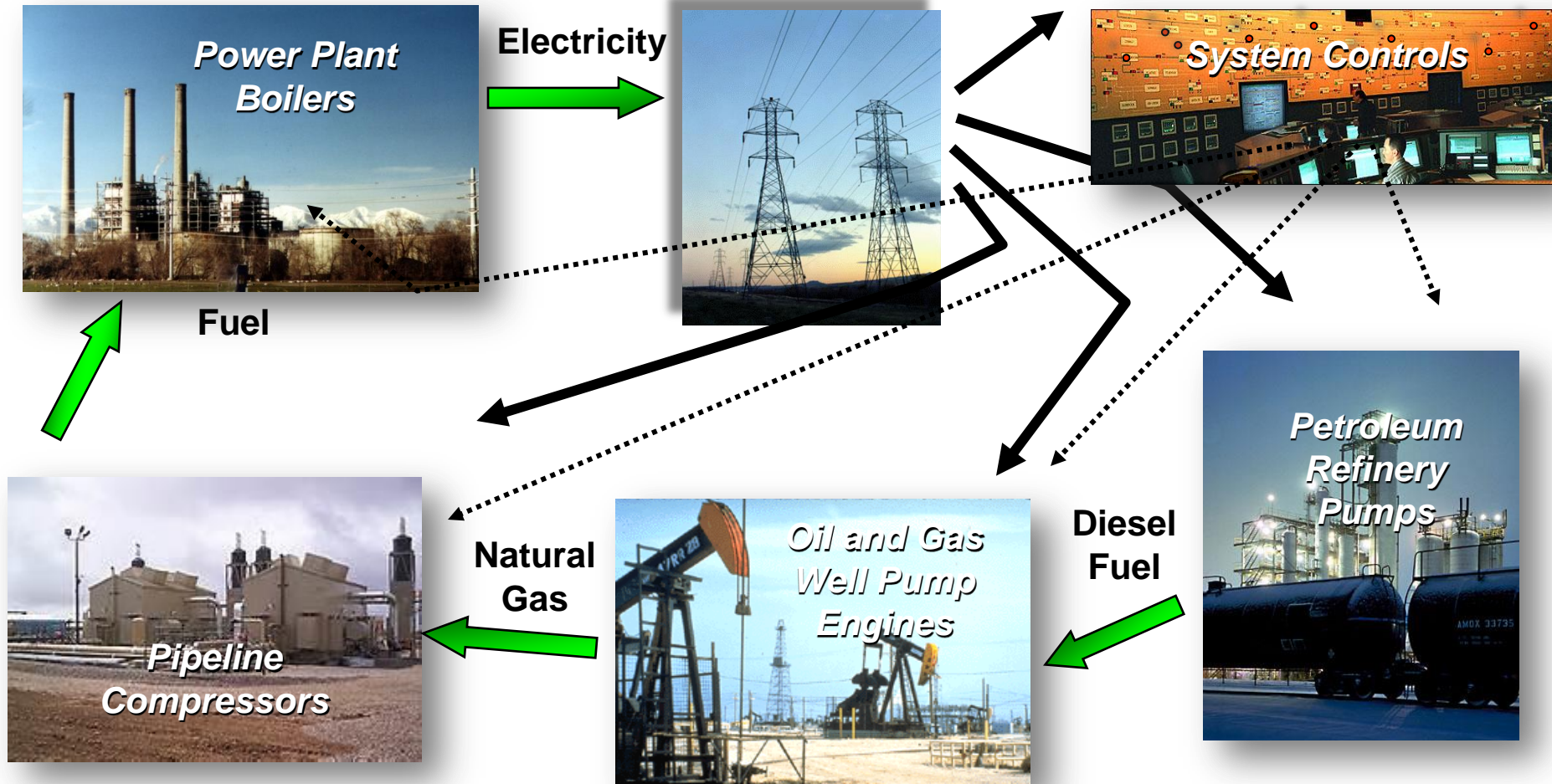
* Not explicitly included in the 16 critical infrastructures defined in Presidential Policy Directive 21 – Critical Infrastructure Security and Resilience

Interdependencies Are Highly Complex and Exist at Different Levels

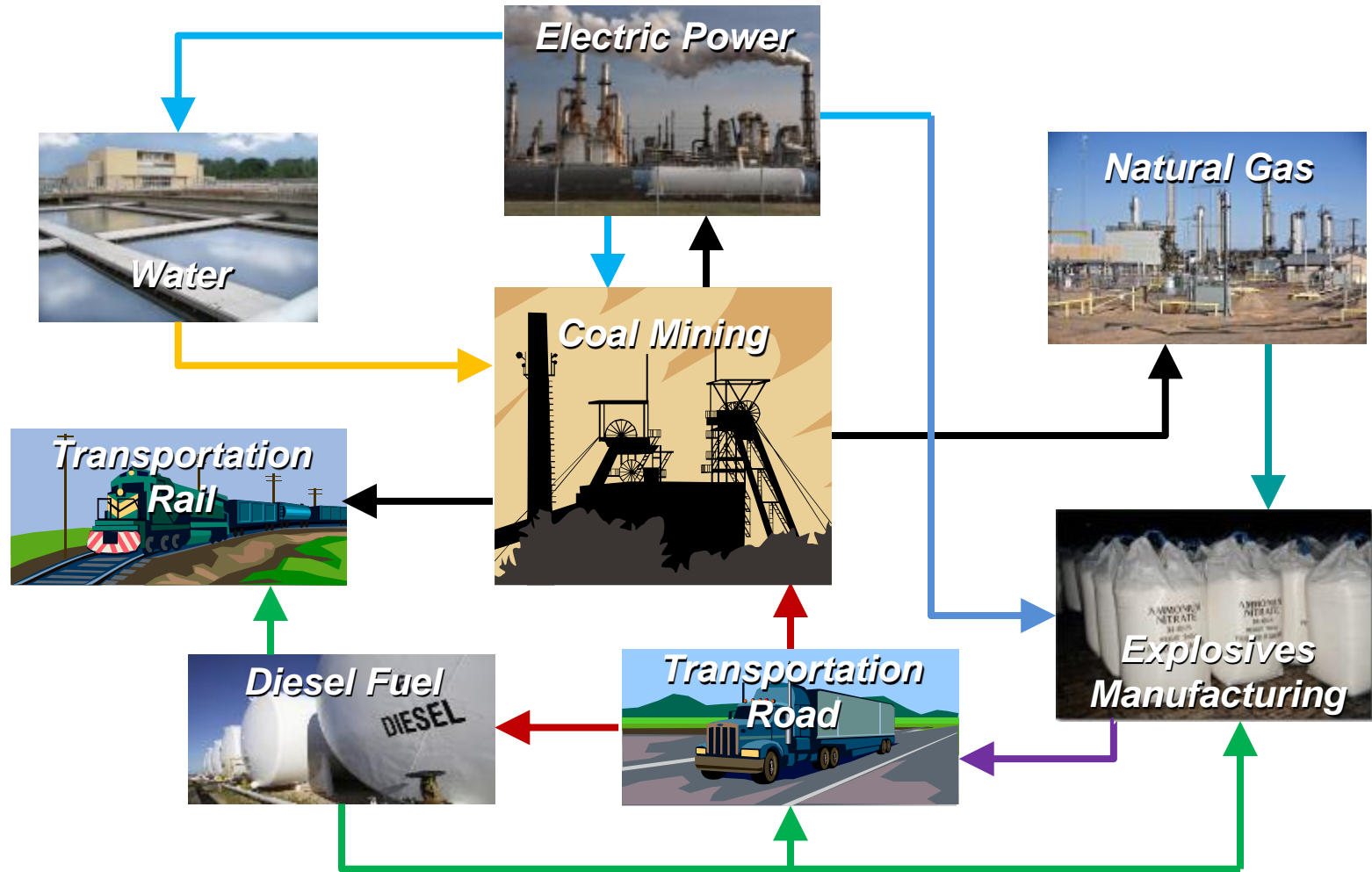
- A “systems of systems” approach is required that addresses linkages within and among:
 - Facilities and assets
 - Networks (physical, cyber)
 - End-to-end systems
 - Communities, regions, and States
 - Between States and multi-State
 - Cross-national border, global
- Linkages may be physical, cyber, or virtual
- Can cause cascading and escalating failures or common cause failures in the case of co-located infrastructure assets



Some High-level Energy Infrastructure *Internal* Interdependencies



Some High-level Energy Infrastructure *External Interdependencies*



Examples of Recent Interdependencies Challenges

■ Northeast Winter Storm – February 2013

- The storm caused power outages, shortages at gas stations, traffic disruptions, and numerous car accidents across the region
- The storm left about 700,000 customers without electricity
- More than 6,300 flights were cancelled in NY city area



■ Hurricane Sandy – October 2012

- Flooded streets, tunnels, and subway lines and cut power in and around the New York City and affected multiple states
- The New York Stock Exchange was closed for trading for two days
- Gas shortages throughout the region led to implementation of odd/even purchase plans
- Five hospitals and 30 nursing homes and adult residential facilities forced to undertake mass evacuations due to power loss



Examples of Recent Interdependencies Challenges

■ Southwest Blackout – September 2011

- Blackout of 7 million people in western Arizona, southern California, and parts of Mexico
- Outage knocked out traffic lights, causing gridlock on the roads in San Diego area
- Nearly 3.5 million gallons of sewage spilled into the water off San Diego, closing beaches



Where We Are Today in Dealing with Interdependencies Challenges

The Good News —

- There is growing understanding among States and Localities, utilities, large businesses, and non-profit stakeholders of:
 - The importance of the extensive physical, cyber, and virtual interconnections among infrastructure systems and assets that under certain scenarios can cause significant adverse impacts on organizations and communities
 - The need to factor interdependencies vulnerabilities and impacts into all-hazards, integrated risk assessment and planning



Where We Are Today—The Good News

- This increasing awareness is based on:
 - Media coverage and lessons learned about destruction and disruption of infrastructure assets and systems from disasters and incidents over the last few years, particularly Superstorm Sandy
 - Activities with stakeholders by DOE, the Department of Homeland Security, FEMA, U.S. Army Corps of Engineers, Environmental Protection Agency, and other federal agencies to highlight the importance of infrastructure interdependencies for assurance and resilience
 - Workshops and other activities at the grass-roots and State levels, and by associations and partnerships to raise awareness of interdependencies and improve community resilience
 - Adoption by the Federal Government of resilience as a national priority, along with *whole community* stakeholder collaboration, creation and fostering of public-private partnerships, and cross-sector/multi-jurisdiction coordination and information sharing
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Where We Are Today—The Good News, cont.

- Interdependencies workshops and tabletop exercises with broad stakeholder representation are becoming common in some regions to identify vulnerabilities, consequences, and preparedness gaps
 - A very recent example is the “Metro New York Disaster War Game & Regional Economic Resilience Initiative” sponsored by the Port Authority of New York and New Jersey that was held Nov. 26 at New York University
 - Preceded by a stakeholder workshop focusing on energy infrastructure lessons learned from Super Storm Sandy
- Energy companies and other service providers, along with local governments are focusing on mitigation measures to improve resilience

Energy Resilience Examples

- **Western Interconnection Synchrophasor Program (WISP)** – many locations within the West
 - Initiative to increase reliability and system performance of transmission systems in Western Interconnection (WECC)
 - Enable greater use of renewable resources such as solar, hydro, and wind
- **Elevating Substations – Southwest Louisiana Electric Membership Corporation**
 - Implemented new approach to raise substation structures and equipment for three Vermillion Parish substations
 - Substations were hurricane-ready in less than 1 year
- **Fuel Cells for Distributed Power – Construction of Freedom Tower in lower Manhattan, NY**
 - Twelve fuel cells totaling 4.8 MW will help power the Freedom Tower and three other new towers under construction at the World Trade Center site
- **Portable Electric Generators – Colonial Pipeline**
 - Colonial Pipeline purchased twelve 2-MW generators, 7 transformers, and associated cabling
 - Deployed during Hurricanes Gustav and Ike



URL: <http://energy.gov/sites/prod/files/Case%20Study%20-%20Western%20Electricity%20Coordinating%20Council.pdf>

URL: <http://www.oe.netl.doe.gov/docs/HR-Report-final-081710.pdf>

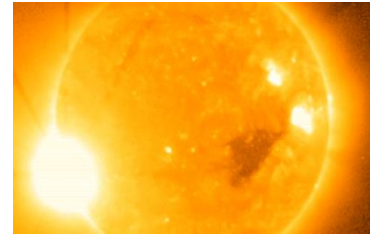
URL: <http://www.naruc.org/Publications/PTI1.pdf>

Where We Are Today—The Challenges

- Our understanding of interdependencies beyond superficial levels remains significantly limited
 - Difficult for stakeholders in workshops and exercises to get beyond the obvious interdependencies involving lifelines (energy, water/waste water systems, communications) and to focus on recovery rather than response
 - Lack of analytical capabilities at the local jurisdictional level to identify interdependencies-related vulnerabilities and assess health and safety, economic, and environmental impacts
- Planning is based on:
 - Lessons learned from past disasters and events, rather than trying to examine what is unknown, or anticipate the unexpected
 - Focus is on longstanding priority threats

Where We Are Today—The Challenges, cont.

- Need to take into account the changing and expanding all-hazards threat environment and avoid “failure of imagination”
 - Natural disasters of increasing intensity
 - Climate change challenges—flooding from coastal surge and rising sea-levels, drought and rising temperatures that threaten agricultural production, infrastructure assurance, and spread of insect-related and other diseases
 - Technological disasters and IT system disruptions exacerbated by the growing complexity and consequent fragility of the systems that run our infrastructures and essential services
 - Aging and deteriorating infrastructure
 - Increasingly sophisticated cyber attacks on critical infrastructures and essential services
 - Emerging and unexpected threats (Black Swan events), for example, new pathogens and terrorist attacks utilizing weapons of mass destruction



Where We Are Today—The Challenges, cont.

- At State and Local levels, there is general awareness among emergency managers and public health on the importance of cyber threats and IT systems resilience, but
 - Information-sharing barriers continue to impede identification and assessment of cyber and physical interdependencies necessary for security, preparedness and priority restoration of lifelines and other critical assets
 - Lack of an integrated physical/cyber/and virtual-focused regional risk assessment approach and associated decision support capabilities that can be used at the local level to make informed security and resilience investment choices
 - Limited understanding of how cyber attacks and IT systems vulnerabilities could significantly complicate response and recovery

Where We Are Today—The Challenges, cont.

- Limited appreciation of how prolonged power outages can impact provision of services and supplies that meet healthcare or human care/social service needs, e.g.,
 - For medical surge support (availability of emergency generators and adequate fuel to run them for extended periods, laundry services, blood banks, diagnostic services)
 - Access to patient records, laboratory, and other health information
 - 2-1-1 call services that provide information and resources during emergencies to at-risk individuals and the broader public
 - Elderly and disabled living at home who are reliant on respirators and other power-dependent equipment
 - Dialysis centers



Where We Are Today—The Challenges, cont.

- Federal, State, and Local regulations and policies that can intensify impacts caused by interdependencies during emergencies, or cause interdependencies-related consequences in themselves
 - e.g., State requirements for additives, such as ethanol, to gasoline or other fuels that can lead to fuel shortages, particularly in conditions where there are supply disruptions from natural disasters or other causes
 - Time limits on emergency power generator testing
- In some cases, may require waivers
- Constraints need to be identified and discussed with agencies in advance of emergencies



Where We Are Today—The Challenges, cont.

- Silos that in many cases reinforce each other
 - Cyber and physical security and resilience remain largely separate disciplines, cultures, and missions from the national to local levels
 - Emergency planners and managers seldom take cyber systems security and resilience into account in emergency plans and exercises focusing on natural disasters
 - Often there is limited interface
 - Among functional areas—public health, energy, transportation, etc.
 - Between local emergency management and social service groups responsible for at-risk individuals and societal well-being



Foundations of the National Strategy for Information Sharing

Fostering Collaboration for Energy Assurance and Resilience

- Need to cut across the silos to address interdependencies with a holistic, regional approach
 - Requires engaging key stakeholder organizations and groups with local, state, and federal agencies to focus on all-hazards cyber and physical interdependencies, and information sharing
 - There have been a large number of regional collaborations developed across the U.S. over the last decade that have addressed infrastructure interdependencies, many resulting in on-going public-private partnerships and resilience improvement activities
 - Some of these initiatives have been sponsored by Federal or State agencies, and others by local governments, businesses, or non-profits organizations
 - A list of some of these partnerships can be found on FEMA's website: <http://www.fema.gov/public-private-partnership-models>



Fostering Collaboration for Energy Assurance and Resilience, cont.

- Entails:
 - Bringing together or leveraging an existing partnership of public-private and non-profit stakeholders with state and federal agencies
 - Through lessons learned from disasters, workshops and tabletop exercises, develop mutually agreed requirements that include:
 - Information-sharing on all-hazards threats and continuity plans
 - Identifying additional assessment capabilities and other tools and mechanisms that could be utilized, and what new capabilities need to be developed
 - Enable utilities and other infrastructures to mutually assess, in a secure and appropriate way, co-located assets under different scenarios, including cyber-attacks and disruptions, where there could be cascading impacts
 - Enable private sector and non-profit organizations and associations to do the same

Fostering Collaboration for Energy Assurance and Resilience, cont.

- Supporting this effort can be shared depending on available resources, with the Federal Government providing technical expertise, guidance, capabilities, and other support, and potentially State and Local grants and in-kind stakeholder contributions in time and effort
- Such an initiative would take a few years but potentially has a great payoff in building and sustaining cross-sector and discipline collaboration and overcoming barriers to understanding and dealing with infrastructure interdependencies
 - Will also lead to the improvement of energy and broader regional resilience plans



Discussion Questions

1. Are there examples of interdependencies impacts, issues, or action items that you would like to share at today's workshop?
2. Are there projects or activities you may know about or which your agency or organization is working on (or intending to undertake) that address interdependencies-related needs?

Recent Energy Interdependencies Studies

- **Dams and Energy Sectors Interdependency Study**
 - Study highlights importance of hydroelectric power generation as part of a study to examine the interdependencies between two critical infrastructure sectors – Dams and Energy
 - <http://energy.gov/oe/downloads/dams-and-energy-sectors-interdependency-study-september-2011>
 - **Interdependence of Electricity System Infrastructure and Natural Gas Infrastructure**
 - Contains recommendations from the Electricity Advisory Committee on actions to be taken by DOE given the interdependence of the Nation's electric infrastructure and natural gas infrastructure
 - <http://energy.gov/sites/prod/files/EAC%20-%20Interdependence%20of%20Electricity%20System%20Infrastructure%20and%20Natural%20Gas%20Infrastructure%20Oct%202011.pdf>
 - **Water - Energy Interface**
 - Describes effort directed at technologies and concepts to reduce the amount of freshwater used by power plants and to minimize any potential impacts of plant operations on water quality
 - <http://www.netl.doe.gov/technologies/coalpower/ewr/Water/>
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Useful Sites on Energy Resilience

- **Energy Assurance Daily**
 - Covers major energy developments in electricity, petroleum, and natural gas industries; energy prices; and other relevant news
 - <http://www.oe.netl.doe.gov/ead.aspx>
 - **Emergency Situation Reports**
 - Contains impact studies on the disruption to energy infrastructure caused by major disasters
 - http://www.oe.netl.doe.gov/emergency_sit_rpt.aspx
 - **Electric Disturbance Events (OE-417)**
 - Provides information on electric emergency incidents and disturbances
 - <http://www.oe.netl.doe.gov/oe417.aspx>
 - **Analysis & Outreach**
 - Contains some lessons learned from conferences, briefs, state or local plans, and tools
 - <http://www.oe.netl.doe.gov/outreach.aspx>
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We Appreciate Having the Opportunity Today to
Share Insights and Ideas With You

This presentation will be made available for your use with colleagues and stakeholders to increase understanding of infrastructure interdependencies and the need to address the challenges they raise for energy assurance and broader regional resilience