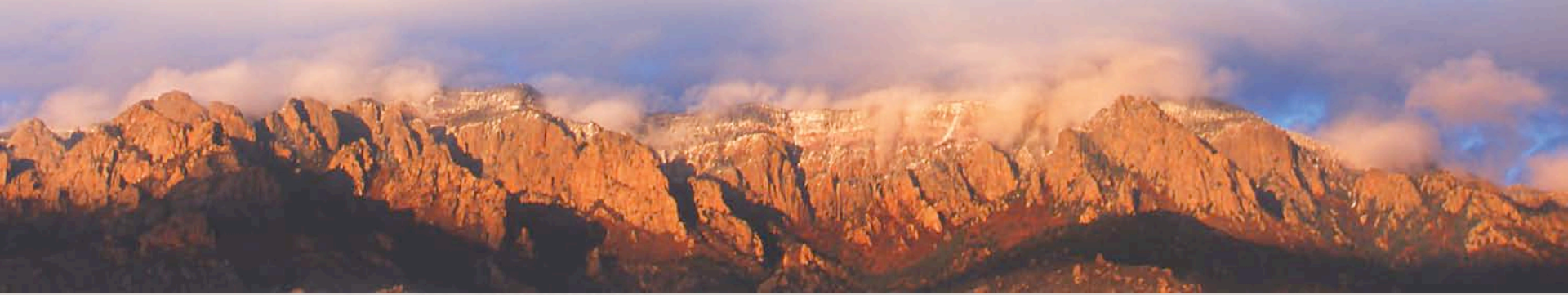

Exceptional service in the national interest

Sandia National Laboratories

Climate Change and Energy Sector Security and Reliability

Atlantic Council – July 24-25, 2012

Mike Hightower
Distinguished Member of the Technical Staff
Sandia National Laboratories
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National and international security challenges have shifted since the end of the cold war

Nuclear Challenges

Unprotected Nuclear Material

Balanced Nuclear Weapons Reductions

Weapon and Missile Proliferation

Emerging Non-Nuclear Challenges

Vulnerable Infrastructure

Competition over Natural Resources

Regional Instability

Climate Change Impacts all Three - The Energy Sector is tied to all Three

President's Commission on Critical Infrastructure Protection circa 2000

- "…the nation is so dependent on our infrastructures that we must view them through a national security lens. They are essential to the nation's security, economic health, and social well being."
- "The water supply infrastructure and other critical infrastructures are mutually interdependent."
  - Public health, energy, agriculture, transportation
- Distributed infrastructures, such as the energy sector, are difficult to protect or secure using traditional approaches

Infrastructures are Vulnerable, Interdependent, and
System Level Resiliency is needed for a Secure and Reliable Energy Sector

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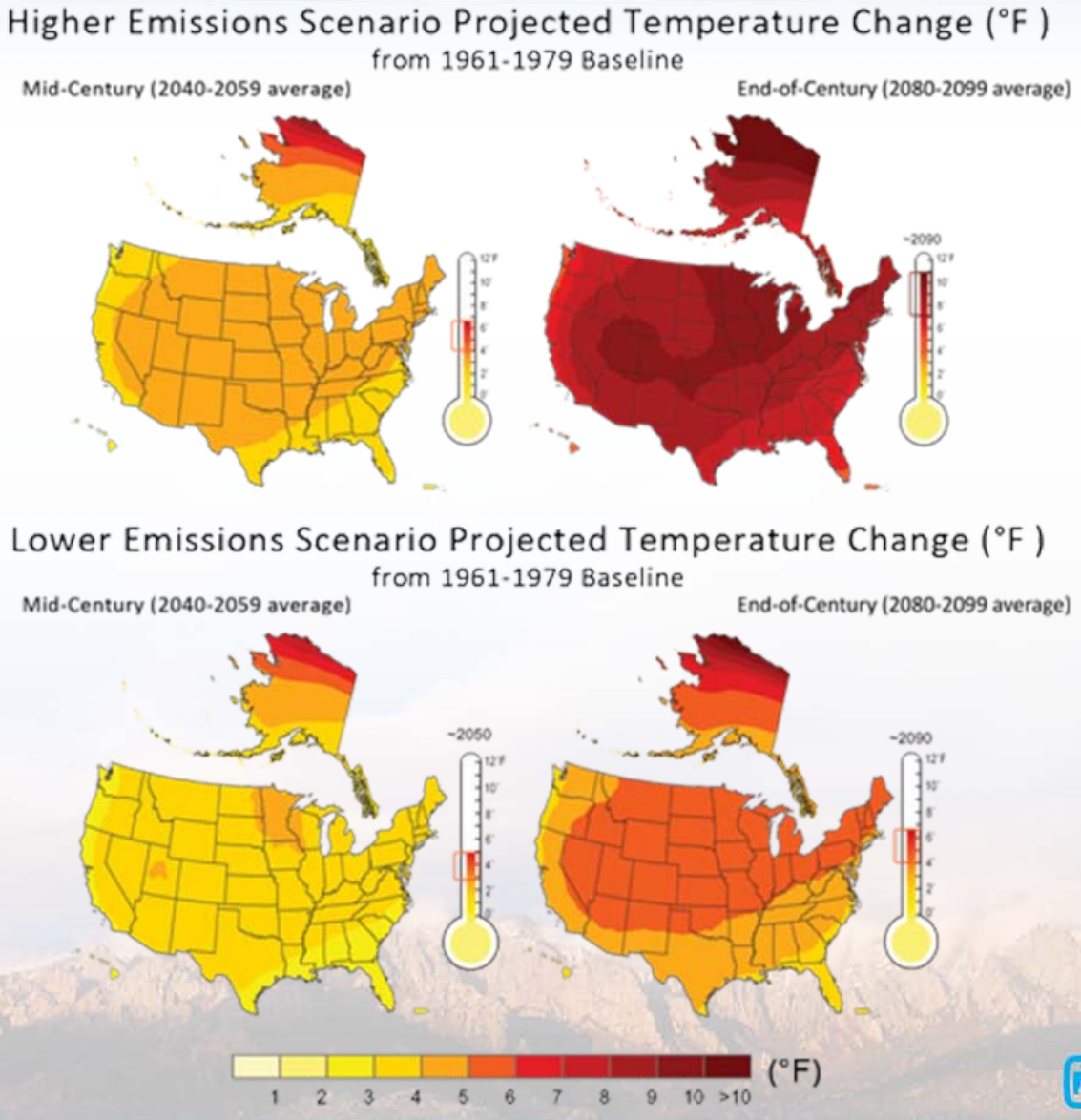
Climate Change Has Cascading Impacts on the Energy Sector



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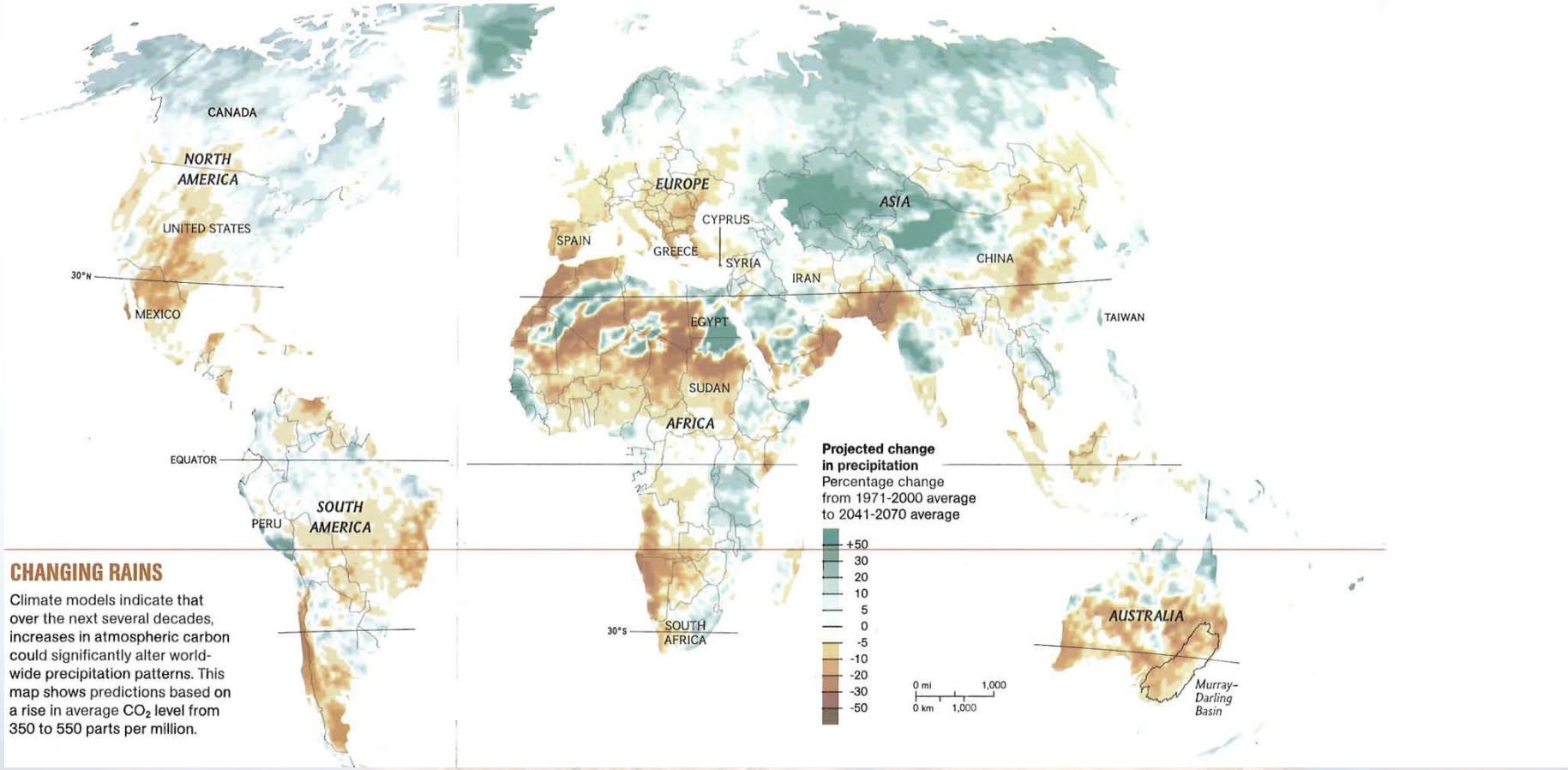
Climate Changes will Impact Precipitation and Regional Water Supplies and Resources



Nat. Geo. April 2009 from IPCC

Mid-latitude population belt will be strongly affected

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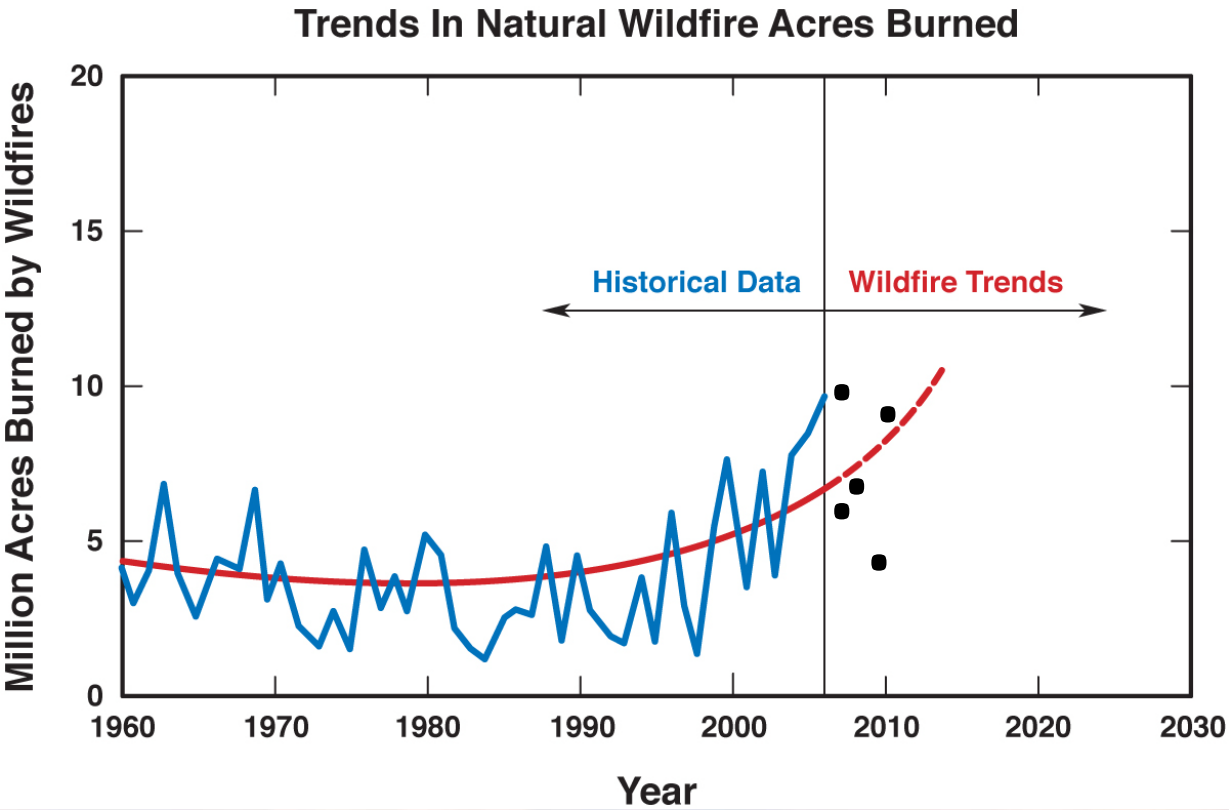
Changes in Water Availability will Impact Watersheds and Associated Ecosystems and Services

Current trends show that the number, size, and severity of wildland fires has grown significantly over the past four decades



Two sources contribute: forest management practices and climate change

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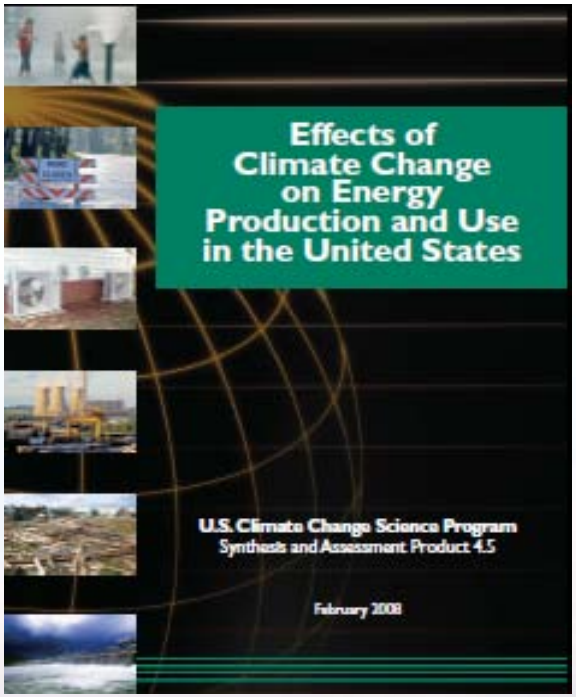
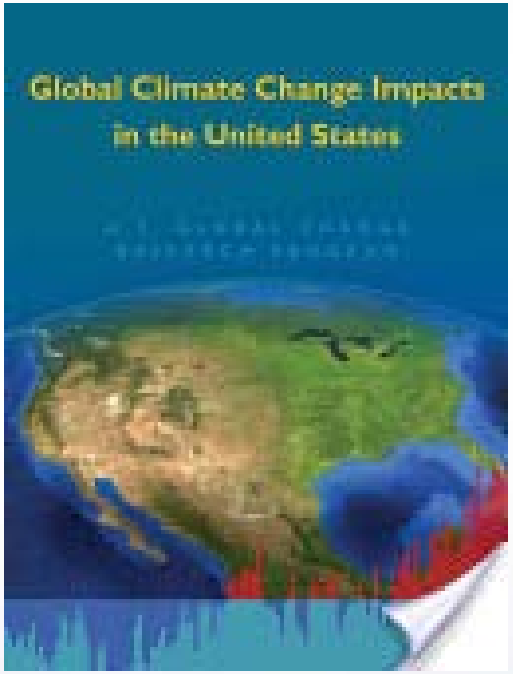
Major References on Climate Change and Impacts on the Energy Sector

U.S. Climate Change Science Program
2008





U.S. Global Change Research Program
2009 – Impacts by Sectors

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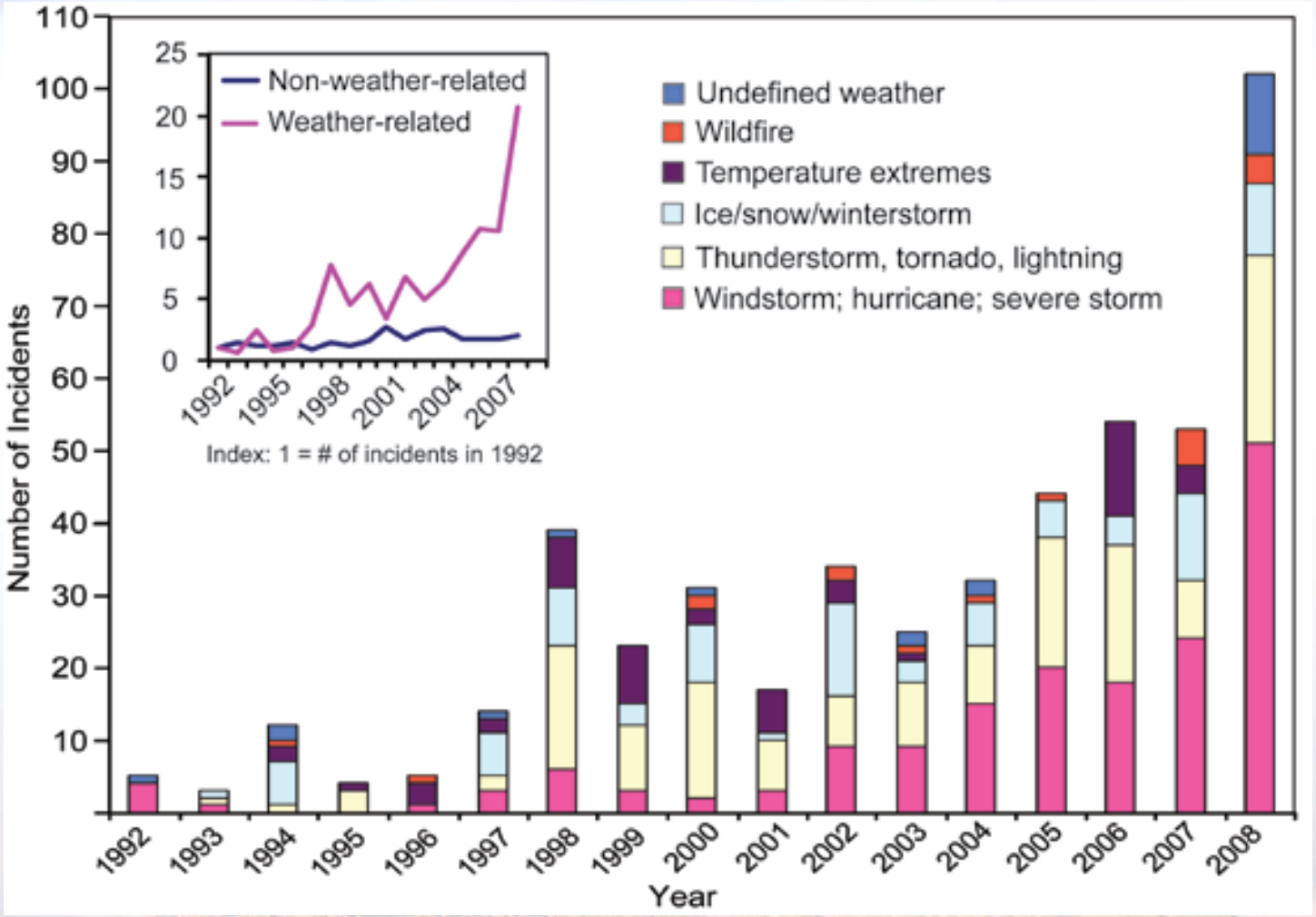
Significant Weather-Related U.S. Electric Transmission Grid Disturbances are Increasing



Customers impacted per incident has tripled

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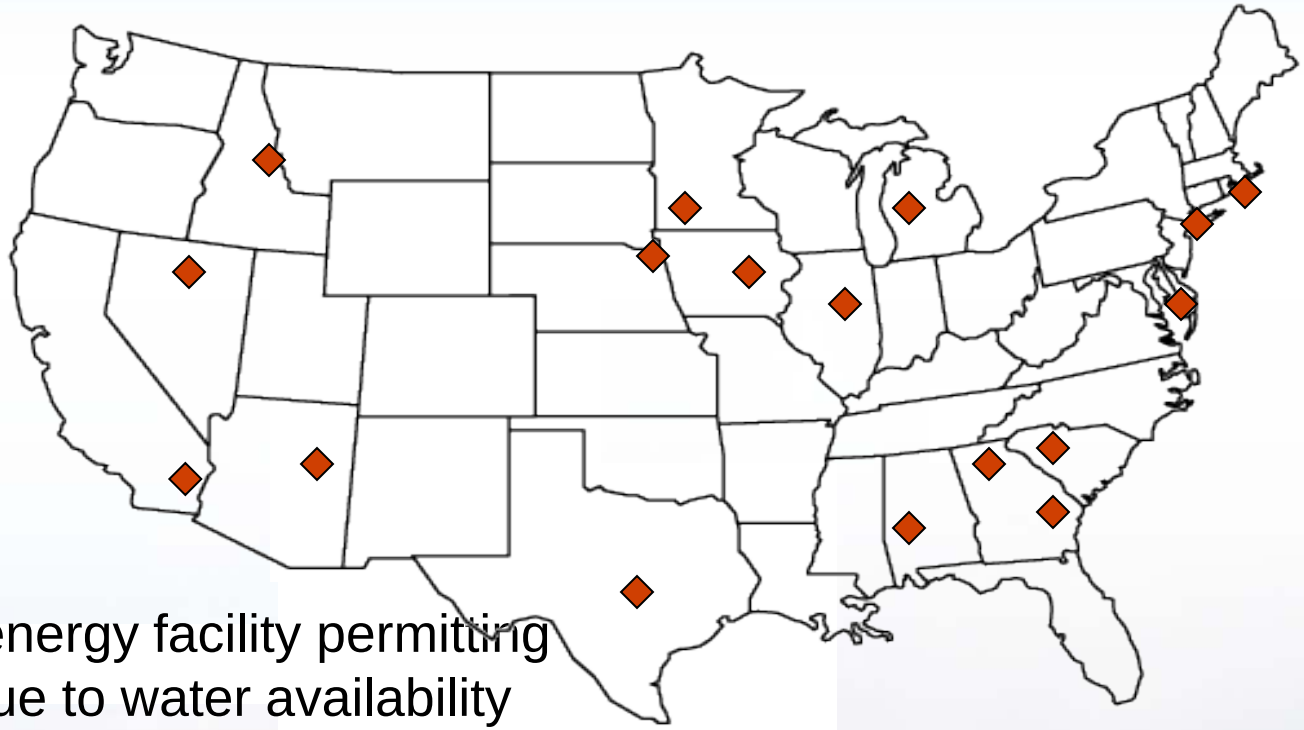
Water Limitations are Already Impacting Energy Development



- Recent energy facility permitting issues due to water availability

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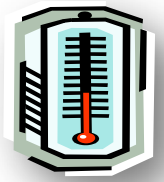
Climate Impacts on the Energy Sector

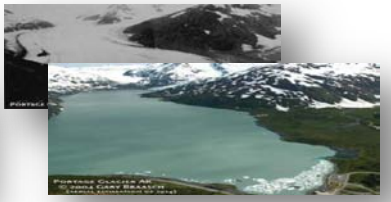


Temp Increase

Droughts & Floods

More Frequent Bigger Storm Events

Rising Sea Level



Snow Cover Shrinking

Impacts on…

Resource Production

- Competition for access to water
- Increased production interruptions
- Early season delays
- Pad damage
- Precipitation impact on biofuels

Transport & Terminals

- Damage to shore-line facilities
- Increased shipment interruptions
- Increased ice-load variation
- Reduced barge and other shipping seasons

Refining

- Reduced access to water
- Increased flooding
- Loss of peak cooling capacity

Pipelines

- Thaw subsidence and frost jacking
- Increased setbacks
- Loss of capacity in existing pipelines

Electricity Generation

- Competition for access to water
- Increased peak demand and loss of peak cooling capacity
- Increased flooding
- Increased wind and solar variability

Transmission

- Damage to lines from storm events, temperature increases, and floods
- Increased congestion

From Jan Dell, CH2MHill

KEY CLIMATE CHANGE IMPACT MESSAGES ABOUT THE ENERGY SECTOR

- **Warming will be accompanied by decreases in demand for heating energy and increases in demand for cooling energy. The latter will result in significant increases in electricity use and peak demand in most regions.**
- **Energy production is likely to be constrained by rising temperatures and limited water supplies in many regions.**
- **Energy production and delivery systems are exposed to sea-level rise and extreme weather events in vulnerable regions.**
- **Climate change is likely to affect some renewable energy sources across the nation, such as hydropower production in regions subject to changing patterns of precipitation or snowmelt.**

Ref: U.S. Global Change Research Program
2009 – Impacts by Sectors

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Need Integrated Energy System Surety and Resiliency Concepts to Address Climate Issues

- Many regions in the U.S. are likely to be negatively impacted by climate changes
- Safe, secure, and reliable energy supplies and operations are an important national and economic security issue
- Energy system surety should include consideration of all energy supplies, resources, and interdependent infrastructures
- An integrated system approach focused on resiliency against multiple climate issues and other threats is a very practical and cost-effective approach for improving the security and reliability of the energy sector

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