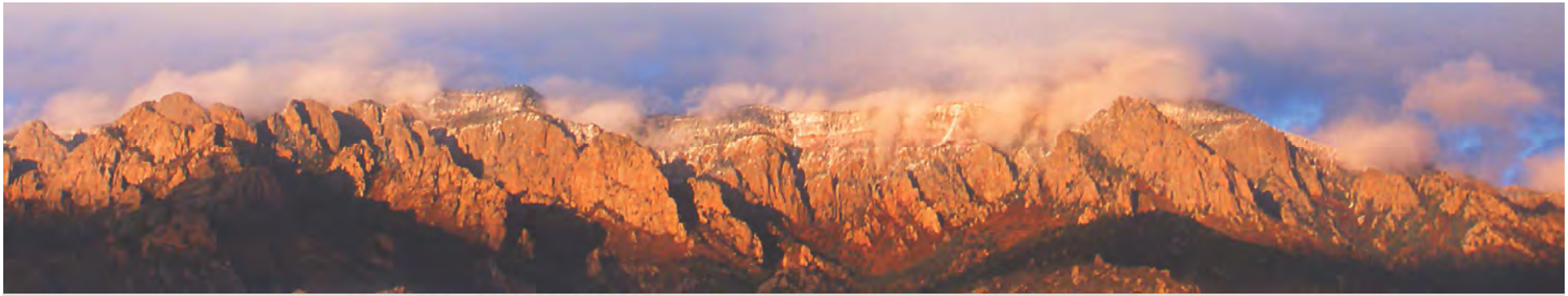

Exceptional service in the national interest

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Water Surety and Sustainability for Mission Assurance

Army Net Zero conference

Chicago – January 18, 2012

Mike Hightower
Energy Surety Engineering and Analysis
Sandia national Laboratories

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

Non-Nuclear Challenges

Vulnerable infrastructure

Competition over Natural Resources

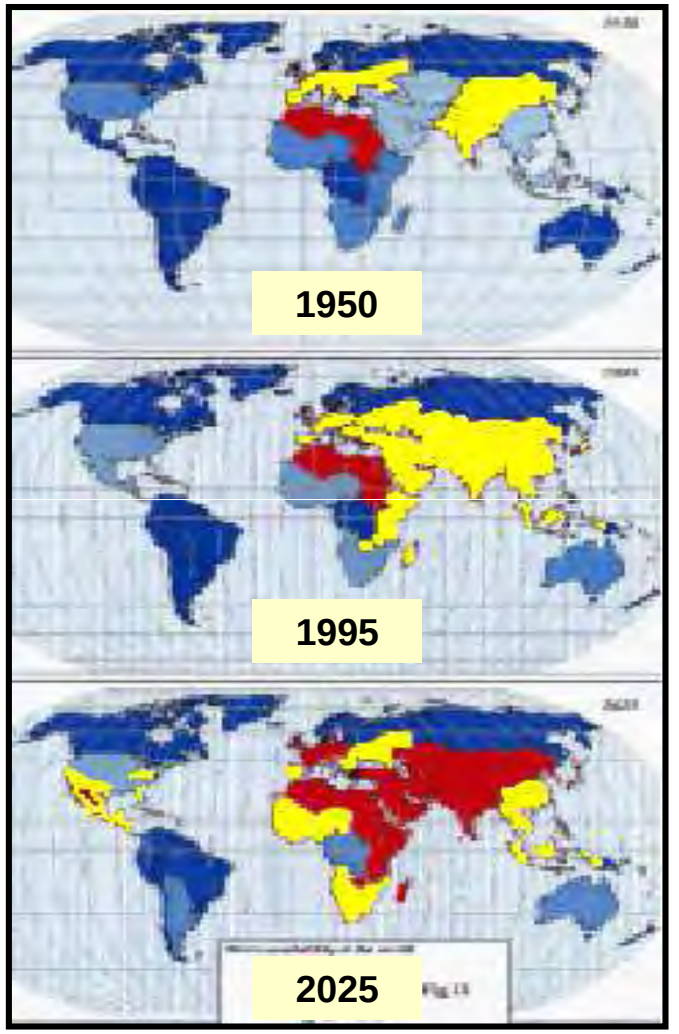
Regional Instability

Water is a growing international security concern due to increasing water stress

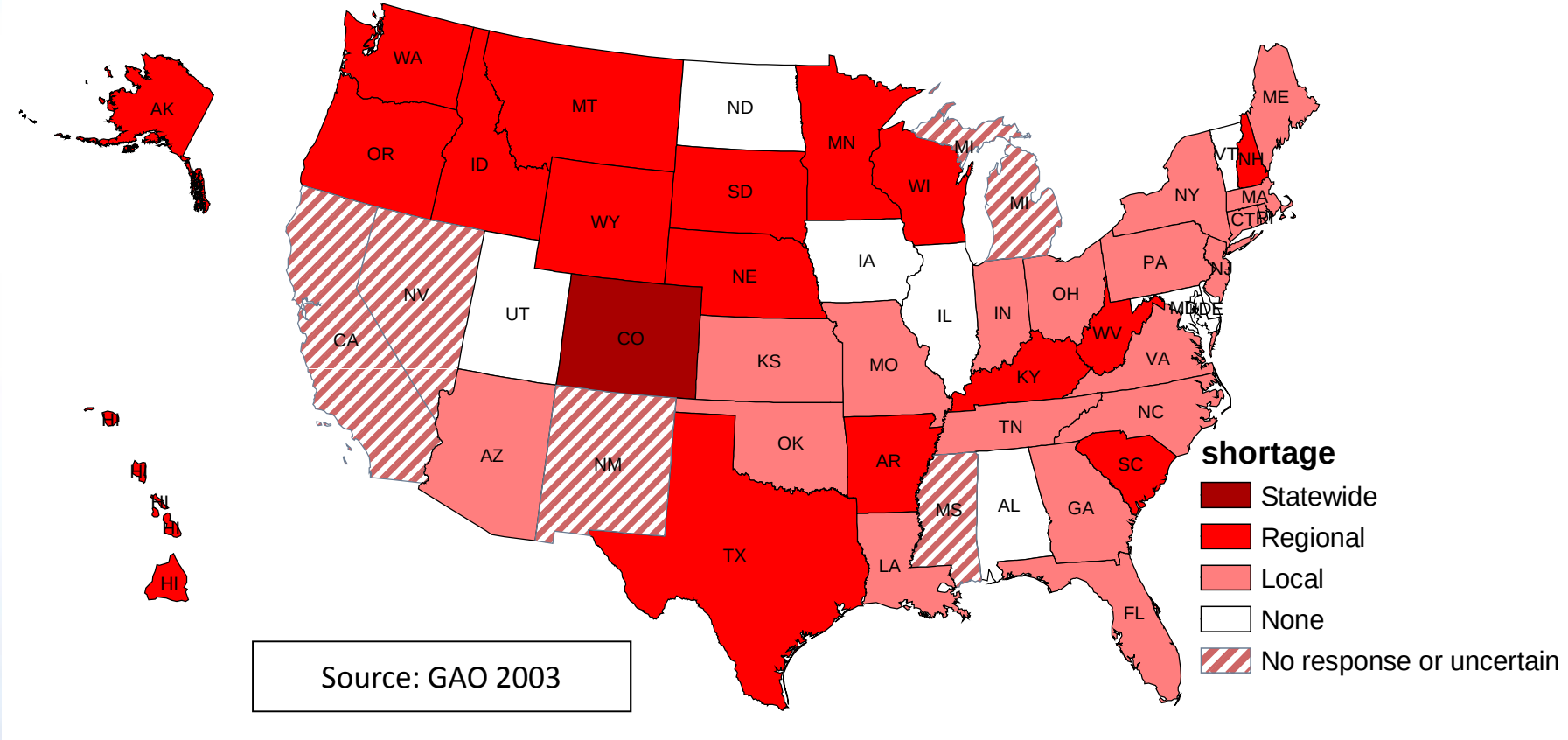
- In 1990, poor water supply and sanitation was the 2nd leading cause of death and disability worldwide.
- In 1998, 25 million "water" refugees compared to 21 million war-related refugees .
- Over 50% of world's major rivers are dry or heavily polluted.
- By 2025, 20% more fresh water will be needed for irrigation and 40% more for cities to maintain current per capita water levels.

"Water promises to be to the 21st century what oil was to the 20th century: the precious commodity that determines the wealth of nations."

Fortune Magazine, May 15, 2000



Most State Water Managers Expect Some Shortages by 2013 Under Average Conditions



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."
- "Few infrastructures are taken more for granted than our fresh water systems."
- "The water supply infrastructure and other critical infrastructures are mutually interdependent."

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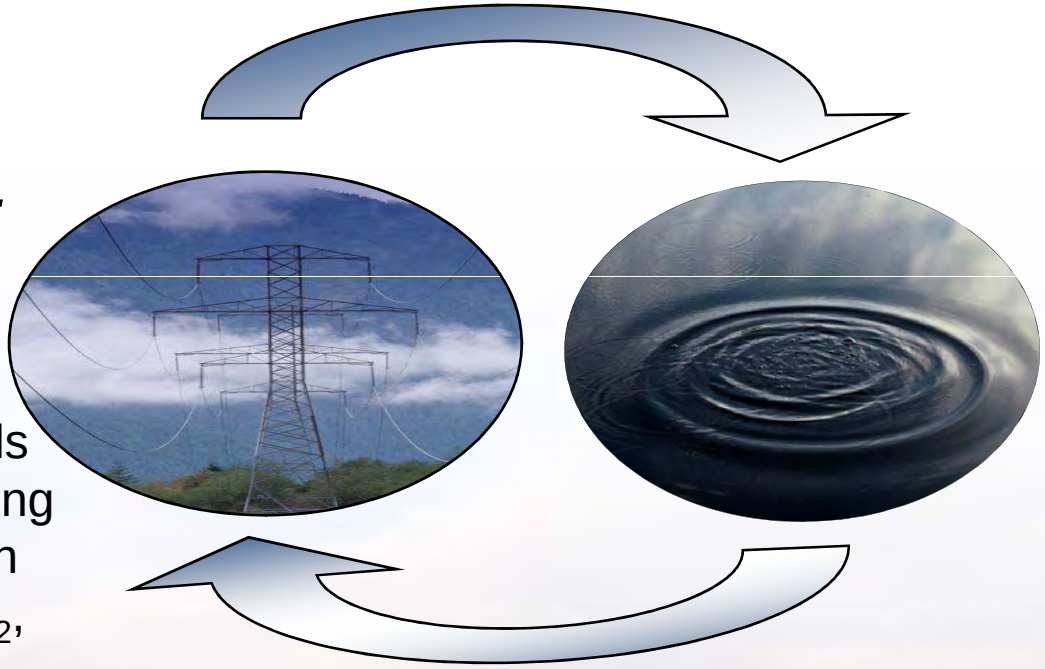
Energy and Water are … Interdependent

Water for Energy and ***Energy for Water***

Energy and power production require water:

- Thermoelectric cooling
- Hydropower
- Energy minerals extraction/mining
- Fuel Production (fossil fuels, H_2, biofuels)
- Emission control



Water production, processing, distribution, and end-use require energy:

- Pumping
- Conveyance and Transport
- Treatment
- Use conditioning
- Surface and Ground water

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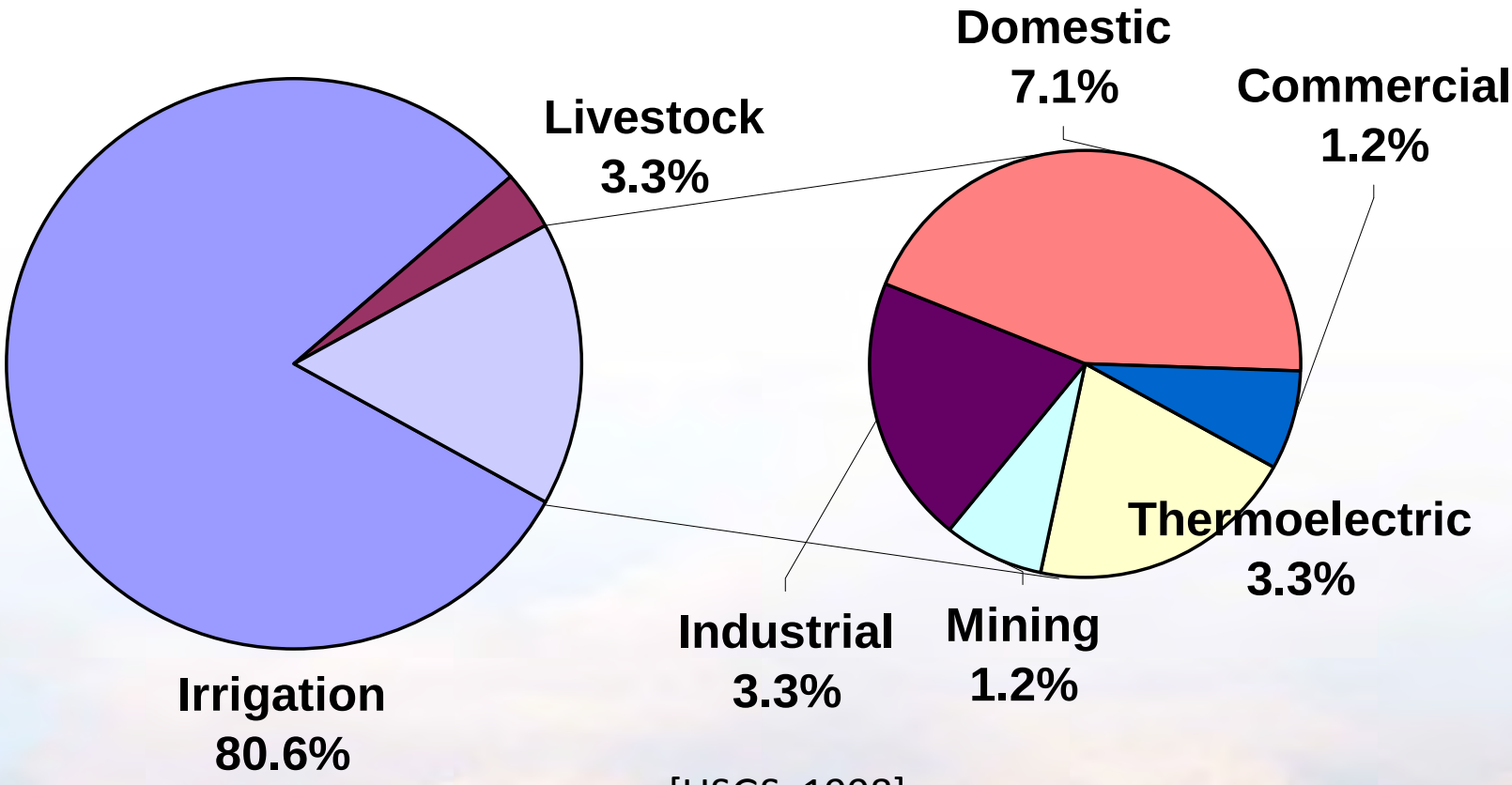
Water Consumption by Sector

U.S. Freshwater Consumption, 100 Bgal/day



[USGS, 1998]

Energy accounts for 27 percent of non-agricultural fresh water consumption

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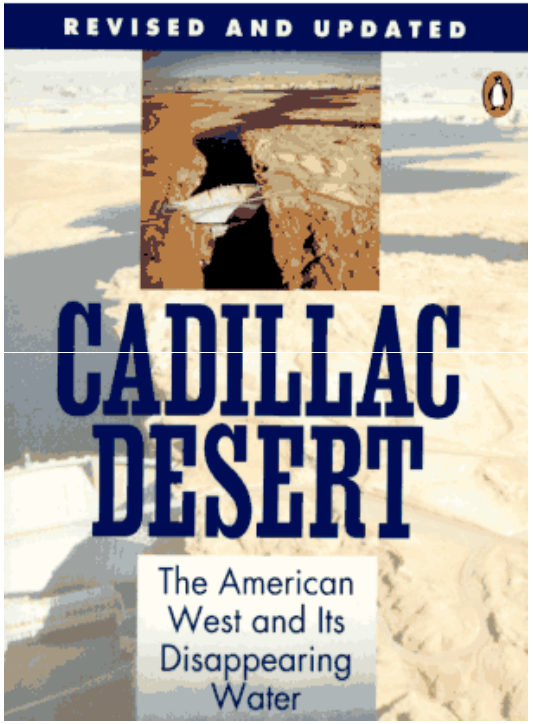
Water Availability Is Already Impacting Energy Development

- Recent energy facility permitting issues due to water availability

Water resources and water infrastructures are facing a spectrum of concerns and threats



unsustainable practices

water quality and safety

inefficient management and water reliability

water infrastructure security and protection

watershed damage

Suggested Water System Surety and Performance Metrics in 2002

Water Surety – Safe, secure, and reliable water supply for sustained system operations and assured system and mission performance

Performance Parameters	Water Surety Metric
Safety	Supply safe supplies of water to end user
Security	Protection of water supply infrastructure
Reliability	Can provide water when and where needed
Sustainability	Can be maintained for long durations
Cost Effectiveness	Water provided at affordable cost

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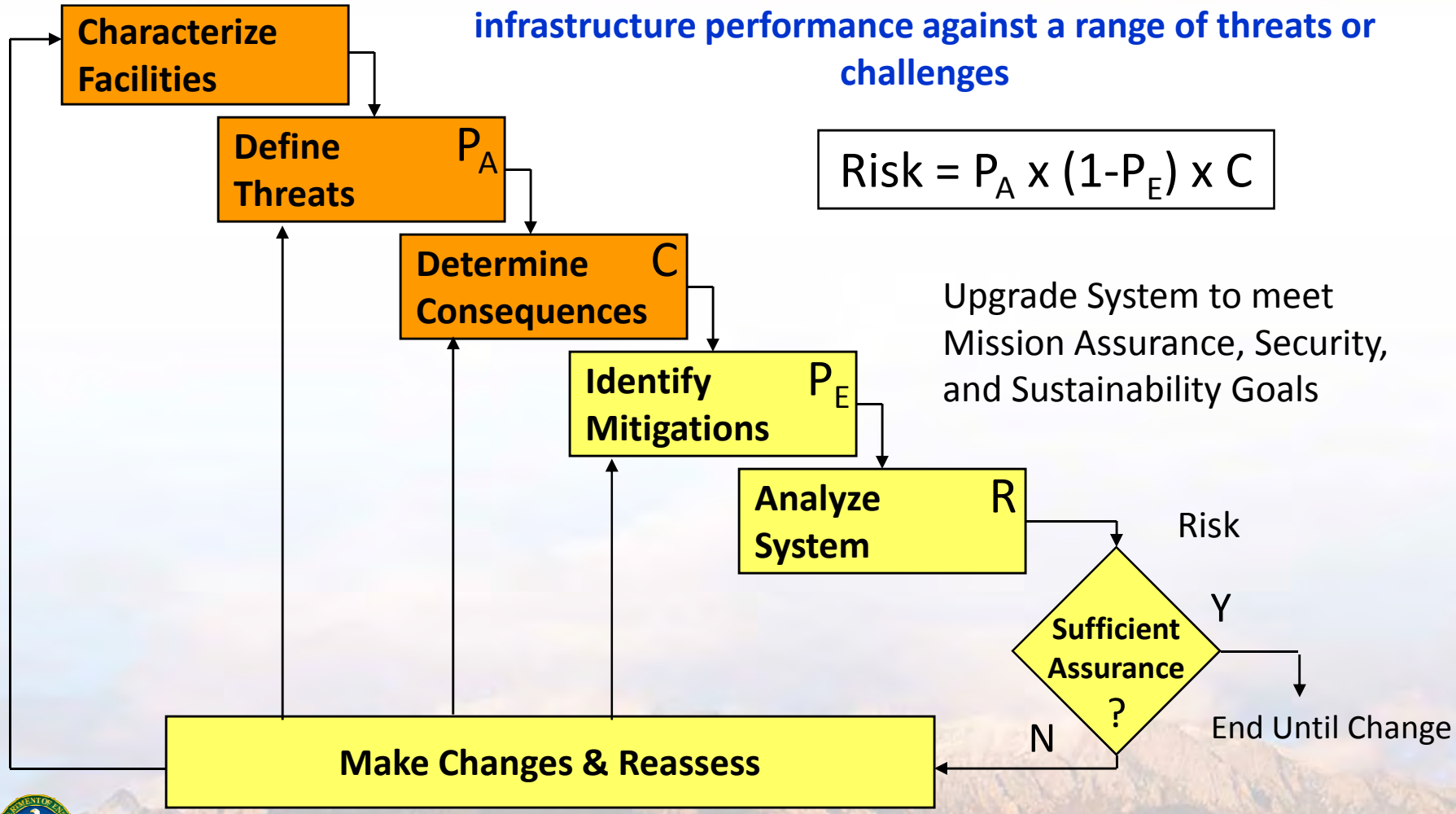
Risk-based Water and Energy Surety Assessment Tools Exist to Support Decisions

A quantitative approach to assess energy or water infrastructure performance against a range of threats or challenges



$$Risk = P_A \times (1-P_E) \times C$$

Upgrade System to meet Mission Assurance, Security, and Sustainability Goals

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Water system supply and mission assurance considerations and tradeoffs

- **Domestic needs**
  - Safe, high quality supply and treatment
- **Mission Operations needs**
  - Building cooling water, steam make-up water, industrial processes water, and other mission operational water
- **Fire Protection needs**
  - Pressure regulation and water storage requirements
- **Recreational needs**
- **Waste water treatment**
- **All these base water needs have associated energy demands**

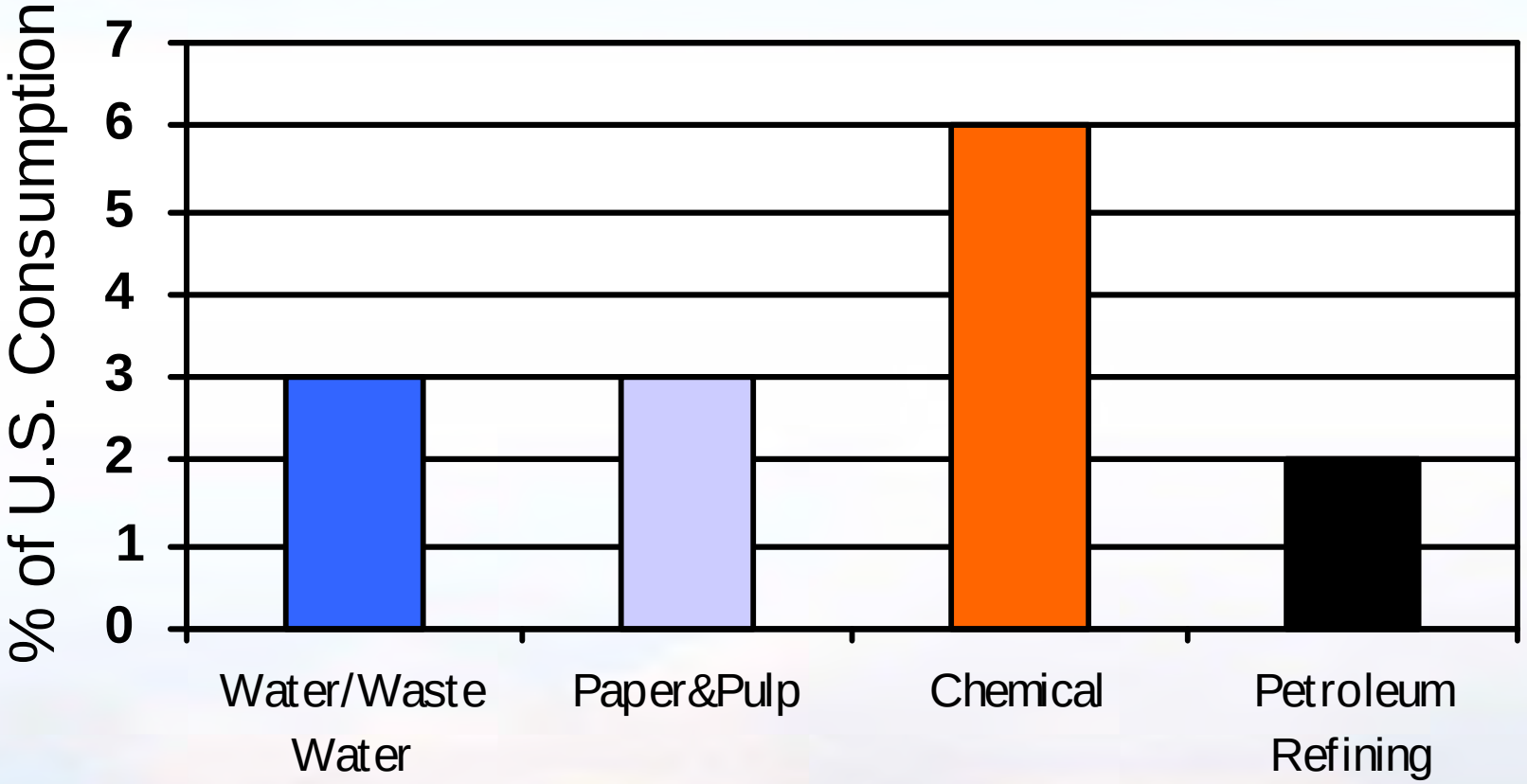
Reliability vs. security and cost

Reliability and sustainability of supplies

Storage for reliability vs. cost

Reliability vs. safety

Energy Demand for Water and Waste Water Supply and other Sectors



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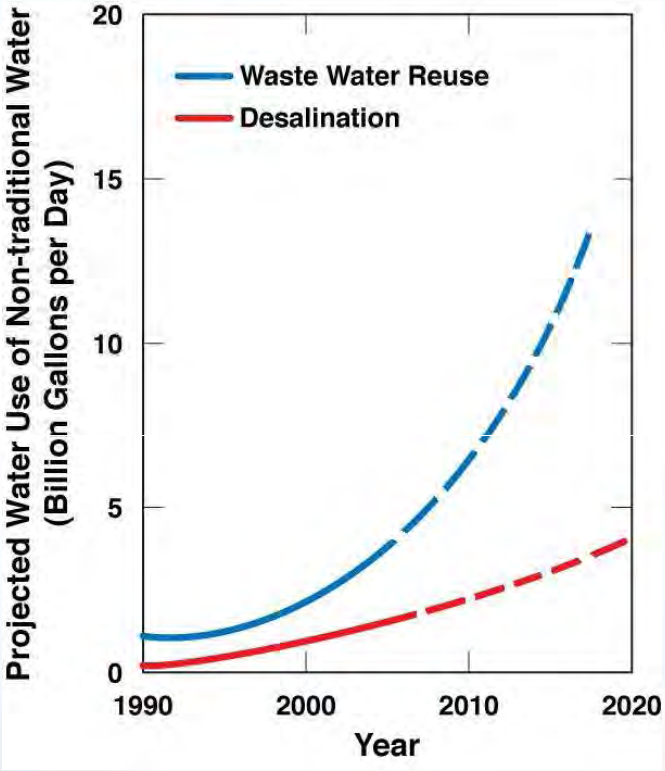
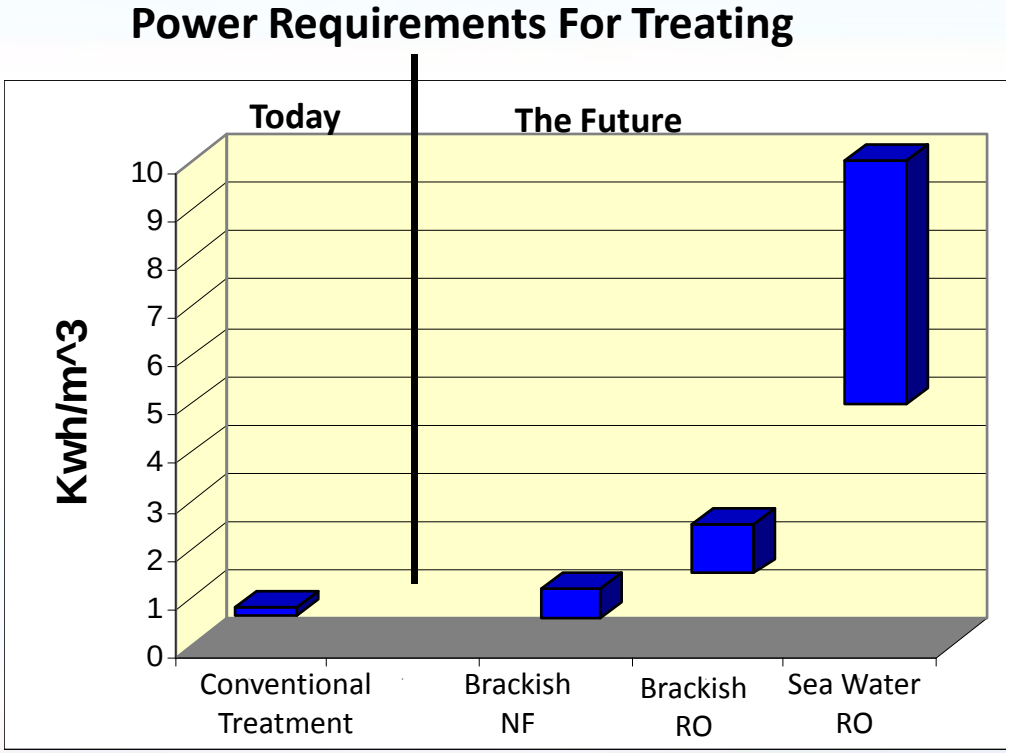
Growing Use of Non-traditional Water Resources Will Require Additional Energy Considerations



(From EPA 2004, Water Reuse 2007, Mickley 2003)



(Einfeld 2007)

- Desal growing at 10% per year, waste water reuse at 15% per year
- Energy demand for water supply and treatment can range from 5-15 kwhr/kgal

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The 2010 QDR Provides Similar Metrics for Energy Security for DoD

- **Defines Energy Security**

  "Energy security for the Department means having assured access to reliable supplies of energy and the ability to protect and deliver sufficient energy to meet operational needs"

- **Definition really identifies "energy assurance" or "energy surety" – safety, security, reliability**

- **Directs facilities to:**
  - Address energy security while simultaneously enhancing mission assurance
  - Promote investments in energy efficiency
  - Ensure that critical assets are prepared for prolonged outages: natural disasters, accidents, attacks

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Summary

- Water resource and water supply reliability, security, and sustainability are a growing national and international challenge.
- Water and energy are critically linked in supporting mission operation and assurance, and therefore need to be considered together.
- Risk-based tools exist to support bases in evaluating various tradeoffs, upgrades, and modifications needed to support energy and water surety and sustainability at military installations.

QUESTIONS?

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