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Mountain West Water Institute
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U.S. Department of Energy Initiatives to Address the Energy-Water-Climate Nexus

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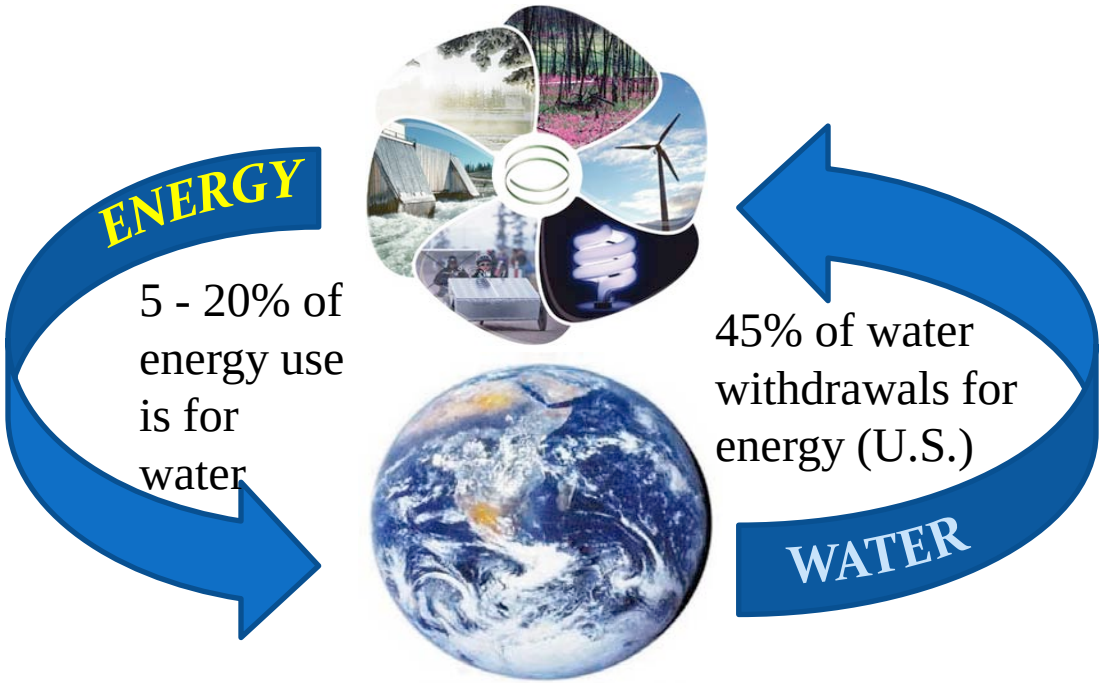
Global Nexus of Energy, Water, and Climate

- **Human Society Requires Both Energy and Water**
- **Energy Production Requires Water, and Water Production Requires Energy**
- **Climate Change is Altering How the Environment Provides Both Energy and Water to Society**



Sustainability Issues

- Population Growth
- Increased Energy and Water Demand
- Climate Impacts on Water Resources
- Climate Mitigation Technologies may require more water

Increasing Constraints on Sustainability

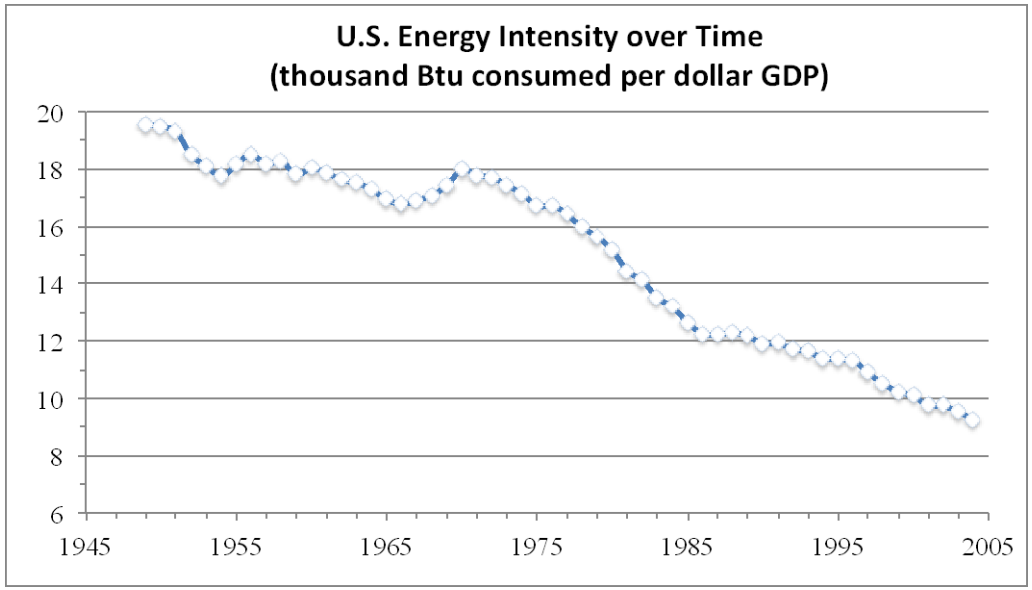
- ***Increasing Energy Demand.*** Global electricity production is estimated to increase by 87% from 2007 to 2035. Most of will be in developing nations that are already water stressed.

- ***Increasing Water Demand.*** Global freshwater withdrawals tripled since 1950. Estimated 40% gap between global supply and demand by 2030. Increased risk of water conflicts.

- ***Climate Change Multiplies Water Stress.*** Climate Change will alter the water cycle, increase water-related risks, damage critical infrastructure, and alter energy use.
  - Changes in precipitation. Increased flooding and drought.
  - Sea level rise, flooding may damage critical infrastructure.
  - Higher demand for cooling may increase energy and water demand.
  - Displacement of human populations may increase global insecurity.

The Role of the U.S. Dept. of Energy

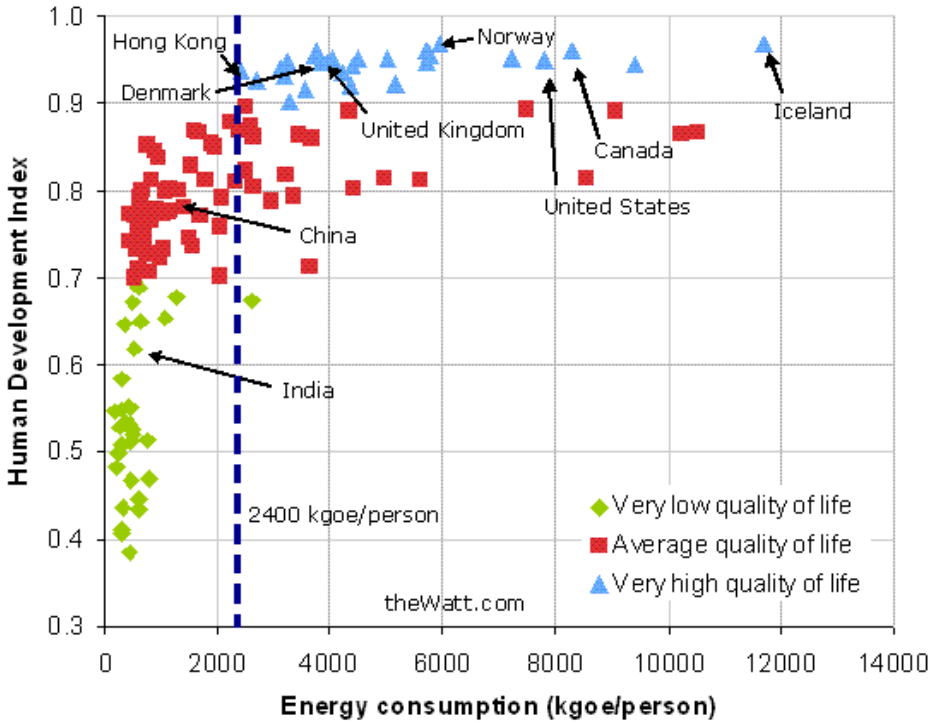
- ***The mission of the Department of Energy*** is to ensure America's security and prosperity by addressing its energy, environmental, and nuclear challenges through transformative science and technology solutions.
- ***Energy Security.*** Help transform the U.S. energy system and secure U.S. leadership through development, demonstration, and deployment of energy technologies that are cleaner, more efficient, and more sustainable.
- ***Economic Prosperity.*** Foster scientific and technological innovation in strategic areas. Examples include:
  - Materials, computing, and engineering for improved production and use efficiency.
  - Environmental research to reduce human impacts.



Key Energy and Water Challenges

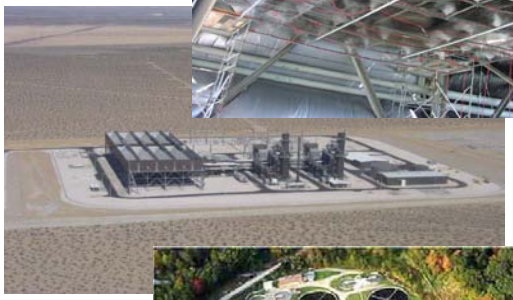
- ***Energy Security Challenges***.
  - Water constraints limit options for production of transportation fuels.
  - Water shortages interrupt electricity delivery.
  - Alternative energy technologies may increase water demand for energy.

- ***Prosperity depends on affordable, reliable energy.***
  - Correlation between energy availability and quality of life.
  - How much energy is needed for prosperity varies by culture, geography, economy.
  - Innovation, efficiency reduce the amount of energy needed for prosperity.



Strategies to Address these Challenges

- ***Enhance Scientific Understanding.*** Improve energy/water/climate modeling to predict impacts on Global, National, and Regional scales.
- ***Promote Energy and Water Efficiency.*** Assess lifecycle water demands for energy services and promote water conservation through improved efficiency in energy production and use.
- ***Advanced Cooling.*** Develop, demonstrate, and deploy less water intensive cooling technologies (e.g. dry cooling, wet/dry hybrid cooling).
- ***Utilize Non-Traditional Water Resources.*** Expand water recycling within power plants and utilize degraded/impaired waters (e.g. saline aquifers, wastewater, oil & gas produced water).

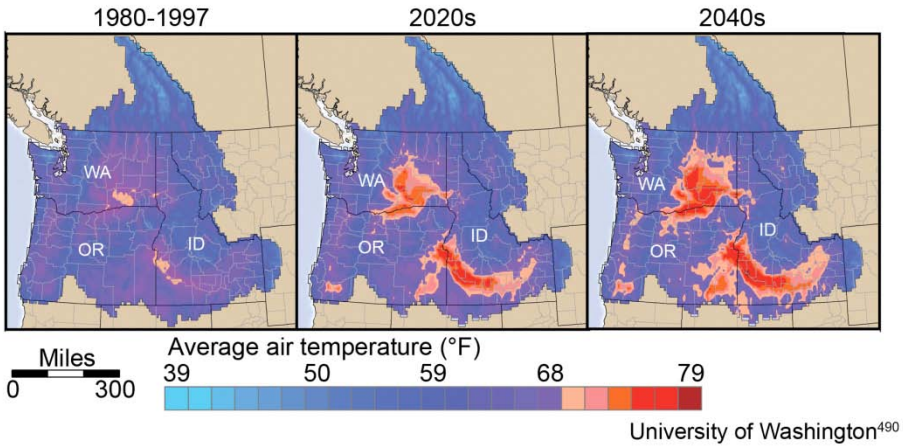


Improving our Scientific Understanding

- ***Climate and Environmental Sciences*** . DOE supports efforts to gain a predictive, systems-level understanding of:
  - Science associated with climate change and its resultant impacts.
  - How to control fate of energy-derived by-products in terrestrial ecosystems.

- ***Energy Systems.***
  - Technical support for planning of future energy systems.
  - For example, support to Western States Water Council and Western Governor's Assoc. to help account for water during transmission planning.
  - Collaborative team led by Sandia. Includes ANL, EPRI, INL, NREL, PNNL, Univ. of TX.

Decreasing Habitat for Cold Water Fish



Salmon can be found where average air temperature is less than about 70°F (shown in blue). Projected average August surface air temperatures in the Columbia Basin suggest that salmon are likely to be threatened by rising temperatures across much of their current habitat, based on a higher emission scenario.[91,486,497]

Advanced Energy and Water Technologies

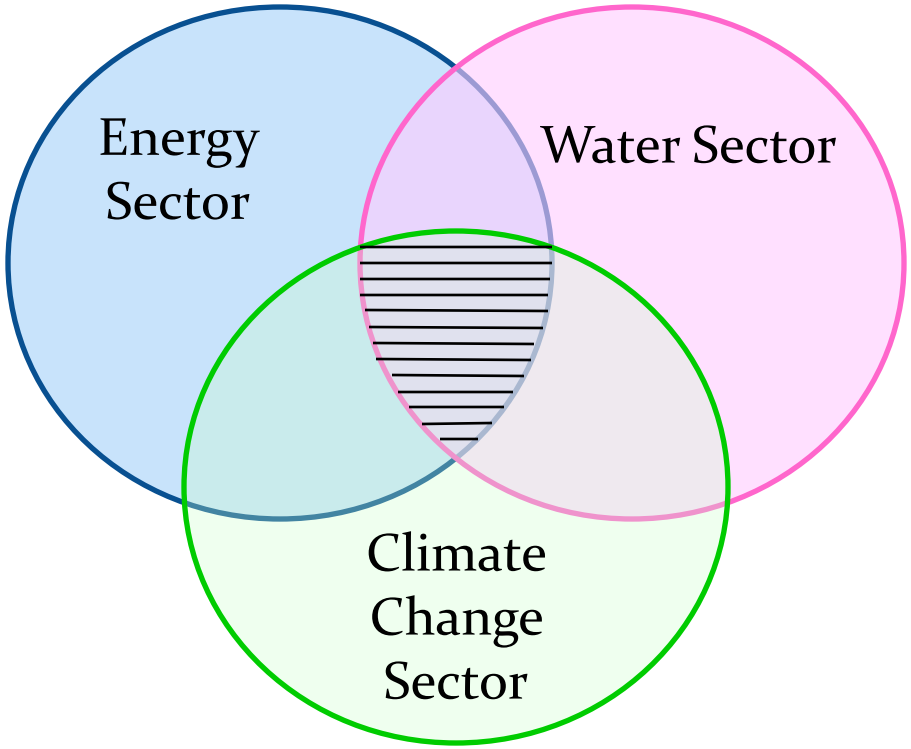
- ***Advanced Cooling Technologies***.
  - Improve performance and reduce costs of wet, dry, and hybrid cooling.
  - Reduce fouling of intake structures, improve intake system performance.

- ***Expand recycling/reuse of degraded water.***
  - Enhances flexibility in providing water to produce energy.
  - Reduced impacts of energy development on water quality.
  - Example include desalination technologies, and technologies to remove contaminants from hydrofracking fluids.

Advanced Cooling Pilot. San Juan Power Station, Farmington, NM

Seeking Synergistic Solutions.

Reducing Energy Use :
-less water demand
- less GHG emissions



Reducing Water Use:
- less energy demand
- less GHG emissions

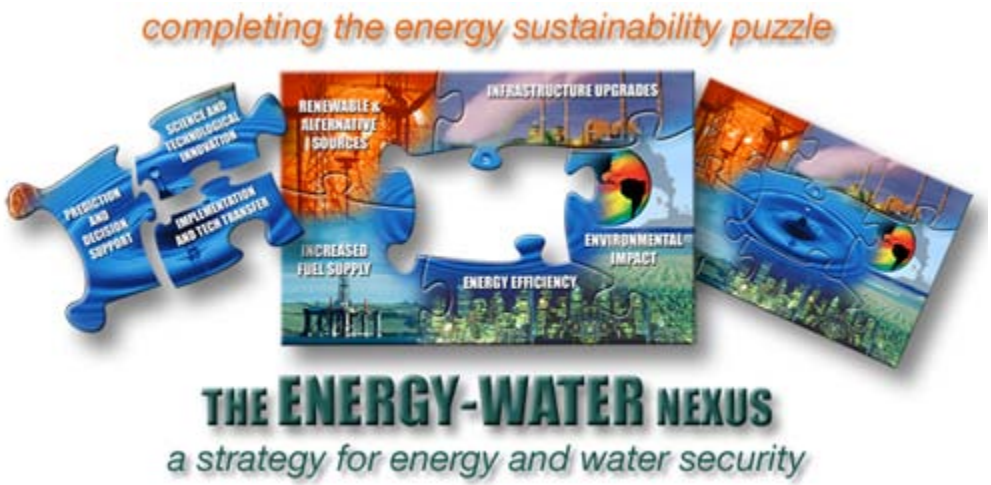
Summary

- ***A "Perfect Storm" may be coming.*** Combination of population growth, increased human demand for natural resources, and reduced environmental flexibility from climate change pose a real threat to human well-being.
- ***Need improved resiliency.*** More technological options and enhanced planning and coordination are needed.
- ***Five actions we can take today.***
  - *Develop and Use Improved Models.*
  - *Develop and Deploy Better Technology.*
  - *Coordinate and Integrate.*
  - *Build Public Awareness.*
  - *Remove Barriers. Incentivize Early Action.*

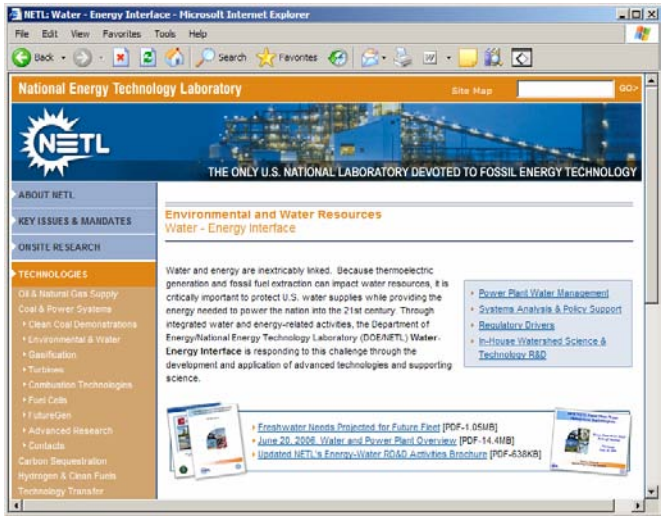
Interested in Learning More

Mountain West Water Institute

http://www.mwwi.org



www.sandia.gov/energy-water



http://www.netl.doe.gov/technologies/coalpower/ewr/water/index.html

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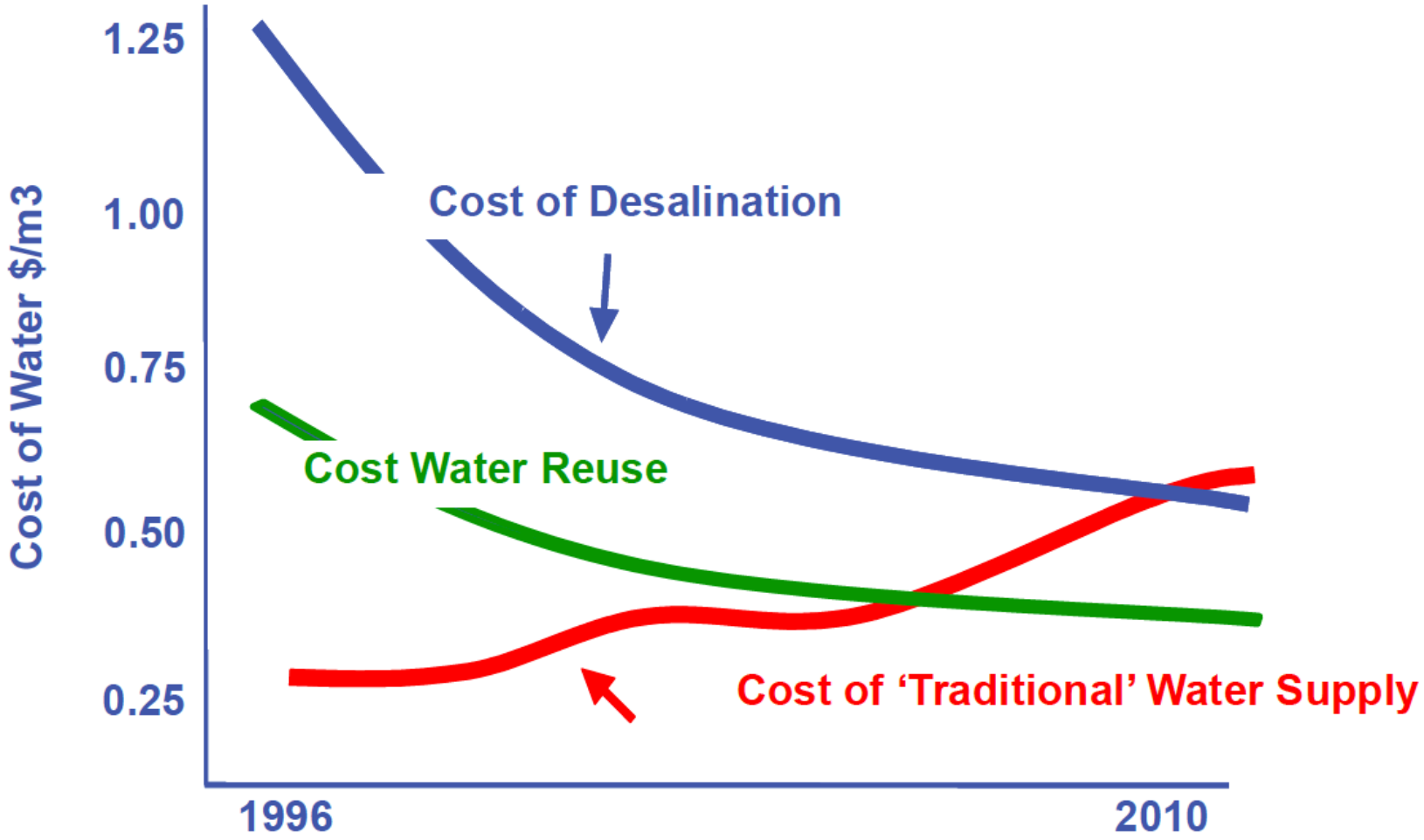
Reduced Costs through R&D