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# **Water-Energy Research at the U.S. Department of Energy**

Presentation to

## **2010 GWPC Annual Forum**

**Water & Energy in Changing Climates:  
State, Federal and Local Views**

Dr. Allan R. Hoffman  
U.S. Department of Energy  
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# Outline of Presentation

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- Two simple messages
- Defining water security and energy security
- The linkages
- Providing a context
- DOE R&D activities
- Concluding Remarks

# Two Simple Messages

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- **Water and energy are as basic as it gets**
  - access to both is critical to poverty reduction, sustainable economic development and national security
- **Water and energy issues are inseparable**
  - but policy goals associated with providing adequate energy and clean water supplies are often in conflict

# Defining Security

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- A search of the literature reveals no widely accepted definitions for either water or energy security
  
- Two useful working definitions:
  - Water security: the ability to access sufficient quantities of clean water to maintain minimal standards of food and goods production, sanitation and health
  - Energy security:
    - energy is important only as it allows the provision of services that are important to human welfare (heating, cooling, ...)
    - security rests on two principals:
      - using minimal energy to provide an energy service
      - access to diverse supply of reliable, affordable and environmentally benign energy resources

# Linking Water and Energy

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- Until fairly recently:
  - water people rarely thought about energy
  - energy people thought about water in limited ways - hydropower, thermoelectric cooling
  
- This worked for most of the 20<sup>th</sup> century, but will work no longer
  
- Today
  - it is recognized that the water-energy nexus is a serious national and global issue, and that
  - water-energy issues must be addressed together

# How Are Water and Energy Related?

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- **Energy is needed to:**
  - extract water from underground aquifers
  - transport water through canals and pipes
  - manage and treat impaired water for reuse, and
  - desalinate brackish and sea water to provide new fresh water supplies.
  
- **Many forms of energy production and use depend on the availability of water:**
  - hydropower
  - cooling of thermal power plants
  - fossil fuel production and processing
  - biofuels
  - carbon capture and sequestration
  - hydrogen economy

# Other Linkages

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- ❑ Energy production and use can lead to **contamination** of underground and surface water supplies
- ❑ If competing water uses limit use of **waterways** for transport of goods, rail and truck will require more energy to move those goods
- ❑ **competition** for water resources is already limiting licensing and operation of power plants, and
- ❑ **climate change** has the potential to disrupt the hydrological cycle and impact global water resources long before other impacts are felt

# The Context

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- The largest user of water in the U.S. is power plant cooling
  - 85 percent fresh water; 15 percent saline
  
- On a global basis, neither water nor energy are in short supply:
  - The earth is a water-rich planet
  - there are large, even unlimited, energy supplies still to be exploited
  
- What is in short supply is clean water and energy that people can afford to buy

# Federal Responsibility

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- ❑ A number of Federal agencies address water issues, but none currently at the water-energy nexus
  
- ❑ *But this may be changing:*
  - **Energy and Water Research Integration Act (H.R. 3598)**
    - ❑ requires DOE to integrate water-related issues into current energy RD&D programs
  
  - **Energy and Water Integration Act of 2009 (S.531)**
    - ❑ calls for in-depth analysis of impact of energy development and production on water resources
  
  - **American Clean Energy & Security Act/2009 (H.R. 2454)**
    - ❑ calls attention to water requirements of energy supply mix

# Water-Energy Research Needs

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- R&D to:
  - reduce steam power plant cooling requirements
    - Nuclear, fossil, concentrating solar
  - reduce energy requirements of desalination
  - develop less energy-intensive technology for water decontamination, treatment and reuse
  - reduce water use in agriculture

# Research Needs (continued)

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- understand the water requirements of emerging energy technologies:
  - biofuels
  - carbon capture and sequestration
  - oil and gas shales
  - tar sands
  - hydrogen economy
- understand the impact of global climate change on spatial and temporal variability of water resources

# DOE Water-Energy R&D Activities

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- Several program offices are supporting water-energy R&D
  - Energy Efficiency & Renewable Energy, Fossil Energy, Policy and International Affairs, Nuclear Energy, Science
  
- Many national laboratories and contractors are carrying out these R&D activities
  
- These efforts will receive increased emphasis in the future as the US and other countries undertake efforts to adapt to the impacts of climate change
  - an initial report to the President by the interagency Climate Change Adaptation Task Force is scheduled for October

# A Sampling of DOE R&D Activities

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- ❑ minimizing the environmental impact of water used for the hydrofracturing of gas shales
- ❑ reducing water used by biofuels, nuclear, geothermal and concentrating solar power systems
- ❑ detecting, understanding and predicting climate change impacts on precipitation
- ❑ opportunities for hydropower upgrades at existing facilities
- ❑ analytical tools for managing energy-water tradeoffs in hydropower systems
- ❑ impacts of drought on water availability for power plant cooling in Western U.S.

# DOE R&D Activities (continued)

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- ❑ advanced, more efficient separation technologies for treating degraded water
- ❑ improving the quality of oil and gas produced water
- ❑ addition of water flows to energy planning models
- ❑ use of mine water and treated wastewaters in thermal power plants
- ❑ use of saline formations for combined thermal power plant water needs and carbon sequestration
- ❑ water-related issues affecting conventional oil and gas recovery and potential shale oil development in Utah

# Concluding Remarks

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- In recent years there has been a growing understanding and acknowledgment that water and energy issues are inseparable
- A broad range of water-energy R&D activities currently is supported by the U.S. Department of Energy and the level of support is likely to increase
- Thank you
  - [allan.hoffman@ee.doe.gov](mailto:allan.hoffman@ee.doe.gov)
  - 202-586-8302