

Responding to Emerging Power Plant-Water Issues – DOE/NETL's R&D Program



*American Coal Council
2004 Spring Coal Forum*

*Dallas, Texas
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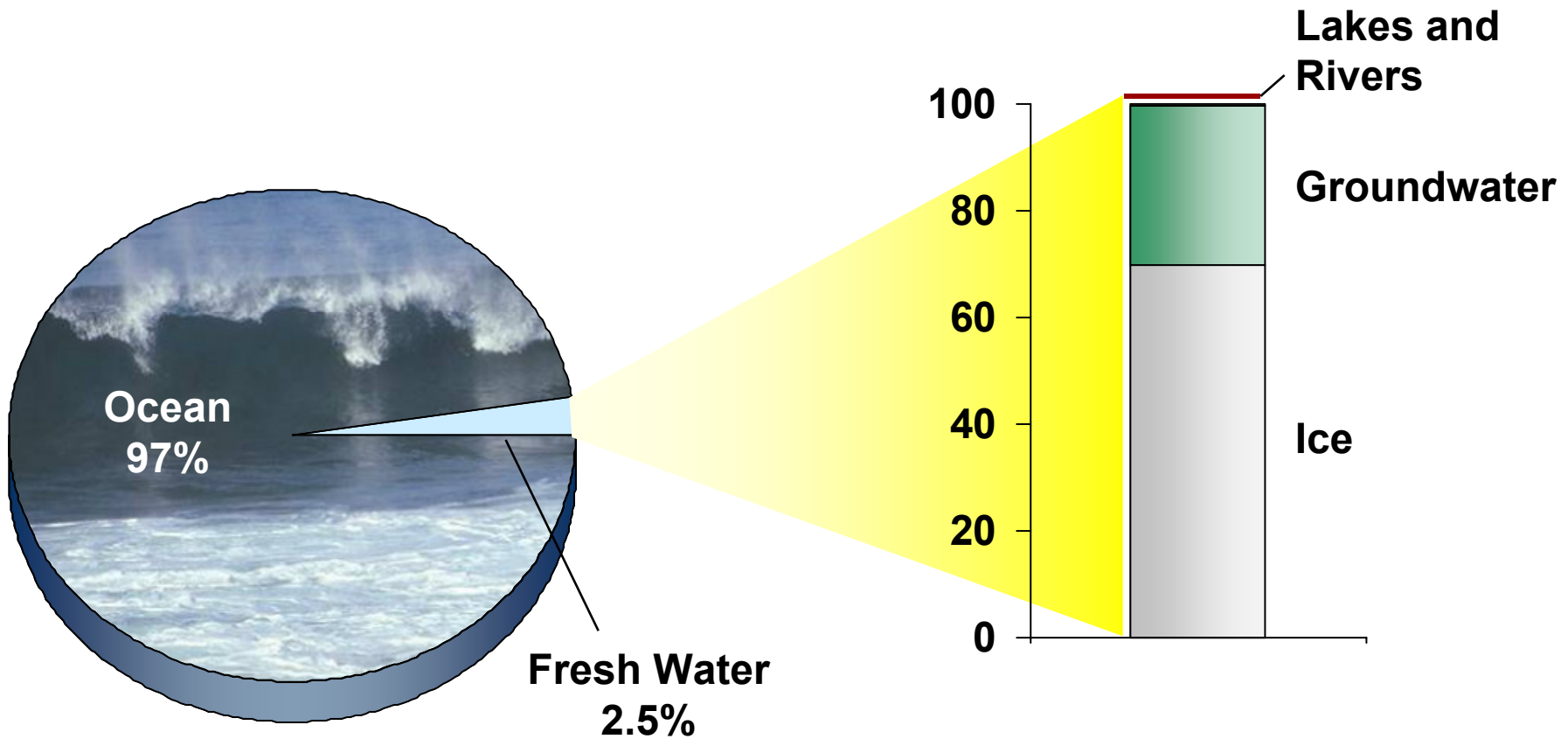


Presentation Outline

- **Background**
- **Power plant-water issues**
- **DOE/NETL R&D program**
- **Conclusion/future plans**



Global Water Availability



Three Things Power Plants Require

1) Access to transmission lines



2) Available fuel, e.g., coal or natural gas



3) Water

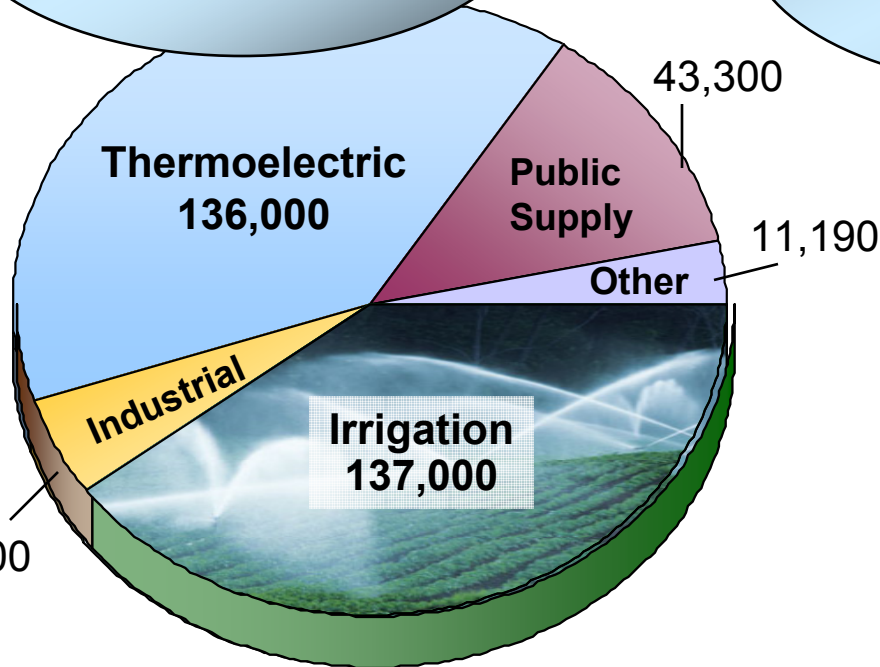


Freshwater Withdrawals and Consumption

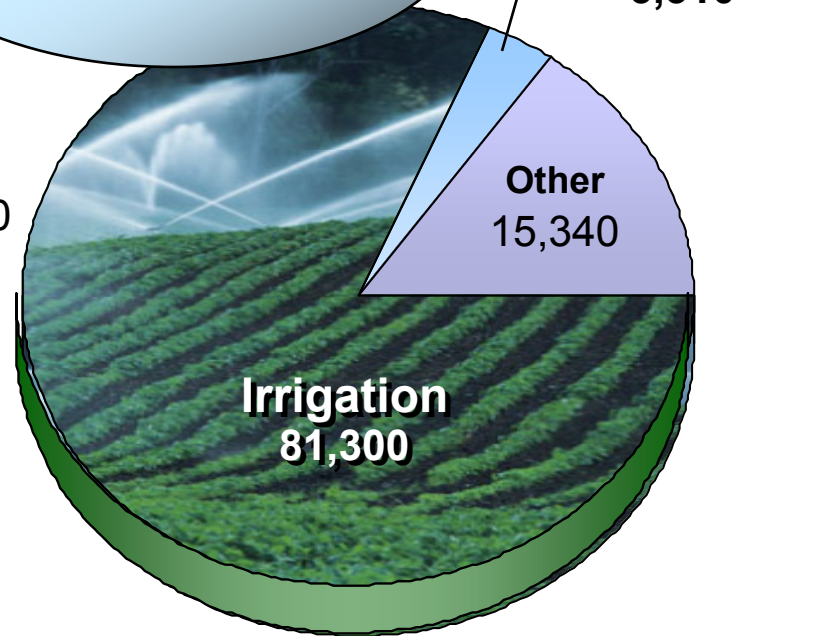
Mgal / Day

Thermoelectric accounts for ~ 39% of withdrawals

Thermoelectric accounts for ~3% of consumption



Withdrawal



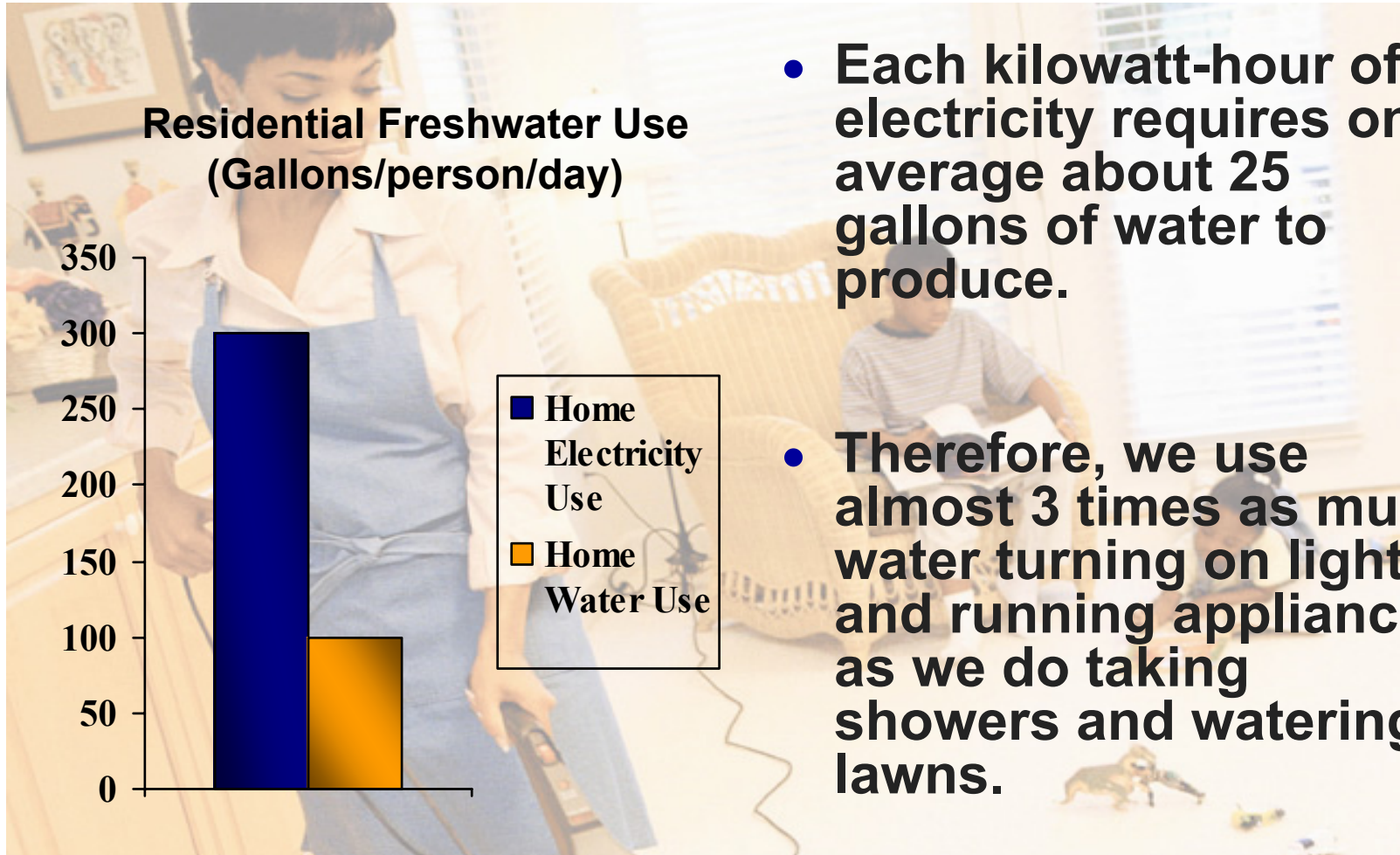
Consumption

Sources: "Estimated Use of Water in the United States in 1995," USGS Circular 1200, 1998

"Estimated Use of Water in the United States in 2000," USGS Circular 1268, March 2004



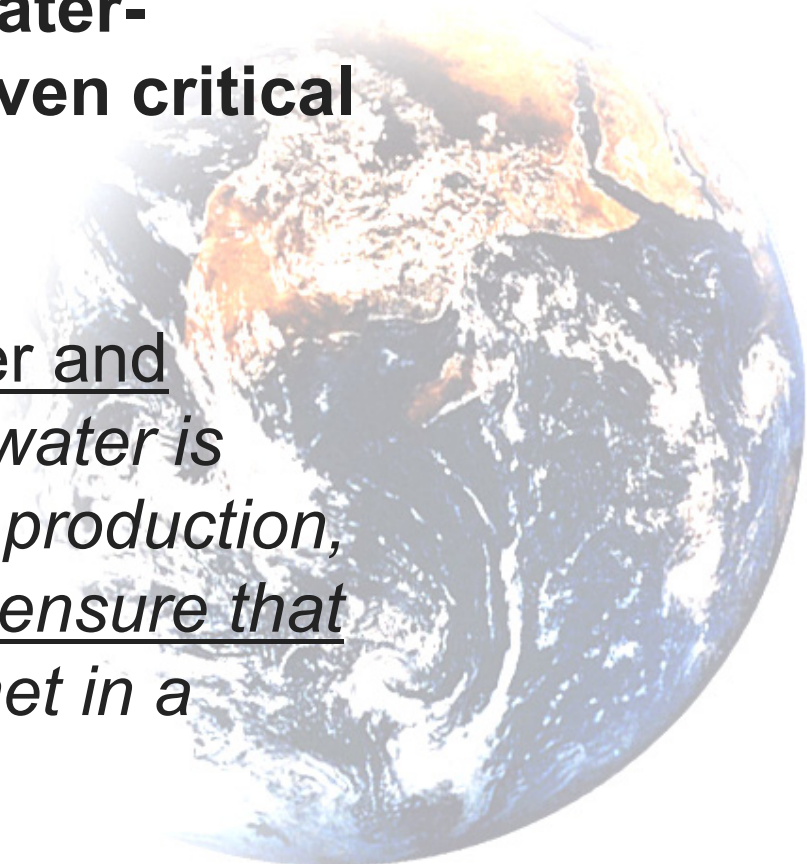
Water and Electricity Are Inextricably Linked



- Each kilowatt-hour of electricity requires on average about 25 gallons of water to produce.
- Therefore, we use almost 3 times as much water turning on lights and running appliances as we do taking showers and watering lawns.

Water for Energy is a Global Issue

- **United Nations identified water-energy nexus as one of eleven critical challenges for the future:**
 - **Critical Challenge 10: Water and Energy – *Recognizes that water is vital for all forms of energy production, and that there is a need to ensure that energy requirements are met in a sustainable manner.***



Source: The United Nations World Water Development Report, 2003



Water is Also Dependent Upon Electricity

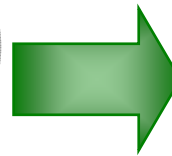


Summer 2003 blackouts in Midwest and Northeast clearly demonstrated interdependency between energy and water

Electric Power Supply / Demand Imbalance

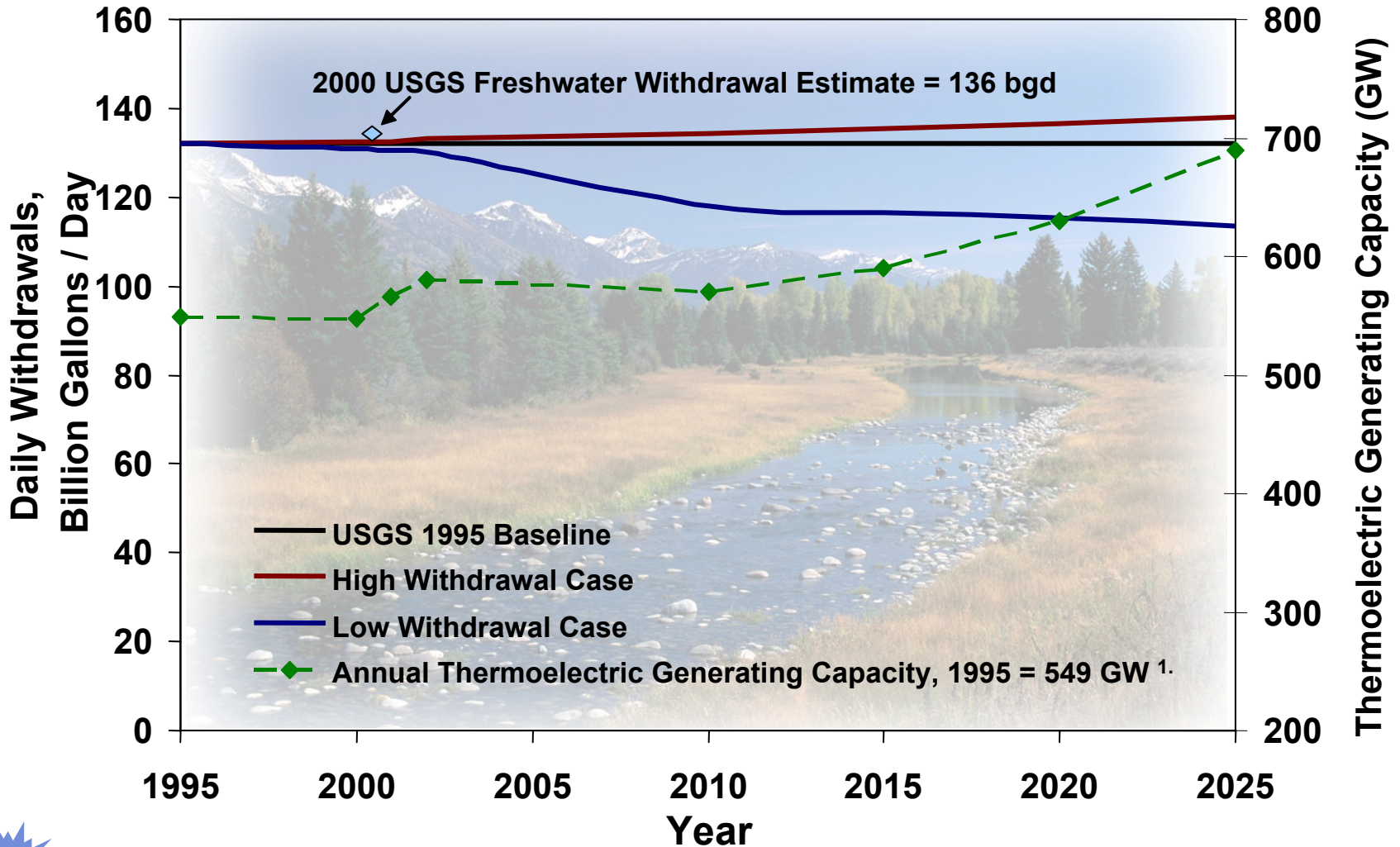


Blackouts Throughout Northeast and Midwest



Disruption of drinking water treatment and distribution

Daily Freshwater Withdrawals Needed to Meet Forecasted Increases in Thermoelectric Capacity



Ref. Draft DOE/NETL White Paper, "Estimating Freshwater Needs to Meet 2025 Electricity Generating Capacity Forecasts," April 2004.

Water-Related Impacts on Power Plant Siting and Operation in the News

- **Drought Settles In, Lake Shrinks and West's Worries Grow**

– *New York Times*, May 2004

- **Utility Faces Opposition to New Pueblo, Colorado, Coal-Fired Plant**

– *The Pueblo Chieftain*, April 2004

- **Western Power Plants Come Under Scrutiny as Demand and Drought Besiege Supplies**

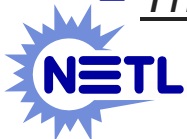
– *Land Letter*, March 2004

- **California Water Officials Delay Power Plant Hearing Due to New EPA Rules**

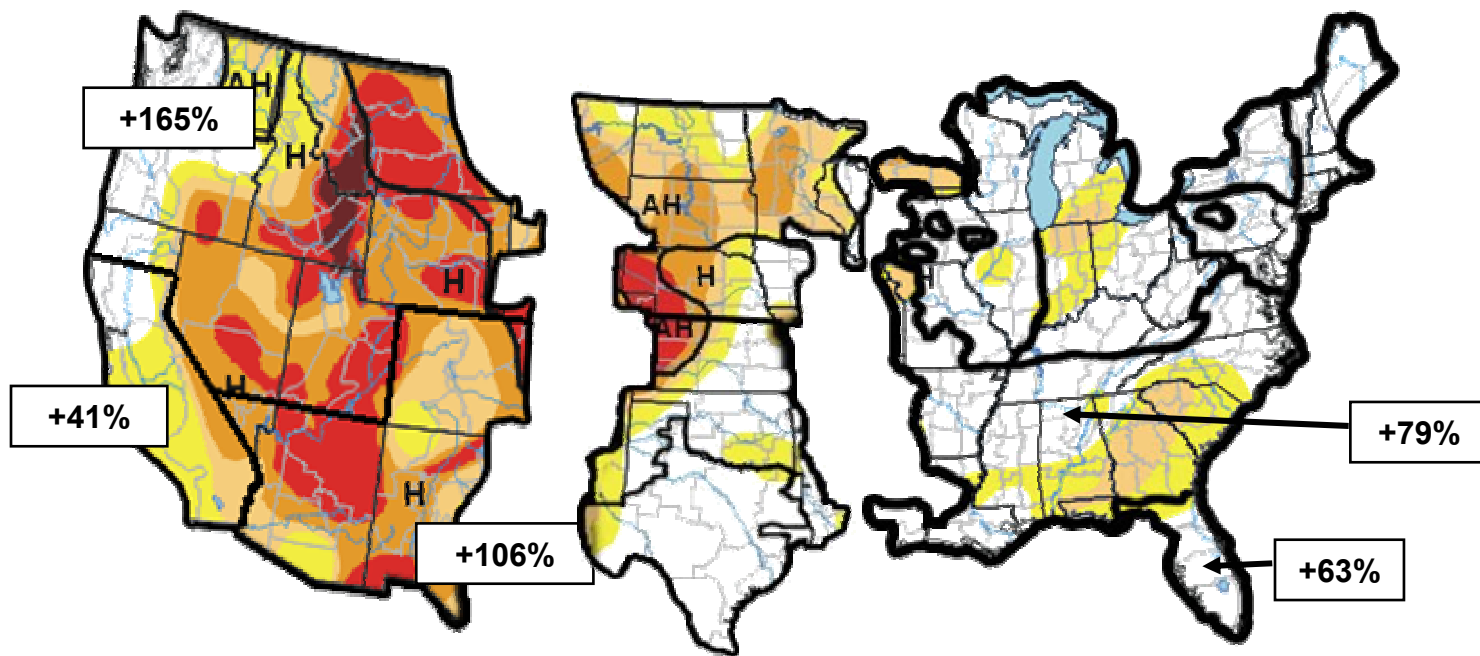
– *The Tribune*, February 2004

- **Water, Taxes Could Be Barrier to Expanding Local Power Plant**

– *The Pueblo Chieftain*, November 2003



Drought Conditions Compared to 2025 Projected Regional Thermoelectric Generation Capacity Increases



Intensity:

- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

Drought impact Types:

- Delineates dominant impacts
- A = Agricultural (crops, pastures, grasslands)
- H = Hydrological (water)
- (No type = Both impacts)

Regional thermoelectric generation capacity by North American Electric Reliability Council Region

Sources: USDA and EIA



Water Quality Related Issues

- **§316(a) and (b) – cooling water discharge and intake regulations**
- **Air-water interface**
 - Hg deposition
- **TMDLs/discharge permits**
 - Hg, Se, As, nitrates in ash ponds
- **Abandoned mine drainage**



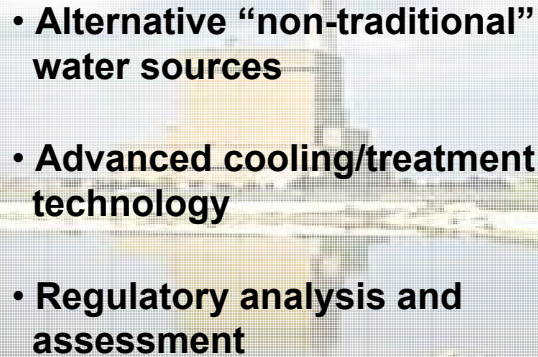
Key Takeaways

- **Water is critical to thermoelectric generation**
- **DOE/NETL analysis projects that on a national basis freshwater withdrawals for new fossil-based generating capacity may either increase slightly or decrease through 2025**
- **However, water is also a regional issue:**
 - Population growth and concomitant increases in electricity demand will occur in regions that are water challenged
 - Demand for water for power will increasingly compete with other sectors such as agriculture, domestic, and in-stream use
- **Environmental considerations such as §316(b) will impact permitting and operation of existing and new coal plants**



DOE/NETL Water-Energy R&D Activities

Power Generation

- 
- Alternative “non-traditional” water sources
 - Advanced cooling/treatment technology
 - Regulatory analysis and assessment

Watershed Science & Technology

- Remote sensing
- AMD treatment and remediation
- TMDL trading
- Water quality sampling and analysis

Carbon Sequestration

- Terrestrial sequestration/eco-assets
- Geological sequestration

Water Supply & Demand Issues

Oil & Gas Exploration

- Water management technology
- Coal bed methane and produced water
- Regulatory analysis and assessment



Current DOE/NETL Water R&D Activities

- Non-traditional process and cooling water
- Innovative water recovery and cooling technology
- Advanced cooling water intake technology
- Advanced pollutant measurement and treatment technology



Water Management Research Objectives¹.

- Reduce withdrawal of fresh surface and/or ground water for thermoelectric power generation
- Minimize potential impacts of power plant operations (both air emissions and effluent discharges) on water quality

¹.DOE/CURC/EPRI “*Clean Coal Technology Roadmap,*” www.netl.doe.gov



Current DOE/NETL Power Plant-Water Projects

PROJECT TITLE	RESEARCH ORGANIZATION
Strategies for Cooling Electric Generating Facilities Utilizing Mine Water: Technical and Economic Feasibility	WV Water Research Institute
Use of Produced Water in Re-circulated Cooling Systems at Power Generation Facilities	EPRI
Water Extraction from Coal-Fired Power Plant Flue Gas	UNDEERC
Environmentally-Safe Control of Zebra Mussel Fouling	NY State Education Department
Fate of As, Se, and Hg in a Passive Integrated System for Treatment of Fossil Plant Waste Water	TVA & EPRI
Use of Coal Drying to Reduce Water Consumed in Pulverized Coal Power Plants	Lehigh University
Demonstrating a Market-Based Approach to the Reclamation of Mined Lands in West Virginia	EPRI
A Novel Concept for Reducing Water Usage and Increasing Efficiency in Power Generation	University of Pittsburgh
An Innovative Freshwater Production Process for Fossil Fired Power Plants Using Energy Stored in Main Condenser Cooling Water	University of Florida
Lignite Fuel Enhancement	Great River Energy

Ref. "Innovative Approaches and Technologies for Improved Power Plant Water Management," www.netl.doe.gov/publications/factsheets/program/Prog055.pdf



Use of Produced Water in Recirculated Cooling Systems



San Juan Generating Station

- EPRI and Public Service of New Mexico investigating ways to reduce freshwater withdrawals
- Evaluate use of oil/gas produced water as cooling water for PNM's San Juan Generating Station
- Reduce withdrawals from San Juan River by as much as 17%
- Part of ZeroNet initiative to reduce overall freshwater use in New Mexico



Strategies for Cooling Electric Generating Facilities Utilizing Mine Water

- West Virginia University Water Research Institute
- Evaluate use of mine water as a source of cooling water
- Investigate feasibility of using underground mines as a heat sink for cooling



Discharge from underground coal mine

Limerick Nuclear Power Plant to Use Coal Mine Water for Cooling

- Exelon Corp.'s Limerick nuclear power plant to reduce water withdrawal from Delaware River
- Plant will use water from Schuylkill County, PA coalmine during 4-5 month trial run in summer 2003
- Wadesville Mine Pool is an active mine ~78 miles from Limerick
- Mine will provide 14.5 million gallons/day to plant



Limerick Nuclear Power Plant

Source: Philadelphia Inquirer, July 8, 2003 and personal communication with Exelon Corp.

Power Plants in Anthracite Region Using Mine Pool Water

Company Name	Plant Location	Generating Capacity (MW)	Cooling Water Source
Gilberton Power Co.	Frackville, PA	80	Unnamed mine pool
Northeastern Power Co.	McAdoo, PA	50	Siverbrook Mine
Panther Creek Generating Station	Nesquehoning, PA	83	Lausanne Mine
Schuylkill Energy Resources	Shenandoah, PA	80	Maple Hill Mine
WPS – Westwood Generation	Tremont, PA	31	Lyken Mine
Wheelabrator Frackville Energy Co.	Frackville, PA	42	Morea Mine

Source: DOE/NETL Report, “ Use of Mine Pool Water for Power Plant Cooling,” August 2003





Pacific Northwest National Laboratory



An 11 national laboratory effort to address a broader set of energy-water science & technology needs

THE ENERGY ~ WATER NEXUS

a strategy for energy and water security



Summary

- **Water availability and quality, future regulations, and issues of public perception related to freshwater resources will challenge power plant design and operation**
- **DOE/NETL will continue to partner with industry, academia, and other key stakeholders to carry out research directed at freshwater management**
- **This program will help to maintain coal's strategic role in providing U.S. with secure, reliable, affordable, and environmentally sound energy while protecting our vital freshwater resources**





**“Whiskey is for drinking;
water is for fighting.”**

– Mark Twain

www.netl.doe.gov/coalpower/environment

