

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

8th Electric Utilities Environmental Conference

*Tucson, AZ
January 24-26, 2005*



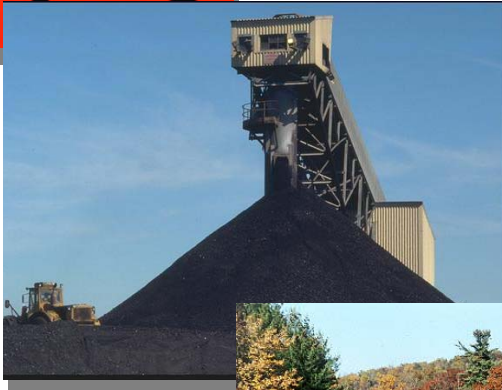
Jeff Hoffmann, Tom Feeley and Barbara Carney
US Department of Energy/National Energy Technology Laboratory



Three Things Power Plants Require



1) Access to transmission lines

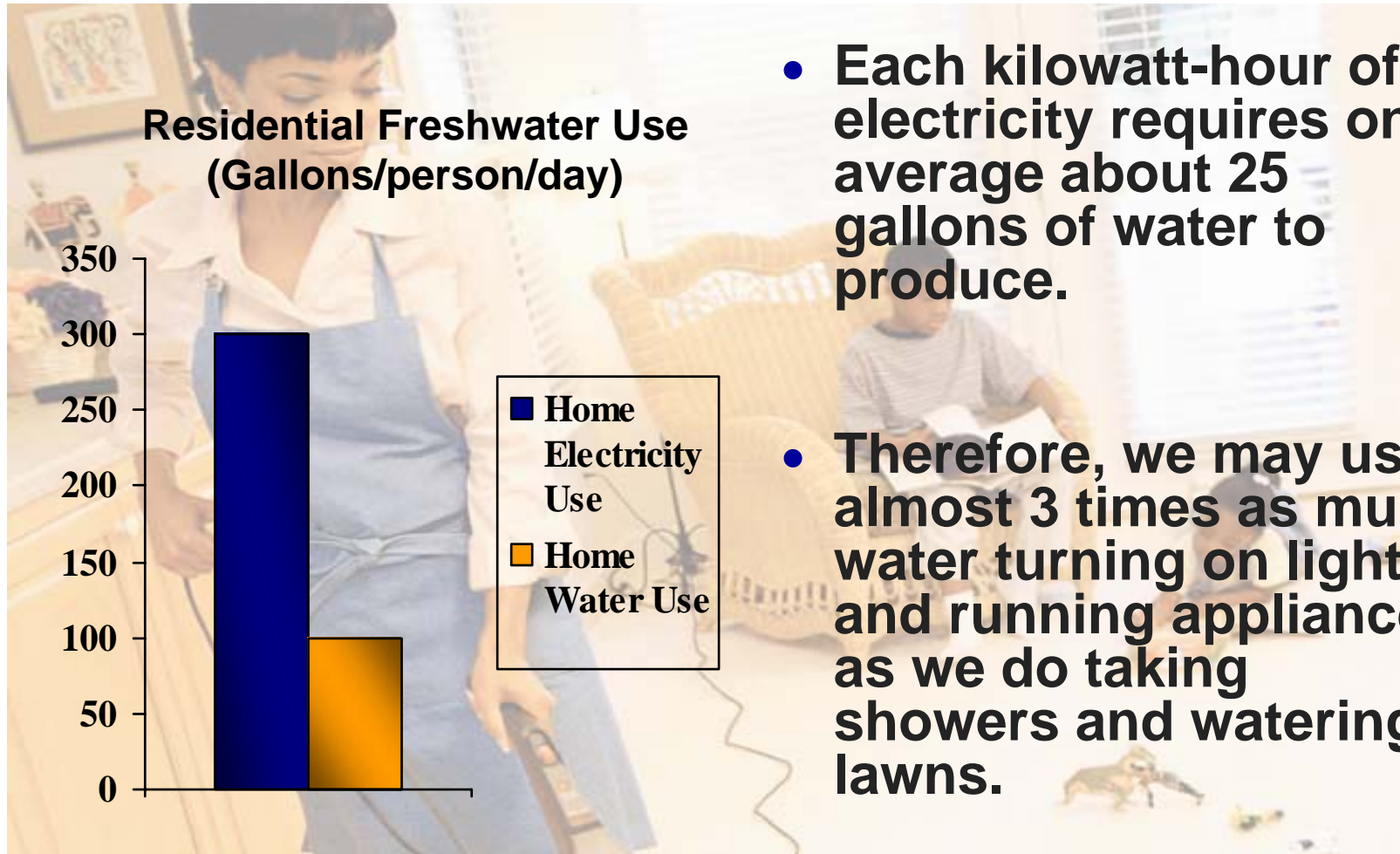


2) Available fuel, e.g., coal or natural gas



3) Water

Water and Electricity Are Inextricably Linked



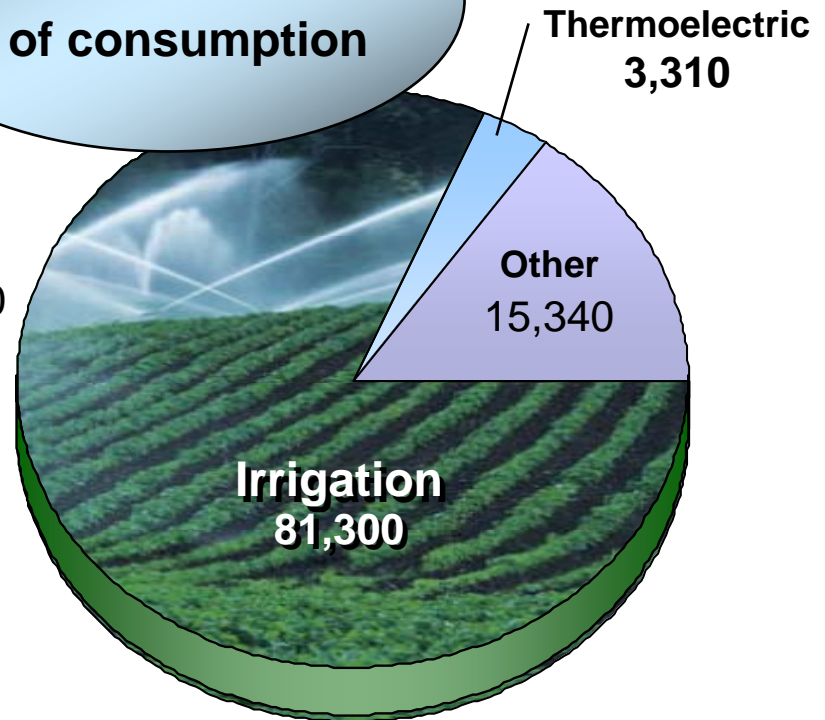
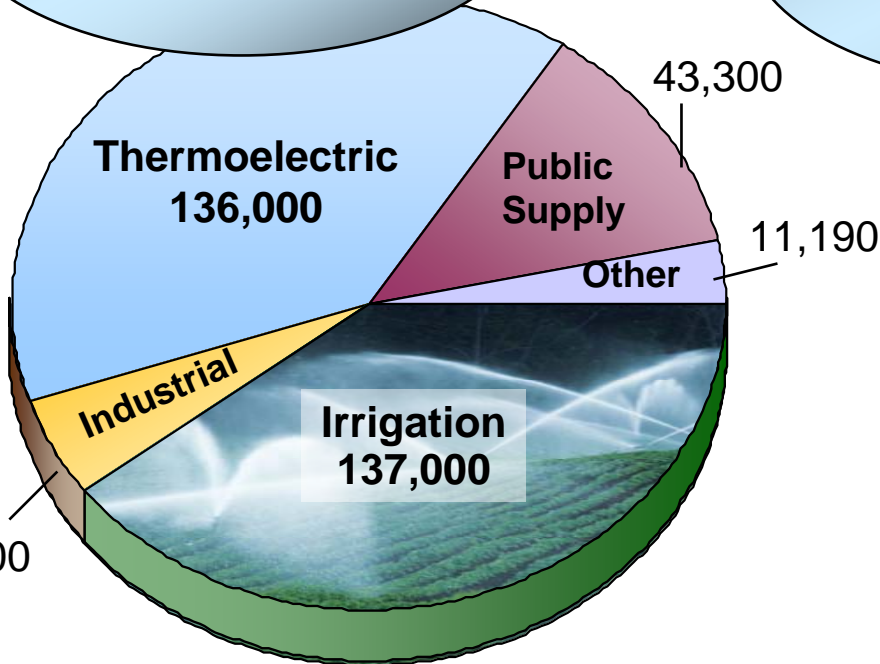
- Each kilowatt-hour of electricity requires on average about 25 gallons of water to produce.
- Therefore, we may use almost 3 times as much water turning on lights and running appliances as we do taking showers and watering lawns.

Freshwater Withdrawals and Consumption

Mgal / Day

Thermoelectric
accounts for
~ 39% of withdrawals

Thermoelectric
accounts for
~3% of consumption



Withdrawal

Consumption



Ref.: "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-Related Impacts on Power Plant Siting and Operation in the News

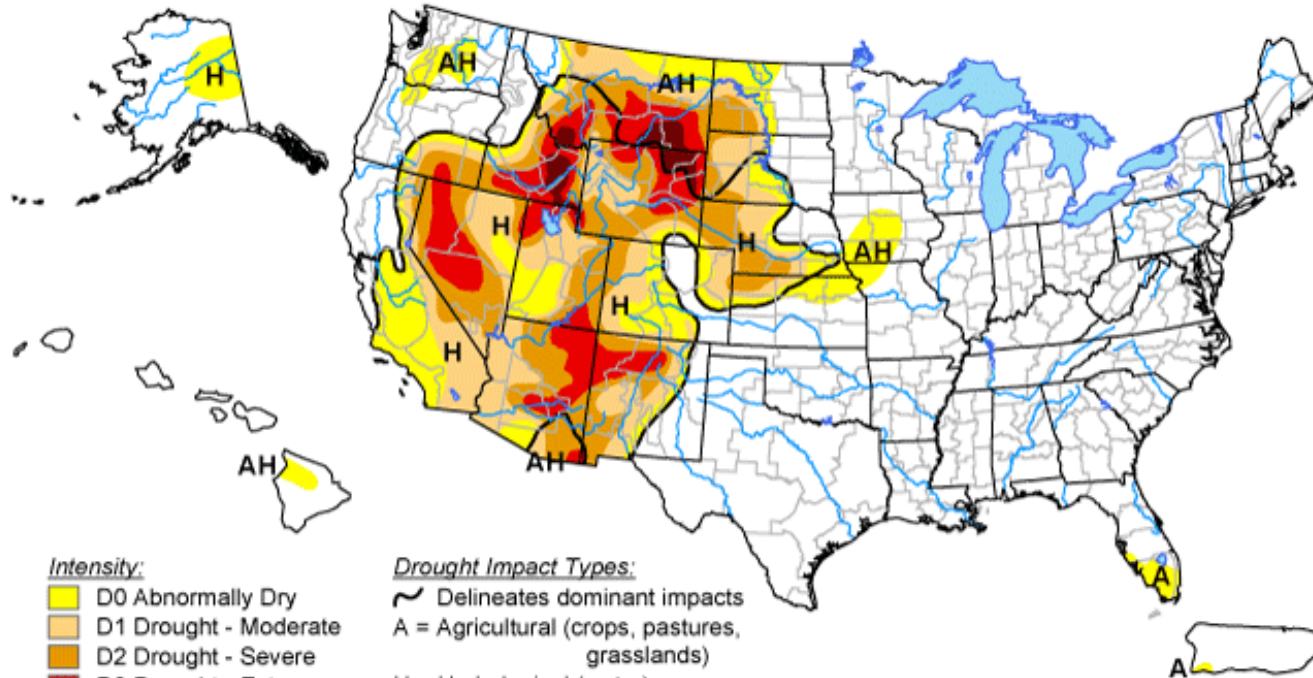
- **Lack of Water May Shut Down Power Plant on Arizona- Nevada**
 - *U.S. Water News Online*, November 2004
- **Drought Settles In, Lake Shrinks and West's Worries Grow**
 - *New York Times*, May 2004
- **Utility Faces Opposition to New Pueblo, Colorado, Coal-Fired Plant**
 - *The Pueblo Chieftain*, 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



Regional Drought Conditions Exacerbate Situation

U.S. Drought Monitor

December 21, 2004
Valid 7 a.m. EST



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)

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.



Released Thursday, December 23, 2004

Author: David Miskus, JAWF/CPC/NOAA

<http://drought.unl.edu/dm>

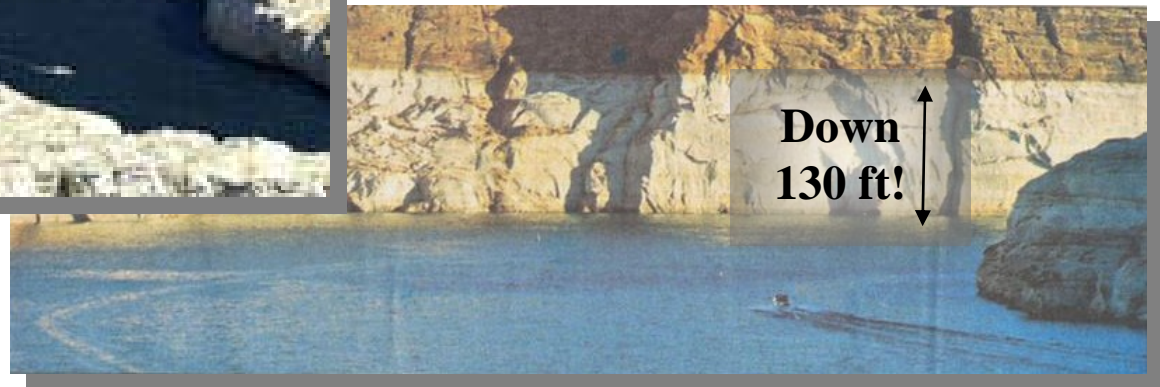


Western Drought Continuing



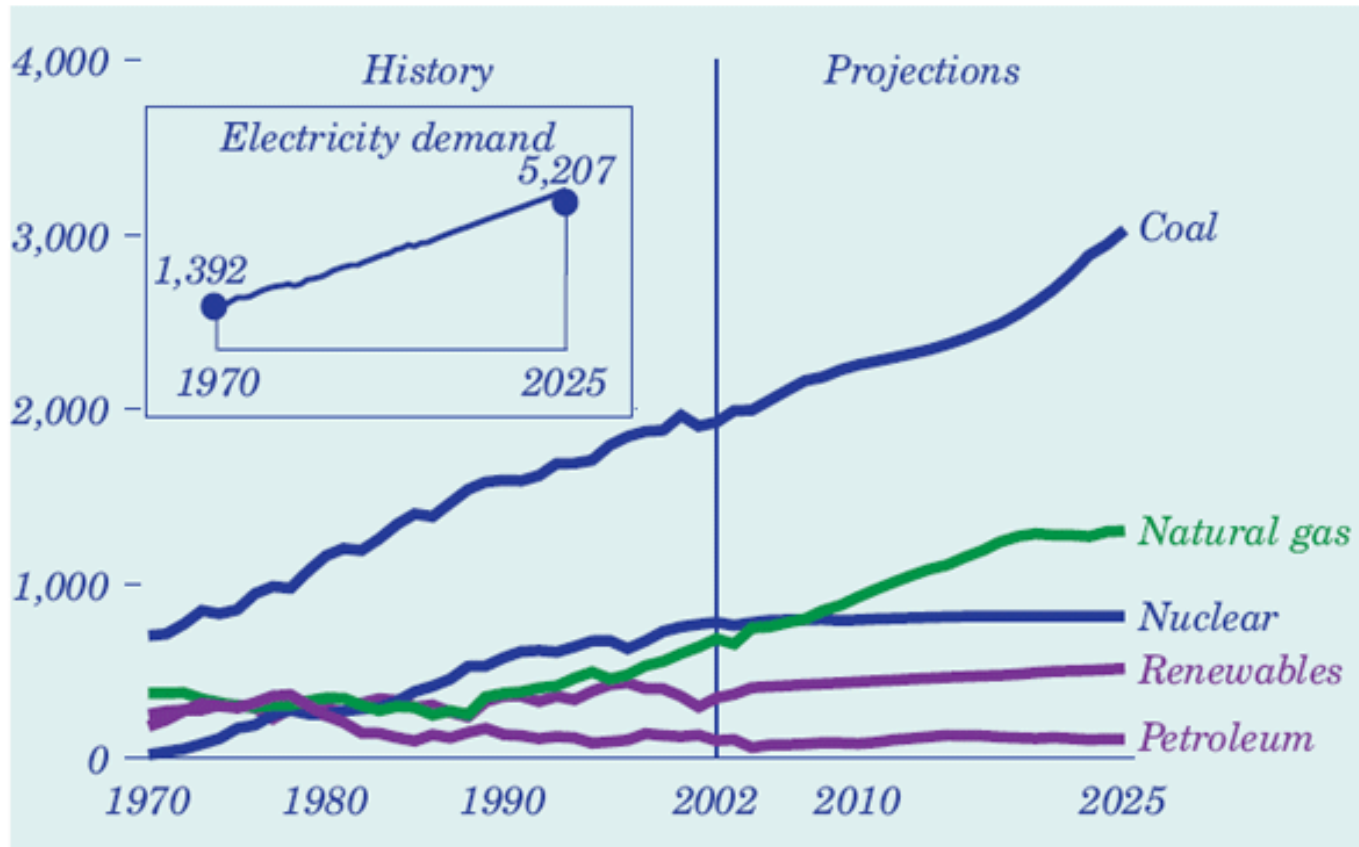
Lake Powell

- 5 years of drought
- Less than 1/2 full



Thermoelectric Generation is Increasing

Figure 4. Electricity generation by fuel, 1970-2025 (billion kilowatthours)



Source: Energy Information Agency, AEO 2004



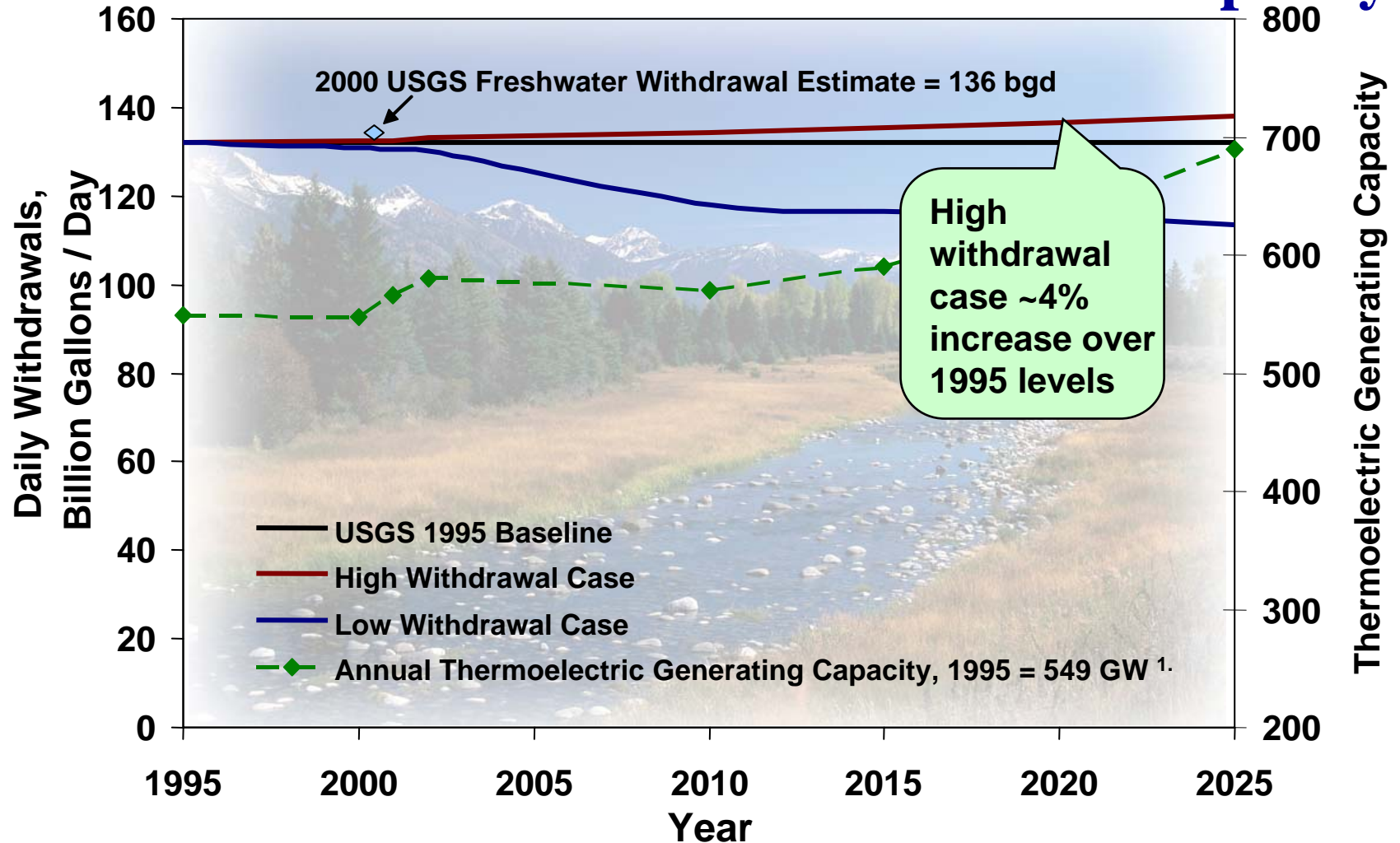
Estimating Power Sector Freshwater Needs



- **Conducted analysis to estimate amount of freshwater needed to meet AEO2004 projected increase in thermoelectric generating capacity**

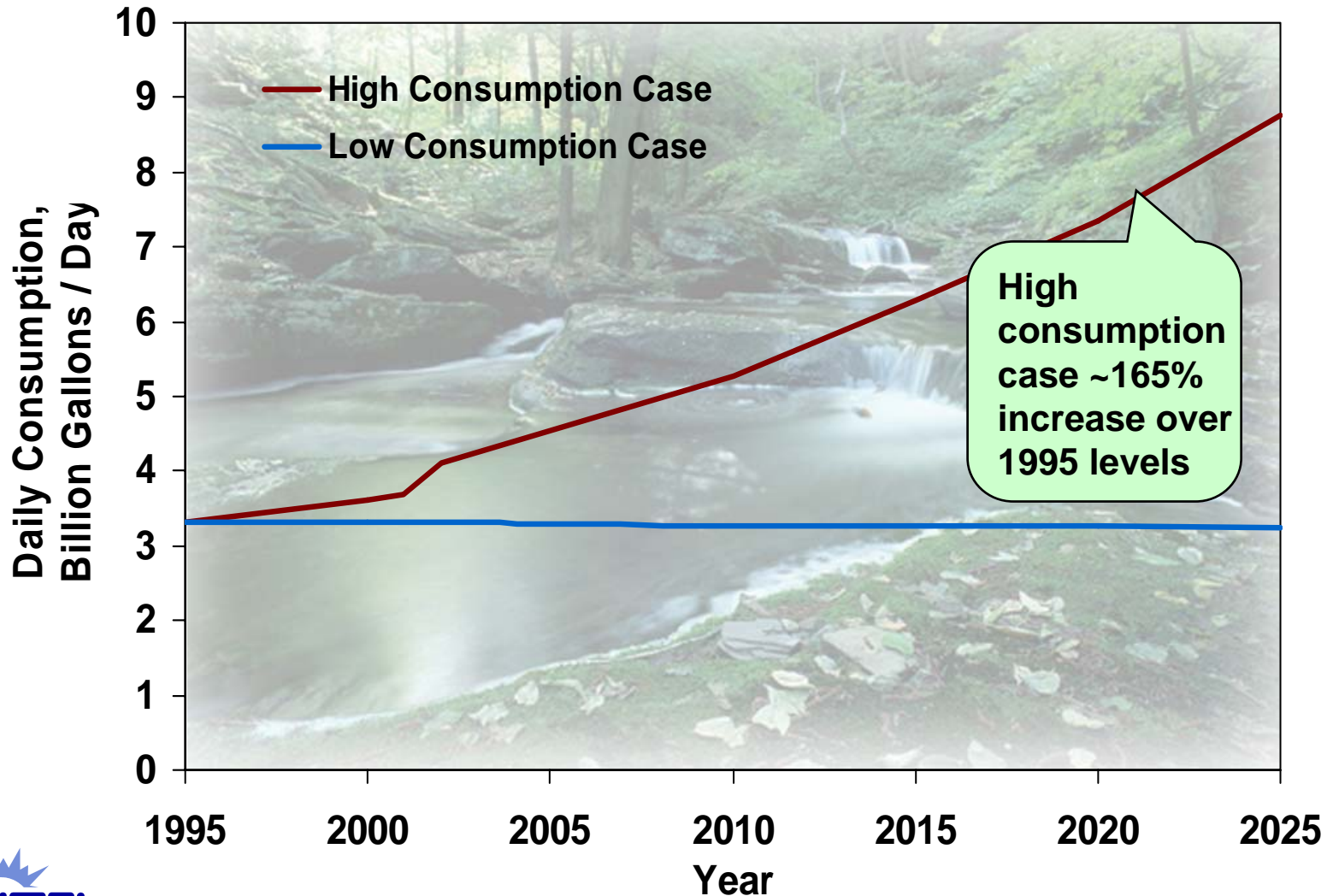
Estimating Freshwater Needs to Meet 2025 Electricity Generating Capacity Forecasts,
DOE/NETL, June 2004

Daily Freshwater Withdrawals Needed to Meet Forecasted Increases in Thermoelectric Capacity



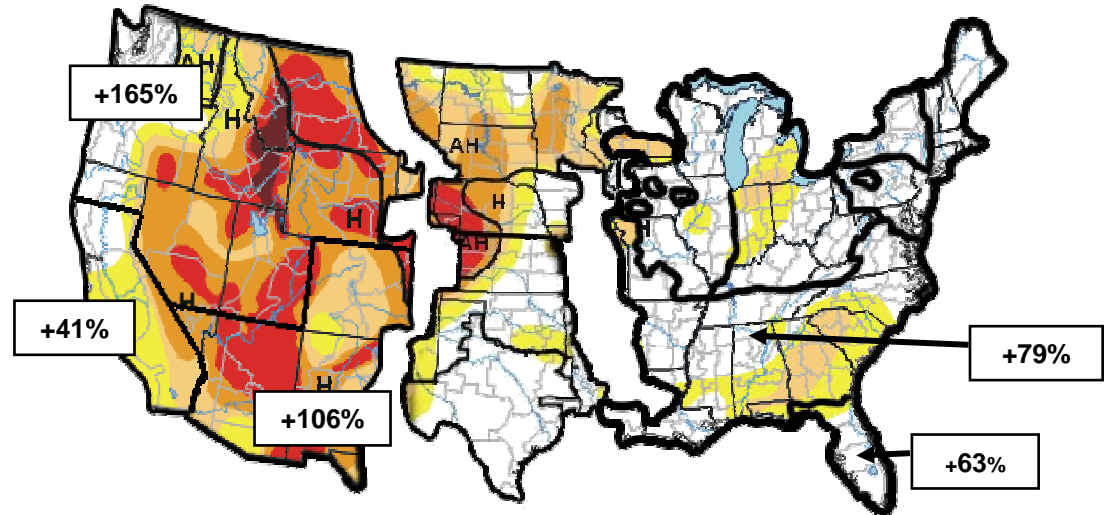
Ref. DOE/NETL, "Estimating Freshwater Needs to Meet 2025 Electricity Generating Capacity Forecasts," June 2004.

Daily Freshwater Consumption Needed to Meet Forecasted Increases in Thermoelectric Capacity



Future Analysis

- Projected regional increases in thermoelectric capacity of 41-165% in western U.S, 63-79% in southeast U.S., by 2025
- Western and southeast U.S. already facing water availability issues
- Largest increase in population also projected in these areas



EIA projected regional thermoelectric generation growth by North American Electric Reliability Council Region

- Potential for conflict in several western cities as power generators compete with other water users

NETL kicked off a regional freshwater needs assessment in October 2004

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**



NETL's Power Plant Water R&D Program 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

¹DOE/CURC/EPRI "Clean Coal Technology Roadmap," www.netl.doe.gov



DOE/NETL Water R&D Activities

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



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

Pennsylvania Already Using Coal Mine Water for Cooling

- Exelon Corp.'s Limerick nuclear power plant reduced water withdrawal from Delaware River using water from Schuylkill County, PA coalmine during 4-5 month trial run in summer 2003
- A number of other small generators in the anthracite region of Pennsylvania are using mine water for cooling



Limerick Nuclear Power Plant

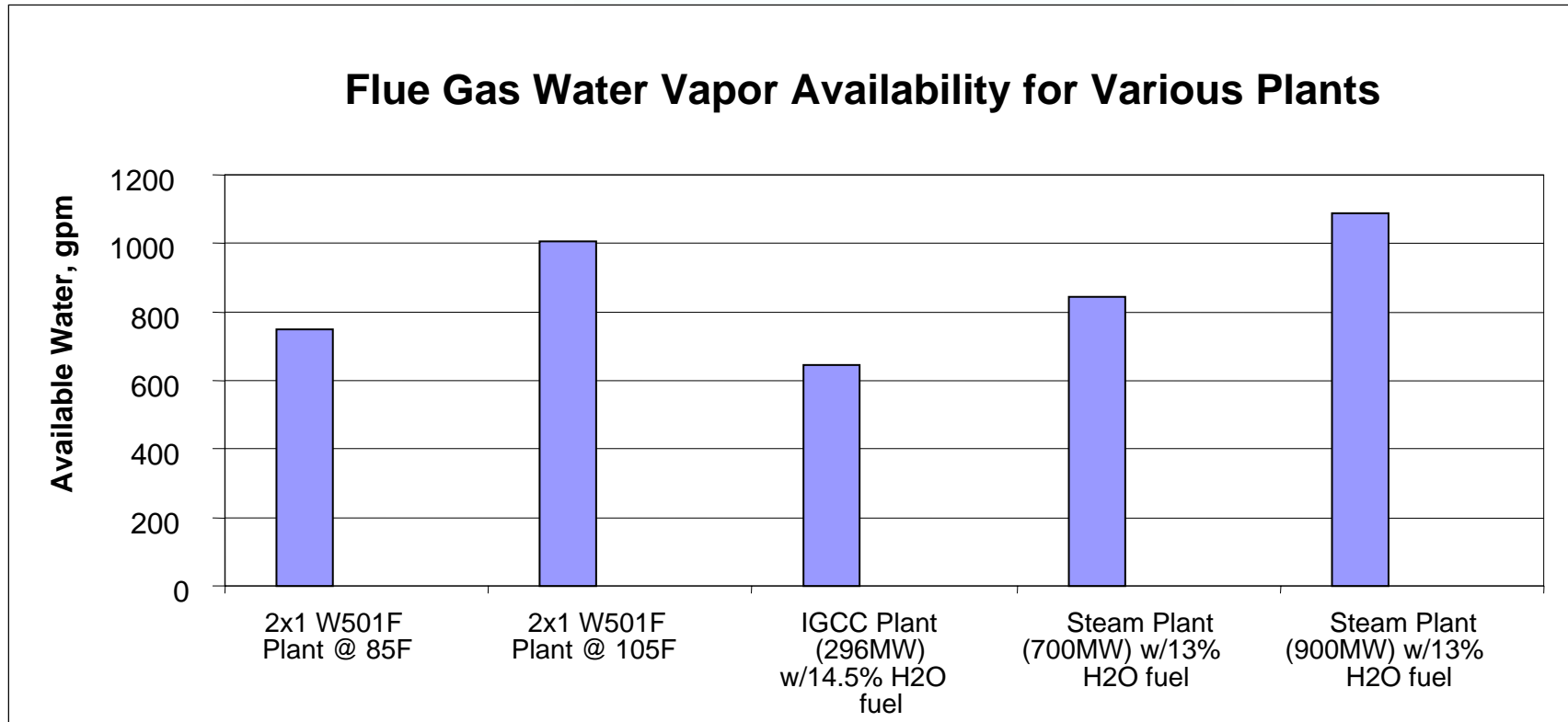
Company Name	Plant Location	Generating Capacity (MW)	Cooling Water Source
Gilberton Power Co.	Frackville, PA	80	Unnamed mine pool
Northeastern Power Co.	McAdoo, PA	50	Siverbrook Mine
Panther Creek Generating Station	Nesquehoning, PA	83	Lausanne Mine
Schuylkill Energy Resources	Shenandoah, PA	80	Maple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

Water Extraction from Coal-Fired Power Plant Flue Gas



- **Energy & Environmental Research Center and Siemens Westinghouse Power Corporation**
- **Develop and test a desiccant-based dehumidification process that removes water from exhaust gas of fossil fuel-fired power plants**

How Much Water is Available in Flue Gas?



- Could provide 10%-15% of makeup water in recirculating cooling system



Source: University of North Dakota Energy & Environmental Research Center

Use of Produced Water in Re-circulating Cooling Systems



San Juan Generating Station

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

Future Plans

- **Issue second power plant-water solicitation late FY05 (summer 2005) to expand NETL's water research program**
- **Continue to work with key stakeholders to implement broad energy-water RD&D program**





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

– Mark Twain

For more information please
visit our website at:

[*www.netl.doe.gov/coal/E&WR*](http://www.netl.doe.gov/coal/E&WR)

