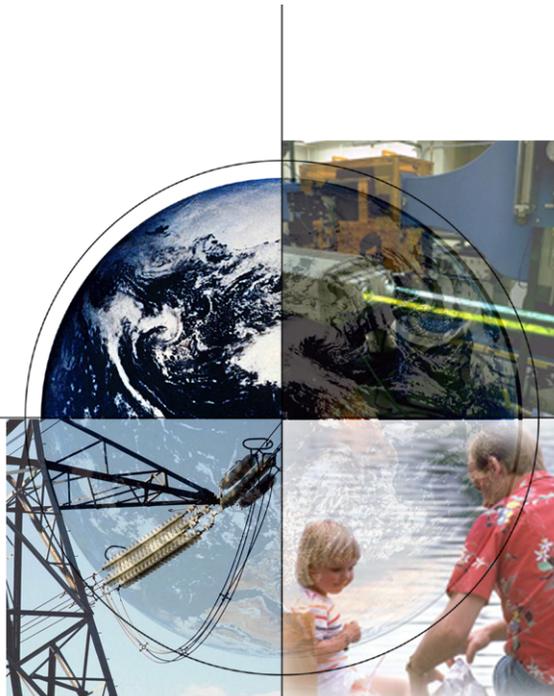


# Responding to Emerging Power Plant-Water Issues – DOE/NETL's R&D Program

## *3<sup>rd</sup> Annual West Virginia Water Conference Emerging Water Issues...Science and Solutions*

*Roanoke, WV  
October 28-29, 2004*

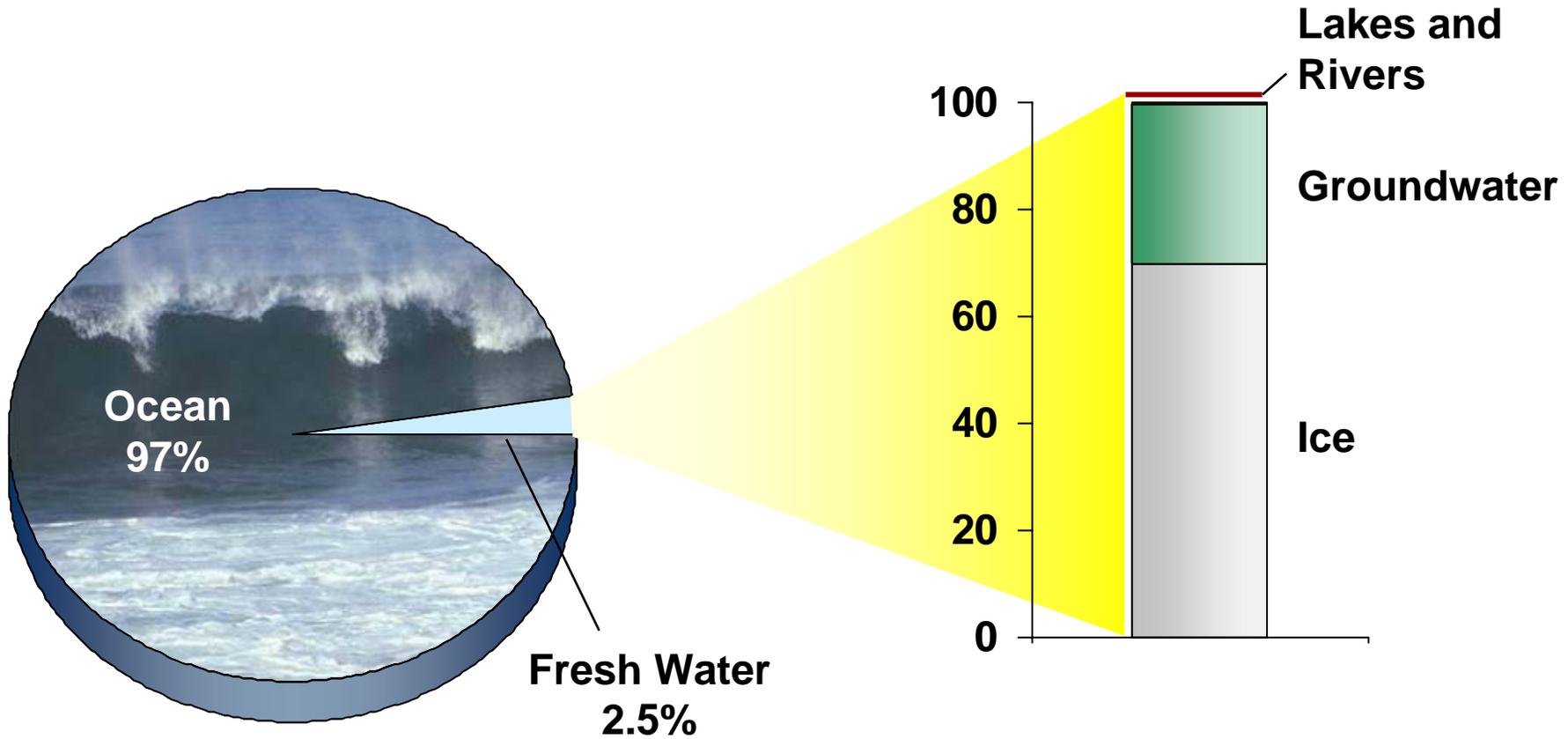


Thomas J. Feeley, III  
Technology Manager

National Energy Technology Laboratory



# Global Water Availability



# Three Things Power Plants Require



**1) Access to transmission lines**



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

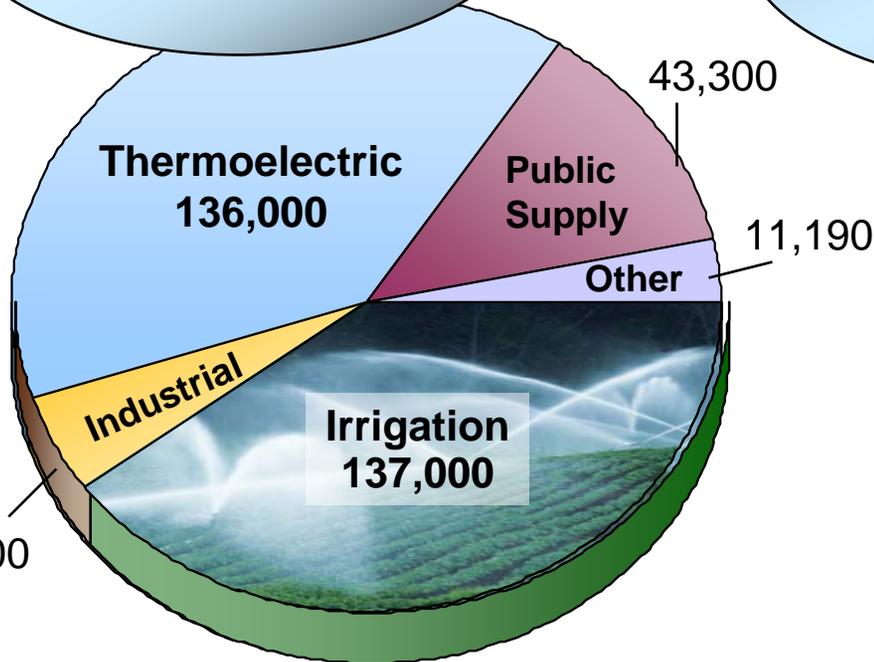


**3) Water**

# Freshwater Withdrawals and Consumption

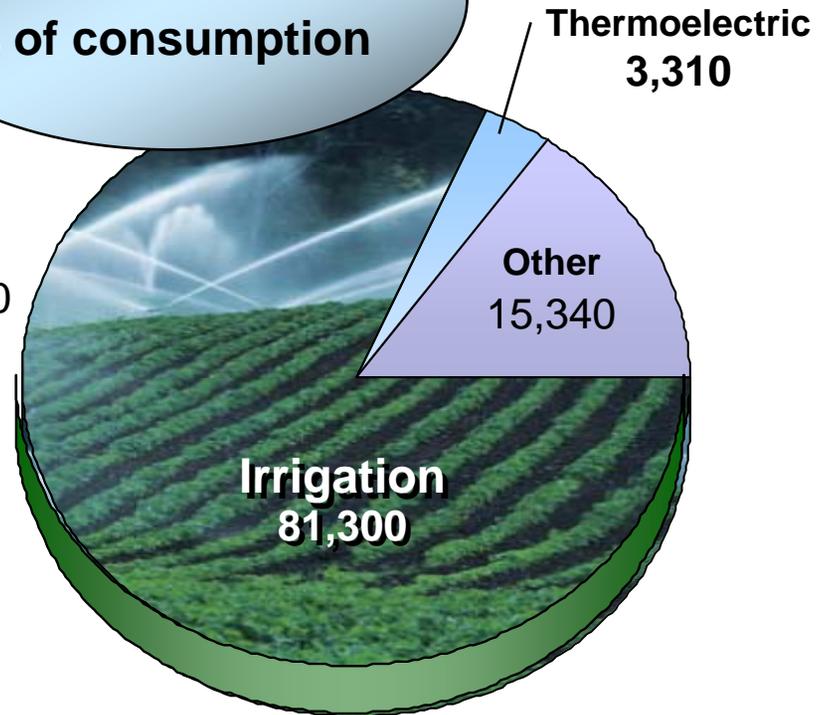
*Mgal / Day*

Thermoelectric  
accounts for  
~ 39% of withdrawals



**Withdrawal**

Thermoelectric  
accounts for  
~3% of consumption



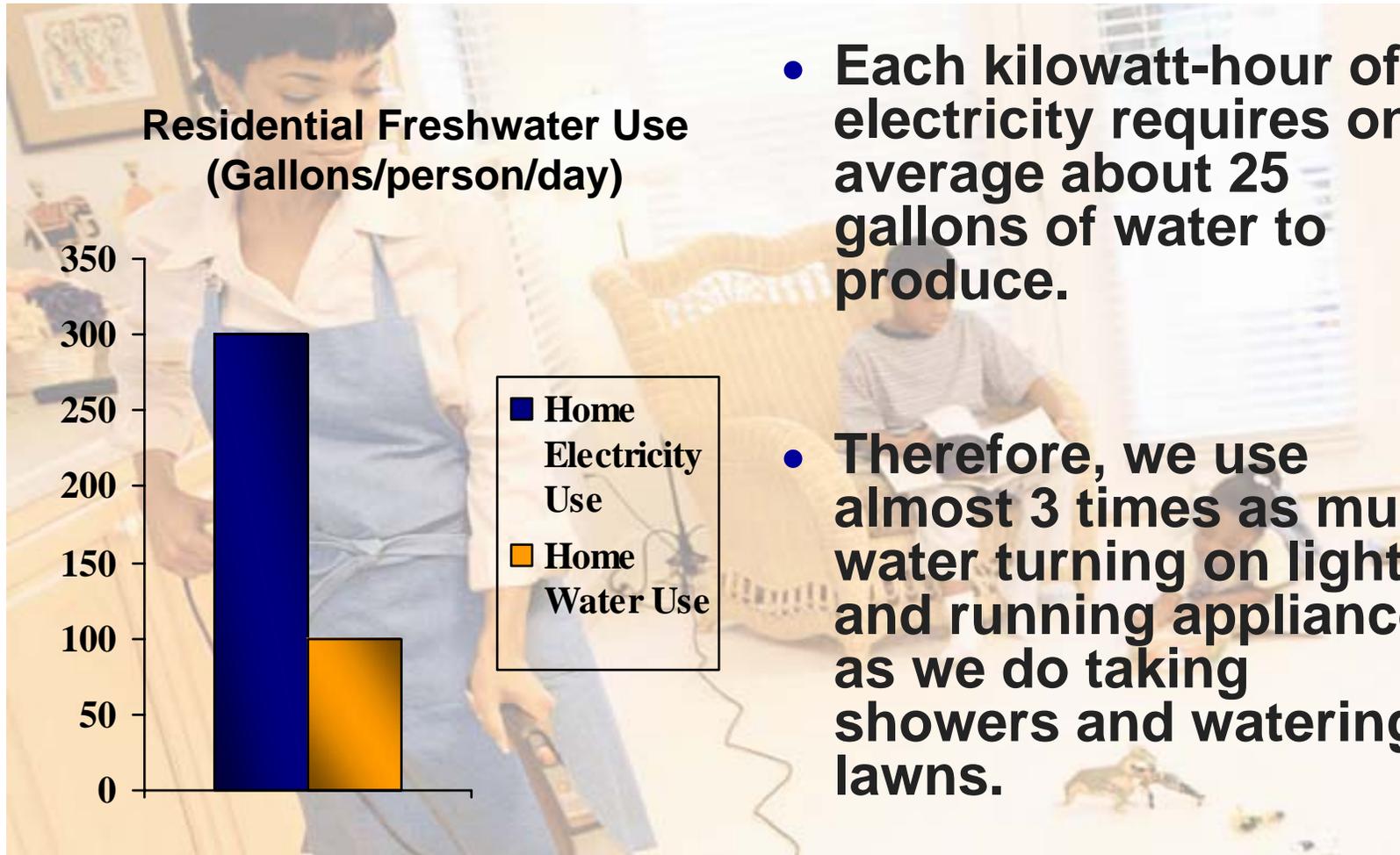
**Consumption**



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 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-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

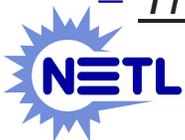
– Land Letter, March 2004

- 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



# Estimating Freshwater Needs to Meet 2025 Generating Capacity Forecasts

**NETL conducted an analysis in May 2004 to estimate the demand thermoelectric power plants will have on freshwater resources through 2025 using EIA's 2004 Annual Energy Outlook's reference case forecast for thermoelectric generating capacity.**



# Assumptions

- All new facilities will use closed loop recirculating systems (wet cooling tower)
- Cooling system water needs considered approximate and do not vary depending on geographic location or source water-body characteristics
- All retirements equipped with once-through cooling systems

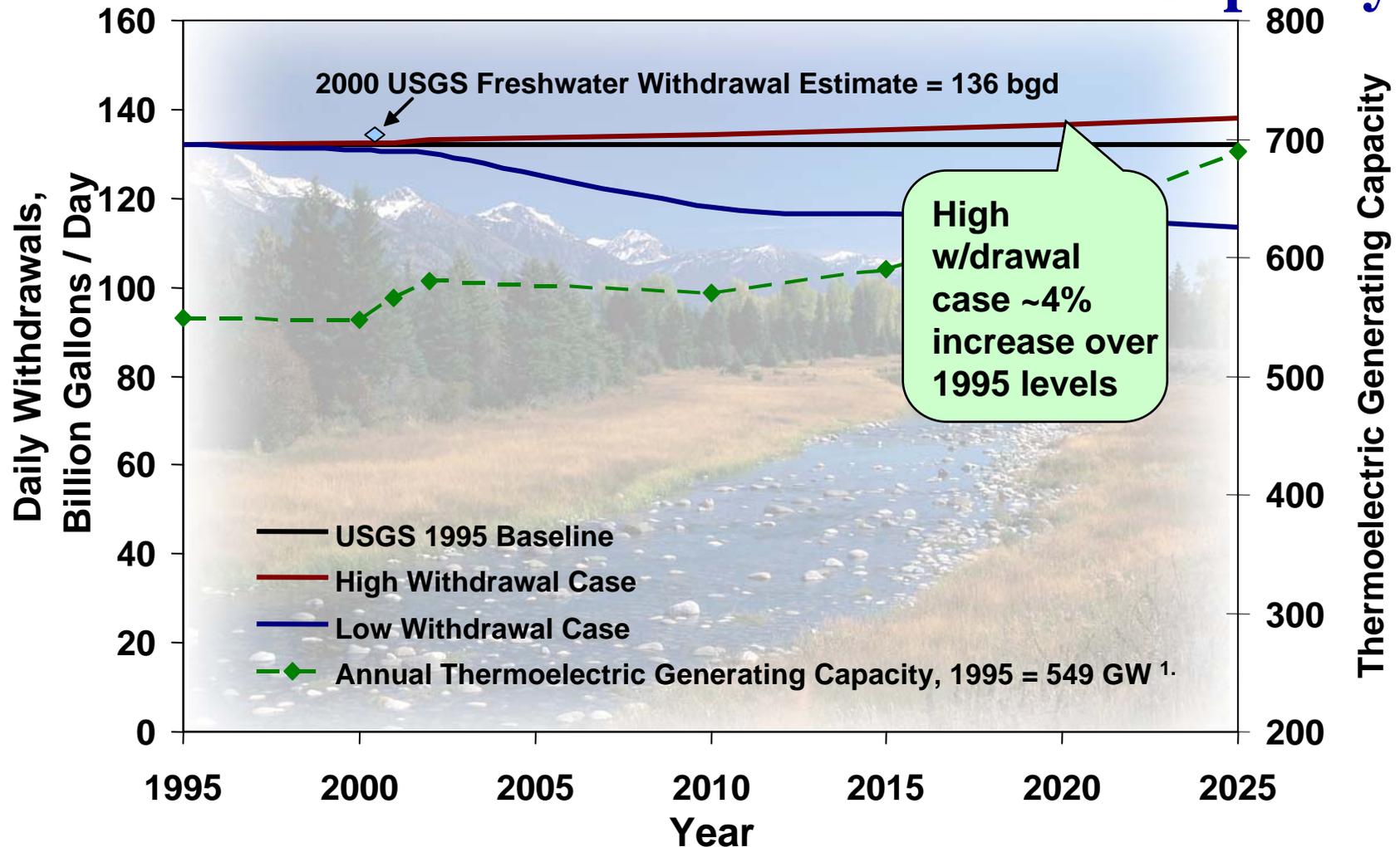


# Six Thermoelectric Capacity Addition/Retirement Scenarios Evaluated

<u>Case</u>	<u>Additions</u>	<u>Retirements</u>
1	Freshwater	Freshwater
2	70% Fresh/30% Saline	70% Fresh/30% Saline
3	Saline	Saline
4	Fresh	Saline
5	Saline	Fresh
6	Reduced by Repowering	None (Repowering)



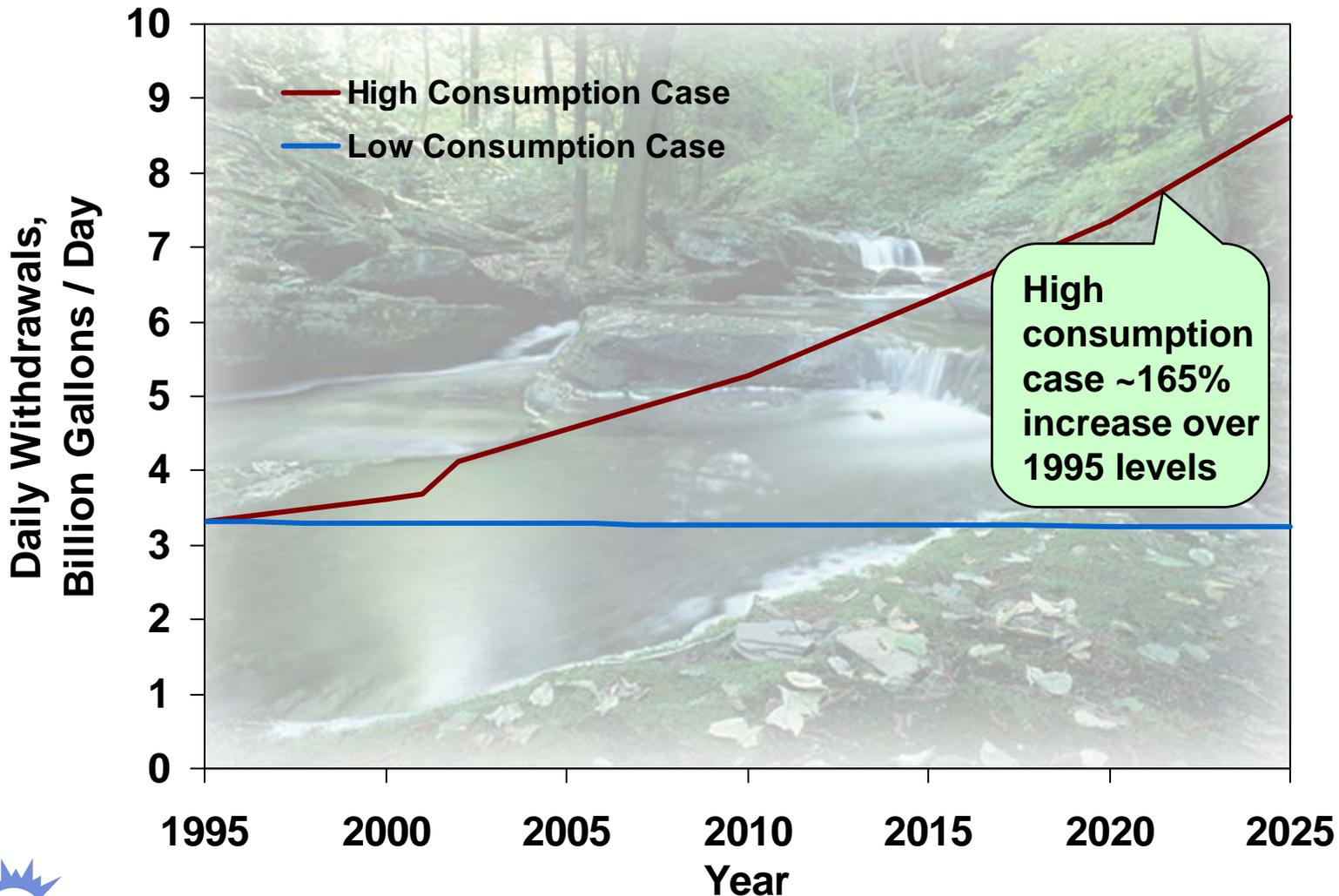
# Daily Freshwater Withdrawals Needed to Meet Forecasted Increases in Thermoelectric Capacity



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



# Projected Average Daily Water Consumption by Thermoelectric Power Generation

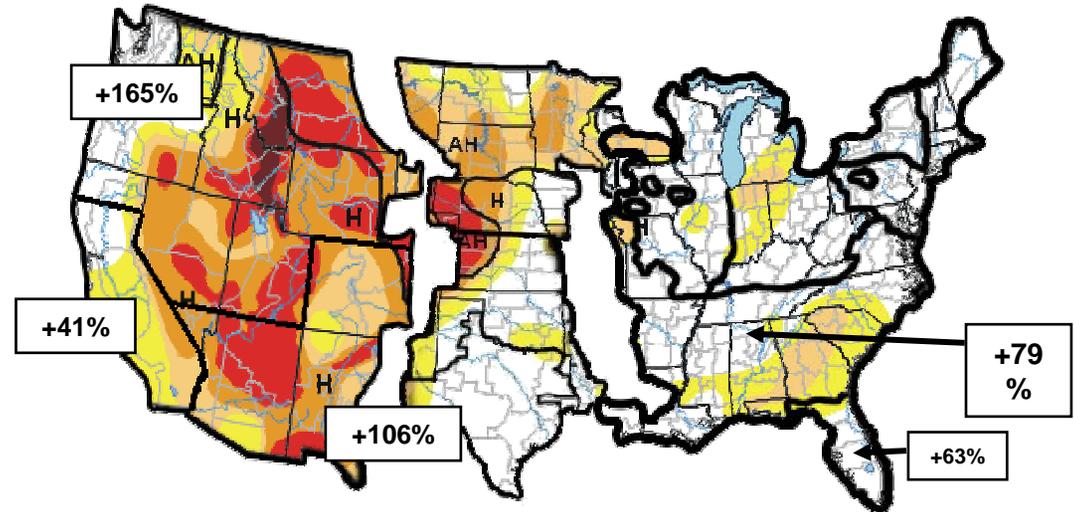


# Analysis Summary

- **Freshwater withdrawal in 2025 range from a 14% decrease to a 4% increase compared to 1995 levels**
- **Freshwater consumption in 2025 range from a 2% decrease to a 165% increase compared to 1995 levels**
- **Largest consumption, withdrawal increases were for case assuming all new plants use freshwater and all retired plants use saline (Case 4)**
- **Largest consumption, withdrawal decreases were for case assuming all new plants use saline and all retired plants use freshwater (Case 5)**
- **Thermoelectric power freshwater consumption, while increasing, still very small relative to other industries**

# 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***



# 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



# Water Management Research Objectives<sup>1</sup>.

- 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

<sup>1</sup>DOE/CURC/EPRI “*Clean Coal Technology Roadmap*,” [www.netl.doe.gov](http://www.netl.doe.gov)



# 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



# 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***

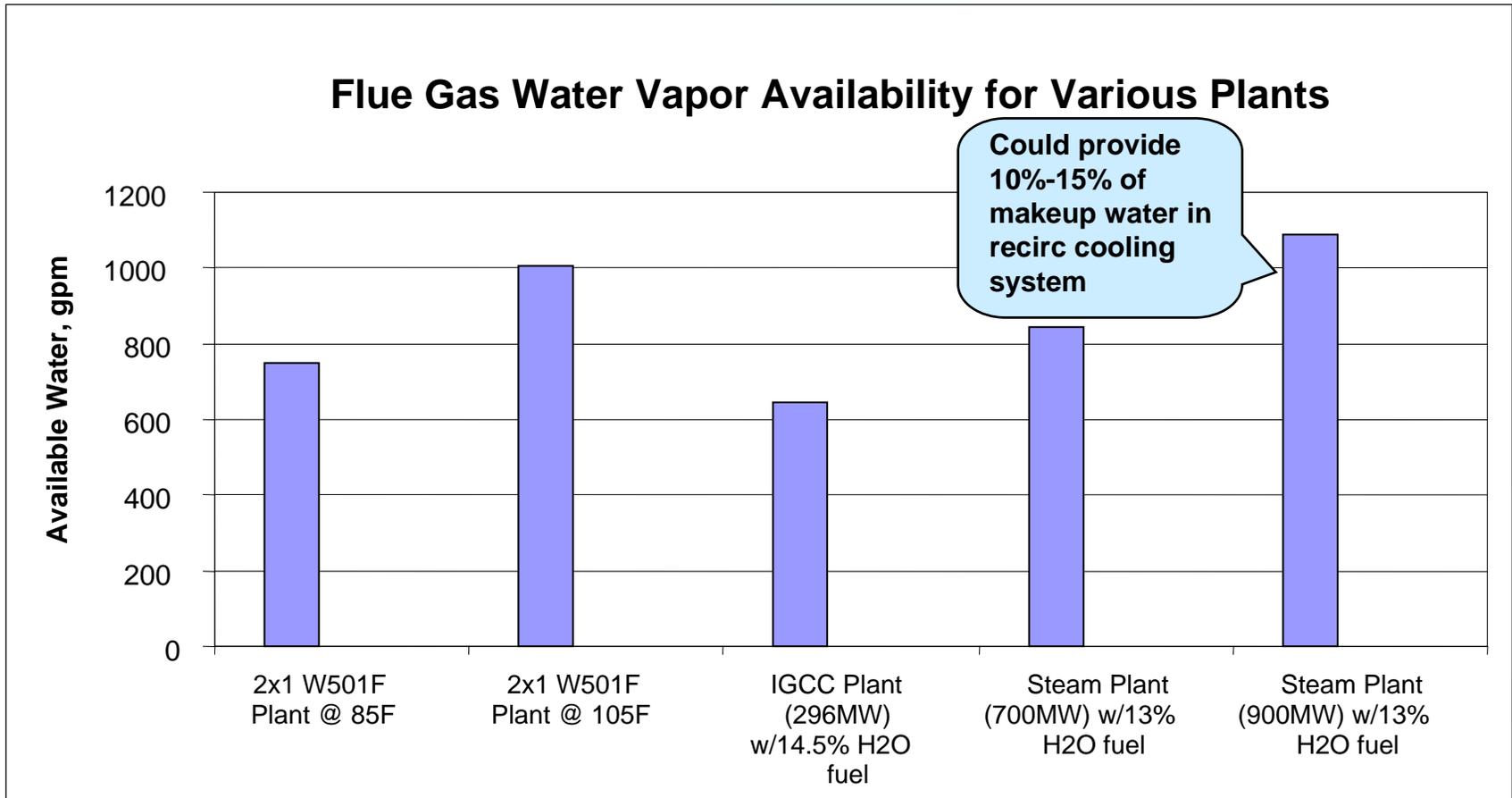
Company Name	Plant Location	Generating Capacity (MW)	Cooling Water Source
Gilberton Power Co.	Frackville, PA	80	Unnamed mine pool
Northeastern Power Co.	McAdoo, PA	50	Siverbrook Mine
Panther Creek Generating Station	Nesquehoning, PA	83	Lausanne Mine
Schuylkill Energy Resources	Shenandoah, PA	80	Maple 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?



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)

