River Network
Connecting People, Saving Rivers

Burning Our Rivers:
The Water Footprint of Electricity

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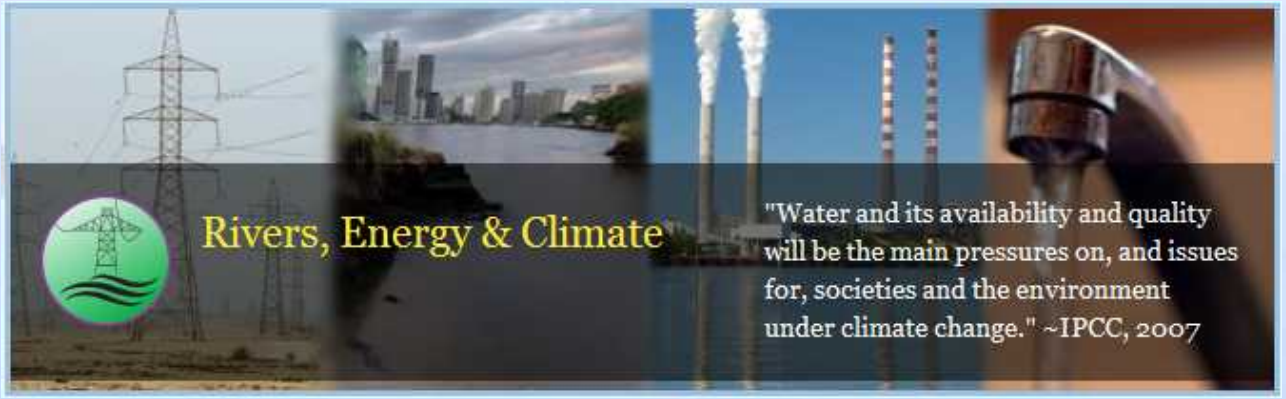
Outline

1. River Network's role and Burning Rivers report background
2. Report key findings
3. Recommendations and opportunities

River Network's Role

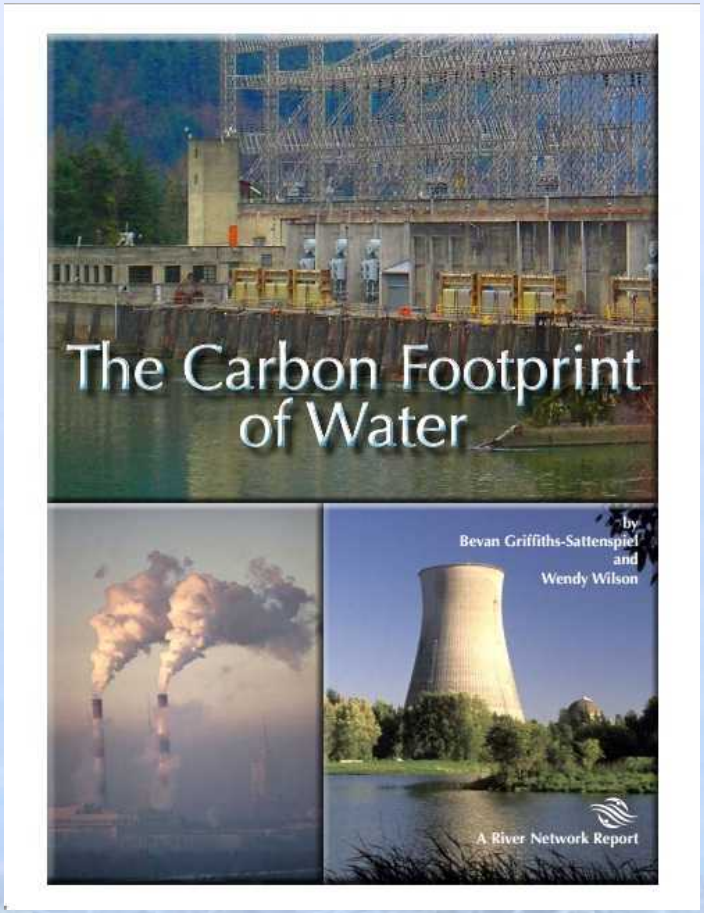
Through our Rivers, Energy & Climate Program we are helping local organizers address impacts of climate change and the water energy nexus…



- **Developing tools and resources to use on the ground**
- **Helping connect local leaders; sharing success stories**
- **Building capacity for nation-wide grassroots action**

Communicating The Water-Energy Nexus

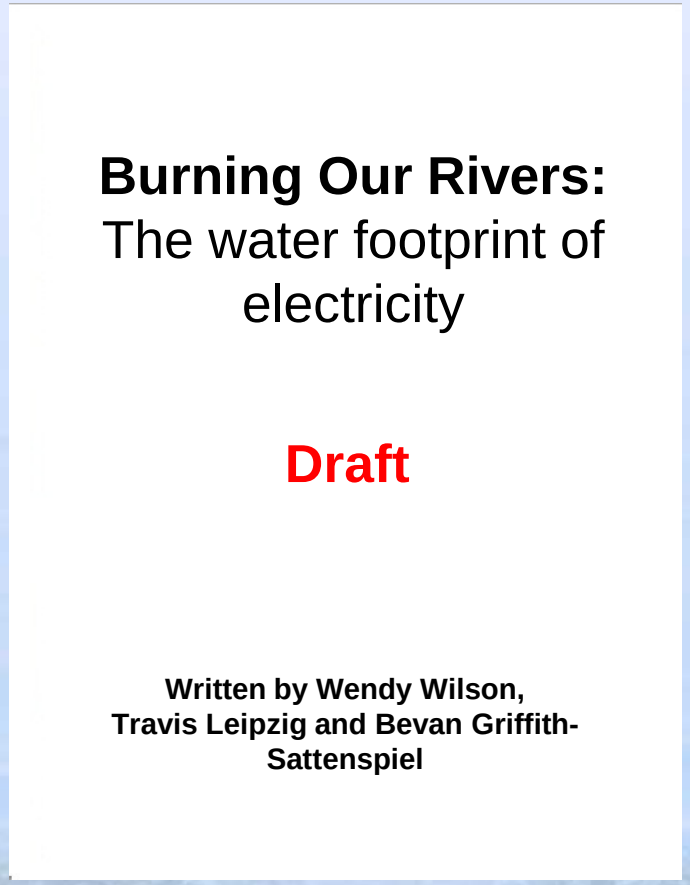
Energy for water



- U.S. annual total = 521 million megawatt hours per year
- 13% of total U.S. consumption of electricity
- More than entire energy-intensive pulp/paper and petroleum sectors *combined*
- Comparable to the combined electricity consumption of all the microwaves, color TV's, and computers found in our homes

Communicating The Water-Energy Nexus

Water for energy



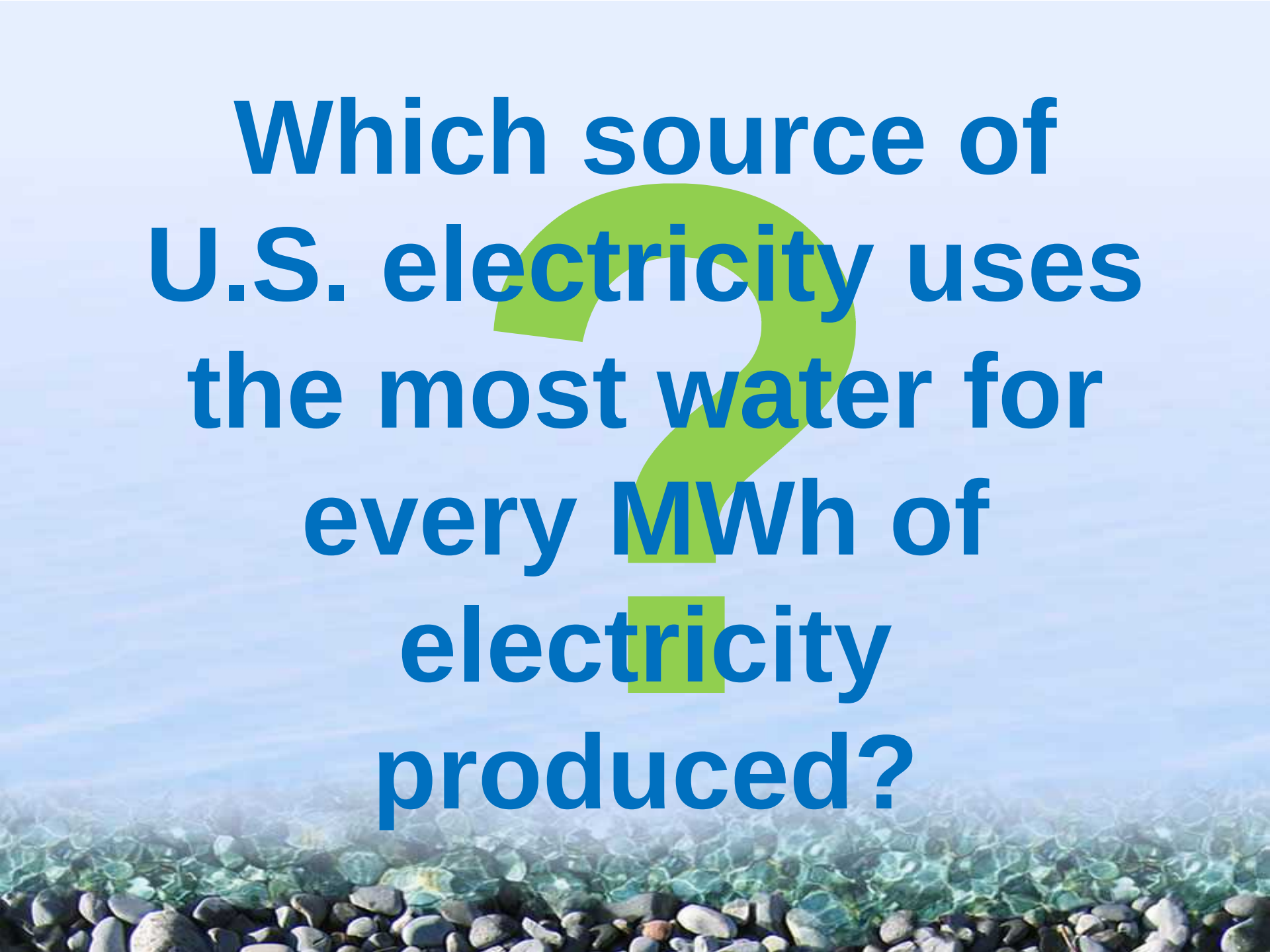
Energy-related Water Stress

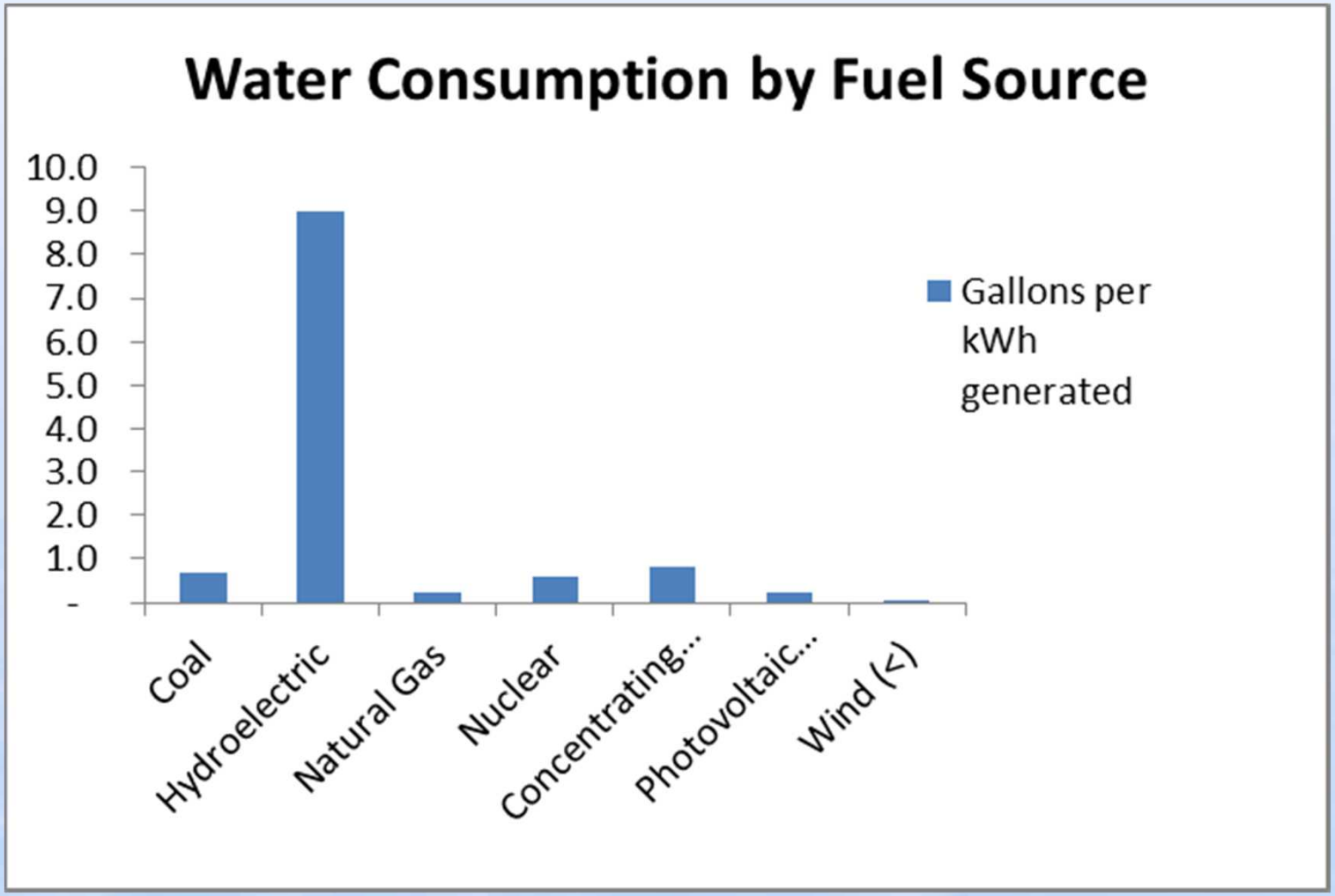
FIGURE 10. Where Power Plants Drive Water-Supply Stress

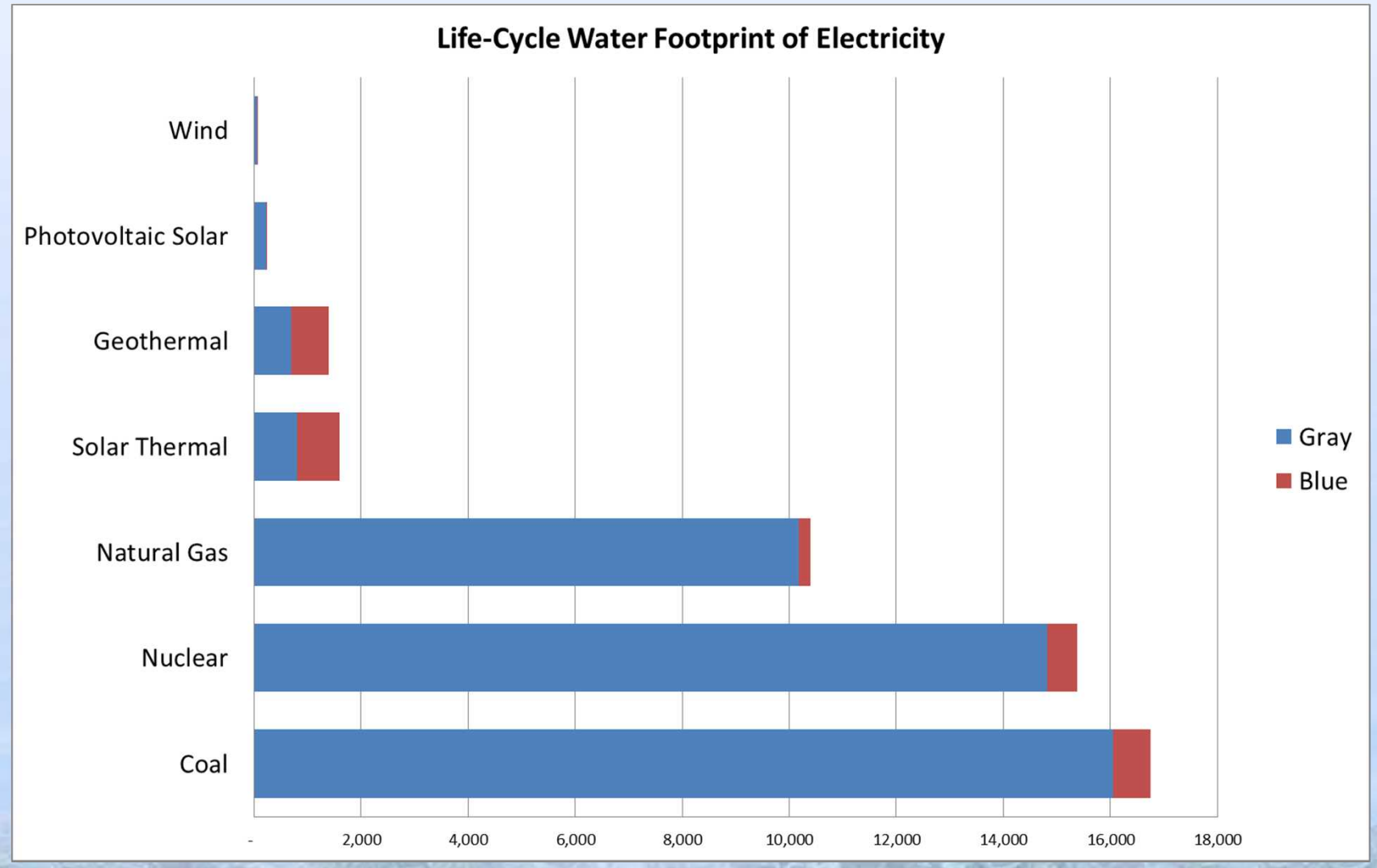
Calculating the Water Supply Stress Index both with and without power plant water use shows the contributions of plants in each basin, including where power plants were the primary driver of water-supply stress.

Source: Union of Concerned Scientists: 2011

Which source of U.S. electricity uses the most water for every MWh of electricity produced?




Water Consumption by Fuel Source
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
-
Coal
Hydroelectric
Natural Gas
Nuclear
Concentrating...
Photovoltaic...
Wind (<)
Gallons per kWh generated


Life-Cycle Water Footprint of Electricity
Wind
Photovoltaic Solar
Geothermal
Solar Thermal
Natural Gas
Nuclear
Coal
-
2,000
4,000
6,000
8,000
10,000
12,000
14,000
16,000
18,000
Gray
Blue

Water Use for Typical Cooling Systems

Table 1 – Average Cooling System Water Use and Consumption

Type of Cooling Water System	Average gal/kWh	
	Water Use	Water Consumption
Once-through	37.7	0.1
Recirculating wet	1.2	1.1

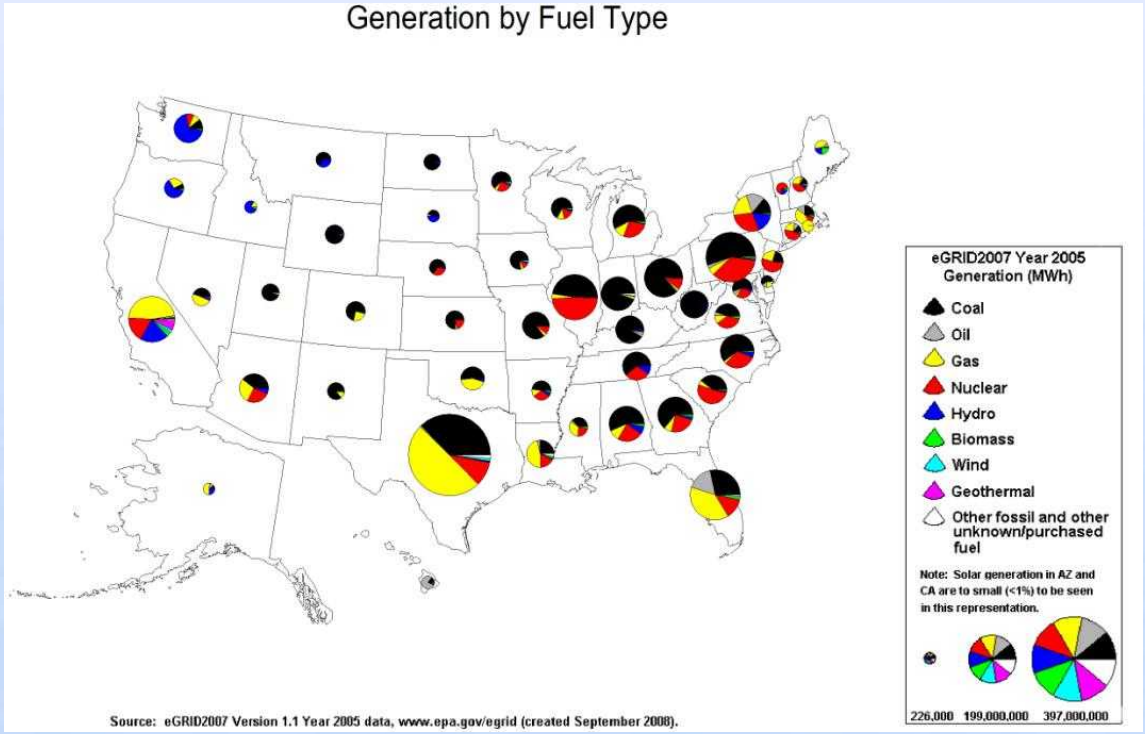
Water consumption: Water is withdrawn from a source but not directly returned to the source because it is evaporated, transpired, incorporated into products and crops, or consumed by people or livestock.

Water use/withdrawal: Water is removed from the ground or diverted from a surface source for use. This water is typically returned to the environment .

Department of Energy/Office of Fossil Energy's Power Plant Water Management R&D Program. Summary July 2005. <http://www.netl.doe.gov/technologies/coalpower/ewr/pubs/IEP_Power_Plant_Water_R&D_Final_1.pdf>

U.S. Sources of Electricity

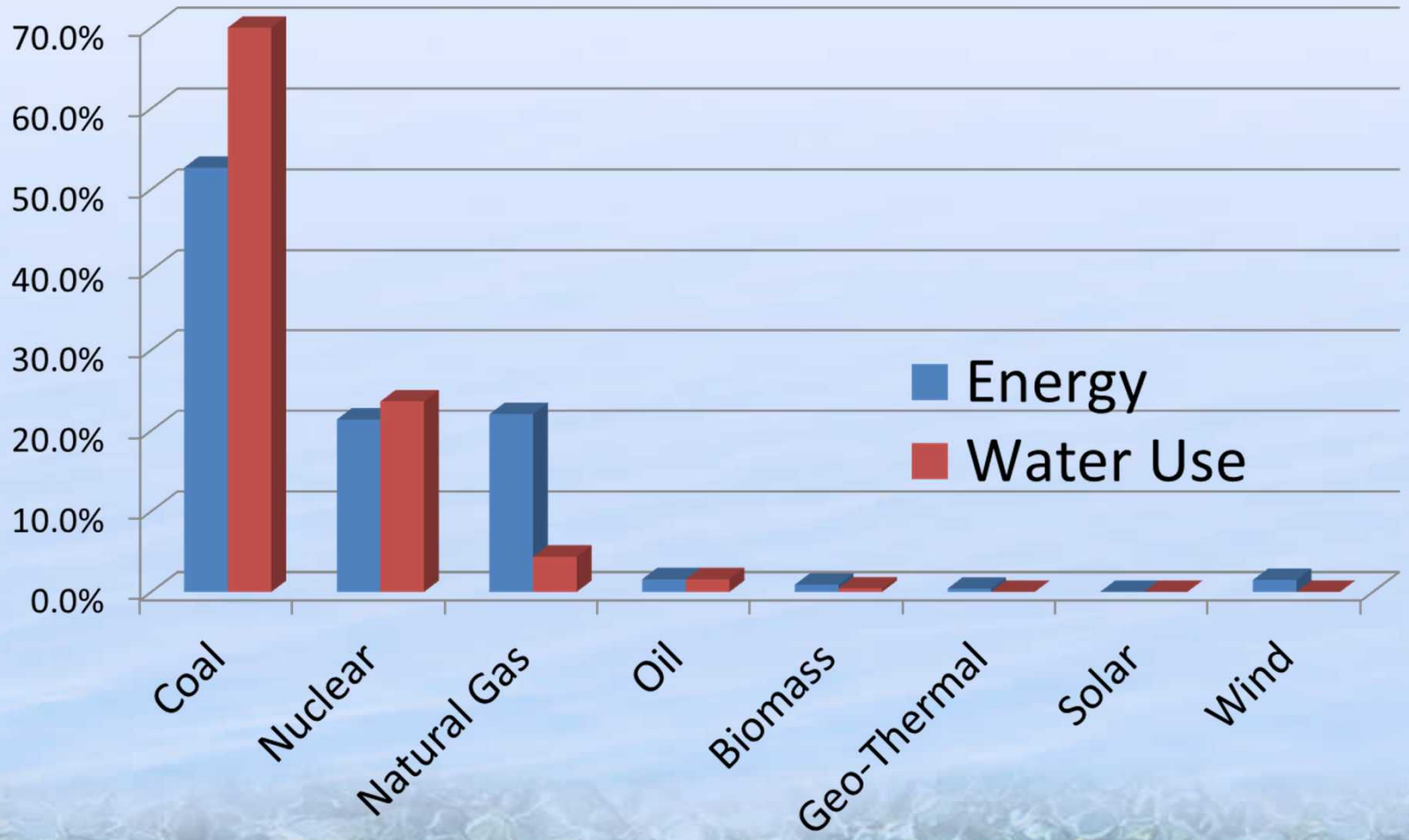
- Thermoelectric power accounts for 90% of all U.S. electricity
  - Coal (49%)
  - Natural Gas (20%)
  - Nuclear (19%)
  - Petroleum (2%)
- Hydro (6%)
- Renewables (3%)



Thermoelectric Power: ***Electrical power generated from a heat source, such as burning coal or nuclear fission, indirectly through devices like steam turbines.***

EIA <http://www.eia.doe.gov/cneaf/electricity/epa/epa_sum.html>, diagram from <http://www.nrc.gov/images/reading-rm/basic-

Energy produced vs. water used



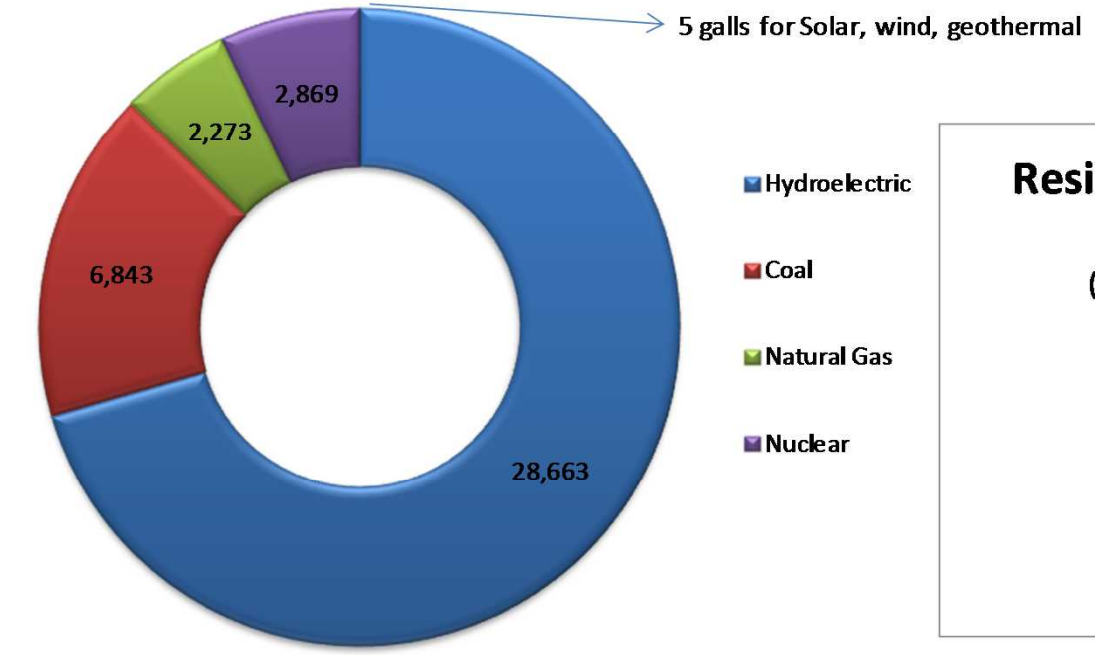
Thermoelectric Power uses…

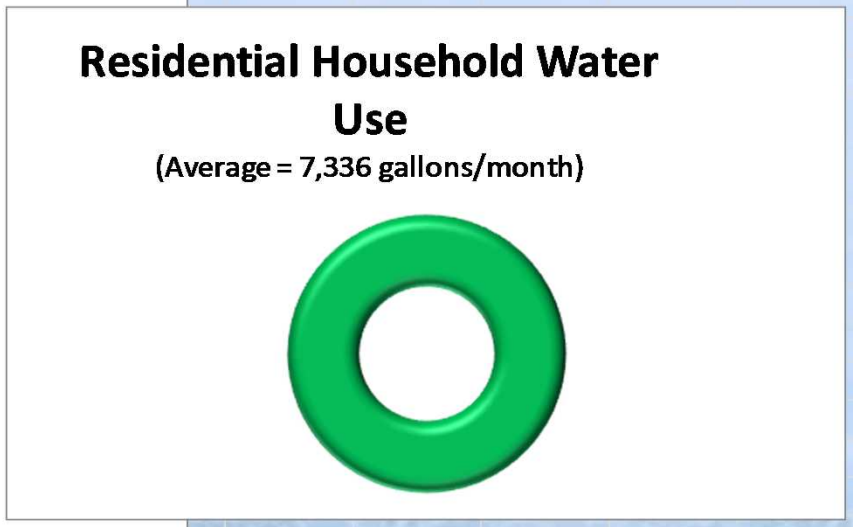
- As much as all agricultural water
- 53% of all fresh surface water withdrawals *(USGS, 2010)*

"Consumptive Water Use for U.S. Power Production" >http://www.nrel.gov/docs/fy04osti/33905.pdf>, USGS and Michael Hightower, Sandia National

Water used for electricity

Five times as much as direct water use





Recommendations and opportunities…

1. Changing WHAT we burn and HOW we burn it.

- **Decommissioning or retrofitting old once through thermoelectric plants**
- **Wider deployment of water-efficient renewable energy technologies**
- **Carefully assess carbon capture and sequestration technologies that depend on increased water use**

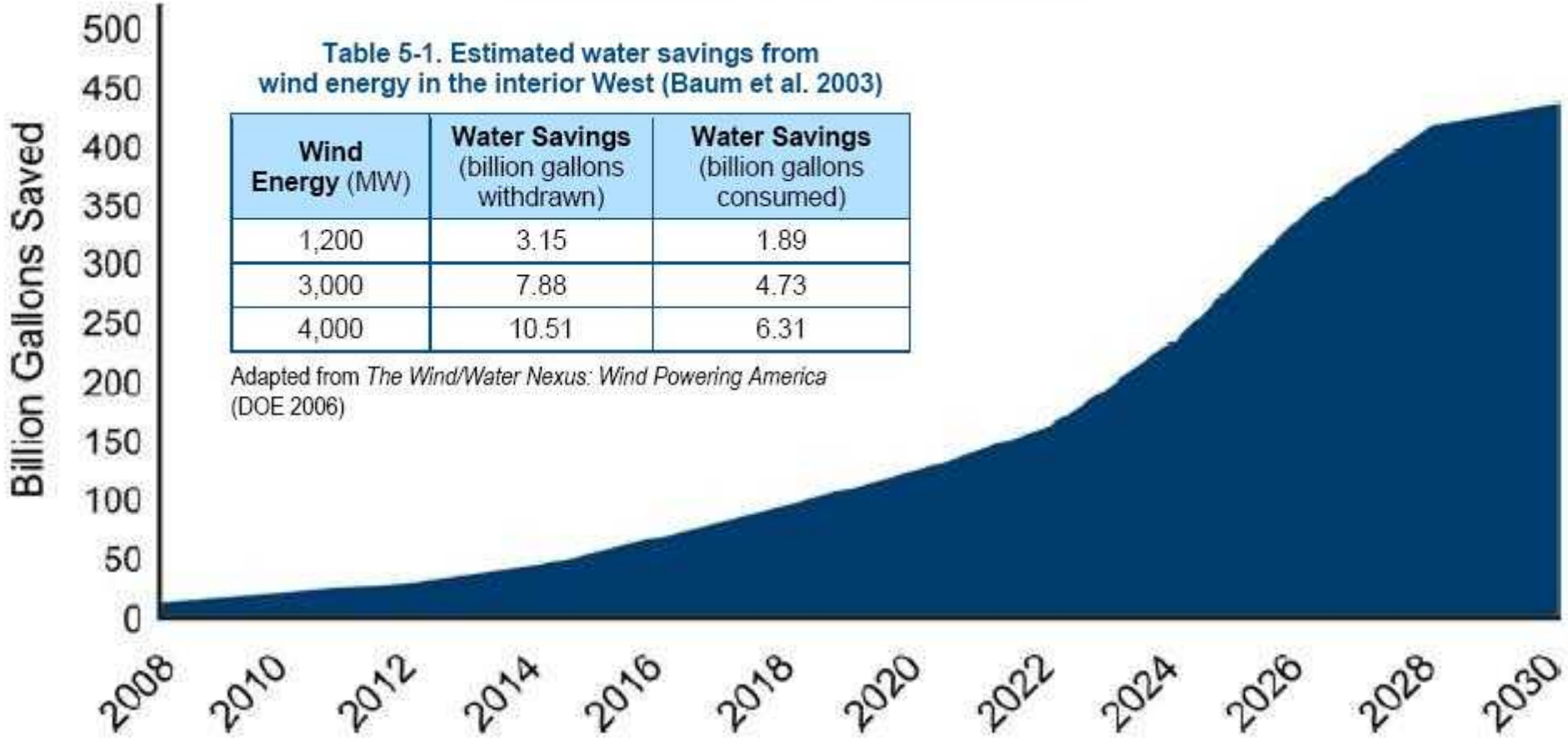
Renewables save water

Figure A-19. Annual water consumption savings due to deployment of wind energy

Table 5-1. Estimated water savings from wind energy in the interior West (Baum et al. 2003)

Wind Energy (MW)	**Water Savings** (billion gallons withdrawn)	**Water Savings** (billion gallons consumed)
1,200	3.15	1.89
3,000	7.88	4.73
4,000	10.51	6.31

Adapted from *The Wind/Water Nexus: Wind Powering America* (DOE 2006)



Source: U.S. Department of Energy, 20% Wind Energy by 2030 <http://www.20percentwind.org/20p.aspx?page=Report>

2. **Better measurement of energy-related water use and stronger regulation of water impacts in the electric industry.**

- **Strengthening water impact analysis and agency coordination during siting and permitting of new facilities**
- **Improve data collection and monitoring on water use and pollution at existing facilities**
- **Develop and adopt standardized “Energy-Return-on-Water-Invested” (EROWI) decision making tools for energy companies and public utility commissions.**

3. Strengthen watershed level and community-based programs to reduce water and electricity use

- **Promote efficiency**
- **collaborate for success**
- **Encourage wider adoption of Integrated Resource Recovery**
- **Assure stronger public involvement in water conservation planning**
- **Promote green infrastructure, watershed restoration and community-based sustainability programs**

The End