



# **The Energy-Water Nexus: Balancing Electricity Need and Environmental Concern**

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# New and Emerging Water Regulations and Challenges for Electric Generation

## **WATER SUSTAINABILITY**

Droughts    Over Allocation

Raw Water Quality

## **FISH PROTECTION**

Fine Mesh Screens    Thermal Discharge

Cooling Tower Retrofits (Fed and States)

Impingement/Entrainment Reductions

## **Watershed Protection**

New TMDLs (Regional, Air Deposition)

Arsenic Cancer Slope Factor

Nutrient Criteria

## **WATERPOWER**

GHG Emissions

Fish Passage

Environmental Flows

## **EFFLUENT GUIDELINES**

Bottom Ash Handling    FGD WW Treatment

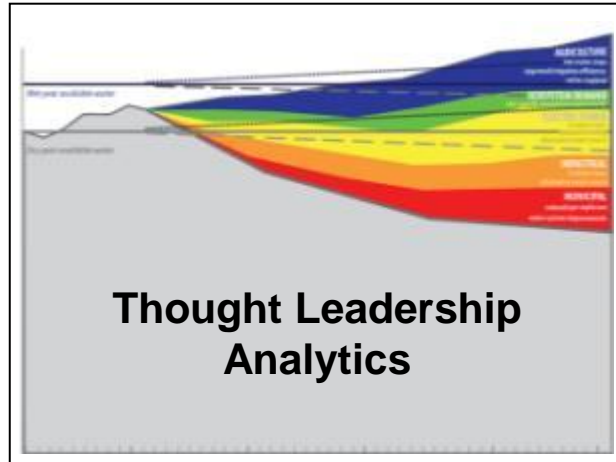
Classification and Handling of Fly Ash

Se & Hg Limits

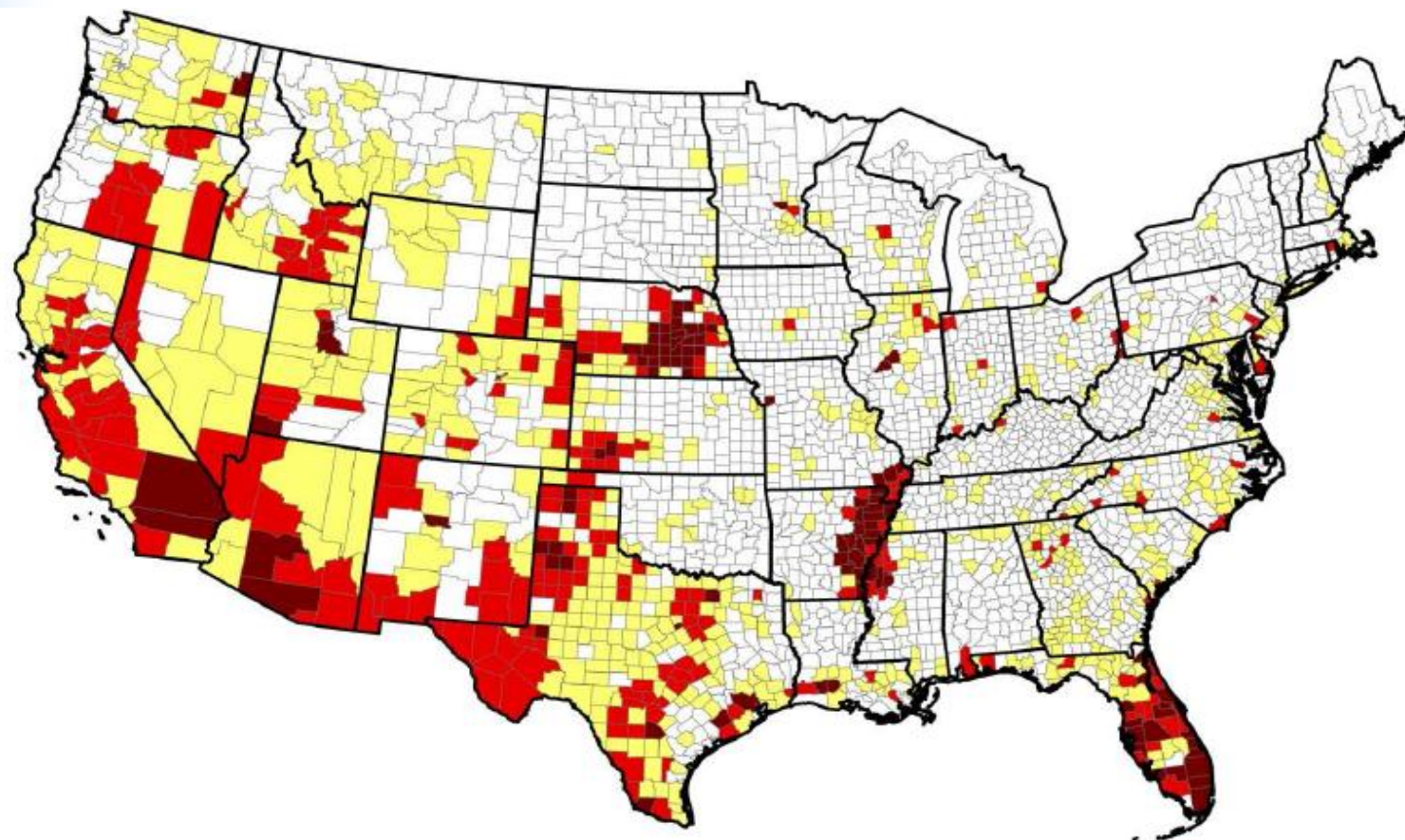
ZLD

**Plenty of new water related challenges and risks to address**

# EPRI Research – Water Management and Water Conservation



# Water Sustainability Outlook for the US



**Water Supply Sustainability Index (2030)**  
**Business as usual**

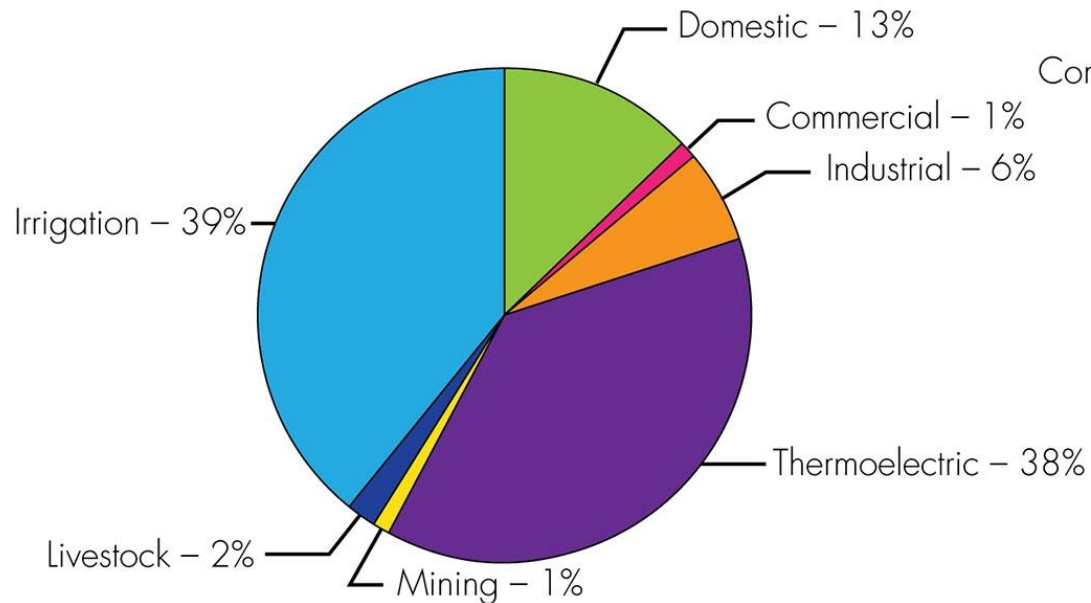
- Highly susceptible (106)
- Moderately susceptible (247)
- Somewhat susceptible (695)
- Susceptibility less likely (2034)

Reference: "Water Use for Electricity Generation and Other Sectors: Recent Changes (1985-2005) and Future Projections (2005-2030)", EPRI Report 1023676

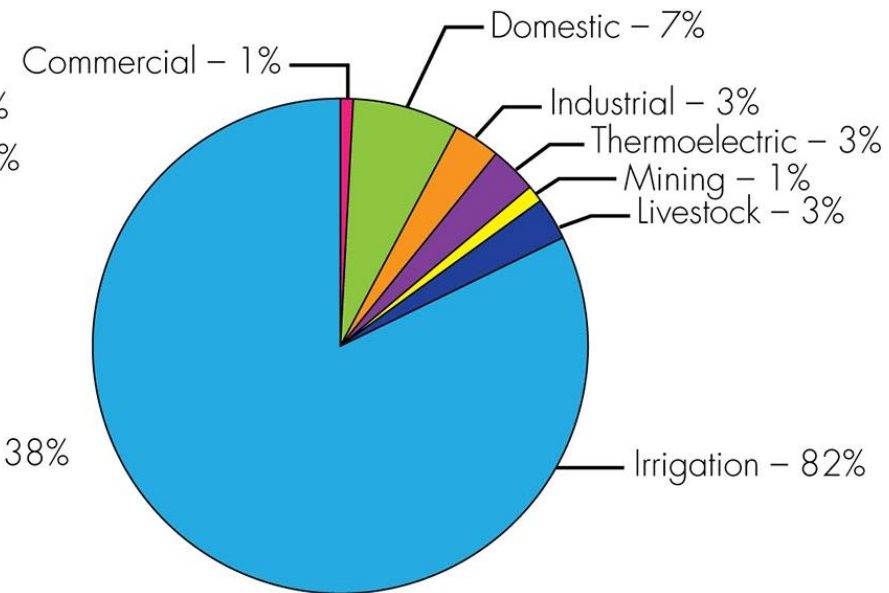


# Freshwater Withdrawal and Consumption

**Freshwater Withdrawal by Type (USGS)**



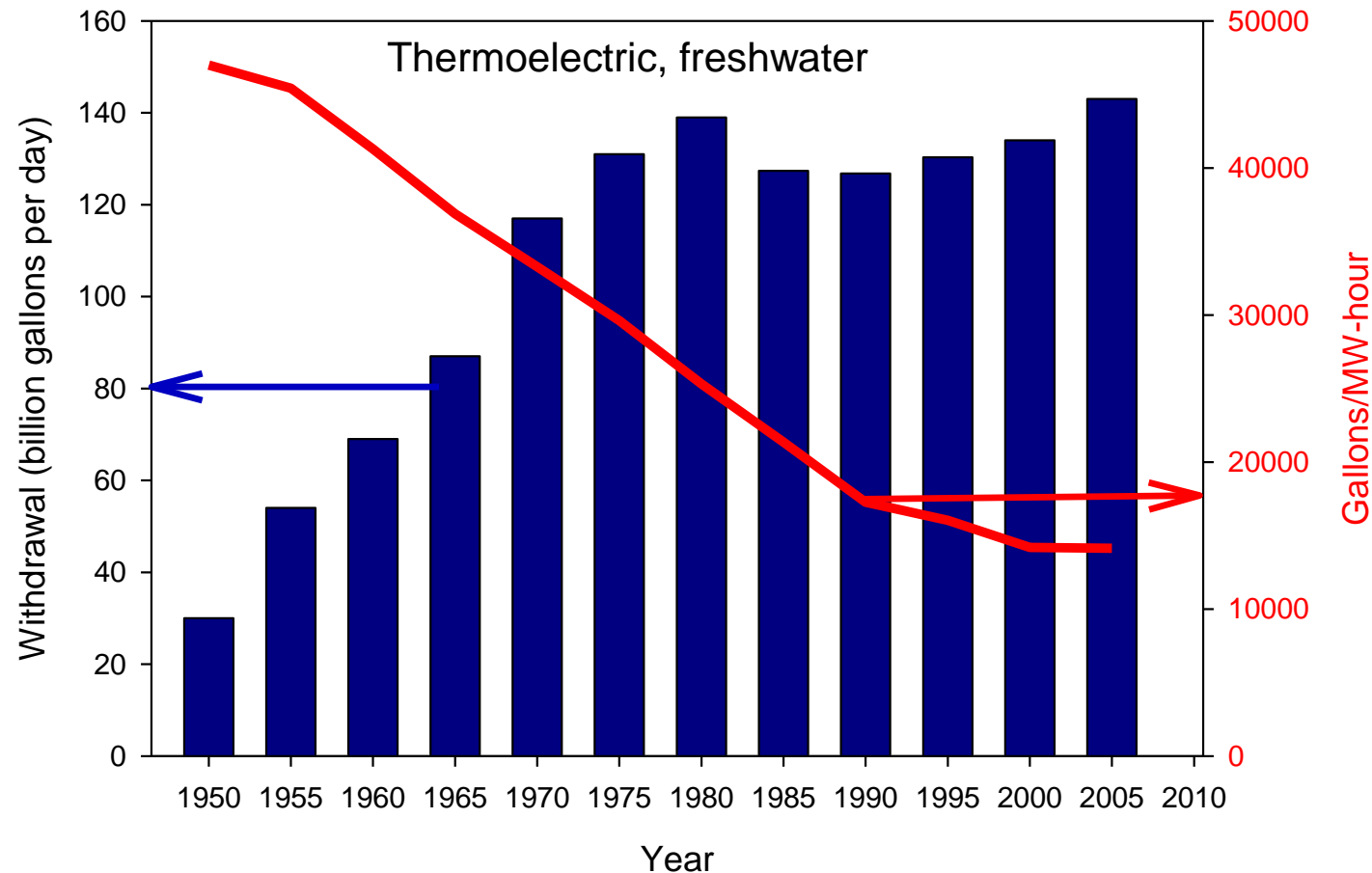
**Freshwater Consumption (USGS)**



Sources: EPRI, USGS

# Thermal Power Plants

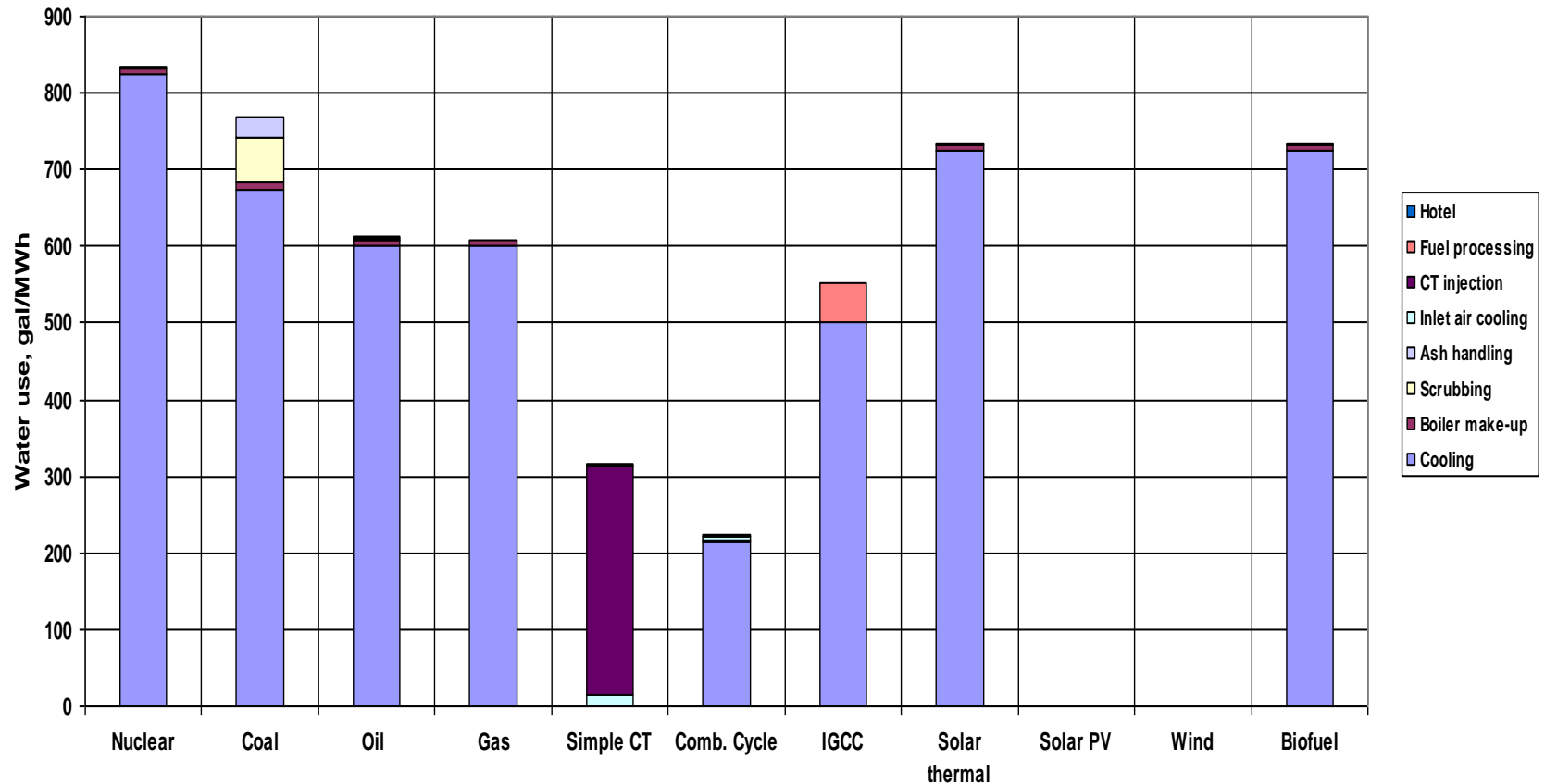
## Increasing Water Withdrawals and Increasing Efficiency



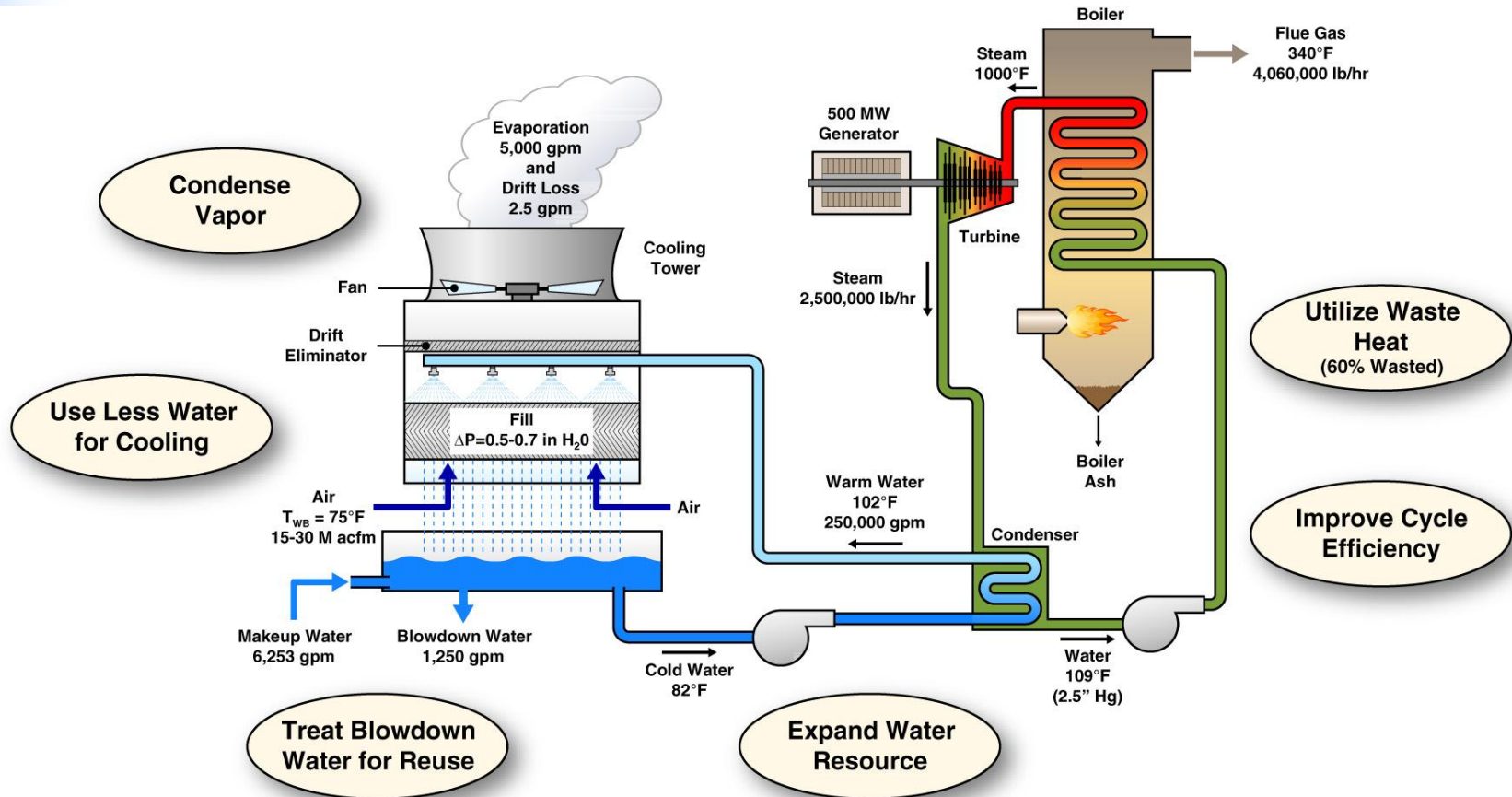
Reference: "Water Use for Electricity Generation and Other Sectors: Recent Changes (1985-2005) and Future Projections (2005-2030)", EPRI Report 1023676

# Water Use Efficiency (Steam Cycle Plants Using Wet Cooling Towers)

Water Use by Plant Type



# Opportunities for Power Plant Water Use Reduction



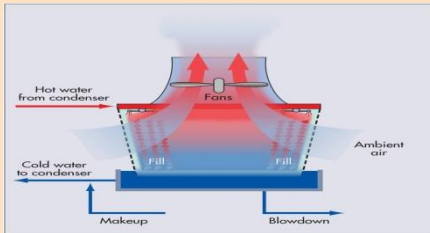
**Research Priorities:** Advancing cooling technologies, novel water treatment and waste heat recovery concepts to improve efficiency and water use



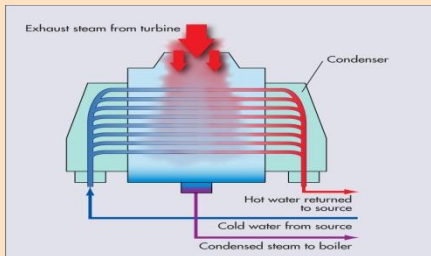
# What Cooling System Options are Currently Deployed in the Industry?

## Water Cooling

### Cooling Tower (42% in US)



### Once Through Cooling (43% in US)



## Cooling Pond

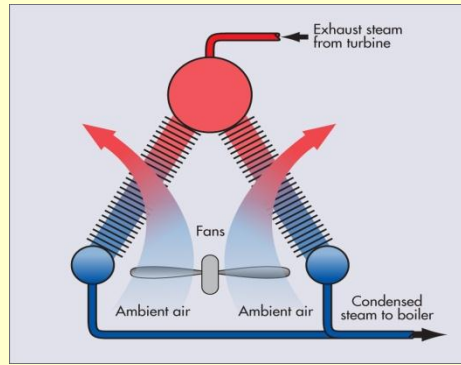
(14% in US)



## Air Cooling

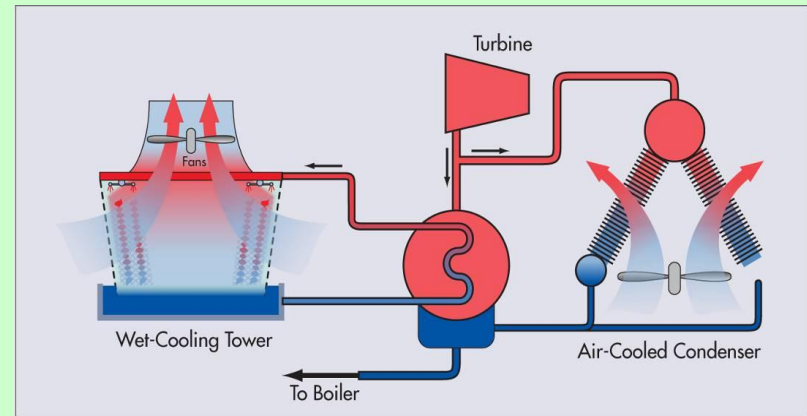
### Air Cooled Condenser

(1% Usage in US)



## Hybrid Cooling

(<1% in US)



**Trend Continues Towards Increased Cooling Tower Use**

# Bighorn---530 MW Combined-Cycle with ACC

## Issues with Dry Cooling:

- Cost
- Size
- Hot weather penalty
- Wind effects

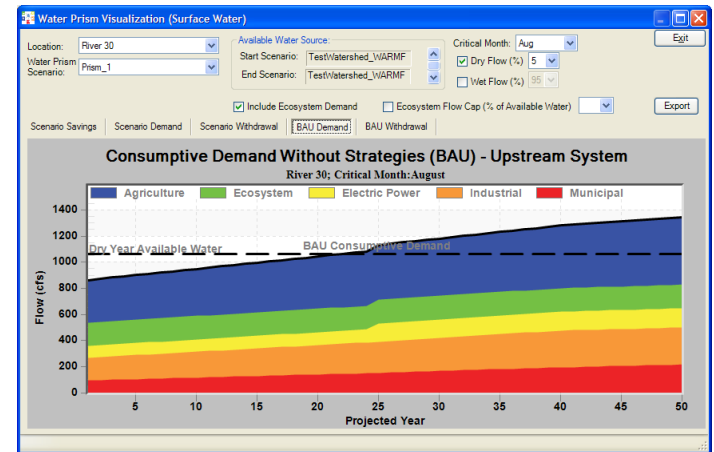
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## Animation Slide



# Water Prism Analysis Tool

Example Water Prism for a River



- Water Prism - decision support system for siting/retrofitting power plants; understand/verify water risks; explore water saving benefits across sectors; encourage collaboration
- Computes system water balance on regional scale
  - Surface water watershed model
  - Groundwater sources & uses
- Projects consumptive & withdrawal demands for 40 to 50 year horizon
- Comparative analysis of water saving strategies through scenarios, stakeholder engagement

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# Together...Shaping the Future of Electricity