

completing the energy sustainability puzzle



ENERGY *and* **WATER**

Eastern Region Needs-Assessment Workshop

**Baltimore, MD
December 12-14, 2005**

Overview



- **Setting the stage**
 - Energy/Water Nexus issues and concerns
 - Discussion of emerging needs and time horizons
- **Developing national and regional solutions**
 - DOE Energy-Water Science and Technology Roadmap overview - defining future research to solve the energy-water interdependencies problems
- **Why are we here?**
 - Workshop goals and objectives
 - Ultimate goal and benefit to the U.S.



Setting the Stage



US Energy Sustainability

A critical piece is missing



Energy and Water are Inextricably Linked

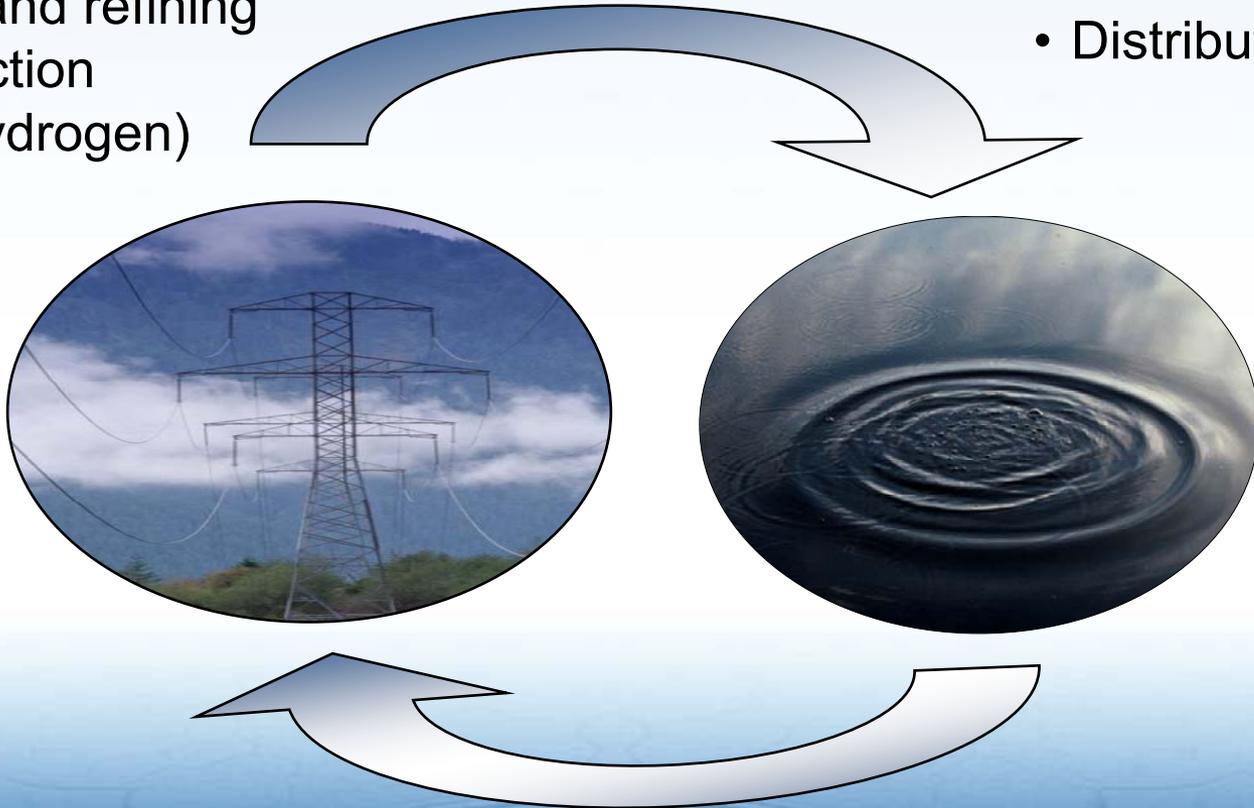


Water for Energy

- Thermoelectric cooling
- Hydropower
- Extraction and refining
- Fuel production (ethanol, hydrogen)

Energy for Water

- Pumping
- Treatment
- Distribution

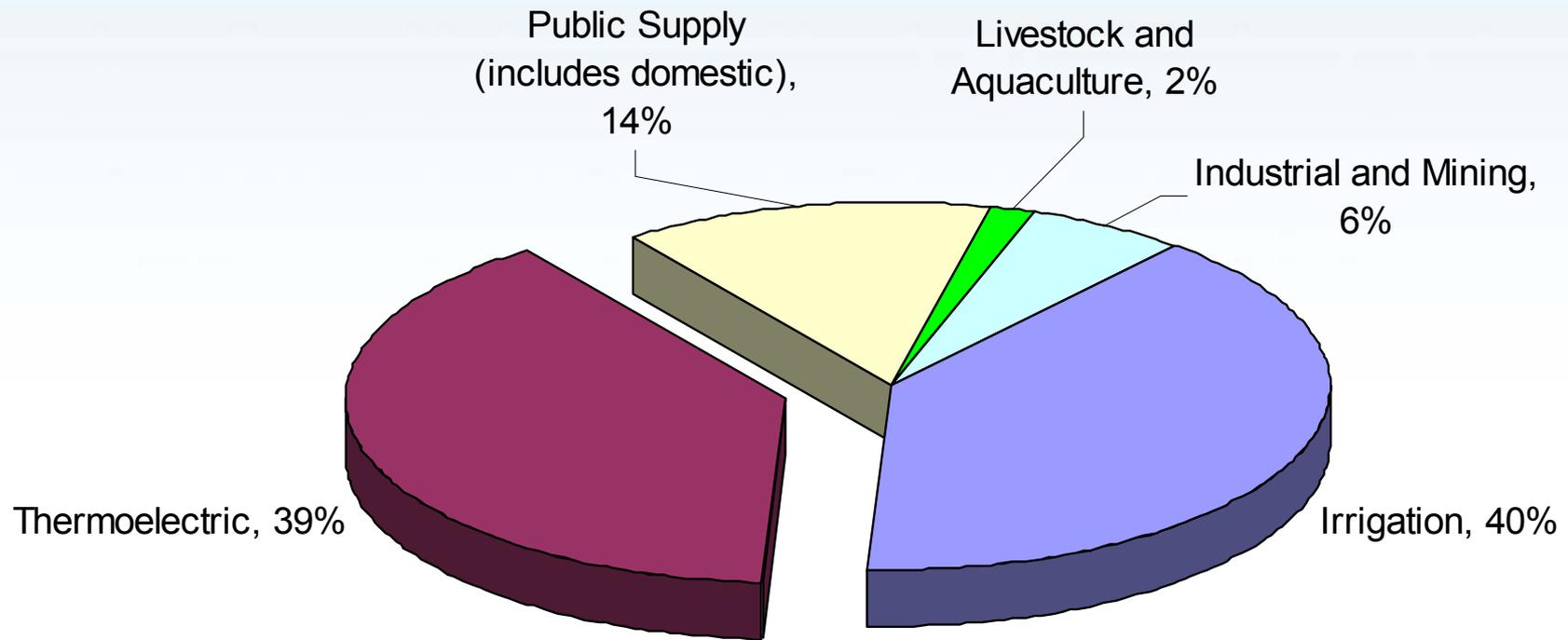




Water for Energy



Estimated Freshwater Withdrawals in the U.S. by Sector (2000)



Source: USGS Circular 1268, March, 2004

Withdrawal vs. Consumption



- **Power Plants**

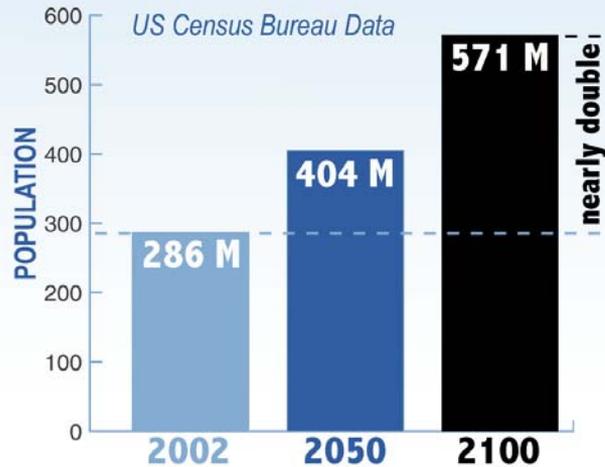
- 136,000 Mgal/day withdrawn
- 4,000 Mgal/day (~3%) consumed
(EPA ruling 316A/B may increase consumption)

- **Irrigation**

- 137,000 Mgal/day withdrawn
- 84,000 Mgal/day (~61%) consumed

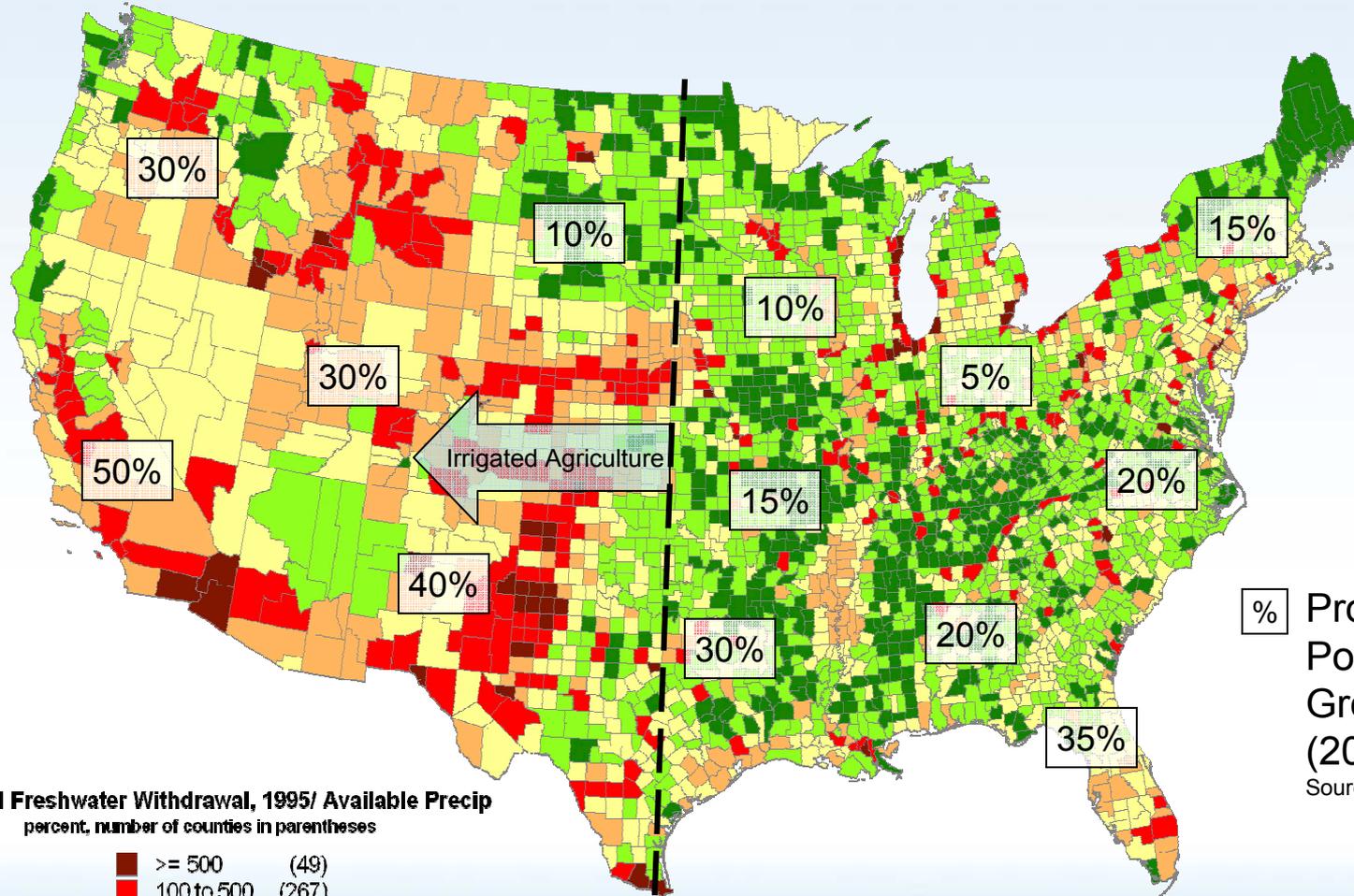
Source: USGS Circular 1200 (Year 1995) and 1268 (Year 2000)

Will water supplies be sufficient to meet US energy demands in 20 years?



- Population could increase significantly; fresh water will not
 - Population increases will not necessarily be in water-rich regions
- Energy industry must compete for water with agriculture, other industries, and domestic use
- Climate change and energy-industry operations could impact water supplies, quality, and energy demand

Water Availability is a Nationwide Problem



% Projected Population Growth (2000-2020)
Source: NETL (2002)

Total Freshwater Withdrawal, 1995/ Available Precip
percent, number of counties in parentheses

Dark Brown	>= 500	(49)
Red	100 to 500	(267)
Orange	30 to 100	(363)
Yellow	5 to 30	(740)
Light Green	1 to 5	(1078)
Dark Green	0 to 1	(614)

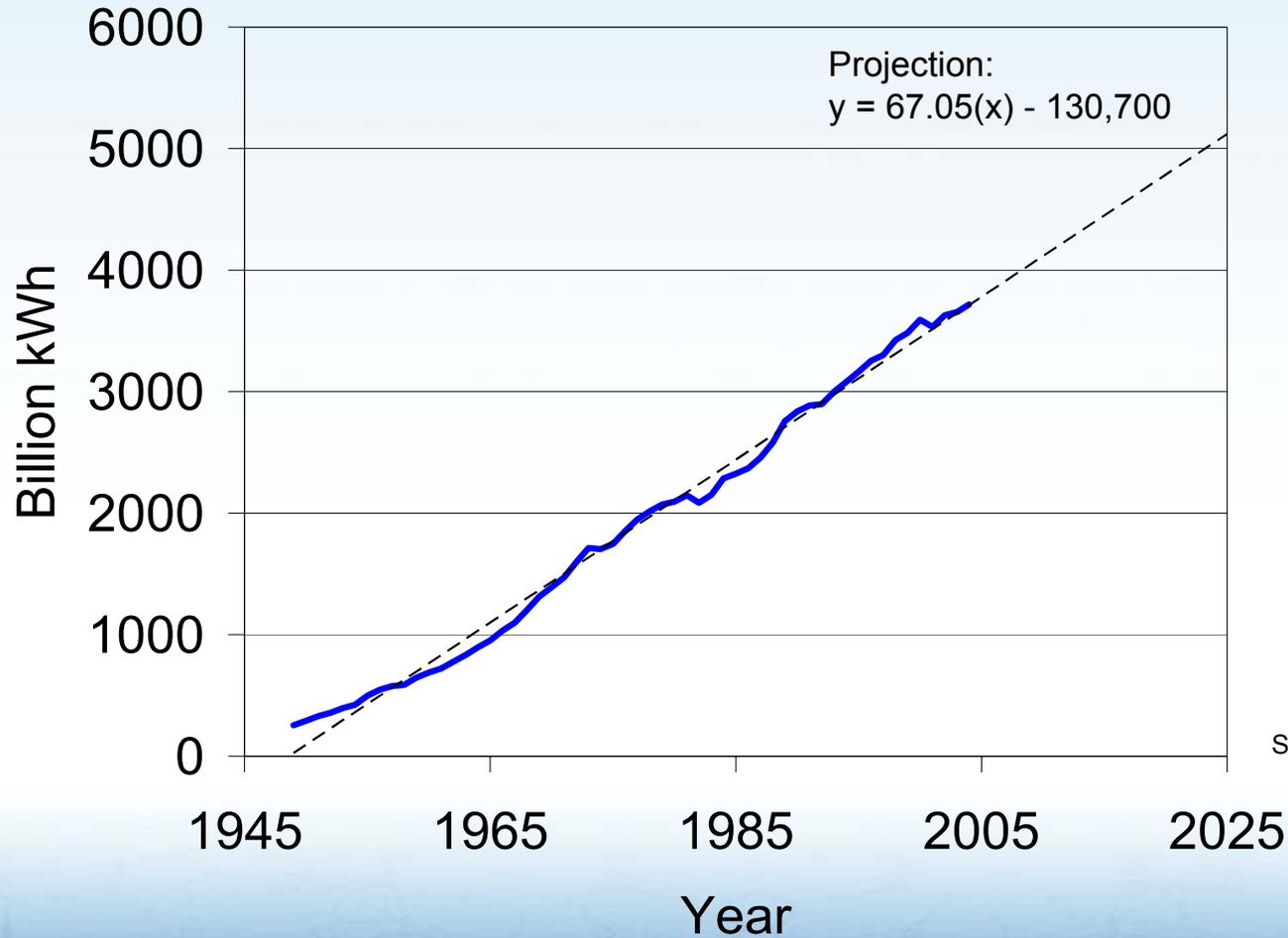
Source: USGS Circular 1200 (Year 1995), EPRI 2003



Energy Needs



The U.S. will need 30% more electricity by 2025



Source: DOE/EIA-0384(2004)

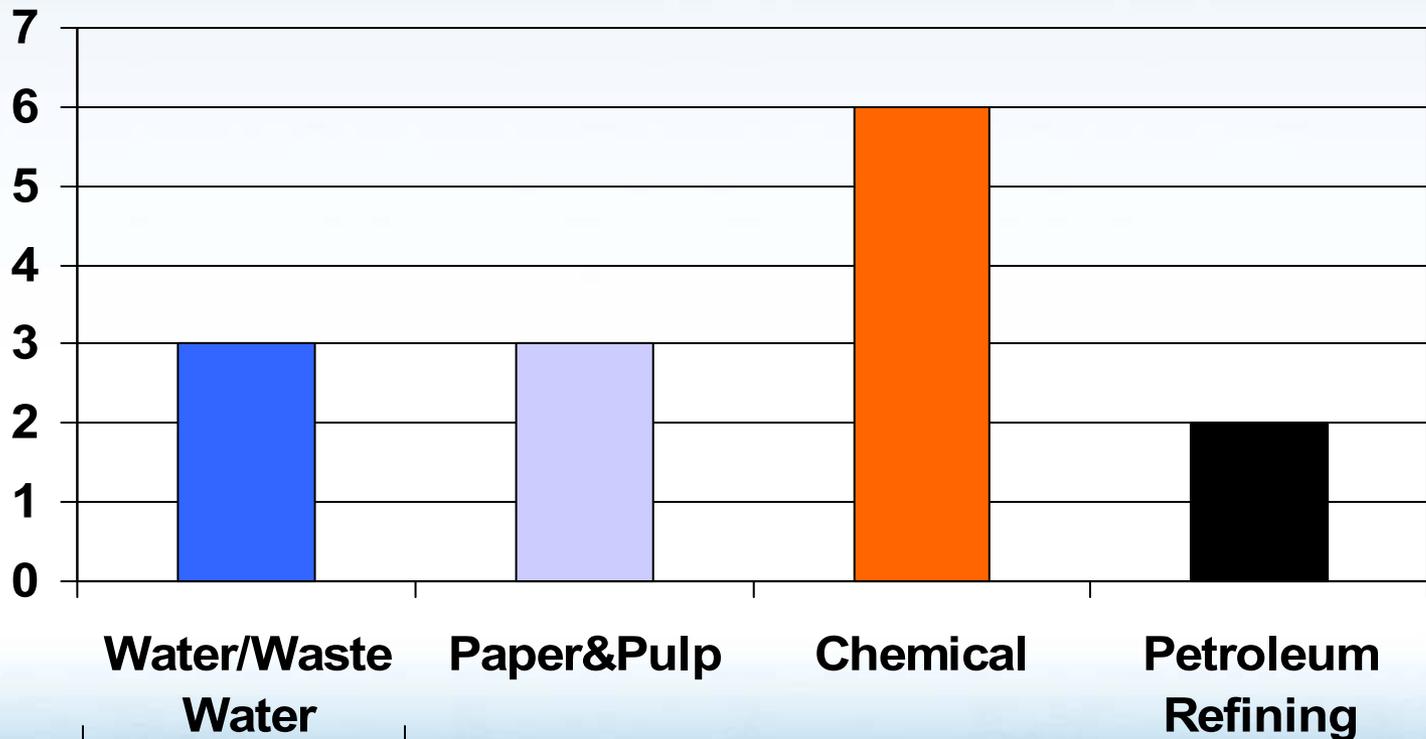
Energy for Water

Currently the Water/Wastewater Sector is a Major User of Electricity



Percent of
U.S.
Electricity
Generation
Used by
Industry

Source: DOE:2004



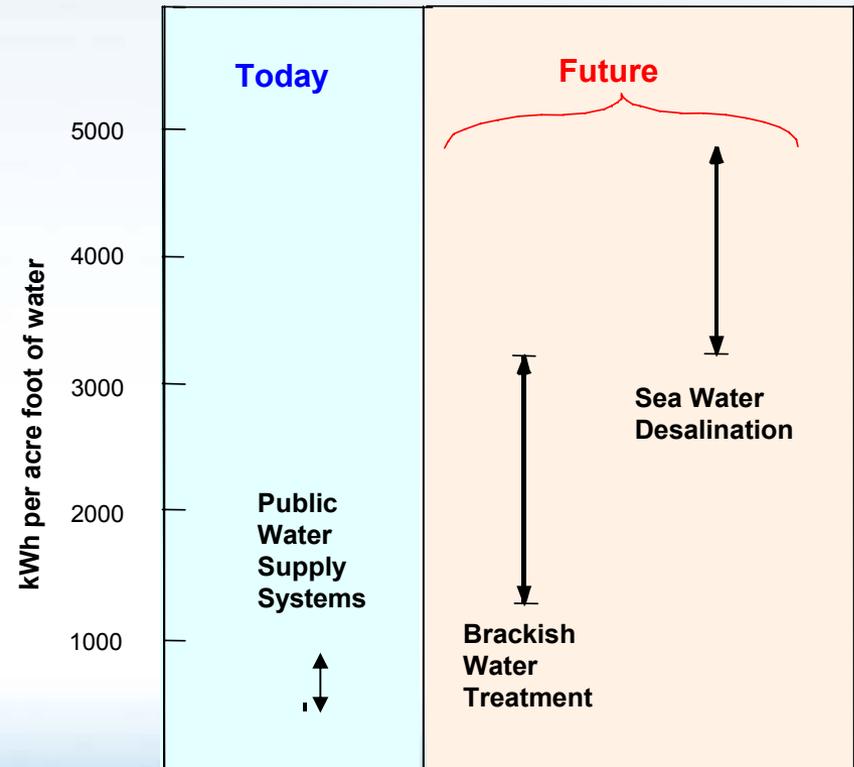
Will increase in future

Future water supplies and treatment will be more energy intensive



- **Readily accessible fresh water supplies are limited and have been fully allocated in some areas**
 - Increased energy for pumping at deeper depths and longer conveyance
- **New technologies to access and/or treat non-traditional water resources will require more energy per gallon of water**
 - Impaired water, produced water, brackish water, and sea water

Power requirements for current and future water supply



Source: EPRI (2000), Water Desalination Task Force (2003)

Energy and Water Interdependency Issues Are Appearing Now



- Water rates in the Las Vegas Valley will go up . . . because of increased electricity costs (Las Vegas SUN, 2002)
- Utility regulators put ecology ahead of electricity in rejecting a major power plant . . . that would use 2,500 gallons per minute to cool its steam turbines (Arizona Daily Sun 2002)
- Georgia Power Loses Bid to Draw Water from Chattahoochee (Miami Herald, February 2002)
- EPA Orders Mass. Power Plant to Reduce Water Withdrawals (Providence Journal, RI, July 2002)
- Idaho Denies Water Rights Request for Power Plants (U.S. Water News Online, August 2002)
- Pennsylvania Nuclear Power Plant to Use Wastewater from Coal Mines (The Philadelphia Inquirer, July 2003)
- Utilities Warn of Power Crunch if Flows Are Cut (Greenwire, July 2003)
- Governor Mike Rounds of South Dakota called for a summit to discuss drought-induced low flows on the Missouri River and the impacts on irrigation, drinking-water systems, and power plants (News Release, February 2005)



Overview



- **Setting the stage**
 - Energy-Water Nexus issues and concerns
 - Discussion of emerging needs and time horizons
- **Developing national and regional solutions**
 - DOE Energy-Water Science and Technology Roadmap overview - defining future research to solve the energy-water interdependencies problems
- **Why are we here?**
 - Workshop goals and objectives
 - Ultimate goal and benefit to the U.S.

Recent Energy and Water Forums



- **Sandia and Los Alamos Water for Energy Forum 2002**
 - Treatment of produced water, need for advanced treatment technologies, and regional approaches to utilize produced water
- **National Energy Technology Lab Water for Energy Forum 2002**
 - Recognized need for improved cooling technologies, non-traditional water sources, pollutant measurement and treatment.
- **National Renewable Energy Laboratory**
 - Use of renewable energy for water supply
- **American Council for an Energy-Efficient Economy**
 - Roadmap for Energy in the Water and Wastewater Industry
- **Sustainable Water Resources Research Workshop**
 - Need better integrated regional planning, better characterization of water supply availability, and advanced technologies and modeling capabilities

Energy-Water Legislation

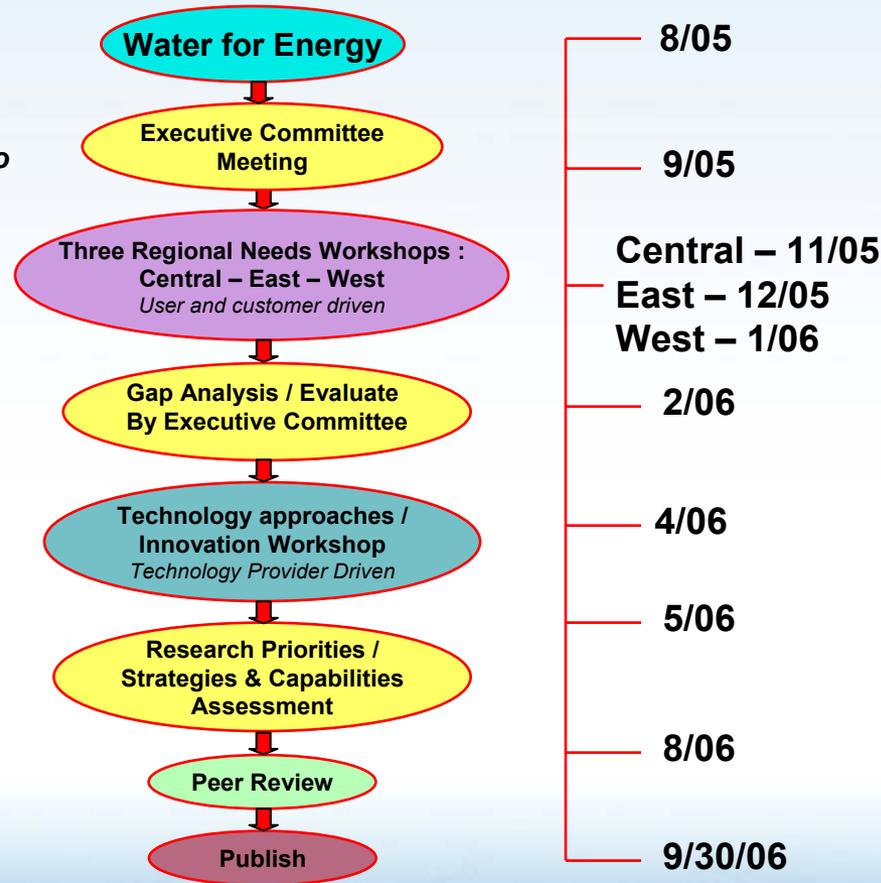


- **FY05 appropriations bill provided funding for two specific Energy-Water efforts:**
 - **Report to Congress**
 - **Address energy and water interdependencies, current trends in energy and water issues and demands, general gaps between current program direction and emerging concerns, and possible future needs**
 - **Due to Congress by February 2006**
 - **National Energy-Water Roadmap for DOE**
 - **Assess emerging energy and water issues based on user and stakeholder needs and develop energy and water science and technology priorities**
 - **Due to DOE by September 2006**
- **Energy Policy Act of 2005**
 - **Established DOE role in energy and water related issues**

National Energy-Water Technology Roadmap Process



Executive committee consists of ~ 20 esteemed members from industry, government, and academic institutions to provide external direction and review of process.



Energy-Water Roadmap Planning and Implementation Team



- **Sandia National Laboratories**
 - Coordinate all workshops – logistics, participants, facilitators
 - Interface with Executive Committee and National Lab Advisory team
 - Coordinate science and technology issues analysis
 - Develop Energy-Water Roadmap
- **UNM Utton Transboundary Center and Lawrence Berkeley National Laboratory**
 - Coordinate policy, regulatory, and economic issues analysis

Partnerships and integration will be crucial for program success



- Integration of agencies (federal, state, tribal), utilities, and industry responsible for water, energy, economic development, and environmental management
- Universities and labs to perform fundamental research in areas relevant to program
- Industry and utility consortia involvement in testing and evaluation of water and energy technologies

Overview



- **Setting the stage**
 - Energy-Water Nexus issues and concerns
 - Discussion of emerging needs and time horizons
- **Developing national and regional solutions**
 - DOE Energy-Water Science and Technology Roadmap overview - defining future research to solve the energy-water interdependencies problems
- **Why are we here?**
 - Workshop goals and objectives
 - Ultimate goal and benefit to the U.S.

Needs Assessment Workshops

Goals and Objectives



- **Three regional workshops: Nov 2005 through mid-January 2006**
- **Focus on emerging user and stakeholder problems, issues, and needs and science and technology role in developing effective solutions**
- **Interested in broad spectrum of regional, state, and local participation and input**
 - **Representatives from energy companies, electric utilities, water utilities, water managers, economic development groups, energy regulators, environmental groups, tribal nations, other water-use sectors**
- **Will capture all issues, needs, and recommendations identified in each workshop**
- **Use results to rank regional and national priorities and to focus future science and technology research, development, and implementation**



Examples of Science and Technology Problems and Needs for Energy and Water



- Improved materials, processes, or technologies to enhance efficiency or performance of energy production, cooling, water treatment, etc.
- Science-based regulations or policy
- Improved understanding of chemical or biological processes that impact water and energy-use efficiency
- Modeling or decision support tools for improved cooperation of resource management and utilization
- Improved technology transfer and economic evaluations of costs and benefits
- Real-time resource monitoring and sensing
- Better understanding or evaluation of future energy or water alternatives

National Impact of Energy-Water Science and Technology Roadmap



- Understanding the interdependencies of water-reliant systems and their impact on future energy supplies
- Ensuring regional water availability
- Balancing future water demands across all users and stakeholders
- Developing science and technology to reduce water use, loss, and environmental impact in energy systems

