



Thermoelectric Cooling Technologies and Water Allocation

Can Water Be Allocated Using Pricing?
Hydrovision 2008
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Overview

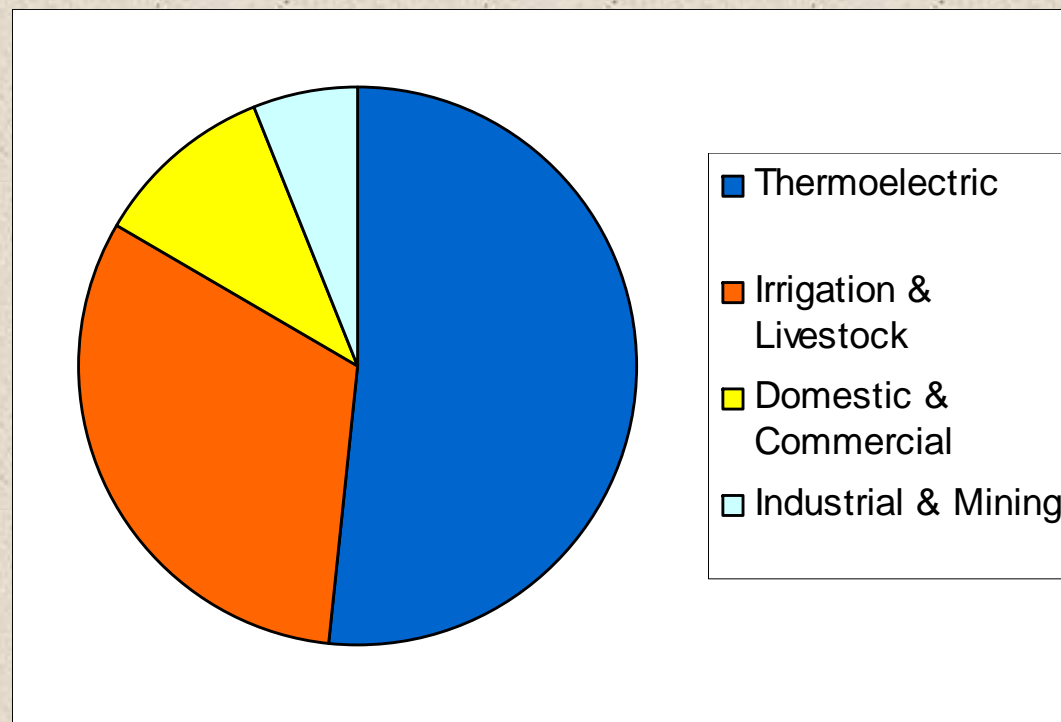
- Water withdrawal and consumption trends
- How water cost and availability determine thermoelectric cooling technology
- How water markets may affect the electric power industry
- Water market challenges



Water Withdrawals

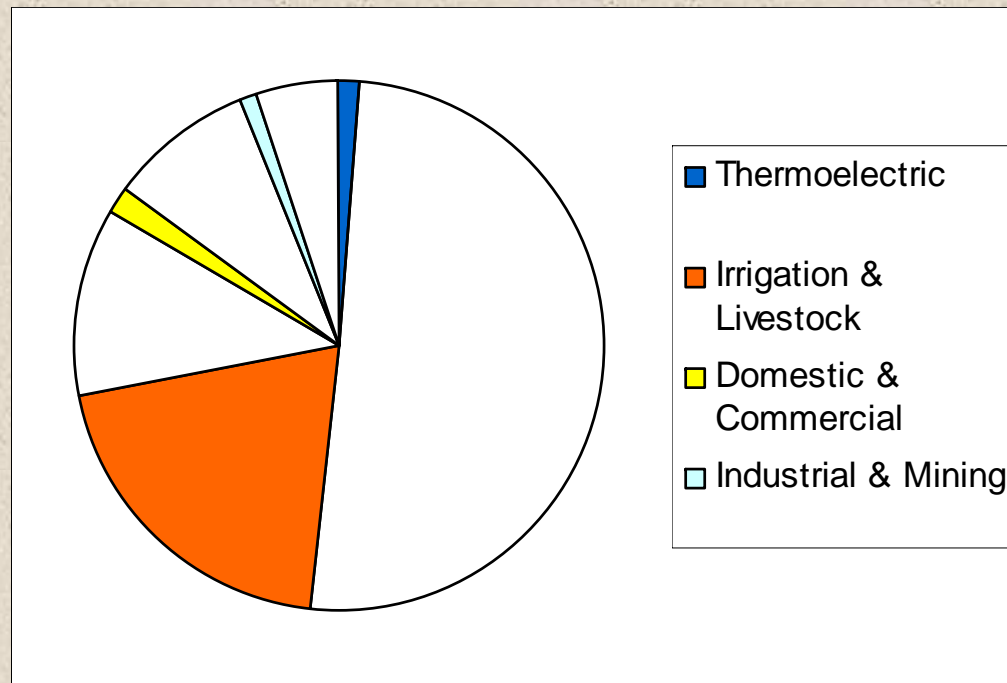
Thermoelectric power accounting for 52% of fresh surface water withdrawals in U.S.

- Source: USGS (Hutson et al., 2004)



Water Consumption vs. Withdrawal

- Thermoelectric consumes only about 1% of total surface water withdrawals
 - The rest is returned.
- Irrigation (and livestock) consume about 20%
 - Source for consumption: USGS (Solley et al., 1998)



Water Needs, By Technology

(gal/MWh)	Water Withdrawal		Water Consumption	
	Once-through cooling	Cooling towers	Once-through cooling	Cooling towers
Fossil	20,000-50,000	500-600	300	480
Nuclear	25,000-60,000	800-1100	400	720
Natural Gas	7,500-20,000	230	100	180

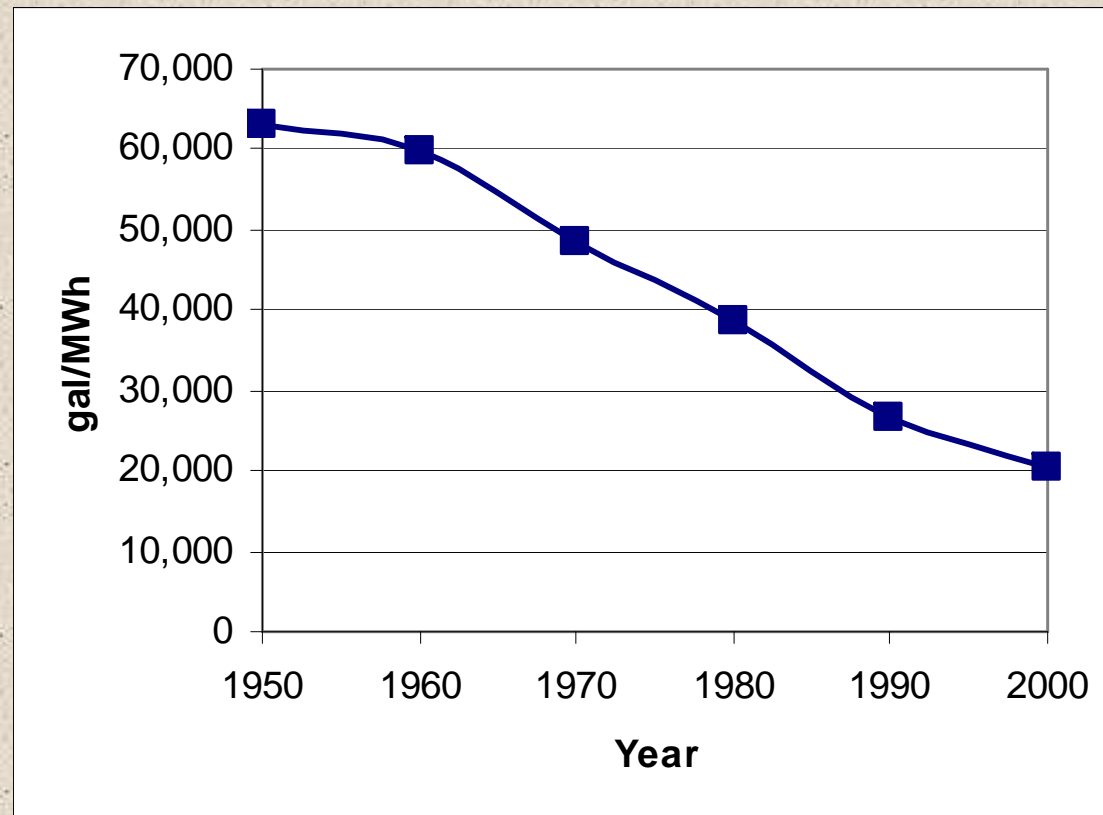


Trend in U.S. Thermoelectric Power Water Withdrawal Efficiency

■ Dramatic improvement since 1950

- Shift from once-through cooling to cooling towers

■ Has offset a tripling of power demand

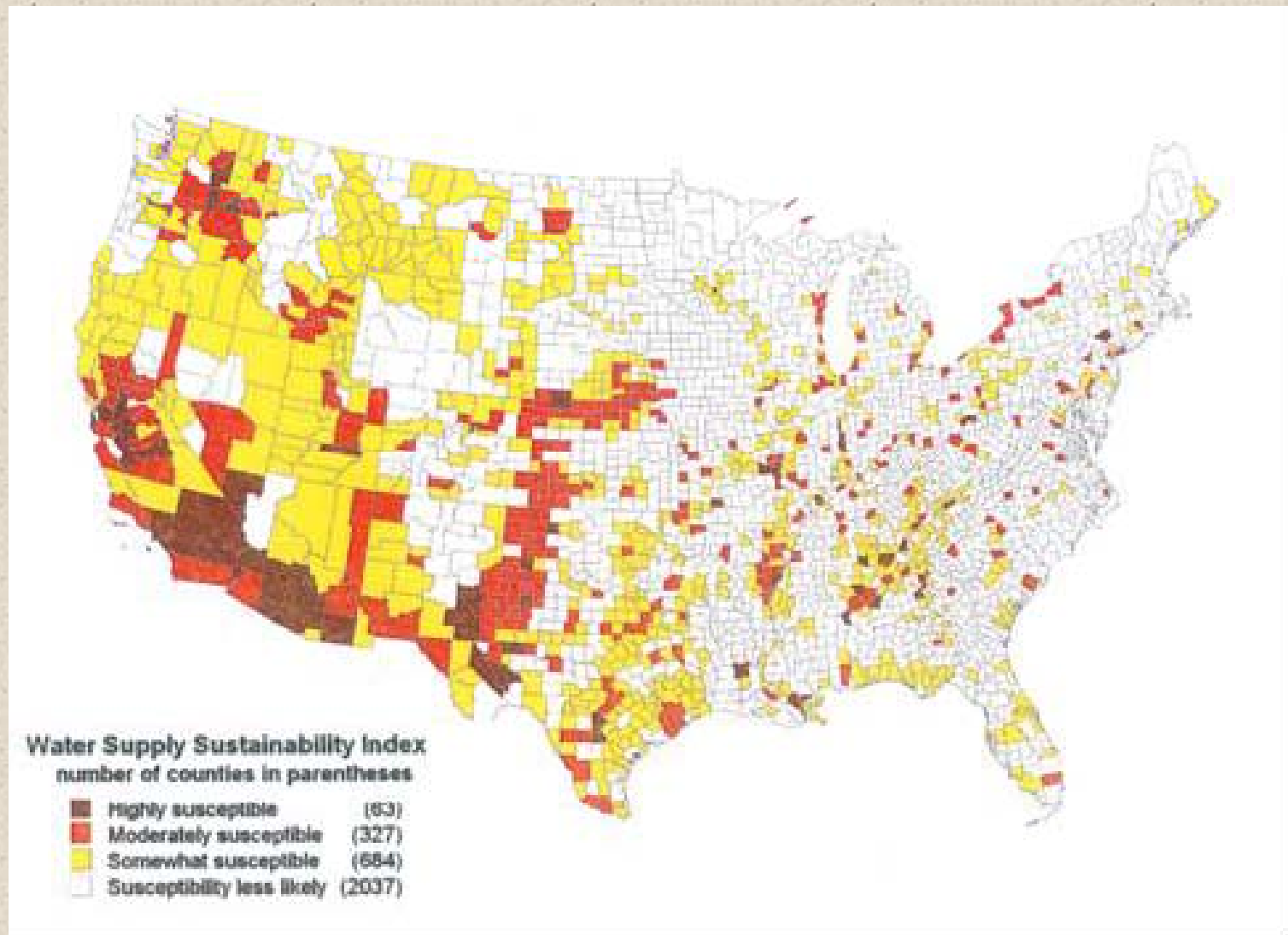
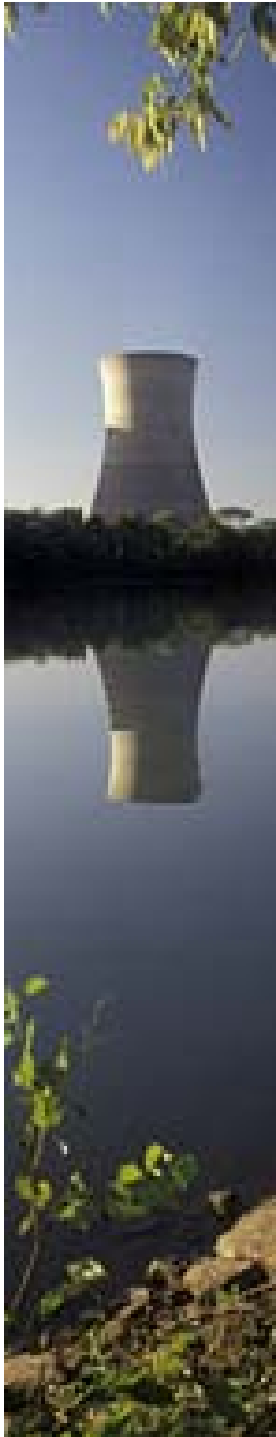




Implications for Thermoelectric Power Plants

- **Water can constrain plant siting**
- **Consumption, not withdrawals, is the key issue for new plants**
- **Power plants must compete with larger consumers of water**
 - **Irrigators**
 - **Growing populations in same regions**

New Power Plants Will be Sited, Many in Areas Where Water is Scarcest



Project Conducted for Electric Power Research Institute



- **Objective: Develop water sustainability research plan for EPRI**
- **Conducted interviews of EPRI members**
 - **Is water an important cost factor in your operations?**
 - **If you are siting new capacity, are you limited by:**
 - **Availability of water?**
 - **Water discharge/water quality issues?**
 - **Available regional planning tools?**



Plant Siting and Technology Decisions

- **Regional demand dictates need for new capacity**
- **Transmission capacity and fuel availability are primary siting factors**
- **Availability and cost of water are then evaluated**
 - **Includes acquisition, conveyance, and treatment costs**
- **These drive decisions on cooling technology**
 - **Air vs. water cooling, depending on cost of water**
 - **Conventional vs. degraded waters, depending on treatment cost**



Potential Impact of Full Cost Pricing

■ Objective: allocation of water to high-value activities

- Will promote water-conserving technologies, reducing water consumption
- Will promote treatment of degraded waters, increasing water supply

■ Irrigation consumes much more water, so this is where there are the greatest potential gains

- Potential transfers from agricultural to municipal uses



Market Pricing – Acquisition and Treatment Issues

■ Uncertainties hinder market

- Water rights and administrative procedures
- Leases greatly exceed sales of water rights
- Jurisdictions can help by adjudicating rights

■ Negative externalities

- Reductions in stream flows, and groundwater “mining”
- Community impacts of fallowing/community value of water

■ Treatment requires

- Clear rights to waste water
- Disposal of the wastes removed
 - Waters from oil and gas exploration are plentiful but require extensive treatment



Conclusions about Water Pricing

- **Can accelerate adoption of water-conservation technologies by thermoelectric power generators**
- **Can also increase supply through treatment of nontraditional waters**
- **Effective market policy requires**
 - **Clear water rights**
 - **Maintaining stream flows**
 - **Responsible treatment of degraded waters**



Questions?

