California Energy Commission

Water and Energy in California

California Council on Science and Technology

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California Energy Commission

Background

Commission Purpose

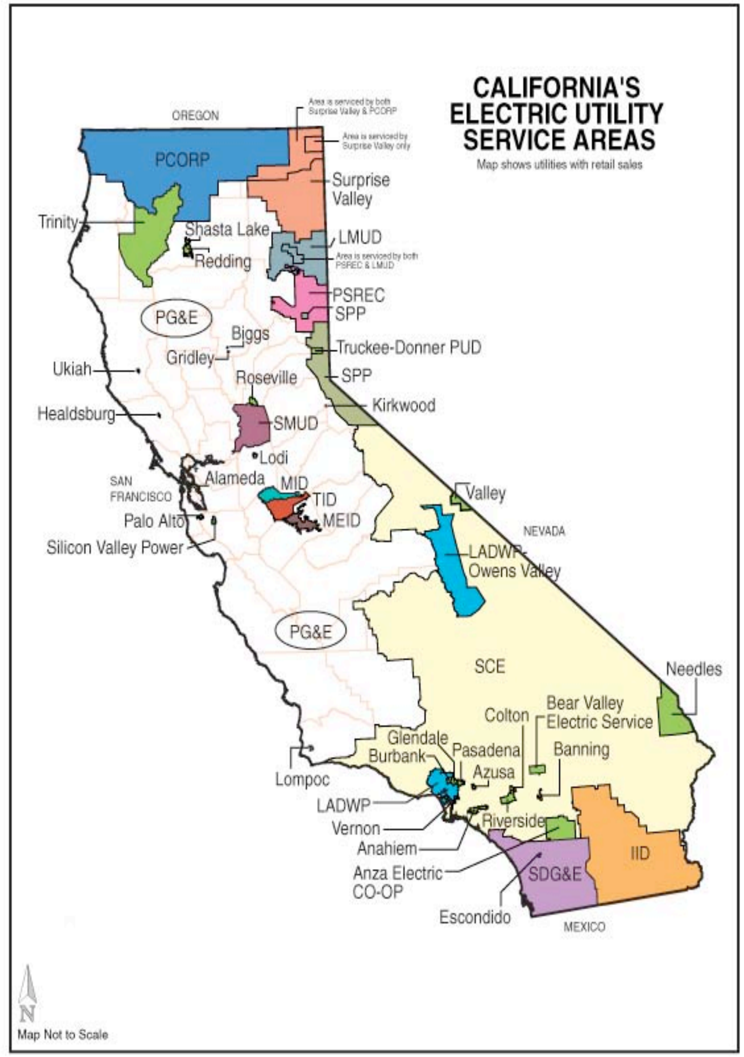
- License thermal power plants 50 MWs and larger
- Adopt appliance and building energy efficiency standards
- Forecast state energy use
- Conduct public interest energy research
- Maintain energy information and performing analysis
- Propose to the Governor integrated state energy policies

CEC Public Interest Energy Research (PIER) Program

- IOU Ratepayer-funded program launched in 1997 by AB1890
- Addresses electricity, natural gas, and transportation sectors
- $80M annual budget; nearly $400M in active projects
- A leader in no/low-carbon science and technology programs
  - Efficiency and Demand Response
  - Renewables
  - Clean Fossil Generation – Distributed Generation, Combined Heat & Power
  - Transportation
  - Energy Systems Research – Transmission and Distribution
  - Environmental Impacts of energy production and end use
- Strong emphasis on collaborations
  - Avoid duplication/builds on past work/ensures relevance
  - Regular coordination with IOUs via the Emerging Technology Coordinating Council and Transmission Program Advisory Committee
  - State Agency Partnerships (CARB, CPUC, CEC T-24, DGS/DOF,CDF,CFA,CalEPA, IWMB)
  - Market Partnerships (California builders, Collaborative for High Performance Schools, California Commissioning Collaborative, major equipment manufacturers)
  - Use California Capabilities (Universities, National Laboratories, High Technology Companies)
  - Leverage/complement Federal Investments – Photovoltaics, Biomass, Smart Grid, Efficiency

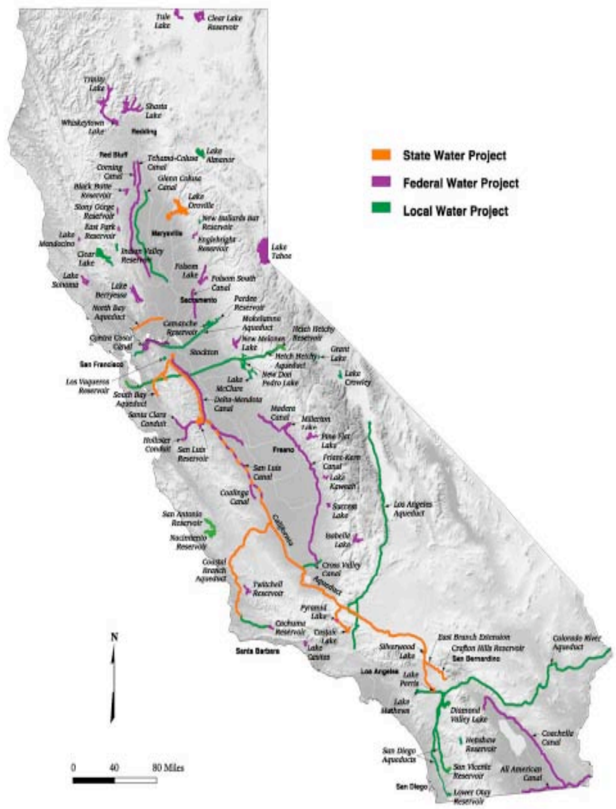
Electricity System

- Population: *34 million, 1.2% per year growth*
- Multiple Utility Service Territories
- 2004 Electricity Use: *271,000 GWh*
- 2004 Peak Demand: *56,435 MW*
- Annual growth: *Consumption - 1.4%* *Peak - 1.65%*



California's Water-Energy Nexus

- 2/3 of Precipitation in North
- 2/3 of Demand in the South
- Water Demand: *43 maf*
  9 maf Urban
  34 maf Agricultural
- Energy Use:
  19% of Electricity
  33% of Natural Gas
- Population by 2030:
  48 million
- 2030 Water Demand:
  43-50 maf



	Northern California kWh/MG	Southern California kWh/MG
Supply & Conveyance	2,117	9,727
Water Treatment	111	111
Distribution	1,272	1,272
Wastewater Treatment	1,911	1,911
Regional Total	5,411	13,022

Refining Estimates of Water Related Energy Use In California, CEC, December 2006

Parallel Concerns

- Growing Demand
- Infrastructure
- Resource Adequacy
- Cost
- Source Quality/Diversity
- Reliable Supplies
- Environmental Protection
- Long-term Uncertainty

Water-Energy – A Policy Timeline

- 2000 *Methodology for Analysis of the Energy Intensity of California's Water Systems* – Robert Wilkinson
- 2004 *Energy Down the Drain-The Hidden Costs of California's Water Supply* – NRDC and the Pacific Institute
- 2005 *California's Water-Energy Relationship* – California Energy Commission Staff Report
- 2005 *Integrated Energy Policy Report-Chapter 8:Integrating Water and Energy Strategies* – California Energy Commission
- 2006 *Embedded Energy Savings Related to Water Efficiency* – California Public Utility Commission proceedings
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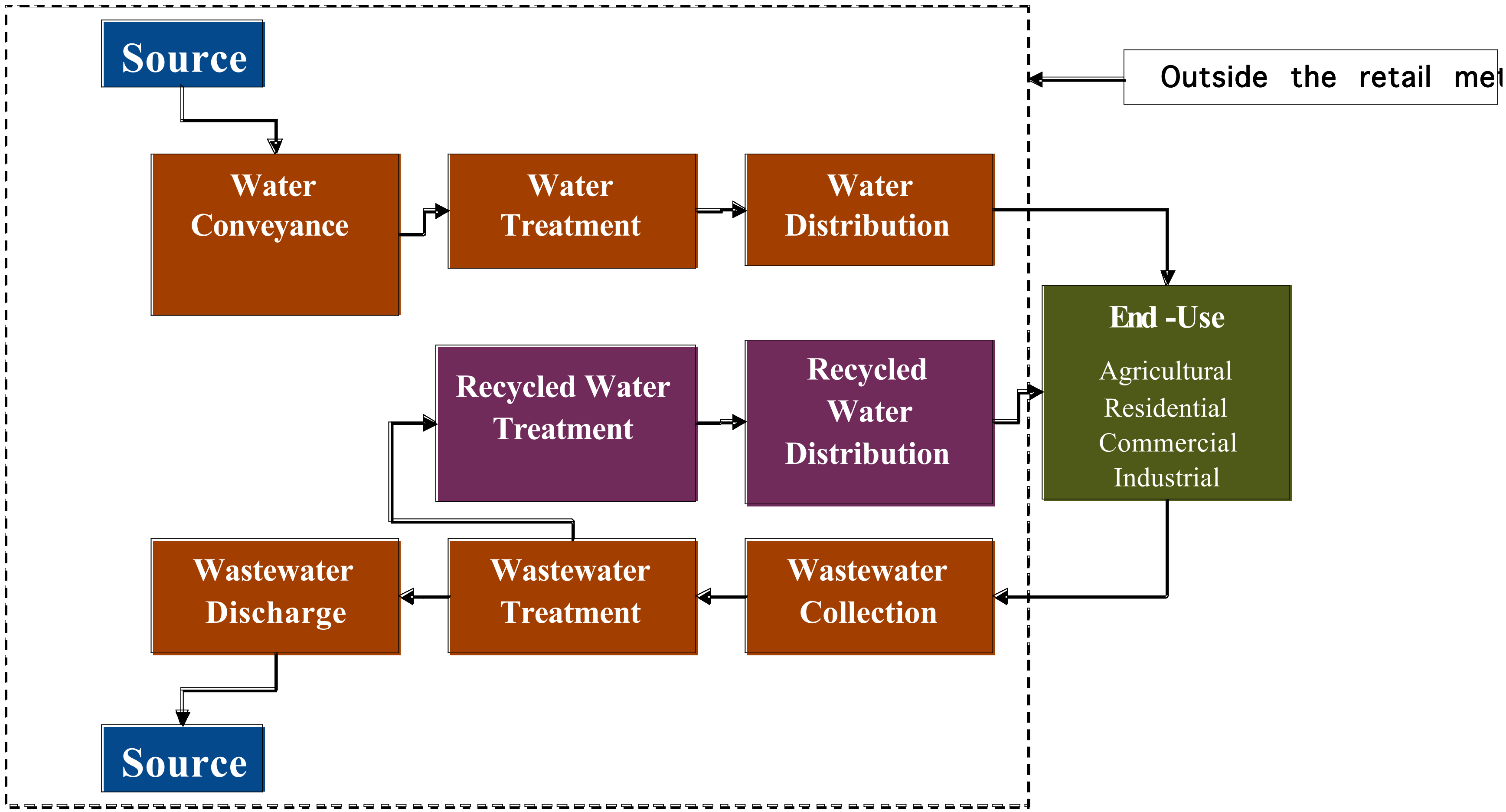
Where Energy is Embedded in Water
The Water-Use Cycle



Energy is embedded in water in each sector, and is cumulative.

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Integrated Energy Policy Report 2005 Water & Energy Recommendations

- Evaluate and conduct research to understand interaction of water and energy within the state.
- Identify new and innovative technologies to achieve energy and water efficiency savings.
- Address potential savings throughout the water use cycle, especially in Southern California.
- Focus on identifying and implementing cost-effective retrofits in the water system.
- Increase efficiency and provide both net and peak energy savings.
- Examine increased savings through Time Of Use water tariffs and meters and increased flexibility in water deliveries.

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California Climate Change Response

- California Global Warming Act 2006 (AB 32)
- Energy industries in California must accommodate:
  - Economic growth
  - Population growth
  - Environmental laws and goals
- California must reduce greenhouse gas emissions to 1990 levels by 2020
- Governor Established Climate Action Team (CAT)
- Water-Energy Subteam (WETCAT): Current Draft Strategies
  - Require Water Recycling Plans at Wastewater Treatment Plants
  - Urban Water Reuse
  - End Use Water Conservation and Efficiency
  - Energy Intensity of Water System
  - Increase Renewable Energy Production

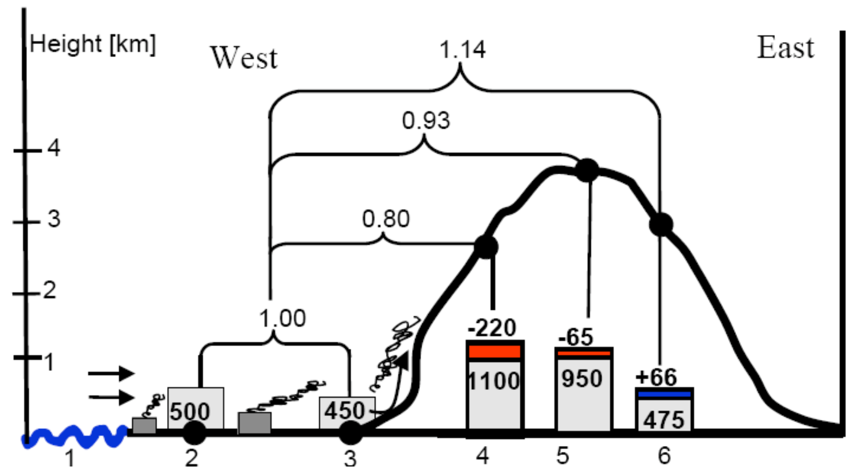
CEC – PIER Water-Energy R&D Priorities

- ***Assessing and Mitigating Climate Change Impacts on Water Supplies***
  - Information and models to assess the likely ramifications of climate change on on water resources
  - Information and tools to mitigate and/or adapt to climate change effects
- ***Increasing Energy Production from Water***
  - Increase cost-effective, environmentally preferred self-generation by water and wastewater agencies
  - Develop/enhance tools for better environmental protection while optimizing hydropower operations
- ***Energy Savings by End Users***
  - Increase efficiency of water-related energy use throughout the water use cycle
  - Maximize energy and water savings through efficiency improvements, appliances and other viable options
- ***Electricity Storage***
  - Maximize use of [water] storage to shift loads off peak and integrate intermittent renewable generation
- ***Once-Through Cooling***
  - Develop a consistent regulatory approach, including protocols & guidelines for assessing ecological effects of once-through cooling
  - Update current data adequacy regulations for state's coastal power plants
- ***Energy Savings through Water Efficiency***
  - Increase understanding of water-energy interdependencies
  - Identify new and innovative technologies & measures for achieving energy and water efficiency savings
  - Identify potential savings throughout the water cycle, especially in Southern California
  - Identify & implement cost-effective water system retrofits that reduce energy and peak demand
  - Increase savings through development of TOU water tariffs and meters
  - Increase flexibility in water deliveries

Snowpack Vulnerability to Climate Change

- Aerosols may be reducing precipitation levels in the Sierra Nevada. Reducing this deleterious effect may reduce the negative impacts of climate change on water resources
- Additional measurements scheduled for 2008
- Extensive field study under development with NOAA and DWR for 2010

Topographic cross section of the central Sierra Nevada showing the effects of urban air pollution on precipitation as the clouds moves from west to east across the mountains.



Climate Monitoring, Analyses, and Modeling

- California Climate Data Archive (www.calclim.dri.edu)
- Installation of meteorological and hydrological monitors in key areas/transects. Reference Climate Network (NOAA)
- California Re-analysis (57-years)
- Climate change detection and attribution
- Irrigation and temperature trends in CA.
- Role of aerosols in regional climate
- Inter-comparison of regional climate models
- Climate (including hydrology) and SLR Projections (late in 2009)

10 Km x 10 Km

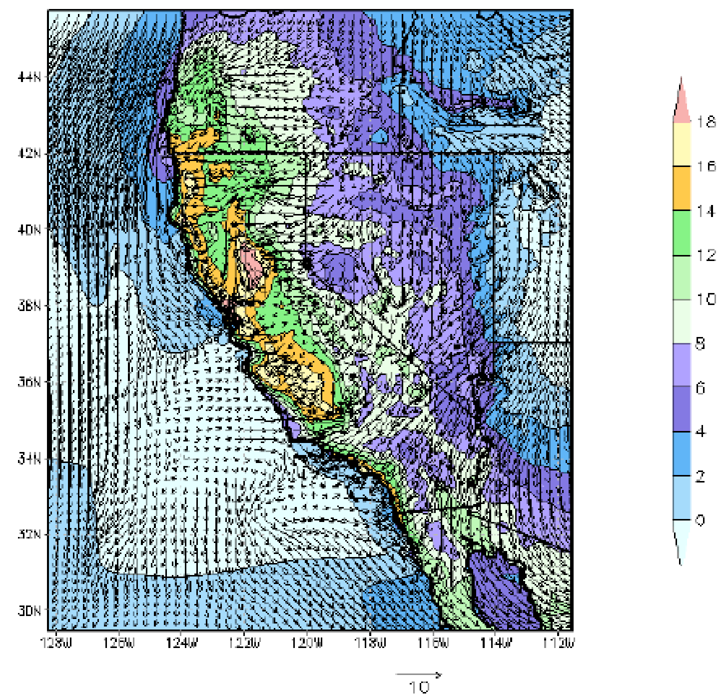


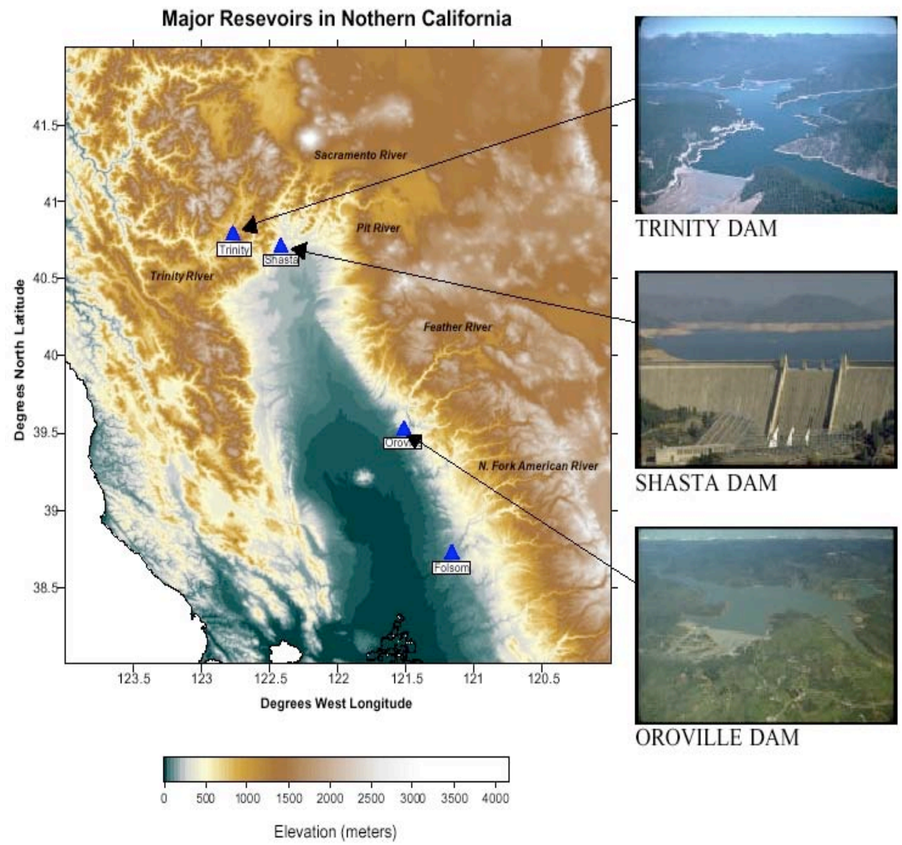
Figure 24. An example of Santa Ana events, 00Z October 26, 2003

Source: Scripps

INFORM Model for Reservoir Operations

Problem: How do you maximize hydropower generation and water supply at large, multipurpose reservoirs while ensuring environmental protection including flood control?

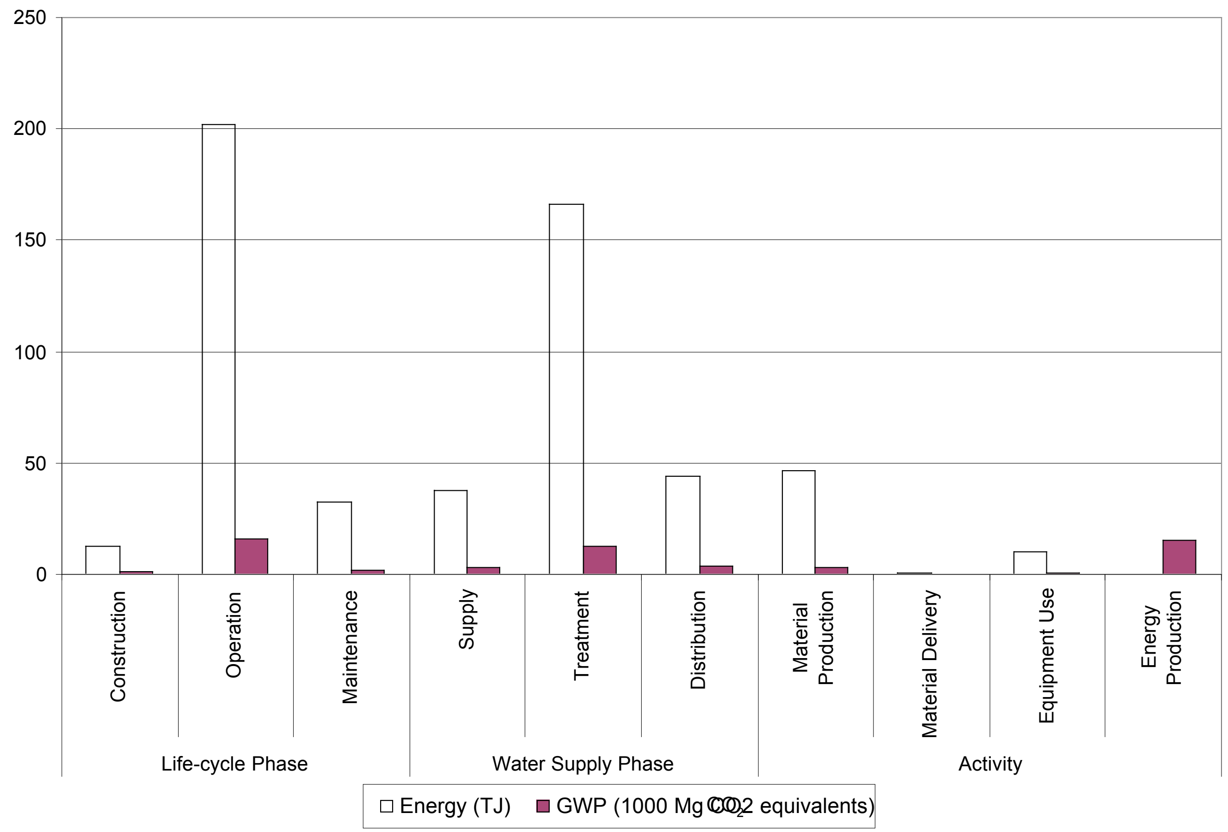
Solution: Development of probabilistic runoff forecasts that can give reservoir managers greater confidence in their decisions as well as development tof decision support models that help managers balance competing water demands.



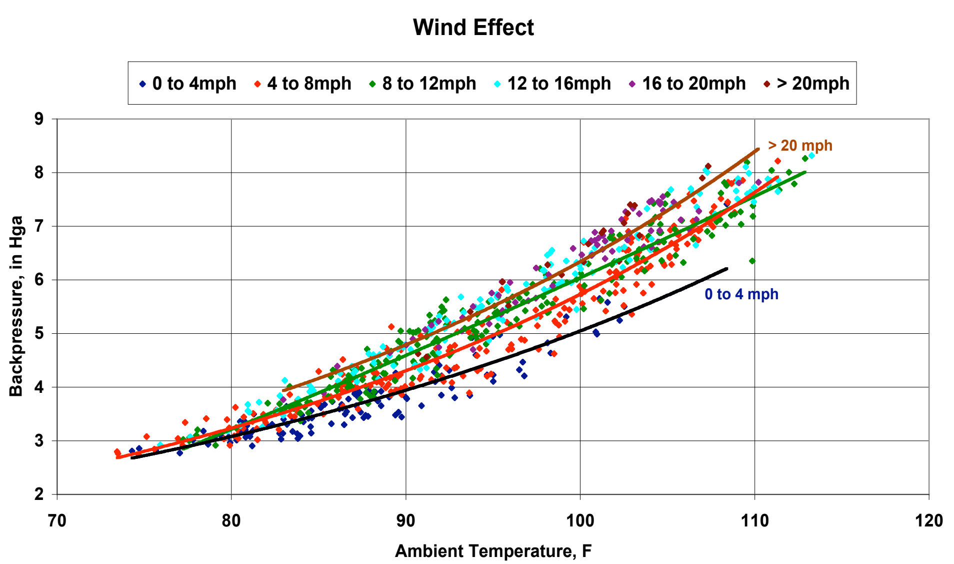
Life Cycle Analysis Tool for Water Utilities

Problem: What are the energy and environmental trade-offs between alternative water supply options for local water districts?
Solution: Development of a life-cycle assessment model for evaluating construction and operation of water supply and wastewater treatment systems in California

Figure 7: Annual Average Energy Use and GWP Results



Improved Dry Cooling Technology



Problem: *Use of an air-cooled condenser (dry cooling) can reduce power plant water use by up to 95% but performance is affected by with sudden wind a performance penalty during the hottest hours of the year can be lost.*

Solution: Research has demonstrated that 75% of this lost capacity can be recovered by introducing just a small spray of water into the air passing through the dry cooling towers. Other on-going efforts to improve dry cooling performance include modeling the effects of wind and evaluating measures to reduce air recirculation effects.

DIGITAL CONTROL SYSTEM FOR OPTIMAL OXYGEN TRANSFER EFFICIENCY

Problem

- Aeration of wastewater is energy intensive.
- Excess aeration wastes energy.
- Inadequate aeration violates health regulations.
- Optimum aeration is essential.
- Current aeration monitoring technology is bulky, expensive, and is not deployed often enough to keep the aeration process fine tuned, resulting in wasted energy.

Solution

- Develop a light-weight system for accurate monitoring and control of aeration levels.
- This will reduce electricity demand.
- The new small size and light-weight equipment will allow activated sludge wastewater treatment facilities to conduct aeration efficiency measurements .in-house on a regular basis with minimal technical assistance.

CALIFORNIA AGRICULTURAL WATER ELECTRICAL ENERGY REQUIREMENTS

- Problem
  - Irrigation districts deliver water to farms using fixed water delivery schedules.
  - Farmers want water at a time different from the fixed schedule, and resort to ground water pumping.
  - Pumping ground water is more energy intensive than receiving surface water from irrigation district.

- Solution
  - Develop an automatic control where a gate is operated remotely by the irrigation district.
  - Automation cuts down on energy and manpower, and gives farmers a viable option for using surface irrigation water.

ZERO LIQUID DISCHARGE FOR INLAND DESALINATION

- Problem
  - Rapidly growing California's inland communities will desalinate brackish inland waters to meet future water needs.
  - Affordable desalination is needed in inland areas to make brackish water sources useable.
  - Brine waste can not be disposed of by discharge into the ocean.
  - Economical methods of treating the brine waste to recover product water is needed.
- Solution:
  - Develop a novel technical approach involving alternating applications of reverse osmosis (RO) with other processes .
  - Remove the least soluble salts that limit product water recovery in the primary RO and reduce brine waste volume.
  - Demonstrate the feasibility of a cost effective energy efficient membrane-based Zero Liquid Discharge (ZLD) system.

Thank You

www.energy.ca.gov

References

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Refining Estimates of Water Related Energy Use In California

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California's Water-Energy Relationship

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Integrated Energy Policy Report, 2007

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