

California Energy Commission
Quadrennial Water Review Comments – June 19, 2014
Water-Energy Nexus

Water and energy systems are inextricably linked -- producing energy uses large quantities of water, and treating, transporting and heating water consumes large amounts of energy. Water delivery and wastewater treatment systems are among the largest consumers of energy in the nation. Reducing water use translates into direct energy savings.

Since the California Energy Commission issued its landmark finding in 2005 -- that water-related energy uses account for about 19% of all electricity and 30% of non-power plant natural gas used within the state -- California's water and energy sectors have been collaborating on strategies for achieving the incremental resource, economic, and environmental benefits that can be found at the intersection of water, energy, and climate.¹ Climate change will be one of the major challenges facing water resources in this century, along with increased population growth.

California unprecedented drought brings this point home. California has approximately 14,000 megawatts of hydroelectric generation capacity, or about 25% of the state's electricity production capacity. Actual annual in-state hydroelectric production varies from year to year. Hydroelectric production is a declining portion of California's in-state generation mix. Currently it averages about 14% of total in-state power production, down from closer to 60% in the 1950s.

In the last year, California has experienced some of the driest periods on record, leading the State and federal government to announce extremely low water allocations. California is currently in a three-year drought period, with snowpack and reservoirs levels extremely low. California's hydropower resources are estimated to produce less than half of normal in 2013.

In light of these conditions, on December 17, 2013, Governor Brown directed agency leadership in Department of Food and Agriculture, State Water Resources Control Board, Department of Water Resources, and Office of Emergency Services to convene an interagency Drought Task Force to meet weekly and review expected allocations, state preparedness, and whether conditions warrant declaration of a statewide drought. The Governor took action to declare a State of Emergency on January 17, 2014, that will address growing water, agricultural, and economic concerns around the state.

Over two dozen agencies are now part of the Governor's ongoing Drought Task Force. The California Energy Commission, California Public Utilities Commission, California Independent System Operator, State Water Resources Control Board, and Department of

¹ <http://www.energy.ca.gov/2005publications/CEC-700-2005-011/CEC-700-2005-011-SF.PDF>

Water Resources also meet weekly with the Governor's Office to develop tools to provide assessment of drought impacts on hydropower generation and water needs of thermal generation, and to monitor continuing or emerging issues that impact California's electric grid, including additional costs associated with replacement power expenditures, in 2014 and into the coming year if the drought persists.

California Water-Energy Coordination Efforts

Even before the drought, and despite decades of separate jurisdiction, California's water and energy sectors are working together collaboratively through a variety of agency and stakeholder forums to advance understanding of the state's water-energy nexus, all with the goal of reducing carbon emissions.

AB 32 Scoping Plan

Assembly Bill 32 required the California Air Resources Board to develop a Scoping Plan that describes the approach California will take to reduce greenhouse gases (GHG) to achieve the goal of reducing emissions to 1990 levels by 2020. The State's roadmap for reducing greenhouse gas emissions, AB 32 includes sections that require significant investments in water conservation, water efficiency projects and water recycling.

The Scoping Plan was first adopted by the Board in 2008 and must be updated every five years. The Board approved the First Update to the Climate Change Scoping Plan on May 22, 2014. Multiple state agencies will continue to develop a comprehensive approach to reduce emissions from the energy and transportation sector. The Update also highlights roles for the water, agriculture, forestry and natural resources sectors to both reduce greenhouse gas emissions and strengthen those sectors against the impacts of climate change.

Energy Principals Group

Executive leadership from the California's energy, air, and water agencies meet regularly to discuss agency perspectives, strategies, and interagency coordination to meet California's goals for reducing GHG reductions. The Energy Principals are currently conducting a multi-agency project to develop a tool to examine pathways for achieving deep reductions in state GHG emissions, including characterization of water supply and demand as it affects energy use. The Energy Principals are also overseeing reliability planning for Southern California with the loss of the San Onofre Nuclear Generating Station, including planning for preferred resources, transmission upgrades, and conventional generation. Contingency planning, should resources not appear in the locations or amounts needed, include a request to delay once-through cooling power plant retirement or fast-tracking specific locations for conventional generation.

http://www.arb.ca.gov/cc/scopingplan/2013_update/first_update_climate_change_scoping_plan.pdf

Water-Energy Team

Founded in 2006, the Water-Energy Team of the Governor's Climate Action Team (WET-CAT) is comprised of state agencies that are tasked with developing strategies to reduce GHG emissions. The Water-Energy Team is one of eleven sector working groups under the Climate Action Team (CAT). Each group is tasked with implementing the various measures contained in the Air Resources Board's (ARB) *Scoping Plan* and the *2009 Adaptation Strategy*.

http://www.climatechange.ca.gov/climate_action_team/water.html

California Climate Adaptation Strategy

The California Natural Resources Agency, in coordination with other state agencies, is updating the 2009 *California Climate Adaptation Strategy*. The draft 2013 *Safeguarding California Plan* augments previously identified strategies in light of advances in climate science and risk management options.

The draft *Safeguarding California Plan* provides policy guidance for state decision makers, and is part of continuing efforts to reduce impacts and prepare for climate risks. The 2009 *California Climate Adaptation Strategy*, one of the nation's first multi-sector plans for preparing for climate risks, provides an excellent foundation for this update. In California and across the globe, our understanding of climate risks and community impacts continues to evolve, both as a result of improved modeling and direct observation of changing climate conditions and extreme weather events. The *Safeguarding California Plan* is not meant to replace the 2009 *California Adaptation Strategy*, but to add new recommendations and replace portions of the prior document where new information allows for updating and revision.

http://resources.ca.gov/climate_adaptation/

See also:

http://www.climatechange.ca.gov/climate_action_team/reports/climate_assessments.html

California Water Plan:

The *California Water Plan* provides a framework for the State's water management in the future. The Plan is updated every five years. *Update 2013* will quantify how future population and socioeconomic scenarios together with climate change scenarios may affect the water demands and water supply conditions and describe strategies that can be used to adapt to climate change. The updated Water Plan will include an implementation plan for recommendations, development of the California Water Management Progress Report, Sustainability Indicators, and Finance Plan. As part of the Sustainability Indicators effort, the increased energy use resulting from decreased groundwater levels may be assessed and the water footprint of production to that of consumption may be evaluated as an indicator of sustainable water use.

<http://www.waterplan.water.ca.gov/cwpu2013/prd/index.cfm>

California-Federal Agency Climate Adaptation Working Group

The California Department of Water Resources (DWR) has established an informal California-federal agency climate adaptation working group, which is largely focused on research activities. Several new federal programs—such as the Department of the Interior Climate Science WET-CAT Update 2011, the National Oceanic and Atmospheric Administration (NOAA) Climate Service, and NOAA’s California pilot project for the National Integrated Drought Information System—offer the opportunity to partner on mutually beneficial activities to develop over the next several years. DWR, for example, is funding tree-ring reconstructions of stream flow in the Sacramento-San Joaquin and Klamath River basins for drought planning purposes, an effort that could be expanded with a federal funding contribution. Federal partnership opportunities exist in the emerging research area of climate and hydrology, extreme events, and adaptation approaches, a topic key for flood management and storm water applications.

California Power Plant Siting

The mission of the California Energy Commission’s Siting, Transmission, and Environmental Protection Division is to ensure that energy facilities are authorized in an expeditious, safe and environmentally acceptable manner. In addition, the division prepares environmental documentation for the Commission as required by the California Environmental Quality Act (CEQA). The Legislature established the California Energy Commission in 1975 and mandated a comprehensive siting process for new power plants. The Legislature gave the Energy Commission the statutory authority to license thermal power plants of 50 megawatts or greater along with the transmission lines, fuel supply lines, and related facilities to serve them. Water supply and use is an important component of the license review process for all forms of thermal power plants, solar, geothermal, or natural-gas fired.

California Energy Commission Water-Energy Research and Development

California’s water and energy resource agencies work collaboratively to develop strategies that achieve large water savings and efficiencies. The Energy Commission’s Energy Research and Development Division funds research, development and demonstration projects that help bring to market technologies that provide increased environmental benefits, energy efficiencies and lower energy costs to California rate payers. The Energy Commission partners with public and private water agencies and industry groups to ensure that funded projects do not duplicate research efforts undertaken by other agencies or research organizations. Recent research results have been incorporated into the Building Energy Efficiency Standards of 2013. Approximately \$12.8 million has been spent on water-energy research since 2006.

The research and development program seeks ways to reduce energy consumption or impacts associated with each step in California's water use cycle, from source to end user. Some examples of recent projects associated with these steps are highlighted below.

Water Supply and Conveyance

Water supply and conveyance is characterized by large water-collection and transportation infrastructure systems throughout the state. Water transported away from its source often requires pumping over hills and mountains and into storage facilities, requiring large amounts of energy. Transporting and treating water for use by residents, businesses and agriculture accounts for about 8 percent of California's overall energy use and about 83 percent of the energy used by the water sector. The RD&D Program focuses on ways to reduce energy use, increase energy efficiencies and advance technologies that reduce consumption of water or increase the use of renewable energy.

RD&D Project: Risks and Benefits of Energy Management for Drinking Water Utilities

Public health and safety, system reliability, and prudent cost management are all dependent upon how well a water utility manages its energy demands and power supply options. The Water Research Foundation (WRF) is a large research organization devoted to drinking water research. In a project funded by the RD&D Program, WRF assessed the risks associated with energy management and energy conservation practices used by drinking water utilities that may impact storage of source waters or the quality of treated water. This project resulted in the development of a reference manual highlighting current trends, energy management strategies, and technologies, and is a source of illustrative applications on risk management framework. The guide characterizes the full range of energy management options available to water agencies and can be downloaded at: <http://www.waterrf.org/Pages/Projects.aspx?PID=3058>

Water and Wastewater Treatment

California has set ambitious goals for increasing its renewable energy by 33 percent, improving its distributed generation of local energy by 12,000 megawatts, and reducing its greenhouse gas emissions 20 percent by 2020. To achieve these goals, California's water and wastewater agency sector must invest in technologies which reduce the amount of electricity needed to treat and deliver clean, safe and affordable water to homes, farms and businesses.

Water treatment facilities use energy to pump and treat water. Overall, about 12% of the water sector's annual electric consumption is used for treating water. The RD&D Program focuses on processes and technologies that treat potable water, wastewater, and storm and urban runoff with the goal of reducing energy intensity of water and wastewater treatment systems and developing options that reduce energy consumption. Also needed are ways that utilities can incorporate gaseous emissions into their energy generation systems.

RD&D Project: CASCADE Clean Energy System for Wastewater

The CASCADE (Computer-Assisted Strain Construction & Development Engineering) Clean Energy solution is a sustainable wastewater treatment model that selects "smart" microorganisms to treat wastewater more efficiently than existing processes. Based on their metabolic characteristics, these "smart" microbes

boost methane production which can then be used by onsite fuel cells to generate electricity for use by the treatment facility. This technology reduces greenhouse gas emissions to the atmosphere – in this case, methane – using it as an energy source.

Water Distribution

The water distribution system is the essential link between the water supply source and the consumer. Pumps allow water to move through the system; valves allow water pressure and flow direction to be regulated along the way. Water utilities determine water demand and distribution based upon customer requirements. Much of the demand for water and energy required to treat and transport water coincide with the seasonal peak energy demands experienced by electrical utilities, so reducing the energy required to distribute water could help avoid power outages and delay the need for building new power generating facilities. The distribution segment of water-use cycle accounts for 5% of all electricity used by the water sector. The RD&D Program seeks projects that reduce energy intensity of distribution systems and assist water distributors to accurately forecast upcoming demand.

RD&D Project: Water Consumption Forecasting Improves Efficiency of Pumping Operations

This project, conducted by EMA, Inc., a technology and management consulting firm, evaluated a variety of short-term consumption forecasting tools that were in use by electric, gas and water utilities. Prototype models of these forecasting methods were then developed and demonstrated by four different water utilities that previously had not been forecasting their consumption. All forecasting methods worked well for the utilities and the level of success was shown to be dependent upon the expertise and commitment of utility staff. This research supports California's goals to identify programs that can reduce electricity demand from the water supply system during peak hours of operation and develop methodologies that reduce the energy needed to distribute water.

Water End Use

Once water has reached the customer, additional energy is needed to heat, cool, clean or pump the water, depending upon its intended purpose. The RD&D Program focuses on projects that develop technologies, tools, and techniques that reduce water use and the associated indirect energy use in the agricultural, residential and commercial industry sectors.

RD&D Project: CO2 Cleaning System Reduces Energy Use in Industrial & Commercial Laundries

In the midst of a drought, wouldn't a water-free laundry be nice? With a grant from the Energy Commission, CO2Nexus is doing just that. Commercial laundries are among the most water- and energy-intensive industries. Each industrial laundry machine can use over 300,000 gallons of water every year. CO2Nexus, Inc. has developed a commercial fabric and textile cleaning system which introduces gaseous CO2 into the cleaning chamber and pressurizes it into liquid form. The garments go through the cleaning cycle, and then the chamber is depressurized, returning the CO2 into its gaseous form, leaving the garments already dry and reducing the need for an additional drying step. This represents a significant opportunity to save water and eliminate the need for gas and electric dryers.

Water for Energy

Besides the critical role of energy to power the water cycle, water is essential to generate most forms of electricity. As water flows, its kinetic energy can be converted directly into hydroelectric energy. The Sierra Nevada snowpack plays a central role in California's hydropower generation because it acts as a natural water reservoir with relatively predictable flow. Research has projected that global warming will increase the proportion of California's precipitation that falls as rain, reducing the annual snowpack, thereby changing runoff timing. The RD&D Program seeks projects that address impacts of energy generation on water supply and quality and ones which assist water resource agencies better manage water supplies and hydropower generation through more efficient forecasting strategies.

RD&D Project: Improving Hydropower Reservoir Management

The Integrated Forecast and Reservoir Management (INFORM) project is an on-going effort that demonstrates the importance of present-day meteorological, climate and hydrologic forecasting for the Northern California river and reservoir system. In close collaboration with water forecast and management agencies, a software system was developed that contains a variety of forecasting components. Extensive tests with historical data and a five-month period of testing for the wet season 2005-2006 demonstrates the value of the system in advancing the current state of forecasting, managing and planning operations in the region. This research cites evidence that existing hydropower systems can be managed more efficiently in meeting water supply, flood control, hydropower generation and environmental protection needs.

California Energy Commission Appliance Standards

Since 1974, the California Energy Commission has been tasked with establishing energy efficiency performance standards for appliances and California buildings. The Appliance Efficiency Program is responsible for a significant amount of in-state water savings. Cumulative savings amount to over 43.1 million acre-feet as of 2013.

In recent years, the authority of the Energy Commission to set standards that also save water has been clarified and expanded (e.g., The Water Conservation in Landscaping Act of 2006 (Assembly Bill [1881, Laird, Chapter 559, Statutes of 2006) requires the Energy Commission, among other things and to the extent funds are available, to set performance standards and labeling requirements for landscape irrigation equipment to reduce consumption of energy or water.)

As part of its current scoping process, the Energy Commission is considering what water-related energy efficiency opportunities should be pursued in the upcoming standards proceedings. Water-saving standards under consideration include further reductions for toilets, urinals, and faucets. Expected adoption for the new standards is expected by December 2014, with an effective date of July 2015. These have potential annual savings of 0.27 million acre-feet per year or 86.6 billion gallons.

CPUC Water Energy Efficiency

The California Public Utilities Commission (CPUC) recently authorized a series of investor-owned utility pilot programs exploring whether energy savings may be realized through water conservation measures. Implicit in this approach is the concept that saving water saves energy. http://www.cpuc.ca.gov/NR/rdonlyres/23B3B3DD-682D-44EB-BF0A-14298018C664/0/AB2404_Report_re_WaterEE_Pilots_4_1_10.pdf

The CPUC's Energy Division is currently analyzing whether an increase in investor-owned utility energy efficiency portfolio emphasis on measures that maximize energy savings in the water sector – such as through leak loss detection and enhancement of water systems efficiency – may be warranted.

The Energy Division is also currently considering how cost effectiveness should be analyzed for water/energy nexus programs. In June of 2011, the CPUC released a draft report on whether embedded energy in water programs should be added to the mainstream energy efficiency portfolios. <http://www.cpuc.ca.gov/PUC/energy/Energy+Efficiency/Water-Energy+Nexus+Programs.htm>