Energy in Water – Dual Savings Opportunities

Testimony of Lon W. House, Ph.D.

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before the

Committee on Energy and Natural Resources

United States Senate

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Thank you Mr. Chairman and members of the Committee. I appreciate the opportunity to address this important legislation. My name is Lon W. House, Ph.D. I am the president of Water and Energy Consulting[1], and I serve as the Energy Advisor to the Association of California Water Agencies. I am the Water-energy consultant for the California Public Utilities Commission, and I am a Water-energy researcher for the California Energy Commission.

The bill, S 531, calls for several studies to collect data on energy usages in water delivery and treatment. This is a laudable effort that should provide valuable information for future reference. In addition to the steps taken in your bill, there are other immediate opportunities to save water and energy that could be implemented now. My testimony is going to provide suggestions in this area. I recognize some of these suggestions are out of the scope of this committee but I am offering them for your consideration as a member of the finance committee Mr. Chairman and Ranking Member Murkowski's role on the Appropriations Committee.

Energy in Water

The use of water requires energy: energy to procure, treat and distribute freshwater, and collect and treat wastewater, as well as the energy the customer puts into water to heat/cool, pressurize, and treat the water for their use. Nationwide, residential consumers alone use 5.5 percent of all the electricity in the U.S. to heat, treat, and pressurize water for their domestic use[2]. The commercial, industrial, and agricultural sectors can use another 8.5 percent of the electricity consumed nationally for their water processing and treatment[3]. The water and wastewater sector consumes about 4 percent of electricity used in the U.S. to supply water to customers and treat the wastewater produced[4].

Projections of Energy Use in Water

There is an increasing need to address water conservation and associated energy conservation in the water sector. There are areas of the U.S. that are subject to chronic water shortages[5], and the energy used for providing and using water is

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[2] U. S Household Electricity Report, Table US-1, Energy Information Administration, available at: http://www.eia.doe.gov/emeu/reps/enduse/er01_us.html (for residential use) and http://www.eia.doe.gov/cneaf/electricity/epm/table5_1.html for total electricity consumption.

[3] California Energy Commission (CEC), 2005. "California's Water-Energy Relationship." Final Staff Report, June 2005 CEC-700-2005-011 http://www.energy.ca.gov/2005publications/CEC-700-2005-011/CEC-700-2005-011-SF.PDF

[4] EPRI, Electric Power Research Institute, 2002. Water and Sustainability (Volume 4): U. S. Electricity Consumption for Water Supply & Treatment—The Next Half Century, No. 1006787, Palo Alto, California.

[5] U.S. Government Accountability Office (GAO) "Freshwater Supply: States' View of How Federal Agencies Could Help Them Meet the Challenges of Expected Shortages", GAO-03-514, July 9, 2003

expected to significantly exceed population growth. In the next decade, water systems are expected to add significant amounts of new electrical load as they access previously unused water sources and address increased treatment requirements[6]. Over the next 45 years, electricity demand associated with supplying water and its treatment is expected to double, alongside population growth. Irrigation pumping and industrial uses (excluding mining), however, are projected to triple in that same time frame[7].

Water Programs Have Dual Water And Energy Impacts

Water conservation and efficiency programs have several characteristics that make them more attractive than simple energy conservation programs.

Water efficiency saves water and energy—energy efficiency saves only energy

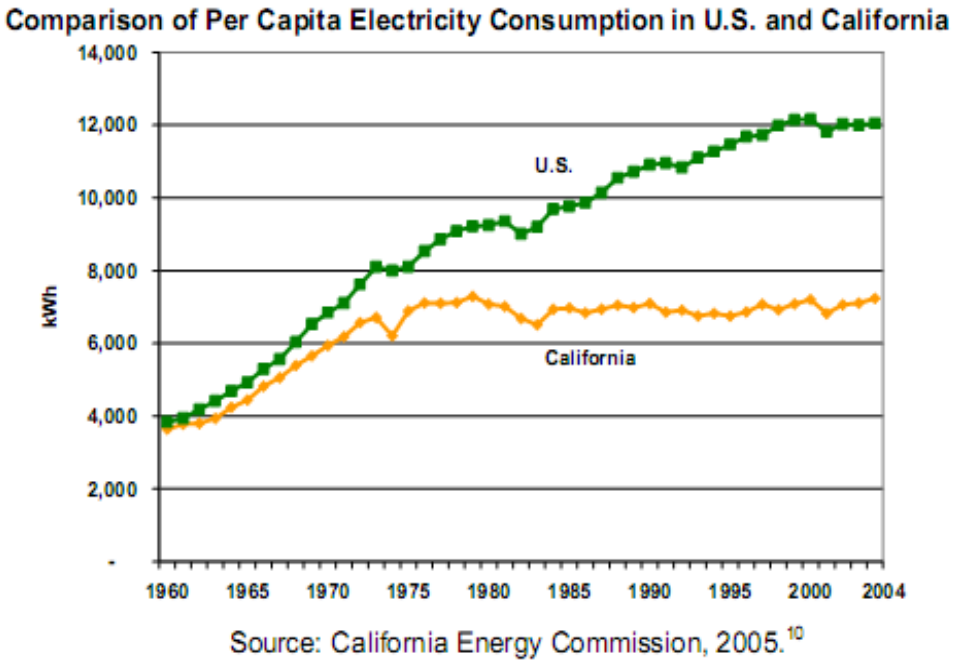
Every time you save water you also are saving the energy that was previously used to treat and distribute that water. Water conservation and efficiency programs give you a double environmental impact for your dollar.

Water efficiency savings are more permanent

Energy efficiency tends to reduce the rate of increase in energy use. This is due to the substitution effect, where the energy savings that are realized with a more efficient appliance or application are often replaced by the energy use of another appliance (the energy savings that come from a more efficient refrigerator are replaced when the customer buys a new flat screen TV). However, when a customer buys a more efficient clothes washer or installs low water landscaping, they don't usually turn around and use that water somewhere else in their house.

The following graph shows that California, through billions of dollars of investments in energy efficiency, has managed to stabilize its per capita electricity usage. By comparison, California has reduced its per capita water usage by 50 percent in the last 40 years. The state's total annual water consumption has remained the same since 1970 even as its population has doubled to nearly 37 million. Its per capita water use has plunged to less than half of what it was then.

[6] House, L. W.2007. "Will Water Cause The Next Electricity Crisis?" Water Resources Impact 9 (1), January 2007.
[7] "Energy Demands On Water Resources", Report To Congress On The Interdependence Of Energy And Water, U.S. Department Of Energy, December 2006.



Water Systems Have an Interest, Ability, and Proclivity to Invest in More Renewable Generation

Water and wastewater systems have a unique opportunity to significantly increase the amount of renewable generation available. They have electrical load (pumping and treatment facilities), available land (for solar and wind), fuel sources (for biogas), and multiple sites for hydroelectric generation. Already in California, water and wastewater agencies have renewable generation over 3,000 MW of existing capacity, with more than 1,000 MW of additional capacity under consideration. Across the nation, these systems have the facilities, professional staff, and local leadership capability to play a foundational role in transforming the nation's energy policy if the proper incentives are available and current impediments are reduced.

Demand/Generation Statistics of California Water Agencies

Demand and Demand Response

Water agencies in California currently ~2,800+ MW maximum demand

Water agencies curtail approximately 400+ MW of on-peak demand

Water agency generation

500+ MW of existing standby generators available

Hydro - 2,547 MW existing, +255 MW new small in-conduit potential

Biogas - 57 MW, +36 MW new potential

Wind - 1 MW, + unknown potential

Natural gas engines - existing ~100 MW, +200 MW additional potential

Solar - 18 MW installed, 48 MW under construction, +500 MW being reviewed by water agencies.

Options for Energy Reductions in Water Sector

Looking at water systems comprehensively (addressing both the consumer and the supply systems) and ensuring conservation, efficiency, and renewable generation projects are designed in tandem creates even greater efficiency and conservation opportunities which can result in significant water and energy savings and dual benefits to the environment.

There are three principle implementation areas within the water sector: 1) reduce the energy embedded in water delivered, 2) reduce the energy in the water used by customers and amount of water used by customers, and 3) increase the amount of renewable generation by water agencies.

1. Reduce the energy embedded in water delivered

Provide incentives to water systems to invest in more efficient system configuration, components, and operation to improve energy efficiency and to reduce peak electric demand.

Energy Efficiency (system redesign and retrofitting of equipment, low-friction pipe, high efficient pumps, adjustable speed drive motors, SCADA [Supervisory Control And Data Acquisition] system installation with real-time pump and process integration, efficient lighting, increased efficiency treatment options). 25% of industrial electricity use and 50% of municipal and wastewater use is due to pumps. High efficiency pumps are typically 20% more efficient. Purchasers typically use lowest installed cost - not lifecycle cost, and purchase the less efficient options. Pumps have a 15-20 year typical life, so the pumps purchased today will be consuming electricity for a long time. Variable Frequency Drives (VFDs) are also a good option on pumps with varying demand to reduce electricity consumed.

Peak Electric Demand/Demand Response (increased storage, aggregation of water system utility accounts, SCADA system installation, improvements to primary/secondary water and wastewater treatment). All water systems have some sort of water storage to accommodate varying demands for water throughout the day. They can use that storage to reduce their pumping during the electrical peak demand periods. In California, the water agencies in the state typically reduce their electrical demand by 400 MW during on-peak hours[8]. Increased water storage facilities could result in hundreds of MWs of additional on-peak electrical demand reduction.

Improve leak detection and reduce system loss (SCADA improvements, Automated Meter Reading (AMR)/Advanced Metering Infrastructure (AMI) installation). There is always some leakage within water systems, due to the necessity to maintain a pressure differential between inside the system and outside the system. As systems age they develop more leaks. The development of relatively inexpensive AMI and AMI allows almost instantaneous feedback on water movement throughout the water distribution system and can allow leaks to be identified and addressed rapidly.

Increase energy utility investments in water system efficiency and demand response. One of the frustrations in California has been the relative lack of ability of

[8] House, L.W., "Water Supply Related Electricity Demand in California", Demand Response Research Center Report, LBNL-62041, December 2006.

water systems to participate in utility energy conservation programs[9]. While this is slowly changing, the utility energy conservation programs typically address energy systems they are familiar with - air conditioning, lighting, heating, etc.–that do not apply to water system efficiency improvements. The ability of increased water system storage to reduce peak electrical demands likewise has been neglected by utility programs.

Increase use of recycled water. The use of recycled water for agricultural, industrial and commercial purposes and for outdoor irrigation results in significant reductions in the demand for water from the environment and in the amount of energy needed by the water sector. The wastewater has to be treated anyway. If that water can be used in lieu of additional fresh water it saves not only all that water but all the energy associated with providing the additional fresh water. California has a state policy that no fresh water can be used for electrical production if there are available alternatives–including recycled water–recycled water is a major component of existing and future water supplies.

Capture and use of stormwater and rainwater. The use of stormwater and rainwater to supplement fresh water sources can significantly enhance available fresh water supplies and are often at energy costs lower than other new sources of fresh water.

Increase research on improving energy efficiency of water systems

Improvements in the energy efficiency of water systems will have long lasting results. Additional research needs to be accomplished in the following areas.

*Reductions in energy requirements of new water supplies (*desalination, membrane technology, well head treatment, integrated water system planning, natural treatments systems)

Reductions in energy requirements of water distribution and service systems

Reductions in energy requirements of wastewater treatment and recycled water systems.

2. Reduce the energy in the water used by customers and amount of water used by customers

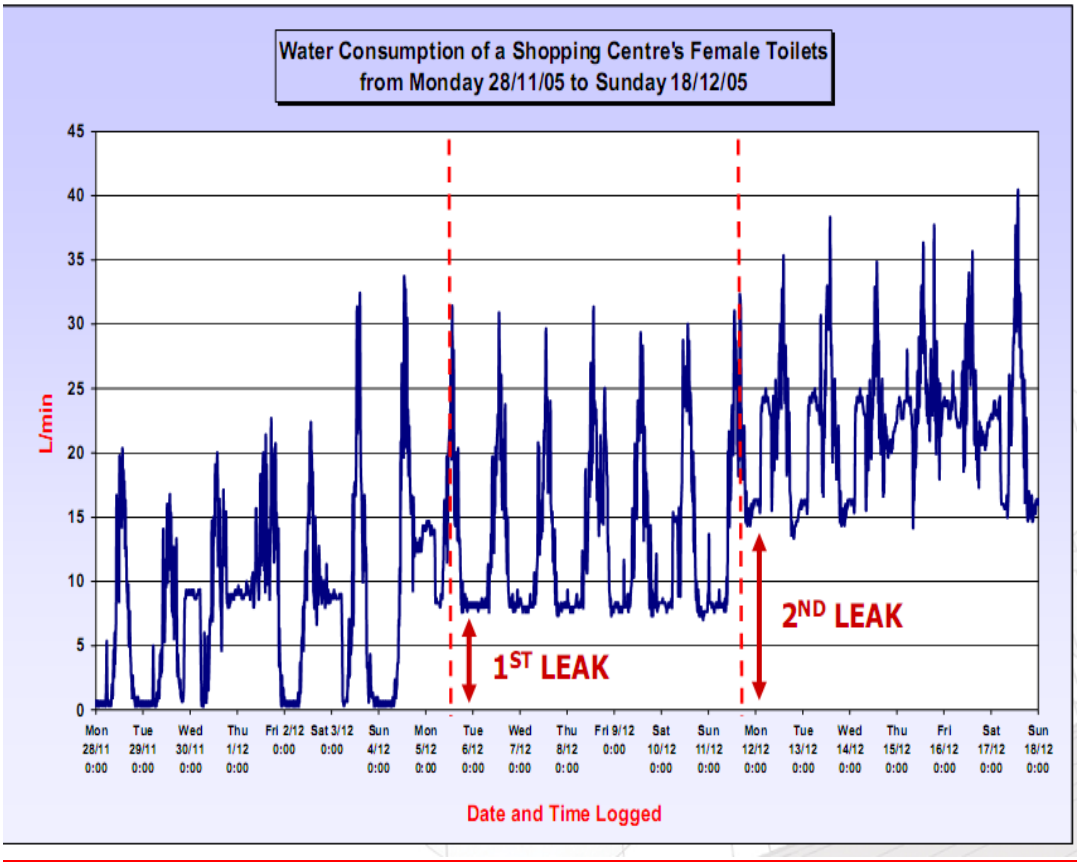
Provide incentives that encourage customers to more efficiently use existing water supplies and to reduce water demand which saves both water and energy.

New appliance efficiency standards (residential and commercial clothes washers, dishwashers, clothes dryers, pool and spa pumps and heaters, showerheads and faucets, toilets, urinals, landscaping irrigation). New appliance standards should be evaluated based upon the contributions of both their water and energy savings.

Rebates/grants/tax credits for efficient appliances that go beyond current standards (aggressive production tax credits spur market share growth for the most energy and water efficient appliances, combine ENERGY STAR and WATERSENSE labeling). More efficient water-using appliances save both water and energy–directly, as in the case of water heaters, dishwashers, clothes washers–indirectly, by reducing water use as in the case of high efficiency toilets. Incentives for increased efficiency should involve both water and energy savings.

[9] House, L.W. "Public Versus Private Customer Perspectives on Participation in Demand-side Programs", Strategic Planning for Energy and the Environment, Volume 27, No. 3, Winter 2008, pg 59-66.

Improve leak detection (AMR/AMI installation). The development of relatively inexpensive AMI and AMI allows almost real-time water consumption information, which makes customer leak detection virtually instantaneous, as the following graph illustrates. This allows customer leaks to be identified and fixed much more rapidly than has been the case in the past.



Incorporate water efficiency requirements into new construction and upon resale (LEED standards, plumbing fixtures, appliances, landscape and landscape irrigation, cooling towers, decorative and recreational water features). New construction and transfer of ownership presents a unique opportunity to reduce water consumption which, once accomplished, continues to save water and energy for an extended period of time.

Increase electric and gas utility programs in water programs. There is a need to increase electric and gas utility programs in water efficient appliances and processes. Allowing energy utilities to partner with water systems on water conservation projects as part of their energy saving portfolios has tremendous potential. California has a pilot program through the California Public Utilities Commission (CPUC) that allows the investor owned energy utilities (IOUs) to partner with water providers to implement jointly funded programs designed to save energy via water savings[10]. This pilot focuses on efforts that conserve water, use less energy-intensive water, make delivery and treatment systems more efficient, and determine actual water savings and actual energy savings.

[10] A.07-01-024 et. al.

3. Increase the amount of renewable energy generated by water agencies.

Provide incentives and remove impediments for water systems to become more energy self-sufficient and, where possible, to feed renewable power into the grid. It should be noted that the majority of water systems are government owned, and traditional incentives such as tax credits have limited effectiveness. About 85 percent of the fresh water systems serving more than 10,000 people in the U.S. are publicly owned, and about 91 percent of systems serving more than 100,000 people are publicly owned. Nearly all of the wastewater treatment plants are owned by public institutions (municipalities or specially designated districts)[11].

Rebates/grants for renewable generation including small hydroelectric, in-conduit hydroelectric, solar, biogas and wind generation. California has a couple programs in this area: the California Solar Initiative (CSI) that deals primarily with solar and the California Self Generation Incentive Program which deals with other types of renewables. For the CSI, California has two levels of incentives–one for tax paying entities that can take advantage of tax credits, and another higher incentive level for those entities that cannot use tax credits. There are constraints in both these programs that result in less renewable generation developing than would otherwise be the case. Specifically, there is a low maximum size allowed (on the order of 1 MW per installation) that results larger projects not being developed, and the requirement that all energy produced must be used on site also truncates the size of these installations.

Tax Credits that promote private public partnerships for renewable energy installation and energy production. The ability of public entities to use tax credits like the CREBS (Clean Renewable Energy Bonds) to develop renewable energy projects provides access to money that would otherwise be unavailable to the public entities. PG&E (Pacific Gas & Electric Company) recently filed an Application for Photovoltaic Program with the CPUC in which they are seeking partnerships in the development of solar projects with guaranteed prices for the solar electricity.

Net Energy Metering programs allow the offset of retail rates with the renewable generation. Net Energy Metering (NEM) tariffs in California allow renewable generation to be credited against retail rates for electricity at the specific location. A major disadvantage of this program is that any electricity generated in excess of use is not compensated for. This results in much smaller renewable projects (particularly solar) than may be economically attractive, as there is no ability to sell excess electricity generated to the utility.

Remote Net Metering Programs that allow renewable generation at one location to be credited against a portion of retail rates another system location. California's AB (Assembly Bill) 2466 is called the Local Government Renewable Energy Self-Generation Program and is codified as Section 2830 of the Public Utilities Code. It allows government entities to generate renewable energy at one location, and have it credited against part (the generation part only) of retail rates at another location. It's size limit is1 MW and the inability to access any other incentives in the development of the renewable project are limiting its usefulness.

[11] USEPA, 2002. Community Water System Survey, United States Environmental Protection Agency, Office of Water, Washington, D.C., December 2002, EPA 815-R-02-005A.

Renewables Feed-In Tariffs that provide a utility standard contract with specified renewable energy price. California's Assembly Bill (AB) 1969 added Public Utilities Code Section 399.20, authorizing tariffs and standard contracts for the purchase of eligible renewable generation from public water and wastewater facilities. It has size limitations (1 MW) and the inability to access any other incentives in the development of the renewable project is resulting in less renewable generation that could be developed.

Conclusion and Recommendations

Thank you for this opportunity to discuss these issues before this Committee. I would like to make the following suggestions.

1. Legislation should recognize and encourage the economic and environmental benefits associated with the energy efficiency-water use efficiency/conservation. Two practical things that could be done now are to combine the DOE energy star program with the EPA Watersense program for water using appliances, and promote the use of recycled water, especially where its use would result in a lower overall energy footprint and have positive environmental impacts.

2. Legislation should encourage the use of renewable energy sources to address energy needs associated with all aspects of water use–recognizing that most of the water systems are publicly owned. Expand the energy efficiency and conservation block grant program in the 2007 energy bill to allow water agencies to be eligible units of local governments. Expand the funding for the CREBS bond program.

3. Legislation should encourage federal agencies to identify opportunities to advance energy and water efficiency, including alternative/renewable sources of energy. Federal installations should be required to use life cycle costs in the procurement process, and take into consideration both the water and energy savings that result from more efficient technologies and processes.

4. Federal Agencies (the Department of Energy and the Environmental Protection Agency) should expand research on improving the energy efficiency of water supplies, water systems, water and wastewater treatment, and in water use.