Californians Rallied to Make Water Conservation a New Lifestyle in 2015, but will the Savings Persist?... What Best Practices Can the Water and Energy Industries Learn from Each Other?

Katie Elliott, MCE
Ted Elliott, Elliott Family Cellars

ABSTRACT

Water conservation[1] has become a new lifestyle in many parts of California. In fact, many communities exceeded the 25% state mandate, despite relatively low fines and enforcement penalties levied on consumers. Yet, in the energy efficiency field, despite decades of spending millions of dollars through public goods charges, reductions in energy use are closer to 1-3% annually. Key factors include social norming (if your neighbors are browning their lawn, you should, too!), sheer marketing power (you've seen the highway marquee signs about the importance of conserving water, but how about energy?), and program approach (sure, everyone loves a free light bulb from their utility, but the success on the water side came from a much larger movement of players working in concert together). If we can analyze what's enabled such tremendous water savings in many communities – both in the recent California drought and in other states and campaigns across the U.S., can we apply these lessons and tactics on the energy side?

Can energy utilities overcome formidable regulatory and institutional barriers so they, too, can lead innovative campaigns that result in similarly impressive results?

And are the water savings here to stay, or will they fall prey to the rebound effect after a year of El Nino storms?

This paper examines the factors that have made saving water a bigger splash (at times) than saving energy, and what insights each industry can learn from the other.

Introduction

The Next Water-Energy Nexus

The water-energy nexus is a big buzz these days. And rightfully so. The transportation, treatment, disposal, and heating of water and wastewater accounts for 20% of California's total electricity consumption and 30% of its non-power plant related natural gas consumption (CEC 2005). Experts across the country are exploring ways to reduce the energy-intensity of water, and the water-intensity of energy – on both the supply and demand side.

The buzz this paper aims to create is on the "next water-energy nexus": applying the successful underpinnings of each sector to transform the other. It is more policy and programmatic than purely technical.

[1] The authors recognize the technical and programmatic distinction between "conservation" (turning something off) and "efficiency" (using less without sacrificing performance or comfort), but use the terms interchangeably in this paper for the sake of simplicity. The authors hope that greater emphasis is put on water *efficiency* in the coming years, rather than exclusively on *conservation* – the gold standard can be smart irrigation controllers and drip irrigation rather than a brown lawn, for example. Likewise, the authors believe the energy industry has been wise to focus on things like a higher SEER and HVAC controllers rather than promoting the outright elimination of air conditioning.

Background

This paper examines similarities and differences between the approach to save water and the approach to save energy, and what the two industries can learn from each other. The case studies in the following section are presented to spark ideas for energy efficiency program administrators and implementers. The authors' hope is that water utilities may also learn from the success of their peers, and that regulators will work to break down barriers hindering conservation. Table 1 provides high-level background.

Table 1. High-level summary of similarities and differences between water and energy industries

Item	Similarities	Differences
Regulatory framework	Political and regulatory complexities	Stronger framework to advance energy efficiency than water conservation (decoupling, public goods charge, loading order preference, state goals, etc.); different approaches to rate-setting; different levels of public input; water utilities subject to conservation disincentive
Infrastructure	Much of core infrastructure is ageing; rapid new developments in software technology	Significantly higher penetration of AMI for energy than water (thereby greater potential for data-based efficiency solutions)
Consumer awareness	General lack of awareness	Consumers typically hold a tangible view of water as either scarce or plentiful (depending on climate); whereas their view of energy is more abstract
Workforce	Shared challenges like "silver tsunami" (aging workforce near retirement age)	Most water utilities are relatively small compared to energy IOUs, and have fewer employees by comparison
Procurement	Typically high cost of securing new supplies	Energy can be generated from many renewable and non-renewable sources, whereas there is a finite amount of freshwater (and desalination is very expensive)
Footprint	Regional-based	Different economies of scale: energy field dominated by large IOUs while water providers are typically small municipalities

Water and Energy: Sister Resources Living Worlds Apart

These two precious commodities share much in common – political/regulatory complexities, ageing infrastructure, a general lack of awareness by their users, workforce challenges like the "silver tsunami", general consumer price inelasticity, typically high cost of securing new supplies, and potential for significant hardship and economic impact in the event of supply shortage or disruption.

Despite their many shared attributes, water and energy exist in wildly divergent regulatory and institutional constructs, with vastly different legal frameworks, governance structures, and financial models.

Stronger regulatory framework advancing energy efficiency. At least 25 states have enacted or have pending electricity or gas decoupling[2] legislation, some states also allow bill charges to promote efficiency, and some states allow utilities to earn shareholder incentives for meeting or

[2] Decoupling is a regulatory mechanism that separates sales from revenues.

exceeding efficiency targets. In addition, some states, like California, have adopted a "loading order" policy that gives preference to efficiency in its resource acquisition strategy. Furthermore, many states have enacted strict appliance and equipment standards that exceed federal standards (occasionally by a wide margin). These regulations contribute to a sizable workforce created around an industry that has significant and (generally) reliable funding streams.

Despite the tremendous effort required to comply with progressive energy efficiency regulations, much of the success of the energy efficiency field is due to the necessary innovation that energy utilities have undergone to comply with – and benefit from – the many regulations they're subject to. Indeed, efficiency is the new normal for a majority of large energy utilities.

Meanwhile, the majority of water utilities are small municipalities (not large investor-owned utilities), with limited regulation outside a mandate to provide "cost-of-service" pricing and meet water quality regulations. Very few water utilities have decoupling. The author is unaware of any water utilities with a conservation ("public goods charge") line item.

Conservation disincentives further hinder water utilities from promoting conservation. Not only do water utilities typically lack an incentive to conserve, but many actually experience a *disincentive to conserve.* The two main technical conservation disincentives are "demand hardening" (reducing the "slack" in the system, thereby undermining consumers' ability to further conserve during droughts or supply emergencies) and the "throughput incentive" (whereby revenue declines in step with conservation). A third disincentive is political – water utility governance is by elected officials, who may choose not to promote conservation amidst concerns that it could jeopardize their chance of reelection.

Different approaches to rate setting. Electrical utilities often have more bandwidth in rate setting. Rates for both resources must follow similar guidelines (i.e., be fair and reasonable), but there is much more proliferation of market-based rates for energy than for water. Some might argue that the water industry simply needs better infrastructure to roll out rates that send price signals, but the issue is both technological and regulatory. A series of recent court cases about water rates designed to discourage overuse has spread concern among water utilities about their ability to use rate-setting as a conservation method.

Energy utilities subject to greater public input. Energy utilities operating in states with progressive energy efficiency policies are often subject to a tremendous amount of public input on their efficiency plans, budgets, and program designs. Perhaps if water utilities' conservation plans were subject to a similar level of public input, increased levels of participation and innovation would occur.

Different economies of scale. Water utilities are often much smaller than their energy counterparts in terms of geographic territory, revenue, and number of customers. There are many advantages to being small, but when it comes to running conservation programs and campaigns, there can be great value in economies of scale.

Common Ground: Finding Lightbulb and Watershed Moments

At a basic level, water and energy conservation efforts share a common approach – rebates, marketing, education, and training programs. One key difference is the magnitude and

persistence of savings. On the energy side, these strategies typically lead to annual load reductions of about 1-3% in states with regulatory frameworks that promote energy efficiency (ACEEE 2016). Equivalent water conservation figures are less well studied on a state or national scale with the exception of savings during droughts like the one currently affecting California, where consumers are saving an average of nearly 25% at the time of writing.

Making a Splash with Water Conservation Efforts

Similar to energy efficiency, water conservation efforts come in many forms (i.e. rates, standards, education, partnerships). As summarized in Table 2, this section presents case studies and high-level research on innovative efforts to encourage consumption reduction.

Table 2. Summary of research and case studies presented in "Making a Splash" section

Water Conservation Approach	**Research Institutions**	**Case Studies**
Rate Structures	Water Institute at University of North Carolina; Stanford Woods Institute for the Environment	Centennial Water and Sanitation District
Standards		EPA WaterSense program and California standards
Education and Communication	UC Davis	Denver Water and Marin Municipal Water District
Integrated Demand Side Management		Tampa Bay and MCE

Rates: Overcoming the Price of Cheap

Municipal and private water companies are required to set rates that are fiscally viable, efficient, and fair. They must be based on the cost of providing the service ("cost-of-service" model). Unfortunately, this framework typically does not look at the long-term consequence of having reached "peak water" and over-appropriating water supplies in many watersheds across the U.S. Furthermore, there is a prevailing perception that conservation programs increase rates or hurt revenue. Indeed, conservation is a short-term investment with long-term benefits. Every gallon saved is a gallon that doesn't need to be pumped, treated, stored, and delivered. The challenge lies in the details of designing a rate structure that is fiscally viable, efficient, and fair – *while promoting conservation.*

As illustrated in Table 3, water rates can be classified into three primary buckets: *blocks, flat/uniform, or budgets*. The section below provides an overview of the theory behind how each rate structure promotes conservation.

Table 3. Summary of types of water rate structures and their conservation theory

Rate type	**Overview**	**Conservation theory**
Blocks - increasing or decreasing	Price varies based on volumetric usage	Sends highest users a price signal to conserve (assumes price inelasticity)
Flat/uniform	Same rate, regardless of consumption level	Sends all consumers price signal to conserve (if priced high enough)
Budgets	Volumetric allowance	Encourages consumers to use what utility deems "reasonable" for their needs

Increasing block rates (IBR) have soared in popularity over the past two decades, with over half of the utilities across the county (and two-thirds in California) employing IBR. In theory they send a price signal to the highest users, enabling utilities to cut urban water use and avoid costly infrastructure projects.

Despite its popularity, some researchers warn of potential pitfalls in using IBR to promote conservation. For example, if the highest users are price inelastic, then IBR will do little to achieve reductions. Another issue raised by water economist David Fuente at the Water Institute at University of North Carolina (UNC) is potential for "issues about revenue stability. Furthermore, in the absence of real-time data and sophisticated dashboards, IBR sends unclear economic signals – customers don't know how much they've used, what block rate they're in at any given time, or the marginal price they face" (D Fuente, Researcher, University of North Carolina, pers. comm., March 3, 2016). And furthermore, a recent court case in the 4th District Court of Appeals in California ruled against scarcity pricing when the prices do not correspond directly to the cost of providing service. If this ruling holds as a precedent for other utilities interested in scarcity pricing models, it may significantly hinder utilities' ability to promote conservation through IBR.

Another rate type with conservation potential is **flat or uniform pricing** (with subsidies for low-income households, if affordability is a concern). Water is a normal good and economic theory and empirical studies suggest that customers will reduce water use if prices are increased. Fuente cites heating oil in Maine as a model rate structure – the resource is priced by the market (theoretically expensive enough to promote conservation), and the equity issue is solved with subsidies for low-income households.

Another approach gaining popularity is **water budgets**, which are volumetric allotments of water based on customer-specific and conservation needs. For utilities, benefits can include stable revenue generation, efficiency, and drought responsiveness. However, water budgets require more granular customer data. Initially, they were used by only a handful of water agencies in California. By 2007, at least 25 water providers across the U.S. used water budgets. Centennial Water and Sanitation District in Colorado documented an average of 25% reduction in demand after implementing its water budget program in 2003. In the following five years, demand has decreased 18-31% despite population growth (Mayer 2008).

In sum, the mainstream approach to rate setting is financial-based (such as IBR). Meanwhile, some think tanks, like the UNC Water Institute, suggest an economic approach (such as uniform pricing), which has seen great success in scarcity environments, like Australia.

Rates are an area where electric and gas utilities arguably lead the way in promoting conservation (through tiered rates and real time pricing), although energy budgets are unchartered territory for electricity and gas utilities.

Of note, although it's out of the scope of this paper, is the debate over water as an "economic good" or "public good". With the agricultural sector using 75-80% in many western states, the debate over water appropriations and privatizing water has far-reaching effects (B. Beopple, Assistant Director, State of the Rockies Project, pers. comm., March 2, 2016).

Standards are Golden

To complement the market-based approach of rate setting, standards are a key regulatory mechanism with vast untapped water conservation potential.

In 1989, Connecticut was the first state to enact water efficiency standards. A handful of other states followed, and the federal government enacted national standards as part of the U.S.

Energy Policy Act of 1992. This legislation set minimum efficiency levels for all toilets, urinals, showers, and faucets manufactured in the United States. At the time of writing, nine states have their own mandatory standards for plumbing fixtures (California, Colorado, Connecticut, Iowa, Georgia, Nevada, New York, Texas, and Washington) – see Figure 1 below.

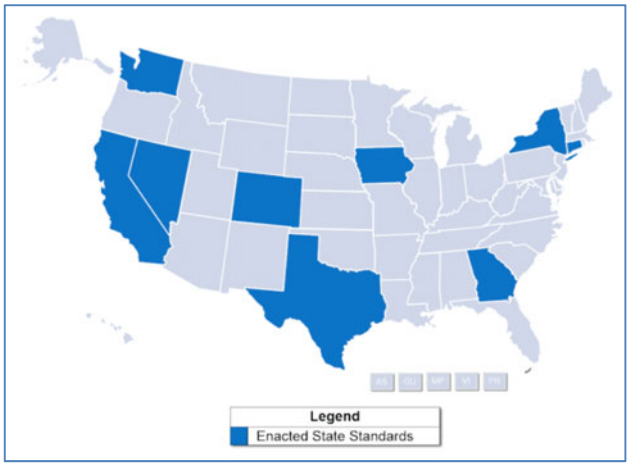

Figure 1. States with mandatory plumbing standards. *Source*: National Conference of State Legislators 2015

WaterSense program. In 2006, the U.S. Environmental Protection Agency (EPA) created the WaterSense Program, which is a voluntary national program that certifies products using 20% less than the federal minimum without sacrificing performance. According to its website, "since the program's inception in 2006, WaterSense has helped consumers save a cumulative 1.1 trillion gallons of water and more than $21.7 billion in water and energy bills" (WaterSense 2016). By comparison, the EPA's energy efficiency corollary, ENERGY STAR "has grown to represent products in more than 70 different categories, with more than 4.8 billion sold since 1992. More than 1.5 million new homes and more than 22,000 facilities proudly carry EPA's ENERGY STAR certification, use dramatically less energy, and are responsible for substantially less greenhouse gas emissions than their peers" (ENERGY STAR 2016).

California leads the way. California currently leads the way in water efficiency standards (as well as energy standards). Governor Jerry Brown's 2015 drought Executive Order mandated emergency regulations to improve the efficiency of water appliances, which enabled the California Energy Commission to accelerate approval of water appliance standards. These standards are significantly more stringent than EPA's WaterSense program (for example, usage in urinals will be cut in half). The national Conference of State Legislature estimates that California's water efficiency standards could save over 10 billion gallons of water in the first year.

Standards are a catch-22 for water utilities, while some energy utilities have a revenue recovery mechanism and even can earn shareholder incentives from energy savings resulting from codes & standards. One notable difference between energy and water utilities' approach to conservation standards is how comparatively large some energy utility's standards departments are. For example, the California investor-owned utilities (IOUs) collectively received $45.5

million between 2013-2015 to run a statewide codes and standards (C&S) program. Furthermore, C&S energy savings are included in the calculation for the IOUs' energy efficiency shareholder incentive process. The C&S work is enabled through the public goods charge, and is financially sound due to decoupling and a shareholder incentive mechanism.

For water utilities, promoting the development of stringent standards could put them out of business because they don't have a mechanism to offset the revenue loss.

Education and Communication is Key!

Conservation education and communication are often the first line items to be cut from utility budgets in times of fiscal drought, yet have potential to be tremendously impactful. This section highlights the approaches and successes of Denver Water and Marin Municipal Water District, as well as emerging research from UC Davis.

Denver Water conservation campaign. According to Conservation Specialist Michael Thomas, Denver Water has been "creating a culture of conservation" since 1936, when it first advertised on street trolleys asking customers to conserve. Since 2006, Denver Water has run a "Use Only What You Need" campaign. Videos and billboards standout with catchy phrases like "Don't Be That Guy" – see Figure 2. In addition, Denver Water uses bus advertisements, sandwich board-wearing conservation ambassadors, and large educational sculptures. The utility estimates the messaging campaign has played a key role in reducing consumption by at least 20% (Denver Water 2016).

Figure 2. Denver Water's advertising campaign includes a series of catchy billboards. *Source*: Denver Water

In addition to the education and advertising campaign, the utility provides free audits at customers' request. Of the approximately 1,200 audits it conducts each year, it found that over 55% have at least one leak. It also discovered (not surprisingly) that less than half of customers have evapotranspiration controllers designed to ensure landscapes are watered only when needed.

Denver Water cites customer satisfaction and communicating the value and need to save water as key drivers for the audits and marketing campaign. The impressive 20-30% savings it

achieved was icing on the cake – and considering the scarcity of securing new water resources in the Denver area, the author conjures that the conservation campaign likely has long term financial benefits, too.

Marin Municipal Water District (MMWD) Education Program. MMWD reaches 10,000 school kids each year through its education program. MMWD offers field trips, assemblies, and classroom visits. It uses interactive "journals" and home audit checklists to engage students in the content. MMWD is committed to bringing the material to life, by always starting programs with interactive games. Students are asked to fill out a survey at the end of each program, and receive a deck of wildlife cards to take home (which is great branding for the agency).

Director of Conservation Dan Carney proclaimed: "what really makes conservation work in the long run is engaging people in their hearts and minds – making it meaningful for them and their community. Effectively communicating the value to those individuals is a lifetime achievement; that's what we call a *water-lightbulb moment*. That person will be motivated for the rest of their life" (D. Carney, Director, Marin Municipal Water District, pers. comm., February 28, 2016).

Part of the rationale for the education program is to create a generational shift. Until recently, many students learned the hydrology cycle in such a way that makes water seem "renewable" – and ignores the grave consequences of depleting non-rechargeable aquifers or overpumping lakes, rivers, and streams. Carney explains, "Culturally, water has been taken for granted. Everyone has a blue recycling bin. We need to catch up on the water side" (D. Carney, pers. comm.).

On the value of education programs, Carney states: "there's no question in my mind that a dollar invested in high quality water education is the best investment in conservation that we can make" (D. Carney, pers. comm.).

UC Davis Center for Water-Energy Efficiency. The Center is partnering with utilities in California to test the impact of deploying WaterSmart Software – often dubbed "the Opower of water conservation – on both water *and* energy consumption in the residential sector. WaterSmart educates consumers on their home water use by mailing home water reports to customers that benchmark them against their peers and provide customized suggestions on reducing water usage.

Preliminary results show an average of 2.5-3.5% water savings within the first few months of program deployment via randomized control trial (Edward Spang, Associate Director, UC Davis Center for Water-Energy Efficiency, pers. comm., March 17, 2016). In terms of energy savings, the initial results suggest no spillover savings occurring in household gas usage, but a 1.2-2.4% reduction in electricity use was detected.

Originally, the study authors expected to see some gas savings coincident with water savings given the widespread use of gas hot water heaters in California (i.e. if a household is conserving significant amounts of hot water as well as cold water you might expect lower water *and* gas bills). While the link to gas usage is not yet evident, the results do suggest a spillover effect from saving water to saving electricity. Perhaps consumers are transferring a conservation mindset from water to electricity, e.g developing new habits to save water may influence the development of new habits to save electricity. As the study is ongoing, UC Davis will continue to refine their analysis and understanding of the water-energy co-benefits and spillover effect of WaterSmart software and publish their final results at the close of the project period.

Innovation through Integration: Uniting Demand and Supply Side Resources

Conservation forecasts don't typically play a central role in water utilities' supply planning process. However, as aquifers become depleted and droughts increasingly frequent and severe, some early adopters are breaking with tradition.

Tampa Bay Water's experience offers insights for other utilities interested in taking an integrated view of demand and supply side resources. Desalination is an option, but would cost about $7.00/gallon compared to $0.80/gallon for efficiency. To forecast how conservation might impact future procurement needs, Tampa Bay conducted a potential study by collecting market saturation data, then analyzed billing and appraisal data. Efficiency levels were then defined through "passive" (standards) and "active" (incentive and education programs) approaches. Tampa Bay is forecasting 13% savings by 2035 (9% passive; 4% active). The utility forecasts $50 million in savings at a cost of $28 million.

Integrated demand side management (IDSM) is a buzz in the energy field. MCE, a community choice aggregator in Northern California, is one of many energy utilities exploring IDSM. It recently submitted a proposal to the California Public Utilities Commission to create a ten-fold increase in its demand side management savings. The energy efficiency proposal is linked to the company's procurement target of reducing 2% of its annual load through a variety of IDSM strategies.

Tying it Together: Californians reduce consumption by 31% in one month!

Turning back to the question of what can be learned from California's recent drought experience, the case study below describes the success of crosscutting efforts of regulation paired with education, marketing, and collaboration.

In April 2015, Governor Jerry Brown issued a first-ever executive order mandating statewide reductions in water use (Executive Order B-29-15). Nearly a year later, more than 70% of California remained in an "extreme" drought, and nearly half the state in "exceptional" drought – the most severe category according to the U.S. Drought Monitor (KQED 2016). Urban water suppliers[3] were assigned conservation standards based on a tiered structure. In the most efficient tier (up to 65 residential gallons per capita day), the conservation standard was 8%; in the highest tier (215-612 residential gallons per capital day), the target was 36%. The consequences (financial, and to the state's water supply) received a great amount of press.

Three months after the Governor's Executive Order (July 2015), consumers across the state had reduced monthly consumption a whopping 31%. The drought even "vaulted over all other issues in recent polling as the top concern among Californians" (KQED 2016). These results are especially impressive considering the declining trend in per capita consumption, despite modest population growth, leading up to the drought (which makes additional savings even harder to achieve when starting from an efficient baseline).

California's success is due to a combination of factors: the widely publicized proclamations from political and celebrity figures like Governor Jerry Brown; collaboration across state agencies, local utilities, and nonprofits; huge advertising campaigns; well-funded rebate and education programs; and media shaming of highest users; and the large financial

[3] Executive Order B-29-15 defined "urban water supplies" as "serving more than 3,000 customers or delivering more than 3,000 acre feet of water per year

consequences of not reducing that were imposed[4]. It's an example of command-and-control paired with financial incentives and social norming to create significant behavioral change. Imagine the efficiency reductions possible with hefty fines, daily news reports, highway marquee signs reminding consumers to conserve, and frequent Governor updates and proclamations.

As for the question of whether savings persist is unknown at the time of writing, but February 2016 was the sixth straight month that savings had declined – coinciding with a wet El Nino season and the added challenge of producing ever-increasing savings in winter months when landscaping irrigation needs are lower. In February 2016, monthly savings were 17% statewide (compared to 27.5% in June 2015), bringing the cumulative savings below Governor Jerry Brown's 25% target (KQED 2016). Figure 3 illustrates statewide monthly and cumulative savings, compared to 2013 usage.

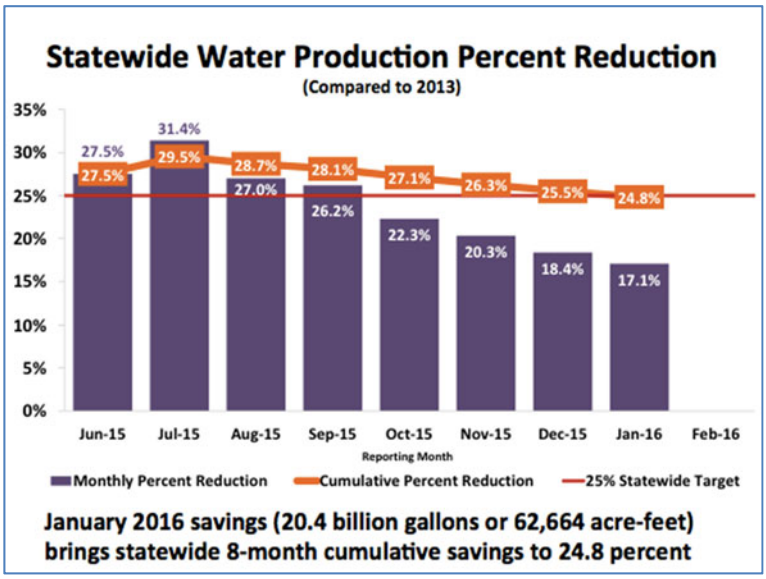

Figure 3: Monthly and cumulative reduction in California water usage from June 2015 to February 2016, compared to 2013. *Source*: KQED 2016.

Despite slacking conservation efforts, urban residential consumption continued to decline. At 61 gallons per day (49.5 in the Bay Area), Californians use more than the 35 gallons per day Australians used during their recent decade-long drought, but significantly less compared to the U.S. national average of 80-100 gallons per capita (USGS 2016). And California's consumers' ability to cut 31% in one month and achieve sustained savings of approximately 25% for nearly a year is quite noteworthy.

Conclusion

[4] Consumer law outlawed this practice, although at the time of publication it was legal to list names of individuals if they have violated a local ordinance. Contra Costa Water District reported the 10 most egregious water users, which included an executive VP of the Oakland A's baseball team, a Giants pitching star, a former Chevron executive, and KTVU news anchor Julie Haener, to name a few. Purportedly the article "shamed them into changing behavior immediately" (D. Heagerty, Director, Public Water Trust, pers. comm., February 26, 2016)

One might argue that the energy industry would be wise to take note on the strategies that enabled successes like California's impressive water reduction and turf removal. However, one could also argue that the energy industry's more measured approach reduces the "conservation fatigue" that can result from the short-term blitzes more common in the water field.

Persistence may also wane more quickly with the blitz approach. For many water conservation managers, conservation disincentives can inhibit a desire for persistence beyond a temporary supply shortage. Meanwhile, energy efficiency program administrators tend to operate under a long-term horizon, aiming for measures with lasting persistence. Sustained market potential ought to be a shared goal for water and energy utilities alike, but formidable barriers persist before that goal is realized.

The "Soft" Path Forward

Amory Lovins famously called for a "soft" energy path, proclaiming that the issue was less a "hard" lack of supply and more a need for a "soft" strategy that favors efficiency and renewables over fossil fuels. It's high time for the water industry to adopt this approach. To get there will require both incremental and disruptive innovation. Small wins must lay the foundation for tidal sea change. And we mustn't forget that it takes a village: command-and-control paired with market forces, education, and behavioral approaches.

Based on the case studies presented herein, and on interviews with water and energy utility experts across the country, the following changes are recommended for water and energy fields alike (where not already adopted):

- Remove the disincentive to conserve – through a combination of regulatory and market-based mechanisms like decoupling and restructuring utility governance models
- Restructure rates to better promote conservation (add a public goods charge!)
- Rollout advanced metering infrastructure (to be paired with rates, technologies, and programs that promote conservation)
- Move the needle on standards
- Expand development of data tracking and analytic platforms
- Bolster partnerships with schools
- Increase conservation outreach through targeted and strategic approaches
- Change utility bills to be more relatable (for example, water bills shown in gallons per day, not cubic-feet-per-second; energy bills with benchmarks and comparisons)

As Douglas Kenney from the University of Colorado Natural Resources Law program summarized, "When I think of conservation, I think the energy sector is so far ahead. Higher rates during peak demand, decoupling, established bill charges to fund conservation. The water sector has a lot to learn from the energy sector. I don't know if people agree with me on that point, but I think the water sector is very much playing catch up" (D. Kenney, Director, Western Water Policy Program, pers. comm., February 26, 2016).

And yet, only about half the nation's states have enacted electricity decoupling and bill charges to promote energy efficiency. Furthermore, 25% statewide energy savings, as has been done on

the water side during California's recent drought, is unheard of in the energy sector. As advanced as many view the energy industry (as compared to water), opportunities exist in both fields, and lessons learned abound.

References

ACEEE blog. *2015 was a good year for energy efficiency. 2016 could be even better*. 2016. http://aceee.org/blog/2016/01/2015-was-good-year-energy-efficiency

Ajami, N., B. Thompson, and D. Victor. Stanford Woods Institute for the Environment. *The Hamilton Project: Path to Water Innovation*. 2014. https://woods.stanford.edu/sites/default/files/files/path_to_water_innovation_thompson_paper_final.pdf

California Energy Commission. *California's Water-Energy Relationship*. 2005. http://www.energy.ca.gov/2005publications/CEC-700-2005-011/CEC-700-2005-011-SF.PDF

Denver Water. *Conservation*. 2016. http://www.denverwater.org/Conservation/UseOnlyWhatYouNeed/VideoGallery/

ENERGY STAR. *About ENERGY STAR*. 2016. https://www.energystar.gov/about

KQED. *Drought Watch*. 2016. http://ww2.kqed.org/science/series/california-drought-watch/

KQED. *Drought Watch. MAP: California Water Conservation Misses Governor's Mandate in January*. 2016. http://ww2.kqed.org/science/2016/02/25/california-water-conservation-misses-governors-mandate-in-january/

Mayer, Peter. *Water Budgets and Rate Structures: Innovative Management Tools*. 2008. http://www.mwdoc.com/WACO/2010/10-0402%20WACO%20-%20AWWA%20Article%20on%20Tiered%20Rates.pdf

Quesnel, K. and N. Ajami. ReNUWIt. *Funding Water In Times of Uncertainty: The Case for a Public Goods Charge in California*. 2015. http://waterinthewest.stanford.edu/sites/default/files/Ajami-PGC-WhitePaper-FINAL02172015.pdf

Quesnel, K., N. Ajami, and N. Wyss. Stanford Woods Institute for the Environment. *Tapping Into Alternative Ways to Fund Innovative and Multi-Purpose Water Projects: A Financing Framework from the Electricity Sector*. 2016. http://waterinthewest.stanford.edu/sites/default/files/Woods%20Funding%20Water%20Projects%20Whitepaper%20v09.pdf

USGS. *Water Questions and Answers*. 2016. http://water.usgs.gov/edu/qa-home-percapita.html

WaterSense. *About Us*. 2016. https://www3.epa.gov/watersense/about_us/index.html