

Saving Water and Energy Together: Helping Utilities Build Better Programs

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Executive Summary

Water and energy are inherently linked, intersecting at both the supply side (electric generation and water/wastewater facilities) and the end-use side (residential, commercial, industrial, and agriculture sectors). This intersection is commonly called the “energy-water nexus.” On the supply side, this intersection is apparent in the massive amounts of water needed to produce and deliver electricity while huge amounts of energy are required to treat and transport water. On the end-use side, energy and water are connected in our homes, businesses, and industrial facilities. The water-energy linkage means that efficiency programs that save water will also save energy and vice versa. If utilities recognize this intersection and work together on joint programs they could learn from one another, document savings, share costs, and potentially achieve greater savings.

Although there are examples of collaboration going back to the early 1990s, experience with jointly run water and energy efficiency programs has been relatively limited. However, there are several program areas where collaboration can be mutually beneficial and should be more fully implemented. The program types profiled here are good recent examples in the residential, commercial, industrial, agricultural, and municipal (water/wastewater) sectors, all with several promising models for joint water and energy utility-run programs.

RESIDENTIAL

Some residential energy efficiency programs are already integrating energy and water by implementing cost-effective programs that save both energy and hot water resources. However, we believe that there are more opportunities that utilities can take advantage of to achieve greater savings, particularly those that include embedded energy savings on the cold water side. There are many residential program models that lend themselves to being jointly run by both water and electric utilities such as equipment and technology programs, whole home efficiency approaches, behavior and information feedback, new construction, and resale program opportunities. One example of a successful joint programs is the collaboration between the Pacific Gas and Electric Company and East Bay Municipal Utility District who work together to administer a high-efficiency clothes washers rebate program (Cluett et al. 2013; PG&E 2013a). There are also opportunities for multifamily joint programs such as the Puget Sound Energy program run in partnership with the Saving Water Partnership. The program provides multifamily building owners with free energy audits and retrofit incentives for energy- and water-saving appliances (PSE 2013).

COMMERCIAL BUILDINGS

Commercial buildings include a large range of facilities such as offices, hotels and motels, warehouses, schools and universities, laundries, retail stores, and many other commercial activities. The largest energy uses in commercial buildings include heating, cooling, ventilating, water heating, office equipment, and a variety of process loads. Due to this range of needs, there are many opportunities for joint water and energy efficiency programs that are customizable to the particular commercial facility. Program models that seem to be well suited for joint administration include equipment and technology programs, whole building efficiency, and new construction opportunities. The SureBet Business Energy Efficiency program, offered by NV Energy, works to retrofit and upgrade commercial operations in commercial buildings in their service region. One of their projects was with

JW Marriott, where they completed a retrofit of an older steam cooker with a high-efficiency electric steam cooker in one of the hotel's kitchens, resulting in water and energy savings (NV Energy 2013).

AGRICULTURE

Energy and water use on farms can be very high and due to the scale of farming (thousands of acres, hundreds of thousands of animals), small changes can dramatically reduce water and energy use. Energy and water efficiency in the agricultural sector can be increased through awareness of established techniques that increase efficiency and implementing new technologies where appropriate. Water and energy utilities can use their differing strengths to implement effective energy and water efficiency programs together that save money and reduce waste on farms. For example, Southern California Edison (SCE), Pacific Gas and Electric (PG&E), the U.S. Environmental Protection Agency, and Western United Dairywomen partnered together to provide dairy farmers with an informative half-day workshop. Participants receive information and partake in comprehensive discussions on SCE and PG&E rebate and incentive programs, energy cost reduction strategies, and how to develop and finance energy efficiency, water quality, and air updates (PG&E 2013b).

INDUSTRIAL PROCESSES

The industrial sector offers tremendous opportunities for energy and water savings through the implementation of energy and water efficiency within existing facilities and industrial processes. The industrial sector typically includes manufacturing, mining, construction, and agriculture, and there are opportunities for joint water and energy efficiency in all of these sub-categories. In this report we primarily focus on manufacturing and we talk about agriculture separately. Manufacturing efficiency programs include a few different approaches such as efficiency target support, Strategic Energy Management (SEM), and working with small and medium-sized businesses. These strategies can be deployed to improve efficiency of equipment in a facility or to improve the efficiency of the process or system. For example, the City West Water in Melbourne, Australia undertook a steam efficiency program to improve the water and energy efficiency of its business customers' steam systems. The program provides free steam system audits highlighting efficiency improvement opportunities and training. City West Water monitors the potential savings of improvement opportunities identified through the steam system audit reports, and tracks the progress of implementation of these opportunities through meetings with customers (City West Water 2010).

MUNICIPALITIES (WATER/WASTEWATER)

In many cities, sourcing, treating, and distributing potable water plus collecting, treating and reclaiming wastewater form one of the largest energy-using municipal operations (EPA 2013a). Wastewater facilities consume large amounts of energy and many are becoming increasingly focused on reducing their energy consumption by increasing energy efficiency in their facilities and influencing their customers to reduce water consumption. These programs range from relatively simple equipment updates to whole system retrofits. Saving energy and water in water and wastewater facilities is an opportunity for energy and water utilities to work together. For example, the Sheboygan Wastewater Treatment Plant (WWTP) Energy Efficiency Initiatives program implemented a series of energy efficiency

measures in their wastewater treatment plant and reduced their energy use by 20 percent (Mackres 2011).

CONCLUSIONS AND RECOMMENDATIONS

Utilities should take advantage of the benefits to joint programs by “just adding water” to current energy programs and expanding their objectives and by developing and implementing some of the joint program approaches recommended in this report. Across all sectors there are ample opportunities for water and energy utilities to design and administer water- and energy-saving programs together. As a first step to implementing water and energy utility-run programs, utilities should look to increase collaboration by:

- Beginning a dialogue about opportunities between the two (or more) utilities and establishing relationships.
- Creating utility partnerships for joint messaging.
- Collaborating to identify unique funding opportunities.
- Developing a format to add energy savings calculations to water programs and vice versa.
- Working with energy regulators to establish credit for embedded energy savings from water efficiency programs (and vice versa).
- Creating a clearly communicated strategy with measurable goals to help clarify priorities and cement roles.

Introduction

Water and energy are inherently linked, intersecting at both the supply side (electric generation and water/wastewater facilities) and the end-use side (residential, commercial, industrial, and agriculture sectors). This intersection is commonly called the “energy-water nexus.” On the supply side, this intersection is apparent in the massive amounts of water needed to produce and deliver electricity. Coal, nuclear, and solar thermal energy generation are water intensive. Water is needed to create steam and to power turbines, but most of the water is withdrawn for cooling and then either lost in the process or discharged back into the environment. Conversely it also takes immense amounts of energy to clean and transport water. Water and wastewater utilities consume large amounts of energy to treat water—often running pumps, motors, and building equipment 24 hours a day, 7 days a week. On the end-use side, energy and water are connected in our homes, businesses, and industrial facilities.

The water-energy linkage means that efficiency programs operated by a water utility will benefit an energy utility and vice versa. Energy efficiency is a cost-effective way to reduce water use in the power sector and improvements to water efficiency can reduce energy use by water and wastewater utilities. Since efficiency decreases the demand for energy it also reduces the need to generate electricity and consume water for that generation. In addition, end-use water efficiency reduces the energy demand to treat and transport water from the water/waste water facilities into people’s homes. If utilities recognize this intersection and work together on joint programs they could learn from one another, document their savings, share costs, and potentially achieve greater savings.

Water and electric utilities differ greatly in size, number, business structure, and the regulatory environment they operate in, all of which play a role in how they can create effective joint programs. Ninety percent of water customers are served by publicly-owned and operated servers (EPA 2012b) while about 70% of electric customers are serviced by investor-owned utilities (IOU) (EIA 2013). In addition, water utilities are generally smaller and they serve smaller geographic areas compared to energy service territories, meaning there are a far greater number of water utilities than energy utilities (EPA 2012a). These differences can be challenging for joint electric and water utility-run end-use efficiency programs and in some cases joint programs may not be the best option.¹

Several studies have compiled some of the most prominent barriers to joint water and energy utility water and energy efficiency programs. A recent report from California Public Utility Commission staff identified some barriers within evaluation of embedded energy metrics (White and Zafar 2013) and the Pacific Institute recently published a survey of water and energy managers in California to better understand barriers to coordination (Cooley and Donnelly 2013). The Pacific Institute outlined the top ten most significant barriers to coordination between water and energy utilities in California, in order of what survey participants found to be the greatest barrier. The barriers they found are listed on the next page:

¹ For more information on economic and utility business model barriers, see Dyballa (2013).

1. The water sector has limited or inconsistent funding available for combined programs.
2. Limited staff time.
3. Insufficient guidance about how to equitably allocate costs and benefits among project partners.
4. Water-related pricing policies.
5. Lack of established relationship among potential partners.
6. Insufficient guidance on how to quantify water, energy, and cost savings.
7. Inability to share customer data/customer privacy concerns.
8. Significant temporal and spatial variability in determining water, energy, and cost savings.
9. Too much emphasis on getting perfect information before starting the programs.
10. Energy sector has limited or inconsistent funding available for combined programs (Cooley and Donnelly 2013).

Despite these barriers, collaboration between water and electric utilities can be powerful in that both utilities can explore efficiency opportunities that may not have been cost-effective or feasible absent a joint effort. In addition, profiled in ACEEE's recent report (Young and Mackres 2013) and the Pacific Institute's report (Cooley and Donnelly 2013) are examples of joint programs that were able to overcome these barriers. Below we discuss some of the many benefits of joint water and energy utility run efficiency programs.

BENEFITS OF JOINT PROGRAMS

The inherent link between water and energy is not the only reasons that water utilities and energy utilities should implement joint programs. Below are some of these benefits.

- Joint programs can also help utilities get a greater benefit per customer. Water programs often struggle with cost-effectiveness and limited staff time (Pacific Institute 2013) but joint water and electric utility programs can help make efficiency measures more cost-effective. Joint programs can help improve cost-effectiveness because they will realize and count the savings from both water and energy. Joint programs also share the financial burden between multiple entities (Haramati et al. 2008).
- Creating dual water and energy audits, rebate programs, and education and outreach efforts reduces the number of times utilities knock on doors. Utilities do not need to expend extra time and money contacting customers separately; rather, they can show a customer all the efficiency opportunities available to them at once. This is also more convenient for customers who only need to be disturbed once and can get upgrades done together rather than piecemeal.
- Water and energy utilities may have relationships with different manufacturers and retailers and running joint programs means that the utilities can bring in multiple stakeholders and take advantage of those different relationships. More contacts often result in greater participation and therefore a greater uptake of the technology.
- Bringing energy and water utilities together helps ensure that opportunities for greater savings are not missed. Water and energy utilities have different metrics for measuring

savings, different technological expertise, and different priorities. Having multiple perspectives and agendas present in the program planning process can ensure that savings opportunities don't fall through the cracks.

- Having water and energy utilities together during the planning process helps ensure that unintended consequences are avoided.
- Joint programs can help increase knowledge of the relationship between water and energy through advanced tracking, metering, and evaluating. Sharing data and tracking where energy and water savings are occurring on both the demand and supply side will increase our understanding of the water-energy nexus. This will assist in developing water and energy “footprinting”² methods for use in other sectors such as facility management, land use planning, and new development permitting. Increased data and knowledge can also help make it easier for more utilities to implement programs.

Unfortunately, experience between joint water and electric utility programs has not been as extensive as it should be. We have found the number of programs that are coordinating to save both energy and water are limited, and there are even fewer programs that are jointly run by electric and water utilities. With this report we provide greater information on the types of programs that already recognize the water-energy nexus and have the potential to be successful joint water and electric utility programs. We also make recommendations on the opportunities that exist for new joint water and electric utility programs.

Joint Utility Program Models

There is an excess of unrealized potential for joint end-use water and energy efficiency utility programs where collaboration would be mutually beneficial. The program models profiled below are in the residential, commercial, agricultural, industrial, and municipal (water/wastewater) sectors and are either already being jointly implemented by utilities, or are program concepts that seem “promising” for joint implementation.

RESIDENTIAL

In this report residential efficiency programs refer to programs run by utilities and aimed at reducing end-use consumption in residential homes, including single-family and multifamily housing. Some residential energy efficiency programs are already integrating energy and water by implementing cost-effective programs that save both resources. However, we believe that there are more opportunities that utilities can take advantage of to achieve cost-effective savings. Below are some residential program models that lend themselves to being jointly run by both water and electric utilities.

² “Footprinting” in this report refers to a standardize measure of impact that energy has on water consumption and water has on energy consumption.

Equipment and New Technology Programs

Residential equipment programs spur greater installation of high-efficiency technologies. These are some of the most common combined energy and water efficiency programs because they are simple, and can be applied to the many appliances that use both water and energy (e.g., clothes washers, dishwashers and low-flow fixtures such as showerheads, and faucets). Utilities can partner to achieve savings by promoting highly efficient technology and equipment.

Higher upfront costs can be a barrier to new equipment. Equipment and new technology programs can help customers overcome this barrier by providing financial incentives. Utilities can combine funding sources for rebates to retailers and customers. The partnership between Pacific Gas and Electric Company and East Bay Municipal Utility District is a good example of this type of program. These utilities work together to administer a high-efficiency clothes washer rebate program that successfully jointly implemented the program and are helping customers purchase high-efficiency clothes washers (Cluett et al. 2013; PG&E 2013a).

Bringing in manufacturers and retailers to convince customers of the benefits of technologies that save both water and is another way to improve the impact of an equipment and technologies program.³ Greater savings can also be achieved by promoting energy-efficient technologies in the marketplace, aiming to alter the marketplace so that it internalizes energy-efficient technologies and they become standard practice (i.e., market transformation). Retailers and manufacturers have an opportunity to influence the decision-making of the homeowner

Collaborating to Calculate the Water-Energy Nexus

Energy and water utilities should work together to determine baseline energy use, water use, and the extent to which water and energy use are intersecting in water and wastewater facilities. This allows water and wastewater utility managers and operators to better understand their electricity provider's rate structure and how their current operations impact energy use within that structure. Monitoring should report water and energy consumption in comparable metrics so that the intersection between the two resources is better understood. Energy and water utilities can work together to ensure that those metrics are reported and agreed upon. Establishing these metrics and baselines are crucial steps towards easing the process of collaboration between these two types of utilities.

Once the baseline is established, ongoing monitoring and measuring of water processing and output, and energy consumption will help show whether energy and water saving improvements are being realized. Monitoring and measuring are important to assess trends in the energy intensity of the water enterprise on a per customer basis. It will also help the facilities better understand the intersection between water and energy and identify deeper savings and make sure they are not losing out on potential additional savings. Water and wastewater utilities should also report their data to centralized public sources such as EPA's ENERGY STAR Portfolio

³ See York et al. (2013) for explanation of the benefits of using manufacturers and retailers in advancing efficient technology and equipment.

when appliances are purchased. Energy utilities and water service providers can combine funding and contacts to help educate retailers and manufacturers about energy- and water-efficient product choices and leverage their influence over customer decision-making. Large retailer such as Home Depot, Lowes and Sears sell appliances and plumbing fixtures, and utilities can partner with these stores to help promote the program and reach a large number of customers at the point of purchase. Successful utility incentive programs can shift the set of products available on store shelves toward more efficient products.

Equipment and new technology programs can also take advantage of existing infrastructure that highlights water and energy benefits in appliances such as voluntary rating programs. ENERGY STAR® and WaterSense® are EPA's voluntary programs that promote energy- and water-efficient products and homes through labeling and certification, which incentivizes manufacturers to offer a wider variety of high-efficiency choices in both water and energy. The ENERGY STAR and WaterSense labels help educate consumers and retailers about water savings in addition to energy savings and spurs companies to create more efficient products so they can claim the label. These labels can be used in joint water and energy utility programs to help inform customers and drive them to purchase efficient products. Utilities can offer incentives for labeled products or use them as education tools. For example, Glendale Water and Power, a publicly-owned utility that serves water and electric customers in California, provides appliance rebates for high-efficiency products that use both water and electricity (GWP 2013). The qualifications for many of the appliance rebates are that they meet ENERGY STAR or WaterSense guidelines.

Whole Home Approach

Greater efficiency and lower program costs can be gained by looking at the home in its entirety, rather than piecemeal. Whole home efficiency programs look at the entire home, taking into account the interactive effects of electric and water equipment, insulation, and the building envelope. Whole home retrofit programs can include a variety of tools and approaches such as:

- **Audits.** A residential audit is an inspection, survey or analysis of the energy and/or water use in a person's home. The purpose of the audit is to evaluate the overall efficiency of a house and to suggest the best ways to improve energy or water efficiency. An audit should include identification of water or air leaks and recommended upgrades.
- **Kits.** An energy and water efficiency starter kit is often provided to customers by utilities and often includes a variety of measures and technologies, including high efficiency showerheads, faucet aerators, fixtures, light bulbs etc.
- **Rebates.** An amount paid by way of reduction, return, or refund on what has already been paid. Rebates are used to incentivize or supplement product sales or major efficiency upgrades.
- **Metering and Monitoring.** Electricity and water meters are devices that measure the amount of energy and/or water consumed in a residence. Monitoring the readings on both the electric as well as the water meter helps pinpoint when resources are being used the most in the home and from which source.

A joint water and energy whole home audit should also include repair of leaks. Leaks are encountered both inside and outside residences, and may include leaking pipes and faulty valves. Leaks not only waste water but also waste energy required to heat that water. Comprehensive audits of leaky pipes, faucets, and showerheads in the home coupled with pipe insulation can save water, gas and electricity all in one home efficiency upgrade. East Bay Municipal Utility District (EBMUD) provides customers with free home survey kits to help home owners detect and fix leaks saving them water and energy (EBMUD 2013). Similarly, the city of Palo Alto's Smart Energy Program now includes a Whole Home Efficiency Audit Pilot Program which provides whole home survey audits for homeowners, analyzing all water and energy using equipment, including bathroom and kitchen fixtures, heating, ventilation and cooling (HVAC), insulation, irrigation systems (Palo Alto 2013).

Whole building multifamily efficiency programs are another opportunity for large electricity and water savings. Multifamily buildings represent about a quarter of the residential housing market and are often overlooked in efficiency programs. There is also a large amount of savings potential per participating building because they are far larger and house more people than single family homes. However multifamily buildings have a diverse and complex ownership structure and utility bill payment responsibilities for market-rate and affordable multifamily housing means the multifamily market has unique program needs. These needs require utilities to work with multifamily building owners to develop programs that match. For some multifamily owners and property managers water is one of their largest expenses since it is not individually metered and may therefore be paid by the building owner. This poses a great opportunity for joint programs because saving on water costs may be attractive for multifamily property owners, providing a foot in the door for greater efficiency upgrades. One example of these types of multifamily programs is Puget Sound Energy's program, run in partnership with the Saving Water Partnership, which provides multifamily building owners with free energy and water audits and retrofit incentives for energy and water saving appliances (PSE 2013). Another example of a joint water and energy utility run efficiency program is the Multifamily Energy and Water Efficiency Program in Austin, TX, which provides multifamily facility owners with holistic water and energy efficiency evaluations, rebates and other incentives to save water and energy and their associated costs to end-users. The collaboration among Austin Water Utility (AWU), Austin Energy (AE), and Texas Gas Service (TGS) (the three main utilities in this central Texas region) resulted in an effective efficiency program and helped customers overcome split incentives inherent in multifamily energy efficiency (Young and Mackres 2013).

New Construction and Resale Opportunities

When a home is being purchased or sold there is an opportunity for retrofits and upgrades to the home. The programs below are meant to ensure that homes being sold and new homes coming onto the market are more efficient and meet higher efficiency standards.

NEW CONSTRUCTION PROGRAMS

New construction efficiency programs are meant to increase the efficiency of new homes through incentives, standards and builder training when new homes are being planned and constructed. New construction is an optimal program for joint efforts by water and energy utilities because both water and energy utilities have a stake in the efficiency of homes

entering the market. In addition the best chance to ensure that the home has a higher efficiency from the start is during the construction process. Higher efficiency construction may have a higher cost of construction. However, joint utility programs can help increase the financial incentives available to builders and ensure that homes are constructed with both energy and water efficiency in mind. As previously discussed, water and energy utilities have relationships with different builders and retailers allowing them to use these contacts and maximize outreach to potential homebuyers.

Residential new construction efficiency programs often employ a two pronged approach. First, these programs may look to target home builders by offering incentives for construction of highly efficient homes. The second approach to new construction efficiency programs is to target homebuyers to purchase efficient homes. Utilities should work with manufacturers and retailers to help leverage and communicate the benefits of water savings and energy savings to new homebuyers. In addition, water and energy utility programs can integrate water efficiency measures and performance goals into existing programs such as ENERGY STAR and WaterSense, both of which offer a New Home label. EPA's ENERGY STAR new homes label includes a comprehensive package of best building practices for water management and a host of efficient water consuming appliances such as dishwashers and clothes washers (EPA 2013b). WaterSense's New Home label establishes criteria and a certification process for certifying the indoor and outdoor water and energy efficiency of a new home (EPA 2008). These certifications help improve the appeal of an efficient home to buyers.

Currently Pepco, is working with home builders to sponsor high-efficiency homes to that qualify for the ENERGY STAR label (PEPCO 2013). Their website includes links to homebuilders and ENERGY STAR's website to inform customers of the benefits of efficient homes. Similarly, KCP&L in Kansas City, MO, is running a rebate program for builders constructing ENERGY STAR-certified homes that are three stories or less including a Home Energy Rating System inspection (KCP&L 2013). While neither of these examples are joint programs, they could readily be expanded to include local water utilities.

RESALE PROGRAMS

Programs that target homes during the resale process can improve efficiency and help homeowners increase the value of their home. Resale is an ideal time for joint water and energy efficiency programs because the homeowner is already making updates and improvements to the house in order to make it more attractive on the market. Joint utility programs targeted at resale opportunities can be as simple as rebates for energy- and water-efficient equipment, replacing inefficient plumbing, or more comprehensive whole home retrofits. In addition, programs that target the resale market are able to educate realtors about the benefits of an efficient home thereby helping potential buyers realize the value of such features. In San Diego, CA, the Public Utility Department implemented an Ordinance that requires that all buildings, prior to a change in property ownership, be certified as having water-conserving plumbing fixtures in place. This ordinance and the activities spurred by it are helping create greater efficiency in homes re-entering the market within the City of San Diego Public Utilities Department service area (City of San Diego 2013). This approach could easily be expanded to include minimum energy efficiency upgrades as well.

Improving Information and Behavior Programs

Behavior programs offer an opportunity to take advantage of social science and new feedback technology to inform customers of their resource consumption to spur changes in their energy or water use. Utilities can coordinate energy and water standards for joint measurement, dashboards, and data collection. As smart meters⁴ are installed they should include information on both energy and water consumption so homeowners can get hourly feedback on both water and energy use. This feedback technology allows customers to more quickly identify leaks or theft, helping them to better understand what they are spending their money on. According to a recent study done by the Institute for Electric Efficiency (IEE), smart meters were installed in more than 45 million (or nearly 40 percent of) U.S. households as of July 2013 (IEE 2013). However, smart meters for water and natural gas utilities are far less common. One example of where water use is captured by smart meters is in the city of Davis, CA. Davis unveiled its Water Conservation Program in April 2013, which includes a turnkey, cloud-based software package that integrates water utility metering and billing information and uses the power of social norms to improve customer engagement (City of Davis 2013).

COMMERCIAL BUILDINGS

Commercial efficiency programs, as defined in this report, focus on improving the energy efficiency of commercial buildings through technological updates, building improvements, and, in some cases, behavior changes. Commercial facilities include a large range of facilities such as office buildings, hotels and motels, warehouses, schools and universities, laundries, retail stores, and many others commercial activities. As a result, the commercial sector has many process-specific water and energy consuming tasks (e.g., process rinses, photographic processing, car washing, laundry, process cooling, etc.). Due to this range of needs, there are a lot of opportunities for joint water and energy efficiency programs that are customizable to the commercial facility. Below are some program models that are well suited as joint programs.

Whole Building Approach

Similar to the residential sector, whole building commercial programs take a comprehensive look at a commercial building and identify savings opportunities that exist throughout the whole building. Since commercial buildings require a wide variety of water and energy systems, programs have to be customized to the specific needs of each building. Whole building programs lend themselves well to joint water and energy efficiency programs in the commercial sector because by looking at the various interactions of a facility comprehensively, it is easier to identify where the major water and energy opportunities exist.

Hotels are particularly well suited to joint programs as they require large amounts of water for landscaping and hot water for the guest bathrooms, laundry services, and kitchens as well as extensive energy needs for heating, cooling, electronics, and lighting. Auditing the

⁴ A smart meter is usually an electrical or water meter that records consumption of electric energy or water use in intervals of an hour or less and communicates that information at least daily back to the utility for monitoring and billing purposes. Smart meters enable two-way communication between the meter and the central system. Unlike home energy monitors, smart meters can gather data for remote reporting (Ehrhardt-Martinez et al. 2010).

whole building to find efficiency opportunities for both energy and water can identify large potential savings across the whole facility, from installing new toilets and washers to sealing leaks, recycling water wasted to drains, and replacing water heaters. The SureBet Business Energy Efficiency program, offered by NV Energy, works to retrofit and upgrade commercial operations in commercial buildings in their service region. One of their projects was with JW Marriott where they completed a retrofit of an older steam cooker with a high-efficiency electric steam cooker in one of the hotel's kitchens, resulting in water and energy savings (NV Energy 2013). Similar to NV Energy's program, Hilton's LightStay Program included efforts to improve energy and water efficiency throughout their hotel buildings. Their system analyzes performance across 200 operational practices, such as housekeeping, paper product usage, food waste, chemical storage, air quality, and transportation. LightStay also provides a "meeting impact calculator" feature that calculates the environmental impact of any meeting or conference held at a Hilton property (Hilton 2013).

Commercial retrofits can require high upfront costs and temporarily obstruct business activities, which can be a barrier to large scale retrofits. Large commercial facilities take time and money to identify savings opportunities and then implement those improvements. Program costs can be split between water and energy utilities if they work together to implement programs. Sharing the cost and staff time can help improve the cost-effectiveness of these programs and lighten some of the administrative burdens. Utilities may also feel more secure and be more likely to commit to measures with longer paybacks if they are sharing the costs. In addition, the facility owner is able to reap greater cost savings in the long run if they, simultaneously, implement measures to save both water and energy. The utilities benefit from joint funding and staff resources while customers realize greater savings.

Southern California Gas and West Basin Municipal Water District's Cash for Kitchens program seeks to increase water efficiency in more than 600 commercial kitchens. The program has achieved its goal of auditing around 75 facilities a year and has seen benefits from working in partnership with Southern California Gas and West Basin Municipal Water District such as a larger number of customers, reduced staff time, and reduced number of visits per customer (Cooley et al. 2013).

Another program model that works well for commercial facilities is the performance-based program approach, which sets sustainability goals for energy and water use at the facility. Utilities can work together to help these facilities measure their water and energy consumption, set targets and achieve savings. One example of a water and energy saving commercial program is Darden Restaurants which committed to reduce water and energy consumption by 15% by 2015 in all of their restaurants (Young and Mackres 2013). Not only did they exceed their savings targets but they were able to do it with little cost to the company. Restaurants and food processing companies use the majority of their water in washing and sanitation both of which require the use of large amounts of hot, energy-intensive water (Schultz Communications 1999). Sustainability goals, such as the 15% reduction goals established by Darden Restaurants, take a comprehensive look at opportunities to reduce water and energy waste, forcing these companies to look at where they can save both water and energy simultaneously. These programs are well suited to be run by energy and water utilities because they require expertise in both water and energy

consumption across a commercial space. Utilities can promote and assist commercial facilities in designing and implementing plans to meet performance goals. They can also provide ongoing technical support to help commercial building owners realize efficiency improvements.

One-stop-shop efficiency programs are an excellent option to help inform customers about all the water and energy efficiency programs available to them because on-stop programs house information in a centralized location. Small businesses can be difficult to serve due to their limited time and resources as well as their variability. One-stop-shop models are ideal for small commercial buildings because they allow businesses to learn about and pick the most effective measures that fit their needs (Nowak et al. 2013). These models are also effective joint water and energy programs because they target customers when they are already thinking about improving the efficiency of their business or commercial facility and make it simple for customers to learn about opportunities. These programs often have a website that contains all the resources a customer needs for energy and water efficiency upgrades. They can also be coupled with technical support including staff on the ground to assist customers in taking full advantage of efficiency gains. The Watts to Water Program, administered by Denver Metro Building Owners and Managers Association (BOMA), is an example of a one-stop-shop program that helps commercial properties reduce energy and water consumption (Young and Mackres 2013). Similarly, Energize Connecticut CT's Small Business Energy Advantage Program is a "one-stop" energy savings service that includes water-saving equipment such as spray nozzles, showerheads, and kitchen equipment (Nowak et al. 2013).

Equipment and New Technology

Equipment and new technology programs incentivize the use of new, highly efficient equipment and technology in order to spur greater end-use efficiency and market penetration of efficient products. Commercial end-use water-energy programs can benefit by offering a diversity of water and energy products because there is no single technology or practice that can improve efficiency among all of commercial customers.

As in the residential sector, upfront costs to high-efficiency equipment can be deterrents to customers. Utilities may offer financial incentives or rebates to customers who purchase high-efficiency equipment to help overcome that barrier. For example the Southern California Edison Ozone Laundry Program was jointly implemented by Pacific Gas and Electric Company, Southern California Edison, and San Diego Gas and Electric Company and offered rebates of \$200 for every 1,000 gallons of monthly sustainable reductions in water use and wastewater flow that is achieved through the implementation of the ozone laundry technology (Young and Mackres 2013).

Utilities can also work together to implement programs that focus on helping efficient technology penetrate the market. These programs can serve to educate realtors and manufacturers about the importance of joint savings between water and energy for equipment that uses both. One example is PG&E Emerging Technologies Program partnered with two water agencies (EBMUD and the San Jose Water Company) to investigate emerging monitoring and telecommunications technologies to determine whether these technologies can help water agencies distribute water more energy efficiently

(CPUC 2010). PG&E concluded that one of the best opportunities for energy savings was the integration of real-time pump electricity consumption. This program allowed for real-time feedback of electricity consumed at EBMUD's pumping system.

New Construction and Leasing

Commercial new construction and leasing efficiency programs work to improve the efficiency of new and released buildings by setting standards and incentives for efficiency and by working with architects, builders, manufacturers, and realtors to showcase the benefits of highly efficient buildings. Water and energy utilities provide resources and incentives to help building owners consider various design options. Taking the whole building system and looking at the energy and water uses and how the two interact is key to ensuring deep savings in commercial buildings. Water and electric utilities can jointly implement design assistance program, providing technical expertise and analysis during the earliest stages of the design process.

Utilities can also help incentivize energy and water savings by promoting the use of sustainability or green certification standards that include water and energy saving measures and metrics. Many of these certifications are already in place regionally and nationally, such as the U.S. Green Building Council's new LEED version 4 for commercial new construction (USGBC 2013). These types of broad certificates help give guidance to commercial building owners and designers to help ensure the new building are lower energy and water users. These certificates and labels also make commercial spaces more attractive to leasers. Austin Energy offers financial incentives to promote the installation of energy-efficient technologies in new commercial construction projects. Austin Energy (AE) Commercial New Construction program offers incentives to commercial construction projects being built within the service area of AE (AE 2013).

AGRICULTURE

Due to the scale of farming (thousands of acres, hundreds of thousands of animals), small changes can dramatically reduce water and energy use. Energy efficiency in the agricultural sector can be increased through awareness of established techniques that boost efficiency and by implementing new technologies where appropriate.

Increasing Awareness

It can be challenging to get information to farmers. Penetrating farmers' close-knit communities by building strong relationships is extremely important. Successful efficiency programs tend to have a local agent available to answer questions and assist farmers with efficiency upgrades. Since water utilities tend to be more local and municipally run, with smaller service territories, a joint utility-partnership provides access to electric utilities that was previously unavailable. Such programs can take advantage of a water utility's local connections while still getting the advantages of shared resources and increased cost-effectiveness of efficiency measures through combined energy and water savings. For example, Southern California Edison (SCE), Pacific Gas and Electric (PG&E), the Environmental Protection Agency and Western United Dairymen partnered together to provide dairy farmers with an informative half-day workshop. Participants receive information and participate in comprehensive discussions on: SCE and PG&E rebate and

incentive programs, energy cost reduction strategies, how to develop and finance energy efficiency and water quality and air updates (PG&E 2013b).

Assessing a farm's energy and water use and potential efficiency improvements together across the entire farm enables a comprehensive idea of how waste reduction and reduced energy costs can be achieved throughout the entire farm. Some energy efficiency programs focus solely on the farm "headquarters," excluding on-farm energy and water use such as tilling and irrigation. As a result these programs are missing out on potential savings. Joint water and energy programs should perform comprehensive audits of water use and energy use, while simultaneously considering where the two overlap. This added information creates a broad picture for farmers and helps them realize all their potential upgrades.

Equipment and New Technology

Energy in water use varies depending on the type of farm. Despite these differences there is a wide variety of technologies available that can increase the efficiency of a farm that should be championed by joint water and energy utility programs. For example:

- Precision agriculture. Also known as satellite farming, precision agriculture is a farming management strategy based on measuring and tracking the field using GPS to respond to specific needs down to a square meter. This technology helps minimize chemical application, watering, fertilizer application, etc., while helping to optimize harvest as well as reduce excess water use.
- Drip or micro-irrigation. Agricultural irrigation is the second largest water withdrawing use in the United States (Kenny et al. 2009). Drip-irrigation is a water saving irrigation method that reduces the use of water and fertilizer by allowing water to drip slowly, reducing leaching, increasing efficiency and minimizing waste.
- Conservation tillage. A method of growing crops without disturbing the soil through tillage. Instead holes are punched into the ground to plant seeds, decreasing erosion. This method reduces energy consumption since equipment for tilling is not needed but it also helps reduce excess water running off fields into sewer systems and therefore reducing energy needed to process and treat that excess water runoff.
- Variable Frequency Drive (VFD). The motors on milking vacuum pumps are sized for wash cycles that require high vacuum capacity. However, less vacuum – and lower horsepower – is needed for milking versus washing. A VFD can significantly reduce energy use by regulating the speed of the vacuum pump motor to match its load requirement at any given time. With the VFD, the vacuum pump motor requires less horsepower and less energy during each milking.

For farmers to take advantage of these technologies, water and energy utility programs should work together to assist farmers with funding applications, provide incentives, create a one-stop-shop website, help them implement the new technology, and provide on-going technical support. For example, the Northwest Energy Efficiency Alliance (NEEA) is working with consultants, advisors and partners to implement the Agriculture Irrigation Energy Efficiency initiative which promotes innovative irrigation technology to farmers in

Washington, Oregon and Idaho (NEEA 2013). The program goal is to reduce water and energy consumption through 20% irrigation efficiency improvements by 2020.

INDUSTRIAL PROCESSES

The industrial sector offers tremendous opportunity for energy and water savings, and a significant opportunity to improve energy and water efficiency within facilities and industrial processes. The industrial sector typically includes manufacturing, mining, construction and agriculture and there are opportunities for joint water and energy efficiency in all of these sub-categories. In this section we will primarily focus on manufacturing. Joint industrial efficiency programs can include a few different approaches such as efficiency target support and Strategic Energy Management (SEM).⁵ These strategies can be deployed to improve energy and water efficiency of equipment in a facility or to improve the efficiency of the process or system.

System or Process Efficiency

Process or system focused efficiency programs are well suited to incorporate water and energy savings simultaneously because they require a thorough examination of the use of resources across a system. Industrial water and energy efficiency programs can be modeled after energy efficiency SEM programs that “just add water.” SEM programs are organization-wide management programs that set long-term energy savings goals and use tracking and reporting systems that can help drive greater savings. Performance-based programs and SEM programs are good models for joint water and energy efficiency programs because they can include multiple metrics in the savings goals. Similar to the commercial sector, some industrial water and energy savings programs are being driven by “sustainability goals.” Utilities should work together to help industrial facilities set their performance targets and identify savings opportunities. A successful joint water and energy management program should also include the following steps:

1. Metering and monitoring energy and water consumption;
2. Identifying and implementing savings measures; and
3. Verification of savings.

Combining the measuring and metering of water and energy will help the facility better identify where water and energy savings intersect and how they can achieve greater joint savings.

There are many processes that can be implemented in industrial facilities to save water and energy such as: changing pump operation hours, improving the efficient use of steam; and cooling water recirculation. Steam system efficiency is particularly attractive for a joint water and electric utilities program because increased steam efficiency reduces both energy and water use. Utilities should begin by doing a system audit of the water and energy consumption by the steam system for an industrial facility. Once the opportunities have

⁵ For more information on SEM for small to medium-sized industrial facilities, see also Wilson and Macklin (2013).

been identified, the utilities can assist with improvements to reduce water and energy consumption. One example of a steam efficiency program was undertaken by City West Water in Melbourne, Australia to improve the water and energy efficiency of its business customers' steam systems. The program involves providing free steam system audits highlighting efficiency improvement opportunities and training. City West Water monitors the potential savings of improvement opportunities identified through the steam system audit reports, and tracks the progress of implementation of these opportunities through meetings with customers (City West Water 2010).

MUNICIPALITIES

In many communities, sourcing, treating, and distributing potable water and collecting, treating and reclaiming wastewater, are large users of electricity.⁶ Electric utilities can work with water-supply and wastewater facilities to help them improve their energy efficiency. Working together at water and wastewater facilities can help energy and water utilities come together and build relationships that may spur water and energy end-use efficiency programs down the line.

Energy efficiency programs at water-supply and wastewater facilities range from updating equipment to whole system retrofits. According to EPA's ENERGY STAR program, 10 percent energy savings can be readily achieved by upgrading municipal water supply and wastewater systems, resulting in collective savings of about \$400 million and 5 billion kWh annually (EPA 2012a). Program approaches focused on equipment, infrastructure and monitoring are discussed below.

Equipment and Infrastructure Improvements

Some water and wastewater processing facilities struggle to obtain the capital necessary to update their infrastructure (WEF 2012). According to a study done by Black and Veatch, one of the largest concerns for water utilities is their aging water and sewer infrastructure (much of which was built in the 1950s) and the lack of capital for repairs and updates (Black & Veatch 2012). Black and Veatch also report that energy costs can account for as much as 30 percent of their operating budgets. Energy efficiency programs help free up money that would otherwise be spent on operating costs at the water facility. Water utilities can instead reinvest saved money back into aging infrastructure which further increases the efficiency of water treatment and transportation, only adding to the potential energy and water savings. This dynamic was achieved by the Sheboygan Wastewater Treatment Plant (WWTP) Energy Efficiency Initiatives. Sheboygan implemented a series of energy efficiency measures in their wastewater treatment plant and reduced their energy use by 20 percent (Mackres 2011).

Improving infrastructure in water and wastewater facilities also includes reducing leakage in municipal water and waste water utilities. Leaks cause waste in water and in energy required to pump and process that lost water. Unfortunately, leaks are difficult to detect and can be expensive to repair. Electric utilities can help water and wastewater facilities identify and repair leaks through incentives and technical assistance. For example, the Leak Detection Pilot program of Southern California Edison, an electric utility, provides

⁶ For more information on energy efficiency for water and wastewater facilities, see also Elliott et al. (2006).

assistance to water utilities in auditing their water distribution systems for leaks and recommending repairs and other interventions. The goal of the program is for repairs to provide: 1) direct water savings from reduced leakage in the distribution system; and 2) embodied energy savings from reduced electricity requirements for water supply, conveyance, treatment, and distribution resulting from avoided leakage.

Conclusions

Energy efficiency is a cost-effective way to reduce water use in the power sector and improvements to water efficiency can reduce energy use by water and wastewater utilities. Every drop of water consumed requires watts of electricity that are used to collect, transport, and treat that water. Similarly, every watt of thermal-powered electricity consumed is embodied with drops of water needed for cooling. Water and energy utilities should work together to ensure that the opportunities to save energy and water in these processes are not lost. Limited program experience is a hurdle; however, there are a lot of opportunities where joint water and energy savings programs not only make sense but would spur greater savings.

There are a host of potential benefits from joint water and energy utility-run programs including:

- Joint water and electric utility programs can help make efficiency measures more cost-effective through sharing expenses and staff time.
- Water and energy utilities have relationships with different manufacturers and retailers that can be leveraged to increase market penetration of programs and technology.
- Bringing energy and water utilities together helps ensure that opportunities for savings are not missed.
- Creating dual water and energy audits, rebate programs, and education and outreach efforts reduces the number of times utilities knock on doors.
- Joint programs can help increase knowledge of the relationship between water and energy through advanced tracking, metering and evaluating.

Utilities should take advantage of the benefits to joint programs either by “just adding water” to current programs and expanding their objectives or beginning to develop and implement some of the program approaches recommended in this report. Across all of the sectors there are ample opportunities for water and energy utilities to design and administer water and energy saving programs together. Table 1 outlines the sectors and program models covered in this report and highlights some of the reasons why these models are appropriate for joint programs.

Table 1. Joint Energy and Water Utility Efficiency Program Model Summaries

Sectors	Program Models	Why Programs Should be Implemented Jointly	Examples
Residential	Equipment New Technology Programs	<ul style="list-style-type: none"> • Equipment and technology programs benefit from collaboration because the utilities can combine funding for rebates to retailers and customers to incentivize the use of efficient water and energy consuming technologies. • Equipment and new technology programs can also take advantage of existing infrastructure that highlights water and energy benefits in appliances such as voluntary rating programs. • Energy and water utilities can combine funding and contacts to educate retailers and manufacturers about efficient product choices and leverage their influence over customer decision-making. 	<ul style="list-style-type: none"> • Pacific Gas and Electric Company and East Bay Municipal Utility District Clothes Washer Program (Cluett et al. 2013; PG&E 2013a). • Glendale Water and Power appliance rebate program (GWP 2013)
	Whole Home	<ul style="list-style-type: none"> • Whole home efficiency programs look at the entire home and the interactive effects of electric and water equipment, insulation, and the building envelope making it easier to identify water and energy saving opportunities. • Comprehensive audits of leaky pipes, faucets, and showerheads in the home coupled with pipe insulation can save water, gas and electricity all in one home efficiency upgrade. • For some multifamily owners and property managers water is one of their largest expenses and is an opportunity for joint programs because potential water savings provide a foot in the door for greater energy efficiency upgrades. 	<ul style="list-style-type: none"> • East Bay Municipal Utility District Leak Detection Program (EBMUD 2013). • Puget Sound Energy and Saving Water Partnership (PSE 2013). • Multifamily Energy and Water Efficiency Program in Austin, TX. (Young and Mackres 2013).
	New Construction and Resale	<ul style="list-style-type: none"> • New construction is an optimal program for joint water and energy utility programs because both water and energy efficiency improvements can be made at a lower cost during construction and because both water and energy utilities benefit from efficient homes entering the market. • Resale is ideal for joint water and energy efficiency programs because the homeowner is already making updates and improvements to the entire home to make it more attractive on the market. 	<ul style="list-style-type: none"> • Pepco ENERGY STAR® New Homes Program (Pepco 2013). • Kansas City Power and Light Company ENERGY STAR® New Homes Program (KCP&L 2013). • City of San Diego Public Utilities Department Plumbing Retrofit Upon Re-Sale Ordinance (City of San Diego 2013)

Sectors	Program Models	Why Programs Should be Implemented Jointly	Examples
	Behavior	<ul style="list-style-type: none"> • Utilities can coordinate energy and water standards for joint measurement, dashboards, and data collection. • As smart meters are installed they can report information on both energy and water consumption so homeowners can get hourly feedback on their water use and energy use together. 	<ul style="list-style-type: none"> • City of Davis Water Conservation Program (City of Davis 2013)
Commercial Buildings	Whole Building	<ul style="list-style-type: none"> • It is easier to identify water and energy saving opportunities based on the interactive effects of all processes including both energy and water. • Commercial retrofits can require high upfront costs and temporarily obstruct business activities so costs can be split between the two utilities if they work together to implementing programs. • Utilities can work together to help facilities measure their water and energy consumption, set targets and achieve savings for performance-based program models. 	<ul style="list-style-type: none"> • Southern California Gas Company and West Basin Municipal Water District's Cash for Kitchens (Cooley et al. 2013) • NV Energy SureBet Business Energy Efficiency program (NV Energy 2013) • Hilton LightStay Program (Hilton 2013) • Darden Restaurant, 15X15 Program (Young and Mackres 2013)
	Equipment New Technology Programs	<ul style="list-style-type: none"> • Commercial end-use water-energy programs can benefit by offering a diversity of water and energy products because there is no single technology or practice that can improve efficiency among all of commercial customers. • Equipment and technology programs benefit from collaboration because the utilities can combine funding for rebates to incentivize the use of efficient water and energy consuming technologies. • Joint programs can help educate a wider variety of retailers and manufacturers about the importance of joint savings between water and energy for equipment that uses both resources. 	<ul style="list-style-type: none"> • Pacific Gas and Electric Company Emerging Technologies Program (CPUC 2010)
	New Construction and Leasing	<ul style="list-style-type: none"> • Water and electric utilities can jointly implement design assistance program, providing technical expertise and analysis during the earliest stages of the design process and helping builders realize greater energy and water savings. • Joint programs can push for broader "green" labels that include water and energy efficiency making commercial spaces more attractive to potential leasers. 	<ul style="list-style-type: none"> • Austin Energy Commercial New Construction program (AE 2013)

Sectors	Program Models	Why Programs Should be Implemented Jointly	Examples
Agriculture	Increasing Awareness	<ul style="list-style-type: none"> Joint programs can take advantage of a water utility's local connections while still getting the advantages of shared resources and increased cost-effectiveness of efficiency measures through combined energy and water savings. Joint programs can better assess a farm's energy and water use and potential efficiency improvements together across the entire farm which gives a comprehensive idea of how waste reduction and reduced energy costs can be achieved. 	<ul style="list-style-type: none"> Pacific Gas and Electric Company Education and Training sessions (PG&E 2013b)
	Equipment New Technology Programs	<ul style="list-style-type: none"> Water and energy utility programs can work together to assist farmers with funding applications processes, provide incentives, create a one-stop-shop website, help them implement the new technology, and provide on-going technical support. 	<ul style="list-style-type: none"> Agriculture Irrigation Energy Efficiency initiative (NEEA 2013)
Industry	System or Process Efficiency	<ul style="list-style-type: none"> Process or system focused efficiency programs are well suited because they require a thorough examination of the use of resources across a system, easing the process of identifying water and energy savings. Performance-based programs are good models for joint water and energy efficiency programs because they incorporate metrics for multiple resources. 	<ul style="list-style-type: none"> City West Water in Melbourne Australia Steam Efficiency Program (City West Water 2010)
Municipal	Equipment and Infrastructure Improvements	<ul style="list-style-type: none"> Saving energy and water at water and wastewater facilities is an opportunity for energy and water utilities to work together and build relationships. Some water and wastewater processing facilities struggle to obtain the capital necessary to update their infrastructure and working with energy utilities can help alleviate some of the financial burden. Leaks in water/wastewater facilities are difficult to detect and can be expensive to repair. Electric utilities can help water and wastewater facilities identify and repair leaks through incentives and technical assistance. 	<ul style="list-style-type: none"> Southern California Edison Leak Detection Pilot (CPUC 2010) Sheboygan Wastewater Treatment Plant (WWTP) Energy Efficiency Initiatives (Mackres 2010)

Recommended Next Steps

Water and energy utility-run programs utilities should increase joint collaboration by:

- Beginning a dialogue about opportunities between the two (or more) utilities and establishing relationships.
- Creating utility partnerships for joint messaging.
- Collaborating to identify unique funding opportunities.
- Developing a format to add energy savings calculations to water programs and vice versa.
- Working with energy regulators to establish credit for embedded energy savings from water efficiency programs (and vice versa).
- Creating a clearly communicated strategy with measurable goals to help clarify priorities and cement roles.

Regulatory bodies seeking to improve water and energy efficiency should address these resources simultaneously because water and energy are mutually dependent resources. The program models proposed here can help inform the development of water-energy efficiency programs designed comprehensively to be implemented jointly by water and energy utilities.

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