

Initiative Description

CEE National Municipal Water and Wastewater Facility Initiative

Introduction

Public facilities that treat and distribute drinking water and that collect and treat wastewater are widespread and energy-intensive, accounting for approximately 3 percent of U.S. electricity use (approximately 100 billion kWh annually).¹ At this level of consumption, water and wastewater facilities are one of the largest and most energy intensive loads owned and operated by local governments, representing up to 35 percent of municipal energy use. Preliminary estimates indicate a national energy savings potential in the range of 15-30 percent, or 15.75-31.5 billion kWh.² There are also significant opportunities to reduce peak load demand and to generate electricity on-site.

Energy-efficiency programs can provide substantial value to municipal water and wastewater utilities and their customers. The potential benefits to municipalities include lower energy costs as well as non-energy benefits, such as reducing the need for chemical additives, reducing solids accumulation and deferral/reduction of capital expenses. In 2002, the Consortium for Energy Efficiency (CEE) formed a Water and Wastewater Committee to: 1) serve as a platform for members to exchange program information and resources, 2) better understand the water/wastewater industry (i.e., its structure, energy use, decision-making, regulatory environment, etc.), 3) begin outreach efforts to the water/wastewater industry (and other industry stakeholders), and 4) explore the merits of a national program initiative to improve the effectiveness of local programs serving this sector.

The Water and Wastewater Facility Initiative is intended to maintain a sustained focus on facility energy-efficiency at the national and local levels. At the national level, the Initiative sends a strong message to the water and wastewater industry and their suppliers that the energy-efficiency program community is organized and actively supporting energy-efficiency at the facility level. Since even the largest efficiency programs can reach only a fraction of the municipal water facility market, there is a real opportunity for programs to come together to send a national message to the water/wastewater sector and their suppliers that there is a large and viable market for energy-efficiency.

At the local level, the Initiative provides a forum to help administrators increase program effectiveness through greater communication, coordination and development across similar programs nationwide. It also provides a clearinghouse function to share program resources,

¹ EPRI, *Water and Wastewater Industries: Characteristics and Energy Management Opportunities*, 1996. This figure does not include energy usage to treat or transport water in the industrial and agricultural sectors, or large transmission systems like the California Aqueduct which transmits raw water from Northern California to Southern California.

² This range is necessarily broad, given the variety of facility types, sizes, and regional operating conditions in the sector, and the variety of electro technologies used to transport and treat water and wastewater. Energy-efficiency opportunities range in scale from 2 percent on average (premium-efficiency motor replacement) to 30 percent (process control strategies).

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experiences and insights in an organized manner and make them available for members to incorporate them into their programs, thus avoiding wasteful duplication of effort.

In addition to providing a national presence, a forum and a clearinghouse, the Initiative offers members a template of credible program resources and a series of recommended participation levels. The participation levels are graduated according to available resources and program objectives, ranging from recommended strategies to increase energy-efficiency awareness in the sector to gradually more complex approaches to energy efficiency, such as equipment replacement, system optimization, process modifications/improvements and facility energy management and benchmarking.

Finally, the Initiative organizes members to identify and develop new products and services where they are currently lacking. CEE's Water/Wastewater committee has identified a number of products that they wish to see developed (or updated) in collaboration with industry, including design guidelines for new facilities, energy reference manuals, audit manuals, case studies.

This Initiative lays the groundwork for a coordinated strategy that focuses on facility energy efficiency. The goal of the initiative is to increase demand for improved facility energy performance and to encourage suppliers of products and services to adopt energy-efficiency as a standard business practice. The Water/Wastewater Committee believes this goal can be realized through greater coordination among energy-efficiency programs and through industry partnerships. CEE will pursue the following activities in support of this goal:

1. Raising awareness among senior-level decision-makers at municipalities of the benefits of energy-efficient water facilities
2. Focusing member energy-efficiency programs on key motor system and process opportunities as a means to demonstrate the benefits of facility energy management
3. Supporting the development of an industry-wide metric to describe the energy-performance of water and wastewater facilities, allowing comparisons within water and wastewater facilities over time as well as across similar facilities (normalizing for differences in size, age, regulation, etc.)
4. Developing cooperative relationships with the water and wastewater industry and their suppliers via trade, industry and professional associations, such as the American Water Works Association and the Water Environment Federation, the National Electrical Manufacturers Association (NEMA, representing motor and drives manufacturers) and Electrical Apparatus and Service Association (EASA, representing sales and service providers of motors and drives), the Hydraulics Institute (HI, pump manufacturers) and the Water and Wastewater Equipment Manufacturers Association.

A CEE national initiative targeting municipal water supply and wastewater treatment facilities is well timed in light of current trends in the industry, including new, mandated water quality requirements, continued population growth (especially in urban areas), and aging national water infrastructure.³ Non-regulatory issues can also increase energy consumption levels, such as improving drinking water taste and color. Given the need for major investment in our nation's

³ Many municipal facilities are 30 or more years old and in need of major repair, upgrade and replacement.

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water infrastructure,⁴ this Initiative is intended to provide a consistent national approach for programs to shape the expected increase in demand for water treatment technologies, equipment and services toward greater energy-efficiency.

Goals and Objectives

CEE's vision for this Initiative is for municipal leaders to understand the connection between its mission to meet public demand for clean, safe, affordable water and energy efficiency, and to support continuous improvement in energy performance. To meet this expectation, water utility managers and operators will need credible resources to monitor and manage facility energy performance over time and to identify opportunities for improvement.

The goal of this Initiative is to transform the market for water supply and wastewater services by enhancing the impact of local energy-efficiency programs that target the municipal water and wastewater systems (individually and collectively) and coordinating their efforts with stakeholder industries. The objectives of the initiative are to:

1. Increase demand for energy-efficiency products and services within the municipal water and wastewater sector.
2. Transform the delivery of products and services to the municipal water/wastewater sector by encouraging industry stakeholders to incorporate energy-efficiency as a standard business practice.

Scope

This Initiative focuses on “publicly-held” water and wastewater facilities, including those operated by municipalities, counties, water districts or authorities, and townships (referring to them, generally, as “municipal” systems). While the energy savings within some industrial water treatment facilities, such as food processing, pulp and paper and pharmaceutical plants, can be substantial, this Initiative targets municipal facilities because of their prevalence among member service territories and because their processes, motivations, and decision-making are relatively similar.⁵

Depending on their size, water and wastewater utilities can have any number of “facilities” or “plants” that treat, collect and distribute drinking water and wastewater – each with different energy demands and energy-efficiency opportunities. Rather than targeting specific equipment or processes (or entire water utility systems), this Initiative seeks improved energy performance at the facility or plant level, such as a treatment plant or a pumping station. The Initiative supports a common strategy and a template of standard energy-efficiency measures (and resources) that programs can draw-on to improve facility energy performance, i.e., energy input per unit of water pumped or treated (kWh/MG, kWh/BOD).

⁴ The Congressional Budget Office, the General Accounting Office and the U. S. Environmental Protection Agency all agree there is a national funding gap estimated to be as high as \$1 trillion for water infrastructure over the next 20 years.

⁵ It is assumed that many of the technical tools and market approaches developed under this Initiative could also be applied to industrial water treatment facilities

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Not only does a facility-level approach help determine the most appropriate projects; it also helps obtain support from senior-level decision-makers within state and local governments, such as city managers, mayors and city counsels, who need to understand the benefits of energy-efficiency. Aggregating energy-efficiency projects at the facility level (including high-efficiency equipment, more energy-efficient systems, and process improvements) usually results in larger projects that require higher-level budget authority. The ensuing evaluation process raises awareness among these important decision-makers about the benefits improved water/wastewater facility energy performance can bring to their city. Raising awareness among these decision-makers and gaining their support is a significant feature of a facility approach because it is these decision-makers that can put permanent changes (policies, procedures, requirements, etc.) into effect that encourage energy-efficiency.

With a facility-level approach, the Initiative recognizes that a variety of energy saving opportunities exist within water supply and wastewater treatment systems and provides a common framework for participants to incorporate into their programs, or to design a dedicated water/wastewater facility program.

Initiative Approach

This CEE Initiative consists of a number of activities that support member projects with municipal water supply and wastewater treatment facilities and the state and local governments that build, own and manage them. These activities national awareness building efforts to promote the benefits of energy-efficiency to water and wastewater operators, managers and municipal leaders; building a template of relevant program resources, including all the research reports, tools, case studies, and materials that have been identified by the CEE Water Committee or developed cooperatively through the Initiative, including new products developed out of the CEC-AWWARF research project and ENERGY STAR water and wastewater focus.

CEE will introduce the program template to member participants and provide assistance in accessing and utilizing it.

Promoting the Benefits of Energy Efficiency

In order to raise awareness among senior-level decision-makers about the benefits of energy-efficient water and wastewater facilities, CEE will develop a national message that makes a compelling case for facility energy management.

The goal of this activity will be to build a case for energy-efficiency that recognizes the regulatory, capacity and budget pressures that specific decision-makers face on a daily basis, such as 1) senior-level officials in state and local governments (targeted by region or size), 2) prominent industry, professional, trade associations (national, regional and state), 3) water and wastewater plant operators and managers, 4) state and federal regulators and certification boards, and 5) product and service providers, including consulting engineers and design, architectural and engineering firms.

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To facilitate dissemination of materials CEE will provide a clearinghouse of materials for participants to integrate into their programs, such as case studies, testimonials and training opportunities, into their energy-efficiency programs. The clearinghouse will ease access to materials, generate greater customer interest in energy-efficiency and encourage participation in local programs.

Through the Initiative CEE will also explore opportunities to promote the benefits energy-efficient water and wastewater facilities nationally via trade and industry meetings and through the trade press. For instance CEE will approach the Motor Decisions Matter (MDM) campaign, and explore outreach opportunities through other national energy-efficiency efforts such as the Compressed Air Challenge and DOE's BestPractices Program that apply to the water and wastewater sector.⁶

Finally, CEE will explore interest among the Initiative participants, water/wastewater industry and other industry stakeholders in a developing a national awareness campaign promoting the benefits of energy-efficiency at the facility and water utility level.

Water/Wastewater Program Template

CEE has developed a program template based on prior CEE Initiatives and research efforts to help focus energy-efficiency program administrators on key energy-saving opportunities within the sector. CEE will provide these tools to Initiative participants who wish to establish a water/wastewater efficiency program or want to market existing programs to facilities in their region.

The template provides information on a variety of energy conservation measures from simple motor change-outs to more complex process improvements. While the template includes information on "low-hanging" fruit such as motors, drives and key motor systems, these measures are intended to help program participants demonstrate the value of proactive facility energy management and to explore opportunities to institutionalize continuous improvement. The Initiative recognizes that successfully completing energy-saving projects is an important tactic to help water and wastewater customers see the value of both and to communicate that value to senior management within municipalities.

Water and Wastewater Facility Initiative Template

Energy Conservation Measures	Resource (examples)	Est. Savings	Avail.
Motors	CEE Motors Initiative DOE's Motor Master Software DOE Best Practices	2%	Now
Motor Management - Promotional materials	Motor Decisions Matter Campaign	5%	Now

⁶ The MDM campaign is currently targeting water and wastewater facilities as part of a national effort to build awareness among senior-level decision-makers about the benefits of premium-efficiency motors and motor. An MDM article appearing in *Water Wastewater International Magazine* (Setp. 2003, Vol 18, Issue 6) is attached. For more information, see www.motorsmatter.org.

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<ul style="list-style-type: none"> - Repair Specs - Repair-Replace Decision-making tools - Motor Planning tools - Assessment Tools 	DOE Best Practices		
<p>Motor Systems</p> <ul style="list-style-type: none"> - Pumps - Fans - Compressed Air - Drives 	<p>DOE’s Pump System Assessment Tool and DOE Best Practices</p> <p>DOE’s Fan System Assessment Tool and DOE Best Practices</p> <p>Compressed Air Challenge and DOE Best Practices</p> <p>NEMA Standards & Guidelines, DOE-EPRI ASD Master</p>	<p>20%</p> <p>5.5%</p> <p>17%</p> <p>15-50%</p>	<p>Now</p>
<p>Process-specific Energy Efficiency Opportunities</p> <ul style="list-style-type: none"> - Water: Filtration, Control Strategies, Use of Storage, Use of back-up generators - Wastewater: Aeration (instrumentation and control systems, fine bubble diffused air systems) - New energy saving technologies and practices 	<p>EPRI, AWWA, WEF and Member Research and Case Studies</p> <p>NYSERDA Reports on EE Opportunities in Wastewater Plants, Sludge Management, Process Monitoring</p> <p>NYSERDA, CEC, SCE</p>	<p>10-20%</p> <p>9-40%</p> <p>10-20%</p>	<p>Now</p> <p>Now</p> <p>Now</p>
<p>Facility Energy Management</p> <ul style="list-style-type: none"> - Internal Energy Assessment - Metering and Monitoring - Benchmarking against other facilities⁷ - Energy Performance Rating System - Recognition and Rewards 	<p>EPRI Energy Audit Manuals</p> <p>AWWARF Best Practices for Energy Management</p> <p>DOE Case Studies/ Best Practices</p> <p>Iowa Database (IAMU)</p> <p>Member Research (PG&E)</p> <p>ES Energy Mgmt. Guidelines</p> <p>WI Checklist</p>	<p>10%⁸</p>	<p>Mixed</p> <p>Now</p>
<p>Supporting Resources for Municipalities</p> <ul style="list-style-type: none"> - Guidelines on Procurement of Energy-Efficiency Equipment within State and Local Government - Generation Opportunities 	<p>CEE State and Local Government Procurement Initiative</p> <p>CEC Peak Load Reduction Programs</p>		<p>Now</p> <p>TBD</p>

⁷ CEC-AWWARF Research Project, estimated to be a 24 month project starting in 2005

⁸ The Alliance to Save Energy has found that metering and monitoring systems alone have enabled water utilities to cut energy consumption by 10 percent, see Wateryg pg. 23.

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using Bio-gases - Guidelines for Energy Efficient Design of Water and Wastewater Facilities	WI Report on the Development of Energy Consumption Guidelines for WI Municipal Water and Wastewater Plants		TBD
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While substantial energy savings can be realized through more energy-efficient motors, motor-driven equipment and processes, the Initiative encourages programs to support a facilities-level approach to maximize cost-effective energy savings in the sector. This approach recognizes the fact that a variety of energy-consuming equipment and processes are used in municipal water and wastewater systems to meet different regional requirements and conditions across the country. While motors and motor-driven equipment use a significant amount of energy to pump, filter, and aerate water, each piece of equipment is part of an interactive system.

The Initiative recognizes that making a change in one component of the may significantly affect the performance of another component and, perhaps, the performance of the facility as well. Therefore it is important to consider facility performance when introducing energy-efficiency measures and to determine which measure or combination of measures will result in the biggest energy reduction for a given investment, and avoid degradation in performance.

National Energy Performance Metric for Water and Wastewater Utilities

This Initiative supports the development of an industry-wide, metric to describe the energy-performance of water and wastewater facilities. In recognition of the potential benefit to programs of such a metric, CEE is participating on the CEC-AWWARF research project to develop a water utility energy index. There are two major reasons for participating in this research effort: 1) to help ensure that member program needs and expectations are taken into account in the development of the index through the exchange of information and contribution of efficiency program experience, and 2) to develop relationships with water industry resulting in a metric that is mutually accepted and supported by the energy efficiency community and the water/wastewater industries

ENERGY STAR

CEE members will participate in EPA’s Water and Wastewater Focus under this Initiative in order to: 1) enhance communication with a network of water industry partners participating on the Focus⁹, 2) coordinate member programs with Energy Star activities/offerings, 3) more effectively utilize ENERGY STAR as a marketing platform and 4) provide input on a number of proposed products that could benefit member programs, including: an Energy Performance Rating System (EPRS), Energy Efficiency Assessment and Opportunities Report, Energy Management Guidelines, Financing information, Technical training and support for use of the EPA rating system and other ENERGY STAR tools, and EPA recognition of energy performance improvement through Energy Star.

Potential Energy Savings and Other Benefits

⁹ including public and private drinking water organizations, POTWs/local governments, and related industry, national, and state associations.

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Energy Benefits. Energy is the second highest budget item for municipal water and wastewater facilities after labor costs. It is also one of the highest costs that municipalities face overall. EPRI has estimated that water facilities can achieve 5-15 percent energy savings thru adjustable speed drives and high efficiency motors and drives and 10-20 percent energy savings thru process optimization and SCADA systems. In wastewater facilities, EPRI estimates that 10-20 percent energy savings are possible through process optimization (e.g. lower D.O.) and another 10-20 percent energy savings are available thru equipment modifications.¹⁰

The Northwest Alliance found that at small and medium sized facilities (5-20 mgd) can save an average of nearly 425,000 kWh annually through process optimization. This amounts to nearly 50 percent savings of targeted systems; overall facility savings are approximately 30 percent.

Peak Load Demand Savings. In addition to helping programs realize savings through best practices, programs can utilize Initiative resources for load management and demand response. In wastewater plants, peak flow rates and peak organic loads, which require increased pumping and treatment capacity, occur during the midday and afternoon hours, coincident with the summer peak demand periods of many electric utilities. Peak demand for electricity at treatment plants is mainly for operation of aeration systems used in treating organic loads (typically accounting for over 50 percent of plant process use). Process control, scheduling and storage offer significant peak load reduction opportunities.

Many of the peak demands for water, and the energy requirements to process and transport water, coincide with the peak seasonal demands experienced by electric utilities. Energy management mainly relates to pumping systems. Therefore use of high-efficiency equipment, utilizing effective instrumentation and control, managing pumping operation by efficient use of available storage, operating emergency generators for peak clipping offer the greatest demand reduction opportunities.

During the California Energy Crisis, the California Energy Commission specifically targeted water and wastewater facilities to reduce loads on the grid. As of December 31, 2002, the program achieved approximately 60 MW of verified peak load reduction capability. These programs were originally designed to encourage generation at these facilities. Opening the program to load shifting and efficiency projects doubled enrollment and nearly doubled expected savings. "Load shifting project account for one-third of the expected savings and had a leveled cost on par with generation. The efficiency projects accounted for a much smaller amount of overall savings, about 8 percent, but these projects were more cost effective with leveled costs 33 percent less than either generation or load shifting."¹¹

Non-energy Benefits. Energy-efficiency projects typically provide additional benefits to customers, such as lower maintenance costs, longer equipment life and better control. Although

¹⁰ Estimates based on audit process developed by EPRI and HDR Engineering, presented by Keith Carnes at the ACEEE Water and Wastewater Energy Roadmap Workshop, July 29, 2004.

¹¹ See CEC Peak Load Reduction Programs, Fourth Quarter 2002 Report – Final 06-11-03, Section 8 Water Agency Program Elements. Reporting on AB 970 Water/Wastewater Program Element and SB 5X Water Agency Generation Program Element. Pg. 8-39

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these benefits are frequently not measured or attributed to energy-efficiency projects within water facilities, it is likely that city managers and water facility operators will find them as compelling (if not more so) than the energy cost savings. A recent evaluation conducted by the NW Alliance estimated that quantifiable non-energy benefits of \$35,000 per year per facility in solids removal, deferral/reduction of capital expenses and reduced odor liability. In addition to the above, there were benefits operators themselves from energy-efficiency projects and facility energy management. Operators were more confident due to the ability to monitor their plants and safely treat water, especially since stable effluent meant a reduced risk of permit violation.

Benefits of Participation

The initiative is designed to offer value to administrators who have yet to launch a program aimed at water and wastewater facilities as well as those for which water and wastewater facilities have been an important part of their marketing or energy efficiency activities.

Participation in the initiative provides utilities a number of benefits:

- *Save efficiency program resources:* CEE provides product, process and program information as well as market research that reduce the need for administrators to dedicate resources to program planning and product research.
- *Maximize customer savings:* Widespread program promotion and support of cost-effective water and wastewater energy-efficiency opportunities will encourage increased availability of energy efficient products and services among suppliers and greater competition. Competition should eventually lead to lower prices for products and services, enabling utilities to provide even greater value to their customers.
- *Gain recognition:* Participants in this initiative will be contributing to a national effort that contributes to a cleaner environment and stronger economy. As this effort increases the market presence of high-efficiency products and services, it cuts emissions associated with power production. In addition, more energy-efficient water and wastewater facilities help cut the productions costs which can be passed down to water utility ratepayers. CEE will undertake an ongoing public relations effort that communicates initiative offerings and accomplishments to the participants.

Furthermore, CEE will work to facilitate communications among program administrators, water and wastewater utilities and product and service suppliers. CEE will compile information about participating electric utilities' programs on an ongoing basis. This information will be presented to the water and wastewater industry and their suppliers in order to encourage wider availability of products and services.

Participation

The Initiative has established several levels of participation that take into account varying levels of program resources (e.g., budget, staff), the structure and needs of local water and wastewater facilities and the desired program impact. The initiative offers a graduated or phased approach to demonstrate the benefits of energy efficiency to operators and city managers and to generate support for facility energy management strategies.

Level 1: Programs to Promote, Educate and Train
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<ul style="list-style-type: none">- a commitment to provide staff or contractual resources, or other resources as needed to support energy-efficiency projects within municipal water supply and wastewater treatment customers either through an existing program or through a dedicated energy-efficiency program;- utilize the template to promote the facility-level energy-efficiency message to water and wastewater customers in your area (including education and training activities);- Notify CEE of current program offerings for inclusion in program summary.
<p>Level 2: Programs that Support Energy Saving Projects</p> <ul style="list-style-type: none">- Utilize the template to complete at least three (3) energy-saving projects and share the results with the other Initiative participants.- Complete at least one (1) case study documenting successfully implemented project for a water/wastewater utility in your area.- Experience a 20 percent increase in the number of water and wastewater facilities participating in energy-efficiency programs in your area, or recruit program participation from the largest municipal water and wastewater facilities in your area.
<p>Level 3: Programs that Support Facility Energy Management</p> <ul style="list-style-type: none">- Utilize the template to assist water and wastewater customers to monitor energy use facility-wide, helping them to identify, prioritize and implement projects to improve facility performance.- Document project impact in terms of improvement facility energy performance and share the results with the other Initiative participants.- Complete at least one (1) case study documenting successfully implemented project for a water/wastewater utility in your area
<p>Level 4: Developing New Program Resources*</p> <ul style="list-style-type: none">- Assist CEE to identify new program materials (case studies, research, tools, etc.) that are currently lacking or outdated.- Participate in collaborative efforts to develop needed program materials in partnership with the water and wastewater industry (as necessary)- Participate in collaborative research projects (such as piloting the water utility energy index or energy performance rating system) <p><i>* Participants may be asked to contribute toward the funding of development efforts as supplemental projects.</i></p>

At the national level, this Initiative provides a platform for the energy-efficiency program community to focus its efforts to achieve energy savings in this very important sector. Through this Initiative CEE members are demonstrating their commitment to the sector and to working with the industry to identify and promote a more sustainable energy future.

Member Interest

Since August 2002, CEE’s Water and Wastewater Committee has met to discuss their mutual goals and objectives for the water and wastewater sector. Together, they represent a broad range of member interests. Most of the committee members currently serve water and wastewater customers through their existing custom programs and prescriptive rebate programs (motors, drives, lighting, etc.). Others administer programs focusing on process optimization, such as

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NYSERDA, the Northwest Energy Efficiency Alliance, Bonneville Power Admin., the California Energy Commission, Wisconsin Department of Administration, TVA and Efficiency Vermont. There are also new construction programs, such as those administered by NYSERDA and the California investor owned utilities (SCE, SDG&E and PG&E). Finally, there are a number of organizations that have researched the water-energy connection and contributed to the committee's thinking about the opportunity, such as non-profit groups and national laboratories. See committee roster, attached.

TECHNICAL BACKGROUND

Market Description

Wastewater Collection and Treatment Market. There are approximately 15,000 wastewater treatment plants operating in the United States. More than 70 percent of the U.S. population is served by these publicly-owned treatment works – relatively few in number are operated privately (less than 10%). According to EPRI, over 75 percent of wastewater plants are small (1.0 mgd or less in capacity), serving 7 percent of the US population. Approximately 4 percent are large (10.0 mgd or greater in capacity) and serve over 70 percent of the population.¹²

Wastewater systems generally consist of three principal components: collection systems (sewers and pumping stations), treatment facilities, and effluent disposal. Wastewater aeration, pumping and solids processing account for most of the electricity used in wastewater treatment. Primary treatment methods are usually similar across facilities. All wastewater plants, for example, need to collect, filter and remove solid matter from incoming streams. Typically, pumps are the most prominent energy consumers. Approximately 42,000 wastewater pumping stations across the country operate around-the-clock to meet continuous and varying wastewater flows.

Secondary treatment types vary widely, although most employ bacterial cultures to remove organic materials still remaining after primary treatment. These bacteria require oxygen to function via aeration.¹³ Aeration powered by fans and blowers constitutes the largest energy expense at most wastewater facilities. The most common types of wastewater treatment are activated sludge, lagoon, oxidation ditch/extended air plant, and trickling filter. One of the most common treatment types, activated sludge, is also one of the most energy-intensive. For example in a typical activated sludge treatment plant the aeration system typically represents 60 percent of a plant's electricity use; pumping represents an additional 15 percent.

Water Treatment and Distribution Market. There are roughly 200,000 water treatment systems in the country, of which approximately 60,000 are community water systems that serve year-around residents, e.g., residents served by municipal, county, and private water utilities as well as trailer parks, subdivisions and apartments with their own supply systems. Most of the water in the United States is provided by community water systems. Nearly 80 percent of the U.S. population is supplied by about 5 percent of these systems. The remaining 95 percent include a large number of small and very small systems serving populations of 3,300 or less. Approximately two-thirds of the systems are supplied by surface water; the balance is served by groundwater.

¹² EPRI, Water and Wastewater Industries: Characteristics and Energy Management Opportunities, 1996. (2-16)

¹³ Aeration may be defined as the introduction of air into secondary treatment tanks to facilitate the decomposition of organic mater in wastewater.

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Public agencies (municipalities, counties, water districts or authorities, and townships) own and operate most community water systems and use a similar decision-making process. A small number are privately operated.

Since approximately 80 percent of the electricity used at these facilities is for pumping it is no wonder that most of energy saving opportunities within the sector relate to pumping equipment and operational control systems. On the process side, many municipal water and wastewater treatment plants are shifting from chlorine-based disinfection to ultraviolet (UV) disinfection to eliminate the risk of storage and handling of toxic chemicals. Although UV disinfection is energy intensive, it adds no chemical residue. This feature is important for discharge to sensitive aquatic environments (and for wastewater reuse). In general, low pressure UV systems are substantially more efficient than medium pressure systems.

For both water and wastewater managers and operators meeting permit and staying within budget are the single most important drivers in this market.¹⁴ There is also a general desire among both operators and design/engineering firms to maintain or improve reliability of their facilities. Energy-efficiency opportunities must be framed with these factors in mind. Particularly on the minds of water operators are decisions to implement new regulations under the Safe Water Drinking Act such as implementing portions on arsenic and radon control, required filtration and groundwater disinfection. Similarly for wastewater operators, meeting new and more stringent Total Maximum Daily Loads (TMDLs) for effluent components pose significant challenges.

Since water and wastewater facilities are most often owned and operated by municipal governments, procurement, planning and budgeting must be done in conjunction local government policies and procedures. Water and wastewater department managers must compete for resources with other municipal departments which can constrain opportunities to implement energy-efficiency projects. Upper-level decision-makers within municipalities do not necessarily understand the value in these projects and will not always support them if they are more costly. The chart below illustrates the water supply and wastewater utility operating environment, including state and federal government influences.

Product and Service Providers

There is no shortage of product and service providers serving the municipal water and wastewater sector. Traditionally large municipalities have 3-or-4 consulting engineers (or engineering firms) on contract for projects. Mid-sized cities often have one firm that they rely on to implement facility projects; while smaller cities tend to use local contractors for simple projects that are not completed in-house.

There are several large, well known and well respected A&E firms that design and build facilities as well as large project integration firms (e.g., Montgomery Watson Harza, Brown and Caldwell, Malcolm Pirney, US Filter, CDH). There are also many smaller engineering firms that serve local and national markets (such as BacGEN, GDS Associates, Quantum Engineering). In

¹⁴ See, PG&E, Municipal Wastewater Treatment Plant Energy Baseline Study, 2003.

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addition, there are a number of product manufacturers that provide engineering installation and consulting services for water and wastewater plants such as manufacturers of motor, drives, pumps, and controls.

While most engineering firms have the capability to deliver energy-efficiency and process optimization services, few promote them to their customers. The Northwest Energy Efficiency Alliance and the Bonneville Power Authority have worked with one provider of process optimization services, BacGen, to help cultivate the market for energy-efficiency services among small- and medium-sized water and wastewater facilities in the region. After six years, BacGen has demonstrated that there is a viable market for water and wastewater process optimization services (and energy-efficiency). Ironically after seven years and over 80 successful projects, BacGen has virtually no competition.¹⁵ It appears engineering firms do not see the value of optimizing the treatment process to save energy, or have a difficult time gaining customer interest. Although the majority of consulting engineers in the Northwest have seen heightened awareness about energy efficiency among operators in the last several years, they have not substantially changed the way they design and suggest strategies to their clients.

In terms of diagnosis, most engineering firms have the capability to conduct audits of facilities and propose solutions to increase efficiency; however, few do so because it would represent a substantial departure from their standard business model which is centered on customer expectations to meet permit, be reliable and minimize costs.

A lack of support from municipal leaders compounds the problem. The NW Alliance found that while nearly all the facility operators interviewed were becoming more aware of energy efficiency opportunities, nearly 40 percent felt that it was not supported by the city.

Barriers to Energy Efficiency

1. Upper-level decision-makers, such as city managers, mayors, city councils and water-utility regulators also do not appreciate the value of energy-efficiency or how it relates to their primary responsibilities to serve the public, plan for future demand, manage capital and operating budgets across departments, maintain revenues and meet regulations.

The Initiative includes an outreach strategy to municipal leaders to help them see the value of energy-efficiency and how it supports their priorities. CEE intends to develop and support a national message and to support delivery of the message by encouraging Initiative participants to share project results with leading municipal decision makers and ask them to support energy management. The development of an energy performance rating system for water and wastewater facilities could provide the means to quickly demonstrate to municipal leaders the opportunity for improvement and to seek their support.

2. Most operators and managers are not aware of energy consumption, do not see monthly energy bills, and are not motivated to investigate even the most cost-effective energy-efficiency improvements. Those who are aware of energy consumption and are motivated to implement

¹⁵ With Alliance support, BacGen developed a set of low-cost and low-maintenance technologies for small and medium-sized facilities based on products available “off the shelf”. NW Energy Efficiency Alliance, BacGen: Market Progress Evaluation Report, No. 3, Oct. 2004.

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energy-efficiency improvements don't have the resources to pursue projects, much less implement an energy management systems.

The Initiative will highlight the benefits of energy-efficiency through case studies, articles in the trade press and at trade shows. Participants are encouraged to work with their water and wastewater customers through program to demonstrate the benefits of energy-efficiency and to assist operators with projects.

3. Municipalities are required to build water and wastewater facilities with a 20 year life, as result the equipment specified is often oversized to accommodate future peak load requirements.

The Initiative will work with state and federal regulatory bodies as well as A&E firms to explore opportunities for new facilities to specify equipment on a shorter time-horizon, say five years. CEE's Procurement Initiative for State and Local will also be used to help in this effort.

4. Designers, specifiers and the supply community are conditioned to meet the regulatory demands of the industry and don't offer energy-efficiency as a value added service.

Designers, specifiers and the supply community will respond to changes in demand from water and wastewater operators and managers and municipal leaders. The Participants in the Initiative will support suppliers of products and services to incorporate energy-efficiency as a standard business practice through their programs.

5. Projects typically take a long time to develop and implement because of municipal government bureaucracy and regulatory hurdles.

As energy-efficiency practices and energy management becomes an accepted part of the municipal business, they should take no longer than other projects. Incidentally, there are instances where participating in energy-efficiency programs can help accelerate the approval process. Customers participating in projects through NYPA have found that contracts are let and completed faster than under normal practices. BPA found that municipalities that projects funded via performance contracting are approved and completed more quickly.

6. Municipalities tend to be risk adverse and are therefore hesitant to implement new technologies.

The energy-efficiency community has a great deal of experience working with municipalities on water and wastewater projects. Aggregating, organizing and presenting the results of these projects may very well help reduce perceived risk.

7. Municipalities have limited resources, capital and operations budgets are constrained. Many operators at smaller facilities report constraints on their O&M budgets that can restrict their access to and adoption of emerging technologies.

*Programs can provide assistance with the financing of projects if that is a barrier, there are also opportunities in the area of energy performance contracting. The goal of the Initiative is to marshal the evidence to demonstrate, even to smaller facility managers that they can't afford **not** to manage energy wisely.*

Initiative Description

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8. Facility managers and operators are unfamiliar with new technologies which keeps them from considering energy-efficiency projects. In other cases, operators may have had poor experiences with energy-saving technologies in the past, such as drives.

Raising awareness of energy-efficiency technologies and their benefits through the coordinated efforts of program participants and national outreach strategies will help raise awareness levels among facility operators and managers. Sharing case studies and other information on successful projects can help demonstrate that energy-efficiency technologies have improved over time and address prior impressions.

9. There is a tendency for water facility staff to wait until equipment failure rather than to be proactive.

The Initiative will make the case that it is more expensive to wait for failure than to be proactive. The MDM campaign will be used to help promote this message.

10. It is difficult to quickly assess the potential for improvement within a single facility. What level of energy performance should municipalities aim for? Is one project enough?

CEE is participating in joint-efforts with AWWARF and ENERGY STAR to develop a reliable water and wastewater utility metric that can form the basis of an energy performance rating system and benchmarking tool. With these tools water facility operators and managers will be able to assess their facility's performance relative to similar facilities across the country.

11. The municipal water and wastewater sector places a high priority on meeting public demand for water services and meeting environmental water-quality standards. Energy-efficiency is typically not part of municipal culture. Energy-efficiency is not valued, not a priority.

Today there is no perceived link between energy-efficiency and higher municipal priorities such as meeting water quality permits. This Initiative is dedicated will municipal leaders make that link. As demonstrated in the Northwest, more energy-efficient facilities are better controlled and give operators more confidence as to how the facility is performing overall. We believe this positive impact will be compelling.

12. There is a split incentive between those who build new facilities and those who operate them and those who pay their operating costs, such as electric utility bills.

The Initiative will explore opportunities to introduce energy-efficiency into the design and construction of new facilities. Educating municipal leaders and regulators will be an important start to precipitate demand for new facilities that are build with energy-efficiency and energy management in mind.