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Innovation in the Water Sector: Pathway to Zero Net Energy

A MASSACHUSETTS-BASED PARTNERSHIP WAS ESTABLISHED IN 2007 THAT FOCUSED ON ACHIEVING ZERO NET ENERGY AT WASTEWATER AND DRINKING WATER FACILITIES. THE MODEL OF THIS SUCCESSFUL COLLABORATION HAS BEEN ADAPTED BY OTHERS IN THE WATER SECTOR.

What interest does the wastewater and drinking water sector have in improving its energy performance? Will the sector work with environmental and energy agencies to learn about and work on the connection between energy and water? These were some of the questions that led to the creation in 2007 of the Massachusetts Clean Energy Partnership for Wastewater and Drinking Water Facilities, a collaborative effort to improve energy performance and reduce greenhouse gas emissions at wastewater and drinking water facilities. The Partnership was formed from state agencies (the Massachusetts Department of Energy Resources and the Massachusetts Department of Environmental Protection), the US Environmental Protection Agency's (USEPA's) Office of Wastewater Management and USEPA Region 1–New England, the University of Massachusetts Lowell, and energy utilities' energy-efficiency program administrators. (A photograph of the Partnership team is on page 79.)

Long before other states and USEPA regions recognized the challenge of air and water quality trade-offs in the water sector, agencies in the Partnership began working on strategies to address the water–energy nexus. Sponsored by USEPA’s Office of Wastewater Management and supported by the Global Environment and Technology Foundation and the University of Massachusetts Lowell, the Partnership worked with facilities to (1) reduce energy use and associated greenhouse gas emissions, (2) promote sustainable water infrastructure, (3) improve asset management, (4) conserve natural resources, (5) reduce or avoid operating costs, and (6) improve process effectiveness and efficiency.

The Partnership successfully engaged federal and state agencies, municipal drinking water and wastewater facilities, universities, energy providers, trade associations, nonprofits, and the consultant community. It started by promoting a goal of zero net energy that would generate as much energy onsite as was needed to meet facility demands. Emphasis was placed on efficiency and conservation programs, process optimization, onsite energy generation (e.g., solar, wind, combined heat and power [also known as cogeneration]), and a management systems approach to support energy improvements continuously and over time. Results included reductions and/or avoidance of costs, reduction of energy use and associated greenhouse gas emissions, improved operations, and safer working conditions.

Approximately one-third of Massachusetts’ 250 drinking water and 120 wastewater municipal facilities or districts have participated in the Partnership’s programs since its creation. Its collaborative model has been successfully replicated across the New England states and in 15 other states and US territories. The Partnership was named as one of five finalists in the 2015 Innovations in American Government national competition sponsored by the Harvard Kennedy

School’s Ash Center for Democratic Leadership. It also received a Leading by Example award in 2015 from the Commonwealth of Massachusetts for outstanding energy and environmental efforts.

workshop in Lowell, Mass., in March 2008. High attendance at both workshops meant that some people had to be turned away. Because of this degree of interest, the Partnership began offering what

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PARTNERSHIP ACTIVITIES

The Partnership used a “plan-do-check-act” framework presented in USEPA’s *Energy Management Guidebook for Wastewater and Water Utilities* (USEPA 2008). A facility using the framework first establishes and sets priorities for energy performance (plan), then implements specific projects or practices to meet energy targets (do), followed by monitoring and measurement (check) and regular review and adjustments to continuously improve energy performance (act).

The Partnership first offered an introductory workshop in Connecticut in December 2007 followed by a

would become 17 interactive “energy roundtables” from 2008 to 2014. These meetings created opportunities for operators and facility directors to learn about successes and challenges from their peers. (The sidebar on page 80 is a list of advice that came from roundtable participants.) The meetings also included facility tours that showcased equipment and process changes to improve energy performance. Discussion and presentations covered a wide variety of topics, including energy audits (preparation and adoption of results), interpretation of energy bills, process improvements, new equipment and monitoring systems, ways to engage



The members of the Massachusetts Clean Energy Partnership for Drinking Water and Wastewater Facilities. First row, left to right: Linda Darveau, Gina Snyder, Madeline Snow, Ann Lowery, Cynthia Greene. Second row, left to right: Michael DiBara, Jamie Doucett, Jason Turgeon, Alexe Law-Flood. Not shown: Aimee Powelka and Jim Horne.

staff in changing behavior, low- or no-cost ways to improve energy performance, available funding sources and assistance, and the value of communicating energy improvements to

despite funding challenges and obstacles arising from running existing programs in “silos” without the work of engaging with other agencies and those regulated by

generation. Every roundtable meeting and onsite visit affirmed the movement to view wastewater facilities as sustainable resource-recovery facilities rather than merely disposal facilities (Water Environment Federation 2011). Operators and directors of drinking water and wastewater facilities increasingly have come to embrace energy as part of their everyday responsibilities and to insist that their consultants and engineers incorporate energy considerations early in design and upgrades. Energy utilities have also shifted their perceptions. Few had previously thought of these facilities as having a meaningful potential for and commitment to energy reductions. Through the energy roundtable meetings, energy utilities have come to work closely with drinking water and wastewater facilities to achieve energy-efficiency goals.

Energy use and onsite energy generation. From 2008 to 2010, the Partnership achieved the following:

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ratepayers, boards, and/or municipal officials. Participating facilities (a total of 125) were supported with more than 100 onsite technical assistance visits; software to analyze energy use; 42 energy audits; renewable energy feasibility studies; information to increase awareness of and access to grants, loans, incentives and rebates; and new funding through the Massachusetts Clean Energy Center.

For more than eight years, the Partnership has survived and flourished

governmental entities. Keys to success include a strong inter-agency planning team, senior management support, a deep respect for the experience and expertise of facility operators, and the nimbleness to experiment and evolve as conditions and priorities change.

RESULTS

Shift in thinking. The Partnership’s work has shifted thinking in the water sector about energy, energy use and costs, and onsite energy

Pathway to Zero Net Energy: Advice to Operators From Energy Roundtables

Plan early.

- Ask your energy providers about incentives before planning or implementing any energy project.
- Incorporate energy efficiency in design or as early as possible.
- Engage external stakeholders in understanding options for onsite energy generation and/or efficiency way before you need them to make a decision or issue an approval.

Pay attention to energy.

 There are always opportunities to be more efficient.

- Ask questions.
- Start by looking at energy use and costs through energy bills and submetering information.
- Do an energy audit/evaluation that looks at the process and operator behavior, not just at lights and equipment.
- Look at energy supply as well as demand.
- Look for opportunities to shift intermittent operations out of peak demand periods to reduce costs.

Think about systems and programs.

 Don’t focus only on individual energy projects.

Look for and cultivate these assets:

- Operator engagement.
- A “champion.”
- Top management support.

Communicate efforts and results.

 Publicize results, internally and externally.

- Obtained \$66.1 million in federal funding to fully implement energy audit and feasibility study recommendations for the Massachusetts Energy Pilot and Green Reserve Projects (USEPA 2009)
- Installed 8.8 MW of clean energy: 18 photovoltaic projects (4,922 kW—see an example on this page), three wind turbine projects (3,350 kW), two cogeneration projects (305 kW), and two hydroelectric projects (285 kW)
- Saved 21 communities a total of approximately \$5 million annually through energy efficiency and onsite energy generation
- Reduced annual carbon dioxide emissions by 34% (22,000 tons of greenhouse gas emissions per year)

Since 2010, on the basis of information prepared by the Massachusetts Department of Energy Resources and the Massachusetts Department of Environmental Protection (MA DOER & MA DEP 2015), the Partnership has made these contributions:

- Saved Massachusetts communities a total of more than \$35 million
- Reduced electricity consumption by approximately 240,000 MW·h
- Removed over 100,000 tons of carbon dioxide (all voluntary and all without new regulations)
- Increased total operating onsite generation by 173% from 16 MW pre-2007 to 43 MW in 2014 (an additional 9 MW of generation is under development, which will result in over 52 MW statewide)
- Continued to support the use of the Massachusetts state revolving fund's low-interest loans for energy-efficiency and renewable-project development
- Generated \$487,000 in revenue from renewable energy certificates and solar renewable energy certificates for communities from 30 renewable energy projects



The Massachusetts Clean Energy Partnership for Wastewater and Drinking Water Facilities was instrumental in implementing numerous clean-energy projects—among them a 48-kW solar photovoltaic system at the City of Lowell's Regional Wastewater Treatment Plant.

Most recently, in 2014, a new “gap funding” grant program provided through the Massachusetts Clean Energy Results Program (a government-led statewide partnership between the Massachusetts Department of Environmental Protection, the Massachusetts Department of Energy Resources, and the Massachusetts Clean Energy Center) provided \$1.7 million for 30 projects. This grant program leveraged \$2 million in energy utility incentives to move the projects forward. The funded projects will reduce enough electricity to fully heat and power 897 homes—the greenhouse gas equivalent of removing 5,369 cars from the road—over 15 years (MA DOER & MA DEP 2015).

SUMMARY

The Massachusetts Clean Energy Partnership for Wastewater and Drinking Water Facilities was created to address energy use, costs, greenhouse gas emissions, and air and water quality at wastewater and drinking water operations, issues that do not traditionally fit into

drinking water and wastewater regulatory programs. Federal, state, and municipal government; energy utilities; professional trade associations; and a university worked together to integrate existing tools and resources (e.g., energy tracking, audits, technical assistance) while creating new opportunities (e.g., peer learning, policy changes, new funding sources).

This collaboration reduced energy use and associated greenhouse gas emissions, increased the onsite generation of renewable energy, and supported a shift in the wastewater sector's identity from treatment/disposal to water resource-recovery facilities that produce clean water and recover nutrients while efficiently managing and generating their own energy.

What started as an experiment in Massachusetts to gauge the potential for significant energy improvements in the water sector has become a model of success for other states and US territories. This collaborative model is also being applied to other energy-intensive sectors in hopes of achieving similar successes.

ABOUT THE AUTHORS



Madeline Snow is a project manager at the Lowell Center for Sustainable Production, University of Massachusetts, 600 Suffolk St., c/o TURI, 5th Fl., Lowell, MA 01854 USA; madeline_snow@uml.edu. She earned a bachelor's degree in biology and environmental studies at New College in Sarasota, Fla., and a master's degree in public administration from Harvard Kennedy School, Cambridge, Mass. She has been working for 13 years with organizations to improve compliance and sustainability practices. She has also worked with the US Environmental Protection Agency (USEPA) and several states to improve energy management in

the drinking water and wastewater sector, which included contributions to USEPA's Energy Management Guidebook for Wastewater and Water Utilities, co-facilitation of 15 introductory workshops, and the design/facilitation of 25 energy management roundtable meetings. Snow worked in the Massachusetts Department of Environmental Protection for 25 years. Linda Darveau is an environmental specialist at USEPA Region 1–New England in Boston, Mass. Ann Lowery is assistant commissioner at the Massachusetts Department of Environmental Protection in Boston, and Michael DiBara is a project manager at the Massachusetts Department of Environmental Protection in Worcester, Mass.

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