Achieving Wastewater Market Transformation through Customer-Focused, Customized Services

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ABSTRACT

Wastewater facilities offer significant potential for delivery of cost-effective efficiency services to economically and geographically diverse populations. Efficiency Vermont's wastewater market initiative is successfully penetrating and transforming this market in Vermont. Since the beginning of Efficiency Vermont in 2000, more than 40% of Vermont's municipal wastewater facilities have actively engaged with Efficiency Vermont to reduce electric costs through efficiency projects. Our high degree of market penetration is a result of targeted outreach, training, and customized services focused on understanding and overcoming the unique barriers facing all the key market actors in this industry sector.

Efficiency Vermont's "wastewater market initiative" is focused on understanding the challenges facing wastewater facility personnel and town managers, so that implementing efficiency improvements will achieve their priorities. The Efficiency Vermont wastewater market initiative consists of three core components:

1. Customizing client services to meet the needs of the customer, including technical assistance, financial incentives, third-party project review, and pilot scale technology testing.
2. Actively partnering and engaging with industry associations, engineers, and regulators to raise market awareness of efficiency benefits and leverage trade association resources.
3. Sponsoring training and education opportunities for facility operators and managers to promote energy and subsequent non-energy benefits of upgrading equipment and systems.

This paper describes Efficiency Vermont's experience and results to date in the wastewater market, a traditionally risk-averse industry sector. Examples of successful services, approaches, and technologies are highlighted, especially those applicable outside of Vermont.

Introduction

The wastewater market in Vermont is composed of approximately 100 municipal and 70 private and industrial facilities throughout the state. Many of the facilities in Vermont are operating beyond the design life of the equipment and systems. Often, systems are oversized, equipment is antiquated, and processes are similar to those used one hundred years ago. Control systems and strategies are frequently limited to on/off operation of equipment, and usually implemented based on personnel availability. Given the desire to maintain local tax rates, municipal facilities have access to minimal capital resources for upgrades and equipment replacements. Moreover, for municipalities, wastewater operations are typically their most

energy-intensive accounts. Electric utility bills often represent thirty percent of the total annual operating budget of a wastewater facility (Metcalf & Eddy, 2003).

In 1999, the Vermont Public Service Board and the Vermont legislature instituted a new approach in the state for the operation of ratepayer-funded efficiency programs; Efficiency Vermont was created. Efficiency Vermont is the nation's first energy efficiency utility, and was created to help all Vermonters save energy, reduce energy costs, and protect Vermont's environment. Vermont Energy Investment Corporation, an independent, non-profit organization is under contract to the Vermont Public Service Board to operate Efficiency Vermont. As an energy efficiency utility, Efficiency Vermont administers virtually all electric-ratepayer system benefits charges collected across the state to fund improvements in energy efficiency at a statewide level. The Efficiency Vermont contract is a multi-year, competitively bid, performance-based contract that includes clearly specified, quantitative goals (e.g., electric energy savings, total resource benefits), but does not dictate how savings are achieved. The Efficiency Vermont contractor is granted the freedom and flexibility to decide how best to achieve energy savings. Since its inception Efficiency Vermont has achieved electric energy savings at an average rate of 2.6 cents per kilowatt-hour (kWh). This represents a highly cost-effective "supply" of electricity that benefits ratepayers across the state. The Efficiency Vermont contract also has performance metrics that require geographic equity and encourage demographic equity in the distribution of benefits. When assistance is provided to wastewater market customers, especially municipalities, Efficiency Vermont is able to provide benefits to broad and diverse populations, often directly benefiting the constituents of tax paying communities.

Market Barriers

Many market barriers need to be addressed in order to achieve a wastewater sector where wastewater facilities will factor the energy impacts of treatment processes and equipment purchases into their decision making processes. The primary barriers facing these facilities are

- Lack of capital for increased first costs associated with more energy efficient design and equipment. First costs are often prioritized over the life cycle cost of equipment and systems.
- Lack of knowledge and understanding among operators of this equipment regarding the long-term energy and non-energy benefits of energy efficiency improvements. Many facility operators never even see their facilities' electric bills.
- Risk aversion and hesitancy to spend taxpayer funds for implementing new systems and doing things differently from in the past.
- Regulatory and safety concerns that a "new" approach to treatment may create state or federal compliance problems.
- Energy efficiency options are "extras" in design fees, and budgets do not accommodate additional time or funding to investigate more energy efficient design alternatives.

Market Opportunities/Potential

There are more than 16,200 publicly owned treatment works (POTWs) in the United States. The number grows higher if private and industrial facilities are included. It is estimated that 30 percent of a wastewater treatment plant's operational cost is typically budgeted for

electricity, and that usage amounts across the country may increase an additional 30-40% during the next 20 to 30 years (Metcalf & Eddy, 2003). Typically the largest energy using systems in wastewater facilities, and also, the largest energy saving opportunities, relate to treatment processes rather than to building systems. In particular, aeration and pumping systems are the major electric users in wastewater facilities. Not surprisingly, therefore, motor upgrades and installation of variable frequency drives to control various aeration and pumping processes have proven to be highly cost-effective. These measures offer large kWh savings for modest capital investments. Moreover, the application of variable controls is appropriate for a large majority of wastewater facilities in Vermont and across the country.

In order to realize the potential savings existing in the wastewater market, customers must become aware of and motivated to implement changes at their facilities. Providing customized services targeted to meet the needs and challenges of each facility and customer is critical for achieving electric savings through efficiency projects. Customer service, training, and case studies from Efficiency Vermont promote greater understanding and document the real benefits that other facilities have achieved through efficiency improvements. The efficiency measures of greatest potential for Vermont facilities include:

- Variable frequency drives (VFDs) on aeration equipment, including centrifugal blowers, positive displacement blowers, and mechanical aerators.
- VFDs on pumping equipment, especially at pump stations and pumping applications with daily run hours.
- Automated and variable control strategies for VFDs, ultraviolet disinfection systems, and influent flow management (including computer programming upgrades to "SCADA"[1] systems)
- For new construction projects, process changes to newer, more energy-efficient systems (e.g., rotary press dewatering instead of centrifuge dewatering, "claricone"[2] settling tanks instead of conventional clarifiers)
- Implementation of methane-fueled co-generation at plants that use anaerobic digestion for sludge stabilization and volume reduction.

Efficiency Vermont's Approach

In order to serve the wastewater market more effectively, Efficiency Vermont has created a "target market team." This team is charged with evaluating savings opportunities more comprehensively than one customer and facility at a time. With this team, we can work to overcome market barriers more effectively than, and in parallel with, customer-specific project activities. In general, the efforts of the team are focused on achieving dual goals of kWh resource acquisition, and long-term market transformation. Our long-term goals for Vermont's wastewater market are:

[1] SCADA is an acronym for "supervisory control and data acquisition." It is a proprietary computer programming system that tracks and controls plant operations. Many facilities that have a SCADA system are not using it to its full potential to optimize energy use and other operational functions.

[2] Claricones are a special type of wastewater clarifier (i.e., settling tank) that induces separation of materials because of its physical shape (which resembles an ice cream cone), and uses no electrical power to induce flow and settling.

- Wastewater operators are aware of the energy and cost impacts of each piece of equipment and its operation.
- Wastewater operators monitor ongoing energy use at their facilities, and continuously seek opportunities for process and efficiency improvement.
- The Wastewater community is dedicated to reduce energy usage and costs, and is aware of available resources, including Efficiency Vermont, to help them achieve this goal.
- Equipment and system decisions made by design professionals and community members will truly be based on creating facilities and systems with the lowest Life Cycle Costs.
- Vendors and suppliers will routinely stock and recommend energy efficient equipment and systems.

There are three primary components to the services and activities delivered by Efficiency Vermont that help us to overcome market barriers and achieve the goals listed above.

1. Provide customized client and project services to meet the needs of the customer, including technical assistance, financial incentives, third-party project review, and pilot scale technology testing.
2. Actively partner with industry associations to leverage their expertise and resources, and target outreach to operators, engineers and regulators to raise market awareness of efficiency benefits.
3. Sponsor training and education opportunities for facility operators and managers to promote energy and non-energy benefits of equipment and system upgrades.

Item #1 is focused on promoting resource acquisition through efficiency project implementation. Items #2 and #3 are focused on promoting long-term market transformation within the wastewater community.

Custom Approach to Projects – Achieving Resource Acquisition

The large majority of Efficiency Vermont projects at wastewater facilities include assistance beyond prescriptive efficiency rebates. In fact, prescriptive incentives only account for about 2% of Efficiency Vermont total kWh savings achieved in this target market to date. The majority of wastewater projects completed are customer-specific and customized. The availability of customized services for these customers is crucial to achieving implementation of efficiency measures. Particular attention must to be given to addressing the individual needs and concerns of each customer. In general, customized services provided by Efficiency Vermont consist of both technical and financial assistance.

Technical assistance is provided in many forms to wastewater personnel and other key wastewater market actors. Efficiency Vermont project managers work directly with customers, design professionals, trade allies, and regulators to assist with identifying efficiency opportunities and calculating estimated energy savings. Smaller upgrade projects may not have the benefit of assistance from an engineer, and operators may be working solely with equipment suppliers. In these cases, technical assistance from Efficiency Vermont, and independent verification of savings estimates, is often vital for the project to receive approval to move forward from the facility's decision-making body. Efficiency Vermont continues to improve our ability to make accurate savings estimates, as we engage and complete more projects within

this target market. Each project offers an opportunity to collect more data and information, and to improve savings assumptions and calculation. In addition, as we complete more projects, we are able to provide new customers with specific examples of successful projects, so that they may feel confident in an application's proven track record. Specific technical assistance services provided to customers includes site visits, savings estimates, pre- and post-installation metering, pilot scale temporary installations, and relevant contacts at other facilities that have implemented similar projects. As we continue to collect more electrical metered data from projects, we are compiling a database that will improve project managers' abilities to estimate savings accurately for a wide variety of wastewater equipment, applications, and measures. The database continues to expand as resources and metering opportunities become available. This effort has proven to be a valuable resource to our customers as well. Customer's use of this data verifies to superiors the value of their improvements at the facility level.

Temporary installation of energy-saving VFDs can be a compelling way to promote an equipment installation, while increasing confidence in savings estimates and reducing the perceived risk of pursuing an energy efficiency project. When an operator can see that a new technology not only improves his or her process control, but reduces electric power demand by 25%, 50% or more, project excitement and motivation can significantly speed equipment approval and installation.

There are several ways in which we support wastewater facilities' efficiency projects financially. Many facilities rely on financial incentives for equipment replacement and process upgrade projects. In particular, municipal facilities are often highly constrained by the lack of available capital for project implementation. These are cases where up-front incentives are the deciding factor for energy efficiency improvements. Cash incentives are not the optimal financial strategy for all projects, however. For new construction and major upgrade projects, funding is often provided through State and Federal agencies in the form of loans and grants. For these projects, a customer incentive post-installation is less important for achieving measure installation, as is financial support to design professionals in the early stages of project design. In these cases, we offer design incentives to engineers and/or provide financial support for activities that are outside the normal scope of work included in design professional's fees. Examples of "extra" work scope includes identification and comparison of alternative technologies, cost and savings analyses, energy modeling, and modification to boilerplate specifications. Efficiency Vermont project managers can offer cash flow analyses, life cycle costing, and other project economics analysis assistance to customers, such as evaluating loan financing and leasing options to acquire energy saving equipment. Whenever possible, we help to identify potential, supplemental sources of funding, to reduce customers' costs and improve the likelihood of project implementation.

Below are three example projects. In each case, Efficiency Vermont provided assistance to the projects customized services based on the specific needs and challenges of the facility.

Example Project #1: VFD Upgrade for Centrifugal Aeration Blowers

The City of Winooski Water Pollution Control Facility (WPCF) contacted Efficiency Vermont to evaluate the efficiency opportunities related to the plant's two 75-horsepower (HP) centrifugal aeration blowers. These two blowers are sequenced, so that one blower is operating 24 hours each day. Originally, process control for the blowers was only available through a throttle valve. Energy savings are minimal from use of this type of "control" strategy. The

motor supplier/contractor saw an opportunity for installation of variable frequency drives, and recommended that the facility chief operator contact us for assistance with savings estimates and financial incentives. While Efficiency Vermont considered the project to be highly cost-effective, the municipality was not confident that the estimated savings would actually be realized. The WPCF Chief Operator contacted two separate engineers for their opinions on the project. One recommended installing VFDs, the other did not. A phone call to the blower vendor offered no additional clarity, and left the operator wondering if he would void equipment warrantees upon installing VFDs. There was no clear path forward, and no consensus on whether to install VFDs.

Many individuals believe that motor speed on a centrifugal blower can be lowered minimally, if at all, thus electric energy savings would be minimal or non-existent. How did we break this impasse? Efficiency Vermont worked with the facility Chief Operator, the motor/VFD supplier, and the facility's electrician to test a temporary VFD installation. After a qualified electrician wired in a VFD, bypassing the existing motor controls, data was collected at varying motor speeds, including kW, amps, and blower discharge pressure. Additional information collected was on process conditions (e.g., sufficient aeration and mixing in tanks), equipment noise and temperature, and blower check valve operation. While maintaining acceptable process conditions at approximately 75% motor speed, the kW power demand of the blower dropped to about half the full-speed load.

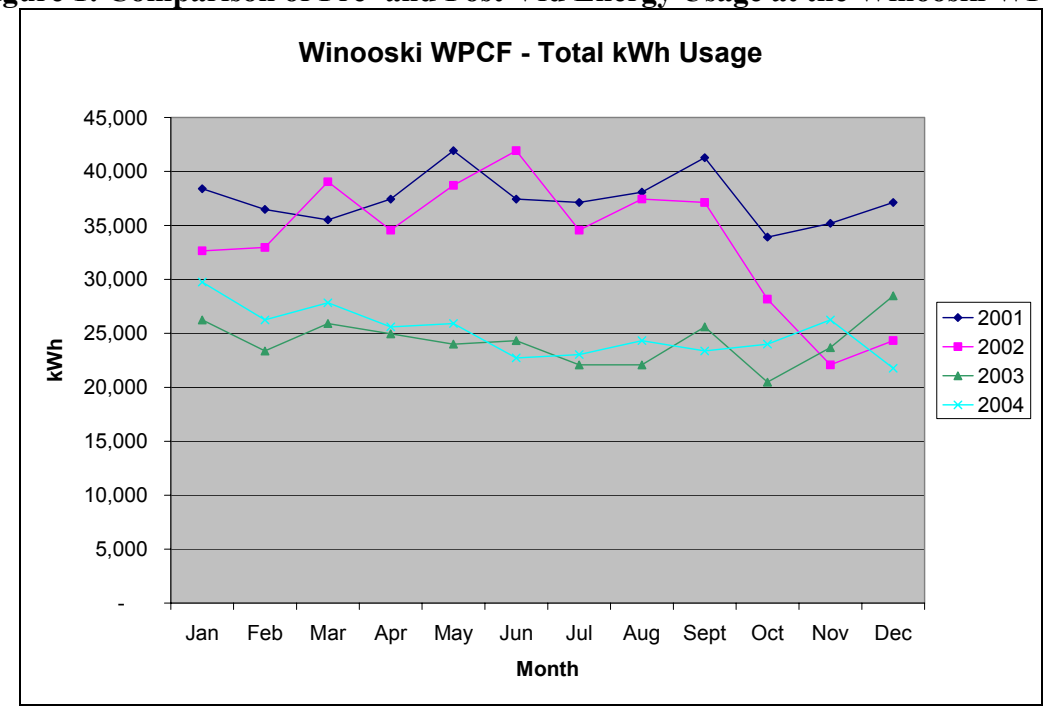
The results of this pilot test were so dramatic, that the chief operator immediately chose to pursue implementation of the VFD measures. The total project consisted of purchase and installation of two VFDs, wiring and panel installation, and computer programming. The electric energy savings for the City of Winooski is approximately 140,000 kWh/year, representing roughly 32% of the previous total plant usage. Figure 1 illustrates Winooski WPCF's monthly electric usage for the years 2001-2004. The VFD installation occurred mid-October of 2002. Computer programming control strategies was a key component in the successful operation of the new system. Motor speed can be adjusted upward or downward based on discharge pressure data, dissolved oxygen data, or motor amperage. Including all three criteria ensures that the blower does not slip into a state of "surge," where the motor continues to operate, but no air is being discharged. After the controls were fine-tuned, the system has operated smoothly and consistently. The municipality is very pleased with the project's energy and process benefits.

Example Project #2: New Construction/Major Renovation

The Town of Richmond Wastewater Treatment Facility (WWTF) was in the process of designing for its 20-year major upgrade, including plans for increased capacity and different treatment processes. Often, market-driven events may be the most cost-effective time to install efficiency measures since facilities then need only consider a measure's incremental cost in economic analyses, and not the full equipment cost. The municipality was highly interested in maximizing energy efficiency and minimizing the life cycle costs to the town. The Town has an Energy Coordinator to help with energy related issues, and to promote improved energy efficiency. The design engineer was also committed to a quality project and meeting the goals of the town. Through ongoing discussions, and technical assistance, we were able to provide the engineer with energy analyses and cost savings estimates for the efficient design alternatives. This technical analysis was highly valuable and relevant to the engineer to justify installation of a rotary press sludge dewatering system, which has higher first costs than the more commonly

specified centrifuge dewatering system. Our analysis confirmed a lower electrical operating cost of the rotary press system compared to a centrifuge. The engineer furthered the analysis by estimating the improved volume reduction resulting from use of the rotary press, which results in an added benefit of lower annual sludge disposal costs. The joint effort of Efficiency Vermont and the engineer provided sufficient information for the town decision makers to recognize that the rotary press system has a lower lifecycle cost than the centrifuge, and was an energy-efficient and cost-effective design choice. The final project included the following efficiency measures:

Figure 1: Comparison of Pre- and Post-Vfd Energy Usage at the Winooski WPCF



Source: Efficiency Vermont

- Rotary press for sludge dewatering
- VFDs on aeration blowers
- VFDs on pumps for aeration basin and digester tank
- VFDs on sludge feed and transfer pumps
- Lighting efficiency and occupancy sensor controls
- Premium efficient motors

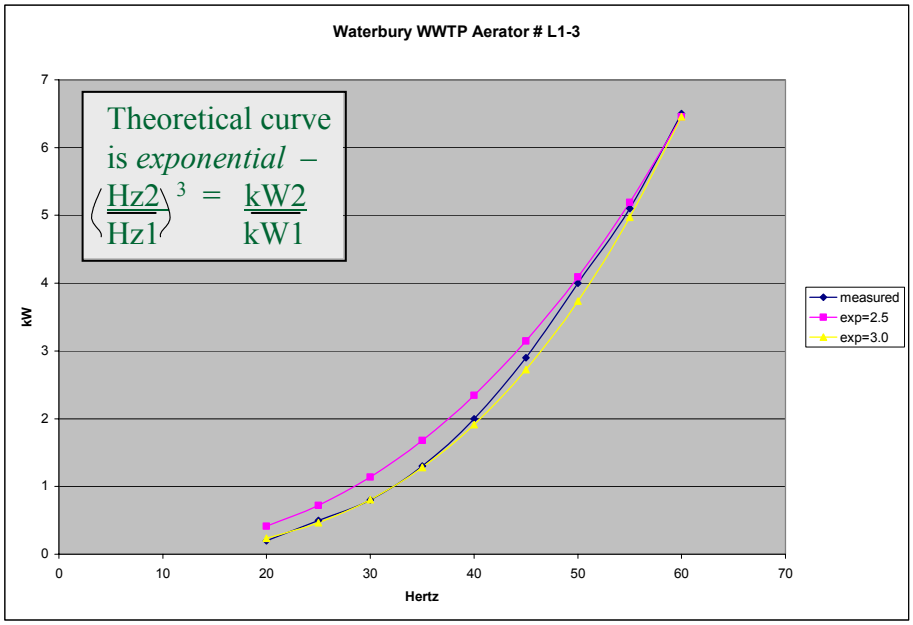
The project's efficiency measures will save the town more than 147,000 kWh per year of electricity and have an estimated net simple payback of approximately 4 years. The Town will save more than $100,000 in Total Resource Benefits[3] over the life of the efficiency measures.

[3] Total Resource Benefits (TRB) is the present value of the avoided cost for electrical and fuel savings over the lifetime of the equipment.

Example Project #3: VFD Upgrade to Lagoon Mechanical Aerators

The Town of Waterbury Wastewater Treatment facility consists of two aerated lagoons, with 18, 7.5-HP mechanical aerators that float on the top of the lagoon and provide aeration and mixing from rotating fan blades. The facility had recently hired a new Chief Operator, who contacted Efficiency Vermont to investigate efficiency opportunities for the aerators. We recommended installing VFDs. When calculating the estimated savings, there was a difference of opinion regarding whether to treat the mechanical aerators as fans or as pumps. This distinction is important since there are typically more losses and lower efficiency savings for pump applications than for fan applications. We considered the aerators to be fans, and treated them as centrifugal loads. Our VFD analysis algorithms require that we use an exponent of 2.5, rather than 3, in order to be conservative in our savings estimates. The project consisted of replacing 3 existing motors with premium efficient motors and installing 3 VFDs. Only 3 VFDs were implemented, rather than 18, because the facility had minimal budget available for the project. After VFD installation, we collected data on the kW power demand for the aerators as a function of motor speed. We were able to confirm that the power profile for the mechanical aerator approximated a fan (rather than a pump), and that the 2.5 exponent was indeed appropriate, and even conservative. Figure 2 shows the results of this data collection. Annual energy savings from the three VFDs is approximately 70,000 kWh. In addition to the energy savings, the facility now benefits from improved process control that allows mixing at lower motor speeds and can eliminate periods of over-aeration and foaming. As the Waterbury facility benefits from lower electric bills, the Chief Operator uses this budget capacity to fund additional motor/VFD installations for more of the aerators. As this approach becomes "baseline" for this facility, our incentives will diminish, and ultimately disappear.

Figure 2: Waterbury Mechanical Aerator Power Demand As a Function of Motor Speed



Source: Efficiency Vermont

Partnerships and Outreach – Working Together toward Market Transformation

Resource acquisition of electric savings occurs in the short-term through direct customer interactions that provide technical and/or financial assistance targeted to overcome the particular market barriers impacting potential facility efficiency projects. In the long-term, more comprehensive market savings can be achieved through market transformation efforts taking place today. The market transformation activities of greatest significance in the Vermont wastewater market include actively partnering with relevant trade associations, providing outreach and marketing materials to operators, design professionals, suppliers, and regulators on successful efficiency projects and their benefits, and offering training and education opportunities for operators and other key market actors.

One of the best ways to promote market transformation in Vermont's wastewater market is to focus heavily on leveraging the technical expertise and market access available through relevant trade associations. In particular, Vermont's two major, statewide associations that serve the wastewater market are Vermont Rural Water Association (VRWA) and Green Mountain Water Environment Association (GMWEA). Both of these organizations represent local chapters of national organizations. Efficiency Vermont is a member of both organizations. Some of the ways we work together with these organizations is to have exhibitor displays at their annual trade shows, collaborate on training opportunities, and make joint site visits to customers' facilities. Combining the expertise available through multiple organizations allows us all to serve our customers more comprehensively and effectively.

In addition, we also work to show facility decision-makers that similar facilities have already implemented similar projects, are saving money, and are happy with the project results. Promoting awareness of successful projects is important to create an atmosphere of credibility and confidence, thereby countering the perceived risk associated with doing something new and different.

Outreach marketing efforts for this target market also focus heavily on leveraging the mechanisms and resources of trade associations. For instance, publishing case studies of successful projects in trade association newsletter provides high visibility for the benefits of energy efficiency upgrades. We also provide basic information on Efficiency Vermont services to VRWA and GMWEA in brochure form, so that they are able to help "spread the word" regarding opportunities for customers to receive technical and financial assistance. Moreover, when facility decision makers can see that two, separate, third-party organizations agree on the benefits of an efficiency project, they are much more likely to approve it. No longer is a facility operator left to defend and describe technology improvements or justify cost expenditures, but independent subject matter experts can explain the project rationale and estimated savings calculations. Distributing "project profiles" of successful projects also reduces the perceived risk many community leaders feel when considering changes to time-tested, conventional approaches to wastewater treatment.

Education and Training – Market Transformation through Customer Awareness

In addition to the informal education that occurs during customer interactions with project managers on specific projects, Efficiency Vermont continues to develop, sponsor, and support more formal training opportunities for operators, managers, and others integral to the decision-making process for these facilities. Through our strong linkages with VRWA and

GMWEA, we have offered training and made presentations to several hundred facility operators across the state. In particular, we continue to build on the training model in place with VRWA. Efficiency Vermont initially developed a one-day training curriculum in collaboration with VRWA staff for a course titled, *Basics of Motors, Drives, and Energy Efficiency*. Efficiency Vermont also purchased equipment for the course, which includes a laboratory component, and supported the other costs associated with the training location, instructor, etc. Efficiency Vermont and VRWA also ensured that the class was approved by State Water Supply and Wastewater Management divisions for training credit hours toward operator certification requirements. The interest and feedback from the class has led the VRWA make this course part of its standard and ongoing training offerings for water and wastewater operators each year. For many class participants, this course provides the first introduction to formal concepts in energy efficiency and reducing electrical operating costs. This class and other outreach presentations continue to stimulate project ideas for possible facility upgrades and are highly valued among operators.

Efficiency Vermont's Results in the Wastewater Market

Since the beginning of Efficiency Vermont in March 2000, 46% of the municipal wastewater facilities in Vermont have engaged with us seeking technical and financial assistance for their improvement plans. There has also been a continuing increase in the number of completed projects and amount of electric energy savings from this target market as we have focused attention on it. The number being completed each year is now much higher than when Efficiency Vermont first began operations. Table 1 provides information on the annual numbers of completed projects at wastewater facilities in Vermont.

Table 1: Completed Projects at Wastewater Facilities in Vermont

Year	Number of completed projects at wastewater facilities
2000	3
2001	3
2002	12
2003	17
2004	13

Electric energy savings currently being achieved in this market are also significantly higher than during the early years of Efficiency Vermont. In total, the wastewater community in Vermont is saving over 3,590 MWh of electricity annually with the efficiency upgrades installed through the end of 2004, generating approximately $6.2 million in societal Total Resource Benefits over the life of the equipment. Project savings and average incentive costs are shown in Table 2 and Table 3. Table 2 presents the data broken out by measure type, and Table 3 shows it broken out by project type. It is significant to note that the large majority of kWh savings are achieved in motors, controls, and industrial process measures. Much smaller savings are achieved in building-related measures, such as lighting and fuel switches.

Table 2: Distribution of Measure Types for Vermont Wastewater Facilities through March 2005

Measure Type	Total Annual kWh Savings	% of total savings	Average Incentive ($/MWh)
Lighting and Controls	25,689	1	195
Motors, Controls, and Industrial Process Efficiency	3,415,854	95	86
Space Heat Fuel Switch, Design Incentives, and Other	154,208	4	61

Table 3: Distribution of Project Types for Vermont Wastewater Facilities through March 2005

Project Type	Total Annual kWh Savings	Average Incentive ($/MWh)
Retrofit	131,182	18
Market Opportunity – Prescriptive	59,219	145
Market Opportunity – Custom	2,525,488	80
New Construction/Major Renovation	879,862	107

Our work in the wastewater market has been recognized in concrete ways by state associations and agencies. In 2003, Efficiency Vermont was honored with the GMWEA, sponsor of the year award for our continued efforts in promoting efficiency in electricity as well as conserving water. Efficiency Vermont and the Village of Essex Junction Wastewater Treatment Facility were jointly honored with a 2003 Vermont Governor's Award for Environmental Excellence and Pollution Prevention. This award was in recognition of the pioneering work of Efficiency Vermont and the Village of Essex Junction for installing the region's first methane cogeneration operation in a small treatment facility.

Future Plans

Current plans for future activities include continued customer-specific technical and financial assistance for projects. Other market-related work will include:

- Collecting information on the state's facilities for benchmarking, specifically kilowatt-hours of electricity per million gallons treated (kWh/MG). This metric is typically used for wastewater facilities to compare an individual plant's electric consumption to a range of electric use typically found for each category of wastewater facility (e.g., lagoons, activated sludge, fixed film, etc.)
- We will focus more on educating and developing relationships with system and equipment suppliers. Particular attention will be paid to helping vendors "upsell" high efficiency models through the technical and financial assistance available from Efficiency

Vermont. We will also work to encourage increased stocking and specifying of high efficiency systems.

- We will identify ways to increase leveraging of VRWA and GMWEA expertise and resources. Our plans are to investigate developing and delivering additional operator training courses. Some possible classes include *Understanding Electric Utility Bills*, *Understanding How Automated Controls Can Save You Money*, and *Identifying Cost-Effective Energy Efficiency Upgrades for Your Facility*. These types of classes increase the awareness and understanding among facility operators and can motivate them to take action at their own plants.
- We will continue participation in regional and national initiatives that are relevant to the wastewater target market (e.g., Consortium for Energy Efficiency [CEE]). Collectively, participating organizations can have a greater impact on manufacturers, suppliers, and other associations to increase awareness and support of efficiency improvements.

Conclusions

The wastewater market offers significant electric savings potential. Typically, only a small portion of these savings will be realized through prescriptive incentive programs. Customers need customized assistance in order to bring projects to completion. Technical assistance is key to overcoming risk aversion, especially for municipal facilities. Other activities that are important for long term market transformation include ongoing work with trade associations, design professionals, suppliers, and regulatory agencies. Training and education are important ways to overcome lack of awareness of the many benefits of energy efficiency improvements.

References

[EPA] U.S. Environmental Protection Agency, 2003a. *Clean Watersheds Needs Survey (CWNS) 2000 Process Report*. Available online: http://cfpub.epa.gov/cwns/process.cfm

[EPA] U.S. Environmental Protection Agency, 2003b. *Clean Watersheds Needs Survey (CWNS) Report to Congress.* Available online: http://www.epa.gov/owm/mtb/cwns/2000rtc/toc.htm

Kennedy, T.J. et. al., 1997. *Energy Conservation in Wastewater Treatment Facilities: WEF Manual of Practice No. FD-2*, Alexandria, Virg.: Energy Conservation Task Force of Water Environment Federation.

Lutz, A.L. 2005. "Economic Opportunities in Waste Water Treatment." *Energy Engineering* 102 (1): 21-39.

Metcalf & Eddy, 4th ed. 2003. *Wastewater Engineering: Treatment and Reuse*, Boston, Mass.

Vesilind, P.A. et. al., ed. 2003. *Wastewater Treatment Plant Design*, Alexandria, Virg.: Water Environment Federation.