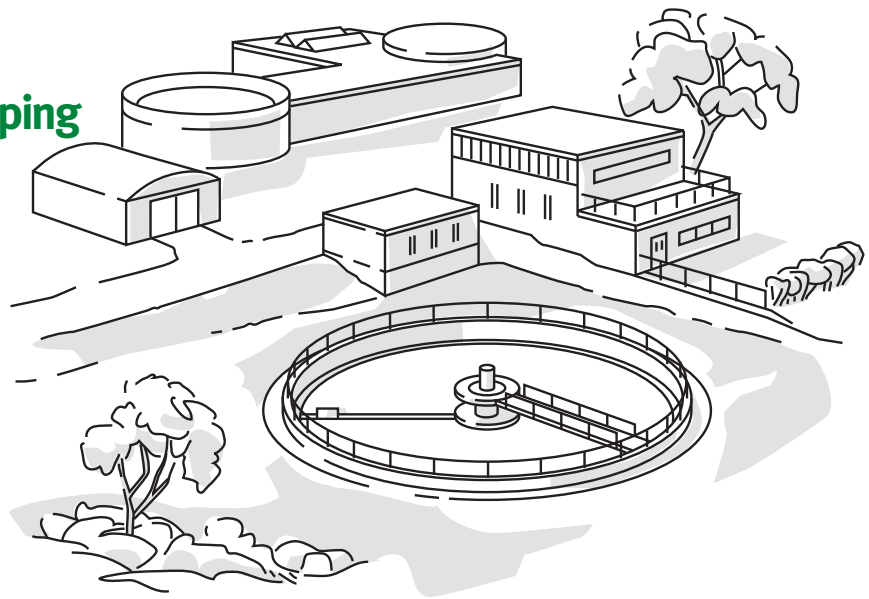


Reduce Energy Use at Water and Wastewater Facilities

- **Aeration**
- **Water and Waste Pumping**
- **Automated Controls**
- **Solids Dewatering**
- **Motors**
- **Leak Detection**



This publication will help you to strengthen your facility's bottom line through energy-efficiency improvements.

Water and wastewater facilities are well positioned to benefit from energy-efficiency improvements because of their round-the-clock operations. For example, a Vermont water supply facility recently invested in leak detection services. By pinpointing and repairing leaks in their system, the facility reduced its electricity costs by \$1,500 per year. The cost for the leak repair was only \$3,000. Not including the value of water savings, the simple payback for this improvement is 2 years.

SAMPLE VERMONT WASTEWATER FACILITY UPGRADES

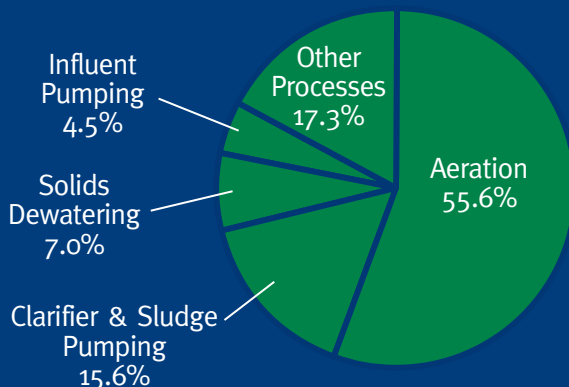
Aeration Upgrade Oxygen demand for the secondary treatment of wastewater is more difficult to meet during summer months and, therefore, requires a higher flow of air. In the winter, the oxygen concentration of the mixed liquor remains higher, requiring less airflow from the aeration equipment. This reduced wintertime airflow requirement provides an opportunity to reduce the aeration blower speed by using a variable frequency drive (VFD).

During the summer months of June-September, one Vermont plant's aeration system requires a 100 HP blower to maintain sufficient dissolved oxygen levels. In all other months of the year, the system can be trimmed down to 80% flow. A VFD control on the motor will save about 61,600 kWh or \$6,900 annually in electricity costs. The cost of installing such a control system, including material and labor, was about \$20,400. This enables a simple payback, prior to any incentives, of 2.9 years.

Dewatering Upgrade During a dewatering process upgrade at a local Vermont wastewater facility, two processes were considered: centrifuge separation and a rotary press. By choosing the rotary press, the town is saving more than \$6,500 each year in energy costs. A majority of the energy savings is associated with a reduction in Biochemical Oxygen Demand (BOD) of the filtrate. The rotary press also has lowered annual disposal costs by \$7,500. Although the rotary press costs \$60,000 more than a centrifuge, the simple payback for the rotary press, prior to any incentives, is 4.3 years.

Annual kWh Savings:	63,500
Electricity Costs Savings:	\$ 6,500
Disposal Savings:	\$ 7,500
Annual Savings:	\$ 14,000

Typical Energy Use for an Activated Sludge WWTP



Wastewater Treatment Energy-Saving Opportunities

In Vermont, there are roughly 100 municipal wastewater facilities as well as 40 industrial and more than 30 private facilities. Facilities are typically designed for growing communities and peak load conditions. It is likely that many pumps, fans, blowers and presses are sized to meet these maximum demands. The average flow at Vermont plants, however, is typically only about 50% of the maximum flow permitted. Many processes have variable-duty requirements and offer a potential for energy savings if operations are varied to match process loads. Aeration, pumping, dewatering and controls are areas to consider when looking for energy savings.

Aeration and Pumping

Aeration and pumping represent the largest energy-using processes at wastewater facilities. You can often reduce energy needed for aeration and pumping process by installing variable frequency drives (VFDs) on the motors that run the blowers and pumps. VFDs can match motor speeds to load requirements, eliminating the inefficiencies of throttling valves and bypass lines. The use of VFDs also can extend the life of pumps, blowers and motors by reducing wear from friction and heat.

Motors

Premium-efficiency motors use less energy than standard-efficiency motors. Replacing older motors with premium-efficient motors can result in significant savings. Efficiency Vermont offers financial incentives to help reduce increased first costs and to shorten payback time.

Table 1 (below) compares two types of motors and illustrates savings opportunities. Annual savings are based on continuous-run applications for open drip-proof, 1800 revolutions per-minute motors.

Table 1
Premium-Efficiency Motor Savings (ODP, 1800 RPM)

Horsepower	Standard Efficiency	Premium Efficiency	Annual Savings
10	89.5%	91.7%	\$148
30	92.4%	94.1%	\$323
100	94.1%	95.4%	\$797

Solids Dewatering

Solids dewatering may consume 7% or more of your total plant energy costs. Therefore finding the most efficient dewatering method for your facility is important. Some of the more common dewatering processes are centrifugal separation, filtration, squeezing, and drying beds. Each method has benefits and drawbacks. The power usage from highest to lowest for municipal sludge dewatering processes is shown in **Table 2**.

Table 2
Energy Usage of Common Dewatering Processes

Centrifuge	Uses Most Energy
Recessed-Plate Filter Press	
Belt-Filter Press	
Rotary Press	
Lagoons and Drying Beds	Uses Least Energy

The energy consumed by centrifuge dewatering can be as much as 15 times the amount used by a belt-filter press. Centrifuges can cost more to maintain and have a high centrate (separated water) suspended-solids concentration. The newest alternative to the centrifuge and belt press is the rotary screw press. The rotary screw press can use up to 66% less energy than a belt press and 95% less energy than a centrifuge, not including additional savings from reduced filtrate biological oxygen demand (BOD) loading. A typical rotary press uses between 3–5 horsepower and operates on a variable frequency drive to adjust to the incoming sludge flow. The press rotates at very slow speeds: 0.05–0.2 rpm. The slow rotating speeds reduce maintenance needs while maximizing solids capture. Rotary presses can be run continuously or in intervals to reduce operation during peak electricity rate hours.

Sensors and Automated Controls

To automatically keep plant processes aligned with actual conditions, install on-line sensors and automated controls to monitor and adjust process parameters. This approach will maintain or increase process effectiveness while reducing energy use. On-line sensors can monitor a range of processes, including flow rates, dissolved oxygen levels, chlorine residual levels, tank levels and more. This information can provide the basis for appropriate adjustments as influent parameters change, while also improving process control.

Electric Bills for Water and Wastewater Treatment Facilities

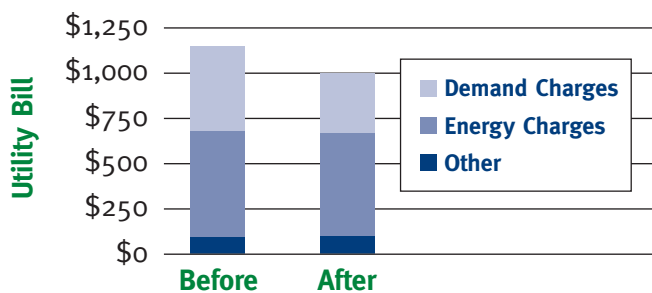
A key to reducing energy costs is to understand your facility's electric bill. Your electric costs are determined by several components:

- your electric rate;
- your energy use; and
- your maximum power demand during “peak” hours.

It's important to understand your electric rate. If you're not sure what your rate is, contact your electric utility for assistance. Depending on your utility and the amount of energy you consume, you may or may not have demand charges in addition to energy charges. A demand charge, measured in kilowatts (kW), reflects the maximum power used during a 15- or 30-minute interval for the billing cycle. You may have demand charges for peak hours only, or for both peak and off-peak hours. Peak hours are typically between 6am and 10pm Monday through Friday. Your utility can confirm the specifics of your electric rate.

Energy charges, based on kilowatt hours (kWh) consumption, can also have different billing rates for peak and off-peak hours of use. Because demand and energy charges for peak hour electricity can be significantly higher than off-peak rates, it may be cost-effective for you to shift some electric demand from peak to off-peak times. The chart below illustrates the significant cost savings for a sample wastewater facility's electric bill by shifting 10kW of peak demand to an off-peak billing period.

Sample Wastewater Facility Utility Bill
Before and After 10kW of Demand is “Shifted” from Peak to Off-Peak Hours



Your electric bill may have other charges besides energy and demand charges. Most common are power factor penalty fees and a “ratchet” charge. Large numbers of inductive motors, or other equipment that creates magnetic fields, can degrade the quality of electricity in your facility. If your power factor drops below utility-specified minimum levels, you may be charged penalty fees. If your utility uses a ratchet charge, your demand charges will be determined by the maximum demand for the billing month or a percentage of the maximum demand from the preceding 11 months. In this way, a high demand for one month may continue to cost your facility money for an entire year. Identifying ways to reduce facility demand during peak hours can create lasting savings for your facility.

Water Treatment Energy-Saving Opportunities

In Vermont, there are more than 1,300 water treatment facilities. The processes involved in converting raw water into potable water are energy intensive. Upgrading and maintaining motors and pumps can significantly lower operating costs.

Centrifugal Pumps

Centrifugal pumps are often sized for peak and growing demands. To compensate for oversized pumping capacity, the pumps are frequently operated with a valve partially closed to balance the system. A more efficient option to balance a pumping system is to trim the pump's impeller, replace it with a smaller one, or install a variable frequency drive (VFD).

Pumps that are used for a process that requires a constant flow rate can be trimmed instead of throttled. The savings associated with trimming a pump impeller can be as much as 25%. The payback for replacing or trimming an impeller is between 2 and 5 years.

Installing a VFD is another option for reducing pump flow. Careful planning is necessary to ensure that proper outlet pressure is maintained. Some Vermont water system operators have found this to be a useful energy-saving opportunity.

Motors

In general, the greatest savings are gained by improving the efficiency of a plant's largest energy users. Typically, these users are processes with the largest motors and the longest run times. Using premium-efficiency motors can offer significant energy savings with short payback times.

Leak Detection and Repair

Old pipelines, worn valves and mechanical damage all contribute to water leakage and loss of system pressure. To compensate for the loss in water pressure, pumps run at a higher load, using excess energy. Leak detection and repair help reduce pumping costs. Other potential benefits of leak detection and repair include:

- Increased operator knowledge of systems
- More efficient use of treatment chemicals
- Reduced risk of property damage and associated liability and insurance costs
- Reduced risk of contamination

In general, if your "unaccounted-for water" is more than 10 to 20 percent, a leak detection survey is in order. Pinpointing the location and repairing associated leaks is typically cost effective. Tools such as flow and pressure meters and data loggers are effective for leak detection. Ultrasonic leak-detection equipment, which identifies the sound of water escaping a pipe, is another method for detecting leaks in water mains.

The Vermont Rural Water Association (VRWA) provides leak detection services for public water systems in Vermont. In addition, VRWA offers training classes on energy-efficiency improvements for facilities and leak detection and repair techniques. See www.vtruralwater.org for more details.

LOCAL PUMPING STATION SAVINGS EXAMPLE

Pump Station VFDs A Vermont water pumping station investigated the savings associated with installing variable frequency drives (VFDs) on several pumps that were being controlled by throttling valves. Two pumps, a 30 HP and a 40 HP, were being throttled on average to 25% and 50%, respectively, of full flow. The savings and cost breakdown of using VFDs on these pumps are shown in **Table 3**.

Table 3
Pump Station VFD Savings

Motor Size	Annual Savings	Payback (w/o incentives)	Return on Investment
30	\$2,200	3.2 years	29%
40	\$1,900	4.2 years	20%

Efficiency Vermont can assist water and wastewater facilities to realize the types of savings highlighted on these pages by providing technical support, design review, economic analysis, financial incentives, and assistance in obtaining financing or arranging leases. Please call us to discuss your plans for projects.



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