



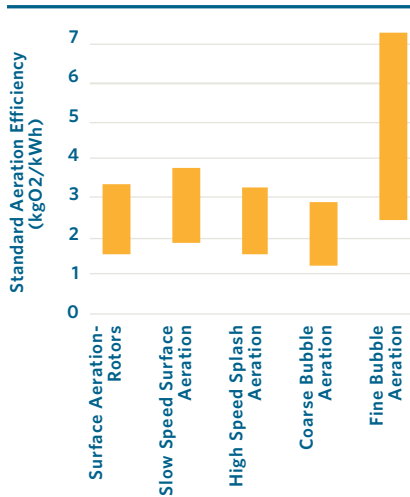
Water and Wastewater Treatment Energy Savings Guide

Oregon water and wastewater treatment plants face challenges of growing hydraulic demand, rising operating costs, increased regulatory requirements and outdated equipment and facilities. Throughout the state, treatment plants continually look for ways to control costs, while improving effluent quality and meeting temperature standards. Because treatment plants require a significant energy input, energy efficiency offers an expanding opportunity to trim operating costs.

Energy Trust of Oregon is here to assist you in identifying energy improvement options for your plant. The Energy Savings Guide explains many ways to save energy in your operation and will help you decide where to focus your efforts.

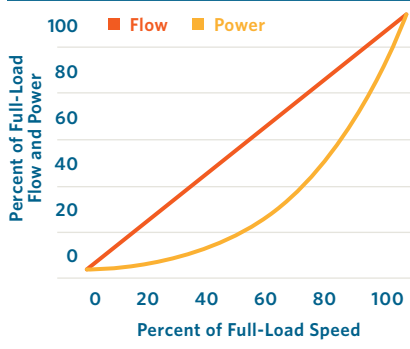
Our contact information is at the end of the guide. We're ready to talk with you about what energy improvements will make the most sense for your business.

OXYGEN TRANSFER EFFICIENCY OF SELECTED AERATION TECHNOLOGIES



Data Source: Environmental Dynamics, Technical Bullet 127

VFDs AND THE AFFINITY LAWS

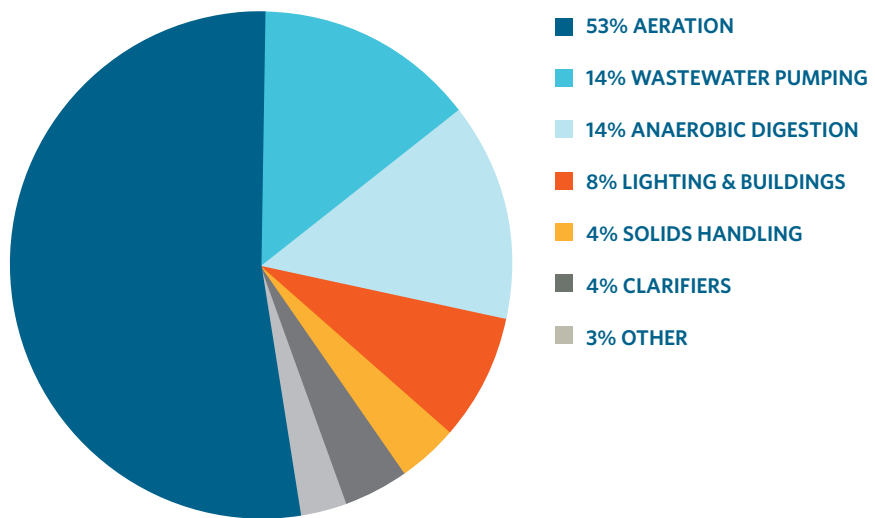


ABOVE: Variable frequency drives improve pump and fan efficiency by reducing motor shaft speed to the minimum revolutions per minute (rpm) necessary to satisfy flow requirements. A graph of the affinity laws shows that the flow produced by a pump or fan is directly proportional to shaft speed, while the power requirement for that flow is proportional to shaft speed cubed. For example, at 80 percent of full-load flow, a pump or fan operates at 80 percent of full-load rpm, but uses only 51 percent of full-load power, yielding a steady state energy cost reduction of 49 percent. At 50 percent of full-load flow, the pump or fan operates at 50 percent of full-load rpm, but uses only 13 percent of full-load power, yielding an energy cost savings of 87 percent.

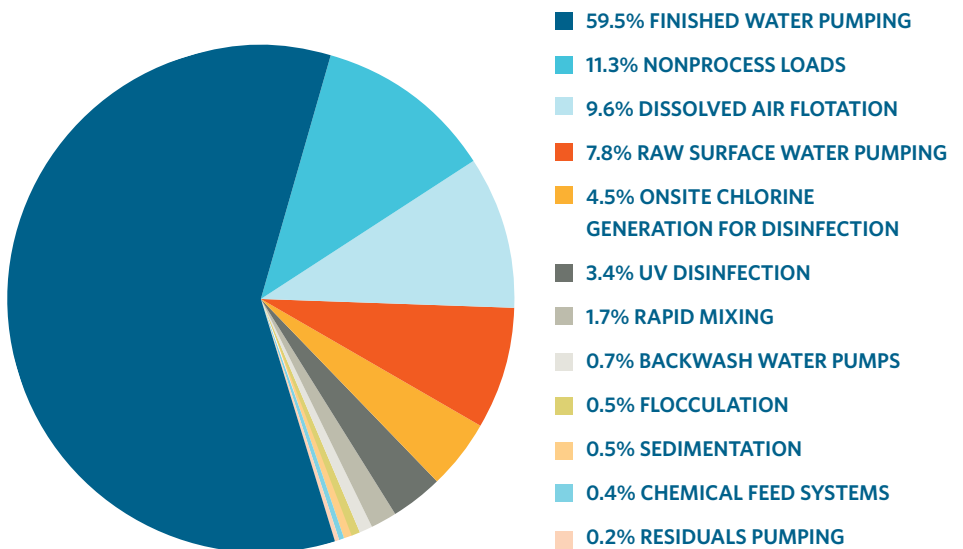
LEFT: Typical range of oxygen transfer efficiency for selected aeration technologies, using a metric of kilograms of oxygen dissolved in water per kilowatt hour of electrical energy consumed. Technologies that maximize the efficiency of oxygen transfer reduce energy expenditure and operating cost per unit of oxygen dissolved.

The Oregon Department of Energy reports that a city's electrical power cost for wastewater treatment can consume 25 percent or more of the entire city's electrical bill. Nationwide, that's more than \$4 billion annually. According to EPA's ENERGY STAR® program, municipalities can reduce energy costs for water and wastewater treatment by 15 to 30 percent through cost-effective changes to their operations.

TYPICAL WASTEWATER TREATMENT ENERGY USE DISTRIBUTION



TYPICAL WATER TREATMENT ENERGY USE DISTRIBUTION



AERATION SYSTEM

Could operations and maintenance improvements reduce energy use in aeration basins? Making simple Operations & Maintenance (O&M) adjustments to existing aeration equipment can reduce energy costs.

- ❑ Optimize the dissolved oxygen (DO) set point to reduce the amount of blower energy. It's not uncommon for systems to operate with DO levels that exceed what is required.
- ❑ Clean DO sensors and adjust their position to provide a more accurate assessment of DO levels.
- ❑ Adjust control systems to optimize mechanical mixing and bubble diffusion.
- ❑ Implement the most-open-valve strategy in which the aeration zone with the highest oxygen demand is opened fully to reduce pressure at the blowers. DO levels in remaining aeration zones are controlled by valves that maintain the proper DO set point for each zone.
- ❑ Adjust the placement of mechanical mixers for more efficient oxygen transfer.

Consider upgrading your existing aeration basin technology.

Aeration uses between 40 and 60 percent of the energy consumed in a typical treatment plant. Improving oxygen transfer efficiency can significantly impact total energy consumption in your facility.

- ❑ Upgrade from coarse bubble diffusion to fine bubble diffusion to increase the efficiency of oxygen transfer and reduce blower load while maintaining proper DO control.
- ❑ Install automated DO controls to reduce aeration energy by up to 40 percent compared to control systems that use manual sampling. Systems that rely on manual DO sampling often operate at levels that are much higher than necessary. Installing a DO sensor with integrated aeration control allows levels to be maintained within a narrower band, thereby reducing blower load.
- ❑ Add DO probes to different zones of the aeration basin to provide more accurate DO readings and optimize aeration for each zone.
- ❑ Upgrade systems that use mechanical mixing by installing controls that cycle on and off in response to process control parameters.
- ❑ Retrofit mechanical mixers with variable frequency drives (VFDs) which adjust the speed of the mixer motors to match the process needs in real-time.

Are there opportunities to improve the efficiency of blower systems by implementing O&M measures? Making adjustments to blower system controls can yield substantial energy savings at little cost.

- ❑ Adjust controls to optimize blower staging.
- ❑ Determine blower efficiency over its operating range and compare to manufacturer's performance data. If blower efficiency had degraded, it could benefit from a rebuild.
- ❑ Find and reduce obstructions to blower airflow to decrease the pressure in the blower system, with accompanying energy savings.

Could capital improvements to your blower system lead to substantial energy savings? Up to 75 percent of the lifecycle cost of a blower system is attributable to energy use. When replacing an existing blower system, select a blower appropriate for the application. Your Program Representative can work with you to determine the blower technology that best fits your needs now and in the future.

- ❑ Install controls that allow staging of systems that have multiple blowers. Control systems optimize blower staging based on system requirements.
- ❑ Upgrade to a high efficiency multi-stage centrifugal blower or turbo blower system. These high efficiency blowers are capable of providing a wide range of airflow based on DO sensor feedback.
- ❑ Add VFDs with sensor control to existing centrifugal blower systems to adjust the speed of the blower to system demand, thereby reducing energy use when oxygen demand is lower.
- ❑ Identify oversized blowers and investigate using Energy Trust incentives toward the purchase of more appropriately sized blowers.

PUMPING

Could O&M improvements improve pumping system efficiency? Low-cost adjustments to existing pumping systems could boost energy efficiency.

- Determine pump system efficiency over the range of pumping requirements and stage pumps for optimum energy use.
- Adjust basin fluid levels to decrease pump head and reduce pump load. Wet-well levels can be raised in pumping stations to reduce pump head.
- Identify and adjust poorly calibrated valves that decrease pump efficiency.
- Determine pumping efficiency over the operating range and compare to the manufacturer's performance curve. If the pump has degraded efficiency, it may benefit from a rebuild.

Can energy be saved through capital improvements to pumping systems? Pumping accounts for as much as 67 percent of the energy used to maintain a typical municipal treatment facility. Improvements in pumping technology have the opportunity to substantially reduce facility energy use.

- Install VFDs on pumps that move varying volumes of fluid to adjust speed to match pumping demand in real-time. When less pump flow or pressure is required, pump speed and accompanying energy use will be reduced.
- Replace worn or inefficient pumps with new, high-efficiency pumps that use less energy and operate with less maintenance and downtime.
- Oversized pumps that operate at constant flow are good candidates for impeller trims. Trimming the impeller is frequently a lower-cost alternative to making larger capital investments in pumps, motors or control technology.
- Install different sized pumps in new plants or during plant expansion. As seasonal flows change, controls can bring different pump combinations online to match pumping need.
- Improve piping and valves to decrease friction losses.

LIGHTING

Could plant lighting be improved for better function and energy efficiency? Modern lighting technologies offer better performance and efficiency compared to older technologies. An upgrade to lighting systems is likely to have a quick payback, while increasing the comfort of those working in the space.

- Use occupancy sensors or timers to turn off lamps in unoccupied spaces. Equip occupancy sensors with a time delay to turn off lamps after a set period after workers leave seldom-occupied pumping stations or other isolated areas.
- Consider installing LED lighting as an energy-efficient replacement for other less-efficient technologies. LEDs combine ultra-high efficiency with excellent performance and long life in an increasingly affordable package. The long service life of LEDs reduces maintenance and production disruption due to light failure. LEDs also produce very little heat, which decreases the plant's cooling load.
- Add photo sensors on indoor and outdoor lighting systems to dim or switch off lamps when natural light levels are sufficient.

ANAEROBIC DIGESTION

Could the efficiency of digester mixing be improved?

Anaerobic digestion accounts for about 14 percent of the energy used at a typical activated sludge wastewater treatment plant. O&M and capital improvements applied to digesters can increase the efficiency of digester mixing, while often improving digester gas yields.

- Adjust existing digester mixing systems to use the minimum number of mixers possible for adequate mixing of influent and a high volume of gas.
- Optimize mixer speed in systems with VFD-controlled motors to reduce energy use while maintaining a high output of digester gas.
- Replace mixing systems that are not functioning correctly or operating inefficiently with higher efficiency systems.
- Upgrade existing systems such as gas lance or draft tube systems to a linear motion mixing system.
- Install a methane-fired boiler to reduce or eliminate the need for natural gas to heat the digesters.
- Install a flare pilot that reduces or eliminates the use of natural gas to flare excess methane.

MOTORS

Are motors in your treatment process operating as efficiently as possible? Several energy-saving strategies may be applicable to electric motors that are using more energy than necessary.

- Adjust existing motor control systems to minimize the amount of energy used for normal operation. Small adjustments to control systems could lead to significant energy savings.
- Add VFD control to motors to adjust the speed to process needs in real-time. During periods of reduced demand, the rpm of the motor could be reduced to lower energy use. VFDs also help reduce noise, heat and motor wear.
- Retrofit motors that run constantly with control systems that rely on sensor feedback to turn off the motor when the system does not require motor operation.
- Replace oversized motors with high-efficiency motors more appropriately sized for the load.
- When they need replacing, upgrade standard-efficiency motors with premium-efficiency motors.
- Rebuild worn motors to an efficiency similar to the original specifications for that motor. Green rewinds are a cost effective way to boost energy efficiency.

UV DISINFECTION

Does your plant's ultraviolet (UV) disinfection system need adjustment? UV disinfection systems can use more energy than necessary to ensure proper disinfection. UV dose control systems ensure that energy is not being wasted.

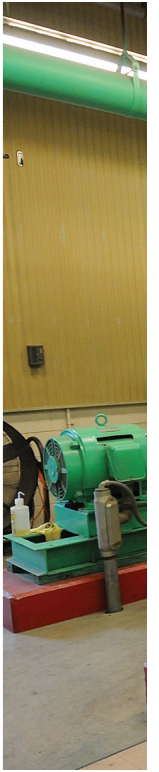
- Control UV lamps with turbidity sensors that optimize the number or intensity of operating UV lamps according to total suspended solid (TSS) levels and flow. This will reduce energy use while ensuring adequate exposure to UV light.
- Upgrade to low-pressure high-output UV for a more energy-efficient way to provide a high-level of disinfection.
- Clean or replace UV lamps by adopting a routine maintenance schedule.
- Add filtration systems or alter upstream treatment processes to reduce TSS levels. Reducing TSS allows a reduction in the number of UV lamps needed for disinfection.

SCADA

Would installing a SCADA system offer robust savings?

Supervisory Control and Data Acquisition (SCADA) systems can reduce costs by optimizing whole-system performance. SCADA systems allow treatment plants to be more nimble in responding to dynamic conditions.

- Consider installing SCADA controls to improve coordination and optimization of treatment processes. Typical simple payback of two to five years.
- Upgrade an existing SCADA system to increase energy savings potential through enhanced system oversight and control. Adding system data loggers or upgrading software allows controllers to further reduce or eliminate inefficient processes.



ENERGY PLAYS A CENTRAL ROLE IN WATER AND WASTEWATER TREATMENT

Energy Trust can help your facility take control of your energy and reduce the impact of energy on your bottom line.

Energy Trust provides cash incentives and technical services to help your plant improve energy efficiency and reduce operating costs. Our highly skilled industrial energy experts are located throughout Oregon. They will work with you to understand your business needs and help you achieve your goals.



Discover how to continuously improve your energy performance.

Email us at production@energytrust.org, call **1.866.202.0576** or visit www.energytrust.org/industrial-and-ag.