save on **energy** save on **expenditures**

Smart energy management yields significant water and wastewater facility savings

By Lee E. Ferrell

Sustainability: It is a four-piece puzzle balanced to include operational, water, energy and carbon-efficiency solutions. Water and wastewater treatment facilities are able to reduce operation and maintenance costs with it, and because the production of energy is directly related to greenhouse gas (GHG) production, energy reduction is directly related to carbon reduction and dollars saved.

Figure 1. Typical Water Process Energy Usage Breakdown

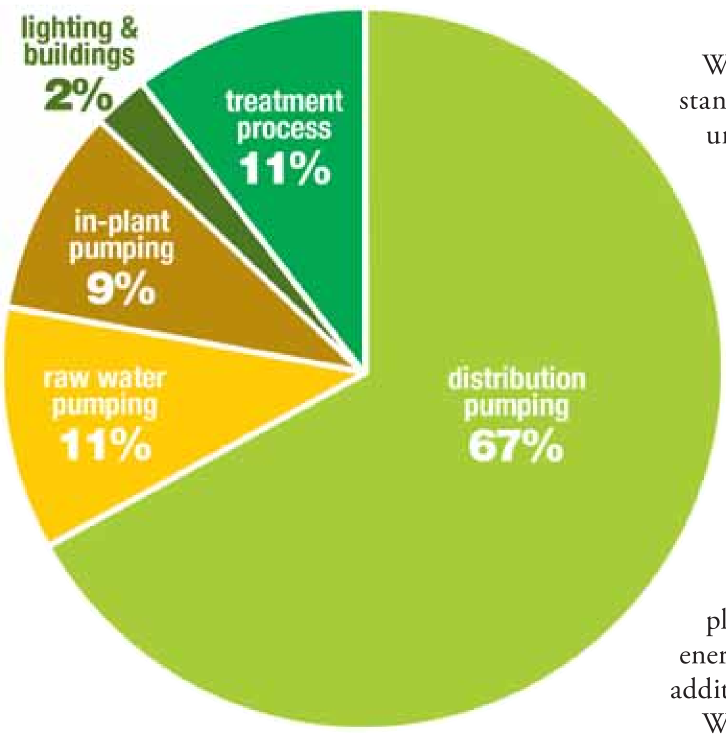
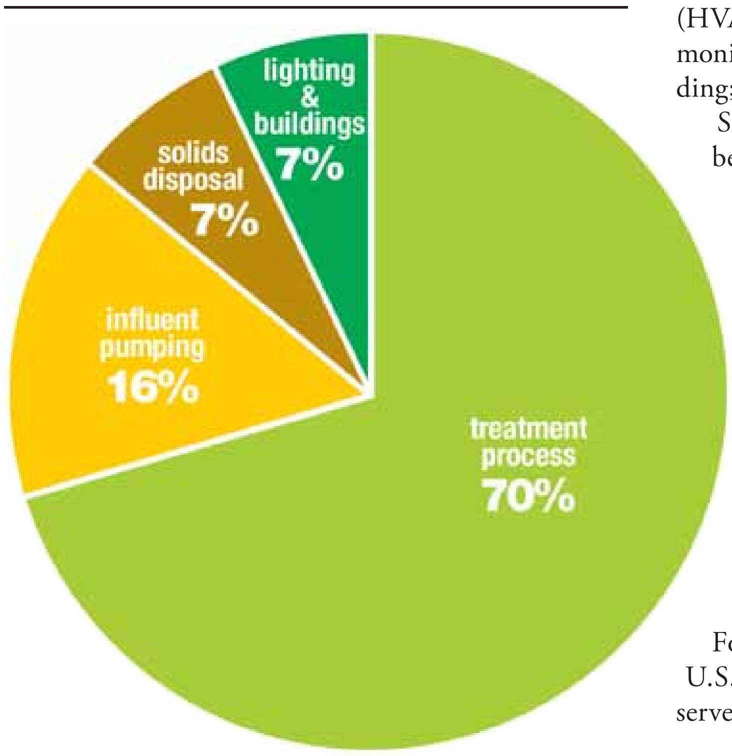


Figure 2. Typical Wastewater Process Energy Usage Breakdown



Water and wastewater facilities need a substantial amount of electrical energy to conduct unit processes and operations. In fact, the U.S. Environmental Protection Agency (EPA) has estimated that 3% of the power generated in the U.S. is used for water and wastewater treatment. This usage equates to 56 billion kWh, $4 billion and 45 million tons of GHG production. It is evident that significant savings in energy management must be found and addressed.

Energy Management

The first step in analyzing energy management opportunities for a water or wastewater treatment facility is to create an energy action plan (EAP). The EAP will identify common energy conservation measures (ECMs) along with additional ECMs specific to the facility's process.

Water and wastewater treatment facilities have some common ECMs, such as installing energy-efficient motors and variable frequency drives (VFDs); managing heating, ventilation and air conditioning (HVAC) and lighting loads; implementing a power monitoring system; monitoring demand; load shedding; cogeneration; and alternative energy sources.

Some of the largest energy savings, however, can be found in management opportunities specific to water or wastewater treatment facilities.

Water Treatment

Energy usage in water treatment plants depends on the type of water used (surface or ground), the quality of the incoming water, the pumping requirements and the processes used to treat the water. It is important to note that groundwater requires around 30% more energy usage than surface water. The typical distribution of energy usage in water treatment is shown in Figure 1.

According to a detailed AWWA Research Foundation (AwwaRF) report, there are 52,000 U.S. community water systems—4,000 of which serve 85% of the population. Water systems using surface water account for 11% of the 52,000 facilities and produce 50% of the water consumed. Seventy-four percent of the water systems use ground sources but produce only 30% of the required water. The remaining 15% of systems either purchase the remaining water consumed or produce it another way, such as desalination.

Pumping is the largest consumer of energy for a water treatment facility, representing more than 87% of the total energy consumed. This is why energy management opportunities for water treatment plants focus primarily on pumping applications such as influent pumping stations for surface water, well pumps for groundwater and high-service pumps for effluent and booster pumps.

Proper maintenance and operation is the first step in maintaining the nameplate efficiencies of the motor, pump and overall pump system. Water treatment plants have chemical feed systems that also need to be properly controlled and monitored to maintain efficient operation of the plant.

Providing storage to allow for pumping during low energy demand times for electric utilities and distributing the water by gravity during high demand times can assist with obtaining incentives or reduced rates. Pump optimization with SCADA systems or specific pump optimization software are available to help manage energy in a water treatment facility.

High-efficiency fixtures and lamps, lighting monitoring and control, energy-efficient ballasts for plant fluorescent fixtures and ultraviolet (UV) disinfection or pretreatment systems provide additional opportunities to reduce energy.

Wastewater Treatment

Energy usage in wastewater treatment plants depends on the influent characteristics, the effluent goals, the pumping requirements and the processes used to treat the wastewater. The most opportunistic energy management areas for wastewater treatment plants are found primarily in aeration and pumping applications. This includes aeration for activated sludge and aerobic digestion, as well as return and waste-activated sludge pumping. Further, lift and influent pump stations and effluent pumping requirements can provide energy savings. The typical distribution of energy usage in wastewater treatment is shown in Figure 2 (page 36).

Aeration for activated sludge and nitrification processes are the largest consumer of energy for wastewater treatment facilities, with pumping at a distant second. Seventy-percent of the energy consumed in a wastewater treatment plant is used for processes and 16% for pumping. Other reports, such as the AwwaRF report, estimate aeration at 55% of energy used and pumping at 9%. Management of energy consumption is critical for certain processes and systems in wastewater treatment plants.

Dissolved oxygen (DO) monitoring and control are critical for energy efficiency. The control of an aeration system includes adequately spaced and maintained DO sensors with properly sized blowers. The type of blower must be evaluated for the application. For example, the best blower may be a positive displacement, centrifugal with variable speed or a single-speed centrifugal controlled with vanes, valves or VFDs.

Pump and blower optimization also should be considered in wastewater applications. Knowing which pumps or blowers to use and when, and maintaining control over the requirement, is extremely important. The pump and blower systems should be evaluated to determine the best efficiency and utilization of information to load the most efficient system at the optimum time. Equalization basins can be used to assist with pumping energy requirements. This is accomplished by shifting treatment to low energy demand times to save costs.

Another opportunity for energy management in wastewater treatment is found within the handling and removal of solids. Applications that can dewater sludge efficiently will reduce sludge-handling costs. There are many different types of systems developed or being developed to use the sludge as a biofuel for cogeneration or peak shaving of demand. The methane produced by anaerobic digestion of the sludge can be used for cogeneration or heating requirements to save energy. Flaming or flaring off the excess gas after the sludge heating process typically wastes any methane gas that could be used to produce electricity. When generation of electricity or heating use is not utilized, flaring off the excess gas reduces GHGs.

As with water treatment, opportunities exist in wastewater treatment to utilize lighting and lighting control more efficiently. A greater opportunity exists, though, for UV energy-saving ballasts in wastewater treatment because of the larger quantity and usage.

According to the Electric Power Research Institute, there are more than 15,000 publicly owned treatment works in the U.S. today and a need for 2,500 more facilities to meet future requirements. Energy consumption for wastewater treatment was estimated to be 21 billion kWh in 2000. Further, it is estimated that energy usage will be 26 billion kWh by 2020 and 30 billion kWh for the year 2050. Two trends in wastewater that may increase the consumption of energy are increasing pipe friction due to the age of the systems and more rigorous treatment requirements. WWD

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