White Paper

Investing in Wastewater Treatment Upgrades: Boosting the Triple Bottom Line

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Investing in Wastewater Treatment Upgrades: Boosting the Triple Bottom Line

Projects that improve wastewater treatment infrastructure can, increase operating efficiency, help the local environment, provide economic benefits, improve the reliability of compliance, and enhance the community's quality of life. Cities and water authorities can attain these benefits without investing their own capital up front and yet earn immediate long-term guaranteed cost savings.

It's accepted wisdom that investments in roads, bridges, communications, and power supplies help communities prosper and grow.

That is equally true for investments in wastewater treatment. In fact, modern and efficient plants help communities boost the "triple bottom line" of economic prosperity, environmental quality, and social benefit.

While it may seem counterintuitive in a time of economic duress, now is an excellent time to pursue wastewater treatment plant improvements. Upgrades can increase treatment efficiency, allowing the community to accommodate industrial growth without the high cost of plant expansion. Plant improvements also can:

- Boost the economy by creating construction, operations and maintenance jobs.
- Improve consistency in permit compliance.
- Reduce greenhouse gas and other air emissions.
- Displace fossil-fuel energy with renewables, such as digester gas, wind and solar power.
- Enhance water quality, wildlife habitats, aesthetics and recreation.
- Automate processes and enable limited staff to accomplish more.
- Curtail odors and improve community relations.
- Improve the quality of biosolids provided to farmers, landscapers and residents.

Timely action

Many treatment plants today face tightening permit limits at a time when facilities and equipment are aging. They also face a wave of retirements among experienced operators and supervisors while trained replacements are in short supply.

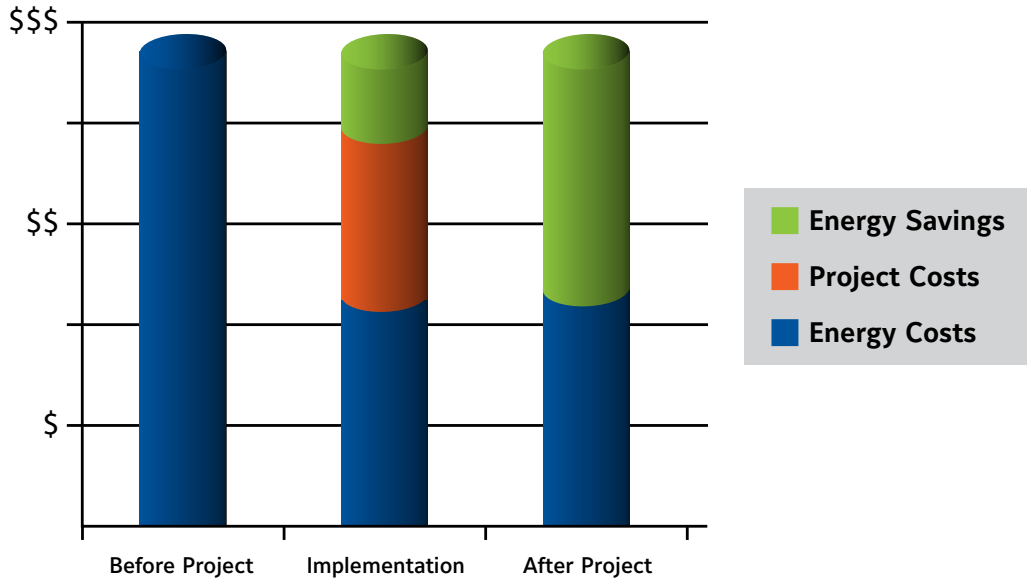
Progressive cities and water authorities have discovered that performance contracts make it possible to undertake substantial improvements without waiting for more favorable economic conditions.

Under a performance contract, an energy service company (ESCO) completes a package of upgrades and improvements that reduce energy and operating costs by a defined amount over a contract term of 10 to 15 years.

The improvements are offset from the savings that result. Annual results are guaranteed by the performance contract. If savings in a given year fall short of the contract amount, the ESCO must write the owner a check for the difference. Usually, financing is structured so that

monthly savings are greater than the monthly payment on the improvements, and the owner thus sees immediate positive cash flow. At the end of the contract when the improvements are fully paid for, the owner reaps the full benefit of the savings.

Performance contracts can make it feasible to complete even long-payback projects (such as renewable energy) by bundling them with short-payback projects (such as lighting retrofits, control automation, variable-speed drives, and upgrades to high-efficiency boilers, motors and drives).



Performance Contracting Funding Model

Looking end to end

Treatment plant owners looking to upgrade now will find a wide array of new and emerging technologies that can substantially improve energy and operating efficiency. Here are a few areas with high potential for efficiency gains.

Motors

It is easy to neglect the motors that drive a vast array of treatment plant equipment. Without a regular program of upgrades, a plant eventually can find itself with dozens or hundreds of motors that are old, unreliable, and inefficient.

An upgrade of selected motors to premium-efficiency models can bring rapid payback through long-term energy and maintenance savings. Industry projections for a steady rise in electricity prices make motor upgrades all the more attractive.

Aeration systems

Aeration is the single largest electricity consumer in conventional activated sludge wastewater treatment plants. Facility managers increasingly look to high-efficiency blowers and diffusers and automated control systems to curtail power consumption.

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Here, advancing technology has created a variety of appealing possibilities. New high-efficiency single-stage blowers are receiving significant attention. Even as that technology takes hold, high-speed turbo blowers are gaining favor for their simple operation, small footprints, and low noise.

Fine-bubble and fine-pore diffusers are steadily replacing coarse-bubble systems, and the latest technologies include special coatings that limit accumulation of biological growth, reducing maintenance.

In many cases, it is not necessary to invest in new blowers and diffusers – process improvement via automation can save significant energy. Many plants run aeration blowers at a constant rate, delivering far more oxygen than effective treatment requires. Here, a simple and low-cost solution is a programmable logic controller-based system that uses a dissolved oxygen sensor in a feedback loop to optimize oxygen delivery automatically.

A cost-effective aeration upgrade depends on a careful analysis of the entire system to determine the mix of equipment replacement and control technology that will deliver the optimum return on investment.

Plant buildings

As plant owners look to upgrade treatment processes, a common tendency is to overlook building systems as sources of savings. Larger treatment plants may include multiple buildings for functions like administration, maintenance, equipment storage, pumping, laboratory, solids processing, and staff services.

Often, these buildings are less than optimally efficient. For example, some may be heated or ventilated essentially full-time, even though they are occupied only for short periods during the workday, or only a few times per month or per year for performance of scheduled maintenance. Common improvements to investigate for buildings include:

Ventilation. Proper ventilation is essential, especially in buildings exposed to wastewater, but it is clearly not necessary to operate fans and move high-volume air through the space when no one is present. Effective indoor air monitoring and automated ventilation controls can provide a safe and pleasant environment for operations staff while conserving energy.

Lighting retrofits and controls. High-efficiency light fixtures are beneficial, but so is proper lighting control. Motion sensors or timers can be used to turn lights on only when plant personnel are present. Sometimes lights in large spaces are left on continuously because the fixtures take 10 to 15 minutes to achieve full brightness. New fixtures with high-efficiency lamps and very short "strike times" can stop that practice.

Air-handling systems. As usages and office layouts change in an administrative building, the air-handling system may no longer fit – some areas may be kept too warm and others too cool. In such cases, rebalancing of the air distribution system can improve staff comfort and increase heating and cooling efficiency.

Building automation systems. In multiple buildings with different functions and occupancy patterns, it can be difficult to achieve efficient heating and cooling manually. A building automation system enables easy programming of optimum heating, cooling, ventilation and other conditions in multiple buildings from a single interface.

Building envelope. Older or poorly sealed windows can lose substantial energy. New windows with high-performance glass can help both to optimize daylighting and passive solar heating and to minimize heat losses. While window replacements tend to have long payback periods, measures like insulation, weather stripping, and caulking around doors and windows are inexpensive and will return the investment quickly.

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Energy monitoring and supply-side control

Operators understandably focus on process parameters such as flow rates, liquid levels, and chemical feed rates. But monitoring of energy consumption is also important. The U.S. EPA estimates that the nation's wastewater plants and drinking water systems spend about $4 billion per year on energy to treat water. There is no way to control what can't be measured, and that means energy-consumption monitoring tools are essential.

Critical energy metrics, such as time-of-use electricity pricing, can be programmed into a supervisory control and data acquisition (SCADA) or building automation system, enabling operators to make decisions that cut power costs without compromising treatment performance. Steps operators might take as a result can include:

- Learning how utilities calculate electric and natural gas bills.
- Reviewing monthly energy bills.
- Shedding certain non-essential loads during times of peak-hour pricing.
- Exercising powered equipment during overnight off-peak periods.
- Where possible, running motors and pumps at scheduled intervals, rather than continuously.

Headworks

Plant owners can improve preliminary treatment with automated processes, notably fine screens and screenings washers. Automated fine screening systems not only save labor but also help improve downstream processes.

Removal of small floatables like strings, produce labels, and small plastic particles keeps those items from entering and clogging sludge piping and pumps. In the long run, this can substantially reduce repair and maintenance expense. Fine screening also keeps the same materials out of biosolids, resulting in a cleaner-looking product that improves the perception of quality for farmers and enhances general community acceptance.

Meanwhile, screenings washing and bagging systems help reduce odors in the plant neighborhood and make conditions more pleasant and sanitary for plant operators.

Finding assistance

With innovative financing tools like performance contracting, communities can upgrade facilities and equipment and offset project costs through energy and operating cost savings, and usually enjoy lower costs immediately. And cost savings are only the beginning.

One resource for wastewater treatment plants looking to save energy and reduce greenhouse gas emissions is the EPA ENERGY STAR® program, which offers energy-efficiency tools and resources to help eliminate energy waste and cut operating costs.

Plant managers can track energy use, energy costs, and carbon emissions by using Portfolio Manager, EPA's online benchmarking tool. It enables managers to compare their facilities' energy use with other peer plants using the EPA's energy performance rating system.

The time is right to investigate wastewater treatment plant upgrades as a route to higher efficiency and lower costs. A high-performing treatment plant is a community asset, supporting economic prosperity, a clean environment, and enhanced quality of life.

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The wastewater treatment plant in Twinsburg, Ohio, is using federal stimulus funds.

Case Studies

Looking to renewables

Wastewater treatment plants are excellent sites for renewable energy. The most common renewables projects make use of digester methane for electric power generation or combined heat and power. These installations can bring fast payback from utility power and natural gas savings, while destroying methane, a greenhouse gas many times more potent than carbon dioxide.

Plants with existing digester-methane-to-energy systems can augment them by accepting high-BOD wastes, such as whey, liquid scrap from food processors, waste product from bottling plants, and other compatible waste streams with low nitrogen content for injection into the digesters. This increases methane production and gives local businesses an easy way to dispose of the materials responsibly.

In addition, many treatment plants have large land areas that can accommodate installations of solar power, and in some cases wind power, for in-plant needs. Covering carports and similar accessory structures with solar panels is one example of using space creatively to generate on-site power. Some wind and solar projects can be financed without up-front investment under power purchase agreements (PPAs).

In the most common form of PPA, a treatment agency allows a third party to install photovoltaic panels or wind turbines on its property and agrees to purchase the resulting energy at a specified price for an agreed-upon term, typically 15 to 20 years.

Microturbine turns 'waste' gas into a resource

The wastewater treatment plant in Twinsburg, Ohio, is using federal stimulus funds to install a 65 kW Capstone C65 microturbine that will make use of digester methane that previously was flared.

The modular unit includes the microturbine, gas conditioning system (filtration, dehydration and compression), and an emergency power generator. Air conditioning and ventilation are also included to maintain the optimum equipment environment.

Exhaust heat will be captured and used to preheat the digester boiler loop. The existing combination natural gas/methane boiler will no longer be needed, and that means savings on purchased fuel.

The microturbine is part of a $1.8 million performance contract with Johnson Controls that also includes solar heating for the city's outdoor swimming pool, high-efficiency lighting and building envelope improvements for the wastewater treatment plant and other city buildings, and utility submetering.

The 15-year contract includes $46,000 in guaranteed annual energy and operating cost savings and total savings of $691,000.

Investing in the future – without tax increases

The City of Rome in upstate New York (population 35,000) invested in its wastewater treatment plant as part of an effort to attract news businesses and revitalize its economy in the face of state and local budget cuts and a shrinking tax base.

Starting in February 2008, the city worked with Johnson Controls on a performance contract to modernize the plant, trim its energy costs and increase its capacity to meet the wastewater needs of new businesses.

The improvements required no up-front investment and no tax or user rate increase and will pay for themselves through operating cost savings. The city will see benefits totaling $8.6 million over the 15-year contract term.

The modernized plant is better able to meet its permit requirements and can process additional high-strength wastewater, allowing the city to generate more revenue from existing businesses and attract new businesses to the city. The work included installation of a fine-bubble aeration system with automated dissolved oxygen controls that regulate blower output and minimize energy consumption.

City of Rome, New York: One of three energy efficient variable vane blowers installed.

The improvements required no up-front investment and no tax or user rate increase and will pay for themselves through operating cost savings.

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