The Path to Resilience: Maximizing Energy Savings at Wastewater Treatment Plants

Wastewater treatment facilities can account for up to 30% of a municipality’s energy use. Plants that set energy efficiency as a strategic priority can increase resilience, while significantly reducing energy use and increasing cost savings.

Resilience and Energy Efficiency at Wastewater Systems

Resilience is the ability for a treatment system to prepare for, cope with, recover from, and adapt to a range of climate-related threats. Often, resilience focuses on the physical infrastructure and how this infrastructure can respond to a variety of threats, such as loss of power generation and availability, preparing for extreme rainfall and/or flooding events, or digital threats. However, resilience also relates to a variety of threats through staff training and engagement, ongoing plant monitoring, maintenance, and improvements to plant infrastructure or equipment. Ongoing plant maintenance and monitoring, along with improvements to infrastructure, is where energy efficiency fits into resilience. It is a long-term process that balances risks and resources to achieve plant resilience.

It is critical to not only maintain water treatment infrastructure during power outages, but also to make sure facilities are using energy efficiently across all aspects of the treatment process. Making plant improvements that improve plant performance and reduce energy use will likely create a more resilient facility to weather future disruptions and recover more swiftly from unprecedented events.

Assessments: An Early Step Towards Resilience

An important first step towards achieving energy resilience is to assess the facility’s current energy use and identify efficiency opportunities. Understanding a facility’s current energy use can lead to identifying energy reduction opportunities. Two steps start the resilience journey:

Benchmarking energy use.

Plants can’t reduce energy unless they know how much they are already using! Benchmarking is the process of selecting one year of energy use as a baseline for facility energy use, usually energy used per million gallons of flow. Then, a benchmark is created by comparing a plant’s annual energy usage against plants of similar size or flow. Once energy use is benchmarked, an energy reduction plan can be developed to address target areas of the facility that use the most energy. As energy reduction projects begin, plants should continue tracking usage over time to see how much energy is reduced over time. Plants can’t manage their utilities without understanding their usage first! For more information on benchmarking your plant’s energy use, please visit our benchmarking publication here.

Get an energy assessment.

Energy assessments are a key step to identifying energy-saving opportunities at a facility, which may include more efficient equipment or process optimization and maintenance efficiency opportunities. An energy assessment can also help identify new technology opportunities for your facility and even evaluate improvements or technologies the facility has been exploring for implementation. After an on-site energy assessment has been completed, a report will be generated that prioritizes all opportunities based on investments and payback period, environmental impact, or other desired metrics. Through this process, assessors can also review available funding sources, such as energy efficiency incentives from utilities or grant funding to help reduce the cost of project implementation.
Key Approaches to Energy Resilience

Renewable Energy

Renewable energy is a natural fit for treatment plants. Many plants across Illinois have seen a rise in energy costs, which increases the financial burden on municipalities to ensure treatment systems continue to operate. Treatment plants can explore energy generation and resource recovery as sustainable options to produce reliable electric and gas to fuel the treatment process.

First, treatment plants are an ideal candidate for solar photovoltaic (PV) systems, as they typically have large open spaces, high electricity demand, and long operating hours. To reduce electrical costs, plants are starting to use solar energy to power their treatment facilities, which reduces operating costs, peak demand charges, and contributes to local emissions reduction goals. Solar can also be used for thermal heating at WWTPs, such as space heating, hot water, or other industrial processes. Now that the 30% federal tax credit is accessible to public facilities as a direct payment from the IRS, the benefits of municipal-owned solar arrays are even more attractive, where municipalities had previously been limited primarily to power purchase agreements to see solar benefits. Facilities can install solar arrays in the following ways:

**Ground-Mount Solar Arrays**

These are the most common type of solar installation and take advantage of available land. Ground-mount solar arrays take advantage of the optimal solar window, south facing orientation with maximum sun exposure, to produce electricity needed to fuel the plant. They also provide the easiest access for maintenance, as the arrays, inverters and mounting equipment are all on the ground.

**Floating Solar Arrays**

These are less common in the U.S., but a truly viable option for installing solar on retention reservoirs, cooling ponds, stormwater ponds, or wastewater lagoon systems. Floating solar is as simple as it sounds – the panels float on top of water where land may traditionally be unavailable. These systems are built on-ground and then fed towards the water. Panels are anchored in place to either the shore or the bottom of a body of water. The added cooling effect of evaporation from the water helps the panels stay cool, maintaining better operating efficiency for the life of the system, and reducing dust build-up on the panels that can reduce their output.

**Roof-Mount Solar Arrays**

Roof-mounted solar arrays are not as common for water or wastewater treatment facilities. The solar system size needed to provide the majority of electricity for a plant usually does not fit on the facility building roof. Building rooftops may not also be situated in the best solar window (9am - 3pm south exposure) for electricity production. However, roof-mounted solar may still be an option for small buildings, lift stations, or other small system components for treatment plants.
In Illinois, solar is the most common renewable energy source installed at treatment facilities; however, two other types of renewable energy opportunities are available for treatment facilities:

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<tr>
<th>Wind Turbines</th>
<th>Hydropower</th>
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<td>Wind turbines generate electricity by harnessing the kinetic energy of wind. This may be a viable option for plants in rural areas where wind speeds are high but are generally not suitable for urban or suburban locations where wind speed is low and development around the plant is dense.</td>
<td>Electricity can be generated by using the energy of flowing water. Plants near rivers, streams, or other water bodies can harness hydropower to supplement their electricity needs. Sometimes, the effluent from the plant itself, if there is a high enough drop-off, can power a hydro-turbine without impacting the receiving water body.</td>
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**Energy Recovery**

Often, byproducts such as sewage sludge are treated as waste streams and discarded at a landfill. However, modern plants seek pathways to reuse waste streams to recover those resources. Sewage sludge, which is an energy and nutrient-rich byproduct, can be recovered to create resource streams. Recovery streams include biogas from anaerobic digestion, heat contained in wastewater, biosolids for land application, nutrient capture, and more.

**Combined Heat and Power**

In addition to installing a renewable energy system, plants can also recover energy from their treatment processes and byproducts. Often, byproducts such as sewage sludge are treated as waste streams and discarded at a landfill. However, modern plants seek pathways to reuse waste streams to recover those resources. Sewage sludge, which is an energy and nutrient-rich byproduct, can be recovered to create resource streams. Recovery streams include biogas from anaerobic digestion, heat contained in wastewater, biosolids for land application, nutrient capture, and more. The most common kind of resource recovery is energy recovery from sewage sludge biogas. Through a combined heat and power (CHP) system, plants can generate electricity and heat that can be used to power plant processes, heat digesters, or be used for space heating. CHP is an efficient system to provide energy security in times of need while increasing energy reliability, lowering utility costs, providing plants with storm resilience and emergency preparedness, and protecting plants from increasing energy prices. Each million gallons per day (MGD) of wastewater flow can produce enough biogas in an anaerobic digester to produce 26 kilowatts (kW) of electric capacity or 2.4 million Btu per day of thermal energy in a CHP system (EPA Combined Heat & Power Partnership, 2011, which is two times the size of a home residential solar array worth of production per MGD! Other types of energy recovery systems include:

- **Water-source heat pumps**: Water-source heat pumps can be used to draw heat from or reject heat to effluent streams or non-potable water supplies within plants, which would reduce natural gas use and costs.

- **Renewable natural gas (RNG)**: Treatment plants can scrub their digester gas and interconnect into the natural gas pipeline regionally. Nicor Gas currently has a pilot program for RNG.

- **Pyrolysis of Class A biosolids**: The heating of an organic material, or pyrolysis, can create many different byproducts that can be sold, such as bio-oil for refining to biodiesel, bio-char for carbon sequestration, and more.

- **Algal wastewater treatment**: This treatment type can capture carbon, phosphorus, and nitrogen and the algae byproducts can be used for animal feed, fertilizer, bio-oils and bioplastics, and other resources.
Resources and Support

We encourage treatment plants to explore opportunities to add renewable energy and energy recovery systems at their plants to increase resilience and plant efficiency. Many resources are available to help plants navigate opportunities and help determine the best pathways to energy resilience. The list below highlights available support in Illinois for wastewater systems:

The U.S. Department of Energy Better Buildings Sustainable Wastewater Infrastructure Accelerator (US DOE SWIFT) works with water resource recovery facilities to accelerate a pathway towards sustainable infrastructure. There are many great resources available through this program for plants wishing to explore resource recovery.

University of Illinois-Chicago Energy Resources Center (ERC at UIC) provides technical assistance partnerships with plants to explore CHP with facilities, providing market opportunity analyses, technical assistance, and education around CHP for a variety of applications. They also offer technical assistance for community hauling and anaerobic digesters for resource recovery and to reduce food waste in landfills.

The EPA Drinking Water and Wastewater Resilience Program is funded by the America’s Water Infrastructure Act to provide training, resources, and funding opportunities to increase the ability of America’s water systems to resist climate change, cyber-attacks, supply chain fluctuations, and more. Multiple programs and resources are available, that may help you, depending on your facility’s needs. The program also hosts a Resilient Strategies Guide and a Climate Resilience Evaluation and Awareness Tool (CREAT) that can help communities plan their next resiliency steps.

Algal Wastewater Treatment System - Village of Gardner

Learn more about the program and apply now for your no-cost energy assessment now! APPLY @ [https://www.istc.illinois.edu/](https://www.istc.illinois.edu/) or [https://www.smartenergy.illinois.edu/water/](https://www.smartenergy.illinois.edu/water/)