Clean Energy Results Program

Energy Efficiency and Renewable Energy Opportunities at Water and Wastewater Facilities

The first step to saving money or energy bills is to assess your plant's current performance. The free ENERGY STAR Portfolio Manager Benchmarking tool will help you track your energy use. In addition, MA DOER has analyzed the energy use at your facility, and benchmarked it by comparing it to other Massachusetts water treatment facilities using the MassEnergyInsight tool. MassEnergyInsight is a free web-based tool available from DOER which is compatible with EPA's Portfolio Manager. It allows you to track the impact of energy efficiency improvements, analyze your quarterly and annual energy use by fuel, and compare your facility with other facilities located here in Massachusetts. See the DOER website for more information.

Most facilities will benefit from having a comprehensive energy audit that includes an energy balance. An energy balance is performed by looking at all of the energy coming into a plant and monitoring the large energy users to find out how that energy is distributed within the plant. With some relatively inexpensive metering equipment, you may be able to do this in-house.

Once you have an idea of where your plant stands and what the major energy users are, you can develop an energy management plan. EPA offers assistance in setting up energy management programs through a free manual available from the National Service Center for Environmental Publications. Also, Mass Save is an initiative sponsored by Massachusetts' gas and electric utilities and energy efficiency service providers. The sponsors of Mass Save work closely with MA DOER to provide a wide range of services, incentives, trainings, and information promoting energy efficiency that help residents and businesses manage energy use and related costs. Please see https://www.masssave.com/en for more information.

For questions about benchmarking and energy management planning or technical help with energy efficiency and renewable technology evaluations, contact Jason Turgeon at turgeon.jason@epa.gov or 617-918-1637.

If you don't have a Supervisor Control and Data Acquisition (SCADA) system, add one and set it up to monitor energy use at different phases of the process. The energy savings made possible by a well-run SCADA system may help justify the cost to senior managers.

If you do have a SCADA system, add as many data loggers as possible at different phases of the process. Use this data to find and eliminate wild swings in energy, air, pumping, etc. A well-controlled process is an efficient process.

The tips below will help you save energy in your plant, but they may not give you the best results unless you use them as part of an energy management plan.

The Design Phase

The Design Phase is the best time to think about energy efficiency and renewable energy. A well designed plant could conceivably produce more energy than it uses!

- Specify energy efficiency and renewable energy production at the outset. EPA is working with partner organizations to develop Request for Proposal (RFP) and Request for Quotation (RFQ) guidance. Draft versions are available.
    - Set targets in RFPs and RFQs, i.e. a 50% reduction in energy use per flow or zero net energy buildings.
    - For cutting edge facilities, specify integrated resource management, decentralized treatment with localized water reuse, energy recovery from the effluent and sludge, and nutrient recovery.
    - Choose design firms that have significant experience designing energy efficient projects.
- Choose projects based on lifecycle cost, not lowest first cost.
- If the facility can use the heat, consider cogeneration (combined heat and power or CHP), either from natural gas or plant-produced methane or syngas.
- When purchasing blowers, pumps, and other motors, buy only premium efficiency versions and buy versions that are properly sized to current loads.
    - Allow flexibility in design to add more equipment later for growth
    - If you must buy additional horsepower in anticipation of future growth, buy multiple smaller units instead of fewer large units to allow you to reduce horsepower while waiting for demand to grow.
    - Add Variable Frequency Drives (VFDs) on all appropriate motors, especially pumping and aeration motors with variable flows.

Aeration

- Aeration is often 60% of the electric load at secondary treatment facilities.
    - Install automatic Dissolved Oxygen (DO) control on aeration system:
    - Include VFDs on blowers and mechanical aerators.
    - Turn down your DO setpoints as low as you can-you should be able to run at 1.5 mg/L or less in most cases.
    - Install automated variable DO setpoint devices that adjust air supply to influent DO loads.
    - Add luminescent DO probes for better reliability.
- If using mechanical aeration:
    - Evaluate switching to diffused air.
    - Look for more efficient mechanical aerators.
    - Evaluate adding separate mixing blades to reduce air needs.
- If using diffused aeration:
    - Convert from coarse bubble to fine bubble aeration.
    - Reduce air pressure when possible.
    - Check for leaks in the blower ductwork, especially if the ductwork is buried or otherwise hidden from view.

    - When upgrading blowers, consider the newest generation of magnetic and air bearing turbo blowers. While more expensive up front, they are much more efficient, have reduced maintenance, are smaller and quieter, and can be placed in less expensive structures.
    - In lagoon and tank storage applications, consider using laminar flow mixers (i.e. SolarBee) or submerged mixers (i.e. Pax Water) to eliminate stratification and bring oxygenated air from the surface. This may eliminate or reduce the need to aerate.

Pumping

In drinking water plants, pumping is often 90% or more of the electric load. In wastewater plants, it is typically 20-30%.

- Install VFDs on pumps with long run hours that are throttled or have bypasses.
- Run pumps in parallel.
- Reduce pressures where possible.
- Downsize pumps where oversized.
    - Consider adding a pony pump if there are highly variable flows.
- Consider adding energy recovery systems to replace pressure reducing valves, which waste pumping energy.
- Find and fix leaks in distribution systems.
- In drinking water storage tanks, consider using laminar flow mixers or small submerged mixers to prevent water from stratifying instead of using large pumps to mix water.
- Turn off plant water pumps during unmanned periods.

Lift Stations

Lift stations have many opportunities for savings.

- Install VFDs on pumps.
- Install pony pumps at stations to handle base loads at stations with highly variable flows.
- Install improved pump controls.
- Install premium efficiency pumps/motors instead of rewinding older pumps.
- Vary well levels to reduce loads, especially during peaks.
- Install motion-detecting lights or lights on timer switches in infrequently-used stations.
- Install programmable thermostats to keep temperatures low in infrequently-used stations.
- Evaluate the entire pumping and distribution system to look for redundancies. It's not unusual for system operators to entirely eliminate some pump stations.

HVAC

HVAC controls are very important, especially where codes mandate frequent air changes.

- Check the codes to see if air changes can be reduced in cold temperatures.
- Install demand controlled ventilation based on occupancy or air quality.

- Install programmable thermostats to keep the temperatures low during unoccupied periods.
- Install heat exchangers to recapture heat from exhaust air.
- Install solar thermal heat through rooftop (hot liquid) or wall (hot air) systems.
- Heat and cool with heat pumps using effluent.
- Upgrade to high efficiency boilers.
- Install a green roof for better insulation and stormwater benefits.
- Paint roofs white, especially over air conditioned spaces, to reduce summer air conditioning loads.

Lighting

Lighting can be a significant energy user.

- Replace High Intensity Discharge (HID) and T12 or T8 lighting with high efficiency T5 fluorescent or LED lighting.
- Install occupancy sensors in areas that are frequently unoccupied.
- Install photo controls and dimming systems.
- Use daylight wherever possible.

Sludge

Sludge has an energy content similar to coal. Start thinking about how to use sludge as an energy and fertilizer resource, instead of treating it as a liability.

- All facilities should consider gasifying sludge.
- Facilities with sufficient space can use solar drying in greenhouses, even in cold climates.
    - If you have or can add anaerobic digestion at your facility:
    - Make sure the process is optimized to get the most gas and highest levels of Volatile Solids (VS) destruction.
    - Add a combined heat and power (CHP) system to capture the methane.
    - Add food waste, Fats, Oils and Grease (FOG), or other high Biological Oxygen Demand (BOD) waste streams to boost revenue and gas production.
    - Pretreat your sludge with ultrasonic, heat and pressure, or chemical pretreatment systems to boost VS destruction and gas production.
- If your facility incinerates sludge:
    - Recapture waste heat from the stack and turn it into electricity.
    - Improve dewatering before incineration.
    - Consider switching to gasification.
- If your facility pelletizes or dries sludge:
    - Investigate gasification options.
    - Optimize the drying process.
    - Recapture waste heat for use in the process or for building heat.

On-Site Energy Generation

On-site energy generation is an option for almost all facilities.

- Use sludge to produce power.
- Use FOGs for power or biodiesel.
- Use the sun for light and heat and investigate PV (solar electric) potential.
- Investigate the potential for wind at your facility.
- Outfalls or drinking water intakes with significant head may be good candidates for hydropower.
- If you have a constant heat load, consider switching to natural gas-fired CHP systems.

Demand Management Programs

- Get a check every month for participating.
- Get free energy use data to help you track consumption and spending.

This document based on work done by private energy consultant James Rogers, PE, with updates by Jason Turgeon, EPA.