MANAGING ENERGY COSTS FOR SMALL WASTEWATER SYSTEMS

August 29th, 2022

Caitlyn Leo, Research Engineer

ENVIRONMENTAL FINANCE CENTER AT SACRAMENTO STATE

EFCN environmental finance center network

CAUSES OF INCREASING ENERGY COSTS

- More stringent effluent requirements (nutrient removal, contaminants of emerging concern)
- Enhanced treatment of biosolids
- Aging infrastructure in collection systems
- Increased electricity costs
- Changes in influent composition due to climate related factors

EFFECT ON SMALL WASTEWATER SYSTEMS

- Small systems often lack the funding, personnel, and access to training to adapt to changing effluent standards, upgrade infrastructure, and other necessary process changes
- Provide an overview of available resources and funding options for small wastewater systems to help manage increasing costs

STEPS TO MANAGE ENERGY COSTS

Step 1: Self-assessment of energy use

Step 2: Conduct an energy audit

Step 4: Implement energy control measures

Step 3: Develop an energy management plan

DETERMINING YOUR FACILITY'S ENERGY USE

DETERMINING YOUR FACILITY'S ENERGY USE

- Self-assessment
  - Free online tools available
  - Don’t need outside help
- Energy Audit
  - Varying levels of detail and price
  - Opportunities to receive assistance in paying for and conducting audits

SELF-ASSESSMENT

- EPA's Energy Use Assessment Tool
  - Free, downloadable, excel-based tool
  - Designed for small to medium wastewater systems
  - Analyzes a facilities utility bills, provides baseline energy use and costs, plot their energy use over time for up to five years, identifies areas for improvement
  - User inputs: utility bills, process information (influent/discharge volume, etc.), building information (HVAC, lighting fixtures, etc.).

SELF-ASSESSMENT
(ENERGYSTAR PORTFOLIO MANAGER)

- **EnergyStar Portfolio Manager**
  - Free, online tool
  - Calculates energy use intensity and gives a score 1-100 to benchmark against other wastewater facilities
  - Tracks changes in energy use and costs over time
  - User inputs: utility bills, process information (influent/discharge volume, etc.), building information (HVAC, lighting fixtures, etc.).

SELF-ASSESSMENT
(NYSERDA WASTEWATER CHECKLIST)

- **NYSERDA Wastewater Checklist:**
  - More high-level and can be done quickly (great starting point)
  - Designed specifically for small wastewater facilities
  - A series of yes or no questions for each treatment process that helps identify potential areas for energy reduction
  - A little outdated, many states have made their own adaptations of this checklist!

SMALL WASTEWATER TREATMENT PLANT CHECKLIST

(If any are not applicable, do not provide a response for that particular question)

	YES	NO	Additional comments and information
1. INFLUENT/EFFLUENT PUMPING			
A. Do you have influent and/or effluent pumps?			
B. If yes, do you have variable speed control on the influent pumps?			
C. If yes, are premium-efficiency motors currently installed on the influent pumps?			
D. If yes, do you have variable speed control on the effluent pumps?			
E. If yes, are premium-efficiency motors currently installed on the effluent pumps?			
Subtotal Grayed			
2. PRE-AERATION/POST-AERATION			
A. Does your plant utilize aeration blowers/compressors for preaeration, post-aeration or other aerated channels?			
B. If yes, are there currently means to throttle the amount of air delivered or otherwise adjust output?			
Subtotal Grayed			
3. INTERMEDIATE PUMPING			
A. Do you have intermediate pumps to convey flow from primary to secondary processes or from secondary to tertiary treatment processes?			
B. If yes, do you have variable speed control on the intermediate pumps?			
C. If yes, are premium-efficiency motors currently installed on the intermediate pumps?			
Subtotal Grayed			
4. BIOLOGICAL PROCESSES - ACTIVATED SLUDGE PROCESSES			
A. Does your plant utilize aeration blowers/compressors as part of the activated sludge process?			
B. If yes, are there currently means to throttle the amount of air delivered or otherwise adjust output?			
C. If yes, are premium-efficiency motors currently installed?			
D. Does your plant use mechanical aerators (including mixers in pure oxygen systems)?			
E. If yes, do the aerators have variable speed control?			
F. Is your aeration system controlled via dissolved oxygen levels and/or pressure differentials?			
G. If yes, are dissolved oxygen/pressure sensors located within the aeration basins?			
H. Do you currently use a fine-bubble aeration system?			
I. If you have a pure oxygen system, do you have a vacuum pressure swing adsorption (VPSA) O2 generation system?			
J. Do you currently have variable speed return activated sludge (RAS) pumps?			
K. Do you currently have variable speed waste activated sludge (WAS) pumps?			
Subtotal Grayed			
5. BIOLOGICAL PROCESSES - FIXED FILM (trickling filters, RBCs, etc.)			
A. Does your plant utilize supplemental aeration blowers/compressors as part of a fixed film process?			
B. If yes, are there currently means to throttle the amount of air delivered or otherwise adjust output?			
C. If yes, are premium-efficiency motors currently installed?			
D. Do you utilize pumping for conveying flow to the trickling filters?			
E. If yes, do you have variable speed control on the these pumps?			
F. Are your trickling filter distribution arms mechanically driven?			
Subtotal Grayed			

ENERGY AUDITS

- Identify operation and capital improvements necessary to reduce energy use
- Identify opportunities to incorporate renewable energy
- Can be conducted on existing plants or designs

TYPES OF ENERGY AUDITS

- American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Tiered Energy Audits
  - Level I – Walk-through analysis
  - Level II – Energy Survey and Analysis
  - Level III – detailed analysis of capital, process modifications, etc.

TYPES OF ENERGY AUDITS
(ASHRAE TIERED ENERGY AUDITS)

- ASHRAE Tiered Energy Audits
  - Level I – Walk-through analysis
  - Level II – Energy Survey and Analysis
  - Level III – detailed analysis of capital, process modifications, etc.

Most valuable for wastewater systems, Level I typically covered by self-assessment

TYPES OF ENERGY AUDITS
(RENEWABLE ENERGY ASSESSMENT)

- Renewable Energy Assessment
  - Identify opportunities for incorporation
  - Desktop analysis for possible technologies
  - Feasibility study for most promising options

ENERGY AUDITS
(PROGRAM OPTIONS)

- Work with your utility and a program administrator
  - Program administrators (PAs) can help fund audits and identify incentives for energy projects
- Contact your utility to find your PA
  - Some states also have state-run efficiency programs
- Paying for energy audits
  - Typically split 50/50 between utility and wastewater system
  - Some utilities may not offer assistance

OUTSIDE ASSISTANCE FOR ENERGY AUDITS

EFCN TECHNICAL ASSISTANCE (TA)

- Wastewater systems that treat one million gallons per day or less can receive assistance in assessing options to lower energy use
- A request for TA can be filled out on the EFCN website

US DOE INDUSTRIAL ASSESSMENT CENTERS (IACS)

- Apply to receive a free energy assessment
- Must be within 150 miles of a participating university and have annual energy expenditure between $100,000 and $3.5M
- For more information check the US DOE IACs website

Industrial Assessment Center
U.S. DEPARTMENT OF ENERGY

RURAL ENERGY FOR AMERICA PROGRAM ENERGY AUDIT & RENEWABLE ENERGY DEVELOPMENT ASSISTANCE

- Provided though the USDA
- Grants for energy audits, renewable energy technical assistance, renewable energy site assessments.
- Must be located in a designated rural area and operated by a state, local government, or tribe
- For more information check website

DEVELOPING AN ENERGY MANAGEMENT PLAN

DEVELOPING AN ENERGY MANAGEMENT PLAN

- What did your self-assessment/energy audit identify as areas for potential energy efficiency improvement?

- Identify applicable and accessible energy control measures (ECMs)

ENERGY CONTROL MEASURES

- Changes in your facilities operation that reduce the amount of energy used
  - Equipment vs non-equipment
  - Process related
  - Incorporating alternative energy sources

EQUIPMENT RELATED ECM'S

- Optimizing efficiency in various wastewater treatment processes from preliminary to tertiary treatment

- References for comprehensive discussion of ECMs for specific process element/equipment
  - NYSERDA Water and Wastewater Energy Management Best Practices (2019)
  - AWWA's Self-Assessment of Wastewater Treatment Plant Optimization (2017)

NON-EQUIPMENT RELATED ECM'S

- Building improvements
- Reducing loading
- SCADA Systems
- Co-generation technology
- Organizational strategies (peak electric demand reduction, submetering processes, etc.)

IMPLEMENTING ECMS

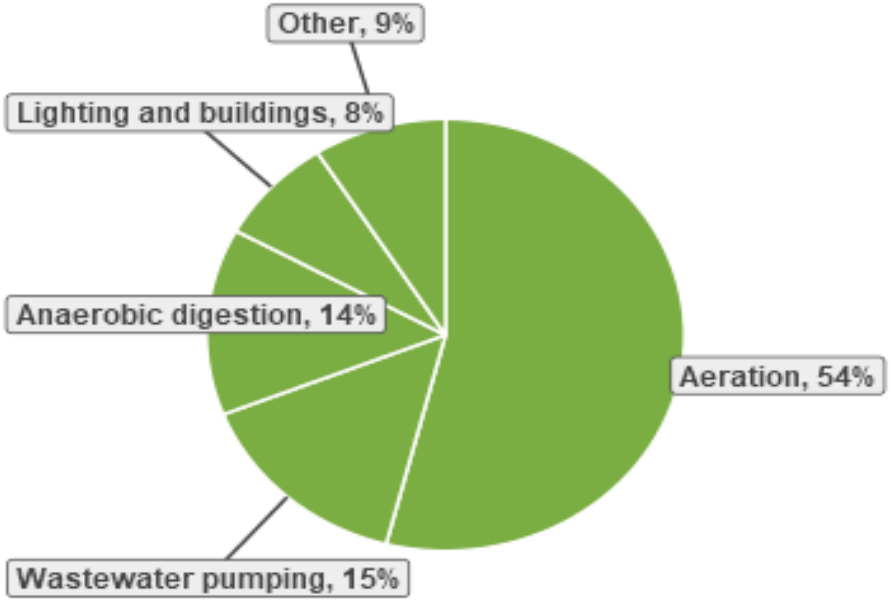
Step 1: Most accessible changes

(e.g. operational strategies, small equipment upgrades)

Step 2: More intensive upgrades that may require financing or outside funding

Step 3: Work on incorporating renewable energy sources

ENERGY USE IN A TYPICAL WASTEWATER TREATMENT PLANT



Note: The "Other" category combines all end uses that consume less than 5% of the overall energy for this sector, including belt presses and clarifiers.

ENERGY CONTROL MEASURES
(AVAILABLE TOOLS)

- Aeration and pumping the two most energy intensive processes
  - Start with looking at pump and motor efficiency
- **DOE's Pumping System Assessment Tool (PSAT)**
  - free, downloadable software that helps utilities assess the efficiency of pumping system operations.
- **DOE's MotorMaster+ Motor Selection Management Tool**
  - free, downloadable motor selection and management tool
  - manage motor inventory/maintenance logs to evaluate energy efficiency

INCLUDING ECMS IN FACILITY UPGRADES

- Most important time to consider ECMs
- Guidance from the consortium for energy efficiency (CEE) on incorporating energy efficiency into requests for qualifications and proposals can be found here.

STAFF TRAINING AND DEVELOPMENT

- An informed staff is crucial to creating a sustainable energy management plan
  - Operators should understand basic energy use calculations and concepts
  - Staff should have familiarity with energy efficiency measures at their facilities

STAFF TRAINING AND DEVELOPMENT
(TRAINING RESOURCES)

Training and development resources:

- **NYSERDA Basic Operator Training:** overview of the basic calculations and concepts of energy use and efficiency for wastewater treatment operators.
- **Better Plants Virtual In-Plant Training (2022):** series of recorded online trainings focusing on helping wastewater treatment plants improve their energy efficiency.

FUNDING ENERGY EFFICIENCY PROJECTS

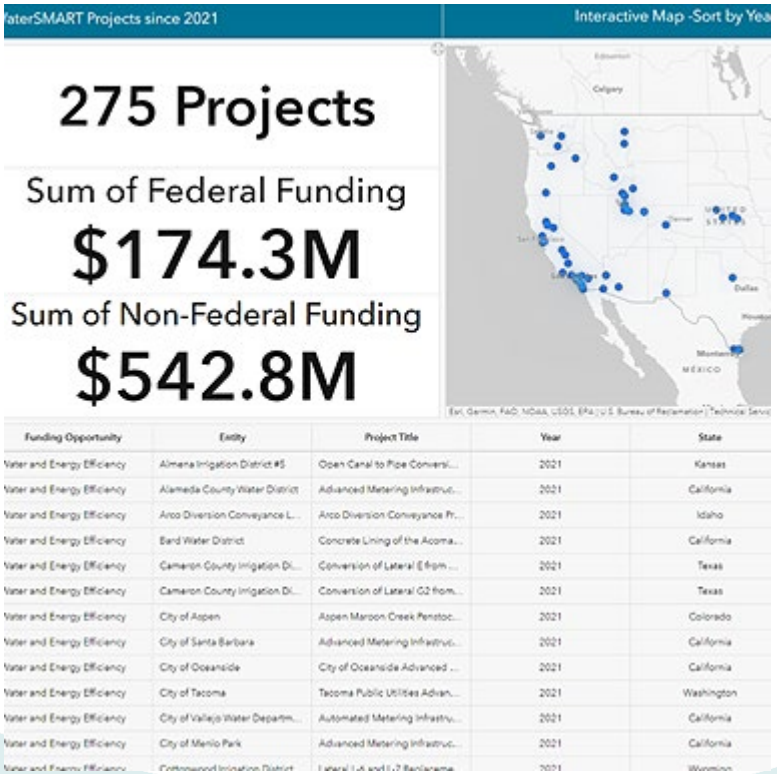
CLEAN WATER STATE REVOLVING FUNDS (CWSRF)

- **Description:** finance projects that reduce energy usage at publicly owned treatment works (POTW)
- **Funding type:** low-interest loans
- **Eligibility:** Projects include installing energy and component efficient equipment, onsite renewable energy, methane capture.
- For more information and application requirements look at their website.

Clean Water
State Revolving Fund

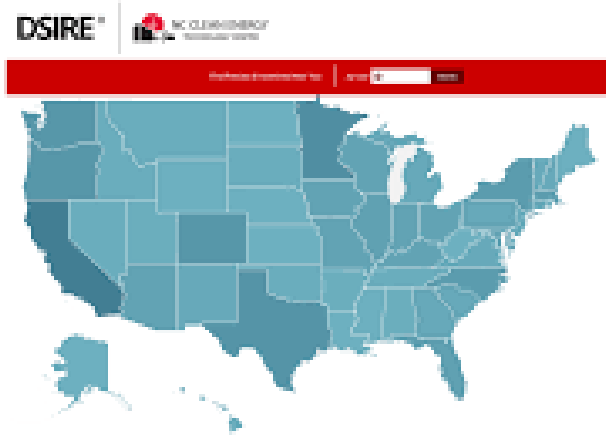
US BUREAU OF RECLAMATION WATERSMART PROGRAM WATER AND ENERGY EFFICIENCY

- **Description:** Renewable energy projects and high-efficiency indoor appliances and fixtures are included in eligible projects
- **Funding type:** grant, 50/50 cost sharing
- **Eligibility:** States, Tribes, and water districts
- For more information and application visit their website
  - Applications for FY23 closed July 28th



DATABASE OF STATE INCENTIVES FOR RENEWABLES AND EFFICIENCY

- **Description:** comprehensive source of information on incentives and policies supporting renewables and energy efficiency.
- **Funding type:** state incentives and policies to support energy projects
- **Eligibility:** dependent on incentive or policy



FINANCING GUIDANCE

- US DOE Fact Sheet on Financing Energy Performance Contracting discusses key steps involved in financing an energy savings performance contracting project.
- Energy Star financing guidance for energy efficiency projects here

QUESTIONS

Contact:

Caitlyn Leo
caitlyn.leo@owp.csus.edu