

Energy neutrality for the domestic wastewater industry is within reach

A Guide to Net-Zero Energy Solutions for Water Resource Recovery Facilities (ENER1C12)

The Central Issue

Behind labor costs, energy is often the second-highest operating cost at a water resource recovery facility (WRRF). Additionally, fossil fuels are the basis of most purchased energy, which contributes to a larger carbon footprint, as well as public health risks attributed to air pollution by the wastewater sector.

Context and Background

The Water Environment Research Foundation (WERF), with collaboration by the New York State Energy Research and Development Authority (NYSERDA), is advancing knowledge and implementation of energy-efficient best practices in the industry, moving WRRFs closer to achieving energy neutrality. Energy neutrality for the domestic wastewater industry is within reach. This research contributes greatly to the industry's understanding of the complexities, opportunities, and challenges that WRRFs face as they strive for energy neutrality. This research sought to aid WRRFs in moving toward "net-zero" energy use through near-at-hand practices and technologies in the areas of energy conservation, demand reduction, and enhanced production.

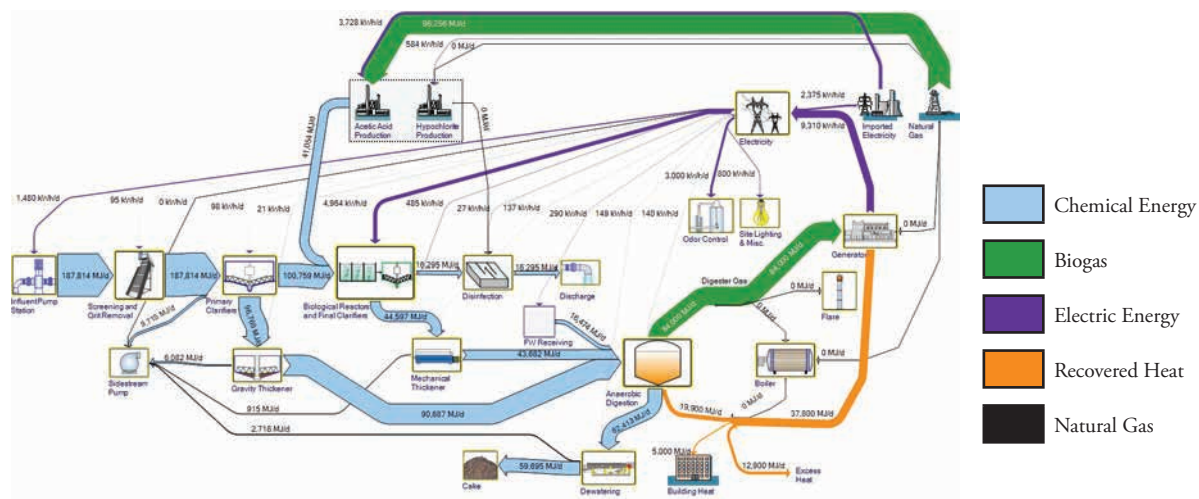


The WRRF in Ridgewood, NJ began receiving fats in 2013 for biogas production at the facility. The original 10,000-gallon capacity was expanded to 30,000 gallons.

Findings and Conclusions

The researchers modeled 25 common process configurations and identified the pathway followed by those WRRFs to achieve energy neutrality. From this evaluation, they found:

- Consistent use of best practices resulted in approximately 40% lower energy consumption than "typical" performance.
- Improving primary treatment and solids capture had the most significant total positive impact of all the best practices modeled.
- Significant savings in aeration blower electricity usage was achieved by reducing fouling in fine bubble diffusers through improved operation and maintenance procedures – a best practice that is often overlooked.
- Anaerobic digestion with combined heat and power (CHP) was the most advantageous approach to energy recovery, reducing energy requirements by up to 35% at WRRFs that have anaerobic digestion.
- Dewatered biosolids still retained a significant portion of the influent chemical energy, presenting opportunity for additional energy recovery.



Example of Energy Balance of Food Waste Co-Digestion Applied to BNR (Best-Practice)

A Guide to Net-Zero Energy Solutions for Water Resource Recovery Facilities

This report is one in a series of studies that can enable new ways of thinking about energy efficiency and recovery, and inspire and motivate WRRFs to consider approaches to move their facilities toward net-zero energy. Findings from these reports provide opportunities to save costs and enhance sustainability, as well as provide solutions to overcome obstacles common to energy projects.

Management and Policy Implications

The study demonstrated that conventional secondary treatment and nitrification facilities can become net-energy positive. However, BNR and ENR facilities can currently achieve as high as 50-60%

energy neutrality. Energy positive plants, or those nearly so, can reduce their energy consumption significantly.

WRRF managers, engineers, operators, and the engineering consultants who design upgrades and new facilities can identify the type of facility they operate, examine its process configuration against the Sankey (energy balance) diagrams included in this report, and identify the design elements needed to become more energy efficient. Federal and local policymakers can use this research to define assistance or incentives appropriate for accelerating achievement of net-zero wastewater treatment.

Related WERF Research

Project Title	Research Focus
Triple-Bottom Line Evaluation of Biosolids Management Options (ENER1C12a)	Uses a TBL approach to evaluate common wastewater solids management technologies and processes relative to their potential for long-term sustainability, including energy neutrality.
Demonstrated Energy Neutrality Leadership: A Study of Five Champions of Change (ENER1C12b)	Documents the steps used by utility leaders at WRRFs close to energy neutrality and the lessons they learned to explain to readers what they achieved in terms of energy and other benefits, and how they accomplished it.
Identification of Barriers to Energy Efficiency and Solutions to Promote Those Practices (ENER7C13)	Uses a national survey of input on barriers from more than 110 wastewater service utilities, along with utility focus groups that captures detailed experiences regarding barriers to successful deployment of energy efficiency initiatives.
State of the Science and Issues Related to the Recovery of Heat from Wastewater (ENER10C13)	Evaluates the state of heat recovery from wastewater by examining the extent of its use, the performance of available technologies, and emerging economic, environmental, social, and regulatory issues which could impact its use. Includes theoretical models to help guide utilities to develop heat-recovery projects.
WaterWatts: A Modern Look at Wastewater Power Metering Data (ENER15C15)	Includes a collection and analysis of dis-aggregated power metering data by process, at water resource recovery facilities, including BNR plants.

Principal Investigators:

Steve Tarallo, ENV-SP
Black & Veatch
Paul Kohl, P.E.
Philadelphia Water Department

Project Team:

Teresa DiGenova, P.E.
Mike Elenbaas
Alok Patil
Christine Polo, E.I.T.
Gustavo Queiroz, P.E.
Patricia Scanlan, P.E.
Andrew Shaw, P.E., ENV-SP
Erica Zamensky
Black & Veatch

Ralph Eschborn, P.E.
Kevin Frank, P.E.
Terry Goss, P.E.
Rob Pape, P.E.
AECOM

Ned Beecher
NEBRA

Technical Reviewers:

Robert Humphries, Ph.D.
Water Corporation (Australia)
Michael Keleman, MSEV
InSinkErator
Ted McKim, P.E., BCEE
Reedy Creek Energy Services

Kathleen O'Connor, P.E.
NYSERDA

Susan Pekarek, P.E.
Johnson County Wastewater

Beth Petrillo
NYC Environmental Protection

Joe Rohrbacher
Hazen and Sawyer

Jim Smith D.Sc.
U.S. Environmental Protection Agency National Risk Management Research Laboratory (Retired)

Jason Turgeon
Phil Zahreddine, M.S.
U.S. Environmental Protection Agency



To Order

Contact WERF at 571-384-2100 or visit www.werf.org and click on Search Research Publications & Tools. WERF Subscribers: Download unlimited free PDFs. Non-Subscribers: Charges apply to some products.

Refer to Stock No. **ENER1C12**
For more information, contact
Lauren Fillmore at lfillmore@werf.org