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Head: **Achieving energy neutrality through co-digestion**
Deck: Water Environment & Reuse Foundation research provides both information and examples of successful energy recovery

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Many in the water sector are striving to make water resource recovery facilities (WRRFs) be energy self-sufficient. Achieving this goal will reduce both waste and costs. To help foster this, the Water Environment & Reuse Foundation (WE&RF; Alexandria, Va.) has conducted many research projects that examine ways utilities can recover energy and reach energy neutrality. Combining waste treatment with renewable energy recovery provides benefits that such conventional practices as fossil fuel utilization and landfilling cannot offer.

This collection of WE&RF research highlights programs at WRRFs that support energy recovered from wastewater as a renewable energy source. The projects highlighted below are intended for facilities practicing (or planning to practice) several different processes, including co-digestion; incineration; and energy recovery and food waste management through anaerobic digestion (co-digestion). The WRRFs and other agencies examined in these projects provide valuable information that others can learn from and incorporate into their own practice to reach their sustainability goals.

Co-Digestion of Organic Waste Addressing Operational Side Effects (ENER9C13)

WE&RF initiated a series of complementary studies to better expand the science and understanding of the best practices to advance co-digestion as an option for increased energy recovery. This first project is one in a collection of research intended to advance anaerobic digestion to enhance renewable energy. The ENER9C13 study evaluated five WRRFs in New York, Texas, and California for co-digestion design, performance data, and operation and maintenance issues.

The findings indicate that digestion of fats, oils, and grease (FOG), food waste, and other organic wastes can increase a WRRF's energy production. As the facilities studied were early adopters of this process, the findings highlighted challenges they faced and the steps they took to address them.

In addition, the WRRFs interviewed identified their best management practices for co-digestion systems. These practices may be beneficial to other facilities beginning their co-digestion programs. First, they recognized that consistent record keeping is crucial for operational decision making and identifying potential problems with accepting these wastes. Second, they recommended screening hauled wastes and creating a permit system for haulers who take measures to improve source control. Third, they recommended scheduling deliveries when WRRF staff members are present for unloading. Lastly, these facilities found that

monitoring digester gas production requires better process control parameters than volatile solids destruction, which can be relied upon in anaerobic digestion of wastewater solids alone.

Energy Recovery from Thermal Oxidation of Wastewater Solids: State-of-Science Review (ENER13T14)

The research team on ENER13T14 performed a state-of-the-science review to evaluate the potential for energy and heat recovery from thermal oxidation of wastewater solids. They compared the value of the energy with that of coal in a triple bottom line approach and estimated the quantity of renewable energy available from thermal oxidation of wastewater solids.

The goal was help WRRF managers identify how much energy could be recovered through implementing energy recovery projects and the potential for these projects helping facilities meet sustainability objectives. The research team developed seven scenarios to represent thermal oxidation (incinerator) system configurations. These scenarios identified potential energy recoverable from wastewater solids and residuals. Scenarios included co-firing wastewater solids with such alternative feedstocks as FOGs and woodchips to evaluate the potential for increased energy production.

The energy recovery in each of the seven scenarios produced more electricity than the solids process required to operate. This proves that energy recovery from thermal oxidation, theoretically, can make solids processing a net energy provider for WRRFs. The process is sustainable when compared to fossil fuel power generation; and existing and emerging thermal oxidation technologies provide reliable, effective, and flexible systems for implementing energy recovery.

Renewable Energy Production from DoD Installation Solids Wastes by Anaerobic Digestion (ENER14R14)

Department of Defense (DoD) institutions, such as the Air Force Academy, produce large quantities of food waste and consume large quantities of energy. This study demonstrated demonstrates that the energy in food waste, if recovered, can supply 60% of the energy requirements for such DoD installations worldwide and help meet the DoD sustainability goals. Ultimately, the project demonstrated that anaerobic digestion is successful as a means of treating food waste and producing renewable energy to partially offset an installation's energy demands while reducing waste disposal. Biogas generated by the digestion process can be used without further treatment to generate energy. To further maximize energy production, the biogas can be purified to biomethane as a natural gas substitute.

The results revealed that that anaerobically digesting this food waste meets or exceeds performance objectives; moreover, the practice is cost-competitive with alternative methods of food waste management. Using anaerobic digestion to dispose of food waste while recovering energy also represents a significant greenhouse gas savings compared to landfills or composting. The produced biogas can be sent to a combined heat and power generator to produce electrical power that can be used to reduce facility power costs. The ultimate end use of the biogas or biomethane had a significant impact on cost-effectiveness.

Learning from WE&RF's research

Overall, the goal for these projects and others in WE&RF's portfolio is to help WRRFs and other agencies become energy neutral and reduce the demand for purchased electricity or natural gas. The information obtained and insights derived can help to show how different

energy recovery methods can be incorporated. Even more so, however, exploring real-life applications can encourage decision-makers to use new technologies to help their operations long-term

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