RFI DE-FOA-0000933, *WASTE: Waste Applications for Sustainable Technologies for Energy*

Responses to Category 2 Questions - Submitted by:
Water Environment Federation
Barry Liner, Ph.D., P.E., Director, Water Science & Engineering Center
601 Wythe Street, Alexandria, VA 22314
Phone: 703-684-2435, Email: bliner@wef.org

The Water Environment Federation (WEF) appreciates the opportunity to respond to the Request For Information Number DE-FOA-0000933. Founded in 1928, WEF is a not-for-profit technical and educational organization of 36,000 individual members and 75 affiliated Member Associations representing water quality professionals around the world. WEF members, Member Associations, and staff proudly work to achieve our mission to provide bold leadership, champion innovation, connect water professionals, and leverage knowledge to support clean and safe water worldwide.

WEF advocates that wastewater treatment plants are not waste disposal facilities, but rather water resource recovery facilities (WRRF) that produce clean water, recover nutrients, and have the potential to reduce the nation's dependence upon fossil fuel through the production and use of renewable energy. WRRFs are typically the largest energy consumers in local government, accounting for 30 to 40% of the total energy consumed. WEF has developed *The Energy Roadmap: A Water and Wastewater Utility Guide to More Sustainable Energy Management*, an initiative to help on both the energy conservation and the energy generation aspects of the water sector (http://www.wef.org/energywater.aspx).

More specific information is provided below in WEF's responses to the questions in the RFI Category 2, ***Moving from Pilot to Commercial Scale in Waste-To-Energy with the Intention of Producing Fuels, Products and Power,*** are submitted in conjunction with the National Association of Clean Water Agencies (NACWA) and the Water Environment Research Foundation (WERF). NACWA and WERF have submitted responses to the Category 1 and 3 questions, respectively. As collaborators on the *Water Resources Utility of the Future… Blueprint for Action* (http://www.wef.org/about/page.aspx?id=12884902710), WEF, NACWA, and WERF appreciate your consideration of the information submitted.

1. ***What major technical or economic barriers are you experiencing in your efforts to transition from pilot to commercial scale waste-to-energy operations and what role should government play in assisting in this transition? Please do not include any proprietary information in your response.***

There is a lack of incentive for utilities to be energy efficient or to generate energy, which is critical because water and wastewater utilities are typically risk averse. While private capital is available, most municipal projects do not attract private investors due to project size and up-front cost, lack of consideration of lifecycle costs and non-financial benefits, and regulatory barriers to public-private partnerships. For example, standardization is needed for the state definitions of energy service companies (ESCO), and WRRFs and their energy streams (biogas/biosolids) should be included.

Energy generated from biosolids and biogas is not consistently included in renewable energy portfolio standards. If it were, calls for 80% renewable energy by 2035 coupled with market forces could boost energy generation in the water sector. Standardization of eligible sources is needed. Anaerobic digesters are often only cost effective if you can sell electricity back to the grid or use the gas for vehicle fuel. Often,

selling electricity back to the grid is hindered by electric companies through tariffs and interconnection policies. There is a lack of incentive for anaerobic digestion partners, such as dairy farmers, because it is cheaper to take their waste to a landfill. Policy could incentivize or require feedstock to go to WRRFs.

Regulations are not streamlined and often mandate other priorities over energy efficiency and power generation from anaerobic digestion in combined heat and power systems. Sometimes regulations even present barriers to innovation (RICE rule, emissions permits, FERC regulations). Integrated planning (water quality, energy savings, air quality, etc.) is needed. In addition, there is little guidance from the federal level down to the state. A framework that is useful for local officials, operators, and others is needed. This framework should be interwoven with the permit process, and there should be a streamlined approach to approving new technology. Utilities need the flexibility to innovate while meeting permit requirements.

Water quality improvements require more energy. As nutrient regulations have become more stringent, plants must use more energy for aeration in nutrient treatment. Carbon is a necessary source of energy for bacteria in aerobic nutrient removal and anaerobic processes. Getting enough carbon for both aerobic and anaerobic processes can be problematic.

2. ***What unit operations in your waste-to-energy process technology could be improved and how would this help enable commercial operations?***

WRRFs have thousands of methane flares nationwide. These flares are used to dispose of excess biogas that cannot be used for fuel or electricity production due to the barriers discussed in question one and in NACWA's and WERF's submissions for Categories 1 and 3 to this RFI. Flaring biogas both wastes renewable natural gas fuel and adds CO_2 from combustion and methane (from incomplete combustion) to the atmosphere. Advances in technologies used to clean the biogas to pipeline quality standards would help reduce or eliminate flaring by providing better fuels for municipal fleets (buses and trucks running on natural gas) or direct injection into natural gas utility distribution grid.

3. ***What technologies and pathways have proven to be the most effective, and what technologies and pathways present difficulties in scale up? How could those difficulties be overcome with Federal assistance?***

In order to help identify reference installations for new technologies to speed adoption, WEF and WERF have created Leaders Innovation Forum for Technology (LIFT) (http://www.werf.org/lift). The LIFT Technology Evaluation Program (TEP) provides a credible, well-documented vetting system to screen new technologies and processes by facilitating collaboration among facilities for the evaluation and testing of new technologies. The TEP also enables the sector to more rapidly deploy new technologies and remove existing impediments, such as the mitigation of risk and cost of innovative technology deployment through collaborative partnerships. This program, entering its second year, was created due to a lack of a national innovation program in the water sector. The topic areas that LIFT members are evaluating now are related to energy generation and nutrient recovery from wastewater. Federal assistance could help speed this process through 1) financing some of the research to increase the number and scale of studies, and 2) aiding in the dissemination of knowledge to regulators to encourage acceptance in the permitting process.

4. ***Elaborate on the need for additional RDD&D on the effluents produced by WTE technologies. Effluents could include those from biorefineries, breweries, or any other industrial operations with excess waste water.***

While wastewater contains energy content, nutrients (phosporus and nitrogen), and water for reuse, other resources can potentially be recovered as well. For example, there is potential value in exploring the

recovery of energetic chemicals (direct energy content) and other chemicals (embedded energy) from wastewater. Some of these chemicals such as succinic acid and propanediol are proposed by DOE as prime commercial green chemicals and most of the feedstock for these chemicals has still been corn or sugar. Biosolids or even sewage could be very attractive alternate feedstocks.

5. ***Comment on the technology applications that have been developed and tested under detailed investigations, and small scale integration efforts that would be ready to be demonstrated at a larger, pre-commercial scale.***

Gasification and pyrolysis applications can be used to create liquid fuel. For example, Los Angeles has operated a pilot project for the past four years that uses a thermo-chemical process to convert biosolids into market-ready, drop-in, No. 2 diesel fuel. KORE Infrastructure won a 2012 EPA Region 10 award for Green Chemistry from this project. The process uses pyrolysis to reduce biosolids by 90% and then utilizes the Fischer-Tropsch process to transform syngas into advanced biofuels without the use of outside energy.

The Orange County Sanitation District (OCSD) provides reused wastewater for power plant cooling water while also generating electric power and steam from wastewater using central generation units and hydrogen fuel cells. The central generation units are a reciprocating and traditional technology, but the use of fuel cells at a wastewater treatment facility is cutting edge. OCSD is piloting technologies to raise digester gas production using co-digestion of food waste and cell lysis technology.

6. ***What high-value bio-products, beyond heat, power, and fuel, could be produced by WTE technology applications and what does the potential market for those products look like? Please provide specifics on the associated feedstocks as well as estimates of economic calculations and analysis.***

The primary high-value products from a wastewater stream are nutrients, phosphorous and nitorgen, that can be used for fertilizer. This is very common through land application of Class A biosolids and through a number of nutrient recovery technologies, including those that reclaim the mineral struvite (a phosphorus compound) from waste water. The process is crucial given the world's supply of phosphorous is expected to decline over the next few decades, with potential negative effects on agriculture. In addition, innovative startup companies are working to recover chemicals and metals from wastewater. For example, three winners or finalists from the 2012 Imagine H2O prize (co-sponsored by WEF) are currently in the early stages of commercialization of the processes.

- New Sky Energy (http://www.newskyenergy.com/) uses a CO_2-negative technology to enable onsite production of needed valuable chemicals from chemical wastes on-hand, including salts from industrial or agricultural wastewater and CO_2 from flue gas. New Sky's outputs include carbonates (e.g., soda ash, limestone), acids (e.g., sulfuric or hydrochloric acid), bases (e.g., sodium hydroxide), and gases (e.g., hydrogen, oxygen)
- Bilexys' (http://www.bilexys.com/) technology uses bacteria to take unwanted organic matter in wastewater and turn it into valuable chemicals, like food-grade cleaning agents that can be used immediately, on-site, to maintain factory equipment.
- Tusaar (http://tusaar.com/) seeks to commercialize a metal sequestering technology developed at the University of Colorado, Boulder, under initial funding by the US National Science Foundation and the US Department of Energy. The patented technology works to recover and recycle rare earth and precious metals, as well as sequestering actinides in industrial waste and process streams.