

WATER ENVIRONMENT RESEARCH FOUNDATION
In collaboration with the
New York State Energy Research and Development Authority

Request for Proposals

Proposals must be received by February 27, 2012, 4:00 p.m., EST

Energy Balance and Reduction Opportunities, Case Studies of Energy-Neutral Wastewater Facilities and Triple Bottom Line (TBL) Research Planning Support

RFP No. ENER1C12

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In 2011, the Water Environment Research Foundation (WERF) Board of Directors approved new research topics that had urgency, fit within current budget constraints, supported ongoing research, can take advantage of collaborative opportunities, and offered the greatest return on investment. The **Energy Production and Efficiency** program met these criteria. This RFP is for the first research project of what is envisioned as a multi-project, multi RFP effort over the next 5 years. This RFP is to investigate energy efficiency and production opportunities that achieve energy-neutral wastewater treatment and have the potential to expand energy production by, and implement energy efficiency improvements at, wastewater facilities.

Background:

In 2007, WERF began research under a 5-year program called the Operations Optimization Challenge (OWSO). The goal of the program was to improve efficiency or reduce cost at wastewater facilities by 20% through research outcomes that focused largely on tools, energy efficiency case studies, and compendiums. A number of excellent tools, research products, and research outcomes were realized. That 5-year program is at its end and there remains significant opportunity to better manage energy and recover resources at wastewater facilities.

The program's technical advisors and a number of subscribers realized wastewater facilities can achieve energy self sufficiency (i.e., net energy neutrality) through a combination of demand reduction, energy efficiency, and energy recovery/on-site power production. A team of experts was assembled and asked to prepare a state of knowledge report and a research plan to achieve net energy neutrality. [A copy of the Exploratory Team Report is linked here.](#) This new research program was named Energy Production and Efficiency (or "Energy").

The overarching goal of the Energy program is to develop and demonstrate economical and environmentally responsible processes and provide guidance on activities and approaches that support net energy neutrality at wastewater facilities that treat flows of five million or more gallons per day (mgd). This will be accomplished primarily through two pathways: reducing plant energy demand through alternatives to conventional secondary treatment and energy efficiency, and capturing the latent energy of wastewater and other organics to generate energy for use on-site and to export off-site.

Key elements of the Energy Production and Efficiency research program over its 5-year duration will include:

- Develop baseline energy flows for common WWTP process configurations, including opportunities for demand reduction, energy efficiency, and energy recovery/on-site energy production. (Task 1 of this RFP).
- Identify the types and extents of actions taken by specific wastewater facilities that have achieved energy net neutrality or near net neutrality (defined as a 60% operating energy reduction from a best practice baseline); and develop information that can be used by other facilities to achieve this end. (Task 2 of this RFP).
- Assess the triple bottom line (TBL) sustainability of the numerous biosolids-to-energy recovery and other biosolids management practices. (Task 3 of this RFP).
- Promote wide-spread use of anaerobic digestion, as well as generation and use of biogas for multiple purposes, including heat and energy production. (Deferred for future RFP estimated for fall 2012 release).
- Develop viable lower-energy alternatives to conventional activated sludge treatment. (Deferred for future RFP estimated for summer 2013 release).
- Develop innovative energy recovery processes that use wastewater, residuals and other organics as feedstocks. (Deferred for future RFP estimated for spring 2014 release).

WERF is collaborating with the New York State Energy Research and Development Authority (NYSERDA) to co-fund this research. It is highly recommended that a multidisciplinary team be assembled to perform the work described in this RFP. It is envisioned that teams will develop and submit proposals that cover all of the Tasks 1 – 3 described below. However, WERF will consider proposals from teams interested in performing only one or two of the tasks in this RFP, if any are submitted. New York State relevance and benefits are one Selection Criteria (see below) on which proposals will be evaluated. As such, proposers are strongly encouraged to include partners located in New York State on their multidisciplinary teams.

Importance of this Research:

Conventional activated sludge secondary treatment processes typically represent the largest energy demand for wastewater facilities; often 50-60% of a facility's energy budget. While at the same time, greater numbers of wastewater facilities are recognizing potential opportunities for demand reduction, energy efficiency, and energy recovery/on-site energy production, the combination of which could result in facilities that are net energy neutral. WERF subscribers and the ratepayers of New York State will benefit from this research through access to:

- Case studies that detail the practices and processes of net (or near net) energy neutral facilities.
- Information that bridges the knowledge gap and provides the means to overcome barriers that impede use of anaerobic digestion, as well as increase generation and use of biogas for multiple purposes (e.g., heat, generation of electric power, vehicle fuel, sale to natural gas providers).
- New, lower-energy alternatives to conventional activated sludge treatment, particularly those that can be applied in retrofit situations.

- New energy recovery technologies and processes that use wastewater and biosolids as feedstocks (i.e., microbial fuel cells; gasification, pyrolysis, other thermal conversions)

Research Goals:

The overarching goal of the WERF Energy Production and Efficiency program is to develop and demonstrate economical and environmentally responsible processes and provide guidance on activities and approaches that will foster energy self sufficiency for wastewater facilities that treat flows of five or more million gallons per day (20 million liters per day).

Required Activities for Proposal:

The research team will propose how they will complete the following activities in their Project Approach:

- Task 1 - Develop baseline energy flows for common WWTP process configurations, including opportunities for demand reduction, energy efficiency, and energy recovery,
- Task 2 - Compile energy neutral (or near neutral) WWTP case studies, and
- Task 3 - Identify sustainable options for managing biosolids through a triple bottom line assessment of diverse thermal conversion, bioconversion, and land application processes and management approaches.

As mentioned previously, it is envisioned that teams will develop and submit proposals that cover all three tasks (Tasks 1 – 3). However, proposals from teams interested in performing only one or two of the tasks will be considered, if any are submitted.

Task 1: Baseline Energy Flow for Common WWTP Configurations

Goals:

- To develop generalized energy balances for common WWTP configurations, and to assess the potential opportunities for demand reduction, energy efficiency, and energy recovery/on-site energy production within these configurations;
- To develop an understanding of the types of facilities that have the greatest potential for energy recovery/on-site energy production; and the factors (i.e., effluent targets, space limitations, air emissions regulations, etc.) that may limit the facilities' potential to achieve energy net neutrality or near net neutrality; and
- To produce a document that can be used to guide other wastewater facilities toward net energy neutrality (from their current baselines).

Proposed Activities:

Identify and perform energy evaluations of common publicly-owned wastewater facility process configurations. Generate baseline energy balances/flow diagrams for each configuration, including management of process sidestreams, and identification of practices (i.e., aeration control) which are considered "Best Management Practices." Determine where the greatest potential for energy reduction and/or recovery lies for each process configuration studied.

The primary focus of the energy evaluations should be 'operating' energy (e.g., equipment electricity requirements, energy requirements associated with final deposition of sludge, etc.). The energy required to produce and supply the common chemicals (i.e., chlorine, methanol, etc) used in processes should also be included. [Do not include specialty chemicals (i.e., polymers).] Energy use depends significantly on desired effluent quality; therefore, baseline energy flows need to be determined for effluent concentration ranges, i.e., for total nitrogen ranges: 8-10 mg/l, 4-6 mg/l, and <3 mg/l as N.

At a minimum, the following process configurations are to be assessed; however, additional configurations will be favorably considered in the evaluation process:

- Conventional activated sludge
- Fixed film systems
- Biological Nutrient Removal – nitrification
- Biological Nutrient Removal – Nitrification/Denitrification
- Membranes
- Pure oxygen systems
- With primary treatment versus without primary treatment

Proposal requirement:

Include a list of the process configurations that will be evaluated and discuss the relationship of each configuration to the publicly-owned WWT sector. Describe your approach for generating the baseline energy balances/flow diagrams and how the findings will be presented in the final report.

Note: the solids management process configurations evaluation should be coordinated with Task 3 (*Triple Bottom Line Evaluation of Biosolids Management Alternatives*).

Task 2: Energy Neutral WWTP - Case Studies

Goals:

- Using case studies, document successful changes made by specific WWTPs who have already become energy neutral or near-neutral (60% reduction from a best practice baseline).

Proposed Activities:

Compile a list of WWTPs that are currently (as of 2011) considered energy net neutral or near net neutral. The primary focus should be on the best examples of facilities that are energy net neutral; international facilities may be included on the list. (The Strass plant, WERF case study OWSO4R07a/b, should not be one of these as it is already well documented).

Once the list has been developed, select a subset of the facilities which represent varying successful approaches to achieving net energy neutrality. This subset will represent the facilities for which case studies will be developed.

The case studies, which should each be approximately four (4) pages in length, should be similar in content and format to those provided in WERF report OWSO4R07b. The case studies should qualitatively examine the processes and energy management/practices employed to achieve net energy neutrality, including tradeoffs or unanticipated consequences experienced by the facilities as a result of the practices/processes. The case studies should also examine impacts of the changes on the facilities' carbon footprint/greenhouse gas emissions. The proposer should plan to present the results of tasks 1 and 2 at a joint WERF and WEF committee meeting (plan for a meeting in Alexandria, VA) seeking to better define energy neutrality/self-sustaining for WWTPs and define metrics to track progress towards achieving these goals.

Proposal requirement:

For the purposes of this proposal, 'energy neutrality' is defined as a 60% reduction in energy by either demand reduction or production from a best practice baseline. Discuss this definition and suggest any refinements to the definition of energy neutrality in the proposal.

Provide your team's approach to conducting this task, including a list of potential case study facilities and a discussion of why each is on the list. Describe how material will be organized in the case studies and the number of case studies which will be provided.

Task 3: Triple Bottom Line (TBL) Evaluation of Biosolids Management Alternatives

Goals:

- To perform a triple bottom line assessment of various biosolids management alternatives, including biosolids-to-energy recovery and other beneficial uses of residuals, by examining the complete spectrum of effects - operational, economic, environmental, and societal - both positive and negative. The results of this task will be used to focus future WERF research on those economically and operationally viable alternatives deemed to have the least environmental negatives and the greatest social positives.

Proposed Activities:

Develop metrics and evaluate hard-to-quantify benefits and detriments as well as costs which are important considerations of biosolids management options. Established and emerging technologies should be considered (i.e., landfilling and other conventional practices, thermal conversion, bioconversion, and other processes/technologies that result in energy products). Provide useful, transparent, and defensible assessments of the spectrum of applicable benefits, potential detriments, and costs. This includes advancing TBL applications for biosolids management evaluations to reflect environmental and social outcomes as well as the financial aspects of sustainability. This can be accomplished without estimating the economic cost of intangible, hard-to-quantify environmental and social outcomes. Focus energy evaluation on 'operating' energy (energy expenditures within the control of the facility), but include the energy of producing and supplying common chemicals (i.e., lime) used for biosolids management and

the impacts that recycled streams from the evaluated biosolids management options have on liquid stream energy usage.

One challenge of this task will be to adapt available TBL guidelines and TBL data from planning assessments prepared for facility-specific alternatives and synthesize this information to inform research planning across an array of management options. Another challenge will be evaluating innovative and emerging biosolids management processes (e.g., pyrolysis, gasification) where limited data are available. It is critical to note that references generated only a few years ago may not have up-to-date emissions data for nitrous oxide or carbon sequestration potential. A literature review, as well as interviews with key researchers (performing direct measurements), is desirable to ensure use of up to date information on carbon footprint effects, including both direct emissions of greenhouse gases and carbon sequestration potential of various alternatives.

Proposal requirements:

- Describe the proposed framework for the TBL evaluation, focusing on the relevance of the proposed TBL evaluation approach to energy research.
- Describe the metrics to be included in the TBL evaluation, and whether or not they are equally weighted. If appropriate, describe the rationale behind the different weightings.
- Define the proposed boundary of the TBL evaluation.
- Provide a list of technologies/processes/management options to be evaluated.
- Discuss regional factors that may affect the TBL evaluation of the technologies/processes/management options proposed.
- Present an example of how the TBL evaluation results will be presented.

Potential Additional Scope that would Augment Findings of Previous Work (Tasks 1 – 3)

(Note: This would be work performed outside of the original \$500,000 budget).

Proposer should indicate ability to perform supplemental work related to Tasks 1-3 should the need arise and funds become available during the period of performance. Proposers may wish to briefly provide an approach for optional tasks and associated outcomes and estimated budgets.

Deliverables: A single comprehensive report combining the results of all findings (Tasks 1-3) or multiple products [i.e., a research report augmented by fact sheets or multiple reports (Task 1 and 2 report and Task 3 report)] may be proposed. At least one presentation at a relevant New York State wastewater conference (e.g., NYWEA Annual Meeting in NYC) and a WERF webinar are required. WERF also expects that the research team will present the results to the Energy Issue Area Team either by webconference or at a face-to-face meeting (scheduled in conjunction with a major conference, such as WEFTEC).

Proposal Content:

Proposers must follow WERF's solicited RFP instructions for submitting proposals. Solicited research proposal instructions are on the WERF website at www.werf.org/funding.

The proposals must also be prepared to be consistent with Guidelines for NYSERDA Solicited Partnership Proposals that are available [here](#).

Proposals are due in WERF's offices by 4 p.m. Eastern Standard Time on February 27, 2012. Proposals received after that date will be returned to sender. As part of the evaluation process, WERF reserves the right to request interviews, either via conference call or in person, with qualified proposers, if necessary.

Communication:

The topics of energy production and efficiency are of great interest to WERF subscribers and electric utility ratepayers in New York State. Comprehensive distribution to multiple key stakeholders is expected of the results of this effort. The proposal must include a communications plan with the following components:

- A list of proposed articles to be written for water-related publications, i.e., WE&T, WERF Progress, Water Online, and Clearwaters.
- A description of materials (e.g., summary papers, fact sheets, other) to be developed specifically for NYSERDA and the New York State wastewater sector, developed in coordination with WERF management.
- A description of materials to be developed for federal agency staff (USEPA, DOE, DOI, HUD, DOA-RUS), developed in coordination with WERF management.
- A plan to convey the results of this effort to NGOs (WEF, NACWA).
- A list of other target audiences, and corresponding descriptions of the types of communications and communication activities that will be developed for these audiences.
- A list of proposed presentations and/or briefings, including a list of specific conferences (e.g., NYWEA Annual Meeting in NYC, NYWEA Energy Specialty Conference, etc.) or other venues (e.g., WERF webinar, NYWEA webinar).
- The name of a designated communication liaison (employed by the contractor) who will work with the WERF communications department on products and knowledge transfer, including on-going progress reporting.
- Acknowledgement that all reports and deliverables co-funded by NYSERDA must meet New York State's accessibility requirements.

Proposers can access additional guidance on communication plans from the WERF website [here](#).

Sampling Procedures, Statistical Analysis and Quality Assurance:

This proposal is not expected to involve any direct measurement of environmental parameters but to assess and evaluate data compiled from other, reliable sources.

Target Audience:

The target audience includes owners, managers, engineers and operators of wastewater facilities, the engineers/consultants who serve these facilities, and the municipal officials who allocated funding for projects at the publicly owned facilities.

Project Duration: 1 year to 18 months

Funding:

WERF, in collaboration with New York State Energy Research and Development Authority (NYSERDA), will provide up to \$500,000 for the research described in this RFP. WERF funds will come from the Energy Production and Efficiency program budget. Proposers who bring additional resources and leverage additional funding to better achieve the objectives of this research will be given preference.

Proposers need to present a detailed budget based on their anticipated scope of work. Proposers must identify and obtain commitments for any funds beyond those requested from WERF. Proposers are encouraged to consider and identify opportunities for leveraging resources (dollars and other assets). Examples of leveraging opportunities include external (e.g., grant) funding, partnerships with other funding agencies, engaging interested WERF subscribers and other in-kind contributions.

Proposed budgets should match funding to milestones. Continued funding will be dependent upon successful attainment of each milestone.

Selection Criteria:

WERF will evaluate the proposal based on the following components:

- Multidisciplinary team whose member' education, knowledge and experience directly relates to the tasks required in the scope as well as availability of proposed key personnel and commitment to support this effort (30% weight)
- A clear, focused and creative research plan/approach that demonstrates technical and scientific merits to meet the stated research goals. (30% weight)
- A competitive, realistic budget that matches funding needs to milestones and demonstrates the value of the research relative to the proposed cost. Leveraging opportunities (i.e., external funds, partnerships, collaborations (Federal and State agencies), in-kind contributions) will be favorably considered. Commitments for leveraging and partnerships must be submitted with proposals and can be provided by a letter of intent indicating financial/in-kind commitments where appropriate. (10 % weight)
- A detailed communication plan specifying products, timelines and targeted audiences; and intention to work in coordination with WERF to provide the most appropriate products of greatest usability. Demonstrated ability to effectively communicate research to end-users (i.e., wastewater community), and to develop products that can influence wastewater facility design, operation and funding decisions. (10 % weight)
- Submission of a complete proposal of overall high quality that addresses the required elements as outlined in the RFP instructions. (5% weight)
- Relevance and benefits of the proposed project to New York State. At a minimum, this should include team partners located in New York State, as well as consideration of the wide range of flows (i.e., less than 1 MGD to greater than 300 MGD) treated at facilities throughout the State, typical wastewater treatment processes used in the State, and the State's climatic conditions (current and future). (15% weight)

Notes:

- Proposal must meet applicable federal requirements regarding salary caps, Disadvantaged Business Enterprises, and paper reduction (as related to the use of surveys).
- WERF reserves the right to request interviews with proposers.
- WERF reserves the right to suggest and negotiate the addition of experts to proposed teams in order to bring the best talent to bear. Proposers cannot “lock up” experts to serve only on their team.

Related WERF Research Reports:

WERF, 2007 *An Assessment Tool for Managing Cost-effective Energy Recovery from Anaerobically Digested Wastewater Solids* 01-CTS-18UR

WERF, 2008, *State of the Science Report on Energy and Resource Recovery from Wastewater Solids*, OWSO3R07

WERF, 2009, *Best Practices for Sustainable Wastewater Treatment: Initial Case Study Incorporating European Experience and Evaluation Tool Concept* OWSO4R07a

WERF, 2009 *An Economic Framework for Evaluating the Benefits and Costs of Biosolids Management Options* 04-CTS-2

WERF, 2010 *Co-digestion of Organic Waste Products with Wastewater Solids – Interim Report* OWSO5R07a

WERF, 2010 *Development of a microbial fuel cell for sustainable wastewater treatment* 06U1R06

WERF, 2010 *Energy Efficiency in Wastewater Treatment in North America: A Compendium of Best Practices and Case Studies of Novel Approaches* OWSO4R07E

WERF, 2010 *Energy Efficiency in Value Engineering: Barriers and Pathways* OWSO6R07A

WERF, 2010 *Overview of State Energy Reduction Programs and Guidelines for the Wastewater Sector* OWSO6R07A

WERF, 2010 *Technology Roadmap to Optimize Wastewater Treatment in a Carbon-Constrained World* OWSO4R07d

WERF, 2011 *Decision Support System for Sustainable Energy Management* OWSO7C07

WERF, 2011 pending publication *Demonstration of the Carbon Heat Energy Assessment Plant Evaluation Tool (CHEAPET)* OWSO4R07g

WERF, 2011 *Electricity Generation from Anaerobic Wastewater Treatment in Microbial Fuel Cells* OWSO8C09

WERF, [2011 Energy Management – Exploratory Team Report](#)

WERF, 2011 *Energy Production and Efficiency Research – The Roadmap to Net-zero Energy* ENER1

WERF, 2011 *Site Demonstration of the Life Cycle Assessment Manager for Energy Recovery (LCAMER) Tool* OWSO4R07f

WERF, 2011 *State of the Science on Biogas, Treatment, Co-generation and Utilization in High Temperature Fuel Cells and as a Vehicle Fuel* OWSO10C10a

WERF, 2011 pending publication *Barriers to Biogas Use for Renewable Energy* OWSO11C10

Other References

Brown and Caldwell, 2010 *Evaluation of Combined Heat and Power Technologies for Wastewater Facilities*
http://www.cwwga.org/documentlibrary/121_EvaluationCHPTechnologiespreliminary%5B1%5D.pdf

Melbourne Water, 2007 *Triple Bottom Line Guidelines*,
<http://www.lifecycleguidance.dtf.vic.gov.au/admin/library/attachments/Melbourne%20Water%20Triple%20Bottom%20Line.pdf>

NYSERDA, 2008 *Statewide Assessment of Energy Use by the Municipal Water and Wastewater Sector*, <http://www.nyserda.org/publications/08-17%20Statewide%20Assessment%20of%20Energy%20Use.pdf>

NYSERDA, 2010 *Water & Wastewater Energy Management Best Practices Handbook*

Sylvis, 2009 *Biosolids Emissions Assessment Model (BEAM)* Canadian Council of Ministers of the Environment

USEPA, 2011. *Opportunities for Combined Heat and Power at Wastewater Treatment Facilities*.
http://epa.gov/chp/documents/wwf_opportunities.pdf

Wisconsin Focus on Energy, 2008 *Water and Wastewater Industry Energy Best Practices Guidebook*.