

# Energy Efficiency RFP Guidance For Water-Wastewater Projects

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## Purpose

Energy efficiency offers abundant and largely untapped cost and energy savings opportunities at most water and wastewater treatment facilities. Many water-wastewater utilities wish to include energy efficiency provisions in facility upgrades and new construction. However many utilities and municipalities do not know how to clearly and effectively include energy efficiency in project requests for qualifications (RFQs) or requests for proposals (RFPs). State and electric utility-sponsored efficiency programs have resources dedicated to the water-wastewater sector, and may offer technical assistance, training or incentives for qualifying projects. The Energy Efficiency RFP Guidance for Water-Wastewater Facilities (The Guidance) is an informational resource for water and wastewater utilities seeking to improve the energy performance of their facilities through an upgrade, expansion or new construction project. The Guidance discusses key components of an energy efficiency RFQ or RFP and provides focused recommendations for particular energy intensive equipment and processes. It also includes sample language, which RFP writers may, if appropriate, transfer directly to their own solicitations. After reading this Guidance, municipal RFP writers should have an increased understanding of how to translate interest in energy efficiency into solicitations for energy efficient facility designs.

## How to Use The Guidance

The Consortium for Energy Efficiency (CEE) developed The Guidance for water-wastewater utility managers and municipal officials to use in composing solicitations for design services. The Guidance has two key components: (1) it outlines RFP structure and content and provides recommendations specific to the incorporation of energy efficiency, (2) it provides high-level information and recommendations for particular energy intensive processes.

The Guidance is not an engineering best practices resource. It is meant to act as a bridge between the rapidly expanding knowledge base regarding best practices for energy efficiency, and the implementation of these practices in project design and realization. It is by no means a complete accounting of energy efficiency opportunities, but rather an effort to shift current solicitation processes toward greater prioritization of energy considerations.

For the purposes of this document, the term energy efficiency will be used to refer to improvements in energy performance relative to a baseline or standard practice. Energy efficiency measures or projects are changes or upgrades to equipment or systems, or changes in behavior that result in a decrease in energy consumption. In water-wastewater treatment, common energy efficiency measures include upgrades to process equipment such as blowers and diffusers, pump optimization, addition of variable speed drives, and process optimization.

Every RFP or RFQ will likely be unique, including what aspects of energy efficient design, equipment, and process are appropriate to that project. The sample language provided in

this document will be appropriate for many but not all projects. Additionally, care should be taken to thoroughly understand the cost and schedule implications of particular efficiency measures, prior to making specific recommendations in requests for services. Before issuing a request or investing in or entering into a design contract, CEE recommends consultation with procurement and engineering professionals. The Consortium for Energy Efficiency (CEE) developed this Guidance document for water-wastewater utility managers and municipal officials to use in composing solicitations for design services. The Guidance has two key components: (1) it outlines RFP structure and content and provides recommendations specific to the incorporation of energy efficiency, (2) it provides high-level information and recommendations for particular energy intensive processes.

## Background

Energy costs are a major concern for water-wastewater utilities and municipal officials, accounting for as much as 55% of facility operating budgets (Dimitriou 2007, MA DEP 2007). Process upgrades, expansion and new facility construction pose the best opportunities to thoroughly integrate energy efficiency and biogas energy production into the water or wastewater treatment operations. Municipal utilities across the U.S. and Canada are interested in pursuing opportunities to save energy and money at their facilities. However many utilities do not have the expertise on staff to incorporate efficiency into solicitations for design services, or to evaluate project proposals on an energy performance basis. This is a major barrier to realizing the 20-40% energy savings potential available at many water-wastewater treatment facilities (Jones et al. 2007, WI Focus on Energy 2007), and contributes to unnecessary costs, energy consumption and pollutant emissions.

Any water-wastewater utility or municipality—regardless of size or process—conducting an upgrade or new construction project should contact its local electric and/or gas utility to learn whether its project is eligible to receive technical support, incentives, or other efficiency program services. State, regional and utility energy efficiency programs assist end users with improving the energy performance of their facilities, buildings or homes by providing financial incentives, technical expertise, training and other services. The range of program offerings to utility customers includes prescriptive incentive programs, energy studies and audits, customized project support, new construction programs, and others. To see a list of energy efficiency program administrators, and find out what offerings are available in your area, see <http://www.cee1.org/cee/members.php3>.

Energy efficiency program can provide critical support to energy improvements at small facilities, where programs' limited financial resources can mean the difference between top-of-the-line high-efficiency equipment and the least expensive option. Whereas retrofit or new construction of large treatment facilities may run into the tens of millions of dollars and overshadow efficiency program incentives, smaller facilities are likely to see their financial analyses and decisions deeply affected by program dollars. Because program incentives typically work on a percent of project (or equipment) cost basis – up to a certain capped

amount – lower-cost projects may be eligible for incentives up to fifty percent (or more) of project costs. Small treatment facilities sit squarely in the “strike zone” for efficiency programs: small facilities are generally more energy intensive than medium and large facilities (Ast et al. 2008), they have a greater need for technical assistance and resources, and their budgets are on a scale at which program incentives can have a large impact.

The American Recovery & Reinvestment Act (ARRA) provided water-wastewater utilities with access to funding opportunities for green projects, including energy efficiency and biogas production. Given the current Administration’s focus on energy and climate issues at both the state and federal level, it is not unreasonable to think that additional funding may be available for green projects on an ad hoc or regular annual basis. We intend that the Guidance should allow water-wastewater utility managers to capture more state and federal funding, and to put that funding to better use improving energy performance at their facilities.

## The Energy Efficiency RFP Guidance

Energy efficiency program administrators identified a need among their municipal customers for consistent information on energy efficiency opportunities at water and wastewater treatment facilities, and how to incorporate these opportunities in solicitations for design services. In response programs began to explore the opportunity to develop nationally-consistent guidance through the CEE Municipal Water & Wastewater Committee. Early drafts of the Guidance were based on *Guidelines for Writing the Green RFP* from the American Institute of Architects. These early drafts also benefited from review by a panel of consulting engineers, and by water and wastewater facility operators and municipal purchasing managers from the Northeast region. Feedback from each of these groups has been incorporated into the Energy Efficiency RFP Guidance document. The Water Environment Federation (WEF) was instrumental in development of the Guidance. WEF members from throughout the U.S. contributed valuable feedback throughout development of the Guidance.

The Energy Efficiency RFP Guidance is a set of recommendations and model language for officials to use in solicitations for design services. The specific recommendations provide information and context as to RFP structure, energy consumption at treatment facilities, and general information about related concepts such as lifecycle cost analysis. The model language will equip RFP writers with ready-to-use language clearly indicating to respondents the tools, standards and methods to use in their evaluation of efficiency opportunities in project design.

The Energy Efficiency RFP Guidance contains model language that may be inserted directly into any agency’s project request, where appropriate. Model language is presented throughout the text in italics. What follows is general guidance, and will not apply at every facility. If using the model language provided, it is important to have your document

reviewed—preferably by an engineering professional—to ensure that it is coherent and addresses your agency’s specific concerns.

The Guidance document contains two sections:

- Section I outlines the structure and content of an RFP, including suggested modifications to incorporate consultant qualifications, skills, and methods relevant to ensuring appropriate consideration of energy savings opportunities. It then provides general guidance on topics relevant throughout an Energy Efficiency RFP.
- Section II provides specific recommendations – including tools, standards and best practices – for particular energy intensive applications including pumping, aeration, solids handling.

## I. COMPONENTS OF AN ENERGY EFFICIENCY RFP

Though the structure may vary, most RFQ and RFP’s contain several common components. The most commonly found sections are described below. The order of these sections may vary between documents.

- **Project Background Information** – This provides an introduction and context for the RFP. This section outlines the impetus for the project, and clearly states goals for the project, typically in general terms.
- **Scope of Work** – This section discusses in greater detail the project for which the RFP has been issued. It describes the work to be done and the expectations of the issuing agency.
- **Qualifications** – This includes a list of the qualifications which the issuing agency is looking for from respondents.
- **Criteria for Evaluation or Selection** – This explains the selection process and how submissions will be evaluated. Some requests outline specific scoring and weighting mechanisms while others list the selection criteria without indicating their relative importance in decision making. This section also notes how and when respondents will be notified of a decision.
- **Specifications for Statement of Qualifications Submission** – This section describes the required method and format for submitting responses. It often describes the timetable for submitting responses.
- **Legal Requirements** – Usually boilerplate that lays out the rights of the issuing agency and terms regarding the selection process.

### 1. Project Background: Plant & Process Information

For any upgrade project – and possibly for new construction projects as well – it is important to provide respondents with basic facility data. Key pieces of information include facility size, age, typical flows (summer, winter, wet weather), and process type (e.g. activated sludge secondary treatment, membrane bioreactor). It is recommended to provide a process-flow diagram, indicating process stages and location in the facility. Also it is

important to disclose what is driving the project (e.g. new effluent quality standards, increased flow capacity, energy cost reduction). This information will provide respondents with some project context in which to situate facility energy performance.

## **2. Criteria for Evaluation or Selection: Qualifications**

A municipality intent on prioritizing energy considerations should pay careful attention to specifying that RFP respondents possess experience in implementing and evaluating energy efficiency and/or renewable energy measures. When listing qualifications, a municipality should ask respondents to clearly describe their experience related to energy efficiency and energy management at water and wastewater facilities. The focus on energy should not take precedence over respondents' technical expertise in water-wastewater. A qualified respondent will have documentable expertise in both energy and water-wastewater treatment. Water-wastewater treatment systems are complicated, interconnected systems. Qualified respondents must be able to demonstrate an understanding of how different treatment processes and their operation affect energy consumption and vice versa. In addition, respondents should be asked to provide a list of their relevant projects from the last 5 years, which includes for each project a description; size and cost information; energy efficiency measures evaluated; and contact information for an owner's representative who can provide further information and act as a reference.

In recent years we have seen a proliferation of grants, rebates, and tax credits made available for projects that aim to reduce energy consumption or that use alternative fuel sources. When considering a firm for a water or wastewater facility project, municipalities should seek to identify those that are familiar with these funding sources, by asking for a list of respondents' projects that have received outside funding, and for the funding sources.

Below is a sample list of qualifications asked for in a typical project request, followed by additional items specific to an Energy Efficiency RFP:

### Common to all requests: Qualification Information

- *Responsibilities and authority level of all team members*
- *Years of experience*
- *Education – degrees, schools and years obtained*
- *Professional registrations and certifications*
- *Relevant licenses*
- *Client references*

### Specific to Energy Efficiency RFP: Experience

- *Description of recent projects of a similar scope and scale including date, cost and size of project, energy efficiency measures evaluated; and client contact information*
- *Experience with alternate funding opportunities such as government incentives and grants, utility rebate programs, and other options*

- *Sample energy efficiency study which demonstrates life cycle cost analysis (specify methods used) skills and methods and familiarity with water and wastewater treatment processes*

### **3. Additional Considerations: Treatment Capacity Sizing**

Anecdotal evidence suggests that many water-wastewater treatment plants are operating significantly below their design capacity. Plants are typically designed based on 20-year estimates of projected flow or demand, and many are oversized relative to current flow rates. For example, a facility designed to accommodate 10 MGD that is operating at 2 MGD of average daily flow is very difficult to operate efficiently, even if the facility was designed with efficiency in mind. High design flows will accommodate energy efficiency only if scalability and modular design are included from the outset (e.g. using a multiple smaller pumps sized for average demand, equipped with variable frequency drives – if appropriate – and cascading controls, rather than fewer large pumps sized for peak demand).

*[Local jurisdiction or facility] desires a consultant with proven ability to analyze multiple possibilities with goals of minimizing energy use and reducing fossil fuel consumption. The selected consultant shall develop a cost-benefit analysis that considers both capital expenditures and operating costs, including projected energy savings, and incorporates alternate funding opportunities such as government incentives, energy rebate programs and others, as appropriate. The consultant not only must properly size systems to meet permit requirements but also evaluate the opportunity for operational flexibility in treatment processes to minimize energy consumption and peak energy loads under various flow conditions, both current and projected. All analyses and recommendations should be based on the latest applicable codes. All upgrades should be coordinated with [local electric and gas utilities].*

### **4. Additional Considerations: Lifecycle Cost Analysis**

Discussions with engineering firms and treatment facility operators indicate that the decision making process for plant upgrades and new construction focuses primarily on first costs and capital expenditures, rather than on operating expenses and life cycle cost. There is also a perception throughout much of the water-wastewater community that energy efficient designs and systems come at a cost premium relative to traditional systems. This is certainly true for some systems, but is not the case in many others. For instance, there is no cost premium to align process buildings to shorten and straighten pumping runs, which may dramatically reduce pump energy requirements. Meanwhile increased competition in the marketplace is driving down the cost of many emerging high-efficiency technologies.

While the first cost of efficient equipment and processes is low or falling, energy prices are on the rise and threaten to overwhelm municipal budgets. A central motivation when municipalities consider upgrades or redesigns of their water-wastewater treatment operations is the need to reduce the amount of money being spent every month on

unnecessary energy consumption. Expanding the basis of discussion to include operating costs is critical to encouraging design and installation of energy efficient systems.

Capital cost evaluation alone fails to account for operation and maintenance costs, which typically exceed – sometimes many times over – the up-front cost of the equipment. Lifecycle cost analysis is a means of integrating operations and maintenance costs into the evaluation and planning of a facility upgrade or expansion project. Lifecycle cost simply means evaluating the cost of a piece of equipment over an expected lifetime for that product, including the energy and maintenance costs that it will incur over that time. When two or more products are compared, the basis for this comparison should be the full cost of each product over this lifecycle.

*Any design or upgrade must be evaluated for energy efficiency and a lifecycle energy cost comparison developed for review by [local jurisdiction, etc.] officials. All comparisons should include capital, operation and maintenance expenses. Provide a sample report which demonstrates consultant's capabilities and methods for performing a life cycle cost analysis and computing energy savings.*

## **5. Additional Considerations: Energy Use Baseline**

In order to understand the impact of energy efficiency improvements, a facility must establish a baseline of current energy performance. For new construction, this is a more difficult question to address as there is no immediate point of reference for energy performance. For retrofit or new construction projects, the ENERGY STAR benchmarking tool for wastewater facilities can provide an indication of how a proposed facility might perform, both in terms of absolute and relative energy intensity (kBTU/gallons/day or performance relative to facilities of similar size). The tool may also be used to indicate how a proposed retrofit might impact energy performance. The sample language below provides an example for how project requests might utilize ENERGY STAR Portfolio Manager.

*For this project, a pre-retrofit ENERGY STAR Rating<sup>1</sup>, the weather normalized energy intensity in kBTU/gallons per day, and an estimated post-retrofit ENERGY STAR Rating using EPA's ENERGY STAR Portfolio Manager shall be provided. If the facility type is not eligible for rating in Portfolio Manager, then the normalized source Energy Use Index (e.g. btu/gal treated) will suffice.*

The ENERGY STAR benchmarking tool focuses on energy use at the facility level. In evaluating specific processes within a facility it is also important to measure the energy use of individual systems and pieces of equipment. This may be accomplished through sub-metering – measuring the energy use of a particular process by adding a meter to a piece of equipment or a system. Sub-metering may help an operator to understand power usage

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<sup>1</sup> The ENERGY STAR Portfolio Manager benchmarking tool can be used to compare the energy performance of buildings and water-wastewater treatment facilities. To learn more about Energy Star benchmarking for water-wastewater treatment facilities, see [http://www.energystar.gov/index.cfm?c=water.wastewater\\_drinking\\_water](http://www.energystar.gov/index.cfm?c=water.wastewater_drinking_water)

during specific stages of the treatment process and establish priorities regarding efficiency upgrades. Consider requesting that sub-metering of energy intensive equipment be included in the project design.

## II. Process-Specific Guidance

A challenge in providing guidance of any depth and specificity stems from the uniqueness of drinking water-wastewater facilities. Each facility, even those employing similar treatment processes, is subject to variables that will determine the appropriateness and effectiveness of energy efficiency measures. That said, three activities typically account for the majority of energy use in these facilities: pumping, aeration, and solids handling. Pumping alone accounts for about 90% of the energy consumed in drinking water treatment, whereas the three activities combine to make up approximately 85% of energy use at a typical activated sludge wastewater facility. An Energy Efficiency RFP should request that the selected consultant provide, as part of the preliminary and final design process, a thorough assessment of potential energy saving measures including control and operations strategy for pumping, aeration, and solids handling. For each measure, the consultant should provide capital and life-cycle costs and annual kWh savings. This assessment should include information on process design, operation, maintenance and monitoring requirements, and regular efficiency testing for large process equipment.

Given the relative energy intensity of pumping, aeration, and solids handling, specific guidance for projects in these areas is provided below (*italics*). Ultraviolet disinfection and nutrient removal processes are also discussed, as these processes are becoming more commonplace and more energy intensive. None of these systems operate in isolation; changes in one area can impact the performance of other systems and the treatment process as a whole. The guidance document reinforces the importance that municipalities select a design firm which demonstrates an understanding of how system adjustments may impact energy consumption, reliability and effluent quality.

### 1. Pumping

The design of a water or wastewater pumping system will greatly affect energy use. A proper design should consider the energy implications of peak flow rates, pipe/forcemain sizes, and equipment selection. Careful attention should also be paid to the proper application of variable speed pumping and multi-stage pumping strategies.

*Preliminary and final designs of pumping system projects should include details regarding the following energy efficiency considerations:*

- *Types of pumps which minimize energy use and maintenance problems, especially clogging with wastewater debris.*
- *Pump operating point selection and number of pumps needed to maximize energy efficiency for average operating conditions while meeting peak flow and reliability requirements.*

- *System energy performance calculations under a range of operating conditions (present and future conditions,, dry and wet weather flows, largest pump out of service, continuous operation with variable speed control verses on-off constant speed operation. etc.)*
- *Lifecycle cost assessment of premium vs. standard efficiency equipment, including energy and maintenance costs*
- *System monitoring and control strategy*
- *Equipment service schedule*
- *Operation and maintenance manual for pumps and control system.*
- *Energy management training for operations staff*

## **2. Aeration**

Aeration in the secondary treatment process accounts for 30-60% of total energy consumption at the typical activated sludge wastewater treatment facility (EPRI 2000; WEF 1997). There are a number of opportunities to improve the energy performance of aeration systems, including dissolved oxygen (DO) sensors and automated controls, fine bubble diffusers, efficient blowers, and variable speed drives. Not all of these opportunities are appropriate at every facility, but each one should be evaluated for any project that includes an aeration system upgrade or expansion component.

*Preliminary and final designs of activated sludge system projects should include details regarding the following energy efficiency considerations:*

- *Evaluation of latest fine bubble diffuser and blower technology, and DO control strategies*
- *Process for annual efficiency testing (amp draw, head loss, air flow, back pressure, and other relevant system performance metrics)*
- *Equipment service schedule, including diffuser maintenance (cleaning, replacement of broken units, etc.)*
- *Operation and maintenance procedures to maximize energy efficiency and system performance*
- *Energy management training for operations staff Regarding blower technology and dissolved oxygen management:*
  - *Consider system performance under a wide range of operating conditions*
  - *Consider “packaged” blower products that include blower, variable speed drive, DO sensor, and PLC controls*
  - *Evaluate the opportunity for multi-blower or cascading blower operation*
  - *Compare curves of various types of blowers,, including high-speed turbo blowers, based on wire to air efficiency (Standard CFM/kWh)*
  - *Assess DO control system and DO sensor technology, and consider optical sensor technology*

### 3. Solids Handling

A variety of techniques and processes are applied to the solids handling function of a wastewater treatment plant, most of them focused on reducing the volume of material that will ultimately need to be disposed through land application, incineration, or other means. When evaluating a new system, it is important to consider not just the energy requirements of the equipment, but the costs associated with the current solids handling method, such as hauling, incineration, and ultimate solids disposal.

Treatment facilities are increasingly utilizing anaerobic digestion of solids as a means to supply the onsite energy needs of the facility. The biogas from this digestion process may be used to generate electricity and heat. EPA has a resource for treatment plants interested in combined heat and power opportunities. For details see [www.epa.gov/CHP/markets/wastewater.html](http://www.epa.gov/CHP/markets/wastewater.html).

*In evaluating solids digestion, dewatering, and disposal options, include details regarding the following for each alternative:*

- *System energy performance calculations under a range of operating conditions (present conditions, growth scenarios)*
- *Lifecycle cost assessment of premium vs. standard efficiency equipment (including maintenance costs and sludge disposal costs)*
- *Potential for variable speed drive technology*
- *Options for sludge disposal or reuse other than current method*
- *System monitoring and control*
- *Equipment service schedule*
- *For a facility with anaerobic digestion that currently flares digester gas:*
  - *Evaluate technologies or processes that maximize methane production (e.g. the use of fats, oils and greases [FOG]), to be used for electricity production and/or heating for processes or buildings*
  - *Provide lifecycle cost assessments and estimates of potential energy generating capacity. Analysis should consider both capital expenditures and operating costs, and incorporate alternate funding opportunities, as appropriate*

### 4. Ultraviolet Disinfection

Ultraviolet light provides final effluent disinfection at many wastewater facilities. This practice is becoming more common and increasingly energy intensive. Key considerations for energy performance include the ability to modulate system output to the level required for disinfection (dose-pacing control) and system turndown (bank size and output

variability). Design of the system should allow for reduction in both the number of operating lamps and lamp output, to match flow conditions (Focus on Energy, 2006).

## 5. Nutrient Removal

Nitrification (ammonia oxidation), the process of removing ammonia from the treated effluent, is often accomplished in the aeration basins of an activated sludge facility. The air requirements for nitrification facilities are significantly higher than facilities designed to remove only carbonaceous BOD. If a current discharge permit does not require ammonia removal, in most cases the system should be controlled to ensure that nitrification does not occur in order to save aeration energy. However requirements for nitrification may be imposed as treatment requirements become increasingly stringent with regard to nutrient removal, so an upgrade designs should provide the flexibility for future nitrogen removal. An agency may wish to include language requesting that respondents investigate and offer design possibilities (and outline the energy implications) for anticipated nutrient removal requirements. If nitrification is required, energy recovery through provision of anoxic zones to provide denitrification should also be considered in order to reduce overall energy requirements.

## CONCLUSION

This Guidance is intended to assist municipal decision makers with integrating energy efficiency into water-wastewater project designs. The Guidance has two essential aims: (1) to improve consistency in water-wastewater project requests and in the evaluation of project proposals, and (2) to identify and describe the key elements of a request for an energy efficient project design. This document is not intended as a thorough energy efficiency best practices resource. Excellent best-practices resources are available from WEF, EPA, and others (see the Resources section, below).

Use of this Guidance is no substitute for review by an engineering professional.

## Resources

The following are excellent resources for more information about energy efficient equipment and operations at water and wastewater treatment facilities.

- U.S. Environmental Protection Agency, 2008, *Ensuring a Sustainable Future: An Energy Management Guidebook for Wastewater and Water Utilities*. Available at [http://www.epa.gov/waterinfrastructure/pdfs/guidebook\\_si\\_energymanagement.pdf](http://www.epa.gov/waterinfrastructure/pdfs/guidebook_si_energymanagement.pdf)
- Focus on Energy, 2006, *Water & Wastewater Industry Energy Best Practice Guidebook*. Available at <http://www.werf.org/AM/Template.cfm?Section=Home&TEMPLATE=/CM/ContentDisplay.cfm&CONTENTID=10245>
- Water Environment Foundation, 2009, *Manual of Practice 32: Energy Conservation in Water & Wastewater Facilities*. Available at [www.wef.org](http://www.wef.org).

- For a list of CEE member energy efficiency program administrators, many of which offer resources for municipalities and water-wastewater utilities, see <http://www.cee1.org/cee/members.php3>

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