



Energy Conservation and Performance Contracting: An Alternative Funding Mechanism for Wastewater Infrastructure Needs

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The City of Clearwater owns and operates three advanced water reclamation facilities (WRF): the 5-mgd East WRF, the 13.5-mgd Northeast WRF, and the 10-mgd Marshall Street WRF. The City was interested in conducting energy audits of the three WRFs to evaluate facility efficiency and identify energy and operation and maintenance (O&M) cost-saving solutions. The City evaluated the qualifications and approaches of preapproved energy service companies (ESCO) currently on the state list, and selected an ESCO team to conduct a detailed energy audit.

The preliminary energy audit identified a total of 19 potential projects to reduce en-

ergy, chemical use, and equipment maintenance/operations costs. The ESCO team reviewed potential projects with City engineering and operations staff, and a final list of 12 projects were chosen for a detailed energy audit evaluation. The selected types of projects for implementation under the City's performance contract include:

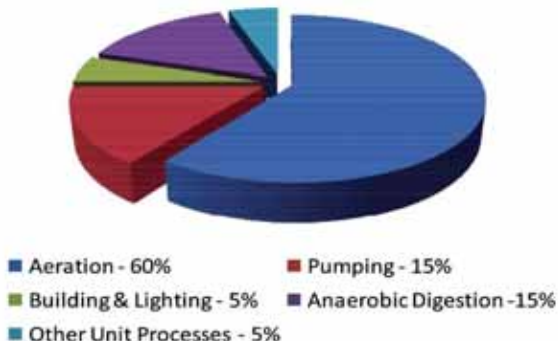
- ◆ Anaerobic digester biogas-to-power cogeneration facility with fats, oils, and grease (FOG) augmentation
- ◆ Centrifuge dewatering to replace aging belt filter presses
- ◆ Mixer replacements in the fermentation and first anoxic and second anoxic basins

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- ◆ of the five-stage Bardenpho biological nutrient removal (BNR) processes
 - ◆ Odor control improvements at the headworks
 - ◆ Building and exterior lighting improvements
- Continued on page 6*

Project Goals Reduce O&M and Fund Needed Improvements

Electricity is typically 25% to 45% of WWTPs Annual Operating Budget



Performance Contracting



Energy / Performance Services Contracting



Alternative Project Delivery Process



Savings from a Single or Combined Group of Energy Conservation Projects



O&M Savings Pay for the Cost of the Selected Capital Improvements

Continued from page 4

Project Implementation

The City developed nine projects for implementation at the three WRFs within an 18-month contract period, with a total project cost of \$9,861,759. The work includes owner/direct/purchase (ODP) of major equipment items to eliminate taxes and reduce costs, and ensure project execution and guaranteed operation and maintenance savings by the ESCO. The City and the ESCO developed the measurement and verification (M&V) criteria used during the terms of the contract to monitor the O&M savings.

The recommended improvement program is cash-positive on day one, and the improvements are paid for by the O&M savings over a 15-year payback period as required by F.A.C. 489.145 – Guaranteed Energy, Water, and Wastewater Performance Savings Contracting.

The benefits of this type of program for the City include the ability to provide an alternative funding mechanism for needed capital improvement programs, reduction in operational costs, and guaranteed O&M savings through implementation of the recommended improvements to pay for the new infrastructure.

The major steps to energy services contracting requires the selection of an ESCO, conducting the preliminary and detailed energy audits, evaluation of the alternatives, selection of the recommended improvements for implementation, selection of the financing method, developing the terms and conditions for the M&V process, and execution of the performance contracting agreement. The design production of specifications and contract drawings, construction of the recommended improvements, staff training and ESCO contractual maintenance, and M&V occur during the implementation of the project. Other requirements to undertaking performance contracting for wastewater and water utilities include the utility's willingness to utilize an alternative project delivery process.

Regulatory Requirements



Energy Reduction Methods

Energy services contracting or performance contracting is an alternative project delivery process in which savings resulting from a single or combined group of energy conservation projects, renewable energy projects, and other facility improvements that reduce O&M, are used to pay for the cost of the capital improvement. The City successfully used performance contracting on government services

buildings with the implementation of lighting and heating, ventilation, and air conditioning (HVAC) improvements to reduce energy costs and use the savings to pay for the capital improvements. The City decided to evaluate the feasibility of using this same approach on its three water reclamation facilities to finance capital improvements, while also reducing energy and O&M costs, which has an immediate and direct benefit to the bottom line of any municipality.

Energy services contracting enables governmental agencies to make infrastructure and facility improvements by reducing operating expenses and making a positive impact on capital budgets. Through the implementation of renewable energy conservation and O&M reduction projects, operation costs are reduced and more dollars are available for the operation and maintenance of facilities and infrastructure. This approach allows projects to be funded without tax increases, bond issues, or upfront monies from capital budgets. The Energy Services Coalition (ESC) provides additional information at <http://www.energy-services-coalition.org> (WEF, MOP No. 32).

In the state of Florida, energy services contracting or performance contracting is regulated under F.S. 489.145 – Guaranteed

Energy, Water, and Wastewater Performance Savings Contracting. The goal of the state policy is to encourage government agencies to invest in energy, water, and wastewater efficiency and conservation measures to minimize energy and water consumption and wastewater production, and maximize energy, water, and wastewater savings (<http://www.leg.fl.us/statutes/>). The regula-

tions outline the procedures and requirements, including:

- Licensed ESCOs or “guaranteed energy, water, and wastewater performance savings contractors” prequalified and experienced in the analysis, design, implementation, or installation of energy efficiency and conservation measures through performance

Continued on page 8

Project Financing

Projects Funded Without Requiring Tax Increases, Bond Issues, or Upfront Monies from Capital Budgets



Energy Audit



Table 1 Recommended Projects from Detailed Energy Audit

Facility Improvement Measure (FIM)	Owner/Direct/ Purchase Cost for Equipment	Annual Energy and Operation Savings (Year 1)
No. 1 NE WRF Odor Control Improvements	\$127,000	\$45,618
No. 2 NE WRF Indoor/Outdoor Lighting	NA	\$15,921
No. 3 NE WRF Dewatering Centrifuges and BFP Rehab.	\$399,514	\$48,149
No. 4 NE WRF Anaerobic Digester Methane Cogeneration w/ FOG Augmentation	\$971,162	\$160,377
No. 5 NE WRF Mixer Replacement in Anoxic and Fermentation Basins	\$578,000	\$82,989
No. 6 Marshall Street WRF Indoor/Outdoor Lighting	NA	\$16,368
No. 7 Marshall Street WRF Dewatering Centrifuges and BFP Rehab.	\$372,507	\$56,249
No. 8 Marshall Street WRF Mixer Replacement in Anoxic and Fermentation Basins	\$511,500	\$77,007
No. 9 East WRF Indoor/Outdoor Lighting	NA	\$4,838
Total Savings Year 1		\$507,516
Total Savings Over 15 Years		\$9,439,248
Total ODP Cost	\$2,959,683	
Construction	\$6,902,076	
Total Project Costs	\$9,861,759	
Payback Period		15 Years
15 Years of Annual Performance Assurance Services	\$231,707	
10 Years of Annual Maintenance Services	\$2,902,619	
Total Costs to City	\$12,996,085	

Continued from page 7

contracts, and required selection procedures in accordance with F.S. 287.055.

- ◆ Investment-grade energy audit or detailed energy audit report with analysis of proposed energy, water, and wastewater conservation measures, and the costs, savings, and benefits required prior to entering into a contract with an ESCO.
- ◆ The capital cost of the performance contract must pay for itself with the cost savings over a term of 20 years or less.
- ◆ The program established under the performance contract must be cash-positive in the first year of the contract term.
- ◆ The ESCO may provide for financing, including tax-exempt financing, by a third party, and the third-party financing contract is separate from the performance contract.
- ◆ Annually, the government agency must submit an M&V report as outlined in the performance contract to the state Department of Management Services to validate that savings have occurred.
- ◆ The government agency may reduce the capital debt of the proposed performance contract by the application of any grant monies, rebates, or other capital funding available to reduce the program costs; however, the life cycle costs completed in accordance with F.S. 255.255 may not use any grants, rebates, or other capital funding to demonstrate that the energy services program is cash positive on day one.
- ◆ The ESCO must include a written guarantee that the annual savings will meet or exceed the amortized cost of the performance contract.
- ◆ The performance contract with the ESCO must contain a provision for annual reconciliation of the guaranteed energy/operational cost savings, and if the reconciliation reveals a shortfall, the ESCO is liable to the government agency to provide payment equal to the shortfall amount.
- ◆ The ESCO must provide a 100 percent public construction bond to the government agency for its faithful performance.

In summary, a government agency would implement an energy services or performance contract with a state-qualified ESCO, which acts as the project developer and assumes the technical and performance risk associated with the project. The ESCO team may include engineers and contractors as subconsultants to the ESCO to assist in implementation of the energy audits, detailed design, and construction of the energy services contract. The ESCOs typically offer the following services:

- ◆ Develop, design, and arrange financing for energy-efficient projects.
- ◆ Install and maintain the energy-efficient equipment involved.
- ◆ Measure, monitor, and verify the project's annual energy savings.
- ◆ Assume the risk that the project will save the guaranteed amount of energy and/or operational savings.

Energy Audit

Following selection of the ESCO by the City, a preliminary and a detailed energy audit were conducted to determine the feasibility of using a performance contract with an ESCO to implement energy conservation measures at the City's three WRFs.

The preliminary audit considered all types of renewable energy, energy conservation, chemical use reduction/elimination, and other measures to reduce O&M costs at the three WRFs. The 19 potential renewable energy projects included photovoltaic solar, cogeneration of biogas from anaerobic digesters, energy conservation projects such as replacement of mixers and oxidation ditch aerators, screw pump replacements, aeration blower optimization/dissolved oxygen control, and

M&V, Performance Assurance and Maintenance Services

FIM	M&V
NE Odor Control	Chemical Use & H ₂ S Levels in Headworks Building
Lighting at Three WRFs	Pre- & Post Retrofit Wattage
Centrifuge Dewatering	Max. Polymer Use, kWhr Use, Min. % TS, Min. % Solids Cap.
Mixer Replacements	Pre- & Post Retrofit Wattage
Biogas Cogeneration & FOG	Annual Run-Time & Available Hrs

Additional Services that Can Be Provided by ESCO

- Performance Assurance Services: Annual Reconciliation of Energy and Operational Savings by Agreed Upon Reporting Methodology and Frequency of M&V
- Maintenance Services by ESCO vs. Self-Implemented

building improvements. Other operational improvements to reduce O&M included biosolids handling, programmable logic controller upgrades, odor control optimization, disinfection alternatives (ultraviolet, ozone),

and membrane filtration.

The estimated capital, O&M, and pay-back period was developed for the 19 initial alternatives and reviewed by the City. The solar

Continued on page 10

Continued from page 9

panel renewable project to produce electricity for use at each WRF had high capital costs and a low return on investment, with payback in upwards of 40 years. All projects with payback periods greater than 20 years were eliminated from further consideration and the City desired to only consider projects with the payback from energy savings within 15 years or less.

Table 1 summarizes the recommended improvement projects selected by the City. A total of nine projects, or facility improvement measures (FIMs), were selected for implementation at the Northeast WRF (NE WRF), the Marshall Street WRF, and the East WRF. The City decided to ODP the major equipment items under each FIM to reduce costs by eliminating tax. The total major equipment costs for the project procured under ODP is \$2,959,683. The costs for engineering, permitting, and construction of each project are \$6,902,076, and the combined total projects costs are \$9,861,759, as summarized in Table 1.

The annual energy and operation savings for each FIM is also summarized in Table 1. The first-year annual savings is \$507,516. Over the 15-year contract period, and accounting for a 3 percent escalation rate, the total savings is \$9,439,248. The payback for the proposed energy services program is 15 years.

In addition to the capital costs and O&M savings, the City and the ESCO negotiated contractual performance assurance services (PAS) and annual maintenance services (AMS) for specific equipment. The purpose of

the PAS is for annual reconciliation of energy and operational savings by performing agreed-upon M&V. The work includes both one-time equipment measurement and ongoing annual measurements of energy use or operational costs to demonstrate agreed-upon savings. The annual PAS payments range from \$12,458 in Year 1 to \$18,844 in Year 15, for a total cost of PAS over 15 years of \$231,707, as shown in Table 1.

In addition, the City elected to self-implement maintenance on all FIMs, with the exception of FIM No. 4, NE WRF anaerobic digester methane cogeneration with FOG augmentation. The City requested a shared maintenance program for this FIM, which has new facilities to receive FOG to augment the anaerobic digesters, and the related cogeneration unit and gas cleaning facilities to burn the digester biogas and generate power for use on site. The City requested that the ESCO provide AMS for the following components for a 10-year period:

- ◆ Maintenance, parts, and lubrication for the reciprocating engine generator that will use anaerobic digester biogas as fuel to generate power.
- ◆ Maintenance, parts, and lubrication for the biogas fuel conditioning system.
- ◆ Maintenance, parts, and routine cleaning of the FOG receiving and storage system.

The total cost of the AMS for Year 1 is \$253,197, and over the 10-year maintenance period, the total cost is \$2,902,619, as summarized in Table 1.

Under the terms of the performance con-

tract with the City and the ESCO, following the annual M&V reconciliation, any annual savings above those projected remain with the City and are not shared or returned to the ESCO.

Financing and Scheduling

The ESCO provided financing alternatives to the City's finance department for review, including a municipal lease option. The City's finance department reviewed other options, including bank loans, and decided that it was in its best interest to self-finance the project with capital funds that were available. The advantage of this program to the City is that many of the projects, such as FIM No. 3, 5, 7, and 8, were already in their 10-year capital improvement plan (CIP). The City was able to remove these from bonding requirements under the CIP and finance them under the performance contract program. This approach allowed the City to finance projects without additional tax increases or bond issues. In addition, the performance contract program does not impact the City's bonding capacity, so the removal of projects from the CIP allows it to fund additional projects under the bond (as desired).

Another big advantage of this program for the City is that all nine projects will be implemented simultaneously, with the agreed-upon 18-month schedule for engineering design, permitting, construction, startup, and commencement.

Other Considerations

Some of the important factors that any municipality should consider and understand when evaluating the feasibility of undergoing and executing an energy services performance contract include an understanding of not only the ESCO selected, but the subconsultants the ESCO will use for engineering design and permitting, and the general contractor and subconsultants used for general, electrical, instrumentation and controls, and HVAC. For the City's selection, the ESCO team included an engineering consultant and general contractor that had worked on numerous wastewater design and construction contracts for the City. The team understands the City's staff, its design standards, and most importantly, its treatment facilities.

References

- WEF Manual of Practice, No. 32. (2009) "Energy Conservation in Water and Wastewater Treatment Facilities." ◊