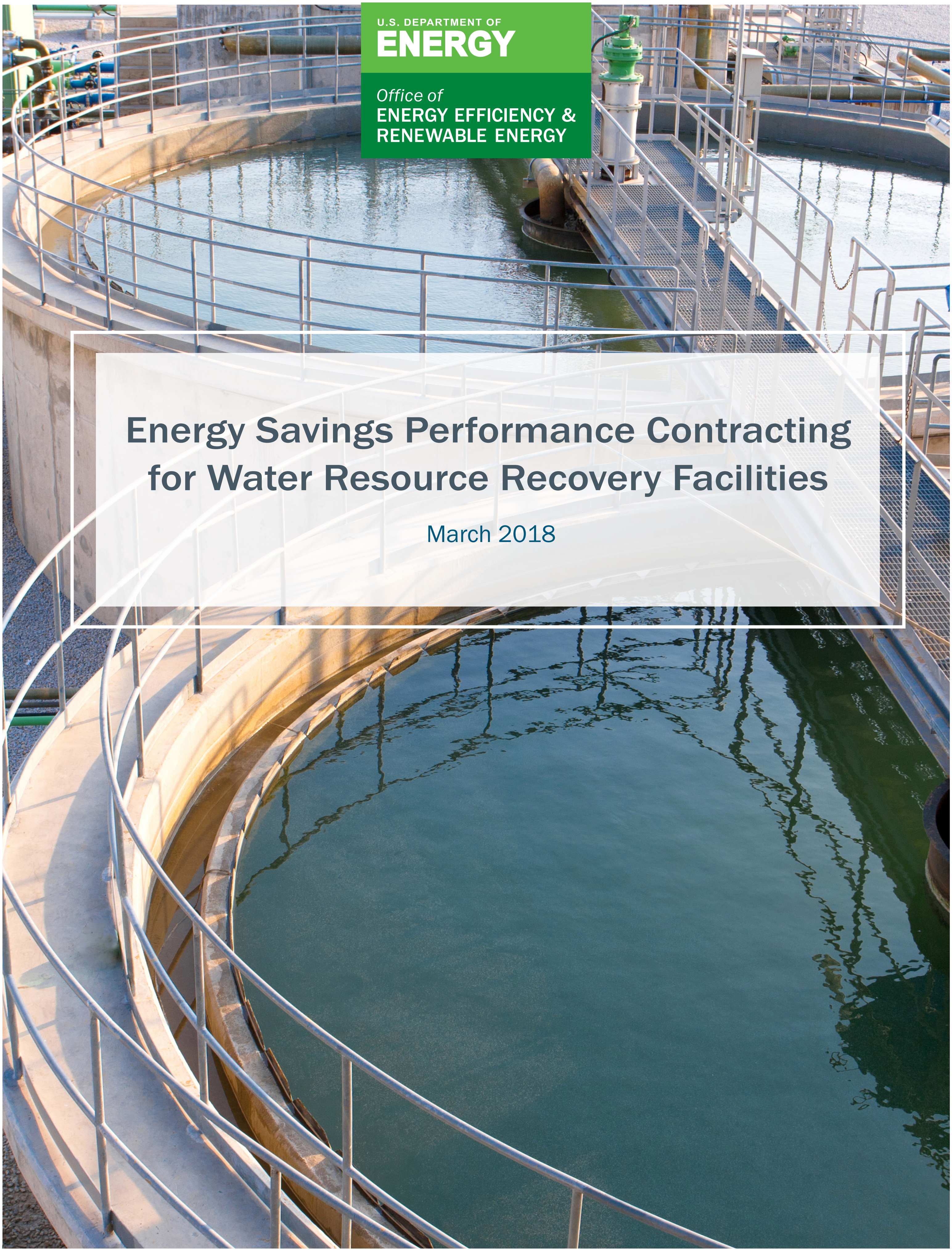

U.S. DEPARTMENT OF
ENERGY

Office of
ENERGY EFFICIENCY &
RENEWABLE ENERGY

Energy Savings Performance Contracting for Water Resource Recovery Facilities

March 2018

Disclaimer

This document presents the basics of energy savings performance contracting (ESPC) for water resource recovery facilities (WRRFs). It was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of the authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

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FOR MORE INFORMATION

This document and additional Energy Savings Performance Contracting (ESPC) resources are available in DOE's ESPC Toolkit, located at https://betterbuildingssolutioncenter.energy.gov/espc/home and on DOE's State and Local Solution Center, located at https://energy.gov/eere/slsc.

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Energy Savings Performance Contracting Series – Guides for State and Local Government Sectors

DOE's Energy Savings Performance Contracting Series for State and Local Government Sectors introduces energy savings performance contracting (ESPC) as a way to increase energy efficiency and upgrade facilities in particular government sectors. Each guide provides critical detail for owners to consider ESPC as an option and core resources to take the next step to initiate a project. Each provides information on how ESPC works, its components, and the potential project benefits with respect to typical barriers in the sector. Project examples demonstrate how guaranteed annual energy and operational savings cover the cost to install a wide variety of sector-specific measures. Industry representatives involved in the government sector provided experience and insight on barriers, opportunities, and benefits.

K-12 SCHOOLS:

Energy Savings Performance Contracting: A Primer for K-12 Schools (2016)

This primer explains how schools can use energy savings performance contracting to save money by improving building energy efficiency and reducing operating costs, all while increasing occupant comfort and productivity. The following chapters provide K-12 faculty, school boards, and building managers with an introduction to ESPC benefits, guidance for getting started, and resources to support the ESPC implementation process.

WATER RESOURCE RECOVERY FACILITIES:

Energy Savings Performance Contracting in Water Resource Recovery Facilities (2017)

This guide was specifically developed to provide decision-makers at water resource recovery facilities (WRRFs) with information, examples and resources to consider the option of energy savings performance contracting as a way to upgrade facilities with an emphasis on compliance.

COMING NEXT:

Small Facilities

Energy Savings Performance Contracting in Small Facilities

Hospitals And Healthcare Facilities

Energy Savings Performance Contracting in Hospitals

List of Acronyms

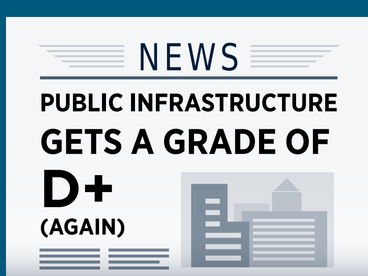
ASCE	American Society of Civil Engineers
AEE	Association of Energy Engineers
CEM	Certified Energy Manager
CHP	Combined Heat and Power
CMVP	Certified Measurement and Verification Professional
CREBs	Clean Renewable Energy Bonds
DO	Dissolved oxygen
DOE	U.S. Department of Energy
ECM	Energy Conservation Measure
EERE	Office of Energy Efficiency & Renewable Energy
EIA	U.S. Energy Information Administration
ESC	Energy Services Coalition
EPA	U. S. Environmental Protection Agency
ESCO	Energy Service Company
ESPC	Energy Savings Performance Contracting
EUM	Effective Utility Management
FEMP	Federal Energy Management Program
HVAC	Heating, Ventilation, and Cooling
IGA	Investment-Grade Audit
IPMVP	International Performance Measurement and Verification Protocol
LOC	Life of Contract
M&V	Measurement & Verification
NACWA	National Association of Clean Water Agencies
NAESCO	National Association of Energy Service Companies
NASEO	National Association of State Energy Officials
NIST	National Institute of Standards & Technology
NPDES	National Pollutant Discharge Elimination System
O&M	Operations & Maintenance
P.E.	Physical Engineer
QECBs	Qualified Energy Conservation Bonds
RFP	Request for Proposals
SCADA	Supervisory Control and Data Acquisition system
SEO	State Energy Office
SWIFt	Sustainable Wastewater Infrastructure of the Future
TELP	Tax-Exempt Lease Purchase agreement
VFD	Variable Frequency Drive
WEF	Water Environment Federation
WRRF	Water Resource Recovery Facility

Contents

Executive Summary

In recent years, a growing number of utilities responsible for cleaning wastewater have been moving from a strict focus on wastewater treatment to an integrated focus on water resource management, some formally renaming themselves water resource recovery facilities (WRRFs). WRRFs are responsible for meeting strict regulatory and permitting requirements and high performance standards. They are accomplishing this in the face of many challenges, including tightening budgets, aging infrastructure, increasing capital and operational costs, rising energy prices, and tighter regulatory requirements. The American Society of Civil Engineers (ASCE) assigned a grade of "D+" to the state of wastewater infrastructure in the United States and noted that state and local governments devote approximately 98 percent of the capital investments annually to maintaining and improving the infrastructure. With an estimated capital improvement need of $271 billion over the next 25 years —combined with general industry concerns about energy supply reliability, resiliency, and sustainability— many WRRFs are considering alternative project delivery methods.

The American Society of Civil Engineers (ASCE) assigned a **GRADE OF D+** to the state of wastewater infrastructure in the United States



For more than a decade, WRRFs across the country have used Energy Savings Performance Contracting (ESPC) to successfully upgrade aging infrastructure and meet increasingly rigorous regulatory requirements. Instead of making capital improvements as funds become available, ESPC provides a way to fund and implement facility-wide, comprehensive, and cost-effective improvements all at once using self-generating funds. Projected guaranteed savings from energy-saving projects and operations and maintenance cost savings meet finance payments over the useful life of the equipment. ESPC operates on the concept that the operating budget has opportunities for improved efficiency throughout it, and these savings can be redirected to pay for improvements.

Project examples in Chapter 3 of this guide demonstrate how nine WRRFs—large and small—upgraded their facilities, ensured ongoing compliance, improved the bottom line, satisfied future demands, and improved environmental performance. For example:

- Fort Worth's Village Creek Water Reclamation Plant in Texas initiated a $35 million project funded by $2.6 million in guaranteed annual savings plus a $1.3 million utility rebate, without raising taxes or tapping the city's capital reserves. Savings come from increased digester gas production, Supervisory Control and Data Acquisition (SCADA) system replacement and aeration system improvements and additional upgrades that help the facility comply with emission reduction plan mandates.
- The Opequon Water Reclamation Facility in Virginia, through its $47 million ESPC project, processes biosolids and organic waste by anaerobic co-digestion to generate more than 50 percent of the plant's electricity needs. Guaranteed annual savings of $2.9 million are redirected from utilities, chemicals and biosolids hauling budgets to pay for the project. It will stabilize rates for customers and promote economic development in the region.
- The City of Glens Falls, New York upgraded infrastructure including biosolids holding tanks and mixing equipment and a SCADA system with no controls. The project achieved compliance at no added cost, avoiding the need to raise taxes, issue a bond or add to municipal debt.
- In the City and County of Honolulu, the Kailua Wastewater Treatment Plant saves $638,000 a year to pay for $6.2 million in upgrades. Improvements reduce noise and odors from the plant, address deferred maintenance, cut operation and maintenance costs, save taxpayer dollars, and created 67 construction jobs. The plant improved air and water quality, reduced energy use by 28 percent and invested in renewable energy, helping to meet Hawaii's Clean Energy Initiative goals.
- The small city of Hutchinson, Minnesota achieved $32,000 in guaranteed annual savings and $60,000 in biosolids handling to pay for a $375,000 project that improved efficiency of motors in the plant and lighting throughout all government buildings.

HOW IT WORKS

An Energy Services Company (ESCO) develops and implements the ESPC project and guarantees projected results. A third party finances the total project cost based on the guaranteed annual savings to pay for the improvements. The finance term is typically within 15 to 25 years, limited by the useful life of the equipment. The ESPC process is authorized in state statutes that set requirements for government sectors. This guide describes a typical five-step ESPC process. This guide also provides additional resources and guidance to help you get started on your ESPC project. Many states provide additional guidelines and offer supportive resources.

CHAPTER 1. Introduction to Energy Savings Performance Contracting

What Is Energy Savings Performance Contracting?

Energy Savings Performance Contracting (ESPC), or performance contracting, is a budget-neutral approach to implementing facility improvement projects without using funds from capital budgets. Guaranteed cost savings from energy- and water-saving projects meet finance payments over the useful life of the equipment. ESPC also can be an effective near-budget-neutral approach to leverage capital budgets or other funding sources.

If you face these problems at your facility, ESPC may be an ideal solution:

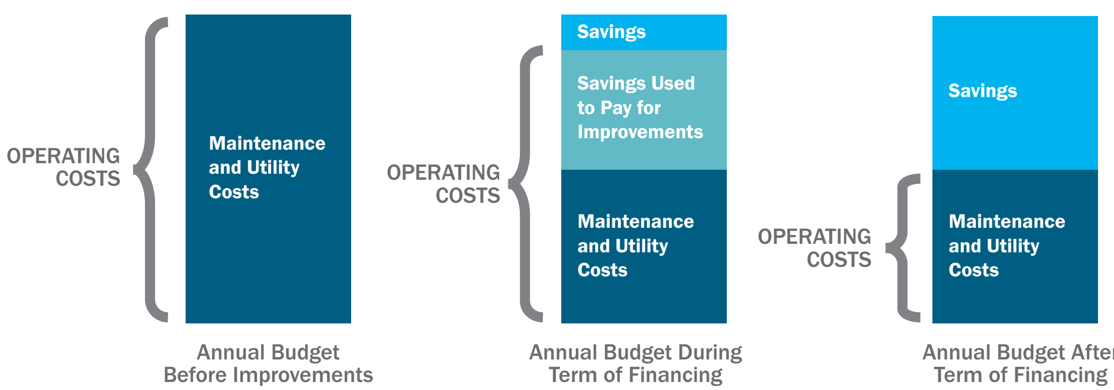
- ✓ Old or inefficient equipment
- ✓ Too many demands on your budget
- ✓ Deferred and/or recurring maintenance problems
- ✓ Limited available staff time
- ✓ Operations or compliance issues

Many successful projects have been completed in the federal, state, and local government sectors. Any large facility or group of facilities is a good candidate for ESPC, including schools, colleges, hospitals, commercial office buildings, and multi¬¬-family buildings. While the majority of ESPC projects are historically focused on the improvement of buildings systems, municipal utilities that operate water resource recovery facilities (WRRFs) and other similar energy-intensive operations have been embracing performance contracting.

Redirecting Utility and Operational Savings to Pay for Facility Improvements

It is rare for a facility to be operating at maximum efficiency. Deferred maintenance, aging equipment, and inefficient operations all increase utility and operation and maintenance (O&M) costs above their optimum levels. ESPC redirects such unnecessary utility and O&M costs to pay for improvements over the useful life of the equipment, as shown in the Figure 1 below.

Figure 1: How Savings Pay for Improvements



Upgrading to more efficient equipment and optimizing operations reduces utility costs. Using new equipment reduces the demand for replacement parts and contracted maintenance services, resulting in O&M savings. The resulting savings free up a portion of the annual budget to pay for improvements over time. Figure 1 depicts an annual operating budget before, during, and after payments for improvements. The middle column shows that the annual utility and O&M savings resulting from facility improvements are redirected to make payments throughout the financing term. The last column shows that after the financing term is complete, the equipment owner continues to accrue savings which can be used for other purposes.

An Energy Services Company (ESCO) develops and implements the ESPC project and guarantees projected results. It is important to select an ESCO with wastewater-specific experience for WRRF projects. A third party finances the total project cost based on the guaranteed annual savings to pay for the improvements. The finance term is typically within 15 to 25 years, limited by the useful life of the equipment.

See Chapter 4 for more details on the components of ESPC.

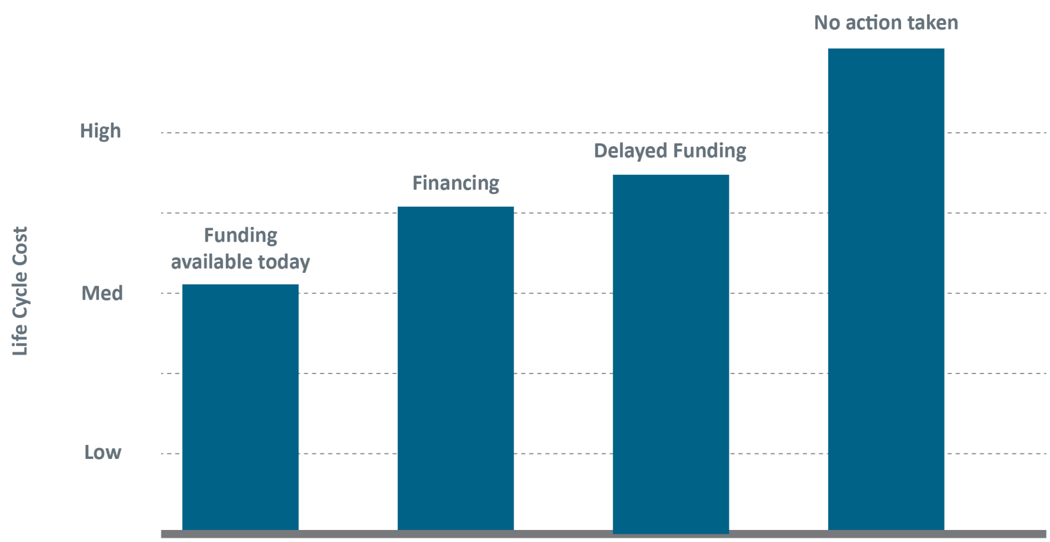
See Chapter 6 for additional resources and guidance to help you get started on your ESPC project.

Benefits of ESPC

Overcome the Barrier of Limited Budgets

Limited capital budgets present a barrier to funding energy efficiency projects. ESPC can remove the financial barrier, by using savings to pay for upgrades today instead of waiting for a capital budget allocation. If you wait for funding to become available in the future instead of financing today, it will actually end up being more expensive, because the cost of continuing to pay high utility bills during the waiting period exceeds the interest cost of financing the improvements today. By comparing different project funding approaches using the ENERGY STAR® Cash Flow Opportunity Calculator and Financial Value Calculator located at www.energystar.gov/financialevaluation, Figure 2 shows that financing energy efficiency projects is more cost-effective than waiting for future capital budget appropriations or taking no action.

Figure 2: Cost of Doing Nothing



Improve Facilities and Systems

ESPC's comprehensive approach may upgrade some or all of an owner's systems or facilities at once, capturing synergies and economies of scale. It modernizes infrastructure, improves the work environment, and streamlines maintenance practices to sustain savings and effective operations. The aeration and pumping systems in a facility represent good opportunities, representing more than 50 percent and up to 15 percent of the energy consumption respectively.

Demonstrate Environmental Stewardship

Reducing long-term energy use through efficiency and renewable energy conserves natural resources, reduces air and water pollution and reduces our dependence on fossil fuels. Many governments have energy savings and/or climate goals or long-term sustainability plans. ESPC provides the financial means and technical expertise to achieve those goals, comply with environmental standards, replace antiquated systems, improve processes and operations, and reduce the volume of waste.

Use Capital Budget Dollars Wisely

Capital budgets are limited and often stretched across many priorities. With a 23 percent growth in demand on wastewater treatment expected by the year 2032, the American Society of Civil Engineers estimates that wastewater infrastructure will require $271 billion in new investment over the next 25 years to meet the increased demand and federal regulatory requirements.[1] Three-quarters of that is expected to go toward improvements to existing plants. With ESPC, utility and O&M dollars that are no longer needed for their original purpose can be invested in infrastructure improvements. Reducing energy and water use helps stabilize the utility budget, reducing the risk of future volatility in energy prices and reducing the associated taxpayer burden.

Support Economic Development

Large-scale ESPC projects create jobs, and according to some ESCOs, as much as 70 percent of the project cost remains in the community. ESCOs often use local contractors that are familiar with the facility and already have a good working relationship. Many owners have challenged ESCOs to buy locally and contract with local companies as much as feasible – an objective stated in the RFP.

ESPC OPPORTUNITY

Increased efficiency may also provide additional plant capacity to serve additional customers. This can mean an opportunity to bring in new commercial and industrial businesses that spur economic development in the community.

CHAPTER 2. How Water Resource Recovery Facilities Can Use ESPC

Water resource recovery facilities (WRRFs) are responsible for meeting strict regulatory and permitting requirements and high performance standards with tightening budgets. WRRFs accomplish this in the face of many challenges, ranging from aging infrastructure to increasing operational costs and rising energy prices. This chapter highlights how ESPC can help address some of these challenges while achieving additional benefits in the process.

WRRF Priorities

Limited resources challenge WRRFs to do more with less. As O&M costs increase, deferred maintenance escalates to critical levels in WRRFs across the country.

The cost savings attainable through increased energy efficiency can help WRRFs meet the listed challenges. ESPC helps fund both critical system upgrades and process improvements that in some cases can enable WRRFs to increase revenues.

Maintaining Public Health and Environmental Standards

The mandate of the wastewater industry has always been two-fold, maintaining public health and performing environmental stewardship to meet all applicable water quality standards.[2] Capital needs continue increasing with tightening regulatory requirements and rising costs.

WRRFS ACROSS THE COUNTRY FACE COMMON CHALLENGES:

- Complying with increasingly stringent regulatory requirements to meet customer, public health, and environmental needs
- Providing reliable service, which entails security, emergency preparedness, and resiliency
- Meeting public expectations for reasonable and predictable rates and taxes
- Balancing revenues with rising utility and O&M costs for aging systems to ensure longevity of assets
- Meeting rising demand for clean water from an increasing population
- Budgeting for steadily rising utility costs or unpredictable increases in utility costs

Upgrading Infrastructure

Infrastructure is aging and investment is unable to keep up with the need. According to the American Society of Civil Engineers (ASCE),[3] capital investment needs for the nation's wastewater and stormwater systems total an estimated $271 billion over the next 25 years. ASCE assigned a grade of "D+" to the state of wastewater infrastructure in the United States and noted that state and local governments incur approximately 95 percent of the capital investments annually to maintain and improve the infrastructure. Furthermore, aging equipment typically costs more to maintain and operate.

Managing Energy Costs

Most WRRFs were constructed with a primary focus on regulatory compliance, not operational efficiency as a function of life-cycle cost and continual asset management. With continuous operation, WRRFs are often one of the largest utility users in a community. In fact, for local governments, water resource recovery accounts for 30 to 40 percent of the total energy consumed.[4] Within WRRFs, energy is often the second highest operating cost, behind labor costs.[5] To compound the problem, the cost of energy continues to increase. Between 2000 and 2010, the cost of energy in the United States increased by approximately 80 percent,[6] and the U.S. Energy Information Administration (EIA) projects that energy costs will continue to increase through 2040.[7] According to EIA, the price of oil (5.1%/year), natural gas (4.6%/year), coal (2.7%/year), and electricity (2.3%/year) are all expected to rise.

The ESPC Solution

The WRRF sector has enormous infrastructure needs to meet demands and increasingly rigorous regulatory requirements. Economic factors, combined with general industry concerns about energy supply reliability, resiliency, and sustainability have encouraged many WRRFs to consider alternative project delivery methods. WRRFs across the country have used ESPC to improve operations, achieve regulatory compliance, upgrade aging infrastructure, improve the bottom line, plan for future needs, and improve environmental performance. Instead of making capital improvements as funds become available, ESPC provides a way to fund and implement facility-wide, comprehensive and cost-effective improvements all at once using self-generating funds. Approaching upgrades in this way improves overall operations and plant effectiveness.

ESCOs have been implementing ESPC projects for wastewater treatment facilities for more than a decade

ESCOs have been implementing ESPC projects for wastewater treatment facilities for more than a decade, either as standalone projects or as part of comprehensive municipal projects. These projects are good examples of using public-private partnerships to modernize critical infrastructure, and many ESCO customers find that the collaborative nature of performance contracts is more efficient and better meets their needs.[8] It is important to select an ESCO with experience specific to WRRFs and that experience can be documented by including specific questions about experience and requests for qualifications in the Request for Proposals (RFP).

Success stories demonstrate that ESPC is a viable option for WRRFs (See Chapter 3). The benefits of ESPC projects are numerous and typically include cost savings, improved treatment, and increased system reliability. Improving energy efficiency in WRRFs can lead to a range of environmental, economic, and other benefits.

ESPC OPPORTUNITY

The Effective Utility Management (EUM) Collaborative Effort of six associations, including the Water Environment Federation (WEF) and the National Association of Clean Water Agencies (NACWA), with the U.S. Environmental Protection Agency (EPA), developed a process to help wastewater utilities identify and prioritize their management needs.

OF THE NINE EUM ATTRIBUTES, FOUR CAN BE **DIRECTLY ADDRESSED** THROUGH ESPC:

Infrastructure Stability. EUM

In an ESPC project, critical infrastructure is upgraded at the lowest lifecycle cost. The ESCO considers initial cost, long-term utility costs, and recurrent O&M costs in its financial evaluation with considerations for acceptable risk, anticipated growth, and system reliability. Equipment is maintained long-term based on standardized maintenance and warranty-protection protocols to sustain performance.

Financial Viability. EUM

As an alternative funding approach, ESPC removes the backlog of many capital budget needs enabling those funds to support other operations. Investing in infrastructure without capital expenditures reduces or eliminates the need to turn to other funding sources (such as increased taxes) for such improvements and reduces the impact of future utility cost increases. Efficiency improvements can increase capacity and offset future capital needs. Improvements can be designed to increase gas production and generate electricity from waste, maximizing the value of waste streams and minimizing the environmental impact.

Operational Optimization. EUM

An ESPC project provides sustainable performance improvements that minimize energy and water use, loss and impacts from day-to-day operations.

Operational Resiliency. EUM

By optimizing energy efficiency, an ESPC project's modern equipment, improved systems and automated controls help to proactively minimize long-term business risks (financial, environmental, safety, security and natural disaster-related risks). ESPC projects have many potential environmental benefits depending on the project scope, such as reduced air and water pollution, conversion of waste to energy and reduced water use.

ESPC PROVIDES **ANCILLARY BENEFITS** FOR THE REMAINING FIVE EUM ATTRIBUTES:

Product Quality. EUM

ESPC can provide equipment and systemwide solutions to help the WRRF meet regulatory and reliability requirements in its process to provide treated effluent, potable water, and process residuals.

Customer Satisfaction. EUM

Diverting financial waste streams to pay for facility improvements helps to keep rate or tax increases at bay. Improved operations also help WRRFs remain responsive to customer needs or emergencies.

Water Resource Adequacy. EUM

ESPC improvement measures can monitor and control processes to detect and control leaks to conserve water usage and reduce treatment needs.

Employee and Leadership Development. EUM

A comprehensive ESPC project potentially provides the opportunity for the WRRF to be an environmental leader in the community by leading by example. For employee development, an ESCO can conduct a training program for maintenance staff and help establish a preventive maintenance program to engage staff in effective long-term maintenance.

Community Sustainability. EUM

ESPC can address cost-effective approaches to expand plant capacity for long-term community needs.

CHAPTER 3. ESPC Opportunities and Successes

Significant cost savings are possible in the highly energy-intensive wastewater sector. This chapter highlights cost-saving opportunities often included in ESPC projects for water resource recovery facilities (WRRFs) and includes real-world ESPC project successes that demonstrate the diversity of facility goals and effective and reliable WRRF solutions.

An ESPC project optimizes efficiencies throughout the wastewater treatment operation and captures cost savings across the board - in utility budgets for energy and water savings, in operations budgets for maintenance savings, and in capital equipment budgets by offsetting related future expenditures and bringing in new revenues. Combined cost savings pay for a comprehensive ESPC project to upgrade aging infrastructure, meet compliance requirements, improve the bottom line, increase environmental performance and help facilities plan for future needs.

Opportunities for Savings in WRRFs

The project examples in this chapter illustrate how ESPC projects can address many different systems to capture combined benefits. Numerous equipment replacements, system upgrades and plant-wide facility improvements are proven to reliably deliver savings while achieving or exceeding performance targets. Some specific system and equipment improvements are highlighted below.

- Aeration Systems
- Pumping Systems
- Supervisory Control Data Acquisition (SCADA) Controls (monitoring, system automation)
- Energy Production
  - Anaerobic Digestion
  - Combined Heat and Power
  - Landfill Gas
- Biosolids Management
- Water Conservation Through Enhanced Reuse
- Building Improvements

Aeration Systems

The aeration process usually accounts for the largest energy use at the facility, exceeding 50 percent, followed by pumping operations at 10-15 percent.[9] Due to oversized equipment, inefficient operation, or lack of controls, the amount of air delivered to the aeration basins is usually much more than required for adequate mixing and biological activity. Highly aerated sewage may lead to biosolids settling problems and solids carryover into the plant effluent. Further, compressing excess air wastes energy. Low-risk proven technologies can increase oxygen transfer efficiency to more effectively aerate wastewater with aeration system controls, more efficient aeration equipment, advanced controls with dissolved oxygen (DO) or ammonia sensors, high-efficiency blowers and conversion from coarse-bubble or mechanical aeration to a fine-bubble diffuser system.

Pumping Systems

As the second most energy-intensive system in WRRFs, responsible for 10-15 percent of a facility's energy consumption, pumping systems offer an opportunity for substantial energy savings. Cost-saving measures include: right-sizing the pump and motor (matching the pump and motor to requirements by replacing inefficient pumps and trimming impellers of over-sized pumps), upgrading efficiency of pumps and motors, optimizing distribution piping, eliminating unnecessary valves, installing variable frequency drives (VFDs) to control pump speed as needed, and institutionalizing improved O&M practices through regular preventive inspection and maintenance. Care must be used to assure that the design capacity of wastewater treatment systems is maintained to avoid potential permit compliance issues.

Supervisory Control Data Acquisition (SCADA) Controls (monitoring, system automation)

Replacing the Supervisory Control and Data Acquisition (SCADA) system, the most common type of control automation for wastewater systems, can provide electricity savings of 12 to 30 percent.[10] It also achieves operational cost savings, improved service and longer equipment life. It is important to avoid double-counting of savings if savings are attributed to better control of aeration blowers or better control of pumping.

Energy Production

In recent years, a growing number of utilities have moved from strict wastewater treatment to water resource management. Wastewater coming into a plant generally contains five times the amount of energy needed to treat it[11] -- energy that can be used to convert a wastewater plant into an energy generation facility. Energy efficiency in equipment, processes, and operations is the first step of this transition. Facilities can expand this energy efficiency foundation with resource recovery measures to move closer to sustainable wastewater infrastructure. ESPC's comprehensive approach to facility improvements coupled with long-term savings can enable that goal in several ways:

ANAEROBIC DIGESTION

A by-product of the anaerobic digestion process is methane biogas that, when cleaned, can be used like natural gas. In addition, the de-watered biosolid residuals can be used as a soil amendment. Anaerobic digesters with excess treatment capacity can accept and process additional biosolids and organic wastes, including food waste, to further increase biogas production. Anaerobic digestion generates green energy from waste, reduces the volume of waste disposed in landfills, and reduces greenhouse gas emissions. It maximizes biogas production, significantly increases electricity generation potential and minimizes the environmental impact of waste. The biogas can be used in a number of ways: combusted for combined heat and power (CHP), cleaned to pipeline quality and sold to pipeline companies, and/or cleaned and compressed for use as compressed natural gas to fuel vehicles. While sale of biogas is rare, it would likely get the spot price for natural gas, and depending on where the WRRF is located, possibly a subsidy for biogas production and/or some form of renewable energy credit.

COMBINED HEAT AND POWER (CHP, CO-GENERATION)

CHP is ideally suited for a WRRF where biogas is available from anaerobic biosolids digestion. Anaerobic biosolids digesters produce methane biogas that can be combusted to generate electricity, producing power onsite and reducing the need to purchase electricity for plant operations. Heat from the exhaust can be recovered and used in plant processes such as digester heating, sludge drying or other process needs. If available, onsite natural gas can be purchased and used to supplement biogas or used as the primary fuel to generate power. Excess electricity could be offered for sale to the electric utility. Site-specific project economics need to be carefully evaluated.

LANDFILL GAS

Where a landfill is located near a WRRF, methane can be harvested from the landfill and used in the WRRF's CHP process described above. This arrangement also reduces greenhouse gas emissions from the landfill by 60 to 90 percent.[12]

Biosolids Management

The water content in digested biosolids has a direct impact on the cost of hauling, landfilling, composting or pelletizing processes. Biosolids are typically diverted to a dewatering facility to reduce water content, which reduces volume and the related hauling cost. Determining efficient dewatering technologies, such as centrifuges, belt filter processes, or dryers/pelletizers depends on the plant size, volume and characteristics of the biosolids, regional disposal costs, and other operating factors. Recovering waste heat to dry sludge will lower operating costs for biosolids management.

Water Conservation Through Enhanced Reuse

Maximizing the use of "plant water" or final effluent in place of purchased "clean water" for treatment and plant purposes can reduce operating expenses. An ESPC project can include a water use audit that evaluates all water uses for tasks, such as system washdown and line flushings, to find opportunities to reduce water cost expenses. Projects can include a recycled water system such that treated wastewater is reused to water city parks and golf courses, irrigate agricultural land, and augment onsite cooling processes.

Building Improvements

While not as energy intensive as wastewater treatment processes, onsite buildings also have energy savings opportunities. ESPC projects can include building improvements as part of a comprehensive approach to manage utility costs and modernize all facilities, including lighting upgrades, HVAC upgrades, energy management controls, and other improvements.

O&M Cost-Saving Opportunities in Plants

- Reduced chemical use
- Reduced biosolids transportation costs
- Reduced tipping fees

New Plant Revenue Sources

- Sales of excess energy generated
- Fees for processing waste from new sources
- Fees from accepting additional landfill waste

ESPC OPPORTUNITY

Energy use in wastewater systems is expected to increase by up to 20 percent in the coming decades. Deferred maintenance needs reaching $271B and rising energy use for the foreseeable future offer an upgrade opportunity.

A comprehensive facility retrofit can reach energy savings of 50 percent.

ESPC Project Successes

The examples of ESPC project successes in WRRFs demonstrate the diversity in facility management priorities and effective comprehensive solutions. They also represent a range of facility types and sizes.

Product Quality. EUM

Aging infrastructure and increasingly stringent environmental requirements can lead to regulatory compliance issues. Several of the WRRFs were in critical need of upgrades to remain compliant or to meet anticipated future compliance requirements. ESPC provided a solution for system improvements to reduce the risk of plant failure and compliance violations.

- **Riverbank, California**'s ESPC project includes improved water production quality designed to meet expected future requirements of the State Water Quality Board. (See page 18)
- The **City of Fort Worth**'s ESPC project helped the city comply with Texas Emission Reduction Plan mandates by shrinking the facility's carbon footprint. (See page 11)
- **Rome, New York**'s operational upgrades make it easier for the plant to meet NPDES discharge permit requirements. (See page 16)

Infrastructure Stability. EUM

The project examples show a wide variety of infrastructure improvements. ESPC proves to be a viable option for small facilities as well, as the following examples demonstrate.

- **City of Rome, New York**, with a population of 35,000. (See page 16)
- **Riverbank, California**, with a population of 23,000. (See page 18)
- **Hutchinson, Minnesota**, with a population of 14,000. (See page 19)

Financial Viability. EUM

ESPC projects reduce the demand on capital budgets. Some facilities avoided ratepayer increases that otherwise would be required to pay for improvements. Some projects were bottom-line driven with a focus to increase revenues.

- The **Back River Wastewater Treatment Plant in Baltimore** used ESPC to benefit the city's bottom line, avoiding drawing down the capital budget and creating jobs for contractors. The facility reduced utility bills as a hedge against future rising utility costs. (See page 13)
- The **City of Rome, New York**, has an Economic Development Plan to attract new businesses to the City. The plan's prime objective is to expand the plant's capacity, thus enabling the facility to accept added waste and associated revenue. (See page 16)
- In **Fort Worth**'s project, excess power is produced to generate new revenues for the city. The city paid for the project through the ESPC's guaranteed savings without raising taxes or tapping the city's capital reserves. (See page 11)
- The **Opequon Water Reclamation Facility** brought in $630,000 in new revenues from tipping fees by accepting organic waste. It also reduced hauling and chemical costs by dewatering biosolids. (See page 12)

Operational Resiliency. EUM

ESPC projects achieve many environmental benefits that can include reducing fossil fuel use, reducing air and water pollution, reducing chemical use in treatment processes, reducing greenhouse gas emissions, reducing landfill transport fuels, and generating energy from waste. WRRFs often can utilize renewable energy cost-effectively and have land area to more easily site large solar arrays or wind turbines.

- **Kailua Wastewater Treatment Plant in Honolulu** reduced noise and odors as well as air and water pollution from its operations as a result of its ESPC project. It also installed a solar electric photovoltaic system. (See page 14)
- The **Opequon Water Reclamation Facility** reduced levels of chemical use. (See page 12)

WRRFs have a unique opportunity to generate their own energy by harvesting biogas from biosolids processing, then using heat produced by energy generation to offset digester heating requirements. In plants that already have anaerobic digesters and are flaring gas, a co-generation system is a particularly effective solution. Onsite energy generation provides the added benefit of energy security in the event of a power outage. The system also reduces air pollution and greenhouse gas emissions while reducing concerns about rising utility budgets. (See Energy Production above for more detail on systems.)

- **Alexandria Renew Enterprises**' project redirected digester gas to the pasteurization flare, reducing natural gas costs. (See page 15)
- The **Opequon Water Reclamation Facility** produced methane gas from anaerobic co-digestion to generate more than 50 percent of the plant's electrical needs. (See page 12)

Increasingly, WRRFs are becoming zero net energy (ZNE) facilities, producing enough renewable energy to meet their own annual energy requirements. Facilities first implement cost-effective energy efficiency measures to reduce energy needs. WRRFs can convert waste to energy, utilizing waste as a valuable natural resource and reducing waste transport costs. Facilities then install renewable energy systems. Long-term advantages of ZNE facilities include: lower O&M costs, lower energy costs, resiliency to power outages and natural disasters and improved energy security.

- **Fort Worth**'s project generates power from digested gas and will reduce the facility's carbon footprint by 20,000 metric tons of CO_2 equivalent per year and electrical consumption by 39 percent, putting it on track to meet its long-term goal of becoming a Zero Net Energy Facility. (See page 11)

Community Sustainability. EUM

ESPC's comprehensive facilitywide approach for long-term performance lends itself to planning for future plant needs. Many plants need to expand capacity to meet future population demands and consider future landfill sites.

- The **City of Glens Falls, New York** increased plant effectiveness, thereby reducing the impact on the landfill. Avoided landfill costs improved the cash flow of the ESPC project. (See page 17)
- The **Back River Wastewater Treatment Plant** in Baltimore installed a co-generation system that can expand as city facilities expand. (See page 13)
- **Rome, New York's** ESPC project expanded the plant's capacity to process additional volumes of high-strength waste. (See page 16)

Village Creek Water Reclamation Plant, Fort Worth, TX

Photo source: http://www.nctcog.org/envir/stewardship/pdf/Codigestion_JerryPressley.pdf

The City of Fort Worth initiated a seventh phase of its $69 million citywide ESPC project, focusing on the Village Creek Water Reclamation Plant. A $35 million initiative in the plant reduced electrical consumption by 39 percent, helping it to move towards its long-term goal of becoming a Zero Net Energy Facility. Annual savings plus a one-time $1.3 million utility rebate fund the project without raising taxes or tapping the city's capital reserves.

Facility improvements increased digester gas production that power two 5 MW combustion turbines, and generate waste heat to power two 1000-hp steam-driven blowers. Other upgrades included a Supervisory Control and Data Acquisition (SCADA) system replacement, aeration system improvements, pump and motor upgrades, HVAC improvements, a lighting retrofit, and power factor corrections. The city far exceeded the ESCO-guaranteed annual savings of $2.6 million. In a follow-up phase, excess power will be produced to generate new revenues for the city. The project helped the city comply with the Texas Emission Reduction Plan mandates. The facility's carbon footprint shrank by 20,000 metric tons of CO2 equivalent per year.

PROJECT COST

$35 million

GUARANTEED ANNUAL SAVINGS

$2.6 million

(actual savings far exceed guaranteed savings)

SIMPLE PAYBACK

12.4 years

Financial Viability. EUM

Operational Resiliency. EUM

Product Quality. EUM

OPEQUON WATER RECLAMATION FACILITY, Frederick Winchester Service Authority (FWSA), Winchester, VA

Photo courtesy of Dennis Clough, Energy Systems Group

The Opequon Water Reclamation Facility is a 12.6 million gallon-per-day enhanced nutrient removal facility. It has very strict nitrogen and phosphorus removal requirements to help improve water quality into the Chesapeake Bay.

In the ESPC, a Green Energy Facility is now being constructed to process biosolids and up to 125,000 gallons per day of organic waste to produce methane gas through anaerobic co-digestion. The methane gas will be used to generate up to 848 kW of electricity that, at start-up, will meet more than 50 percent of the plant's electrical needs. A new biosolids dewatering process will reduce chemical use and eliminate half the bio-solids hauled to the landfill. The facility will harvest and sell phosphorus from the wastewater stream, a rare element essential for crop fertilizer.

The $47 million ESPC project creates cost savings from reduced energy and chemical use and lower landfill hauling fees. It offsets future capital costs and provides $630,000 in new revenues from tipping fees for accepting organic waste. Savings will cover the cost of the project and create a revenue stream that will stabilize rates for customers and promote existing and future economic development in the region.

PROJECT COST
$47 million

ANNUAL SAVINGS (FIRST YEAR)
$2.9 million
(including new revenues)

Financial Viability. EUM

Operational Resiliency. EUM

BACK RIVER WASTEWATER TREATMENT PLANT, Baltimore, MD

Photo source: Golden, Onion Dome Digesters by Kristian Bjornard is licensed under CC BY 2.0

The Back River Wastewater Treatment Plant in Baltimore, Maryland built a combined heat and power (CHP) plant, converting environmentally damaging waste into a high-value environmentally friendly commodity. The plant was already using anaerobic digesters to process the waste, and capturing residual methane gas to heat the digesters, but not all the gas could be utilized. Instead of flaring the remaining methane gas into the atmosphere, a CHP plant fires the gas in electricity-producing generators, provides co-generated steam to offset heating requirements for processing biosolids, and purifies any remaining gas to fuel boilers that heat facilities.

To optimize the entire wastewater treatment plant's efficiency, the ESCO replaced outdated boilers and chillers with new ones equipped to run on methane gas, installed efficient lighting equipment, and replaced inefficient electrical motors.

Utility and operational savings from this comprehensive project will pay for the entire $14 million project within 15 years (8 years if electricity costs rise as expected). The digester gas co-generation plant was projected to generate 2.4 megawatts of electricity with available methane supply, providing 20 percent of the plant's electricity needs and eliminating 12.9 million pounds of carbon emissions annually. The co-generation system can expand as city facilities expand. The ESPC project benefits the city's bottom line, did not draw down the capital budget, and is creating jobs for contractors. Lower utility bills also provide a hedge against future rising utility costs.

PROJECT COST

$14 million

ANNUAL SAVINGS

$1.8 million

(in energy and operational costs)

Financial Viability. EUM

Community Sustainability. EUM

KAILUA WASTEWATER TREATMENT PLANT, City and County of Honolulu, HI

Photo Source: https://www.kktunnel.org/2017-2/

Kailua Wastewater Treatment Plant in the City and County of Honolulu, Hawaii leveraged $638,000 in annual dollar savings from both energy efficiency and renewable energy measures to fund a $6.2 million ESPC project. Measures included:

- A 297 kW solar electric photovoltaic system represented $151,000 of the total dollar savings per year and reduces greenhouse gas emissions
- Automated controls manage flow rates to improve effluent rate and reduce over-pumping
- Compressed air optimization corrects oversizing, reduces leaks, provides greater reliability and minimizes maintenance requirements
- Biosolids pumping optimization reduces overpumping risks
- Lighting system improvements have longer-life components to reduce maintenance
- Electrical demand management enables instantaneous and continuous energy use monitoring to better balance loads between pump stations

Improvements reduced noise and odors from the plant, addressed deferred maintenance, cut operation and maintenance costs, save taxpayer dollars, and created 67 construction jobs. The plant improved air and water quality, reduced energy use by 28 percent and invested in renewable energy, helping to meet Hawaii's Clean Energy Initiative goals. The documented environmental benefits are comparable to removing 560 cars from the road.

PROJECT COST
$6.2 million

GUARANTEED ANNUAL SAVINGS
$638,000

FINANCING TERM
15 years

Operational Resiliency. **EUM**

ALEXANDRIA RENEW ENTERPRISES, Alexandria, VA

Photo source: https://alexrenew.com/

Alexandria Renew Enterprises' main wastewater treatment facility is a 54-million-gallon-per-day, high-tech treatment plant. Alexandria Renew had completed a $250 million plant upgrade and, due to rising utility costs, looked for additional energy cost-saving measures.

Natural gas fueled a pasteurization burner involved in the wastewater treatment process. The ESCO successfully redirected the digester gas to the pasteurization process burner, reducing natural gas costs. Building improvements in 780,000 square feet of facility space in 20 buildings provided additional savings through lighting system upgrades, steam trap retrofits and boiler replacements. Alexandria's electric rate structure makes it more cost-effective to use off-peak electricity rather than natural gas. By installing electric boilers, the Authority took full advantage of off-peak electric savings. Project savings totaled $267,000 in energy costs and $42,000 in non-energy costs.

The environmental benefit is substantial, removing 546 tons of greenhouse gas emissions from the atmosphere each year.

PROJECT COST

$5.9 million

ANNUAL ENERGY SAVINGS

$267,000

ANNUAL NON-ENERGY SAVINGS

$42,000

Operational Resiliency. **EUM**

CITY OF ROME, NEW YORK

Photo source: http://energyservicescoalition.org/Data/Sites/1/documents/casestudies/NY-City_of_Rome.pdf

The City of Rome, New York (population 35,000), like many small American cities, was struggling to maintain services and make critical infrastructure improvements in the wake of state and local budget cuts and a shrinking tax base. As part of its Economic Development Plan, the city was actively marketing itself to attract new businesses and keep its economy strong. The city installed $2 million of municipal building improvements through ESPC, paid for through utility bill savings. After this proven success the city turned to ESPC to modernize the wastewater treatment plant and expand its capacity.

A fine bubble aeration system replaced an inefficient, 30-year-old mechanical aeration system that handled an increasing demand for waste treatment. The new system includes energy-efficient variable-vane blowers, efficient membrane diffusers, variable frequency drives (VFDs) on low-lift pumps, and dissolved oxygen (DO) controls that efficiently automate blower output and reduce energy use. The plant can process greater volumes of high-strength waste and can more easily meet NPDES discharge permit requirements.

Upgrades of $6.6 million save more than $100,000 annually to help cover financed project costs, avoiding the need to raise taxes. The existing system would have resulted in more costs because of a long lead time for expensive custom parts and ongoing excessive energy use. The expanded capacity will attract new businesses to Rome, generating additional revenue from processing waste.

PROJECT COST
$6.6 million
(plus $2 million for the plant)

GUARANTEED SAVINGS
$8.6 million

FINANCING TERM
15 years
(Tax-Exempt Lease Purchase (TELP) agreement)

Infrastructure Stability. EUM

Financial Viability. EUM

Product Quality. EUM

Community Sustainability. EUM

CITY OF GLENS FALLS, NEW YORK

The Glens Falls wastewater treatment facility serves the city from five plants that include sewage systems, metering systems, monitoring and control of dams and water pumping stations. It also processes solid waste from outside customers. The city's objectives for the ESPC project included: upgrade and improve plant infrastructure, achieve compliance with the state's Department of Environmental Conservation, and avoid the need to raise taxes, issue a bond or add to municipal debt.

ESPC provided a way to upgrade infrastructure that achieves compliance at no added costs. The first phase involved rebuilding biosolids holding tanks, installing biosolids mixing equipment, installing belt filter presses and adding a Supervisory Control and Data Acquisition (SCADA) system with new controls. The second phase incorporated an ultraviolet channel disinfection system, an expansion of the SCADA system, a grease concentrator system and upgrades for a fuels handling station that offset fuel oil consumption in the fluidized bed incinerator. The resulting increase in biosolids increased revenues and avoided landfill costs.

PROJECT COST
$850,000

ANNUAL ELECTRICITY & FUEL OIL SAVINGS
$190,000

ANNUAL MAINTENANCE SAVINGS
$100,000

AVOIDED LANDFILL COSTS
$121,000

Community Sustainability. **EUM**

CITY OF RIVERBANK, CALIFORNIA

Photo courtesy of Darin Smallen, City of Riverbank

Riverbank, California operates a wastewater treatment facility that serves the city's 23,000 residents. The plant consists of a headworks (mechanical bar screen, screenings compactor, Parshall Flume), four mechanically aerated lagoons, and seven percolation ponds. The city selected an ESCO to provide a comprehensive solution that would lower utility costs and increase control of dissolved oxygen (DO) with the primary process. The ESCO converted the surface aeration turbine pumps to fine bubble diffusers with new aeration blowers, variable frequency drives (VFDs), a harmonic filter, silencers, filters, check valves, pressure relief valves, pressure gauges and a control panel.

Future plant needs were considered. If flows increase, the system can be incrementally upgraded with activated biosolids, clarification and disinfection to create Title-22-quality water in case the State Water Quality Board establishes that requirement.

PROJECT COST
$3.9 million

GUARANTEED ANNUAL SAVINGS
$200,000

FINANCING TERM
Municipal Lease

Infrastructure Stability. **EUM**

Product Quality. **EUM**

HUTCHINSON WASTEWATER FACILITY, Hutchinson, MN

The small city of Hutchinson, Minnesota used ESPC to upgrade its more than 3.5 million-gallon-per-day wastewater facility in addition to other government buildings. Variable frequency drives (VFDs) allow the plant's motors to run at 30 to 35 percent capacity instead of at 100 percent, saving far more than projected. Throughout all facilities, energy-efficient lighting saves the utility dollars and enhances aesthetics. Maintenance staff spend less time maintaining motors and replacing lighting equipment, and can turn their attention to other important building maintenance tasks.

PROJECT COST
$375,000

GUARANTEED ANNUAL SAVINGS
$32,000

ACTUAL ANNUAL SAVINGS
$60,000

Infrastructure Stability. **EUM**

CHAPTER 4. The Components of ESPC

ESPC can capture guaranteed cost savings to provide facility improvement projects today, without the need to use funds from capital budgets unless desired. Understanding the components that make up ESPC enables facility owners and managers to make full use of this tool. This chapter explores the role of ESCOs, covers the identification of projects and savings opportunities, discusses funding sources and financing, and explains what a savings guarantee is and how it works.

State Laws

Most states have enabling legislation for ESPC contracts that may set requirements for ESPC projects in state and local governments regarding procurement protocol, allowable measures, financing terms, structure of the guarantee, measurement and verification (M&V), and budget funding streams. Contact your State Energy Office (SEO) for information and guidance.

See Chapter 6 to locate your SEO and other resources.

Energy Service Company (ESCO)

An ESCO develops and implements performance contracts and provides the following services in a turnkey approach:

- Identifies and evaluates project opportunities
- Proposes a project with a cash flow from savings to pay for all costs
- Provides education on project financing
- Designs, installs, manages construction, and commissions the project
- Trains staff members
- Provides ongoing maintenance services (optional)
- Measures, verifies and guarantees savings
- Provides a fixed-cost project, carrying the risk and cost of change orders

This mature industry uses standardized processes and approaches with flexibility and creativity to meet ever-changing challenges and interests of owners. ESCOs differ from energy engineering firms in that they assume both the technical design risk and system performance risk and apply the financial savings guarantee. The result is large-scale, comprehensive projects with guaranteed performance. It is critical to select an ESCO with specific experience in the wastewater sector.

Candidates for ESPC Projects

The size and scope of ESPC projects are governed by facility needs, the operations savings potential, financing term, savings stream options, and the minimum project size an ESCO is willing to develop.

State and local government facilities are generally good candidates for ESPC projects. With long-term ownership of the facilities, governments typically allow for 15- to 25-year financing terms, enabling large-scale comprehensive projects.

Although ESCOs typically develop projects of $1 million or more, some ESCOs will develop smaller projects. Several different strategies can overcome the size and scope barrier to attract an ESCO. Expanding the project scope to all facilities and across multiple divisions can make a project economically viable for ESCOs. Yet another way is to incentivize ESCOs to develop projects with upfront capital, as available. Small-scale governments can consider a joint Request for Proposals (RFP) with neighboring governments that agree to select a single ESCO for each individual project, variously called bundling, pooling, or aggregating.

Facility Improvement Measures

ESPC projects can include a wide variety of facility improvement measures. The ESCO will assess the cost-benefit of each measure and present a package of measures to the owner. Together the owner and ESCO select a package of bundled measures that best meets the owner's needs and requirements.

Typical Facility Improvement Measures

The cost-saving measures generate the savings to pay for an ESPC project. This arrangement presents a unique opportunity for a comprehensive approach to address potential cost-saving improvements needed in the owner's facilities, and to capture synergies among measures.

ESPC measures often include the following equipment upgrades in buildings and grounds, along with optimized management and operational strategies. See the tip box for additional or alternative measures specific to your sector.

Equipment Upgrades

- Lighting equipment
- Boilers, chillers, HVAC equipment
- Landscape irrigation systems
- Water-saving fixtures

Budget Management and Operation Improvements

- Automation system
- Demand response technologies
- Utility rate adjustments
- Staff training programs
- Energy management services

Infrastructure Improvements

- Central plant
- Distributed generation systems
- Combined heat and power (CHP) systems
- Renewable energy systems

The complete list of potential facility improvement measures is extensive. Each facility type has additional opportunities specific to its own operations.

ESPC OPPORTUNITY

Opportunities for cost savings and revenue generation at WRRFs could include:

Equipment Upgrades or Infrastructure Improvements

- Aeration system (proper sizing, efficient operations, dedicated blowers, diffuser replacement, improved controls, system conversion)
- Pumping system (pumps, motors, variable frequency drives (VFDs), pipe coatings)
- Supervisory Control and Data Acquisition (SCADA) controls (monitoring, system automation)
- Energy production systems (anaerobic digestion, combined heat and power (CHP), hydropower, landfill gas)
- Biosolids management

Operations and Maintenance Improvements

- Reduced chemical use
- Reduced biosolids transportation costs
- Reduced tipping fees

New Revenue Generation

- Sales of excess energy generated
- Fees for processing waste from new sources
- Fees from accepting additional landfill waste

See Chapter 3 for more detail on:

- Opportunities for savings in WRRFs (potential improvements, O&M cost-saving opportunities, new revenues)
- Examples of ESPC project successes (comprehensive solutions to upgrade plants, achieve compliance and enhance revenues)

Some states, through legislation, have expanded the potential scope beyond typical facility improvements to include:

- Vehicle conversions and fueling/charging station infrastructure
- New construction, to help fund energy efficiency improvements in new facilities
- Greater percentage of operational savings
- Power purchase agreements to secure lower-rate utility costs through solar energy systems
- Waste management services
- Data Management Systems
- Revenue generation enhancements

Bundling of Measures

The ESCO will identify each potential measure and estimate the itemized costs and savings. While each measure is assessed for its own cost-effectiveness, a group of measures can be “bundled” that produce annual savings to support financial terms. The bottom line determines which bundle of measures can be included in the ESPC project. That is, the sum of annual cost savings for all measures, in addition to other funding sources that may be available, are intended to meet or exceed the annual finance payment over the allowable financing term. For example, lighting and controls projects have short payback periods which, when bundled, offset the higher payback periods of boiler and chiller replacements or renewable energy systems. Even measures that increase energy use to improve operations can be included if balanced by short-payback measures that deliver savings to offset the new cost. On the other hand, some long-payback measures may need to be cut if the overall project savings are not sufficient to offset those costs.

Chapter 3 presents project examples demonstrating the types of measures that, when bundled together, deliver savings to support the total ESPC project cost.

Funding Sources

Measures deliver savings (avoided costs) in various itemized budgets such as utilities, O&M, and capital. Budget savings streams are funding sources used to pay for projects. All funding sources should be considered to leverage the savings for optimum value.

Budget Savings Streams

Those savings to be re-directed may come from several government budget categories. State statutes often specify budgets that can be applied to ESPC financing, such as:

Utility budget

- Gas, electricity, steam, chilled water, etc.
- Water and sewer savings

Operations budget

Budgeted products or services that will not be needed after installation such as replacement parts and outmoded maintenance contracts on replaced equipment

Personnel budget

Funds made available by eliminating a staff position that will not be needed after installation. This is rarely used because displaced staff members are usually reassigned rather than terminated.

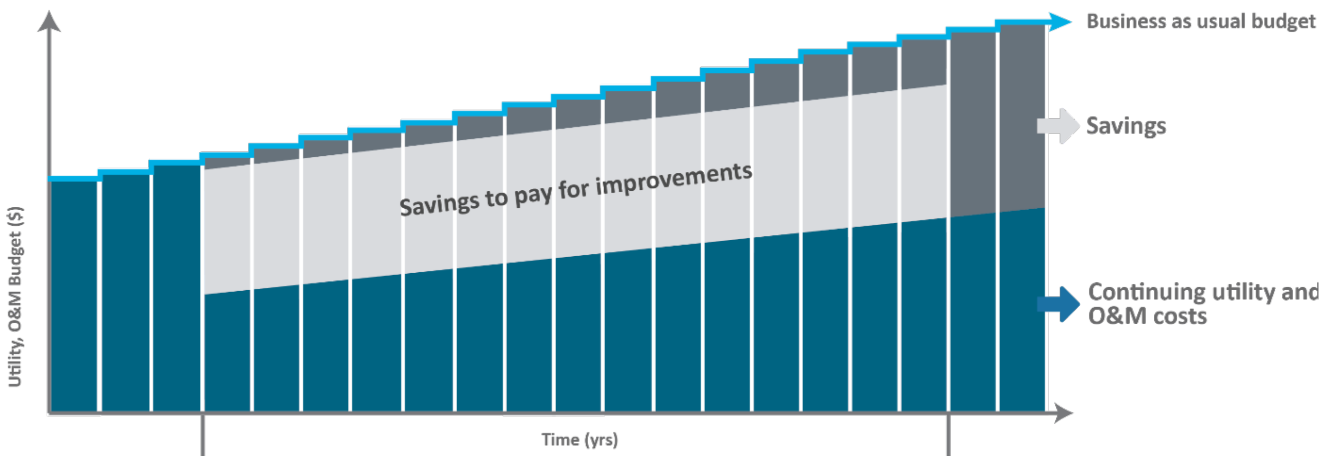
Capital budget

- First-year capital infusion to buydown the cost of the project
- Future capital avoidance, e.g., when capital improvement funds are scheduled for future equipment replacements that can instead be folded into the ESPC project

Cash Flow

Figure 3, below, illustrates the typical cash flow scenario throughout the life of an ESPC project. The dark blue segments show the true utility and operation and maintenance (O&M) costs before and after the retrofits. The light grey block shows the money no longer needed [avoided costs or what are referred to as project savings] that pays for the project over the financing term. The dark grey segments show the savings that continue after the owner finishes paying for the ESPC project, through the remaining useful life of the equipment.

Figure 3: ESPC Cash Flow



Leveraging Funds

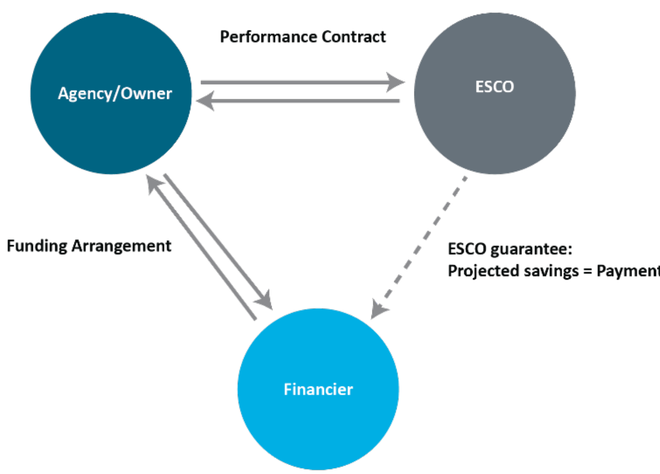
An ESPC project is often structured to be self-funding through projected guaranteed savings. However, other funding sources can augment the savings streams to expand the project scope. For example, internal funding, utility rebates, grants, emissions reduction credits, tax credits, or other funding sources may be used as a project buy-down.

Financing

Figure 4 displays the contractual arrangements between the ESCO, the facility owner, and the financing institution (financier). The facility owner has a performance contract with the ESCO and a separate contract with a financing company. The financier relies on the ESCO's guarantee as a backstop to ensure payment from a creditworthy owner. The guaranteed projected savings are intended to exceed the annual financing payment each year. Via the guarantee, the ESCO bears the financial risk as a backstop to the owner for the financial obligation and performance risk it undertakes to construct the project. In the event of a shortfall in actual savings in any year, the ESCO, through the terms of the critical savings guarantee in the contract, pays the owner the difference.

The ESCO can educate the owner about the financing arrangement. Recent federal regulations prohibit the ESCO from participating in an advisory role, unless they are registered as a municipal advisor in the state in which they are operating. The ESCO typically does not provide project financing for governments, as governments can usually obtain better financing terms from financiers directly.

Figure 4: Two-Contract Agreements



Financing Mechanisms

One of the most common financing mechanisms for a government ESPC project is a Tax-Exempt Lease Purchase (TELP) agreement. A number of national-level financing companies are knowledgeable about the ESPC approach and offer such financing. (See Chapter 6 for resources.)

Owners can also consider internal financing or bonds and can compare the rates and benefits of different options. In addition to traditional bond types, there are also special energy efficiency and renewable energy bonds which might apply:

- The DOE Better Buildings Financing Navigator can help you identify financing mechanisms to consider. See https://betterbuildingssolutioncenter.energy.gov/financing-navigator
- State, local and tribal governments may issue Qualified Energy Conservation Bonds (QECBs) to finance energy conservation projects. See http://energy.gov/savings/qualified-energy-conservation-bonds-qecbs
- Public power utilities, electric cooperatives, government entities (states, cities, counties, territories, Indian tribal governments), and certain lenders may issue Clean Renewable Energy Bonds (CREBs) to finance renewable energy projects. See http://energy.gov/eere/slsc/new-clean-renewable-energy-bonds

Financing – Minimum Amounts

The minimum project cost is dependent on what the ESCO and financing companies will consider. ESPC projects typically range in the millions of dollars, however some ESCOs are willing to do smaller-scale projects. Financing companies have a minimum threshold for Tax-Exempt Lease Purchase (TELP) financing (often $500,000 or more). This minimum financing amount can vary regionally and with the national economic climate, so ask firms that specialize in financing ESPC projects about their minimum financing level for your area. Local commercial banks can be an option, especially for smaller amounts, and may provide competitive financing.

Financing Term

Most states have enabling legislation for ESPC projects that provides for multi-year financing in state and local governments. The maximum financing term for an ESPC project is defined by several key factors:

- Legislation in most states allows a financing term of 15-25 years
- The financing term should not exceed the average useful life of the equipment
- Financial institutions set the maximum finance term based on the project value and risk

Debt Consideration

TELP financing is structured to be paid from projected savings in annual utility and operating budgets. Those budgets are annually renewable and subject to annual appropriations, so the payment obligations may not be considered debt and may not impact your debt ceiling according to state statutes and rulings.

Guarantee of Projected Cost Savings

Projected annual cost savings are guaranteed to meet or exceed the annual financing obligation, as set forth in the ESPC contract and financing agreement. If projected annual cost savings do not meet the guaranteed amount in any year, the ESCO will make up the cost difference.

In most states, statutes establish the minimum guarantee period. The guarantee is often required for each year of the financing term; however, some states have set a lower requirement of the first three years of demonstrated performance. Contact your SEO about requirements in your state. (See Chapter 6)

To arrive at the guarantee of savings, the ESCO first establishes a baseline year of unit utility use (kWh of electricity, therms of natural gas, gallons of water, etc.). Then the ESCO estimates unit savings compared to the baseline. Estimates are based on standardized engineering calculations, equipment specifications and measurements or computer models, assuming a typical weather year and consistent facility operations. The ESCO sets forth a conservative guarantee of savings, typically 85 percent or more of expected unit savings.

The approach to establish the guaranteed energy savings varies as required by state statutes (for government facilities), state ESPC programs or ESCO practices. A common approach is for the ESCO to project annual cost savings based on unit savings. For the first year, current utility rates establish cost savings. For future years, the ESCO applies an agreed-upon escalation rate to forecast cost savings. The escalated unit rates, whether higher or lower than the actual unit rates for the specified year, determine the guaranteed cost savings. Actual future utility and inflation rates may differ from the forecasts. The ESCO is not at risk if actual future rates are lower and does not benefit if actual future rates are higher.

A process to measure and verify savings is needed to determine if the guarantee is met each year, as described below. Technical assistance can be very helpful in assessing and negotiating the performance guarantee. (See Chapter 6 for technical assistance options.)

Measurement and Verification (M&V)

A rigorous measurement and verification (M&V) process is critical to validate savings and is a typical best practice to ensure a successful ESPC. The International Performance Measurement and Verification Protocol (IPMVP) is a standardized approach to measure and verify savings of ESPC projects. It provides four options for measuring performance, with varying levels of cost and accuracy to apply to different types of measures. The Federal Energy Management Program (FEMP) of the U.S. Department of Energy (DOE) also offers a practical guide, often used by states, to applying IPMVP protocols in projects, entitled M&V Guidelines: Measurement and Verification for Performance-Based Contracts.[13]

The ESCO will develop an M&V plan to establish the protocol for determining actual savings. Each year that a guarantee is required, the ESCO will verify performance with respect to the M&V plan and deliver an annual M&V report. If guaranteed savings are not achieved, the ESCO will pay for the deficiency as guaranteed in the contract.

A measurement or calculation process is preferred over stipulated (agreed to in advance) savings for all measures. Basing reported savings on actual measured results ensures the ESCO bears the risk of performance.

The M&V plan should be prepared by a Certified Measurement & Verification Professional (CMVP). A technical consultant can provide independent, third-party review of the M&V plan, contract documentation, and annual M&V reports.

See Chapter 6 for technical assistance options.

Annual Budgeting

Annual finance payments are paid out of annually appropriated utility and operating budgets. Several cost drivers impact your actual budget from year to year, such as atypical weather, changes in facility operating hours and scheduling facility upgrades, unexpected changes in utility rates and changes in facility use. These are outside of the ESCO's control and budget appropriations will be impacted and managed as usual.

Mitigating Risks

It is important to understand and mitigate potential risks when negotiating the ESPC contract. Risks fall into three general categories: financial, operational, and equipment performance.

You can mitigate risks in several ways:

- Contact your State Energy Office (SEO) or other state entity responsible for ESPC for technical assistance. Some state ESPC programs maintain a pre-qualified list of ESCOs.
- Use standardized procurement and contracting documents

- Hire a project facilitator (some states provide a list of pre-qualified firms)
- Clearly state project plans, financial performance, expectations, and roles and responsibilities in contract documents
- Use the Risk, Responsibility and Performance Matrix to help assess risks you and the ESCO would carry (See Chapter 6, Tools).
- Require a detailed M&V plan before executing the contract, including clearly defined M&V procedures
- Establish consensus of the financial arrangement and contract requirements by finance, facilities and administrative personnel
- Identify a project champion on staff to shepherd project and track and monitor project results

CHAPTER 5. The ESPC Process

ESPC can be a straightforward process. This chapter outlines the ESPC process used by many state and local governments since the mid-1990s. The exact steps may vary by state, but most states have enabling legislation that prescribes the procurement, contracting and financing process for state agencies, higher education institutions, public school districts and local governments.

The ESPC PROCESS	**STEP 1** Decide if Energy Savings Performance Contracting (ESPC) is a good solution for you	**STEP 2** Select an energy service company (ESCO)
STEP 3 Assess cost-saving opportunities through an Investment Grade Audit (IGA)	**STEP 4** Execute an Energy Savings Performance Contract and financing agreement	**STEP 5** Verify savings and enjoy the benefits

See Chapter 6 for more resources and guidance to help you get started.

STEP 1: Decide if Energy Savings Performance Contracting (ESPC) is a good solution for you

The first step is to consider how a performance contract would work for you. Review your facility needs, current staff capabilities, and the potential to make cost-saving facility improvements. Set goals and gain internal consensus to pursue ESPC. Get to the “go” decision.

Find resources that may be available in your state. Contact your State Energy Office (SEO) to learn about resources or technical assistance that may be available. See Chapter 6.

Check requirements in your state. State statutes establish ESPC requirements by sector. Contact your SEO for details. See Chapter 6.

Learn more about ESPC. Gather enough information about performance contracting to articulate how

Is ESPC a Good Fit For You?

Do you spend more than $60,000 a year on utility bills? If so, an energy savings performance contract may work for you. It is likely to benefit you if you have:

- Aging equipment and outdated systems
- Recurring maintenance problems or operational issues
- High maintenance costs
- Scarce budget resources
- Limited energy management expertise
- Too many demands on your facilities and maintenance staff

ESPC works to decision-makers and other potential champions within your organization. There may be assistance available to help you get started via the following:

- **Chapter 6** in this document.
- **ESPC State and Local Solutions Center:** https://energy.gov/eere/slsc/energy-savings-performance-contracting
- **Energy Services Coalition (ESC) Resources:** http://energyservicescoalition.org/performance-contracting

IIdentify a champion. Identify a champion inside your organization who understands the benefits of ESPC and can help gain consensus. You may be the champion, but it will be invaluable to gather allies that can help you advance the ESPC process within your organization. You can find a set of resources to help you build a successful network of ESPC project champions in the Department of Energy's ESPC Toolkit.

Determine if your facilities are good candidates for a performance contract. Your ability to use ESPC depends on whether there are significant energy, water and O&M savings opportunities. ESCOs vary in the minimum size of projects they will take on. A simple rule of thumb is that you may have potential for a performance contract if combined energy and water utility bills are greater than $60,000 per year. Preliminary discussions with local ESCOs will help you answer this question for your area.

Assemble a project team. Put together a project team within your organization to explore the possibility of a performance contract and to later usher it through. The project team—ideally led by a champion—has a common understanding of the ESPC process, its risks, costs, challenges and benefits. Include facilities staff as well as financial, legal, and procurement staff at the onset.

Set goals. Think big! ESPC projects can be broad in scope and scale with a variety of measures that deliver energy, water and operational savings.

Get buy-in. Internal consensus and buy-in are critical for the success of an ESPC project. The project team makes a consensus-based decision to proceed with ESPC, while key decision-makers and influencers agree to support the success of an ESPC project. Diverse goals may lead to the same solution. For example: The chief financial officer wants ways to fund the backlog of facility needs. Top decision-makers want to use limited budget dollars for maximum benefit to the organization and stakeholders. A city may have a policy to demonstrate sustainability or a specific target to reduce energy efficiency. Facility staff may be more interested in improved equipment and operations. ESPC provides a potential solution to meet all these needs. You can find a set of resources to help you build a successful network of support for energy savings performance contracting in DOE's ESPC Toolkit.

ESPC SUCCESS TIP

Include your WRRF engineers and operations staff on the ESPC team at the outset. They can offer critical insights to help identify additional opportunities for savings. It may also be valuable to include your local environmental regulating agency representative.

STEP 2: Select an ESCO

An ESCO will be your partner for a long time, so it is important to select one that shares your vision and is capable of meeting your needs. A Request for Proposals (RFP) is an excellent way to identify interested ESCOs and compare approaches.

Get assistance. Many states have procurement assistance or pre-qualified ESCOs to streamline your solicitation process and provide peace of mind. (See Chapter 6 for resources and technical assistance.)

Review the model RFP. Working with your procurement department, review the model RFP and evaluation protocol to customize for your project. Note the unique differences for this type of procurement: 1) Because an ESCO solicitation is largely qualifications-based, it is premature to expect a cost proposal at this stage. An ESCO can provide cost markups for each category and the cost to conduct the IGA. 2) An ESPC scope of work is not developed before the RFP. The successful respondent will both develop the scope of work and perform that work. 3) It is important to ask for documentation of specific experience with the unique wastewater sector.

What can an ESCO do for me?

- Identify and evaluate energy, water and operational savings opportunities
- Provide engineering services from design to equipment specifications
- Act as the prime contractor constructing a wide variety of projects
- Provide long-term energy management and maintenance services as desired
- Educate staff about financing, identify financial incentives and help bring in a financial partner
- Guarantee performance through efficiency savings

Define the Scope. List the improvement needs in your facility. This leads to the economy of scale to achieve the best value from your ESPC project. Prioritize the list to identify the greatest needs. Once you select your ESCO, you can work together to determine a specific plan of approach.

Develop a facility profile. Include a facility profile in your RFP to help the ESCO grasp the potential opportunity for ESPC. Describe the facility condition, maintenance problems, and any planned equipment replacement or renovation plans. Include utility bill history for at least the past year.

Specify your needs and goals. List any specific projects or issues you would like the ESCO to consider. These could include: replace failing equipment, fund planned replacements, meet efficiency targets, overcome maintenance problems, improve operations, achieve deep retrofits to optimize efficiency, and ensure minimal disruption of operations during construction. List any environmental regulations that apply and any special considerations. Project needs are not intended to be prescriptive, but will help direct the ESCO to identify cost-saving strategies.

Solicit ESCOs. Invite ESCOs to participate. Visit the following resources to find a list of service providers:

- Your State Energy Office (SEO): http://naseo.org/members-states
- Energy Services Coalition (ESC): http://energyservicescoalition.org/members
- National Association of Energy Service Companies (NAESCO): http://www.naesco.org/members-escos
- DOE's Qualified List of Energy Service Companies (ESCOs): http://energy.gov/eere/downloads/department-energy-qualified-list-energy-service-companies

ESPC SUCCESS TIP

Based on best practices from state and local governments, consider requesting the following detail in an ESCO solicitation:

- A description of company experience providing ESPC services for WRRFs, including auditing, design, project management, and follow-up monitoring.
- Resumes for staff to be assigned to the project, including experience, expertise and certifications for work with WRRFs and a description of each person's role in the project.
- A project list and case studies for WRRF projects.
- Environmental engineering partners that the ESCO will work with on improvement measures related to the wastewater treatment process.
- Also request that the ESCO answer the following:
- How will the guarantee be structured to ensure the facility continues to meet permitting requirements and environmental regulations?
- What risk will be apportioned by each party regarding permitting and environmental regulations?
- What types of measures has the ESCO installed in WRRFs? These may include non-ESPC projects, if clearly noted. Address each of the following: (See list in Step 3).
  - What types of measures may be applicable to this facility?
  - What measurement and verification (M&V) protocols would you apply for each measure to ensure savings are met?
  - How is the cost of auditing the facility determined?

Invite ESCOs to tour the facility. Interested ESCOs will want to visit your facility and interview facility staff before preparing their proposals. Schedule a site visit for all interested ESCOs to attend at the same time. To maintain a level playing field, ensure that all attendees hear all responses. Restrict the site visit to a few hours, making sure there is sufficient time to see critical facilities and operations. The RFP response will not result in a preliminary audit so extended access to facilities and staff does not need to be granted at this time.

Evaluate proposals and select your ESCO. Evaluate the qualifications of each ESCO for the skills, expertise and experience you need, particularly specific experience in this unique sector. Review the cost markups based on reasonableness. Use a quantitative and qualitative approach - assign specific point values to each scoring criterion and provide qualitative descriptions that support the point value. Interview the top contenders to better evaluate their approach and their ability to work with you. Notify the top-ranked ESCO and begin negotiations.

STEP 3: Assess cost-saving opportunities through an Investment Grade Audit

Your ESCO will perform an investment grade audit (IGA) that identifies cost-saving opportunities and evaluates their potential. This provides you with critical information to later negotiate your ESPC and implement the project. Based on results of the IGA, the ESCO will prepare a project development agreement proposing a package of measures to include in the project.

Get technical assistance. It is valuable to have expert assistance at this stage to review the ESCO's analysis of costs, cost savings and M&V approaches. (See Chapter 6 for resources and ways to obtain technical assistance.)

Set aside interim funds for the IGA. The cost of the IGA can ultimately be rolled into your ESPC, so that the guaranteed savings pay for the IGA. However, if you choose not to sign a performance contract after the IGA is performed, you will still be responsible for paying for the audit, so it is critical to have funds set aside in advance. You do not pay for the audit if the ESCO is unable to identify a package of measures that can be paid from projected savings given the criteria you established.

Negotiate an IGA and project development agreement with your ESCO. Establish your criteria for the audit. Typically defined in legislation, these criteria include the maximum financing term and budget categories that can be used as savings (energy, operations, personnel, etc.).

Bundling Measures:

Combined savings from bundled measures pay for the total cost.

- **Controls:** Install a new energy management control system to improve operational strategies
- **Lighting:** Replace lamps and ballasts or entire fixtures
- **Process Improvement:** Install variable frequency drives (VFDs) or replace pump motors
- **Renewables:** Wind, and solar PV can be included as well, when cost-effective in the bundled package
- **Operations:** Make a variety of improvements in operation and maintenance

Measures that typically have short payback periods, such as lighting and controls improvements, offset the higher payback periods of other measures when bundled together. This results in a comprehensive approach to optimize system performance and cost-effectiveness. See Chapter 2 for more discussion.

ESPC SUCCESS TIP

It is critical to select an ESCO with specific experience in the WRRF sector including auditing, design, project management, implementation and follow-up monitoring. The ESCO should understand the operating budget of municipal utilities to determine where savings can be achieved and how to redirect those savings into investments in the WRRF systems. Requests for documented experience can be included in the project Request for Proposals (RFP).

Execute the contract. Host a kickoff meeting with your ESCO to reinforce goals, discuss facility operations and needs and set the schedule and next steps.

Approve the baseline. The last one to three years of utility bills provide a pattern of your facility's energy and water use, given the operations, schedules and weather impacts. The ESCO establishes a baseline to represent the energy use before the ESPC. This is the basis for establishing ESPC savings. It is important to review and approve the ESCO's assumptions.

Take an active role in the process. Make facilities staff available to provide facility access and share operational details. Hold regular meetings with your ESCO to discuss preliminary findings and reinforce your goals.

Review the IGA results. Review the technical and cost details presented in the IGA and discuss the suggested improvements with your ESCO. Your ESCO will recommend a set of measures that optimizes cost-effectiveness and benefits.

Ensure savings can be measured and verified. A Measurement & Verification (M&V) plan provides the protocols for determining savings. Discuss and negotiate the reasonable level of M&V services to provide for each measure. Avoid stipulated (pre-agreed) savings in favor of a measurement approach where feasible and cost-effective.

Assess the risks. Discuss what financial and performance risks you take on and which are taken on by the ESCO. The risk matrix developed by DOE's Federal Energy Management Program (FEMP) provides a good basis for this discussion. Also approve an acceptable price escalation rate using a FEMP tool for ESPCs based on projections of the U.S. Energy Information Administration (EIA). FEMP provides an energy escalation-rate calculator using National Institute of Standards & Technology (NIST) projections to determine a reasonable escalation rate for the term of the project. (See Chapter 4. Mitigating Risks. See Chapter 6, Tools)

Consider the Project Proposal. The ESCO will present a financial pro forma, or cash flow analysis, of a proposed ESPC project. It includes a list of potential measures along with the cost and annual savings. The ESCO presents a bundle of measures that will deliver cost savings sufficient to repay the annual finance payments over the financing term. The projections include an escalation rate for future utility rates and other costs as well as the interest rate for financing. It shows the annual guaranteed savings versus the annual finance payment. This is the basis for negotiating the subsequent performance contract to install and implement the measures.

STEP 4: Execute the ESPC Contract and Financing Agreement

An ESPC contract is your roadmap for implementing and tracking the project over the long term. It should clearly define roles and responsibilities and explicitly state how savings are determined and how the guarantee will be applied.

Get technical assistance. It is valuable to have independent third-party review to help negotiate an effective ESPC. (See Chapter 6 for resources and technical assistance.)

Negotiate the scope and terms of the contract. Fully review and discuss the contract. Make sure the ESCO fully documents the schedules that define roles, responsibilities, construction schedule, training from the ESCO, equipment to be installed, equipment warranties, and the structure of the guarantee and how savings will be verified. Get input from your engineering, financial and legal staff. Negotiate costs and ask for open-book pricing to ensure that you receive good value. Consider the impact of escalation rates to estimate future cost savings.

Negotiate a guarantee to meet your needs. The guarantee is the cornerstone of an ESPC. Projected savings are guaranteed and structured to cover the annual financing payment. The ESCO pays any remaining balance if projected annual savings levels are not reached.

Arrange financing. Work with your financial officer to determine the best funding or financing strategy, with educational support from your ESCO. A common option for governments is a Tax-Exempt Lease Purchase (TELP) agreement. Leverage grants, utility rebates, and in-house funds to maximize your project scope and reap more benefits. Competitively select a financing company.

Review maintenance requirements and services. An ESCO often requires routine maintenance on new equipment to guarantee performance or savings. Additional services can include reviewing operation strategies, reporting on equipment operating problems, and repairing and replacing equipment.

Execute the contract. The ESPC and financing agreement are signed at the same time.

Oversee construction. Meet regularly with your ESCO to discuss the schedule and approve next steps.

Manage the escrow account. Set up and manage an escrow account that enables drawdown payments to the ESCO during the construction period.

ESPC SUCCESS TIP

Due diligence is critical. Review the contract to ensure it explains how the new systems sustain the ability to meet environmental regulations and permitting criteria. Involve your professional team, including any consultants, to review and approve contract terms and have discussions with the ESCO if needed to get all questions answered.

STEP 5: Verify savings and enjoy the benefits

Follow-up monitoring helps ensure that you are getting full value from your energy savings performance contract. The success of the monitoring effort depends on the level of detail you documented in the contract.

Approve the installation. Review the requirements detailed in the contract and upon completion of the project installation check that all equipment was installed as specified.

Participate in commissioning. Confirm that equipment and systems function as designed. Also confirm that applicable codes and environmental regulations are met.

Operate the facility as mutually agreed in the contract. The ESCO will maintain, monitor, and verify the installation as specified. Review the roles and responsibilities as stated in the contract to ensure you do your part to sustain equipment performance and savings.

Maximize benefits through trained staff. Your ESCO will train your facility staff in optimal operation of equipment and systems. Ask for a video of the training or a training manual. Staff training will help ensure savings and minimize future maintenance, while maximizing the life of the equipment.

Initiate preventive maintenance practices. With new equipment and trained staff, and with maintenance problems eliminated, staff can turn their attention from short-term fixes to long-term preventive maintenance.

Review the annual measurement and verification (M&V) reports. Meet with your ESCO regularly to ensure guaranteed savings are achieved as outlined in the contract. Report any concerns immediately and apply the contract protocol in the event of a savings shortfall, i.e., realized savings, do not meet the contract specifications.

Develop a life-of-contract plan. Savings and contract benefits accrue during the guarantee period and financing term that may last 15 years or longer. During this “life-of-contract” phase, maintaining long-term operational performance is critical to realizing continued savings. Develop a Life of Contract (LOC) Plan to manage the contract for the entire guaranteed savings period and capture performance data from M&V reports and energy management systems. Personnel responsible for the project’s success can use this plan to monitor and document activities over the contract term, providing continuity in the event of personnel changes.

Summary of M&V Options

The International Performance Measurement and Verification Protocol (IPMVP) presents a standardized approach to measure and verify savings of ESPC projects. A companion resource, *FEMP M&V Guidelines: Measurement and Verification for Performance-Based Contracts,* Version 4.0, presents ways to apply IPMVP in projects.

There are four options for measuring performance, with varying levels of cost and accuracy for applicability to all types of measures. One can determine savings for an individual measure or for the whole facility, as shown below.

Individual Measure Options

- OPTION A - Retrofit Isolation Key Parameters: Savings are determined by field measurement of a key parameter.
- OPTION B - Retrofit Isolation All Parameters: Savings are determined by field measurement of all parameters of the system.

Whole-Building Options

- OPTION C - Whole Facility: Savings are determined by measuring energy use at the whole facility level.
- OPTION D - Calibrated Simulation: Savings are determined through simulation of the energy use of the whole facility.

It is important to apply an appropriate level of rigor to each type of measure—that is, to avoid over-simplification for a dynamic and high-cost system, and avoid excessive measurements for a simple low-cost measure.

ESPC SUCCESS TIP

As in Step 4, special attention remains critical in the monitoring phase to ensure regulations and requirements continue to be met and that permitting and re-permitting remains viable.

CHAPTER 6. Getting Started

If you are not familiar with the ESPC approach, getting assistance from an ESPC professional can support a smooth process and a successful project outcome. ESPCs are complex, involving construction, engineering, budgeting, financial, and legal issues, with finance payments hinging on guaranteed projected savings over a long-term performance period. Technical assistance and proven resources can help all of these steps run smoothly.

Guidance and Resources

U.S. Department of Energy (DOE)

- Office of Energy Efficiency & Renewable Energy (EERE) ESPC Fact Sheet. DOE summarizes the benefits of ESPC, includes example projects, including one at a WRRF, and compiles a list of ESPC guidance and resources across DOE.
- Office of Energy Efficiency & Renewable Energy (EERE) ESPC Toolkit. DOE provides general information about ESPC as well as targeted resources to support decision-making and eliminate barriers to ESPC projects.
- Office of Energy Efficiency & Renewable Energy (EERE) State and Local Solution Center. DOE provides informational resources and tools to help state and local governments understand and implement ESPC projects.
- Federal Energy Management Program (FEMP). Designed for federal agencies, FEMP provides many resources and tools suitable for developing successful ESPC projects that can be used in the state and local government space as well.

State Energy Office (SEO). A number of SEOs have ESPC programs including customized documents, a list of pre-qualified ESCOs, free technical assistance and other resources. Find contact information at:

- National Association of State Energy Officials website: http://naseo.org/members-states
- Energy Services Coalition website: http://www.energyservicescoalition.org/chapters

Energy Services Coalition (ESC). ESC is a public-private partnership that promotes and supports the widespread use of ESPC. Search for:

- ESCOs serving your area
- Financing companies that finance ESPC projects
- Consultants

The ESPC Accelerator catalyzed public-sector energy efficiency investments of

MORE THAN **$2 BILLION**

during the program and left a legacy of valuable tools and resources to support ESPC into the future.

U.S. Department of Energy Resources

DOE's Energy Savings Performance Contracting (ESPC) Accelerator was designed to support expanded use of ESPC by state and local governments and K-12 schools. During 2014-2016, DOE worked with 25 state and local agencies to develop solutions for the most common barriers to ESPC, leveraging innovative and best-practice approaches for success. As a result, the ESPC Accelerator catalyzed public-sector energy efficiency investments of more than $2 billion during the program and left a legacy of valuable tools and resources to support ESPC into the future.

The ESPC Toolkit is a collection of those resources that will enable state and local communities to learn and benefit from the work of the ESPC Accelerator. It includes the best practices and innovative approaches that states, cities, and K-12 schools have used to successfully establish and implement performance contracting. Resources are organized by phase of an ESPC project so that potential users of the mechanism can easily find the information they need at each stage of their ESPC decision-making process.

U.S. Department of Energy Assistance

Initiated in 2016, the Sustainable Wastewater Infrastructure of the Future (SWIFt) Accelerator is working over three years with 27 state, regional, and local agencies that are engaging with 90+ water resource recovery facilities in their jurisdictions to accelerate a pathway toward a sustainable infrastructure. Partners will seek to plan the energy efficiency of their participating water resource recovery facilities by at least 30 percent and integrate at least one resource recovery measure. The Accelerator aims to catalyze the adoption of innovative and best-practice approaches in data management, technologies, and financing for infrastructure improvement. Partners will participate in developing tools and resources that DOE will make available to help other WRRFS implement these approaches more successfully, i.e. a data management guide for the wastewater sector issued by DOE in November 2017.

Another Accelerator assists WRRFs implementing combined heat and power. The Combined Heat and Power (CHP) for Resiliency Accelerator supports and expands the consideration of CHP solutions to keep critical infrastructure operational every day and night regardless of external events. As a collaborative effort with states, communities, utilities, and other stakeholders, Partners are examining the perceptions of CHP among resiliency planners, identifying gaps in current technologies or information relative to resiliency needs, and developing plans for communities to capitalize on CHP's strengths as a reliable, high-efficiency, lower emissions electricity and heating/cooling source for critical infrastructure. At the conclusion, DOE will publish a toolkit with partner-developed and inspired tools that will support other communities in utilizing CHP as a resiliency solution in critical infrastructure.

DOE Tools

Model Procurement and Contract Documents

Model procurement and contract documents are available for download from the U.S.Department of Energy (DOE) website: http://energy.gov/eere/wipo/model-documents-energy-savings-performance-contract-project. Documents include:

- RFP templates to solicit an ESCO both directly and as part of a pre-qualified ESCO list
- Contract for an Investment grade audit (IGA)
- ESPC contract
- Financing solicitation

Customized documents may also be available from your State Energy Office (SEO).
(See above for contact information.)

General Tools

Fact Sheet about ESPC, including benefits, example projects, including one at a WRRF, and a list of select DOE ESPC resources.

ESPC Toolkit DOE provides general information about ESPC as well as targeted resources to support decision-making and eliminate barriers to ESPC projects.

Other Tools

eProject Builder

This database tool provides consistent tracking and reporting of ESPC project data, enabling project owners to make the business case for ESPC, negotiate strong ESPC projects, and standardize project results reporting. https://eprojectbuilder.lbl.gov/home/#/login

Risk, Responsibility, and Performance Matrix

This document helps determine the risk, responsibility, and performance of a contractor's proposed approach under a Federal energy savings performance contract (ESPC). https://energy.gov/eere/femp/downloads/espc-risk-responsibility-and-performance-matrix

Energy Escalation Rate Calculator

The Energy Escalation Rate Calculator (EERC) computes an average annual escalation rate for a specified time period, which can be used as an escalation rate for contract payments in energy savings performance contracts and utility energy services contracts. http://energy.gov/eere/femp/energy-escalation-rate-calculator-download

The ESPC Financing Decision Tree for public-sector organizations enables users to select the form(s) of ESPC financing best suited to their jurisdiction's conditions. The tool includes a mini-glossary with an explanation of each financing type included. Developed especially for the public sector.

The Better Buildings Financing Navigator

The Navigator helps you cut through the complexity of the many ways to finance projects to identify financing mechanisms to consider for your specific project. https://betterbuildingssolutioncenter.energy.gov/financing-navigator

Hiring Additional Assistance

Even with the resources mentioned above, it may be prudent to obtain additional professional technical assistance. Overseeing an ESPC project requires specialized technical energy expertise. It also requires in-depth knowledge and understanding of ESPC to critically review the contracts and conduct the necessary due diligence. It requires time and attention to detail that may be a burden for staff to assume on top of existing duties.

Project Facilitator/Owner's Representative or Agent/Third-Party Consultant

A specialized industry has developed to provide ESPC technical assistance in the form of project facilitators, also known as owner's representatives or agents or third- party consultants. Involving a project facilitator is a recognized best practice, and is often required or recommended for state projects.

A project facilitator can help you navigate the process, serve as your technical expert to conduct due diligence during project development and provide confidence in cost and savings projections to ensure your project's performance. The facilitator will be most involved during the IGA, through contract negotiations and during the post-construction measurement & verification (M&V) period and first-year M&V report review. A project facilitator can provide strategic advice and guidance, such as ensuring engineering calculations are reasonable and accurate, recommending and approving measures, considering risk management strategies, ensuring the M&V plan is reasonable, applying recognized standards and best practices, and validating annual M&V reports.

The best time to engage a project facilitator is after the ESCO has been selected, but before contract negotiations begin. This is when "the rubber meets the road" and when the project facilitator can provide the most value. If desired, a project facilitator can help develop an RFP and advise on ESCO selection, but this is a less critical task and free services may be available. Some states provide free services through ESPC programs, usually to assist with upfront education, getting internal buy-in and soliciting an ESCO.

Specialty Consultant

In addition to an ESPC project facilitator, other specialists can supplement your staff capabilities, including:

- Project management firm to help oversee construction
- Design engineer familiar with any specialized technology or system in your facility

ESPC SUCCESS TIP

In addition to an ESPC project facilitator, WRRF projects would benefit from a technical wastewater specialist to:

- Advise on any measures that impact plant operations
- Review equipment specifications, cost estimates and savings projections
- Critically review performance criteria and operations and maintenance recommendations
- Ensure the plant will continue to meet regulatory requirements and permitting criteria
- Evaluate the ESCO's guarantee and advise on performance or financial risks

Ideally the WRRF technical specialist would be familiar with your specific facility and its operations.

What to Look for in an ESPC Project Facilitator

Substantial ESPC experience is critical, along with energy engineering credentials and M&V experience. Certifications ensure minimum requirements and understanding of recognized protocols, such as Certified Energy Manager (CEM) and Certified Measurement and Verification Professional (CMVP). A Professional Engineer (P.E.) and/or an academic engineering degree is also valuable but not necessarily required. (See Appendix for qualifications to consider.)

Payment strategies

At least part of the consulting cost may be integrated into the ESPC project cost and paid from savings. Payment options include a fee for services, hourly rate structure, fee as a percentage of total contract value, fee paid from energy saved, and in some cases, subsidized assistance through the State Energy Office (SEO).

How to find a consultant

Some state ESPC programs have pre-qualified consultants, so first ask your own or neighboring SEOs for a list of qualified consultants who serve your region. The Association of Energy Engineers (AEE) certifies professionals through rigorous testing and background requirements. (See AEE's Certified Professionals Directory including CEM and CMVP, http://www.aeecenter.org/custom/cpdirectory/) The Energy Services Coalition (ESC), with its ESPC mission, is also a good resource. (See Appendix for a potential scope of work to include in an RFP to solicit a qualified project facilitator.) Also consider joining chapters of professional organizations for local engagement and networking with ESPC stakeholders and the ESPC market in your area.

Supporting Materials

Request for Proposals for Project Facilitator Services

Below are potential core elements to include in an RFP to solicit a Project Facilitator for an ESPC project. The examples provided are based on state and local government best practices and lessons learned.

PROJECT OVERVIEW

Include an overview of your potential project, including a list of operations and systems and a general description of facility needs.

CONTRACTOR REQUIREMENTS

- Proposers must, at a minimum, meet the following requirements:
- Five years of experience in overseeing or advising on performance contracting projects for governments, with references, preferably in projects for similar types of facilities
- Experience or equivalent involvement providing these services for at least three projects, preferably in your sector
- Energy engineering expertise, experience, Certified Energy Manager (CEM) credential and academic background (Professional Engineer, P.E., preferred but not required)
- Measurement & verification (M&V) expertise including a Certified Measurement & Verification Professional (CMVP)
- Engineering analysis experience including energy auditing, utility rate analysis and work with a variety of energy systems, specifically in water resource recovery facilities (WRRFs)
- Ability to perform the tasks outlined below

TASKS

Act in an owner's advisory role to comment and make recommendations, balance water quality requirements/standards with selection/installation of energy conservation measures (ECMs), provide technical insight and quality control and assist in interactions and communications with the ESCO. The awarded proposer may participate in some or all of the following tasks:

- **Investment Grade Audit (IGA) and Project Development**
  Assist in negotiating the IGA contract with the ESCO. Attend the kickoff meeting to establish an agreed plan of action. Review the audit and project proposal, including baseline calculations, proposed measures, assumptions and savings calculations, cost estimates, commissioning plan, operation and measurement plan, and M&V plan. This will involve participation in multiple progress meetings including review meetings for the IGA process. The development of a valid energy baseline and an appropriate M&V strategy is fundamental and paramount to the overall viability of the ESPC project. The project facilitator will help evaluate the risk and cost of the performance measurement strategies.

- **Contract Negotiations and Contract Review**
  Review the draft contract and make recommendations for negotiations. Critical elements include: project scope, cash flow, guarantee, measurement and verification (M&V) protocols, training by the ESCO, construction schedule, standards of comfort, equipment to be installed, equipment warranties and roles and responsibilities for O&M.

- **Design, Construction and Implementation Support**
  Provide general project oversight services during construction to help ensure that the project is completed on schedule and designed and built as planned. Review submittals of designs, equipment performance specifications and installation plans. Help establish roles, responsibilities, expectations, timelines, communications, logistics, and an effective submittal review process. Help ensure regular inspections, commissioning, training, acceptance criteria, O&M requirements, and M&V guidelines are met. Monitor work progress in accordance with the planned schedule. Help provide resolution to any project-related issues that might arise.

- **Measurement and Verification (M&V) - Review and Validation**
  Review, comment, and approve the ESCO's M&V plan. Review and approve annual M&V reports submitted by the ESCO to ensure the M&V Plan and contract provisions are correctly applied to determine savings according to the guarantee. The M&V period may extend through the entire financing period, up to 25 years in some states. The first several years are most critical to ensure performance, so you can consider reducing the frequency of reports in later years.

- **Other Support**
  Other support services may be desired depending on staff capabilities and project scope:

  - INTERNAL EDUCATION AND RFP SUPPORT: Prior to issuing an RFP, help compile and organize utility and facility information. Assist to build internal understanding and consensus for the project, potential scope and approach. Advise on RFP development and ESCO selection.

  - PROJECT MANAGEMENT: Provide assistance to oversee the project during installation and implementation.

  - ENGINEERING SUPPORT: Additional assistance in design.

CONTRACTOR RFP RESPONSE REQUIREMENTS

- **Experience**

  - Describe demonstrated experience in the evaluation, design, development and management of performance contracts on behalf of public-sector clients. Include the length of time providing services described in this RFP, with a minimum of five (5) years of similar experience in overseeing or advising on performance contracting projects for governments for the listed tasks. Include technical experience in analysis of energy systems, including controls, utility rate analysis, etc.

  - Describe the processes, tools, resources and services to provide third-party consulting assistance associated with a performance contracting project related to the project design and development, audit review, ESCO interactions, contract negotiations, implementation, management, M&V, training and other core services.

- Describe your experience and/or understanding of financing mechanisms and financial assistance that may be available.
- Describe your working knowledge of relevant state statutes and typical government procurement and contracting practices for performance contracts.
- Identify the individual(s), including subcontractors, assigned to this project. Note that a single individual may be desired to be the lead contact and main service provider in order to maintain continuity and ease of communications. If additional people are intended to provide some of the core services, describe the rationale for this approach and how communications will be managed and coordinated. Provide resumes, descriptions of their roles and responsibilities, qualifications and experience related to these tasks. Identify personnel certified by the Association of Energy Engineers (AEE) as a CEM or personnel with similar credentials from a comparable nationally recognized organization. Identify personnel who have a state P.E. license.
- Provide a signed statement that: no conflict of interest issues would exist; assigned individuals would avoid working for any ESCO that may be selected for this work and maintain confidentiality of the project during the development and procurement phases; and that the firm will avoid any other work with the selected ESCO through the duration of the contract resulting from this RFP.

• **References**
Provide three references from similar projects performed in the wastewater sector:

Project Name:		
	Primary Contact Person	**Alternate Contact Person**
Name:		
Street Address:		
City, State, Zip		
Phone, including area code:		
Email address:		
Description of the project. Include project size (facility size and dollar amount), start/end dates, types of measures, unique features, issues or problems and how resolved, etc. This may be presented in a full-page format, not to exceed 2 pages per project.		
Description of services performed. This may be presented in a full-page format, not to exceed two pages per project.		

• **Cost**

- HOURLY RATES: Provide all-inclusive hourly rate for these services. Billing rates may be listed as a blended rate (desired) or as a rate per individual (in this case, list the percentage of time each person will spend on the project).
- PROPOSED COST: Propose the number of person hours to be dedicated to each task and the resulting cost.
- PROPOSED PAYMENT STRATEGY: Propose how some or all consulting costs can potentially be rolled into the ESPC and paid through savings.
- TRAVEL COSTS: Note if travel expenses are included in the hourly rate. Describe the mode of travel, typical travel expenses that would be billed, and origin of travel.

Endnotes

[1] American Society of Civil Engineers. *2017 Report Card for America's Infrastructure - Wastewater*. 2017. http://www.infrastructurereportcard.org/

[2] Focus on Energy. *Water and Wastewater Industry, Energy Best Practice Guidebook*. 2006. https://focusonenergy.com/sites/default/files/waterandwastewater_guidebook.pdf

[3] American Society of Civil Engineers. *2017 Report Card for America's Infrastructure - Wastewater*. 2017. http://www.infrastructurereportcard.org/

[4] Water Environment Research Foundation (WERF) with New York State Energy Research and Development Authority. *A Guide to Net-Zero Energy Solutions for Water Resource Recovery Facilities*. http://www.energy.gov/sites/prod/files/2015/10/f27/WERF.ENER1C12-Executive-Summary.pdf

[5] American Council for an Energy Efficient Economy (ACEEE). *Driving Energy Use in the U.S. Water and Wastewater Industry by Focusing on Operating and Maintenance Cost Reductions*. Pages 6-31. 2009. http://aceee.org/files/proceedings/2009/data/papers/6_83.pdf

[6] U.S. Energy Information Administration. *Annual Energy Review 2011*. Page 72. 2012. DOE/EIA-0384 (2011). http://www.eia.gov/totalenergy/data/annual/pdf/aer.pdf

[7] U.S. Energy Information Administration. *Annual Energy Outlook 2015 with Projections to 2040*. Pages ES-5, ES-7. 2015. http://www.eia.gov/forecasts/aeo/pdf/0383(2015).pdf

[8] Donald Gilligan, National Association of Energy Service Companies (NAESCO), conversation December 2016.

[9] U.S. Environmental Protection Agency. *Evaluation of Energy Conservation Measures for Wastewater Treatment Facilities*. 2010. https://nepis.epa.gov/

[10] Alliance to Save Energy. *Watergy: Energy and Water Efficiency in Municipal Water Supply and Wastewater Treatment*. http://www.gwp.org/Global/ToolBox/References/WATERGY.%20Water%20Efficiency%20in%20Municipal%20Water%20Supply%20and%20Wastewater%20Treatment%20(The%20Alliance%20to%20Save%20Energy,%202007).pdf. Page 16.

[11] NACWA, WEF, and WERF. *Towards Energy Neutrality at WRRFs – Results and Findings of Recent Research*. April 2, 2014. Page 5. http://www.werf.org/c/KnowledgeAreas/Energy/Latest_News/2016/Energy_Production_and_Efficiency_Fact_Sheet_2016.aspx

[12] U.S. Environmental Protection Agency. *Local Government Climate and Energy Strategy Guides: Energy Efficiency in Water and Wastewater Facilities: A Guide to Developing and Implementing Greenhouse Gas Reduction Programs*. 2013. http://www3.epa.gov/statelocalclimate/documents/pdf/wastewater-guide.pdf

[13] Prepared for the U.S. Department of Energy Federal Energy Management Program. *M&V Guidelines: Measurement and Verification for Performance-Based Contracts, Version 4.0*. November 2015. http://energy.gov/eere/femp/downloads/mv-guidelines-measurement-and-verification-performance-based-contracts-version

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