FEMP
Federal Energy Management Program

# How To Determine and Verify Operations and Maintenance Savings in Energy Savings Performance Contracts

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# Authors

The authors of this report are:

Phil Voss, National Renewable Energy Laboratory (NREL)

Christine Walker, Pacific Northwest National Laboratory (PNNL)

# Contacts

Ira Birnbaum
Federal Energy Management Program
EE-5F, 1000 Independence Ave S.W. Washington, D.C. 20585-0121
Phone: 202-287-1869
E-mail: Ira.Birnbaum@ee.doe.gov

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*Contributors:*

Kurmit Rockwell, DOE-FEMP

Priya Stiller, DOE-FEMP

Matt Joyner, NREL

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# List of Acronyms and Abbreviations

| | |
|---|---|
| CRAC | computer room air conditioner |
| CRAH | computer room air handler |
| DOE | U.S. Department of Energy |
| ECM | energy conservation measure |
| ESCO | energy services company |
| ESPC | energy savings performance contract |
| FEMP | Federal Energy Management Program |
| IDIQ | indefinite delivery indefinite quantity |
| M&V | measurement and verification |
| O&M | operations and maintenance |
| R&R | repair and replacement |
| UESC | utility energy service contract |
| WCM | water conservation measure |

# Executive Summary

Operations and maintenance (O&M) savings frequently occur in energy savings performance contracts (ESPCs). During FY 2022, 37% of reported annual cost savings for projects awarded under the U.S. Department of Energy (DOE) ESPC indefinite delivery indefinite quantity (IDIQ) contracts and in the performance period were due to O&M or other energy- and/or water-related cost savings, with the balance (63%) from utility cost savings (i.e., energy or water cost savings).[1] Sometimes the energy- and water-related cost savings are acknowledged and included in payments within ESPCs; other times, for various reasons, they are not.

As presented in this guide, FEMP recommends including energy- and water-related cost savings that are O&M (including related repair and replacement) savings in the financial aspects of an ESPC, to the extent such savings can be documented. Inclusion of these savings will help augment project scopes and/or lower interest costs (by shortening financing terms). However, there is a burden of proof as to what constitutes acceptability in O&M savings that needs to be carefully considered and documented in individual projects.

Beyond promoting a key tenet used in U.S. federal performance contracting—that savings must be from actual budgets and therefore based on the level of O&M that is actually occurring, not what should have been performed—FEMP also recommends good practice in establishing and documenting O&M baselines, formulating the rationale for baseline adjustments during the performance period, and conducting ongoing verification activities. This document concludes with five examples of how O&M savings may be handled, in situations ranging from the partial displacement of O&M contracts to consolidation and "virtualization" of servers in data centers.

A key theme that permeates this guide is the importance of thoroughly documenting all conditions and assumptions used in the development of and accounting for O&M costs and savings throughout the ESPC life cycle, from baseline-setting to measurement and verification (M&V) of the savings during each year of the performance period. Doing so not only prevents internal claims of non-performance (especially in the case of staff turnover during the contract term), but also simplifies ordering agency and energy service company (ESCO) response in the event of scrutiny from oversight organizations, such as government audits.

While this guide focuses on federal ESPCs, it may also be applicable when O&M savings are included in utility energy service contracts (UESCs) and non-federal ESPCs.

[1] Yoon, Y et al. Reported Energy and Cost Savings from the DOE ESPC IDIQ Program: FY2022. Oak Ridge National Laboratory, October 2023.

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# 1 Introduction

This document was originally developed in 2007 by the Operations and Maintenance (O&M) Savings Determination Working Group of the Federal ESPC Steering Committee (FESC). It was revised in 2017 by Lawrence Berkeley National Laboratory (LBL) with assistance from the National Association of Energy Service Companies (NAESCO) and was reviewed by the U.S. Department of Energy's Office of General Counsel and by members of FESC. This document is a further revision and update to the prior versions, incorporating updates from the Energy Act of 2020. The Energy Act of 2020 amended the ESPC authority, including adding that a Federal agency shall not "limit the recognition of operation and maintenance savings associated with systems modernized or replaced with the implementation of energy conservation measures, water conservation measures, or any combination of energy conservation measures and water conservation measures." (42 U.S.C. 8287(a)(2)(F)(iii)) This addition further reinforces the need to carefully assess O&M savings when including them in an ESPC. This document serves as a guide to incorporating, documenting, and verifying O&M savings in ESPCs, and may also be useful when considering O&M savings in UESCs.

A 2016 analysis of annual measurement and verification (M&V) reports from over 250 active federal ESPC projects showed that roughly 25% of the reported cost savings were due to reductions in "other energy-related and O&M" costs; a 2023 analysis of over 180 active federal ESPC projects showed that this had increased to 37% of reported cost savings. These energy- and water-related cost savings may include savings from O&M, including repair and replacement (R&R) costs, along with other sources (e.g., savings from maintenance or replacement cost avoidance, demand response program participation, fuel switching, data center server virtualization, etc.). While potentially constituting a substantial portion of a project's savings, these energy- and water-related cost savings need to be reviewed, verified and documented just like energy and water cost savings. Although there are distinctions, for the purpose of this document, the term "O&M savings" includes O&M, R&R, and other energy- and/or water-related savings.

In late 2016 and early 2017, LBL and NAESCO interviewed over 40 representatives of federal agencies and energy service companies (ESCOs) to try to assess the norms and obstacles around incorporating O&M savings in ESPCs. O&M savings can be a very valuable addition to ESPCs, permitting greater scope in projects (e.g., allowing a desired but economically marginal energy conservation measure to be included in an ESPC) and lowering costs (by shortening project terms and thereby reducing interest expenses). However, lack of proper documentation and performance period verification risks over-accounting and/or under-accounting of the O&M cost savings. The role of this guide is to promote a fuller accounting of O&M savings in ESPCs supported by good practices to assure that those savings are credible and persistent.

Documenting and verifying O&M savings will help ensure persistence of the savings for the contract term, avoid conflicts, and address potential oversight concerns. Key items to address

with ESPC projects are baseline documentation, savings calculation methods, and verification of O&M savings. This document provides direction in these areas for recurring and one-time energy- and/or water-related cost savings, given the following key assumptions:

- An ordering agency's decision to commit ongoing funds from O&M budgets towards ESPC project payments has long-term impacts and must be documented adequately for future staff and oversight organizations.
- "Savings" due to redirected labor that do not reduce actual (budgeted) expenses—whether by in-house staff or O&M contractors—cannot be claimed as savings in an ESPC.
- It is incumbent on the ordering agency to maintain O&M cost records, as these are critical in order to document baseline O&M costs for an ESPC.
- ESCOs should include detailed information in their performance period M&V reports to clearly convey the source of O&M savings, as well as sufficient data to verify any savings claimed.

Several examples of allowable savings, and considerations to ensure savings will be achieved and documentable, are covered in Section 5.

## 1.1 Background

O&M cost savings are allowable in ESPCs as long as the sources of costs and savings are clearly documented. O&M savings include reductions in expenses (other than direct energy or water cost savings) that are related to energy-and water-consuming equipment replacement, improvements in operation and maintenance efficiencies, and/or retrofit activities.

As defined in the DOE Generation 4 IDIQ ESPC, "**e**nergy- (or water-) related cost savings are generally recurring reductions in expenses (other than energy (or water) costs) related to energy-consuming (or water using) equipment, generally affecting operations, maintenance, renewal, or repair expenses of equipment. One-time energy- (or water-) related cost savings may result from avoided expenditures of O&M, repair and replacement, or capital expenditures funds for projects (e.g., equipment replacement) that, because of the ESPC project, will not be necessary."

Sources of energy- and water-related savings include:

- Avoided capital or operating expenses
- Transfer of responsibility for O&M and/or R&R to the ESCO
- Avoided renovation, renewal, or repair costs as a result of replacing old equipment (this may include costs such as energy losses or O&M expenses that would continue to increase without the ESPC project).

Methods for estimating O&M savings resulting from changes to equipment have not been developed for the International Performance Measurement and Verification Protocol (IPMVP) or

FEMP's M&V Guidelines: Measurement and Verification for Performance-Based Contracts (the latest version can be found on FEMP's M&V web page).[2] However, the general rule to follow is that any savings claimed from O&M activities must result in a real decrease in anticipated expenditures, not simply freed up O&M staff time. O&M budget baselines may not be based on what an agency site should be spending for proper O&M; baseline expenditures must be based on what the site is spending when the baseline is established. The agency's O&M expenditures after implementation must decrease for savings to be considered real.

## 1.2 Existing Guidance

FEMP's Practical Guide to Savings and Payments (2009) describes a few related example scenarios regarding one-time and recurring payments arising from O&M cost savings. The guidance sets out sources of allowable energy- and/or water-related cost savings, which include avoided costs of programmed expenditures that become unnecessary due to implementation of an ESPC project. As discussed above, such savings must come from real and verifiable budgets, not from the perceived value that the ordering agency receives for the reduction. Simply redirecting labor or O&M efforts that do not reduce real expenditures may not be claimed as savings under an ESPC.

In addition, the Department of Energy's ESPC IDIQ contracts include a Risk, Responsibility, and Performance (RRP) Matrix that summarizes risk and responsibility allocation in an ESPC project, including information on key issues regarding O&M savings. For instance, the RRP Matrix distinguishes recurring costs, such as those from conventional annual O&M activities, from one-time costs, such as the replacement of equipment that has already been included in appropriations (i.e., budgeted). Both are permissible under the contract, although the RRP Matrix warns that including one-time savings in ESPCs may present some risk to ordering agencies if the appropriations to replace that equipment have not been received prior to task order award.

[2] https://www.energy.gov/femp/measurement-and-verification-federal-energy-savings-performance-contracts

# 2 Project Development Approach

## 2.1 Calculation Method

The most common approach for calculating O&M cost savings involves the same concepts as those used for determining energy savings: performance-period O&M costs are subtracted from baseline values, as shown in the equation below.

$$\text{O\&M Cost Savings} = \{\text{Baseline O\&M Costs}\} - \{\text{Performance-period O\&M Costs}\}$$

This method is appropriate for most projects and is simple to apply to ECMs/WCMs that include elimination of a maintenance contract or reduction in repair parts and materials that can be verified and documented. For projects in which R&R reductions are achieved, costs for replacement parts can often be determined from purchasing records and averaged to arrive at an annual baseline value. Labor costs for particular services may be more difficult to quantify since service records may not be representative or may lack sufficient detail. For example, parts costs for replacement lights or steam traps may be relatively easy to quantify from purchasing records. Labor costs to replace these same items are often more difficult to quantify because time spent on these specific tasks may not be well documented. Labor reductions on these tasks would not qualify as "real savings" if total labor expenditures at the agency site do not decrease. Although the agency receives value in the sense that labor is freed up to perform other useful tasks, this value does not typically result in monetized savings that may be paid to the ESCO.

Baseline O&M costs should be based on actual budgets and expenditures to the greatest extent practical. This involves determining the baseline costs of these parts or services through review and documentation of annual O&M expenses for equipment being upgraded or replaced. Estimated expenditures should be avoided if at all possible. In cases where actual budget information is not available and must be estimated, parts and labor costs may be derived from resources such as RSMeans,[3] but estimated expenditures should be adjusted to reflect any site-specific factors that would affect costs. ESCOs should get agreement from the agency and the agency should review and ensure that sources of estimated costs are acceptable before these sources are used to develop detailed savings estimates.

## 2.2 Defining and Documenting the Baseline

Establishment of credible O&M baseline costs is critical, and adequate documentation of the costs and methods for determining them should be included in the M&V plan (see Section 3). In general, the baseline labor and equipment costs may be determined from the following:

- Historical data on costs of equipment parts and consumables
- Records of historical contract labor hours based on work orders and timesheet billing systems

[3] www.rsmeans.com

- Labor rates, including benefits and overhead as well as any part-time or temporary labor services (if labor services and costs will be eliminated)
- Scope of work for existing O&M services contracts.

An issue in defining the baseline is establishing the time period for analysis. The number of years of records needed to define the O&M baseline may depend on information available and variability of O&M costs. If equipment has required an atypically high level of maintenance during recent years of service, the baseline should generally be weighted to indicate this (except where, for instance, recent expenses have been skewed by a one-time emergency repair). This decision requires engineering judgment and will depend on the availability of historical data. A fundamental goal, besides accurately representing the baseline, is to provide transparency in the decision-making process by thoroughly documenting why a specific method was chosen, what data were available and used, and how the cost savings formulas and variables were determined.

In general, using as much historical data as possible is recommended when defining the baseline conditions. Ideally, requirements for maintenance parts and/or labor should be determined for the recent life of the equipment, from which an average annual cost may be calculated. If the O&M costs vary dramatically from year to year, particularly if there is a clear trend (usually upward, as equipment reaches or exceeds its rated life), it may not be appropriate to use a simple average cost. This is a case-by-case decision since overall savings must be sufficient to cover payments for federal ESPCs. The key is determining with confidence that historical costs would continue if not for the project. Actual site data should be used wherever possible. Conducting a "reality check" on historic O&M costs using facility maintenance cost data sources such as RSMeans' or other sources is recommended to ensure that site data are realistic.

For sites that do not have detailed O&M records and where the ESCO will be performing some of the O&M tasks, the agency may allocate a portion of its O&M budget to cover those ESCO services during the contract term. This approach requires a long-term commitment from the agency and therefore should be carefully vetted with those most familiar with the O&M and budgeting at the facility. The ESCO should get conceptual confirmation from the ordering agency for this approach before spending the time to calculate the savings in detail. The decisions and rationale should be clearly documented in the RRP Matrix, ESPC proposal and awarded contract documents.

If an ESPC project adds new equipment or requires preventive maintenance activities that were not previously conducted, O&M costs may increase over the baseline conditions. These costs and the responsibility for them must be made clear in both the ECM description and the project's financial schedules, just as savings would be. If it is the site's responsibility to perform O&M activities that are new to them, then the additional costs should be treated as "negative savings"

and should be specifically detailed.[4] If the ESCO is responsible for performing new O&M activities on the installed equipment, those expenses will be itemized in the price proposal and performance period expenses of the project.

## 2.3 Managing Repair and Replacement Costs and Savings

A site's O&M budget may include general funding for emergency R&R. Sometimes this is the only R&R budget, and it is not allocated for specific equipment (e.g., boiler X will be replaced in year Y). For agency sites with an unspecified R&R fund, it may be possible to claim one-time or periodic avoided material costs and/or contracted labor fees (though whether to apply such funds is at the discretion of the ordering agency). Alternatively, if the ESCO is assuming R&R responsibility for some of the installed equipment, a justified portion of the avoided annual budget attributed to material replacement and contracted labor cost could be allocated as an annual savings. In both cases, the rationale for claiming the cost savings, the source of savings, and the specific year(s) of implementation must be carefully reviewed and documented, with sufficient detail such that any subsequent site project staff or an outside party (such as an auditor) can understand and accept the savings calculations during a project review in the future.

## 2.4 Escalation Rates

Baseline budgets and service contract fees may be escalated to account for inflation during the contract term. Escalation rates need to be documented and, except when directed from other authorities (e.g., governmental policy guidelines), should come from credible inflation forecasts from sources such as the President's Council of Economic Advisers (CEA)[5] (the CEA's inflation rate is incorporated into the recommended ESPC energy escalation rate calculator, EERC), not "ballpark estimates" by agencies or ESCOs. See 10 CFR 436.14.

Another source for escalation rates would be an existing O&M contract, either a multi-year contract with agreed-upon escalation rates or a 1-year contract with option years that include cost escalation rates for the future option year(s). The general inflation rate from CEA (as described above) could be applied to years beyond the contract or options.

[4] Treatment of such costs as "negative savings" is required under the statute, which states that the ESCO must "incur costs of implementing energy savings measures, including at least the costs (if any) incurred in making energy audits, acquiring and installing equipment, and training personnel[.]" (42 U.S.C. 8287(a)(1))
[5] www.whitehouse.gov/cea

# 3 The Project-Specific M&V Plan

Determining the appropriate level of effort to invest in the M&V of energy- and/or water-related cost savings follows the same instruction as for energy cost savings: the level of M&V rigor should be a function of (a) the magnitude of expected benefits (savings and performance improvement) from the ECM/WCM, and (b) the risk of not achieving those benefits.

The M&V plan for an ESPC project should include the following items to document any O&M cost savings for each ECM:

- Description of the O&M baseline, including the method by which it was developed (e.g., averaging of part replacements or equipment repairs expended from a number of years of facility logs; review of third-party O&M contract)
- Detailed explanation of how savings will be generated (i.e., describe where, when and how energy- and/or water-related cost savings will occur)
- All relevant cost savings calculations, with references to documentation and sources used
- The method and frequency by which verifications will take place during the performance period, in sufficient detail that these verifications could be conducted by an outside party.
- Documentation requirements and responsible party for performing O&M tasks during the performance period, including frequency, type, and format of reporting requirements.

The M&V plan should be written so that someone who has not been involved in the development of the project or an outside auditor understands and accepts the methodology and savings calculations in the plan.

## 3.1 Calculating Savings and Adjusting Baselines

Calculation methods documenting how the baseline O&M and R&R budgets were established, taking into consideration costs for contracted labor and materials for equipment replacement, equipment maintenance and repairs, and any other relevant factors should be included in the project-specific M&V plan. Additional details should be included such as hourly labor costs, labor inflation rates, hours required per specific task, and equipment lifetimes.

The M&V plan should also specify how adjustments could be made to savings calculations to account for changes at the facility. Factors such as changes in operating hours, occupancy, loads, and equipment life will affect HVAC system maintenance costs. If baseline cost data will be adjusted, the reasoning and methodology should be included.

It is necessary to define how actual costs will be accounted for during the performance period. The ESCO should specify what, if any, additional facility management oversight or logs need to be maintained, the nature and frequency of entries, and how the results will be interpreted. Examples include logging of routine preventive maintenance, equipment failures and

frequencies, equipment down time, and complaints. The process and any ordering agency responsibilities should be agreed to prior to award and documented in the signed contract.

Best practice is to use standard accounting procedures that allow for direct comparison of baseline to performance period costs ("apples to apples"). Another option may be to use a "control group" facility that is similar to the project site to determine what the O&M costs would have been in the absence of the ECM.

## 3.2 Defining Ongoing Verification Activities

The M&V plan should specify all performance period verification activities and include the following:

- How savings persistence will be ensured and, equally as important, documented. This is especially critical because staff turnover is likely over the typical ESPC term and new staff need to understand site and ESCO O&M responsibilities and the basis for claimed savings
- How compliance with performance standards for the facility will be verified, including the frequency of the ESCO and ordering agency reviewing O&M logs and reporting any potential deficiencies in performance of those tasks by either party
- What will occur if performance standards are not met (e.g., adjusted payments, actions to restore performance, etc.)
- How savings will be counted if site behavior changes, and what will occur if measured O&M savings are less than estimates
- How long O&M savings will continue to be counted and applied to the ESPC—cost savings may in some cases only be scheduled for part of the contract term (though it is not unreasonable in some cases for the savings to persist through the life of the contract).

# 4 M&V Reports During the Performance Period

O&M savings must be adequately verified and reported throughout the performance period. Generally, this is documented in the M&V report, issued periodically (at least annually) during the performance period. Key items that should be addressed for each ECM include the following:

- Description of any verification activities to ensure persistence of savings
- Detailed explanation of any baseline adjustments, with reference to the M&V plan's discussion of how these changes (e.g., of space usage, operating hours, etc.) were to be handled
- Assurance that performance standards (e.g., work order resolutions or scheduled preventive maintenance routines) are being adhered to by the party performing the work.

## 4.1 Verifying and Reporting Savings

Adequate documentation of performance period O&M savings should include the following:

- Source of O&M savings for each ECM/WCM
- O&M logs, including service performed, who performed the work and when, and the next scheduled service (for both ESCO- and agency-performed O&M)
- Review of key variables affecting the realization of savings
- Verification that standards of performance have been met
- Dates and times of on-site verification activities, including agency witnessing, as appropriate (witnessing is required for federal ESPCs).

# 5 Example Scenarios

These hypothetical examples are provided to illustrate some of the common sources of O&M savings in ESPC projects. Ordering agencies and ESCOs should carefully consider site-specific conditions and agency requirements when applying these examples to a specific project. In each example, O&M savings are calculated using the following equation:

O&M Cost Savings = {Baseline O&M Costs} – {Performance period O&M Costs}

## 5.1 Example 1: O&M Savings from the Elimination of a Maintenance Contract

Prior to the implementation of the ESPC, space conditioning at the facility was provided by aging boilers and chillers that were maintained by a third party under a maintenance contract. The ESPC replaces the aging equipment with newer, more efficient equipment that the ESCO maintains for the life of the contract.

This is probably the easiest type of O&M savings to quantify and verify, and likely the least controversial. Since a maintenance contract (or at least a portion of one) will be eliminated, O&M cost savings may be claimed. The annual O&M savings will be the cost of the maintenance contract during the baseline year (increased slightly each year to account for price inflation, assuming this is provided for in the eliminated service contract). It is straightforward to document that these cost savings are achieved since the former equipment is no longer in service and no longer requires maintenance, and the O&M contract was eliminated or not renewed. The O&M savings is then the difference between the annual cost of the old contract, adjusted for inflation, and the performance period maintenance costs, which will be zero (the ESCO will incur O&M costs as part of its fulfillment of this role, but these will be incorporated into its performance period expenses, and often reflected in a separate financial schedule (Schedule 3 in eProject Builder, for instance)).

The first step is to determine the site's current costs for the service contract that will be eliminated. A review of the service contract showed costs of $22,250 in the baseline year, with an annual increase in fees of 2.5%. During the performance period, the baseline costs will be the current costs inflated by a constant amount each year (2.5%). Per above, the actual O&M costs for the formerly contracted maintenance personnel in the performance period are expected to be zero. The savings stream for the ten-year ESPC is shown in Table 1.

**Table 1. O&M Maintenance Savings from Eliminated Service Contract**

| Annual System Maintenance Cost | | | |
|---|---|---|---|
| Year | Baseline Cost | Performance Period Cost | Proposed Savings |
| 0 | $22,250 | - | - |
| 1 | $22,806 | $0 | $22,806 |
| 2 | $23,376 | $0 | $23,376 |
| 3 | $23,961 | $0 | $23,961 |
| 4 | $24,560 | $0 | $24,560 |
| 5 | $25,174 | $0 | $25,174 |
| 6 | $25,803 | $0 | $25,803 |
| 7 | $26,448 | $0 | $26,448 |
| 8 | $27,109 | $0 | $27,109 |
| 9 | $27,787 | $0 | $27,787 |
| 10 | $28,482 | $0 | $28,482 |
| | | | **$255,507** |

Verification of these savings includes review and confirmation that the equipment and related O&M contract were eliminated, and this should be documented in the post-installation report. The first-year M&V report and all subsequent performance reports will thoroughly document the source and persistence of savings (e.g., documenting with facility personnel that no O&M contract with an outside vendor has been executed for the covered equipment). The facility should also verify that the ESCO is performing the required O&M activities – government review of the post-installation report, annual M&V reports, and government and ESCO-performed O&M activities, and documentation of those results, may serve as government witnessing for those activities.

## 5.2 Example 2: O&M Savings from Reduction in O&M Staff

Prior to the implementation of the ESPC, space conditioning at the facility was provided by aging boilers and chillers that were operated and maintained by in-house employees. The ESPC replaces the aging equipment with newer, more efficient equipment, which the ESCO will operate and maintain. As a result of this retrofit, three of the site's O&M staff members will no longer be required. Two staff members will be taking retirement, while one other will be transferred to another division, filling an existing approved and budgeted position within the agency—i.e., one that would have been filled anyway.

Since there will be a reduction in the site's maintenance staff, O&M labor savings may be claimed (with the full understanding, as in Example 1 above, that the eliminated O&M effort will now be performed by the ESCO and reflected in its performance period expenses). The first step is to determine the site's current costs for the staff members who will be eliminated. A review of the site's accounting records indicates that the salaries and benefits of the three eliminated employees (adjusted somewhat for the fact that two of the three were late- career and thus compensated more generously) would normally cost the agency $310,000 during the last year before the ESPC's installation. This is the baseline cost for year 0. During the performance period, the adjusted baseline costs will be the sum of the annual salaries and benefits of the staff members who will be eliminated inflated by a constant amount each year (2% in this case). The actual O&M costs (i.e., salaries) for these staff in the performance period are expected to be zero.

The savings stream from these savings for a ten-year period is shown in Table 2, which assumes that a 2% annual increase in compensation costs would have occurred.

**Table 2. Labor Cost Savings for 10-Year Contract**

| Annual System Labor Costs | | | |
|---|---|---|---|
| Year | Baseline Cost | Post-Install Cost | Net Savings |
| 0 | $310,000 | - | - |
| 1 | $316,200 | $0 | $316,200 |
| 2 | $322,524 | $0 | $322,524 |
| 3 | $328,974 | $0 | $328,974 |
| 4 | $335,554 | $0 | $335,554 |
| 5 | $342,265 | $0 | $342,265 |
| 6 | $349,110 | $0 | $349,110 |
| 7 | $356,093 | $0 | $356,093 |
| 8 | $363,214 | $0 | $363,214 |
| 9 | $370,479 | $0 | $370,479 |
| 10 | $377,888 | $0 | $377,888 |
| | | | **$3,462,301** |

The post-installation verification of the O&M savings will confirm the maintenance staff reductions and that the ESCO has assumed prescribed O&M activities. The first-year M&V report and all following performance reports will thoroughly document the source of savings and confirm that the ESCO is continuing to perform the O&M activities (e.g., documenting with facility personnel that no replacement staff have been hired for these tasks, or no staff have been assigned to tasks performed by the eliminated staff.)

If the site's maintenance staff is not reduced, then it would be necessary to determine what new O&M responsibilities the facility has taken on, and to assess the contractual responsibility (ordering agency or ESCO) if a savings shortfall is evident. During the performance period, it is important to establish that any unforeseen maintenance by in-house personnel was not due to the equipment installed under the ESPC. In some cases this may require examination of service call records from before and after the implementation of the ESPC. All of this information should be thoroughly documented during the entire performance period, with periodic review and acceptance of this documentation by the ordering agency.

As a reminder, to legitimately claim savings in this scenario, staff positions at the site must be eliminated in order not to risk guaranteed savings. Government review of the post-installation report, annual M&V reports, and government and ESCO-performed O&M activities, including confirmation that in-house personnel have not been hired to perform tasks eliminated by the ESPC and documentation of these results, may serve as government witnessing for those activities.

## 5.3 Example 3: O&M Savings from Decreased Need for Replacement Equipment

Material-related savings frequently result from lighting and lighting controls projects. In this hypothetical example, the agency staff performs the maintenance both before and after the equipment installation. Although there is no reduction in staff for which to claim labor savings, there will be cost savings on replacement materials.

For this project, lighting maintenance savings will result from the following:

- Reduced material requirements (e.g., lamps, ballasts)
    - Longer equipment life—LED lamps have longer lifetimes
    - Reduced operating time—Controls measures increase equipment life by reducing burn time.
- Warranty-related savings—Newly installed lamps and drivers come with a manufacturer warranty of five years.

The reduction in equipment costs is determined by calculating the difference between what replacement parts for the baseline would cost and what parts for the new lighting system cost.

For this project, the following assumptions apply:

- Lamp, ballast, and driver costs and expected lifetimes are defined in Table 3.

**Table 3. Costs and Lifetimes for Lighting Equipment**

| Equipment | Rated Life (hours) | Cost Per Unit |
|---|---|---|
| 4-foot T8 lamp (existing) | 20,000 | $2.78 |
| Two-lamp electronic ballast (existing) | 60,000 | $16.70 |
| 4-foot TLED lamp with driver (new) | 50,000 | $18.30 |

- Increased cycling of the lights resulting from the occupancy sensors has a negligible effect on TLED lamp/ballast life
- The entire project (including all other measures) has a performance period of 10 years
- Escalation of materials costs will be 2.0% per year.

The first step is to determine the site's costs for replacement lighting equipment. A review of the site's records indicated that replacement lighting equipment for the fluorescent T8s totaled $4,250 and $4,650 the last two years, with an average of $4,450. A reality check based on the expected useful service life of the equipment and known operating hours was then conducted to confirm that this value is reasonable, as shown in Table 4.

**Table 4. Calculated Baseline Material Costs**

| Baseline | Quantity | Cost |
|---|---|---|
| Lighting equipment (Two-Lamp T-8 fixtures w/ RO electronic ballast): | 5,000 | - |
| Run Hours: | 3,000 | - |
| Lamp replacements per year: | 1,000 | $2,780 |
| Ballast replacements per year: | 100 | $1,670 |
| **Annual Cost:** | **-** | **$4,450** |

The third step is to estimate the expected replacement equipment costs during the performance period. These calculations are shown in Table 5.

**Table 5. Proposed Performance Period Material Costs**

| Post-Installation Equipment | Quantity | Cost |
|---|---|---|
| Lighting equipment (Two-Lamp TLED fixtures): | 5,000 | - |
| Run Hours (with occupancy controls): | 2,250 | - |
| Lamp replacements per year: | 100 | $1,830 |
| Driver replacements per year: | - | $1,845 |
| **Annual Cost:** | **-** | **$3,675** |

Next, the cash-flow from the material savings is determined, accounting for the warranty that comes with the new lighting system. Under this warranty, all replacement lamps will be provided by the equipment manufacturer at no cost for the first five years. Using the escalation rate of 2.0% for material costs, the material maintenance cost savings for the 10-year project term would vary year to year, as shown in Table 6.

**Table 6. Annual System Equipment Cost Savings on Replacement Parts**

| Note | Year | Baseline Cost | Performance Period Cost[a] | Net Savings |
|---|---|---|---|---|
| | 0 | $4,450 | - | - |
| Warranty Period | 1 | $4,539 | $0 | $4,539 |
| Warranty Period | 2 | $4,630 | $0 | $4,630 |
| Warranty Period | 3 | $4,722 | $0 | $4,722 |
| Warranty Period | 4 | $4,817 | $0 | $4,817 |
| Warranty Period | 5 | $4,913 | $0 | $4,913 |
| Year 0 costs escalated to Year 6 | 6 | $5,011 | $4,139 | $872 |
| | 7 | $5,112 | $4,221 | $891 |
| | 8 | $5,214 | $4,306 | $908 |
| | 9 | $5,318 | $4,392 | $926 |
| | 10 | $5,425 | $4,480 | $945 |
| | | | | **$28,163** |

[a] Note that year 6 costs represent $3,675 (see Table 5) escalated at 2% per year.

Annual verification of the O&M savings will include the ordering agency reporting the actual number and cost of replacement lighting equipment to the ESCO, who will compare the data to what would have been required in the baseline case and incorporate any differences into its

annual M&V reports. In this case, witnessing should be satisfied by review of site data and the ESCO's annual M&V report.

## 5.4 Example 4: O&M Savings from Decreased Need for both Labor and Replacement Equipment

Material-related savings can also result from ECMs that replace large capital equipment, such as chillers and boilers. In this hypothetical chiller example, the agency staff performs the O&M, both before and after the installation of the two new chillers, and that O&M is being conducted by an on-site contractor. The ability to claim savings from both contract labor and replacement materials is conditioned on negotiation with, and consent from, the O&M contractor. In addition, there is an avoided cost capital savings in the third year of performance because the chiller replacements had been scheduled for that time and the ordering agency has worked with its budget authority to ensure that the expected budget allocation will materialize as planned.

For this project, chiller O&M savings will result from the following:

- **Contract labor savings**—Per site logs and the labor contract, the effort to maintain the existing chiller plant is costing the site $40,000 annually in labor and the contractor and site have settled on the new cost being half this, $20,000 per year for the remainder of the O&M contract (three years) after construction is complete. After this point, there are no additional labor savings, as the expectation is that the agency would then have replaced the chillers itself with ones requiring comparable O&M effort, so future O&M costs remain at $20,000 per year adjusted for 2% annual escalation.
- **Reduced material requirements** (e.g., valves, pump and motor parts/replacement)—These parts have been costing the site an average of $25,000 annually on the existing chiller plant and are expected to cost zero for the first five years of the performance period (due to warranty coverage). The agreed-upon annual cost that would have been incurred by the site starting in performance year 4 with its own new chillers is $12,000, adjusted for 2% annual escalation for the remainder of the contract term.

**Avoided cost**— The site has agreed to make a capital contribution in the third year of performance (the fifth year of the term, counting two years of construction) of $500,000, the budget allocation expected for the replacement of the two 600-ton chillers (and is therefore an avoided cost).

The reduction in equipment costs is determined by an independent government estimate, referring to a source such as RSMeans, as well as O&M experts within the agency, and then consulting and negotiating with the current O&M contractor, which has been active at the site for many years and is signing a new five-year contract with the site roughly simultaneous to the awarding of the ESPC. The estimated difference between replacement parts and contracted labor costs that will be incurred by the site from the baseline to after the chiller plant upgrade is shown in Table 7.

In the table, the total costs of the existing labor (column a) and existing materials (column b) are shown in column c; performance period costs (column d) are subtracted from the total baseline costs, resulting in savings (shown in column f), which also represents the annual payment to the ESCO. The one-time avoided cost for chiller replacement of $500,000 in year 3 is shown in column e, and in the savings column as a payment to the ESCO.

**Table 7. Annual Cost Savings for Materials (R&R) and Contract Labor from Chiller Upgrade**

| Performance Year | (a) Baseline Labor Cost | (b) Baseline Materials (R&R) Cost | (c) Total Baseline Labor and Materials Cost | (d) Performance Period Labor Cost | (e) Performance Period Materials (R&R) Cost | (f) Labor and Materials Savings[a] |
|---|---|---|---|---|---|---|
| 1 | $40,000 | $25,000 | $65,000 | $20,000 | $0 | $45,000 |
| 2 | $40,000 | $25,500 | $65,500 | $20,000 | $0 | $45,500 |
| 3 | $40,000 | $26,010 | $66,010 | $20,000 | $500,000 | $546,010 |
| 4 | $20,400 | $12,000 | $32,400 | $20,400 | $0 | $12,000 |
| 5 | $20,808 | $12,240 | $33,048 | $20,808 | $0 | $12,240 |
| … | … | … | | … | $0 | … |
| 10 | $22,974 | $13,514 | $36,488 | $22,974 | $0 | $13,514 |
| **Totals** | **$271,659** | **$165,721** | | **$211,659** | **$500,000** | **$725,721** |

[a] These calculations show the total annual savings and payments including the $500,000 one-time savings and payment in year 3 from the avoided chillers' replacement expense.

In this example, it is worthwhile to consider the risks being assumed by the ordering agency. In the first three years of performance, the labor savings (of $20,000 per year) have been contractually agreed upon between the agency and its O&M contractor, so achieving the savings can be seen as low risk. Similarly, the claimed materials savings (five years' worth) on the replacement chillers are low risk because the ESCO has obtained a warranty to cover the costs. The amount of savings is estimated based on expectations about the site's planned O&M costs during that period. Additionally, the avoided cost capital contribution in the third payment year represents a risk of the funds not being made available.

Verification of savings will include confirming and documenting that the O&M contract was reduced by $20,000 per year in the post-installation report, and verification annually that costs beyond the contractual agreement have not been incurred for O&M and documenting this in the annual M&V reports. Witnessing may be accomplished by reviewing and confirming the accuracy of the documentation

## 5.5 Example 5: O&M Savings from Decreased Need for Labor and Replacement Equipment in a Data Center

Data centers are an intriguing opportunity for ESPCs, partly because of the large prospect for O&M savings. Savings sources such as "consolidation" make data centers a fairly unique—and sometimes challenging—target for ESPCs, but also a potentially very worthwhile and lucrative one.

One hypothetical example involves a roughly 500,000 square foot (sf) government office building with a 9,000 sf data center and roughly 11,000 sf of dispersed small data centers (< 5,000 sf) and server closets (< 500 sf). While these spaces constitute only about 4% of the building space, the ESCO's investment grade audit estimates that their energy consumption represents 30-35% of the facility's energy consumption.

The ESCO (working with a sub-contractor that specializes in energy-efficient data center design) recognizes numerous opportunities centered on consolidation of the majority of the 11,000 sf of distributed data center functionality into the main data center space. Because most of the servers, both in the central data center and the distributed spaces, are substantially under-loaded – the great majority use less than a third of their capacity (which is typical) – the ESCO proposes to transfer almost all of the dispersed server activities into the central data center through physical "consolidation" of servers (primarily utilizing the most recently procured equipment and retiring older machines).

The central data center is currently served by computer room air handlers (CRAHs) that are supplied by the facility's chilled water supply from its two 30-year-old 500-ton centrifugal chillers. The ESCO proposes to replace the two chillers with three: a 150-ton chiller and water-side economizer devoted exclusively to the data center, along with 250- and 400-ton centrifugal chillers dedicated to the general building load (though still connected to the data center in the event of a breakdown in the dedicated cooling system). This will allow the building's main chilled water system to be shut down for at least 8-10 hours each day, as well as on most weekends, while the 150-ton chiller and its associated economizer can operate exclusively to serve the data center, generating much warmer chilled water (since dehumidification is unnecessary and temperature requirements are much looser with improved air management in the data center). The new configuration will allow the retirement of numerous direct expansion computer room air conditioners (CRACs) in the small, dispersed data centers and server closets.

Savings from O&M (not to mention energy) are difficult to estimate for this project, so the two parties used both published industry standards and site records to reach agreement. This included the ordering agency reaching out to individual departments to negotiate budget concessions in exchange for expected reductions in both computing and cooling equipment in the dispersed data centers and closets. While the site agrees to credit $30,000 of contracted labor for the reduction of a servicing expense on the CRACs, much of the total savings comes from the reduction in purchases of new servers and other data center equipment (including CRACs), given the consolidation (Table 8).

**Table 8. Annual Cost Savings for Materials (R&R) and Contract Labor from Data Center Retrofit ECM**

| Equipment or Labor | Findings/Assumptions | Baseline Cost (annual) | Performance Period Cost (annual) | Net Savings (annual) |
|---|---|---|---|---|
| Dispersed CRAC units | 50 units averaging 5 tons each; 4 units added/replaced per year | $75,000 | $0 | $75,000 |
| CRAC unit servicing | Non-warrantee service calls have cost an average of $32,000/year over previous 5 years | $30,000 | $0 | $30,000 |
| Dispersed and central data center servers | 100 → 40 physical servers with "refresh" rate of four years, so 25 → 10 new per year @ average cost of $6,000/unit | $150,000 | $60,000 | $90,000 |
| Data center power supply equipment and labor (UPSs, batteries, etc.) | Two 10-kW UPSs (average) per 20 distributed data center/server closets. UPSs @ $50/kW-year. No incremental UPS costs in central data center after ESPC | $20,000 | $0 | $20,000 |
| **Total** | | **$275,000** | **$60,000** | **$215,000** |

This project, including the consolidation of the distributed data centers and server closets in the building, will save a great deal of energy from various sources:

- Elimination of the dispersed CRACs
- Downsizing of the computing and associated data center equipment throughout the building
- Right-sizing of the data center cooling equipment (including a better ability to scale to reduced loads, including through use of the water-side economization); and, indirectly
- Right-sizing and staging of the cooling system for the remainder of the building, and the ability to turn that system off for at least 8-10 hours per day when the building is unoccupied (since the data center will now have a dedicated cooling system of its own).

The individual ECM's economics, as well as those of the overall ESPC, are made much more viable by the $215,000 of annual O&M (including repair and replacement) savings generated, reducing the project term from 18 to 16 years. By closely evaluating key information sources at its disposal—primarily its own records—the agency is able to comfortably agree to these savings and save considerable money in interest payments over the term (since the same project paid off more quickly accrues less interest cost).

Annual verification of savings will include confirming and documenting that right-sizing and consolidation resulted in and sustained the reduced O&M costs as described in Table 8. Witnessing may be accomplished by reviewing the annual O&M costs and savings documentation.

# 6 Lessons Learned

Lessons learned from actual projects provide some key points to keep in mind. Again, the key test regarding documentation is whether an ordering agency staff-person who has not been involved in the development of the project, or an outside auditor, can understand and accept the sources of savings and savings calculations at any time during the project performance period.

- An agency's decision to commit funds from future years' O&M budgets towards ESPC project payments has a long-term impact and must be documented adequately for future staff in both the M&V plan and the annual reports. Information should include why a specific method was chosen, what data were available and used, how cost savings were determined, and what method will be used to verify them during the performance period.
- Operations and maintenance budget baselines should not be based on what the agency site should be spending for proper O&M; rather, baseline expenditures should be based on what the site is spending (and would likely be spending into the future). The O&M expenditures after implementation must decrease for savings to be considered real.
- Ordering agencies should maintain thorough O&M cost records that will be needed to document baseline O&M costs. These records should be included in the ESPC proposal.
- Ordering agencies should maintain documentation of O&M service performed, (e.g., O&M logs, including when the service was performed) by either the ESCO or the agency staff throughout the contract term.
- ESCOs should include detailed information in M&V reports to clearly convey the source of O&M savings as well as sufficient data to verify any savings calculations performed. Ideally, these records should be stored in an electronic format also available to the ordering agency (such as eProject Builder, a free publicly available tool).
- If savings are claimed and payments are to be made from reductions in site staff labor, those staff positions must be eliminated.

O&M savings are legitimate cost reductions that may be applied to payments in many ESPCs. As long as there are true budgetary savings that accrue, these are a very valuable source for helping to fund ESPCs. This is particularly true when trying to integrate long-payback ECMs that may lengthen the term of the ESPC beyond an acceptable (and sometimes legally permissible) duration. However, O&M savings claims in ESPCs can easily have an appearance of impropriety, whether legitimate or not. Consequently, both agencies and ESCOs need to take great care in carefully documenting the basis for and verification of O&M savings for future review by parties that were not part of the original project.

# Appendix 1: Federal-Specific References

## Federal Regulation

### 10 CFR § 436.31

"Energy cost savings means a reduction in the cost of energy and related operation and maintenance expenses, from a base cost established through a methodology set forth in an energy savings performance contract, utilized in an existing federally owned building or buildings or other federally owned facilities as a result of—

(1) The lease or purchase of operating equipment, improvements, altered operation and maintenance, or technical services, or…"

### 10 CFR § 436.36

"(a) Any amount paid by a Federal agency pursuant to any energy savings performance contract entered into under this subpart may be paid only from funds appropriated or otherwise made available to the agency for the payment of energy expenses and related operation and maintenance expenses which would have been incurred without an energy savings performance contract. The amount the agency would have paid is equal to:

> (1) The energy baseline under the energy savings performance contract (adjusted if appropriate under §436.37), multiplied by the unit energy cost; and
>
> (2) Any related operations and maintenance cost prior to implementation of energy conservation measures, adjusted for increases in labor and material price indices."

## Federal Financial Schedules

O&M and R&R costs and savings are found in three places in the financial schedules for a DOE IDIQ ESPC project: cost savings and payments in Schedule 1, performance-period cash flow in Schedule 3, and first-year estimated energy and cost savings by ECM in Schedule 4.

### Schedule 1 — Annual Cost Savings and Payments

Schedule 1 presents the annual savings and payments for each year of the ESPC project and includes the estimated annual cost savings, guaranteed cost savings, annual payments and annual dollars retained by the ordering agency over the course of the project.

One-time energy- and/or water-related cost savings are often applied as a Year 0 (Implementation Period) guaranteed cost savings and payments.

### Schedule 3 — Performance-Period Cash Flow

Schedule 3 presents the cash flow for the ESPC project and includes the details of all annual performance-period expenses incurred by the ESCO and paid by the ordering agency over the course of the project.

Performance-period expenses are delineated by contract year in the following line items: Management/Administration; Operation; Maintenance; Repair and Replacement; Measurement and Verification; and other applicable expenses.

### Schedule 4 — First Year Estimated Cost Savings by ECM

Schedule 4 presents a summary of the baseline costs and estimated annual cost savings that will be achieved by each of the ECMs/WCMs included in an ESPC project. This schedule documents the changes in costs to the customer during the first year. Costs for subsequent contract years may be determined by applying the appropriate escalation rates, if used.

First year savings (or increase in use or costs) due to each ECM are quantified for all energy and commodity sources along with their individual cost impacts. Line items for each ECM include baseline energy use and costs, energy, water and cost savings, demand savings, demand cost savings, other energy-related and O&M cost savings, and others. Savings in this table are positive, while additional costs are recorded as negative values.

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