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How to Determine and Verify Operating and Maintenance Savings in Energy Savings Performance Contracts

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FEMP
Federal Energy Management Program

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Abbreviations and Acronyms

CRAC	Computer Room Air Conditioner
CRAH	Computer Room Air Handler
ECM	Energy Conservation Measure
FEMP	Federal Energy Management Program
M&V	Measurement and verification
O&M	Operations and maintenance
R&R	Repair and replacement

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Executive Summary

Operations and maintenance savings are a frequent phenomenon in energy savings performance contracting (ESPC). Sometimes they are acknowledged and credited towards paying down these financed projects; sometimes, for avoidable or unavoidable reasons, they are not. This guide posits that, where legitimate, O&M (and related repair and replacement) savings should be credited in ESPCs' financials, helping to augment project scopes and/or lower interest costs (by shortening financing terms). However, there is a burden of proof as to what constitutes legitimacy 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 need to be from actual budgets and therefore based off the level of O&M that *is* occurring, not what *should have been* performed – the guide also recommends good practice in establishing O&M baselines, formulating the rationale for baseline adjustments during the performance period, and conducting ongoing verification activities. The document concludes with five examples of how O&M savings can be handled, in situations ranging from the partial displacement of O&M contracts to consolidation and "virtualization" of servers in data centers. One key theme that permeates the guide is the importance of thoroughly documenting all conditions and assumptions used for O&M 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 almost inevitable case where staff turnover takes place during the contract term), but also simplifies customer and ESCO response in the event of scrutiny from oversight organizations, such as government audits.

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 review from the U.S. Department of Energy's Office of General Counsel. Subsequently, a draft was provided to the FESC for review. It serves as a guide to incorporating, documenting, and verifying O&M savings in energy savings performance contracts (ESPCs).

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 dollar savings were due to reductions in "other energy-related and O&M" costs. These other energy-related cost savings can include savings from repair and replacement (R&R) costs and assorted other miscellaneous sources in which dollars but not necessarily site energy use is saved (*e.g.*, renewable energy credits, demand response program participation, fuel switching, data center server virtualization, etc.). While they can constitute a substantial portion of a project's savings, O&M and R&R cost savings are often not as diligently verified or reviewed as strict energy savings.

In late 2016 and early 2017, LBL and NAESCO interviewed over 40 representatives of federal agencies and the energy service companies (ESCOs) that deliver their ESPCs to try to assess the norms and obstacles around incorporating O&M savings in ESPCs. The work was commissioned by the U.S. Department of Energy's Federal Energy Management Program (FEMP) and driven by two key concerns. First, 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, O&M savings in ESPC projects are sometimes claimed with limited documentation and performance period verification, exposing customer facilities to savings shortfalls and reprimands from oversight organizations. The role of this guide is to promote the use of legitimate O&M savings in ESPCs while advocating good practices to assure that those savings are credible and persistent.

To support the integrity of ESPCs, new projects must strengthen the basis for O&M cost savings. Documenting and verifying O&M and other energy-related savings will help ensure persistence of the savings for the contract term, avoid conflicts, and address oversight concerns (the majority of ESPC projects in the U.S. are conducted by public sector institutions). Key items identified for improvement in new projects are baseline documentation, savings calculation methods, and verification of O&M and R&R savings. This document provides direction in these areas for recurring energy-related cost savings, given the following key assumptions:

- An organization'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 –should not be claimed as savings in an ESPC.
- It is incumbent on ESPC customer organizations 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.

Background

O&M and other energy-related cost savings are generally allowable in ESPCs. We define them here as reductions in expenses (other than energy cost savings) that are *related* to energy-and water-consuming equipment.

Energy-related cost savings can result from avoided expenditures for operations, maintenance, equipment repair, or equipment replacement due to the ESPC project. This includes capital funds for projects (*e.g.*, equipment replacement) that, because of the ESPC project, will not be necessary. Sources of energy-related savings include:

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

Methods for estimating O&M (including R&R) 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[1]. 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 effort. O&M budget baselines cannot be based on what an organization *should* be spending for proper O&M; baseline expenditures must be based on what the customer *is* spending. The organization's O&M expenditures after implementation need to decrease for savings to be considered real.

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 and R&R cost savings. The guidance sets out sources of allowable energy-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 customer receives for the reduction. "Savings" due to redirected labor or O&M efforts that do not reduce real expenditures cannot be claimed as savings under an ESPC.

In addition, the Department of Energy's IDIQ contracts include a "risk and responsibility matrix" that provides information on key issues regarding O&M savings. For instance, the matrix distinguishes *recurring* costs, such as those from conventional O&M activities, from *one-time* costs, such as the replacement of a piece of equipment that had already been budgeted for. Both are permissible under the contract, but the matrix warns that including these savings in ESPCs presents some risk to customers, for instance that the budgeted equipment funds may fail to materialize as expected.

[1] *M&V Guidelines: Measurement and Verification for Performance-Based Projects, Version 4.0* (2015)

2 The M&V Approach

Determining the appropriate level of effort to invest in the M&V of energy-related cost savings follows the same dictum 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 project, and (b) the risk of not achieving those benefits.

Calculation Method

The most common approach for calculating energy-related cost savings involves the same concepts as those used for determining energy savings: Performance-period labor and equipment costs are subtracted from adjusted baseline values, as shown in the equation below.

O&M Cost Savings = {Adjusted Baseline O&M Costs} – {Actual O&M Costs}

This method is appropriate for most projects, and is simple to apply to those that include elimination of a maintenance contract or reduction in staff. 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 may sometimes not qualify as “real savings” if total labor *expenditures* at the customer site do not decrease. Although the customer receives value in the sense that labor is freed up to perform other useful tasks, this value may not result in monetized savings that can be paid to the ESCO. Sites considering ESPCs should evaluate the degree to which their documentation captures O&M labor and strongly consider enhancing their record-keeping in order to reflect the work.

Baseline O&M and R&R costs should be based on actual budgets and expenditures to the greatest extent practical. This involves essentially “measuring” the baseline consumption of these parts or services. 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 can be derived from resources such as RSMeans[2], but estimated expenditures should be adjusted to reflect any site-specific factors that would affect costs. ESCOs should get agreement from the customer and the customer should review and ensure that sources of estimated costs are acceptable before these sources are used to develop detailed savings estimates.

Example applications of legitimate O&M savings following these guidelines are demonstrated in several specific examples in Section 5.

[2] www.rsmeans.com

3 The Contractual M&V Plan

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

- A detailed explanation of how savings will be generated
- A description of the O&M baseline, including the method by which it was developed (*e.g.*, averaging of hours expended from x number of years of facility logs)
- All relevant cost savings calculations, with references to sources used
- A thorough description of conditions that would necessitate baseline adjustments, including quantification of the expected effects from these changes (*e.g.*, of space usage, operating hours, etc.)
- 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.

The key test of the validity of the M&V plan is whether a customer staffer who has not been involved in the development of the project, or an outside auditor, understands and accepts the savings calculations in the plan *at any time during the project performance period*.

Defining and Documenting the Baseline

Establishment of a credible O&M baseline is critical. In general, the baseline labor and equipment costs can be determined from the following:

- Historical data on costs of equipment parts and consumables
- Records of historical labor hours based on work orders and timesheet systems
- Labor rates, including benefits and overhead as well as any part-time or temporary labor services
- Existing contracts for O&M services

Adequate documentation in the M&V plan should include the following:

- Identification of key variables affecting the realization of savings
- Specification of how the customer's expenditures will directly be reduced by the implementation of the measure or O&M contract
- Definition of the O&M performance standard (*e.g.*, annual chiller tube cleaning or lamp replacements within 48 hours of burnouts) during the performance period.

An issue in defining the baseline is establishing the time period for analysis. How far back do you go to define the O&M baseline? If equipment has needed an atypically high level of maintenance during the last 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 historic 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 can be calculated. If the O&M savings 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 from the ESPC should be sufficient to cover payments (this is a requirement for federal ESPCs). The key is determining with confidence that historic 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 RSMeans' facility maintenance cost data 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 assuming some O&M responsibility, the customer can allocate a portion of its O&M budget to cover ESCO services. This approach requires a long-term commitment from the customer 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 customer for this approach before spending the time to calculate the savings in detail.

Though it is rare, energy projects can increase O&M costs over the baseline conditions by adding new equipment or by requiring certain preventive maintenance activities that were not previously conducted. Since only real budgetary savings should be claimed, O&M "savings" can sometimes be negative if additional costs are incurred. These costs and the responsibility for them should be made clear in both the ECM's narrative and the project's cost schedules, just as savings would be. If the responsibility is the facility's, then the additional costs should be treated as "negative savings" and should be specifically detailed. If the responsibility for the new O&M is the ESCO's then those expenses will generally be itemized in the performance period cash flow of the project.

Managing Repair and Replacement Costs and Savings

In some cases, 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 customers with an unspecified R&R fund, it may be possible to claim one-time or periodic avoided material costs and/or sub-contracted labor fees (though ESCOs should be aware that some customers may be unwilling to concede these funds). Alternatively, if the ESCO is assuming responsibility for some portion of the infrastructure, 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 documented, in sufficient detail such that an outside party (such as an auditor) can understand and accept the savings calculations sometime in the future.

Calculating Savings and Adjusting Baselines

Documentation of calculation methods should include how the baseline O&M and R&R budgets were established, taking into consideration costs for labor and materials for equipment replacement, equipment maintenance and repairs, and any other relevant factors. 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 equipment failures and frequencies, equipment down time, and complaints.

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.

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 site turnover is likely over the typical ESPC term and new staff may be dubious about claimed savings
- How compliance with performance standards for the facility will be verified
- What will occur if performance standards are not met
- How savings will be counted if site behavior changes, and what will occur if actual O&M costs incurred by the site exceed estimates
- How long O&M savings will last -- 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 Reporting Period

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

- Description of any verification activities
- 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.

Verifying and Reporting Savings

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

- Dates and times of on-site verification activities, including customer witnessing, if appropriate (witnessing is required for federal ESPCs)
- Review of key variables affecting the realization of savings
- Verification that standards of performance have been met.

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[3] (the CEA's inflation rate is incorporated into the popular ESPC escalation rate calculator, EERC), not "ballpark estimates" of customers or ESCOs.

[3] www.whitehouse.gov/cea

5 Example Scenarios

These hypothetical examples are provided to illustrate some of the common sources of O&M savings in ESPC projects.

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 verify, and the least controversial. Since a maintenance contract (or at least a portion of one) will be eliminated, O&M cost savings can 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 in the eliminated service contract). There can be little disagreement that these cost savings are achieved, since the former equipment is no longer in service and no longer requires maintenance. O&M savings are calculated using the following equation:

O&M Cost Savings = {Adjusted Baseline O&M Costs} – {Actual O&M Costs}

The O&M savings is then the difference between the annual cost of the old contract, adjusted for inflation, and the actual 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	Existing Baseline	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 confirmation in the post-installation or first-year M&V report that the equipment and related O&M contract were eliminated. 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.

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 customer's operations and maintenance 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 organization – *i.e.*, one that would have been filled anyway.

Since there will be a reduction in the customer's maintenance staff, O&M savings can be claimed (with the full understanding, as in Example 1 above, that some portion of the eliminated O&M effort will now be undertaken by the ESCO and reflected in *its* performance period expenses). O&M savings are calculated using the following equation:

O&M Cost Savings = {Adjusted Baseline O&M Costs} – {Actual O&M Costs}

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 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	Existing 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 first-year or post-installation verification of the O&M savings will confirm the maintenance staff reductions and that the ESCO has assumed prescribed O&M activities. 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, or no staff have been assigned to tasks performed by the eliminated staff.)

A problem could arise if the 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 (customer or ESCO) if a savings shortfall is evident. For example, it could be that a new building was constructed, requiring facility personnel to take on new O&M responsibilities. 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 customer contract managers.

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 customer is responsible for 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:

1. 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.
2. 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.

O&M Cost Savings = {Adjusted Baseline O&M Costs} – {Actual O&M Costs}

For this project, the following assumptions apply:

1. 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' T8 lamp (existing)	20,000	$ 2.78
2-lamp electronic ballast (existing)	60,000	$ 16.70
4' TLED lamp with driver (new)	50,000	$ 18.30

2. Increased cycling of the lights resulting from the occupancy sensors has a negligible effect on TLED lamp/ballast life.

3. The entire project (including all other measures) has a performance period of 10 years.

4. 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	Qty	Cost
Lighting equipment (2-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 Eqpt.	Qty	Cost
Lighting equipment (2-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 Cost Savings on Replacement Parts

Annual System Equipment Cost				
Note	Year	Existing Cost	Perfor-mance Period Cost*	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
Yr. 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

* 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 customer reporting the actual number and cost of replacement lighting equipment to the ESCO, which will compare the data to what would have been required in the baseline case and incorporate any differences into its periodic M&V reports.

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 customer is responsible for O&M, both before and after the installation of the two new chillers, but that O&M is being conducted by an on-site contractor. The ability to claim savings from both labor and replacement materials is conditioned on negotiation with, and consent from, the O&M contractor. In addition, there is a capital savings in the third year of performance because the chiller replacements had been scheduled for then and the customer has worked with its budget authority to assure that the expected budget allocation will materialize as planned.

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

1. 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 (per its O&M contract) 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 customer would then have replaced the chillers itself with ones requiring comparable O&M effort.

2. 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% inflation the following year. No O&M savings are forecasted after year 5, when the R&R warranty expires.

In addition, the site has agreed to make a capital contribution to the financing in the third year of performance (the fifth year of the term, counting two years of construction) of $500,000, the budget allocation it is expecting for the replacement of the two 600-ton chillers.

The reduction in equipment costs is determined by referring to RSMeans, as well as O&M experts in the organization, 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 what replacement parts and contracted labor will cost the site from the baseline to after the chiller plant upgrade is depicted in Table 7, below.

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

Annual System Labor and Materials Cost					
Performance Year	Existing Labor Cost	Performance Period Labor Cost	Existing Materials (R&R) Cost	Performance Period Materials (R&R) Cost	Labor and Materials Savings*
1	$ 40,000	$ 20,000	$ 25,000	$ -	$ 45,000
2	$ 40,000	$ 20,000	$ 25,500	$ -	$ 45,500
3	$ 40,000	$ 20,000	$ 26,010	$ -	$ 46,010
4	$ 20,400	$ 20,400	$ 12,000	$ -	$ 12,000
5	$ 20,808	$ 20,808	$ 12,240	$ -	$ 12,240
Totals	**$ 161,208**	**$ 101,208**	**$ 100,750**	**$ -**	**$ 160,750**

* These calculations exclude the $500,000 one-time savings in year 3 from the avoided chillers' expense.

In this example, it is worthwhile to consider the risks being assumed by the customer. In the first three years of performance, the labor savings (of $20,000 per year) have been contractually agreed upon between the customer and its O&M contractor, so the savings can be seen as risk-free. Similarly, the claimed materials savings (five years' worth) on the replacement chillers are without risk because the ESCO has obtained a warranty to cover them. However, the dollar amount of those savings is estimated, based on expectations about what the customer *would have* spent during that period (first with the old chillers and then, in the last two years, with its own replacement equipment).

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" and "virtualization" 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 audit estimates that their energy consumption represents 30-35% of the facility's energy usage.

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 both physical "consolidation" of servers (primarily utilizing the most recently procured equipment and retiring older machines), as well as extensive "virtualization" of processing functions. Virtualization essentially concentrates the activities of multiple individual servers on one piece of hardware.

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 centrifugals 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 machine 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, but the two parties, using both published industry standards and site records, are able to reach agreement. This has included the government facilities customer having to reach 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 savings comes not from labor but from the reduction in purchases of new servers and other data center equipment (including CRACs), given the consolidation and virtualization.

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

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

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).

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

6 Lessons Learned

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

- A customer'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 customer site *should* be spending for proper O&M; rather, baseline expenditures should be based on what the customer *is* spending (and would likely be spending into the future). The O&M expenditures after implementation need to decrease for savings to be considered real.

- Customers 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.

- 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 customer (such as eProject Builder[4], a free publicly available tool).

O&M savings are very legitimate 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 where ESPC customers are trying to integrate long-payback ECMs that can have the effect of lengthening 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 customers and ESCOs need to take great care in making sure to carefully document them for future review by parties that were not part of the original project.

[4] eprojectbuilder.lbl.gov

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…"

Federal Cost Schedules

O&M and R&R savings and costs are found in two places in the financial schedules for a DOE IDIQ or Army Corps MATOC ESPC project: performance-period ESCO expenses in Schedule 3, and first year energy and cost savings by ECM in Schedule 4.

Schedule 3 — Performance-Period Cash Flow

Schedule 3 presents the cash flow for the ESPC project and includes the details of all performance-period expenses incurred by the ESCO 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; Permits and Licenses; Insurance; and Property Taxes.

Schedule 3 shows all performance-period costs incurred by the ESCO, whereas baselines and savings are found in Schedule 4.

Schedule 4 — First Year Energy and Cost Savings by ECM

Schedule 4 presents a summary of the estimated annual cost savings that will be achieved by each of the ECMs included in an ESPC project. This schedule documents the changes in costs to the customer during the first year. Costs for subsequent contract years can 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 electric energy savings, electric 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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