Energy Savings Performance Contracting and New Construction

Phillip L. Smith, PE, CEM

ABSTRACT

Energy savings performance contracting (ESPC) is a tool that has been available to the federal government for several years to assist departments and agencies to meet energy reduction targets mandated through a series of executive orders. ESPCs have been traditionally applied to existing facilities—an energy services company (ESCO) would gather data on a government customer's facilities, analyze that data to identify retrofits and operational strategies that would result in reduced utility costs to operate the facilities, and subsequently implement the identified retrofits/strategies using the savings generated by the improvements to pay for the improvements. The ESCO guarantees that the savings will be available to pay for the improvements, and it demonstrates that the savings exist through various measurement and verification protocols throughout the performance period of the ESPC.

In a new construction scenario, many of the data points available when undertaking a traditional ESPC are lacking. However, the General Services Administration, in partnership with the Department of Energy's Federal Energy Management Program (FEMP) element and a couple of ESCOs, has successfully adapted ESPCs to new construction by using innovative techniques to establish performance baselines and building system simulation programs. This article will cover the basic concepts in the application of ESPCs to new construction and use a couple of case studies—the federal courthouse in Gulfport, Mississippi, and the Federal Research Center at White Oak in Silver Spring, Maryland, to demonstrate the value of this approach to the federal government. The ESCO for both case studies was Sempra Energy Solutions (SES).

CONCEPTS

The application of ESPCs in a new construction scenario is a fairly recent innovation. The first delivery order awarded under one of the federal indefinite delivery, indefinite quantity "umbrella"-type contracts was made about two and a half years ago (September 2001). Since that initial project (the Gulfport Courthouse) was awarded, there have been a couple of other delivery orders awarded under the Department of Energy's IDIQs. There are a few other projects in the development phase.

The need that a new construction ESPC addresses is two-fold. The first aspect is the initial construction cost of a new federal facility. The current working estimates on federal projects often exceed the amounts programmed for these projects. This circumstance occurs for a variety of reasons, but the preeminent one is associated with the federal budget. The nature of the congressional authorization and appropriation process normally results in limited funding and lengthy approval times for new facilities. Projects may sit on the shelf for a number of years, and the budgets associated with these projects may not be updated to reflect current economic conditions at the time they are approved. Once approved, the ultimate end users of a facility take a renewed interest in its design, often resulting in some measure of functional scope creep. This puts additional pressure on an already constrained budget. Upgraded energy features intended for the facility often fall victim to bringing the budget back in line with the programmed amount.

The second aspect of the need for the ESPC/new construction approach is the energy performance of the building itself. Despite design criteria that call for high performance buildings, the desired level of performance is frequently not achieved. Part of the reason for this shortcoming is related to budget, as previously indicated. Another reason is the perspective that the designers of a building bring to the project. Safety factor upon safety factor is often applied to building mechanical systems to ensure the functionality of the end product. While the resultant building may indeed be functional, it may not be as energy efficient as it could be. Bringing an ESCO with an energy performance perspective onto the design team can serve to enhance the building's efficiency in that respect, helping overcome a "first cost" mentality that is nurtured by the normal facilities acquisition process with life-cycle costing considerations.

The idea of using an ESPC in the new construction environment is similar to that in a traditional retrofit scenario (see Figure 1). Energy savings are achieved via the introduction of various energy conservation measures (ECMs).

The principal difference between the retrofit and new construction application is that there are no actual utility bills for the new facility to establish a baseline energy performance. We'll look at some ways to address that difference later on in this article.

The degree of potential involvement by the energy services company is pretty large with new construction:

Concepts

Range of ESCO Services—Implementation

- Financing agent for ECM savings
- Install subset of ECMs
- Construct discrete, energy-related scope of work
- Subcontractor (mech, elec, and/or cntls) for entire building
- General contractor for entire building

At the minimalist end, the ESCO would serve as little more than a banker. At the other extreme, the ESCO could undertake construction of the whole building—a role that neither GSA nor FEMP has been quite willing to embrace at the time of this writing. On the two projects discussed in this article, Sempra ended up in the middle of this range: construction of a discrete, energy-related scope of work.

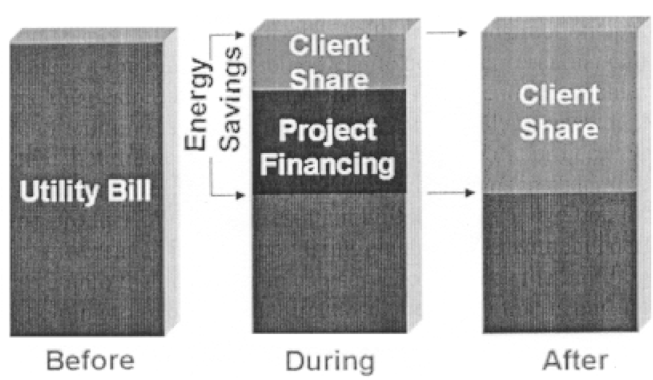

Figure 1. Concepts—Energy Performance Contracting

Savings achieved via introduction of various energy conservation measures (ECMs)

With regards to the operations and maintenance responsibilities attendant with a new construction ESPC, there is again a broad spectrum of potential levels of ESCO involvement:

Concepts

Range of ESCO Services—O&M

- Warranty only
- Operate and/or maintain ECMs installed by ESCO
- Operate and/or maintain all ESPC ECMs
- Full building operation and maintenance

In both the Gulfport and White Oak projects, Sempra ended up going with the maximum level of involvement: full building operation and maintenance.

Simulation programs were used to identify energy savings. Again, the concept is similar to that associated with a traditional retrofit scenario.

The basic approach for determining what you have to work with includes considering:

- Model baseline condition
- Value engineer design from energy standpoint
- Model energy efficient design

Energy $\$_{base}$ – Energy $\$_{eff.}$ = Level of Alternative Financing Available

You come up with a base case, see what that means in terms of energy use, and then compare that to the most energy efficient facility that can be achieved through this process.

Considerations that can be factored into the baseline include:

- Current design for new building.
- ASHRAE 90.1 standards.
- Energy performance of current location.
- Typical, recent experience of customer.
- Combination of above

Baseline establishment represents one of the most dynamic aspects of the ESPC new construction equation. You occasionally have to rein in the tendency to go with a baseline that would be associated with a total energy disaster-type building. You do not want to poison the well for further use of this concept.

The first case study that will be examined is the Dan M. Russell, Jr. United States Courthouse (see Figure 2) located in Gulfport, Mississippi.

The Gulfport project consisted of a new eight-story tower and the historic preservation of a 1923, two-story brick building, which was the former Gulfport high school. The project houses the offices of the United States District Magistrate and Bankruptcy Courts, District and Bankruptcy Court Clerks, Probation, Marshal Service, Attorney, Circuit Library, Senate and the General Services Administration (GSA). The former high school building is a Mississippi landmark and is eligible for designation on the National Register of Historic Places. The total square footage of the project is approximately 220,000 sf, which includes a stand-alone service building that supports the entire campus (chillers, boilers, emergency generator).

Sempra Energy Solutions' role consisted of general contracting, energy auditing, design engineering, financing, project management, commissioning, performance measurement and verification, and whole building operations and maintenance.

Categories of savings are similar to those you would see in a traditional retrofit ESPC:

Figure 2. Federal Courthouse, Gulfport, MS

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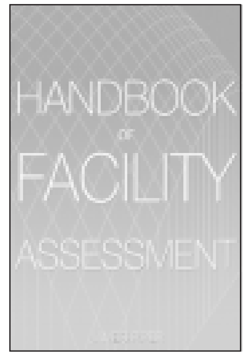

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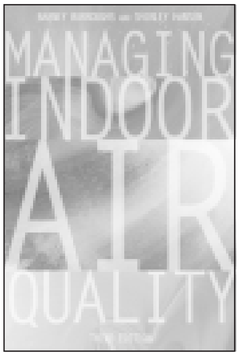

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- Annual savings
  - Energy savings
  - O&M savings

- One-time ancillary cost savings/cost avoidance

The principal difference is in how the savings are calculated.

Table 1 provides a summary of the ECMs that generated the energy savings for the Gulfport project:

Table 1.

• Glazing Upgrades	$10.2k
• Lighting Upgrades	$16.5k
• Lower ChW Coil Static Pressure	$8.1k
• VFDs on Air Handling Units	$8.3k
• **VFDs on ChgW & HW Pumps**	**$4.9k**
• **Increased Chiller Eff., Plant ΔT**	**$13.0k**
• Occupancy Controlled Ventilation	$10.0k
• **Cooling Tower Water Meter**	**$5.9k**
• Single Electrical Service Meter	$5.9k
Total Energy Savings	$83.7k

The primary ECMs—those reflected in bold type in the above table—represent those building features that Sempra, as the ESCO, physically installed. The dollar values associated with the energy savings resulting from those features for the first year of the performance period appear in the right-hand column.

The entries in the less-bold font are the secondary ECMs that contributed savings to this project. These features were installed by the general contractor for the courthouse. Again, the figures on the right represent the Year 1 energy savings.

Operations and maintenance savings contributed substantially to the viability of the project. Full building O&M is performed by Sempra, not just O&M on ECMs. The normal GSA approach to structuring an O&M contract is base plus four option years. As originally proposed, the performance period for Sempra to perform O&M services was 15 years; the period was extended to 17 years in the delivery order award.

This table summarizes the savings information previously described as well as the implementation cost of the project.

ESPC Financials

• Capital Investment:	$1.6 Million
• Annual Energy Savings:	$ 84 Thousand
• Annual O&M Savings:	$ 40 Thousand
• Cost Avoidance (annualized):	$ 37 Thousand
• Amount Financed: (17 years @ 8.4%)	$1.9 Million

This provides a snapshot of the economics that underwrote this ESPC delivery order. Note the substantial difference between the capital investment and amount financed figure. This $300K difference is a function of borrowing money at 8.4 percent, putting it into an escrow-type account earning about 2 percent, drawing the escrow account down during the process of purchasing equipment and completing construction, and then waiting for over a year to begin making payments against the amount borrowed. This represents an issue that should be addressed differently on projects with similar construction sequences.

The second case study is the Federal Research Center at White Oak (Figure 3). The overall project is a state-of-the-art 3-million square foot, $900 million Food & Drug Administration office and lab compound built by the General Services Administration. The campus is located on the site formerly occupied by the Naval Surface Warfare Center. The final build-out of the campus will be comprised of five groups of interconnected buildings and their shared infrastructure.

Sempra Energy Solutions' role consists of general contracting associated with the central utilities plant and campus electric and hydronic distribution systems in addition to design engineering, financing, project management, commissioning assistance, and performance measurement and verification, as well as whole building operations and maintenance

Figure 3. Federal Research Center—White Oak, Silver Spring, MD

for all buildings on the campus.

Table 2 represents a tabulation of the facilities that will comprise the FDA campus.

This project features the following elements:

- Combined heating and power for White Oak Campus.
- Energy conservation measures; includes photovoltaic element.
- Cost avoidance/one-time ancillary savings.
- Sempra-provided operations and maintenance services.

The centerpiece of this project is a cogeneration plant. The cogen plant is sized to support Phase 1 & 2 as shown in the facilities tabulation, expandable to support the entire campus at end-state. Additional energy savings beyond the cogen plant are derived from building-specific ECMs, most of which will be constructed by parties other than Sempra. The exception is the photovoltaic system, which will be installed by Sempra. Even though the PV system did not generate sufficient energy savings to be self-supporting, there were enough savings in the overall project to enable inclusion of this ECM.

Table 2.

PHASE	BUILDING NAME/GROUP	GROSS SQ FT	OCCUPANCY DATE
1	CDER LAB	129,000	Oct-2003
2	CDER OFFICE	554,000	Jan-2005
3	SHARED USE (Phase 1)	122,000	Mar-2005
3	CDER OFFICE Expansion	367,000	Apr-2006
3	CDRH LAB	128,000	Sep-2006
4	CDRH OFFICE	373,000	Dec-2006
3	LOGISTICS Bldg	141,000	Apr-2006
3	DAY CARE	21,000	Dec-2005
4	SHARED USE (Phase 2)	61,000	Jan-2007
4	CBER LABS	303,000	Nov-2008
4	CBER Bio Terror Lab	75,000	Mar-2008
4	CBER OFFICE	133,000	Nov-2007
4	CBER Bio Terror Office	105,000	Apr-2008
5	BUILDING ONE Renovation	90,000	Jan-2007
5	OC & ORA	357,000	Nov-2008
6	CVM OFFICE	123,000	Nov-2009
	Build-out	3,082,000	

ACRONYMS:

OC	Office of the Commissioner
ORA	Office of Regulatory Affairs
CUP	Central Utility Plant
CDER	Center for Drug Evaluation and Research
CBER	Center for Biological Evaluation and Research
CDRH	Center for Devices and Radiological Health

In addition to the cost avoidance associated with not having to pay for the central plant and associated hydronic and electrical distribution systems, some cost avoidance was identified due to a value engineering effort applied to the existing facilities designs. Finally, Sempra will provide O&M services to the campus.

The total savings make-up for the project is comprised of the following:

- One-time ancillary savings
  - — avoided demolition costs

- avoided construction costs
- avoided temporary heating and cooling costs

- Annual savings
  - energy savings
  - O&M savings

The maintenance shop portion of Building 100 was slated to be torn down. Instead, this structure now houses the chillers, boilers, and ancillary equipment for the central utilities plant. While retaining this structure did not save much in terms of CUP construction costs, it did help schedule-wise.

The most obvious savings related to this project is not having to build the CUP using capital appropriations. Although we identified these one-time ancillary cost savings, we did not spend much time trying to quantify/refine those savings, as they were not used in the overall financial mix of the project.

Energy savings were calculated by using the non-cogen to cogen case for supplying the total campus electric needs, then the cogen rate was applied to the other ECMs. PV savings were calculated using the local electric utility tariff. O&M savings were calculated by comparing non-SES to SES-provided services.

Table 3 is a snapshot of the fiscal elements of this project:

Table 3. Project Financials

• Capital Cost	$27.5M
• Annual Energy Savings	$ 1.4M
• Annual O&M Savings (net, 3rd year value)	$ 1.1M
• Total Annual Savings (net)	$ 2.5M
• Simple Payback 6.7 Years	
• Capital Cost Available from Savings —20 years @ 8.1%	$28.7M
• Required Construction Cost Savings (including avoided demolition)	$0

The capital cost line represents the cogen plant, hydronic distribution system, primary electric service, and photovoltaic component. There was no need to use cost avoidance to get the project to work financially.

The biggest contributor to the energy savings depicted in Table 4 was going from the purchase of power from the utility to producing power on-site.

Table 4. Energy Conservation Measure Savings

• Photovoltaic	$2,842
• Central Plant Improvements (CHP)	$1,040,000
• Lighting Upgrade	$41,849
• Glazing Upgrade	$54,800
• AHU Redesign	$158,011
• VFD on Pumps	$46,757
• Economizer Cycle	$18,443
• Demand Controlled Ventilation	$18,783
• Night Setback	$42,914
Total Energy Savings	**$1,424,000**

As previously mentioned, the central utilities cogeneration plant formed the centerpiece for this project. Building 100, both the fire house and the maintenance garage portions, is being refurbished and converted into an efficient central utility plant (CUP) that will provide all electric power, chilled water, and heating hot water for underground distribution to the FDA White Oak Campus of laboratories and office buildings.

The CUP will be constructed in three phases to meet the utility needs of the phased campus building construction schedule. CUP energy cost savings are derived primarily from:

- The use of natural gas engine driven electric generators to produce electric power.

- The recovery of waste engine heat to provide heating hot water and heat energy to drive an absorption water chiller.

- The use of high temperature difference chilled water and condenser water to reduce pumping and cooling tower fan energy.

The CUP produces and distributes 13,800 volt, 3-phase electric power, 39°F chilled water, and 200°F heating hot water. In the initial CUP construction phase, one 5,800 kW dual fuel (natural gas and diesel) engine driven generator is installed which will satisfy 100 percent of the Phase 1 and 2 electric power demand. The annual cost of natural gas and diesel fuel for the engine is less than the annual cost of purchased power from PEPCO under the existing tariff for the site. The "free" waste heat recoverable from the engine oil cooler and water jacket is transferred to the hot water heating system. Recoverable higher temperature waste heat from the exhaust stack gases is used in warm weather to power an 1130-ton absorption chiller. In cold weather the recoverable engine stack gas heat is added to the heating hot water system.

One of the most remarkable aspects of this project was the pace at which it developed. The concept of using an ESPC in conjunction with the White Oak campus was first proposed in October 2001. An initial proposal was submitted in January 2002, with the final proposal presented in March 2002. The delivery order for the ESPC was ultimately awarded in July 2002, only nine months after the notion was first introduced. This is less than half the amount of time it normally takes from kick-off to delivery order award for most traditional ESPCs. Hot and chilled water was provided to the campus approximately one year after award. The project entered the performance phase in January 2004.

Wrap up

Some factors were common to both of the case study projects that contributed to their success. Principal among these were:

- Identification of key stakeholders
- Continuous communication
- Mutually developed program goals

Getting everyone on board and engaged throughout the process is critical to having a successful project.

As alluded to during the examination of the two case studies, there are myriad benefits that can be realized by applying an ESPC approach to federal new construction, such as:

- Reduced first-cost to government;
- Reduced recurring costs to government;
- More energy efficient campus;
- Fixed accountability on systems performance.

Also, in the case of White Oak, greatly enhanced energy security for the campus was realized.

For both of the case studies presented, Sempra became involved relatively late in the design phase for the facilities to be supported. ESCO involvement much earlier in the process—preferably at the pre-concept stage—would have additional benefits in shaping the energy performance of the affected buildings. This appears to be the case with subsequent phases of campus development at White Oak.

As construction budgets become tighter and energy performance goals become more stringent, the ESPC/new construction approach should become more widely applied across all federal agencies.

ABOUT THE AUTHOR

Mr. Smith is the director of Federal Project Development for Sempra Energy Solutions. He developed and implemented several comprehensive energy savings performance contract projects for the federal government, as well as other public and private institutions during the course of the past five years. He was Sempra's project lead for the General Services Administration's new federal courthouse in Gulfport, Mississippi; and he is currently heavily involved at the senior project management level in development of the central plant to support the Food and Drug Administration's Federal Research Center at White Oak, Maryland. Prior to joining Sempra, Mr. Smith garnered 25 years of successful management and leadership experience as an officer in the U.S. Army Corps of Engineers, culminating with nearly seven years as director of Public Works at two major Army installations responsible for all aspects of engineering design, construction, facility maintenance and repair, utilities, housing operations, and environmental programs. He is

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