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Achieving Deeper Energy Savings in Federal Energy Performance Contracts

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ABSTRACT

Legislation requires each agency of the United States Federal Government to reduce the aggregate energy use index of its buildings by 30% by 2015, with respect to a 2003 baseline. The declining availability of appropriated funding means that energy performance contracting will be key to achieving this goal. Historically, however, energy performance contracts have been able to reduce energy use by only about 20% over baseline. Achieving 30% energy reductions using performance contracting will require new approaches and a specific focus on achieving higher energy savings, both by energy services companies (ESCOs) and by agencies. This paper describes some of the ways federal agencies are meeting this challenge and presents results from the efforts of one agency—the U.S. General Services Administration— to achieve deeper energy savings in conventional energy savings performance contracts.

INTRODUCTION

The Energy Independence and Security Act (EISA) of 2007 required each agency of the U.S. Federal Government to meet an annual schedule of targets for reduction in the aggregate site energy use intensity (EUI) of its buildings with respect to its 2003 baseline.[1] The schedule has the ultimate goal of a 30% reduction for each agency by 2015 (EISA 2007). Figure 1 illustrates the progress for the entire U.S. federal government through 2012, the latest year for which statistics are available. While results vary for individual agencies, it is seen that the government as a whole did not meet its goals for 2011 or 2012. Overall, the data since 2003 indicate that the aggregate EUI of government buildings is not falling rapidly enough to keep pace with the annual targets.

There are a number of factors in the pipeline that could mitigate this situation. The American Recovery and Reinvestment Act of 2009 (ARRA) awarded $5.5 billion to the U.S. General Services Administration (GSA) to convert federal buildings to high-performance green buildings and to build new, energy-efficient federal buildings, courthouses, and land

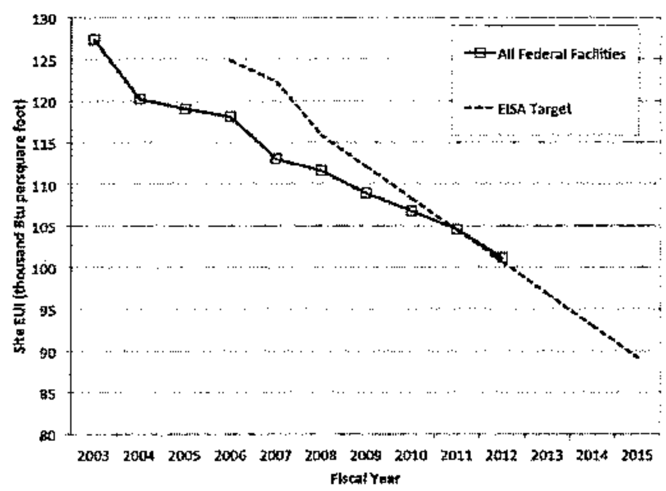

Figure 1 *Aggregate site energy use index (EUI) for U.S. federal buildings, 2003–2012, with annual targets as mandated by the Energy Independence and Security Act (EISA) of 2007.*

[1] All years quoted refer to the U.S. government's fiscal year, which begins on October 1 and ends on September 30. Thus, October 1, 2014 is the first day of fiscal year 2015.

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ports of entry (ARRA 2009). Another $7.4 billion in ARRA funding was awarded to the Department of Defense (DOD) for construction and retrofit of energy-efficient buildings and other energy-related projects. Some projects from both agencies were still under construction at the end of 2012 when statistics for Figure 1 were reported. In addition, in December 2011, President Obama challenged federal agencies to enter into $2 billion worth of performance-based energy service contracts by the end of 2013. Few of these projects had been constructed by the end of 2012 either. In May 2014, the President renewed his commitment to this effort, challenging federal agencies to enter into an additional $2 billion in performance-based contracts by the end of 2016.

While investment from ARRA and the presidential challenge will certainly help the government meet its energy goals, federal agencies will also need to achieve deeper savings than they have from energy conservation projects performed in the past. Greater emphasis on the use of performance-based contracting means that these deeper savings will have to be achieved through energy savings performance contracts (ESPCs) and utility energy savings contracts, the two primary pay-from-savings contracting vehicles available to the federal government. Unfortunately, as discussed below, such vehicles tend to deliver only modest levels of savings. This paper describes several approaches to achieving deeper energy savings using performance-based contracts.

SAVINGS FROM HISTORICAL ENERGY PROJECTS

Determining the change in EUI that results from a typical federal energy performance contract is problematic. Federal projects tend to involve subsets of buildings at large multi-building facilities such as military bases, prisons, and laboratories. Since individual buildings at these facilities are rarely metered, measurement and verification of savings is achieved through retrofit isolation methods, i.e., options A and B according to the terminology of the International Performance Measurement and Verification Protocol (EVO 2012). Usually no attempt is made to determine savings on a building-wide basis. However, for this paper, the authors were able to obtain the percent energy reduction for a group of 84 recently awarded federal ESPC projects. The average reported savings for this group was 21.2%.

Clearly, reducing EUI by an average of 21.2% will not allow the government to achieve its goal of reducing EUI by 30%. For this reason, government agencies have actively sought to increase the level of energy savings that can be obtained through energy performance contracting. Several such methods are discussed in the sections that follow.

COMBINING ESPC WITH BUILDING RENOVATION

Many agencies provide limited funding to perform renovations of existing buildings. A good example is the DOD's sustainment, restoration, and modernization (SRM) program. An Air Force document (USAF 2003) defines these three activities as follows:

- **Sustainment:** Includes annual maintenance and scheduled repair activities to maintain the inventory of real property assets through its expected service life. Includes regularly scheduled adjustments and inspections, preventive maintenance tasks, and emergency response and service calls for minor repairs. Also includes major repairs or replacement of facility components that are expected to occur periodically throughout the life cycle of facilities. This work includes regular roof replacement, refinishing of wall surfaces, repairing and replacement of heating and cooling systems, replacing tile and carpeting, and similar types of work.
- **Restoration:** Includes repair and replacement work to restore facilities damaged by inadequate sustainment, excessive age, natural disaster, fire, accident, or other causes.
- **Modernization:** Includes alteration of facilities solely to implement new or higher standards (including regulatory changes), to accommodate new functions, or to replace building components that typically last more than 50 years (such as foundations and structural members).

Combining ESPC With SRM Energy Funds

Where DOD installations have SRM funds designated solely for energy conservation measures (such as the replacement of HVAC equipment), one method of achieving deeper energy savings is to use these funds as one-time payments from savings in more comprehensive ESPC projects. Such one-time payments improve the economics of an ESPC by reducing the amount that must be financed. This allows additional, longer payback conservation measures to be included in the project, increasing the level of savings that the ESPC would achieve without the one-time payment.

There is a long history of using SRM and other available appropriations as one-time payments in ESPC projects. Such payments are permissible under law if the ESPC accomplishes the objective that the SRM or other funding was intended to achieve or makes the original project unnecessary. An example would be where a DOD site has SRM funding available for modernization of a central boiler plant and an ESPC at the site includes installation of distributed ground-source heat pumps to provide cooling and heating for the buildings served by the central plant. The ESPC would demolish the central plant, making the modernization project there unnecessary. This would free up the SRM funding for use as a one-time payment from savings in the ESPC project.

Combining ESPC With Comprehensive SRM Renovation Projects

Nevertheless, the majority of SRM projects are designed to achieve comprehensive renovations of buildings. These projects include some activities that are related to building energy use and others that are not. Reducing energy use is often a secondary goal, behind extending the useful life of the building, and the projects tend to achieve energy reductions on the order of 20% over the baseline.

As with energy-focused SRM projects, much deeper energy savings could be achieved in comprehensive renovations if it were possible to apply the energy-related portion of the SRM funding as a one-time payment from savings in an ESPC. As an example, consider replacement of single-pane windows with double-pane windows, which could be necessary in a comprehensive renovation of an older structure. If the cost of the double-pane windows were available to the ESCO as a one-time payment from savings, private financing could fund the incremental cost of triple-pane windows under an ESPC. Likewise, if the cost of a conventional roof replacement were available to the ESCO as a one-time payment from savings, private financing could fund the incremental cost of additional insulation. Reducing heating and cooling loads using triple-pane windows, a highly insulated roof, and other efficiency measures could have a synergistic effect, reducing the required capacity of heating and cooling equipment. This would further reduce the energy use of the building and improve the economics of the ESPC project, allowing additional conservation measures to be implemented. It is estimated that such projects can achieve savings greater than 50% over the baseline (Zhivov 2013).

Unfortunately, a number of issues must be worked out before such a project becomes possible. First of all, by legislation, only energy-conservation measures can be installed in a federal ESPC project. This means that a separate contractor, in addition to the ESCO, is required to perform tasks unrelated to building energy use, such as replacement of foundations and structural members and replacement of tile and carpeting. Coordinating contract award, design, and construction of two closely-related projects being performed by separate contractors under separate contracts—and separate contracting structures—creates legal, procurement, and logistical issues that have yet to be fully resolved.

GSA'S APPROACH

As the landlord for the civilian U.S. federal government, GSA maintains an inventory of more than 376 million square feet (35 million square meters) of workspace for 1.1 million federal employees and preserves more than 481 historic properties. Although GSA was a major recipient of funding from the ARRA legislation, additional funding is needed to upgrade all of its facilities and meet the EISA energy reduction target by 2015.

GSA receives some limited funding from Congress for building sustainment and modernization and could benefit by combining such projects with ESPC. However, while legal and contracting issues associated with the combined funding approach are being resolved, GSA chose a more conventional approach to achieving deeper energy savings in its ESPC projects. For its National Deep Energy Retrofit (NDER) program, GSA used the Department of Energy (DOE)'s ESPC indefinite delivery, indefinite quantity (IDIQ) contract directly, i.e., with no expectation of one-time payments from savings (though appropriations were eventually used in some projects). A series of design charettes was held involving ESCOs, GSA regional offices, and DOE's Federal Energy Management program to emphasize both to the ESCOs and to GSA managers the desire to achieve deeper energy savings. Participants in the charettes analyzed the barriers to achieving deeper energy savings in ESPC projects, and developed collaborative solutions for overcoming barriers.

As part of the NDER effort, GSA also established a project management office (PMO) to centralize the ESPC award process. The PMO's guidance on pricing, financing, engineering, and contracting gave regional offices the confidence they needed to quickly move forward with projects and maintain steady progress. As a result, GSA was able to award ten projects in two months' less time than the average length of time required to award a single project under DOE's IDIQ contract.

The ten ESPC task orders awarded by GSA under the NDER program had a total value of $172 million. The task orders cover 14.7 million square feet (1.4 million square meters) of space at 21 facilities. They will reduce GSA's energy consumption by 365 billion Btu (385,00 GJ) per year, resulting in a $10.8 million annual cost savings.

GSA's approach ultimately did result in deeper energy savings for the NDER projects. The ten NDER projects were among the 84 federal ESPC projects for which the authors obtained data on percent savings over the baseline. The average savings for the GSA NDER projects was 38%, compared to just 19% for the remaining 74. Based on the Wilcoxon signed-rank test, the difference in means between the percent savings of the ten GSA NDER projects and the 74 non-NDER projects is statistically significant with $p = 0.00296$. One project will achieve net zero energy use (100% savings) and another will achieve 60% energy savings. GSA has shown that conventional ESPC projects can achieve the same level of savings as has been promised for the mixed-renovation-ESPC approach, without the legal and logistical hurdles.

Analysis of GSA NDER Results

All things being equal, one would expect deeper energy savings to be associated with higher preretrofit energy use and higher energy prices. Higher preretrofit energy use should present more opportunities for conservation, and higher energy prices should allow the energy savings to finance more energy conservation measures. If this is the case, it would provide GSA with a simple first-order method of selecting candidate sites for future deep retrofit efforts.

Figure 2 is a plot of the percent savings achieved in the ten GSA NDER projects versus the preretrofit EUI. If anything, the data indicates that higher preretrofit EUI is associated with lower savings. However, this trend seems to be an artifact due to the presence of the single project that achieved 100% savings. Figure 3 excludes this point. The trend is still for lower savings with higher preretrofit EUI, but the slope of this line is not statistically significant.

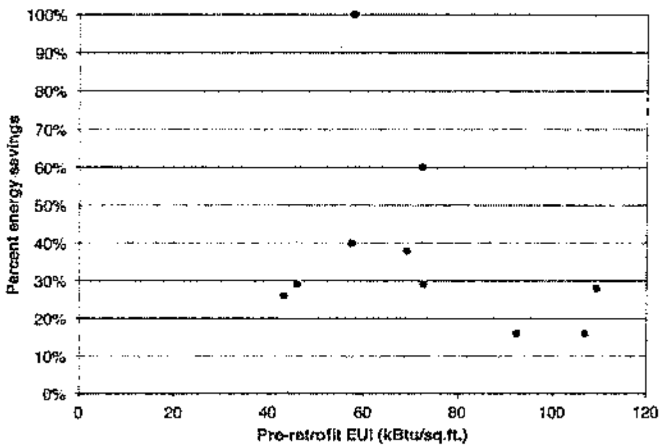

Figure 2 *Percent savings over baseline versus preretrofit EUI for GSA NDER projects.*

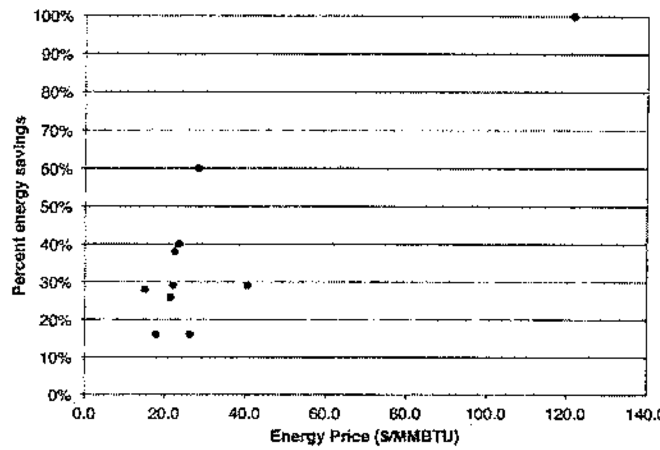

Figure 4 *Percent savings over baseline versus energy price per MMBtu (MJ) for GSA NDER projects.*

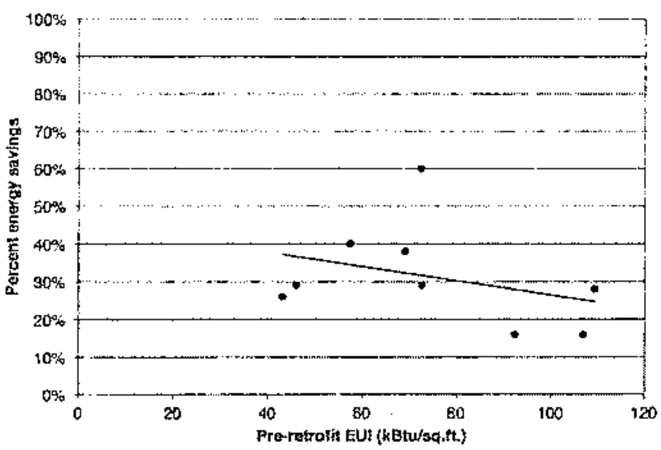

Figure 3 *Percent savings over baseline versus preretrofit EUI for GSA NDER projects, excluding the net zero project.*

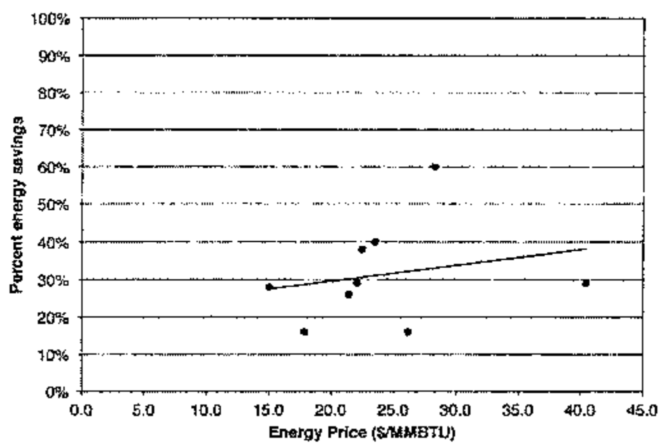

Figure 5 *Percent savings over baseline versus energy price per MMBtu (MJ) for GSA NDER projects, excluding the net zero project.*

Figure 4 is a plot of percent savings over baseline versus energy unit price ($/MMBtu [MJ]) for the ten projects. The figure indicates that higher energy prices are associated with higher savings, but, again, this perception is due to the presence of the single net zero project. When this point is excluded, as in Figure 5, the trend line is still in the expected direction—with higher energy prices being associated with higher savings—but the slope of the line is not statistically significant.

A similar result is evident when percent savings is plotted versus energy cost per unit building area. Figure 6 shows that higher energy costs are associated with higher savings, but again, the single net zero project is influencing this perception. When this point is excluded, as in Figure 7, the trend is not as clear; in fact, the regression line indicates that higher energy cost is associated with lower savings. Again, however, the slope of the line is not statistically significant.

The availability of one-time payments from savings is another factor that could affect the level of savings achieved. One-time payments improve the economics of ESPC projects, allowing more energy conservation measures to be included, which could result in higher savings. However, as shown in Figure 8, this was not the case for the ten GSA NDER projects. Percent energy savings appears unrelated to the percentage of the total investment that was made available to the ESCO as a one-time payment from savings.

The ten projects from the GSA NDER program provide too small a sample from which to draw definitive conclusions. However, the results do provide some negative evidence: based on these projects, there is no evidence that the level of savings available through ESPC is associated with higher energy prices or with preretrofit EUI. Put another way, the results show that low energy prices and low preretrofit EUI are

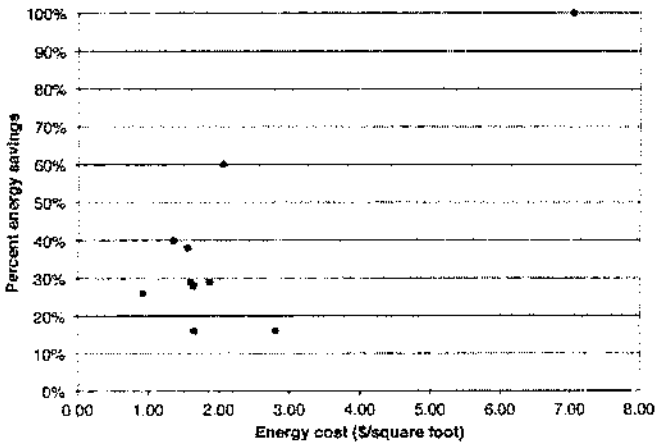

Figure 6 *Percent savings over baseline versus energy cost per square foot (0.093 meters) for GSA NDER projects.*

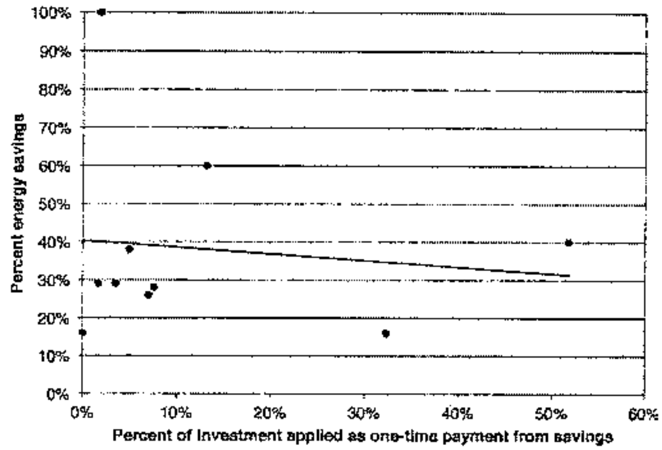

Figure 8 *Percent savings over baseline versus percent of investment that was provided as a one-time payment from savings by GSA.*

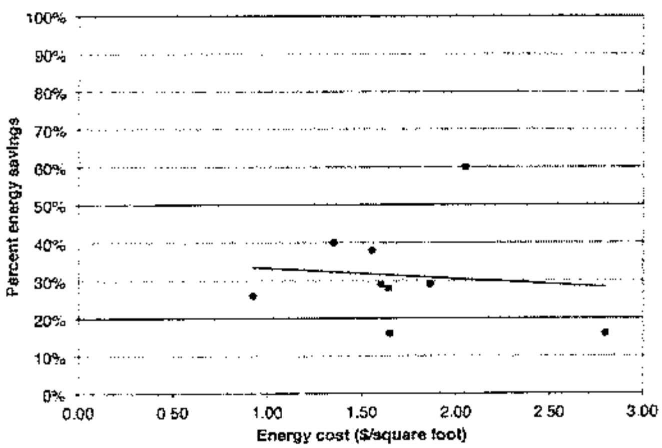

Figure 7 *Percent savings over baseline versus energy cost per square foot (0.093 meters) for GSA NDER project, excluding net zero project.*

no reason to exclude buildings from consideration for deep energy retrofit projects. The lack of availability of appropriations does not seem to be a barrier either, as the percent savings achieved in these projects appeared unrelated to the amount of investment made available as a one-time upfront payment. It is likely that deep energy retrofits are possible in a wide variety of GSA buildings. GSA is examining other methods of screening buildings, including analysis of 15-minute interval energy use data.

CONCLUSION

In the U.S., two main models have emerged for achieving deeper energy savings in energy performance contracts. One is to combine a performance contract with a comprehensive renovation project. Analysis suggests that this method has the potential to achieve savings greater than 50%. However, contracting law in the U.S. makes it likely that such an approach will require a separate contractor in addition to the ESCO to perform construction tasks unrelated to building energy use. Coordinating contract award, design, and construction for two closely related projects being performed by separate contractors under separate contracts—and separate contracting structures—creates legal, procurement and logistical issues that have yet to be fully resolved. One such project is under development by the U.S. Army, but it remains to be seen whether this approach, for all its potential, will be possible under current federal acquisition regulations.

The U.S. General Services Administration chose a more conventional path toward deeper energy savings, using DOE's ESPC IDIQ contracting vehicle directly. A key element of GSA's National Deep Energy Retrofit strategy was a series of design charettes that examined methods to overcome barriers to deeper savings and signaled to both energy service companies (ESCOs) and regional GSA managers that the projects were intended to achieve higher savings than previous ESPCs. The establishment of a central project management office to manage the NDER and other projects was another key innovation. As a result, GSA's NDER projects achieved average savings of 38%, which is twice the average savings achieved in a set of 74 other recently awarded federal ESPC projects. These results are statistically significant. Two of the ten projects achieved energy savings greater than 50%, indicating that GSA's approach can achieve the same level of savings as that promised for an ESPC combined with a comprehensive renovation.

REFERENCES

ARRA. 2009. *American Recovery and Reinvestment Act of 2009.* Washington, DC: U.S. Congress. www.gpo.gov/fdsys/pkg/BILLS-111hr1enr/pdf/BILLS-111hr1enr.pdf.

EISA. 2007. *The Energy Independence and Security Act of 2007*. Washington, DC: U.S. Congress. www.gpo.gov/fdsys/pkg/BILLS-110hr6enr/pdf/BILLS-110hr6enr.pdf.

EVO. 2012. International performance measurement and verification protocol: Concepts and options for determining energy and water savings, volume 1. International Performance Measurement and Verification Protocol. Energy Valuation Organization. http://evo-world.org/

USAF. 2003. Planning and Programming appropriated funded maintenance, repair, and construction projects. Air Force Instruction 32-1032. www.wbdg.org/ccb/AF/AFI/afi_32_1032.pdf.

Zhivov, A. 2013. Energy Efficient Retrofit of Government/Public Buildings. Presentation to IEA ECB Program Executive Committee Meeting Technical Day, June 12, Rome, Italy. www.enea.it/it/enea_informa/events/riqualificazioneedifici_12giu13/05ZhivovPresentationinRome.pdf.