Energy Savings Performance Contracting in the United States:
A Report to Tekes, the Finnish Technology Agency

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Abstract

This report presents case studies of eight energy savings performance contracts (ESPCs) performed in a variety of public and private buildings in the United States. The case studies examine the building owners’ reasons for using ESPC, the process by which the contract was implemented, the energy conservation measures installed, the approach to measurement and verification of savings, and lessons learned. Finally the report examines the common aspects of the eight cases and suggests some best practices for use of ESPCs.

Abbreviations

DOE   U.S. Department of Energy
DSHS  Department of Social and Health Services
ECM   Energy conservation measure
ESCO  Energy services company
ESPC  Energy savings performance contract(ing)
FEMP  DOE Federal Energy Management Program
GSHP  Ground source heat pump
ha    Hectare
HVAC  Heating, ventilating, and air conditioning
IDIQ  Indefinite-delivery, indefinite-quantity (contract)
IPMVP International Performance Measurement and Verification Protocol
kW    Kilowatt
kWh   Kilowatt-hour
M&V   Measurement and verification
MTSU  Middle Tennessee State University
MW    Megawatts
NARA  National Archives and Records Administration
RFQ   Request for qualifications
TJ    Terajoule (10^{12} Joules)
TMY   Typical Meteorological Year
TSSBA Tennessee State School Bond Authority
UESC  Utility energy services contract
Energy Savings Performance Contracting in the United States: A Report to Tekes, the Finnish Technology Agency

Introduction

An energy savings performance contract (ESPC) is a method of financing energy efficiency improvements in which the cost savings generated by the installed conservation measures are used to pay all financing and investment costs for the project. In the United States, ESPCs account for about $2 billion in project investment each year, with about 17% of the investment in facilities operated by the U.S. federal government, 50% in other public and institutional facilities, and 33% in privately owned facilities.

As public-sector organizations in the United States have sought to reduce their energy consumption and cost, ESPCs have played an increasingly important role in improving energy conservation goals. For example, of the $450 million spent on energy conservation improvements each year at federal facilities, only 24% is funded by Congressional appropriations. Regarded as an “alternative” funding source only a few years ago, energy savings performance contracting is now the predominant method of procuring energy conservation measures (ECMs) for government facilities.

ESPCs offer several advantages to public institutions in addition to energy conservation. Budget requests for capital improvement projects can take years to yield funding, and even then there are no guarantees that requests will be granted. An ESPC is usually a much faster and more certain means of realizing energy improvements and related infrastructure improvements. Also, ESPCs require no up-front investment on the part of the facility owner (though capital funds are sometimes used to leverage larger projects).

An important difference from the traditional design–bid–build process is that in an ESPC, the energy services company (ESCO) provides a single point of accountability, from energy audit through design, construction, and commissioning. This eliminates any uncertainty about who is responsible if design or construction issues arise. ESPC contracts are also negotiated with a fixed price. The ESCO guarantees the construction cost and assumes financial responsibility for cost overruns. Unless the facility owner elects to increase the project scope, there are no change orders.

Savings and performance guarantees are another advantage of ESPCs. In a traditional construction contract, equipment performance is usually guaranteed for one year. In most ESPCs, the ESCO provides a guarantee of energy savings and must reimburse the owner for any savings shortfalls. The ESCO’s (or contractor’s) measurement and verification
(M&V) services provide the owner with assurance that the specified performance of the equipment and standards of service (temperature, humidity levels, etc.) will be maintained for the life of the contract.

Despite their benefits, ESPCs do offer some challenges for public entities. Because of the wide array of technical, financial, legal, and energy-related issues that must be addressed, negotiating an ESPC can be a complicated and time-consuming process. Since few ESPC customers have expertise in all of these areas, most require some type of third-party assistance. Many of the U.S. states that promote ESPCs offer some type of technical and contracting assistance. The federal government offers similar assistance to its agencies through the U.S. Department of Energy’s (DOE’s) Federal Energy Management Program (FEMP) and other programs.

This report presents case studies of eight ESPC projects carried out in the United States. These projects cover a broad geographical area and involve a variety of different institutional settings and ESPC implementation models. This report focuses primarily on ESPCs in the public sector because federal, state, and local governments comprise the majority of the U.S. ESPC market, and also because information about their ESPCs is generally in the public domain and readily available, as opposed to proprietary information about private-sector contracts. Three of the projects were for federal sites, four were for other public institutions, and one was for a privately owned building. These case studies are intended to provide Tekes and the government of Finland with a useful introduction to how ESPCs are used in the United States.
U.S. Army’s Fort Polk

Background

Fort Polk is a 200,000-acre (81,000-ha) U.S. Army base in West Central Louisiana near the town of Leesville. As of the early 1990s, the base contained 4003 permanent family housing units in 1290 separate buildings. Constructed in nine phases between 1972 and 1988, most buildings were townhouses comprising two-to-six attached units. The majority were heated and cooled by minimum-efficiency electric heat pumps, while about 20% used minimum-efficiency electric central air conditioning and natural-gas-fired furnaces. The base had outsourced the maintenance of this equipment, much of which was nearing the end of its useful life, to a series of private contractors, but by 1993 the high numbers of service calls had overwhelmed several contractors’ budgets and their capabilities to provide acceptable service to the tenants.

Faced with the requirements of Executive Order 12902, which called for a 30% reduction in energy use by 2005 relative to 1985 consumption in, and with much of its space conditioning equipment nearing the end of its useful life, Fort Polk’s family housing was in need of major renovation. With no prospect for the large appropriation required to install new equipment, Fort Polk chose to implement an ESPC. With the assistance of the Army’s Center of Excellence for Performance Contracting (U.S. Army Engineering and Support Center in Huntsville, Alabama), a feasibility study was performed and a request for proposals developed. The RFP conveyed a preference for the use of ground source heat pumps (GSHPs). An agreement was negotiated based on the one bid received from Co-Energy Group.

The Contract

The contract between the Army and the ESCO was a shared-savings type of performance contract. It called for Co-Energy Group to replace the heating and air conditioning in all
4003 of the family housing units with GSHPs and other ECMs in return for a share of the resulting energy and maintenance cost savings over a 20-year period. Co-Energy Group would install $18.9 million worth of equipment in the residences and would also be responsible for maintenance, repair, and replacement of the installed equipment over the life of the contract.

Co-Energy began installing GSHPs — with a total capacity of about 6600 tons, or 23,200 kW — and corresponding vertical bore heat exchangers in 1995. In most units, a hot gas desuperheater was installed on the heat pumps to supplement hot water heating. Indoor and outdoor light fixtures were converted to compact fluorescent lighting, and some fixtures were delamped altogether. Low-flow shower heads were installed in each residence, and ceiling insulation was added in some upstairs units.

**Measurement and Verification**

As originally awarded, the contract called for using M&V Option C, which is utility meter billing analysis (IPMVP 1999). The objective was to determine savings by comparing actual monthly energy use with historical use, with savings valued at the actual blended rate charged by the utility.

The contract contained a formula for the baseline monthly electricity consumption in kWh as a function of total degree days (defined as the sum of monthly base-65°F heating and base-65°F cooling degree days). Based on regression of about five years of historical billing data for all areas of Fort Polk (including non-residential areas) with total degree days, this formula was used to predict the monthly electricity consumption that would have occurred if the retrofits had not been installed. In each month, the ESCO’s payment for electricity savings was determined as follows:

1) The number of base-65°F heating and cooling degree days in the previous month (as measured at the weather station at Fort Polk’s airfield) was summed to determine the number of total degree days.

2) The number of total degree days was substituted into the regression formula to determine the baseline electricity consumption.

3) The actual electricity consumption (as determined from that month’s utility bill) was subtracted from the baseline electricity consumption to determine the number of kWh saved for the month.

4) The number of kWh saved was multiplied by the blended electricity rate (total electricity cost divided by total kWh consumed, according to that month’s utility bill) to determine the electricity cost savings.

5) The electricity cost savings was multiplied by a percentage to determine the ESCO’s share of the monthly electricity cost savings. The schedule for the ESCO’s share began at 80% in the first year of the contract, rose to 90% by year three, and declined thereafter to 65% by year 20. Overall, the ESCO was to have received 77.5% of the electricity cost savings.
6) A similar procedure was used to determine gas savings.

Since the ESCO was assuming responsibility for maintenance and repair of the installed equipment, Fort Polk would no longer have to pay a private maintenance contractor. This maintenance savings was shared with the ESCO as well. Based on what it had been paying the maintenance contractor, Fort Polk calculated its per-residence maintenance cost. This cost was inflated each year along with the consumer price index to calculate the maintenance cost savings. Similar to the schedule for energy savings, the ESCO received a share of the maintenance savings that began at 80% in the first year of the contract, rose to 90% by year three, and declined thereafter to 65% by year 20. Overall, the ESCO was to receive 77.5% of the maintenance cost savings.

The contract included no provision for savings shortfalls. The ESCO was to be paid according to actual energy savings as determined from the regression formula and the monthly bills using current-month energy rates.

**Project Results**

The Fort Polk ESPC was the subject of an extensive evaluation performed by Oak Ridge National Laboratory (Hughes and Shonder 1998). The conservation measures were shown to reduce electrical energy use by 25.8 million kWh per year, which is 32.5% of the electrical energy previously used in family housing. Peak electricity demand in a typical year was reduced by 7.55 MW, which is 43.5% of the pre-retrofit peak demand. In addition, the project reduced natural gas consumption by 260,000 therms (27 TJ). All savings figures are normalized to a Typical Meteorological Year (TMY) at the site.

Although the conservation measures performed as expected, as time went on the contract itself was found to have a number of limitations. One problem discovered during initial stages of construction was the requirement for a summer indoor design temperature of 78°F (26°C) and a winter indoor design temperature of 68°F (20°C). While not too far outside the norm, many Americans would find such setpoints to be uncomfortable. However, in accordance with this requirement, the ESCO installed thermostats that did not allow these setpoints to be exceeded. When tenants began complaining that their residences were too cold in the winter and too warm in the summer, base personnel installed ceiling fans in some of the residences. These of course used additional electrical energy and reduced the savings from the retrofits. Eventually, Fort Polk requested that the ESCO replace the non-adjustable thermostats with conventional adjustable ones. This decision also reduced the electricity savings from the project.

The M&V plan for the Fort Polk project was designed to estimate the actual gas and electricity savings as accurately as possible by comparing actual monthly energy use against pre-retrofit energy use as calculated, per calendar month, by regression analysis of five years’ pre-retrofit energy use data. The savings were then to be valued at the actual prices paid for gas and electricity. While such attention to accuracy may seem like a good idea, there are drawbacks to this approach. In an ESPC of this type, the ESCO obtains private financing to purchase and install the conservation measures. The
payments from the site to the ESCO are based on actual monthly energy savings, which depends on the weather. Because the GSHPs are more efficient than the equipment that was replaced, the longer the GSHPs operate (to heat or cool the residences) the more energy is saved. Conversely, in relatively mild weather when less heating and cooling is required, energy savings are reduced. In their shared-savings agreement with Fort Polk, the ESCO assumed the risk that mild weather would reduce energy savings and the site’s payments, and therefore increased the risk that the contract would not yield sufficient income to make the loan payments to the financier.

Another drawback of the Fort Polk contract was the use of the current blended electricity rate to value the savings and determine the payments to the ESCO. Under this arrangement, the ESCO assumed the risk that payments from the site would be reduced if electricity prices fell.

Today shared-energy-savings contracts are rare because of the effort required to determine energy and cost savings monthly, and also because these contracts represent a high degree of uncertainty and risk to the ESCO. ESCOs and ESPC customers have generally agreed since then that sharing the weather and energy price risks is a better deal for both parties than forcing the ESCO to take those risks and price them into the contract. In most ESPC contracts today, the site assumes the risk for both weather and energy prices, and the ESCO guarantees a level of savings sufficient to pay off the financing for the project in a timeframe that is acceptable to the customer. Energy savings are calculated on the basis of a TMY, and energy prices are assumed to escalate throughout the contract term at a fixed rate that is negotiated by the site and the ESCO. Payments are generally fixed, increasing annually according to the negotiated rate of energy price escalation.

Valuing electricity savings at the blended rate (i.e., the total monthly cost divided by the number of kWh consumed) also tends to underestimate the true value of the savings, because blended rates are always lower than marginal rates — the rates that are effective at the highest level of energy consumption, where the savings actually occur. In the case of Fort Polk the retrofits significantly lowered peak demand as well as overall usage. Without the usual peak demand charges, the blended monthly electricity rate severely undervalued the cost savings.

As it turned out, a few years after the ESPC was awarded it was modified to correct these problems. Energy savings were calculated based on a TMY, with constant electricity and gas savings (one-twelfth of the annual amounts) assumed each month. Energy rates for calculating cost savings were adjusted to make them closer to the marginal rates and were escalated at a constant rate through the rest of the contract term.

In 2003, in keeping with privatization efforts being made throughout the U.S. Department of Defense, the Army privatized Fort Polk’s family housing. The Fort Polk ESPC was liquidated, and Co-Energy was paid an amount sufficient to pay its creditors.
U.S. DOE–FEMP Super ESPC Program

Background

The U.S. Department of Energy’s Federal Energy Management Program (FEMP) created the Super ESPC program to reduce the time and effort required for Federal agencies to award ESPC contracts at federal agency facilities. FEMP awarded indefinite-delivery, indefinite-quantity (IDIQ) contracts to selected ESCOs using a process that fulfilled the competition requirements of the Federal Acquisition Regulations (FAR). To set up ESPC projects for their facilities, agencies award delivery orders to the pre-selected Super ESPC ESCOs.

Super ESPC project development is carried out in four phases. In Phase 1, an ESCO and an agency explore opportunities for energy savings through informal communications, meetings, and exchange of information. If the potential for a project exists, the ESCO develops an initial proposal, which is the goal of Phase 2. The initial proposal is based on a preliminary survey of the site and includes a description of proposed energy conservation measures (ECMs) and estimates of energy and cost savings. The agency reviews the initial proposal and decides whether or not to proceed.

If the initial proposal is acceptable, development proceeds to Phase 3. The agency transmits a letter confirming its intention to award the delivery order to the ESCO and issues a delivery order request for proposal. In response, the contractor performs a detailed energy survey and submits a report that describes the basis for the project’s contractually guaranteed savings. The detailed energy survey is the ESCO’s comprehensive audit of facilities and energy systems at the project site. The detailed energy survey augments, refines, and updates the preliminary site survey data and provides the information needed to update the feasibility analyses of the ECMs under consideration for the project. The agency's project team reviews the proposal and submits its comments to the ESCO. Based on these comments and further negotiation, the ESCO develops a final proposal. This is a fixed-price proposal for installation of the ECMs, and usually includes performance of ongoing services such as M&V and operations and maintenance. Phase 4 of the development process entails construction, commissioning, and agency acceptance of the ECMs.

The performance period begins after the agency formally accepts the completed project. In the United States, most agencies of the federal government are funded by the U.S. Congress through the budget process and are prohibited from issuing their own debt. For this reason, the ESCO obtains the financing required to fund project construction. During the performance period, the agency pays the ESCO from the savings that are generated by the ECMs. The ESCO uses this payment to repay the lender and to fund the performance-period services called for by the contract.
Federal regulations require that the savings from Super ESPCs exceed their costs in each year of the contract, and the ESCO must guarantee a level of annual cost savings that is sufficient to pay for the debt service and any performance-period services under the contract. M&V is also required, and at least once a year, the ESCO produces an M&V report detailing the results of a program of measurements, inspections, engineering calculations, and comparisons with energy baselines, carried out to estimate the level of savings being delivered by the installed equipment. If the savings do not meet the guarantees, the agency can withhold payments to the ESCO up to the level of the shortfall.

A key element of the Super ESPC program is the use of project facilitators, who assist the agency in the contract development process. FEMP project facilitators are objective, expert consultants for technical, financial, and contractual issues who help to optimize the financial value of ESPC projects. Use of a project facilitator is mandatory for those who use DOE’s Super ESPCs. Up to the notice of intent to award (end of Phase 2) FEMP provides project facilitation free of charge; further services through the first year of the performance period are available on a reimbursable basis.

Since the program began in 1998, more than $700 million in conservation projects have been funded through the use of Super ESPCs, saving the federal government an estimated $1.6 billion in energy and energy-related costs.

A Typical Project

An example of a recent Super ESPC project is the one being implemented by Johnson Controls, Inc. for the National Archives and Records Administration (NARA). The project involves the Lyndon B. Johnson Library in College Station, Texas, and the Gerald R. Ford Library in Ann Arbor, Michigan. The ECMs in this project are listed below:

Gerald R. Ford Library
- Boiler replacement
- Energy management control system upgrade
- Variable air volume conversion
- Energy efficient lighting upgrade
- Variable-frequency-drive electric motors

Lyndon B. Johnson Library:
- Chilled water and hot water systems improvements
- Energy management control system upgrade
- Airflow improvements
- Heating, ventilation and air conditioning system upgrades
- Energy efficient lighting upgrade
The total implementation price of $4.3 million dollars (which is very nearly equal to the program average of $4.7 million) is financed for 20 years at 6.2% interest. The project is expected to save 1.4 million kWh of electricity, 3300 MBtu of natural gas and 23,000 MBtu of steam each year. The total estimated cost savings in the first year of the performance period is $498,000. Based on analysis of previous years’ utility bills, it was agreed to escalate this amount by 2.9% per year. Of the estimated savings, the ESCO guarantees 75%, and each year NARA pays the ESCO one dollar less than the guaranteed savings.

In addition to debt service, payments to the ESCO fund performance-period services costing $65,000 per year (escalating at the same rate as the guaranteed savings) of which about 40% is for M&V, 43% is for operations and maintenance, and 17% is for management and administration.

M&V for the project is mostly based on FEMP’s Option D, which is calibrated simulation. During project development, Johnson Controls used building energy analysis software to develop pre-retrofit models of the libraries’ energy use as a function of weather, occupancy, and other parameters. The models were calibrated using utility bills from the two sites. The retrofit technologies were then implemented in software and used to predict post-retrofit energy use and the energy savings. Each year, Johnson Controls performs a series of measurements on the installed equipment (for example, flue gas analyzers are used to measure boiler efficiency, and power meters are used to measure the draw of motors installed on fans and pumps). A report is prepared to show that the efficiency and power use of the installed equipment is the same (within measurement error) as the values used to estimate post-retrofit energy use.

NARA is just one of the 18 agencies of the U.S. federal government that have used the Super ESPC contract to implement energy conservation projects at their facilities. Since 1998, more than 130 Super ESPC contracts have been awarded.
Middle Tennessee State University

Background

Located in Murfreesboro about 30 miles southeast of Nashville, Middle Tennessee State University (MTSU) serves more than 22,000 students, awarding undergraduate and graduate degrees in a variety of academic areas including Business Administration, Fine Arts, Music, Science, Nursing, and Social Work. The campus consists of 109 buildings on a 466-acre (189-ha) site. As one of the 45 educational institutions governed by the Tennessee Board of Regents, MTSU receives funding for maintenance and capital improvements from the operating budget of the State of Tennessee.

By 1999, rapid growth in enrollment, a growing backlog of deferred maintenance, and the declining availability of state funding led the university to seek alternative methods to upgrade its aging facilities. Recognizing the potential of using energy cost savings to fund improvements to its energy infrastructure, the university established the Center for Energy Efficiency, which worked with the Tennessee Board of Regents to establish a program to allow self-funding of energy conservation projects.

The Project

In December 2001, after evaluating proposals from a number of ESCOs, MTSU awarded Siemens Building Technologies an ESPC with an ordering capacity of $10 million. To date, approximately $8.2 million of that capacity has been exercised. Completed projects include lighting upgrades in 1.5 million square feet (139,000 square meters) of building space, installation of a 10-MW backup generator (which allowed the university to switch
to a lower-priced interruptible electric rate), HVAC retrofits, controls adjustments, and installation of vending misers on campus vending machines. Total savings from the conservation measures installed to date are estimated to be about $900,000. Projects have been financed with Tennessee State School Bond Authority (TSSBA) bonds that have a maturity of 15 years.

Overall, MTSU officials have been satisfied both with the project and the process. The equipment is performing well, and MTSU believes they are receiving the savings that were projected.

**Lessons Learned**

Given the success of the MTSU program, the Tennessee Board of Regents developed a vehicle to allow other universities in its system to use ESRCs to fund energy conservation projects. In 2003, the Tennessee Board of Regents awarded three blanket ESRCs, one for each of the three main geographical regions of Tennessee (East, Middle, and West). The program is modeled on the DOE FEMP Super ESRC — an IDIQ contract was awarded to a single ESCO in each region, and institutions implement projects by issuing delivery orders against the IDIQ for their particular regions.

As in the DOE Super ESRC program, the project implementation process begins with a kickoff meeting between a regional ESCO and an acquisition team for the customer in that region. The institution presents its list of needed improvements and supplies the ESCO with an inventory of energy-related equipment, building areas, descriptions of energy management systems and procedures, utility billing records, and other needed information. The ESCO makes a preliminary site survey and uses the information gathered to develop an initial proposal. The initial proposal contains a summary of the potential scope of work, a list of ECMs, preliminary estimates of project costs and annual energy and maintenance savings, a subcontracting plan, and a preliminary project schedule.

After reviewing the initial proposal, the institution negotiates with the ESCO to further refine the scope of the project. When the institution is satisfied with the proposal, the ESCO performs a detailed energy survey. The detailed energy survey entails the collection of detailed information about the facilities and their operation needed to define the final project scope, construction costs, and energy and cost savings.

Information collected for the detailed energy survey is used to develop a final proposal, which provides the detailed project scope and cost proposal. The final proposal also includes detailed calculations of the energy and energy-related cost savings that will result from the project. Upon award, the final proposal becomes a contract in which the ESCO agrees to provide design and installation of the ECMs for a fixed price. Unlike the ESRCs awarded under the FEMP program, ESCOs in Tennessee Board of Regents contracts usually make no guarantees of performance beyond what is covered under equipment warranties. According to Joe Whitefield, director of the Center for Energy Efficiency, the Tennessee Board of Regents views the contract primarily as a funding
vehicle, with energy conservation as a secondary benefit. For this reason, the program does not place much emphasis on M&V of savings. The institution is expected to assess the validity of the energy savings projections in the final proposal prior to contract award. The Center for Energy Efficiency at MTSU provides assistance to other universities in making these assessments.

Another major difference from FEMP’s Super ES PC program is that ESPCs awarded under the Tennessee Board of Regents program are self-funded using bonds issued on behalf of the institutions TSSBA. Aside from warranties, the ESCO’s role in the project essentially ends when the conservation measures are installed and accepted by the institution. ESCOs may also perform operations and maintenance on the installed equipment, but this would be done under a separate contract.
Morgan County School District Re-3

**Background**

Fort Morgan is a city of 11,000 in northeast Colorado about 80 miles from Denver. The local school district consists of eight schools that serve a total of 3000 students. In 2001, faced with high operating costs and a growing maintenance backlog, but lacking the funding required to perform needed equipment upgrades, the district chose to implement its first ESPC. The state of Colorado encourages public entities to use performance contracting and provides technical and contracting assistance through its Rebuild Colorado program. Using this assistance, the school district developed a request for proposals and sent it out for bid. A proposal submitted by Ennovate, an ESCO in suburban Denver, was selected over two other proposals received.

![Columbine School](image-url)

**The Project**

Ennovate developed a list of 41 proposed ECMs with final pricing and energy cost savings. The list was placed in a spreadsheet, allowing the school district to select or reject options to customize the financial and technical performance of the project. All pricing was open-book, and the school was able to review equipment, labor, project management, engineering, and overhead costs, as well as other pricing details. The ECMs to be installed were selected based on a combination of the district’s facility improvement needs, the overall cost savings, and project cash flow.

Among the conservation measures included in the project were the following:

- Lighting upgrades, including T-8 lamps, occupancy sensors, and new fixtures in underlit classrooms and gyms
• Variable-speed drives on hot and chilled water pumps
• Replacement of aging boilers with condensing boilers
• Replacement of single-pane, steel-frame windows with double pane, low-emissivity windows
• Instantaneous-demand hot water heaters
• Replacement of electric cooking equipment with natural-gas-fired cooking equipment
• Radiant gas heating systems in gymnasiums and workshops
• A district-wide, internet-accessible HVAC control system

Construction began in June 2002 and was completed in June 2003. The total cost was $2.5 million, which was financed by the district through a lease-purchase agreement with a term of 12 years. Finance charges will add about $725,000 over that period.

**Measurement and Verification**

First-year savings from the project were estimated at $360,000 comprising $257,000 in gas and electricity costs, $53,000 in operational savings, and $50,000 in capital cost avoidance. Ennovate verifies the electric and gas savings only.

During project development, calibrated baseline formulas were developed to predict hourly gas and electricity use in each school based on occupancy and outside air temperature. To measure savings, gas and electric meters at each school are read electronically once per hour. Baseline energy use is also calculated in each hour, and energy savings is defined as the difference between the baseline and the meter readings. To calculate cost savings, year-one energy prices are assumed to escalate by 3% per year. Ennovate reports energy and cost savings to the district in monthly e-mails and makes a formal energy savings reconciliation presentation to the school board each year.

In accordance with Colorado statutes that pertain to performance contracting with local governments, if Ennovate falls short of its guaranteed savings for any given year as determined by the M&V process described above, it must pay the school district the amount of its shortfall for that year.

**Results and Lessons Learned**

According to district officials, the overall experience with the performance contract has been positive. To date the equipment has performed as advertised, and the guaranteed savings have been delivered. Were the need to arise, the district would definitely consider another performance contract, although some thought that installing all of the equipment in one year (the majority during just one summer) caused too much disruption. School district officials stated that in the future they would stage the installation of the ECMs over several years.
Washington State ESPC Program

Background

The State of Washington is another that encourages all state and local agencies to use performance contracting for energy conservation projects. Since 1986, about $145 million in energy conservation projects have been carried out in Washington using ESPC. Like many other states, Washington has realized that there are a number of benefits to providing assistance to the agencies that use ESPC. In this case assistance is available from the Department of General Administration’s “GA Energy Team” on a fee-for-service basis to state agencies, colleges and universities, cities and towns, counties, school districts, port facilities, libraries, hospitals, and health districts. The Energy Team provides an array of services similar to those offered by project facilitators in DOE’s Super ESPC program — assistance in ESCO selection, proposal evaluation, technical and contracting assistance, evaluation of M&V plans and reports, etc.

In Washington, the project implementation process begins when a government agency issues a request for qualifications (RFQ) that invites ESCOs to submit a detailed statement describing the range of services offered, past experience, management approach, approach to M&V, financial stability, and other pertinent aspects of their business. The agency reviews and evaluates the qualifications of the ESCOs that respond and generally selects three for further interviews. In some cases, each of the three ESCOs may be asked to perform a preliminary survey of the site and prepare a list of conservation measures, which will serve as an initial proposal. Based on the interviews (and evaluation of the preliminary surveys, if required), the agency makes its selection. At this time, the agency also begins the process of securing financing for its project. In Washington, most projects are financed through lease–purchase agreements with the State Treasury.

The winning ESCO performs a detailed energy survey, which is an investment-grade audit that analyzes current building conditions, establishes base-year (pre-project) energy consumption, and identifies and defines the energy efficiency and cost reduction measures that will be implemented, with their associated energy and cost savings. After negotiations with the agency, the ESCO presents a final proposal containing the complete scope of work for the project, energy and cost savings guarantees, and a firm, fixed price proposal for construction of all ECMs. When all parties are in agreement, the ESCO proceeds with construction.

In general, ESCOs secure their own financing during the construction period. Only when construction is complete and the ECMs have been commissioned and accepted by the agency does the State Treasury release the funding secured through the lease–purchase agreement. The agency then pays the ESCO’s expenses for the audit, construction, and construction-period interest.
A Representative Project

Eastern State Hospital is a psychiatric care facility operated by the State of Washington. Located in Medical Lake just outside of Spokane, the facility provides evaluation and inpatient treatment for individuals with serious or long-term mental illness. The entire complex contains about twenty buildings, some of which were constructed in the 1880s.

In 1998, faced with increasing energy and maintenance costs at the hospital, an aging physical plant, and a shortfall in its capital improvement budget, the Washington Department of Social and Health Services (DSHS) decided to investigate performance contracting as a way to implement the many upgrades that were needed at Eastern State. With the assistance of the GA Energy Team, DSHS issued an RFQ, formed an evaluation committee, and selected Abacus Resource Management Company to make a proposal. Abacus performed a detailed energy audit of the hospital and developed an extensive list of ECMs. DSHS ultimately settled on a package of improvements worth $2.5 million, which included installation of T-8 lamps and electronic ballasts, a campus-wide energy management and control system, variable-speed drives on fans, new steam boilers in the central plant, hot water boilers in individual buildings, steam trap replacement, and repairs to the steam and condensate piping systems. The project was financed over a ten-year period using the state’s lease–purchase program. Guaranteed savings from reducing use of electricity and natural gas were about $315,000 per year.

State law in Washington requires M&V of guaranteed energy savings. The ESCO is generally required to produce an annual M&V report for one to three years after construction, or until it is established that guarantees are being met and the equipment is operating according to specifications. M&V is based on IPMVP and is most often a mixture of Option A (stipulated values) and Option B (retrofit isolation) techniques. If the annual report indicates that savings are less than the guarantees, the ESCO must pay the agency the amount of the shortfall.

The Eastern State Hospital Project was the first use of ESPC by the DSHS. The successful results from the project led to a decision by DSHS to audit all of its facilities in the state. As a result, ESPCs were implemented at a number of other facilities.
Sullivan County School District

Background

In 1999, officials from the Sullivan County School District attended a seminar at Middle Tennessee State University and came away with the idea of using an ESPC to fund much-needed improvements in the schools the district operates in East Tennessee. The idea was put into practice in August 1999 when the district sent out a request for qualifications to ESCOs. Ten companies responded in all, and of these three were selected to perform a walk-through audit of one of the school buildings to develop a preliminary proposal for the single building. After reviewing the proposals, the district selected Energy Systems Group (ESG), and invited the company to develop a formal proposal for all 28 of the district’s schools.

The Project

After performing a detailed energy survey, ESG proposed a comprehensive set of ECMs. The final project, approved in June of 2001, included many of the measures typically applied in schools, such as lighting upgrades (primarily conversion of fluorescent lighting
to T8 fixtures with electronic ballasts), HVAC system upgrades, replacement of single-pane windows with high efficiency double-pane windows, and an energy management control system. Other measures such as attic insulation, dropped ceilings (to reduce space conditioning requirements in spaces with high ceilings) and replacement of electric stoves and ovens with gas-fired equipment were included as well. Substantial savings in water and sewer costs would also be realized through replacement of lavatory fixtures. The total construction cost was $24.2 million, which the school financed through a bond issue approved by the Sullivan County Commission.

The cost-saving measures included in the project were not limited to energy and water conservation alone. ESG also installed a new telecommunications system, which allowed the district to obtain telephone service at a lower cost. A new point-of-sale system implemented in school cafeterias has increased both sales and use of the low-income lunch program, which has increased revenue to the school district. An automated maintenance management system has reduced operational costs as well. These savings are tracked by ESG and the district, but are not part of the guarantee.

ESG does guarantee utility cost savings for the entire 15-year term of the project. M&V of these savings is based on utility bill analysis, in conformance with IPMVP Option C. As part of the detailed energy survey, ESG developed baseline energy use models for each school by correlating pre-retrofit gas and electricity consumption with heating and cooling degree days, the number of days in the billing period, and the number of occupied and unoccupied days in the billing period. Each school receives a monthly report on its utility use, and the district receives quarterly reports that compare actual utility costs for each school with what utilities would have cost under the baseline conditions. In addition, ESG produces an annual report that provides more detailed information on the savings accrued during the previous year. If the savings fall below the guarantee, ESG must pay the district the amount of the shortfall.

Results/Lessons Learned

According to Maintenance Director Joe Akard, the performance contract is proceeding exceptionally well, with savings ahead of schedule. During the first year of the performance period, ESG guaranteed $753,000 in savings from electricity and gas costs and $132,000 in savings from water and sewer costs. Actual savings, according to the utility bill analysis, were $940,000 in electricity and gas costs and $180,000 in water and sewer costs.

It should be noted that the use of utility bill analysis as the primary method of M&V does have some drawbacks in contracts of this type. Since actual energy use determines the savings, the ESCO must pay close attention to energy use in the treated buildings to ensure, for example, that lights are turned out in the evenings, equipment is not left running over weekends, and temperature setpoints are not overridden. The ESCO must also keep track of any changes in the energy consuming equipment in the buildings (a new copy machine, for example) and adjust the baseline formula accordingly. In this case, ESG monitors energy use continuously via the internet and develops weekly reports.
that are shared with the district during twice-weekly meetings. ESG also helped the
district write its first energy policy to define appropriate operating practices.
Community Towers Complex Case Study

Background

Located in downtown San Jose, California, the Community Towers Complex consists of the ten-story Great Western Bank Building and the twelve-story California Commerce Bank Building, together encompassing a total of 350,000 square feet (33,000 square meters). Both were constructed in the 1960s. In the early 1990s, while preparing to sell the complex, the owners set out to reduce their operating and maintenance costs compared to other office buildings in the downtown area to enhance the property’s profitability and its attractiveness to prospective buyers. While searching for a contractor to replace a set of aging chillers, the owners heard about performance contracting and learned that they could reduce energy and maintenance costs even further through a comprehensive energy conservation retrofit. They also learned that a healthier work environment for their building tenants — including better lighting and improved indoor air quality — could further enhance the marketability of their building.

The owners sent out a request for proposals for an energy efficiency retrofit and received three bids. Within a month of receiving the bids, the owners selected Viron Energy Service and signed a contract for the job. The contract called for Viron to provide an audit of energy use in the building, systems engineering design and construction management for the energy improvements, training of building operations staff, post-installation maintenance, and performance monitoring of the new systems.
**The Project**

Viron estimated that the buildings were using an average of 4.4 million kWh of electricity and 104,000 therms (11 TJ) of natural gas per year. Based on an assessment of the buildings’ equipment, Viron recommended improvements including high efficiency lighting, electronic controls, and conversion of air distribution systems to variable volume with digital zone control. A high efficiency domestic water heater was also installed. Two 30-year-old, 500-ton (1800 kW) capacity centrifugal chillers were replaced with two high efficiency, 275-ton (970 kW) capacity, CFC-free, rotary screw chillers.

While most ESPCs are based on ESCO or third-party financing, with repayment out of the customer’s savings stream, in this case the building owners were able to finance the entire $1.4 million project themselves. The local gas and electric utility, through its demand side management program, provided utility rebates totaling $260,000, reducing the net cost of the project by 19%. The owners financed the project over a seven-year period with a positive cash flow.

Under its contract with Community Towers, Viron guaranteed an annual energy cost savings of $175,000, and the project resulted in $20,000 per year in maintenance savings, for a total annual savings of $195,000. To support its energy savings guarantee, Viron provides electronic monitoring through the energy management system. A monthly report is sent to Community Towers indicating the actual energy cost savings relative to the guaranteed savings. As in most other contracts of this nature, if savings guarantees are not met, Viron pays the building owners the amount of the shortfall.

**Results/Lessons Learned**

Community Towers’ owners say that they consider the contract a success. Taylor Clayton, Vice President of Boccardo Properties, enthusiastically describes the benefits of the comprehensive energy efficiency retrofit from a building owner’s perspective. “I consider the energy savings as fuel for improvements to our business. The new systems, including chillers, have greatly benefited our customers. In the long and short haul this investment will help us to renew our leases and bring new customers to our buildings.”
Background

Located on a 156,000-acre site on the coast of North Carolina, Camp Lejeune is the largest U.S. Marine Corps base in the world and uses about one-quarter of the total energy consumed by the Marine Corps. On any given day, about 45,000 Marines are on active duty at Camp Lejeune. Residential areas of the base include a total of 4640 homes that house about 11,000 Marines and family members.

By the mid-1990s, Camp Lejeune’s family housing was consuming 91 million kWh of electricity per year on average. At 19,600 kWh per residence, this was about 30% higher than the average residential electricity use for this region of the United States. Part of the problem was that in much of the housing heating and cooling was supplied by minimum-efficiency air source heat pumps that had been installed in the early 1980s and was nearing the end of its service life. The maintenance and repair costs for this equipment were also a problem. After considering several options, officials at Camp Lejeune decided to replace the air source heat pumps with ground source heat pumps (GSHPs).

The Project

Camp Lejeune received three proposals for financing and implementing the energy retrofit, two for ESPC projects and the third from a subsidiary of the local utility for a project financed and carried out under a utility energy services contract (UESC). U.S. federal agencies are allowed under several authorities to finance energy projects through UESCs offered by their utility providers, which are similar to ESPCs. Both ESPCs and UESCs allow private, third-party capital to be used to purchase and install ECMs, which is repaid over time using the energy cost savings generated by the ECMs. A primary difference between the two financing vehicles is that UESCs are not required by law to include performance or savings guarantees or M&V. Also Super ESPC terms can be as long as 25 years, whereas UESCs have generally been limited to 10-year terms. Agencies’ policy makers and contracting officers commonly set strict upper limits on contract terms to minimize the government’s long-term commitments (and financing costs).

Camp Lejeune decided to fund the project through a UESC contract with a subsidiary of the local utility. Camp Lejeune personnel indicated that a primary reason for selecting the UESC over an ESPC was the 10-year contract term offered by the utility.

Beginning in May of 2000, air source heat pumps were replaced with GSHPs in 2054 residences. Altogether the new installed equipment provided 3450 tons (12,130 kW) of heating and cooling capacity at a total construction cost of $12.7. Camp Lejeune paid a portion of this cost to the utility upon completion of construction and the utility financed
the remainder. Over the ten-year contract term, Camp Lejeune was to pay the utility a total of $15.5 million.

Measurement and Verification

Although UESC contracts do not require savings guarantees or verification, Camp Lejeune insisted on a savings guarantee that would be verified annually through analysis of the previous year’s utility bills. Using five years of pre-project utility billing data, the baseline electricity consumption in family housing for a TMY was estimated to be 91.1 million kWh, and the total annual demand (defined as the sum of the monthly billing demands for the 12 months of the TMY) was estimated at 734,000 kW. In each year of the post-retrofit period, the utility was to normalize electricity use and billing demand for the previous 12 months to the same typical year. Normalized post-retrofit electricity use and total demand were then subtracted from the baseline electricity use and demand to estimate the annual savings. The guarantee was based on an electricity savings of 20.9 million kWh per year and demand savings of 83,500 MW. Using energy and demand prices from 2002 ($0.033 per kWh and $9.25 per kW of billing demand) the energy cost savings was estimated at $1.5 million. Camp Lejeune was to pay one-twelfth of this amount to the utility each month. If the normalization showed the actual energy cost savings to be less than 90% of this value, the payment to the utility was to be reduced by the amount of the shortfall.

Project Results

It was clear in the first year after installation that the savings targets were not being met. In addition, heat pumps in more than half of the residences were unable to maintain heating setpoints during very cold weather because of undersizing of both the heat pumps themselves and the ground heat exchangers. An analysis of utility bills performed by a third party after the second year of the contract estimated the normalized energy savings at 13.8 million kWh and total demand savings at 40,000 kW. Using the contract energy prices, this translated into a savings of $873,000 — about 60% of the guaranteed cost savings. Over the ten-year contract period, the shortfall in savings would amount to nearly $6 million dollars.

Following the completion of the two-year billing analysis, Camp Lejeune and the utility began a lengthy period of negotiations. Camp Lejeune’s position was that it was the utility’s responsibility to repair and/or upgrade the heat pumps that were unable to meet heating setpoints and that its monthly payments to the utility should be reduced for the remainder of the contract to reflect the $6 million shortfall. Utility company representatives presented its own analysis claiming that the majority of the shortfall was due to excess energy use by the residents of Camp Lejeune family housing.

Nevertheless, a simple calculation might have raised concerns that the utility’s original savings estimate was too optimistic. Prior to the retrofits, each residence was using on average 19,600 kWh of electricity per year. The estimated savings of 20.9 million kWh
per year amounts to more than 10,000 kWh per residence, which is about 51% of the pre-retrofit electricity use.

However, conventional wisdom in the GSHP industry would predict about 33% savings for a residential retrofit, which agrees with independently verified savings of 33% from a similar retrofit project in military housing at the U.S. Army’s Fort Polk. These facts might have led to the conclusion that the Camp Lejeune project was unlikely to reduce electricity use by 51%.

Ultimately, the utility installed backup resistance heating to allow undersized heat pumps to meet peak heating loads. This resolved the problem in these residences, but increased electricity use and demand during the winter months and reduced savings. Camp Lejeune accepted partial responsibility for the savings shortfall, and total payments to the utility were reduced by $3 million rather than the $6 million originally requested.

**Lessons Learned**

Despite the problems that occurred in this project, Jim Sides, utility manager at Camp Lejeune, remains positive. “We learned a lot, and those lessons have made us smarter consumers of performance contracting services.” The first thing Sides recommends is to make certain the project is well-designed. “Have designs reviewed by a third party subject matter expert who has no ties to the ESCO and will tell you the hard truth. If necessary design changes render the project unfeasible because of payback, don’t do the project.”

Sides also recommends that savings guarantees be well-written and iron-clad. “One of the benefits of a performance contract is that the ESCO assumes the technical risk. Without a savings guarantee, technical risk shifts to the customer.”

Finally, Sides urges potential customers to personalize the project. “Think about it. If this were your money, would you do the project?”
Conclusions

The case studies presented in this report illustrate some of the models by which ESPCs are implemented in the United States and some of the diversity of customers who use ESPCs. While it is difficult to generalize across this small sample, the projects do have some commonalities. Many involve similar ECMs, with lighting upgrades, variable-speed drives for fans and pumps, energy management control systems, and replacement of boilers and chillers being the most common. This is not surprising. Most buildings designed for human occupation require heating, air conditioning, and lighting, and as these systems age, they require replacement. Technological progress is usually such that newer equipment is more efficient than the equipment being replaced. The increase in efficiency lowers energy bills, and the resulting cost savings allows the conservation measures to pay for themselves over time.

It is also important to note that lighting upgrades, variable-speed drives, and energy management control systems all have relatively low installation costs compared to the energy savings they generate, resulting in short payback periods. In many projects, ECMs with higher installation costs and lower savings, such as ground source heat pumps, are “bundled” together with these shorter-payback ECMs to reduce the length of the contract term.

The main reasons cited by customers for using ESPCs are also similar across the sample: in general, funding from other sources was uncertain or unavailable altogether, and an ESPC was the only method of funding available. Nevertheless, the decision was influenced by a variety of factors. Many ESPC customers cited the need to upgrade aging equipment, either to maintain performance or to reduce operating costs. In the case of U.S. federal government sites, the need to reduce energy consumption to meet energy-efficiency goals is another strong driver for ESPC.

The availability of technical and contracting assistance was a key influence in the success of many of the projects examined. ESPCs involve a wide array of technical, financial, legal, and energy-related issues, and few ESPC customers have expertise in all of these areas. In FEMP’s Super ESPC program, a small group of project facilitators guide federal customers from the initial stages of a project through the first year of the performance period, providing assistance in the selection of ECMs, development of energy baselines and M&V plans, evaluation of pricing and financing offers, and other aspects of project development. Many U.S. states offer similar project development assistance (or referrals to assistance from the private sector) for state government agencies, school districts, hospitals, and other institutions through their state energy offices.

Guaranteed savings with well-defined M&V of savings is another key aspect of successful ESPC projects. As the name implies, energy savings is the primary objective of an ESPC, and ESPCs are intended to pay for themselves from the energy savings generated by the conservation measures installed. Although the case studies show that
savings guarantees are not universal in ESPC, it could be argued that a contract without a savings guarantee should not properly be called an energy savings performance contract. Without a savings guarantee, the customer assumes the risk that the cost savings from the installed ECMs may not be sufficient to cover the cost of their installation. Most successful projects do include savings guarantee, and use some version of the IPMVP guidelines for M&V of these savings.

The experience of the U.S. federal government illustrates the success of the umbrella contract concept. Umbrella (or IDIQ) contracts administered by a central contract center have several advantages over site-specific ESPCs. The U.S. government agencies have had the authority to implement ESPC contracts since the 1980s, but prior to the advent of the IDIQ contracts in 1998; annual awards were averaging less that $25 million per year. Since 1998, that average has grown to about $300 million per year, with 90% of project investment made using IDIQ contracts.

Because umbrella contracts eliminate the need to “reinvent the wheel” each time a new contract is awarded, development time and effort is reduced. With pre-qualified ESCOs, there is no need to issue requests for qualification, which eliminates another step in the process.

Use of umbrella contracts offers economies of scale as well. It enables a small cadre of experienced professionals to provide contracting and technical support to large numbers of customers. Most agency procurement teams, on the other hand, will be involved with only one or two ESPCs in their entire careers.

Umbrella contracts also allow procurement history to be put to work. For example, the FEMP program has developed pricing and financing benchmarks that allow agency procurement teams to compare the ECM pricing and financing offers they receive on their projects with pricing and financing costs of other projects throughout the federal government.
Center for Energy Efficiency at Middle Tennessee State University. Web page, http://cee.web.mtsu.edu/


