ESPC Implementation at Fort Polk, LA

1 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 town-houses 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 needed to install new equipment, Fort Polk chose to implement an Energy Savings Performance Contract (ESPC). With the assistance of the Army's Center of Excellence for Performance Contracting (U.S. Army Engineering and Support Center in Huntsville, AL), a feasibility study was performed and a request for proposals developed. The request for proposal (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.

Figure 1. Entry to Folk Polk, LA.

2 The Contract

The contract between the Army and the Energy Service Company (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.

3 Site

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 town-houses comprising two to six attached units.

4 Measurement and Verification

As originally awarded, the contract called for using measurement and verification (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 5 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.

5 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 5 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.

6 Reference

Hughes, P. J., and J. A. Shonder, 1998. *The Evaluation of a 4000-Home Geothermal Heat Pump Retrofit at Fort Polk, Louisiana: Final Report.* Oak Ridge National Laboratory, Oak Ridge, TN, Report No. ORNL/CON-460, March 1998.