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MAKING SHARED ENERGY SAVINGS WORK

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Executive Summary

MAKING SHARED ENERGY SAVINGS WORK

Shared energy savings (SES) is a low-investment, low-risk contracting procedure that can significantly increase energy efficiency at DoD installations. By decreasing installations' energy use by only 10 percent, SES can save some $300 million a year. Under SES, contractors finance and implement efficiency measures and share the resulting dollar savings with DoD.

Notwithstanding its low risk and low investment, however, SES faces several obstacles:

- Establishing prior energy use – "baselines" – in DoD buildings in order to measure savings is difficult since (1) very few buildings are individually metered, and (2) most energy service companies have no confidence in computer-simulated baselines.
- Installation managers are unwilling to implement SES without the guarantee they will receive a portion of DoD's share of savings.
- Uncertainties regarding the applicability of law and regulation to SES contracting are slowing implementation.
- The Military Departments have not agreed upon the appropriate economic criteria to be used in the competitive award of SES contracts.

Those obstacles can be overcome. To do so, we recommend the following actions:

- The Services should initially award installation-wide SES contracts rather than individual building contracts. Energy contractors have confidence in the use of metered data as a baseline, and installation-wide metered data are available. At the same time, the Services should anticipate SES contracting for individual buildings by installing meters in buildings that have high potential for energy savings. The Services should establish a revolving fund, added to existing management funds, to finance the metering.
- To overcome contractors' distrust of simulations, OSD's Energy Policy Office and the Department of Energy (DOE) should conduct a joint test of DOE's energy-use simulation model, ASEAM2, on a variety of DoD

buildings. Such testing should increase contractors' confidence in the use of simulations to establish baselines.

- Each Service should institute an SES rebate program to guarantee that a portion of DoD's savings is returned to the installation that generated those savings.

- The Energy Policy Office should work with the Office of General Council to formulate a policy on the legal and regulatory issues that pertain to SES contracting. Such a policy will facilitate SES implementation by clarifying the legal and regulatory issues and eliminating the duplication of effort needed for each Service to research those issues.

- The Services should use the economic analysis parameters prescribed for energy-conservation projects by the National Energy Conservation Policy Act. While economic analysis is important, there is little reason to expect the choice of economic analysis parameters to be critical to contractor selection.

These recommendations will remove the obstacles to SES implementation and allow the Services to join the many state and local governments and private companies currently enjoying the huge benefits of this innovative concept.

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CHAPTER 1

FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

FINDINGS

Shared energy savings (SES) contracting is a concept with the potential to save DoD a substantial portion of its installation energy budget with minimal investment and little risk to DoD. SES contractors install energy saving measures and are paid a share of the savings only if the promised level of savings actually occurs. The concept has been widely applied in the private, state, and local sectors. Following a recommendation to implement SES, DoD established a pilot program to test the applicability of SES in DoD installations.[1]

Because SES contracting is a new and unfamiliar contracting arrangement within the Federal Government, DoD has encountered a number of procedural, policy, and legislative obstacles that have delayed its implementation. Recognizing that delay, DoD's Energy Policy Office established a Joint-Service committee – the Shared Energy Savings Steering Group – to help expedite the SES pilot program. The committee asked us to identify the various obstacles and recommend methods for overcoming them.

One major obstacle is the uncertainty over the proper method for establishing a reliable energy baseline. The baseline is a measure of the energy being used before a contractor makes any improvements, and it serves as the yardstick against which to measure the contractor's performance. We find that agreement on the baseline is crucial to SES contracting, and baseline calculation can be extremely complex. Energy service companies (ESCOs) prefer a simple approach based on a history of metered data, and they have little confidence in baselines determined by simulations. However, projects currently being considered for SES contracting include only a small number of an installation's buildings and very few of those buildings are individually metered. Therefore, histories of energy use do not exist. Moreover, installations generally do not have funds readily available to pay for meter

[1]LMI Report ML207. *Shared Savings Contracting for Reducing Energy Costs of Defense Facilities*. Greider, G. M., and J. M. Baker. Jan 1983.

installation. Furthermore, most installations do not have the expertise to develop baselines from simulations and they are unlikely to develop that expertise because each installation will only handle one or two SES contracts. The most comprehensive simulation technique is the Department of Energy's (DOE) ASEAM2 model,[2] but it has only been tested on one building and is not yet accepted by the ESCOs.

Inter-Service debate over the proper economic analysis method for comparing SES proposals has also slowed SES implementation. The economic analysis is one of several criteria used to select the best offer, and the Services cannot agree on what discount rate to use nor how to compare proposals with unequal contract terms. We find that SES falls into a category of projects for which DOE has prescribed a discount rate of 7 percent. We further find that the decision on how to compare unequal contract terms depends on future decisions about what will actually follow an SES contract. For instance, the economic analysis requires a prediction of whether the Government will operate the contractor's equipment in-house or will award another SES contract after the initial contract period. Once again, however, most installations do not have the expertise for this level of net present value analysis.

An SES contract can be initiated only with the cooperation and full support of management at the installation involved. Although the projects in the pilot programs are being handled at various headquarters levels, the installation must help gather data for the request for proposals and it will be responsible for contract management after award. The installation therefore bears some of the costs involved. It also suffers the inconveniences while the contractor's equipment is being installed and runs the risk of being without the equipment's use if the contractor defaults. We find that if installations are asked to bear these costs and risks, they want to share in the benefits. However, current procedures give no share of the savings to the installations involved.

We also find that SES contracting has been delayed by uncertainty about what legislation and regulations apply to this new form of contracting. We find no common guidance in this area. Little case history is directly applicable to SES, and each Service has been independently researching the issues, debating their

[2]A Simplified Energy Analysis Method, Version 2.

applicability to SES, and trying to decide what to include in the requests for proposals. Progress has been cautious because without common guidance, each individual Service runs the risk of making a wrong choice and breaching a regulation or public law.

CONCLUSIONS AND RECOMMENDATIONS

To solve the baseline calculation problem, we recommend that the Military Services:

- Pursue installation-wide SES contracts to ease the problem of the lack of meters. All installations have at least 1 meter for the whole installation that provides many years of energy-use data for establishing a reliable installation-wide baseline.
- Install meters on those buildings that have high potential for energy savings and are candidates for SES contracting. Meters provide a measure of energy usage that has credibility with ESCOs. The cost of installing meters can be covered by a revolving fund established as part of each Service's management fund within DoD Instruction 7460.2. Part of the money saved from each SES contract would then go back into the revolving fund to pay for metering more buildings.
- Place responsibility for determining the baseline and writing requests for proposals at the major command level or other "center of expertise." Unlike individual installations, those centers will become involved with many SES contracts and will be able to develop expertise in baseline development and economic analysis.

We further recommend that:

- The Assistant Secretary of Defense (Production and Logistics) [ASD(P&L)] request DOE participation in a joint test of DOE's ASEAM2 baseline simulation model. Further testing is needed on a variety of DoD buildings to increase contractor confidence in simulation-derived baselines. The test should also compare the cost of simulation with the cost of metering. If ASEAM2 proves effective and economical, it can be used until all buildings are metered and a history of energy usage is established.
- ASD(P&L) direct that the Military Services use the DOE's energy conservation analysis procedures, which conform to the National Energy Conservation Policy Act. Those procedures prescribe a 7 percent discount rate. Comparisons of contract terms of unequal length should be kept simple by assuming that they will all roll over (i.e., be extended) at an established recontracting cost.

- The Military Services institute an SES "rebate" program for returning a portion of the dollar savings to the installations that participate in SES contracting. Installations will aggressively pursue SES contracts only if the perceived benefits are sufficient to offset the effort and risks of implementation.

- ASD(P&L) strongly urge OSD counsel to provide its opinions and policy on the legal and regulatory issues of SES contracting. The Service legal counsels have approached a consensus on most legal and regulatory issues and have presented that consensus to OSD legal counsel. Uncertainty persists, however, because OSD counsel has not yet reviewed the inputs and published the OSD policy concerning them.

CHAPTER 2

THE CONCEPT OF SHARED ENERGY SAVINGS

In 1987, DoD spent nearly $3 billion on energy at its installations. If it could increase energy efficiency by only 10 percent, DoD would save approximately $300 million annually. Shared energy savings is a concept that has the potential to reduce DoD's energy budget by 10 percent or more without substantial cost or risk to DoD. SES projects result in increased energy efficiency while shifting the performance risks and financing of energy conservation projects from DoD to private contractors. From DoD's perspective, SES contracts are largely self-financing since payments to the contractor are made from savings as they occur. Moreover, DoD pays the contractor only if savings actually occur. SES projects are winning arrangements for both DoD and the contractor.

State and local governments as well as private firms have successfully employed SES to reduce energy costs in a variety of commercial, industrial, and institutional buildings. As a result, the number of ESCOs that undertake SES projects has been increasing and the industry is now well established.

BACKGROUND AND CONCEPT

Concern over the availability of oil and gas in the 1970s and early 1980s prompted energy users to increase their energy conservation and efficiency efforts. A large portion of the decrease in energy demand during the early 1980s resulted from increased energy efficiency. While declining energy prices have reduced somewhat the number of cost-effective energy conservation measures – those that cost less than the price of fuel saved – many opportunities still remain. According to DOE studies: "... even under an extremely low oil price scenario, conservation and efficiency improvements will continue at only a slightly lower rate than under a high price scenario."[1]

The SES concept was developed in response to the needs of energy users in both the public and private sectors of the economy. While industrial and commercial

[1] *The Energy Report*. Volume 15, Number 48, p. 893.

users, for example, are generally able to finance conservation measures themselves, many of them prefer to avoid the inherent risks, are unfamiliar with available technologies, or have competing projects with higher priorities. Similarly, state and local governments and nonprofit organizations such as school boards and hospitals see similar drawbacks and often lack the necessary investment funds. The concept of SES evolved to meet both private and public sector needs. An SES contract is an agreement between a building owner and a contractor – an ESCO – that identifies conservation opportunities and supplies the necessary technical expertise, financing, construction, and maintenance services to carry out the project. The ESCO also assumes most of the risks of an energy conservation project by agreeing to receive payment only in proportion to the actual savings realized. ESCOs may finance the projects themselves or through third parties.

The SES concept – also known as performance contracting – has been summarized succinctly as follows: ESCOs " . . . audit energy use in buildings to identify the optimal mix of measures for energy efficiency, then install and maintain these measures, often paying for the whole project at no up-front cost to the building owner. In exchange, they get a share of the savings that the project produces. The building owner is guaranteed to pay no more for energy than would have been the case without the efficiency measures. This type of business arrangement – in which payment for goods and services rendered is contingent upon their successful operation – is called performance contracting."[2]

Many states have established full-scale SES programs including, for example, New York, California, Iowa, and Michigan. SES contracting is now a successful industry comprising more than 100 firms able to finance and install energy conservation measures on a performance contracting basis. More than 2,000 buildings have been retrofitted under SES contracts.[3]

DoD's SHARED ENERGY SAVINGS OPPORTUNITIES

DoD installations present many opportunities for reduced energy costs because budget constraints have limited spending on building maintenance and

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[2]Shepard, M. and R. Weisenmiller. "The Tool Kit: An Introduction to Financing Options for Energy Projects." *Financing Energy Conservation*. American Council for an Energy Efficient Economy. Washington, D.C., 1986. p. 2.

[3]Klepper, M. "Issues in Performance Contracting: The Next Ten Years." Ibid. p. 167.

rehabilitation. In particular, funding for the Energy Conservation Investment Program (ECIP) has consistently fallen below requirements.[4] DoD established ECIP to provide investment funds for energy conservation projects. Unlike the ECIP program, however, SES contracting allows DoD to undertake conservation projects that reduce operations and maintenance (O&M) costs without draining scarce investment funds from higher priority projects. Moreover, since the risk of performance falls to the contractor in SES contracts, DoD is assured that SES projects will be cost-effective.

DoD established a Joint Service committee – the Shared Energy Steering Group – to implement and help expedite an SES pilot program. That group meets regularly to share experiences among the Services and report on the progress of DoD's various SES projects. The Shared Energy Steering Group asked LMI to examine various issues in SES contracting within DoD and to find ways of accelerating the process.

DoD is now close to signing its first SES contracts. Appendix A lists the current status of DoD and other Federal Government SES pilot projects. So far, the Military Departments have issued four requests for proposals (RFPs) for SES projects and other SES projects are at various stages. Elsewhere in the Federal Government, the U.S. Postal Service has awarded an SES contract for improved lighting in the General Mail Facility, San Diego, Calif., and the Department of Housing and Urban Development (HUD) has issued an RFP for its headquarters building in Washington, D.C.

Congress revised the National Energy Conservation Policy Act (NECPA) in 1986 to allow Federal agencies to enter into SES contracts of up to 25 years. The law states, in part:

> Such contract shall provide that the contractor shall incur costs of implementing energy savings measures, including at least the costs (if any) incurred in making energy audits, acquiring and installing equipment, and training personnel, in exchange for a share of any energy savings directly resulting from implementation of such measures during the term of the contract.

In December 1987, the Senate adopted a bill to improve the Federal Energy Management Program (S.1382). That bill, if passed by the House, would encourage

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[4] *Defense Energy Management Plan*. Sep 1985. p. 6-4.

Federal agencies to keep a portion of shared savings at the installation level and would also establish a goal for all Federal agencies to reduce their installation energy use per square foot by 10 percent between 1985 and 1995.

SHARING SAVINGS MAKES SENSE

One misconception that seems to exist at some installations is that without an SES contractor intervening, DoD could capture all or nearly all of the energy savings for itself. That concept, however, fails to take into account that the contractor must pay the costs of equipment, personnel, and financing from its share of the savings. Without a private contractor, DoD would have to bear all such costs itself. Moreover, DoD would have to furnish the up-front investment capital and would also bear the risks of nonperformance.

For example, one Army installation recently reported receiving an unsolicited proposal for the installation of new lighting at a seemingly high cost. Installation personnel felt, probably correctly, that they could install the same improvements themselves at lower cost. That example, however, illustrates the disadvantages of sole-source bidding rather than the disadvantages of SES contracting. Given enough competition, ESCOs should submit proposals that fairly reflect their costs and that offer a correspondingly high share of savings to DoD. The U.S. Postal Service has, for example, awarded an SES contract for the installation and maintenance of improved fluorescent light fixtures.

Moreover, because ESCOs are energy-conservation experts, they are likely to recognize money-saving opportunities that DoD might otherwise miss. In the example cited above, the installation could perhaps have installed lighting improvements at a lower cost than the contractor, but the fact remains that it had not thought to do so before the contractor proposed the idea. Whether the installation now installs those improvements itself or relies on a contractor to install them, it will save money. Furthermore, SES contracting is necessary to undertake those conservation projects that require investments greater than available ECIP funds.

REMOVING THE OBSTACLES

In this report, we address the obstacles that have slowed DoD's efforts to implement SES and recommend ways to overcome them. SES contracting is a new and unconventional approach to reducing the energy budget; conventional contracting procedures must be modified to make SES work.

In its present early state within DoD, SES contracting can be complex and time-consuming. Coordination among engineers, contracting officers, lawyers, and associated personnel is necessary to select likely sites, write RFPs, evaluate proposals, and negotiate and monitor contracts. SES transactions currently must be tailored to each application; standard "generic" approaches are not yet possible. Moreover, all of the participants involved in DoD's pilot SES projects are necessarily new to the process since institutional experience has yet to be accumulated. Nevertheless, the potential for energy cost savings is high, and once established, SES is likely to become just another contracting arrangement with standard contracts and procedures. The challenge lies in reaching that point.

CHAPTER 3

ESTABLISHING THE BASELINE

Establishing the baseline is one of the most important issues in SES contracting since the building owner uses that baseline to estimate energy savings and thus payments to the ESCO. Those payments are based upon the difference between actual measured energy use and the baseline – an estimate of what energy use would have been without the ESCO.

Ideally, a baseline provides a measure of only those energy reductions that are due to a contractor's actions, not of those that are due to changes in building use or weather. In addition, a baseline must be simple enough to serve as a basis for billing payments.

Baselines should also be as flexible as possible to accommodate changes that occur after an SES contract has been signed. Buildings and the uses to which they are put often change. For example, building owners may install new energy-using equipment, increase occupancy rates, or add more lighting. Ideally, the method for calculating savings should be able to predict the extent to which such changes affect energy use and adjust the baseline accordingly. When such adjustment mechanisms are included in the baseline methodology, they are usually referred to as "adjustment indices." Adjustment indices may be formulas for adjusting the baseline based on occupancy rates, lighting output, and other measurable changes. Similarly, if the changes are more radical or cannot be easily measured, the SES contract should allow for negotiated baseline changes.

The baseline for a particular building must be developed from either historical or estimated energy-use data. Estimates may be based on a comparison with similar buildings or from a more-or-less detailed analysis of the building and its energy-using equipment. ESCOs prefer metered data since they believe it is both simpler to use and more reliable than estimation.

Insofar as baselines are concerned, we recommend the following actions:

- The Military Services should award installation-wide SES contracts. Installations are metered, making the development of installation baselines relatively straightforward.
- Each Service should establish a revolving fund to pay for metering buildings that are candidates for SES contracts. The most likely way to implement that fund would be to include metering in each Service's management fund established under DoD Instruction 7460.2.
- DoD's Energy Policy Office should join with DOE (1) to validate the latter's simulation model (ASEAM2) on a variety of DoD building types and with varying levels of input detail, and (2) to compare the costs of running a simulation with the cost of metering as a means of establishing the baseline.
- The Services should continue to experiment with different methods for establishing the baseline, with an emphasis on approaches that use some form of metered data. They should also continue to test regression equations based on metered energy-use data.
- Major commands or equivalent levels should collect energy-use data from installations under their purview and develop the baselines so that they can accumulate SES experience.

The energy services industry has not developed a standard approach to baseline determination; a variety of approaches currently exist.[1] Nevertheless, most ESCOs use relatively simple baseline methodologies because they judge that such methods give the best trade-off between cost and accuracy. The three basic methods for establishing a baseline are (1) engineering calculations, (2) regression analysis, and (3) simulation.

Ideally, a baseline methodology accounts for all of the variables – apart from conservation measures – that affect energy use. In practice, however, all of the variables cannot be measured with precision or, at least, to measure them with increasing precision entails increasing cost. The greater the perceived imprecision of the baseline estimate, the greater the risk to both the building owner and the ESCO. The risk to the ESCO is that it will not be paid for actual energy savings achieved if baseline calculations overestimate the current usage. The risk to the

[1]The findings and conclusions regarding industry baseline methods are based on a survey of ESCOs conducted for LMI by Lane and Edson, P.C.

building owner is similar: a baseline that underestimates current usage could attribute larger than actual savings to the ESCO and thus inflate payments. As a result, some ESCOs limit the type of work they accept to projects that fit the types of baseline estimating methods they have developed through their own experience.

BASELINE METHODS

Engineering Calculations

Engineering calculations incorporate experience about the energy-using characteristics of building properties and heating, ventilation, and air-conditioning (HVAC) equipment. Such calculations can be used to establish a baseline when the conservation measures are fairly tightly defined. Lighting is a good example. The energy-use baseline is simply the electrical consumption per existing light fixture times the number of fixtures. A contractor who decides to install more efficient lighting can calculate percent savings based on the difference between the energy efficiency of the new and that of the old lighting fixtures.

ESCOs use engineering calculations that vary from simple to sophisticated. DoD is also experimenting with a variety of engineering calculations to establish baselines for several SES pilot projects. For example, the Army, in its RFP for Corpus Christi Army Depot, Tex., specifically requires the installation of a chiller that meets certain performance specifications (although additional measures could also be proposed). Because the equipment is fairly closely specified in advance, the baseline can also be specified using engineering calculations to estimate existing energy usage and the savings from installing new equipment. A significant drawback to such an approach is that it limits the flexibility of the contractor and thus limits the potential energy savings.

The Air Force and the Navy have simultaneously devised an innovative way of developing a contractor-proposed baseline using engineering calculations. In their approach, the contractor has the freedom to propose different energy saving measures that presumably reduce the amount of time that energy-using equipment is in use or increase the efficiency of that equipment. The contractor then proposes a baseline to specify the amount of time that the pre-existing equipment was used and its efficiency ratings. Energy savings are measured by comparing the amount of time that the replacement equipment is used and its efficiency with the baseline. The RFP would require contractors not only to propose energy conservation measures, but also to propose a way of establishing a baseline, validating it before the contract is signed, and measuring it afterward. If the proposed baseline cannot be validated, the top-ranked contractor would be given the option of removing itself from competition or going ahead with a reduced share of savings.

Regression Analysis

Regression analysis is a statistical technique that uses historical metered data to isolate one or more of the variables that affect energy use. A regression analysis results in an equation that relates energy use to weather and/or building-use variables. Used as a baseline, a regression equation estimates what energy use would have been without the ESCO while eliminating the effect of variables not under the ESCO's control. ESCOs using regression analysis usually prefer single-variable equations, but some firms also use regression equations with two or more variables. A simple regression using degree days to estimate energy use appears to be the most common baseline method among ESCOs.[2]

When historical, metered energy-use data are available, regression equations define energy use in terms of the entire building and thus afford contractors the most flexibility to propose a variety of conservation measures without being limited to specific types of equipment.

Unfortunately, most individual buildings on DoD installations are not metered. DoD, therefore, generally has no historic, metered energy-use data for individual buildings from which to develop regression baselines. Installations have not been able to afford the installation of meters even though new technology has been lowering their prices.[3] One alternative for developing such metered data would be for an installation to install meters only on buildings that are likely candidates for SES contracting. Those meters could be installed up to a year before the SES RFP is released and only on the buildings that are likely candidates for SES contracting. In that way, data could be provided to prospective offerors, and since the RFPs have been taking more than a year to prepare, the data gathering would

[2]Degree days are a standard measure of the extent to which the outside ambient temperature falls below (or rises above) the temperature at which it is not necessary to heat (or cool) a building.

[3]Metering costs range between $100 and $1,500 per meter depending on the type of fuel being metered and whether the meter is installed during or after building construction.

not delay the process. ESCOs generally desire 1 to 3 years of energy-use data; 1 year would, therefore, fall at the bottom limit of that range.

One way to fund this approach would be for each Service to establish a revolving fund for metering. Each Service would have to start its fund with "seed money" to get the process started. The first installations to program SES contracts would apply for funds from the revolving account to install the meters needed to establish the baselines. Once the contracts have been awarded, the cost of the metering would be deducted from the savings and put back into the revolving fund to pay for metering at the next installations. When the last installations to be metered have repaid the fund, it would be terminated and the funds returned to the Service. Although such revolving funds are unusual, they are not unknown. The most promising avenue is within DoD Instruction 7460.2, which authorizes a "management fund" for each Service. Those management funds are revolving funds and could serve to handle the money needed for the installations' metering needs.

If we have to seek an alternative to this aggressive metering program, baseline development becomes more difficult although not impossible. For example, some ESCOs have successfully installed energy efficiency measures on college campuses, which have many parallels with DoD installations. One approach has been to start with metered buildings and have the contractor install meters on the remaining buildings before developing baselines for them. A similar approach could work for DoD installations.

Without revolving funds, DoD has a limited number of options for developing reliable regression baselines. One alternative is for the installation to pay for the required meters and then get reimbursed through the SES rebate discussed subsequently in Chapter 5. Installations may be willing, in effect, to establish their own revolving funds knowing that the expenditure of funds is only temporary and that the rebate will eventually make the investment worthwhile.

Another approach is for DoD to undertake installation-wide SES contracts. Energy use histories exist for entire installations and master-metered areas within installations. A baseline could be developed for the total installation rather than for individual buildings within the installation. SES contractors could be required to place individual meters in those buildings in which energy conservation equipment is to be installed. The savings could, initially at least, be measured from the large area baseline. While it is easier to develop a baseline for a metered installation than for an unmetered building, it may be more difficult to develop baseline *adjustments* for an installation than for a single building because it may be more difficult to isolate and monitor the relevant variables for the former than for the latter.

Regression analysis based on metered data, however, does not inevitably provide a reliable baseline. The Navy, for example, attempted to use regression analysis to develop a baseline for Building 3400 at Naval Training Center Great Lakes, Mich. Historical energy-use data were available for that building and were analyzed to determine the correlation between past energy use, weather, and building-use factors. The Navy considered 13 variables and concluded that the number of cooling degree-days and the monthly average sky cover showed the most significant correlation with natural gas usage. Those two variables explained about 88 percent of the variation in gas usage between October 1982 and April 1985. Unfortunately, the resulting regression equation failed to predict subsequent natural gas usage (October 1985 through January 1987) with enough accuracy to serve as a satisfactory baseline. The regression equation developed for electricity use, however, is satisfactory, predicting energy use in the period October 1985 through January 1987 within 5 percent of actual use. Appendix B further details the Building 3400 regression analysis.

Simulation

The third method for establishing a baseline is simulation. In essence, a simulation of building energy use is a sophisticated set of engineering calculations that attempts to forecast energy use based on a buildings size and shape, its HVAC equipment, the levels of insulation, the types of windows and doors, and other salient characteristics. However, baselines developed from simulations have a number of drawbacks in the eyes of the energy services industry: (1) they are perceived as being complex and thus expensive to use, (2) they are not well understood by either the ESCOs or their customers, and (3) the results are considered less accurate and less reliable than historical metered data. Unless and until ESCOs are convinced that simulations are accurate, inexpensive, and easy to use, they are likely to attribute additional risk to projects that depend on simulated data and will demand higher savings shares to compensate for that risk. That attitude poses a problem for DoD, since most DoD buildings are not individually metered.

DOE's Federal Energy Management Program (FEMP) has sponsored the development of an energy use simulation model, ASEAM2.[4] The model runs on a microcomputer and is sophisticated and user-friendly. The user can put in as much or as little data (within limits) as available and ASEAM2 will insert default values for the missing data.

Some ESCOs have expressed reservations about the ASEAM2 model. They apparently fear that it will be costly to use and are unsure of the accuracy of its conclusions. Even though the model runs on a microcomputer with relatively easy input, the fact that it resides on 16 floppy diskettes is somewhat intimidating. Questions exist regarding the cost of gathering the detailed input data for the model or, conversely, the accuracy of its output if detailed inputs are not available. For example, ASEAM2 asks for the R-value of insulation, and in many cases, that value cannot be determined easily.

The Department of Housing and Urban Development (HUD) has used ASEAM2 to develop a baseline for its headquarters building in Washington, D.C. The RFP for an SES contract on that building has now been released to prospective contractors. The lessons learned from that experience will undoubtedly have an influence on DoD's approach to establishing a baseline.

To increase ESCOs' confidence in ASEAM2, we recommend that DoD join with DOE to validate the model on a variety of building types in addition to the large HUD building. As part of that validation exercise, DOE could also demonstrate the validity of ASEAM2's outputs based on various levels of input data detail. Such validations, which could compare ASEAM2's results with actual metered data, would go a long way toward easing ESCOs' uncertainties. DoD and DOE should also compare the cost of using ASEAM2 to develop a baseline with the cost of metering to do the same thing. Metering technology is advancing and becoming less expensive. Since metered data are highly reliable, the accuracy and cost of simulation should be compared with those of metering.

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[4]ASEAM Version 2.1 is now available. For price and ordering information, contact: American Consulting Engineers Council, Attention: Mr. A. Willman, 1015 15th Street, NW, Suite 802, Washington, D.C. 20005.

OTHER BASELINE ISSUES

Adjustment Indices

ESCOs and their customers often need adjustment indices for altering the original baseline when changes occur in a building's layout or use. Such adjustments can either be part of the original baseline or later additions. Engineering calculations are commonly used to develop such adjustment indices. For example, if additional energy-using equipment is added, such as computers, engineering calculations are well suited to estimating additional energy use. Regression equations, since they are based on past experience, are less well suited to the development of adjustment indices. A regression equation employing a building-use variable such as occupancy, however, could serve to estimate energy increases due to increased occupancy, if used with caution. Simulation – although rarely used at present to develop adjustment indices – could also be used to estimate energy-use changes resulting from post hoc building changes.

Building Data

In addition to the lack of historical, metered energy-use data, DoD also faces a lack of engineering data on existing HVAC equipment. Without those data, problems can arise in the development of baselines from engineering calculations and contractors can have difficulties estimating possible energy saving opportunities, regardless of the baseline method. While ESCOs could conduct "walk-through" audits, such audits are generally insufficient for calculating a reliable baseline or estimating likely savings. Building-use data – such as occupancy rates – are not always available either, creating potential additional difficulties for the regression approach.

Centers of Expertise

We recommend that DoD place responsibility for developing the baseline in "centers of expertise" above the installation level in order to give SES personnel the opportunity to develop experience with more complex baseline estimating methodologies than most private building owners (or DoD installation personnel) would have the opportunity to develop. DoD is not limited to the most simple baseline methodologies if it places responsibility for developing baselines and calculating savings at the major command or other level. More complex baseline methodologies may include multivariate regression analysis and simulations.

PERFORMANCE GUARANTEES

Another issue related to baseline determination is the performance guarantee; that is, deciding what level of savings constitutes nonperformance and how the savings will be split between DoD and the ESCO when savings are greater or less than promised. Ideally, the performance guarantee of an SES contract should provide an incentive for the contractor to increase savings beyond the minimum promised and, conversely, should penalize the contractor if savings are less than promised.

Suppose, for example, that the SES contract promises 20 percent total energy savings with a 50 percent share of the savings going to DoD. If actual savings equal 20 percent, then DoD saves 10 percent and pays 10 percent of the baseline dollar value to the ESCO. But suppose actual savings are only 15 percent? Is the ESCO now in noncompliance with the contract? Should DoD terminate the contract? If not, how much should DoD pay to the ESCO and how much should it keep to itself in such a case?

Figure 3-1 illustrates two possible approaches for determining DoD's savings share. In the first approach, the performance guarantee is 50 percent of actual savings. Using the second approach, the performance guarantee is 10 percent of the calculated baseline no matter what actual savings turn out to be.

The first approach appears to be the one most commonly used in existing SES contracts. Under that approach, DoD would accept lower than promised savings but would also share in any savings increase above 20 percent. Using the second approach, DoD would save 10 percent as long as the ESCO achieved total savings of 10 percent or more. The ESCO would only be in noncompliance if total energy reduction was below 10 percent, not just below 20 percent. However, the contractor would have a very strong incentive to save as much as possible since its share of the savings would diminish rapidly at savings levels below the promised 20 percent. The ESCO would also have a strong incentive to increase savings since it would keep all of the marginal savings. However, DoD would not profit from those increased savings as it would under the first approach.

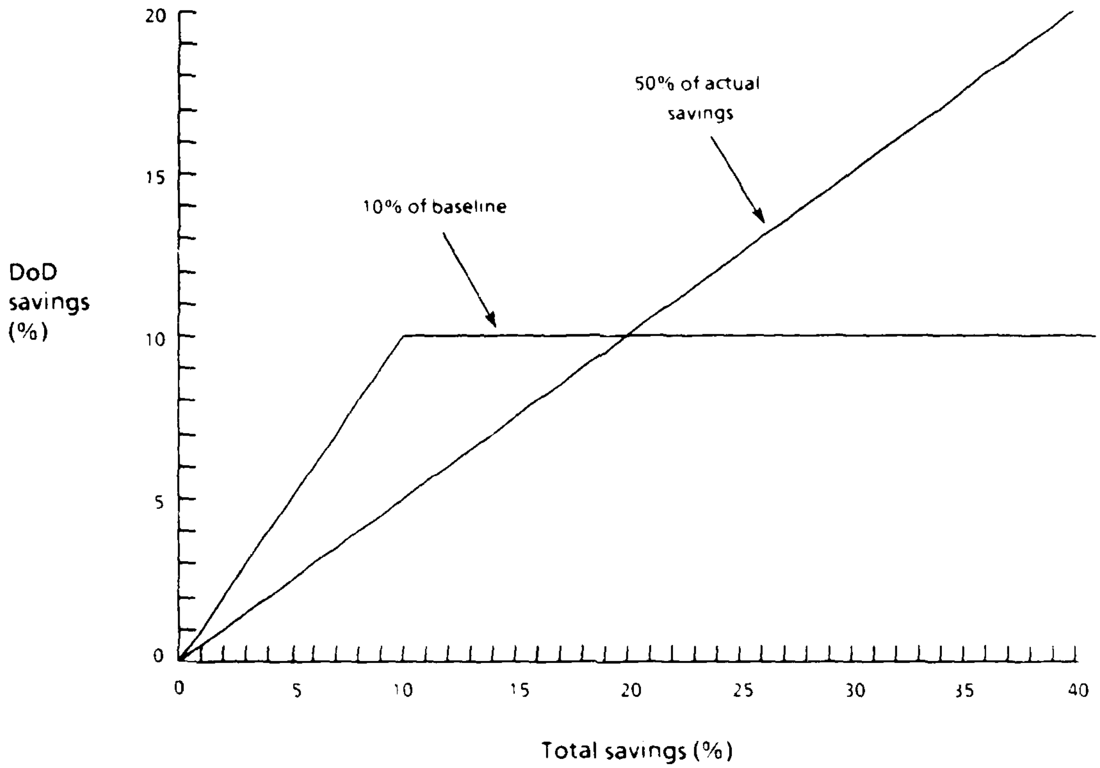

FIG. 3-1. DOD'S SHARE OF SAVINGS RESULTING FROM DIFFERENT ADJUSTMENT METHODS

We recommend that DoD use a combination of these two approaches: provide strong penalties for falling below the total promised savings (such as a minimum level of savings to DoD) but share increased savings on a sliding scale. That is, vary the share at levels above the promised savings. The result would fall slightly below the 50 percent curve in Figure 3-1. There is no good way at present to determine the exact form such an adjustment should take, and we recommend that DoD experiment with various percentages during the SES pilot program.

The question of how often to measure savings then arises. It appears to be fairly standard practice to measure savings on a monthly basis since energy use is most often billed monthly. However, because the shorter the measurement interval, the more likely random events are to affect energy use, DoD should require a minimum level of savings before making SES payments.

According to one experienced SES practitioner, "... it is extremely important to recognize that random effects can cause variations in energy usage. Energy curves are rarely steady; even factoring in weather and all known variables, energy consumption can vary 5 to 10 percent for unknown reasons. Consequently, it can be expected that in some months, a 5 to 10 percent 'energy savings' may be measured without any effort from anyone. To eliminate the potential of paying for random energy savings, the contract should require a certain level of energy savings before any payment is due."[5]

As a result of decreasing energy prices in recent years, some ESCOs have begun to include energy price "floors" in their contracts in order to limit losses if energy prices fall more than anticipated. Energy price floors generally reflect prices prevailing at the time the contract is signed. We recommend that, if a price floor is included in an SES contract, DoD should also include a price "ceiling" to limit price increases to a certain level. The maximum increase could possibly be based on DOE's energy price escalators (discussed in Chapter 4).

[5]Yates, P. "Energy Agents for Local Governments." *Financing Energy Conservation*. Op cit. pp. 96–97.

CHAPTER 4

EVALUATING SES PROPOSALS: ECONOMIC ANALYSIS

In this chapter, we focus on economic analysis procedures for selecting the SES proposal that offers the highest savings over the life of a project. *Economic analysis* refers to the procedures for estimating and evaluating total dollar costs and savings over the life of a project; economic analysis, life-cycle analysis, and investment analysis all mean essentially the same thing (although investment analysis implies that a project includes an up-front cost followed by later savings). We use the term *project* to refer to a specific energy saving opportunity – a building or set of buildings – while *proposals* are suggested ways of realizing the project submitted by private contractors. A project may last longer than any one particular proposal.

We stress that the results of an economic analysis of SES proposals are only as reliable as the data used in that analysis. The economic analysis of proposed savings, while important, should be only one of several source-selection criteria. Other important criteria include the technical feasibility of the proposals as well as the proposers' relative technical expertise, reliability, and financial strength.

Despite the caveats, however, an economic analysis remains an important part of the evaluation process. One of the most important functions of an economic analysis – apart from selecting the best proposal – is to provide an incentive for contractors to submit competitive bids in the first place. The mere knowledge that an economic analysis is an important part of DoD's selection procedure will tend to maximize DoD's share of the savings.

We recommend that in their economic analyses, DoD energy managers proceed as follows:

- Discount promised energy savings to establish the life-cycle savings of each proposal using a real (uninflated) discount rate of 7 percent, consistent with DOE regulations for evaluating conservation projects
- Use DOE escalators to forecast energy prices and use constant prices to forecast all other costs and savings

- Assume that savings continue for at least as long as the longest proposal, with shorter proposals rolling over at an assumed renegotiation cost
- Use sensitivity analyses to test the choice of proposals
- Perform the analysis at the major command or equivalent level so that DoD develops institutional experience evaluating SES proposals.

RELIABILITY OF SAVINGS ESTIMATES

Individuals from both ESCOs and state SES programs have asserted that discounted life-cycle savings should be used with caution as a criterion for comparing SES proposals. That is, unless a full-fledged (and usually expensive) energy audit is conducted in advance, SES proposals normally embody only rough estimates of possible savings.

The reliability of energy savings forecasts depends in large part upon the thoroughness of the preliminary energy audit. The thoroughness of the audit, in turn, depends upon the amount of up-front money available. Even then, many SES contractors are suspicious of any audit carried out by another firm. However, ESCOs do not appear to be willing, in most cases, to carry out their own audit on speculation without a strong probability that they will obtain the contract. Even reducing the competition to only two contractors would probably not provide sufficient incentive to a contractor to risk the expense of an extensive audit. A "walk-through" audit – in which a contractor judges potential energy-savings during a brief visit to the building – can normally only generate an approximate savings forecast.

When competing for a Government SES contract, however, a walk-through audit will probably be all that is possible because of the scarcity of up-front funds to apply to more extensive audits. Thus, the discounted life-cycle savings estimate is less dependable than an analysis resulting from a more thorough audit. Since the inputs to the discounted life-cycle analysis are normally rough estimates, decision-makers should weigh the analysis results accordingly.

FORECASTING CASH FLOWS AND DISCOUNTING

The appropriate method of economic analysis for selecting the proposal that offers the most savings over time is to calculate the discounted savings promised by each proposal. The analysis should (1) take into account all the pertinent costs and savings over the *project* life and (2) adjust the net of those costs and savings (the "cash flows") to a consistent time period by discounting in order to express them as a single value. In order to estimate discounted cash flows, forecast costs are expressed as negative values and forecast savings as positive values; everything else being equal, the proposal with the highest discounted cash flows or net savings is the most cost-effective.[1]

The economic analysis of SES proposals is not, however, a screening method for separating cost-effective proposals from non-cost-effective proposals, since all of them should reduce energy costs compared to DoD's existing usage. Indeed, analysts could conceivably make a random choice among the proposals and still arrive at a cost-effective project (although such a method would eliminate the contractors' incentive to maximize savings). Economic analysis is simply a method for choosing the economically optimal proposal among a set of cost-effective proposals.

Economic analysis normally requires a number of steps such as defining a project, establishing feasible alternatives, and forecasting a cash flow. The analysis of SES projects, however, is far simpler. DoD must still define a project in order to issue an RFP, but the submitted proposals then become the set of feasible alternatives for carrying out that project. The forecast cash flows are embodied in the proposals and DoD analysts need not separately estimate them.

As we demonstrate later in this chapter, analysts may not always need to discount SES proposals to choose among them; the proposal with the highest annual savings should provide the highest total savings. However, if the proposals do not fully amortize the contractors' costs so that DoD's share of the savings are lower at the beginning of the contract and increase over time, then DoD must usually discount to make the choice among different proposals. Although DoD is not making any explicit up-front investment of its own, it is giving up some early savings for later savings. Also, when recurring costs – such as recontracting (rollover) costs – are involved, discounting may be necessary.

Discounting is a relatively straightforward procedure that is widely used and understood. With the increasing availability of small computers and spreadsheet programs throughout DoD, the calculations have also become fairly easy.

[1]By contrast, a life-cycle cost analysis assumes that all proposals yield identical benefits. Costs are generally expressed as positive values and, therefore, the proposal or alternative with the *lowest* discounted life-cycle cost is considered the most cost-effective.

Nevertheless, a number of issues unique to calculating the discounted savings of SES projects need to be resolved. The Shared Energy Steering Group has expressed a desire that economic analysis methodology be standardized across the Military Departments to the extent possible. With such standardization, the same criteria will be applied to all of DoD's SES projects regardless of which Military Service is involved.

Required Discount Rate

If the costs and savings of SES proposals are unevenly distributed over time, Federal guidelines require that they be discounted for comparison. Furthermore, because the primary purpose of an SES project is energy conservation, DoD is obligated to use the 7 percent discount rate prescribed by the Department of Energy. However, the choice of discount rate is not critical since the relative ranking of most SES projects will not be highly sensitive to the discount rate.

While SES projects do not normally require up-front investments,[2] they nonetheless fall within the scope of Federal discounting guidelines since they are projects, "...for which the adoption is expected to commit the Government to a series of measurable costs extending over 3 or more years or which result in a series of benefits that extend 3 or more years beyond the inception date."[3] That is, the cash flows are distributed over time and discounting is, therefore, required to compare alternative distributions.

The Office of Management and Budget (OMB) establishes the basic guidelines for evaluating Government projects. DOE has modified those guidelines for the evaluation of certain energy projects. The OMB and DOE guidelines are summarized and compared in Table 4-1. OMB Circular A-94 directs Federal agencies to use a 10 percent real discount rate (excluding inflation) when evaluating projects whose cash flows are distributed over time.[4] DOE's guidelines, which are incorporated in Subpart A of Part 436 of the Code of Federal Regulations (10 CFR Part 436), prescribe a 7 percent real discount rate and a 10 percent reduction of the initial

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[2]While considerable time and effort may be spent in preparing RFPs and evaluating proposals, those are "sunk costs" that should be excluded from the economic analysis.

[3]Office of Management and Budget. *Circular Number A-94*. 27 Mar 1977, p. 1.

[4]*Real* discount rates exclude inflation and must be used with constant dollar forecast cash flows; *nominal* rates include inflation and must be used with then-year or current dollars.

investment amount. When evaluating potential energy conservation, solar energy, and photovoltaic projects, 10 CFR Part 436 supersedes OMB A-94.

TABLE 4-1

COMPARISON OF ECONOMIC ANALYSIS GUIDELINES

Methodology	OMB guidelines	DOE guidelines
Discount rate	10%	7%
Cash-flow dollars	Constant (uninflated)[a]	Constant (uninflated)[b]
Inflation rate	Not applicable	Not applicable
Cash-flow period	Annual	Annual
Cash-flows assumed to occur	End-of-year or mid-year	End-of-year
Amount of initial investment included	100%	90%
Initial investment assumed to occur	Not specified	Period zero
Other costs to be included	All economic costs	All economic costs
Tax effects	None	None
Sensitivity analysis	Vary costs, not discount rate	Vary costs, not discount rate

[a] May reflect changes in *relative* prices where there is a reasonable basis for estimation

[b] Must use DOE energy price escalators to incorporate relative changes in energy prices

In particular, 10 CFR Part 436 applies to the evaluation of SES projects because it must "... be followed by all Federal agencies for all energy conservation and renewable *projects* undertaken in new and existing buildings and facilities owned or leased by the Federal Government, unless specifically exempted." (Emphasis added.) More specifically, 10 CFR applies to "... alternative building systems and designs for existing and new Federally owned and leased buildings to reduce their consumption of nonrenewable energy."[5]

The 10 percent discount rate in OMB Circular A-94 is based on the private sector rate of return. The 7 percent rate in 10 CFR Part 436 is a modification of the private rate based on the assumption that market-based energy prices, especially for nonrenewable fuels, do not incorporate the full social costs of using and producing energy. DOE incorporates the lower discount rate and reduction of the initial

[5]Ruegg, R. *Life-Cycle Costing Manual for the Federal Energy Management Program.* pp. iii & xvi.

investment as an adjustment for the social benefits of energy savings that it feels are not fully reflected in the energy price. (A complete discussion of that assumption is far beyond the scope of this study.)

Discount Rate Sensitivity of SES Comparisons

The choice of discount rate is not critical to the evaluation of SES proposals. The ranking of SES proposals is relatively insensitive to the discount rate since they do not involve large up-front investments. As stated before, discounting is only necessary when comparing proposals that offer savings that vary from year to year; the lower the annual variance, the less sensitive the answer to the choice of discount rate. Table 4-2 demonstrates the discount rate sensitivity of four hypothetical SES proposals; Figure 4-1 illustrates the same information graphically. In particular, if all proposals promise percentage savings that stay the same from year to year, then discounting is unnecessary for comparisons among them.[6] For example, Proposal A, which promises a 25 percent savings for each of 25 years, is clearly better than Proposal B, which promises only 20 percent savings per year; discounting is unnecessary when comparing the two.

Even when the savings vary from year to year, some proposals dominate others no matter what discount rate is used. Proposal B, for example, is better than Proposal D at every discount rate above zero even though both proposals promise the same average savings – 20 percent – over 25 years. We prefer Proposal B because it provides the savings earlier. Discounting is based on the assumption that we demand a premium when receiving benefits at a later, rather than an earlier, date. When two proposals offer the same total benefits, therefore, we unequivocally prefer the one that provides higher savings earlier. Proposal B promises 20 percent savings in the early years while Proposal D promises no savings to begin with and only climbs to 20 percent by year 11 of the contract. Thus, we do not need to discount in order to rank Proposals A, B, and D.

The relative desirability of Proposal C, however, depends on the discount rate. It promises an average savings of 28 percent – higher than any of the other proposals – and yet offers lower savings during the early years of the contract. Whether we prefer Proposal C to the others, therefore, depends upon how much we

[6]Discounting might be necessary if the terms (in years) of the proposals differ, depending upon our assumptions. See the subsequent discussion of unequal project terms.

TABLE 4-2

DISCOUNT RATE SENSITIVITY OF HYPOTHETICAL SES PROPOSALS

Proposal	A	B	C	D
% Savings:				
Years 1 – 5	25%	20%	8%	0%
6 – 10	25	20	18	10
11 – 15	25	20	28	20
16 – 20	25	20	38	30
21 – 25	25	20	48	40
Average	25%	20%	28%	20%
Present value @: ($000)				
10%	$920	$740	$710	$420
7%	$1,180	$940	$1,020	$640
Ranking @:				
10%	1st	2nd	3rd	4th
7%	1st	3rd	2nd	4th

Note: Assumptions are as follows: Energy cost = $5.40/MBtu (Natural gas); Total baseline = 150,000 MBtu; DoD share of savings = 50 percent.

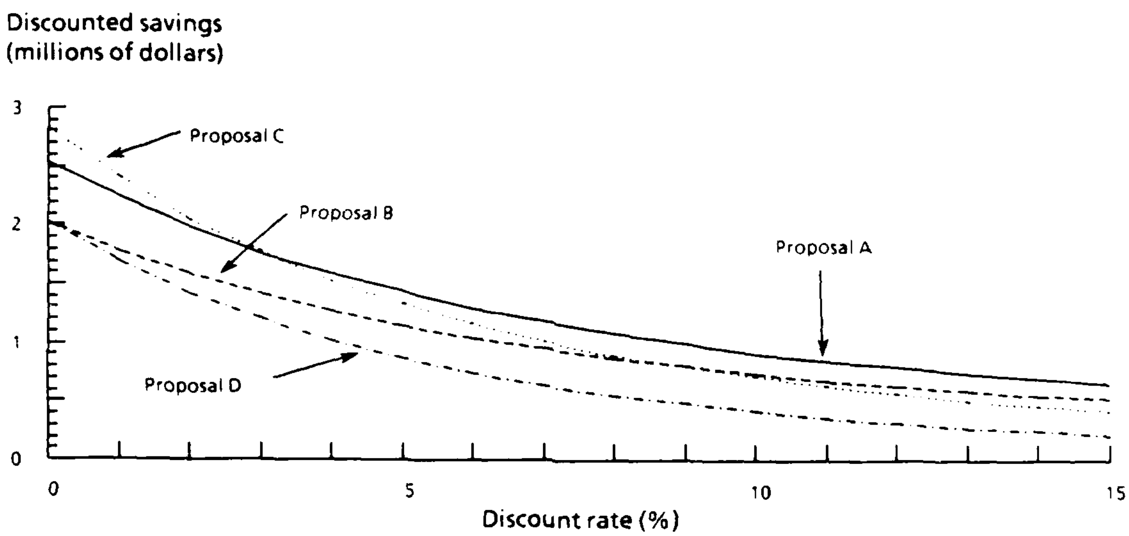

FIG. 4-1. DISCOUNT RATE SENSITIVITY OF HYPOTHETICAL SES PROPOSALS

value the later benefits; that is, it depends upon our discount rate. Suppose we are choosing among Proposals B, C, and D. At a discount rate of 10 percent (OMB A-94), we would choose Proposal B, while at a discount rate of 7 percent, we would choose Proposal C. At any discount rate above 3 percent, however, Proposal A remains the unambiguous winner (see Figure 4-1).

Nevertheless, we should remember that the precision of the discounted life-cycle savings depends upon the precision of the input data. If our choice between two proposals swings between discount rates of 7 and 10 percent, then the two proposals are probably rather close to begin with and the final decision is likely to be based on factors other than the discount rate.

Energy Price Forecasts

In conjunction with the 7 percent *real* discount rate, DoD must use *constant* dollar (uninflated) cash flow forecasts. Energy prices, however, should be calculated using DOE's energy price escalators, which attempt to estimate future changes in energy prices relative to the general rate of inflation. That is, energy prices calculated using DOE's escalators are still constant dollar forecasts but take into account the expected difference between energy price inflation and the general rate of inflation for other goods. For example, if the general inflation rate is expected to be 4 percent and distillate fuel prices are expected to increase by 5 percent, the distillate fuel escalator would be approximately 1 percent. 10 CFR Part 436 requires that a discounted life-cycle analysis use the forecast of energy price escalators that DOE publishes periodically.[7] The most recent escalators forecast relative energy price changes from 1987 through 2017.[8]

COMPARING PROPOSALS WITH UNEQUAL PROJECT TERMS

DoD has two choices for determining the term (in years) of an SES project when preparing an RFP. It can specify the contract term in advance or it can allow contractors to propose their own term (subject to a maximum of 25 years). Leaving

[7]Even OMB Circular A-94 (p. iii) states that, "Estimates may reflect changes in the *relative* prices of cost and/or benefit components where there is a reasonable basis for estimating such changes."

[8]DoD analysts must currently use the energy price escalation rates that DOE has specifically prepared for DoD and that are contained in a 23 December 1987 memo from the Deputy Assistant Secretary of Defense (Logistics) and that supplant the escalation rates in the 1987 edition of National Bureau of Standards Handbook 135.

the contract term open gives contractors more freedom to propose any number of energy saving ideas with a variety of economic lives. The comparison of discounted life-cycle savings, however, becomes slightly more complicated among proposals of different terms.

When all proposals have the same term, the comparison is relatively easy. We can simply discount the expected savings over the life of each contract and make a one-to-one comparison of the results to determine which proposal has the highest savings. When the proposals have different terms, however, we must make a number of assumptions about the future in order to convert the unequal terms into a set of equal-term alternatives. We refer to that conversion process as "normalizing" the term of the proposals. Proposals can be normalized by assuming that they roll over (are recontracted) when the contracts end. DoD should include a rollover cost in the cash flows when those rollovers occur. That rollover cost should cover the cost to DoD of issuing a new RFP, recontracting with the same contractor, or taking over the project itself.

A simple comparison of the discounted savings expected for each proposal – without normalizing them – is equivalent to assuming that once the shorter contracts have ended, the building will revert to its previous level of energy use. Besides being a generally unrealistic assumption, that approach strongly biases the analysis in favor of the longest term proposals. Since contractors would recognize that bias, it is likely that they would propose contract terms at or near the maximum, thus canceling out the advantages of an open term.

In order to convert unequal term proposals into alternatives of equal terms, DoD analysts should (1) establish the possible future options after each proposal ends, (2) select the best future option for each proposal, and (3) when comparing the alternatives, include the best set of future options with each proposal.[9]

In practice, it is neither possible nor desirable to extend the analysis indefinitely into the future, nor is it even necessary to use the lowest common multiple of contract lengths. The analyst only need look ahead for a reasonable length of time, at least equal to the longest term proposal. For example, the lowest common multiple of three proposals with terms of 5, 6, and 7 years is 210 years. It would, of

[9]For the theory behind the comparison of unequal term projects see, for example, Haley, C.W. and L.D. Schall, *The Theory of Financial Decisions*. New York, 1973. pp. 50 – 51.

course, be hopelessly unrealistic to make any assumptions about energy savings 2 centuries from now. Moreover, it is unnecessary, since discounting rapidly reduces cash flows beyond 30 years or so to insignificance, as demonstrated in Table 4-3.

TABLE 4-3

$1,000 PER YEAR SAVINGS DISCOUNTED AT 7 PERCENT FOR VARIOUS TERMS

Term	Present value	Difference
20	$105,900	
25	116,500	$10,600
30	124,100	7,600
40	133,300	9,200
50	138,000	4,700
100	142,700	4,700
210	$142,900	$ 200

To illustrate how the procedure works in practical terms, consider the comparison shown in Table 4-4 between a 5-year contract and a 10-year contract. In that example, we need only construct and compare two alternatives: Proposal A and a normalized Proposal B. Each alternative is 10 years long (the lowest common multiple in this case).

The first normalizing assumption – which in reality is the absence of any assumptions about the future – is the one discussed above, a return to the status quo. Proposal A would clearly be the winner in this case. Under the second assumption, DoD retains all of the savings once the ESCO is out of the picture. That assumption – which gives Proposal B the advantage – is also unrealistic. The ESCO's share of savings covers the costs of operations, maintenance, and equipment replacement, all of which DoD would have to assume once the contractor is no longer present.

The last four normalizing assumptions are more realistic. If we assume an identical rollover (same savings share to DoD, no recontracting cost), then our two hypothetical proposals are even. An identical rollover does not necessarily assume that the same ESCO is awarded an identical contract. It simply means that the

TABLE 4-4

NORMALIZING PROPOSALS OF UNEQUAL LENGTH

	Savings		Winner
	Years 1 – 5	Years 6 – 10	
Proposal A (10 years)	10%	10%	
Proposal B (5 years)	10%		
Normalizing assumptions			
1. No normalization	10%	0%	A
2. Total savings to DoD	10%	20%	B
3. Identical rollover	10%	10%	Tie
4. Higher savings to DoD	10%	11%	B
5. Lower savings to DoD	10%	9%	A
6. Recontracting expense	10%	10% ($50,000)	A

installation expects to continue saving approximately the same amount of energy in the future. The installation could carry out the conservation measures itself, contract with the same ESCO, or contract with a different ESCO.

The fourth and fifth normalizing assumptions are similar to the third, with the difference that the savings vary slightly. These are potentially realistic assumptions as long as there is a good basis for believing that the savings are likely to increase or decrease slightly in the future. It would be unreasonable, however, to assume that the savings will vary significantly from the savings promised by the initial contract. Since these normalizing assumptions bias the decision slightly in favor of either the shorter or the longer term contract, an installation that wishes to encourage longer or shorter term contracts could assume lower or higher savings, respectively.

The sixth normalizing assumption assumes that a new SES contract will be signed once the first contract ends and adds a cost to cover recontracting at that time. The recontracting cost is discounted to the present and slightly offsets the discounted savings.

We recommend that DoD normalize all proposals by assuming a rollover cost but that it not assume significantly different savings after the initial contract ends. Those assumptions best appear to reflect reality. They are, moreover, relatively simple and straightforward. As we have pointed out, the economic evaluation should not attempt to fine-tune the numbers since the inputs are likely to be approximations.

COMPARING PROPOSALS WITH EQUAL PROJECT TERMS

If the RFP establishes the contract term, then the proposals are already normalized. In that case, the analysis will probably have to include estimated residual values since the RFP term may not coincide with the economic life of the assets. When, on the other hand, the term is proposed by the bidders, the economic life is likely to coincide with the term and the residual value will be low enough to be ignored. Any contractor that attempts to recoup its investment costs before the installed equipment has worn out will propose a lower savings share to DoD (and thus place itself at a disadvantage in its cost proposal) compared with a contractor that recoups its costs over the full life of the equipment. The same reasoning applies whether the savings come primarily from installed equipment or from labor-intensive maintenance.

SENSITIVITY ANALYSIS

Because the input data and assumptions used to compare SES proposals are likely to be approximate, sensitivity analysis becomes important when proposals appear to yield similar savings. A sensitivity analysis can help show how robust the selection of the "best" project is. That is, will small changes in the discount rate, promised savings, recontracting cost, or other parameters swing the selection from one alternative to another? If they do, the assumptions can be reconsidered or the initial selectee can be awarded the contract. When the analysis method and assumptions are laid out precisely in the RFP, sensitivity analysis may not alter the selection in any case. However, the economic analysis is unlikely to be the sole selection criterion.

MODELS FOR ANALYZING CONSERVATION PROJECTS

A number of computer software packages exist to help DoD conduct the economic comparison of SES alternatives. It is not necessary for DoD to use a standard model, however, but it should use standardized methodology for economic analysis. Furthermore, we recommend that the individual installations not be burdened with the task of analysis. The ranking of proposals according to discounted life-cycle savings would be best carried out at the major command or equivalent level. Centralizing the evaluation process will allow experience to accumulate.

The following subsections describe three models available for conservation projects. All of the models run on IBM PC™ or compatible microcomputers.

Federal Buildings Life-Cycle Costing Model (FBLCC)

FBLCC is the energy conservation model prepared under the auspices of DOE. It incorporates all of the requirements of 10 CFR Part 436 and can be used to evaluate all types of energy conservation projects, including but not limited to SES. The model is relatively simple to use but does not permit direct input of percent savings shares. The savings must be converted to MBtu savings first. FBLCC is available as a stand-alone model and is also incorporated in ASEAM2, DOE's simulation model.

Energy Efficiency Investment Analysis (ENVEST)

ENVEST was prepared by the Alliance to Save Energy and the Governor's Energy Council, Commonwealth of Pennsylvania. It is the most sophisticated and flexible of the three models and allows detailed analysis of a variety of conservation project types including SES. The model is more sophisticated and flexible than FBLCC and is therefore slightly more complex. Nevertheless, it incorporates user-friendly menus and other features to ease data entry. Like FBLCC, it does not permit direct input of percent savings data.

LMI Life-Cycle Savings Model (LCSM)

LCSM is a LOTUS 1-2-3™ spreadsheet model that was written specifically for SES projects; it allows direct input of percent savings. It is relatively simple and straightforward but lacks the sophistication and flexibility of ENVEST. LCSM incorporates the requirements of 10 CFR Part 436, including DOE's energy price escalators. All parameters can be altered for sensitivity analysis, however. The model is described in more detail in Appendix C.

Price and ordering information for ENVEST and FBLCC can be obtained from the following:

ENVEST: Alliance to Save Energy
1925 K Street, NW
Suite 206
Washington, DC 20006

FBLCC: National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161

CHAPTER 5

SHARING ENERGY SAVINGS WITH THE INSTALLATION

An SES contract cannot be implemented or successfully executed at an installation without the support and enthusiastic cooperation of the installation management. However, installations currently have little incentive to participate in SES since they receive none of the savings. To provide an incentive, DoD must share some of the savings with the installations that participate.

An installation implementing an SES contract would bear some of the costs even though the RFPs would be handled at headquarters level. The installation would still have to assist in the contracting effort and would have to manage the contract, once awarded. It would also bear most of the risks involved. For instance, if an SES contractor were to install new, sophisticated equipment and then default on the contract, the installation would have to find someone to maintain it. In addition to these risks, the installation would bear the inconveniences involved. As equipment is installed, temporary measures may have to be taken such as shutting down heating and air-conditioning systems and relocating workers. Installations are aware, however, that currently no means exist to reimburse them for these costs, risks, and inconveniences. As the SES measures begin showing savings in the cost of utilities, an installation must lower its estimates of future utility costs and revise its utility budgets for future fiscal years. It is therefore funded less for utilities in future fiscal years and the Government's savings are absorbed at the major command or Service level.

Some at the Service level have argued that installation managers should not need incentives to save the Government money. They should be willing to assume the risks and spend the resources if it means reducing the Government's utility budget. However, that approach seems idealistic. With the pressure of so many requirements on an installation's contracting and engineering staffs, it would be easy for even the most professional manager to conclude that an SES contract is not worth the risks and inconvenience involved especially since the concept is so new.

This lack of incentive is certainly one of the reasons no SES contract has yet been awarded.

CURRENT POLICIES ON SHARING THE SAVINGS

Currently, no DoD- or Service-level policies or regulations prevent SES savings from going to the installation. In fact, DoD Directive 4001.1, 4 September 1986, states:

> Unless prohibited by law, a share of any resources saved or earned at an installation should be made available to the installation commander to improve the operations and working and living conditions at the installation.

Support at the Service comptroller level for this sharing is mixed. However, all Service comptrollers point out that many policies and restrictions on the transfer of funds occur at the major command level. Some major commands impose restrictions on the installations' authority to move money between accounts and may resist returning SES savings to the installations, or may impose severe restrictions on their use. Thus, any policy to return SES savings to installations must be fully supported at the major command level.

FORM OF THE SHARED SAVINGS

Since the goal is to provide an installation with the incentive to implement an SES contract, any savings it receives must be in a form acceptable to it. The installation management must perceive that it is really getting the money the contract has saved. If the major command buries such savings in an installation's budget and merely indicates that they were "taken into account" during the budget process, the installation is unlikely to feel it has benefited. That feeling becomes more negative during a period of severe budget cutting when the installation's budget has been reduced. Moreover, installation management must be confident that the saving is actually returned, the return must be enough to capture its attention, and relatively few restrictions must be imposed on how it can be spent. Only if those three criteria are met will the installations begin to aggressively pursue SES contracts.

Keeping the savings at the installation during the first year is relatively easy. If an SES contract is awarded and energy savings begin immediately, the installation can move money out of the utilities account and put it to some other use.

All Services allow such transfers although some major commands require notification. In future fiscal years, however, the installation must reflect the savings by requesting less utilities money. If it does not reduce its request and is funded for utilities as though no savings had been realized, its utilities budget will be inflated. Not only is that inflation a dishonest estimate of the Services' utilities needs, it also skews the data on SES.

To maintain credibility in the budget process, then, the SES savings must be returned to the installation as a separate line item in the budget. A title of "SES Rebate" would be appropriate since the word "award" may give the impression that the installation must compete for it. A rebate also implies that it is a return of some of the resources expended on the SES contract. Whatever the title, however, this separate line item will provide the perception needed that the installation is actually receiving tangible benefits from its efforts.

The effort to administer this additional budget line item should be minimal. Administration of the SES contract requires that both the Government and contractor shares of the savings be well documented to determine how much the contractor is paid for its portion. The installation need simply reflect the amount of Government savings under the "SES Rebate" line item in its budget request to the major command. Both installation and major command management must understand that the major command will fully fund all SES rebates. The installation commander must, however, request the rebate in the Major Force Programs (MFP) in which the money will be spent since an installation cannot transfer monies between MFPs. The commander may decide, for example, to split the rebate request among MFPs in the same ratio as the utilities were saved or may feel that the greatest need is in one particular MFP. The commander should then be allowed to spend the rebate on any legitimate operations and maintenance requirement. It may be used, for example, to reduce the Backlog of Essential Maintenance and Repair, fund an approved minor construction project, or fund employee positions to run the SES contract. Maximum flexibility will provide maximum incentive to initiate an SES contract.

The major commands must keep track of the SES rebates and the intended uses reported by the installations in their budget requests. SES savings must be reported to the Program and Budget Operations Directorate of the Office of the Assistant Secretary of Defense (Comptroller). They are reported through the Op-5 Schedule of the report entitled *Budget Justification Material for OSD Submission.* The Op-5 Schedule shows last-minute adjustments to the following fiscal year's budget, and SES savings would show up there as a reduction in utilities costs. DoD will allow the major commands to keep the savings as long as they report the intended uses of those savings. The Program and Budget Operations Directorate sees no obstacles to implementing this plan but points out that policy implementation is up to each Service since procedures differ markedly among Services.

AMOUNT OF THE SHARED SAVINGS

The amount of the SES rebate need only be enough to provide the incentive an installation needs to implement an SES contract. Any additional savings should be absorbed at the Service level to satisfy the most pressing requirements of each Service. The Service may let the major command absorb these additional savings since much of the effort of implementing an SES contract falls on the major command's staff.

Estimating the amount needed to provide an installation with sufficient incentive is somewhat speculative. However, discussions with Service managers of the SES programs have provided a starting point. If an installation were allowed to keep all of the Government's share of SES savings for the first 5 years of a 25-year SES contract, it would receive 20 percent of the total savings over the life of the contract. In reality, it would probably receive less than 20 percent since the Government's share is likely to be lower in the first years of the contract as the contractor pays for his capital investments. Any more than 5 years, however, would impose an undue accounting burden for both the installation and the major command, and 5 years is probably the limit of the current installation managers' planning horizon. Similarly, selecting 20 percent of the monetary savings instead of the time period would also complicate the record keeping. If the SES contract term is for less than 25 years, the term of the SES rebates should be reduced proportionally. On a 10-year contract, for example, the installation would get SES rebates for the first 2 years. This procedure eliminates any temptation to the installation to implement only a short-term SES contract in order to realize a greater share of the savings.

Moreover, the major command must implement some audit mechanism to ensure that reported savings are genuine. If this were not done, an installation may be tempted to let a contractor inflate his claim of energy savings and thereby enjoy a larger SES rebate.

The first-five-years method of determining the amount of SES rebate seems to be the easiest to implement. An installation would simply have to include the date and term of the contract against each SES rebate line item in its budget request. The amount of the rebate would be the Government's share of the previous period's shared energy savings, and it would be taken from the same documents that authorized the previous SES payment to the contractor.

One exception to this procedure must be accounted for. Some SES contracts may require the contractor to maintain parts of facility systems that the contractor has not installed. A contractor who installs a more efficient air handler, for instance, may be required to perform maintenance on existing ducting, dampers, and other parts of the system connected to that air handler. That requirement makes sense from a maintenance program viewpoint. However, what is actually happening is that the installation is getting maintenance paid for out of the shared energy savings because the Government's share will be reduced by the cost of this additional maintenance. Some installations see this mechanism as a way to get all of the Government's share of the savings and thus avoid the need for an SES rebate program. Those installations would expand the contractor's maintenance responsibilities throughout the facilities' systems until the entire Government's share goes to pay for this additional work. In other words, the Government's share of the savings is now zero. The legality of this procedure is discussed in the next chapter, but if maintenance is done on Government property, this subsidy has to be accounted for. The value of this maintenance must be deducted from the installation's line item request for an SES rebate.

CHAPTER 6

LEGISLATIVE ISSUES

One of the prime causes for the delays in SES contracting has been the difficulty in deciding what legislation and directives apply to this new form of contracting. The maze of laws and directives governing Federal procurement were not written with SES contracting in mind and no precedents or case histories are available for reference. The application of these laws to SES must therefore be interpreted. To reach a consensus on the interpretations, LMI convened a meeting of the legal counsels responsible for SES contracts in each Service. Their opinions have been presented to the OSD counsel for a final ruling and are summarized in Table 6-1. An OSD ruling would accelerate SES contracting by establishing a unified approach and eliminating the duplicated effort in researching the same issues. These issues are addressed in more detail below.

ADVICE OF LEGAL COUNSELS

Service Contract Act (41 USC, 351, ff)

The Services unanimously held that an SES contract is a service contract and falls under that legislation.

Buy American Act (41 USC, 10c)

At the end of an SES contract, the equipment the ESCO has installed may be acquired by the Government. Since some of the most energy-efficient equipment is foreign-made, the Buy American Act is involved. That Act requires that articles acquired for public use be manufactured in the United States. However, the General Agreement on Tariffs and Trade (GATT) has allowed some foreign countries – primarily European Economic Community countries and Japan – to be considered domestic for the purposes of the Act.

Davis-Bacon Act (40 USC, 276a to a-7)

The Davis-Bacon Act requires that contracts for Government construction specify Department of Labor (DOL) wage rates for the people working on the

TABLE 6-1

LEGISLATION AND REGULATIONS AFFECTING SES

Legislation or regulation	Applicable to SES?
Service Contracting Act (41 USC, 351, ff)	Yes
Buy American Act (41 USC, 10c)	Yes[a]
Davis-Bacon Act (40 USC, 276a to a-7)	Maybe[b]
Anti Deficiency Act (41 USC, 11)	Yes
Small & Small Disadvantaged Business Legislation (FAR Part 19)	Maybe[c]
Work-in-kind as savings (1985 Budget Act)	Yes[d]
OMB Circular A-76	No
Qualified Bidders' List (QBL) (FAR 9.2)	No
Brooks Act (40 USC, 541 ff)	No

[a] Although this Act applies, the GATT has allowed some foreign countries to be considered domestic for the purposes of the Act. Since European Economic Community countries and Japan are exempted, the Act will not have much effect on SES

[b] There are conflicting rulings on this. Until this is resolved, it should be applied if the SES contract has mainly construction, upgrade, and maintenance aspects to it, which SES contracts typically do

[c] SES has not been exempted from this requirement. However, a local determination must be made that FAR 19 502 - 2 applies to the contract.

[d] However, work-in-kind must be limited to energy systems in buildings covered by an SES contract

contract. SES equipment will be installed in Government facilities; however, the contractor will retain ownership. Thus, the question of whether an SES contract is "Government" construction arises. A 27 March 1987 DOL ruling states that Davis-Bacon applies to the New Cumberland Army Depot steam generation plant contract. That project is not strictly shared energy savings, however, and other indications imply that the Act should not apply to SES. A Department of Justice ruling, for example, indicates it does not. OSD is looking for a test case to settle the issue. In the meantime, a contracting officer should apply Davis-Bacon if the contract has mainly construction, upgrade, and maintenance aspects to it, which SES contracts typically do.

Anti-Deficiency Act (41 USC, 11)

The Anti-Deficiency Act prohibits obligating the Government to a purchase unless funds have been appropriated. At the end of the contract, the Government would like to guarantee buy-back of the improvements if any economic value remains. Moreover, a buy-back table should be included for each year of the contract in case the Government must terminate for convenience. Those measures would reduce the contractor risk and increase the Government's share of the savings. A majority of the Service counsels held that those measures may be incorporated into an SES contract if accompanied by the phrase "subject to the availability of funds."

Small and Small Disadvantaged Business Legislation

Nothing exempts SES from legislation that requires some Government contracts to be set aside for small and small disadvantaged businesses. However, one Service counsel feels that Federal Acquisition Regulation (FAR) Part 19.502-2 may restrict SES contracts as candidates for small businesses. The reference states that set-asides shall not be made unless there is a reasonable expectation of obtaining at least two responsible offers from small businesses and of awarding one of them at a reasonable price. The nature of most SES contracts, which require heavy investment for a number of years before a return is made, may preclude one or both of these required expectations. The decision should be a local one and would depend on the nature of the contract.

Work-in-Kind as Savings (1985 Budget Act)

The Consolidated Omnibus Budget Reconciliation Act of 1985 amended the National Energy Conservation Policy Act by granting authority for SES contracts. The Statement of Managers' report accompanying the Budget Act is a joint explanatory statement of the Committee of Conference, and Subtitle C contains language that may affect some SES contracts:

> Although energy efficiency improvements frequently provide benefits in addition to energy savings, such as more reliable equipment or increased comfort, the contracts authorized herein are for the purpose of energy savings alone, and any other benefits which arise therefrom must be ancillary to that purpose.

Some Services want to take the Government's share of the savings in the form of contractor maintenance of existing equipment. For example, the dampers and ductwork in a building must still be cleaned and adjusted even after a more efficient air-conditioning unit is installed. The system will not be energy efficient unless the entire system is maintained properly, not just one component. A narrow interpretation of the Manager's Report, however, may prevent an SES contractor from maintaining anything he has not installed. In any event, a majority of the Service counsels held that the entire building's energy system in any building covered by an

SES contract may be maintained by the SES contractor in lieu of some of the Government's share of the dollar savings.

OTHER FINDINGS

In addition to the issues brought before the legal counsels, the SES Steering Group posed several other issues and they were researched by LMI. The findings are also included in Table 6-1 and are addressed in detail below.

Office of Management and Budget Circular A-76

OMB Circular A-76 requires that before the Government contracts for certain functions, it compare the estimated contract cost with the cost of performing that function in house; such comparisons can become quite lengthy and involved. However, the author of the circular, the OMB Deputy Associate Administrator for Procurement Policy, has determined that OMB Circular A-76 does not apply to SES contracting. This is based on paragraph 7a of the circular which states:

> Unless otherwise provided by law, this Circular and its Supplement shall apply to all executive agencies and shall provide administrative direction to heads of agencies.

SES is "otherwise provided by law" in the National Energy Conservation Policy Act (42 USC, 8201), which states:

> The head of a Federal agency may enter into contracts under this title solely for the purpose of achieving energy savings and benefits ancillary to that purpose.

Qualified Bidders List (FAR 9.2)

Members of the SES Steering Group cited the advantages of using a Qualified Bidders' List (QBL) for selecting ESCOs. Such a list would provide a pool of qualified ESCOs from which to select when contracting for SES. That list would simplify SES contracting and avoid the risk of getting an unqualified contractor. It would also reduce the risks for the qualified ESCOs since they would feel more confident about their chances of landing the contract. This would encourage them to assume the costs of proposal preparation and compete for the contracts. Industry has made great use of this concept.

QBLs are covered in the FAR, Subpart 9.2. The procedures are tightly controlled. FAR 9.202(a)(1) states that the Service Secretary or designee must prepare a written justification for the necessity for establishing the QBL and specify why the qualification requirement must be demonstrated before contract award. Moreover, contrary to expectations, the QBL does not prevent other contractors from bidding on a particular contract. FAR 9.202(c) states that a potential offeror may not be denied the opportunity to submit and have considered an offer for a contract solely because the potential offeror is not on a QBL or has not been identified as meeting a qualification requirement. FAR 9.206-3(b) requires that after a solicitation, the activity responsible for a QBL must assist interested concerns in meeting the standards specified for qualification. The FAR, then, does not seem to permit a restriction of offerors to a small convenient pool of qualified ESCOs.

If the SES contract contains a large construction requirement, the DoD FAR Supplement (DFARS) Part 36.273 may apply. It states that prequalification procedures are used when it is necessary to ensure timely and efficient performance of critical construction projects by limiting offers to companies of proven competence. It would be difficult to sell SES as a "critical construction project" requiring "timely and efficient performance."

The goal of ensuring qualified proposers may still be achieved, however, by using negotiated contracting, with the selection based on price and other factors. These other factors may include the proposer's experience and previous SES history and serve as a means of eliminating incompetent contractors. The proposers are reduced to those within a competitive range before negotiations are conducted to determine their best and final offers. The resulting list comes very close to the desired pool of qualified ESCOs although the procedures must be repeated for every SES contract.

The Brooks Act (40 USC, 541, ff)

The Brooks Act allows procurement of architect-engineer (A-E) services based on demonstrated competence and qualifications of prospective contractors rather than the lowest bidder. It is generally preferred over normal contracting procedures but can only be used for A-E services. ESCOs have demonstrated for years that SES contracting is not restricted to A-Es and it would be hard to justify why that is now so. Moreover, FAR 36.601(b) states:

> Other than "incidental services" as specified in the definition of architect-engineer services in 36.102, services that do not require performance by a registered or licensed architect or engineer, notwithstanding the fact that architect-engineers also may perform those services, should be acquired pursuant to Parts 13, 14, and 15. [That is, under normal contracting procedures].

In its current form, then, the Brooks Act does not apply to SES contracting.

CHAPTER 7

CONCLUSIONS – TIPS FOR SUCCESS

LARGER PROJECTS EQUAL LARGER SAVINGS

SES contracting has the potential to reduce DoD's approximately $3 billion-a-year facility energy budget without reducing performance. Despite that potential, the initial pilot projects are unlikely to attract high-level visibility and encouragement within DoD because of their relatively small scale.

SES projects outside the Federal Government usually involve efficiency improvements costing more than $50,000.[1] Contractors apparently have little interest in projects in which the investment is much less than that because of the relatively high transaction costs required to establish an SES contract of any size.

The initial pilot projects constitute a necessary first step. However, DoD should move as rapidly as possible to institute larger SES projects. SES contracts that cover an entire installation or a large area within an installation promise higher savings to DoD. Those higher savings will tend to attract higher-level interest within DoD and thus greater encouragement and support for the overall SES program. Larger contracts would also be likely to attract more contractor interest, leading to greater competition among contractors and a larger percent savings share for DoD.

MAINTAINING INSTALLATION FLEXIBILITY

Some personnel involved in SES contracting have expressed concern that SES contracts may reduce an installation's flexibility. If steps are not taken to avoid it, the installation of energy saving equipment could disturb operations during construction and the buildings may subsequently be hard to modify. In other words, SES contracts should not ignore non-energy costs that installations may have to bear on their own.

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[1]Klepper, M. "Issues in Performance Contracting: An Agenda for the Next Ten Years." *Financing Energy Conservation*. Op cit. p. 173.

SES contracts should also be written to minimize possible conflicts between non-energy maintenance contractors and SES contractors. ESCOs are responsible for reducing energy use; if they do not, they can forfeit all or part of their revenues. Therefore, they are likely to involve themselves in any and all aspects of building maintenance that affect energy use even if other contractors are involved.

The key to reducing these concerns is good contract language and a reliable ESCO. Installations can preserve their flexibility to make changes in building uses if the SES contract incorporates a baseline with automatic adjustments for small mission changes and a renegotiation clause for major mission changes. Selecting a reliable ESCO that will be relatively easy to work with is important albeit difficult. In addition, the contract must clearly spell out the ESCO's rights regarding building maintenance and must place clear limits on those rights.

CONCLUSIONS

In summary, many concerns about SES contracting are due to the novelty of the approach within DoD. Those concerns are likely to evaporate as DoD's installations gather more and more experience with SES contracting. Other concerns are more valid and may even cause difficulties in some of the early SES pilot projects. Yet that is the purpose of a pilot program: to distinguish through experience the concerns that result in real problems from the concerns that, in practice, are inconsequential. SES contracting is being used successfully outside the Federal Government and there is no reason why it cannot be made to work for DoD. The potential gain is large and the hurdles are relatively small.

APPENDIX A

THE STATUS OF DoD'S SHARED ENERGY SAVINGS PILOT PROJECTS

Table A-1 lists the current, pending, and proposed projects that constitute DoD's shared energy savings (SES) pilot program. Because this is a pilot program, the dates in the table are liable to change as unforseen obstacles develop. As the lessons learned from these early efforts are disseminated, however, the time between choosing a project site and contract award will decrease and additional ; rojects will be added to the list.

The Military Services have a total of 13 SES projects current or pending and have identified 9 more specific future projects with target award dates in FY89 and FY90. They are also continuing to look for additional potential SES projects. The following 4 projects - including 2 projects outside DoD - have been awarded or are close to award.

The Corpus Christi Army Depot is now very close to contract award; the SES contract there will apply to Building 1808, an aircraft hangar used primarily for painting aircraft. The request for proposals (RFP) – which stipulated a 25-year contract term – required contractors to propose an improved chilled water system, but also allowed the contractor to propose additional conservation opportunities.

The Navy is currently evaluating technical proposals for an SES project at the Naval Hospital in Long Beach, Calif. Possible conservation measures include cogeneration, improved lighting, chiller replacement and/or controls, with a contract term not to exceed 10 years.

Apart from DoD, other Federal agencies have made considerable progress, although they have fewer projects currently pending. The U.S. Postal Service was the first to award a contract. The contractor is installing – and will be maintaining – improved fluorescent lighting at the General Mail Facility in San Diego. The contract will last 7 years.

The U.S. Department of Housing and Urban Affairs (HUD) is currently evaluating SES proposals for its Washington headquarters building and hopes to

TABLE A-1

TIMETABLE OF SHARED ENERGY PILOT PROJECTS IN THE FEDERAL GOVERNMENT

	RFP issued	Preposal conference	Proposals due	Contract award
DoD current pending projects				
Corpus Christi Army Depot, Corpus Christi, TX	3 11 87	4 8 87	8 14 87	8 88
Naval Hospital, Long Beach, CA	8 [illegible]7 87[a]	9 [illegible] 87	3 4 88	9 88
Seymour Johnson AFB, Goldsboro, NC	2 29 88[b]	3 [illegible]0 88	6 23 88	[illegible] 88
Building 3400, NTC, Great Lakes, IL	5 2 88[c]	6 8 88	7 [illegible]9 88	
Trident TCF, Bangor, WA	[illegible] 88		-	
SPCC, Mechanicsburg, PA	[illegible] 88			
PMTC, Point Mugu, CA	3 88			-
Naval District Washington, Washington, DC	3 88			
San Diego Naval Region, San Diego, CA	9 88			
Fort Bliss, El Paso, TX	[illegible] 88			
Norton AFB, Ontario, CA	2 88			
DoD proposed future projects				
Bergstrom AFB, Austin, TX				
Fort Sam Houston, San Antonio, TX				
Naval Hospital, Newport, RI				FY89
NATC, Patuxent River, MD				FY89
NAS, Corpus Christi, TX				FY89
Fort Eustis, TX				FY89
Fort Bragg, NC	-			FY89
Naval Medical Center, Bethesda, MD				FY90
NETC, Newport, RI				FY90
NAS, Cecil Field, FL				FY90
NSC, Oakland, CA				FY90
Other Federal agencies				
U.S. Postal Service General Mail Facility, San Diego, CA	4 3 87	4 20 87	[illegible] 87	12 14 87
U.S. Department of Housing and Urban Affairs Headquarters Building Washington, D.C.	[illegible] 87	[illegible] 5 88	[illegible] 8 88	[illegible] 88
Lawrence Berkeley Lab, Berkeley, CA	10 88	12 88	2 89	[illegible] 89
Oak Ridge Associated Universities, Oak Ridge, TN	3 89	5 89	[illegible] 89	[illegible] 89

Note: Dashes indicate date is yet to be determined.

[a] RFTP issued, invitation to bid to be issued 6/88

[b] Original RFP issued 5/6/87

[c] Original RFP issued 9/15/86, solicitation canceled 12/3/87

award a contract early in 1988. The contract is not to exceed 10 years, but HUD would prefer an even shorter contract.

The Department of Energy maintains the Clearinghouse on Energy Financing Partnerships to keep track of Federal sector SES projects. Data from the Clearing house combined with data from the Military Departments form the basis of Table A-1. The Clearinghouse periodically updates and publishes its information on Federal SES initiatives. To obtain those updates, as well as other related information, contact the Clearinghouse at the following address:

Clearinghouse on Energy Financing Partnerships
2000 North 15th Street
Suite 407
Arlington, VA 22201
Telephone: (703) 243-4900

Another useful source of information on Federal SES projects, baseline methods, and related topics, is the Federal Energy Management Program, which can be contacted at the following address:

Federal Energy Management Program
U.S. Department of Energy
(CE 10.1) Room 5F-064
1000 Independence Avenue, SW
Washington, DC 20585
Telephone: (202) 586-1145

APPENDIX B

DEVELOPING A BASELINE USING REGRESSION ANALYSIS: BUILDING 3400, NAVAL TRAINING CENTER, GREAT LAKES

This appendix addresses some of the important "lessons learned" as a result of the Navy's experimentation with regression analysis for developing shared energy savings (SES) baselines. The Navy has concluded that linear regression can be a useful tool in some circumstances but that it is not universally applicable. We focus on the regression analysis carried out to develop fuel and electricity baselines for Building 3400, Naval Training Center, Great Lakes, Ill., because it was incorporated in the original request for proposals (RFP) for that project.

Regression analysis is a statistical technique for measuring the correlation between a dependent variable (in this case, energy use) and one or more independent, or predictor, variables (e.g., temperature, cloud cover, humidity, occupancy rates, and so forth). Least-squares regression can determine (1) whether the correlation among the variables is significant and (2) how much variation the independent variables can account for in the dependent variable.

Regression analysis can generally be used only when both metered energy use data and weather data are available. A satisfactory regression baseline may also require building-use data such as occupancy rates. Weather data are usually available even though they may have been gathered at some distance from the installation (at the nearest airport, for example). In many cases, such weather data explain most of the variations in building-energy use. In some cases, however, building-use factors may also have a large effect on energy use, particularly in industrial facilities. For that reason, many private energy contractors tend to avoid such facilities unless their energy use can be satisfactorily modeled.

In the case of Building 3400's fuel use, the Navy found that, subsequent to the development of the baseline, actual energy use increased significantly over the baseline level. In addition, even in the earlier periods when actual and predicted annual fuel use were very close, Navy personnel felt that the month-to-month variations between actual energy use and the baseline estimate were unacceptably high.

The Naval Energy and Environmental Support Activity (NESA), Port Hueneme, Calif., used linear regressions to develop two baselines, one for electricity and another for fuel use (natural gas and fuel oil) in Building 3400.[1] NESA had metered energy-use data for the building, along with weather data and building-use data. The regression baseline was a good one in terms of past energy use history. In particular, two weather factors – cooling degree days and sky cover – appeared to predict nearly 90 percent of the variation in fuel use in Building 3400 between October 1982 and April 1985. After issuing an RFP using that fuel baseline, however, the Navy found that fuel use between October 1985 and January 1987 increased significantly beyond the level predicted by the baseline and the initial RFP was withdrawn. A new RFP is being developed that does not use linear regression.

Lessons Learned

Why did the predictive power of the model change in such a short time? Despite its northern location, Building 3400 uses far more fuel in the summer than the winter because that fuel powers a 664-ton absorption chiller as well as several small reciprocating chillers. Because those chillers appear to be the main energy users in Building 3400, it is probable that their operating efficiency decreased compared with their efficiency during the period in which the baseline was developed, resulting in a quantitative change in the relationship between the building's energy use and the weather.

Even though Building 3400's energy use shifted after the baseline had been established, an energy contractor might be able to surmount such difficulties. That is, an energy contractor would maintain the equipment – chillers in this case – in peak condition. A contractor would carefully monitor energy use and take steps to reduce any sharp increases that it observed, such as Building 3400's gas consumption increase in the summer of 1986. If Building 3400's increase in gas consumption was in fact due to a decrease in the efficiency of its chillers, that is simply another indication that DoD installations lack the necessary funds to

[1]Swanson, K.T.C. *Natural Gas and Electricity Consumption Baseline Development at Naval Training Center Great Lakes, Building 3400, Great Lakes, Illinois*. NESA 41-028. Dec 1985.

maintain their equipment at peak operating efficiency not necessarily proof that regression analysis does not work. SES contracting can help provide the funds for improving such maintenance thereby ensuring that actual energy use would fall below the baseline.

Despite the Navy's unfortunate experience with a regression baseline for the Building 3400 pilot project, regressions remain useful tools for developing satisfactory baselines. First, historical metered energy-use data must be available. Second, quantitative changes in the building's energy use may require a modification of the baseline.

NESA, for instance, has also performed a regression analysis of the energy use at Long Beach Naval Hospital, Calif., where a regression baseline is likely to be used. NESA has also examined a number of installations using the techniques of regression analysis. That organization is a source of information and possible assistance for any of the Military Services desiring to explore the use of regression analysis for developing energy-use baselines.

Building 3400 Regression Equation

Regression analysis estimates an equation of the form:

$$Energy\ use = C + A_1X_1 + A_2X_2 \ldots + A_nX_n + e \qquad \text{[Eq. B-1]}$$

where:

C = a constant,
X_n = weather and building-use variables,
A_n = coefficients that estimate the change in energy use with changes in X_n,
e = an error term to measure the unexplained variation.

After examining 10 weather variables and 3 building-use variables for Building 3400, NESA found that 2 weather factors – the monthly number of cooling degree days and the monthly average sky cover – explained about 88 percent of the variation in fuel use. NESA's resulting baseline equation was as follows:

$$Fuel\ use = C + A_1X_1 + A_2X_2 + e \quad \text{[Eq. B-2]}$$

where:

C = 69,924 therms per month,
A_1 = 132 therms per cooling degree days,
A_2 = -5,411 therms per average sky cover,
X_1 = cooling degree days per month,
X_2 = average sky cover per month,
$e = 0$.

The error term equals zero because the *expected* error is zero. When the model is used to predict actual fuel use, differences are likely to occur between the predicted and the actual values for any month. If the regression model is accurate, those differences will not be systematically biased in any direction and, over time, should average close to zero.

Figure B-1 illustrates the close fit between the actual data used to develop the baseline and the *post hoc* predicted values given by that baseline during the original measurement period (October 1982 through April 1985). They are very close as we would expect from the high "coefficient of determination" – the measure of how much the two variables explain – of 88 percent.

Figure B-1 also illustrates the difference between actual and baseline fuel use during the subsequent baseline validation period (October 1985 through January 1987). In that period, however, the differences, instead of being relatively small and unbiased as before, have become unacceptably large and show a substantial upward bias. In statistical terms, the error terms are no longer unbiased.

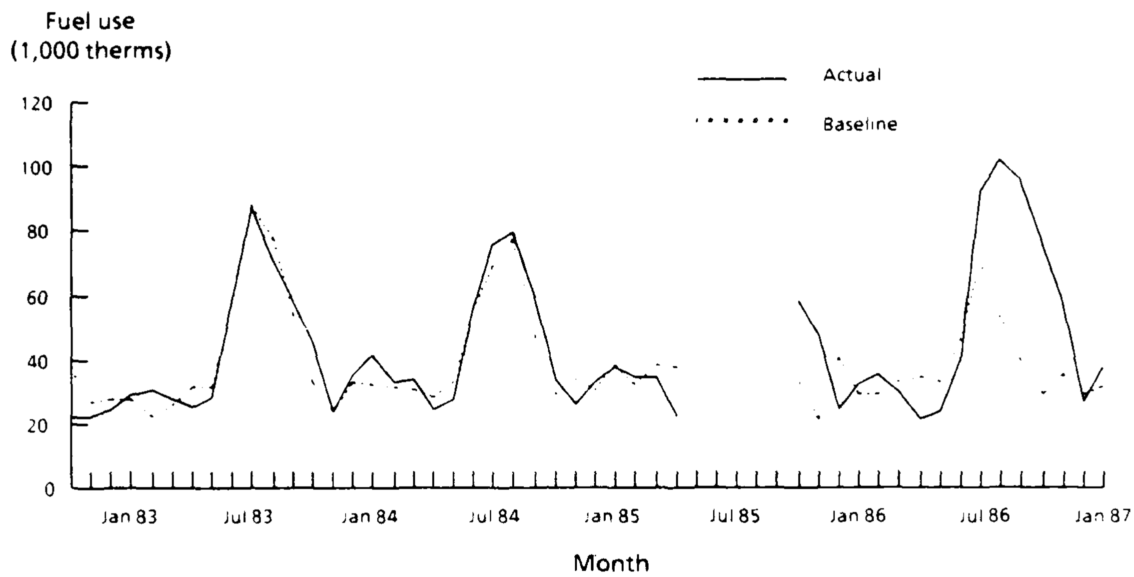

FIG. B-1. ACTUAL VERSUS BASELINE ENERGY USE

APPENDIX C

LIFE-CYCLE SAVINGS MODEL

INTRODUCTION

The Life-Cycle Savings Model (LCSM) is designed to aid the evaluation of shared energy savings (SES) proposals. The model ranks those proposals according to the net present value of their total life-cycle savings; it considers the best proposal to be the one with the highest discounted savings. LCSM is consistent with Federal regulations concerning the evaluation of energy conservation projects:[1] it escalates energy prices using Department of Energy (DOE) fuel price escalators and discounts cash flows using a 7 percent real discount rate. For sensitivity analyses, however, the user can override the DOE escalators and can use other discount rates. The model analyzes the cash flows for each project over the same length of time (up to 30 years with a 25-year maximum contract term). LCSM does not use other methods such as internal-rate-of-return, savings-to-investment ratios, or discounted payback. Those methods do not work for SES projects since there is normally no initial investment.

LCSM OUTPUT

Figure C-1 illustrates the LCSM output summary as it appears on the computer screen. The discounted savings of each proposal (rounded to the nearest ten dollars) are ranked from highest to lowest. If two or more proposals promise equal savings, then the output will indicate a tie. LCSM can handle up to 10 proposals at a time.

The output summary also displays the proposal terms (contract lengths), residual value (if any), and the major assumptions used in the calculations. In addition, LCSM can display a bar graph comparing the proposals.

[1]Subpart A, Part 436 of Title 10 of the Code of Federal Regulations (10 CFR Part 436).

SHARED ENERGY SAVINGS
LIFE-CYCLE SAVINGS MODEL — Version 1.1

OUTPUT SUMMARY:

Run date: 1 - Mar - 88
Discount rate: 7.0%
Project name: Sample

Proposal #:	Savings:		Term:	Terminal value:
>>#4	$1,533,610	<<"BEST"	10	$0
#5	$1,533,610	<< TIE	10	$0
#3	$1,515,170		8	$0
#2	$1,500,460		7	$0
#1	$1,468,200		5	$0
#6	$0		0	$0
#7	$0		0	$0
#8	$0		0	$0
#9	$0		0	$0
#10	$0		0	$0

ASSUMPTIONS:

DOE Region:	3	PA, MD, WV, VA, DC, DE
Project length:	30	years
Total baseline:	155,000	MBtu's
Rollover cost:	$50,000	
Percent savings after contract ends:		
Electricity	90.0%	
Distillate	100.0%	
Residual fuel	100.0%	
Natural gas	100.0%	
Steam coal	100.0%	
Other	100.0%	

FIG. C-1. OUTPUT SUMMARY

LCSM INPUT

LCSM accepts both project-specific and proposal-specific inputs as summarized in Table C-1. Project-specific inputs – which remain the same for all proposals – include baseline energy use and prices for six fuel types (corresponding to DOE's five major fuel types plus an "other" category). They also include project length, DOE region, contract rollover cost, assumed savings gain or reduction after initial contract, and maximum project term. Proposal-specific inputs – which normally differ among proposals – include contract term, terminal value, total projected savings by year, and DoD's share of savings by year.

TABLE C-1

SAMPLE INPUT ASSUMPTIONS

Baseline usage:		
Natural gas	150,000 MBtus	$5.40/MBtus
Electricity	5,000 MBtus	$19.80/MBtus
Distillate	- -	- -
Residual fuel	- -	- -
Steam coal	- -	- -
Other	- -	- -
Proposals:	#1	#2
Term (years)	5	7
Terminal value	$0	$0
Total percent savings		
Natural gas	20.0%	- -
Electricity	15.0%	- -
Distillate	0.0%	- -
Residual fuel	0.0%	- -
Steam coal	0.0%	- -
Other	0.0%	- -
Percent DoD share of savings		
Natural gas	50.0%	- -
Electricity	60.0%	- -
Savings gain/reduction after contract ends		
Natural gas	0.0%	
Electricity	-10.0%	

Note: Input values are illustrative only

CALCULATIONS

Fuel Price Escalation

LCSM forecasts the total savings of each proposal by projecting DoD's percent energy savings and multiplying those savings times the forecast dollar value of the baseline for each year. To calculate the dollar value of the baseline, the model normally forecasts fuel prices using DOE's fuel price escalation rates for the region of the U.S. in which the project is located. However, the model will ignore DOE's escalators if the user specifies region "zero." The user can also input alternative escalation rates if so desired. Table C-2 shows how the model forecasts fuel prices for each year.

TABLE C-2

FORECASTING ENERGY PRICES

Year	Natural gas		Electricity	
	DOE rate	$/MBtu	DOE rate	$/MBtu
0, 1987	1.31%	$ 5.40	-1.75%	$ 19.80
1, 1988	1.31	5.47	-1.75	19.45
2, 1989	1.31	5.54	-1.75	19.11
3, 1990	3.71	5.75	-1.06	18.91
4, 1991	3.71	5.96	-1.06	18.71
5, 1992	3.71	6.18	-1.06	178.51
6, 1993	3.71	6.41	-1.06	18.32
7, 1994	3.71	6.65	-1.06	18.12
8,1995	3.54	6.89	1.40	18.38
		.		.
29, 2016	3.54	14.29	1.40	24.61
30, 2017	3.54%	$14.80	1.40%	$24.95

Starting with the 1987 base price, LCSM escalates prices using the escalation rates specific to each fuel type. The formula is as follows:

$$P_n = (1 + E_n) \times P_{n-1}, \qquad \text{[Eq C-1]}$$

where:

n = year,
P_n = fuel price in Year n,
E_n = DOE fuel price escalator in Year n.

Analysis of One Proposal

For each year of the project and for each proposal, LCSM multiplies the total savings times DoD's savings share to determine DoD's overall savings. Table C-3 illustrates that process. As shown in that table, the model multiplies DoD's overall percent savings times the baseline Btu to determine savings in Btu. LCSM then multiplies Btu savings times the fuel price to determine DoD's constant dollar savings for each fuel type. LCSM ignores both total savings and the contractor's savings since only DoD's net savings are germane to the choice between proposals.

The basic calculation is as follows:

$$S_n = T_n \times D_n \times B_n \times P_n \qquad \text{[Eq. C-2]}$$

where:

n = year,
S_n = DoD savings in Year n ($/year),
T_n = total savings from baseline in Year n (percent),
D_n = DoD share of savings in Year n (percent),
B_n = baseline fuel consumption in Year n (MBtu/year),
P_n = fuel price in Year n ($/MBtu).

In the sample calculations, we assume that the user has specified a project length of 30 years. Project length, which is an input, must at least equal the longest proposal and cannot exceed 30 years. There is nothing particularly magic about the 30-year limit; however, DOE's escalation rates extend no further and, in our judgment, assumptions about energy savings after that time are tenuous at best.

Net Cash Flows and Discounted Savings

After making the calculations described above, LCSM constructs a two-dimensional table of cash flows shown in Table C-4. The rows represent project years

TABLE C-3

ANALYSIS OF PROPOSAL NUMBER 1

Year	Natural gas (20% x 50%)[a]	Electricity (15% x 60%)[a]	Natural gas (10.0% x150,000)b	Electricity (9.0% x 5,000)[b]
1	10.0%	9.0%	15,000 MBtu	450 MBtu
2	10.0	9.0	15,000	450
3	10.0	9.0	15,000	450
4	10.0	9.0	15,000	450
5, contract ends	10.0	9.0	15,000	450
6	10.0	8.1	15,000	405
7	10.0	8.1	15,000	405
.				
.				
.				
29	10.0	8.1	15,000	405
30	10.0%	8.1%	15,000 MBtu	405 MBtu

[a] Percent DoD savings from baseline = (Total savings) x (DoD share)
[b] DoD's MBtu savings from baseline = (Percent DoD savings from baseline) x (Baseline MBtu)

and the columns represent savings for each fuel type, the terminal value, and rollover costs. Normally, an SES proposal will show some savings in every year for at least some fuel types. Terminal values, if any, occur at the end of the project life (not at the end of the initial contract). The only negative cash flows are the rollover costs that occur when each contract terminates (if that occurs before the end of the project life). If a specific proposal is shorter than the chosen project length, LCSM assumes that the proposal rolls over at equal or similar savings. The user can specify whether DoD's savings stay the same, increase, or decrease once the original contract has ended.

LCSM sums the yearly cash flows represented in the two-dimensional table and then discounts those cash flows to the present. The discounted savings or "net present value," are rounded to the nearest $10. LCSM's default discount rate is 7 percent; the user can alter that rate if desired.

TABLE C-4

NET CASH FLOWS AND DISCOUNTED SAVINGS

Project year	Savings					
	Natural gas (15,000 * $5.47)	Electricity	Total energy	Terminal value	Rollover cost	Net cash flows
1	$ 82,061	$ 8,754	$ 90,815			$ 90,815
2	83,136	8,601	91,737			91,737
3	86,220	8,510	94,730			94,730
4	89,419	8,420	97,839			97,839
5, contract ends	92,737	8,330	101,067		($50,000)	51,067
6	96,177	7,418	103,595			103,595
7	99,745	7,339	107,085			107,085
.						
.						
.						
29	214,423	9,965	224,388			224,388
30	222,014	10,105	232,119	$0		232,119
Total	4,205,683	257,668	4,463,351	$0	(250,000)	4,213,351
Present value @ 7.0 percent	$1,466,285[a]	$103,238	$1,569,523		($101,322)	$1,468,201
Discounted savings (rounded)						$1,468,200[b]

Note: DoD's $ savings from baseline = (DoD MBtu savings from baseline) * (Energy prices).

[a] Lotus 1-2-3 calculates present value with the built-in function @NPV (rate, range).

[b] @ROUND (Present value, [illegible])

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Shared energy savings (SES) is a low investment, low-risk contracting procedure that can significantly increase energy efficiency at DoD installations and lead to major savings. Under SES, contractors finance and implement efficiency measures and share the resulting dollar savings with DoD. However, SES faces several obstacles: establishing energy baselines, motivating installations to participate, determining which laws and regulations apply, and choosing the economic criteria to be used in the competitive award of SES contracts.

To overcome these obstacles, we recommend: (1) the Services should initially award installation wide SES contracts rather than individual building contracts. Energy contractors have confidence in the use of metered data as a baseline, and installation wide metered data are available. At the same time, the Services should anticipate SES contracting for individual buildings by installing meters in buildings that have high potential for energy savings. The Services should establish a revolving fund, added to existing management funds, to finance the metering; (2) to overcome contractors' distrust of simulations, OSD's Energy Policy Office and the Department of Energy (DOE) should conduct a joint test of DOE's energy-use simulation model, ASEAM2, on a variety of DoD buildings. Such testing should increase contractors' confidence in the use of simulations to establish baselines. (3) each Service should institute an SES rebate program to guarantee that a portion of DoD's savings is returned to the installation that generated those savings; (4) the Energy Policy Office should work with the Office of General Council to formulate a policy on the legal and regulatory issues that pertain to SES contracting. Such a policy will facilitate SES implementation by clarifying the legal and regulatory issues and eliminating the duplication of

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effort needed for each Service to research those issues; (5) the Services should use the economic analysis parameters prescribed for energy conservation projects by the National Energy Conservation Policy Act. While economic analysis is important, there is little reason to expect the choice of economic analysis parameters to be critical to contractor selection.

These recommendations will remove the obstacles to SES implementation and allow the Services to join the many state and local governments and private companies currently enjoying the huge benefits of this innovative concept.