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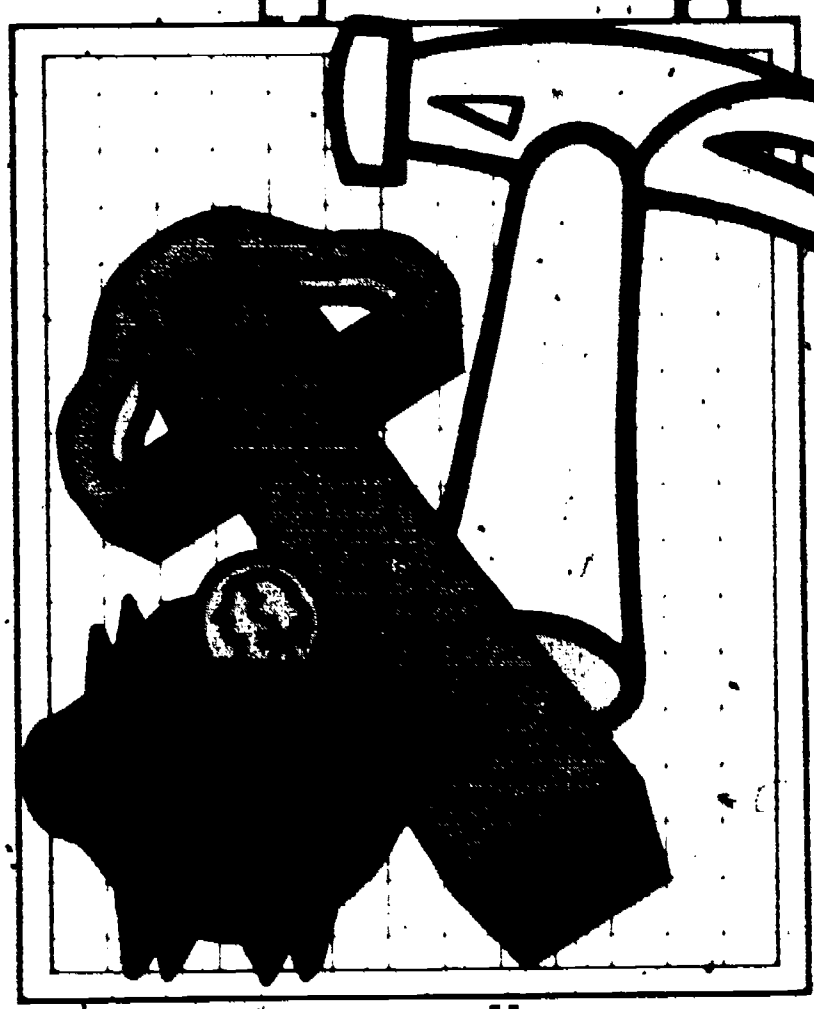
ABSTRACT

The information provided in this guidebook is based on a field evaluation of grantees in the Institutional Conservation Program (ICP). The ICP, authorized by the National Energy Conservation Policy Act of 1978 and administered by the Department of Energy, provides energy audits and 50 percent matching grants for detailed energy analyses and for the installation of energy-saving capital improvement to schools and hospitals. The evaluation studied the experiences of a sample of Cycle I and Cycle II ICP grantees to determine the impacts of the program and the factors that contribute to achieving and sustaining energy savings. Among these factors, strong and effective leadership by institution managers was clearly linked to the success of energy conservation programs. Thus, the key elements of the manager's role in effective energy conservation are highlighted. Major areas considered include: energy and the organization; energy and management decisions; and management and the energy conservation process (focusing on evaluating in-house resources, performing energy analyses, developing and implementing energy management strategies, and maintaining the energy management program). An introduction (providing a description of a typical conservation program and other information) and sources of additional information are included. (JN)

Institutional Manager's Guide to Energy Conservation



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Definitions of Terms Used in the Guidebook

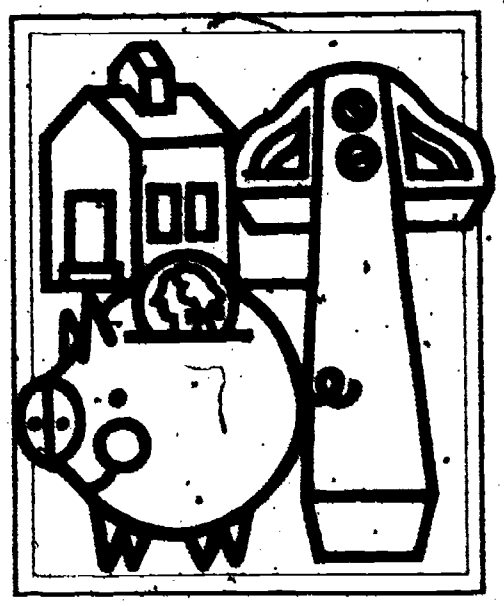
Energy Analysis — Systematic analysis of the energy use patterns of a facility which determines the financial, energy savings and other benefits of carrying out various energy conservation activities. The scope of the analysis varies, but generally includes: developing an energy consumption profile; assessing the current status of energy systems and their requirements; identifying conservation measures.

ECMs — Energy Conservation Measures are equipment or facility improvements installed to reduce energy consumption and have paybacks greater than 1 year. There are four general categories of investments for saving energy, including modifications to: the building envelope (including windows, doors, roofs and walls), (2) mechanical systems (including boilers, pumps, HVAC systems, etc.), (3) lighting (reductions or conversion from incandescant to fluorescent), and (4) special systems (solar and other alternative sources, heat recovery, etc.). The cost and energy saving potential of ECMs vary by type of ECM and by the facility in which they are installed. The exact combination of ECMs that will be most appropriate for a facility will vary depending on such factors as the characteristics and condition of the facility, the occupancy and use patterns of the facility, climate conditions and energy costs.

O&Ms — Operations and Maintenance procedures are low-cost or no-cost actions that reduce energy consumption. They are part of the ongoing practices for operating and maintaining the facility. They may be carried out by maintenance staff, by occupants of the buildings or by outside service contractors. They involve keeping physical plant equipment in efficient working condition, avoiding the waste of energy and reducing where possible heating, cooling and lighting usage. O&Ms may be very cost effective but they require ongoing monitoring to ensure that energy savings are maintained.

DOE — U.S. Department of Energy.

ICP — Institutional Conservation Program, of the DOE.



1. Introduction

Energy Conservation Works

Are you one of the key managers of an institutional building or complex? The results of a nationwide evaluation of the Institutional Conservation Program, a DOE-sponsored grant program that seeks to help eligible nonprofit institutions save fuel and avoid energy costs, determined that institutions that participated in the first two grant cycles and that implemented comprehensive energy conservation programs on the average achieved considerable reductions in their energy consumption:

- Grantees saved an average of 13.2% of their pre-ICP consumption.
- Participating schools reduced energy usage by 21.6%; hospitals by 8.3%.
- Oil usage reductions by grantees totaled an estimated 2.25 million barrels of oil per year.

Where top management took a strong role in the conservation program, institutions enjoyed twice the energy savings of other grantees. And where managers had daily contact with operating personnel, greater savings generally occurred.

Have You Read and Shelved an Energy Conservation Handbook or Two?

This guidebook is different from energy program "cookbooks" because it addresses the concerns and responsibilities of institutional managers in conducting successful energy conservation programs. This guidebook is keyed to managers of schools and hospitals and the information it contains is grounded in hundreds of case studies of institutions that participated in the ICP. Most of those schools and hospitals achieved impressive savings, yet evaluators discovered several factors that kept participants from attaining an even greater energy conservation potential. This handbook describes the tasks involved in developing a successful energy conservation program, potential problem areas, and success stories documented in the field. So, whether you've read "those energy handbooks" before, or are considering the idea for the first time, you will find useful information in the pages that follow.

For additional ICP evaluation findings, see **An Evaluation of the Institutional Conservation Program:** Prepared for U.S. DOE by The Synectics Group, Inc. under subcontract to Opportunity Systems, Inc. April 30, 1983.

Conservation Policy Must Be Thorough and Begin With Top Management

You are the key to the success of any energy conservation program in your institution. The weight of your authority and the effectiveness of your management and delegation will determine whether enthusiasm is mustered, plans are implemented, procedures are complied with, and equipment is installed and maintained. Your interest, whether personal or implied through delegation to a competent staff, will keep the program operating at maximum efficiency. This fact was proven time and again in field studies. It will be discussed in detail in the first section of this guidebook. Other management responsibilities in an energy conservation program that were identified during the ICP evaluation are discussed in following sections.

A Short Description of the Typical Conservation Program

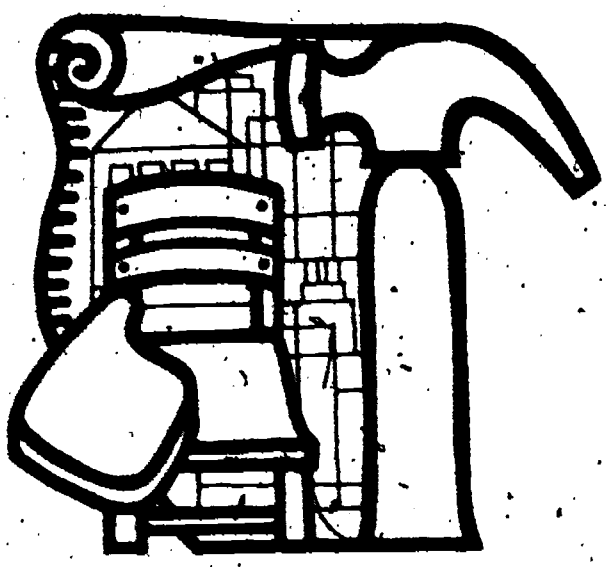
A discussion of the major points in an energy conservation program is in order before we examine problems and success in various areas. The following steps are fairly typical:

1. **Assess Your Mission vs. Energy Conservation**—What mission-oriented values (e.g., patient comfort, bright classrooms) are you unwilling to modify for the sake of reducing energy consumption and costs? What regulations and codes must be maintained?
2. **Evaluate In-House Resources**—How much information is currently on hand concerning energy consumption, operation of systems, etc.? Has your institution ever undergone an energy analysis? What is the level of technical knowledge and skills of your maintenance staff?

3. **Perform and Energy Analysis**—This systematic analysis of the energy use patterns of a facility determines the financial and other benefits of carrying out various energy conservation activities. It can vary enormously in cost and scale, but it will provide you with information and options.
4. **Develop a Strategy**—On the basis of the audit, determine what level of savings you will seek at what costs. Decide who will manage and drive the program. Will you use O&Ms only or invest in some capital improvements (ECMs)?
5. **Implement the Strategy**—This calls for persistence, patience, good planning, and the investiture of authority from the top.
6. **Keep the Program Going**—Monitor results, fine-tune operations, keep equipment in good repair, and continue to stimulate participation and energy consciousness.

This general framework will be elaborated upon as we discuss the various findings from the ICP evaluation and their ramifications for the overall energy conservation process. The rest of this guidebook is organized into the following sections:

- Energy and the Organization.
- Energy and Management Decisions.
- Management and the Energy Conservation Process.



2. Energy and the Organization

Energy Management Must Start at the Top

Energy conservation in most organizations is not just a one-person responsibility or a one-time investment in hardware: energy conservation reaches virtually every level of an organization, and is affected by the attitudes and actions of each of its members, as well as by the installation of energy conservation equipment. Maximum energy efficiency can rarely be achieved merely by assigning it as a task to a single portion of the organization such as the facilities or maintenance department. Although it is obvious that success would be impossible without a major involvement of those responsible for the facility's operation and upkeep, it is not enough for top management to assume that they can do it alone.

Depending upon the type and size of your organization, you as the top manager may be unable to devote personal attention on a frequent, much less daily basis, or provide the technical expertise required. However, you must modify your management policies, if necessary, to guarantee that every staff level below you is conducting daily operations with the awareness that you and the institution view energy conservation as a high priority. Your energy policies must do more than merely state the need for controlling energy consumption — they must place your authority for committing your institution's staff and resources behind daily actions as well as future planning.

Success Calls for Team Spirit

Until recent years, you as a manager had little cause to give attention to energy conservation because of its relatively minor financial impact on the organization. Because this has changed, you now have an opportunity to address energy with the management concentration usually reserved for the obvious mission-related costs you are accustomed to dealing with. However, with energy conservation, the total responsibility cannot rest on a single subordinate. The energy issue benefits from virtually everyone's attention. Everyone should know how his/her function affects energy use and cost, and should explore the various ways to modify his/her function to favor energy conservation. However, the best results can be expected only if you as the top manager recognize the importance of this sum of individual actions, and incorporate them into your energy conservation program.

Positive Incentives Can Enhance Results

To produce effective results, once your policy on energy and its priority in the organization are delineated, you need to promote participation in your energy conservation program. To the extent that positive and continuous incentives can be built into the program, the more likely it is that the policy will result in automatic and continuous results.

Positive Incentives Can Enhance Results

At one ICP evaluation site, 4 schools in a district were visited. The school system's administrator was concerned with ways to save energy dollars and was reasonably well informed on general technical methods. His management approach is to allow each principal to handle the task in his own way. Added incentives to principals were that the dollars saved through energy conservation were returned to the schools, energy accomplishments were published monthly, and each month the school achieving the greatest results was awarded the district's energy conservation flag.

The result was considerable daily awareness of energy results and a degree of competition among the schools. For example, the principal at one high school was very enthusiastic about saving energy. He reported that he continually looked for additional O&Ms to the point that he received complaints from parents that water coolers had been turned off. The ECMs installed through ICP included insulation in ceilings and floors, air conditioning retrofit, and window reductions. The dollars returned to the school from the savings of the ECMs and active O&M efforts allowed the principal to purchase and install window shades throughout the school.

For example, within an institution, a monthly newsletter can inform the entire staff of the energy accomplishments of a particular department. In addition, the newsletter can also announce new ideas and techniques for saving energy. In school districts, publishing and disseminating the goals and results of individual schools, and providing public recognition of the results can foster a degree of competition to improve participation. Finally, financial rewards always provide positive incentives.

Your Energy Manager: The Team Leader

Having made the decision to invest time and money in energy conservation, you must delegate specific responsibilities to your staff and organize an energy management team. This may be accomplished within your facility's existing organizational structure, or you may need to revise the existing structure or possibly increase your staff.

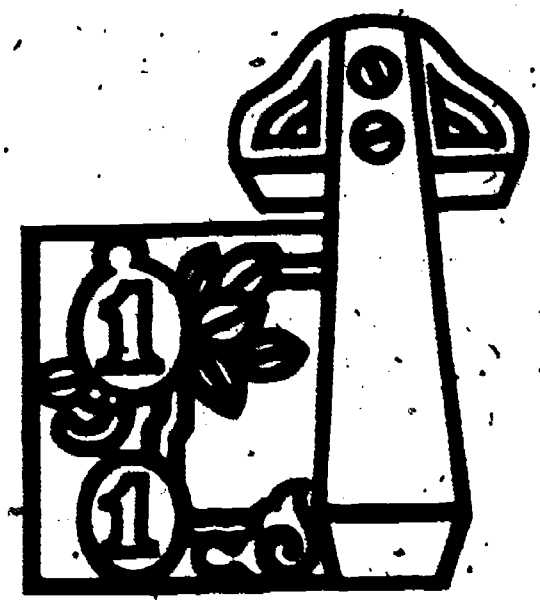
The most effective energy management structure places you at the top with authority to oversee all operations, investments, and energy decisions. You then need an energy manager, who has daily contact with the maintenance staff, technical knowledge of the energy conservation technologies you undertake, and the authority to make decisions and implement change. The qualifications of the person to accept this position may vary by the type, size and complexity of your institution. For example, in a small school district or individual school, this may be you. However, in a large urban school district, university, or hospital an energy manager may be the current director of your physical plant; in some cases a new position may need to be created for the energy manager. Regardless of where the position is located within your organizational structure, the energy manager's job must include:

- adequate technical skills to understand, adjust, and diagnose the energy systems in the facility; or knowledge enough to hire the necessary skills, and delegate the responsibilities
- adequate time and authority to carry out operating policies effectively, without conflicting with other duties or priorities;
- well-defined responsibilities relating to daily operations, periodic maintenance, and overall facility energy performance
- adequate mechanisms for feedback — energy use and cost data, instruments, etc. — needed to make regular assessments of the facility's energy system performance.

Your energy manager, then, is in a position to lead the institution's day-to-day energy conservation activities.

Strong Leadership and Technical Skills are Associated with Increased Energy Performance

In the ICP evaluation it was found that institutions where there were structured energy programs and where the quality of the energy manager was rated excellent, energy savings averaged about 20%. Where the energy manager was rated less than excellent, the average savings were 9%. This supports the principle that people are vital to energy savings.



3. Energy and Management Decisions

Establish Energy as a Cost Component in Decision Making

A piecemeal approach to energy conservation may result in periodic investments that achieve some energy savings. However, the more comprehensive task of the top manager should be to analyze the degree of cost effectiveness that is achieved by energy saving actions as compared to other cost saving efforts. Energy conservation is a relatively recent addition to the top manager's tools and techniques for controlling operating costs.

Whether you apply the energy conservation tool or some other cost saving mechanism is a key question for you in both near-term and long range planning. The answer will become clear from a simple comparison of cost effectiveness. However, you must ensure that the dollar benefits of energy conservation are conscientiously reviewed on an equal level with conventional cost-savings considerations. Furthermore, just as you wouldn't invest in a new staff member without monitoring his or her performance, you should plan into every energy conservation expenditure methods, and instrumentation as appropriate, for confirming the actual results. The added cost of this, if any, can be considered as part of the necessary investment to save money. If energy conservation projects always could be relied on to accomplish a known result regardless of their environment, quality of installation, initial adjustments, preventive maintenance, etc. this might be an unnecessary consideration.

Energy Management Through Budget Responsibility is Effective

What might be the cost-effectiveness of shifting a hypothetical laundry operation from a daytime to a nighttime schedule? Viewed from a narrow perspective, the conclusion might be negative, because the energy cost savings from operating large energy consuming equipment during off peak hours could be greater than the additional labor costs of night shift operations. However, by establishing the objective of reducing laundry costs as a budget responsibility for the department's manager, and by providing useful data to the manager on energy versus other operating costs, the manager may reach a creative voluntary solution. If energy conservation becomes the tool for the department manager to reduce the laundry budget, it will probably be used effectively. The manager will then seek assistance from Maintenance and other sources once the basic costs and benefits are presented clearly.

Demand Feedback

A universal observation throughout the ICP evaluation was that after money had been spent for hardware and systems to reduce energy consumption, the facility's top management did not know whether the projected energy cost savings had been achieved. Although a few technical managers had maintained records of total monthly and annual fuel consumption throughout the ICP involvement, almost none had scrutinized such records in enough detail to be informed on the overall achievement. Even in the cases where actual results indicated less achievement than projected, there had been no attempt to diagnose or correct the ECM's performance. The common management attitude was one of blind faith that the projected savings would automatically occur. Therefore, in order for you to know if you're getting your money's worth, you must establish a program for monitoring performance of both the equipment you install, and the individuals who operate and maintain that equipment.

Ongoing Monitoring Programs Avoid Wasted and Inefficient Energy Use

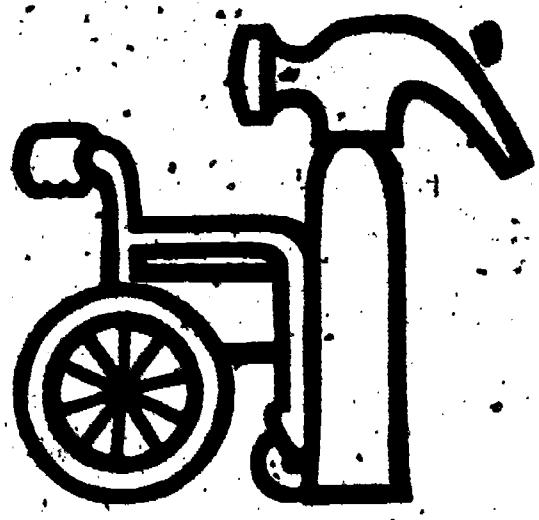
Although the ICP was intended to facilitate reductions in energy consumption, it was observed that very few institutions have the administrative or mechanical capacity for systematically monitoring and controlling the major factors that may cause high consumption. In the cases where monthly, seasonal, or—more normally—annual monitoring of consumption is performed, there does not seem to be an effective application of the resulting knowledge for the purpose of reducing energy consumption. Whereas 47% of the sites visited where ECMs had been employed reported some type of monitoring activity, only 17% actually metered energy performance. It is doubtful that timely investigation and correction of inefficient hardware operation is resulting from the monitoring activities. For example, one hospital that included daily monitoring of electricity consumption, peak demand, and temperatures on an hourly basis simply stored results in a desk drawer. No attempt was made by the maintenance staff to use the monitoring reports for energy conservation.

Your Energy Personnel Must Have Modern Expertise

As was mentioned earlier, you must—if you have neither the skills nor the time—delegate the daily tasks of energy conservation to a reliable staff person (or persons). Cost-effective energy saving actions will create demands for analysis, control, and efficient operation of today's more sophisticated systems and equipment. In the past, simple energy systems required only people who could keep equipment operating; the present and future require much greater talent to insure not only that equipment works but that it is at all times optimally adjusted and controlled to maintain efficiency. If you choose the modern hardware route to saving money you must also invest in the people to assure that the hardware does its best.

Effective Managers and Staff Augment the Energy Savings of Sophisticated Equipment

The ICP evaluation experience repeatedly found that managers apparently assumed that sophisticated "space—age" energy efficient equipment could be maintained and operated by personnel with "Model T" training and wage scales. The frequent result was that equipment was bypassed when it failed because of a lack of repair ability or trouble shooting talent. In many cases, maintenance personnel deliberately ignored the so-called automatic hardware because it was advertised not to need manual intervention. While automatic and complex equipment can be more efficient, it is also frequently true that its complexity carries with it more potential failure modes or adjustment needs than older, simpler and less efficient hardware. Therefore, you as top manager must understand that making investments in sophisticated energy saving hardware will not have long term cost effectiveness if you ignore the appropriately trained people to go with it.



4. Management and the Energy Conservation Process

Assess Your Mission vs. Energy Conservation

As top manager, you must decide to what extent energy conservation activities can be undertaken without affecting the prime mission of your institution. You must assess established procedures, and determine which are based on existing health or safety standards or regulations and which have arisen from convenience and precedent. Only the latter can be modified.

Clear knowledge of these factors will be valuable when you are deciding exactly which energy conservation measures to implement. For example, if your know that minimum lighting levels are required, you can inform analysts of these situations before they spend your money to recommend altering them. Further, once recommendations are made, you will have a basis for determining their feasibility. (Additional guidelines for reviewing recommendations and implementing ECMs are presented in later sections of the guidebook.)

Management Actions Can Modify Traditional Practices and Increase Energy Efficiency

Other examples that require more management psychology than pure engineering analysis of hardware and systems lie in the area of modifying traditional mission-oriented practices. For example, at hospitals, many changes could conserve energy if conventional medical practices could be altered. Because energy conservation and the attendant dollar savings cannot be undertaken at the expense of quality medical service, you as top manager may feel the existing medically related practices are inviolate. However, ventilation or conditioning often can be provided only when actually needed by providing the necessary communication, scheduling, and control functions. Frequently, the facilities or maintenance departments can install automatic controls to save energy without having an impact on medical staff expectations. This, then, is a necessary task for top management—to motivate all levels of the organization to analyze and act on individual actions that contribute to energy conservation while sustaining your institution's prime mission.

Evaluate In-house Resources

All energy management efforts focus on reducing consumption, but many fail to recognize the institution's internal capabilities for doing so. You should not assume that energy solutions come only from outside experts. The skills and experience of your own staff, and their familiarity with the facility, can lead to some of the most practical and cost-effective energy-saving measures. Your staff has a sense of what will work and what won't work, and they tend to know the areas that are most inefficient or in need of repair. Also, they are more likely to maintain an energy measure that they identify themselves than one imposed from the outside. Many energy consultants find that some of their most practical recommendations originate from building staff suggestions, which they then investigate and develop. While it is true that outside experts can identify more complex and innovative energy measures and thus be a net benefit to the energy effort, many of the lower-cost, practical, maintainable options already exist in the collective wisdom of your staff.

Since in many cases your staff can offer valuable energy-saving ideas, you need a serious and focused effort to elicit them. This can be accomplished by meeting with staff informally, by requesting a brief report on energy-saving suggestions, or by creating an energy "suggestion box." Additional creative mechanisms for motivating ideas from staff can include: an institution-wide contest for energy suggestions, public recognition or award for the "energy saver of the month," and, of course financial rewards are always appreciated.

In recent years, as energy conservation has become a viable method for reducing operating costs, it is likely that you have received information on energy conservation, or actually participated in some level of conservation activity, from analyses to implementing some measures. If you have had energy analyses conducted for your particular facility, or have general literature on energy conservation in your type of facility, now is the time to review those studies to determine if any of the recommendations are appropriate for you to consider. They may identify formats for collecting and reviewing data, or suggest some procedures that your staff can immediately implement. This review and evaluation of in-house resources ultimately may avoid duplicating efforts by your staff or by outside consultants.

Knowledgeable Staff Can Provide Valuable Contributions To Energy Programs

Throughout the ICP evaluation, it was observed that on-site personnel sometimes were not considered sufficiently capable and/or are specifically directed not to concern themselves with mechanical equipment. However, often during building "walkthroughs," respondents discussed their ideas for additional conservation activities (both O&Ms and ECMs that could be implemented in-house at low costs). For example, at one midwestern hospital, a building engineer reported his ideas for recovering dryer exhaust heat from the laundry to preheat the domestic hot water. In addition, he recommended using the hospital's emergency generators to reduce peak consumption. However, neither of these projects or other suggestions had been implemented since the engineer did not have the authority, the backing of those with the authority, nor any other mechanism through which his ideas could receive attention.

Perform an Energy Analysis

An energy analysis is a systematic analysis of the energy use patterns of your facility, and to be effective, it should determine the financial, energy savings, and other benefits of carrying out various energy conservation activities. Since an energy analysis can vary enormously in cost and scope, you must assess your needs and expectations so that it will provide you with the information and options needed to implement cost-effective energy conservation measures. The effective energy analysis can be structured into three general tasks. These are:

- Developing an energy consumption profile.
- Assessing the current status of energy systems and requirements.
- Identifying conservation measures.

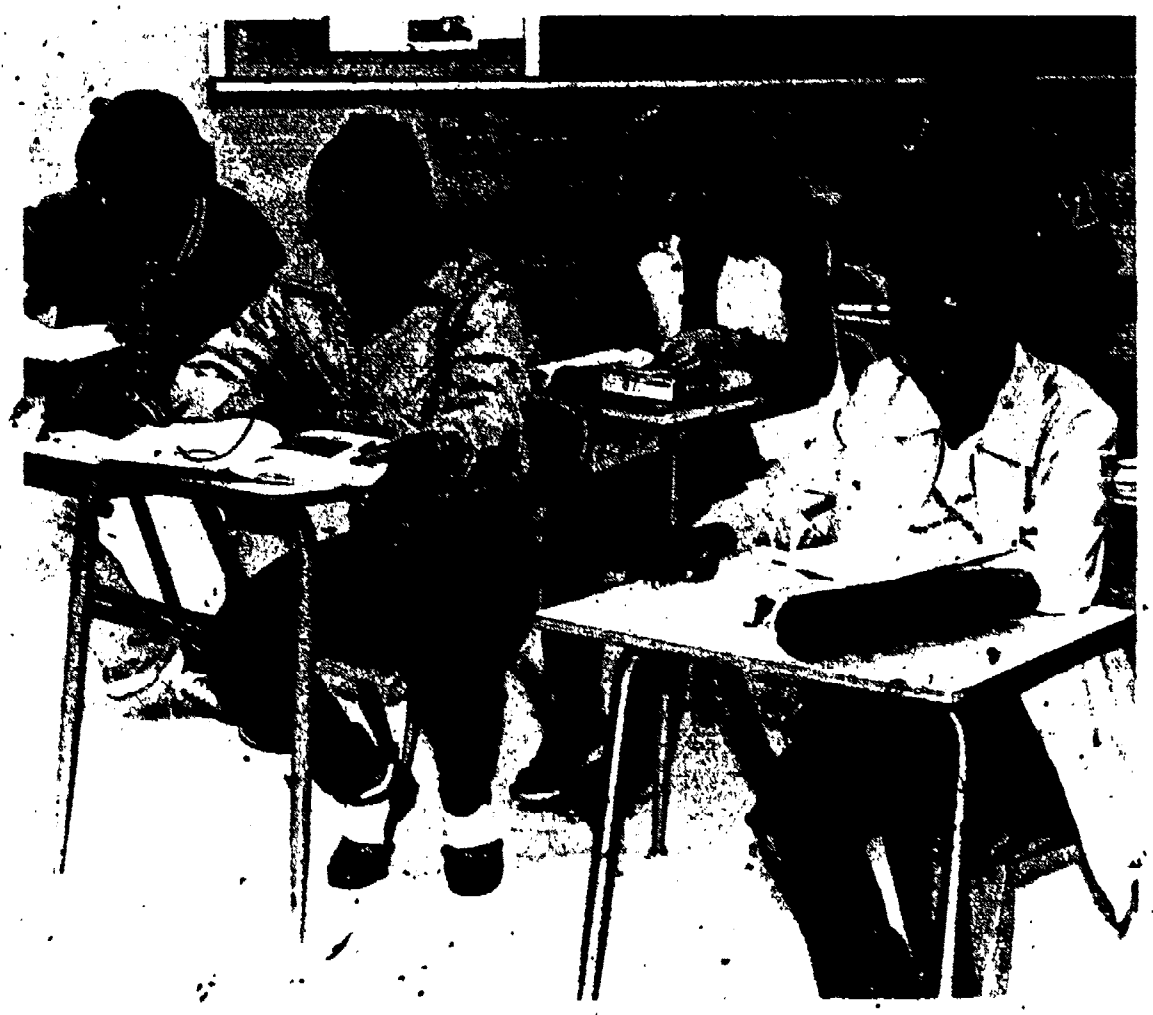
Whereas a discussion of the specific data to be included in your energy analysis is beyond the scope of this guidebook, the remainder of this section discusses the decisions you need to make in conducting an effective energy analysis.

What is the Focus of the Analysis?

Depending upon your needs and your financial commitment to energy conservation, the scope of your activity can range from identifying low-cost/no-cost basic operating and maintenance procedures (O&Ms) to a detailed, comprehensive technical analysis of energy systems and capital investments in equipment or structural modifications. You must determine what the scope should be. For example, if you are just starting an energy program, and you do not have a large budget to invest in energy conservation, you may want to conduct a simple audit to identify O&Ms, implement those O&Ms, track consumption, and use the results to convince your board of directors that greater achievements could be made if they include funds for capital investments in next year's budget. On the other hand, if you have already implemented O&Ms, or if you want or need to incorporate a comprehensive analysis into your long-term planning process, you should conduct a comprehensive analysis.

Comprehensive Analyses Foster Increased Energy Savings

The overriding emphasis of energy analysts whose work was examined in the ICP evaluation was in many cases to identify capital improvements that could save energy, rather than to present analysis of the "total" facility. For example, while some or all of the ECM expenditures theoretically were productive, approximately 50% of the ECM grantees provided evidence to the evaluation team that additional O&M efforts may have been more appropriate than the implemented ECMs. Overall, these grantees showed average energy savings of 1.7% as opposed to 10% average savings where the need for additional O&M efforts was not evident. In many cases, an O&M focus might have resulted in the O&Ms "outsaving" the more costly ECM expenditures. This is further illustrated by the fact that only 39% of the technical analyses reviewed recommened additional O&Ms beyond the preliminary ideas generated by the earlier energy audit. In cases where the technical analysis did identify further O&Ms, institutions showed an average of 16.4% savings, while those in which technical analysis failed to recommend additional O&Ms showed an average of 10.3% savings.



The Advantages of Monitoring Your Analyst's Progress

Reports prepared for ICP participants varied greatly in quality, scope, and effectiveness. One common pattern observed during site visits was that certain energy auditors and analysts tended to recommend the same O&Ms and ECMs at all buildings. In cases of buildings that are very similar this practice may be acceptable, but most seemingly "similar" buildings are in fact quite different in their energy character due to the variations in mechancial equipment, utilization, numbers of users, operating and maintenance conditions, siting, and other factors. It is likely that if you monitor your auditor's progress you can ensure that he recommends the most cost-effective ECMs for your facility.

Who Should Conduct the Analysis?

Depending upon your assessment of your staff's capabilities, much or all of the audit can be conducted in-house. Many "do-it-yourself" audit kits are available from local utility companies, State and local energy agencies, and some universities. A review of these audit kits will let you know if any of them will fill your needs. At a minimum, your energy manager must be able to develop and monitor your facility's energy consumption profile.

In many cases, particularly complex campuses and hospitals, your energy manager, with the assistance of your maintenance staff, also should be able to supply a comprehensive assessment of the status of energy systems and their requirements.

Once you have a consumption profile and an assessment of existing systems, you may want to provide this information to an outside contractor and allow him or her to focus on the identification of energy conservation measures. A registered engineer or engineer/architect team who is familiar with your facility as well as with energy conservation (e.g., a staff member from an engineering firm who has worked for you before) should be chosen.

However, some firms/consultants may be able to offer you a cost-effective energy audit package that will meet your needs in all three areas, and would not interrupt the schedules of your staff. In any case, it is your responsibility to make sure that the audit addresses your needs and expectations.

Therefore, you or your energy manager should monitor the analyst's progress and assign a staff member to act as a "secondary auditor." This will result in a two-way communication: the analyst will learn the specifics of your facility, and your staff-member/auditor will become familiar with the analyst's methods and recommendations.

Develop an Energy Management Strategy

Conducting an energy analysis will not by itself result in energy savings. You need to create a definite strategy for acting on the analysis recommendations. This strategy should consist of specific goals (e.g., what level of savings at what costs), and the specific means to achieve them (e.g., who will operate the program). This takes planning and coordination, and it is a step frequently overlooked.

Your responsibilities (in conjuntion with your energy manager) in developing an energy conservation strategy are to (1) review the measures recommended in the analysis; and (2) select those that are most appropriate and cost-effective. The steps involved in each are outlined below.

Review Conservation Measures Recommended in the Analysis

- Are energy and cost savings projections realistic? Were the basic assumptions of the analyst correct—that is, were operating hours realistic, health and safety regulations addressed?
- Are recommended energy conservation measures appropriate for your facility? Can they be implemented within your existing systems? Do they blend with your normal operating procedures and schedules (e.g., do recommendations for automatic boiler controls conform to operating hours? Are there recommendations for installing vestibules on doorways that are not used)?
- Is your staff capable of maintaining the measures? Would training be required or should you consider outside maintenance contracts?
- Is performance measureable? Will you need to invest additional funds in instruments to measure performance? Will these costs outweight the savings?
- Do energy measures conflict with your facility's prime mission, or regulations governing your prime mission?
- Are energy measures economically feasible? Can you afford to install all measures now? If not, can you rank measures by payback and energy savings projections, in order to facilitate your decision?
- Do the measures serve a purpose beyond energy conservation? Can you rank measures by priorities justified by the age of equipment to be replaced? Might an ECM for window modifications also solve the problems with leaks?

The Need for Instruments to Confirm Savings

A major midwestern hospital installed three major ECMs, including: automatic chiller control, boiler stack heat recovery, and HVAC system modifications.

All of the equipment was properly designed, installed, and maintained, yet after more than a year, only a fraction of the expected savings was being achieved. Further investigation uncovered no obvious operating problems, but it was also evident that there was not enough instrumentation to discover whether the individual ECMs were producing results. The lesson is that an additional expenditure for instrumentation could have helped identify adjustments that would increase energy savings.

Cost-Effective ECMs Also Might Help Recover the Costs of Needed Repairs and Renovations

At one ICP high school, the heating system had become so ineffective that students had to be sent home on cold days. The ECMs installed consisted of 128 thermostatic control valves on individual thermostats, a night setback time clock, ceiling insulation, lighting modifications, and boiler dual fuel burner replacement with conversion from oil to gas. Overall, the high school achieved a 31% savings in energy consumption. Although it was quite evident that boiler replacement was imminent regardless of the availability of federal funds, it is likely that an overall energy conservation program would not have occurred in the institution. Therefore, even though the success of the boiler ECM actually may be due to the correction of a poorly maintained system, this institution's ICP participation also has brought valuable energy conservation knowledge to the institution's occupants, managers, and maintenance personnel.

Select the Most Appropriate and Cost-Effective Energy Conservation Methods

- Separate capital improvement measures (ECMs) and O&M measures into two groups. O&Ms can then be implemented as soon as possible, while planning for capital measures.
- For each energy measure, identify:
  - Purchase and installation costs
  - Maintenance, monitoring, and instrumentation costs
  - Installation, maintenance, monitoring requirements.
- Develop an Q&M plan that specified changes in building and equipment methods and schedules, and changes in preventive maintenance procedures; this should include specific job description changes for each affected staff position, as well as general procedural guides.
- Develop a plan for ECMs that specifies building and equipment modifications, projects costs for each measure and optional combinations of measures, and projects an expected timetable for procurement, installation, operation and on-going maintenance.
- Combine the O&M and ECM plans into an overall work plan which includes all of the technical administrative support resources and assignments needed to implement the energy measures.

These efforts should give you a clear blueprint for achieving and maintaining your energy conservation goals.

Implement Your Energy Management Strategy

Similar to any new program, implementing your energy program requires persistence, patience, good planning, and support from the top. Assuming that you have decided what you are going to do, and who is going to do it, the next question is how to implement your program. It is likely that you have a limited amount of money to invest, and therefore, want to implement as much as you can within your budget limitations. Therefore, you should begin by implementing O&Ms that can be operated and maintained by your staff.

Start with O&Ms

You and your energy manager should formalize an O&M implementation plan, and inform the entire institution of proposed changes and their impact on facility operations (e.g., changes in daily, weekly, monthly, seasonal or annual schedules).

Then, to the degree possible, your energy manager (with your assistance and approval) should record all new operating schedules and maintenance procedures and distribute them to the individuals involved in effecting the changes. Specify changes in job descriptions, and make sure that those individuals, as well as those who work with them, understand their new responsibilities and the degree of authority with which they are to carry them out.

Depending on the kinds of O&M measures involved, some of your maintenance staff may need additional training in boiler efficiency, mechanical equipment control, or new maintenance procedures. In some cases your energy analyst may be able to train staff during the analysis or in a follow-up program. There are also courses in building operation and management offered through various trade groups. Whatever the method, be sure your staff is trained to handle its new workload.

The Importance of Keeping Up O&M Practices

The ICP evaluation field interviews showed that in many cases, facilities were not maintaining the O&M measures recommended in their energy audits. These facilities experienced only 3% average energy savings, compared to 15% at facilities that were keeping up with their O&Ms. There was also an impact on the cost-effectiveness of the facility's ECMs: where O&Ms were not being maintained, ECMs were only one-sixth as cost-effective as ECMs in facilities whose O&Ms were kept up. That is, a dollar of energy savings cost, six times as much in ECM expenditures when basic O&M practices were not followed.

Energy Conservation Measures: Capital Investments

You are now ready to invest in ECMs. In addition to your existing budget and traditional fund raising methods, there are a number of additional options for financing energy conservation projects. You may decide that, for the sake of simplicity, you may want to undertake only those projects that you can pay for with your own resources. However, among the options you may wish to consider are:

- U.S. DOE Institutional Conservation Program (ICP).

  Described earlier, this program provides funds for technical assistance studies, as well as for the installation of ECMs. The program operates on annual grant cycles, and is administered through State energy offices. For more information on eligibility and funding, contact your State energy office.
- State Energy Conservation Programs.

  Several states are now sponsoring energy conservation programs for nonprofit institutions. Some states also provide information and assistance in developing innovative financing mechanisms for energy conservation. Again, contact your State energy office.
- Innovative Financing Mechanisms.

  Several equipment manufacturers, energy service companies, engineering firms, and some utilities currently are offering various innovative financing plans for energy conservation. The details of these plans often are very complex and vary in their terms, depending on the parties involved. Therefore, if you consider one of the following options, be sure you understand the implications of your decision.
  - *Leasing*, in which the user leases the energy equipment from an outside party. Leasing is increasingly offered by manufacturers as a way to facilitate sales, and is often tailored to meet the client's needs. Leasing is also a vehicle used by third-party investors as part of tax-sheltered investment programs. Commercial leasing of energy equipment to nonprofit institutions, however, is not very attractive to third-party investors, because tax credits are not available to the lessor if the lessee is a nonprofit organization.
  - *Shared-Savings Agreements*, in which an outside party installs (and often maintains) energy conservation equipment in the user's facility. The energy costs saved by the equipment are then shared in a negotiated agreement between the user and the outside party.
  - *Energy Service Contracts*, in which an outside party agrees to pay the user's energy bills, and charges a fixed fee which is less than the user's base year energy costs. The outside party implements energy measures and seeks to reduce the user's energy costs, so that the energy bills it pays are less than its fixed fee from the user.

Procuring and Installing Equipment

While the procurement process for energy equipment or modifications may be the same as the one you use for other purposes, many energy projects require some special considerations:

- Space and Specifications.

  Before hiring contractors to install new equipment, you must make sure that adequate space is available to house the equipment, and that all equipment specifications can be met. For example, some computer systems require special climatic conditions. All equipment should have easy access for adjustments and repairs, and also should be located in an area to avoid tampering (e.g., thermostats could have solid locked covers to prevent continual adjusting, and air conditioning units should be located in an area to allow maintenance staff to change filters, etc.).

- Maintainability.

  Energy equipment, especially newer and more complex technologies, often requires a lot of adjustment and maintenance. The procurement process should ensure that the manufacturer, building staff, or a service contractor are capable of maintaining the equipment. New technologies also may involve unforeseen costs to correct problems, and these should be allowed for in operating costs.

- Reliability.

  Much energy equipment, especially electronic control systems, and many of the companies that design, manufacture, and install them, are relatively new, with only a few years experience in the field. Be sure you contact references for the same equipment and the same installer, preferably in similar facilities. Ask for financial statements or other proof of business stability from manufacturers and installers. Ask for and examine warranties or other forms of guarantee that will protect you against equipment failure.

- Performance.

  Unlike many investments, energy projects often are justified entirely on projected energy savings. Yet, once projects are installed, there is often no way to measure, let alone assure, that the promised performance is achieved. Ways to avoid this problem are to:

  - Require that instrumentation be included in the installation to measure actual performance.
  - Include performance measurement in warranties or other assurance documents, so that you are protected against inadequate performance as well as against outright failure.
  - It is important to be sure your equipment works before completing the procurement. Be sure that mechanical or electronic equipment is tested on-line before accepting it.

The Importance of Performance Guarantees

In one school facility, heating systems controls were installed and set in the summer, which is the normal period for major maintenance work for most schools. However, the equipment's performance could only be observed in the winter when the heating system was operating. Problems with the controls that came up the following winter were addressed in the spring, but then recurred the next winter. Two years after installation, the problem had still not been diagnosed or corrected, and the normal manufacturer's and contractor's guarantees had expired. This shows how critical it is to observe and confirm equipment performance *before* guarantees, warranties, etc. expire.

- Training

  As much as possible, involve your facility staff in the nuts and bolts of the installation. This can save on installation labor, and will help them understand how the equipment works. In any case, make sure you take advantage of any training services provided by the manufacturer or installer.

- Documentation

  Ask installers/manufacturers to provide as much concrete documentation on the equipment as possible, including operating manuals, maintenance manuals, and as-built drawings, so that your facility staff is prepared to handle the equipment.

Maintaining Service Contracts Can Avoid Unexpected Costs

A midwestern high school installed a new boiler designed to burn sawdust from a nearby lumber mill. However, several factors were not taken into account in planning the project, including: the moisture content of the sawdust, which caused chronic performance problems; the cost of delivering the sawdust, which increased operating costs; and the school staff's unfamiliarity with the equipment, which prevented them from solving some of the operation problems. The lesson is that any unfamiliar technology like this must be given very thorough consideration for these hidden problems, and provisions should be made for covering unforeseen costs or operation problems in such unpredictable situations.

The National Society of Professional Engineers has prepared two useful guides on the subjects of ECM procurement and energy project management, which are listed in "Sources of Additional Information" at the end of this guidebook.

Keep the Energy Management Program Going

There is a natural tendency to assume that once the last bolt is tightened on an energy project, the job is done and your attention can go to other things. Though this is true to an extent, in another sense the job has just begun. Energy dollars are saved over months and years, and savings require regular attention in order to continue at their expected rate. Concerted action is needed to counter the tendency to "return to normal" that so often follows a period of innovation. This section suggests some practical means of keeping your energy savings on target.

The ideas in this section should become part of your energy manager's routine, with assistance from your accounting and maintenance staff. As a manager, your role should be to see that these practices are adopted and kept up, so that your time is not consumed with too much detail.

Monitor Energy Performance

Ongoing monitoring of energy consumption provides the basis for evaluating the success of an institution's energy conservation program. Reviewing and comparing monthly fuel bills and adding equipment metering are two effective methods for identifying the areas of potentially greatest savings as well as quickly pinpointing consumption-increase problems.

Make A Target Energy Budget

Your energy analysis should produce projected energy and cost savings from each of the energy measures you install as well as the combinations of measures, to provide a basis both for estimating total savings potential, and for subsequent monitoring. By subtracting the savings projections from your base year consumption levels you can establish a target energy budget, that can then be used to track energy performance.

Review Energy Bills

As your energy bills come in, record the consumption and cost data for that billing period, or have your energy manager do it. This will allow you to track energy consumption and compare actual consumption with projections as well as your target goals. Two other important issues in reviewing your energy bills are:

- Is the bill correct?

  Are there billing errors due to meter misreading, computer error, double billing, etc.? Compare bills to your base year and target budgets to see if a given bill appears significantly off. If so, check with your staff and your energy supplier to resolve the discrepancy.

- Are you purchasing energy most economically?

  This involves examining such issues as:

  - *Electric Rates.*

    Utilities in many States are creating different rate features, based on time-of-day usage, seasonal usage, peak demand, and other factors. Consult your utility or your State public utilities commission to learn more about your rate options.

  - *Gas Rates.*

    Some gas utilities are offering lower rates to customers who maintain alternate fuel capabilities. This may involve periodic interruptions in gas service, but if you can use an alternate fuel during interruptions, the cost savings may be substantial.

  - *Fuel Purchasing.*

    Local governments and other regional groups are beginning to use cooperative purchasing strategies for heating oil. This can offer substantial price advantages.

Evaluate Energy Performance

Recording energy data each month is one thing; using it to assess your facility's performance is another. The real value of doing energy accounting is to measure—with the hope of improving—energy efficiency. How do you measure energy performance? One of the simplest ways is to keep a chart of your year-to-date consumption. If your consumption is increasing, consider the following factors:

- Has the weather been more severe than in the base year?
- Have the hours of operations, the square footage in use, or the number of people using the facility increased?
- Has energy-using equipment such as computers, medical equipment, etc. been installed?

Investigate Problems

Assuming that you have implemented a comprehensive conservation program in your facility, identifying problems should be relatively easy. However, even when your energy manager and maintenance staff are conducting an excellent program, consumption data may inform you that expectations are not being met. Some complex ECMs (e.g., computer systems, boiler interconnects, heat recovery) may require the attention of the installer, manufacturer, or service

contractor. The fact that you have been tracking energy performance and are aware of problems when they occur will prevent both energy and dollar losses over the long term.

Monitor Program Upkeep

Though you may have spelled out O&M procedures for your staff, and arranged for service for ECMs, it is nonetheless important to check to see that the orders are being carried out. The energy performance review process using energy bills is one way to see if things are working, but it is not a substitute for a more "hands-on" assessment of what's going on in the boiler room. You may want to ask your energy manager to do spot checks or quarterly reports on both internal staff adherence to O&M procedures and external service contactors' adherence to specified requirements.

Support Energy Performance

Even with the best physical plant, your facility is not likely to maintain the energy efficiency it is capable of unless the people who use and maintain it are properly motivated toward that end. While motivation is essentially a quality within individuals, there are several ways management policies can encourage individual support of institutional goals. Energy management goals can be supported through such means as:

- Reporting Systems.

  Receiving useful information that relates to an individual's energy conservation efforts on a regular basis can be a motivator. If, for example, a school principal sees monthly reports on his building's energy performance, he has a basis for continuing or improving his efforts.
- Publicity.

  Success should be highlighted in the institution's regular communications media, such as staff memos, newsletters, posted announcements, etc. Individuals who have contributed to improving energy performance could be recognized, through special mention, formal or informal awards, or just personal appreciation.
- Job Evaluation.

  Some key positions could have energy efficiency targets incorporated as part of their regular personnel evaluation process. Energy performance should be more of a carrot than a stick in this regard.

* U.S. GOVERNMENT PRINTING OFFICE: 1984-421-060:11101

Sources of Additional Information

There are many publications on energy conservation, energy auditing, and related topics. Below is a suggested list of sources of information that are useful for schools and hospitals.

Association of Energy Engineers. Energy Auditing. Atlanta: The Fairmont Press. 1980. Available from:
The Association of Energy Engineers
Atlanta, Georgia
404/892-1784

Blue Cross of Greater Philadelphia. Final Report of the Philadelphia Hospital Energy Conservation Program. Philadelphia, 1979. Available from:
Blue Cross of Greater Philadelphia
1333 Chestnut Street
Philadelphia, PA 19107

Blue Cross of Greater Philadelphia. Practical Energy Management in Health Care Institutions. Philadelphia, 1977. Available from:
(see above)

Brown, Robert J. Life-Cycle Costing: A Practical Guide for Energy Managers. Atlanta: The Fairmont Press, 1980. Available from:
The Fairmont Press
P.O. Box 14227
Atlanta, Georgia 30324

Dubin, Fred, S. How to Save Energy and Cut Costs in Existing Industrial and Commercial Buildings. Park Ridge, NJ: Noyes Data Corporation, 1976. Available from:
Noyes Data Corporation
Noyes Building
Park Ridge, NJ 07656

Minnesota Department of Energy Planning and Development. Energy Accounting Procedures Manual for Local Governments and School Districts. 1981. Available from:
Minnesota Department of Energy Planning and Development
St. Paul, MN
612/296-8899

National Society of Professional Engineers. Guide to a Successful Project: Energy Conservation and Management. Available from:
National Society of Professional Engineers
2029 K Street, NW
Washington, D.C. 20006

National Society of Professional Engineers. Model Competitive Procurement Procedure. Available from:
(see above)

Southeast Georgia Planning Commission. Energy Conservation and Management Guide for Small Municipalities and School Districts. Available from:
Southeast Georgia Planning Commission
P.O. Box 2049
Waycross, Georgia 31501
912/285-6097

Thumann, Albert. Handbook of Energy Audits. Atlanta: The Fairmont Press, 1979. Available from:
The Fairmont Press, Inc.
P.O. Box 14227.
Atlanta, Georgia 30324

U.S. Department of Energy. Energy Audit Workbook for Hospitals. 1978. Available from:
NTIS
U.S. Department of Commerce
Springfield, Virginia 22161
Document #: DOECS-00412

U.S. Department of Energy. Energy Efficient Hospitals: DOE-Assisted Retrofit Projects. Office of Institutional Conservation Programs, 1981. Available from:
U.S. Department of Energy
Technical Information Center
P.O. Box 62
Oak Ridge, TN 37830

U.S. Department of Health, Education, and Welfare. Public Health Service. Health Resources Administration.
Criteria for Design Review and Licensure Surveys of Solar Systems in Health Care Facilities. DHEW Pub: #HRA/79-617
Energy Issues in Health. DHEW Pub. #HRA/79-14510
Energy Management in Health Care Institutions. USGPO #017-022-0046508
Solar Energy for Health Care Institutions. DHEW Pub. #HRA/78-618
Total Energy Management for Hospitals. DHEW Pub. #HRA/78-613
The above 5 publications available from:
Health Resources Administration
Division of Energy Policy and Programs
5600 Fishers Lane
Rockville, MD 20857
301/443-6652

Other Contacts

- your State energy office
- your local electric or gas utility
- The American Association of School Administrators
  1801 N. Moore Street
  Arlington, Virginia 22209
  703/528-0700
- The American Hospital Association
  Energy Task Force
  840 N. Lake Shore Drive
  Chicago, IL 60611
- The Association of Physical Plant Administrators
  Energy Task Force
  11 Dupont Circle
  Washington, D.C. 20036
  202/234-1662