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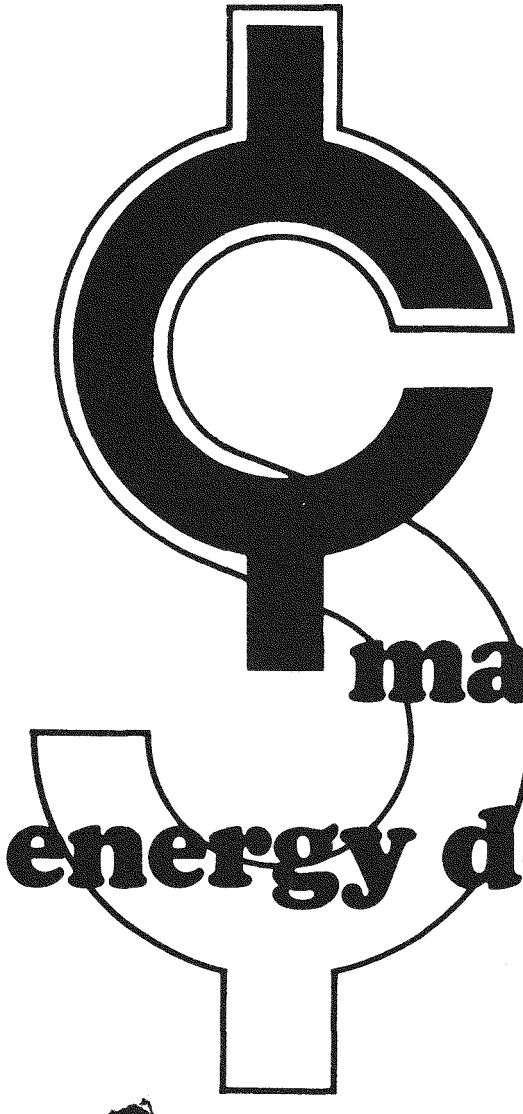
A GUIDE TO IDENTIFYING ENERGY AND COST SAVING OPPORTUNITIES IN INSTITUTIONAL BUILDINGS

VOLUME 1
Energy Audit

Published June, 1979



making cents of your energy dollar

PREPARED FOR:
U.S. DEPARTMENT OF ENERGY
Assistant Secretary for Conservation and Solar Applications
Institutional Building Grants Program Division

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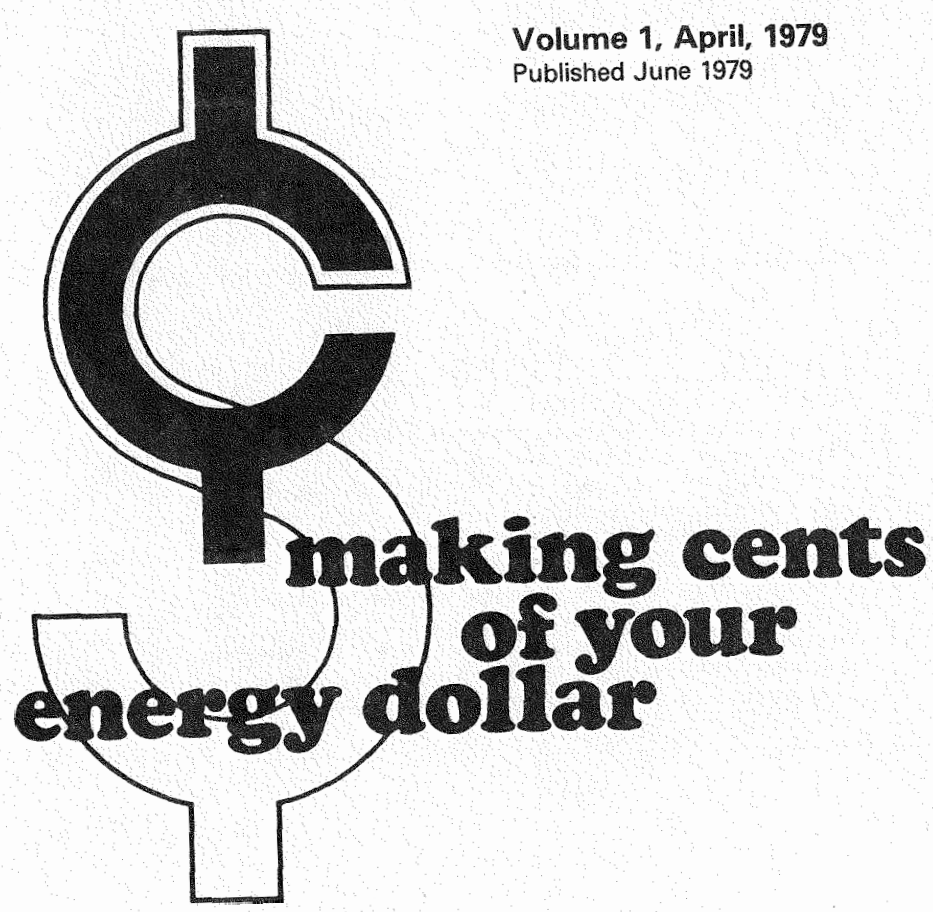

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While the recommendations contained in this Handbook have been reviewed for technical accuracy, the U.S. Department of Energy, its contractor, and the State Energy Offices are not liable if potential costs savings identified as a result of using this manual are not actually achieved. The U.S. Department of Energy does not endorse or recommend the use of any specific brand of equipment which may be represented within the Handbook.

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Major contributions as associate authors were made by:
Dr. Calvin E. Anderson, Jo Anne R. Phipps and Charles A. Bottinelli

Charles A. Bottinelli
Project Manager

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1 USING THE HANDBOOK

A THE ENERGY AUDIT

This handbook is directed at conducting an energy audit and is a vehicle to establish an energy management program. It is primarily a guide to the identification and correction of inefficiencies in building energy systems and a practical handbook for energy management task forces. It may also be an aid in the training of state energy auditors and/or operational personnel/managers of schools, hospitals and public buildings pursuant to the National Energy Conservation Policy Act (NECPA) of 1978. Further, it is suitable for use by para-professionals implementing the energy audit phase of the schools/hospitals/public buildings program.

The handbook's core is a logical sequence of steps for conducting energy audits and the implementation and monitoring of a comprehensive energy management program. Practical energy conservation opportunities, including simple, "quick-fix", low-or-no-cost options (operational and maintenance - O&M) as well as selected capital intensive energy measures (retrofit and redesign) are indicated clearly in the easy-to-use Energy Audit Checklist. It should be noted that it is the primary responsibility of the energy auditor to identify energy saving opportunities. Management's responsibility is to follow-up on recommended O&M options.

Model calculations are provided in Volume 2 for the majority of both types of conservation opportunities so that the management may compute potential savings and payback, using the results for intelligent decision making. These models have been standardized and programmed in such a way that it is possible to enter climatological data unique to particular heating and cooling zones. It must be emphasized, however, that potential savings are approximate, rather than precise, because each building is unique.

SUGGESTIONS FOR QUALIFIED ENERGY AUDITORS

1. Make an appointment for an energy audit with the building manager and/or the operations engineer of building well in advance for a 3-4 hour time block (minimum) and indicate that you will be sending the handbook. Inform the building representative that the Energy Inventory section must be completed prior to the time of the energy audit. Detach the convenient confirmation form (on the last page of this section) and attach it to the cover of the Handbook prior to mailing.

2. Upon arrival use the Handbook to explain briefly what information will be sought in the walk-through tour of the building and the way in which the energy audit will be conducted. Confirm that Energy Inventory forms have been completed.

3. Review the content of these forms with the building representative(s).

4. Using the Energy Audit Checklist, and with the assistance of the building representative(s), complete the items under ADMINISTRATION.

5. Proceed with the tour in the following order of energy systems:

   BUILDING ENVELOPE
   LIGHTING
   VENTILATION
   HEATING
   COOLING
   WATER

   Conditions to be checked are listed within each energy system.

6. Be sure that each condition is checked.

7. It is recommended that together the energy auditor and the management representatives complete the following elements of the Energy Audit Report:

   1. Condition Summary Page
   2. Evaluation of Potential for Energy Conservation Measures
   3. Evaluation of Potential for Solar and Renewable Resource Measures

   Depending on state requirements, one or more of the elements of the Energy Audit Report may be necessary for compliance. Be certain to keep a duplicate set of these documents.

Note: Energy auditors will not implement any of the O&M options. O&M options will be implemented by facility engineering or maintenance personnel; redesign and retrofit options may be implemented later with professional assistance.

INSTRUCTIONS FOR BUILDING ENERGY MANAGEMENT COORDINATOR

1. Read the Handbook and complete the Energy Inventory section of the Audit Report prior to the energy audit.

2. Inform appropriate personnel of the date and time of the energy audit, if appropriate.

3. After the energy audit implement appropriate O&M options as indicated by the Energy Audit Checklist.

4. Calculate potential energy savings (where possible) of O&M and energy measure (retrofit) opportunities using the model calculations provided in Volume 2, if desired or required by your state.

5. Continue to consult the Handbook. It can be a valuable tool as you refine your energy management program.

B ENERGY MANAGEMENT--A TEAM APPROACH FOR INSTITUTIONS.

Remember that effective energy management must be a team effort. You can't do it alone!

Why the team approach?

The team approach considers every facility a unique system. Any basic management approach requires that all concerned understand the ways energy is used in the building, how building systems interrelate, the effects of the external environment and the "human" element.

The team approach allows for flexibility while meeting the needs of the management and staff. Each facility's management must establish its own energy management goals and decide how to achieve them in light of individual programs.

The team approach encourages the development of an energy ethic, while systematically conserving energy and money.

Who is the team?

The composition of the team will vary with the size of the work force. It should, however, include a high level administrator, budgeting and maintenance personnel. Some important guidelines are:

- Appoint an energy management coordinator.
- Keep the team small (7 or less).
- Try to keep meetings under an hour in length.
- Assign specific tasks to specific people.
- Have a well-planned, organized agenda for each meeting.
- Provide deadlines and reporting dates for all individuals and subgroups.
- Indicate team responsibility in following developed guidelines.
- Be sure everyone is aware of the parameters of the team's functions.
- Any effective energy management program must include the commitment of upper management. Establish this important link by showing top management the utility bills. Emphasize that energy management will not only optimize energy use but will also save money for the facility.
- Communicate!

What are the team tasks?

- Determine the physical characteristics, the normal use and occupancy of the building, using the Energy Inventory.
- Determine annual energy consumption, using Examine Utility Bills. Don't forget to analyze the electrical rate structure, power factors, load profiles and demand peaks. Call your local utility if you need help.
- Set a realistic goal for reduction of energy usage based upon estimated savings for energy systems within the building.
- Improve the efficiency of the heating and cooling equipment by making necessary adjustments or repairs. Recommend replacement of worn-out systems with more efficient ones.
- Maintain records of monthly energy usage, and continuously monitor the systems to insure that selected energy conservation options are implemented and are functioning appropriately.
- Establish an adequate training program for maintenance and operating personnel.
- Provide a less extensive training program for all other personnel.
- Take immediate action on the following:
    - Schedule regular maintenance of equipment.
    - Establish guidelines for effective energy management of office, food service, laboratory, laundry, dishwashing and other high energy demand equipment.
    - Post signs requesting occupants to turn off lights in unoccupied areas, to use stairways whenever possible and to close windows and doors when heating/cooling systems are operating.
    - Develop charts and graphs to remind occupants of the progress of your program.
    - Acquire resource support--budgetary or manpower--for the commitments necessary to sustain your energy management program.

Remember: Energy management programs prove effective only when individuals understand the importance of energy management and make a commitment to achieve the goal.

C

SURVEY CONFIRMATION MEMO

TO: _____

FROM: _____
Energy Conservation Auditor

SUBJECT: Date and Time of your Energy Audit

This memo is to confirm that I will be at your facility,

_____, on _____,
address month

_____, at _____. Please allow at least three
day time

hours for our energy audit.

To make our meeting more productive, I suggest the following agenda:

1. Review with your energy team the walk-through survey and discuss the information you have filled out in Section 4 of the enclosed handbook, Making Cents of Your Energy Dollar. (Note: Section 4 must be completed prior to the audit.)

2. Proceed as a group to audit your facility using the walk-through checklist in Section 2 of the handbook.

3. Review with your team how you calculate potential savings against current usage and rank retrofit options.

4. Answer any questions you or your team may have concerning the survey, the handbook and/or our program.

I will look forward to working with you on this important program.

Enclosure

2 CONSERVATION OPTIONS

Identifying Opportunities to Save

Energy conservation options are opportunities to save energy dollars. These options fall into two major categories:

1. Operational and Maintenance Procedures: Changing, rescheduling, or maintaining existing equipment or systems with available resources.

2. Energy Measures (Retrofit): Furnishing with new parts, equipment or technology not available or included at the time of construction.

It is important to understand the typical energy use patterns of your institution type in order to facilitate identification of energy intensive areas, energy use distribution patterns within systems and as a basis for comparision of your institution with other similar institutions.

Armed with a basic knowledge of your building's functions, use patterns and physical characteristics (The Energy Inventory) and the Energy Audit Checklist, you will have no difficulty in spotting symptoms of energy inefficiency and in identifying your options for savings.

A TYPICAL ENERGY USE PATTERNS

Because each building is unique in structure, site orientation, climate and function, a general document cannot identify specific energy use patterns that exist in your facility. It is possible, however, to identify typical patterns of consumption for schools, hospitals and public buildings.

Included in the following discussion are energy "pies" which indicate energy consumption by divisions typically found in these institutions.

Examine each of four "pies". Note the areas which have the greatest impact on energy consumption because these are also the areas where appropriate energy conservation options can have the greatest impact on energy and dollar savings.

EDUCATIONAL INSTITUTIONS

In 1977 the nation's educational institutions consumed 1.1 quadrillion BTU's or approximately 1.5% of the total U.S. consumption of energy of all forms. As energy costs continue to erode educational budgets, the importance of a comprehensive energy management program for educational institutions becomes obvious.

If the physical plant and its occupants can use efficiently the energy entering the building, at least a 30 - 50% energy savings can be realized. Much of this savings can be effected at no or low-cost.

As can be seen from Figure 1, energy is utilized in a number of ways. Although these percentages will vary for educational institutions in different regions of the country, the heating, ventilation and air conditioning (HVAC) systems usually represent the greatest single usage. Lighting and general electrical represent the second major category.

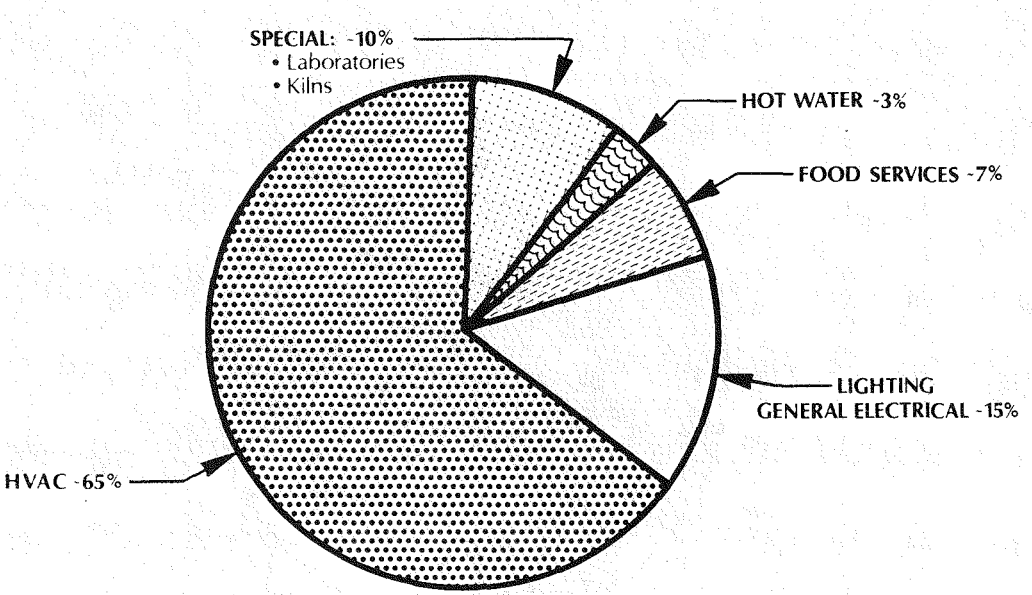


FIGURE 1. Major Energy End Uses in a Typical U.S. Educational Institution. (Adapted from Energy Audit Workbook for Educational Institutions, Fuel & Energy Consultants, Inc., 1978. p.2.

HOSPITALS

Nearly 90% of all U.S. hospitals were designed and constructed before 1974 when the importance of effective energy management was beginning to surface. It is estimated that, in hospitals where a comprehensive energy efficiency program has not been established, a 20% reduction in energy consumption can be achieved in the first year of such a program. It is wise to assume that present trends will result in energy costs which will represent more than 5% of a hospital's budget. A conservation effort will become increasingly more cost-effective.

Where is energy consumed in a hospital? Environmental control (heating, ventilation and air conditioning) requires the greatest share of all energy used in a typical hospital; lighting and wall receptacles often represent the second highest end use. See Figure 2.

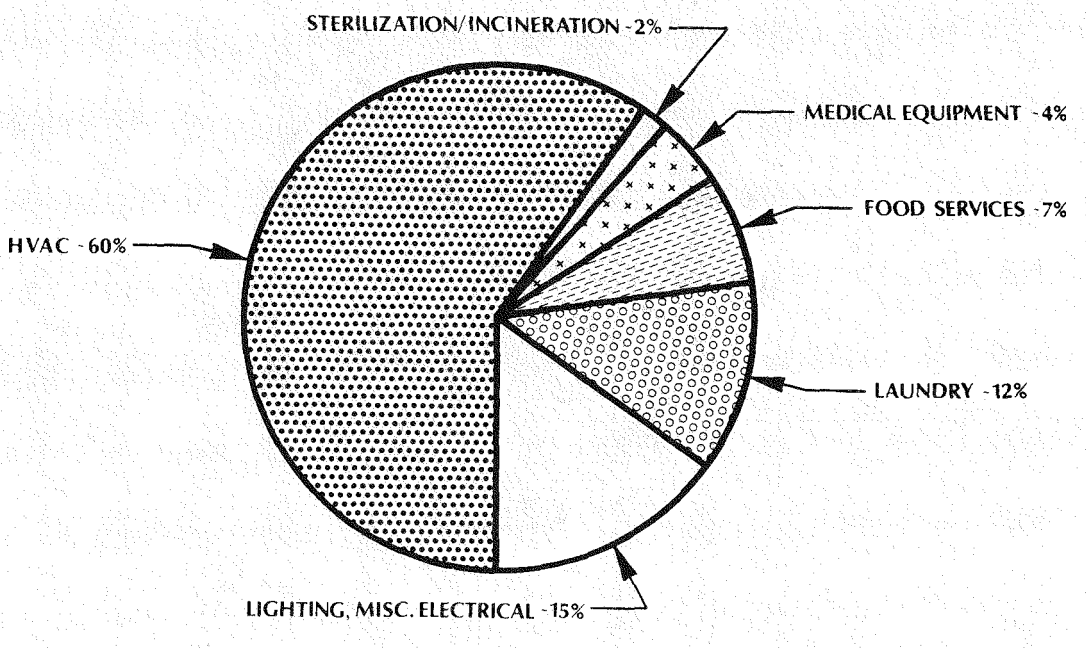


FIGURE 2. Major Energy End Uses in a Typical U.S. Hospital (Adapted from Practical Energy Management in Health Care Institutions, Blue Cross of Greater Philadelphia, July, 1977. p. 2)

PUBLIC BUILDINGS

Local Government (Office-Type Facility)

Although consumption percentages will vary with buildings' designated functions and the climate zones in which they are located, Figure 3 illustrates major energy uses of a "typical" office building. Again, space conditioning represents the area of highest consumption.

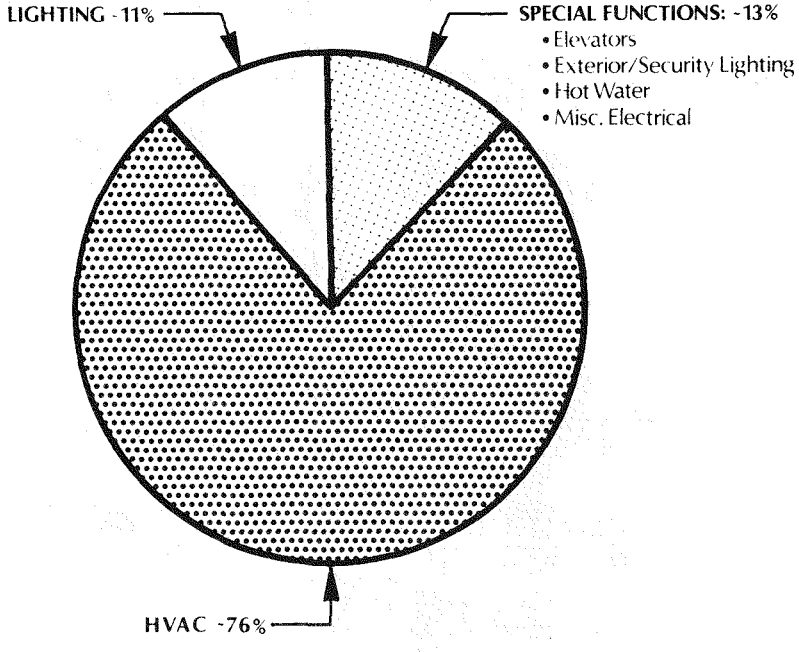


FIGURE 3. Major Energy End Uses in a Typical U.S. Office Building (Adapted from Energy Audit Workbook for Office Buildings', Fuel & Energy Consultants, Inc., 1978. p. 2.)

Long-Term Public Care Facilities

Public care facilities, such as nursing homes, which have not implemented comprehensive energy management programs, usually exhibit atypical energy consumption when compared to other buildings of a similar type, size, use and climate zone.[1] It is not unusual to discover total energy consumption in the range of 300,000 to 360,000 BTU's per gross square foot per year, especially in the cooler climate zones. However, it is possible, working within the guidelines of state and local health codes, to reduce energy consumption in nursing care facilities by 30 percent or more by implementing a sound energy management program.

Figure 4 indicates typical energy uses for a nursing home facility. Notice that space heating, cooling, ventilation and lighting contribute to over three-fourths of the total consumption of the facility. These areas, then, represent major energy conservation opportunities.

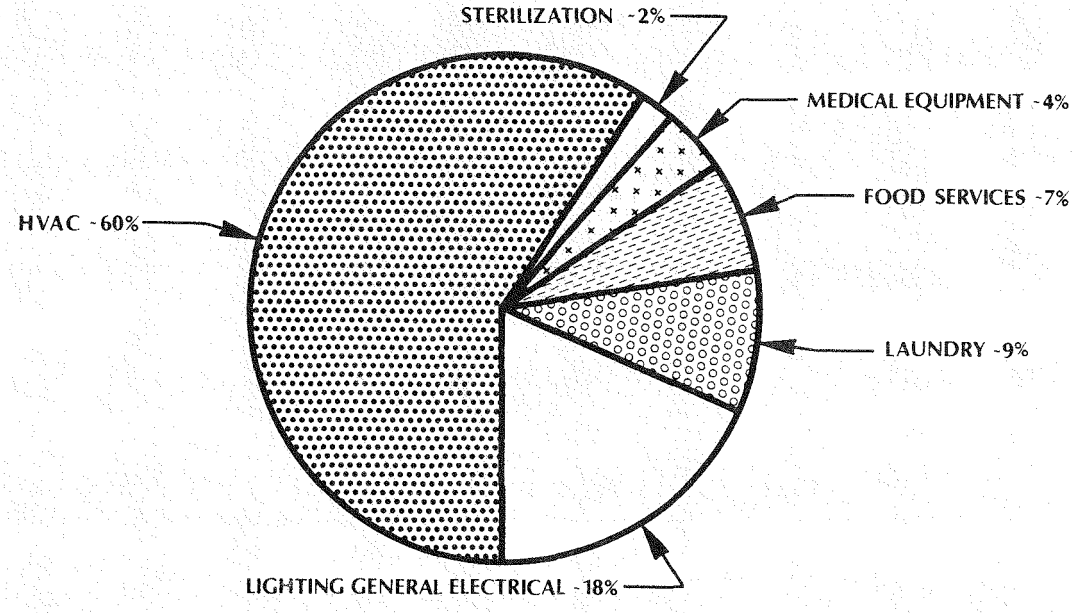


FIGURE 4. Major Energy End Uses in a Typical U.S. Nursing Home. (Adapted from Energy You Can Bank On, Colorado Energy Conservation and Alternatives Center for Commerce and Industry, 1978. p. 44)

[1] Nursing Homes Technical Report, Colorado Energy Conservation and Alternatives Center for Commerce and Industry, August, 1978. p. 13.

B THE BUILDING SYSTEMS

All buildings depend on many support systems for the maintenance of a comfortable and productive working environment. As a tool in diagnosing major problem areas, the Energy Audit Checklist is organized according to the following seven building systems:

I. Administrative
II. Lighting
III. Envelope
IV. Ventilation
V. Heating
VI. Cooling
VII. Water

Following are brief discussions of each of the seven systems.

I. ADMINISTRATIVE SYSTEM:

Perhaps the most important of all, the administrative "system" includes the human element - the people who have an important impact on how much energy is consumed and when it is consumed. It is for the maintenance of a comfortable working environment for building occupants that a facility's energy systems are designed. These same systems can be modified to become more energy efficient by the establishment of energy management procedures. Effective communication and cooperative effort among all concerned is vital.

II. LIGHTING SYSTEM:

Since the lighting systems of many existing buildings were designed within the restrictions of initial cost economies, without knowledge about final space use and subdivision, and without benefit of relatively recent developments and research findings in the field, there exists significant potential for lighting system modification. These modifications can reduce substantially energy consumption (and associated costs) while still providing occupants with the quality and quantity of illumination required to perform their various tasks and functions.

Before undertaking any change, one must recognize that a lighting system is just that -- a system. Its many elements are interrelated with one another, just as the lighting system is interrelated with other systems in the building. While energy can be conserved by proper delamping, realize that such action should be taken only after the entire system has been analyzed and all options evaluated. Conservation of energy is important, but it must be achieved in a manner consistent with other requirements, including those of productivity and visual comfort, aesthetics, Federal, State and local codes and ordinances.

III. ENVELOPE SYSTEM:

The building envelope contains elements which, although they do not consume energy directly, do affect the amount of energy which must be supplied to the building to maintain comfort.

There are two major factors which greatly affect heat gain in the summer and heat loss in the winter: infiltration and transmission.

Infiltration

Infiltration refers to the passage of outside air into a building through apertures such as cracks around windows and door jambs, doors and windows left open, and outside air dampers which do not close tightly. In winter, infiltration causes heat loss. The cool outside air which enters the building must be heated to maintain desired indoor conditions. During summer, infiltration causes heat gain. The warm outside air which enters the building must be cooled to meet desired conditions. In many cases, additional energy must be expended to further treat the outside air by humidification, dehumidification, or filtering. Although non-energized elements (windows, doors,) are prime determinants of the amount of air infiltrated, the human element is also important. Doors or windows left open needlessly have a dramatic impact on infiltration. When doors or windows are left open to offset interior temperatures which are too hot or too cool, the waste involved is magnified even more.

Transmission

Transmission is the amount of heat transmitted into or from a building through the various components of the building envelope, primarily exterior walls, windows, doors, skylights, roofs and floors. Heat always is conducted from an area of higher temperature to an area of lower temperature. Accordingly,during winter, heat flows from the interior, through the building envelope, to the exterior, causing heat loss. During summer, the process reverses: heat is transmitted from outside to inside, causing heat gain. The rate of transmission depends on the composition and thickness of the various materials utilized in construction of the building envelope, the difference between indoor and outdoor temperature and the surface area. This rate can be slowed by, among other things, addition of insulation or storm windows, especially on those portions of the building most affected, and by modifying the indoor temperature.

It is strongly advised that expert technical assistance be obtained before insulating. This will help ensure that the proper type and correct amount are installed, that cost effectiveness will result and that any potential problems -- such as moisture condensation can be avoided.

IV. VENTILATION SYSTEM:

Ventilation contributes to heat gain or heat loss (and humidification/dehumidification) depending upon the season. The ventilation system provides a building with fresh air by exchanging inside air for outside air. The rate of ventilation is expressed in cubic feet per minute (CFM) or in air changes per hour. The greater the rate of air exchange, the more

heating or cooling is required to offset the heat loss or heat gain caused by the unconditioned air that is brought into the building. In many instances, the single most dramatic area of energy conservation--and one achieved with virtually no expense -- involves reduction of the ventilation rate which may be set far above actual requirements.

V. & VI. HEATING & COOLING SYSTEMS:

The largest energy users in most buildings are the heating and cooling systems. It is no secret that when energy was inexpensive, equipment was often oversized and inefficient.

Your facility's total heat loss is equivalent to the amount of heat which the heating system must add to the space (in a given time) to maintain a given temperature. Infiltration imposes a significant load on the heating and cooling systems which increases total energy consumption.

Your facility's total heat gain is the amount of heat which the cooling system must remove from the space (in a given time) to maintain a given temperature.

In most cases, those factors which contribute to heat loss and heat gain can be modified.

Four subcategories of heating and cooling affect each system and its efficiency. They are: 1) operating practices, 2) maintenance modifications, 3) systems modifications, and 4) control adjustments.

1. Operating Practices:

Minor deviations from accepted standards of comfort or operating practices will generate savings. Some deviations may be more acceptable than others.

2. Maintenance Modifications:

The importance of routine equipment maintenance to your energy management program cannot be over emphasized. Regular maintenance will extend the useful life of equipment, save you energy dollars and provide better service.

3. Systems Modifications:

Each system interacts with the others in a building. Although modifications of inefficient systems are encouraged, a careful analysis by a trained engineer should precede any actual system changes.

4. Control Adjustments:

Your building's original controls probably were chosen more on a cost basis than on an energy conserving basis. Lack of proper maintenance can result in a decrease in sensitivity.

VII. WATER SYSTEM:

Domestic hot water may account for 2% - 4% or more of the total energy consumed in your facility. Chilled water provided in drinking fountains also is a factor in total energy consumption. Aside from the need to conserve water, a careful examination of the domestic water system will indicate opportunities for energy savings.

C ENERGY AUDIT CHECKLIST

After a basic understanding of the facility has been gained through completion of the Energy Inventory and from the preceding discussion of building systems, your team is ready to schedule a walking tour of the building. Outside areas as well as the main buildings are to be included in the tour which should be conducted during normal operating hours.

The checklist which follows is organized according to building systems. Trouble spots are indicated by appropriate symptoms or conditions, each capable of being observed by individuals with non-technical backgrounds in energy management. (No elaborate equipment is required; however, it is recommended that, if available, a standard dry bulb thermometer, a light meter and the building plans be used to facilitate data collection.)

Corresponding to each condition are appropriate operational and maintenance procedures (O&M) and conservation measures (retrofit options) which can rectify the problem. The O&M options should be implemented, where possible, before considering the energy conservation measures. Keep a record of your progress by indicating the dates of implementation of O&M options, initials of "implementors" and whether applicable. Energy measures should be checked if they are to be considered or if they do not apply.

Remember: First priority should be given to the operational and maintenance options--usually the most rapid means of reducing energy consumption. Operational and maintenance options include the reset or readjustment of existing systems to achieve increased efficiency and generally involve "no-cost" or "low-cost" prodecures. Only when all possible operational and maintenance options have been employed should the more capital intensive energy measures (retrofit and redesign options) be considered.

ENERGY AUDIT CHECKLIST

ADMINISTRATION

CONDITION EXISTS	CONDITION DOES NOT EXIST	
☐	☐	A-1 Thermostats on heating/cooling units are vulnerable to occupant adjustment.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
· Reset thermostats to correct settings.	☐	☐	☐
· Install or replace locking screws to prevent tampering.	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
· Install tamper-proof locking covers on thermostats.	☐	☐
· Install pre-set solid state electric thermostats if existing controls are electric.	☐	☐
· Relocate thermostats in return air ducts where they will be inaccessible to occupants.	☐	☐

ENERGY AUDIT CHECKLIST

ADMINISTRATION

CONDITION

☐ EXISTS ☐ DOES NOT EXIST

A-2 Thermostat settings have not been adjusted for change in seasons.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
· Adjust thermostats to 68°F. in heating season and to 78°F during cooling season.	☐	☐	☐
· Change the location of thermostats from areas subject to extreme temperature fluctuations, such as next to windows, or over a heating or cooling unit.	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
Replace existing thermostat with a thermostat which has a separate setting for cooling and a separate setting for heating or use one thermostat to control heating and one thermostat to control cooling.	☐	☐

ENERGY AUDIT CHECKLIST

ADMINISTRATION

CONDITION

☐ EXISTS ☐ DOES NOT EXIST

A-3 Unoccupied or little used areas are heated or cooled unnecessarily.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
· Reduce winter thermostat settings to 55°F in unoccupied areas.	☐	☐	☐
· Where possible, turn off heating systems if nothing in space can freeze.	☐	☐	☐
· Use spot heaters/coolers in large spaces with low occupancy.	☐	☐	☐
· Turn off cooling systems in unoccupied areas, if possible.	☐	☐	☐
· Disconnect electrical devices, close drapes, and shut off air systems, if nothing in space can freeze.	☐	☐	☐

Suggested Energy Measures: *(Retrofit)*

	TO BE CONSIDERED	N.A.
· Install system controls to reduce heating/cooling of unoccupied spaces.	☐	☐

ENERGY AUDIT CHECKLIST

ADMINISTRATION

CONDITION

☐ EXISTS ☐ DOES NOT EXIST

A-4 Off-hour activities are scheduled.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
• Reschedule off-hour activities to accomodate partial shutdown of building systems.	☐	☐	☐
• Reschedule custodial and cleaning activities during working hours whenever possible .	☐	☐	☐
• Re-examine original assumptions regarding occupancy patterns and building usage. Modify patterns for increased energy efficiency.	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
• Install an automated energy management system that will control all spaces in accordance with usage.	☐	☐

ENERGY AUDIT CHECKLIST

ADMINISTRATION

CONDITION: EXISTS	CONDITION: DOES NOT EXIST	
☐	☐	A-5 Building temperatures are not adjusted for unoccupied periods.

Suggested O & M Options:

DATE COMPLETED	INITIALS	N.A.	
☐	☐	☐	· Reduce thermostat settings by a minimum of 10°F at nights, for weekends and holidays during heating season.
☐	☐	☐	· Shut down all air conditioning units atnight, on weekends and holidays.

Suggested Energy Measures: (Retrofit)

TO BE CONSIDERED	N.A.	
☐	☐	· Install automatic controls such as time clocks or automated management systems.

ENERGY AUDIT CHECKLIST

ADMINISTRATION

CONDITION

☐ EXISTS ☐ DOES NOT EXIST

A-6 Heating/cooling equipment is operating in lobbies, corridors, vestibules and/or other public areas.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
· Close supply ducts and radiators and/or lower heating set points in the above areas if there is no possibility of freeze-up. Disconnect electrical heating units (or switch off at breaker box).	☐	☐	☐
· Close air conditioning supply ducts serving the above areas.	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
· Properly adjust and balance air/water systems and controls.	☐	☐

ENERGY AUDIT CHECKLIST

ADMINISTRATION

CONDITION EXISTS	CONDITION DOES NOT EXIST	
☐	☐	A-7 Heating/cooling equipment is started before occupants arrive and/or is operating during last hour of occupancy.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
• Experiment with start-up times and duration of operation to determine satisfactory comfort levels for occupants. Reduce or turn off heating and cooling during the last hour of occupancy, allowing the building to "coast".	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
• Install a time clock or an automated energy management system that will reduce heating and/or turn off air conditioner.	☐	☐

ENERGY AUDIT CHECKLIST

ADMINISTRATION

CONDITION		
EXISTS	DOES NOT EXIST	
☐	☐	A-8 Use of equipment associated with laundry and custodial services coincides with heavy electrical demand periods.

Suggested O & M Options:

DATE COMPLETED	INITIALS	N.A.
☐	☐	☐

- Require that major electrical equipment be used in accordance with guidelines that avoid peak electrical demand periods.

Suggested Energy Measures: (Retrofit)

TO BE CONSIDERED	N.A.
☐	☐

- Install a demand control system to automatically monitor power demand and to shut off assigned secondary loads to lower demand peaks to pre-established level.

ENERGY AUDIT CHECKLIST

ADMINISTRATION

CONDITION: EXISTS	CONDITION: DOES NOT EXIST	
☐	☐	A-9 Blinds and curtains are not used to help insulate the building.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
·Instruct personnel to close interior shading devices to reduce night heat loss in winter and to reduce solar heat gain during the summer.	☐	☐	☐
·Repair or replace damaged or missing shading devices.	☐	☐	☐
·Place reminders where appropriate.	☐	☐	☐

Suggested Energy Measures: *(Retrofit)*

	TO BE CONSIDERED	N.A.
·Add reflective or heat absorbing films to reduce solar heat gain in summer. (Caution: Natural lighting and solar heat gain in winter will be reduced. Also, unless protected by an additional layer of glass, these films are subject to damage.)	☐	☐
·Install outdoor shading devices.	☐	☐

ENERGY AUDIT CHECKLIST

ADMINISTRATION

CONDITION

EXISTS	DOES NOT EXIST	
☐	☐	A-10 No records of maintenance for motors and motor driven equipment are available.

Suggested O & M Options:

DATE COMPLETED	INITIALS	N.A.
☐	☐	☐

Using name plate data, prepare an up-to-date list of all motors and pumps used in the facility and list routine maintenance to be performed on each.

Check regularly for:

1. Correct motor voltage and amperage.
2. Loose connections and worn contacts.
3. Unbalanced voltages on 3-phase motors.
4. Improper grounding.
5. Packing wear.
6. Wear and binding on bearings and drive belts.
7. Proper sequencing of pumps and motors.

Suggested Energy Measures: (Retrofit)

TO BE CONSIDERED	N.A.
☐	☐

- Replace worn equipment with more efficient units, if available.

ENERGY AUDIT CHECKLIST

ADMINISTRATION

CONDITION EXISTS	CONDITION DOES NOT EXIST	
☐	☐	A-1.1 Control devices are not inspected on a regular basis.

Suggested O & M Options:

DATE COMPLETED	INITIALS	N.A.
☐	☐	☐

•Routinely check all time clocks and other control equipment for proper operation, correct time and day and for night and proper programming of on-off set points. Protect from unauthorized adjustment.

Suggested Energy Measures: (Retrofit)

TO BE CONSIDERED	N.A.
☐	☐

•Consider using an automated energy management system as an alternative.

ENERGY AUDIT CHECKLIST

ADMINISTRATION

CONDITION

EXISTS	DOES NOT EXIST	
☐	☐	A-12 Conditioned air or heated water is discarded.

Suggested O & M Options:

DATE COMPLETED	INITIALS	N.A.

None Practical

Suggested Energy Measures: (Retrofit)

TO BE CONSIDERED	N.A.
☐	☐

*It is important for a building owner to be aware of heat recovery measures. However, it is not wise to install such equipment without first analyzing the energy characteristics of the building, performance of the hardware, and how it fits into the overall energy plan. See Heat Recovery Options in Part B of Volume 2.

ENERGY AUDIT CHECKLIST

LIGHTING

CONDITION

EXISTS ☐ DOES NOT EXIST ☐

L-1 Incandescent lamps are used in offices, workrooms, hallways, and gymnasiums.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
· Where possible use a single incandescent lamp of lower wattage rather than two or more smaller lamps of combined higher wattage.	☐	☐	☐
· Discontinue using extended service lamps except in special cases such as recessed directional lights where short lamp life is a problem.	☐	☐	☐
· Discontinue using multi-level lamps. The efficiency of a single wattage lamp is higher per watt than a multi-level lamp.	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
· Replace non-decorative incandescent lamps with more energy conserving types such as fluorescents in general purpose areas and mercury vapors in large group areas. (See "Lighting" section in Part B of Volume 2.)	☐	☐

ENERGY AUDIT CHECKLIST

LIGHTING

CONDITION

EXISTS ☐ DOES NOT EXIST ☐

L-2 In fixtures where flourescent lamps have been removed, the ballasts have not been disconnected.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
• Disconnect ballasts which still use significant amounts of energy even though tubes have been removed.	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
• Replace unnecessary tubes with "dummy" types which draw little current and yet provide uniform lighting effect.	☐	☐

ENERGY AUDIT CHECKLIST

LIGHTING

CONDITION

EXISTS ☐ DOES NOT EXIST ☐

L-3 When burned out flourescent lamps and/or ballasts have been replaced, more efficient lights have not been installed.

Suggested O & M Options:

DATE COMPLETED | INITIALS | N.A.

- When relamping, replace fluorescent tubes with more efficient and lower wattage types such as 35 watt instead of 40 watt to achieve a reduction in electrical energy consumption. Wherever possible, replace burned out ballasts with more efficient lower wattage energy conserving ballasts. ☐ ☐ ☐
- Consider not replacing burned out bulbs or lamps and disconnecting ballasts in areas where delamping is possible. For example, in four-lamp fixtures allow two lamps to remain, disconnecting appropriate ballasts. ☐ ☐ ☐

Suggested Energy Measures: (Retrofit)

TO BE CONSIDERED | N.A.

- Install more efficient fluorescent tubes and ballasts in all existing luminaires (fixtures). (Note: Verify that new lamps will work with existing ballasts.) ☐ ☐
- Lowering luminaires (fixtures) will increase illumination levels on the task area, and may permit a reduction in the number of fixtures or the wattage of lamps. ☐ ☐

ENERGY AUDIT CHECKLIST

LIGHTING

CONDITION

EXISTS ☐ DOES NOT EXIST ☐

L-4 Lamps and fixtures are not clean.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
· Establish a regular inspection and cleaning schedule for lamps and luminaires. Dust build-up reduces effectiveness.	☐	☐	☐
· Replace lens shielding that is yellow or that has become hazy with new acrylic lenses which do not yellow.	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
. Replace outdated or damaged luminaires with modern types that are easy to clean.	☐	☐

ENERGY AUDIT CHECKLIST

LIGHTING

CONDITION

☐ EXISTS ☐ DOES NOT EXIST

L-5. Exterior lighting is used.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
•Replace exterior 150 watt flood lamps with 75 watt flood lamps to reduce consumption yet maintain adequate illumination.	☐	☐	☐
•Eliminate outdoor lighting where practical.	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
•Install a control device (i.e., time clock, photocell) to automatically turn off lights when not needed.	☐	☐
•Replace exterior incandescent lamps with more efficient types such as high pressure sodium, or metal halide. See "Lighting" section in Part B of Volume 2.	☐	☐

ENERGY AUDIT CHECKLIST

LIGHTING

CONDITION

EXISTS ☐ DOES NOT EXIST ☐

L-6 Lights are on in unoccupied areas.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
• Provide signs instructing occupants to turn off lights when leaving room.	☐	☐	☐
• Organize task areas to eliminate unnecessary illumination.	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
• Rewire switches so that one switch does not control all fixtures in multiple work spaces.	☐	☐
• Provide timer switches in remote or seldom used areas where there will be brief occupancy periods.	☐	☐

ENERGY AUDIT CHECKLIST

LIGHTING

CONDITION

EXISTS	DOES NOT EXIST	
☐	☐	L-7 Natural lighting is not optimized.

Suggested O & M Options:

DATE COMPLETED	INITIALS	N.A.
☐	☐	☐
☐	☐	☐

- Utilize natural lighting whenever possible.
- Clean walls or repaint with light reflective non-glossy colors.

Suggested Energy Measures: (Retrofit)

TO BE CONSIDERED	N.A.
☐	☐

- Install light sensors and dimming equipment which automatically compensate for varying natural lighting conditions.

ENERGY AUDIT CHECKLIST

LIGHTING

CONDITION

☐ EXISTS ☐ DOES NOT EXIST

L-8 Two lamps have not been removed from four-lamp fixtures where possible.

Suggested O & M Options:

DATE COMPLETED | INITIALS | N.A.

- Remove two lamps and disconnect ballasts. ☐ ☐ ☐

Suggested Energy Measures: (Retrofit)

TO BE CONSIDERED | N.A.

None Practical

ENERGY AUDIT CHECKLIST

BUILDING ENVELOPE

CONDITION ☐ EXISTS ☐ DOES NOT EXIST

B-1 Improper alignment and operation of windows and doors allows excessive infiltration.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
• Realign or re-hang windows or doors that do not permit proper closure. In extreme cases consider permanent sealing of windows.	☐	☐	☐
• Make sure that automatic door closing mechanisms are working properly. Adjust for faster return.	☐	☐	☐
• Replace or repair faulty gaskets in garage or other overhead doors.	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
• Consider resizing exterior doors; i.e., delivery doors, making them smaller to reduce excessive infiltration.	☐	☐
• Add expandable separate enclosures, where practical.	☐	☐
• Install self-closing doors on openings to unconditioned spaces.	☐	☐
• Install a switch on overhead doors that prevents activation of heating/cooling units when door is open.	☐	☐
• Install vestibule doors at major entrances.	☐	☐

ENERGY AUDIT CHECKLIST

BUILDING ENVELOPE

CONDITION

EXISTS ☐ DOES NOT EXIST ☐

B-2 Ceiling/roof insulation is inadequate or has been water damaged.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
· Before replacing water damaged insulation, repair roof where required.	☐	☐	☐
· Verify that vapor barrier faces the conditioned space and is intact.	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
· Add new insulation to meet recommended standard. See Volume 2 for advantages/disadvantages of various insulation materials. (Check the cost effectiveness of this measure particularly if your facility is over three stories.)	☐	☐

ENERGY AUDIT CHECKLIST

BUILDING ENVELOPE

CONDITION: EXISTS	CONDITION: DOES NOT EXIST	
☐	☐	B-3 Weatherstripping and caulking around windows, doors, conduits, piping, exterior joints, or other areas of infiltration is worn, broken or missing.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
• Use quality weatherstripping and caulking to insure that all areas of infiltration are sealed. (See Part B, Volume 2 for performance levels of sealants.)	☐	☐	☐
• Replace broken or cracked windows. (Air leakage is most evident when wind is blowing against the side of the building.)	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
•Where practical, cover all window and through-the-wall cooling units when not in use. Specially designed covers can be obtained at relatively low cost.	☐	☐
•In areas with constant strong winds, consider installing wind screens to protect exterior doors from direct blast of prevailing winds. Screens can be opaque, constructed inexpensively from concrete block or can be transparent, constructed of metal framing with armored glass. Careful positioning is necessary for infiltration control.	☐	☐

ENERGY AUDIT CHECKLIST

BUILDING ENVELOPE

CONDITION: EXISTS	CONDITION: DOES NOT EXIST	
☐	☐	B-4 Excessive expanses of glass exist on exterior walls.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
• When replacing windows, replace with thermopanes, utilizing the same casings.	☐	☐	☐
• Keep curtains and drapes closed in unoccupied spaces.	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
• Totally or partially insulate windows. Consider replacing windows with walls.	☐	☐
• Install double pane windows.	☐	☐
• Consider adding reflective or heat absorbing film to minimize solar gain in summer and heat loss in winter. (Note: Any window film reduces natural lighting and winter solar gain.)	☐	☐
• Consider installation of adjustable outdoor shading devices.	☐	☐

ENERGY AUDIT CHECKLIST

BUILDING ENVELOPE

CONDITION

EXISTS	DOES NOT EXIST	
☐	☐	B-5 There is no insulation between conditioned and unconditioned spaces.

Suggested O & M Options:

DATE COMPLETED | INITIALS | N.A.

None Practical

Suggested Energy Measures: (Retrofit)

TO BE CONSIDERED | N.A.

- Insulate between heated/cooled spaces and unconditioned or outside areas such as parking garages, porticos, storage, basements and attics. ☐ ☐

ENERGY AUDIT CHECKLIST

VENTILATION

CONDITION: EXISTS	CONDITION: DOES NOT EXIST	
☐	☐	V-1 An excessive quantity of outdoor air is used to ventilate the building.

Suggested O & M Options:

DATE COMPLETED	INITIALS	N.A.	
☐	☐	☐	• Reduce outdoor air quantity to the minimum allowed by codes by adjusting outdoor air dampers during hours of occupancy.

Suggested Energy Measures: (Retrofit)

TO BE CONSIDERED	N.A.	
☐	☐	• Replace old style dampers with new high quality opposed-blade models with better close-off ratings.

ENERGY AUDIT CHECKLIST

VENTILATION

CONDITION

☐ EXISTS ☐ DOES NOT EXIST

V-2 Outdoor air intake dampers open when building is unoccupied.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
• Close outdoor air dampers when building is unoccupied. Be sure dampers have proper seals and adjust to insure complete closure.	☐	☐	☐
• Where codes permit, close outdoor air dampers during first and last hours of occupancy to permit fast warm-up and cool-down.	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
• Install controls which will automatically close dampers during unoccupied periods.	☐	☐

ENERGY AUDIT CHECKLIST

VENTILATION

CONDITION		
EXISTS	DOES NOT EXIST	
☐	☐	V-3 Ventilation systems are not utilized for natural cooling capability.

Suggested O & M Options:

DATE COMPLETED	INITIALS	N.A.
☐	☐	☐

- Whenever possible, use outside air for cooling rather than using refrigeration. (Use economizer cycle, if available.)

Suggested Energy Measures: (Retrofit)

TO BE CONSIDERED	N.A.
☐	☐

- Install an economizer cycle with enthalpy control to optimize use of outside air for cooling.

ENERGY AUDIT CHECKLIST

VENTILATION

CONDITION

EXISTS	DOES NOT EXIST	
☐	☐	V-4 Exhaust system operation is not programmed.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
• Discontinue use of unnecessary exhaust fans.	☐	☐	☐
• Re-wire toilet exhaust fans to operate only when lights are on. (Fans are often wired in reverse . Correct as needed.)	☐	☐	☐
• Schedules should be established so that exhaust fans run only when needed.	☐	☐	☐
• Consider grouping smoking and other areas with similar exhaust requirements so that they may be served by one exhaust system.	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
• Install time clocks or other controls to shut-off exhaust system when not needed (when permitted by code).	☐	☐
• Install a rheostat in series with exhaust fan to modulate fan speed so that no more than the necessary amount of air will be exhausted.	☐	☐
• Install chemical or electronic odor or particulate remover to reduce the need for using outside air for ventilation.	☐	☐
• Install controlled or gravity dampers on all exhaust ducts to close ducts when fan is not operating.	☐	☐

ENERGY AUDIT CHECKLIST

VENTILATION

CONDITION: EXISTS	CONDITION: DOES NOT EXIST	
☐	☐	**V-5 Return, outdoor air and exhaust dampers are not sequencing properly.**

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
• Adjust damper linkage.	☐	☐	☐
• Be sure damper motors are operating properly.	☐	☐	☐
• Readjust position indicators to accurately indicate damper positions.	☐	☐	☐
• Reset linkage or replace dampers if blades do not close tightly.	☐	☐	☐
• Close all outdoor air intake dampers when equipment is shut off and when building is unoccupied.	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
• Replace old style dampers with new high quality opposed-blade models with better close-off ratings.	☐	☐

ENERGY AUDIT CHECKLIST

VENTILATION

CONDITION

EXISTS ☐ DOES NOT EXIST ☐

V-6 During heating season, temperature of air flow to space feels too cold.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
• Raise supply temperature to a minimum of 60°F in interior zones and 65°F in perimeter zones during winter. Be sure to lower the supply temperature to 55°F during the cooling season. (Check local codes.)	☐	☐	☐
• Reduce air volume to prevent a draft effect during heating season.	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
None Practical		

ENERGY AUDIT CHECKLIST

VENTILATION

CONDITION

EXISTS ☐ DOES NOT EXIST ☐

V-7 Air flow to space feels unusually low or is inconsistent from one space to another.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
• Utilize ductwork access openings to check for any obstructions such as loose hanging insulation (in lined ducts), loose turning vanes and accessories, and closed volume and fire dampers. Adjust, repair or replace as necessary.	☐	☐	☐
• Inspect all room air outlets and inlets (diffusers, registers and grilles). They should be kept clean and free of all dirt and obstructions. Clean and remove obstructions as necessary.	☐	☐	☐
• Clean or replace dirty or ineffective filters on a regular basis.	☐	☐	☐
• Post signs instructing occupants not to place objects where they will obstruct air flow.	☐	☐	☐
• Consider rebalancing system.	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
None Practical		

ENERGY AUDIT CHECKLIST

HEATING

CONDITION

EXISTS ☐ DOES NOT EXIST ☐

H-1 Multiple boilers or heaters fire simultaneously.

Suggested O & M Options:

DATE COMPLETED	INITIALS	N.A.
☐	☐	☐

- Adjust controls so that boiler #2 will not fire until boiler #1 can no longer satisfy the demand.

Suggested Energy Measures: (Retrofit)

TO BE CONSIDERED	N.A.
☐	☐

- Purchase and install automatic staging controls if applicable.

ENERGY AUDIT CHECKLIST

HEATING

CONDITION EXISTS	CONDITION DOES NOT EXIST	
☐	☐	H-2 Stack temperature appears excessively high (greater than 400°F plus room temperature).

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
· Insure that proper amount of air for combustion is available in furnace room.	☐	☐	☐
· Examine and clean air intake filters.	☐	☐	☐
· Perform flue gas analysis on a regular basis to insure proper air to fuel ratio.	☐	☐	☐
· If furnace is over-firing, verify that spuds and nozzles are properly sized. Also check that fuel pressures are not too high.	☐	☐	☐

NOTE: Checks and maintenance of boiler operations should be performed by qualified personnel. If there are none on the staff of the institution, consideration should be given to obtaining assistance from a service contractor.

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
· Purchase kit for flue gas analysis if frequent testing is anticipated.	☐	☐

ENERGY AUDIT CHECKLIST

HEATING

CONDITION

EXISTS	DOES NOT EXIST	
☐	☐	H-3 Water in heating system is heated when there is no need.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
• Turn off boiler, pumps or heat source.	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
• Install control to automatically shut down heat generating device when outside air temperature reaches 60°F.	☐	☐

ENERGY AUDIT CHECKLIST

HEATING

CONDITION

EXISTS	DOES NOT EXIST	
☐	☐	H-4 Space temperatures are higher or lower than thermostat settings.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
· Recalibrate thermostat.	☐	☐	☐
· Blow out moisture, oil and dirt from pneumatic lines (for pneumatic systems); clean contacts if electrical control system.	☐	☐	☐
· Recalibrate controllers.	☐	☐	☐
· Insure that control valves and dampers are modulated properly.	☐	☐	☐
· Insure that heat generating device is producing heat and that heat distribution to the space is unobstructed.	☐	☐	☐
· Make sure that air intake volume is not excessive.	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
· For electric control systems, install pre-set solid state thermostats which do not require calibration.	☐	☐

ENERGY AUDIT CHECKLIST

HEATING

CONDITION

EXISTS ☐ DOES NOT EXIST ☐

H-5 Heating system's hot water temperature feels excessively hot during periods of mild weather.

Suggested O & M Options:

DATE COMPLETED	INITIALS	N.A.
☐	☐	☐
☐	☐	☐

- Experiment with hot water temperature reduction until an acceptable comfort level is reached.
- Make sure that reset controls work properly.

Suggested Energy Measures: (Retrofit)

TO BE CONSIDERED	N.A.
☐	☐

- Purchase and install automatic temperature controls to schedule heating water temperature according to outside temperature.

ENERGY AUDIT CHECKLIST

HEATING

CONDITION

EXISTS	DOES NOT EXIST	
☐	☐	H-6 Condensate from street steam is being discharged to sewer drain.

Suggested O & M Options:

DATE COMPLETED	INITIALS	N.A.

None Practical

Suggested Energy Measures: (Retrofit)

TO BE CONSIDERED	N.A.
☐	☐

- Install pump to return condensate to boiler or return condensate by gravity if possible. Condensate can also be used to heat domestic water or boiler combustion air prior to its return to the boiler feedwater system.

ENERGY AUDIT CHECKLIST

HEATING

CONDITION

☐ EXISTS ☐ DOES NOT EXIST

H-7 Heating pilot lights are on during cooling season.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
· Turn pilots off. (Enter shut-off and turn-on dates in your log book and post a notice in the boiler/furnace room.)	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
· Replace worn units with new electronic ignition models to avoid unnecessary fuel consumption.	☐	☐

ENERGY AUDIT CHECKLIST

HEATING

CONDITION

EXISTS	DOES NOT EXIST	
☐	☐	H-8 Steam radiators or other steam equipment fail to heat or operate erratically.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
• Check the temperature of the pipe on the downstream side of steam traps. If it is excessively hot, the trap probably is passing steam. This can be caused by dirt in the trap, a valve off the stem, excessive steam pressure, or worn trap parts (especially valves and seats). If the pipe is moderately hot (as hot as a hot water pipe), it probably is passing condensate, which it should do. If it's cold, the trap is not working at all, and should be replaced or repaired. Initiate a steam trap maintenance program.	☐	☐	☐
• Clean or replace thermostatic control valves on radiators.	☐	☐	☐
• Check air vent valve. If not operating properly, replace.	☐	☐	☐
• If thermostatic trap is malfunctioning, clean or replace bellows element.	☐	☐	☐
• Water pockets may be obstructing steam flow. Correct by repitching or rerouting pipes.	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
None Practical		

ENERGY AUDIT CHECKLIST

HEATING

CONDITION: EXISTS	CONDITION: DOES NOT EXIST	
☐	☐	H-9 Steam, condensate and heating water piping insulation is in disrepair or missing.

Suggested O & M Options:

DATE COMPLETED	INITIALS	N.A.
☐	☐	☐

- Inspect pipes for broken or missing insulation. Repair or replace as needed.

Suggested Energy Measures: (Retrofit)

TO BE CONSIDERED	N.A.
☐	☐

- Install additional pipe insulation in accordance with design specifications and energy conservation codes.

ENERGY AUDIT CHECKLIST

HEATING

CONDITION

EXISTS ☐ DOES NOT EXIST ☐

H-10 Operation of oil burner is accompanied by excessive smoke and sooting.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
• Inspect burner nozzles for wear, dirt and incorrect spray angles. Clean and adjust as necessary.	☐	☐	☐
• Verify that oil is flowing freely and that oil pressure is correct.	☐	☐	☐
• Perform flue gas analysis to set proper air to fuel ratio.	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
• Purchase kit for flue gas analysis if frequent testing is anticipated.	☐	☐

ENERGY AUDIT CHECKLIST

HEATING

CONDITION

EXISTS ☐ DOES NOT EXIST ☐

H-11 Soot and odors are detected in areas where they are not expected.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
· Heat exchanger may have burned out. Replace.	☐	☐	☐
· Stack draft may be inadequate. Clean and correct as necessary.	☐	☐	☐
· Perform flue gas analysis to obtain proper air to fuel ratio.	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
· Purchase kit for flue gas analysis if frequent testing is anticipated.	☐	☐

ENERGY AUDIT CHECKLIST

HEATING

CONDITION

☐ EXISTS ☐ DOES NOT EXIST

H-12 Evidence indicates faulty or inefficient boilers or furnaces.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
• Remove scale deposits, accumulation of sediment and boiler compounds on water side surfaces. Examine and treat rear portion of boiler (the area most susceptible to scale formation).	☐	☐	☐
• Remove soot from tubes.	☐	☐	☐
• Observe the fire when the unit shuts down. If the fire does not cut off immediately, it could indicate a faulty solenoid valve. Repair or replace as necessary.	☐	☐	☐
• Inspect all boiler insulation, refractory, brick work and boiler casings for hot spots and air leaks. Repair and seal as necessary.	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
• Replace dangerous or ineffective units with more efficient modular type units. (Note: Do not install oversize unit.)	☐	☐
• If applicable, install baffle-type devices in the tubes to improve efficiency.	☐	☐

ENERGY AUDIT CHECKLIST

HEATING

CONDITION

EXISTS ☐ DOES NOT EXIST ☐

H-13 Air is humidified.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
· Discontinue or reduce humidification where possible.	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
None Practical		

ENERGY AUDIT CHECKLIST

HEATING

CONDITION

EXISTS ☐ DOES NOT EXIST ☐

H-14 Burner short-cycles.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
• Hot water temperature limit switch may be set too low. Reset as required.	☐	☐	☐
• Thermostat may be faulty. Replace if necessary.	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
None Practical.		

ENERGY AUDIT CHECKLIST

HEATING

CONDITION

EXISTS ☐ DOES NOT EXIST ☐

H-15 Combustion air to boiler/furnace is not preheated.

Suggested O & M Options:

DATE COMPLETED | INITIALS | N.A. ☐

None Practical

Suggested Energy Measures: (Retrofit)

TO BE CONSIDERED ☐ N.A. ☐

- Utilize heat from flue gas to preheat combustion air by means of a heat recovery device.

ENERGY AUDIT CHECKLIST

HEATING

CONDITION

EXISTS ☐ DOES NOT EXIST ☐

H-16 Hot water radiation units fail to operate.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
• Radiators are air-locked. Open air vents and bleed off air until water appears.	☐	☐	☐
• Bleed off water in pneumatic air lines if necessary. (Pneumatic lines may be frozen.) Check for air leaks.	☐	☐	☐
• Repair faulty valves.	☐	☐	☐
• Repair or replace faulty thermostats.	☐	☐	☐
• Hot water pump or booster pump may not be functioning. Repair or replace as necessary.	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
None Practical		

ENERGY AUDIT CHECKLIST

HEATING

CONDITION

EXISTS	DOES NOT EXIST	
☐	☐	H-17 Radiators, convectors, baseboards and finned-tube heaters are not providing sufficient heat.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
• Boiler temperature may have dropped. Correct as necessary.	☐	☐	☐
• Bleed air from units.	☐	☐	☐
• Establish a systematic cleaning schedule.	☐	☐	☐
• Remove items obstructing discharge grilles.	☐	☐	☐
• Bleed off water in pneumatic air lines if necessary. (Pneumatic lines may be frozen). Check for air leaks.	☐	☐	☐
• Repair faulty valves.	☐	☐	☐
• Repair of replace faulty thermostats.	☐	☐	☐
• Hot water pump or booster pump may not be functioning. Repair or replace as necessary.	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
None Practical		

ENERGY AUDIT CHECKLIST

COOLING

CONDITION

☐ EXISTS ☐ DOES NOT EXIST

C-1 Space temperature is higher or lower than thermostat setting.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
· Re-calibrate space thermostat.	☐	☐	☐
· Blow out moisture, oil and dirt from pneumatic lines (for pneumatic control system). Clean contacts on electric control systems.	☐	☐	☐
· Re-calibrate controllers.	☐	☐	☐
· Verify that control valves and dampers modulate properly, especially the economizer section of the system.	☐	☐	☐
· Limit excessive outdoor air intake when not operating economizer cycle.	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
· For electric control systems install pre-set, solid state thermostats which do not require calibration.	☐	☐

ENERGY AUDIT CHECKLIST

COOLING

CONDITION

EXISTS ☐ DOES NOT EXIST ☐

C-2 Chiller is operating during cold weather to provide air conditioning.

Suggested O & M Options:

DATE COMPLETED | INITIALS | N.A.

None Practical

Suggested Energy Measures: (Retrofit)

TO BE CONSIDERED | N.A.

- Provide a water interchange system injecting cooling tower condenser water directly into the system's chilled water circuits. Except for pumping and cooling tower fan horsepower, this provides free cooling. Special care must be taken in treating and filtering condenser water. ☐ ☐
- If system is forced air, using DX coils and air cooled condenser, install economizer cycle to obtain free cooling. ☐ ☐

ENERGY AUDIT CHECKLIST

COOLING

CONDITION

EXISTS	DOES NOT EXIST	
☐	☐	C-3 Reheat coils are used to maintain zone temperatures.

Suggested O & M Options:

DATE COMPLETED	INITIALS	N.A.

None Practical

Suggested Energy Measures: (Retrofit)

TO BE CONSIDERED	N.A.
☐	☐

- Convert to variable air volume system if the reheat coils are not necessary to supply heat during the heating season.

ENERGY AUDIT CHECKLIST

COOLING

CONDITION

☐ EXISTS ☐ DOES NOT EXIST

C-4 Multiple air conditioning compressors start at the same time.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
• Adjust electric controls to stage compressor operation properly.	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
• Should automatic controls not exist, purchase and install. This will allow compressor #2 to cut in when compressor #1 can no longer satisfy space conditioning load.	☐	☐

ENERGY AUDIT CHECKLIST

COOLING

CONDITION

EXISTS ☐ DOES NOT EXIST ☐

C-5 Building utilizes a dual duct or multizone system.

Suggested O & M Options:

DATE COMPLETED | INITIALS | N.A.

None Practical

Suggested Energy Measures: (Retrofit)

TO BE CONSIDERED | N.A.

- Convert dual duct or multizone systems to variable air volume, if building has a separate heating system. ☐ ☐
- Install controls to automatically reset hot and cold deck temperatures. ☐ ☐

ENERGY AUDIT CHECKLIST

COOLING

CONDITION

EXISTS ☐ DOES NOT EXIST ☐

C-6 Insulation on cooling line pipes and ducts appears inadequate.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
• Repair or replace damaged insulation.	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
• Insulate all delivery lines and ducts in accordance with recommended R-values.	☐	☐

ENERGY AUDIT CHECKLIST

COOLING

CONDITION

EXISTS	DOES NOT EXIST	
☐	☐	C-7 Air conditioning load trips circuit breaker on extremely warm days.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
• Tighten wire lugs if loose.	☐	☐	☐
• Replace defective circuit breakers.	☐	☐	☐
• Clean condenser on air cooled systems.	☐	☐	☐
• Clean scale build-up in condenser on water cooled systems.	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
• Consider installing insulated underground storage tank that would allow night operation of chiller when electrical demand is low. This reservoir tank would be a source of supply of chilled water for daytime operation. Chiller would not be operated during the day.	☐	☐

ENERGY AUDIT CHECKLIST

COOLING

CONDITION

☐ EXISTS ☐ DOES NOT EXIST

C-8 Air of inadequate volume or temperature is being discharged through grilles.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
·Defrost evaporator coil if iced. Determine cause of icing and correct.	☐	☐	☐
·Clean evaporator coil, fins and tubes.	☐	☐	☐
·Clean or replace air filters.	☐	☐	☐
·Fire damper may be closed. Open and replace fusible link if necessary.	☐	☐	☐
.Balancing damper may have slipped and closed. Open to correct position and tighten wing nut.	☐	☐	☐
·If fan is rotating backwards, reverse rotation by reversing electrical contacts.	☐	☐	☐
·Clean condenser coil and/or water tower nozzles.	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
·Install differential pressure-sensing switches to alarm when air flow drops significantly.	☐	☐

ENERGY AUDIT CHECKLIST

COOLING

CONDITION

EXISTS ☐ DOES NOT EXIST ☐

C-9 Refrigeration condensers or coils are dirty, clogged and/or not functioning efficiently.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
· Determine if normal operating temperatures and pressures have been identified and if all gauges are checked frequently to insure design conditions are being met.	☐	☐	☐
· Increased system pressure may be due to dirty condensers which will decrease system efficiency. High discharge temperatures often are caused by defective or broken compressor valves. Repair or adjust as required.	☐	☐	☐
· Inspect the liquid line leaving the strainer. If it feels cooler than the liquid line entering the strainer, it is clogged. It is very badly clogged, if frost or sweat is visible at the strainer outlet. Clean as required.	☐	☐	☐
· Clean coils and/or other elements as needed on a scheduled basis. Include dehumidification coils.	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
None Practical		

ENERGY AUDIT CHECKLIST

COOLING

CONDITION

EXISTS	DOES NOT EXIST	
☐	☐	C-10 Chilled water piping, valves and fittings are leaking.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
• Repair joint or piping leaks.	☐	☐	☐
• Repair or replace valves.	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
None Practical		

ENERGY AUDIT CHECKLIST

COOLING

CONDITION EXISTS	CONDITION DOES NOT EXIST	
☐	☐	C-11 Chiller operation is not optimized. (Listen for short-cycling.)

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
· Raise chilled water supply temperature.	☐	☐	☐
Note: This is especially important if system was designed for a 75°F space temperature and the space setting has been raised to 78°F for energy conservation purposes.			
· Remove scale deposits from condensers.	☐	☐	☐
· Check refrigerant charge.	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
· Reduce peak loads with electric load limiters. (This option saves money but no energy.)	☐	☐

ENERGY AUDIT CHECKLIST

COOLING

CONDITION

EXISTS ☐ DOES NOT EXIST ☐

C-1.2 Refrigeration compressor short-cycles.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
· Refrigerant charge is low or refrigerant is leaking. Find and repair leak. Recharge system.	☐	☐	☐
· Repair electrical control circuit if required.	☐	☐	☐
· Reset high/low pressure control differential settings if needed.	☐	☐	☐
· Liquid line solenoid valve may be leaking. Repair or replace.	☐	☐	☐
· Evaporation coil may be iced up or dirty. Defrost and clean.	☐	☐	☐
· If frost is detected on the liquid line strainer, it is clogged. Clean strainer.	☐	☐	☐
· Clean condenser coil.	☐	☐	☐
· If condenser is a cooling tower, ascertain if spray nozzles are plugged. Make sure water flow is unobstructed. Clean tower of leaves and debris.	☐	☐	☐
· Remove scale deposits from shell/tubes on water condensers.	☐	☐	☐
· Repair suction valves in compressor, if needed.	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
None Practical		

ENERGY AUDIT CHECKLIST

COOLING

CONDITION

EXISTS ☐ DOES NOT EXIST ☐

C-13 Refrigeration compressor runs continually. (Direct expansion systems.)

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
· Contacts in starter circuits of controls may be fused. Repair and replace as necessary.	☐	☐	☐
· Bubbles in sight glass indicate low refrigerant charge. Repair leaks and recharge.	☐	☐	☐
· Refrigerant charge may be too high. Check discharge pressure and purge excess.	☐	☐	☐
· Compressor valves may be leaking. Overhaul compressor.	☐	☐	☐
· Liquid line solenoid valve may be stuck open. Repair or replace.	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
· Load may be greater than design. Consider replacing with chiller and water cooled condenser system.	☐	☐

ENERGY AUDIT CHECKLIST

WATER

CONDITION

EXISTS	DOES NOT EXIST	
☐	☐	W-1 Storage tanks, piping and water heaters are utilized inefficiently.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
• Replace damaged or missing insulation.	☐	☐	☐
• Reduce hot water temperature to 105°F - 115°F where allowed by code.	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
• Install insulation on all hot water lines and storage tanks.	☐	☐
• Install a small domestic hot water heater to maintain desired temperature in water storage tank. This could eliminate the need for operating one of the large space heating boilers during summer months.	☐	☐
• Install de-centralized water heating.	☐	☐

ENERGY AUDIT CHECKLIST

WATER

CONDITION

EXISTS	DOES NOT EXIST	
☐	☐	W-2 Drips or leaks are evident in hot water systems.

Suggested O & M Options:

	DATE COMPLETED	INITIALS	N.A.
• Repair all leaks including those of the faucets and pumps.	☐	☐	☐

Suggested Energy Measures: (Retrofit)

	TO BE CONSIDERED	N.A.
None Practical		

ENERGY AUDIT CHECKLIST

WATER

CONDITION

EXISTS	DOES NOT EXIST	
☐	☐	W-3 Electric water heater has no time restrictions on heating cycle.

Suggested O & M Options:

DATE COMPLETED	INITIALS	N.A.	
☐	☐	☐	• Utilize "vacation cycle" on water heater when not needed during extended periods. (Note: Complete deactivation could cause leaks.)

Suggested Energy Measures: (Retrofit)

TO BE CONSIDERED	N.A.	
☐	☐	• Limit the duty cycle with a time clock or other control devices to avoid adding the water heating load to the building during peak electrical demand periods. (Additional hot water storage capacity may be required.)

ENERGY AUDIT CHECKLIST

WATER

CONDITION EXISTS	CONDITION DOES NOT EXIST	
☐	☐	W-4 Devices to conserve heated water have not been utilized where practical.

Suggested O & M Options:

DATE COMPLETED	INITIALS	N.A.

None Practical

Suggested Energy Measures: (Retrofit)

TO BE CONSIDERED	N.A.
☐	☐
☐	☐
☐	☐

- Install mixing valves.
- Replace standard faucets with self-closing, flow restrictor types. (Note: Highly mineralized water or water containing sediment can cause blockages.)
- Install a solar water heater to assist in meeting building hot water demand. This will reduce significantly consumption of traditional energy fuels in facilities which are large users of hot water.

3 EXAMINE UTILITY BILLS

DETERMINING HOW MUCH ENERGY YOU USE

The only way that you can determine if you are saving energy and dollars is to keep accurate records. The best sources of information for those records are your utility bills and meters. The purpose of this section is to explain how to interpret your utility bills and how to organize that information so that it is meaningful.

The following two pages illustrate how to record data from your utility bill on energy data sheets. The first page demonstrates how to record data for natural gas. This sample shows how to record one month's energy bill information. The next time period's data is to be recorded on the next line. (If you have utility bills from several past years, it would be wise to select a baseline year such as 1975 or 1976 so that you can compare your present usage to it.) The next page explains how to record electrical data. The same type of information can be recorded for other types of fuel sources on separate data sheets. (Blank data sheets are supplied at the end of this section so that you may begin your own energy data collection.)

After recording your final month's fuel consumption, add the monthly fuel consumptions. Record the total annual consumption in the "total" row.

Please note that two conversion factors are used for both electricity and steam consumption. The larger figures indicate the values to be used in reporting in compliance with the April 2, 1979, Federal Register, Part VI, Department of Energy, Energy Measures and Energy Audits Grant Programs for Schools and Hospitals and Buildings Owned by Units of Local Government and Public Care Institutions: Section 450.42 (a)(11). These larger figures represent point of generation values and include transmission losses and production inefficiencies.

The smaller of the conversion factors for electricity and steam are to be used for institutional record keeping and in the calculations provided in Volume 2 since these reflect on-site consumption. Remember, these factors are standard conversions and are not adjusted for altitude.

Although the format of your utility bill may be different, the contents are the same. If you have a question, call your local utility for an explanation.

Energy Data Form

	A		B		C		D		E		F		G	
Month	Reading Date		Gas Used (CCF)		Gas Cost		Gas Cost Adjustment		Total Cost (C+D=E)		$/CCF (E÷B=F)		Heating Degree Days	
	FROM	TO	CURRENT	BASE	CURRENT	BASE	CURRENT	BASE	CURRENT	BASE	CURRENT	BASE	CURRENT	BASE
Jan														
Feb														
Mar														
Apr														
May														
Jun														
Jul														
Aug														
Sep														
Oct	10-19	11-20	7703		$697.29		$644.59		$1341.88		$.17		737	
Nov														
Dec														
TOTAL														
BTU Conversion Factor			x 103,000	x 103,000										
Total BTU's														

NATURAL GAS _____ CCF/YR.

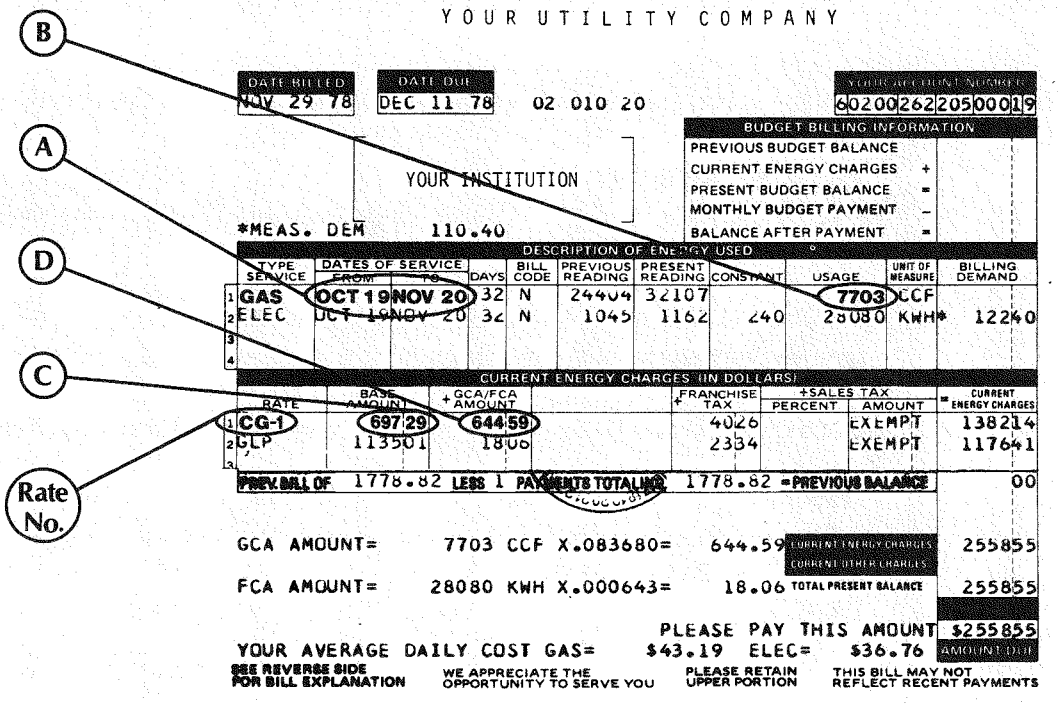
Natural Gas Rate No. CG-1

Building Your Institution

NOTES: This form is intended to be a working document. If it is kept monthly, you will see how effective your Energy Conservation Programs are.

CURRENT means current month.

BASE means the corresponding month of your base year.



Energy Data Form

	A		B		C		D		E		F		G	
Month	Reading Date		KWH Used		Measured Demand KW		$ Cost		FCA Fuel Cost Adjustment ($)		Total Cost (D+E=F)		$/KWH (F÷B=G)	
	FROM	TO	CURRENT	BASE	CURRENT	BASE	CURRENT	BASE	CURRENT	BASE	CURRENT	BASE	CURRENT	BASE
Jan														
Feb														
Mar														
Apr														
May														
Jun														
Jul														
Aug														
Sep														
Oct	10-19	11-20	28080		110.40		$1,135.01		$18.06		$1,153.07		.04	
Nov														
Dec														
Column B Totals														
On-Site BTU Conversion Factor			x 3,413	x 3,413										
Total BTU's														
Column B Totals														
Point of Generation BTU Conversion Factor			x 11,600	x 11,600										
Total BTU's														

ELECTRICITY _____ KWH/YR.

Electricity Rate No. GLP

Building A Public School

NOTES: This form is intended to be a working document. If it is kept monthly, you will see how effective your Energy Conservation Programs are.

CURRENT means current month.

BASE means the corresponding month of your base year.

YOUR UTILITY COMPANY

B

C

A

D

Rate No.

E

DATE BILLED: NOV 29 78 | DATE DUE: DEC 11 78 | 02 010 20 | 60200262205000019

A PUBLIC SCHOOL

* MEAS. DEM 110.40

BUDGET BILLING INFORMATION

PREVIOUS BUDGET BALANCE	
CURRENT ENERGY CHARGES	+
PRESENT BUDGET BALANCE	=
MONTHLY BUDGET PAYMENT	–
BALANCE AFTER PAYMENT	=

DESCRIPTION OF ENERGY USED

	TYPE SERVICE	DATES OF SERVICE FROM	TO	DAYS	BILL CODE	PREVIOUS READING	PRESENT READING	CONSTANT	USAGE	UNIT OF MEASURE	BILLING DEMAND
1	GAS	OCT 19	NOV 20	32	N	24404	32107		7703	CCF	
2	ELEC	OCT 19	NOV 20	32	N	1045	1162	240	28080	KWH*	12240
3											
4											

CURRENT ENERGY CHARGES (IN DOLLARS)

	RATE	BASE AMOUNT	+ GCA/FCA AMOUNT		+ FRANCHISE TAX	+ SALES TAX PERCENT	+ SALES TAX AMOUNT	= CURRENT ENERGY CHARGES
1	SC-1	697.29	644.59		40.26		EXEMPT	1382.14
2	GLP	1135.01	18.06		23.34		EXEMPT	1176.41
3								

PREV. BILL OF 1778.82 LESS 1 PAYMENTS TOTALING 1778.82 = PREVIOUS BALANCE .00

GCA AMOUNT= 7703 CCF X.083680= 644.59 — CURRENT ENERGY CHARGES 2558.55

FCA AMOUNT= 28080 KWH X.000643= 18.06 — TOTAL PRESENT BALANCE 2558.55

PLEASE PAY THIS AMOUNT $2558.55

YOUR AVERAGE DAILY COST GAS= $43.19 ELEC= $36.76

SEE REVERSE SIDE FOR BILL EXPLANATION | WE APPRECIATE THE OPPORTUNITY TO SERVE YOU | PLEASE RETAIN UPPER PORTION | THIS BILL MAY NOT REFLECT RECENT PAYMENTS

USING THE BLANK ENERGY DATA FORMS

Using utility bills from your base year and the most recent months of the current year, complete the forms. Fuel used should be in the appropriate units for each fuel type for each reading period. For oil and propane, use gallons (GAL); for natural gas, use hundred cubic feet (CCF) or thousand cubic feet (MCF); for steam, use pounds (LBS); for electricity, use kilowatt hours (KWH).* Include cost adjustments and billing demand where appropriate. Degree days for a particular period can be obtained from the library, the airport or the weather bureau, if not included in the Degree Day Charts in Part B, Volume 2. Convert annual consumption totals of each fuel type into BTU's.

*Billing units may vary according to your utility's billing procedure. (For example, natural gas may be billed in cubic feet - CF, in hundreds of cubic feet - CCF, in thousands of cubic feet - MCF, or in therms.) Adjust your entries accordingly.

Energy Data Form

	A		B		C		D		E		F		G	
Month	Reading Date		Gas Used CCF		Gas Cost		Gas Cost Adjustment		Total Cost (C+D=E)		$/CCF (E÷B=F)		Heating Degree Days	
	FROM	TO	CURRENT	BASE	CURRENT	BASE	CURRENT	BASE	CURRENT	BASE	CURRENT	BASE	CURRENT	BASE
Jan														
Feb														
Mar														
Apr														
May														
Jun														
Jul														
Aug														
Sep														
Oct														
Nov														
Dec														
TOTAL														
BTU Conversion Factor			x103,000	x103,000										
Total BTU's														

NATURAL GAS _____ CCF/YR.

Natural Gas Rate No. _____

Building _____

NOTES: This form is intended to be a working document. If it is kept monthly, you will see how effective your Energy Conservation Programs are.

CURRENT means current month.

BASE means the corresponding month of your base year.

Energy Data Form

	A		B		C		D		E		F		G	
Month	Reading Date		KWH Used		Measured Demand KW		$ Cost		(FCA) Fuel Cost Adjustment ($)		Total Cost (D + E = F)		$/KWH (F ÷ B = G)	
	FROM	TO	CURRENT	BASE	CURRENT	BASE	CURRENT	BASE	CURRENT	BASE	CURRENT	BASE	CURRENT	BASE
Jan														
Feb														
Mar														
Apr														
May														
Jun														
Jul														
Aug														
Sep														
Oct														
Nov														
Dec														
Column B Totals														
On-Site BTU Conversion Factor			x 3,413	x 3,413										
Total BTU's														
Column B Totals														
Point of Generation BTU Conversion Factor			x 11,600	x 11,600										
Total BTU's														

ELECTRICITY _____ KWH/YR.

Electricity Rate No. _____

Building _____

NOTES: This form is intended to be a working document. If it is kept monthly, you will see how effective your Energy Conservation Programs are.

CURRENT means current month.

BASE means the corresponding month of your base year.

Energy Data Form

	A		B		C		D		E		F	
Month	Reading Date		Fuel Used (Gallons)		$ Cost		$/Gallon (C ÷ B = D)		Heating Degree Days		Fuel Used Per Degree Day (B ÷ E = F)	
	FROM	TO	CURRENT	BASE	CURRENT	BASE	CURRENT	BASE	CURRENT	BASE	CURRENT	BASE
Jan												
Feb												
Mar												
Apr												
May												
Jun												
Jul												
Aug												
Sep												
Oct												
Nov												
Dec												
TOTAL												

Conversion Factor:		
#2 Oil	x 138,690	x 138,690
#6 Oil	x 149,690	x 149,690
Propane	x 95,475	x 95,475
Other	x	x
Total BTU's		

OIL ☐#2 Oil ☐#6 Oil _____ Gal./Yr.

PROPANE _____ Gal./Yr. Other _____ Gal./Yr.

PERCENTAGE TOTAL CONSUMPTION _____ %

CURRENT YEAR _____ BASE YEAR _____

NOTES: This form is intended to be a working document. If it is kept monthly, you will see how effective your Energy Conservation Programs are.

CURRENT means current month.

BASE means the corresponding month of your base year.

Energy Data Form

	A		B		C		D		E		F	
Month	Reading Date		Steam Used (1,000's of Lbs.)		$ Cost		$'s Per 1,000 Lbs. (C ÷ B = D)		Heating Degree Days		Steam Used Per Degree Day (B ÷ E = F)	
	FROM	TO	CURRENT	BASE	CURRENT	BASE	CURRENT	BASE	CURRENT	BASE	CURRENT	BASE
Jan												
Feb												
Mar												
Apr												
May												
Jun												
Jul												
Aug												
Sep												
Oct												
Nov												
Dec												
Column B Totals												
On-Site BTU Conversion Factor			x 1,000	x 1,000								
Total BTU's												
Column B Totals												
Point of Generation BTU Conversion Factor			x 1,390	x 1,390								
Total BTU's												

STEAM _____ LBS./YR.

PERCENTAGE TOTAL CONSUMPTION _____ %

CURRENT YEAR _____

BASE YEAR _____

NOTES: This form is intended to be a working document. If it is kept monthly, you will see how effective your Energy Conservation Programs are.

CURRENT means current month.

BASE means the corresponding month of your base year.

4 THE ENERGY AUDIT REPORT

The following pages are elements comprising the Energy Audit Report, in compliance with requirements of DOE rule-making of April 2, 1979. It is recommended that this section be completed by institutional personnel and/or a qualified state energy auditor.

The following elements are included:

A. Auditor Certification
B. Condition Summary Page
C. The Energy Inventory
D. Evaluation of Potential for Energy Conservation Measures
E. Evaluation of Potential for Solar and Renewable Resource Measures

Special instructions are included to clarify information requests and to facilitate completion of the report. Please note that implementation of the recommendations for changes in operating and maintenance procedures is required in order to qualifiy for a grant to perform technical assistance.

A Auditor Certification

1. I, _____ (print), am qualified to perform energy audits by:

   ☐ successful completion of State training course of

   _____ (date).

   ☐ training and experience equivalent to successful completion of State training course:

   _____ (detail or date of State waiver of requirement).

2. I am not employed to operate this building. ☐ yes ☐ no

3. My financial interests in connection with this energy audit are:

   ☐ no outside interests

   ☐ own, have stock in, or employed by

   ☐ a consulting firm

   ☐ an equipment manufacturer

   ☐ an energy supplier

4. The audit has been conducted in conformance with the requirements of the State of _____ and 10 CFR Part 450, Subpart E.

_____ (Signature) _____ (date)

B

Condition Summary Page

ADMINISTRATION

- ☐ A-1 Thermostats on heating/cooling units are vulnerable to occupant adjustment.
- ☐ A-2 Thermostat settings have not been adjusted for change in seasons.
- ☐ A-3 Unoccupied or little used areas are heated or cooled unnecessarily.
- ☐ A-4 Off-hour activities are scheduled.
- ☐ A-5 Building temperatures are not adjusted for unoccupied periods.
- ☐ A-6 Heating/cooling equipment is operating in lobbies, corridors, vestibules and/or other public areas.
- ☐ A-7 Heating/cooling equipment is started before occupants arrive and/or is operating during last hour of occupancy.
- ☐ A-8 Use of equipment associated with laundry and custodial services coincides with heavy electrical demand periods.
- ☐ A-9 Blinds and curtains are not used to help insulate the building.
- ☐ A-10 No records of maintenance for motors and motor driven equipment are available.
- ☐ A-11 Control devices are not inspected on a regular basis.
- ☐ A-12 Conditioned air or heated water is discarded.

LIGHTING

- ☐ L-1 Incandescent lamps are used in offices, workrooms, hallways and gymnasiums.
- ☐ L-2 In fixtures where flourescent lamps have been removed, the ballasts have not been disconnected.
- ☐ L-3 When burned out flourescent lamps and/or ballasts have been replaced, more efficient lights have not been installed.
- ☐ L-4 Lamps and fixtures are not clean.
- ☐ L-5 Exterior lighting is used.
- ☐ L-6 Lights are on in unoccupied areas.
- ☐ L-7 Natural lighting is not optimized.
- ☐ L-8 Two lamps have not been removed from four-lamp fixtures where possible.

BUILDING ENVELOPE

- ☐ B-1 Improper alignment and operation of windows and doors allows excessive infiltration.
- ☐ B-2 Ceiling/roof insulation is inadequate or has been water damaged.
- ☐ B-3 Weatherstripping and caulking around windows, doors, conduits, piping, exterior joints, or other areas of infiltration are worn, broken or missing.
- ☐ B-4 Excessive expanses of glass exist on exterior walls.
- ☐ B-5 There is no insulation between conditioned and unconditioned spaces.

VENTILATION

- ☐ V-1 An excessive quantity of outdoor air is used to ventilate the building.
- ☐ V-2 Outdoor air intake dampers open when building is unoccupied.
- ☐ V-3 Ventilation systems are not utilized for natural cooling capability.
- ☐ V-4 Exhaust system operation is not programmed.
- ☐ V-5 Return, outdoor air and exhaust dampers are not sequencing properly.
- ☐ V-6 During heating season, temperature of air flow to space feels too cold.
- ☐ V-7 Air flow to space feels unusually low or is inconsistent from one space to another.

Condition Summary Page

HEATING

- ☐ H-1 Multiple boilers or heaters fire simultaneously.
- ☐ H-2 Stack temperature appears excessively high (greater than 400°F plus room temperature).
- ☐ H-3 Water in heating system is heated when there is no need.
- ☐ H-4 Space temperatures are higher or lower than thermostat settings.
- ☐ H-5 Heating system's hot water temperature feels excessively hot during periods of mild weather.
- ☐ H-6 Condensate from street steam is being discharged to sewer drain.
- ☐ H-7 Heating pilot lights are on during cooling season.
- ☐ H-8 Steam radiators or other steam equipment fail to heat or operate erratically.
- ☐ H-9 Steam, condensate and heating water piping insulation is in disrepair or missing.
- ☐ H-10 Operation of oil burner is accompanied by excessive smoke and sooting.
- ☐ H-11 Soot and odors are detected in areas where they are not expected.
- ☐ H-12 Evidence indicates faulty or inefficient boilers or furnaces.
- ☐ H-13 Air is humidified.
- ☐ H-14 Burner short-cycles.
- ☐ H-15 Combustion air to boiler/furnace is not preheated.
- ☐ H-16 Hot water radiation units fail to operate.
- ☐ H-17 Radiators, convectors, baseboards and finned-tube heaters are not providing sufficient heat.

COOLING

- ☐ C-1 Space temperature is higher or lower than thermostat setting.
- ☐ C-2 Chiller is operating during cold weather to provide air conditioning.
- ☐ C-3 Reheat coils are used to maintain zone temperatures.
- ☐ C-4 Multiple air conditioning compressors start at the same time.
- ☐ C-5 Building utilizes a dual duct or multizone system.
- ☐ C-6 Insulation on cooling line pipes and ducts appears inadequate.
- ☐ C-7 Air conditioning load trips circuit breaker on extremely warm days.
- ☐ C-8 Air of inadequate volume or temperature is being discharged through grilles.
- ☐ C-9 Refrigeration condensers or coils are dirty, clogged and/or not functioning efficiently.
- ☐ C-10 Chilled water piping, valves and fittings are leaking.
- ☐ C-11 Chiller operation is not optimized. (Listen for short-cycling.)
- ☐ C-12 Refrigeration compressor short-cycles.
- ☐ C-13 Refrigeration compressor runs continually. (Direct expansion systems.)

WATER

- ☐ W-1 Storage tanks, piping and water heaters are utilized inefficiently.
- ☐ W-2 Drips or leaks are evident in hot water systems.
- ☐ W-3 Electric water heater has no time restrictions on heating cycle.
- ☐ W-4 Devices to conserve heated water have not been utilized where practical.

C ENERGY INVENTORY

Knowing Your Building

This information is essential to your understanding of building energy demand, using the audit checklist, preparing a report of the energy audit* and to your development of a realistic energy management program.

The Energy Inventory organizes important data concerning your building or facility according to the following categories:

A. General Administrative Information
B. Occupancy Patterns/Operating Conditions/Activity Groups
C. Physical Characteristics
D. Annual Energy Consumption Summary
E. Energy Systems
   a. Lighting
   b. HVAC
   c. Heating & Cooling Sources
   d. Water
   e. Special Services
F. Solar and Renewable Resources
G. General Remarks

Much of this information may be required later by your state energy office in your application for technical assistance. Should technical questions arise concerning mechanical equipment in operation in your building, consult your engineer or the appropriate service company.

It is suggested that the different sections in the Energy Inventory be filled in by qualified personnel:

- General Administrative Information, Occupancy Patterns/Operating Conditions/Activity Groups, and Annual Energy Consumption Summary might best be completed by the building administrative personnel.
- Physical Characteristics and Energy Systems--Lighting, Water Usage might best be completed by maintenance personnel.
- Energy Systems--Ventilation, and Heating and Cooling might best be completed by the building engineer. (In the absence of a building engineer the maintenance personnel should complete these sections).
- The Section dealing with Special Services such as laundry and food preparation might best be completed by the special services personnel

* Information elements marked with an asterisk (*) are not specifically required by federal rule-making but can be useful for energy management programs in individual institutions and may be required for completion of calculations in Part A, Volume 2.

A. GENERAL ADMINISTRATIVE INFORMATION

1-2. Indicate if single building or complex, enter the name, check the appropriate ownership, type and category. If other applies, enter a 1 or 2 word description. (for example, a hospital which is neither a general hospital nor a TB hospital would check "other" and add "obstetrics and gynecology"or"eye, ear, nose and throat", "orthopedic", "chronic disease", or other appropriate brief description.

3-4. Provide building address (do not use P.O. Box number--enterstreet address) and phone number. Note year constructed and date of last major addition or modification.

5-6. Record names and telephone numbers of building manager, building operator; record names of mechanical and electrical engineers. Record names and telephone numbers of person responsible for the building.

7. Has an energy management coordinator been designated?

8. Indicate whether major changes are anticipated in the facility proper or in its function for the next fifteen years; e.g., new construction, rehabilitation or demolition.

9. Indicate whether any other energy audit work has been completed or is currently underway.

10. Describe any conservation measures which have been implemented or are being considered and expected cost and energy savings expressed as an annual percentage reduction in the type of fuel affected. Attach additional page if necessary.

11. Describe any previous architectural/engineering studies.

12. Provide the names of the original architects and engineers of the building.

---

1. Name of Building or Complex: _____
   Owner: _____
   Public _____ Private _____
   Non-Profit _____ Indian Tribe _____

2. Building Type and Category:

☐ School	☐ Hospital	☐ Local Gov't.	☐ Public Care
___ Elementary	___ General	___ Office	___ Nursing Home
___ Secondary	___ Tuberculosis	___ Storage	___ Long-term Care
___ Junior College	___ Psychiatric	___ Library	___ Rehab. Center
___ College or Univ.	___ Other, specify	___ Services	___ Orphanage
___ Vocational	_____	___ Police Station	___ Public Health Ctr.
___ LEA Admin.		___ Fire Station	___ Residential Child Care
___ Other, Specify		___ Other, Specify	___ Other, Specify
_____		_____	_____

3. Building Address: _____ City _____
   State _____ Zip _____ Telephone Number _____

4. Year constructed: _____ Year of last major addition or modification: _____

5. Building Manager: _____ Telephone Number: _____
   Building Operator: _____ Telephone Number: _____
   Person responsible for building: _____
   Telephone Number: _____

* 6. Mechanical Engineer: _____ Electrical Engineer: _____

7. Energy Management Coordinator designated: Yes☐ No☐

8. Anticipated building modifications: _____

9. Previous energy audit work completed: Yes☐ No☐ Specify, _____

10. Conservation Measures (retrofit) already implemented or under consideration:
    Yes☐ No☐ Specify project, cost and expected energy savings: _____

11. Previous architectural/engineering studies: Yes☐ No☐ Specify: _____

* 12. Original Architects: _____
    Original Engineers: _____

B. OCCUPANCY PATTERNS/OPERATING CONDITIONS/CLIMATE INFORMATION/ACTIVITY GROUPS

1. Complete occupancy schedule. If the institution operates on a seasonal schedule, or has other periods of at least a week's duration when the building is only partially occupied, the number of weeks partial use by calendar quarter should be entered, along with the approximate percentage of total gross square feet in use during such periods.
2. Provide summer/winter operating conditions: average indoor temperature, normal indoor relative humidity, outside design temperature, average seasonal relative humidity.
3. Note U.S. heating and cooling zone in which building is located and climate information unique to your location. Refer to heating and cooling degree data from the charts in Part B, Volume 2.
4. List the kinds of activities housed within the building.

1.

Day(s)	Time Period	Average Occupancy	or % gsf Occupied	No. of Hours	Weeks/Year
Mon-Fri	day				
	evening				
	night				
Saturday	day				
	evening				
	night				
Sunday	day				
	evening				
	night				

Quarterly Partial Usage:

Quarter	Weeks	% gsf
1st		
2nd		
3rd		
4th		

* 2. Operating Conditions:

	Summer	Winter
Average Indoor Temperature	_____ ^{o}F	_____ ^{o}F
Indoor Relative Humidity	_____ %	_____ %
Outside Design Temperature	_____ ^{o}F	_____ ^{o}F
Outside Relative Humidity	_____ %	_____ %

3. Building Location:

U.S. Heating Zone #_____ U.S. Cooling Zone #_____

Annual Heating Degree Days _____ (Base 65^{o}F) Annual Cooling Degree Days_____ (Base 65^{o}F)

* 4. List Facility activities (e.g., radiology, school administration, mayor's office and staff, etc.) and approximate area and time devoted to each.

a._____ Area_____ SqFt time worked_____ Hrs/Day

b._____ Area_____ SqFt time worked_____ Hrs/Day

c._____ Area_____ SqFt time worked_____ Hrs/Day

d._____ Area_____ SqFt time worked_____ Hrs/Day

e._____ Area_____ SqFt time worked_____ Hrs/Day

(If more space is needed, attach a separate sheet.)

C. PHYSICAL CHARACTERISTICS

1. To calculate gross square feet (gsf) multiply the outside dimensions or measure from the centerline of common walls and multiply by the number of floors. If the building has wings, or the number of floors varies in one part from another, divide the building into sections, calculate the area of each section, and total. (Deduct from the total area any parking garages or other areas which are neither heated nor cooled.) To obtain building volume, multiply average ceiling height times gross floor area.
2. Total the exterior glass area (excluding skylights), noting whether glass is single or double pane.
3. Total the exterior wall surface area (excluding glassed area), noting predominant wall material. Indicate approximate overall thermal transmittance (U_o) for wall structure by multiplying area times U-value. See "U-Values for Typical Roof & Wall Construction" in Part B, Volume 2.
4. Compute surface area of roof (excluding total skylight area). Note general condition. Indicate approximate overall thermal transmittance (U_o) for roof structure by multiplying area times U-value. See Part B, Volume 2.

5-6. Note type and thickness of insulation material in roof, walls and floors. Note if there is none.

7. Sketch position of facility on site with North arrow.
8. Briefly describe general building conditions.

---

1. Gross Floor Area:_____ SqFt X Gross Ceiling Height_____Ft=Volume_____CuFt

* 2. Total Exterior Glass
Area:_____SqFt Single Panes_____SqFt
Double Panes_____SqFt

	North Side	South Side	East Side	West Side
Total Area	_____SqFt	_____SqFt	_____SqFt	_____SqFt
Single Pane	_____SqFt	_____SqFt	_____SqFt	_____SqFt
Double Pane	_____SqFt	_____SqFt	_____SqFt	_____SqFt

* 3. Total Exterior Wall
Area:_____SqFt Material: Masonry_____Wood_____Other_____
U_o:_____BTU Hr/°F Concrete_____Stucco_____

* 4. Total Roof
Area:_____SqFt Condition: Good _____Fair _____Poor _____

U_o:_____BTU Hr/°F

* 5. Insulation Type: Roof_____Wall_____Floor_____

* 6. Insulation Thickness: Roof_____Wall_____Floor_____

7. What is orientation of building on site? (Draw sketch with North arrow.)

8. Description of general building conditions:

_____

_____

_____

_____

_____

D. ANNUAL ENERGY CONSUMPTION SUMMARY

1. Complete fuel use summary for base year (or last 12 months if no base year has been established), using utility records and blank forms provided in Section 3. (If no past records have been kept, call your utility.) Multiply by the conversion factors (as required by the Federal Register, Section 450.42(11), April 2, 1979) and enter the results in Column D as annual BTU consumption. Transfer annual cost for each fuel from the appropriate Energy Data Form in Section 3, to Column E. (Attach copies of the Energy Data Forms from Section 3 to this page.) Compute consumption in BTU's per gross square foot per year by dividing the total of the entries in Column D by gsf. Compute energy dollars per gross square foot per year by dividing the total of the entries in Column E by gsf. (Obtain gross floor area from previous chart and energy costs from Energy Data Forms.)
2. Based on your past year's utility bills, complete peak electrical demand data. For buildings or complexes over 200,000 gsf or if the electric rate contains a a demand charge, determine if demand is recorded. Note times at which typical peaks occur during daily operation. Also note whether demand fluctuates on a seasonal basis indicating month in which the highest demand occurs.
3. If data is avilable, indicate the fuel used by each of the major energy using systems listed and the annual consumption of each. For #5 "special", indicate special purpose facilities (e.g., food service, laundry) which use significant amounts of energy, fuel type used and annual usage.

A Fuel	B Previous 12 Month Totals		C Conversion Factor	=	D BTU's Consumed	E Annual Cost	F BTU's/Gross SqFt/Year	G $/Gross SqFt/Year
1. Electricity	KWH	x	11,600	=				
2. Natural Gas	CCF	x	103,000	=				
3. #2 Oil [1]	gallons	x	138,690	=				
4. #6 Oil [2]	gallons	x	149,690	=				
5. Steam	pounds	x	1,390	=				
6. Coal	tons	x	24,500,000	=				
7. Propane	gallons	x	95,475	=				
8. Other, Specify [3]		x		=				
9. TOTALS								

2. Peak Electrical demand:

Daily: _____ KW Annual: _____ KW

Time: _____ Month: _____

3. Fuel Use by Major Energy-Using Systems:

System	Fuel Type	Annual Use
Heating		
Cooling		
Hot Water		
Lighting		
Special, specify		

[1] #2 Oil should include other distillate fuel oils.

[2] #6 Oil should include other residual fuel oils.

[3] Use a standard engineering reference manual or factors provided by the State for other fuels.

E. ENERGY SYSTEMS

a. Lighting

1-2. For each lighting type, fluorescent and incandescent, note the percentage of gross square feet of the building illuminated. Include an estimate of average usage in hours per week and hours per year.

3. Determine the total wattage presently used to illuminate the building's interior and divide by the gross floor area to compute an average lighting level in watts per square foot.

4. Note total interior and exterior loads in kilowatts by adding the wattages of all lamps (separately for each) and dividing by 1000.

5. Note any unusual lighting applications.

---

1. Fluorescent:

   Percentage of Gross SqFt:_____% Usage: _____Hr/Wk_____Hr/Yr

2. Incandescent:

   Percentage of Gross SqFt:_____% Usage: _____Hr/Wk _____Hr/Yr

* 3. Average Interior Lighting Level: _____Watts/SqFt

* 4. Total Interior Lighting Load: _____KW

   Total Exterior Lighting Load: _____KW

* 5. Unusual Lighting Applications:

_____

_____

_____

_____

E. ENERGY SYSTEMS

b. HVAC:

1-10. Check the type and capacity of HVAC systems found in your building. If knowledge of the system is not available, obtain the information from the mechanical engineer, blueprints, specifications or nameplates. Total the cubic feet per minute (CFM) of air that the air systems supply to the building. Note what percentage of outside air is used. Note the heating and cooling capacities and fan horsepower. (See "HVAC Systems" in Part B, Volume 2.) If a building complex is being audited, provide this information for each building. Attach an additional sheet if needed.

System Type	Total CFM	Minimum % Outside Air	Capacity BTU/Hr	Fan Horsepower
1. Terminal Reheat				
2. Multizone				
3. Dual duct				
4. Variable Air Volume				
5. Induction				
6. Fan Coil				
7. Heat Pump				
8. Air Exhaust				
9. Radiation				
10. Other				

1-3. Economizer Cycle

An economizer cycle is the air handling equipment utilizing outdoor air during the winter season to cool the interior of the building. Two types of economizer cycles are enthalpy control and dry bulb changeover temperatures.

---

* 1. Economizer Cycle: Yes ___ No ___

* 2. If yes, indicate changeover temperature: _____°F (Dry Bulb)

* 3. If yes, indicate if enthalpy control: Yes ___ No ___

E. ENERGY SYSTEMS

c. Heating and Cooling Sources

Heating

1-3. Note the principal fuel used by the heating system. Obtain the rated output (energy output of system in BTU's or KWH's) and the rated input (amount of energy required to obtain the specified rated output) from the equipment specifications.

4-6. Larger buildings tend to have boilers or purchase hot water or steam. Smaller buildings tend to have unitary direct fired equipment. Determine your system type. Estimate the number of hours per day and weeks per year that the heating plant operates.

Cooling

1-3. Note the principal fuel used by the cooling system. Obtain the rated input consumption figure required to generate full capacity cooling from specifications.

4-6. Examine the equipment to determine system type. Estimate the number of hours per day and weeks per year that the system operates.

	Heating System	Cooling System
1.	_____ Fuel Type	_____ Fuel Type
* 2.	_____ Rated Input Consumption	_____ Rated Input Consumption
* 3.	_____ Rated Output Capacity (BTU's/Hour)	_____ Rated Output Capacity (tons)
4.	System Types: (Check ✓) ___Boilers ___Purchased water or steam ___Unitary Direct Fired ____Furnaces ____Package Equipment	System Types: (Check ✓) ___Absorption ___Electric Drive ___Steam Turbine Drive ___Water Cooled Packaged Unit ___Air Cooled Packaged Unit
* 5.	Operation Profile: _____hrs/weekday _____hrs/Saturday _____hrs/Sunday	Operation Profile: _____hrs/weekday _____hrs/Saturday _____hrs/Sunday
* 6.	If not 52 Weeks/Year: _____weeks/year _____from (month) _____through (month)	If not 52 Weeks/Year: _____weeks/year _____from (month) _____through (month)

E. ENERGY SYSTEMS

d. Water Usage

1-8. Arbitrarily select a base year. Examine your water bill and note the reading dates. Note water used for each period in gallons. Note water costs for each quantity of water usage and compute what this means in terms of $/gallon. Indicate heating source.

9-10. Estimate the number of gallons of hot water used per day. The difference between the delivery temperature of hot water and the average ground temperature of city water is the temperature rise. Record it now for later use.

---

*

Reading Dates		Water Used (Gallons)	Cost	$/Gallon
From	To	Base Year	Base Year	Base Year
1.				
2.				
3.				
4.				
5.				
6.				
7. Totals				

8. Domestic Water Heated By: Electricity_____Natural Gas_____

Other_____

* 9. Daily Usage:

Gallons/Day_____

*10. Delivery Temperature_____°F

Average Temperature of City Water_____°F

Temperature Rise_____°F (Delivery temperature - city water temperature)

E. ENERGY SYSTEMS

e. Special Services

1-6. Are laundry services provided? If so, note the number of washer/dryers, each washer/dryer's capacity and the total weekly load.
7. Are food services provided? Complete "Food Preparation and Storage Area Equipment" Chart on the following page, if applicable.
8. Are other special services provided?

---

1. Laundry Yes ☐ No ☐

Enter Fuel Type: N.G. = Natural Gas, E = Electricity

(*Chart)

Washing Data:			Drying Data:			
No. of Washers	Washer Capacity	Total Weekly Loads	No. of Dryers	Dryer Capacity	Total Weekly Loads	Fuel Type
1.	lbs.		1.	lbs.		
2.	lbs.		2.	lbs.		
3.	lbs.		3.	lbs.		
4.	lbs.		4.	lbs.		
5.	lbs.		5.	lbs.		
6.	lbs.		6.	lbs.		

7. Food Yes ☐ No ☐

On the following chart, check the kitchen equipment used in food preparation and storage. Where possible, record information from equipment name plates. Use the "comments" column to note general condition and equipment.

8. Other Yes ☐ No ☐

Describe briefly: _____

_____

_____

_____

(* Chart)

FOOD PREPARATION AND STORAGE AREA EQUIPMENT						
	A	B	C	D	E	F
DESCRIPTION	NUMBER OF UNITS	NAME PLATE INFORMATION (KILOWATTS,BTUs/HR)	HOURS OPERATED DAILY	DAYS/YR IN USE	ANNUAL CONSUMPTION (KWH OR BTU) AxBxCxD	ADDITIONAL COMMENTS
RANGES						
OVENS						
STEAM TABLES						
FRYING TABLES						
FREEZERS						
REFRIGERATORS						
INFRA-RED WARMERS						
DISHWASHERS						
MICROWAVES						
HOODS WITH EXHAUST FANS						
MIXERS						
OTHER						

F. SOLAR AND RENEWABLE RESOURCE POTENTIAL

1. Check characteristics of adjacent property.
2. Indicate nature of location.
3. Note building characteristics, indicating shape as square, rectangular, E-shaped, H-shaped, L-shaped or attach a rough sketch of the configuration.
4. Note roof design. For the orientation of a pitched roof, indicate the compass direction of a line perpendicular to the ridgeline in the direction of the down slope. Note presence of roof obstructions such as chimneys, space conditioning equipment, water towers, mechanical rooms and stairwells. Identify the principal structural material of the roof, e.g., steel, concrete, or wood structural components. Also identify the type of roofing such as shingle, slate or built-up.
5. Indicate nature of southern facing wall.
6. Check type and location of heating equipment.
7. Using information from the National Weather Service, your State's energy office or from charts provided in Part B, Volume 2, enter monthly average insolation and wind speeds.
8. Note any special conditions or characteristics related to potential for solar or other renewable resource application.

---

1. Adjacent open land (not heavily shaded):

   ☐ Field ☐ Yard ☐ Parking Lot Other, specify _____

2. Location:

   ☐ Urban ☐ Suburban ☐ Rural

3. Building characteristics:

   ☐ Roof Unshaded ☐ Southern Wall Unshaded

   Number of Stories _____ General Shape _____

4. Roof:

   ☐ Flat ☐ Pitched, Orientation _____ Primary Structural Material _____ Type of Roofing _____

   Roof obstructions: _____

5. Composition of Southern Facing Wall: _____

   _____

   Southern Facing Wall Glass Area:

   ☐ Less than 25% ☐ 25% to 75% ☐ over 75%

6. Type and location of space heating equipment:

   ☐ Single Unit ☐ Multiple Units

   ☐ Outside, Location _____

   ☐ Inside, Location _____

   Type and location of water heating equipment:

   ☐ Single Unit ☐ Multiple Units

   ☐ Outside, Location _____

   ☐ Inside, Location _____

7. Average Insolation: Average Wind Speed:

Average Insolation (BTU's/SqFt/Year)				Average Wind Speed (miles/hour)			
Jan _____	April _____	July _____	Oct _____	Jan _____	April _____	July _____	Oct _____
Feb _____	May _____	Aug _____	Nov _____	Feb _____	May _____	Aug _____	Nov _____
Mar _____	June _____	Sept _____	Dec _____	Mar _____	June _____	Sept _____	Dec _____

8. Remarks

_____

_____

_____

_____

_____

G. GENERAL REMARKS

1. Provide any additional information considered to be pertinent to the preliminary energy audits or any explanations necessary for understanding entries elsewhere on the forms.

---

1. Remarks: _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

D Evaluation of Potential for Energy Conservation Measures

This evaluation is patterned on the 1976 ASHRAE Systems Handbook, Chapter 1 and the Energy Audit Procedures published by the Ohio Board of Regent in June, 1978. A Relative Importance Factor (RIF), ranging from 15 to 35 is assigned to each of the five items listed. Within each, conditions are described and a Weighting Factor (WF) assigned to each condition. The evaluation of the potential of the building for energy conservation measures is based on the sum of the products of the RIF's and WF's. The higher this value, the greater the potential for energy savings. Since energy audits are intended to make relative comparisons, it is essential that conformity be maintained. Therefore, neither the RIF nor the WF are to be altered. Determine the Weighting Factor as follows:

a. Building Envelope (RIF:15)

Percentage of glass area can be estimated by dividing the glass area in a typical wall by the total wall area, or by dividing the value in the Energy Inventory, Part C #2 by Part C #3. Large or low infiltration can be determined by noting fit-up of outside doors and windows in their frames. Tight fitting doors and windows denote low infiltration and loose fit-up denotes high infiltration.

	WF
Bldgs over 40% glass and large infiltration	1.0
Bldgs over 40% glass	.9
Bldgs with large infiltration	.8
Bldgs under 40% glass	.7
Bldgs with low infiltration	.6
Bldgs under 15% glass	.5

b. Lighting (RIF:15)

To determine power usage for lighting in watts/square foot, add the wattage of all lamps in the building and divide by the gross floor area of the building, as in Energy Inventory, Part E, Section a, #3.

	WF
Lighting over 3 w/SqFt	1.0
Lighting 2 to 3 w/SqFt	.9
Lighting 1 to 2 w/SqFt	.8
Lighting reduced by changes in switching	.7
Lighting that cannot be reduced	.6

C. HVAC System Type (RIF:35)

Check the type of HVAC system found in your building. If knowledge of the system is not available, obtain the information from the mechanical engineer, blueprints, specifications, name plates, contact your local HVAC contractor, or refer to HVAC Systems in Volume 2: Technical Materials and References.

	WF
Reheat or Dual Duct	1.0
Multizone or Induction Units	.9
Rooftop Units, Wall Units, or Unit Ventilators	.8
Fancoil, VAV, or Heat and Vent System	.7
Radiation, Unit Heaters (no fan systems)	.6

d. Outside Air (RIF:20)

Check the ventilation system for outside air percentage. If knowledge of the system is not available, obtain the information from the mechanical engineer, blueprints, specifications, name plates, contact your local HVAC contractor, or refer to Energy Inventory, Part E, Section b.

	WF
75 to 100% Outside Air	1.0
50 to 75% Outside Air	.9
25 to 50% Outside Air	.8
10 to 25% Outside Air	.7
Infiltration, toilet exhausts only	.6

e. Fan Energy (RIF:15)

To determine square feet per fan horsepower (HP), divide building gross floor area by total HP of all HVAC and ventilating fans in the building. HP rating can be found on nameplates of pumps and motors in your air handling systems, or refer to the Energy Inventory, Part E, Section b.

	WF
Under 200 SqFt per fan HP	1.0
200-600 SqFt per fan HP	.9
600-1000 SqFt per fan HP	.8
1000-1500 SqFt per fan HP	.7
1500-2000 SqFt per fan HP	.6
over 2000 SqFt per fan HP	.5

Complete the following table to determine the energy conservation measure potential index:

	RIF	x WF =	EVALUATION
a. Bldg Envelope - % Glass and Infiltration	15		
b. Lighting Levels	15		
c. HVAC System Type	35		
d. Ratio Outside Air	20		
e. Fan Energy	15		
Energy conservation measure potential index:			

E Evaluation of Potential for Solar and Renewable Resource Measures

This evaluation is to be completed in the same manner as the Energy Conservation Measures Evaluation in the previous section.

a. Available Insolation (RIF: 30)

Available insolation is a function of geographic location and site characteristics. Determine average annual horizontal insolation on a horizontal surface from information provided by the State or from the National Weather Service data for your location. Observe whether the building is shaded or unshaded (a building whose roof and south-facing wall are approximately more than half-shaded for more than approximately four hours per day--should be considered "shaded".) If the building itself is shaded, note whether there is open, unshaded land available adjacent to the building site.

	WF
Unshaded and 1300 BTU/SqFt or more	1.0
Unshaded, less than 1300 BTU/SqFt	.5
Open land and 1300 BTU/SqFt or more	1.0
Open land, less than 1300 BTU/SqFt	.5
Shaded, 1300 BTU/SqFt or more	.2
Shaded, less than 1300 BTU/SqFt	.1

b. Fuel Used (RIF: 20)

Note the fuel used for space heating, air-conditioning, and water heating.

	WF
All electric	1.0
Oil or gas heat, otherwise electric	.8
Coal heat, otherwise electric	.4
Oil or gas heat, hot water	.4
Coal heat, hot water	.2

c. Building Characteristics (RIF: 10)

Refer to the Energy Inventory for the description of building size and shape, and the location of heating, air-conditioning, and water heating equipment. A "favorable" building is one which is compact (i.e., square or rectangular), in which the equipment is in one

location on the roof or adjacent to the south-facing wall. A building which is "fair" would be other than compact (i.e., E-shaped, L-shaped, etc.) but in which the equipment is in one location on the roof or adjacent to the south-facing wall, or a building which is compact but in which the equipment is within 5 floors of the roof or 50 feet of the south-facing wall. A building which is not compact and in which the equipment is located beyond five floors of the roof and 50 feet of the south-facing wall is to be characterized as "moderate". A highly irregular building or one in which equipment is in scattered locations--most of which are more than five floors from the roof or 50 feet from the south-facing wall--is characterized as "poor".

	WF
Favorable	1.0
Fair	.8
Moderate	.5
Poor	.2

d. Roof Characteristics (RIF:10)

Refer to the Energy Inventory for the description of the roof pitch, materials, structural materials and obstructions. Characterize the building as "favorable" if the roof is flat or pitched nearly to the south, if the roofing is built-up, shingled or otherwise sufficiently durable to withstand mounting and maintaining solar collectors, if the structural members are strong enough to support additional weight and the roof area is free of obstructions. A "fair" rating would be given a building meeting the above conditions except that the roof pitch is only approximately in the direction of south or where there are roof obstructions. Describe a building as "moderate" if the roof pitch is only approximately toward the south and there are roof obstructions. A building which meets none of these conditions is characterized as "poor".

	WF
Favorable	1.0
Fair	.8
Moderate	.5
Poor	.2

e. Wall Characteristics (RIF:20)

Determine the glass area of the south-facing walls as a percentage of the total wall area, noting the construction material, or refer to Energy Inventory, Part F, #5.

	WF
Over 75% glass; masonry	1.0
Over 75% glass; aluminum or metal	.7
Over 75% glass; wood or other	.6
25% - 75% glass; masonry	.7
25% - 75% glass; aluminum or metal	.6
25% - 75% glass; wood or other	.4
Under 25% glass; masonry	.5
Under 25% glass; aluminum or metal	.3
Under 25% glass; wood or other	.2

f. Wind Speed (RIF:30)

Determine average monthly wind speed using data supplied by the State, obtained from the National Weather Service or local records. Note whether there are natural or man-made barriers in the direction of the prevailing winds.

	WF
Greater than 15 mph, no barriers	1.0
Between 10-15 mph, no barriers	.5
Greater than 15 mph, some obstructions	.7
Between 10-15 mph, some obstructions	.3
Less than 10 mph	.2

Complete the following table to determine the solar and renewable resources potential index:

	RIF	x WF =	Evaluation
a. Insolation Available	30		
b. Fuel Used	20		
c. Building Characteristics	10		
d. Roof Characteristics	10		
e. Wall Characteristics	20		
f. Wind Speed	30		
Solar and renewable resource measure potential index:			

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