GUIDELINES FOR CONDUCTING ENERGY AUDITS OF ADMINISTRATIVE, COMMERCIAL AND OFFICE BUILDINGS

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NOTE: THE AUDIT WORKSHEETS REFERRED TO ABOVE ARE AVAILABLE FROM OECS-NRMU UPON REQUEST.
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PREFACE

These Guidelines have been produced as part of a larger scope of work that has included the identification of policy alternatives for energy management and energy efficiency in the OECS countries and the energy auditing of the following facilities in St. Lucia: Victoria Hospital (the largest hospital in St. Lucia), the Greaham Louisy Building (a government headquarters building) and the St. Lucia offices of the OECS Secretariat. These audits were undertaken as training exercises in support of Government of St. Lucia initiatives to adopt enhanced energy management practices; reports on the audits are available from the OECS-NRMU upon request. An output of these audits, the Guidelines are intended to provide initial guidance to technical officers in OECS countries on how to conduct an energy audit.

Technical assistance in support of the preparation of these guidelines has been provided by Lewis Engineering of Halifax, Canada. Funding for the preparation of this document has been provided by the Canadian International Development Agency, whose participation is gratefully acknowledged.

BACKGROUND TO ENERGY AUDITING

Why Conduct An Energy Audit?

The purpose of conducting an energy audit is to develop a database on which to determine:

1. Patterns and levels of current energy use within a building.
2. Opportunities for cost-effectively reducing energy use within the context of performing the functions intended within a building.

What Types Of Building Do These Guidelines Apply To?

These Guidelines are intended to be applied to administrative, commercial and office buildings since these include many of the highest energy-consuming building in OECS countries.

The Guidelines can also be generically applied to other types of building. However, some aspects of the guidelines may not be applicable to other types of building and, in addition, other types of building may have aspects of energy use that are not specifically addressed by these Guidelines.

How Complicated Is It To Conduct An Energy Audit?

The complexity of an energy audit is a function of the complexity of energy use in the building being audited, and the level of detail of the audit; a small office building might be audited in less than an hour, while a larger building might require 1 or more days.

Aspects of energy audits can be technical in nature, and individuals with a background in building design, technology, construction, engineering or related subject are likely to be more at ease conducting an energy audit that other individuals. Although persons with a technical background may find some aspects of conducting an energy audit straightforward, other aspects are more complex; effective energy auditing therefore requires training.

How Do I Use Energy Audit Information

Analysis of energy audit information will identify:

1. How much energy is used in a building.
2. Where opportunities exist to reduce energy consumption while still allowing normal functions performed in the building.

The identification of how much energy is used is quantitative and based on energy consumption records available for the facility.

The identification of opportunities to reduce energy consumption requires on-site inspection. Opportunities to reduce energy use will fall into one of two categories:

1. Changing operating practices so as to reduce energy consumption.
2. Retrofitting the building so as to make the building itself more energy efficient.

Changing Operating Practices

Opportunities to reduce energy consumption that fall into this category have to do with changing people's behaviour in the workplace. The following measures should be implemented and adhered to since they can result in immediate and significant energy savings at no cost:

1. All lights, computers and other electrical equipment should be turned off when not in use. At the end of the work day a staff person should be designated to ensure that all lights, computers and other electrical equipment in the workplace is switched off.

2. Windows and doors in an air conditioned room should never be left open. If a natural breeze is desired, switch off the air conditioning.

3. The use of electrical equipment bearing a North American or European certification of energy efficiency.

Making A Building More Energy Efficient

A wide range of measures may be taken to make a building more energy efficient. Determining which measures to implement often requires detailed calculation of use within the building and heat gain/loss from the building, and the costing of retrofit options to determine which are cost effective; professional assistance will often be necessary to perform these analyses. The least cost approach is to ensure that energy efficiency is designed into buildings in the first instance. The following retrofit measures, however, will typically result in significantly reduced energy usage and significant energy cost savings in the eastern Caribbean region:

1. Sealing air conditioned spaces so that cooled air stays within the space and warmer outside air does not enter the space.

2. In hotels, installing mechanisms in guest rooms that require the insertion of the guest's key while the guest is in the room to activate the electrical system of the room, and which results in all electrical systems shutting off when the key is withdrawn when the guest leaves the room.

3. Installation of insulation to a level of R 10 in the ceiling/roof of all air conditioned spaces.

Options may also be available for introducing more energy efficient equipment into a building to improve overall energy efficiency.

GUIDELINES FOR PERFORMING AN ENERGY AUDIT

Preparing For The Audit

Before undertaking an energy audit, the following preparations should be made to ensure that the audit goes smoothly and that all required information is available in a timely manner:

1. Establish contact with the senior individual with responsibility for the audit in the facility/building to be audited. All communications concerning the audit and recommendations from the audit should go through this individual.

2. Give a facility at least one week prior notice of an audit visit in order to allow sufficient time for the facility managers to obtain the required documentation and inform the staff of the audit. Identify in writing the documented information that you require, such as electrical bills and plans/drawings.

3. Request that you be accompanied on your audit rounds by a facility staff member familiar with the facility and able to explain your presence to staff.

4. Before entering any area of a facility , always announce your presence and ask permission. Respect facility rules which may delay or prevent entry into some areas. When these situations occur , try to obtain information about energy using equipment in these areas by talking with staff. Obtain and use any required personal protective equipment required by facilities to allow entry to certain areas.

Performing The Energy Audit

Energy audits should be performed using the following worksheets provided in this manual:

- Energy Audit Checklist. These worksheets provide the basic data gathering tool for performing an energy audit. As appropriate to the facility to be audited, the following sections of the Energy Audit Checklist should be completed:

    - General
    - Architectural Components
    - Mechanical Systems, having regard for blowers and fans, boilers and steam systems, chillers and refrigeration systems, cooling towers, compressors and compressed air systems, heating/ventilation/air conditioning (HVAC) systems, drying systems, fire protection systems, heat exchangers, pumping systems, vacuum systems, energy recovery systems and water and sewer systems
    - Electrical Systems, having regard for lighting, motors and drives

- General Electrical Information
- Motor Data
- Room Lighting Assessment

THE CHECKLISTS PROVIDED IN THIS MANUAL SHOULD BE PHOTOCOPIED AND USED AS NECESSARY; BE SURE TO RETAIN A MASTER COPY OF BLANK CHECKLISTS.

The following steps should be taken to complete the energy audit, as appropriate to the facility being audited, and data should be entered onto the relevant worksheets:

1. Obtain and review electricity and fuel use records for the facility; records for the previous 14 months are preferred.

2. Obtain and review any facility drawings showing details of electrical and mechanical systems as well as building construction details. Use drawings to determine the extent of systems and level of building envelope insulating value.

3. Use information gathered as well as interviews with facility maintenance staff to determine age and general condition of the facility and its systems. Determine , from interviews , if any major system or facility upgrades are planned or have been recently completed.

5. Physically inspect and record information on all small portable electrical appliances used in the facility. This should include , for example , computers , printers , photocopiers , printers , refrigerators, small kitchen appliances , and televisions. Try to determine the approximate number of operating hours per week.

6. Physically inspect and record information on electric motors in the facility. If the motors are integrated into equipment such as air conditioners or refrigerators , just obtain information on the equipment , not the individual motors. For motors that are not included with equipment , record motor information on the audit data sheet. For each motor , record sufficient information about motor size, duty , and location to uniquely identify it. Also record information about how the motor is controlled such as simple on/off control or automatic control. If motor is running , obtain running amperage at motor starter using a clip on ammeter if one is available. NOTE: ONLY WORK AROUND EXPOSED LIVE ELECTRICAL CIRCUITS WITH THE ASSISTANCE AND SUPERVISION OF A CERTIFIED ELECTRICIAN.

7. Inspect and record all light fixtures in the facility. In each room or area that can be uniquely identified , measure and record the light level at working surfaces. In each area , determine the number and type of fixtures as well as fixture age , number of lamps , and fixture control. Also inspect and record information on any emergency fixtures in the area.

8. Inspect and record information on all individual unitary and mini split air conditioners in the facility. Determine electrical load information or unit capacity or both . For mini split systems, remember to obtain information from both the internal evaporator section and the external condenser/ compressor section. Also record information about unit location and if it is blocked by furniture or other equipment. Also record information about how each unit is controlled and the location of the controller.

9. Inspect and record information on central air conditioning systems in the facility. Record location , area served , unit type and capacity , condenser location , ductwork size and extent , unit controller type and location , and condition of equipment , filters , ductwork , and controls. Ask building occupants served by each system to describe the level of comfort provided by each system. Determine weekly operating hours of each system. Check level and condition of ductwork insulation and vapor seal.

10. Inspect and record information on fuel using appliances in the facility such as boilers , domestic hot water heaters , emergency generators , and kitchen appliances (if applicable). Determine appliance capacity , age , condition , and fuel consumption. Also inspect fuel storage tanks , piping systems , pumps etc. Look for signs of leakage or system restrictions or blockages that can reduce efficiency.

11. Inspect and record information about other electrical equipment such as elevators , water pumps, exhaust fans, domestic hot water heaters, and transformers. Record information on equipment age, condition, capacity, and weekly operating hours. Also determine and record how the equipment is controlled.

12. Review the energy audit checklist for buildings once the initial audit review is completed. Review each item and ensure it has been addressed (if applicable) or if sufficient information has been gathered to allow it to be addressed. If not , repeat audit steps necessary to address the item.

Using Energy Audit Data

An energy audit generates the data on which to develop options and recommendations for improved energy efficiency. Using the data from the audit, options can be developed and costed to determine how energy use within a building can be made more efficient. A recommendation on a specific course of action can then be developed based on the technical options available, the cost of those options and the significance of the opportunity.

Typically, options for enhanced energy efficiency are evaluated in financial terms, using the concept of simple payback. Simple payback is calculated by dividing the cost of an energy conservation enhancement by the annual savings that are projected from the investment; the figure resulting from this calculation gives the number of years that are required for the savings in energy use to pay for the investment. For example, if an option is identified that will incur a cost of $10,000 to implement and will result in saving $4,000 per year in energy costs, then

$$\frac{\$10{,}000}{\$4{,}000/\text{year}} = 2.5 \text{ years}$$

In this example, the investment would pay for itself in 2.5 years. Most energy efficiency initiatives are capital intensive and the calculation of simple payback does not therefore address labour and other non-capital costs of an initiative; these costs can be factored into the analysis as appropriate.

Generally, investment options with a simple payback of about 3 years or less are considered worthwhile in financial terms as well as energy conservation terms; options with a 3-5 year simple payback are also frequently acted upon, particularly in a climate of rising energy prices since increasing energy costs will decrease the simple payback period. Options with a simple payback of greater than 5 years may not be considered financially justifiable; in this instance, although significant energy efficiency enhancements may still be achieved the cost of these enhancements may not be considered to warrant action.

As noted above, some of the simplest energy efficiency actions can also be the most effective. Turning off lights in an office building, use of roof insulation and ensuring that air conditioned rooms are sealed are simple initiatives that can generate significant energy savings.

ENERGY AUDIT CHECKLIST

GENERAL ELECTRICAL INFORMATION

MOTOR DATA

ROOM LIGHTING ASSESSMENT