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ABSTRACT

Information concerning energy conservation management is presented to aid school administrators in improving the energy efficiency of their buildings and programs. Three general topics are discussed: (1) the general nature and unique characteristics of school energy management; (2) initial steps in developing a conservation program, including formulation of a task force and the conduct of an energy audit; and (3) specific energy saving techniques related to retrofit and operational changes, construction of new facilities, and transportation. Appendix A provides bibliographic references to materials which may be helpful to administrators in initiating or improving school energy conservation programs. All items listed are available through the Education Resources Information Center (ERIC). Appendix B lists governmental agencies and private organizations which provide energy information and assistance. (DC)

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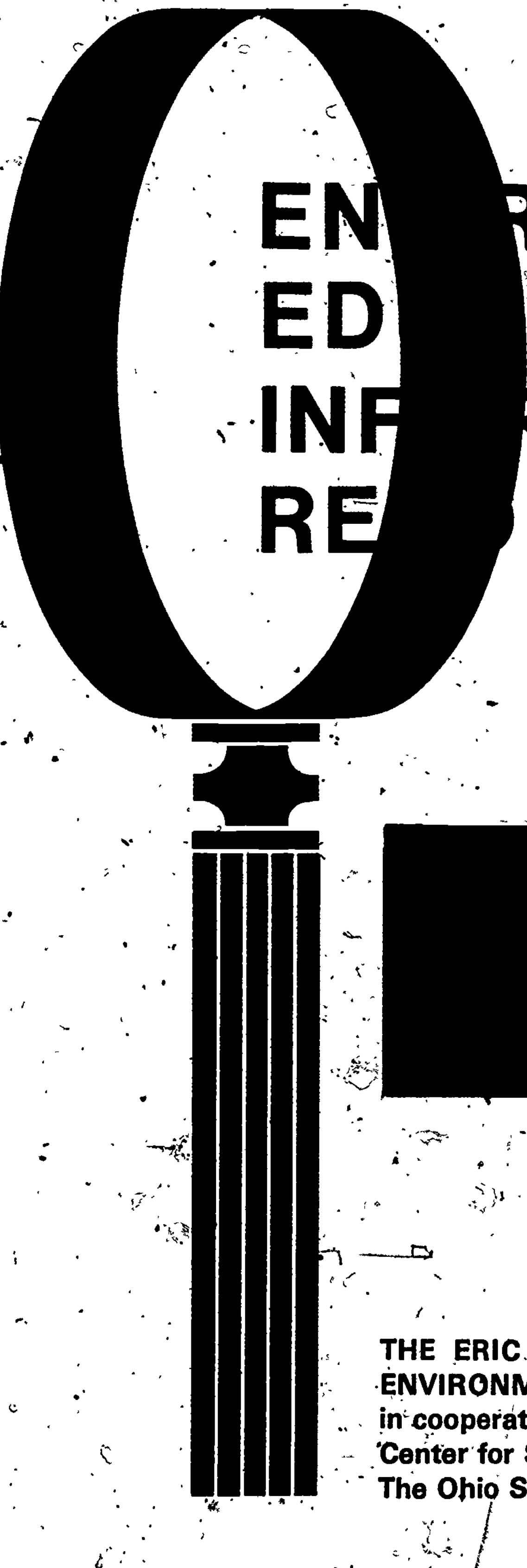

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ENVIRONMENTAL EDUCATION INFORMATION REPORT

THE ERIC SCIENCE, MATHEMATICS AND ENVIRONMENTAL EDUCATION CLEARINGHOUSE
in cooperation with
Center for Science and Mathematics Education
The Ohio State University

SE 035 863

BY
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ENERGY CONSERVATION MANAGEMENT FOR SCHOOL ADMINISTRATORS: AN OVERVIEW

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PREFACE

The purpose of this monograph is to make school administrators aware of information and available resources which will help to improve the energy efficiency of school operations. Because of the complexity of energy problems, no single approach to the proper management of daily energy operations is provided; rather, a broad range of recommendations is made, not all of which will be found appropriate for every situation.

The benefits of energy conservation are already evident in the experiences of many school systems. Educational institutions and school districts have successfully made cost-beneficial improvements in the use of fuels and energy consumption. Planned conservation programs have resulted in more energy-efficient buildings; staff members have been trained in energy retrofit procedures; transportation systems have been altered to save fuel; and school officials have made appropriate use of technical assistance. Many examples of such improvements have been documented.

The assumption upon which this monograph is based is that review of available information can be helpful in organizing an effective energy conservation program or improving an ongoing effort. In addition to the information reviewed in the body of the monograph, Appendix A contains summaries of specific documents obtained from a search of the ERIC catalogs Resources in Education (RIE) and Current Index to Journals in Education (CIJE). Details of their availability are included.

Besides consulting written materials such as this publication, school officials should contact state, federal, and private organizations to obtain additional information and assistance. Appendix B lists government agencies and private organizations which can provide such assistance. Frequently, periodic newsletters or journals, as well as grants and consultant assistance, are available. For example, the federal government, through the Department of Energy, will provide 50/50 matching funds to schools for energy audits and modification of buildings.

Assistance in developing this monograph was received from Dr. Philip K. Piele, Director, and staff of the ERIC Clearinghouse of Educational Management, University of Oregon, who reviewed the manuscript and made recommendations for inclusion in Appendix A.

ENERGY CONSERVATION MANAGEMENT FOR SCHOOL ADMINISTRATORS: AN OVERVIEW

SCHOOL ENERGY MANAGEMENT

It has been estimated that on any given school day approximately 25 percent of the nation's population is located within educational institutions. Energy to support instructional activities for this large number of people is used in a variety of forms, including light, heat, ventilation, equipment operation, and transportation.

As the cost of energy increases and supplies become more limited, school administrators are seriously considering methods to control and manage consumption. Abundant success stories suggest that there are savings available to schools when systematic approaches are applied to the problem. Quick action measures that can be readily accomplished by existing staff should result in immediate reductions of fuel and energy. More complex modifications that may take several years to accomplish can result in greater savings.

As administrators search for ways to reduce energy consumption, they often find that many buildings consume large quantities of energy by virtue of their design. Although major alterations are difficult and costly, low-cost alternatives are possible for the short term, permitting time to plan long-range energy conserving methods. An efficiently managed building can save as much as 30 percent in energy.

The management of schools is unique. Unlike other large commercial users of fuel, they cannot easily pass on increased costs to the consumer. Budgets are often locked into certain spending patterns. In a typical school budget at least 85 percent is allocated to personnel costs (salaries, benefits, etc.) and the remaining 15 percent (called discretionary) to books, athletics, special programs, and utility bills.

Another characteristic of school systems is their vast differences in size, equipment, personnel, and student population. A large urban school is faced with energy costs unlike those of a rural school. Therefore, a specific comprehensive energy management program should be developed for each school entity.

There is little doubt that for the foreseeable future schools will be confronted with increasing energy costs, possible shortages and tightened budgets. Programs for effective energy management must be implemented if current academic environments are to be maintained and school closings caused by energy concerns avoided.

Austerity is causing many school officials to consider recycling and preserving old buildings rather than constructing new facilities. For districts with expanding student populations, however, new construction is unavoidable. Those who are planning new facilities must examine the total needs of the district. Construction of additional space and purchase of new equipment must be done in ways that will permit as much curricular flexibility as possible and still be economically and educationally sound.

New methods and devices to conserve energy are being developed, but they may involve high initial costs and retraining of staff to operate them efficiently. The decision as to what methods to adopt depends on multiple considerations. The construction and operation of buildings should strike a balance between short-term and long-term spending of public funds. Attaining such a balance may require a critical examination of current policies, attitudes about energy, and alternative construction options.

Although the cost of energy is of primary concern to administrators, school districts also have an ethical obligation to play a leadership role in educating the community to be conservation-minded. By example, schools can show that they are concerned with conserving the natural resources of the nation for use by the future generations they are educating. Public support will be greater if a leadership role is exhibited.

PLANNING FOR CONSERVATION

A helpful way to begin the planning of a sound program of energy conservation is the appointment of a task force of people who will be directly affected by the results of the program. An energy task force committee can be used to facilitate participation, initiate activities, and monitor results. A task force also encourages coordination and enhances communication among members, resulting in less duplication and a more comprehensive program. The program's success will depend on the support it receives from the community, faculty, staff, and students, all of whom should be represented on the task force. A more extensive list of groups from which task force members should be selected is as follows:

(1) Members of the board of education

(2) PTA

(3) Faculty members

(4) School administrators

(5) Operations and maintenance personnel

(6) Students

(7) Transportation personnel

(8) Food service personnel

(9) Qualified lay persons

Frequent scheduled meetings of the task force are essential during the beginning phases of operation. Specific actions will be required that may significantly change the way the school functions. Continued dialog during all phases is important but is most critical during the initial phase when an action plan should be developed to

(1) determine goals, objectives, and strategies for each building;

(2) conduct a survey and energy audit for each building;

(3) assign responsibilities to specific individuals and groups;

(4) explore the possibility of using outside consultants; and

(5) recommend specific actions that will result in more efficient energy use.

As the energy conservation plan becomes organized, consideration should be given to the appointment of an Energy Conservation Manager. A large school district, or one with complicated energy problems, should consider hiring qualified individuals to assist with committee responsibilities, employ consultants, coordinate work activities with school personnel, and guide the implementation of the energy conservation program, A smaller system should consider the assignment of a staff member familiar with school operations and provide adequate time for that person to organize an effective program.

AUDITS

One of the most important aspects of an energy management plan is the conduct of a survey and audit. The survey should list all uses of energy and describe the building characteristics. The audit should attempt to determine the amount of energy being used, for what purposes, and whether it is being used effectively. Since most school buildings were designed during a period of abundant and inexpensive energy, initial costs for construction were given more weight in the decision-making process than other factors. A review of current energy consumption can be revealing and provide data required to correct some of the major energy consumption factors.

The energy audit should be initiated by collecting accounting records on annual consumption of all types of energy for each building. With the survey information and energy sources identified, a team of specialists can inspect and evaluate specific facilities. Initial inspection to observe and analyze the building structure, operational practices, and other factors is essential. This procedure familiarizes the inspection team with the types of equipment and operations of the facility.

The level of skill required of the inspection team will depend on the type of building to be audited. Older buildings without climate control systems do not require a sophisticated analysis. Buildings with mechanical ventilation and air conditioning should be audited by individuals with substantial background in these systems.

Some school districts may prefer to hire outside consultants, whereas others may depend on their internal resources to conduct the actual audit. An outside consultant may actually save money. Generally, outside consultants can recognize inadequacies in the building and can identify the lack of technical skills of staff members operating the systems. Professional engineering firms charge a fee for their services. Costs can be held to a minimum if important information is collected in advance and made available to the engineer. Some utility companies, on request, will assign one of their staff members to the audit team without charge. If the school can convince a qualified local citizen to volunteer his or her time to help conduct an audit, the system will benefit from both the expertise and the community concern of the individual.

The result of the audit should be a set of recommendations for action by the school district. These recommendations are generally at two levels; i.e.,

(1) actions that have little or no cost and can be accomplished with the technical skills available to the school district, and

(2) actions that can be achieved through capital investment in modifying building hardware, which will be recovered during the lifetime of the building.

An audit service developed by Educational Facilities Laboratories with federal support is available nationally. The Public Schools Energy Conservation Service (PSECS) is a computer-based auditing service. Information is collected on the type of school, based on date of completion, plan types, construction, mechanical systems and use of glass. Data detailing uses of the school during the day, after school, evenings, and weekends are collected. Finally, energy consumption based on utility bills or actual measurement of fuel is entered.

The PSECS printout of an individual school compares its actual energy use with what it should be using if it were operating according to guidelines. Also provided are suggestions for reducing energy consumption in the school and estimates of the savings that would result if the suggestions were followed. Since the service does not provide on-site analysis, all conclusions require further study. Additional information on this service can be obtained from Public School Energy Conservation Service (PSECS), 1572 South 1400 East, Salt Lake City, Utah 84105; (801) 484-7260. The cost for an elementary school audit is $75; secondary school audits cost $100.

RETROFIT AND OPERATIONAL CHANGES

Provision of a safe and healthful environment conducive to learning is as important to school districts as saving energy costs. Adequate light for safety and good vision, sensible temperature, and ventilation must be provided to students and staff. Educational tasks should be performed in an environment that is physically healthy and psychologically comfortable.

Over the past years, devices and systems used to modify and control the internal environment have tended to be mechanical and electrical, requiring extensive energy for their operation. These systems require considerably more fuel than methods of control that use natural sources (such as sunlight). The need to make the systems more efficient by improving their operation and maximizing the use of natural sources is basic to the retrofit process.

In most instances, custodial, maintenance, and building engineers, and school district specialists, will be directly involved in this process. It should not be assumed that such personnel have the skills necessary to make all modifications. However, they can make major contributions by improving operational and maintenance (O & M) procedures, learning new skills, and improving energy efficiency by making structural, mechanical, and electrical modifications within their capabilities.

School districts need skilled personnel trained to operate and maintain equipment if an energy conservation program is to be fully effective. An O & M training program to upgrade the knowledge and skills of school building personnel concerning architectural, mechanical, and electrical components can be highly beneficial. The increased proficiency and expertise of these individuals realistically can be expected to result in a cost-beneficial savings. In addition, O & M personnel can gain knowledge and improve their technical skills by attending courses at community colleges and technical institutes.

Skill improvement also can be obtained from manufacturer-sponsored courses on specific pieces of equipment or systems. A request made to a manufacturer's representative can often result in assistance and training. The most popular option is on-the-job instruction. A trainer, employed or hired by the school district, uses the actual building and equipment for instructional purposes. Familiarization with specific types of equipment and procedures will result in increased efficiency of operations that can be immediately observed. On-the-job instruction gives trainees only information that is important for their functions.

Inadequate maintenance, conducted in a sporadic, unorganized manner, results in excessive energy consumption. Proper maintenance saves energy and prolongs the lifetime of equipment. A review of current O & M procedures should be conducted and an improved schedule developed and monitored.

Preventive maintenance will also save energy. Particular attention should be given to systems that are most likely to cause excessive energy consumption through maladjustments or lack of maintenance. These include ventilation systems, boilers and their combustion systems, and automatic temperature control systems.

Generally, buildings that are the least efficient should be given priority over those where energy loss is minimal. Similarly, projects that are of low cost and can be accomplished by in-house personnel should receive priority over those that are costly and require outside specialists. Operational changes that minimize disruption of school activities are scheduled first, while those activities that create noise or other disturbances are best scheduled when classes are not in session.

Sample lists of modifications that can be considered by school districts are presented for review; they are not comprehensive and cannot replace an energy audit. Rather, they are intended to give an overview of suggested activities that can be accomplished with technical skills available to the school district.

Heating, ventilation, and air conditioning

1. Insulate hot bare pipes
2. Install caulking and weather stripping
3. Preheat combustion air
4. Replace worn boiler controls
5. Insulate steam lines
6. Install and/or replace steam traps
7. Return steam condensate to boiler
8. Reduce air volume
9. Install automatic thermostats
10. Install heat recovery equipment
11. Install time clocks for air conditioners
12. Install temperature controller and sensor
13. Establish a ventilation operation schedule so exhaust system operates only when needed
14. Reduce use of heating and cooling systems in spaces used infrequently
15. Turn off heat and cooling during the last hours of occupancy
16. Consider closing outside air dampers during the first and last hours of occupancy
17. During the cooling season, flush the building with cooler outdoor air during evening and night hours
18. Turn off all noncritical exhaust fans
19. Keep refrigeration coils free of frost buildup

Lighting

1. Remove lamps of fixtures not needed
2. Replace incandescent lighting with energy-conserving fluorescent lamps
3. Design lighting for specific tasks

4. Lower height of lighting fixtures

5. Control exterior lighting

6. Disconnect ballasts from fluorescent fixtures if lamps are removed

7. Schedule lighting maintenance and relamping programs to maintain good lamp efficiency

8. Use natural light when available in a building

9. Use photocell and/or astronomical time clock controls for outdoor lighting whenever feasible

Operational

1. Schedule student and staff hours to maximize daylight working hours

2. Consolidate activities into fewer rooms

3. Install signs on exterior walls near doors providing instructions to keep doors closed

4. Post signs near electric power-consuming machinery urging it be used sparingly

5. Establish a policy to review efficiency when purchasing energy-consuming devices

6. Repaint or clean exterior finish to improve reflective characteristics; when repainting, use light surfaces to reflect both heat and light

7. Where open space is available, plant trees or large shrubs to act as windbreaks and to reduce solar penetration

8. Install adjustable outdoor shading devices such as sunshades, which reflect solar heat before it enters the building; such sunshades also enable entrance of warming rays during the heating season

9. Reglaze windows with double or triple glazing or with heat absorbing and/or reflective glazing materials

10. Add reflective materials to the window side of draperies to reflect solar heat when draperies are drawn

11. Use opaque or translucent insulating materials to block off and thermally seal all unused windows

12. Install storm windows and doors where practical

13. Repaint or resurface the roof to make it more reflective

14. Add or improve roof and wall insulation

15. Develop detailed shutdown program for maximizing energy savings during holidays and semester breaks, and an abbreviated program for weekends

Water

1. Install decentralized water heating

2. Install efficient nozzles and faucets

3. Adjust valves for minimum water use

4. Reduce domestic water temperatures to 120° F

5. Install flow-limiting shower heads

6. Plan maintenance to prevent faucet drips

7. Increase the amount of insulation on hot water pipes and storage tanks

8. Install a pressure-reducing valve on the main hot water service to restrict the amount of flow

9. Provide hand flush valves for urinal flushing rather than continuous water flow systems

An operational change that requires careful consideration is changing school calendars to take advantage of days least likely to impact fuel and energy resources. A computer simulation of a typical Colorado school suggests that:

(1) Shutting down the school completely during Christmas vacation and the month of January could result in an annual heating fuel saving of 23.9 percent.

(2) Extending Christmas vacation another week could result in heating fuel savings of 5.8 percent per year.

(3) Starting school as late as 11:00 a.m. in the winter and running later in the afternoon would save only about 5 percent of the heating fuel per year.

(4) Using the school on a year-round basis, requiring air conditioning in the summer months, would add 61.2 percent to the annual fuel and electricity bill.

(5) By turning heat on at 7:00 a.m. and off at 3:00 p.m. actual fuel consumption could be reduced by 13.8 percent annually.

Another study, this one conducted by the New York State Education Department, serves as a reminder that a school district's energy policy has an impact beyond the mere consumption of energy by the schools. Energy saved by closing schools may be consumed in the students' homes.

> Closing of school buildings during cold winter months may be counter-productive to total saving of energy. Energy needed for heat, light, and other school operations was found to be somewhat less when schools were closed. Energy consumption, as measured in the homes of children, was somewhat more when schools were closed. Thus it would seem that closing schools causes an increase in the use of fuels and electricity in the homes.

Administrators must consider factors such as climate, physical characteristics, and use of the building when determining scheduling changes. Since it is necessary to keep the building temperature at around 50° F to prevent freezing and structural damage, the amount of savings due to minor scheduling changes will not be significant in comparison to savings derived from retrofitting and other operations changes.

CONSTRUCTION OF NEW FACILITIES

The rate of new school construction in the 1980s will be less than that during the 1960s and early 1970s. Nevertheless, numerous buildings will be constructed, and energy considerations will become a major design consideration. The New Hampshire Board of Education reflected this attitude when it unanimously adopted the following policy: "It is to be expected, before approval of any submitted building plans for any purpose that involves school construction, that the very latest technology available will be utilized in energy conservation."

Architects and engineers are paying more attention to the building shell, insulation requirements, site orientation, amount of glass, multiple uses, equipment, and fuel energy considerations. Typically, energy considerations cause the initial costs of construction to be higher, but lower life-of-the-building costs can be expected. The

Northern California Chapter, American Institute of Architects, estimates that a 50 to 80 percent reduction in energy consumption is possible for new construction.

School districts should calculate the life-cycle cost of a building prior to approval of plans. Factors such as operating and maintenance costs become important considerations. During the life of a school facility, operating and maintenance costs (including energy costs) are three to four times the initial cost of the building. Data needed to conduct a life-cycle cost analysis are

(1) annual fixed charges, based on a capital recovery period of perhaps 20 years and including the interest charges;

(2) annual energy and fuel charges based on different energy sources under consideration and the fuel rate of different equipment;

(3) annual maintenance costs; and

(4) annual replacement cost of equipment.

The architect and engineer selected can assist with calculations and also provide information on the latest alternative technologies. For example, solar energy for heating is becoming more attractive and is feasible for school buildings in many parts of the nation. The National Science Foundation funded the design, construction, and evaluation of several school solar heating units. The results of one experiment at the Grover Cleveland School, Boston, Massachusetts, are as follows:

(1) Solar heating is effective and feasible in the northeastern United States.

(2) Over a full season the solar system is expected to provide more than 2/3 of the heating requirements of the middle third of the school (the portion served by the solar heating system).

(3) Institutional personnel (schools, governments, utilities, etc.) are highly interested in solar energy applications. They took the initiative to understand the system and actively participated in helping others to understand its operation and benefits.

(4) The technically aware public shows considerable interest in solar energy applications as evidenced by the number and types of visitors to the school.

(5) The solar system was compatible with local residences and businesses. No objections to shadowing, aesthetics, or even the inconveniences of the construction were evident.

(6) The construction workers were skeptical initially but became quite proud of working on the project when it became apparent that the solar heating worked.

(7) Even large, roof-mounted planar arrays are not particularly noticeable from a distance of a few city blocks.

(8) It is possible to utilize a solar array as a fascia to enhance a building's roof line.

(9) Resistance to vandalism is a major design consideration. Lexan window solar collectors withstood frequent impacts from thrown rocks and baseballs. There has been no damage to date and, for comparison, the school averages one broken window per week.

(10) Electronic integrators should be utilized for important data which varies randomly; i.e., solar flux.

A multitude of factors should be considered in planning the construction of an appropriate school facility. A helpful list (below) has been compiled by the New Hampshire State Department of Education in its <u>Manual for Planning and Construction of School Buildings</u>.

1. Do not exchange short-term minimal savings for long-term maximum gains.

2. Orient the building to take advantage of the natural energy-saving features of the site--use trees and other buildings as windbreaks from prevailing winds and storms. Place parking area so that it does not expose building to winter winds nor heat up summer cooling breezes.

3. Shape the building for optimum energy use. (Cubic shape maximizes volume while minimizing surface area.)

4. Design the facility on the edge of comfort; use humidity controls and good vapor barriers.

5. Consider burying part of the building to reduce heat losses and air infiltration.

6. Design the building for minimum acceptable exposed wall and roof areas.

7. Use sun to heat the building with south-facing windows, and provide thermal curtains or shades during nighttime, use wind and nighttime ventilation to cool.

8. Supervision during building construction is essential to assure best use of building materials. Ensure vapor barriers and insulation are installed correctly.

9. Provide proper automatic controls--heat, ventilation, and for some lighting. Make use of natural ventilation when available; exhaust air to leeward direction.

10. Design efficient mechanical systems to cut down overheating and overlighting.

11. Use efficient lighting sources--concentrate light on tasks.

12. Room switching should be designed so unneeded rows of lights can be turned off (new fixtures provide means to illuminate only partial number of tubes).

13. Require day/night thermostat control for unoccupied temperature setback.

14. The building gross wall should have a heat loss factor not greater than .20

    a. The glass area of a wall should not exceed 20 percent of the total wall area.
    b. Windows generally should be double-glazed, thermopane, or combination with nighttime insulating curtain or panel.

    c. Locate windows advantageously.

    d. Storm doors or vestibules should be used.

15. The building roof, through proper insulation, should have a heat loss factor no greater than .05; for opaque walls the best factor should be no greater than .06; foundation walls below grade enclosing a heated space shall not be greater than 1.2. Floors to unheated spaces--heat loss factor should be .08 or less.

16. The heating system efficiency should drop no more than 10 percent at 1/2 load.

17. Heating duct air losses should be restricted to 3 percent of air volume.

18. Hot water and steam lines should be insulated.

- Install low-volume boiler fixtures and shower heads.

19. Restrict ventilation to 3 cubic feet of air per person per minute when outside temperature is below 10° F.

20. Large building heating zones involving multiple rooms should be restricted to 3,000 square feet or less. Heating systems should be able to function without outside air being introduced.

21. Consider use of heat recovery systems that remove heat from the exhaust air to preheat incoming air.

TRANSPORTATION

Students must be transported to and from school (when they live outside the walking limits established by the district), on field trips, and for extracurricular activities. Data collected by the National Center for Educational Statistics show that in the U.S. nearly 268,000 school buses travel 2.6 billion miles annually to transport 21 million children attending grades K through 12. School buses use more than 350 million gallons of fuel annually to transport about 52 percent of all pupils in the country. This represents an energy consumption of 43,750 billion Btu's each year--about 7.5 million barrels of oil.

As with other components of an energy management program, a school district should adopt a transportation policy, establish objectives, and initiate a plan. A typical goal could be to transport the maximum number of pupils the shortest necessary distance in vehicles offering the greatest miles-per-gallon for the task.

National leadership to conserve energy in school bus transportation has come from such efforts as the Voluntary Truck and Bus Fuel Economy Program, developed jointly by the Department of Transportation, the Environmental Protection Agency, and the Department of Energy. This program has received the voluntary cooperation of motor carriers, vehicle manufacturers, component suppliers, and trade associations. The goals are twofold; i.e., to save fuel through the application of more fuel-efficient technology, and to encourage more efficient operating practices, including driver and mechanic training programs, better maintenance, and improved routing and scheduling.

One project of the Voluntary Truck and Bus Fuel Economy Program was the publication of ESTEEM--Encouraging School Transportation Effective Energy Management. Copies are available from the Department of Energy, Voluntary Truck and Bus Fuel Economy Program, Washington, DC 20461. The handbook is designed for directors of pupil transportation, school administrators, and others involved in transportation management. It provides practical information about fuel conservation, recommendations for training mechanics and drivers, guidelines for purchasing equipment and fuel, and suggested administrative policies. Also available from this office is a newsletter, Fuel Economy News, that provides current information about transportation conservation efforts throughout the nation. Those interested in receiving copies may submit their name and address to the same office.

The ESTEEM handbook is designed to be used with the U.S. Department of Transportation's publication series, "Fuel Economy Through Teamwork." The series consists of five booklets addressing the subjects of:

1. Pupil Transportation and Energy Conservation
2. Purchasing for Fuel Economy
3. Driving for Fuel Economy
4. Operating for Fuel Economy
5. The Science of Saving Fuel

Copies of the series are available from the U.S. Department of Transportation, Voluntary Truck and Bus Fuel Economy Program, Washington, DC 20461.

The following checklist can be reviewed by school districts to assist in development of a transportation conservation program. It is excerpted from the document, The Energy Crisis in the Public Schools: Alternative Solutions, by Grossbach and Shaffer.

Vehicle Operation

1. Tune and maintain engines to peak performance. Correct faulty sparkplugs, points and carburetion.
2. Use modern analyzing equipment to ensure fuel and oil economy.
3. Keep gas tanks full to avoid excessive evaporation.
4. Ensure that bus tires are properly inflated.
5. Reduce speed limit to as low as practical.
6. Reduce weight by removing luggage racks, extra tire, chains, etc.

7. Drive slowly and carefully the first few miles until vehicle warms up.

8. Avoid the "red line" even in shifting gears.

9. Reduce warm-up time for buses to the very minimum. Have drivers turn off their engines during loading and unloading of children or at any time engine is idling more than 2 minutes.

10. Avoid full throttle operation.

11. Avoid courtesy stops.

12. Schedule bus routes to avoid driving up hills; stay on main roads only.

13. Plan stops on level instead of inclines.

14. Drive slowly back to the bus yard.

15. Use intercoms on buses to reduce stops for controlling discipline.

16. Install two-way radios to direct operation or redirection of buses to avoid unnecessary use.

17. Monitor use of vehicles. Install trip recorders to record driver and vehicle operation. Use this information to reduce use of gas and oil.

18. Plan routes to make only right turns to save on idling time.

19. Consolidate loads.

20. Centralize pickup and return points.

21. Use computers to analyze bus loads and schedule bus runs.

22. Eliminate buses that use excessive amounts of gasoline.

23. Eliminate operation of all buses not truly needed.

24. Use smaller vehicles for long-distance, light-load runs. Use the smallest bus possible.

25. Bus students only during inclement weather.

26. Eliminate transportation for summer school.

27. Encourage high school students to walk to school or to form car pools.

28. Lengthen distances between pickup points.

29. Have older students walk to central pickup points.

30. Cooperate with nonpublic schools to consolidate bus drivers.

31. Reduce field trips.

32. Use shuttle buses for students to and from athletic contests.

33. Minimize staggered school schedules.

34. Provide boarding for students who live in isolated areas a long distance from schools.

35. Use satellite bus parking.

36. If bus drivers have split shifts, determine if their last route ends near their home. If it does, have them take the bus home during the midday period. This will eliminate the extra driving that results from a driver bringing the bus back to the terminal, driving his car home, and driving his car back to the terminal.

37. When adding or replacing buses consider the smallest, most economical vehicle possible.

38. Change legislation which caused some buses to have capacity reduced.

39. Review and evaluate all security measures in the district. Make changes to take care of any increased problems resulting from the energy crisis.

Driver Inservice

1. Train new drivers on existing runs while bus is "deadheading."

2. Use simulators to reduce behind-the-wheel training in vehicles.

3. Increase frequency of driver inservice programs.

4. Retain experienced drivers as long as possible.

5. Train drivers to use pre-planned starts and stops for less gas consumption.

6. Hold joint workshops with maintenance and driver personnel to improve operation.

7. Use an incentive system for reducing vehicle fuel consumption.

Changes in School Organization

1. Reestablish the neighborhood school where students can walk.

2. Establish a four-day school week, thereby saving one day's driving of buses.

3. Consolidate beginning and ending times of all schools, including special education programs.

4. Relocate special education classes to neighborhood walking schools or centralized special classes in one location to avoid excessive transportation.

5. Review special programs to determine need for transportation. Determine if there are some special education students who could walk to their schools.

6. Enter into interdistrict attendance agreements with other districts to avoid excessive bus travel.

7. Change attendance boundaries to reduce transportation.

8. Increase walking distances.

9. Contract with parents to provide transportation.

10. Reduce school year to minimum number of days to save operation costs.

11. Eliminate transportation for summer school.

12. Share equipment and bus runs with neighboring districts.

Use of Vehicles for Trips Other Than to and from School

1. Combine field trip requests from more than one school.

2. Limit field trips to full bus loads only.

3. Establish minimum and maximum distances for field trips.

4. Combine school teams and schedules so several games can be played at the same time. Consolidate bus trips.

5. Have districts share buses when holding athletic events.

Alternate Forms of Transportation

1. Use parent transportation and give assistance to parent in obtaining necessary insurance.

2. Use charter and public transportation.

3. Students should be encouraged to form car pools. Provide them with protected parking.

4. Encourage use of bicycles. Provide adequate and protected bike racks.

5. Have parents provide transportation instead of using after-school activity buses.

Miscellaneous

1. Keep community informed of fuel-saving measures.

2. Use students and employees as resource persons for fuel-saving ideas.

3. Encourage students and employees to use car pools.

4. Develop an information exchange of ideas on fuel conservation between districts.

5. Offer incentives for schools to originate new ideas of fuel conservation.

6. Unload buses at the most sheltered entrance to buildings.

APPENDIX A: RESOURCES FOR ENERGY CONSERVATION MANAGEMENT FOR SCHOOL ADMINISTRATORS

The references in this section contain information useful to school administrators seeking to initiate or improve energy conservation management programs.

All references are identified by either an ED or EJ number which will make it possible to locate them. Documents listed with ED numbers are reported in the appropriate monthly issue of Resources in Education (RIE), a publication of the Educational Resources Information Center (ERIC) aimed toward early identification and acquisition of reports of interest to the educational community. RIE is made up of resumes and indexes. The resumes provide descriptions of each document and abstracts their content. The index section provides access to the resumes by subject, personal author, institution, and publication type. Many of the documents are available in microfiche or paper copy from ERIC Document Reproduction Service (EDRS), P. O. Box 190, Arlington, Virginia 22210, or may be located and reviewed in the growing number of ERIC microfiche collections distributed widely throughout the United States.

References with EJ numbers are journal articles. Abstracts and bibliographic information appears in Current Index to Journals in Education (CIJE), a monthly guide to current periodical literature in education. Approximately 775 educational and education-related journals are included. Copies of many of the articles reported in CIJE are available from University Microfilms International, 300 North Zeeb Road, Ann Arbor, Michigan 48106.

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APPENDIX B: GOVERNMENTAL AND PRIVATE SOURCES OF ASSISTANCE ON ENERGY MANAGEMENT

GOVERNMENTAL AGENCIES

Community Services Administration
1200 Nineteenth Street NW
Washington, DC 20506
202/254-5590

Department of Commerce
14th St. (Between Consititution Ave. and "E" St., NW)
Washington, DC 20230
202/377-2000

Department of Defense
The Pentagon
Washington, DC 20301
202/545-6700

Department of Education
400 Maryland Avenue SW
Washington, DC 20202
202/245-8795

Department of Energy
Washington, DC 20545
202/252-5000

Department of Housing and Urban Development
451 Seventh Street SW
Washington, DC 20410
202/755-5111

Department of Transportation
400 Seventh Street SW
Washington, DC 20590
202/426-4000

Environmental Protection Agency
401 "M" Street SW
Washington, DC 20460
202/755-2673

Government Printing Office
North Capitol and "H" Streets NW
Washington, DC 20401
202/275-2051

Library of Congress
10 First Street SE
Washington, DC 20540
202/426-5000

National Academy of Science-
National Academy of Engineering
2101 Constitution Avenue NW
Washington, DC 20418

National Science Foundation
1800 "G" Street NW
Washington, DC 20550

National Technical Information Service
(Department of Commerce)
5285 Port Royal Road
Springfield, VA 22161
703/537-4660

Tennessee Valley Authority
400 Commerce Avenue
Knoxville, TN 37902

PRIVATE ORGANIZATIONS

Air Conditioning and Refrigeration Institute
1815 North Fort Myer Drive
Arlington, VA 22209

American Association of School Administrators
1801 North Moore Street
Arlington, VA 22209

American Home Lighting Institute
230 North Michigan Avenue
Chicago, IL 60601

American Institute of Architects
1735 New York Avenue NW
Washington, DC 20006

American Institute of Plant Engineers (AIPE)
1021 Delta Avenue
Cincinnati, OH 45203

American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE)
345 East 47th Street
New York, NY 10017

The American Society of Mechanical Engineers (ASME)
345 East 47th Street
New York, NY 10017

Association of Home Appliance Manufacturers
20 North Wacker Drive
Chicago, IL 60606

Association of Physical Plant Administrators of Universities and Colleges
11 Dupont Circle, Suite 250
Washington, DC 20036

Building Officials and Code Administrators International, Inc. (BOCA International)
1313 East 60th Street
Chicago, IL 60637

The Conservation Foundation
1717 Massachusetts Avenue NW
Washington, DC 20036

Council of Educational Facility Planners, International
29 West Woodruff Avenue
Columbus, OH 43210

Edison Electric Institute
90 Park Avenue
New York, NY 10016

Educational Facilities Laboratories
850 Third Avenue
New York, NY 10022

Energy Conservation Council (ECC)
P. O. Box 7800
Atlanta, GA 30309

Illuminating Engineering Society of North America (IES)
345 East 47th Street
New York, NY 10017

Motor Vehicle Manufacturers Association
1909 "K" Street NW
Washington, DC 20006

National Conference of States on Building Codes and Standards, Inc.
1970 Chain Bridge Road
McLean, VA 22101

National Electrical Manufacturers Association (NEMA)
2101 "L" Street NW
Washington, DC 20037

National Energy Foundation
521 Fifth Avenue
New York, NY 10017

National Environmental Systems Contractors Association (NESCA)
1501 Wilson Boulevard
Arlington, VA 22209

National Insulation Contractors Association (NICA)
1120 19th Street NW, Suite 405
Washington, DC 20036

National Mineral Wool Insulation Association, Inc. (NMWIA)
362 Springfield Avenue
Summit, NJ 07901

National Science Teachers Association
1742 Connecticut Avenue NW
Washington, DC 20009

National Solar Heating and Cooling Information Center
P. O. Box 1607
Rockville, MD 20850

Sheet Metal and Air Conditioning Contractors' National Association
8224 Old Courthouse Road
Vienna, VA 22160

Solar Energy Industries Association
Suite 632, 1001 Connecticut Avenue NW
Washington, DC 20036

Solar Energy Institute of America, Inc.
1110 6th Street NW
Washington, DC 20001