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ABSTRACT

The 43 references in this booklet emphasize practical, rather than theoretical, information. They were chosen on that basis from two computer-retrievable data bases maintained by the U.S. Department of Energy. The citations, for the most part, are arranged by source and include industry pamphlets, journal articles, and state and consultant studies. The use of heat pumps and solar energy is treated in a section on special systems. (Author/IRT)

ENERGY SAVINGS IN SCHOOL BUILDINGS: A SELECTED CHECKLIST

Compiled by

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Augusta, ME 04333

September, 1979

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Credit must be given to the Maine Congressional delegation, which arranged initial State Library access to the Department of Energy data files:

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Senator William Cohen
Senator Edmund Muskie

Credit should also be given to J. Gary Nichols, State Librarian, who mandated this checklist, and to Evelyn Duncan, Support Services, Library Development Division.

Introduction

The forty-three references in this booklet were selected from two machine-readable data files maintained by the U.S. Department of Energy: ENERGY DATA BASE and GENERAL AND PRACTICAL (Energy Information).

Arrangement is by type of publication. The focus is on practical information as opposed to the theoretical.

Availability varies. Many items are most easily available from the author(s) or producing agencies; when the cost is known, it is indicated. Others may be out of print. These, photocopies of journal articles, and longer books can most often be obtained thru the resources of a local school or public library. Such libraries are linked to a sophisticated interlibrary loan system, so that the item can be borrowed if it is not available locally. There are two sources here not generally carried by libraries: National Technical Information Service (NTIS) and University Microfilms International. In both cases, the researcher must order from the source on a prepayment basis.

In order to back up the local libraries, the Maine State Library will obtain as many of the publications cited in this booklet as possible. This will be especially valuable to those school administrators and maintenance personnel who need an item for a few weeks only. But for anyone embarking on serious retrofitting or energy auditing, purchase of the needed items is strongly recommended.

Computer-based data files such as the ones used to create this booklet can be searched by State Library personnel. Many dozens of files in diverse subject areas are available. The information in most of these files is arranged much like the entries which you see in this booklet; for example, the abstracts which you find here were found on-line with the rest of the information in the particular citation. In Education, powerful resources exist in the ERIC, EXCEPTIONAL CHILD, PSYCHOLOGICAL ABSTRACTS, and CHILD ABUSE AND NEGLECT data files.

Use of these data files is available to Maine clients thru a State Library service known as TALIMAINE. For further information, write TALIMAINE, Maine State Library, Cultural Building, Augusta, ME 04333.

Don Wismer
State Agencies Librarian
September 7, 1979

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ENERGY AUDIT WORKBOOK FOR SCHOOLS. Department of Energy, Washington, D.C. 84 pages. Available from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. Order number DOE/CS-0041/2. Price codes PC A05/MF A01 (paper copy $6.00, microfiche $3.00). Prepayment required. Sept., 1978.

This workbook describes some simple methods by which the administrator, maintenance manager, or operator of a school can analyze energy uses, determine areas in which energy savings can be made, and estimate the magnitude of cost savings in accordance with U.S. Department of Energy procedures described as Class C Information Audits. It provides a co-it-yourself, fill-in-the-blanks approach to an energy-conservation program for schools that do not have full-time engineering personnel. Of necessity, it is a generalized approach which cannot be as detailed as an energy audit conducted by an engineering team. Although this workbook emphasizes the energy-intensive processes and some of the recognized areas of energy waste in schools, it should be used selectively because each building has its unique energy-use patterns.

2
ENERGY GUIDELINES FOR SCHOOL FACILITIES. Hicks, N.C.B. 123 pages (dissertation from East Tennessee State University, Johnson City, Tennessee). Available from University Microfilm International, 300 North Zeeb Road, Ann Arbor, MI 48106. 1978.

The purpose of the study was to determine energy conservation practices in selected school systems and to identify practical means of efficient utilization of energy resources as they relate to educational facilities. As a part of this study, guidelines to improve the utilization of energy resources in practical ways were developed. The study was presented in three parts: (1) related literature was searched for criteria for guidelines for energy conservation opportunities; (2) a rating sheet was developed and used to determine the significance of the criteria as rated by authorities in the field; and (3) using the rated guideline elements, a survey instrument was developed and used to collect data from the selected area. Results indicated that city school systems had implemented more energy conservation practices than county systems, but that financial cost had little bearing on adoption practices. Many minimal/no cost guidelines had not been implemented by the school systems.

UTILITY INDUSTRY PAMPHLETS

3
GUIDELINES FOR ENERGY MANAGEMENT - EDUCATIONAL FACILITIES. Series: ECS TECHNICAL DATA: ENERGY MANAGEMENT. Available from Northeast Utilities, P.O. Box 270, Hartford, CT 06101. c.1977. 6 pages.

Heating, cooling, lighting and water heating measures for energy management in educational facilities are suggested.

4

LIST OF ENERGY CONSERVATION MEASURES THAT CAN BE IMPLEMENTED IMMEDIATELY IN SCHOOL BUILDINGS. 4 pages. Available from Minnesota Energy Agency, 740 American Center Building, 150 East Kellogg Blvd., St. Paul, Minnesota 55101.
Jan. 22, 1977.

Recommendations are tabulated for space heating systems, ventilation systems, hot water systems, and lighting systems.

5

ENERGY-SAVING TIPS: LIGHTING SYSTEMS. 6 pages. Available from Consumers Power Company, 212 W. Michigan Avenue, Jackson, MI 49201.
Feb., 1974.

Suggestions are presented for improving the lighting systems for commercial and institutional buildings.

6

QUESTIONS AND ANSWERS ON ENERGY CONSERVATION IN SCHOOLS. 10 pages. Available from Educational Facilities Labs., 850 Third Ave., New York, NY 10022.
Feb., 1978.

Seventeen questions are posed dealing with energy conservation in schools. Energy consumption or energy efficiency in schools should be of interest to the populace because it is the taxpayers' money that supports the schools, energy costs being one aspect of their operation. Some areas covered include the cost to implement a conservation program, how much energy do schools use, and energy use efficiency of schools.

7

THINGS YOU OUGHT TO KNOW ABOUT WINDOW REPLACEMENT. 9 pages. Available from Capitol Aluminum and Glass Corporation, 1276 West Main St., U.S. 20, Bellevue, OH 44811.

Common questions asked about replacement windows for schools are answered.

8

IDEAS TO HELP YOU SAVE ENERGY. 81 pages. Available from Columbia Gas of Ohio, Inc., 99 N. Front St., Columbus, OH 43215.
c.1977.

Various means of conserving gas energy are presented for homes, medical facilities, schools, and hotels.

9

7 RULES TO HELP CONSERVE FUEL IN SCHOOLS. 2 pages. Available from Columbia Gas of Ohio, Inc., 99 N. Front St., Columbus, OH 43215.
c.1977.

Simple energy conservation measures concerning thermostats, windows, doors, lighting systems, and maintenance are presented in poster form.

10
SCHOOLS TAKE ACTION AGAINST THE ENERGY CRISIS. Series: ENERGY ACTION STORY. 3 pages. Available from The East Ohio Gas Company, P.O. Box 5759, 1717 E. 9th Street, Cleveland, OH 44101. c.1977.
The energy conservation program by which the Orrville, Ohio City School System reduced utility bills by up to 41% is described.

JOURNAL ARTICLES (GENERAL)

11
MODERN SCHOOLS (author not known). in Electric Comfort Conditioning News 5,3 (April 1978), pages 2-3.
It is stated that schools and colleges consume 1.5 percent of all U.S. energy consumed; 25 to 50 percent of this school-consumed energy is wasted; and 5 to 25 percent of this waste could be avoided without capital expenditures by changing school operating methods. Starting with this information, a program for energy management in schools is outlined.

12
GENERAL PLAN FOR ENERGY CONSERVATION IN SCHOOL DISTRICTS. Baird, T.M. and K.L. Dacko. Aware No. 84 (Sept., 1977), pages 2-5.
A general proposal is given for school districts to assess their energy problems. Goals are outlined for reducing energy consumption both at the individual school level and for an entire system. The plan stresses involvement at all levels of the staff, as well as at the community. Obstacles and possible solutions are listed. The first task is to determine how much energy is used and in which areas of operation. A system to monitor energy consumption and make comparisons over time will need to be devised in order to evaluate the amount of real saving. An energy conservation program developed for school systems in Florida is summarized with its goals listed.

13
ENERGY CONSUMPTION AND CONSERVATION IN SCHOOL BUILDINGS. Graham, M.P. Heating, piping and air conditioning 49, 7 (July, 1977) pages 85-90.
The Carleton Board of Education is responsible for the operation of 56 elementary schools and 13 secondary schools. Energy conservation has become of prime importance due to the rising costs of heating fuels. The Board initiated a study of the energy-use patterns to establish a framework of data with which to work when making decisions about retrofitting and new construction. Data were compiled and reduced to units of kilowatt-hours per square meter per degree-day to make judgments concerning cost benefits, life-cycle costs, or payback periods for various systems or building retrofits. The monitoring system developed is discussed. Measures were put into effect in existing buildings to cut down on energy use and guidelines were established for retrofits and new construction projects. New codes and standards, such as ASHRAE 90-75, provided additional guidelines.

STATE AND CONSULTANT STUDIES

14
DISTRICT LEVEL PLAN FOR CONSERVATION. Series: THE TEEM APPROACH. Anderson, C.E. 54 pages. Available from Colorado Dept. of Education, 201 E. Colfax Avenue, Denver, CO 80203 c.1977.

A six-step energy conservation plan for schools is presented in memo form.

15
ECONOMICALLY RATIONAL ENERGY CONSERVATION PROGRAM FOR INSTITUTIONAL BUILDINGS. McClintock, M. 17 pages. Available from Boston University Center for Energy Studies, Boston, MA 02116. 1977.

A methodology is developed which allows generation of an optimum energy conservation program primarily, but not solely, suited to institutional buildings. The method has the flexibility to allow assessment of (1) technical improvements to the building structures, (2) changes in maintenance and operation policies, (3) alternative energy technologies, and (4) educational aspects of energy conservation for administrative staff, maintenance and operation personnel, faculty, and students. The result of its application is an ordered conservation program in which savings realized from the first measures are used to underwrite the cost of later measures, and it is therefore possible to pay for a large part of the program out of cash flow rather than necessitating capital fund raising programs. Once instituted, of course, many energy conservation measures continue to save long after they have been paid for. An economically rational energy conservation program therefore has the potential to provide some of the highest returns on investment at the present time.

16
ECONOMY OF ENERGY CONSERVATION IN EDUCATIONAL FACILITIES. 5 pages, $2.00. Available from Educational Facilities Laboratory Inc., 850 Third Avenue, New York, NY 10038. 1973.

17
ENERGY AND EDUCATIONAL FACILITIES: COSTS AND CONSERVATION. Educational Facilities Labs., Inc., New York. Available from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. Order number TID-27629-P2. Price codes PC A03/MF A01 (paper copy $4.50, microfiche $3.00). Prepayment required. Apr. 1977.

Data are presented on energy consumption and costs for U.S. primary, secondary, and university-level educational facilities. Opportunities for energy conservation in such facilities are discussed. Since schools consume 5% of all space-conditioning energy used in the USA or 1.5% of the total national energy consumption, reduced energy consumption could contribute significantly to the nation's 1985 energy conservation goal.

18
ENERGY CONSERVATION CHECKLIST FOR UNIVERSITIES AND COLLEGES. 22 pages, $1.50. Available from The Association of Physical Plant Administrators of Universities and Colleges, Eleven Dupont Circle, Suite 250, Washington, DC 20036. c.1977.
Several suggestions are offered as to how universities may save energy in heating and air conditioning, water conservation, building maintenance, lighting and electricity, transportation, and other areas.

19
ENERGY CONSERVATION DESIGN MANUAL FOR NEW NONRESIDENTIAL BUILDINGS. 391 pages. Available from Energy Resources Conservation and Development Commission, State House, Sacramento, CA 95800. 1977.
California Senate Bill 144 and the Warren-Alquist State Energy Resources and Development Act were signed into law in 1974. Senate Bill 144 called for the adoption of energy conservation standards for new non-residential buildings, and the Warren Alquist Act established the California Energy Resources Conservation and Development Commission. The development of this design manual was mandated by Senate Bill 144. During 1976, the Commission awarded six contracts for the preparation of explanatory material to be presented in this manual. The manual has two basic purposes. First, it should assist those who must comply with and enforce the standards. Second, and equally important, it should encourage the design, construction, and operation of energy-efficient buildings in California. A portion of the manual is devoted to compliance and enforcement requirements. Component performance standards for the building envelope are specified.

20
ENERGY CONSERVATION IN SCHOOL FACILITIES. 6 pages. Available from Office of Energy Resources, State House, Augusta, ME 04333. c.1977.
Energy-saving ideas for school heating, lighting, and facility utilization are given.

21
ESTABLISHMENT OF AN ENERGY CONSERVATION MANAGEMENT PROGRAM IN ILLINOIS SCHOOLS. Tuma, S.L. and J.E. Dunwoody, affiliated with the Illinois Dept. of Business and Economic Development, Springfield. Div. of Energy. 66 pages. Available from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. Order number PB-271730. Price codes PC A04/MF A02 (paper copy $5.25, microfiche $3.00). Prepayment required. June, 1977.
This energy conservation manual was written to help local and district school administrators in justifying, organizing, and implementing an effective energy management program within state schools. It discusses energy costs and operating expenses over the life of the facility and gives examples of energy-saving tips together with the forms necessary to make a walk-through school audit.

22
HOW TO SAVE ENERGY AND CUT COSTS IN EXISTING INDUSTRIAL AND COMMERCIAL BUILDINGS: AN ENERGY CONSERVATION MANUAL. Edited by Dubin, F.S., H.L. Mindell and S. Bloome. 735 pages, $24.00. Available from Noyes Data Corporation, Park Ridge, NJ 07656.
1976

Buildings consume for heating, air conditioning, lighting, and power more than 33% of all energy used in the United States, the equivalent of 10 million barrels of oil per day at a time when oil imports are approximately six million barrels per day. Energy conservation programs that have been undertaken within the past three years in existing commercial, institutional, and residential buildings have already resulted in a reduction of their annual fuel and electricity consumption of 20 to 50% and indicate the range of potential savings for almost all buildings now in use. This book is based on reports prepared for the Federal Energy Administration by Dubin-Mindell-Bloome Associates. Part 1 of this energy conservation manual (ECM-1) is directed primarily to owners, occupants, and operators of buildings. It includes a wide range of opportunities and options to save energy and operating costs through proper operation and maintenance. It also includes minor modifications to the building and mechanical and electrical systems which can be implemented promptly with little if any investment costs. The measures contained in ECM-1 would result in energy and operating cost savings of 15 to 30% based on present fuel costs. Part 2 of this manual (ECM-2) is intended for engineers, architects, and skilled building operators who are responsible for analyzing, devising, and implementing comprehensive energy conservation programs which involve additional and more complex measures than those included in ECM-1. ECM-2 includes many energy conservation measures which can result in further energy savings of 15 to 25% with an investment cost that can be recovered within 10 years through lower operating expense.

23
LOW ENERGY UTILIZATION SCHOOL, ENERGY CONSERVATION OPERATION MANUAL, PHASE 2: REPORT. Stein, R.G., C. Stein and D.B. Nathan. 85 pages. Available from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. Order number PB-268555: Price codes PC A05/MF A01 (paper copy $6.00, microfiche $3.00). Prepayment required.
Mar. 31, 1977.

This manual consolidates maintenance and operational steps which will result in the lowest energy use consistent with a schools' educational program. It covers guidelines for maintenance and operating procedures for energy efficiency in the plant. A revised set of standards based on extensive research, and methods of scheduling and controlling the use of the equipment to provide services only when the spaces are occupied and only to the extent required by physical conditions and types of activity. Mainly, the discussion concerns procedures that are the custodian's responsibility.

24
PUBLIC SCHOOLS ENERGY CONSERVATION SERVICE. 8 pages. Available from Educational Facilities Laboratories, Inc., 3000 Sand Hill Road, Menlo Park, CA 94025. c.1977.
A questionnaire which will assist a school district in the development of effective energy conservation programs for their physical plants is described. An order form is provided.

25
SAVING MONEY THROUGH ENERGY AUDITS. Series: INFORMATION FOR SEMINAR PARTICIPANT. Pennsylvania Governor's Energy Council, Harrisburg. 38 pages. Available from Pennsylvania Energy Council, State Street Bldg., 12th Floor, Harrisburg, PA 17101. June, 1978.
This workshop was presented to enable local decision makers and operating personnel who do not have extensive technical training to organize, implement, and sustain an energy savings program in buildings. A large portion of building energy costs are "controllable." An effective program addressing the cause of waste and inefficiency in current building management practices will pay for itself many times over in savings of local tax dollars and private funds. The step-by-step process of establishing an energy budget for any building or complex of buildings is explained. The budget becomes a measuring stick of building energy effectiveness when compared to published information of similar buildings.

26
SCHOOL PLANT ENERGY TASK FORCE PLAN FOR CONSERVATION. Series: THE TEEM APPROACH. Anderson, C.E. 49 pages. Available from Colorado Dept. of Education, 201 E. Colfax Avenue, Denver, CO 80203. c.1977.
Energy-saving ideas for school buildings are presented.

CASE STUDIES

27
CAPITOL AREA VOCATIONAL CENTER. (Author not known). Electric Comfort Conditioning News 5,1 (Jan. 1978), pages 2-3.
The heat recovery system used in an Illinois vocational school to recover heat from lights for use in heating the 196,000 sq. ft. building is described.

28
CARNEGIE-MELLON U.'S SCIENCE HALL. Electric Comfort Conditioning News 5,2 (Feb. 1978), pages 2-4.
The energy audit performed on the science hall at the Carnegie-Mellon Institute, the energy waste found in the air handling system, and retrofitting of the air system are discussed. The retrofit is estimated to result in an annual savings of $300,000 and to have a payback period of 3 years.

29
COLLEGES OF APPLIED ARTS AND TECHNOLOGY. Electric Comfort Conditioning News 5,5 (May, 1978), pages 2-3.
A coordinated energy conservation program initiated in April 1975 by Ontario's 22 colleges of applied arts and technology has resulted in an energy savings of 87.5 million KWH in two years. First energy audits were performed on all buildings to establish energy consumption. Then operation modifications, retrofitting of equipment, and installation of energy conserving devices such as heat recovery and building control systems were affected.

30
ENERGY CONSERVATION IN BOSTON CITY PUBLIC SCHOOLS. Teichman, K.Y. 336 pages. Available from Boston Energy Office, 31 State Street, Boston, MA 02109.
Aug. 1975.
An energy conservation study of three Boston city public schools is discussed in detail. Energy saving recommendations are presented for the Boston English High School, the Boston Latin High School, and the Grover Cleveland Middle School that could conservatively realize savings of $18,200, $3,160, and $35,000 respectively. A complete energy balance is included for an air conditioning unit and the incinerator located at the Grover Cleveland School. In addition, an energy saving recommendation list is provided that could be implemented in all Boston schools. The solar heating experiment being conducted by the General Electric Company at the Grover Cleveland School is discussed in detail. This system is shown to be improperly designed for capturing as much solar insolation as is available in Boston. In addition, the system's storage capability is calculated to be less than 3 hours of the school's needs, and the bypass heat exchangers are shown to be able to dump only 54% of their designed capability. Actual solar system savings are estimated to be only $570 per heating season month as compared to the $3,000 per month reported. The Johnson Service JC/80 Building Control System, used at Boston English and Grover Cleveland, is described in detail. The capabilities of the system, its present operation in the two schools, and recommendations for the system's expansion are presented. Finally, a methodology for conducting an energy conservation study is included.

31
ENERGY CRISIS ANTICIPATED IN JAY HIGH SCHOOL DESIGN. Thorpe, R.L. Electrical Consultant 91,5 (May 1975), pages 10-11.
In the Jay High School in Jay, Maine the BTU's of 30 students and nominal lighting is equal to the heat transmission losses through walls and roof at -20° F outside temperatures. The walls and roof are well insulated and the limited window areas have insulating glass panels. Each classroom at the Jay school is provided with a combination heating-ventilating unit controlled by a room thermostat. This specially arranged unit is capable of maintaining the desired room temperature at 55° F when the school is unoccupied, by activating an electric heating coil. Just before the students arrive in the morning the temperature is brought up to 68 to 70° F. However, within a short time of the students entering the room, the heat produced by the students and lighting raises the temperature to 72° F. As outside temperatures rise to the 40's, 50's and 60's, more outside air is brought in to keep the room from overheating. As outside temperatures drop to the 30's, 20's and 10's, less outside air is required to keep the rooms at 72° F. At the Jay school some outside air is automatically introduced when students enter the classroom, to keep the atmosphere fresh and to maintain the students' alertness. This outside air varies automatically according to need--is heated by mixing

with the warmer air in the classroom and does not require the supplemental heat common to schools designed without recognition of energy conservation principles.

32
FIRST DOE SCHOOL PROJECT LISTS SAVINGS. Murnane, T. Energy User News 4,6 (5 Feb. 1979), page 7.
A DOE-funded project to reduce energy consumption at 10 school buildings will be used to help school officials plan energy conservation projects that will qualify for matching funds under the National Energy Act. A one to eight-year payback period is reported by the American Association of School Administrators (AASA) in its preliminary report. A retrofitting program at one site reduced electricity consumption 32 percent. Computer-based sensors were used by the Lawrence Berkeley Laboratory to monitor the building's heat flows and energy use. Lighting changes that replaced incandescent lighting with the Maxi-Miser Fluorescent System produced the most electricity savings, followed by additional roof insulation and window insulation.

33
NO MAGIC IN COLLEGE'S ENERGY CUTS. Sprackland, T. Energy User News 3,48 (27 Nov. 1978), pages 1,9.
The Greenfield (Mass.) Community College was able to reduce its energy consumption by 45% over a four-year period with a combination of dedicated people and standard, commercially available equipment. Payback for material expenditures was less than six months. The college, located in a 1974 pre-energy crisis building, undertook a program of retrofitting and modification that is handled mostly by staff. Manual override switches were added to the lighting system and fresh air is now used to precool air-conditioned buildings when the outside temperature permits. Other equipment and system changes, including small air conditioners in the computer room, time delay relays, fluorescent lighting, double glazed windows, and reduced glass in doors, are described.

34
REPORT TO IOWA ENERGY POLICY COUNCIL ON ENERGY AUDIT TOUR OF INDIANOLA JR. AND SR. HIGH SCHOOLS, INDIANOLA, IOWA. Edited by R.W. Flanagan. 21 pages. Available from Environmental Engineers, Inc., 215 Shops Bldg., Des Moines, Iowa 50314.
20 Apr. 1976.
Junior and senior high schools in Indianola, Iowa were subjected to an energy audit to determine areas of potential energy savings. A lack of monitoring equipment in the schools make the findings subjective. Faulty equipment, such as variable thermometers, also hampered the study. Previous practices of building engineers allowed only enough comfort to forestall complaints. Lighting and temperature control were found to vary widely within the buildings. A 20 percent reduction of energy use is projected if temperature and lighting management is changed and equipment improved. Estimates for capital expenses are $7,500 to replace control instruments. No formal energy conservation program is proposed. The study covers usage of buildings by teachers, students, adults, and custodians. Charts list current policy, applicability to the building, and capital cost of specific energy-reducing items.

35
REPORT TO IOWA ENERGY POLICY COUNCIL ON ENERGY AUDIT TOUR OF VALLEY HIGH SCHOOL, WEST DES MOINES, IOWA. Flanagan, R.W. 38 pages. Available from Iowa Energy Policy Council, State House, Des Moines, IA 50319. 1976.

The energy audit for Valley High School, West Des Moines, Iowa was conducted on April 19, 1976. All buildings and their usage were checked. Portions of the school buildings used for adult education were noted. Custodial clean up of the building, lighting levels and usage, and heating and air conditioning systems were observed. It was concluded that the overall utilization of lighting in the building was at a peak efficiency and not much can be done for improvement except by recirculating the building and/or removing light fixtures and/or tubes from the light fixtures along with the ballast. Some enormous losses were noted for the heating and air conditioning systems. Changing control sequences and methods of operation during the summer operation could result in a 30 percent reduction in energy input, but would require some capital investment in changes in control sequences as instrumentation. Very little instrumentation exists in any of the air handling systems for the chief engineer to know precisely an instantanious state of conditions of the discharged air, mixed air, and other conditions regarding each piece of air conditioning and heating equipment.

36
RETROFITTING UNIVERSITY BUILDINGS FOR ENERGY CONSERVATION. Sepsy, C.F. and R.H. Fuller. ASHRAE Transactions 82 (1 Feb. 1976), pp. 135-145. Proceedings of the ASHRAE Semiannual Meeting, Dallas, TX 75221.

The Allied Medical Building, a five-story main building consisting of offices, laboratories and classrooms with a two-story wing used for television studios, was studied for energy conservation. Energy savings modifications were analyzed for this building. Savings estimated for the modifications were a 39.9% reduction in gas and electric costs. Actual savings for the first quarter of 1975, based on meter readings compared to the same quarter of 1972, were a 63% reduction in cost.

37
SCHOOL'S FIRST LESSON: USE COMPUTER. Tanz, D. Energy User News 4,12 (19 Mar. 1979), page 7.

The Elmira, N.Y. school system has linked six schools to a building automation system and reduced fuel consumption by 20 to 25% after an energy audit indicated the need for an energy-saving program. A system of distributed processing uses microprocessors instead of telephone wires to communicate between buildings. Structural changes in pre-1960 buildings offered the best potential for energy savings, while electrical and mechanical modifications were all that was needed in newer buildings. A central computer as the first step means that all subsequent energy-saving programs can be monitored and documented. State funding covered 65% of the cost and payback is projected at less than six years, depending on how rapidly the remaining nine schools are connected to the computer. The computer now handles only duty-cycling, but will take on more comprehensive tasks, such as load-shedding, as the programming develops.

38
SOLAR ENERGY AND CONSERVATION AT ST. MARK'S SCHOOL. Final Report Mar. 76-Feb. 77. Jones, W.J. and J.W. Meyer. 181 pages. Available from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. Order number PB-265982. Price codes PC A09/MF A01 (paper copy $9.00, microfiche $3.00. Prepayment required. Feb. 1977.

This report investigates the possibility of employing solar energy at a residential secondary school. The approach was to explore this possibility in the context of a more general survey of opportunities to conserve energy (in particular, fuel) at the school and illustrate how to go about an appraisal of conservation opportunities plus implementation and evaluation of the most productive conservation measures.

39
TERRASET SCHOOL. Carter, D.N. Underground Space 1,4 (Aug. 1977), pages 317-323.

Terraset Elementary School, and earth-covered, open plan complex built in Reston, VA., is described. The initial design criteria and resultant structures are outlined. Topics include: plan form; development of high thermal mass; interior lighting; ventilation and solar heating and cooling; and capital and operational costs. The design of this earth-covered approach is a first step on the road to conserving the dwindling fossil fuel reserves of the earth. (13 diagrams, 1 drawing, 1 graph).

SPECIAL SYSTEMS

40
HEAT PUMP SYSTEM JUDGED BEST FOR COMPACT SCHOOL. Ratai, W.R. Heating, Piping and Air Conditioning 47,4 (1975), pp. 44-48.

The design of an elementary school for efficient flow of student traffic having efficient shape for minimizing heat loss is described. A Helical rotary (screw) compressor was selected for the heat pump.

41
SOLAR ENERGY AND ECONOMIC CONSIDERATIONS. Miller, J.F. ASHRAE Journal 19, 11 (Nov. 1977), pp. 40-42.

Economic considerations affecting selection of solar energy systems for building are briefly discussed. Comparative economic analyses of several candidate solar energy system configurations are tabulated for representative cases of hospital, school, and office buildings in three regions of the USA. System cost, return on investment, and projected payback period are used for economic comparison. The economic impact of using solar energy for supplemental domestic water heating is evaluated. Rules of thumb usually used for collector area and thermal storage optimization are concluded to be generally invalid.

42
TWO TURN TO SOLAR SYSTEMS. Mechanical engineering 98,2 (Feb. 1976), page 15.

Solar systems for a wastewater treatment plant and an underground school. A wastewater treatment plant in Wilton, Maine, and an elementary school in Reston, VA., both depend on solar energy, and both won the 1975 Owens-Corning Fiberglas Corp. awards for energy conservation. The wastewater treatment plant is divided into three basic areas, the sludge digestion area, the liquid clarifier room, and the Bio-Disc building, each with solar collectors set at 60°sup 0° at the southern exposure to provide necessary heat and improve efficiency. Methane produced in the sludge digestion area supplements the energy supply on cloudy days. The school will use up to 80% less energy than a conventional school of its size; it is built under 2-3 ft. of earth to provide insulation and is heated and cooled mainly through a solar energy system that includes a 7000 sq. ft. collector and three 10,000 gal. tanks for storing hot water.

43
ENERGY CONSERVATION AND TOTAL ENVIRONMENTAL CONTROL FOR SCHOOL AND INSTITUTIONAL BUILDINGS. A STUDY IN HEAT PUMP ALLICATION ENGINEERING. Strong, S.J. Pages 487-491. in NESEA 76: Decision Making in Solar Technology, edited by E. Shaw. Conference title: CONFERENCE AND EXHIBITION OF THE NEW ENGLAND SOLAR ENERGY ASSOCIATION, Amherst, MA. Available from New England Solar Energy Association, Townshend, VT 05353. 24 June 1976.

An engineering analysis commissioned to graphically illustrate the advantages of energy conservation and load balancing in school and institutional buildings to members of a school building committee and their consultants is reported. A 1000-student high school sited in an area of 6,000 degree days was selected. Its energy requirements were analyzed and detailed including ventilation loads, internal gains, thermal losses and gains through the structural envelope, domestic hot water and pool heating and humidity control. All possibilities for energy recovery and systems load balancing within the building were explored. The use of solar energy systems and heat pumps is reviewed.