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ABSTRACT

Summarized in this compendium are approximately 500 ideas being used by colleges and universities in the United States to deal with the problem of energy conservation. These ideas range from suggestions that cost pennies to implement to sophisticated computer controls or the construction of new buildings which incorporate alternative energy sources. Generally, the ideas are simple and they can be easily adopted on other campuses. Among the successful energy-saving approaches reported are those that involve education, management, using waste energy, improving lighting practices, modifying ventilation systems, and installing insulation. Grouped according to problem area, each entry includes a short explanation of the procedure followed by a summary of costs and resulting benefits. Appendix tables list ideas by topic, institution, and geographic location. Also provided are names, addresses, and phone numbers of contact persons for each idea. (Author/WB)

This handbook was prepared at the Academy for Educational Development by Sidney G. Tickton, Academy Vice President. Roberta Messalle assisted in project administration and the writing of the handbook, and Susan Penner assisted in the organization and writing. The other principal contributers were Susan Gafvert, secretary; Judith T. Irwin, printing consultant; Reva Tickton, editor; and Alan G. Green, technical consultant.

Additional copies of this handbook are available from the Academy for Educational Development, 1414 22nd Street, N.W., Washington, D.C. 20037, at $12.00 per copy prepaid.

Table of Contents

Preface

Educational managers at colleges and universities will long remember the decade that ran from the late 1960s to the late 1970s as a time filled with frustrating problems. Among the most frustrating that landed on the desks of front-office administrators was the question of how to cope efficiently with the energy situation—at a time when energy costs were jumping 25 to 50 percent a year. All of a sudden everyone realized that the buildings on college or university campuses had been designed when energy was cheap and was expected to remain cheap. Now maintenance budgets were tight. Building reconstruction or new equipment was usually out of the question. Energy conservation became a high-priority item on the president's agenda—in the tri-state area around Pittsburgh (where the Claude Worthington Benedum Foundation has allocated the major portion of its resources) as well as elsewhere in the country.

This handbook summarizes nearly 500 ideas and practices that colleges and universities actually put into operation during the past few years to meet the energy conservation challenge. The handbook is a testimonial to the ingenuity, inventiveness, and persistence of plant engineers, physical plant managers, and administrative leaders on campus.

Most of the ideas in this handbook are relatively inexpensive, as higher education budgets go, and most of the institutions recovered their cash investment in a relatively short period. Generally, the ideas are not complicated nor do they require persons with special training to put them into effect. Many can probably be replicated on other campuses without difficulty.

The Claude Worthington Benedum Foundation is pleased to hear of the successes that have been achieved and to have played a small part in the nation's energy conservation effort by funding the Academy's study. The distribution of the handbook will bring examples of successful ideas to the attention of college and university administrators across the country. We must point out, however, as we have on other occasions, that neither the Academy for Educational Development nor the Benedum Foundation is providing a prescription for any particular institution, nor are we offering any specific advice. All we are saying to you, the educators and managers in higher education, is:

> Here are ideas that are working at real colleges and universities. They reduce energy consumption and save on energy costs. Take a look at these ideas. If they fit your situation, feel free to adopt or adapt them at your institution.

We wish you every success as you tackle a problem that we all know is not going to go away very soon.

Paul R. Jenkins
Executive Vice President
Claude Worthington Benedum Foundation

Foreword

A basic point in education that stands out in my mind now as it did a generation ago is that different people learn in different ways, at different speeds, and in a variety of different circumstances. No one way of learning or teaching is the best for everybody. People have individual differences and this affects their learning patterns.

One way people learn is by studying examples of other people's success. For nearly a century the field services of the land grant colleges and universities have promoted and fine-tuned for farmers a particular process of learning: that is, by studying examples of success, preferably nearby. This approach to education—one of the real highlights in the development of the nation's educational system—helped millions of Americans learn about new ideas in agriculture.

In the preparation of the handbook the Academy took a parallel approach by undertaking to show that much can be learned about energy conservation by studying successful examples. Included here are nearly 500 examples of programs on energy conservation and education reported by colleges and universities across the country. These institutions can help everyone understand better what *can* be done everywhere by telling:

- what is already being done
- how it is being done
- where it is being done, and
- what the results have been.

Some of the examples in this handbook are ideas that are pretty good; some are better than that; some are terrific. There is one common denominator that runs through every page. Each idea listed is working now at some college or university. This handbook not only tells where, but also provides a telephone number of the person to call and the address to write to for further information.

This handbook of examples is the result of the Academy's request to the Claude Worthington Benedum Foundation for the support of a factfinding project that would summarize the ways institutions of higher education are meeting the energy crisis. When the Foundation agreed to this proposal, the Academy invited educational institutions to send in up-to-the-moment information. To give recognition to the most noteworthy efforts reported, if only in a modest fashion, the Academy awarded certificates of achievement to twelve institutions from among those submitting information. The Atlantic Richfield Foundation provided funds to back up each certificate of achievement with a $10,000 grant.

Selection of the institutions which received certificates of achievement was made by a small panel assembled by the Academy. The members were:

- George Bugliarello, President of the Polytechnic Institute of New York

- John G. Kemeny, President of Dartmouth College
- John D. Millett, Executive Vice President of the Academy for Educational Development
- James A. Perkins, Chairman and Chief Executive Officer of the International Council for Educational Development

In screening the information submitted, the panel gave special consideration to innovative ideas and practices that could be applied at or adapted by other institutions of higher education.

The Academy appreciates the support of the Claude Worthington Benedum Foundation and the Atlantic Richfield Foundation. We are grateful also to the hundreds of administrators and faculty members who sent in information about ideas that worked. Their efforts are impressive indeed.

Alvin C. Eurich, President
Academy for Educational Development

Introduction

For at least seven years, as long as the energy crisis has been critical on the world scene, the subject of conservation and the better use of the country's energy resources have been matters of national concern. Numerous articles, reports, studies, books, and analyses on the matters have been prepared, published, and distributed. Yet, today the United States is more dependent on foreign oil supplies than it was seven years ago, has still to develop a comprehensive national energy policy, and has taken relatively few steps toward the goal of assuring the adequacy of the country's energy supply for as little as five to ten years ahead.

There is nothing that one more report can do which will solve or even ameliorate the big energy problems facing the nation and the world. These problems will have to be dealt with by the President, the Congress, the executive branch of the government, the energy departments of the various states, and the captains of industry in energy and energy-related fields. The problems will have to be dealt with also by the leaders of the OPEC countries and of other politically active nations.

What this report can do, however, is to say to the administrators of colleges and universities: *imaginative and persistent steps can reduce energy consumption at a small out-of-pocket cost* and with a quick payback period. In itself this observation is not a new thesis—it runs through many recent publications, particularly those distributed by government agencies. But this report takes a different approach. It makes its points by the use of examples from the here and now. It shows colleges and university administrators that other institutions much like theirs, and possibly located near them geographically, have undertaken successfully to save on energy consumption or have proceeded to educate others to do so.

This report describes examples of successful energy savings or energy education projects reported to the Academy during the first quarter of the calendar year 1980. Appendix Table A provides an alphabetical list of the institutions reporting, along with the names, addresses, and telephone numbers of persons in charge of the projects. These persons can furnish further information on what they did and how they did it. Appendix Table B reclassifies the list by the major approaches taken by the various institutions. Appendix Table C classifies the list geographically. Appendix Table D describes institutions given the Academy's certificate of achievement and the $10,000 cash award.

In reviewing the examples sent in by the colleges and universities replying to the Academy's questionnaire, the Academy's staff was interested to note that a number of small steps taken by some of the institutions reporting are resulting in substantial energy savings, and, in many cases, reduction in costs even after inflation. As we read the entries it occurred to us that similar conservation steps could be taken in our homes, by large manufacturing corporations, by office buildings, by hospitals and health centers, and by many other types of institutions. Any small group of

people could mobilize a small number of associates to spread ideas about ways and means to conserve energy.

The staff also observed that the list of examples includes many from small colleges as well as from large universities; some simple systems as well as some sophisticated computer control operations; and a number of low cost approaches to energy conservation which a number of institutions had to take because of their own financial problems. Obviously, no one has a monopoly on new ideas or on innovative twists to old ideas that can contribute to energy savings. The fact is that whenever there is a "will to conserve," the results that can be achieved in even a year or two are truly astonishing.

Sidney G. Tickton
Academy Vice President

Note to Users of This Handbook

- The examples of ideas in practice included in the handbook are those that educators chose to submit. The Academy makes no claim, therefore, that the handbook is all-inclusive nor has it attempted to document all the information submitted by the institutions reporting.
- Descriptions are brief rather than comprehensive. The material received was abbreviated for use in the handbook. The purpose was to present ideas in terms of their impact on an institution's well-being and to provide the means for interested people to follow up on those ideas they think might prove useful at their own institutions.
- While the ideas contained in this handbook have been reviewed for accuracy, neither the Academy for Educational Development nor the foundations supporting this study nor the colleges and universities reporting can be held liable if the reported potential of savings in energy and costs is not actually achieved. The Academy for Educational Development does not recommend or endorse any specific brand of equipment which may be described in the handbook. Questions about any specific application of an idea in the handbook should be addressed to the reporting institution.
- The Academy is conducting a supplemental survey of colleges and universities to gather additional information on energy education and toward the end of 1980 will publish a complete as possible catalog of energy education programs, courses, workshops, and related activities.
- This handbook includes a number of reports by colleges and universities that they conserved energy by going on a four-day week. An energy task force of the Department of Energy has arrived at a contrary conclusion, suggesting instead that higher education institutions lengthen the work week and then send everybody home for longer vacations.

1

IDEAS ON Conducting Campuswide Conservation Activities

The Problem

Everyone knows that colleges and universities could save a good deal of energy and fuel by taking a large number of small conservation steps on their campuses. The problem at many institutions is how to develop and operate a campuswide conservation plan that has high visibility, encompasses all sectors on the campus, and produces substantial results in energy conservation in return for the time, money, and effort spent.

> **The Challenge** to mobilize the cooperation of all the various groups on the campus (such as students, faculty, administrative staff, trustees, visitors, etc.) in a manner that will reduce energy use and cost in every possible way, and will avoid a substantial investment in renovation and new equipment.

The Ideas

■ **Bentley College** (Waltham, Massachusetts) undertook a series of steps to develop a comprehensive campuswide energy conservation program. The college (a) installed a computer management system to reduce the cost of heating, cooling, and ventilating; (b) reduced lighting, (c) lowered temperatures of rooms and buildings; (d) ran the summer program on a four-day work week schedule, and (e) installed a solar energy system currently providing 60 percent of the hot water used by 700 students in two dormitories, with a third dormitory under construction soon to be tied into the solar system.

> **Results:** The comprehensive measures resulted in a cost avoidance of $367,000, due in part to the effectiveness of the $185,000 computer system. The solar project cost $500,000 and is already saving $10,000 a year net after debt service charges.

★ **Case Western Reserve University** (Cleveland, Ohio) organized a comprehensive energy conservation program at virtually no cost outside of the plant maintenance budget. Since 1973, each of the 86 buildings on the

★ Certificate of Achievement

campus has been involved. Every possible energy cut was made, from rearranging class schedules in order to use fewer buildings, lowering lighting levels and hot water temperatures, and recovering heat that would otherwise escape into the air, to turning off lights between 8:00 a.m. and 5:00 p.m. in rooms with windows, and cutting library, bookstore, and gymnasium hours. Videotapes and conference materials were developed and used as teaching tools by the school of engineering in its energy research and education programs.

Results: In six years the university reduced the energy consumed by 32 percent, using 544 million fewer BTUs of energy in 1979 than in 1973.

★ Lincoln Land Community College (Springfield, Illinois) in 1976 started "Energy Commitment," a program covering all aspects of energy conservation—from resource management and planning to education offerings. Management measures taken included an energy audit, installation of a computer to control the energy-use system, increased insulation, reduced lighting, a four-day week summer schedule, and the building of solar and wind generating systems on the horticulture building. Energy education programs ranged from college courses to gasohol workshops and energy forums for school administrators and government officials. Car pooling and increased mass transit services were organized for the campus community.

Results: The college used bond funds to provide most of the $508,000 in capital expenses incurred. Other programs were financed mainly by small local and federal grants, private contributions, and registration fees for the energy forums. The college has already achieved $77,000 in direct savings. All capital expenditure projects are expected to pay for themselves over a period of time ranging from one month to 16 years.

■ Penn Valley Community College (Kansas City, Missouri) engaged in a comprehensive program of saving energy wherever possible without investing new capital funds. Starting in 1976, the program has ranged from reducing lighting and resetting hot water and room temperatures in accordance with federal guidelines to shutting down unoccupied facilities at night, on weekends, and on holidays. Classes were reorganized to consolidate the occupancy of buildings.

Results: Since 1976 the college has reduced electricity consumption by 62 percent with a cumulative saving in electrical costs of more than $1 million. Gas consumption has been cut by 64 percent for a cumulative saving of $84,000.

★ Certificate of Achievement

■ State University of New York at Oswego (Oswego, New York) is developing a comprehensive conservation program that will use local alternative energy sources and recover wasted heat. A wind-powered generator will capture the continuous winds in the region to provide electricity. Water from nearby Lake Ontario will be used for cooling. Cogeneration, the process of extracting useful heat from the production of electricity, will be used to provide steam and air conditioning. Devices to recover heat otherwise wasted from boiler flues will be installed to preheat the water used in the boilers. Boilers will be redesigned to burn waste crank case oil. Controls will be added to three large boilers in order to increase their efficiency by four to five percent.

Results: All projects are now under construction. Completion is expected in late 1981.

■ State University of New York at Stony Brook (Stony Brook, New York) replanned the use of its entire heating and air conditioning system in order to meet federal temperature level guidelines. The physical plant staff ran the system "off-design" in order to determine how and what could be changed, and then sought cooperation throughout the campus for changes which included (a) shutting down one of two main refrigeration units in the air conditioning system; (b) lowering thermostats and hot water temperatures in the boilers; (c) recirculating warm return air; (d) closing down heating motors and fans at night; (e) monitoring boiler operations; and (f) recovering heat wasted by boilers. Special arrangements were made for laboratories that needed humidity control.

Results: This campus conservation program involved no initial costs beyond the regular budget. During the first year savings were as follows: air conditioning equipment—580,000 gallons of fuel oil valued at $400,000; heating equipment—950,000 gallons of fuel oil, valued at $700,000.

■ University of Pennsylvania (Philadelphia, Pennsylvania) established a Department of Energy Management and Conservation as a separate unit responsible for coordinating all campus operations involving the use of energy. The department's projects have ranged from low-cost community awareness campaigns and lighting reductions to the more costly installation of a central computer to control heating and cooling to the revamping of the insulation on all campus steam lines. The department works with the academic Energy Management Committee to coordinate class and activities schedules to achieve the most efficient arrangements between room occupancy and energy use.

Results: The department has saved the university a total of $8.3 million since operations began in 1976. The department's budget, $80,000 a year, has totaled less than $300,000 since the department was formed.

■ **University of Texas Health Science Center** (San Antonio, Texas) made many in-house adjustments to its energy system using leftover parts from construction, renovation of old buildings, and discarded equipment. Utilizing the work and cooperation of faculty, students, and other personnel on campus, the center made improvements to the chiller and hot water pumps, air units and chemical fume hoods, and cooling systems in the laboratories while maintaining the environmental balance required in the hospitals and exploratory health research facilities.

Results: Most improvements cost no more than $1,000 out-of-pocket because of the in-house design, use of the regular work force, and the use of spare parts. The cost of all projects undertaken was about $31,000. In 1979 alone energy use was cut by 14.7 percent and savings totaled $444,000.

■ **Upsala College** (East Orange, New Jersey) started a one-step-at-a-time conservation program in two buildings that were wasting energy. The heating systems were fitted with timers and clocks, fanpower was reduced, lighting was decreased, and insulation was applied to attic ducts. The quick payback on these improvements provided funds and the impetus for additional conservation steps that included lighting replacement, water temperature control devices, the shutdown of unused buildings in the winter, and a four-day week schedule in the summer.

Results: Since starting the conservation program in 1975 the college has reduced energy consumption by 33 percent and achieved energy savings of $324,000. The total cost of the program during the first four years was $38,000.

■ **Utah Technical College** (Salt Lake City, Utah) appointed an energy committee to recommend and oversee a series of technical energy saving improvements. These included rescheduling the use of buildings based on occupancy needs, analyzing expenses, repairing and updating equipment in the energy system, reducing lighting levels, lowering building temperatures, limiting the intake of outside air during periods of extreme temperatures, reducing and disconnecting fans, increasing boiler efficiency, and going on a four-day week summer schedule.

Results: The $5,700 cost of the project resulted in savings of $92,800 in the first year. Energy consumption was reduced substantially; electricity by 32 percent, gas by 45 percent, and fuel oil by 58 percent

2

IDEAS ON
Using Computer Equipment to Improve the Efficiency of Energy Systems

The Problem

The use of a computer system is an obvious way to manage, control, and evaluate the effectiveness of the lighting, heating, ventilating, and air conditioning equipment on college and university campuses. However, the cost of purchasing and installing a computer system that can provide comprehensive results is relatively high in proportion to the budgets of most institutions and in light of the financial savings that can be achieved, particularly by smaller colleges.

The Challenge — to develop creative solutions to overcome the relatively high cost of the purchase and installation of a computerized energy management system that will operate effectively on college and university campuses.

The Ideas

Note: A number of large universities have found that their energy costs are so high and the control function so substantial that they have given top priority to installing extensive computerized management systems. A number of smaller institutions also report the use of computerized equipment for management and control purposes. The examples that follow represent both the larger and the smaller institutions. No attempt has been made in this chapter to mention all the computerized management programs reported, which are described briefly in Appendix Table A and are listed in the appropriate categories in Appendix Table B.

Larger Institutions

■ Duquesne University (Pittsburgh, Pennsylvania) made a "shared time" contract with a large computer manufacturing company to provide computerized energy management in eight large campus buildings. As energy savings from the system are achieved, the university will expand the com-

puterized system to manage heating, ventilation, and air conditioning operations in all buildings on campus.

Results: Installation and operating costs of $93,500 were recovered during 1977, the first year of operation. By the third quarter of 1979 the accumulated amount of savings totaled $814,000.

■ Howard University (Washington, D.C.) developed a network of mini-computers to manage the energy equipment on its large and diverse campus; the university has a range of buildings, types of equipment, and operating environments and needs that are difficult to centralize and control. The network of mini-computers provides a better quality of controlled service at a reduced cost while cutting total energy use, and can operate alone or can be controlled from the central plant. The system is able to analyze the amount of energy used in each building and pinpoint problem areas. The small computers are simple to operate and the maintenance staff can modify or expand the system without the help of professional programmers.

Results: The university, a federal institution, received an appropriation of $3 million from Congress to set up and operate the network of mini-computers. The project yields annual savings of $570,000, and the university expects all of the investment to be paid back in about four years.

■ Maricopa County Community College District (Phoenix, Arizona) computerized the management of the energy systems at four of the colleges in the district in 1972. In 1980 the system was improved and extended to all campuses in the district.

Results: Cost of improvements and extension was $949,000. Energy savings are expected to be 15 percent of energy used valued at $300,000 a year with the new investment recoverable in three years.

■ Mount San Antonio College (Walnut, California) installed a computerized management system that controls 250 pieces of energy equipment. The computer does not require a computer operator; does not require knowledge of a computer language (English will do); and can be operated by a secretary, an electrician, or a mechanic.

Results: The system cost $164,000; net savings of $60,000 were achieved during the first five months of operation; electrical consumption declined by 20 percent; natural gas consumption by 29 percent. Higher energy decline percentages are expected in the future. The college found also that the computer can monitor alarms for the security system and can identify breakdowns in maintenance. When put into operation these functions will save an additional $140,000 a year.

■ Princeton University (Princeton, New Jersey) installed a sophisticated computer system to control the heating, ventilating, and air conditioning equipment and to monitor the energy consumption in 40 buildings which represented 45 percent of the energy used on the main campus. The system involves a main computer facility linked to microprocessors in each building. The system is unique because it is designed to produce energy savings in a large institution that had already optimized its energy operations.

Results: The computer system cost $3.8 million and went into full operation in January 1980. It is expected to save 900,000 gallons of oil, 4.4 million KWH of electricity, and $800,000 during the first year of operation. The investment is expected to be paid back in less than five years.

Other larger institutions saving energy by computerized management include Anne Arundel Community College (Arnold, Maryland) where the computer equipment cost less than $24,000 and the savings amounted to $23,000 the first year; Northern Arizona University (Flagstaff, Arizona) where the central control system installed in 1978 and costing $100,000 has achieved a 25 to 30 percent energy savings during the past three years and the entire investment will be recovered by 1982; Rutgers, The State University of New Jersey, (New Brunswick, New Jersey) where the expenditure of $440,000 in 1975 for a computerized energy management system has already saved more than $500,000; University of Louisville where the installation of a computerized system costing $200,000 in 1977 saved $170,000 in electricity costs during the succeeding two years; University of Miami (Coral Gables, Florida) where a computerized system costing $500,000 installed in 1979 is estimated to be saving $278,000 a year; and Western Illinois University (Macomb, Illinois) where a $150,000 system funded by the State of Illinois and starting operations in April 1977 reduced electrical consumption during the fiscal year 1977-78 by 8.4 percent with a value of $265,000.

Smaller Institutions

■ Loyola College of Maryland (Baltimore, Maryland) recently extended a computerized energy management system established some years ago for the remainder of the campus to reduce energy consumption used to heat the gymnasium which is old and large.

Results: In-house installation of valves, thermostats, and control parts cost $2,400. Savings are expected to be 48,000 gallons of fuel oil the first year, valued at $24,000.

■ Loyola University (New Orleans, Louisiana) selected a system for energy management that could use soft, low voltage telephone wire to tie 50 percent of the buildings on the campus into a computer which controls temperature and the periods of time heating and cooling units operate. The telephone wire was easy to install and prevented disruption of activities on campus due to construction. The system used by the university is produced by a local company and was in full operation within six months from the date of purchase.

Results: The system saved $57,000 during the first eight months and is expected to pay back all costs within two and one-half years.

■ McNeese State University (Lake Charles, Louisiana) purchased computerized energy management equipment to meet the university's precise specifications, which involved the ability to (a) perform a variety of control activities, (b) reduce equipment failures by reporting comparative performance data, and (c) monitor the security of the entire campus with only one employee on duty in a manner which will provide for the more rapid reporting of fires and the reduction of vandalism and theft.

Results: The cost of equipment and installation amounted to $240,000, funded by the state legislature. Electrical costs the first year are expected to decline by 20 percent, a savings valued at $104,000. Equipment failure rate is expected to be reduced by 25 percent, saving an additional $25,000 per year. The entire investment is expected to be recovered in two or three years.

■ Southwestern University (Georgetown, Texas) purchased a computer to control gas and electrical use on the campus, using the lines of the university's internal telephone system. The computer programs gas and electrical use in a way which cuts out consumption for five out of each 20 minutes during the day.

Results: The computer cost $340,000; savings the first year were $160,000, with electricity consumption reduced by 1.7 million KWH and gas consumption by 500,000 cubic feet.

■ Susquehanna University (Selinsgrove, Pennsylvania) installed a minicomputer in 1977 to control and monitor its heating, ventilating, and air conditioning systems. The university achieved better control over the operation of its air handlers by also tying them into the computer system. Additional savings were made when campus fire and security monitors were added to the computer's control.

Results: In two years the computer system, which cost $55,000 installed in-house, saved $76,000 in costs and 8.2 million KWH of electricity.

■ **Wellesley College** (Wellesley, Massachusetts) installed a small microprocessor energy management computer to monitor the 32 buildings on the college's campus. At the beginning, the computer controlled 50 points; another 100 points of control are being added.

Results: Cost was $42,000, including materials and in-house labor. Savings the first year amounted to $113,000.

Other smaller institutions saving energy by computerized management include **Dean Junior College** (Franklin, Massachusetts) where the computer equipment cost $111,000, and savings were estimated at $28,000 for the first eight months; and **Potsdam College of Arts and Science**, a division of the State University of New York (Potsdam, New York) where a leased mini-computer control system costing $1,100 a month automated outside air dampers and is saving 17 percent of the natural gas used per year.

3

IDEAS ON
Conserving Energy Use by Imaginative Planning and Management

The Problem

If colleges and universities were able to use efficiently all the energy and power entering into or generated on their campuses, they could (according to the Department of Energy) reduce the amount of energy used by 30 to 50 percent. The problem is how to achieve these conservation results on campuses which have large physical plant operations, a variety of building structures and problems, special services creating fluctuating energy needs, and in some cases, campus occupants who have individual control over room temperatures and lighting.

> **The Challenge**... to coordinate and incorporate imaginative energy saving ideas, plans, and management approaches into all phases of campus life and operation.

The Ideas

■ Art Institute of Chicago (Chicago, Illinois) used a computer to analyze the various ways of providing a range of internal climates and temperatures within the limitations of the institute's budget. Heating, ventilating, and air conditioning system changes were then based on the computer's analysis showing the best way to provide the heat and humidity needed to preserve the many art objects, museum artifacts, and valuable library materials on display.

> **Results:** The cost of the changes was $678,000; savings amounted to $346,300 during the first year of operation and a complete payback of investment is expected in 1.7 years. Energy use was cut by 29 percent.

■ Central Piedmont Community College (Charlotte, North Carolina) saved gasoline costs for commuting students by making lecture portions of classes available by telephone. Each student in the program is issued a telephone amplifier to make note-taking easier while listening to the lectures by phone.

Results: The college estimates a 10 percent savings in gasoline consumption, or the equivalent of 294,000 gallons of gasoline. At current costs, this represents a savings to commuting students of $350,000.

■ City Colleges of Chicago (Chicago, Illinois) updates all engineers operating buildings in the system by a training program, designed by faculty and outside consultants, that emphasizes current practical energy saving methods.

Results: The specialized training results in more efficient operations.

■ Creighton University (Omaha, Nebraska) after being notified that its natural gas energy source would be cut off by 1980 because of shortages of supply, constructed a steam and water pipeline to the plant of a regional energy supplier located next to the campus. The pipeline was financed partly by a loan from the university's endowment fund and partly by private contributions to a fund-raising drive.

Results: The total cost of the pipeline was $2,250,000; the investment is expected to be paid back over a 20-year period. Annual savings in energy costs are now about $106,000 and are expected to escalate over the years.

■ Iowa Wesleyan College (Mount Pleasant, Iowa) entered into an unusual cooperative agreement with the local utility company in 1973 under which the company sold municipal revenue bonds to raise funds to install gas fueled boilers in its plant for generating steam for nine of the college's buildings. The college pays the gas bill and reimburses the company for the principal and interest payments on the bonds. In 1979 the college decided to extend the steam line to four other buildings where the boilers needed extensive repairs.

Results: Construction will be completed in 1980. The college expects to recover the cost in three years. Added savings will come from eliminating boiler maintenance.

■ Lake Erie College (Painesville, Ohio) leases gas well drilling rights to a local utility company in an agreement that gives the college a percentage of the profits from the sale of the gas, as well as a free supply of the gas for its own use. A 12-year supply of natural gas is located under campus land owned by the college.

Results: The college receives $1,000 per month in revenue from the sale of gas. Four additional wells, soon to be drilled, will increase revenue and the supply of free gas to the college.

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■ Lake Erie College (Painesville, Ohio) leases gas well drilling rights to a local utility company in an agreement that gives the college a percentage of the profits from the sale of the gas, as well as a free supply of the gas for its own use. A 12-year supply of natural gas is located under campus land owned by the college.

Results: The college receives $1,000 per month in revenue from the sale of gas. Four additional wells, soon to be drilled, will increase revenue and the supply of free gas to the college.

■ Louisiana State University (Baton Rouge, Louisiana) found that rather than hiring outside contractors, it was cheaper to (a) train its three-person maintenance staff to do in-house boiler tune-ups and (b) buy the necessary tools and equipment. With 52 gas-run boilers and hot water generators on an 800 acre campus, the university expects to save energy by having a heating system that is always well maintained and efficient.

Results: The cost of the eight-hour training program was $500 with an additional $3,300 spent on tools and equipment. At the current level of gas prices, net savings are estimated at $148,000 a year.

■ Middlebury College (Middlebury, Vermont) took advantage of the fact that the electric company based its set monthly service fee for the whole year on the energy consumed each year during the peak period between December 15 and March 31.

After determining that the peak was reached in the week prior to the Christmas break due to short days and long hours of studying for final examinations, the college mobilized students, faculty, and other employees to reduce energy consumption during that week. Included were such procedures as serving dinner by candlelight, closing offices and classes by 4:30 p.m., playing the carillon earlier to signify the end of the day, placing strict controls on the use of equipment and appliances, and using smaller, more efficient ovens in the kitchen.

Results: In 1978, the set monthly fee was reduced by five percent. Although the college does not attribute cost-savings wholly to "peak week," administrators were so confident of success that they organized a "peak month" in December 1979 and January 1980 and saved another four and one half percent.

■ Morton College (Cicero, Illinois) cuts cooling costs during the summer by scheduling all classes in the evening; consolidating all classes and administrative activities into one building; going on a four-day week schedule, shutting down completely during three-day weekends, and operating only two of the 18 air conditioning units on campus.

Results: During its first year of operation, the no-cost project cut electricity use by 27 percent. Savings were $14,000.

■ Mount Marty College (Yankton, South Dakota) reduced energy use during the Christmas vacation by shutting down its heating system, consolidating all working staff into one area, and asking members of the staff to supply their own electric space heaters.

Results: The first year of operation resulted in savings of $1,800; in colder weather the savings will be greater.

■ North Carolina State University (Raleigh, North Carolina) tested the cost effectiveness of installing a computerized energy management system before purchasing it.

Results: By running a test program on a microprocessor leased to the computer science center, the university was assured that the large investment in the energy management system would produce energy savings within a reasonable payback period.

■ Southwestern at Memphis (Memphis, Tennessee) organized an incentive program, the "Student Energy Bonus," to complement the successful energy reduction efforts made by its maintenance department. The student government was awarded half of each dollar saved through practical application of electricity conservation. Enthusiastic student support and practices were achieved through posters, T-shirts, newspaper articles, and radio broadcasts.

Results: In 1977 the program resulted in a 15 percent cut in energy use and a net savings of $4,900. In 1978 the net energy savings totaled $6,500. Increased awareness among students of the need for conservation has been an additional long-range benefit.

■ Triton College (River Grove, Illinois) qualified itself under state regulations giving special discounts on electricity bills to schools heating at least one building by electricity. The college, which does not use electricity to heat its campus, qualified for the discount by installing an electric space heater in the ceiling of a building used as a storeroom.

Results: The cost of the space heater was $140, installed. Discounts on electricity bills have amounted to $22,000 a year.

■ Wesleyan University (Middletown, Connecticut) gave the students occupying 27 university-owned townhouses 26 percent of the savings from reductions in their electrical consumption as an incentive toward energy saving. An additional five percent of the savings was given to the social fund of the townhouse complex.

Results: Eighteen students qualified for remuneration during the first quarter the program was in operation.

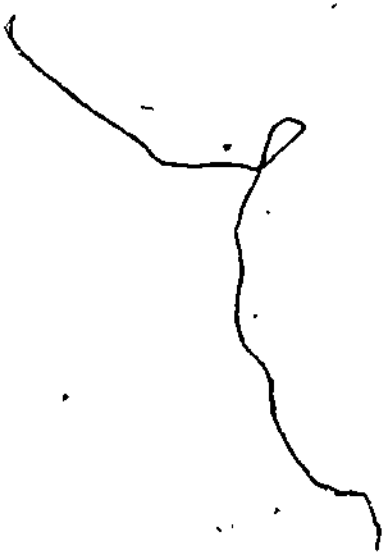
■ West Virginia University (Morgantown, West Virginia) is developing an electric powered van as an alternative to the gasoline powered vans now used in campus maintenance. The test vehicle was funded by a grant from the Department of Energy.

Results: Although testing has not yet been completed, the university expects a 30 percent savings in operating costs.

As indicated elsewhere in this handbook (see index after the appendices), a number of other colleges and universities used good management ideas to conserve energy. Included are the following that have not been described in the text of this report.

- **Guilford College** (Greensboro, North Carolina) which designed a new fieldhouse with many energy savings features, then leased the building to the local YMCA to assure maximum use.
- **Mary Baldwin College** (Staunton, Virginia) which reduced its operating expenses by $975 for each day of interim session by shifting the session from January to May.
- **Middle Tennessee State University** (Murfreesboro, Tennessee) which established an Energy Conservation Task Force that holds monthly meetings between its maintenance department personnel and energy conservationists to discuss and evaluate maintenance and operation changes that could reduce energy use.
- **Pennsylvania State University** (University Park, Pennsylvania) which installed "roll up" windows made of clear vinyl; these raised inside temperatures in the winter by 25 percent and reduced energy loss by 26 percent..
- **Randolph-Macon College** (Ashland, Virginia) which appointed 21 students to conduct a thorough campuswide energy audit in order to qualify for federal matching grant funds and at the same time increase student awareness of the energy problem. A similar procedure at the **University of Maryland** (College Park, Maryland) had the additional benefit of reducing the cost of the audit to one cent per square foot at a time when an outside consultant would have charged five to ten cents per square foot.
- **Taylor University** (Upland, Indiana) which used voluntary and inexpensive assistance from many of its academic departments to develop an energy saving promotional campaign. "Kaptain Kill-A-Watt," a mythical champion of energy conservation, was created and used as the logo to promote, heighten, and encourage conservation awareness and practices within the university community. Student "energy watchdogs," light switch stickers, posters, T-shirts, consumption comparison charts, and cartoons were all part of the campaign to reduce energy use on campus.
- **University of Dubuque** (Dubuque, Iowa) which conducted a building utilization study and then made improvements to four buildings and closed seven others to consolidate the campus and cut energy costs.
- **University of Maryland at Eastern Shore** (Princess Ann, Maryland) which established a supply storeroom on campus to reduce the cost of daily auto trips for supplies. Travel costs were reduced further by replacing standard automobiles in the motor pool with subcompact cars and mopeds.

- **University of North Carolina** (Charlotte, North Carolina) which bought small electric vehicles for maintenance personnel travel on campus to cut costs as well as to increase the visibility of the university's conservation policy.
- **University of South Carolina** (Columbia, South Carolina) which gave engineering students "hands on" experience with a solar system by building a passive solar system into a bus stop.
- **University of Wisconsin System** (Madison, Wisconsin) which had its central office write and distribute to all campuses copies of "Kilowatt Kruncher Kookbook," a manual describing practical how-to-do-it ways of cutting lighting costs.
- **Washington University** (St. Louis, Missouri) which installed timer switches in the bookstacks of the library so students can temporarily light an area while searching for materials; the lights go off automatically in 30 minutes.



4

IDEAS ON Providing Education or Information on the Energy Problem

The Problem

The continuous national debate on the best way to tackle the energy problem reflects the absence of a national policy on saving energy now and on planning for long-range energy conservation. Although the public is concerned about energy matters, the nation's leaders have not been able to focus on a comprehensive plan to meet head-on the various issues involved. Without skilled and knowledgeable leadership in energy conservation and technology, slow progress will be made toward resolving the problem.

> **The Challenge**... to educate as many people as possible on the nature of the energy problem; to inform people on what they can do about energy conservation in their homes, schools, businesses, and communities; and to determine how to train a large enough number of professional specialists, technicians, and managers in the various engineering, science, and other technical disciplines required to meet the country's future need for trained personnel in the energy field.

The Ideas

■ **Brevard** Community College (Cocoa, Florida), Indiana University at South Bend (South Bend, Indiana), Wisconsin Indianhead Technical Institute (Shell Lake, Wisconsin), Navarro College (Corsicana, Texas), and Piedmont Technical College (Ruxboro, North Carolina) offer two- or three-year associate degree credit programs for future technicians in energy conservation specialties. (These programs include solar energy technology, and the installation of solar energy equipment as well as the more common programs in heating, lighting, and air conditioning technology.)

> **Results:** These programs and parallel offerings at other colleges and technical institutes (see index after the appendices) will provide the labor market with a growing number of college graduates having associate degrees and trained to work on energy conservation problems, including the new technical specializations required in solar

energy engineering. Some sources estimate that by 1985 the country will need no fewer than 20,000 persons qualified as solar engineering mechanics or installers of solar energy equipment.

★ California State University and Colleges (a consortium headquartered at Fullerton, California) pooled the efforts and ideas of faculty members on 19 campuses to develop curricula in energy education in the California elementary and secondary schools, to provide technical assistance to those schools, and to conduct teacher education programs, conferences, and workshops on energy problems. Scientists, engineers, sociologists, economists, and environmentalists participate in the consortium's activities.

Results: Technical assistance provided by the consortium enabled 400 energy-related classes to be held in public schools and 52 continuing education courses to be offered at the college level. The consortium prepared a state sponsored manual of energy-efficiency guidelines for builders and developers, and conducted a small grants program for the United States Department of Energy to assist small businessmen and lay people in energy conservation efforts.

■ Clark University (Worcester, Massachusetts) established in 1976 and is still running the "Massachusetts Energy Phone" which it sponsors jointly with the state energy office. The project receives partial funding from the United States Department of Energy. The Energy Phone is manned by students who, with a background in energy studies, provide the general public with telephone information and referral service on energy matters. A manual developed by the university helps to answer common questions; a resource library is available for more complex problems.

Results: By February 1980 the Energy Phone operators had answered 77,000 questions on topics falling into 30 specific categories, and had mailed out 15,000 information packets to callers. A survey showed that 80 percent of the callers took some conservation action within two weeks after their questions had been answered.

■ College of St. Thomas (St. Paul, Minnesota) offers a masters of business administration program with a specialization in energy management. The program was established with the assistance of a small grant from the Minnesota Energy Conference.

Results: Ten full-time students were enrolled in the energy management specialization in the fall semester, 1979-80.

★ Certificate of Achievement

■ Governors State University (Park Forest South, Illinois) created the Midwest Energy Alternative Network, whose purpose is to describe energy conservation opportunities in non-technical language and to teach the public that low cost ways of cutting energy consumption are indeed possible.

Results: The network organizes classes, conferences, and seminars on energy conservation and puts out a monthly magazine to inform lay persons on what is available and possible in energy conservation. Energy-related internships are offered to students at Governors State University whose work on special projects has built up an extensive file of reports, books, and manuals on energy conservation.

■ Harvard Business School (Cambridge, Massachusetts) faculty members researched and wrote a book entitled "Energy Future" to provide the public with an overview on the energy situation. The book concludes that an intensive conservation effort, with government incentives to give conservation a fair chance against conventional resources, could make the largest single impact on reducing oil imports. Also, that the contribution from solar energy can be tripled in the next decade by utilizing solar technologies already available rather than waiting for new big solar systems to be developed.

Results: The book is now being used as an educational reference and guide by universities, business executives, and energy policy makers. Sales have exceeded 100,000 copies. Many members of Congress have copies. President Carter quoted from the book during a press conference.

■ Kansas State University (Manhattan, Kansas) through its University of Man (a community outreach program) constructed a building for use as a working demonstration project to teach the public that solar energy is effective in the sunny but cold central part of the country. The building, a combination greenhouse and community center, uses energy conservation approaches for heating the building and the water needed, the production of food, and the recycling of waste products.

Results: The building, which saves 70 percent in energy consumption over that of a conventional structure, will be used as a community meeting center, a winter food production instruction center for low-income elderly people, a workshop in occupational therapy for handicapped persons, and a living laboratory for university students in agriculture, horticulture, and sociology.

■ New York Institute of Technology (Old Westbury, New York) established in 1976 an "Energy Hotline" to provide information to the general public, to professional persons in the energy field, and to public officials. However, after the first two years, the institute turned the operation of

the hotline over to the New York State energy office and trained state employees to run the program.

Results: The state received a fully operating system with employees trained to run it. The United States Department of Energy published the final report on the project and distributed it to all state energy offices as a guide.

■ Oklahoma State University (Stillwater, Oklahoma) has offered to 40 elementary and secondary school teachers each summer for the past five years a 3-credit-hour graduate course on energy problems and conservation possibilities. The course is free to the participants. Half of the course time is spent in the classroom, the remainder in visiting energy production and conservation activities in the southwest.

Results: Outside sponsors, including a number of energy-related companies, provide the funds for the $25,000 annual budget of the program. The university contributes the faculty. Each year more than 100 persons apply for admission; the 40 selected are chosen to represent all regions of the state, all types of schools, and all areas of education within the school system.

■ Polytechnic Institute of New York (Brooklyn, New York) designed a masters degree program in science and coupled it with a certificate in energy engineering and policy in nine separate engineering fields, in management, and in physics. The program covers all aspects of energy supply and conservation, regional as well as worldwide, and explores energy on the technical, economic, political, social, and humanistic levels.

Results: From its inception until February 1980, this program had awarded 200 certificates in energy engineering and policy, 112 of which went to persons also earning a masters degree in science.

★ University of California at San Diego (San Diego, California) developed an extension division course called "Energy and the Way We Live" consisting of 15 weekly articles run in 540 newspapers and for which credit is given by 342 colleges. The course explores energy technology and consumption, the impact of differing values on energy policy, and various aspects of the worldwide energy dilemma.

Results: The course started in January, 1980, had an estimated enrollment of 8,000 to 10,000 persons, and an estimated readership of five million people. Course materials were used in 450 energy policy community forums being held all across the country, and for a series of half-hour programs broadcast by National Public Radio.

★ Certificate of Achievement

■ University of Miami (Miami, Florida) has provided an extensive graduate program in atomic, hydrogen, nuclear, solar, coal, water, geothermal, wind, and heat recovery produced energy. In 1974 the university established a Clean Energy Research Institute in its school of engineering and environmental design to be the focal point of the univerisity's energy-related activities.

Results: The institute has received $4.5 million for energy research and conferences from private sources, the federal government, and foreign countries. Seminars and workshops attract scientists from around the world. Graduates with energy backgrounds find positions in teaching and in energy research at other universities and colleges or research organizations.

■ University of Pennsylvania (Philadelphia, Pennsylvania) established a graduate program in energy management for graduate students who are interested in problem solving in the energy management field.

Results: The program has graduated ten students with Ph.D. degrees and 31 students with masters degrees in energy management and policy. A large proportion of graduates have found energy-related positions. Enrollment in the program is being expanded in fall 1980 to 70 masters and doctoral degree candidates.

■ University of Rhode Island (Kingston, Rhode Island) encouraged two physics professors at the university to set out to remedy the lack of energy education in the public schools. The result was a university-based Office of Energy Education, which is acting as a statewide, centralized energy education resource center for Rhode Island school teachers.

Results: Since August 1979 the Office of Energy Education has established five graduate courses on energy education for school teachers; has made 13 presentations to the public; and has held 27 meetings with educators in Rhode Island. The office also has distributed energy curriculum packets to high school teachers, sponsored a State Senate Energy Commission public hearing on the university's campus, and entered into working relationships with faculty members at other higher education institutions in the state.

■ West Virginia University (Morgantown, West Virginia) established an Energy Research Center which is separate from the traditional academic units. The center's goal is to produce graduates with advanced degrees in a wide range of disciplines who also have had research experience in coal and other energy areas important to West Virginia.

Results: During the academic year 1978-79, more than 230 graduate students were in the center's program. These students were enrolled

in 42 different departments and units and participated in 176 energy research projects funded at $12 million by federal and state agencies and private donors.

■ **West Virginia University** (Morgantown, West Virginia) also undertook other energy education programs as follows:

- A graduate course offered three hours of credit to elementary and secondary school teachers participating in an intensive, one-week summer study of energy topics and curriculum, followed in the fall by a curriculum development phase.
- In a four-day workshop 90 professional workers in community service centers from various parts of the state were taught how to help people in their areas conserve energy.
- Faculty members and students taught 25 workshops on energy conservation in the home to about 2,000 economically depressed people in rural, senior citizen, and community centers.

As indicated elsewhere in this report (see index after the appendices), energy education activities have been conducted also at the following institutions:

- **College of Marin** (Kentfield, California) which provides a training program that leads to certification by the California Energy Commission and enables participants to conduct energy audits in the state's schools and hospitals.
- **Indiana University at South Bend** (South Bend, Indiana) which designed "Energy for the Future" programs to train energy conservation technicians and educate the public about national energy problems.
- **Morehead State University** (Morehead, Kentucky) which includes in its comprehensive energy education program energy audit training, alternative energy production, and seminars for homeowners and developers.
- **New Mexico Highlands University** (Las Vegas, New Mexico) which provides conservation workshops and follow-up assistance to grade school and junior high school teachers as part of a teacher training program.
- **Ramapo College** of New Jersey (Mahwah, New Jersey) which has an undergraduate curriculum designed by faculty which takes a cross-disciplinary approach to the social, political, scientific, and technical aspects of the energy crisis.
- St. **Joseph College** (West Hartford, Connecticut) which developed an energy education program for the state's elementary schools.

- **Southeastern University** (Washington, D.C.) which offers a graduate degree program in energy management that concentrates on energy policy decision-making.

As mentioned in the note in the front of this handbook, the Academy is conducting a supplemental survey of colleges and universities to gather additional information on energy education and toward the end of 1980 will publish a complete as possible catalog of energy education programs, courses, workshops, and other educational activities.

5

IDEAS ON
Saving Energy by Improving the Efficiency of Boilers in Heating Systems

The Problem

Although the cheapest method of providing the large amount of heat required by most colleges and universities is through the use of a steam or hot water boiler, the very nature of a boiler operation involves some heat loss. Experts estimate that a good boiler operates at 80 percent heating efficiency; the remaining 20 percent of the heat goes up the chimney and is lost. Faulty valves and thermostats that control heat flow to the various buildings and rooms on a campus can also waste energy. Even small improvements in the efficiency of a boiler heating system can, therefore, save energy.

> The Challenge. . to increase the efficiency or reduce the cost and running time of the boilers used in the heating systems at colleges and universities without incurring major capital costs for new equipment or reconstruction.

The Ideas

★ Benedict College (Columbia, South Carolina) studied the heat retention qualities and needs of each building on campus and then installed storm windows and insulation where needed. Thermostats were set at levels required by the government. Boilers were run on schedules to match individual building occupancy needs and were started only when outside temperatures dropped below 40°F. and the relative humidity level rose to above 70 percent. Boilers were never run for more than six hours at a time. Boilermen were placed on flextime to eliminate overtime.

> Results: The initial cost of the project was $28,900. Savings amounted to $91,400 during the first year.

■ Furman University (Greenville, South Carolina) installed a steam line between the boiler in the women's dormitory and the library. The line

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made it possible to shut down the library's boiler during the summer and eliminate at the same time the heat that built up in the library because of the boiler operating in the basement. The boiler in the women's dormitory now provides all the steam needed on the campus during the summer.

Results: The cost of installing the steam line was $102,000. The university expects that the entire investment will be recovered in four to five years.

■ Green Mountain College (Poultney, Vermont) installed electric "sidearm" water heaters in buildings needing hot water or kitchen steam during the summer, and closed its central boiler plant. Using electric hot water heaters was cheaper than operating the boiler plant because the local electric utility company required the college to pay penalty charges during the summer when its peak use of electricity was below preestablished demand peaks. The heaters consumed electricity at the established rate and eliminated the penalty charges. The arrangement not only saved the oil used to fire the boilers but also gave the plant staff time to perform maintenance and repair work on the college's heating system.

Results: The purchase and installation of heaters cost $14,000. The savings in fuel oil amounted to $19,700 during the first summer the boiler plant was shut down. The net return from the investment is expected to grow year after year.

■ Mars Hill College (Mars Hill, North Carolina) began a multiple phase plan to make the heating system more efficient. In Phase I, the college installed individual thermostat valves on each radiator on campus. In Phase II the college modified each furnace and replaced parts that had caused the furnaces to operate at less than peak efficiency. In future Phases III, IV, and V, the college will replace a worn-out furnace, install additional building insulation, apply window glazing to the newer windows, and replace all the single-pane windows.

Results: The total cost of Phases I and II (funded by small grants, some funds from the operating budget, and some donated labor and parts) was $34,300. During the four years, 1975 to 1979, the alterations made in these two phases of the plan have saved 77,500 gallons of oil per year, valued at $78,000.

★ Middlebury College (Middlebury, Vermont) uses a new process for burning oil in its central furnace. The process, called "Complete Combustion Conditioner," works by mixing water and the fuel oil in such a way that the resulting chemical reaction as the mixture enters the boiler in-

★ Certificate of Achievement

creases the surface area of the oil. This improves the burning process by raising the burning temperature to over 3,000°F. and creates more efficient heat while using less oil.

Results: In 1979 the process reduced the oil used by the college by 70,000 gallons, saving nine percent. The college avoided out-of-pocket expense for new capital equipment by leasing the system from the manufacturer for $615 a month.

■ State University of New York at Old Westbury (Old Westbury, New York) rented two mobile boilers to provide for the hot water and the air conditioning needs of the campus during the summer in order to shut down the heating system for repairs. The rented boilers with on-off controls to be used as needed allowed the maintenance personnel to make necessary repairs during the regular day and week shifts, thereby eliminating overtime work by the staff during the prime vacation season.

Results: Rental cost for the two boilers for three months was $31,000; savings during that period were 99,000 gallons of fuel oil and 322,000 KWH of electricity.

■ University of Maine at Bangor (Bangor, Maine) installed self-controlled valves on radiators, a timer that operated the boiler on a 60-minute on-off cycle, and a "high limit" thermostat in two old buildings where the oil consumption was very high, using about one gallon per square foot of floor space. When the buildings were occupied the timer permitted the boiler to operate only when the outside temperature dropped below 60°F.; when the buildings were not occupied the boiler operated only when the temperature dropped below 25°F. The thermostat shut the boiler off whenever the interior temperature rose above 70°F.

Results: The oil consumption in these buildings was reduced by 20 percent. Based on fuel prices in the spring of 1980 the university estimates the cost of the project will be recovered in less than two years.

■ University of Maryland (College Park, Maryland) used "trim controls" and an "oxygen analyzer" to improve the efficiency of the fuel combustion in its boilers. Trim controls regulate the amount of air sent into a boiler to insure the complete burning of the fuel; an oxygen analyzer continually analyzes the exhaust gases from boilers to determine the most efficient air-to-fuel ratio, which varies constantly. Working together, the two devices provide the proper ratio of air-to-fuel needed for the maximum efficiency of the boilers.

Results: The trim controls and oxygen analyzer cost $43,000. Boiler efficiency increased by five percent.

■ University of Tennessee at Chattanooga (Chattanooga, Tennessee) removed two gas-fired boilers which were in poor condition, using excessive amounts of fuel. The boilers were replaced with water-to-steam heat exchangers which were tied into a high temperature water system that served 60 percent of campus heating needs. That system used fuel oil for the water-to-steam conversion. By combining the two systems, the university can now use either gas or oil to power its main steam heating operation.

Results: The conversion cost $207,000 and has resulted in an annual saving of $37,000. The entire investment is expected to be recovered within five to six years.

■ Wellesley College (Wellesley, Massachusetts) installed an oxygen analyzer to give proper air-to-fuel ratio readings for three main boilers. Maintenance staff used the readings to make manual air and fuel adjustments.

Results: The cost of equipment installed by in-house staff amounted to $5,000. The efficiency of the boilers was increased by three percent. Savings amounted to $45,000 during the first year.

■ Wesleyan University (Middletown, Connecticut) altered its heating system which had been designed originally to operate in excess of campus needs in order to allow for future campus expansion by (a) installing economizers, devices to recover the heat wasted from boiler chimneys; (b) using the recovered energy to preheat the water used by the boilers to produce steam heat; (c) replacing a large steam-run chiller with one run by electricity; (d) installing small satellite boilers on campus to provide hot water needed during the summer, making it possible to shut down the central boilers during that period; (e) installing valves to reduce the pressure used to send heat to the various buildings on campus; and (f) installing a water softening system to reduce the formation of clogging sludge in the boilers, a common cause of boiler inefficiency.

Results: The alterations cost $322,000. During the first year of operation, consumption of fuel oil dropped by 6,700 barrels, saving $120,000. The cost of the alterations is expected to be recovered in two to three years.

6

IDEAS ON
Using Energy That Would Otherwise Be Wasted

The Problem

The heating, ventilating, cooling, and lighting arrangements on college and university campuses were installed when energy was cheap and were not designed to interact with each other as a total system. As a result, a good deal of the energy created is usually wasted through the exhaust, ventilating, and draining steps of the physical plant operation. Substantial amounts of this energy can be captured and reused, reducing thereby the use of conventional fuel. Heat exchangers, devices used to recover some of the wasted energy, are effective but are not designed to take advantage of all the energy recovery possibilities available on a large campus.

> The Challenge . . . to create imaginative ways of using every energy-producing operation on campus to serve as an alternative source of energy, and to develop the most economical methods of recovering energy.

The Ideas

■ Clark University (Worcester, Massachusetts) is recovering energy that would otherwise be wasted by constructing a power plant that will use the process of cogeneration (the simultaneous production of electricity and steam) to become virtually self-sufficient in electricity production, and will meet a major portion of the campus needs for heating. Because the plant is designed to produce more electricity than the university will require, a local utility company has agreed to purchase the excess power. The university's power plant will be a demonstration model of an integrated energy system, will be used for energy research, and as a laboratory for high school students and members of the community.

> **Results:** The power plant will be completed and in operation in 1981. The plant is expected to cost $2.1 million of which $1.2 million was financed by a low interest Department of Housing and Urban Development (HUD) loan. Additional support came from the Department of Energy.

★ **Drexel University** (Philadelphia, Pennsylvania) found that its physical education center used great amounts of hot water in the building's laundry and in heating the swimming and diving pools. At the same time, drinking water was used to cool the hot water released from the laundry heating system so that the temperature was sufficiently low for the water to be sent down the sewer without damaging the pipes. To make better use of the heat that was being wasted in this process, the university rerouted the hot water from the laundry heating system to the swimming pool heating system, where it maintained the 360,000 gallon swimming and diving pools at a constant 80°F. temperature, and was then cool enough to be discharged safely into the sewer.

Results: The project cost $28,400. Savings amount to $11,200 each year, with an expected payback of the investment in 26 months.

■ **University of California at San Francisco** (San Francisco, California) uses cogeneration, the simultaneous production of useful electrical power and heat, in its medical center to recover and use steam heat that would otherwise be vented. The hospital requires three steam-run generators to produce electricity 24 hours per day as a source of emergency power. Although essential for emergency standby purposes, the power system was wasting both the electricity it produced and the steam heat released from the generators. The cogeneration process recovers wasted steam and uses it to provide most of the heat required for a number of buildings near the hospital, turning a necessary but energy-wasting electric power source into an effective heating conservation project.

Results: The project cost $247,000; annual savings in heating costs are $87,000, giving the project a 2¾ year payback period.

■ **University of New Mexico** (Albuquerque, New Mexico) recovered heat previously lost to the atmosphere when steam producing boilers released hot gases from their firing operation. A heat exchanging system designed by a faculty member in the mechanical engineering department captured the heat from the gases to raise the temperature of the water used by boilers to produce steam. This "free heat" reduced the amount of natural gas required to run the boilers. By using its own resources to recover the wasted heat, the university saved enough through in-house design, installation, and operation to construct two heat exchanging systems at the cost of purchasing one commercial system.

Results: The cost of constructing and installing in-house two heat exchanger systems was $72,000. The savings amounted to $81,000.

★ Certificate of Achievement

■ University of Oregon (Eugene, Oregon) operated a large chiller system that provided cold water used to lower the temperature of the hot water released from the central power plant and heating system. In order to prevent heat damage to the piping system, the water had to be cooled before being sent into the sewer. The university took advantage of its water rights to a nearby stream by directly piping water naturally cooled to 40°F. during the winter through a series of cleansing sand filters into its chilled water unit, completely bypassing the chilling process. The temperature of the water from the stream is low enough to reduce the heating system waste water to a safe level. By using the "free cooling" provided by the stream water, the university is now able to shut down the chiller operation for the seven months from October through April.

Results: The piping and filtering system cost $25,000; closing the chiller saved $100,000 during the first seven months of operation.

■ University of Rochester (Rochester, New York) developed a heat recovery system through which extremely hot, uncontaminated water discharged from distilleries in science laboratories is collected in storage tanks and pumped into the domestic water supply when hot water is needed. In the past, tap water had been brought into the laboratories to serve as a coolant for the distillery process and was then run into the sewer with a 120°F. temperature. Since starting the heat recovery system, the university has relied mainly on reclaimed water for its domestic hot water needs.

Results: Initial installation costs amounted to $21,900, the annual savings amounted to $17,000, giving the project a 16-month payback period.

As indicated elsewhere in this handbook (see index after the appendices) a number of other colleges and universities have worked out arrangements to use energy that would otherwise be wasted, including the following:

- Cornell University (Ithaca, New York) which recovers and uses heat from the ice rink refrigeration compressor to heat the domestic hot water needed in the ice rink locker room.
- Mount Holyoke College (South Hadley, Massachusetts) which recovers and uses heat normally wasted by an underground steam system to heat the campus greenhouse.
- Princeton University (Princeton, New Jersey) which uses heat given off by a computer system running 24 hours a day to heat buildings adjacent to the building in which the equipment is located.
- Rockefeller University (New York, New York) which recovered enough heat escaping from exhaust systems to heat two major buildings during the winter.

- **San Francisco State University** (San Francisco, California) which captures and uses heat wasted by kitchen stoves to heat the dining hall.
- **University of Missouri** (Columbia, Missouri) which uses the waste heat from its research reactor facility to heat adjacent buildings.
- **University of New Mexico** (Albuquerque, New Mexico) which uses coils to recover heat previously lost through central plant flues. These coils were designed, built, and installed by an engineering professor at a fraction of the commercial cost.

7

IDEAS ON
Saving Energy by Improving Lighting Practices

The Problem

Lighting systems on most college and university campuses were designed when energy was cheap; they waste energy by providing excessive lighting on both the inside (in classrooms, laboratories, halls, athletic facilities, etc.) and the outside (streets, sidewalks, parking areas, etc.). Some specialists say that 50 percent of the total energy used on campuses to provide all lighting, heating, cooling, and ventilation needs could be saved by the more efficient use of lighting. Energy can be saved in the design and placement of the lighting, in the selection of the type, power, and number of lights used, and by the regular maintenance of lighting and fixtures.

> **The Challenge** to change existing lighting systems on college and university campuses to provide lighting at lower cost while (a) continuing to preserve an adequate standard of visual comfort and safety for students, faculty, and other campus personnel; (b) continuing to meet the aesthetic goals of the architect's design; and (c) minimizing the cash investment in new equipment.

The Ideas

■ **Berea College** (Berea, Kentucky) wanted to save electricity throughout the campus. The college also wanted to maintain the special lighting effects that are part of the library building's design. At the library, energy saving fluorescent tubes were combined with 44-watt adapters and used to replace incandescent lamps. On other parts of the campus, 22-watt adapters were combined with fluorescent tubes to replace incandescent lamps.

> **Results:** The adapters and fluorescent tubes worked together to save 225,000 KWH of electricity per year. Installation costs were $7,100 and resulted in annual savings of $7,400. Payback was achieved during the first year

■ **California Institute of Technology** (Pasadena, California) has been able to save electricity by inserting a "phantom tube"—the invention of a

Caltech professor. The tube completes the circuit in a two-tube fluorescent light fixture, permitting the remaining tube to operate normally, but reducing the power requirement of the fixture by the amount previously required by the second tube. Industry and other colleges are now using the phantom tube.

Results: The campus uses 3,300 phantom tubes and saves 1,060 KWHs of electricity a day.

★ **Lafayette College** (Easton, Pennsylvania) encouraged two engineering students to experiment with using capacitors (a device normally used in wiring electrical systems) to reduce the number of fluorescent lights used on campus but still provide an effective, efficient level of lighting. The capacitors, although not originally designed for fluorescent fixtures, work with minor alterations, taking about five minutes for each adaptation and installation. With a capacitor each fluorescent light operates with one of the two tubes, resulting in 50 percent less energy use.

Results: Initial costs were $4,400, with nine percent of energy saved in nine buildings. Savings were $12,000 during the first year of operation.

■ **Lake Forest College** (Lake Forest, Illinois) will save energy and reduce electrical costs without adversely affecting the study atmosphere by using 44-watt circular fluorescent lights which produce the same amount of lighting as 100-watt incandescent light bulbs. Fixtures that take the place of two or three incandescent bulb ceiling fixtures are being installed throughout the campus without additional wiring costs.

Results: The college is in the process of installing 1,500 lights. Data on cost and energy savings will be available in 1981.

■ **Mohawk Valley Community College** (Utica, New York) purchased plug-in wireless remote control units normally used for small appliances and lighting and installed them in individual office complexes. This solved the problem of running the lights excessively because their on-off functions could be controlled only at the main plant; installing individual room light switches was too costly. The remote control units make it possible to turn lights on and off within individual office complexes or at the main plant.

Results: The wireless units have reduced lighting use by 50 percent. At $15.00 per unit, the college expects payback to be reached in eight months. The initial costs were $4,000.

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■ **North Dakota State School of Science** (Wahpeton, North Dakota) found many campus areas were overlighted. By removing bulbs, the school reduced lighting by 50 percent in all hallways and 20 to 50 percent in most classrooms. "Please turn off lights" labels were applied to wall switches, and 24-hour lighting was restricted to safety and security needs.

Results: Data were not available on the annual amount saved.

■ **Susquehanna University** (Selinsgrove, Pennsylvania) reduced its lighting use by disconnecting 756 fluorescent tubes and their fixtures. Energy saving fixtures are being routinely installed for remaining fluorescent lighting. Over 190 incandescent fixtures were replaced with fluorescent fixtures. Parking lot fixtures were changed to use low energy high pressure sodium lamps; walkways are lighted by incandescent lamps.

Results: The college saved $46,000 in electricity use the first year of operation and $29,000 during the second year.

■ **University of Chicago** (Chicago, Illinois) uses a two-circuit timer in classrooms to time and partially cut off lights after the end of a class. The two-circuit timer is silent and, unlike other timers, shuts off only half the lights to allow time to leave the room or reset the timer before it shuts off the remaining lights.

Results: No adverse comments from students or faculty have been reported. Energy savings have not as yet been calculated.

8

IDEAS ON
Saving Energy By Improving Ventilating Systems

The Problem

Ventilating systems are costly, both in dollars spent and in energy used, but are necessary to circulate fresh air, heated air, or cooled air inside college and university buildings to maintain the inside temperature and humidity at comfortable levels. Building standards and health codes require ventilation to provide fresh air to remove smoke, dust, noxious smells, and chemical gases from rooms and campus laboratories.

> **The Challenge**... to save on energy and to reduce costs by adjusting or changing the ventilating system without sacrificing comfortable room temperatures, the necessary fresh air flow, and an appropriate level of humidity; and to do so without spending substantial sums on new construction or equipment.

The Ideas

■ Marquette University (Milwaukee, Wisconsin) found that the heating system in its large main library was uneven—interior rooms were too hot and exterior rooms too cold. To compensate for this uneven distribution of heat and also to conserve energy, the staff developed a plan involving turning off heat in the interior parts of the building and using ventilating fans to send heat to the exterior portions of the building as needed. Operating time of the ventilating fans was adjusted to supply more heat as the need for heating increased in the winter and to reduce the amount in the spring as the need for heat decreased. The plan also involved making periodic temperature checks throughout the building, and by manually adjusting temperatures if required.

> Results: No installation costs were involved. The plan saved $22,000 in steam heat and $6,200 in electricity, for a total savings of $28,200. An added benefit was an improved humidity level in the building.

■ Missouri Western State College (St. Joseph, Missouri) has a totally electric campus. Room heating vents are located in the ceilings, making it difficult to maintain even room temperatures; for example, floor temper-

atures were 57°F. at the same time that ceiling temperatures were 65°F. Only by the college's increasing the temperature settings and using more electricity, could rooms be heated to a comfortable level. However, ceiling temperatures were still higher than those on the floor. The college installed flexible ducts above the ceilings to capture the heat where it entered the room. The ducts were run down the sides of the walls and an elbow attachment directed the air outward into the floor level of the room. Installation of the ducts made it possible to reduce fan speed by 30 degrees and further reduced electrical use.

Results: Slower fan speeds provided more even room heating and saved energy. Installation costs were $840. Within three months of operation the project saved 24,870 KWH of electricity valued at $1,500.

■ Olivet College (Olivet, Michigan) found that the Mott Academic Center (a large, totally sealed building, air conditioned year-round) is occupied by only a few faculty and staff members during the month following graduation (mid-May to mid-June) and the two weeks preceding the fall quarter. During these periods the outdoor temperature is usually pleasant and there is a greater need for ventilating than for cooling the building. The college installed 16 awning-type windows that can be opened to ventilate the building for the six weeks, during which time the air conditioning can be shut down.

Results: The initial investment in the new awning-type windows was $3,500. The savings per day when the air conditioning was shut down amounted to $196, or a total of about $6,000. The entire investment was recovered in about three weeks.

■ University of California at San Diego (San Diego, California) found that decreasing the incoming air supply in the ventilation system by 40 percent could reduce the electrical energy used by 75 percent without reducing comfort. The fans had been operating at a constant rate round the clock and could not be adjusted or controlled. The university replaced existing single-speed fan motors with two-speed fan motors, which made it possible to adjust the speed or shut off the ventilating fans.

Results: The total cost of replacing fan motors was $100,000; annual savings have amounted to $187,000.

■ University of Louisville (Louisville, Kentucky) reduced the speed of six large fans by 20 percent, providing an air flow reduction of 20 percent. The fan speed alterations were made gradually and with daily temperature and humidity checks to insure comfortable room temperature and ventilation.

Results: The modifications cost $200 per fan, a total of $1,200 for the complete project. First-year savings amounted to $41,900.

■ **University of Michigan** (Ann Arbor, Michigan) found that a variable volume air system was an efficient way of ventilating a new building addition; rooms were more comfortable and energy costs were lower. After comparing the new system with the one being used in the main portion of the building, the university decided to convert the entire building to the variable volume air system.

Results: During the first three months of operation, the new air system saved $65,000. Installation costs were $250,000.

■ **Wayne State University** (Detroit, Michigan) found that many laboratories in the chemistry building were in use as few as 10 hours per week, but were receiving continuous ventilation service. The university is installing a variable air control system that will provide minimum air flow during unoccupied periods, normal air flow when a room is not being used as a laboratory, and maximum air flow when the exhaust hoods are in use to remove chemical odors, etc.

Results: Although the project has not been completed, annual energy savings are expected to total 70,000 BTUs per square foot of building space and to achieve savings of $90,000 per year with a two-year payback on the investment.

■ **Williamsport Area Community College** (Williamsport, Pennsylvania) found that during the winter warm air in one of its greenhouses was not circulating from floor to ceiling or from front to back. Insulation was applied to the doors to cut down drafts, but the real savings occurred when the heaters and ducts were relocated on the floor level. Ventilating registers were placed within the duct work so that the hot air was blown under the plant beds.

Results: The project cost $4,069; 1,888 gallons of fuel oil were saved during the first six months of operation. Annual savings are expected to total $3,000.

9

IDEAS ON
Saving Energy by Improving the Efficiency of Water and Cooling Systems

The Problem

A persistent and sometimes expensive problem on college and university campuses is to provide air conditioning or chilled air to buildings which have different cooling needs (for example, kitchens all the time, laboratories and classrooms during the summer, and rooms in sealed buildings in all seasons). When energy was cheap, providing air conditioning and chilling to meet these various needs was no problem. Now the goal is to provide cooled or chilled air or water as cheaply as possible without putting additional strain on the electrical systems generally used to power the chilling and air system.

> The Challenge . . to reduce air or water cooling needs on college and university campuses in any way possible to lower the cost and reduce power consumption.

The Ideas

■ Clarkson College of Technology (Potsdam, New York) tied its chiller into an existing heat sink where water used by the steam heating system is stored when heating is not needed. A heat sink has the capacity to store and maintain water at high or low temperatures. The chiller was used to cool the water to 45°F. and it was then circulated throughout the building to provide air cooling. By using the heat sink to maintain the cold temperature of the water, the college was able to shut down the chiller for periods of time. When the water temperature rises and reaches a temperature of 65°F., the chiller is started once again to bring the water to a 45°F. temperature.

> Results: The project saves 900,000 KWH of electricity valued at about $36,000 a year.

■ Ohio State University (Columbus, Ohio) installed a new rotating high-speed electric chiller for air conditioning a large pharmacy building which housed many research laboratories and required 24-hour energy service.

The electric-run chiller replaced an inefficient and costly steam-run chiller that used natural gas for fuel.

Results: The total cost of the new chiller was $104,000. Savings during the first year of operation were $35,000 and the investment is expected to be paid back within three years.

■ **Tuskegee Institute** (Tuskegee Institute, Alabama) found it uneconomical to operate its large central chilling plant to cool only the hospital and the computer building during the 75 days when the rest of the campus no longer needed air conditioning. To supply cool air to the hospital, the institute reactivated two independent chilling systems that had been shut down when the central chilling plant was installed and connected them with the hospital. A self-contained air conditioning unit was installed in the computer center. These steps made it possible to shut down the main chiller plant for the summer.

Results: The project cost $4,700 and saves $38,000 a year.

■ **University of Colorado Health Science Center** (Denver, Colorado) has a power plant that uses the exhaust steam from electricity production to operate the heating and cooling units. In spite of this efficient method of energy use, an energy audit indicated savings could be increased if the chiller operation could be shut down for a period of time. The university purchased and installed two small chiller systems for areas requiring year-round cooling. The chiller in the central power plant was then shut down for five months during the winter months when air cooling was not needed.

Results: Data will be available in 1981.

■ **University of Louisville** (Louisville, Kentucky) measures both the incoming water for its cooling system and the waste water going into the sewer. The local utility company bills the university for the amount of incoming water and the amount going into the sewage system. Because a good deal of water evaporates in the cooling process, accurate water measuring guarantees that the university is billed only for the amount actually used for both services rather than for an estimated amount.

Results: The meters cost $2,000. Savings were $1,600 the first year and $1,800 during the second year of operation.

■ **University of Pennsylvania** (Philadelphia, Pennsylvania) raised the temperature level of its buildings by six degrees during the summer without reducing comfort.

Results: The university saved $150,000 in one summer season.

■ University of Texas at Austin (Austin, Texas) piped water used for cooling 20 small refrigeration units on campus together with water seeping in from the ground (under boilers and in tunnels) into a system which pumps the water into cooling towers for reuse. Both energy consumption and operating costs were saved by this system; otherwise the water would be wasted and sent down the drain.

Results: The initial investment including installation of piping and labor was $29,200; the annual operating cost is $720; annual savings amount to $62,000; the water saved each year (by not having to be purchased) amounts to 48 million gallons.

■ University of Wisconsin at La Crosse (La Crosse, Wisconsin) made energy conservation a priority when it remodeled an old campus building. A cooling system using chilled water produced in an adjacent building was installed in the old building. Because the building was used for different purposes, and had different air cooling requirements, valves were installed to direct, limit, or block circulating cold air, based on the cooling needs of the rooms, with classroom areas being cooled only when used. Timers were added to restrict cooling to other areas only when the rooms were occupied.

Results: The project expects to produce savings of 80 percent over the conventional system used before the remodeling.

■ Wellesley College (Wellesley, Massachusetts) was wasting energy and maintenance costs in its chilled water plant. Six open cooling towers as well as the cooling condensers were being clogged by a bacterial fungus growth; the water in the towers was exposed to the sun which promoted the fungus growth. An open pan which collected water before it was sent to the condensers was covered, preventing exposure to the sun. Three pumps were installed to circulate the water through a two-stage sand and limestone filter which further reduced clogging from the fungus growth.

Results: The installation costs were $4,000 and produced annual savings of $30,000; the payback period was approximately one month.

10

IDEAS ON

Saving Energy by Monitoring and Controlling Heating, Lighting, Ventilating, and Cooling Systems

The Problem

Some of the energy used by the heating, lighting, ventilating, and cooling systems on college and university campuses could be saved by monitoring and controlling the temperature, output, and operating time of the energy systems. The problem is how to do this within the limitations of the funds available and still provide a comfortable building climate.

The Challenge to improve the efficiency of the heating, lighting, and cooling systems by creating a monitoring or control device or plan that works.

The Ideas

■ **Allegheny College** (Meadville, Pennsylvania) installed an in-house constructed building temperature control system in 28 of its 31 campus buildings. Designed by an energy management firm, the system controls indoor thermostat settings for daytime use, indoor night and weekend setback thermostat settings, indoor vacation setback thermostat settings, and an outdoor air cutoff. The controls brought energy reductions and comfortable room temperatures to the large campus which has a variety of buildings and heating systems.

Results: Installation costs were $15,000. Natural gas consumption was reduced by 27 percent and savings totaled $45,000 for a four-month operating period. Annual savings are expected to reach $80,000.

■ **Chatham College** (Pittsburgh, Pennsylvania) needed to monitor and regulate the 50 separate boilers on campus and felt it could not invest in a computerized control system. The college assigned a work-study student to maintain weekly logs, recording temperatures at 200 locations on campus as well as the temperature of the hot water in each building. This manual system required no additional trained staff and provided the maintenance director with a regular written record from which to identify

and control building temperature fluctuations. Within five weeks the system helped to reduce overall average building temperatures to within two degrees of the federal guidelines.

Results: Implementation cost amounted to $50, the reduction in energy use during the first six months was 15 percent, and savings amounted to $10,000. The payback period was only one or two days. The college feels the program is particularly successful because cooling system adjustments can be made by using the heating system temperature log as a guide.

■ College of the Holy Cross (Worcester, Massachusetts) installed heat timers to control the flow of heat to nine dormitories. Heat timers, weather-actuated controls that automatically regulate indoor heat according to the outdoor temperatures, were installed in and regulated from the main power plant.

Results: At about $1,000 per dormitory, the total project cost $9,000. Energy costs have been reduced by 40 percent and annual savings are about $110,000.

■ Gulf Coast Community College (Panama City, Florida) installed magnetic tape meters in each of its 13 campus buildings. The meters give continuous electricity use readouts every 15 minutes; peak kilowatt use within each 24-hour period can be identified from the readouts. The college was able to pinpoint its high use areas and times and make energy saving adjustments based on the meter readouts.

Results: The meters, provided by the local power company, were installed by the college maintenance staff. Energy consumption has been reduced by 33 percent and savings totaled $9,300 during the first two months.

■ Lyndon State College (Lyndonville, Vermont) employed a full-time energy technician to perform many of the temperature control, adjustment, and monitoring tasks that would be handled by a more costly computerized energy management system on a large campus.

Results: Energy consumption was reduced by 26 percent.

■ Oregon State University (Corvallis, Oregon) found a large laboratory and research building used an extensive amount of energy. In order to reduce energy consumption, the university developed a "Projected Effective Temperature" (Project P.E.T.), which is the single temperature that most closely approximates the wide range of outdoor conditions that could affect the heating or the cooling of a building during a given day.

P.E.T. compares the actual minute-by-minute temperature in the building with the predicted outdoor temperature for each day (based on averages of past years). If the comparison shows, for example, that cooling will probably be needed sometime during the day because the air will be warming up, the heating system is not turned on.

Results: By using either *but not both* the heating and cooling system in one day, allowing the air temperature level in the building to float within greater limits, and installing individual controls on all exhaust hood fans so that they can be turned off when not needed, the university saved 54 percent of the energy previously used. The initial cost of the project was $13,200; the total energy savings the first year were $54,900.

■ University of Connecticut (Storrs, Connecticut) uses thermal labels which change color when heat is being wasted as a low cost method of monitoring the 40,000 steam traps in the campus heating system. A faulty steam trap, which separates the steam from the water in a heating system, can cause heat loss amounting to $150 per year and, undetected, can waste energy for the seven years of its expected life. The university believes that at any one time one-seventh of all the steam traps in the heating system will be faulty. Although the high temperature sensitive labels were intended by the manufacturer for use on electronic equipment, they serve the college as a quick detection device.

Results: After six months of operation and an initial cost of $300 for the application of 2,200 thermal labels, the university estimated savings at $4,600, with a two-week payback period. Full implementation of the idea is underway and is expected to yield $50,000 in annual savings.

★ University of Delaware (Newark, Delaware) felt in 1976 that the capital cost of a computerized energy management system was beyond the capacity of the then current budget, and looked for a temporary way to reduce energy costs. The conclusion: 40 percent of the temperature control and start-stop functions provided by a computerized system could be done manually; and savings would be substantial if the staff concentrated on buildings where energy use was high (39 out of the 113 buildings on campus). The activity, "Operation Bootstrap," employed ten persons acting as "energy controllers" (five daytime, five at night). Their salaries were charged against the gross savings of the project.

Results: The gross savings in energy during the first two years (1977-78 and 1978-79) amounted to $570,000. The cost of the energy controllers and the energy consultant for the project was $205,000. The net savings from the first two years, $302,000, were placed in a re-

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serve account which is now being used to finance the first phase of an automated energy-control system in nine buildings where the energy use is high. The manual system will continue in other buildings so that future savings can be used to extend the automated system.

■ University of Maryland (College Park, Maryland) installed a radio-operated central control system to control the on-off functions of the campus security and parking lot lights. Although the lights could be controlled by timers for normal operations, manually controlled adjustments were still needed for holidays and vacations, the periods of the most wasteful use of lights. The radio system adjusts the operating time schedules to the daily lighting needs with the university's not having to go to the expense of extensive rewiring.

Results: The radio control system cost $12,000 to install, and began full operation in July 1980. Operating results will be available in 1981.

■ University of Pittsburgh (Pittsburgh, Pennsylvania) made several energy system adjustments to control the use of energy in its 14-story engineering building. Lighting was reduced by 50 percent; seven primary fans were adjusted to provide 25 percent less air flow; chillers were shut down during the evening from April to October; all fan systems were shut down seven days a week between 11:00 p.m. and 7:00 a.m. except during very warm weather; light switches were installed in offices and laboratories to provide local on-off control; and a small new chiller was installed to serve the few areas requiring continuous air cooling.

Results: The project reduced energy use within the building by 31 percent and saved $160,000 during the first year of operation.

11

IDEAS ON
Saving Energy by Improving Building Insulation and Reducing Air Leaks

The Problem

Nearly all college and university buildings have one common problem—some of the air inside the building leaks out and some of the air outside the building leaks in. Not only are heating and cooling wasted, but additional fuel is used in an effort to stabilize the room temperature. Solving the problem of air leaks is made difficult by the fact that some of the buildings are designed in a way that prevents the use of the more common insulation techniques or materials. Also, the most cherished and aesthetic parts of some newer buildings (such as a large expanse of windows, large lobbies, or high ceilings) usually waste a good deal of energy.

> The Challenge — to improve the heat retaining qualities of buildings on college and university campuses and to reduce the energy wasted through leaks while at the same time providing comfortable temperatures for faculty, staff, and students and preserving the design and aesthetic quality of the various structures.

The Ideas

■ Connors State College (Warner, Oklahoma) created a cheap insulating and building material by mixing locally abundant, often free, waste products of sawdust and lime mixed with cement. This insulation material is fire-retardant and insect-resistant and can be of great benefit to residents in the economically depressed area surrounding the college. The college is testing the material by making it into wood-framed panels to cover two mobile student housing units, typical of local housing. The college is also testing the insulation on a campus building made of stone.

> Results: Costs to construct insulation panels for one student housing unit were $400. Fuel consumption has been reduced by 60 percent or a savings of $500 on the annual heating costs of $750 per housing unit. The payback period is eight months.

■ Cornell University (Ithaca, New York) used a combination of two

methods to insulate housing units for married students. Because the buildings are single level apartment units constructed of brick over masonry block and have no attics, standard insulation methods were not possible. One and one-half inch thick spray-on urethane foam roofing insulation was applied to the roof, and urea formaldehyde foam was injected into the two inch cavities between the brick outer wall and the masonry block.

Results: The two insulating methods reduced fuel costs to the student tenants by 30 percent, saving $110 per season on an average $300 heating bill.

■ Kansas State University's University for Man (Manhattan, Kansas) developed an education-demonstration project to provide consumers with a kit of ideas for do-it-yourself window insulation designs. The project distributes brochures and information packets, conducts workshop training programs and tours of demonstration homes, and teaches how heat loss or gain can be controlled while preserving the original function and purpose of the windows. The project developed thermal curtains, insulated draperies, interior and exterior insulating shutters, sun shades and screens, and window mounted solar energy collectors.

Results: The project has been providing instruction to students of home economics and architecture and to low-income elderly persons from the rural area surrounding the university.

■ Mercy College of Detroit (Detroit, Michigan) constructed a large building with an auditorium and many health research laboratories two-thirds underground to take advantage of the earth as a natural insulating material. The exposed roof and wall areas of the building were heavily insulated with rigid cellular glass and polystyrene foam board. Window areas were reduced to a minimum and can be opened to take advantage of natural ventilation. The only major expanse of windows was sloped to take advantage of natural lighting. To prevent heat loss around the windows, the college set them in zippered rubber gaskets, much like automobile windshields. Each laboratory has its own individually controlled heating and cooling system which makes the building even more energy efficient.

Results: The building has not been in use for a full year, so pertinent data are not yet available.

■ North Dakota State School of Science (Wahpeton, North Dakota) has several old campus buildings with large expanses of single-pane glass windows. To reduce heat loss, the school replaced all windows with double-glazed windows less than one-half the size of the originals. The remaining portion of each window was covered with an insulated panel.

Results: Window replacements and insulation panels cost $266,000. Data on the annual savings are not yet available.

■ **Philadelphia College of Art** (Philadelphia, Pennsylvania) challenged an energy management class to solve a real energy problem facing the college. The class developed the idea of using inexpensive insulated vertical blinds to cut energy loss through large single-pane glass windows. These windows cover one-third of the college's main building which had been designed originally as an office building and had been given to the college during the past decade. The blinds are mounted vertically on the inside window ledges. The panels are lapped into each other to create a tight seal. Each panel is on an independent swivel, however, to allow control of the flow of outdoor light. The blinds can be produced in-house at a cost of $80 each at the present time; thermopane would cost about $400 per window.

Results: The blinds are expected to save 40 percent in heating oil costs. When all 1,200 blinds have been built and installed, the total cost of the project will be $96,000; $135,000 will be saved in fuel oil costs each year, and the payback period will be from nine to ten months. However, blinds for only 60 windows were installed in the 1979-80 academic year because of budget limitations.

■ Post College (Waterbury, Connecticut) faced a costly replacement of the roofs on classroom buildings when the college found that patching the roofs would no longer control serious water leaks. The college chose instead a "trocal membrane" insulating system made of metal, urethane, the trocal covering, and a two inch layer of gravel which is applied directly over the existing roofing. In addition to this double layer of roofing insulation, the college applied additional ceiling insulation to produce maximum heat and cooling retention.

Results: The cost of insulating the three buildings involved was $72,000. Fuel consumption declined immediately and cumulative savings have amounted to $40,600. The entire investment is expected to be paid back in five years.

■ State University of New York Agriculture and Technical College (Alfred, New York) insulated portions of the window areas by covering them with one inch thick beadboard press-fitted into the window frames and covered with plasterboard on the inside as a fire stop. The beadboard's exterior side is painted a color to conform with the building's exterior and the internal-facing plasterboard is painted to complement or match the room's interior.

Results: The estimated saving is 52 cents on each dollar of insulation cost, with the entire investment expected to be paid back in less than two years.

■ State University of New York at Buffalo-Amherst (Buffalo, New York) found that an excessive flow of cold air between the ceiling and floor in its new 40-building complex caused water pipes to freeze and students to complain about inadequate heating. A study showed the problem to be the insulation which had been installed improperly or was inadequate at building overhangs. By using polyethylene foam strips and polyurethane caulking to fill, insulate, and seal the overhang spaces, the university was able to stop the flow of cold air.

Results: The cost of insulation was $59,200. Savings amounted to $140,000 a year, and the rooms are now comfortable for use by staff, students, and faculty.

■ Tompkins Cortland Community College (Dryden, New York) wanted to preserve the aesthetics of and visibility from the 33,000 square feet of windows in its recently constructed campus buildings, but heat loss from the windows had greatly increased electricity costs. While considering the energy savings solution, the college decided to test several ideas and to make the results available to the community and to other colleges. The college is now testing reflective and insulating film designed to reflect heat inward, interior insulating shutters, fiberglass draperies, and three different window covering sheets made of plexiglass, polycarbonate, and acrylic. Each sheet is a different thickness and is transparent to preserve visibility.

Results: The total cost of the project was $82,000. The college expects that the better insulation will cut electricity costs by 10 percent and pay back the investment within five years.

■ University of Minnesota (Minneapolis, Minnesota) opened an underground space center in 1978 to demonstrate the possibilities of a new type of energy saving construction, that is, building underground using earth as the insulation material covering 75 to 95 percent of the exterior walls with a solar heating system worked into the exposed portion of the building. The center conducts studies on the possibilities of earth sheltering construction, holds conferences, develops courses on the concepts, and handles 200 requests a day for information on the techniques of earth sheltered construction. The center is now an internationally recognized resource.

Results: As a result of the center's work (with state funding), earth sheltered buildings are now regarded as an energy efficient, environmentally unobtrusive design for a home or office. The university has begun the construction of a building which is 95 percent under-

ground that when completed will house both the center and the university's school of engineering. The center has demonstrated that an unoccupied earth sheltered building using only a solar system for heating can maintain a steady internal temperature of 42°F. during severe Minnesota winters.

■ **Wellesley College** (Wellesley, Massachusetts) was losing heat in its residence halls through rotting wooden window sashes. The poor condition of the sashes made it impossible to open and close the windows. Heat was also being lost through the roofs which had been built in an old New England style of architecture that the college wished to keep. The college installed thermal windows and attic insulation to solve the heat loss problem using a loan from the Department of Housing and Urban Development (HUD) to assist in the financing.

Results: The cost of installing 1,032 thermal windows was $382,000. Savings amount to $27,900 a year with the entire investment scheduled to be paid back in ten years. The insulation which cost $55,000 saves $10,000 annually, and the investment is expected to be paid back in five years.

12

IDEAS ON
Using Solar Energy

The Problem

How to capture solar energy in economic ways which can be used in most geographical areas at a time when everyone agrees that solar energy offers the potential of providing a source of energy that: (a) is permanently renewable, (b) does not depend on foreign supplies, (c) does not pollute the air, (d) does not result in large quantities of waste materials which have to be disposed of, and (e) does not involve extensive acquisition costs.

> **The Challenge** . . . to figure out cost-effective ways of adapting solar energy to the local climate-controlled heating and power needs of colleges and universities; and to train professional specialists and technicians in the newly emerging field of solar energy technology.

The Ideas

■ **Bentley College** (Waltham, Massachusetts) set up a 320-panel solar energy system that currently provides 60 percent of the hot water used by 720 students in two dormitories, with a third dormitory under construction soon to be tied in. Unlike most solar installations, this system was mounted on the ground because it was $17,000 cheaper than adapting it to irregular roof surfaces. The location also provided greater accessibility for maintenance and provided for easier adjustment to the angle of the sun. In addition, the system could be tied into other buildings and inspected by students and the public. The college also uses the solar energy system for classes and seminars.

> **Results:** The solar energy system cost $515,000 and produced the equivalent of 602,000 KWH of energy for heating water the first year. Savings in the first year amounted to $10,400. They are expected to grow each year over the 40-year life of the system, and to amount in the aggregate to $2.7 million.

■ **Bethany College** (Bethany, West Virginia) is building a solar system for the new Leadership Conference Center that will supply 44 percent of the heating needed and 86 percent of the hot water required. The college

has been designated by the Department of Energy as a national solar demonstration site.

Results: The cost of the project was $188,400, a large part of which came from the Department of Energy. Several months of operation confirm that the college is realizing substantial savings, but annual data are not yet available.

■ **Central Arizona College** (Coolidge, Arizona) uses two banks of solar collectors, one of copper and one of aluminum, which have been designed and constructed in-house to heat its swimming pool.

Results: An evaluation of each type of collector is being made to determine which is the more effective. The total cost of the project was $36,400. Previously the college had been spending $28,000 each year to heat the pool with natural gas.

★ **Hamilton College** (Clinton, New York) designed and constructed a solar heated concrete block building near its observatory to provide classroom space for astronomy students. The building, with its long south-facing wall lined with ten double-paned, glazed, and sealed windows, demonstrates that a passive solar energy design can work in the cold and cloudy climate of upstate New York.

Results: In 1977, the building including the solar energy features cost $30,000 which was less than the cost of a similar building containing a conventional electric heating system. Each year, 67 percent of the heating comes from the sun; the cost of heating the building from October to April has been only $120.

■ **Memphis State University** (Memphis, Tennessee) has designed and expects to install a system in its law library using solar energy along with a chemical dehumidification process to control the high humidity (important to prevent the deterioration of costly law books and to eliminate a fungus growth on the walls of the library building).

Results: Funding is expected during the 1980-81 fiscal year.

■ **Mississippi County Community College** (Blytheville, Arkansas) is constructing a solar photovoltaic system that will provide the electricity for all of the college's heating, cooling, and lighting needs. Collectors will capture solar energy and solar, or photovoltaic, cells located on the collectors will convert the solar energy into electricity. The campus has been designed to use all energy saving methods (natural ventilation, tree shad-

★ Certificate of Achievement

ing, building design, insulation, and natural lighting) in order to be sure that the solar system will be adequate.

Results: Construction of the solar photovoltaic system is underway. When the system is completed the campus is expected to have a peak energy demand of 4.75 watts per square foot compared with the normal peak demand of 7.2 watts per square foot for institutions of similar size.

■ **Northwest Mississippi Junior College** (Senatobia, Mississippi) is building a solar photovoltaic system that will provide all the heat and electricity needed on the campus without using any fuel oil or natural gas.

Results: Construction is underway. Data will be available in 1981.

■ **San Jose State University** (San Jose, California) is constructing a five-story library building that will obtain most of its heat from solar energy and most of its cooling from cold water collected at night. About 10,000 square feet of glass cut in horizontal angled panels will be located on the library's south wall to collect the sun's heat and distribute it throughout the facility. Venetian blind-type reflectors, located behind half the panels, will send the sun's rays inside to special solar collectors used to heat water. The heated or cooled water will be run through pipes to a storage area; and will be redistributed to provide heating or cooling as needed. A special feature of the building design will be the use of interior lights to supplement the solar heating system. The library's lights will be set in ceiling channels coated with a reflective material which will increase the heat from the lights and reflect it back into the room.

Results: Inasmuch as there will be no backup system for heating, cooling, or ventilation, the sole energy expenditure for this building will be for the electricity to run the lights and the small pumps used to circulate the water in the system. Construction is scheduled to be completed by July 1981.

■ **University of Southern California at Idyllwild** (Idyllwild, California) has developed a pilot program to reduce the costs of growing food and heating buildings at high altitudes in a four-season climate. A passive and active solar system in a greenhouse provides energy year-round to grow food and heat buildings.

Results: With donations of potting soil, seeds, plants and other materials, the university was able to construct the greenhouse at a total cost of $3,000. The first year's crop saved the university $500 in food purchases. The crop in 1980 is expected to save $2,000 to $3,000. After some expansion of the greenhouse, crops are expected to be greater over the next two or three years.

■ **West Virginia University** (Morgantown, West Virginia) has made energy-saving improvements on a 50-year old home to prove that older homes can be redesigned to reduce energy use and maintain comfort without great cost or major reconstruction. The home is typical of many in the university's local community and is located on campus for easy access by community residents. Low-cost energy conservation changes are being undertaken in a way that will make it possible to inform and train low income families on how to modify their own homes. When completed, the home will include the following features: solar greenhouse, window box solar collectors, awnings, insulated exterior walls, skylights, insulating shutters, energy-efficient landscaping, and solar-assisted water heating.

Results: Data will be available in 1981.

13

IDEAS ON

Using Alternative Energy Sources Other than Solar Energy†

The Problem

If colleges and universities could use effectively the various sources of energy that are alternatives to fuel oil, coal, or gas, they could reduce their dependence on the oil coming from foreign sources and hold down the cost of the power and energy used. Alternatives include wind power, water power, sunlight, the heat produced by geothermal wells, or the energy produced by burning wood or waste products.

> The Challenge . . . to work out ways to harness the potential of alternative sources of energy, while making them generally applicable and useable by modern technology, and at the same time reducing the high installation and conversion costs.

The Ideas

■ Clarkson College of Technology (Potsdam, New York) encouraged two faculty members to design a system for converting the central heating plant to burn wood scrap instead of fuel oil. The conversion will lower fuel costs considerably, cut pollution, and reduce the number of maintenance personnel needed to run the plant. Wood scrap, sawdust, chips, shavings, and bark will come from local pulp mills, logging operations, and furniture manufacturers, all located within 50 miles of the college; the two largest sources are just 10 miles from the Clarkson campus.

> Results: The conversion will cost $490,000 and the federal government has made a matching grant which covers one-half of the cost. Energy savings will amount to $175,000 annually, personnel savings will total $25,000 a year. The payback period will be 2.8 years, cut in half for the college (because of matching funds) to 1.4 years.

★ Colby Community College (Colby, Kansas) developed a five-day workshop on alcohol fuel production to teach local farmers how to pro-

† Solar energy is written about in Chapter 12 of this handbook.

★ Certificate of Achievement

duce gasohol from grain using small farm-sized stills. The workshop includes lectures, a specially prepared textbook, video tapes, and hands-on training in the laboratory.

Results: By summer 1980 Colby had conducted 17 workshops with more than 1,000 participants, among them bankers, accountants, college faculty members, business persons, engineers, mechanics, and welders. The U.S. Department of Energy called Colby a pioneer in the field of alcohol fuel production, and invited the college to conduct training sessions for 40 of the programs that the department supports.

Navarro College (Corsicana, Texas), North Dakota State School of Science (Wahpeton, North Dakota), and 25 other technical and community colleges received $10,000 grants from the Department of Energy to conduct gasohol production workshops to train farmers and other persons in their regions on how to produce and use alcohol fuels safely. Most of the workshops followed the Colby College model.

■ Edison Community College (Fort Myer, Florida), using the services of a retired pioneer in the development of wind-electric generating plants, designed and constructed a 50-foot tower and wind generating system mounted on the roof of the science building. The wind power is used to charge a 32-volt lighting system donated by a local lumber and supply store. The electrical work was done by the college's electronics department. Energy students study the system's speed, wind direction, barometric pressure, temperature, wind peaks and averages. The system at peak performance can provide three kilowatts of electricity.

Results: The wind-electric generating system has reduced the college's use of oil and electricity. At the same time the community has become more interested in energy conservation and the possibilities of wind power. Plans have been made to construct and use wind power plants in the community.

■ Lincoln Memorial University (Harrogate, Tennessee) uses geothermal heating from Cudjo Caverns, owned by the university, to provide heating to its historic Grant-Lee Hall.

Results: Annual savings are $22,900 and are expected to increase with the rising cost of energy.

■ Navarro College (Corsicana, Texas) is using geothermal heating to provide hot water and heating to a campus building as well as to the local county hospital.

Results: Total cost of the project is $1 million which is funded 80 percent by the Department of Energy as a demonstration project. The college expects geothermal heating to provide 90 percent of peak heating load needs of the Student Union Building and about 50 percent of the year-round space and water heating needs of the hospital.

■ North Dakota State School of Science (Wahpeton, North Dakota) constructed a new power plant to hum locally available North Dakota lignite coal, utilizing fuel oil only as a standby.

Results: The power plant, a model of local coal use, received state funding assistance toward the $2 million construction costs. Annual energy savings total 25 percent.

■ Oregon Institute of Technology (Klamath Falls, Oregon) is the only institution of higher learning completely heated by geothermal water. The campus heating system receives 192°F. water from nearby Klamath Falls and directs it through a series of heat exchangers in each building. As new buildings are constructed, they are added to this system. The geothermal heating system provides heat to 500,000 square feet of campus space and is a showcase for many government, industrial, and civic groups, as well as for individuals interested in converting traditional fuel heating systems to geothermal heating.

Results: Operating costs for the geothermal system are $20,000 to $25,000 a year; a conventional system would cost about $250,000 a year.

★ Skidmore College (Saratoga Springs, New York) redesigned its heating plant so that it could burn 100 percent waste crank case oil instead of fuel oil. In order to make the plan work, the college added pumps and filters to the existing fuel system and located sources that could provide 600,000 gallons of oil a year. Skidmore also had to convince the surrounding community that the burning of waste oil would not pollute the local air. The college not only earned approval of the New York State Department of Environmental Conservation for a constructive idea, but also gained commendation for removing from the area a large quantity of waste oil which had been a troublesome pollutant of the rural watershed either when used for dust control on rural roads or when dumped as a waste product into landfills.

Results: The cost of converting the heating plant was $25,000; the savings expected each year amount to $234,600; the college expects the investment to be repaid during the first few months of the first year of operation.

★ Certificate of Achievement

■ **Talladega College** (Talladega, Alabama) is experimenting with the production of fuel alcohol or gasohol from the locally available kudzu root; gasohol is usually made from corn and other grains having a high carbohydrate level. The research will expand the base upon which gasohol can be produced and will include the use of plant waste products, pine straw, potatoes, and other regionally abundant plant materials.

Results: By researching the possibility of making gasohol less dependent on corn and grains, the college expects to make gasohol production economical and useful to more regions of the country.

■ **United States Naval Academy** (Annapolis, Maryland) is conducting studies of ways to harness the energy power of ocean currents. At the present time no technological information is available on how to use this source of energy.

Results: The first tests at the Naval Academy were successful; further tests are being made.

■ **United States Naval Academy** (Annapolis, Maryland) researched, designed, and constructed a "fluidized bed combustion" system to enable the institution to use the heat energy content of solid paper and cafeteria waste products that would otherwise be dumped into a landfill. The system uses a closed tank in which the heat from burning solid waste is increased by the pressure of incoming air. The tank is designed in a way that burns waste products without releasing harmful pollutants into the air. The system is used alongside the academy's boiler operation and has completely eliminated the costs of disposing of waste products.

Results: Installation costs were $584,000 and annual savings are $108,000. Oil consumption has been reduced by six percent.

■ **University of Maine at Bangor** (Bangor, Maine) had a research engineer on one of the university's campuses design an auxiliary combustion chamber, to be attached to existing boiler equipment, that could burn inexpensive, locally abundant wood chips instead of oil. In order to compare the efficiency of oil vs. wood chips as fuel, the engineer set up two boilers, one with the new combustion chamber, side by side in one administration building. Tests showed that the greatest savings would be from burning oil during the spring and fall and burning wood chips during the winter, when heating demand is high and constant.

Results: The cost of the experimental combustion chamber and the use of a consultant was $18,000. The annual savings are estimated at $6,000. Several other boilers will be converted by fall 1980. The payback period for the project will be two to three years.

■ **Waynesburg College** (Waynesburg, Pennsylvania) is conducting research on how to tap the methane gas in coal fields under its campus without harming the coal deposits. If recovered instead of being wasted, the methane gas could greatly reduce the college's use of natural gas. One well has been drilled; extraction and distribution systems have been developed. The college has received support from various state agencies and environmental groups to expedite the research.

Results: The technology and experimentation needed to tap an unused energy source is being developed; methane gas reserves in the coal beds in the United States exceed 700 trillion cubic feet; and 225 million cubic feet of that gas is wasted into the atmosphere during each day of mining operations.

As indicated elsewhere in this handbook (see index after the appendices), a number of other colleges and universities are exploring the possibility of using alternative fuels. Among these are the following:

- **Delaware Technical and Community College** (Georgetown, Delaware) which is planning to install a wind turbine system that heats water for the recreational complex and serves as a demonstration project to students, faculty, and the community.
- **Lincoln Land Community College** (Springfield, Illinois) which has installed a wind powered generator to provide a portion of the heating needs of the new horticultural building.

A

The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Allegheny College Meadville, PA 16335 Larry J Yartz Treasurer (814) 724-4341	Monitoring and Controls The college designed an arrangement which centralizes and controls campus heating systems, assures easy maintenance, and identifies trouble spots quickly.
Alvernia College Reading, PA 19607 Sister Mary Victorine President (215) 777-4640	Power Plant Conversion When an old heating system was replaced, the boilers were converted so that they could burn either oil or natural gas which was available locally.
Alvin Community College Alvin, TX 77511 Robert N Richarz Director, Physical Plant (713) 331-6111	Electrical Modifications When the energy system in its older buildings was being upgraded, the college used the energy systems in the newer buildings to provide all of the energy needed on campus.
Amarillo College Amarillo, TX 79178 George H Fowler Director, Physical Plant (806) 376-7848	Computerized Energy Management A computerized management arrangement connects all separate cooling units into a single system and then uses the appropriate equipment to cool individual buildings.
American International College Springfield, MA 01109 Alvin Paige Assistant Dean (413) 737-5331	Incentive Program The college promotes energy conservation and the use of sunlight as an alternative energy source by displaying an attractive sculpture on the campus and at the local town hall.
Anne Arundel Community College Arnold, MD 21012 Daniel Walsch Coordinator, Community Relations (301) 269-7341	Computerized Energy Management The college uses a central computer to control and monitor all of the energy systems on campus.

Note: This appendix presents the complete listing of the programs and innovative approaches submitted to the Academy for Educational Development by colleges and universities that were candidates for Certificates of Achievement.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Art Institute of Chicago Chicago, IL 60603	Administrative
H. Joseph Pluck Assistant to the Vice President (312) 443-3517	A computer was used to analyze how to provide the different internal climates needed to preserve art objects and still balance the institution's operations budget.
Ball State University Muncie, IN 47306	Solar Building Design
Thomas A. Kaluzynski Assistant to the Provost (317) 285-5555	The College of Architecture, with the largest solar installation in the state, holds classes, workshops, and conferences on the design and installation of passive solar systems in homes.
George J. Poulsen Assistant Director, Physical Plant (317) 285-7175	Ventilation Thirty individual air ventilation systems on the campus were centralized into one system which provides consistent service and reduces the overall amount of electricity needed.
Beloit College Beloit, WI 53511	Lighting and Ventilation Adaptations
Audrienne B. Fietz Assistant to the Vice President (608) 365-3391	Field house utility costs are reduced by using metal halide lights and by installing four high-volume ceiling fans to recirculate heat that would otherwise be wasted.
Benedict College Columbia, SC 29204	Campuswide Energy Conservation
Louis W. Bone Director (803) 256-4220	The college made substantial energy savings by starting boilers only when the external temperature dropped and by taking other measures requiring minimal finances and resources.
Bennington College Bennington, VT 05201	Campuswide Energy Conservation
James Vanderpol Vice President for Finance (802) 442-5401	Costs were reduced by analyzing the energy system, resulting in adjusting class scheduling, changing from gas to electricity in the food service operation, and using a lower grade fuel oil.
Bentley College Waltham, MA 02154	Campuswide Energy Conservation
G.A. Peckham Director, Public Relations (617) 891-2241	The campuswide energy savings program features a solar system mounted on the ground that is easier to maintain and is more economical than standard roof mounted systems.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Berea College Berea, KY 40404 Thomas D. Noe Director, Physical Plant (606) 986-9341	Lighting Adaptations The college uses a new commercial adapter to reduce lighting costs while still maintaining the effect of incandescent lighting included in the architect's design for the buildings.
Bethany College Bethany, WV 26032 David Country Director, Auxiliary Services (304) 829-7211	Solar Heated Water A solar system provides most of the hot water needed by the college and partially heats some college space; the existing electrically heated water system now provides a backup supply.
Bethel College and Seminary St. Paul, MN 55112 James M. Woods Director, Physical Plant (612) 638-6272	Monitoring and Controls An electrical control system designed inhouse with timers, malfunction alarms, and adjusted building schedules centralizes the energy systems and identifies problem areas quickly.
Boston University Boston, MA 02215 John J. Hoban Director, Physical Plant (617) 353-2111	Cooling Systems The chiller operation is controlled and operated more efficiently by being based on temperature sensor readings and other signals sent to a computerized energy management system.
Bowling Green State University Bowling Green, OH 43403 James L. Litwin Director, Institutional Studies (419) 372-2140	Information Sharing The continuing education program uses a computer to provide the analysis and coordination needed by the community to establish local energy conservation programs and policies.
Brainerd Community College Brainerd, MN 56401 Curtis S. Murton President (218) 828-2510	Window Modifications Heat loss through the windows is reduced by 35 percent by covering one-half of the total number of single-pane windows with heat retaining materials.
Brandeis University Waltham, MA 02254 Robert N. Colarossi Engineer (617) 647-2291	Cooling Systems By tying four individual inefficient chiller units into a single system, the university matches cooling needs with chilling capacity without using more energy.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Brevard Community College Cocoa, FL 32922	Solar Education
Dr. Norman Abell Director, Solar Engineering Technology (305) 269-5664	A program in solar engineering technology leading to an associate in science degree provides students with training in the installation, design, research, and testing.
Broward Community College Ft. Lauderdale, FL 33301	Computerized Energy Management
William C. Stuckrath Director, Physical Plant (305) 475-6816	By completely automating the operation of its central utility plant, the college is able to manage energy use more efficiently and to reduce both labor and maintenance costs.
Butte Community College Oroville, CA 95965	Information Sharing
Raymond D. Carrozza Chairman, Mathematics, Technology and Communications (916) 895-2451	The college offers courses on alternative energy sources (such as the sun) and on conservation practices to teach consumers simple and practical ways to save energy in their homes and businesses.
California Institute of Technology Pasadena, CA 91125	Lighting Adaptations
Eugene R. Wilson Vice President (213) 795-6811	The "phantom tube" (invented at the college) is a hollow tube that allows a standard two-tube fluorescent lighting fixture to operate on one tube and reduce electricity use by two thirds.
California Polytechnic University Pomona, CA 91768	Lighting Adaptations
Seldon L. Kempton Director, Physical Plant (714) 598-4071	The college avoided costly fixture replacements by altering incandescent light fixtures to use high pressure sodium lamps which consume less electricity than the incandescent lamps.
California State University and Colleges headquartered at Fullerton, CA 92634	Information Sharing
Dr. Cleve Turner Director, Statewide Energy Consortium (714) 773-2106	A consortium pools the energy expertise of faculty at 19 campuses to provide energy education curricula and technical assistance for public schools and continuing education courses for higher education.
Case Western Reserve University Cleveland, OH 44106	Campuswide Energy Conservation
Nancy Smythe Pell Assistant to the Vice President (216) 368-4352	The college's comprehensive low-cost energy saving program includes making changes in the physical plant, rescheduling building use, and conducting energy education courses.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Catholic University Washington, DC 20064	Computerized Energy Management
Col. E.F. Smith Director, Physical Plant (202) 635-5515	The university uses manual controls and a computer to control the demand for and the delivery of steam, thereby avoiding additional boiler startup costs.
Col. E.F. Smith Director, Physical Plant (202) 635-5515	Lighting Adaptations By altering existing lighting fixtures, the university is able to use fluorescent tubes which require less energy than the incandescent lamps previously used.
Central Arizona College Coolidge, AZ 85228	Solar Heated Swimming Pool
Dale Gibson Vice President (602) 723-4141	A solar panel designed and constructed inhouse saves fuel by providing all the heat needed by the swimming pool.
Central Methodist College Fayette, MO 65248	Rescheduling Building Use
John R. Smart, Jr. Coordinator, Off-Campus Study (816) 248-3391	Fuel costs are saved by closing down most of the physical plant in midwinter (during the peak period of fuel use) by sending students off campus for a study excursion.
Central Michigan University Mount Pleasant, MI 48859	Information Sharing
Jon MacLeod Assistant Vice President (517) 774-3401	The university promotes energy conservation by distributing to the public *Energy Story*, a pamphlet describing its comprehensive conservation program.
Central Missouri State University Warrensburg, MO 64093	Water Systems
Harold L. Young Director, Plant Planning (816) 429-4113	Treating hard water with chemicals eliminates scale build-up inside the boiler system, reduces the fuel used, and saves maintenance costs.
Central Piedmont Community College Charlotte, NC 28204	Commuter Conservation
William A. McIntosh Vice President (704) 373-6647	By tape recording lecture portions of classes and making them available by telephone, the college enables students to reduce travel and gasoline expenses.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Central Piedmont Community College (continued)	Commuter Conservation
John M. Cozean Assistant to the Vice President (704) 373-6484	The college cut commuting costs for students by offering courses on Monday, Tuesday, and Wednesday instead of spreading them over a five-day week.
Chatham College Pittsburgh, PA 15232	Monitoring and Controls
Bill Dillon Treasurer (412) 441-8200	A work-study student compiles weekly building temperature logs to enable the college to control building temperatures without investing in an automated control system.
Chattanooga State Technical Community College Chattanooga, TN 37406	Campuswide Energy Conservation
Linda S. Moss Coordinator, Special Projects (615) 622-6262	The program included installation of timers on classroom switches and time clocks on parking lot lights, together with rescheduling the workload of the custodial staff.
Linda S. Moss Coordinator, Special Projects (615) 622-6262	Conservation Design and Planning The college includes energy saving approaches as a part of its analysis of long-range expansion plans to prevent future energy-related problems from developing on the campus.
City College of San Francisco San Francisco, CA 94112	Solar Heated Water
Edward Dierauf Instructor (415) 239-3231	A solar hot water heating system replacing an all electric system saves energy costs and provides students in the community with a demonstration of a solar installation.
City Colleges of Chicago Chicago, IL 60601	Administrative
Richard D. Humphrey Dean (312) 977-2559	Courses describing current conservation practices are used to update all engineers operating buildings in the City Colleges of Chicago System.
Clark College Vancouver, WA 98663	Solar Building Design
Patricia L. Wirth Dean (206) 699-0123	Solar energy is used to heat and light toilet facilities which are specially designed for the handicapped.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Clark University Worcester, MA 01610 Dennis W. Ducsik Chairman, Program on Science, Technology, and Society (617) 793-7172	Heat Recovery The college's power plant will extract heat from its production of electricity and be virtually self-sufficient in electricity production while meeting most of the heating needs.
Dennis W. Ducsik Chairman, Program on Science, Technology, and Society (617) 793-7172	Information Sharing With the aid of a resource library and an information manual, students provide a telephone information and referral service on energy matters to Massachusetts residents.
Clarkson College of Technology Potsdam, NY 13676 G.C. Gonyea Assistant to the Vice President (315) 268-6424	Cooling Systems Heating system water is circulated through the chiller until the water is cold enough to permit the complete shutdown of the chiller, often for as long as three days.
G.C. Gonyea Assistant to the Vice President (315) 268-6424	Power Plant Conversion The college converted its central heating plant to burn wood scrap instead of fuel oil; this will lower fuel costs, cut pollution, and reduce the size of the college's maintenance staff.
Clemson University Clemson, SC 29631 James A. Stanley Energy Conservation Officer (803) 656-2186	Campuswide Energy Conservation The university altered and reduced lighting, insulated pipes, scheduled shutdowns, and conducted frequent audits to monitor energy conservation results.
Cleveland State Community College Cleveland, TN 37311 L. Quentin Lane President (615) 472-7141	Commuter Conservation A four-day work week was established to save energy. Surveys of student and faculty attitudes were made before and after the new schedule and were used to ease the transition.
Coastline Community College Fountain Valley, CA 92708 Peter Vander Haeghen Director, Learning Systems and Services (714) 963-0811	Commuter Conservation Independent study courses offered on television have reduced the amount of gasoline students would otherwise use to commute to class.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Coastline Community College (continued)	Information Sharing
Jack R. Chappell Public Information Officer (714) 963-0811	The college offers a nontechnical educational program that provides administrators with information on energy sources and uses and how to meet the need for technical assistance.
Coe College Cedar Rapids, IA 52402	Heating Systems
C.R. White Consulting Engineer (319) 364-7557	The college found that purchasing steam from a utility company was cheaper than running a single boiler for the food service building alone.
C.R. White Consulting Engineer (319) 364-7557	Monitoring and Controls By installing night set-back and automatic air controls, the college has been able to eliminate the continuous operation of the energy systems in five buildings.
C.R. White Consulting Engineer (319) 364-7557	Rescheduling Building Use Rescheduling and consolidating the use and occupancy of buildings during the summer reduce air conditioning needs.
Colby Community College Colby, KS 67701	Energy Education
James H. Tangeman President (913) 462-3984	Used as the Department of Energy's model, workshops provide training in the layout, design, production, types of grain, and regulations for the production of alcohol fuel from grain.
College of Great Falls Great Falls, MT 59405	Building Insulation
A.H. Rounds Director, Physical Plant (406) 761-8210	The college uses coated sheet metal as an insulating cover to reduce the heat loss through single-pane glass windows.
College of Marin Kentfield, CA 94904	Energy Education
Richard Rodgers Energy Science Department (415) 485-9549	A training program leading to certification by the California Energy Commission enables participants to conduct energy audits in the state's schools and hospitals.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
College of St. Thomas St. Paul, MN 55105	Energy Education
Dr. Daniel E. McNamara Assistant Professor (612) 647-5327	The MBA degree program includes courses for middle management persons on energy conservation and on the most economical uses of energy in homes, industry, and commerce.
College of the Atlantic Bar Harbor, ME 04609	Energy Education
Roc Caivano Faculty Member (207) 268-5015	The college's environmental design program combines an academic and practical curriculum and provides the college with an historic building that is efficient in energy use.
College of the Holy Cross Worcester, MA 01610	Monitoring and Controls
Charles A. Manccini Director, Physical Plant (617) 793-2438	A timer system is centrally located and activated by temperature changes to control the heating and cooling of nine dormitory buildings.
Colorado Women's College Denver, CO 80220	Commuter Conservation
Dr. Sherry Manning President (303) 394-6811	Some classes meet on weekends only in order to reduce the amount of gasoline students would otherwise use to commute to class four or five days a week.
Dr. Sherry Manning President (303) 394-6811	Heating Systems The college saved energy by installing new electric hot water heaters in place of worn heaters which operated on central plant fuel.
Dr. Sherry Manning President (303) 394-6811	Lighting Adaptations Costs were reduced by replacing worn gymnasium lighting fixtures with more efficient fixtures and by replacing incandescent lamps with mercury vapor bulbs.
Dr. Sherry Manning President (303) 394-6811	Solar Heated Swimming Pool Solar energy will eliminate the use of central plant fuel to heat the campus swimming pool.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Connors State College Warner, OK 74469 Bryce B. Wilde Development Officer (918) 463-2931	Building Insulation The college developed and is now testing a low-cost fire-retardant and insect-resistant housing insulation material made by mixing lime-soaked vegetable waste products with cement.
Contra Costa Community College San Pablo, CA 94806 H. Rex Craig President (415) 235-7800	Incentive Program Savings in energy costs are returned to the unit making those savings and are placed in a fund earmarked for new conservation projects. This provides an incentive to the support staff.
Cornell University Ithaca, NY 14853 Robert H. Clawson Associate Plant Director (607) 256-7280	Administrative A study showed that at prevailing rates it would be cheaper for the university to reactivate its own closed hydroelectric plant than to continue purchasing electric power.
Robert H. Clawson Associate Plant Director (607) 256-7280	Alternative Energy Sources By using local lake water in the chillers the university is able to shut down compressors during the winter, thereby reducing costs.
Robert H. Clawson Associate Plant Director (607) 256-7280	Building Insulation The university found urea formaldehyde foam to be an efficient and economic insulating material for all buildings on the campus.
Robert H. Clawson Associate Plant Director (607) 256-7280	Building Insulation The university found spray-on urethane roof insulation effective on buildings that have no attic and cannot be insulated with standard materials.
Robert H. Clawson Associate Plant Director (607) 256-7280	Cooling Systems Fuel and maintenance costs are cut by using an automatic pipe cleaning system which removes deposits from untreated lake water collecting in the chilling system.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Cornell University (continued)	Heat Recovery
Robert H. Clawson Associate Plant Director (607) 256-7280	Heat from the ice rink refrigeration compressor is recovered and used to heat the domestic hot water needed in the ice rink locker room.
Robert H. Clawson Associate Plant Director (607) 256-7280	Heating System Heating needs were better matched with delivery of the heat when the constant air volume heating system was converted to a variable air volume system.
Donald R. Price Director, Energy Programs (607) 256-7733	Information Sharing The university distributed energy conservation information to New York State residents by radio, television, newspapers, fact sheets, and a handbook.
Robert H. Clawson Associate Plant Director (607) 256-7280	Lighting Adaptations Changing ice rink lighting from incandescent bulbs to mercury vapor lamps eliminated an ice melting problem and reduced the consumption of electricity.
Creighton University Omaha, NE 68178	Administrative
Jack Neneman Director of Creative Improvement (402) 449-2108	The university constructed a water pipe line that connected the central power plant with a wholesale utility company and cut costs by not paying retail prices for power.
Daytona Beach Community College Daytona Beach, FL 32014	Energy Education
Charles J. Maybeck Instructor (904) 673-0844	A technical course provides "hands on" training by using campus facilities and equipment as a training laboratory.
Dean Junior College Franklin, MA 02038	Computerized Energy Management
Donald C. Laliberte Director, Physical Plant (617) 528-9100	The campus maintenance personnel installed a computerized energy management system to reduce costs.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Delaware Technical and Community College Georgetown, DE 19947	Alternative Energy Sources
Charlotte H. Purnell Dean of Development (302) 856-5383	The college installed a wind turbine system which heats water for the recreational complex and serves as a demonstration project to students, faculty, and the community.
Drexel University Philadelphia, PA 19104	Heat Recovery
John H. Mueller Director, Physical Plant (215) 895-2806	Heat formerly wasted by the laundry's heating system is now recovered and used to heat two swimming pools.
Duquesne University Pittsburgh, PA 15219	Computerized Energy Management
John A. Davis Director, Physical Plant (412) 434-6005	The savings on a partial installation of a computer will gradually pay for a complete computer system to control plant operations.
Eastern Connecticut State College Williamantic, CT 06266	Heating Systems
Ronald Stephens Plant Maintenance Engineer (203) 456-2231	Boilers are shut down for one shift each day between May and October (a penod of low demand for heat) to conserve fuel oil.
Eastern Illinois University Charleston, IL 61920	Water Systems
M.D. Ignazito Assistant Director, Physical Plant (217) 581-2178	Installing electric valves to control flushing cycles in urinals reduces the water used by 60 to 70 percent.
Edison Community College Ft. Myers, FL 33907	Alternative Energy Sources
Dr. James L. Newton Chairman, Science Division (813) 481-2121	An alternative energy class designed, built, and installed a wind-powered generator that produces the lighting needed by the science building.
Dr. James L. Newton Chairman, Science Division (813) 481-2121	Solar Education Projects for this course have produced a solar water heating system, a solar distillery, an insulated bead wall, and a wind-powered generator.

Institution and Principal Contact Person	Brief Description of Idea or Approach
Embry-Riddle Aeronautical University Daytona Beach, FL 31204 Fredrick H. Willems Director, Physical Plant (904) 252-5561	Monitoring and Controls By assigning security officers to an "energy watch" as part of their routine duty, the university was able to control temperatures better for buildings unoccupied at night.
Erie Community College Orchard Park, NY 14127 David K. Kowalczyk Dean of Finance (716) 648-5400	Campuswide Energy Conservation A comprehensive conservation program altered lighting, removed a wasteful manhole pump, and used time clocks to reduce night temperature of buildings.
Eureka College Eureka, IL 61530 Dr. Rudy Eichenberger Coordinator of Institutional Development (309) 467-3721	Campuswide Energy Conservation A campuswide program cut energy use by the college's gaining the cooperation of the maintenance staff, the faculty, and the students.
Fitchburg State College Fitchburg, MA 01420 John Strohbeen Director, Physical Plant (617) 345-2151	Incentive Program Graphs and charts showing energy cuts are distributed to faculty, students, and maintenance staff to increase awareness of energy conservation practices.
Flagler College St. Augustine, FL 32084 Jack B. Lakes Director, Business Services (904) 829-6481	Water Systems The hot water supply is shut off from 9:00 a.m. to 5:00 p.m. This reduces the fuel needed to operate the boiler system and conserves water.
Florida Keys Community College Key West, FL 33040 Beth B. Smith Director, Community Services (305) 286-9081	Information Sharing A non-credit course on alternative energy sources provides instruction on how to apply conservation techniques and on "how to make your own power."
Florida Memorial College Miami, FL 33054 Burt Kruger Director of Development (305) 625-4141	Information Sharing The college uses a forum to inform students about energy savings possibilities expecting them to carry the message to the black community through the 725 churches affiliated with the college.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Furman University Greenville, SC 29613	Heating Systems
Phill Simpson Energy Engineer (803) 294-3038	The university reduced heating costs by installing a steam line from a building requiring year-round heating to a building needing only partial and seasonal heating.
Gallaudet College Washington, DC 20002	Lighting Adaptations
J.H. Hull Assistant Director, Buildings and Grounds (202) 651-5230	The cost of lighting and conference room glare was reduced when 12 prismatic lighting tubes were replaced with polarized lens lamps.
J.H. Hull Assistant Director, Buildings and Grounds (202) 651-5230	Monitoring and Controls Time clocks and temperature sensors control and reduce heating and cooling services during periods of low occupancy and low need.
George Washington University Washington, DC 20052	Monitoring and Controls
Robert F. Burch Director, Physical Plant (202) 676-o700	Fuel oil was saved by reducing room temperatures, installing new valves, and monitoring outside temperatures.
Robert F. Burch Director, Physical Plant (202) 676-6700	Water Systems A process called reverse osmosis purifies water for laboratory use by filtering it through sand, carbon, and membranes; the process uses less energy than the distillery method.
Georgia Southern College Statesboro, GA 30458	Campuswide Energy Conservation
Hugh R. Hagin Chief Engineer (912) 681-5558	The college has taken steps each year since 1972 to reduce overall consumption of energy without causing discomfort to building occupants.
Goucher College Towson, MD 21204	Heating Systems
A Richard McIntyre Director, Physical Plant (301) 825-3300	Installing an individual boiler to heat the swimming pool was cheaper than the room-heat recovery method previously used.

Institution and Principal Contact Person	Brief Description of Idea or Approach
Governors State University Park Forest South, IL 60466	Information Sharing
Dr Elizabeth A Hagens Professor (312) 534-5000	The Midwest Energy Alternatives Network provides energy conservation information and practical advice to participants to convince them that energy savings are possible.
Joan Lewis Coordinator, Energy Group (312) 534-5000	Lighting Adaptations The university uses low pressure sodium bulbs in the outdoor fixtures and long-lasting fluorescent tubes in inside fixtures to reduce the consumption of electricity.
Graceland College Lamoni, IA 50140	Window Modifications
N James Weate Associate Director of Plant (515) 784-3311	Remodeling old buildings (so that they have smaller windows and more masonry) reduces the amount of heat lost during the winter through the old windows.
Green Mountain College Poultney, VT 05764	Heating Systems
Robert W Kittle Dean (802) 287-9313	Pipes and valves connecting a building to the central boiler plant eliminates the need for a new and separate heating system for that building.
Robert W Kittle Dean (802) 287-9313	Heating Systems Using electric heaters to provide hot water and steam to the kitchen during the summer is cheaper than using the regular boilers for this purpose.
Guilford College Greensboro, NC 27410	Conservation in Design and Planning
Dave Owens Publications Director (910) 292-5511	The college designed a new fieldhouse with many energy saving features, then leased the building to the local YMCA to assure maximum use.
Gulf Coast Community College Panama City FL 32401	Administration
Dr Lewis E Baber Associate Dean (904) 769-1551	A college committee studying energy conservation methods is educating the staff and is recommending additional ways to cut energy use.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Gulf Coast Community College (continued)	Commuter Conservation
Dr. Lewis E. Baber Associate Dean (904) 769-1551	Energy consumption was cut when students and faculty went on a four-day week during the summer.
Dr. Lewis E. Baber Associate Dean (904) 769-1551	Commuter Conservation Registraton by telephone saves gasoline that would be used by students driving to campus.
Dr. Lewis E. Baber Associate Dean (904) 769-1551	Commuter Conservation Commuting students are able to reduce gasoline consumption by taking courses offered on television.
Dr. Lewis E. Baber Associate Dean (904) 769-1551	Information Sharing The college sends information on conservation to other institutions participating in statewide forums on energy savings.
Dr. Lewis E. Baber Associate Dean (904) 769-1551	Monitoring and Controls The college found ways to cut energy use by installing magnetic tape meters which give energy consumption readings every 15 minutes.
Hahnemann Medical College Philadelphia, PA 19102	Cooling Systems
E.F. Pattillo Vice President, Central Services (215) 448-7692	By using air handlers from old equipment, a new computerized energy management system was able to match air conditioning with building needs.
Hamilton College Clinton, NY 13323	Solar Building Design
J.W. Ring Professor of Physics (315) 859-7510	The college designed and constructed a solar heated classroom that shows passive solar energy designs can work even in cold, cloudy northern areas of the country

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Harvard University Boston, MA 02163	Information Sharing
Dr. Robert Stobaugh Professor, Business Administration (617) 495-6296	*Energy Future* (a book written for academicians, business executives, energy policy makers, and the general public) analyzes and reviews the need for a national energy policy.
Hobart College Geneva, NY 14456	Incentive Program
John Bodnar Assistant Director, Student Activities (315) 789-5500	A cash prize was awarded to one of the eight fraternity houses on campus showing the greatest savings in kilowatt hours and gas consumption during a two month contest.
Hood College Frederick, MD 21701	Conservation Design and Planning
Molly S. Baldi Director of Federal and Foundation Support (301) 663-3131	A council was appointed to coordinate with the maintenance staff and a consulting firm to insure that energy saving alterations and recommendations served all campus needs.
Horry-Georgetown Technical College Conway, SC 29526	Energy Education
H. Neyle Wilson Dean (803) 347-3186	The college offers a course in energy conservation and management
Howard University Washington, D.C. 20059	Computerized Energy Management
Chandler Bahn System Engineer (202) 636-6217	Sophisticated computerized equipment monitors and controls the use of energy on the large campus which has a variety of energy systems and equipment.
Hunter College New York, NY 10021	Energy Education
Professor Delores Greenberg Director, Energy Policy Studies (212) 570-5583	The college offers a course which examines the critical relationship between society and energy and describes a number of conservation methods.
Illinois Wesleyan University Bloomington, IL 61701	Solar Installation Variations
Dr Robert S Eckley President (309) 556-3151	Installations of solar screens on the southern exposure of a building reduces the heating and cooling load as well as providing a more even temperature within the building.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Indian Hills Community College Ottumwa, IA 52501	Commuter Conservation
Carl Radosevich Dean, Business Affairs (515) 682-8081	The campus went on a four-day week during the winter to save energy and to reduce the amount of gasoline used by commuters.
Indiana University South Bend, IN 46615	Energy Education
Walton R Collins Assistant to the Chancellor (219) 237-4345	The "Energy for the Future" programs are designed to train energy conservation technicians and to educate the public about national energy problems.
Interamerican University Arecibo, Puerto Rico	Conservation Design and Planning
Neris B Reyes de Ruiz Director, Department of Natural Sciences (809) 878-5835	A new building was constructed on a site that makes possible to the fullest extent the use of solar energy as well as natural lighting and ventilation.
Iowa State University Ames, IA 50012	Information Sharing
William Zeller Coordinator, Residence Life (515) 294-5440	A week-long seminar in the residence halls increased energy awareness among students.
Laurent Hodges Professor of Physics (515) 294-5440	Solar Education Students of physics and architecture are teamed up to design a solar home.
Iowa Wesleyan College Mt. Pleasant, IA 52641	Administrative
L W. Van Winkle Vice President (319) 385-8021	To conserve energy and reduce costs, the college and the local public utility entered into an arrangement which involved issuing municipal revenue bonds, extending a steam line, and installing new boilers.
Jefferson State Junior College Birmingham, AL 35215	Solar Building Design
Jack Freeman Director, Physical Plant (205) 853-1200	Solar panels provide enough heating and hot water in the Solar Agriculture Center to allow an oil-fired burner to serve only as back-up equipment.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Kingsborough Community College Brooklyn, NY 11235	Campuswide Energy Management
Dr. Ralph Edwards Dean (212) 934-5028	The changes made include alterations in lighting; use of small heat pumps; conversion of the heating plant; installation of storm windows; and use of a computerized energy management system.
Kirkwood Community College Cedar Rapids, IA 52406	Commuter Conservation
David Bunting Director, Nontraditional Studies (319) 398-5512	The "Energy Today" program on television served seven off-campus locations of the college and reduced the cost of travel and gasoline for both faculty and students.
Lafayette College Easton, PA 18042	Lighting Adaptations
Donald Noblett Vice President (215) 253-6281	Small capacitors were used in a new way to reduce the energy consumed by fluorescent lights, a cheaper procedure than other commercial methods available.
Lake Erie College Painesville, OH 44077	Administrative
Charles E.P. Simmons President (216) 352-3361	The college leased gas well drilling rights to a utility company in an agreement giving the college a percentage of the profits and an emergency supply of natural gas.
Charles E.P. Simmons President (216) 352-3361	Commuter Conservation Tuition rebates go to students using a computerized car pooling system. This saves the gasoline that would be used by commuting students.
Lake Forest College Lake Forest, IL 60045	Lighting Adaptations
Gordon L. Kensgaard Administrative Assistant (312) 234-3100	By installing circle light fluorescent tubes the college saved electricity while still maintaining a good lighting level for study.
Lakeland Community College Mentor, OH 44060	Monitoring and Controls
H.J. Roseum Director, Physical Plant (216) 951-1000	Adjustments and modifications in equipment have decreased the energy used on campus although space on campus has been expanded by 41,000 square feet.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Lane Community College Eugene, OR 97402 Paul Colvin Director of Facilities (503) 747 4501	Campuswide Energy Conservation By making small energy savings whenever possible the college was able to install gradually a computerized energy management system, a heat recovery process, and additional hot water tanks.
Lansing Community College Lansing, MI 48901 Thomas A. Peterson Facilities Technician (517) 373-7173	Campuswide Energy Conservation The college took a holistic approach to campus energy problems, made conservation alterations, hired an energy technician, and provided energy education to students.
Lebanon Valley College Annville, PA 17003 Robert C. Riley Vice President (717) 867-4411	Conservation Design and Planning Energy saving features were included in the new building plans before the college requested bids for construction.
Lehigh University Bethlehem, PA 18015 Anthony L Corallo Director of Physical Planning (215) 861-3977	Campuswide Energy Conservation The college hired a consulting engineer to direct a campuswide program for decreasing energy consumption.
Lincoln Land Community College Springfield, IL 62708 Dr. Robert L. Poorman President (217) 786-2273	Campuswide Energy Conservation A 26-part energy conservation program at the college ranges from physical plant alterations to the use of solar and wind generating systems.
Lincoln Memorial University Harrogate, TN 37752 Frank W. Welch President (615) 869-3611	Alternative Energy Sources Warm water from a nearby geothermal spring is piped to the campus and because of its steady temperature costs less to heat and cool than tap water
Loma Linda University Loma Linda, CA 92350 John H. Kriley Administrator, Physical Plant (714) 796-7311	Campuswide Energy Conservation The conservation changes made in this comprehensive program include better insulation, centralized controls, and the connection of a new power plant with an older plant.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Louisiana State University Baton Rouge, LA 70893	Administrative
H.I. Collier Director, Physical Plant (504) 388-3186	Training three maintenance persons to do in-house boiler tune-ups and buy the necessary tools was cheaper than hiring outside contractors to tune up the campus' 52 boilers.
H.I. Collier Director, Physical Plant (504) 388-3186	Lighting Adaptations Fluorescent fixtures with a polarized lens have replaced costly lighting arrangements while still maintaining desirable lighting levels.
H.I. Collier Director, Physical Plant (504) 388-3186	Rescheduling Building Use Sixteen campus buildings are closed down after 6:00 p.m.; night classes have been consolidated and are held in two buildings that must be in use during the evening.
Loyola College Baltimore, MD 21210	Heating Systems
Robert R. Sedivy Director, Resource Management (301) 323-1010	The gymnasium's old steam heating system was controlled by using a valve and a thermostat and operating the system with the new mini-computer; costs minimal; savings substantial.
Loyola University New Orleans, LA 70118	Computerized Energy Management
Manuel M. Vega Director, Physical Plant (504) 865-2257	Energy management was computerized by using existing telephone lines without requiring additional construction or modifications.
Manuel M. Vega Director, Physical Plant (504) 865-2257	Solar Heated Water A large open loop solar system provides all of the hot water used by one dormitory.
Loyola University of Chicago Chicago, IL 60626	Information Sharing
Bernard M. Pleskoff Chairman, Energy Committee (312) 274-3000	An Energy Committee sponsors a series of forums where educators meet to discuss energy conservation problems and share ideas about solutions.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Loyola University of Chicago (continued)	Information Sharing
Bernard M. Pleskoff Chairman, Energy Committee (312) 274-3000	"Crisis in Energy," a slide/tape program, dramatizes to students, the faculty, and the community the seriousness of the energy crisis.
Earle W. Otto Superintendent of Buildings (312) 274-3000	Lighting Adaptations Time clocks and switches control the lighting in the dining room which receives enough sunlight for most of its needs.
Lyndon State College Lyndonville, VT 05851	Administrative
Carl A. Pelzel Director, Physical Plant (802) 626-9371	An energy technician employed by this small college is able to perform many of the tasks handled by a computerized management system, and to do them at a lower cost.
Macalester College St. Paul, MN 55105	Heating Systems
James D Rognile Director, Physical Plant (612) 647-6221	The college closes the central power plant during the summer, using individual water heaters for dormitory needs and a small boiler for the food service operation.
Macon Junior College Macon, GA 31206	Monitoring and Controls
Christy Bass Utility Technician (912) 474-2700	Underground cables connect the energy systems in individual buildings with a central power plant control panel which controls and monitors the energy consumption in each building.
Maine Maritime Academy Castine, ME 04421	Conservation Design and Planning
Donald Small Public Works Engineer (207) 326-4311	Energy saving ideas were included in the plans for a new library wing and were inexpensive to add to the entire building during the new construction.
Manhattanville College Purchase, NY 10577	Commuter Conservation
Paul R. Foley Purchasing Agent (914) 946-9600	Carpooling and a four-day academic week during the summer reduce gasoline used by commuting students and cut the amount of electricity used by the college.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Maricopa County Community College Phoenix, AZ 85034	Computerized Energy Management
Paul M. Polen Facilities Manager (602) 244-8355	A computerized energy management system will also serve as a student training laboratory in refrigeration and solar energy.
Marquette University Milwaukee, WI 52344	Heating Systems
Clyde Rymer Energy Engineer (414) 224-7335	An alternating cycle fan system in the library solves a heat distribution problem and reduces energy and fuel costs.
Mars Hill College Mars Hill, NC 28754	Campuswide Energy Conservation
Fred B. Bentley President (704) 689-1141	A comprehensive five-step plan will gradually renovate a heating system that is now wasting energy.
Martin Community College Williamston, NC 27892	Information Sharing
James R. Jenkins Research-Development Officer (919) 792-1521	The college holds workshops for high school teachers on the use of energy, and on alternative solutions to energy problems.
Mary Baldwin College Staunton, VA 24401	Rescheduling Building Use
Dr. Virginia L. Lester President (703) 885-0811	By shifting its interim session from January to May the college reduces its operating expenses by $975 for each day of the session.
McHenry County College Crystal Lake, IL 60014	Information Sharing
Deborah Lee Welch Student Activities Coordinator (815) 455-3700	The college holds energy awareness workshops for students and the community and promotes the use of carpooling.
McNeese State University Lake Charles, LA 70609	Conservation Design and Planning
Paul B Ritter Director of Facilities (318) 478-2360	By writing specifications and requesting bids based on actual energy problems, the university installed a commercial computerized system altered especially to meet its needs.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Memphis State University Memphis, TN 38152	Administrative
James E. Hellums Energy Manager (901) 454-2075	An energy audit on each major building showed where energy was being wasted. The cost of changes made have an energy savings payback of under two years.
Fred Swift Associate Dean- Engineering (901) 454-2171	Administrative The university concluded from a research project that an electronic kilowatt meter which provides daily calculations on energy use and costs has marketing possibilities.
Chris Ramsay Energy Coordinator (901) 454-2411	Computerized Energy Management A computerized system provides energy management, preventive maintenance, and better use of facilities.
Steve Scesa Associate Professor (901) 454-2173	Energy Education A project in a technical course for engineering seniors and graduate students requires recommendations on how to save energy in an existing building.
James E. Hellums Energy Manager (901) 454-2075	Heating Systems By using a number of gas water heaters and small steam boilers, the university is able to close down the main boiler operations during the summer.
Dr. D.W. Jones Director, Center for Nuclear Studies (901) 454-2687	Information Sharing The university's energy office helps homeowners and builders plan energy-efficient homes by publishing a manual with technical information, names of suppliers, and sources of labor.
James E. Hellums Energy Manager (901) 454-2075	Solar Installation Variations To protect valuable library collections, an economical process using solar energy and chemicals dehumidifies the air before it enters the law library heating system.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Mercer County Community College Trenton, NJ 08690	Solar Installation Variations
Robert W. Duncan Associate Professor (609) 586-4800	A tracking solar furnace will be constructed by students; the costs are being covered by the students' engineering club.
Mercy College of Detroit Detroit, MI 48219	Alternative Energy Sources
Alice Hagerty Associate Director of College Relations (517) 592-6080	Two-thirds of the college's new health and science building is being constructed below ground in order to use the soil as a natural insulating material.
Merritt College Oakland, CA 94619	Administrative
Suzanne M. Dye Business Officer (415) 531-4911	The college uses a consulting engineering firm to recommend energy savings opportunities that will keep operating expenses within the budget.
Miami-Dade Community College Miami, FL 33176	Information Sharing
J. Terence Kelly Vice President for Education (305) 596-1345	The college proyides a directory, a site, and the equipment needed to enable the faculty and students to test conservation ideas in an environmental demonstration center.
Middle Tennessee State University Murfreesboro, TN 37132	Administrative
D.H. Grubbs Chairman, Energy Council (615) 898-2708	An energy council with representatives from academic departments coordinates conservation efforts.
J. Gray Padfield Director, Energy Management (615) 898-2411	Administrative Head-residents in dormitories meet with energy management and maintenance staff each season to learn about the energy systems and conservation possibilities in their buildings.
J. Gray Padfield Director, Energy Management (615) 898-2411	Administrative An energy management coordinator was hired to be responsible for all campus energy conservation operations, procedures, analyses, and energy consumption records.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Middle Tennessee State University (continued)	Administrative
J. Gray Padfield Director, Energy Management (615) 898-2411	All maintenance personnel meet monthly with a conservation task force to discuss adjustments and recommendations as well as the success of past conservation efforts
J. Gray Padfield Director, Energy Management (615) 898-2411	Conservation Design and Planning The Director of Energy Management serves as a conservation consultant in the design and planning of buildings constructed, added to, or modified.
Earl Keese Director of Continuing Education (615) 898-2462	Information Sharing The university used funds from a research grant to test the effectiveness of various energy saving devices.
Earl Keese Director of Continuing Education (615) 898-2462	Information Sharing A symposium sponsored by the university brought together architects, industrialists, and businessmen for an exchange of energy saving information.
Earl Keese Director of Continuing Education (615) 898-2462	Information Sharing Managers and owners of small businesses are trained in a four-day seminar organized by the university to perform their own energy audits.
Earl Keese Director of Continuing Education (615) 898-2462	Information Sharing At three conferences organized by the university, local officials and other members of the public received information on how to form a statewide energy conservation network.
J. Gray Padfield Director, Energy Management (615) 898-2411	Lighting Adaptations During a routine replacement of lightbulbs in exit signs, the maintenance staff used lower wattage bulbs in place of 75-watt bulbs.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Middle Tennessee State University (continued)	Monitoring and Controls
J. Gray Padfield Director, Energy Management (615) 898-2411	Faculty and students inform the maintenance staff about any temperature changes in buildings recently fitted with energy saving adjustments.
Earl Keese Director of Continuing Education (615) 898-2462	Solar Information Sharing A short course provides present and prospective home owners with information on solar energy and conservation techniques.
Earl Keese Director of Continuing Education (615) 898-2462	Solar Information Sharing A workshop provides laboratory experience to teach students the design, planning, and operation of a solar greenhouse.
Earl Keese Director of Continuing Education (615) 898-2462	Solar Information Sharing Successful participants in a workshop will be certified to install solar water heating systems in compliance with Tennessee Valley Authority regulations.
J. Gray Padfield Director, Energy Management (615) 898-2411	Ventilation Time clocks controlling fan start-and-stop operations were installed in buildings not included in the university's central control system.
Middlebury College Middlebury, VT 05753	Administrative
Russell J. Leng Dean of Sciences (802) 388-7964	The college won an appeal to the state to maintain its utility rates when the electric company revised its rates to penalize the college for installing its own electrical generating system.
Russell J. Leng Dean of Sciences (802) 388-7964	Administrative Physical plant staff meets with faculty and staff to explain and exchange information on energy systems and conservation potential to help solve building temperature problems.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Middlebury College (continued)	Administrative
Russell J. Leng Dean of Sciences (802) 388-7964	The entire campus restricted its electrical use during the week in which the electric company based its set monthly service fee for the whole year.
Russell J. Leng Dean of Sciences (802) 388-7964	Administrative The college insulated its faculty housing and covered the costs of converting the heating system to burning wood if faculty members paid for wood burning stoves.
Russell J. Leng Dean of Sciences (802) 388-7964	Campuswide Energy Conservation Insulation, fans, time clocks, and timed heating cycles are part of many small but important conservation adjustments in this comprehensive program.
Russell J. Leng Dean of Sciences (802) 388-7964	Heat Recovery A "heat sink" cools and heats a building by first removing building heat with circulating water and then storing it below the building at a warm temperature until needed for heating.
Russell J. Leng Dean of Sciences (802) 388-7964	Incentive Program An energy promotional council develops methods of increasing conservation awareness and incentives within the campus community.
Russell J Leng Dean of Sciences (802) 388-7964	Power Plant Conversion A new process (leased to the college) periodically sprays preheated water onto burning oil in the central furnace resulting in a chemical reaction which burns the oil longer and hotter.
Millersville State College Millersville, PA 17551	Monitoring and Controls
Charles Robie Superintendent of Maintenance (717) 872-5411	Valves on hot water heaters increase the hot water supply while the computerized system controls the availability of hot water and the electricity used to heat it.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Mississippi County Community College **Blytheville, AR 72315**	Solar: Use of Photovoltaics
Harry V. Smith President (501) 762-1020	A solar photovoltaic system will collect sunlight in solar cells and route it through a conditioning system to produce the electricity needed to meet the college's entire energy needs.
Missouri Western State College St. Joseph, MO 64507	Ventilation
Larry W. Smith Director, Physical Plant (816) 271-4417	A ceiling fan and a duct system recirculate rising and wasted hot air and cut heating costs.
Mohawk Valley Community College Utica, NY 13501	Lighting Adaptations
Malcolm A. McNall Director, Physical Plant (315) 792-5435	The college installed wireless remote-control units which are less costly than wall switches and provide local control of lighting previously controllable only at the main power center.
Montclair State College Upper Montclair, NJ 07043	Conservation Design and Planning
Jerome R. Quinn Director of Planning (201) 893-4323	A team of architects, engineers, and college staff included solar energy, special window installations, and a computerized system in the design of a new energy-efficient dormitory.
Harrison Goodall Assistant Professor (201) 893-4161	Energy Education Courses on residential energy conservation and alternative energy conversion systems are offered through the Industrial Education and Technology departments.
Montgomery College Rockville, MD 20850	Lighting Adaptations
Willard L. Meigs Operations Engineer (301) 279-5364	Electricity use was cut when incandescent light fixtures were replaced with low pressure sodium light fixtures.
Willard L. Meigs Operations Engineer (301) 279-5364	Lighting Adaptations The total number of lighting fixtures planned for a new building was cut in half by using sodium pressure fixtures in the design: they shed more light and use less energy.

97

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Montgomery College (continued)	Lighting Adaptations
Willard L. Meigs Operations Engineer (301) 279-5364	Electricity was reduced and noise eliminated when mercury vapor lights in a lecture room were replaced with fluorescent lamps.
Morehead State University Morehead, KY 40351	Administrative
Dr. Jerry Howell, Jr. Director, Center for Environmental Studies (606) 783-3328	A campus conservation committee made a building-by-building survey, performed audits, and created a long- and short-term policy on obtaining grants and adding education programs.
Dr. Jerry Howell, Jr. Director, Center for Environmental Studies (606) 783-3328	Energy Education The university's comprehensive energy education program includes energy audit training, alternative energy production, and seminars for homeowners and developers.
Morton College Cicero, IL 60650	Rescheduling Building Use
Donald T. DeBiase Director, Physical Plant (312) 656-8000	Costs to cool buildings are cut by rescheduling all summer classes to the evening, using a four-day week, and by consolidating all classes and cooling needs into one area.
Mount Holyoke College South Hadley, MA 01075	Heat Recovery
William Fearn Heating Engineer (413) 538-2369	Heat normally wasted through two manholes used for venting an underground steam system is recovered and used to heat the campus greenhouse.
Mount Marty College Yankton, SD 57078	Lighting Adaptations
Sister Marie Helene Werdel Director, Plant Operations (605) 668-1500	Electricity was reduced when incandescent lights were replaced and the number of lights used was reduced.
Sister Marie Helene Werdel Director, Plant Operations (605) 668-1500	Monitoring and Controls Costs of heating the campus were reduced by installing thermostats and heat monitoring devices, disconnecting radiators, and closing exhaust vents.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Mount Marty College (continued)	Rescheduling Building Use
Sister Marie Helene Werdel Director, Plant Operations (605) 668-1500	Energy savings during a Christmas vacation shutdown were made possible by consolidating all working staff into one area and asking them to supply their own electric space heaters.
Mt. San Antonio College Walnut, CA 91789	Computerized Energy Management
Virgil Farnsworth Supervisor, Physical Plant (714) 594-5611	Electricity saved by adjusting the lighting and regulating the water temperature and volume eventually led to the installation of a computerized energy management system.
Navarro College Corsicana, TX 75110	Administrative
Charles G. Orsak, Jr. Assistant Dean (214) 874-6501	The college considered adding solar education programs and conducted a study analyzing the market for solar installations and the skills required of solar technicians.
Charles G. Orsak, Jr. Assistant Dean (214) 874-6501	Administrative A feasibility study was conducted to develop a solar energy education curriculum that would train technicians in all phases of solar energy.
Charles G. Orsak, Jr. Assistant Dean (214) 874-6501	Administrative An energy audit examined the original design, plan, and layout of three campus buildings to develop the most appropriate conservation measures.
Charles G. Orsak, Jr. Assistant Dean (214) 874-6501	Administrative The college contracted with a maintenance company to do a complete campus conservation overhaul that included demolition of two buildings.
Charles G. Orsak, Jr. Assistant Dean (214) 874-6501	Alternative Energy Source A geothermal well supplies a local hospital and the college with hot water and partial space heating.

Institution and Principal Contact Person	Brief Description of Idea or Approach
Navarro College (continued)	Energy Education
Charles G. Orsak, Jr. Assistant Dean (214) 874-6501	An 11-module curriculum in energy conservation provides training at the secondary vocational, and adult continuing education levels.
Charles G. Orsak, Jr. Assistant Dean (214) 874-6501	Energy Education A certification program trains mechanics and installers to work with conventional solar systems.
Charles G. Orsak, Jr. Assistant Dean (214) 874-6501	Information Sharing A three-day workshop provides "hands on" training in the use of solar powered stills that produce alcohol fuel from grain.
Charles G. Orsak, Jr. Assistant Dean (214) 874-6501	Rescheduling Building Use Energy costs were saved and academic priorities maintained when students and staff were rescheduled on a 4/40 plan, or 40 hours within four days.
Charles G. Orsak, Jr. Assistant Dean (214) 874-6501	Solar Building Design A solar lecture/laboratory facility with outdoor space for collectors and storage of solar energy provides "hands on" experience as part of the college's solar energy education curriculum.
Charles G. Orsak, Jr. Assistant Dean (214) 874-6501	Solar Education A course provides training for solar technicians and leads to an Associate of Applied Science degree in Solar Technology.
Charles G. Orsak, Jr. Assistant Dean (214) 874-6501	Solar Heated Water Three banks of 24 solar collectors provide enough hot water for one large campus dormitory.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Nazarene Bible College Colorado Springs, CO 80935	Administrative
Wesley A. Taylor Business Manager (303) 596-5110	An energy audit conducted by a consulting firm was the basis for major conservation alterations and adjustments that more than paid for the costs of the consultation.
New Mexico Highlands University Las Vegas, NM 87701	Energy Education
Dr. Orval D. Hughes Project Director, Energy Education (505) 425-7511	A teacher training program provides conservation workshops and follow-up assistance to grade school and junior high school teachers.
New Mexico State University Las Cruces, NM 88003	Monitoring and Controls
Richard A. MacRone Systems Analyst (505) 646-3021	Outdoor air temperature meters save energy costs by determining when incoming air needs to be pre-heated or chilled before it circulates to remove fumes from the chemistry building.
New Mexico State University-Grants Branch Grants, NM 87020	Incentive Program
Jonette Balmer Coordinator, Energy Information (505) 287-7984	Newspaper articles, films, and the school curriculum promote walking and bicycling in an attempt to discourage excessive driving by students.
Jonette Balmer Coordinator, Energy Information (505) 287-7984	Information Sharing Students, the community, and speakers from utility companies, conservation organizations, and planners participated in a 12-week course examining energy issues.
Jonette H. Ballmer Coordinator, Energy Information (505) 287-7984	Solar Information Sharing A one-time four-evening class on solar energy and its practical application was held in response to continuous requests from students and the local community.
New York Institute of Technology Old Westbury, NY 11563	Information Sharing
Dr. Gale Tenan Spak Deputy Director, Center for Energy Policy (516) 686-7578	A telephone "energy hot line" provided specific answers to questions and sent printed material as a follow-up service to New York residents.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Nichols College Dudley, MA 01570	Campuswide Energy Conservation
Dr. Lowell C. Smith President (617) 943-1560	The college reduced heating oil used by 27 percent by insulating all buildings, using thermostats, using energy saving showerheads, and rescheduling classes.
North Carolina State University Raleigh, NC 27650	Administrative
Charles C. Braswell Director, Physical Plant (919) 737-2181	Before installing computerized control of its energy systems, the university tested the cost effectiveness on a microprocessor leased to the computer science department.
Charles C. Braswell Director, Physical Plant (919) 737-2181	Incentive Program A two-year energy conservation program uses a multi-media approach to increase awareness and cut campus energy costs.
North Dakota State School of Science Wahpeton, ND 58075	Information Sharing
Alvin C. Eckre Director, Special Services (701) 671-2245	Training and technical assistance in the safe production of alcohol fuels from grain are provided to local farmers.
Alvin C. Eckre Director, Special Services (701) 671-2245	Lighting Adaptations Lighting standards were maintained and electricity was saved when the college reduced its lighting by 50 percent.
Alvin C. Eckre Director, Special Services (701) 671-2245	Power Plant Conversion The central oil burning heating plant was reconstructed to burn the coal widely available in North Dakota.
Alvin C. Eckre Director, Special Services (701) 671-2245	Ventilation Steam heating costs were reduced when thermostats were reset and the fresh air ventilating system was altered to use recirculated air in all classrooms and laboratory buildings.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
North Dakota State School of Science (continued)	Window Modifications
Alvin C. Eckre Director, Special Services (701) 671-2245	Smaller double-glazed windows held in an insulated panel replaced old, poorly insulated windows and ended heating and cooling losses.
Northern Arizona University Flagstaff, AZ 86011	Computerized Energy Management
E. Harlin Staires Vice President (602) 523-3151	Centralizing all operations of a hot water heating system by using a computer reduced energy use by 30 percent.
Northern Michigan University Marquette, MI 49855	Lighting Adaptations
Michael G. Hellman Associate Director, Physical Plant (906) 227-2120	Changing the lighting in the gymnasium and field house to metal halide and mercury vapor lamps cut the power used, reduced maintenance costs, and provided better visibility.
Northern State College Aberdeen, SD 57401	Power Plant Conversion
Dr. Joseph M. McFadden President (605) 622-2521	Boilers were converted to burn waste crankcase oil by installing a simple and inexpensive filtering system.
Northland College Ashland, WI 54806	Incentive Program
Harvey B. Haukaas Director of Planning (715) 682-4531	The college reduced its overall energy consumption by offering a free party to the students in the dormitory having the lowest energy use.
Northwest Mississippi Junior College Senatobia, MS 38668	Solar: Use of Photovoltaics
Henry B. Koon President (601) 562-5262	A solar photovoltaic system uses a back-up waste converting and burning system to serve all heating and electricity needs without using any oil or natural gas.
Notre Dame College Manchester, NH 03104	Cooling Systems
Robert Bishopric Superintendent of Plant (603) 669-4298	The college reduced its water and sewage costs by replacing its water cooled refrigeration and freezer compressors with an air cooled system.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Oberlin College Oberlin, OH 44074	Heat Recovery
Joseph Metro Manager of Buildings (216) 775-8434	Instead of tunnels for steamheating pipes being buried, they were insulated; as a result, normally wasted heat is recovered and used as part of the heating system.
Ohio State University Columbus, OH 43210	Cooling Systems
Dallas Sullivan Director of Conservation (614) 422-6240	Replacing a steam-run chiller in the pharmacy building with an electrical system did not interfere with temperature sensitive research programs and cut costs of round-the-clock cooling.
Dallas Sullivan Director of Conservation (614) 422-6240	Cooling Systems The installation of a small individual air conditioning unit eliminated the need to run the large air cooling system round-the-clock to serve the temperature needs of a small computer.
Dallas Sullivan Director of Conservation (614) 422-6240	Ventilation After an energy study, the university found that energy cuts could be made and government ventilation regulations met by reducing the constant air supply to laboratory buildings.
Oklahoma State University Stillwater, OK 74078	Energy Education
Dr. Steve Marks Co-Director, Energy Conference (405) 624-7015	Summer inservice training for public school teachers and administrators gives them a better understanding of energy problems and helps them develop energy curricula.
Dr. E.F. Davidson Vice President (405) 624-5982	Heat Recovery Installation of a heat recovery system has solved an air pressure balance problem; heat from exhaust air is captured and preconditions outside air entering two science buildings.
Olivet College Olivet, MI 49076	Information Sharing
Burton V. Swan Director, Physical Plant (616) 749-7649	A center supported by contributions of time and materials from faculty, staff, and students provides the community with information and useful tips on energy conservation.

Institution and Principal Contact Person	Brief Description of Idea or Approach
Olivet College (continued)	Ventilation
Burton V. Swan Director, Physical Plant (616) 749-7000	The college took advantage of natural good weather and ventilation when building use was low by replacing sealed windows with operable windows. This cut costs.
Oregon Institute of Technology Klamath Falls, OR 97601	Alternative Energy Source
John H. Smith Assistant to the President (503) 882-6231	All buildings on the campus are designed and constructed to use geothermal heating from local hot springs.
Oregon State University Corvallis, OR 97331	Monitoring and Controls
Clifford V. Smith Vice President (503) 754-2447	The temperature monitoring system in a large research building is set up to avoid the use of both the heating and the cooling system on the same day.
Penn Valley Community College Kansas City, MO 64111	Monitoring and Controls
Kenneth Gillespie Director, Physical Plant (816) 756-0220	Energy costs at the college were cut by 62 percent at virtually no cost by lowering temperatures and by reducing lighting levels, the hours equipment operated, and the fan speeds.
Pennsylvania State University University Park, PA 16802	Incentive Program
J. Carroll Dean Manager, Conservation Program (814) 863-0538	Students organized and monitored a five-week energy conservation contest; 40 dormitories were involved; cash awards were given to the top three winners.
Gary A. Shute Coordinator, Energy Extension (814) 863-2938	Information Sharing Students designed energy education courses for the community in order to meet the requirement that they participate in community service prior to graduation.
J. Carroll Dean Manager, Conservation Program (814) 863-0538	Lighting Adaptations The university achieved a 42 percent cut in energy used by lighting each area on the campus at the level needed for the task to be carried on there.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Pennsylvania State University (continued)	Window Modifications
J. Carroll Dean Manager, Conservation Program (814) 863-0538	"Roll up" storm windows made of clear vinyl installed inhouse raise inside temperatures by 25 percent and reduce energy loss by 26 percent.
Philadelphia College of Art Philadelphia, PA 19102	Window Modifications
Michael Levin Designer (215) 893-3172	An energy management class designed an inexpensive insulated vertical blind which can reduce the heat loss during the winter through the college's 1,200 windows.
Piedmont Technical College Roxboro, NC 27573	Energy Education
Thomas E. Carden Director, Industrial Technology (919) 599-1181	The college offers a three-year energy technology program on installation and maintenance of energy systems in both commercial and residential buildings.
Pima Community College Tucson, AZ 85705	Solar Information Sharing
Constance Howard Director, Community Services (602) 884-6720	The college ran a series of training workshops that showed residents of the community how to build and install their own solar hot water collectors.
Polytechnic Institute of New York Brooklyn, NY 11201	Energy Education
Dr. Richard S. Thorsen Chairman, Energy Engineering Program (212) 643-5044	The college offers a masters of science degree program accompanied by a certificate in energy engineering and policy.
Post College Waterbury, CT 06708	Building Insulation
Frank Gomes, Jr. Treasurer (203) 755-0121	By covering the roofs of two buildings with a "trocol membrane" insulating and sealing system, the college eliminated roof leaks and increased heat retention capacity.
Potsdam College of Arts and Science Potsdam, NY 13676	Computerized Energy Management
Ronald J. Scott Director, Physical Plant (315) 268-2955	A micro-computer manages energy consumption, using the steam plant as the center for climate control.

Table A (continued) The 437 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Presentation College Aberdeen, SD 57401	Campuswide Energy Conservation
Peter P. Wolf Director, Physical Plant (605) 225-0420	This college conserved energy by caulking windows, insulating pipes, rescheduling kitchen hours, and reducing room temperatures.
Prestonburg Community College Prestonburg, KY 41663	Campuswide Energy Conservation
Robert D. McAninch Associate Professor (606) 886-3863	The college's goal of 30 percent energy reduction was surpassed by lowering overall temperatures, using space heaters, and reducing lighting.
Princeton University Princeton, NJ 08544	Computerized Energy Management
Michael E. McKay Assistant Director, Construction (609) 452-3966	The university installed a computer control system to monitor the energy efficiency of 40 buildings.
Elmer W. Fry Manager, Mechanical Engineering (609) 452-5472	Heat Recovery By using the heat given off by a computer system running 24 hours a day the university is able to heat the building and reduce the temperature of the computer.
Ramapo College of New Jersey Mahwah, NJ 07430	Conservation Design and Planning
Michael R. Edelstein Assistant Professor of Psychology (201) 825-2800	The college designed a building for ecological living which incorporated many conservation and alternative energy features.
William J. Makofske Professor of Physics (201) 825-2800	Energy Education The faculty designed an undergraduate curriculum which takes a cross-disciplinary approach to the social, political, scientific, and technical aspects of the energy crisis.
William J. Makofske Professor of Physics (201) 825-2800	Information Sharing The alternate energy center conducts workshops for the college family and the local community and carries on small scale research on renewable and alternative energy sources.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Ramapo College of New Jersey (continued)	Lighting Adaptations
Robert W. Johnson Energy Officer (201) 825-2800	By installing brighter street lights the college was able to remove all nearby sidewalk lights, cutting electrical consumption in half.
Randolph-Macon College Ashland, VA 23005	Administrative
Dr. William P. Hesse Assistant Professor of Physics (804) 798-8372.	To increase student awareness of the energy problem and to qualify for federal matching grant funds, the college appointed 21 students to conduct a thorough campuswide energy audit.
Rhode Island Junior College Warwick, RI 02886	Conservation Design and Planning
Priscilla A. Ling Public Relations Officer (401) 825-2181	A large seven-story building, designed as a multipurpose campus, has the most efficient heating, cooling, and lighting arrangements possible.
Rivier College Nashua, NH 03060	Campuswide Energy Conservation
Mrs. Tracy Schier Director of Development (603) 888-1311	An energy audit on the campus resulted in the development of a comprehensive energy conservation program.
Rockefeller University New York, NY 10021	Heat Recovery
Thomas P. McGinnity Director, Physical Facilities (212) 360-1075	Coils installed in two major buildings recovered enough heat escaping from exhaust systems to heat the buildings during the winter.
Rollins College Winter Park, FL 32789	Administrative
Dr. Thomas D. Harblin Chairperson, Conservation Task Force (305) 646-2000	A conservation task force develops and promotes plans to reduce energy waste and educates and motivates members of the college community about conservation possibilities.
Rosemont College Rosemont, PA 19010	Power Plant Conversion
Alexander Spiro Business Manager (215) 527-0200	This multi-building campus is converting its boilers from oil to natural gas as the main source of fuel with oil as backup.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Rutgers University New Brunswick, NJ 08903 John Whyte Energy Management Engineer (201) 932-2078	Computerized Energy Management A mini-computer monitors, analyzes, and controls energy consumption; it has reduced costs and eliminated the difficulty of running a manual management system.
St. John's University Jamaica, NY 11439 Henry Carattini Director, Plant Operations (212) 969-8000	Lighting Adaptations Electric timing devices automatically control classroom lighting to conserve energy.
St. Joseph College West Hartford, CT 06117 Sr. Claire Markham, Ph.D. Assistant Dean (203) 232-4541	Energy Education The college staff developed an energy education program for the state's elementary schools.
St. Mary's College Winona, MN 55987 T.J. Tim Burchill, III Director, College Relations (507) 452-4430	Incentive Program "Ernie Energy," a penguin image, has been adopted as a motivator and educator on energy conservation and is used on posters and memoranda and in newspaper articles.
St. Mary's College of California Moraga, CA 94575 Alan B. Holloway Vice President (415) 376-4411	Campuswide Energy Conservation A campus energy audit by a local utility company triggered a comprehensive conservation and awareness program as well as a conservation marketing research program at the college.
St. Mary's University San Antonio, TX 78284 Sylvia McLaren Assistant Director, Public Relations (512) 436-3327	Commuter Conservation In order to show their concern about the nation's dependence on foreign oil, students circulated a petition pledging signers to drive five miles less per week.
St. Michael's College Winooski, VT 05404 Edward L. Henry President (802) 655-2000	Rescheduling Building Use The Christmas vacation time for the college staff was lengthened to correspond with that of the students; then the campus was shut down for the entire period.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
San Francisco State University San Francisco, CA 94132	Heat Recovery
Leo Dunne Manager, Energy Resources (415) 469-2469	A heat-reclaiming unit captures waste heat from kitchen stoves and uses it to heat the dining hall.
San Jose State University San Jose, CA 95192	Solar Building Design
J. Handel Evans Associate Executive Vice President (408) 277-2122	A new five-story library will use solar and natural energy for 100 percent of its heating, cooling, and ventilation needs with no backup system considered necessary.
Seattle Pacific University Seattle, WA 98119	Campuswide Energy Conservation
Merlin P. Walsh Director, Physical Plant (206) 281-2071	A comprehensive conservation plan reorganized the dormitory heating system, changed the athletic facility lighting, and installed solar panels to heat water.
Sierra Joint Community College Rocklin, CA 95677	Administrative
Ronald Bryant Facility Planning (916) 624-3333	An energy committee developed a public energy education program, an energy monitoring system, a technical audit, and an energy technician training program.
Leland Mansuetti Program Development (916) 624-3333	Energy Education This college offers a degree or certificate in technical energy management as well as courses to upgrade the skills of energy technicians and to educate consumers on energy conservation.
Skidmore College Saratoga Springs, NY 12866	Power Plant Conversion
Stephen F. Harran, Jr. Director, Business Operations (518) 584-5000	The college developed a way for its heating plant to burn 100 percent waste crankcase oil; this lowered fuel bills and removed a waste product and pollutant from the area.
Solano Community College District Suisun City, CA 94585	Campuswide Energy Conservation
Raymond E. Ogden Director, Operations (707) 864-7000	Great energy savings on campus were achieved by small steps such as lowering thermostats and lighting, changing class schedules, and exploring alternative energy sources.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Southeastern Community College Whiteville, NC 28472 William D. Small Superintendent (919) 642-7141	Monitoring and Controls The college cut energy costs by installing time clocks to run equipment more efficiently, by reducing the heating within various buildings, and by reducing lighting.
Southeastern University Washington, DC 20024 Andrew G. Nelson Dean (202) 488-8162	Energy Education The university offers a graduate degree program in energy management which concentrates on energy policy decision-making.
Southern Illinois University Carbondale, IL 62901 Thomas B. Engram Superintendent of Utilities (618) 453-4371	Computerized Energy Management The university invested in a computer system in order to enable it to cut the demand for electricity and to manage other conservation activities as they developed.
Southwest Texas State University San Marcos, TX 78666 E.M. Fauver, Jr. Chairman, Energy Committee (512) 245-2148	Incentive Program A conservation public relations effort uses a poster and bumper sticker campaign, an energy curriculum, and car pooling parking privileges to change attitudes to favor conservation.
Southwestern at Memphis Memphis, TN 38112 Thomas R. Kepple, Jr. Director of Administrative Services (901) 274-1800	Incentive Program The program awarded the student government half of each dollar saved by the practical application of electricity conservation practices.
Southwestern University Georgetown, TX 78626 Robert J. Schwartz Comptroller (618) 453-4371	Computerized Energy Management A computer system installed by the university controls gas and electric consumption efficiently and reduces costs without sacrificing comfort.
Spokane Falls Community College Spokane, WA 99204 Dr. Ronald L. Needham Division Supervisor (509) 456-2897	Energy Education A two-day seminar on earth-sheltered buildings developed such an interest that the college established a program that runs over three-quarters of the year.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Spokane Falls Community College (continued)	Information Sharing
John M. Thompson Director, Learning Resources (509) 456-2860	The college contributed a two-acre site to a community project that used donated plans and labor to build an energy-efficient home which now serves as an energy information center.
Spring Garden College Chestnut Hill, PA 19118	Commuter Conservation
Kay Root Assistant Director of Development (215) 242-3700	The four-day week schedule at this commuter college has cut the traveling expenses of the students as well as reducing the college's operating costs.
Kay Root Assistant Director of Development (215) 242-3700	Energy Education The college offers two-year and four-year degree programs in energy engineering and technology using mainly existing courses arranged to cover every possible angle of energy conservation.
Spring Hill College Mobile, AL 36608	Cooling Systems
Jean Golden Director, Energy Conservation (205) 460-2250	An oversized compressor which malfunctioned often was replaced by a small, more efficient unit that uses less than half the electricity and still services the building adequately.
Jean Golden Director, Energy Conservation (205) 460-2250	Incentive Program A contest with a monetary award was designed to reduce student energy use and utility cost in dormitories.
SUNY Agriculture and Technical College Alfred, NY 14802	Window Modifications
James E. Hawes Principal Engineer (607) 871-6373	A special combination of insulating materials was designed into a panel that covers unnecessary windows aesthetically and reduces heat loss.
SUNY at Binghamton Binghamton, NY 13901	Ventilation
Edward J. Demske Vice President (607) 798-2157	The ventilation in most buildings on the campus was reduced by cutting the size of fan motors and redirecting air flow with no reduction in comfort.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
SUNY at Brockport Brockport, NY 14420 B.R. Wolin Vice President (716) 395-2129	Campuswide Energy Conservation An energy management system makes it possible for a comprehensive conservation program to overcome the deficiencies of an aged and overused physical plant.
SUNY at Buffalo-Amherst Buffalo, NY 14260 Dean H. Fredricks Director, Physical Plant (716) 636-2025	Building Insulation Insulation and sealing of open air spaces above the ceilings in a large dormitory and classroom complex both eliminated heating complaints and reduced heating costs.
SUNY at Old Westbury Old Westbury, NY 11568 Edward A. Quinn Engineer (516) 876-3302	Heating Systems The college rented two mobile boilers to provide hot water and air conditioning for the campus during the summer, allowing the total heating system to be shut down for repairs.
SUNY at Oswego Oswego, NY 13126 Robert F. Bieling Assistant to the Vice President (315) 341-3202	Alternative Energy Source The institution plans to experiment with windpower generation, lake water cooling, burning waste automotive oil, and other alternative sources of energy.
SUNY at Plattsburgh Plattsburgh, NY 12901 B.J. Seawell Vice President (518) 564-2130	Monitoring and Controls The institution switched its air conditioning system from automatic to manual control so that air conditioning was provided only after the outdoor temperature stayed at 78°F. for 48 hours.
SUNY at Stony Brook Long Island, NY 11794 Antoinette Bosco Campus Relations Director (516) 246-3580	Cooling Systems A number of cooling units on campus were eliminated to avoid excessive cooling.
Stetson University Deland, FL 32720 Fred Cooper Director, Public Relations (904) 734-4121	Incentive Program A "Turn On to Turn Off" incentive program tabulated the number of appliances students owned, educated them on the energy these used, and then conducted a conservation contest.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Stetson University (continued)	Incentive Program
Fred H. Cooper Director, Public Relations (904) 734-4121	To increase student awareness of energy problems, the university was blacked out for five hours for a candlelight dinner, an outdoor concert, and a discussion on conservation.
Suffolk County Community College Selden, NY 11784	Solar Installation Variations
John C. Harrington Administrative Vice President (516) 233-5196	By constructing solar greenhouses on the top of outdoor sewage storage tanks, the college provided winter heating for sewage as it was processed at the treatment plant.
Susquehanna University Selinsgrove, PA 17870	Administrative
David C. Henry Assistant Director, Physical Plant (717) 374-0101	An energy task force studies energy problems and passes on to appropriate officials the best suggestions for conserving energy that it can find.
David C. Henry Assistant Director, Physical Plant (717) 374-0101	Computerized Energy Management A central computer system is used to control and monitor all energy systems on the campus as well as the fire and security alarms.
David C. Henry Assistant Director, Physical Plant (717) 374-0101	Lighting Adaptations About 760 fluorescent tubes were removed and 380 ballasts were disconnected in order to reduce excessive lighting on the campus.
David C. Henry Assistant Director, Physical Plant (717) 374-0101	Monitoring and Controls A weather man controller device uses outdoor temperatures as one factor in determining the setting of room temperatures in the dormitories.
David C. Henry Assistant Director, Physical Plant (717) 374-0101	Ventilation Four ceiling fans were installed to circulate heat trapped in high dining hall ceilings.

Table A (continued) The 407 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Taft College. Taft, CA 93268	Information Sharing
Dara Kennedy Special Projects Coordinator (805) 765-4191	The college conducts a course for community residents (mainly workers in nearby oil fields) to increase their energy awareness and their acquaintance with fuel shortage problems.
Talladega College Talladega, AL 35160	Alternative Energy Sources
Dr. Vadiraja V. Murthy Associate Professor (205) 362-5521	A faculty member and a student are researching the possibilities of using the kudzu root tubers as a source of alcohol production for gasohol.
Taylor University Upland, IN 46989	Heat Recovery
Charles R. Newman Director, Service Operations (317) 998-2751	The energy used in the dining hall was reduced by adjusting refrigeration compressors and using hot kitchen exhausts to pre-heat fresh air going into the dining room.
Charles R. Newman Director, Service Operations (317) 998-2751	Incentive Program. The "Kaptain Kill-a-Watt" logo is the energy conservation super hero on campus and is used on T-shirts, light switches, memoranda, posters, and cartoons.
Tompkins Cortland Community College Dryden, NY 13053	Window Modifications
Philip E. Donohue Director, Buildings and Grounds (607) 844-8211	The college is using part of its 33,000 square feet of windows as a laboratory to test five types of treatment for single-pane glass windows that waste energy.
Triton College River Grove, IL 60171	Administrative
Earl Cismesia Superintendent (312) 456-0300	A physical plant official found that by converting one small building to electric space heating, the entire campus could qualify for a special discount on electricity rates.
Tufts University Medford, MA 02155	Administrative
Philip Strassburger Student (617) 666-0926	A team of engineering students trained to identify and analyze energy use, misuse, and overuse on campus reports its findings to physical plant personnel.

Institution and Principal Contact Person	Brief Description of Idea or Approach
Tuskegee Institute Tuskegee Institute, AL 36088	Cooling Systems
George L. Howell, Jr. Assistant Director, Physical Plant (205) 727-8861	By installing independent chillers in the only two buildings requiring year-round air conditioning, the Institute is able to shut down its central chilling system periodically.
United States Air Force Academy USAF Academy, CO 80840	Ventilation
Major Will Stackhouse Associate Professor (303) 472-2196	Heating costs are cut by increasing air circulation so as to distribute the air warmed by the sun in some parts of the building to areas that are in the shade.
United States Naval Academy Annapolis, MD 21402	Alternative Energy Source
Dr. Michael E. McCormick Professor (301) 267-3873	Continued tests and experiments at the Naval Academy explore the possibility of developing a system that could use the energy of ocean waves to generate electricity.
Dr. Clyde C. Richard Assistant Professor (301) 267-3872	Alternative Energy Source A senior engineering class spent a year researching the possibilities of tapping the energy of ocean currents.
Dr. Arthur E. Bock Professor (301) 267-3791	Computerized Energy Management The Naval Academy is using an energy-monitoring computer system to keep energy costs under control.
Dr. Robert Artigiani Assistant Professor (301) 267-3765	Energy Education A panel of professors from different departments of the Academy discusses in a multidisciplinary energy course various aspects of energy conservation and policy.
Dr. Robert W. Love, Jr. Assistant Professor (301) 267-3301	Energy Education Naval history and policy courses now include information on energy studies and data on the Navy's energy consumption.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
United States Naval Academy (continued)	Energy Education
Dr. Richard D. Mathieu Director of Research (301) 267-2504	Many recent projects conducted by senior engineering students that have focused on energy development have been recognized by professional societies.
Dr. Michael E. McCormick Professor (301) 267-3873	Energy Education The requirements for an ocean engineering course include a course on five forms of energy found in the ocean.
Dr. Chih Wu Professor (301) 267-3186	Energy Education Part of a computer course requires students to run a program showing world energy consumption and the depletion that is occurring in the remaining supply of energy resources.
Dr. Chih Wu Professor (301) 267-3186	Energy Education Term papers for an energy conversion course have resulted in a good deal of followup research at the Naval Academy.
LCDR Charles C. Failla Instructor (301) 267-3582	Energy Education After simple and inexpensive alterations have been made, a heat balanced engine is able to double power output or cut fuel consumption in half.
Dr. Chih Wu Professor (301) 267-3186	Incentive Program A visual device was designed to increase student awareness of the problem presented by the growing consumption of the finite resources man now depends on for energy.
Dr. Robert Artigiani Assistant Professor (301) 267-3765	Information Sharing A campus television network periodically airs a series of "Energy Minutes" to increase awareness and generate discussion on the Navy's role in energy use and development.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach.
United States Naval Academy (continued)	Information Sharing
Dr. Arthur E. Bock Professor (301) 267-3791	A movie used in a required engineering course explains the implications of the energy crisis on the Navy, promotes conservation, and encourages research on alternative fuel sources.
Dr. Arthur E. Bock Professor (301) 267-3791	Information Sharing An energy study group works through the various media and classroom instruction to keep Naval Academy staff and students up to date on new internal and world energy developments.
Dr. Richard D. Mathieu Director of Research (301) 267-2504	Information Sharing Energy research papers are encouraged, are used in developing curriculum, are published in professional journals, and are followed up with additional research.
Dr. Rocco M. Paone Professor (301) 267-3476	Information Sharing Guest speakers discuss energy and conservation ideas with faculty members and students during evening seminars.
Dr. Clyde C. Richard Assistant Professor (301) 267-3872	Power Plant Conversion The Naval Academy designed a system which by using waste products as an alternative fuel, saves oil and still preserves the quality of the air.
Unity College Unity ME 04988	Administrative
Daniel O. Rynberg Energy Conservation Coordinator (207) 948-3131	A parttime professor conducted an energy analysis of all campus buildings to pinpoint areas of energy loss or overuse.
Daniel O. Rynberg Energy Conservation Coordinator (207) 948-3131	Information Sharing Three-week "mini-courses" on energy topics include exploring solar energy and tuning automobile engines for fuel economy.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Unity College (continued)	Power Plant Conversion
Daniel O. Rynberg Energy Conservation Coordinator (207) 948-3131	Installing a wood-fired heating system operated by work study students to replace the old fuel oil system reduced energy costs and used a local fuel supply that was abundant and cheap.
Daniel O. Rynberg Energy Conservation Coordinator (207) 948-3131	Water Systems Installing low-cost "water saver" discs in faucets and showerheads has cut hot water consumption by 58 percent.
University for Man at Kansas State Manhattan, KS 66502	Building Insulation
Douglas Walter Solar Energy Specialist (913) 532-5866	When the university purchased an old frame building for office space, the staff insulated the building to cut heat loss and added solar equipment to provide additional heat.
Gary Coates Director, UFM Technology Program (913) 532-5866	Information Sharing The university uses its combination solar greenhouse and community center to educate the public in energy conservation and alternative energy sources.
Gary Coates Director, UFM Technology Program (913) 532-5866	Information Sharing A free university organization, using federal and state funds with minimal tuition fees, teaches non-traditional students to utilize simple conservation measures in their homes.
Gary Coates Director, UFM Technology Program (913) 532-5866	Window Modifications The university developed an education-demonstration project to provide homeowners and renters with a kit of ideas and do-it-yourself window treatment designs for conserving energy.
University of Alabama University, AL 35486	Administrative
Robert A. Wright Assistant Vice President (205) 348-4530	The university's "Energy and Cost Savings Committee" developed a comprehensive plan to conserve energy in campus buildings, involving students, faculty, and staff in the process.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
University of Alabama-Huntsville Huntsville, AL 35807	Information Sharing
Bernard J. Schroer Director, Energy Center (205) 895-6361	The university instigated and hosted a conference for state legislators where they explored energy topics and developed state energy plans and legislation.
University of California, San Diego La Jolla, CA 92093	Monitoring and Controls
J.A. Burfield Manager, Building Operations (714) 452-2975	The campus' general climate requirements are met with reduced energy expenditures by tying all heating and cooling units into a central control system.
T.A. Tribble Superintendent, Utilities and Buildings (714) 452-2928	Ventilation Forty-four fans have been fitted with speed controls so that ventilation can be slowed down when buildings are unoccupied or outside weather permits.
University of California-San Diego, University Extension La Jolla, CA 92093	Energy Education
George A. Colburn Project Director (714) 452-3405	The university's extension division designed a course called "Energy and the Way We Live," which consisted of 15 articles run in 540 newspapers with credit awarded by 342 colleges.
University of California-San Francisco San Francisco, CA 94143	Heat Recovery
Guy J. Lebreton Associate Manager, Physical Plant (415) 666-2848	The university medical center utilizes exhaust steam recovered from three standby generators used for emergency power to heat a number of hospital buildings.
Dr. Harvey Patt Chairperson, Energy Conservation Committee (415) 666-1636	Information Sharing The university designed an energy awareness program which educates community residents and city officials as well as students on energy conservation.
University of Chicago Chicago, IL 60637	Lighting Adaptations
Frederick L. Sweeney Director of Operations (312) 753-3054	Three-hour lighting timers installed in classrooms help eliminate lighting in unoccupied rooms.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
University of Cincinnati Cincinnati, OH 45221 John P. McCall Senior Vice President (513) 475-2588	Energy Education The university's energy control system provides data on energy use and conservation methods for a two-year energy technician degree program.
University of Colorado Boulder, CO 80309 Cindy Steck Research Assistant (303) 492-7283	Incentive Program The university uses mimeographed reminder sheets to alert classes when they have left lights on after vacating classrooms.
University of Colorado Health Science Center Boulder, CO 80262 Gerald T. McCoy Physical Plant Manager (303) 394-7941	Cooling Systems In a comprehensive plan to cut energy costs, the Center shut off its water chilling plant during winter months, using small units to supply specialized areas with needed cooling.
University of Connecticut Storrs, CT 06268 Irving Fallon Physical Plant Energy Coordinator (203) 486-3115	Monitoring and Controls The physical plant staff found that low-cost thermal labels, which change color when steam leaks from radiators, could be used in an inexpensive monitoring system to avoid heat loss.
University of Delaware Newark, DE 19711 Robert Rounds Director, Plant Operations (302) 738-2616	Monitoring and Controls The university organized a manual temperature control system which reduced energy costs and enabled the funding of a computerized system to manage energy use.
University of Dubuque Dubuque, IA 52001 Wayne A. Norman Office of Planning and Development (319) 589-3158	Rescheduling Building Use After conducting a building utilization study the university made improvements to four buildings and closed seven to consolidate the campus and cut energy costs.
University of Evansville Evansville, IN 47702 Harry T. Loveridge Director, Physical Plant (812) 479-2567	Monitoring and Controls By updating engines, installing time clock systems, and closing off dampers seasonally, the university has maintained its equipment and cut energy consumption to a minimum.

Table A (continued) The 407 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
University of Hartford West Hartford, CT 06117	Energy Education
John W. Keenan Director, Special Programs (203) 243-4847	The school of engineering helped introduce energy-related curricula into the public schools starting at elementary levels and provided necessary materials and expertise.
Elliott R. Croll Energy Conservation Officer (203) 243-4325	Monitoring and Controls Building temperatures, taken manually day and night and then plotted on a chart, are used to determine when to use air conditioning.
University of Illinois-Urbana Champagne Urbana, IL 61801	Alternative Energy Sources
George P. Porter Superintendent of Facilities (217) 333-3437	The university is experimenting with alternative fuels, especially coal, in an attempt to reduce its dependence on foreign oil and to cut energy costs.
University of Iowa Iowa City, IA 52242	Campuswide Energy Conservation
Randall P. Bezanson Vice President (319) 353-3120	The university's energy policy includes constant updating of its computerized energy management system and the improvement of energy courses offered.
University of Louisville Louisville, KY 40292	Computerized Energy Management
Edward A. Dusch Director, Physical Plant (502) 588-6274	Electric power costs were substantially reduced by a computerized monitoring and control system and reduced lighting levels.
Edward A. Dusch Director, Physical Plant (502) 588-6274	Cooling Systems Some of the waste water used to cool condensers in the physical plant is cooled by simple evaporation in an open cooling tower; this has resulted in lower sewer costs.
Edward A. Dusch Director, Physical Plant (502) 588-6274	Cooling Systems A modification of pumps feeding fuel to campus boilers eliminated the need for an entire water cooling system.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
University of Louisville (continued)	Ventilation
Edward A. Dusch Director, Physical Plant (502) 588-6274	When no ill effects arose from lowering a ventilating fan's speed by 20 percent, the university's maintenance staff slowed the remaining five fans in the system.
University of Lowell Lowell, MA 01854	Power Plant Conversion
Bernard L. Killion Director, Energy Office (617) 452-5000	The university, with good access to coal, is researching the benefits of burning coal instead of consuming gas and oil for heating.
University of Maine-Bangor Bangor, ME 04401	Heating Systems
Richard A. Eustis Director, Physical Facilities (207) 947-0336	When a building heating system with only one thermostat proved inadequate, heating was divided into five zones giving occupied rooms more heat and cutting back in vacant rooms.
Richard A. Eustis Director, Physical Facilities (207) 947-0336	Monitoring and Controls A valve, setting a "high limit" for room temperature, cuts off boilers when building temperatures exceed 70°F.
Richard A. Eustis Director, Physical Facilities (207) 947-0336	Power Plant Conversion An auxiliary combustion chamber, designed to burn locally abundant wood chips in existing oil-fired boilers, provides the university with an alternative fuel source.
Richard A. Eustis Director, Physical Facilities (207) 947-0336	Power Plant Conversion The university is experimenting with the efficiency of burning coal as a main fuel source by modifying its boilers.
University of Maine-Orono Orono, ME 04469	Window Modifications
John L. McCormack Civil Project Engineer (207) 581-9931	The university is using styrofoam insulation to cover nearly all of the 20,000 square feet of windows which are responsible for 80 percent of the heat loss in its large field house.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
University of Mary Hardin-Baylor Belton, TX 76513 David L. Bigham Staff Accountant (817) 939-5811	Heating Systems The least expensive and most efficient way to replace a central boiler system was to install several smaller boilers in key locations and to tie them into existing radiators.
University of Maryland College Park, MD 20742 James Piper Director, Operations (301) 454-3452	Administrative Ten engineering students working under physical plant engineers conducted a thorough energy audit of all 200 buildings on campus.
Rich Horchler Assistant Director, University Relations (301) 454-3322	Cooling Systems The Dairy Science Department developed and publicized a sterilization process for milk which eliminates the need for refrigerated storage and shipping without ruining the taste of the milk.
Rich Horchler Assistant Director, University Relations (301) 454-3322	Energy Education A sociology course, "Scarcity and Society," explores the way lifestyles are being altered as the energy shortage increases.
Rich Horchler Assistant Director, University Relations (301) 454-3322	Energy Education All angles of the energy problem and the effects of energy development on the environment are studied in a two-year interdisciplinary program on world order.
James Piper Director, Operations (301) 454-3452	Heating Systems An "oxygen analyzer" device works to keep a constant balance of oxygen and fuel in the boilers, thus ensuring the most efficient burning of fuel.
Rich Horchler Assistant Director, University Relations (301) 454-3322	Information Sharing To aid farmers in their planting decisions, an agriculture professor researched the number of calories of food energy that could be produced using one calorie of fossil fuel.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
University of Maryland (continued)	Information Sharing
Rich Horchler Assistant Director, University Relations (301) 454-3[illegible]2	Fusion as an alternative source of energy is researched intensively both by academic classes and the research staff of the university.
James Piper Director, Operations (301) 454-3452	Monitoring and Controls Lighting and security systems for outlying areas and small buildings are operated with radio controls to avoid the cost of computer service.
James Piper Director, Operations (301) 454-3452	Monitoring and Controls Overheating by cast iron radiator systems was remedied by installing automatic radiator valves where manual controls were inefficient.
L. Carole Wharton Planner (301) 853-3688	Reducing Travel Costs A communication system with print out units connects six budget offices and the central administration. This has cut travel and personnel costs in transporting administrative information.
L. Carole Wharton Planner (301) 853-3688	Reducing Travel Costs The university system revised its courier system between campuses and the central administration; this cut overlapping trips and the gasoline consumed in travel.
University of Maryland-Baltimore County Catonsville, MD 21228	Information Sharing
Charlene B. Dale Coordinator (301) 455-2901	Visiting energy experts conducted a four-night forum, "Energy Revolution," to explore with students, faculty, and community residents the causes and consequences of energy use.
University of Maryland-Eastern Shore Princess Anne, MD 21853	Reducing Travel Costs
L. Carole Wharton Planner (301) 853-3688	Travel at this semi-secluded campus was cut by trading in vans and trucks for compact cars and mopeds, and by using a campus storeroom to cut down on trips to town.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
University of Massachusetts-Amherst Amherst, MA 01003	Solar Installation Variations
John R. Findley Assistant Director (413) 545-1960	While training CETA workers, engineering students and faculty constructed four types of solar units—greenhouse, water heating, and two space heating units in family housing.
University of Massachusetts-Boston Boston, MA 02125	Cooling Systems
Thomas McNeil Energy Coordinator (617) 287-1900	New motors in the university's chilling system have reduced energy needs and promise longer life with less maintenance.
Thomas McNeil Energy Coordinator (617) 287-1900	Lighting Adaptations Changing from incandescent to fluorescent lighting in the library reduced both energy consumption and maintenance.
University of Miami Coral Gables, FL 33124	Administrative
Rafael V. Ross Energy Manager (305) 284-4972	An energy management office, created to serve a three-campus system, directs the conservation program and houses the computer which controls plant operations on all campuses.
Rafael V. Ross Energy Manager (305) 284-4666	Energy Education The Clean Energy Research Institute assembles, publishes, and distributes information on energy and offers extensive graduate programs in alternative energy research.
University of Michigan Ann Arbor, MI 48109	Heating Systems
Kenneth Beaudry Manager, Physical Plant (313) 482-2428	The university changed its older multi-zone heating system when a newer variable volume system installed as part of a building addition produced better results and used less energy.
University of Michigan-Dearborn Dearborn, MI 48128	Conservation in Design and Planning
Robert J. West Director, Plant Operations (313) 593-5380	The university cut back in electrical use across campus so that a new library and learning resource center could be phased in without added utility costs or rate hikes.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
University of Michigan-Dearborn (continued)	Heating Systems
Robert J. West Director, Plant Operations (313) 593-5380	Two buildings were cut off from the central heating system; gas burners located in each building were tied into room thermostats; the result was a 20 percent drop in electrical costs.
University of Minnesota Minneapolis, MN 55455	Information Sharing
Ray Sterling Director, Underground Space Center (612) 376-1200	The Underground Space Center demonstrates the possibilities of earth-sheltering construction, which involves building partly underground using earth as insulation.
University of Missouri Columbia, MO 65211	Heat Recovery
Larry R. Long Energy Coordinator (314) 882-3898	The university's research reactor facility, which conducts experiments on intense radiation, produces great quantities of hot water that are now used to heat adjacent buildings.
University of Montevallo Montevallo, AL 35115	Administrative
Lolly S. Argo Assistant Director, Energy Education Program (205) 665-2521	The university has started numerous conservation programs including rescheduling classes, installing a wood-fired boiler, and opening an Environmental and Energy Education Center.
University of New Mexico Albuquerque, NM 87131	Heat Recovery
Mahlon Williamson Assistant Director, Utilities (505) 277-2464	Coils used to recover heat previously lost through central plant flues were designed, built, and installed by an engineering professor at a fraction of the commercial cost.
University of North Carolina Charlotte, NC 28223	Energy Education
Philip E. Hildreth Vice Chancellor (704) 597-2224	The university's architectural degree program now focuses on methods of design that emphasize energy conservation (mainly solar applications).
Philip E. Hildreth Vice Chancellor (704) 597-2224	Energy Education Science and technology degrees in engineering now require many energy-related courses.

Institution and Principal Contact Person	Brief Description of Idea or Approach
University of North Carolina (continued)	Information Sharing
Philip E. Hildreth Vice Chancellor (704) 597-2224	The university's annual forum in 1980 discussed "Future Lifestyles: Choice or Necessity," which focused on energy consumption and depletion of known energy sources.
Edward F. Ayers Director, Physical Plant (704) 597-2156	Reducing Travel Costs The university bought small electric vehicles for maintenance personnel travel on campus to cut costs as well as to increase the visibility of its conservation policy.
University of Oregon Eugene, OR 97403	Cooling Systems
Harold C. Babcock Director, Physical Plant (503) 686-5243	During winter months the university's chilling system is shut down and naturally cool water from a nearby stream is piped in, cleaned through sand filters, and used by the power plant.
University of Pennsylvania Philadelphia, PA 19174	Administrative
Horace I. Bomar, III Director, Department of Energy Management and Conservation (215) 243-8662	The Department of Energy Management and Conservation, an independent office of the university, coordinates conservation practices and policies in the entire physical plant.
Horace I. Bomar, III Director, Department of Energy Management and Conservation (215) 243-8662	Campuswide Energy Conservation The utility cost at one building was excessive and the university employed a professional consultant to suggest ways of conserving energy.
Horace I. Bomar, III Director, Department of Energy Management and Conservation (215) 243-8662	Conservation in Design and Planning The university applied its own set of energy efficiency guidelines to all new construction and renovation projects on campus.
Horace I. Bomar, III Director, Department of Energy Management and Conservation (215) 243-8662	Cooling Systems Great savings in electrical costs were achieved by allowing the temperature of chilled water to rise by 6°F.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
University of Pennsylvania (continued)	Energy Education
Lawrence Eisenberg Director, Energy Center (215) 243-8507	A graduate program in Energy Management and Policy teaches energy conservation through the physical, life, and social sciences, public policy, business, and city planning departments.
Horace I. Bomar, III Director, Department of Energy Management and Conservation (215) 243-8662	Heating Systems All of the steam pipes in the heating system were re-insulated when a review of steam bills from the main meter compared to individual building meters showed a 20 percent heat loss.
Horace I. Bomar, III Director, Department of Energy Management and Conservation (215) 243-8662	Incentive Program Students plan and conduct annual conservation contests, with cash prizes awarded to the dormitories showing the greatest reductions in energy consumption.
Horace I. Bomar, III Director, Department of Energy Management and Conservation (215) 243-8662	Lighting Adaptations After students surveyed the lighting levels on campus, the physical plant lowered or eliminated lighting where possible and posters and stickers informed the campus of these conservation efforts.
Horace I. Bomar, III Director, Department of Energy Management and Conservation (215) 243-8662	Monitoring and Controls Radiators which previously continually overheated older buildings are now controlled effectively by electrical devices that constantly measure and maintain comfortable temperatures.
Horace I. Bomar, III Director, Department of Energy Management and Conservation (215) 243-8662	Rescheduling Building Use Through consolidation, all students and faculty living on campus are housed in a few dormitories during the summer.
University of Pittsburgh Pittsburgh, PA 15260	Monitoring and Controls
Edward Permar Manager, Mechanical Systems (412) 624-5681	Fans were slowed down, a chiller was shut off, temperatures were reduced, and several other steps were taken to make the university's engineering building efficient in energy use.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
University of Rhode Island Kingston, RI 02881	Information Sharing
Dr. Donald F. Kirwan Co-Director, Office of Energy Education (401) 792-2478	Two physics professors organized a university based Office of Energy Education which acts as a statewide, centralized energy resource center for elementary and secondary school teachers.
M.N. Pieter Hinkamp, Energy Manager (401) 792-2141	Power Plant Conversion After successful results in a pilot program, the university is using waste crankcase oil as a supplementary fuel in the central heating plant.
University of Rochester Rochester, NY 14627	Heat Recovery
James O. Dungan Assistant Plant Director (716) 275-4885	Hot water previously discarded from a science building is now piped into the hot water systems instead of being allowed to run down the sewer.
University of Scranton Scranton, PA 18510	Administrative
John S. Flanagan Vice President (717) 961-7416	In order to cut energy costs the university hired an energy officer, initiated a monitoring system to correct energy problems as they were identified, and enlisted student support.
University of South Carolina Columbia, SC 29208	Commuter Conservation
H. Brunton Vice President, Operations (803) 777-5101	The university operates a shuttle bus system in order to discourage students from driving from class to class.
H. Brunton Vice President, Operations (803) 777-5101	Solar Installation Variations In order to give engineering students "hands on" experience with a solar system, the university built a passive solar system into a bus stop.
University of South Dakota Vermillion, SD 57069	Heating Systems
Richard L. Storm Director, Energy Programs (605) 677-5341	After finding that only 40 percent of the central boiler's capabilities were being used, the university installed a smaller unit and saved energy.

130

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
University of South Dakota (continued)	Heating Systems
Richard L. Storm Director, Energy Programs (605) 677-5341	The heat produced by leaving all electric lights on 24 hours a day reduced greatly the amount of heat needed from the more expensive oil-fired heating system.
Richard L. Storm Director, Energy Programs (605) 677-5341	Rescheduling Building Use A plan to reschedule custodians to work during the daytime failed to save energy and the custodians were returned to night shifts.
Richard L. Storm Director, Energy Programs (605) 677-5341	Window Modifications Clear plastic was tacked over all windows and in some places rigid insulation board was wedged in to cover windows in order to improve building insulation.
University of Southern California-Idyllwild Idyllwild, CA 92349	Solar Information Sharing
Carol Bass Coordinator, Energy Projects (714) 659-2171	This rural campus offers "hands on" study of food production and simple construction techniques in a solar greenhouse.
University of Tennessee-Chattanooga Chattanooga, TN 37402	Heating Systems
Robert L. Camperlino Superintendent of Utilities (615) 755-4521	The university found it could tie the entire campus into a new heating system which was originally installed to serve only half the campus.
University of Tennessee-Knoxville Knoxville, TN 37916	Water Systems
William S. Aiton, Jr. Assistant Director, Residence Halls (615) 974-2571	In an effort to combat rapidly rising sewer rates, the university installed low-flow showerheads and toilet dams to cut water consumption.
University of Texas-Austin Austin, TX 78712	Cooling Systems
Miles L. Abernathy Assistant Maintenance-Engineer (512) 471-4106	The university cooling system was altered to use naturally chilled ground water collected from a drainage system in place of the chilled and purified water previously bought from the city.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
University of Texas-Health Science Center San Antonio, TX 78284	Campuswide Energy Conservation
Don L. Read Associate Director, Physical Plant (512) 691-6241	Using mainly spare parts left over from construction and renovation projects, the physical plant staff designed and carried out many low-cost energy conservation programs.
University of Texas-Permian Basin Odessa, TX 79762	Cooling Systems
Jerry M. Redford Director, Physical Plant (915) 367-2305	When air conditioning fans were slowed down, complaints about temperatures stopped, electrical consumption dropped, and the life of the system's parts was increased.
University of Virginia Charlottesville, VA 22903	Water Systems
Robert H. Barnett Director, Business Operations (804) 924-3654	Originally started to fight a drought, an all-out effort to conserve water on campus and in the local community has succeeded in saving plant operating costs as well.
University of Washington Seattle, WA 98195	Heat Recovery
John Heinz Director, Physical Plant (206) 545-1419	The university developed a way to transfer the excess heat given off by equipment running in some buildings to a number of other buildings through already existing underground piping.
Robert D. Wilkinson Manager, Energy Forum Northwest (206) 543-0980	Information Sharing Through workshops, television programs, and publication of conservation information, Energy Forum Northwest encourages communities to take part in energy development and conservation.
University of West Florida Pensacola, FL 32504	Campuswide Energy Conservation
Arthur H. Doerr Vice President (904) 476-9500	The university's comprehensive program includes altering work schedules, reducing lighting and room temperatures, and cutting back on hot water as well as other conservation measures.
University of Wisconsin System Madison, WI 53708	Administrative
Gordon F. Brady Engineer, Division of Physical Plant 08) 263-7330	The central office wrote and distributed to all campuses "Kilowatt Kruncher® Kookbook," a manual describing practical how-to-do-it ways of cutting lighting costs.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
University of Wisconsin-La Crosse La Crosse, WI 54601 Edward H. Cook Engineer (715) 425-3820	Cooling Systems When the old main hall was renovated to house classes, cooling in an adjacent building was cut back so its chilling unit could serve both buildings.
University of Wisconsin-Madison Madison, WI 53706 Thomas J. Murray Director, Energy Information Project (608) 263-2982	Information Sharing Working with several area newspapers, the engineering department wrote a 14-part series of articles on home energy use, local fuel facts, national supplies, and energy technology.
University of Wisconsin-Milwaukee Milwaukee, WI 53201 Rudolph Tichy Director of Facilities (414) 963-4682	Cooling Systems By using cold water from nearby Lake Michigan in its air conditioning system, the university can shut down chiller units for three months each year.
University of Wisconsin-Platteville Platteville, WI 53818 Dennis J. Palmer Assistant Director, Auxiliary Services (608) 342-1845	Information Sharing The university continually runs energy awareness campaigns, lecture series on conservation, and new maintenance projects to keep the campus up to date on the energy problem.
University of Wisconsin-River Falls River Falls, WI 54022 Edward H. Cook Engineer (715) 425-3820	Heating Systems The central steam heating plant is shut down after 9:00 p.m. when the only requirement is for hot water of which there is an ample supply in insulated storage tanks.
University of Wisconsin-Sheboygan Sheboygan, WI 53081 Thomas Drews Maintenance Supervisor (414) 459-3722	Campuswide Energy Conservation The university installed insulation and new heating ducts in rooms where perforated ceiling tiles let heat escape; also switches to dim lights as sunlight enters a room.
Upsala College East Orange, NJ 07019 William Walton Vice President (201) 266-7204	Campuswide Energy Conservation The college uses heat timers, electric control panels, water-saver discs in faucets, and added insulation, along with other measures, in its concerted effort to reduce energy use.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Utah Technical College Salt Lake City, UT 84107	Campuswide Energy Conservation
Dale S. Cowgill President (801) 969-3411	Following some of the suggestions of its energy committee, the college optimized schedules, analyzed utility expenses, and fixed up equipment as part of its comprehensive energy program.
Valencia Community College Orlando, FL 32802	Water Systems
Robert W. Gilbert Vice President (305) 299-5000	The college designed and installed plastic flush valve modifiers which cut the amount of water used in campus restrooms by 50 percent.
Valley Forge Military Academy Wayne PA 19087	Administrative
Major James P. Hopkinson, Jr. Chairman, Science Department (215) 688-1800	The institution established an energy advisory council to develop ideas for energy conservation which the staff can adopt.
Major James P. Hopkinson, Jr. Chairman, Science Department (215) 688-1800	Administrative The institution analyzes in the computer department information on oil consumption of each building on campus to determine whether the buildings are using fuel efficiently.
Major James P. Hopkinson, Jr. Chairman, Science Department (215) 688-1800	Computerized Energy Management When a dormitory was renovated, the institution installed an electronic energy management system which reduced the amount of heating oil used, saved costs, and still maintained comfort.
Major James P. Hopkinson, Jr. Chairman, Science Department (215) 688-1800	Incentive Program A $100 grant for energy education was used for a poster campaign to educate students on energy misuse and overuse.
Wabash College Crawfordsville, IN 47933	Incentive Program
Theodore Bedrick Registrar (317) 362-1400	One fraternity ran a campus energy savings contest and a light switch sticker program to encourage fellow students to conserve energy.

Table A (continued) The 407 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Washington State University Pullman, WA 99164	Ventilation
L.J. Spoonemore Assistant Director, Physical Plant (509) 335-4565	To avoid wasting heated air, the university installed an attachment in the ventilation system to recirculate heated air one additional time before bringing in more fresh, cold air.
Washington University St. Louis, MO 63130	Lighting Adaptations
W.F. Peglar Facilities Manager (314) 889-5582	The bookstacks in the library are equipped with 30-minute timer switches so students can temporarily light an area while searching for materials.
Wayne State University Detroit, MI 48202	Ventilation
Edward A. Everett Energy Manager (313) 577-4311	Fans in a chemistry building were fitted with speed controls so that they could be used differently depending on building occupancy and experiments going on.
Waynesburg College Waynesburg, PA 15370	Alternative Energy Sources
Dr. Joseph F. Marsh President (412) 627-3191	Half of the yearly gas supply comes from tapping the methane trapped in a coal bed beneath the campus.
Wellesley College Wellesley, MA 02181	Building Insulation
Adel A. Rida Director, Physical Plant (617) 235-0320	The installation of more than 1,000 thermal windows and the addition of insulation in attics have helped increase the heat retention capability of the dormitories.
Adel A. Rida Director, Physical Plant (617) 235-0320	Computerized Energy Management A computer system monitors and manages all energy consumption through 50 microprocessors throughout the campus.
Adel A. Rida Director, Physical Plant (617) 235-0320	Conservation in Design and Planning An enclosed heated office was built in the large supply warehouse to avoid heating the entire building which was too costly for just a few employees.

Institution and Principal Contact Person	Brief Description of Idea or Approach
Wellesley College (continued)	Cooling Systems
Adel A. Rida Director, Physical Plant (617) 235-0320	When six clogged cooling towers were fitted with new types of filters, a maintenance problem was solved and energy needed to cool the water was reduced considerably.
Adel A. Rida Director, Physical Plant (617) 235-0320	Heating Systems The college installed an oxygen analyzer device which increases the efficiency of the boiler and works to maintain the best balance of oxygen and fuel oil in the heating system.
Adel A. Rida Director, Physical Plant (617) 235-0320	Heating Systems The college proved to the state that it could burn fuel oil with a higher sulfur content than the oil previously used without polluting the air; the new oil was much cheaper.
Adel A. Rida Director, Physical Plant (617) 235-0320	Heating Systems Individual hot water tanks were installed in outlying campus buildings where the long stretches of pipe in the central system lost too much heat in transmitting the water.
Adel A. Rida Director, Physical Plant (617) 235-0320	Incentive Program A student energy committee led the campus to reduce laundry and elevator use, to begin recycling programs, and to use an energy "hot line" for conservation suggestions.
Adel A. Rida Director, Physical Plant (617) 235-0320	Lighting Adaptations Rescheduling cleaning hours, installing timer switches, and cutting the number of fluorescent tubes were part of a project to reduce electrical and cooling costs.
Adel A. Rida Director, Physical Plant (617) 235-0320	Water Systems Low-volume showerheads which reduce water flow while maintaining pressure have reduced the hot water used by more than one-half.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Wellesley College (continued)	Water Systems
Adel A. Rida Director, Physical Plant (617) 235-0320	When the college is not in session, a large reserve water tank is used to provide water during the peak electrical demand hours when pumping costs so much more.
Adel A. Rida Director, Physical Plant (617) 235-0320	Window Modifications A light plastic applied to the glass of a greenhouse has lowered electrical costs, reduced maintenance needs, and improved plant growth.
Wesleyan University Middletown, CT 06457	Administrative
Peter H. Tveskov Director, Physical Plant (203) 347-9411	Students, faculty, and physical plant personnel make up the Energy Conservation Action Committee which has eliminated a "we-they" obstacle in achieving conservation results.
Peter H. Tveskov Director, Physical Plant (203) 347-9411	Campuswide Energy Conservation A new water softening system, a large new chiller, and added devices to recover waste heat from boiler stacks are part of an attempt to make the central plant energy efficient.
Peter H. Tveskov Director, Physical Plant (203) 347-9411	Incentive Program Occupants of 27 university-owned townhouses received 25 percent of the money saved when they reduced their electrical use during a campus incentive program.
Peter H. Tveskov Director, Physical Plant (203) 347-9411	Power Plant Conversion The boiler system was converted to burn natural gas as well as fuel oil so the yearly supply of oil could be estimated and bought early in bulk for a lower price.
Peter H. Tveskov Director, Physical Plant (203) 347-9411	Rescheduling Building Use The campus closes up all buildings except research laboratories during the summer and hires students who live in town to monitor the buildings.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
West Valley Community College District Campbell, CA 95008	Information Sharing
Dr. Gerald V. Sharp Director, Educational Development (408) 866-6499	The college's interest in local community conservation practices successfully promoted the formation of a governmental steering committee on energy conservation.
West Virginia University Morgantown, WV 26506	Energy Education
Dr. Paul W. DeVore Professor, Technology Education (304) 293-3803	A graduate course offers three credits to elementary and secondary school teachers in an intensive, one-week study of energy topics and curriculum.
M. Dayne Aldridge Director, Energy Research Center (304) 293-2867	Information Sharing The Energy Research Center was established independent of any discipline at the university so that all departments would use or work for this clearinghouse on coal research.
Dr. David McCrory Coordinator of Field Services (304) 293-3030	Information Sharing Faculty members and students taught 25 workshops on energy conservation in the home to economically depressed people in rural, senior citizen, and community centers.
Dr. David McCrory Coordinator of Field Services (304) 293-3030	Information Sharing In a four-day workshop 90 professionals from various communities were taught how to help people in their areas conserve energy.
Dorsey D. Jacobs Director, Physical Plant (304) 293-4913	Reducing Travel Costs The physical plant office is working with a university technology program to develop an electric van that could replace some of the 87 vans used for personnel.
Dr. Paul W. DeVore Professor, Technology Education (304) 293-3803	Solar Information Sharing Faculty members and students volunteered to make a 50-year-old home into an energy efficient demonstration center using solar installations and insulation.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Western Illinois University Macomb, IL 61455	Computerized Energy Management
Dr. James L. Smith Superintendent, Planning and Construction (309) 298-1834	A computerized energy management system monitors temperature, pressure, humidity, motor operation, and lighting on campus.
Dr. James L. Smith Superintendent, Planning and Construction (309) 298-1834	Rescheduling Building Use One selling point in the decision to switch from a quarter to a semester system was the energy to be saved during a January interim shutdown.
Western Wisconsin Technical Institute La Crosse, WI 54601	Incentive Program
Robert E. Beesor Facilities Manager (608) 785-9175	Computer summaries of electric, gas, and oil use in individual buildings are circulated monthly to encourage occupants and maintenance personnel to conserve energy.
Westmar College LeMars, IA 51031	Rescheduling Building Use
Joseph Bottiger Business Manager (712) 546-7081	Students were encouraged to take independent interim projects and internships off campus during an extended winter vacation and interim period so the campus could be closed up.
Joseph Bottiger Business Manager (712) 546-7081	Window Modifications Almost 50 percent of the windows on campus are being sealed up with insulation and masonite (which matches building exteriors) to save energy.
Williams College Williamstown, MA 01267	Administrative
Robert A. Kozelka Chairman, Energy Committee (413) 597-2324	Recently an energy conservation committee was added to the group of 20 standing committees which govern the college.
Robert A. Kozelka Chairman, Energy Committee (413) 597-2324	Campuswide Energy Conservation Attics were insulated, storm windows were replaced, temperatures were set back, and lighting was reduced in an overall attempt to make this old campus energy-efficient.

Table A (continued) The 497 Program Ideas and Innovative Approaches

Institution and Principal Contact Person	Brief Description of Idea or Approach
Williams College (continued)	Heating Systems
John C. Holden Mechanical Engineer (413) 597-2301	Heat loss and the reduction of oil temperatures in a large oil storage tank were remedied by insulating the tank.
Robert A. Kozelka Chairman, Energy Committee (413) 597-2324	Incentive Program One half of the money saved during a four-month conservation contest was returned to the residence halls that participated in the contest.
Robert A. Kozelka Chairman, Energy Committee (413) 597-2324	Incentive Program The students' conservation program included electing an "Energy Czar" for each dormitory, adopting a conservation logo for posters and T-shirts, and conducting an energy forum.
Williamsport Area Community College Williamsport, PA 17701	Heating Systems
William W. Fritz Dean (717) 326-3761	Heat ducts were rearranged and doors were insulated so that a college greenhouse could successfully weather the cold winter.
Wisconsin Indianhead Technical Institute Shell Lake, WI 54871	Commuter Conservation
Dr. Vasant Kumar Coordinator, Research (715) 468-2815	Van-pooling routes were established so that students would not always have to drive their own vehicles to school.
Dr. Vasant Kumar Coordinator. Research (715) 468-2815	Energy Education A two-year energy education program conducts much of its research in an alternate energy laboratory.

B

Topical Listing of Institutions According to Various Aspects of Program Entry

Administrative Functions

Campus Energy Audits, Studies, Policies. Art Institute of Chicago, Cornell, Memphis State, Morehead State, Navarro, Nazarene Bible College, North Carolina State, Randolph-Macon, Sierra Joint, Tufts, Unity College, University of Maryland, University of Pennsylvania, University of Scranton, University of Wisconsin, Valley Forge Military Academy

Leasing Agreements and Contracting Outside Assistance. Gulf Coast, Lake Erie College, Lehigh, Merritt, Navarro, Nazarene Bible College

On-campus Transportation Services: Lincoln Land, University of Maryland, University of Maryland at Eastern Shore, University of North Carolina, University of South Carolina, West Virginia University

Specialized Staff or Training Programs: City Colleges of Chicago, Gulf Coast, Lansing, Louisiana State, Lyndon State, Middle Tennessee State, Middlebury, Sierra Joint, University of Pennsylvania, University of Scranton

Task Forces, Committees, Councils: Fitchburg State, Gulf Coast, Hood, Middle Tennessee State, Middlebury, Morehead State, Rollins, Sierra Joint, Susquehanna, Tufts, U.S. Naval Academy, University of Alabama, University of Miami, University of Montevallo, University of Pennsylvania, Valley Forge Military Academy, Wellesley College, Wesleyan University, Williams College

Utility Rate Negotiations: Creighton, Iowa Wesleyan, Middlebury, Triton

Alternative Energy Sources

Coal: See Power Plant Conversion

Earth Sheltering: See Insulation

Fusion: University of Maryland

Gas Wells: Lake Erie College, Waynesburg

Gasohol: Colby, Navarro, North Dakota State School of Science, Talladega

Geothermal: Lincoln Memorial, Navarro, Oregon Institute of Technology

Note The names of the institutions indicated, in abbreviated form under each heading, are examples only, not a complete listing. Refer to the full listing of institutions in Appendix Table A

Lake Water: See Energy Recovery (cooling)

Ocean Power: U.S. Naval Academy

Solar: See separate solar listing

Waste Automotive Oil: See Power Plant Conversion

Waste Products: Case Western Reserve, Connors State, U.S. Naval Academy

Wind Power: Delaware Tech, Edison, Lincoln Land, SUNY at Oswego

Wood Burning: See Power Plant Conversion

Campuswide Energy Conservation

Benedict, Bennington, Bentley, Case Western Reserve, Chattanooga State Tech, Clemson, Erie Community College, Eureka, Georgia Southern, Kingsborough, Lakeland, Lane, Lansing, Lehigh, Lincoln Land, Loma Linda, Mars Hill, Middlebury, Mount Marty, Nazarene Bible College, Nichols, Penn Valley, Presentation, Prestonsburg, Rivier, St. Mary's College of California, Seattle Pacific, Solano, Southeastern Community College, SUNY at Brockport, SUNY at Oswego, University of Alabama, University of Delaware, University of Evansville, University of Miami, University of Pennsylvania, University of Pittsburgh, University of Texas Health Science Center, University of West Florida, University of Wisconsin at Sheboygan, Upsala, Utah Tech, Wesleyan University, Williams

Commuter Conservation

Car-Pooling Assistance: Lake Erie College, Manhattanville, St. Mary's University, Wisconsin Indianhead

Independent Study Courses: Central Piedmont, Coastline, Gulf Coast, Kirkwood

Short Week/Long Week: Central Piedmont, Cleveland State, Colorado Women's College, Gulf Coast, Indian Hills, Manhattanville, Morton, Navarro, Spring Garden College

Computerized Energy Management

Amarillo, Anne Arundel, Catholic University, Dean, Duquesne, Hahnemann Medical College, Howard University, Lane, Loyola College, Loyola University, McNeese State, Maricopa County, Memphis State, Mt. San Antonio, North Carolina State, Northern Arizona, Oregon State, Potsdam College of Arts and Science, Princeton, Rutgers, Southern Illinois University, Southwestern University, Susquehanna, U.S. Naval Academy, University of Delaware, University of Iowa, University of Louisville, University of Miami, Valley Forge Military Academy, Wellesley, Western Illinois University

Conservation in Design and Planning

Chattanooga State Tech, Guilford College, Hood, Interamerican University, Iowa State, Jefferson State, Lebanon Valley, Maine Maritime Academy, Mercy College, McNeese State, Middle Tennessee State, Middlebury, Montclair State, Ramapo College, Rhode Island Junior College, San Jose State, Spokane Falls, University for Man at Kansas State, University of Michigan at Dearborn, University of Pennsylvania, Wellesley

Cooling Systems

Chiller Maintenance and Installation: Boston University, Brandeis, Cornell, Notre Dame College, Ohio State, Spring Hill, SUNY at Stony Brook, Tuskegee Institute, University of Louisville, University of Massachusetts at Boston, University of Pennsylvania, University of Texas at Austin, University of Texas at Permian Basin, University of Wisconsin at La Crosse, Wellesley

Chiller Shutdown: Clarkson College of Technology, Coe College, Morton, SUNY at Plattsburgh, SUNY at Stony Brook, Tuskegee Institute, University of Colorado Health Science Center, University of Maryland, University of Oregon

Education Programs for Credit

Energy Education: Colby, College of Marin, College of St. Thomas, College of the Atlantic, Daytona Beach, Edison, Horry-Georgetown Tech, Hunter, Indiana University, Kirkwood, Memphis State, Montclair State, Morehead State, Navarro, New Mexico Highlands, Oklahoma State, Piedmont Tech, Polytechnic Institute, Ramapo College, St. Joseph College, Sierra Joint, Southeastern University, Spokane Falls, Spring Garden College, Taft, U.S. Naval Academy, University of California at San Diego Extension, University of Cincinnati, University of Hartford, University of Iowa, University of Maryland, University of Massachusetts at Amherst, University of North Carolina, University of Pennsylvania, University of Rhode Island, West Virginia University, Wisconsin Stout

Solar Education: Ball State, Brevard, Butte Community College, Central Arizona, College of the Atlantic, Edison, Hamilton, Iowa State, Navarro, University of Massachusetts at Amherst, University of Miami, University of North Carolina, University of South Carolina, University of Southern California at Idyllwild

Energy Recovery

Cooling Recovery: Cornell, SUNY at Oswego, University of Oregon, University of Texas at Permian Basin, University of Wisconsin at Milwaukee

Heating Recovery: Clark University, Clarkson College, Cornell, Drexel, Lane, Lebanon Valley, Middlebury, Mount Holyoke, Oberlin, Oklahoma State, Princeton, Rockefeller University, San Francisco State, Solano, SUNY at Oswego, Taylor, University of California at San Francisco, University of Missouri, University of New Mexico, University of Rochester, University of Washington, Washington State, Wesleyan University

Heating Systems and Boiler Maintenance

Boiler Rental: SUNY at Old Westbury

Boiler Shutdown: Benedict, Coe, Eastern Connecticut State, Flagler, Loyola College, Macalester, Memphis State, Seattle Pacific, University of Wisconsin at River Falls

Heat Sinks: See Energy Recovery

Heating Systems Conversions and Alterations: Cornell, Creighton, Furman, Green Mountain, U.S. Naval Academy, University of Louisville, University of Maine at Bangor, University of Michigan, University of Michigan at Dearborn, University of Tennessee at Chattanooga, Wellesley College, Williamsport Area Community College

Hot Water Heaters and Systems: Colorado Women's College, George Washington University, Goucher, Green Mountain, Macalester, Millersville, Navarro, Wellesley College

Radiator Adjustments: Coe, Mars Hill, University of Connecticut, University of Maryland, University of Pennsylvania

Special Boiler Systems: Central Missouri State, Goucher, Middlebury, University of Mary Hardin-Baylor, University of Maryland, University of South Dakota, Wellesley College

Incentive Programs

Multi-Media Promotion: American International College, Iowa State, Middlebury, New Mexico State at Grants Branch, North Carolina State, Rollins, St. Mary's College, Southwest Texas State, Stetson, Taylor, U.S. Naval Academy, University of Colorado, Valley Forge Military Academy, Wabash, Wellesley College, Western Wisconsin Tech, Williams

Staff Incentive: Contra Costa, Fitchburg, University of Colorado

Student Incentive: Eureka, Hobart, Lake Erie College, Northland, Pennsylvania State, Southwestern at Memphis, Spring Hill College, Stetson, University of Pennsylvania, Valley Forge Military Academy, Wesleyan University, Williams

Information Sharing

Demonstration Centers and Research Projects: Miami-Dade, Middle Tennessee State, Morehead State, Olivet, Ramapo College, Spokane Falls, U.S. Naval Academy, University for Man at Kansas State, University of Maryland, University of Miami, University of Minnesota, University of Southern California at Idyllwild, West Virginia University

Non-Credit Courses and Certificates: California State University and Colleges headquartered at Fullerton, Coastline, College of Marin, Florida Keys, Navarro, New Mexico State at Grants Branch, North Dakota State School of Science, Taft, Unity, University for Man at Kansas State, University of Miami, University of Rhode Island, University of Southern California at Idyllwild, West Virginia University

Publications, Audio and Visual Presentations: California State University and Colleges headquartered at Fullerton, Central Michigan, Cornell, Gulf Coast, Harvard, Loyola University of Chicago, Memphis State, North Carolina State, U.S. Naval Academy, University for Man at Kansas State, University of California at San Diego Extension, University of Miami, University of Minnesota, University of Washington, University of Wisconsin at Madison, University of Wisconsin at Platteville

Seminars, Conferences, Workshops, Forums: Bowling Green State, Butte Community College, California State University and Colleges headquartered at Fullerton, Florida Memorial, Iowa State, Lincoln Land, Loyola University of Chicago, Martin, Middle Tennessee State, Morehead State, Navarro, U.S. Naval Academy, University for Man at Kansas State, University of Alabama at Huntsville,

University of California at San Francisco, University of Maryland at Baltimore County, University of Miami, University of Minnesota, University of North Carolina, University of Rhode Island, University of Washington, West Valley Community College, West Virginia University

Services to the Public: Bowling Green State, California State University and Colleges headquartered at Fullerton, Clark University, Florida Memorial, Governors State, Indiana University, Morehead State, New York Institute of Technology, Olivet, Pennsylvania State, Ramapo College, St. Joseph College, University for Man at Kansas State, University of California at San Francisco, University of Rhode Island, University of Southern California at Idyllwild, University of Washington, West Valley Community College, West Virginia University

Solar Information: Ball State, Butte Community College, Middle Tennessee State, Navarro, New Mexico State at Grants Branch, Pima Community College, University for Man at Kansas State, University of Southern California at Idyllwild, West Virginia University

Insulation

Doors: Maine Maritime Academy, Williamsport Area Community College

Earth Sheltering: Mercy College, Spokane Falls, University of Minnesota

Roof: Cornell, Post, SUNY at Buffalo-Amherst, University for Man at Kansas State, Wellesley College

Walls: Connors State, Cornell, Middlebury, University for Man at Kansas State, University of Pennsylvania, Williams College

Windows: Brainerd, College of Great Falls, Eureka, Graceland, North Dakota State School of Science, Pennsylvania State, Philadelphia College of Art, SUNY Agricultural and Technical College, Tompkins Cortland, University for Man at Kansas State, University of Maine at Orono, University of South Dakota, Wellesley, Westmar

Lake Water Cooling

See Energy Recovery (cooling)

Lighting Adaptations

Fixture Alterations and Lamp Replacement: Beloit, Berea, California Institute of Technology, California Polytechnic, Catholic University, Colorado Women's College, Cornell, Gallaudet, Governors State, Lafayette, Lake Forest, Louisiana State, Mohawk Valley, Montgomery, Mount Marty, Northern Michigan University, Seattle Pacific University, University of Massachusetts at Boston

Reductions and Removal: Middle Tennessee State, Montgomery, Mount Marty, North Dakota State School of Science, Pennsylvania State, Ramapo College, Susquehanna, University of Pennsylvania, University of Wisconsin, Wellesley College

Timers: Loyola University of Chicago, St. John's University, University of Chicago, Washington University, Wellesley College

Monitoring and Evaluating Systems

Evaluating Energy Data: Benedict, Chatham, Embry-Riddle, Lyndon State, University of Delaware, University of Hartford

Mechanical Systems Control: Alvin Community College, Bethel College and Seminary, Broward, Macon Junior College, Mohawk Valley, Mt. San Antonio, Penn Valley, University of California at San Diego, University of Maryland, University of Pennsylvania

Temperature Monitoring and Adjustments: Allegheny, Art Institute of Chicago, Benedict, Chatham, Embry-Riddle, Gulf Coast, Middle Tennessee State, Millersville State, Mount Marty, New Mexico State, Oregon State, Penn Valley, Southeastern Community College, SUNY at Plattsburgh, Susquehanna, University of Connecticut, University of Delaware, University of Maine at Bangor

Timers: College of the Holy Cross, Gallaudet, Southeastern Community College, University of Evansville, University of Maine at Bangor, University of Wisconsin at Sheboygan

Power Plant Conversion

Coal: North Dakota State School of Science, University of Illinois at Urbana Champagne, University of Lowell, University of Maine at Bangor, West Virginia University

Dual Fuel: Alvernia, Iowa Wesleyan, Rosemont, Skidmore, Wesleyan University

Waste Automotive Oil: Northern State College, Skidmore, SUNY at Oswego, University of Rhode Island

Waste Products: Case Western Reserve U.S. Naval Academy

Wood Burning: Clarkson College of Technology, Middlebury, Unity, University of Maine at Bangor

Rescheduling Building Use

Central Methodist College, Coe, Louisiana State, Mary Baldwin College, Memphis State, Morton, Mount Marty, St. Michael's College, University of Dubuque, University of Pennsylvania, University of South Dakota, Wellesley, Wesleyan University, Western Illinois University, Westmar

Solar

Passive Solar Systems for Heating and Installation Variations: Ball State, Hamilton, Illinois Wesleyan, Interamerican University, Memphis State, Mercer County, Miami-Dade, U.S. Air Force Academy, University for Man at Kansas State, University of Massachusetts at Amherst, University of North Carolina, University of South Carolina

Solar Building Design: Clark College, Hamilton, Jefferson State, Montclair State, Navarro, San Jose State, University for Man at Kansas State, University of North Carolina, University of Southern California at Idyllwild

Solar Education Programs: See Energy Education

Solar Greenhouses: College of the Atlantic, Lincoln Land, Middle Tennessee State, Suffolk County Community College, University for Man at Kansas State, University of Massachusetts at Amherst, University of Southern California at Idyllwild

Solar-Heated Swimming Pools: Central Arizona, Colorado Women's College

Solar-Heated Water: Bentley, Bethany, City College of San Francisco, Edison, Emerson State, Loyola University, Middle Tennessee State, Montclair State, Navarro, Pima Community College, Seattle Pacific,

University for Man at Kansas State, University of Massachusetts at Amherst

Solar Photovoltaics: Mississippi County Commuhity College, Northwest Mississippi Junior College

Solar Seminars: See Information Sharing

Ventilation System Changes and Adjustments

Ball State, Beloit, Interamerican University, Marquette University, Middle Tennessee State, Missouri Western State, New Mexico State, North Dakota State School of Science, Olivet, SUNY at Binghamton, Susquehanna, U.S. Air Force Academy, University of California at San Diego, University of Louisville, University of Texas at Permian Basin, University of Texas Health Science Center, Washington State, Wayne State, Wellesley, Williamsport Community College

Water Conservation Devices

Eastern Illinois University, Flagler, Mt. San Antonio, Unity, University of Louisville, University of Tennessee at Knoxville, University of Virginia, Valencia Community College, Wellesley, Williams

C

Geographic Listing of Institutions
(alphabetical by state)

Alabama
- Jefferson State Junior College
- Spring Hill College (2)
- Talladega College
- Tuskegee Institute
- University of Alabama
- University of Alabama-Huntsville
- University of Montevallo

Arizona
- Central Arizona College
- Maricopa County Community College
- Northern Arizona University
- Pima Community College

Arkansas
- Mississippi County Community College

California
- Butte Community College
- California Institute of Technology
- California Polytechnic University
- California State University and Colleges headquartered at Fullerton
- City College of San Francisco
- Coastline Community College (2)
- College of Marin
- Contra Costa Community College
- Loma Linda University
- Merrift College
- Mt. San Antonio College
- St. Mary's College of California
- San Francisco State University
- San Jose State University
- Sierra Joint Community College (2)
- Solano Community College District
- Taft College
- University of California-San Diego (3)
- University of California-San Francisco (2)
- University of Southern California-Idyllwild
- West Valley Community College District

Colorado
- Colorado Women's College (4)
- Nazarene Bible College
- United States Air Force Academy
- University of Colorado
- University of Colorado Health Science Center

Connecticut
- Eastern Connecticut State College
- Post College
- St. Joseph College
- University of Connecticut
- University of Hartford (2)
- Wesleyan University (5)

Note: The number of programs entered is indicated in parentheses.

Delaware

Delaware Technical and Community College
University of Delaware

District of Columbia

Catholic University (2)
Gallaudet College (2)
George Washington University (2)
Howard University
Southeastern University

Florida

Brevard Community College
Broward Community College
Daytona Beach Community College
Edison Community College (2)
Embry-Riddle Aeronautical University
Flagler College
Florida Keys Community College
Florida Memorial College
Gulf Coast Community College (6)
Miami-Dade Community College
Rollins College
Stetson University (2)
University of Miami (2)
University of West Florida
Valencia Community College

Georgia

Georgia Southern College
Macon Junior College

Illinois

Art Institute of Chicago
City Colleges of Chicago
Eastern Illinois University
Eureka College
Governors State University (2)
Illinois Wesleyan University
Lake Forest College
Lincoln Land Community College
Loyola University of Chicago (3)
McHenry County College
Morton College
Southern Illinois University
Triton College
University of Chicago
University of Illinois
Western Illinois University (2)

Indiana

Ball State University (2)
Indiana University
Taylor University (2)
University of Evansville
Wabash College

Iowa

Coe College (3)
Graceland College
Indian Hills Community College
Iowa State University (2)
Iowa Wesleyan College
Kirkwood Community College
University of Dubuque
University of Iowa
Westmar College

Kansas

Colby Community College
University for Man at Kansas State (4)

Kentucky

Berea College
Morehead State University (2)
Prestonsburg Community College
University of Louisville (4)

Louisiana

Louisiana State University (3)
Loyola University (2)
McNeese State University

Maine

College of the Atlantic
Maine Maritime Academy
Unity College (4)
University of Maine-Bangor (4)
University of Maine-Orono

Maryland

Anne Arundel Community College
Goucher College
Hood College
Loyola College
Montgomery College (3)
United States Naval Academy (17)
University of Maryland (11)
University of Maryland-Baltimore County
University of Maryland-Eastern Shore

Massachusetts

American International College
Bentley College
Boston University
Brandeis University
Clark University (2)
College of the Holy Cross
Dean Junior College
Fitchburg State College
Harvard University
Mount Holyoke College
Nichols College
Tufts University
University of Lowell
University of Massachusetts-Amherst
University of Massachusetts-Boston (2)
Wellesley College (12)
Williams College (5)

Michigan

Central Michigan University
Lansing Community College
Mercy College of Detroit
Northern Michigan University
Olivet College (2)
University of Michigan
University of Michigan-Dearborn (2)
Wayne State University

Minnesota

Bethel College and Seminary
Brainerd Community College
College of St. Thomas
Macalester College
St. Mary's College
University of Minnesota

Mississippi

Northwest Mississippi Junior College

Missouri

Central Methodist College
Central Missouri State University
Missouri Western State College
Penn Valley Community College
University of Missouri
Washington University

Montana

College of Great Falls

Nebraska

Creighton University

New Hampshire

Notre Dame College
Rivier College

New Jersey

Mercer County Community College
Montclair State College (2)
Princeton University (2)
Ramapo College of New Jersey (4)
Rutgers University
Upsala College

New Mexico

New Mexico Highlands University
New Mexico State University-Grants Branch (3)
New Mexico State University-Las Cruces
University of New Mexico

New York

Clarkson College of Technology (2)
Cornell University (9)
Erie Community College
Hamilton College
Hobart College
Hunter College
Kingsborough Community College
Manhattanville College
Mohawk Valley Community College
New York Institute of Technology
Polytechnic Institute of New York
Potsdam College of Arts and Science
Rockefeller University
St. John's University
Skidmore College
SUNY Agriculture and Technical College
SUNY at Binghamton
SUNY at Brockport
SUNY at Buffalo-Amherst
SUNY at Old Westbury
SUNY at Oswego
SUNY at Plattsburgh
SUNY at Stony Brook
Suffolk County Community College
Tompkins Cortland Community College
University of Rochester

North Carolina

Central Piedmont Community College (2)
Guilford College
Mars Hill College
Martin Community College
North Carolina State University (2)
Piedmont Technical College
Southeastern Community College
University of North Carolina (4)

North Dakota

North Dakota State School of Science (5)

Ohio

Bowling Green State University
Case Western Reserve University
Lake Erie College (2)
Lakeland Community College
Oberlin College
Ohio State University (3)
University of Cincinnati

Oklahoma

Connors State College
Oklahoma State University (2)

Oregon

Lane Community College
Oregon Institute of Technology
Oregon State University
University of Oregon

Pennsylvania

Allegheny College
Alvernia College
Chatham College
Drexel University
Duquesne University
Hahnemann Medical College
Lafayette College
Lebanon Valley College
Lehigh University
Millersville State College
Pennsylvania State University (4)
Philadelphia College of Art
Rosemont College
Spring Garden College (2)
Susquehanna University (5)
University of Pennsylvania (10)
University of Pittsburgh
University of Scranton
Valley Forge Military Academy (4)
Waynesburg College
Williamsport Area Community College

Puerto Rico

Interamerican University

Rhode Island

Rhode Island Junior College
University of Rhode Island (2)

South Carolina

Benedict College
Clemson University
Furman University
Horry-Georgetown Technical College
University of South Carolina (2)

South Dakota

Mount Marty College (3)
Northern State College
Presentation College
University of South Dakota (4)

Tennessee

Chattanooga State Technical Community College (2)
Cleveland State Community College
Lincoln Memorial University
Memphis State University (7)
Middle Tennessee State University (15)
Southwestern at Memphis
University of Tennessee-Chattanooga
University of Tennessee-Knoxville

Texas

Alvin Community College
Amarillo College
Navarro College (12)
St. Mary's University
Southwest Texas State University
Southwestern University
University of Mary Hardin-Baylor
University of Texas-Austin
University of Texas Health Science Center
University of Texas-Permian Basin

Utah

Utah Technical College

Vermont

Bennington College
Green Mountain College (2)
Lyndon State College
Middlebury College (8)
St. Michael's College

Virginia

Mary Baldwin College
Randolph-Macon College
University of Virginia

Washington

Clark College
Seattle Pacific University
Spokane Falls Community College (2)
University of Washington (2)
Washington State University

West Virginia

Bethany College
West Virginia University (6)

Wisconsin

Beloit College
Marquette University
Northland College
University of Wisconsin-La Crosse
University of Wisconsin-Madison
University of Wisconsin-Milwaukee
University of Wisconsin-Platteville
University of Wisconsin-River Falls
University of Wisconsin-Sheboygan
University of Wisconsin System
Western Wisconsin Technical Institute
Wisconsin Indianhead Technical Institute (2)

D

Certificate of Achievement Recipients

Institution	Summary of the Problem, the Approach, and the Results
Benedict College Columbia, South Carolina Campuswide Energy Conservation	**The Problem:** How to conserve energy at a minimum cost. **The Approach:** In order to reduce heating without creating discomfort on campus, Benedict first conducted a study of the specific heating needs of each building on campus and of its heat retention capabilities. From the findings, buildings were fitted with storm windows and with insulation where needed; boilers were run on schedules to match the individual building occupancy needs, but were started only when temperatures dropped below 40°F. and never exceeding six hours without turning off the system for a period; all thermostats were set at government stipulated levels. Additional conservation measures such as lighting reductions and student incentive and energy programs helped to implement this plan. **The Results:** Comparing the 1978 and 1979 heating seasons, the following was achieved: Reduction in: — Boiler use: 3,016 hours (71%); Oil consumption: 323,900 gallons (71%); Electricity use: 130,000 KWH (14%) The initial cost of the project was $28,907 and the net savings during the first year of operation was $91,419, resulting in a payback period of just four months. In addition, the cut in the hours of boiler operation eliminated many hours of employee overtime. **Importance:** Substantial savings were achieved through simple measures by a college which has a minimum of financial resources.

Note: This appendix briefly summarizes the innovative approaches of the twelve institutions selected from among the 497 entries submitted for the Certificates of Achievement issued by the Academy in the Spring of 1980

Table D (continued) Certificate of Achievement Recipients

Institution	Summary of the Problem, the Approach, and the Results
California State University and Colleges headquartered at Fullerton, California La Jolla, California Energy Education	**The Problem:** In 1975 concerned faculty members felt it important that energy education become a part of the curriculum of California's elementary and secondary schools. **The Approach:** The faculty pooled efforts and ideas through the university's 19 campuses, developed an Energy Education Advisory Committee, and later, a Technical Assistance Program. The two activities became the Statewide Energy Consortium, which drew upon the expertise of scientists, engineers, sociologists, economists, and environmentalists to develop teacher education programs. Efforts were then broadened to include continuing education courses and the holding of workshops about energy. **The Results:** Three statewide conferences attended by faculty members and interested teachers resulted in the production of a curriculum for more than 400 energy-related classes in elementary and secondary schools and 52 continuing education courses. At the request of the state, the Technical Assistance Program prepared a manual with energy efficiency guidelines for builders and developers. The consortium was chosen by the Department of Energy to conduct small grants programs for small businessmen and lay people; and has published (and is constantly updating) a *State Directory of Energy Consulting Services* for Californians. The consortium has been able to obtain the greater part of its funding from corporations with home bases in California. **Importance:** The consortium's energy expertise reaches from the 19 campuses to the elementary schools and grassroots levels, and has helped educate about 150,000 people in energy conservation.

Institution	Summary of the Problem, the Approach, and the Results
Case Western Reserve University Cleveland, Ohio Comprehensive Energy Program	**The Problem:** How to undertake a comprehensive energy conservation program at practically no cost. **The Approach:** Starting in 1973, the university undertook a comprehensive energy conservation program encompassing all 87 campus buildings at virtually no cost outside the plant maintenance budget. Every possible energy cut was made, ranging from rearranging class schedules to using fewer buildings, lowering lighting levels and hot water temperatures, and recovering heat that would otherwise be lost into the air, to turning off lights between 8:00 a.m. and 5:00 p.m. in rooms with windows, and cutting library, bookstore, and gymnasium hours. Conference materials and videotapes were prepared on how to audit energy use and became a teaching tool at Case Western Reserve as well as at other educational institutions. The physical plant experimented with using solid waste as an alternative boiler fuel. Alternative energy research and education programs were made a part of the school of engineering. **The Results:** The savings realized by many of the programs are measured in terms of the decrease in the number of BTUs actually used between 1972-73 and 1978-79, as follows: 1972-73 – 1,691 million BTUs 1978-79 – 1,147 million BTUs Reduction in yearly consumption – 544 million BTUs, or 32 percent of the energy consumption six years earlier. **Importance:** The thoroughness of the program was shown by the university's ability to cut energy use for six years in a row with minimal expenditures beyond the regular plant operating and maintenance budget.

Institution	Summary of the Problem, the Approach, and the Results
Colby Community College Colby, Kansas Energy Education	**The Problem:** How to expand the production of gasohol. **The Approach:** The college developed an "Alcohol Fuel Production Workshop" for local farmers to teach them how to produce gasohol from grain in small, farm-size stills. The instruction in this five-day course covers the economics involved in gasohol production, the layout and design of gasohol stills and plants, the necessary regulations and permits, the kinds of grain that can be used, and what can be done with resulting by-products. The course includes lectures, a specially prepared textbook, videotapes, and "hands on" training in the laboratory. **The Results:** Colby has conducted 18 workshops with more than 800 participants who have come from 45 states and six foreign nations. The workshops now enroll bankers, accountants, professors, business persons, engineers, mechanics, and welders. The workshop program, which is located 230 miles from the nearest major city, has drawn the attention of the U.S. Office of Education and the Department of Energy. The Department of Energy asked Colby to run a special training program at the college for directors of 40 gasohol production programs across the country that the department plans to support, using Colby's program and materials as the model. **Importance:** Colby College has been described by national energy officials as a pioneer in the field of alcohol fuel production.

Institution	Summary of the Problem, the Approach, and the Results
Drexel University Philadelphia, Pennsylvania Heat Recovery	**The Problem:** How to reduce the costs of heat and water in the university's large physical education center which houses a laundry in addition to the swimming and diving pools. **The Approach:** The university's large physical education center used great amounts of hot water in the building's laundry and swimming and diving pools. Costly drinking water was being used to lower the temperature of the hot water released from the laundry's heating system. This water had to be cooled before it could be discharged into the sewer without causing heat damage to the pipes. The hot water from the laundry's heating system was rerouted and used by the swimming and diving pools' heating system, after which the water became cool enough to be discharged directly into the sewer. The arrangement eliminated the need for buying drinking water for cooling purposes and provided enough "free" heat to maintain the 360,000 gallon swimming and diving pools at a constant 80°F. temperature. **The Results:** Initial investment — $24,800 Annual savings from: • drinking water no longer purchased to cool the laundry discharge — $1,578 • steam no longer purchased for heating the swimming and diving pools — 9,635 — $11,213 Payback period — 26 months **Importance:** Standard heat recovery techniques were applied to the specialized needs of the university.

Table D (continued) Certificate of Achievement Recipients

Institution	Summary of the Problem, the Approach, and the Results
Hamilton College Clinton, New York Solar Building Design	**The Problem:** How to provide inexpensive classroom space near the observatory for astronomy students. **The Approach:** The college designed and constructed an oblong, solar-heated, block building, made of concrete, heavy insulation material, and wood to provide classroom space near its observatory and to serve as a laboratory for solar energy courses. **The Results:** In 1977, the $30,000 cost of the solar-heated building was less than that of a similar building with a conventional electric heating system. Each year 67 percent of the heating comes from the sun; the annual cost of electricity to heat and light the building from October to April has been only $120. The building also demonstrates that a passive solar energy-design can work in the cold and cloudy northern climate of upstate New York. **Importance:** This project shows that in a cold climate it is possible to save on the use of conventional energy and be cost effective by using a simple solar energy system; also, that this can be done for a small building at a small college.

Table D (continued) Certificate of Achievement Recipients

Institution	Summary of the Problem, the Approach, and the Results
Lafayette College Easton, Pennsylvania Lighting Adaptations	**The Problem:** How to find a cheaper way of cutting energy consumption of fluorescent lights. **The Approach:** Two graduate engineering students experimented with using a capacitor (a device normally used in wiring electrical systems) to reduce the number of fluorescent lights but still have an effective, efficient level of lighting. However, standard fluorescent fixtures will not operate if one of the two tubes is simply removed. The capacitors, although not originally designed for use in fluorescent fixtures, could work with minor alterations, taking about five minutes for each adaptation and installation. With a capacitor, the energy use of each fluorescent light is limited to the amount needed to run the one remaining tube. The capacitors used cost $1.62 each, which was much cheaper than the commercially popular $8.50 "phantom tube"—a hollow tube designed for the same purpose. **The Results:** Cost for the nine major buildings $ 4,425 Savings in the first year $12,000 Energy savings by the nine buildings 9% The cost is a one-time expense; the savings continue year after year and grow as electrical costs rise. **Importance:** The capacitor is an adaptation that avoids the more expensive investment in commercially popular conservation devices.

Table D (continued) Certificate of Achievement Recipients

Institution	Summary of the Problem, the Approach, and the Results
Lincoln Land Community College Springfield, Illinois Comprehensive Energy Conservation	**The Problem:** How to conserve energy at the college and elsewhere. **The Approach:** In 1976 the college started "Energy Commitment," a program covering all aspects of energy conservation—from resource management and planning to education offerings. Management measures taken included an energy audit, installation of a computer system, increased insulation, reduced lighting, a four-day week summer schedule, and the building of solar and wind generating systems on the horticulture building. Energy education programs range from college courses to gasohol workshops for the farmer and energy forums for interested persons. Car-pooling and increased mass transit services were organized for the campus community. The college took on leadership in energy conservation in the midwest by hosting conferences for state college administrators and panel discussions for government officials. The president travels extensively to speak on energy conservation at national forums and post-secondary education conferences. **The Results:** Lincoln Land used bond funds to cover most of the $508,000 capital expenses incurred. Most other programs were financed through small local and federal grants and private donations, along with registration fees for the forums. Although the expected payback periods for all projects range from one month to 16 years, all projects taken on by the college reflect its policy that fairly major expenditures for conservation are a one-time expense and will pay for themselves at different rates with the savings eventually multiplying. **Importance:** This college does everything possible to conserve energy. It makes small one-time capital expenditures with the thought that the savings will multiply continually.

Institution	Summary of the Problem, the Approach, and the Results
Middlebury College Middlebury, Vermont Power Plant Conversion	**The Problem:** How to reduce oil consumption in the college's central power plant. **The Approach:** In 1977 Middlebury tested a new process for burning oil in its central furnace. The process, called "Complete Combustion Conditioner," works by mixing water and the fuel oil in such a way that the resulting chemical reaction as the mixture enters the boiler increases the surface area of the oil. This improves the burning process by raising the burning temperature (to over 3,000°F.) and creating more efficient heat while using less oil. The process also lowers the air intake of the boiler, which reduces heat loss and the exhaust fumes that pollute the air. **The Results:** For the trial month of November 1977, oil consumption was reduced 9 percent, lowering costs by $2,100. In 1979 the process reduced the oil used by 70,000 gallons, also saving 9 percent. The college incurred no out-of-pocket capital expenses inasmuch as the system is leased to Middlebury at $615 a month. **Importance:** Middlebury was the first college to experiment with this system, which works for buildings and institutions with a centralized, oil-burning furnace.

Institution	Summary of the Problem, the Approach, and the Results
Skidmore College Saratoga Springs, New York Power Plant Conversion	**The Problem:** How to find a substitute for fuel oil that would reduce costs. **The Approach:** The college redesigned its heating plant to burn 100 percent waste crank case oil instead of fuel oil. In order to make the plan work, the college had to add pumps and filters to the existing fuel system and had to find sources that could provide 600,000 gallons of waste oil a year. Skidmore also had to convince the surrounding community that burning waste oil would not pollute the local air. After this was accomplished, the college not only earned the approval of the New York State Department of Environmental Conservation for a constructive idea, but also gained commendation for removing from the area a large quantity of waste oil which had been a troublesome pollutant of the rural watershed when used for dust control on rural roads and when dumped as a waste product into landfills. **The Results:** Cost of conversion — $ 25,500 Payback period during the first year — 9 months Annual savings now expected — $234,600 Skidmore has arranged an annual collection program with three suppliers of waste oil, one of which charges only for the cost of the truck used and donates the 100,000 gallons of oil it supplies. **Importance:** The project is not complicated and had a low conversion cost with a rapid payback. Skidmore is the first higher education institution to use waste automotive crank case oil as the sole fuel for its heating system.

Table D (continued) Certificate of Achievement Recipients

Institution	Summary of the Problem, the Approach, and the Results
University of California at San Diego–University Extension La Jolla, California Energy Education	**The Problem:** How to educate a large number of people about the need for energy conservation. **The Approach:** The university's extension division developed a course called "Energy and the Way We Live," consisting of 15 weekly articles run in 540 newspapers and for which credit is given by 342 colleges. This course, designed by energy experts from a variety of disciplines, explores energy technology and consumption, the impact of differing values on energy policy, and worldwide energy dilemmas. The course can be used in conjunction with a local newspaper running the series of articles, or as a self-contained course, or for independent study credit in an area where there is no participating college. "Energy and the Way We Live" is an outgrowth of the university's program, *Courses by Newspaper*, which was started through the annual production of 15-week newspaper courses in 1973; "Energy and the Way We Live" is the twelfth in the series and the most far-reaching. **The Results:** The course, started in January 1980, had an estimated enrollment of 8,000 to 10,000 persons and an estimated readership of five million persons (the combined circulation of the newspapers involved exceeds 15 million readers). Course materials are now being used for 450 energy policy forums being held in various communities across the country; and for a series of half-hour programs broadcast by National Public Radio. **Importance:** "Energy and the Way We Live" is the only national energy course of its kind. It draws its material from energy experts around the world and attracts both nontraditional and traditional students.

Table D (continued) Certificate of Achievement Recipients

Institution	Summary of the Problem, the Approach, and the Results
University of Delaware Newark, Delaware Monitoring and Controls	**The Problem:** How to reduce energy costs on a small budget in anticipation of purchasing a computer when funds become available. **The Approach:** In 1976 the university, finding that the capital cost of a computerized energy management system was beyond the capacity of its then current budget, looked for a temporary way to reduce energy costs. The conclusion: 40 percent of the temperature control and start-up functions provided by a computerized system could be done manually; savings would be substantial if the staff concentrated on buildings where energy use was high (39 out of the 113 buildings on campus). The activity, "Operation Bootstrap," employed 10 persons acting as "energy controllers" (five daytime, five at night). Their salaries were charged against the gross savings of the project. **The Results:** Gross savings in energy, first two years (1977-78 and 1978-79) $507,360 Cost of the energy controllers and the energy consultant for the project 205,360 Net savings, first two years $302,000 The net savings were placed in a reserve account and are now being used to finance the first phase of an automated energy control system in nine high energy use buildings. The manual system will continue so that future savings can be used to extend the automated system further. Importance: The plan provided immediate energy savings within a budget that could not at the time finance the capital cost of a computerized management system.

Index

D

E

F

M

V

W

Activities of the Academy for Educational Development, Inc.

The Academy for Educational Development, founded in 1961 to help U.S. colleges and universities solve some of their long-range educational, administrative, and financial problems, has expanded steadily over the years. Today, the Academy is active not only in higher education, but also in elementary and secondary education, in communications as an art and as an increasingly important form of technology, in international affairs, in studies of the human life cycle, in helping to improve the facilities of institutions that serve the public, in energy conservation and education, and in a wide range of projects aimed at finding new ways to encourage older people to continue their active participation in American life.

The Academy serves its clients in the following ways:

- Preparing long-range educational plans
- Setting up and evaluating new educational programs
- Planning and carrying out innovative experiments in the use of educational facilities
- Conducting workshops on management, instructional technology, energy conservation, and other educational concerns
- Improving educational management
- Improving the process of settling disputes between nations
- Helping colleges and universities find well-qualified administrators and trustees; managing institutions on an interim basis
- Counseling on institutional, organizational, and personnel problems in an effort to find better solutions
- Conducting studies and research on problems of aging, education, energy conservation, communication, and international development
- Planning and administering experimental programs in developing countries
- Sponsoring conferences on the human life cycle, and publishing the results.

The Academy maintains full-service offices at 1414 Twenty-second Street, N.W., Washington, D.C. 20037, telephone (202) 862-1900 where the energy conservation project is headquartered, and 680 Fifth Avenue, New York, New York 10019, telephone (212) 397-0040.