ECT 241 -- Short-Term Energy Conservation Solutions 3 Qtr. Hrs.

Short-term energy conservation practices require minor improvements and investment by adding additional controls or replacing more efficient equipment. The student will get familiar with all new controls and more efficient equipment. During the last half of the quarter, the student will develop a business energy audit and conservation program. Class will visit several organizations with well-organized energy conservation programs.

ECT 131 -- Energy System I 3 Qtr. Hrs.

The student becomes acquainted with the concept of an energy system. Elements of system definition are evaluated, including the setting of boundaries, flow of mass and energy over the boundaries and change within the boundaries. An appreciation of system synthesis is achieved through review of typical systems -- heating and ventilating, electrical process and power systems are considered, as are the interaction between system and environment.

ECT 231 -- Energy System II 3 Qtr. Hrs.

The parameters of energy loads in buildings, process and power systems are identified and quantified. The properties of energy-producing and transport media are investigated. By application of the principles and information from the requisite courses and typical system losses with load and supply data, a system specification is prepared.

ECT 211 -- Solar Hot Water and Space Conditioning 4 Qtr. Hrs.

Completion of this course will enable the student to design an active solar space heating and domestic water heating system. Instruction will include the source of radiation, conversion to a usable form, transporting, storing, and utilization of the energy. The principles of the hardware designs to accomplish these tasks will be taught, as will the system sizing and life cycle costing, with introductions to passive heating and cooling methods and active solar cooling systems. The student will participate in the design and construction of a solar domestic water heating system.

ECT 221 -- Heating, Ventilating, and Air Conditioning Hardware 3 Qtr. Hrs.

This course will familiarize the student with the hardware and mechanisms available on the market that will accomplish the various tasks required of the many different HVAC systems. The availability of complete systems will be reviewed. Supplier catalog information will be evaluated and the student will participate in sample problems and field trips to observe operating systems.

ECT [illegible] -- Energy Controls and Measurement [illegible]

In this course the student will receive instruction in fundamentals of energy controls and measurement, including the International System of Units. The student will become familiarized with indicating, recording and integrating instruments for the measurement of temperature, fluid flow, pressure, power and energy. Emphasis will be on lab work with meters and energy controls directly related to energy conservation.

ECT 242 -- Long-Term Energy Conservation Solutions 3 Cr. Hrs.

The student will become familiar with long-term solutions for energy conservation in business and industry. Includes conversion from gas to oil and oil to coal. Economical use of solar, other alternative energy sources, and new technologies are discussed. Energy legislation is covered. The student will prepare detailed heat loss estimates.

ECT 251 -- Energy Futures 3 Cr. Hrs.

A study of the options and alternatives available to society as it confronts a period of increasing demand and diminishing supply of traditional fuels and energy sources. The course will include overviews of presently available technologies such as solar energy and wind use and future possibilities such as photovoltaics, geothermal, OTEC, and nuclear fusion.

ECT 101 -- The Energy Crisis and Energy Sources 3 Cr. Hrs.

An overview of the history of worldwide energy production, distribution and consumption leading to the factors producing the present energy crisis. A study of the nature of the crisis with emphasis on the shift in society's use of energy away from independent collection and use to a dependence on central marketing, distribution and delivery of fossil fuels and electrical power. The course will explore the relationship between present and foreseeable future energy sources and needs.

ECT 141 -- Immediate Energy Conservation Solutions 3 Cr. Hrs.

Introduction to energy conservation - becoming top priority in home, business and industry. Immediate energy conservation practices in heating, cooling, home appliance, transport, commercial and industrial uses of energy. Hands on experience in insulation and winterization.

ECT 151 -- The Era of Fossil Fuels 3 Cr. Hrs.

A study of fossil fuels, their origin, use and future. Topics include consumer demand, energy source and supply and conservation needs. Federal and state controls will be discussed. Petroleum, natural gas and coal products will be emphasized.

[illegible]

Objective: [illegible]

Course	No.	Description	Credits
[illegible]	[illegible]	Introduction to Technical Math	[illegible]
[illegible]	[illegible]	Blueprint Reading for Building Trades	[illegible]
[illegible]	[illegible]	The Energy Crisis and its Solutions	[illegible]
[illegible]	[illegible]	Practical Energy [illegible]	[illegible]
[illegible]	[illegible]	Building Service Systems	[illegible]
[illegible]	[illegible]	Introduction to Electric Power	[illegible]
[illegible]	[illegible]	Basic Composition	[illegible]
[illegible]	[illegible]	Energy Systems	[illegible]
[illegible]	[illegible]	Immediate Energy Conservation Solutions	[illegible]
[illegible]	[illegible]	The End of Fossil Fuels	[illegible]
[illegible]	[illegible]	Solar Hot Water & Space Conditioning	[illegible]
[illegible]	[illegible]	Short-Term Energy Conservation Solutions	[illegible]
[illegible]	[illegible]	Long-Term Energy Conservation Solutions	[illegible]
[illegible]	[illegible]	Energy Futures	[illegible]

Total Credits 45

Certificate — Energy Systems Analysis

Objective: To provide a program for those wishing to increase their knowledge of energy systems and hardware. Practical applications will be emphasized.

Course	No.	Description	Credits
MAT	[illegible]	Introduction to Technical Math	[illegible]
[illegible]	[illegible]	Building Service Systems	[illegible]
[illegible]	[illegible]	Energy Systems I	[illegible]
[illegible]	[illegible]	Solar Hot Water and Space Conditioning	[illegible]
[illegible]	[illegible]	Heating and Ventilating Hardware	[illegible]
[illegible]	[illegible]	Energy Systems II	[illegible]

Total Credits [illegible]

[illegible]

1st Quarter

[illegible]

2nd Quarter

MAT [illegible]	Tech. Math	[illegible]
[illegible]	[illegible]	[illegible]
EET [illegible]	Practical Energy Calculations & Analysis	3
[illegible]	Technical [illegible]	[illegible]
		[illegible]

3rd Quarter

ENG 111	Basic Composition	[illegible]
EET [illegible]	Energy Systems	3
EET [illegible]	Immediate Energy Conservation Solutions	3
EET [illegible]	Fossil Fuels	3
		[illegible]

4th Quarter

[illegible]	[illegible]	[illegible]
[illegible]	Solar [illegible] Water [illegible] Space Conditioning	[illegible]
[illegible]	Heating [illegible] Hardware	[illegible]
[illegible]	Energy Systems	[illegible]
	Elective	[illegible]
		[illegible]

5th Quarter

EET [illegible]	Short-Term Energy Conservation Solutions	3
[illegible]	Organizational Communications	3
EET [illegible]	Energy Control & Measurement	[illegible]
ENG [illegible]	Technical Report Writing	3
	Elective	3
		[illegible]

6th Quarter

CSC [illegible]	Intro. to Computer Science	3
BET [illegible]	Construction Estimating	3
EET [illegible]	Long-Term Energy Conservation Solutions	3
EET [illegible]	Energy Futures	3
	Elective	3
		[illegible]

2 year total [illegible]

[illegible] Community College is offering a series of Energy Conservation Seminars approximately [illegible] clock hours in duration. These seminars are directed toward individuals interested in energy savings, particularly persons who manage moderate size buildings and small businesses, building managers, maintenance personnel, and community and state officials responsible for energy conservation programs. The general program is structured as follows:

PROGRAM OBJECTIVE: A short-term basic program of practical energy conservation practices.

CURRICULUM: Instructions in layman terms in the following areas:

1. Basics of energy conservation.
2. Insulation materials and applications.
3. Building winterization and ventilation.
4. Proper maintenance scheduling for heating and cooling system efficiency and other immediate practices to conserve energy.

Field experience in practical applications on selected sites will be included. Sites may include low-income dwelling areas, small businesses and other selected target areas.

COASTLINE COMMUNITY COLLEGE

ENERGY MANAGEMENT PROGRAM

Because of the growing concern about shortages of energy sources and the need for consumers to become involved in the proper management of these dwindling energy sources, Coastline Community College was urged to establish an Energy Management Program. In October 1976 an Advisory Committee was formed. The committee had representatives from utility companies, business, industry and education. The purpose of the committee was to advise the college as to the type of energy program it should establish and the type of courses to be integrated within the recommended program. Generally it was felt by the committee that the curriculum should be broad in nature, because the individuals to be trained should be primarily "energy managers" and secondarily "energy technicians."

It was envisioned that this energy manager would be a problem solver, manager of time, materials and people, a coordinator and not necessarily an engineer. However, it should be pointed out that since the Energy Management Program started in September 1977, many engineers have enrolled in Coastline's energy program because they have been appointed as energy managers at their place of employment. Our students have eagerly sought an identification and understanding as to what an energy manager should be.

The Advisory Committee agreed that the term energy manager, was to include conservation with emphasis on the consumer and load management with emphasis on the producer. Therefore, the energy manager was to be trained to evaluate and make recommendations about energy conservation and energy use. This meant that the energy manager was perceived to be an extension to the industry business management team and to provide that management team with reliable energy information. The energy manager could then provide a one, three, five, or ten year energy plan depending upon the needs and desires of the energy business management team. Some of the components of the energy plan would include cost analysis, recommendations for immediate and extended conservation programs, some recommendations for retrofitting of [illegible], and guidelines for the purchasing of new equipment if, and when, needed. The energy manager would have a competent understanding to know when and where to engage any required technical engineering assistance.

After many hours of discussion by the [illegible] committee, the Coastline Community College management program listed below was proposed:

ENERGY MGMT 100	- Energy Management Principles	3 Units
ENERGY MGMT 101	- Energy Economics	3 Units
ENERGY MGMT 102	- Systems Analysis for Energy Mgmt	3 Units
ENERGY MGMT 103	- Energy Management & Human Behavior	3 Units
ENERGY MGMT 210	- Equipment Application for Environmental Control	3 Units
ENERGY MGMT 220	- Energy Management Planning	3 Units
BIS 100 or	- Introduction to Computers	
ENG 105 or	- Technical Report Writing	
SUPV 804	- Introduction to Supervision	3 Units
ELECTIVES		3 Units

SUGGESTED ELECTIVES

BUS 130	- Survey of Data Processing	3 Units
BUS 050 or	Business Math	3 Units
MATH 050	- Technical Math	3 Units
ACCT 101	- Principles of Accounting	4 Units
SUPV 807	- Organization and Management	3 Units
W.E. 083	- Work Experience	3 Units

To establish a high level of instruction and to offer current viable information, professional persons in the energy business were commissioned to develop the proposed energy courses. With the intention of adding additional courses this coming year, the courses listed below are currently being offered under the energy management program:

[illegible]

Course is designed for Energy Management [illegible] of primary energy forms, their history, present and future [illegible] as they relate to public, commerce and industry. [illegible] to other disciplines such as architecture, engineering and government agencies [illegible] applications.

ENERGY MGMT [illegible] [illegible]

Includes life cycle cost of [illegible] energy and [illegible] affected [illegible] socio-political action, [illegible] agencies [illegible]

ENERGY MGMT [illegible] [illegible] ANALYSIS FOR ENERGY MGMT [illegible]

Course is designed to provide students with the [illegible] to effectively identify and analyze organizational energy problems. A creative approach to the application of systematic, quantitative methods and techniques in an attempt to obtain preferred solutions. Course includes field application of [illegible] and a review of current conservation products, services and procedures.

ENERGY MGMT [illegible] - ENERGY MANAGEMENT AND HUMAN BEHAVIOR [illegible] Units

Course seeks to apply knowledge and techniques of the social and behavioral sciences to the solution of practical problems encountered by energy management specialists. Human factors explored include attitudes toward energy consumption, sources of resistance of energy conserving measures, and techniques for modifying energy related behavior. Students to design and carry out group field research projects.

ENERGY MGMT 210 - EQUIPMENT APPLICATION FOR ENVIRONMENTAL CONTROL 3 Units

Course is a practical introduction to air-conditioning systems and their application in commercial, industrial and residential buildings. The primary emphasis of the course will be on conservation from an engineering standpoint.

ENERGY MGMT 220 - ENERGY MANAGEMENT PLANNING 3 Units

Course is designed to provide students with the knowledge to identify energy-using equipment, analyze its operation and prepare recommendations for conserving energy and/or improving efficiencies. Emphasis will be placed on developing energy-management plans.

The college felt that it was essential to schedule the management program in such a way that for any student desiring to become certificated in the program the requirements could be completed within a two-year

[illegible]

[illegible]

[illegible]

[illegible]

Making [illegible] installation [illegible] to show [illegible]

Meeting general [illegible] energy conservation are sound and correct.

The findings of the [illegible] The first HRA class was held in January [illegible] students had previously completed the regular [illegible] course in [illegible] and was thoroughly familiar with the [illegible] required for [illegible] installation and maintenance of heating, ventilating and air conditioning (HVAC) systems. The HVAC technicians [illegible] in the course were already able to identify troubles within a system, interpret [illegible] from technical manuals, and calibrate, repair or replace defective components.

One of the elements of the course that has a major impact on the success achieved to date is the section that deals with how to conduct a building survey. The technician learns to use each measurement device and his newfound knowledge to achieve the following goals of the building survey:

2. Identify equipment whose operation is inefficient.

3. Locate energy leaks.

4. Survey current energy utilization patterns to identify waste.

5. Determine whether the installation of heat reclamation and other energy saving equipment would be cost effective.

6. Prepare a cost saving analysis for the energy saving projects proposed.

With the guidance of DSCC's Air Conditioning and Refrigeration Department Chairman, the initial class conducted a survey of each of the 18 campus buildings. After all of the building surveys were completed, the students, under the direction of the Department Chairman and staff instructors, prepared a report that contained recommendations for changes and detailed the cost of each change. The report also included an estimate of the energy cost savings that could be reasonably expected for each change. Because of a total commitment to the program, action was immediately taken by college officials to implement all of the recommendations. Results of these efforts indicate the following: (See Chart)

Energy conservation can be achieved by taking action in one or more of the following categories:

a. Repair and adjustment of existing building structure and machinery.

b. Time sequencing or reduction of energy use during periods when it is not needed.

c. Installation of new high efficiency energy machinery and energy reclamation systems.

PROGRAM RESULTS

Prior to January 1977

Approximately 35% reduction in the use, consumption of energy (Electricity, oil, gas, water)

Since January 1977 with:

Increased floor area due to major building program
Increased students enrolled
Slightly warmer summer/colder winter
More equipment
More comfort

KWH Reduction 19 Mos.	1,222,400
	$28,738.62
KWH Demand Increase	934
	($ 2,194.90)
Net Dollar Saving	$26,543.72
Estimated Saving Calendar Year '78	$35,391.62
Total Cost - Less Than	$ 500.00

During the initial program planning it had been decided by DBCC that only improvements in the first two categories would be implemented following the building surveys. This decision was necessary to avoid the high cost of installing new energy-efficient machinery and energy reclamation systems until sufficient funds could be budgeted. College officials also felt that considerable improvement was yet to come in the design of such equipment. The decision not to install new machinery also offered an excellent opportunity to find out what can be done with what they presently have.

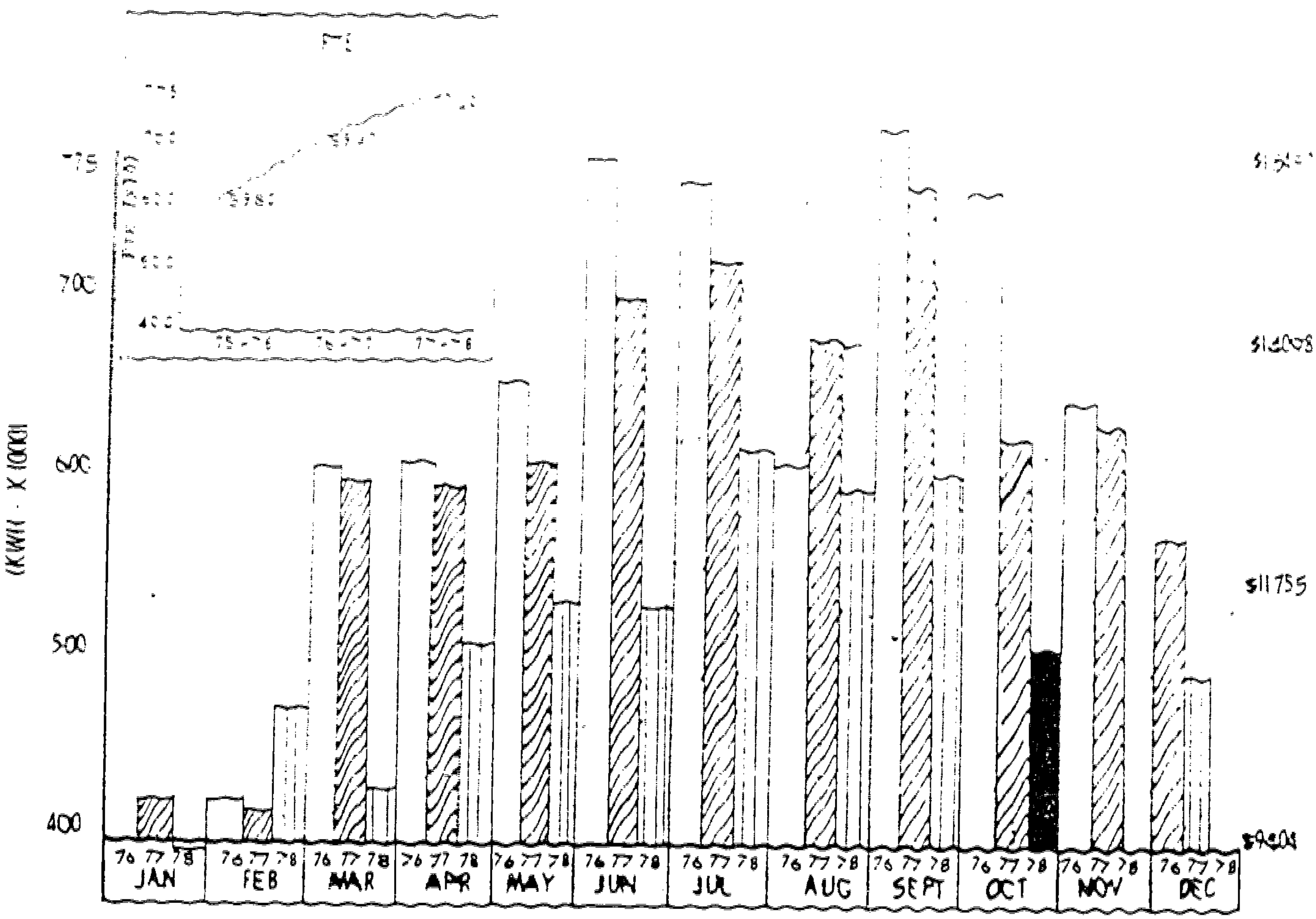
Based on the report, the College instituted the following changes:

- Hallway lighting was reduced 50% and other lighting on campus was lowered wherever possible to acceptable levels.
- The campus maintenance contractor steam cleaned all air handling coils.
- Hallway register dampers were closed to reduce the cooling and heating requirements in these areas.
- Chillers were shut down each night and on weekends.
- A solenoid valve was installed in the water line to a water-cooled air compressor. This interrupted the water flow when the compressor is not operating. A pressurstat and a 7-day timer was installed on a 10-hp air compressor to shut the motor off between work intervals and keep it off at night and on weekends.
- An unused pneumatic control panel for 3 air handlers was correctly connected (apparently for the first time) to the main panel thereby permitting complete shutdown at 9:30 PM and automatic startup at 6:00 AM. It was discovered during the building survey that this panel apparently had never been connected into the system.
- A power guzzling 4000 cfm Power Roof Exhaust fan was shut down.
- Structural gaps requiring approximately 1.5 tons of air conditioning for compensation were sealed. The controlled intake of ventilation air through the air handlers was reduced thereby lowering the cooling load in summer and the heating load in winter.

- The temperature of the chilled water output from a 5 ton chiller for the Photo Lab was increased from 40 degrees Fahrenheit to 60 degrees Fahrenheit.
- A reverse Acting Water Regulating Valve and some associated refitting permitted output water from a water-cooled condenser to be routed as preheated water to a hot water heater. This warm water from the water-cooled condenser was previously wasted.
- All pneumatic controls were calibrated, adjusted and lubricated for smooth operation.
- Timers were installed, thermostats were lowered and additional insulation was added to all hot water heaters.
- Thermostats were checked for proper system connections and were rebuilt where necessary. Several thermostats were found that were never connected to the system.
- A defective plenum wall construction was corrected and air ventilation in the affected areas was readjusted to current energy conservation standards.

The obvious question yet to be answered was, "Would the savings achieved, justify the effort expended." The degree of savings could easily be applied as a measure of the course effectiveness. The bar chart below identifies the kilowatt/hour consumption of DBCC from February 1976 through September 1978. The energy dissipation bars are grouped by month so that comparisons can be made. Despite severe winters and extremely hot summers for the past several years, DBCC has been able to effect an overall energy reduction for each of the past two years.

Note that the energy consumption has been reduced significantly since the inception of the DBCC Energy Conservation Applications Program in January of 1978.



The DBCC program has been different in many respects from typical conservation programs pursued in the interest of saving something, be it money, energy, or time. It was painfully clear that there were many opportunities for energy conservation on this campus, but without organization of plans, surveys and analyses and the initiation of corrective action by technically trained persons the entire effort would have been fruitless.

"Conservation" to a majority of people bears the connotation of sacrifice in order to save. In application of the guidelines for conservation here, it was found that the exposure of the problems led directly to more effective use of HVAC systems and equipment and that greatly improved environment for less cost resulted in every case. Thus by a careful check of operating effectiveness and appropriate corrections, double dividends have been realized.

With the success of the energy conservation activities on the DBCC campus and with the high degree of qualification of the recent graduates of the Energy Conservation Applications Program, there appears to be a tremendous opportunity for the College to be of service to other governmental agencies in Volusia County, and to the HVAC industry in the State of Florida by revision and expansion of the present courses and activities.

The College plans to expand the present 480 hour course by adding 128 additional hours devoted to Pneumatic Controls and increasing the time for Psychrometrics, Air Distribution, and Heat Loads for buildings. Short courses and seminars are planned for qualified HVAC technicians on the installation, use and maintenance of Pneumatic Controls. The second of the seminars on Pneumatic Controls was conducted at DBCC January 8-10, 1979.

In addition, short courses for public service employees are in the making for Spring Semester. The subject and content will depend upon the level of qualifications of the prospective students as determined by a survey.

Finally, public awareness seminars on the opportunities for energy conservation for home owners are planned for the Spring.

Energy conservation is a continuing process. It has been proven that opportunities for saving abound. Every college campus in the United States should have a well organized and active program which involves, like the Marines, "A few good men", who are serious, dedicated and devoted to a single purpose -- more comfort for less energy. Experience has shown that demonstration projects are an extremely convincing tool and should be exploited continuously. Once a program has been initiated it will require high caliber personnel to maintain it and continue to extract the promised savings.

DURHAM TECHNICAL INSTITUTE

ACADEMIC PERSPECTIVE AND THE APPLICATION

OF ENERGY CONSERVATION PRACTICES

Two major [illegible] with respect to energy conservation [illegible] educators in America today, the interest in introducing energy conservation and other energy issues into the educational program, and, as energy consumers, the interest in applying energy conservation and energy management techniques to enhance the energy efficiency of the physical properties such as buildings, machines, and vehicles used in the delivery of educational programs. The opportunity exists, therefore, to serve both as an energy training ground and as a model of good stewardship of energy resources. Durham Technical Institute has moved in both areas of interest. It has sought to integrate education and training in energy matters into its regular programs and special short courses for the community at large, and it has moved to implement systems and to revitalize its structures in the interest of energy conservation.

Academic perspective. Academic programs incorporating relevant energy technologies as a standard part of the curriculum include Architectural Drafting, Historic Preservation Technology, Electronic Technology, and Science and Engineering Technology (SET). Incorporation of energy-related materials have been gradual at the pace set by the faculty as they have acquired appropriate qualifications. This process is as yet by no means complete or, for that matter, comprehensive, but significant strides have been taken and additional curricular changes are under way or in planning.

[illegible] in the building trades.

From a practical point of view, [illegible] methods for energy conservation [illegible] Institute service area is at present [illegible]. The institutional philosophy that results from the present low [illegible] potential [illegible] is to encourage the permeation of energy conservation education into the regular programs of instruction, rather than to implement a separate degree or diploma program.

<u>The application of energy conservation practices</u>. The school has had almost dramatic experience in serving as a community model for the application of a variety of inexpensive energy conservation methods to the operation of the physical plant. By the standards of much of higher education, Durham Tech is poor even though it is a state supported school, operating on a total per Full-Time Equivalent (1 FTE = 16 hours/week for 44 weeks) student budget of approximately $1,200 for the fiscal year ending June 30, 1978. Additionally, the physical plant is the most heavily utilized in all public or private higher education in North Carolina, with a utilization statistic in excess of 80%. The point in representing these statistics is to make clear that whatever energy conservation programs are applied must have low start-up costs and must have at least a manageable effect on the scheduling of the physical plant.

[illegible]

The [illegible] was [illegible]. The school converted in midterm from the normal five-day [illegible] week to a four-day [illegible] operating week [illegible], beginning the second full week in February [illegible], to convert the winter and summer academic terms (the school's peak utility periods) to a four-day week, leaving the spring and fall quarters on the conventional five-day week. All heating and cooling was brought to maintenance levels, beginning two hours before closing on Thursdays and returned to operating levels two hours prior to classes opening on Monday morning, effectively reducing the "energy week" by 13.5 hours, which is 33.4 percent of the academic week and 11.6 percent of the calendar week.

It should be noted that in converting the school's schedule from the five-day week to a four-day week there was no reduction in the number of hours that classrooms and laboratories were used, merely greater occupancy of instructional spaces per day. There was no reduction in employee work hours or student class hours. The teaching day was expanded from 14 hours per day to 15 hours per day to accommodate the required class hours.

[illegible]

[illegible] presented above.

The [illegible] natural gas utilization at Durham Technical Institute points to further confirmation of the assumption that natural gas utilization is closely tied to the reduction in the academic week. Note that in comparing the first half of 1977 to the first half of 1976 the average percent reduction in ccf of gas used per degree day (subtotal under 1977 vs 1976, ccf/degree day difference

While this experiment is only a portion of the school's on-going efforts to apply energy management techniques in the interests of conservation, it does demonstrate that opening one's mind to workable possibilities and then implementing the most workable with genuine determination can result in an exemplary energy conservation program with little or no out-of-pocket investment.

LANE COMMUNITY COLLEGE

ENERGY MANAGEMENT

Lane Community College is a two-year comprehensive public institution of 8,000 full-time equivalent students located in Eugene, Oregon. Efforts in Energy Management and Conservation for both instruction and for the College's plant operations have been underway for a number of years.

The history of energy management at Lane Community College began in 1973 when energy shortages due to low water supplies in hydro-electric generating systems began to be publicized. The usual conservation efforts occurred including parking lot light modification and publicity campaigns to turn lights off, etc. Domestic hot water was curtailed for many campus areas. The electrical boilers which heat the campus were monitored closely to prevent higher than normal demand based electrical charges. These conservation efforts were somewhat effective but primarily helped to offset rate increases subsequently made by the utility company. Following these conservation efforts, the College's staff were able to effect a number of mechanical adjustments to the HVAC system which were somewhat sophisticated but, for the most part, relatively easy to accomplish. These adjustments include closing outside air dampers for night operation, raising mixed air temperatures in multizone units, lowering temperatures in hot decks, raising temperatures in cold decks, disconnecting ballasts in fluorescent lights and relamping some areas. In 1976, after reviewing the literature, the experiences of other institutions, and input from the vendors of controls as well as from an independent local engineering firm, the College undertook a major plant retrofit.

This project, costing approximately $280,000, included the adding of a mini-computer to the centralized control system, the acquisition of oxygen storage tanks from the Federal Government Excess Program to convert to an energy (hot water) storage system, and the addition of a large chiller-like device which removes heat formerly wasted from the air-conditioning system and makes it available for reuse. The project has been quite successful and will have, at the current rate, paid for itself totally within three years.

A number of adjustments to the HVAC system have occurred at the College. These include improving the computer programs operating the HVAC system, replacing the mechanical shield drives on the electrical boilers with hydraulic drives to increase speed of response and improve reliability. The College is also implementing a number of additional or secondary retrofit projects. One such project involved adding booster hot water heaters to the College Foodservice dishwashing unit which has lowered domestic hot water temperatures all over campus from 160° F to approximately 120° F. Another project of this type currently awaiting the identification of a funding source is for the reuse of heat currently wasted from the clothes dryers in the College laundry.

The College has been able to initiate only one "from the ground up" construction project in the more recent era of energy conservation and management. A remote educational center was built in the town of Florence on the Oregon coast which utilizes heat pumps to heat and cool the facility. Energy demands for this unit are quite low and it has proved to be cost effective.

Development of Instructional Module, Future of Energy

Lane Community College is developing an instructional module (a prepackaged course) on the Future of Energy. Specific elements of this course include: The History of Energy, Energy Sources and Uses, the Role of Energy on the Economy, Government and Energy Policy, Abuses of Energy Production and Use, Energy Conservation, and Energy Use and Needs in the Northwest. Within these broad subjects are some 30 different segments. This course is being proposed for use by PROJECT ACCESS, a consortium of seven community colleges to create, develop, and disseminate instructional materials to nontraditional learners via an electronic medium.

Lane Community College is now, through its construction technology program, participating with the local county in building an energy-efficient home. This home is providing direct experience on the design, incorporation, and installation of energy-efficient considerations. In addition to direct training provided, the home also will serve as a model to the community for future advances into proper energy-efficient, barrier free home construction. This particular project is being financed by the county and includes the furnishings of a building site. The finished building will then be sold by the county at public auction.

In addition, the College has been teaching adult education classes since Spring term 1978 as an initial segment of a planned Solar Technician Training Program. These activities are part of what is hoped to be a fully-developed program to produce installers for solar energy equipment. College staff now are participating in the development of State level specifics for the certification of these technicians as well as code requirements. It is expected that not only will the college produce the first of this type of technician in Oregon, but the program soon will become a model for similar efforts elsewhere. Classes have been attended by architects, engineers, plumbers, HVAC technicians, and persons just interested in using solar energy in their own home.

The Science Department at Lane Community College has or is planning to present a number of courses in addition to those required at the technician level. The courses include: Energy and the Environment (4 credits), Future of Energy (3 credits), Solar Energy (4 credits), The Energy Efficient Home (3 credits). In addition, the Physical Science Survey Course (12 credits) includes the energy-related modules of Energy, Its Nature and Use, Electrical Energy Production, and Its Environmental Impact, Nature and Use of Solar Energy, and Radioactivity and Nuclear Energy. These courses place a heavy emphasis on "conservation".

The energy management efforts at the College have been acknowledged in a number of ways. In April 1977, the College was one of the five recipients of Oregon Governor Robert Straub's first Energy Conservation Award. It was the only public institution to receive such an award. In July of 1977 the College was honored to receive the first place grant of $10,000 in the Cost Reduction Incentive Award program of the National Association of College and University Business Officers and the United States Steel Foundation. However, the most rewarding experience has been the many visitors the College has received from all over the country to meet with College staff and its consulting engineers, Marquess Engineering of Springfield, Oregon, to gain more information about what has been done in energy conservation.

LANE COMMUNITY COLLEGE
Energy Management Performance

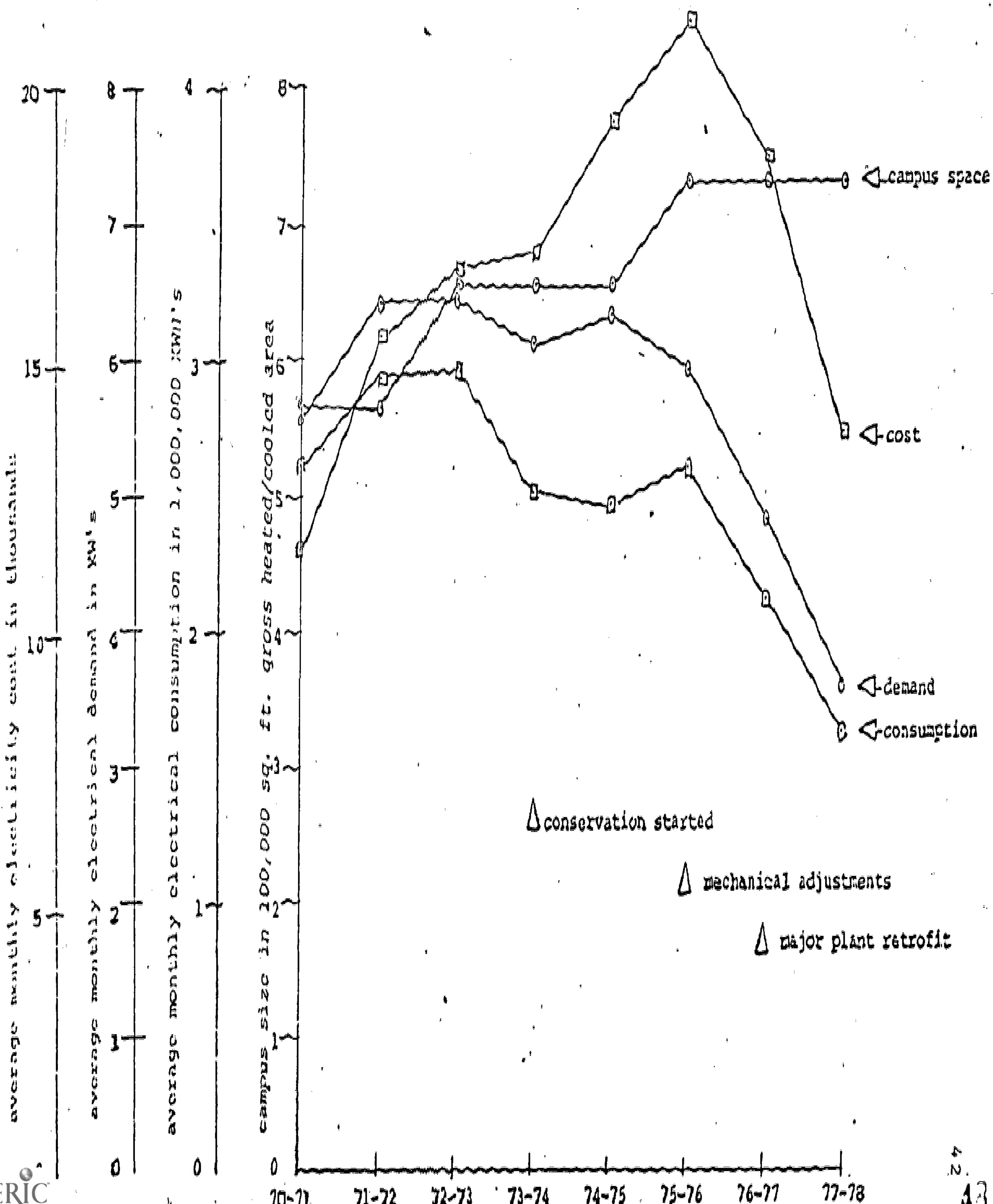
Year	Space in Square Footage	Average Monthly Consumption in KWH's	Average Monthly Demand in KWH's	Average Monthly Cost (4)
1970-71	571,000	2,592,166	5576	$11,576
1971-72	571,000	2,917,250	6424	15,467
1972-73	664,000	2,918,917	6525	16,596
1973-74 (1)	664,000	2,503,880	6242	17,126
1974-75	664,000	2,473,862	6300	19,328
1975-76 (2)	727,000	2,619,667	5967	21,315
1976-77 (3)	727,000	2,137,494	4792	18,383
1974-78 (5)	727,000	1,637,571	3514	13,624

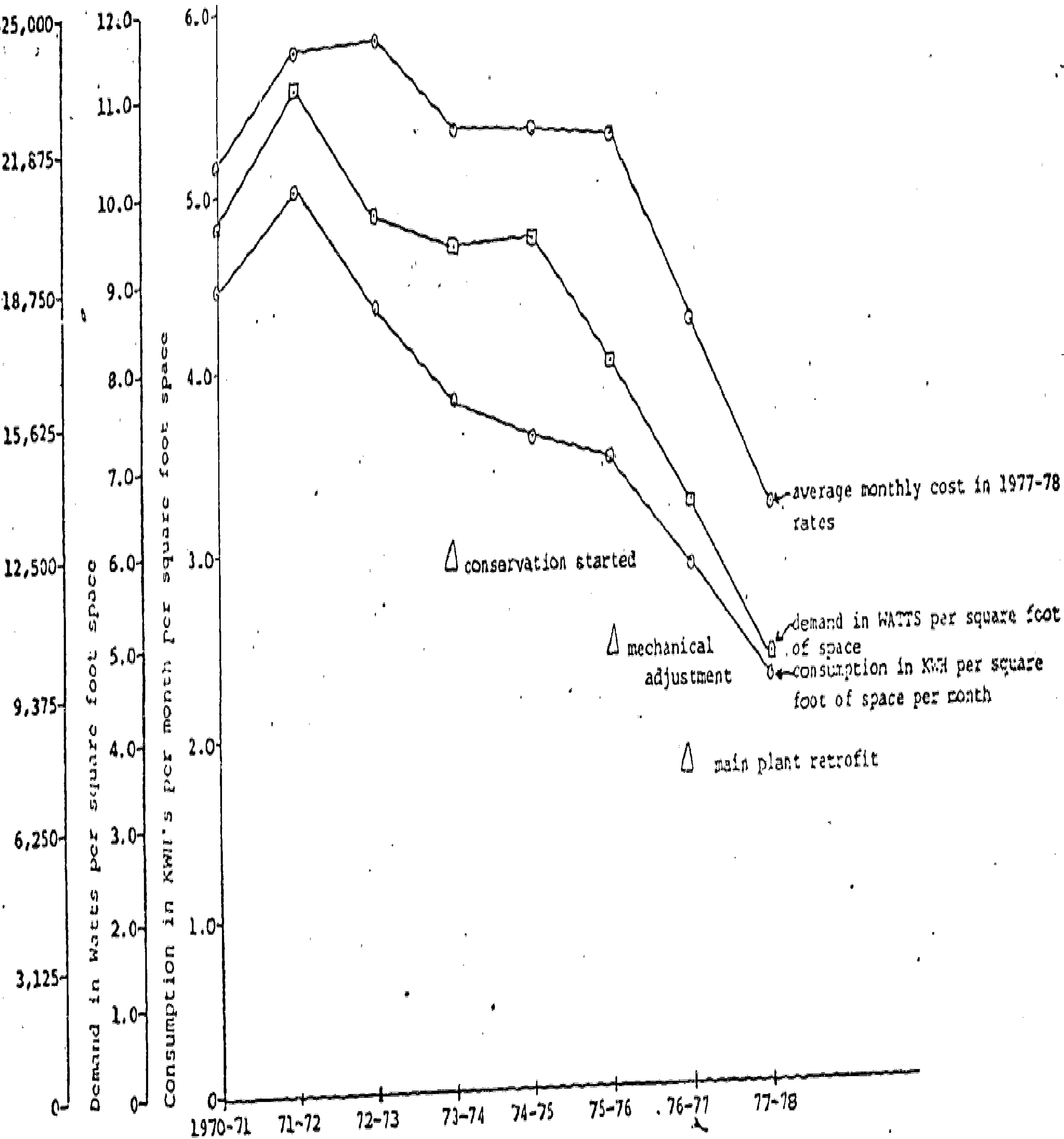
Energy Management Performance, Continued

Year	Electrical Rate Comparisons	Consumption in KWH's per Month per Square Foot Space	Demand in WATTS per Square Foot Space	Average Monthly Cost in 1977-78 Rates
1970-71	81% more now than in 1970-71	4.54	9.70	$21,366
1971-72	57% more now than in 1971-72	5.11	11.25	24,265
1972-73	47% more now than in 1972-73	4.40	9.80	24,455
(1) 1973-74	30% more now than in 1973-74	3.77	9.40	22,200
1974-75	16% more now than in 1974-75	3.73	9.50	22,179
(2) 1975-76	4% more now than in 1975-76	3.60	8.20	22,189
(3) 1976-77	rates same now as in 1976-77	2.94	6.60	18,037
(4) 1977-78	rates same	2.25	4.80	13,624

(1) Conservation efforts began in this time period.
(2) HVAC system adjustments began to take effect.
(3) The major plant retrofit was partially operational during this year.
(4) Not adjusted for many rate increases that have occurred.
(5) First eight months of this fiscal year.

PERFORMANCE OF LANE COMMUNITY COLLEGE'S ENERGY MANAGEMENT SYSTEMS




25,000
21,875
18,750
15,625
12,500
9,375
6,250
3,125
0
Demand in Watts per square foot space
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
Consumption in KWH's per month per square foot space
6.0
5.0
4.0
3.0
2.0
1.0
0
1970-71
71-72
72-73
73-74
74-75
75-76
76-77
77-78
average monthly cost in 1977-78 rates
demand in WATTS per square foot of space
consumption in KWH per square foot of space per month
conservation started
mechanical adjustment
main plant retrofit

THE OHIO STATE UNIVERSITY

ENERGY EFFICIENCY

The Ohio State University is actively engaged in an energy conservation program, the results of which are surpassing the energy savings anticipated when the program originated. The goal stated in the original proposal was to obtain a 20 percent average energy reduction in buildings analyzed. The estimated dollar reduction in utility costs on over 50 buildings now studied range from 30 to 60 percent. Actual metered results on several buildings already modified show that the estimated savings are usually conservative.

BACKGROUND

In early 1973, a proposal for the study of energy conservation in campus buildings was presented to Dr. Edward Q. Moulton, Vice President for Business Administration. At that time, the University's utility bill was approximately $4,000,000 per year and had been increasing at an average rate of 15 percent per year due to increased demand from new and existing building construction and remodeling. While the past rate of increase was determined during a period of relatively stable utility rates and before the occurrence of oil embargoes and reductions in gas allocations, it was evident that increased utility rates would occur. The University saw that the energy situation demanded action to reduce consumption on campus. Therefore, a program for energy conservation was funded for a two-year period, and an Energy Conservation Coordinating Committee was created to oversee the campus activities.

The organization and funding of the program are unique. The coordinating committee consists of members from the faculty and physical facilities. The committee develops and coordinates conservation efforts throughout the campus. Some typical conservation programs with which the committee has been involved are described below.

I. Soliciting Voluntary Efforts

   A. Advertisements in the campus newspaper solicit the help of faculty, staff, and students, in keeping lights out and thermostats at their proper setting and also informs them of energy savings accomplished by the conservation program.

II. Scheduling Building and Equipment Operation to Reduce Energy Consumption

   A. Cooperation with the office of scheduling has allowed most summer classes to be held in buildings or parts of buildings where cooling systems must operate for other reasons.

   B. The spring start-up and fall shut-down of cooling systems are scheduled according to the individual building need for cooling. Needs are based on the types of activities performed in the building such as the amount of interior area and the number of operable windows.

   C. Summer office hours are shifted from the normal 8:00 AM to 5:00 PM to 7:30 AM to 4:30 PM so that cooling systems can be shut down one-half hour earlier each work day.

   D. The Office of Campus Planning has been contacted in the area of space assignments to attempt to group those activities with similar operating hours in the same buildings.

III. Improving Campus Operations

A. An extensive survey was made of the 6 miles (9.7 kilometers) of the campus tunnel system. As a result, leaking valves and traps are being repaired and new piping insulation is being installed.

B. Classes were conducted for maintenance personnel to familiarize them with the energy conservation project. Basic system operations were explained as well as how the systems were being modified to operate more efficiently.

C. A Central Campus Energy Control Center is being installed to monitor and control building systems to achieve energy efficiency.

D. Standards for new building construction have been developed which are guidelines for use by engineers, contractors and architects during building design and construction to encourage the most efficient use of energy in providing the environmental requirements for the building.

E. Activities that fall into the category of utilities management consist of checks of boiler efficiencies and regulation of onsite electric power generation to shave peak electric power demands.

IV. Building Energy Efficiency Program

A. Quick Fix Modifications

1. The manual and time clock starting and stopping of building air conditioning systems and exhaust fans has provided more energy savings than any other single building modification. The cost avoidance achieved has been up to 30% of the original utility cost. The investment required for a 7-day time clock installation is moderate, usually

resulting [illegible] auxiliary heat equipment must be installed [illegible] to maintain space conditions [illegible]. A policy has been developed which states that space thermostats are to be set for [illegible] when the chiller is operating, except rooms served by terminal reheat systems [illegible] the heating season, after chillers are shut down, all thermostats which control units on terminal systems that are capable of providing heat to a space are set at 68°F (20°C). Variable volume units, for example, which handle only cool air, remain at 76°F (24.4°C).

3. Mixed air temperatures, on air handling systems with economizer cycles have been increased from 55°F (12.8°C) to 60°F (15.6°C) or 65°F (18.3°C) during the heating season.

4. The operation of stand-by equipment has been reduced. For example, buildings with two or more boilers or chillers are operated on just one unit except during extreme weather conditions.

5. Guidelines have been developed which are used to adjust lighting levels in existing buildings. Generally, the lighting levels in buildings are higher than required for the task being performed.

B. Retrofit Modifications

1. Exhaust and ventilation air volumes have been reduced by permanent shut down of exhaust fans that are not required or by reducing hours of exhaust fan operation. Closing [illegible] air dampers during unoccupied periods in buildings without continuous exhaust requirements is also being done to reduce the energy consumed to heat and cool outside air.
2. Systems which were originally constant volume have been converted to variable volume by conversion of the terminal units and installation of volume controls on the fans.
3. Building system temperature controls maintenance has been improved.
4. Longer pay back items such as heat recovery, replacement of old equipment with newer more efficient equipment, insulation, storm windows, and installation of solar energy recovery systems have not been undertaken. These items have been analyzed and are being held in favor of the shorter pay back items listed above which are typically less than 2 to 3 years.

SUMMARY OF RESULTS

Total Campus Utilities

During the 1975-1976 fiscal year the total electrical consumption on the campus was reduced 15.6 percent below 1972-1973 levels or a reduction of 36,666,355 kWh as shown in Figure 1.

ENERGY CONSERVATION

THE OHIO STATE UNIVERSITY

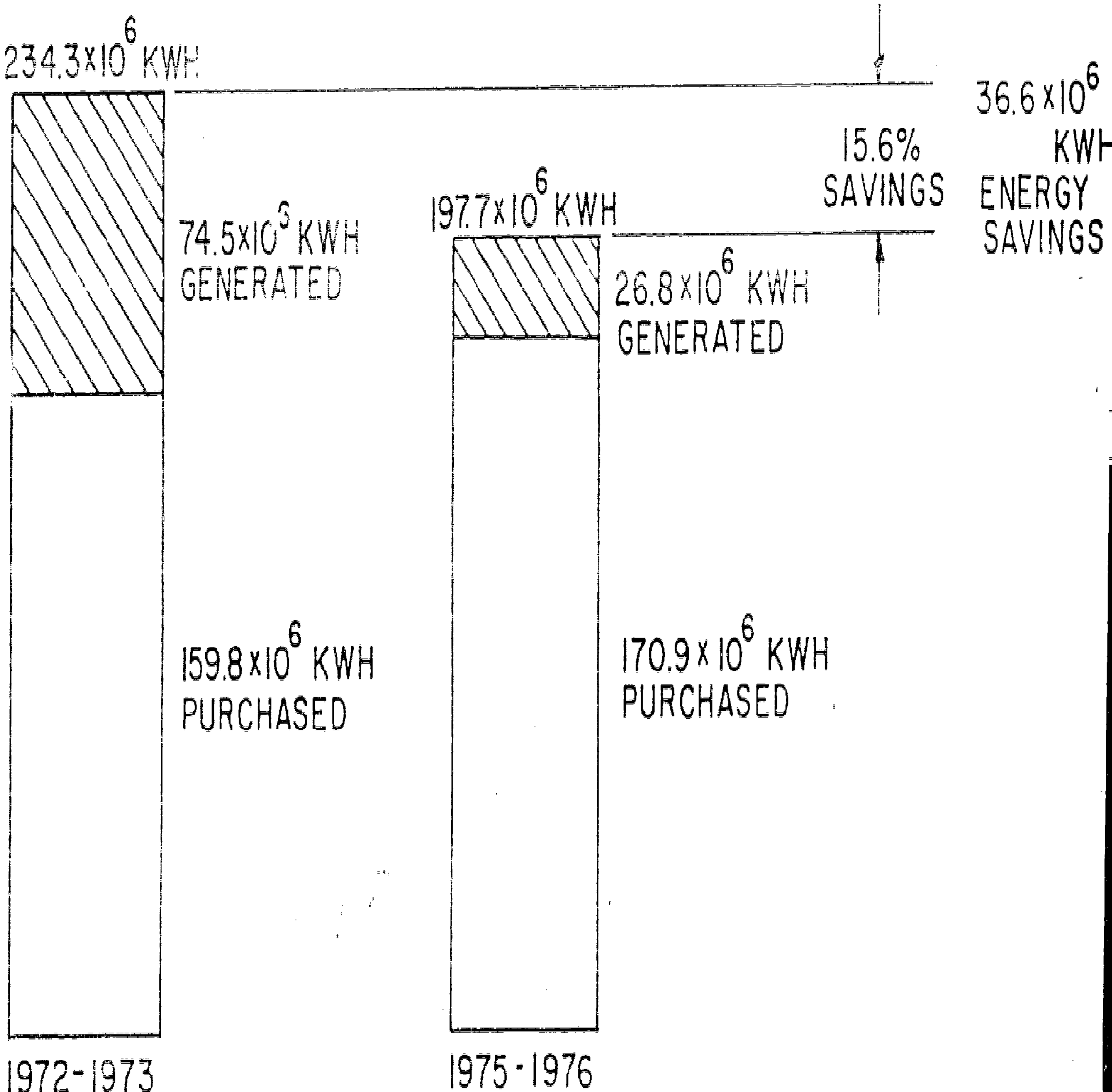


FIGURE I. ELECTRICAL SAVINGS

ENERGY CONSERVATION
THE OHIO STATE UNIVERSITY

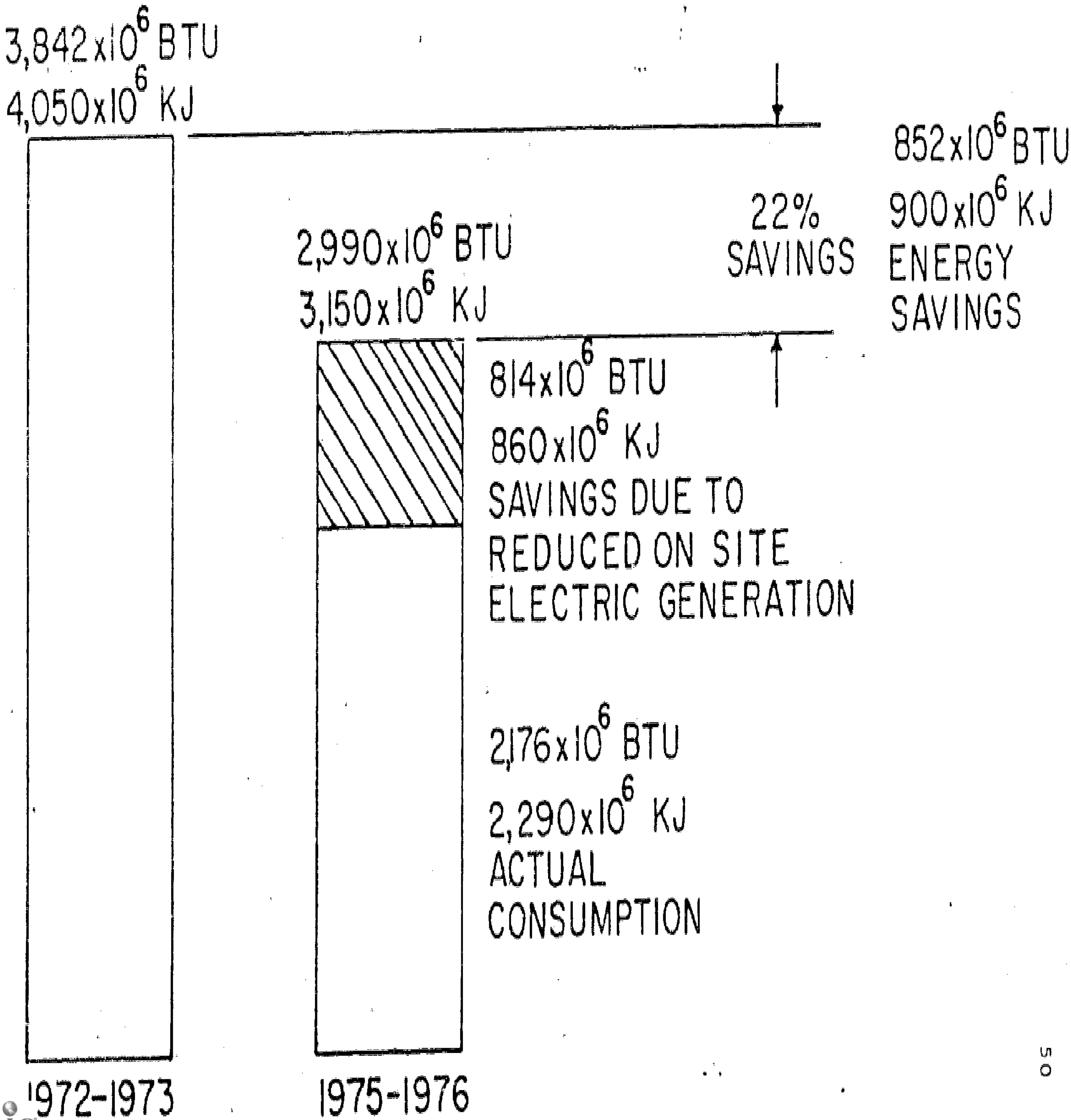


FIGURE 2 NATURAL GAS & FUEL OIL SAVINGS

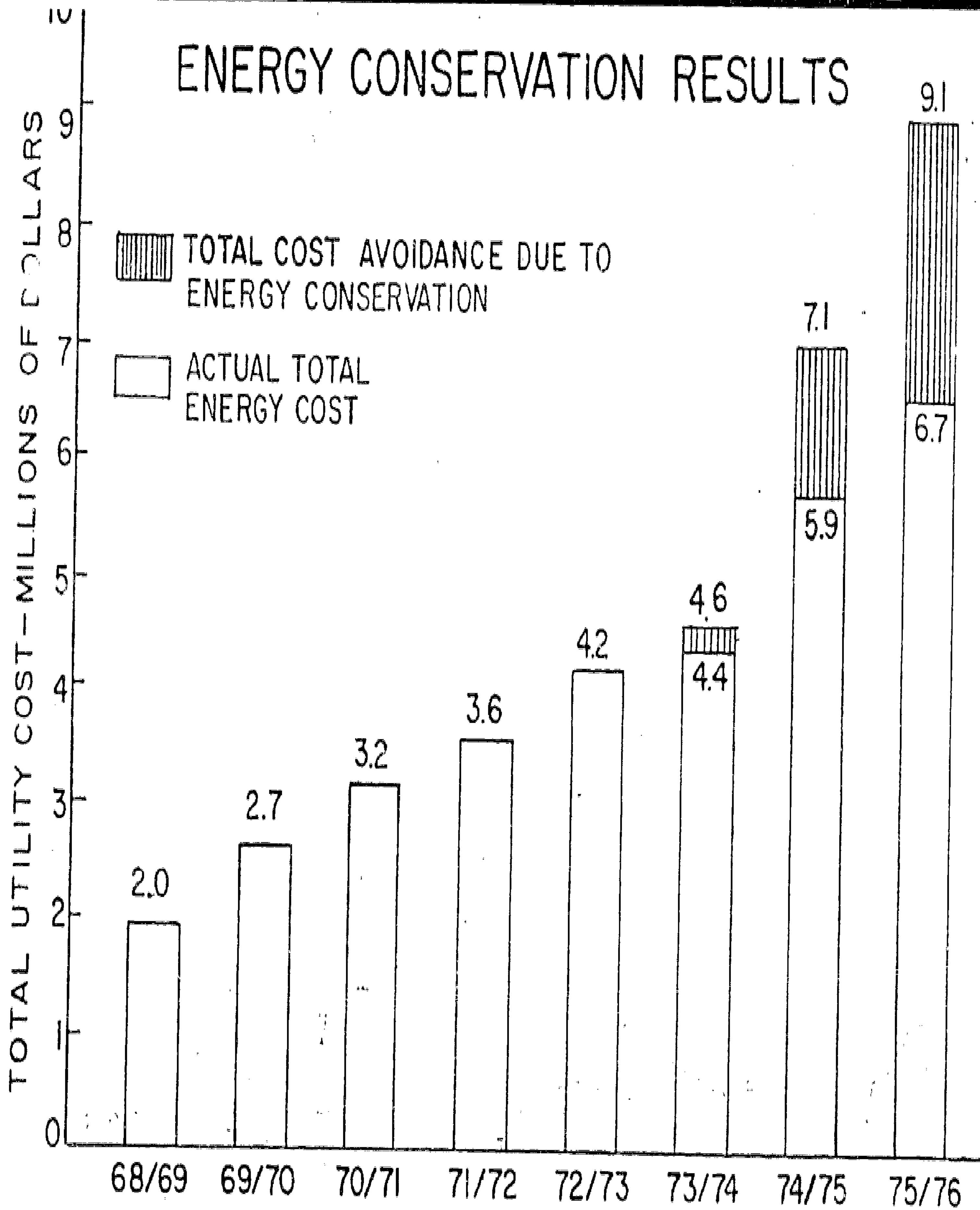


FIGURE 3. RESULTS SUMMARY

The total heat energy (natural gas and fuel oil) used by the campus was reduced 43% below the 1972-1973 fiscal year. A substantial portion of this reduction has resulted from a decrease in the amount of electricity generated at the Central Power Plant. The University now purchases a greater portion of coal-generated electricity in order to conserve natural gas and fuel oil. This decrease in power plant generation accounts for a 21% reduction in total heat energy used; therefore, energy conservation efforts account for a reduction of 22% or an equivalent of 852,089 MCF (24,129 KCM) of natural gas, see Figure 2.

These reductions were achieved over and beyond providing the additional energy needs for 800,000 square feet (74,322 sq. M.) of new buildings served during 1975-1976.

The net effective cost avoidance for the 1973-1975 biennium for natural gas, fuel oil, and purchased power was $1,464,700 with the major portion -- $1,230,902 having been achieved during the 1974-1975 fiscal year.

Figure 3 summarizes the results of the past years efforts and shows the cost avoidance for the 1975-1976 fiscal year at $2.4 million dollars. This was accomplished in spite of a 300% increase in the use of oil, 3,300,000 gallons (12,492 Cu. M.) consumed, due to reduced natural gas allocations. The cost of oil during Fiscal Year 1975-1976 averaged twice that of gas per million BTU (J).

Therefore, the total cost avoidance which can be attributed to energy conservation since 1973 exceeds $3.8 million dollars. It should be noted that in spite of the reduced energy consumption, the University's total utility costs continue to increase. That is the reason the term cost avoidance is used instead of savings to describe the dollar results of the program.

Figure 4 illustrates what energy costs would have been if utility rates had remained constant at the 1968 to 1972 levels and shows the portion of the actual costs which can be attributed to higher energy costs since Fiscal Year 1973-1974.

Building Retrofit Program

Although the Energy Conservation Coordinating Committee is involved in many projects, the area that is of primary importance is the study of campus buildings. This project is directed by Charles Sepsy of the Mechanical Engineering Department and Dallas Sullivan from Physical Facilities Department. It is a joint effort between Mechanical Engineering and Physical Facilities and is treated as a research project to the Mechanical Engineering Department with Physical Facilities as the sponsor.

The objective of the program is to study energy use in campus buildings and identify areas where systems can be modified to reduce consumption. One point should be emphasized, the operational function of a building is not changed to suit the needs of energy conservation. The environmental needs of the operations performed in the buildings are evaluated, and system modifications are proposed within the limits set by those requirements.

The results of the building studies are presented to the coordinating committee in a formal . The committee reviews the report and recommends modificatio... or implementation based on the estimated payback periods.

The building study projects have achieved impressive results and Figure 5 shows part of the reason for the success. A large percentage of the building energy is used for heating and cooling and this is the area where efforts to save energy are concentrated.

ENERGY HISTORY
EFFECT OF RATE CHANGE

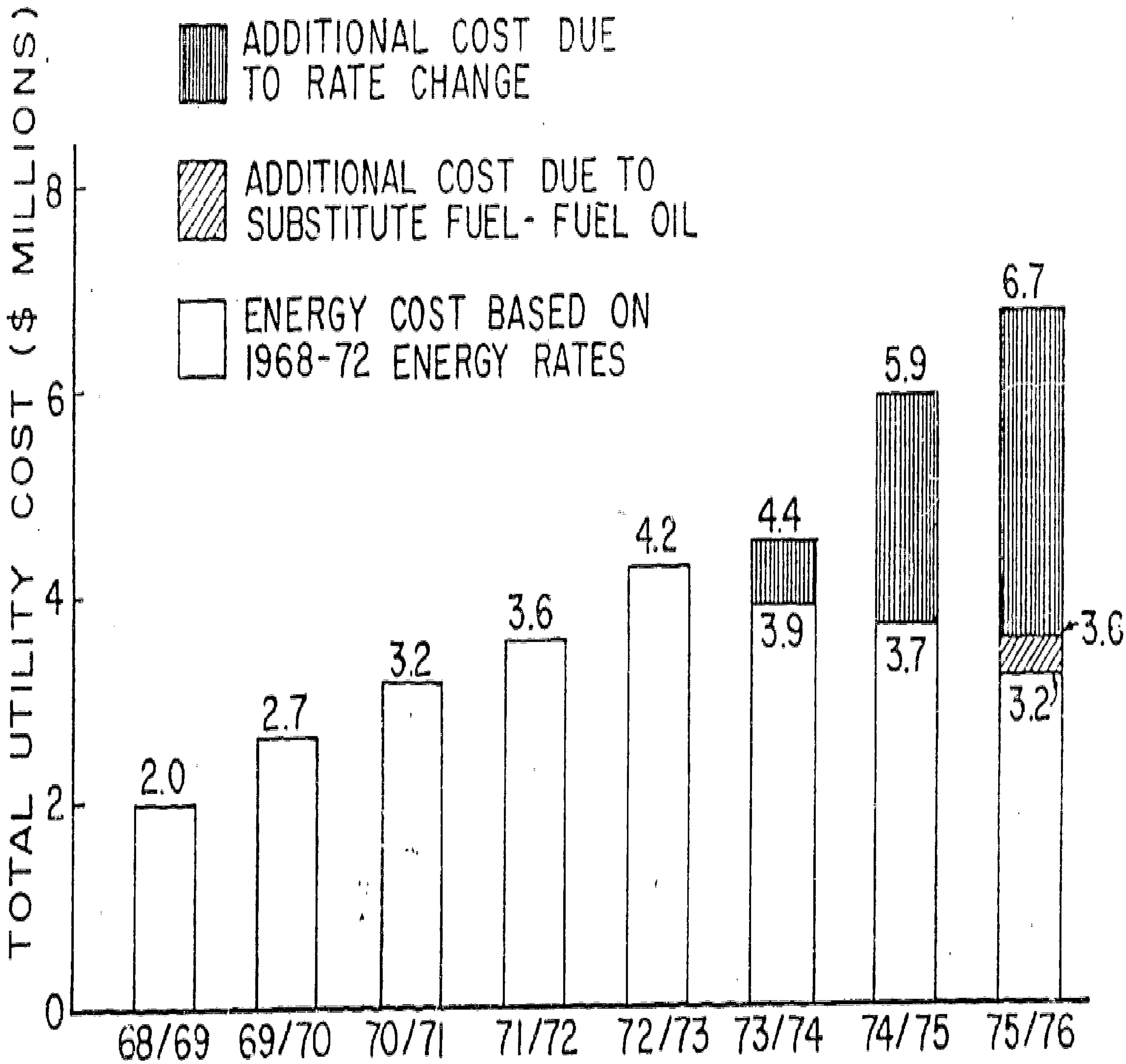


FIGURE 4. INCREASED ENERGY COSTS EFFECT

The program involved in-depth energy studies and implementation of energy conservation modifications for major, high-energy use campus buildings. This is being accomplished on a building-by-building basis. That is, each building is individually analyzed and recommendations are made based on the results of the engineering analysis.

The Energy Analysis and Modifications have been [illegible] buildings which were projected to have energy savings varying from 25 to 50%. The following is a tabulation of these completed buildings.

Building	One-Time Modification Cost	Achieved Cost Avoidance (2)	Months Monitored
Allied Medical	$ 30,000	$ 62,460/yr	15
Biological Sciences	37,156	80,716/yr	12
Electronics Lab (1)	25,750	41,344/yr	9
Health Sc. Library (1)	27,500	69,930/yr	9
Howlett Hall	31,738	53,631/yr	12
McCampbell Hall	54,200	57,700/yr	12
Totals	$206,344	$365,681/yr	

(1) Cost Avoidance shown are based on estimates of steam costs prior to modifications. No steam metered records are available for this period. Steam meters are now recording building consumption. Electric meters were made before and after modifications.

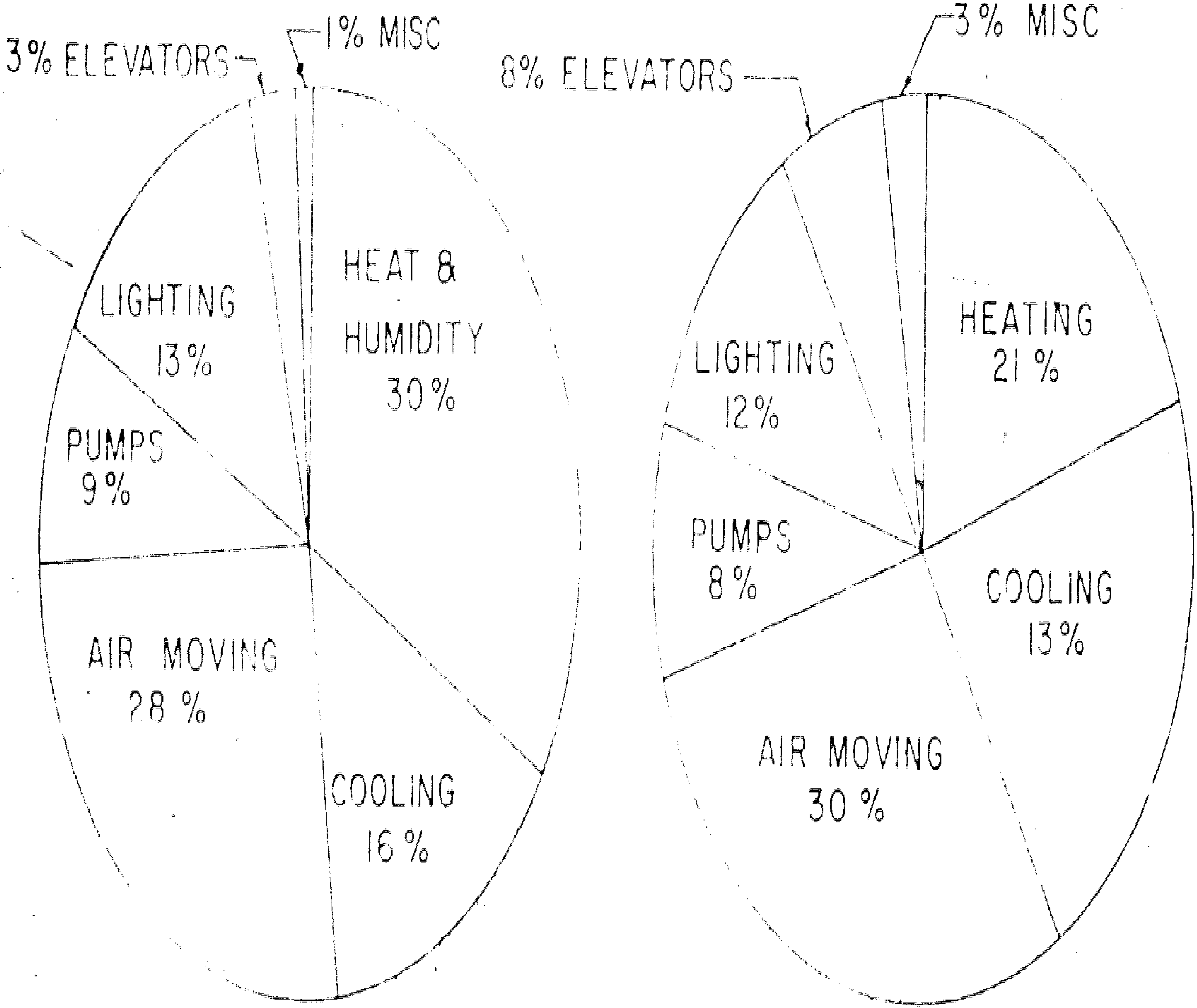
(2) Based on monitored energy use over the period shown and adjusted to total yearly energy savings at current utility rates.

The six test group [illegible] were [illegible] analyzed at the start of the Energy Conservation Program because they were high energy use buildings and it was felt that they would have greater potential for savings. Therefore, it should be emphasized that the large energy savings achieved in these buildings are not to be expected in all future studies. Although [illegible] results of additional building savings are not currently available, predicted dollar cost avoidance for additional buildings analyzed are listed in Table [illegible].

It is necessary to emphasize the need for a professional evaluation of each building and its system. There is no simple list of rules that can universally applied to saving energy in buildings. Each system must be evaluated on an individual basis in order to achieve maximum operating efficiencies.

ANNUAL ENERGY CONSUMPTION

SHOWN IN
PERCENT OF DOLLAR COST



McCAMBELL HALL
HVAC = 83 %

HOSPITAL CLINIC
HVAC = 72 %

FIGURE 5. BUILDING ENERGY CONSUMPTION

UNIVERSITY OF PITTSBURGH

ENERGY CONSERVATION

The question germane to conservation is what can we offer in the University or are able to send out from the University? The basic function of our institution is education so we can expect that our most successful programs will contain strong components of education. At the University of Pittsburgh the faculty of the Mechanical Engineering Department has been involved in energy conservation research and as consultants to public utilities and to other industry and government at all levels for some fifteen years. Furthermore, over the past 25 years courses in the applied thermodynamics sequence such as applied thermodynamics, combustion, air conditioning, power plant engineering and thermal systems analysis have stressed the possibilities of decreasing fuel consumption through the use of recuperation and thermal regeneration and of optimizing the design of thermal systems taking into account energy costs and the potential for waste heat recovery.

In the fall of 1972 the University offered a twelve week continuing education course in energy conservation to a group of practicing engineers and management people from industry. In September of 1974 they began offering a graduate course in energy conservation in the Energy Resources Program curriculum. The purpose of the program is to train college graduates for management positions in the energy companies, in governmental energy agencies and for energy management positions in commercial and industrial concerns. The students who were registered for the course last fall had baccalaureate degrees in the fields of engineering, chemistry, business administration and economics. Contacts with industry were made through personal acquaintances, those of the students or with the help of the marketing division of Peoples Natural Gas Company in Pittsburgh. The students were asked to document carefully and to report upon the following concerns: (1) description of the plant, its energy consumptions and its products; (2) the organizational structure of the energy conservation program and how it related to the management organization; (3) an account of management and employee responses to the project; (4) a description of all energy conservation opportunities which were uncovered and an economic analysis if appropriate; (5) an assessment of the project in terms of its total impact on the plant energy situation. Will it be continued in the future? In what ways were the attitudes of management and employees changed during the project? and (6) an assessment of the utility of the EPIC manual as a guide to the establishment and operation of an energy conservation program in an industrial plant.

Additionally, each student in carrying out his project was expected (1) to help plant management set up an appropriate energy conservation program management organization (in most cases because of the small size of the companies involved this will consist of the service or maintenance engineer or plant manager and the student); (2) initiate the implementation of the program; (3) carry out the plant surveys and system and economic analyses; (4) make periodic reports to the management of possible ECO's, the expected energy saving from each, the capital costs involved and their investment merit and (5) document the whole project by way of a term report, the contents of which constitute an energy conservation project case study.

A second thrust of University involvement is in training functional specialists in some area of energy conservation. Recent examples are training courses for energy auditors. "Energy auditor" is a job title which is not yet well defined. However, generally speaking, it describes a person whose understanding of basic energy concepts, building construction, mechanical systems, utility service supply and billing and economics prepares him to enter a building, collect the data on energy consumption, properly assume an internal energy distribution, study the efficiency of energy intensive systems, predict levels of potential energy conservation, make recommendations for suitable measures to bring about that conservation and make first-level economic studies to cost out the measures and their benefits. In fact, some of these services can be just as well performed by a building simulation programmed for and run on a digital computer for specific classes of buildings.

These programs are presently available for commercial office buildings, hospitals, private residences, apartment buildings, restaurants and supermarkets. Industrial plants are too diversified and thus require a great deal of auditor effort. When simulations are available, the auditors need do little more than gather and verify data and interpret the results to the client. The University can provide the required level of training of auditors as well as the simulation design and maintenance and the computer services. Before leaving the subject, it might be well to give a rationale for energy auditing; and thus the need for universally trained auditors. First we point out that an energy audit need not be an engineering study and does not constitute an acceptable substitute for one. Rather, it is a first-level attempt to justify future engineering and economic studies at a higher level of sophistication and cost. For instance, industrial management may feel the need for a good indication of benefits and costs before investing in a series of expensive design studies; or a government agency may require that an audit be performed to indicate substantial conservation potential before grant money is released for more extensive technical assistance. Obviously the resources of the average householder will not permit the expenditure of funds for engineering or architectural studies. In recognition of this fact, as well as the demonstrated national potential in residential conservation programs, the Governor's Energy Council of the Commonwealth of Pennsylvania, using Federal funds, is supporting an extensive demonstration of residential audits in Allegheny County. The Allegheny County Health Department is demonstrating that its housing inspectors can carry out energy audits with small additional time expenditure over the normal time for housing inspections. The University of Pittsburgh trained one hundred housing inspectors, modified and adapted the FEA CONSRV Program to the University Computer Center equipment and provides not only computer-printed audit reprints to the homeowner, but quarterly reports to the county and to the State on the combined potential for energy conservation determined for each period and the aggregate costs for the measures recommended. The program is periodically brought up-to-date with the latest data on the costs of local labor, equipment, and supplies. This program can be operated with the data supplied by questionnaires mailed to and received back from the occupants of the same residences. However, our experience leads us to the inescapable conclusion that the accuracy of the data is vastly improved if taken by trained auditors. We have now processed the data on over 6,000 dwelling units and foresee an additional 9,000 being processed before the end of the program. This sort of combined educational-technical support effort is more or less duplicated in a similar audit program for food-handling establishments, also being carried out by the Allegheny County-University of Pittsburgh partnership. We expect to reach several thousand restaurants and cafeterias.

The Mechanical Engineering Department is also carrying out a study of the energy use and the potential for conservation in a representative group of hospitals in Western Pennsylvania. This is a component program of the Energy Extension Service Demonstration in Pennsylvania. The data is being gathered by energy auditors who are being trained on-the-job as an adjunct activity to their formal courses in engineering or energy resources. The hospital simulations, when necessary, are made with a computer program developed by the Department with the support of the Veterans Administration.

The faculty in the energy area and the University Administrators also lend their expertise to a wide range of local, State and National Committees, Councils and Commissions dedicated to energy conservation. An example of this activity is the development of the curriculum in Energy Management Technology for the Community College of Allegheny County. One faculty member served on the Advisory Committee who aided in the development of the program described below:

ENERGY MANAGEMENT TECHNICIANS

THE COMMUNITY COLLEGE OF ALLEGHENY COUNTY

The Community College of Allegheny County is presently implementing a career curriculum to train Energy Management Technicians. This person will be trained in standard building insulation techniques, and heating, ventilating and air-conditioning system principles for gas, oil, electric and solar technologies. Emphasis will be on conservation techniques in reducing fossil fuel consumption without lowering the quality of the environment.

The South Campus of the Community College of Allegheny County is particularly well-suited to initiate this program. The college has ongoing career-centered programs in Science and Engineering Technology and Building Construction Technology.

The program proposed will utilize some courses in common with these programs. The initial class should be about ten to fifteen students stabilizing at twenty to twenty-five graduates per year. However, this number could be larger if the market needs are strong enough. An effort will be made to gauge job market needs to prevent over-supplying graduates since job placement is of paramount importance.

A strong point is the selection of Allegheny County as a demonstration area for energy conservation. To achieve success, trained technicians must be available. The county-wide committment of college, industry, and community to energy problems will give added impetus to our program. Although our immediate objective is to address local ~~and~~ regional job needs, the curriculum may be of interest to other areas of the state since the problems of energy management are state and nation-wide.

Since this program will be designed to produce a technician who can deal with complex energy supply systems; to maintain, test, and operate these systems at minimum energy cost, he should be in great demand. Prospective employers would be hospitals, office and apartment buildings, heating contractors, engineering firms, and government.

The College will utilize industry and community resource people as the instructional personnel in the career specialty courses. In this way, maximum real world involvement of instructors can be achieved. Some of the curricular planning will be done by these persons on an adjunct/faculty or consulting basis. The overall program direction will be done by full-time faculty members.

The statement of the problem and definition of specific program objectives are:

Problem Statement:

To implement an associate degree program to train Energy Management Technicians for career positions in industry and government.

Specific Program Objectives

Objective	Evaluation Criterion
1. Establish Advisory Committee	1.1 Scope of representation. 1.2 Active participation of committee members.
2. Gain recognition and approval of proposed curriculum	2.0 Approval of Advisory Committee. 2.1 Approval of college Curriculum Committee. 2.2 Response of Community groups.
3. Conduct employment survey of South Western Pennsylvania	3.1 Percentage of responses. 3.2 Percentage indicating need for program. 3.3 Number of projected openings.
4. Recruitment of Students	4.1 Number of persons enrolling in first offering. 4.2 Number of inquiries about program. 4.3 Number of already employed individuals interested in additional training. 4.4 Contacts with Vocational Students majoring and graduated in HVAC programs.

Objective	Evaluation Criterion
5. Implement Energy Management Technician Program Spring 1978	5.1 Number of Students who complete first semester.
6. Evaluation of Program	6.1 Number of Students in program. 6.2 Revisions suggested by Advisory Committee 6.3 Establishment of dialogue with other schools interested in energy technology.

The course description and outline are as follows:

COURSE DESCRIPTIONS

ENERGY MANAGEMENT TECHNICIAN

ENERGY TECHNOLOGY I

This introductory course covers the theory and practice of energy utilization as applied to the heating and cooling of buildings. Basic measurement techniques and equipment types are presented in the laboratory sessions. Solar energy "State of the Art" is reviewed.

ENERGY TECHNOLOGY II

This course involves a more detailed study of thermodynamics and heat transfer as applied to system design and energy auditing. Additional topics include advanced energy/fuel systems, combustion analysis, and procedures for carrying out economic studies.

ENERGY TECHNOLOGY III

This course is comprised of an individual student practicum which will emphasize the creative application of the principles presented in the prerequisite courses.

TWO-YEAR CURRICULUM

ENERGY MANAGEMENT TECHNICIAN

1st Term		2nd Term	
Technical Math I	3	Energy Technology I	3
English	3	Technical Math II	3
Technical Physics I	3	Technical Physics II	3
Energy and Environment	3	English	3
Mechanical Equipment	3	Electronics	3
Orientation to Technology	1		
	16		15

3rd Term		4th Term	
Energy Technology II	3	Energy Technology III	3
Construction Methods I	3	Construction Methods II	3
Blue Print	3	Social Science	3
Technical Calculus I	3	Electives	6
Humanities	3		
	15		15

INDUSTRIAL ENERGY CONSERVATION

Finally the Mechanical Engineering Department has developed a three hour Industrial Energy Conservation course for the Energy Resources Program in the School of Engineering. The course is designed with the diverse background of the students in this program in mind. Their baccalaureate degrees may have been earned in engineering, economics, business, geography, geology, chemistry or physics. This requires that considerable amounts of applied thermodynamics and economics are introduced and are immediately applied.

The course is given in fourteen three-hour sessions with a full term field project assigned at the beginning. Each period is divided into two parts; the first a formal lecture and the latter part a discussion period focusing on the problems and results of the field projects. The syllabus and a suggested time schedule for the lecture course is found later in this report.

The field projects are carried out in industrial settings. Each student assumes the role of energy conservation coordinator for an industrial plant or a department of an industrial plant. The assignments are mutually decided upon after taking into account the geographical location of the plant with respect to the student's residence, his past industrial experience, if any, and his individual preferences. The reservoir of suitable field project locations are accumulated from faculty contacts and with the help of the local utility marketing division staffs, particularly those of the natural gas distributors. Most of the projects are carried out in small manufacturing plants but several have been found in large organizations who are sending their employees to school for a graduate degree in energy resources. In each instance the project is preplanned with the management of the participating company and the student introduced by a faculty member or a utility marketing person. A management liaison person is designated by each company and is available during the project to the student and faculty.

The goals of the field study are to educate the student in the practical aspects of managing an industrial energy conservation program. To successfully carry out his project the student is striving to accomplish the following:

1. To educate company management to the advantages of energy conservation
2. To bring about the initiation of an energy conservation program
3. To implement an energy conservation program through the first level; that is, to take advantage of energy conservation opportunities that require little or no capital expenditure
4. To educate employees in the necessity for energy conservation in the plant and in their homes
5. To assess the impact of the program on management attitudes, employee attitudes and company profits
6. To assess the efficacy of particular approaches in aiding the establishment and operation of an energy conservation program in industry

The student is expected to spend one-half a day or more each week on his project. He makes frequent informal oral reports to the class and submits both a formal class presentation and a formal written report to his instructor and to his company's management at the end of the term. Shortly after the first meeting between the student and his instructor with company management, a letter is forwarded to his project location which briefly defines the project goals and the obligations imposed by the project on all parties. It is clearly stated that confidentiallity of information will be respected, but that permission to publish student reports as case histories may be requested at some future time. This agreement in principle is considered to be rather informal in nature, rather than a legally binding document. A lack of response is considered by us as tacit approval of the terms. However our own obligations as stated have been met consistently. Resumes of the project results are made available to those interested through the Energy Resources Program office.

The textbook for the course is NBS Handbook 115, Energy Conservation Program for Industry and Commerce, Government Printing Office, Washington, DC, 1974.

Outside references are recommended. Supplementary material is distributed at the beginning of each class period. It is composed of manufacturer's literature and of compilations of data useful in carrying out engineering and economic analyses.

The class periods are approximately three hours long including a twenty minute break. Three one-hour quizzes and a two-hour final examination are given during the term.