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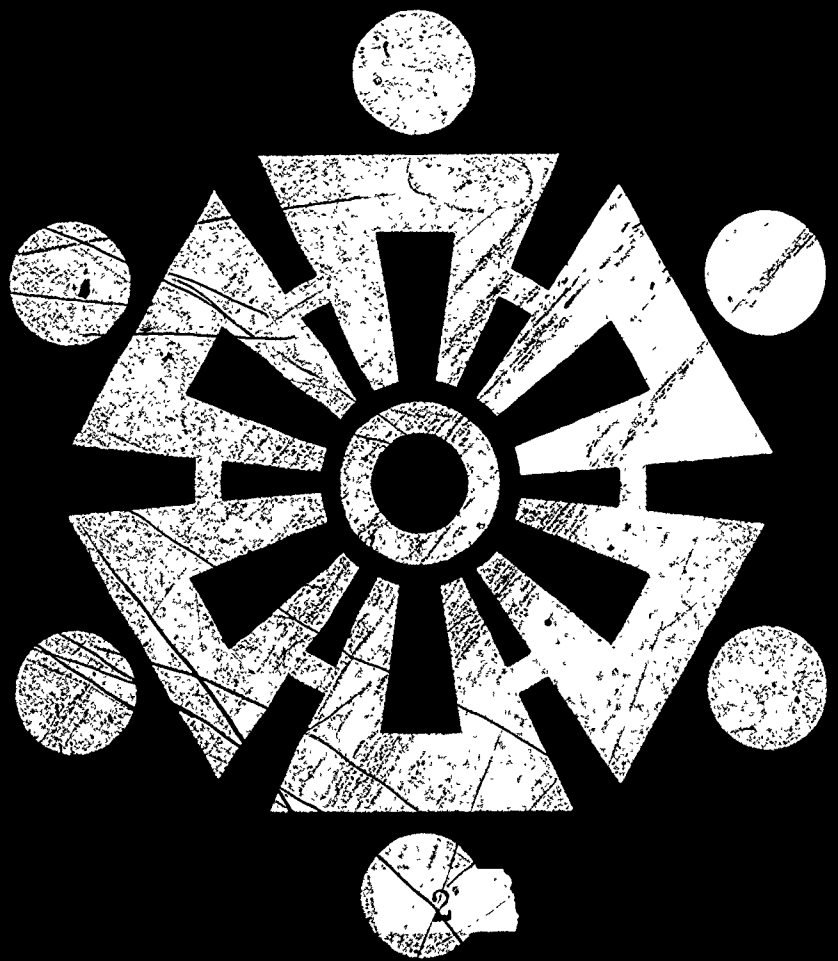
ABSTRACT

This study was conducted to provide a basis for planning for needed energy-related occupational technology programs in two-year educational institutions. A questionnaire was sent to 1,152 junior, community, and technical colleges in fall 1975; 774 (67%) responded. The survey identified 62 existing one- and two-year energy-related programs and 132 planned programs, and found that public institutions are significantly more involved in energy-related technology than are private institutions. This document reports on: (1) the number of existing and planned programs in petroleum technology, coal-mining technology, nuclear energy technology, solar energy technology, laser-optics technology, geothermal energy technology, alternative energy sources, energy conservation, and electrical energy technology; (2) the number of such programs in various geographical areas and at various kinds of institutions; (3) the current and anticipated enrollments in such programs; (4) the number of students who have already graduated from such programs; (5) the degree and type of cooperation between the colleges and energy industries; and (6) the degree of college interest in attending a working conference to assess occupational needs in energy areas. A description of the research methodology is included, as are the survey instrument and a list of the institutions having existing energy programs. (DC)

ENERGY-RELATED TECHNOLOGY PROGRAMS IN COMMUNITY AND JUNIOR COLLEGES:

An Analysis of Existing and Planned Programs



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ENERGY-RELATED TECHNOLOGY PROGRAMS IN COMMUNITY AND JUNIOR COLLEGES:

An Analysis of Existing and Planned Programs

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Foreword

In September 1975 the U.S. Energy Research and Development Administration (ERDA) and the American Association of Community and Junior Colleges (AACJC) began cooperative efforts to determine the types of programs and extent of interest in the energy-related fields. The cooperation was initiated because AACJC represents some 900 two-year colleges offering a vast number of programs in emerging technical fields and ERDA is the federal agency with the primary energy mission.

To assess the interest in emerging energy fields, a joint survey was mailed to all AACJC-member and most nonmember two-year colleges. A commitment was also made to sponsor a series of workshops for the exchange of ideas between colleges, industries, and state and federal agencies and for the development of energy-related curriculum guidelines. This type of cooperation among the colleges, AACJC, and ERDA will insure that the training in energy fields will meet both local and national needs.

The American Association of Community and Junior Colleges appreciates both the opportunity to work with ERDA in this vital area of technology and the assistance of the many colleges that provided information on their programs.

Edmund J. Gleazer, Jr.
President, AACJC

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SURVEY HIGHLIGHTS

SURVEY:

Conducted: October 1975 through January 1976
Community College Population: 1,152
Total Colleges Responding: 774 (67%)

RESULTS:

Existing Energy Programs: Total—76 (7% of 1,152) 62 reported, 14 more estimated for nonrespondents
Planned Programs: Total—158 (14%) 132* reported, 26 more estimated for nonrespondents

Public colleges are much more involved than private colleges in all aspects of energy-related technology programs.

Energy-Related Technologies	Existing Programs						New Colleges with Planned Programs		
	Colleges	*Programs*	*Enrollment*	*1975 Graduates*	*Projected 1976 Graduates*	*Industrial Involvement†*	*Colleges*	*Programs*	*Industrial Involvement†*
Petroleum (oil and gas)	12	13	375	126	143	8	9	11	2
Coal-mining	17	24	2,878	153	343	15	12	12	6
Nuclear energy	18	19	542	83	210	14	17	19	6
Solar energy	1	1	58	40	35	—	30	30	—
Laser-optics	4	4	214	26	59	—	8	8	—
Geothermal energy	—	—	—	—	—	—	6	6	2
Energy	—	—	—	—	—	—	16	18	5
Energy conservation	1	1	92	30	22	—	13	13	—
TOTAL	53	62	4,159	458	812	37	111*	117*	21

NOTE: On this page, the word *college* means a two-year education institution.

*A total of 121 colleges with 132 planned programs were identified when including the 2 colleges with petroleum programs and the 8 colleges with coal-mining programs that were expanding their offerings. (See Table III.1 for further explanation.)

†The two industrial involvement columns are the number of colleges in which industry is involved in their existing or planned energy-related technology programs.

CHAPTER I
Highlights

This state-of-the-art study of existing and planned energy-related occupational technology programs within junior, community, and technical colleges[1] was conducted for the Energy Research and Development Administration (ERDA) and the American Association of Community and Junior Colleges (AACJC). The 1,152 institutions surveyed, which composed two mailing lists—one of AACJC members and one of nonmembers—supplied by AACJC, included nearly all two-year institutions but not all four-year colleges and universities offering associate degrees. The cover letter accompanying and explaining the survey was sent on AACJC stationery and signed by the Vice-President for Programs. (See Appendix A for survey materials.) The survey data was collected from October 1975 through January 1976.

Seven hundred seventy-four (67 percent) institutions responded: 612 AACJC members and 162 nonmembers. It was found that public institutions, both AACJC members and nonmembers, were significantly more involved in energy-related technologies than were private institutions.

The three objectives of the survey research design and the highlights of the results follow:

Objective 1:

To estimate both the number of energy technical programs that colleges presently have and the number they are planning.

Results:

- Sixty-two existing energy technology programs were identified in 6 energy areas. (See Table I.1.)
- One hundred thirty-two energy programs in various planning stages were reported in 8 energy areas.
- To obtain the probable number of omitted programs in the 378 nonresponding colleges, a sample follow-up survey of 44 colleges (12 percent) resulted in an estimate of 14 additional existing and 26 additional planned programs.

Petroleum Technology

- Petroleum technology programs have expanded rapidly in the last five years. The most recent programs, both existing and planned, tend to emphasize extraction methods more than refinery technology.
- Twelve colleges reported 13 existing petroleum technology programs. The Fall 1975 enrollment was 375 students, with 126 graduates reported for calendar year 1975 and 143 projected for 1976.
- Nine additional colleges reported to be planning 11 petroleum technology programs.

Coal-Mining Technology

- Most coal-mining technology programs have been established within the last five years. Upgrading and certification for employed miners are frequently the most important college offerings.
- Seventeen colleges listed 24 existing programs. Estimated enrollment was 2,878, with 153 graduates reported in 1975 and 343 projected for 1976.
- Twelve new colleges reported 12 planned programs.

[1]Throughout this report, the term *college* will mean a two year education institution unless specifically indicated otherwise.

- Six different technical degree tracks, besides upgrading activities, were identified in colleges offering coal mining programs.

Nuclear Energy Technology

- Eighteen colleges reported 19 nuclear energy technology programs. Sixteen of the programs were established in last five years.
- Estimated enrollment was 542, with 83 graduates reported in 1975 and 210 projected for 1976.
- Thirteen of the colleges with existing programs were located both east of the Mississippi and near nuclear power plants.
- Seventeen new colleges reported 19 planned programs. The primary reason for most colleges planning programs was the pending construction of nuclear power plants in their regions.

Solar Energy Technology

- Only 1 existing program in solar energy technology was identified.
- Thirty programs were reported to be in various stages of planning. Approximately 150 heating and air-conditioning programs exist that could offer course sequences to introduce solar installation and maintenance.
- The number of planned solar energy programs would produce graduates far exceeding short-term technician needs.

Laser-Optics Technology

- Laser-optics technology was included in the classification scheme because of the expanding research in laser fusion.
- Four colleges reported programs, with a combined enrollment of 214. For 1975, 26 graduates were reported and 59 were projected for 1976.
- Eight laser-optics programs were reported to be in planning at 8 colleges.

Geothermal Energy Technology

- No existing geothermal energy technology programs were identified.
- Six programs were reported as being planned at 6 colleges in the western United States.

Energy Technology

- No energy technology programs were reported under this title, however, a variety of programs emphasizing alternative energy sources were reported as being planned at 16 institutions.

Energy Conservation Technology

- One energy conservation program with an enrollment of 92 was identified.
- Thirteen colleges reported to be planning energy conservation programs.

Objective 2:

To estimate the degree and type of cooperation between the colleges and energy industries, including the major ERDA contractors.

Results:

- Eight of 12 colleges (67 percent) with existing programs in petroleum technology have petroleum companies actively involved in their programs.
- Fifteen of 17 colleges (88 percent) with existing coal-mining programs reported a close working relationship with coal companies.
- Fourteen of 18 colleges (78 percent) with existing nuclear technology programs reported as having some segment of the nuclear industry involved in their respective training programs. Four colleges reported support from ERDA contractors.
- The areas where colleges indicated the greatest support from energy industries were (1) in their supplying industrial staff to aid both in curriculum planning and, later, in instruction and (2) in their providing industrial facilities and equipment.

Objective 3:

To quantify the degree of college interest in attending a working conference to assess occupational needs in energy areas and initiate planning of needed programs.

Results:

- Five hundred eleven responding colleges (66 percent) reported an interest in energy-related technologies and in a conference. Four hundred ninety-one of the 511 colleges were public institutions.

Conclusions:

- AACJC-member and nonmember colleges are both involved in and desire assistance in (1) identifying energy-related technology occupational needs and (2) establishing educational programs to fill these needs.
- Cooperation in planning is needed between colleges, private industry, and state and federal agencies before colleges establish programs in the emerging energy technologies: laser-optics, solar, geothermal, energy conservation, and general energy. This is critical, because as many as 75 programs were identified as being planned.
- The two-year college system is rapidly expanding its training offerings in all three major energy technology areas: petroleum, coal mining, and nuclear. The system has the capacity to further increase its total output of graduates in any area if the need is projected.

CHAPTER II
Research Design and Methodology

The universe for the survey was comprised of two AACJC mailing lists. the member list contained 891 institutions, and the nonmember list had 333 institutions. Prior to mailing the survey questionnaire in October 1975, time did not permit the research staff to cull potential duplicates, religious schools, or specialized occupational institutions.

From the first mailing, 716 responses were received from 560 AACJC-member and 156 nonmember schools. (See Table II.1.) Two follow-ups were conducted. an omission study of 44 nonrespondents and a separate analysis of 28 institutions for which other publications or the college location indicated a high probability of energy programs. The two follow-ups resulted in 58 additional responses. The 52 member and 6 nonmember responses gave a total of 612 member and 162 nonmember responses, making a grand total of 774 college responses.

A detailed examination of the original two mailing lists comparing them to the 716 initial responses disclosed 72 duplicates: 30 from members and 42 from nonmembers. Subtracting the duplicates from the original lists left 1,152 colleges. 861 members and 291 nonmembers. Duplication was caused by several factors. For example, many AACJC-member colleges had branch campuses on the nonmember list. No attempt was made to remove responses from either the main campus or the branch campus unless an energy program was identified more than once.

Generally, private colleges—both secular and religious—were uninterested in energy curricula, as was indicated both by the low response rate and by the responses' content: Of the 186 private colleges mailed survey questionnaires, only 75 (40 percent) responded, and only 16 (24 percent) were classified as interested in energy education. Of the 111 (60 percent) nonresponding private colleges, 43 were AACJC members and 68 were nonmembers, respectively composing only 5 percent of the AACJC-member mailing list and 23 percent of the nonmember mailing list.

The original responses identified existing programs in 38 AACJC-member and 16 nonmember institutions and programs in various stages of planning in 99 AACJC-member and 19 nonmember institutions. (See Table II.2.) A college having programs in more than one energy area was counted only once when determining the number of colleges with energy programs. A college having existing programs in more than one energy-related area was counted in each of those areas. Also, when a college had both an existing program and a planned program, each program was counted in its respective category.

The follow-up of the 28 colleges that were likely to have energy programs identified 18 programs. 7 existing ones and 11 planned ones. (See Table II.2.)

The colleges selected for follow-up did, in fact, have a larger percentage of programs than the colleges in the original response. Of the original response group, 7 percent of the AACJC-member institutions had existing energy programs and 18 percent were planning energy programs. In the follow-up survey, 25 percent of the colleges had existing programs and 39 percent reported planned programs.

Data Omission and Bias

A follow-up survey of nonresponding colleges was conducted to determine the number of omitted energy pro-

TABLE II.1

SURVEY UNIVERSE AND RESPONSES

Category	Colleges Mailed Questionnaire	Colleges Responding		Colleges Not Responding	
		Number	*Percent*	*Number*	*Percent*
AACJC-MEMBER MAILING LIST					
First Request	861*	560	65	301	35
Private secular and religious colleges		38		43	
Public colleges		522		258	
Follow-up of Nonresponding Colleges					
Colleges selected as likely to have energy-related programs	28	28		0	
Sample of colleges: data omission	34	24		10	
Total	861	612	71	249	29
AACJC-NONMEMBER MAILING LIST					
First Request	291†	156	54	135	46
Private secular and religious colleges		37		68	
Public colleges		119		67	
Follow-up of Nonresponding Colleges					
Sample of colleges: data omission	10	6		4	
Total	291	162	56	129	44
GRAND TOTAL	1,152	774	67	378	33

*Of the 891 AACJC-member colleges on the mailing list sent the questionnaire, 30 proved to be duplicates, leaving 861.
†Of the 333 AACJC-nonmember colleges on the mailing list sent the questionnaire, 42 proved to be duplicates, leaving 291.

grams and to establish an estimate of bias in the survey results. Forty-four institutions were selected from a stratified sample of colleges that did not respond to the initial mailing. The omission sample was weighted according to the number of institutions existing in particular regions of the country. Also, because AACJC-member colleges were more likely to have energy-related programs than nonmembers were, the sample was composed of 34 AACJC-members and 10 nonmembers. Twenty-four responses were received from member institutions and 6 from nonmembers. The returned responses represent a 9 percent sample of the 273 nonrespondent member schools and a 4 percent sample of the 135 nonrespondent nonmembers.

Of the 24 AACJC-member colleges that responded, the percentage having existing and planned programs in the omission survey was smaller than that of the AACJC members responding to the original request: 4 percent versus 7 percent existing programs and 8 percent versus 18 percent planned programs. The 6 nonmember responses identified 1 additional planned program.

To estimate the number of existing and planned programs omitted among the AACJC-member nonrespondents and AACJC-nonmember public college nonrespondents, the percentages obtained from the member omission sample follow-up were used. The 4 percent rate for existing programs and 8 percent rate for planned programs was applied to the 249 nonresponding AACJC-member institutions. Thus, from the results, it is estimated that 10 institutions having existing programs and 20 having planned programs were omitted.

Because of the similarity of the responses of public AACJC-nonmember colleges to that of colleges on the AACJC-member list, the percentages obtained from the omission sample of member colleges were applied to the 61 nonrespondent public nonmember colleges. The estimated omission is 3 existing programs and 5 planned programs. With only 1 energy program identified in private nonmember colleges, it was difficult to estimate private nonmember program omissions. Because of the low number of energy programs identified in the original responses of private colleges,

it is estimated that 1 existing and 1 planned energy program were omitted. The grand total of estimated omitted programs is 14 existing energy programs and 26 planned energy programs.

The omission sample analysis identified fewer energy programs per college than were determined from the original sample. Therefore, because the omission sample percentage was used to estimate the number of programs for nonrespondents, it is most likely that the estimated number is a minimum.

Interest in Energy Occupational Programs and Energy Conference

It was assumed that a college was interested in energy occupational programs if it met one of three criteria. (1) it had an existing energy program, (2) it was planning an energy program, or (3) it was interested in attending the proposed energy conference to discuss energy occupational needs. All but two colleges having or planning energy programs also indicated an interest in attending a conference.

About two thirds of the responding colleges were interested in an energy conference. (See Table II.3.) Public institutions, both member and nonmember, supported the conference approach by 72 percent. Private institutions, as indicated earlier, had much less interest in energy occupations, and only 25 percent desired to attend.

Many colleges through their comments and letters accompanying their responses, expressed interest in energy occupations, although this interest was not easily quantified. Several of the colleges with existing energy programs were willing to host a conference. Also, many colleges with nondegree energy sequences and other alternative approaches to instruction, which did not meet the survey request requirements, explained their program philosophies.

Institutions overwhelmingly favored the two- or three-day regional conference format described in the cover letter. Of the 530 colleges responding to the question, 472 (89

TABLE II.2

ENERGY-RELATED TECHNOLOGIES: IDENTIFIED AND ESTIMATED NUMBER OF EXISTING AND PLANNED PROGRAMS BY CATEGORY OF COLLEGE

Category	Number of Colleges	Number of Energy-Related Technology Programs			
		Existing		*Planned*	
		Number	*Percent*	*Number*	*Percent*
RESPONDING COLLEGES					
AACJC Members					
First request	560	38	7	99	18
Follow-up of nonresponding colleges likely to have energy programs	28	7	25	11	39
Follow-up of sample colleges: data omission and bias	24	1	4	2	8
AACJC Nonmembers					
First request	156	16	10	19	12
Follow-up of sample of colleges: data omission and bias	6	0	0	1	17
Total Responding Colleges	774	62	8	132	17
NONRESPONDING COLLEGES*					
AACJC Members	249	10	4	20	8
AACJC Nonmembers	129	4	3	6	5
Private	68	1	1	1	1
Public	61	3	4	5	8
Total Nonresponding Colleges	378	14	4	26	7
GRAND TOTAL OF RESPONDING AND NONRESPONDING COLLEGES	1,152	76	7	158	14

*For nonresponding colleges, the numbers in the program columns are estimates based on the follow-up sample.

percent) approved. (See Table II.3.) And of the 496 public colleges responding to the question, 451 (91 percent) approved.

Inclusion and Classification of Programs

The research design called for the inclusion and classification of energy-related training programs in the major energy technologies. Programs were classified by energy title: oil and gas, coal, nuclear, solar, geothermal, general energy, and energy conservation. Laser optics was included separately because of expanding energy applications of lasers. Two large training areas scheduled to be emphasized—electrical power distribution and heating and air conditioning—were not listed frequently enough by respondents to provide information for analysis.

Colleges with energy programs were classified as to (1) energy area, (2) whether the programs were existing or planned, and (3) geographical area. The survey instrument requested that the respondent list by title all energy-related degree and certificate programs, including engineering technology programs with energy options. No definitions of energy programs were available to serve as parameters. The program title was the primary criterion for inclusion, the occupations in which graduates were placed being only a secondary concern.

The few existing supply, utilization, and demand studies that have focused on technicians and paraprofessionals in energy areas were difficult to interrelate to the research design. Common operational definitions and perceptions of technical manpower, especially those provided by two-year colleges, are lacking.

The most recent study by the Bureau of Labor Statistics, on *Technician Manpower 1966-1980*, was on technician positions as of 1965. At that time, only 10 percent of the new entrants had received college-related technician training. The National Center for Educational Statistics' report on associate degrees by categories has a two- to three-year time lapse between data collection and publication. For 1970-1971, the only energy category included was nuclear technology.[1]

Econometric projections on the demand for manpower in coal mining for both the nation and the individual states have been completed at several alternative levels of demand for coal.[2]

Project Independence—Nuclear Segment[3] projected demand for nuclear technicians. Although no national survey has been made, two regional analyses of supply and demand for nuclear technicians recently have been completed.[4]

The classification system developed for this survey required telephone calls for additional clarification on the content of programs listed. Many reported programs were eliminated as not being appropriate. While it was recognized that persons trained in many technology programs not included have skills appropriate for energy occupations, it was not possible to include such programs within the dimensions of the research design. (Appendix B contains a list of program titles submitted by colleges but not included in the survey.)

No assessment was made of energy credit courses or community programs that did not lead to a certificate or a degree. Programs less than six months in length were excluded except in two cases where the colleges were expanding into degree programs.

[1] National Center for Educational Statistics, *Associate Degrees and Other Formal Awards Below the Baccalaureate, 1970-1971* (Washington, D.C.: U.S. Government Printing Office, 1973).

[2] Jacob J. Kaufman, *The Demand for and Supply of Manpower in the Bituminous Coal Industry for the Years 1985 and 2000* (University Park, Pa.: Institute for Research on Human Resources, Pennsylvania State University, 1973).

[3] Federal Energy Administration, *Project Independence Task Force Reports Nuclear Segment, Projected Manpower Requirements* (Washington, D.C.: U.S. Government Printing Office, 1974).

[4] Larry Blair, *An Analysis of Nuclear-Related Technician Manpower in Western States*, a report prepared by Oak Ridge Associated Universities (Washington, D.C.: Energy Research and Development Administration, 1975).

TABLE II.3

COLLEGE INTEREST IN AN ENERGY CONFERENCE AND ACCEPTABILITY OF CONFERENCE FORMAT

	Energy Program Interest				Conference Format Acceptable			
	Yes	*Percent*	*No*	*Percent*	*Yes*	*Percent*	*No*	*Percent*
Public institutions	491	72	190	28	451	91	45	9
Private institutions	20	25	60	75	21	62	13	38
TOTAL	511	67	250	33	472	89	58	11

CHAPTER III
The Survey

Two-year educational institutions have been made acutely responsive to the energy crisis. Higher fuel costs are taxing operating budgets during a time when educational funds are scarce. Many students and community groups are requesting courses on energy-related technology. Academic research is concentrating on more efficient energy use and on implementation of energy alternatives. And many colleges are planning programs to educate persons for the new energy-related occupations.

This study was conducted to provide a basis for planning for *needed* technical energy occupations at two-year educational institutions. The survey, cosponsored by the American Association of Community and Junior Colleges and the Energy Research and Development Administration, was mailed to 1,152 AACJC-member and nonmember two-year institutions in the United States.

The analysis presents the results of the 774 institutions' responses. It reports the energy programs, present enrollment, graduates, and geographical location of existing programs. The planned programs are categorized by energy area, geographical location, and stage of planning.

The survey identified 62 existing one- and two-year energy-related technology programs and 132 planned programs. (See Table III.1.) Five of the 8 geographical areas used for classification in this study had existing programs, and all 8 regions each had at least 6 planned programs. The largest number of existing programs in an energy area was the 24 reported coal-mining technology programs, and 30 colleges listed planned programs in solar energy technology.

Geographical Classification of the Colleges

Colleges with energy programs were divided into eight regions plus Alaska and Hawaii "gerrymandered" to include states with similar energy sources.

New England: Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, and Connecticut.

East: New York, New Jersey, Pennsylvania, Delaware, Maryland, West Virginia, and Washington, D.C.

South: Virginia, North Carolina, South Carolina, Kentucky, Tennessee, Georgia, Florida, Alabama, Mississippi, and Louisiana.

Midwest: Ohio, Indiana, Illinois, Michigan, and Wisconsin.

Central: Arkansas, Missouri, Iowa, Kansas, and Nebraska.

North Central: Minnesota, North Dakota, South Dakota, Wyoming, Montana, and Idaho.

Southwest: Oklahoma, Texas, New Mexico, Arizona, Utah, and Colorado.

West: Washington, Oregon, California, and Nevada.

Petroleum Technology

Petroleum (oil and gas) technology programs in colleges have grown rapidly during the last five years. The Arab oil embargo stimulated companies to re-examine known low-producing petroleum locations, to lease more offshore sites, and to make major efforts to extract oil from shale, coal, and tar sands. All these activities have stimulated the develop-

TABLE III.1

ENERGY-RELATED TECHNOLOGIES: NUMBER OF COLLEGES WITH EXISTING AND PLANNED PROGRAMS IN EACH OF EIGHT CATEGORIES

Energy-Related Technologies	Colleges with Existing Programs		Colleges with Planned Programs	
	Colleges	*Programs*	*Colleges*	*Programs*
Petroleum (oil and gas)	12	13	11	13
Coal mining	17	24	20	25
Nuclear energy	18	19	17	19
Solar energy	1	1	30	30
Laser-optics	4	4	8	8
Geothermal energy	–	–	6	6
Energy	–	–	16	18
Energy conservation	1	1	13	13
TOTAL	53	62	121	132*

*The 132 total planned programs includes colleges with existing programs that are expanding offerings in the same field and new colleges planning first-time programs. In later sections on individual energy areas, it is possible only to analyze new planned programs. Therefore, the number of planned programs may vary in the individual petroleum, coal mining, and nuclear tables from that shown here.

TABLE III.2

PETROLEUM TECHNOLOGY: COLLEGES AND THEIR EXISTING PROGRAMS, ENROLLMENT, AND GRADUATES

Regions	Colleges	Programs	Enrollment	1975 Graduates	Projected 1976 Graduates
East	1	1*	26	13	n.a.
South	1	1	56	3	5
Midwest	4	5†	151	94	120
North Central	1	1	36	5	10
Southwest	3	3	85	11	6
West	1	1	n.a.	n.a.	n.a.
Alaska	1	1	21	–	2
TOTAL	12	13	375	126	143

*This is a six-month program.
†This includes one four-month program.

ment of college programs and provide potential technician employment opportunities.

The survey indicated that 12 colleges had a combined total of 13 existing petroleum technology programs. (See Table III.2.) Nine of the programs offered an associate degree in petroleum technology or equivalent. Most focused on training technicians to aid geologists and engineers in both oil and gas extraction and petroleum refining. The 4 remaining programs – 1 offering an associate degree, 1 awarding a certificate, and 2 shorter programs – all emphasized petroleum extraction.

Of the 13 programs, 8 were established in the last two years, 6 of which began in 1975. Three programs were started in 1968-1969, and 2 were begun in 1964-1965.[1]

[1] Of the 9 colleges listed in *Barron's Guide to the Two-Year Colleges* as having petroleum technology programs, 5 colleges responding to the survey did not indicate they had such a program.

Geographically, the Midwest has the most existing and planned programs, the largest enrollment, and the most graduates.

In the survey, enrollment reported in petroleum technology during 1975 was 375. One hundred twenty-six students were graduated in 1975, and 143 students were projected to be graduated in 1976. Having by far the largest program, Illinois Eastern Community Colleges will graduate over 70 persons in both 1975 and 1976. Because 8 of the other programs have only recently enrolled their first classes, the number of graduates should increase significantly in 1977.

Nine colleges are planning a combined total of 11 petroleum technology programs: 1 is in the formal planning stage, 4 are in the preliminary planning stage, and 6 are in the informal planning stage. (See Table III.3.)

One college with a four-month program in oil-well servicing is planning a two-year petroleum technology program. Five of the planned programs—one an oil shale program—emphasize extraction of oil and gas. To implement the programs planned in several colleges, petroleum exploration efforts—including offshore drilling—must be increased in the college's geographic region. The tentative dates reported for beginning some of the new programs are 1976 for one program, 1977 for two programs, 1978 for two programs, and 1979 for one program.

Colleges with petroleum technology programs tend to work either closely with petroleum extraction and refinery industries or not at all. Of the 12 colleges with programs, industry is strongly involved in 8. (See Table III.4.) The oil industry supports the programs of these colleges by making available facilities for 6 colleges (50 percent), instructional staff for 6 colleges (50 percent), curriculum planning expertise for 7 colleges (58 percent), and equipment for 5 colleges (42 percent). Of the 9 colleges planning new programs, only two report industrial involvement. The smallness of this number could partially be because 6 of the programs are still in an informal planning stage.

It was impossible from the survey to determine how many of the existing programs were training persons for industries within the college's local area and how many for a larger region.

Coal-Mining Technology

By far the greatest demand for energy-related technicians is in coal mining. This is because the U.S. coal industry intends to mine more than 1.1 billion tons of coal by the year 1985. One projection published in December 1974 is that 125,000 new employees will be needed to man the 270 mines now to be built, each of which will be producing 2 million tons of coal a year.[1]

Another projection, stated in May 1975 by a representative of Consolidated Coal Company, is that coal-mining companies must hire an additional 152,000 employees between 1976 and 1985, the majority of whom will be inexperienced in coal mining.[2]

Experts discussing manpower needs for the coal mines have emphasized that not only will many new persons be needed but also they will need to be well trained. Because additional pretraining and early upgrading have proved both to increase productivity and to augment mine safety, companies are no longer satisfied with the practice of indoctrinating new employees for fewer than 40 hours before they go underground.

In illustrating this point, one survey respondent ex-

[1] J. Wes Blakely, "The Manpower Scene. Training and Development," *Coal Mining and Processing* (December 1974), p. 52.

[2] Roger M. Haynes, "Manning of Coal Mines," a speech delivered at the 1975 Coal Convention of the American Mining Congress, Pittsburgh, Pa., May 4-7, 1975.

TABLE III.3

PETROLEUM TECHNOLOGY: NEW COLLEGES PLANNING PROGRAMS AND STAGES OF PLANNING

Regions	New Colleges	Program Planning Stage		
		*Informal**	*Preliminary*†	*Formal*‡
New England	1	—	1	—
East	1	2	—	—
South	1	—	—	1
Midwest	2	1	2	—
Central	1	1	—	—
Southwest	2	1	1	—
West	1	1	—	—
TOTAL	9	6	4	1

*In-house planning and discussion are taking place.
†Program planning is being conducted with intention of submitting the program to the state board for approval.
‡Program has been submitted to state board and is awaiting approval.

plained that a coal-mining company with more than 2,000 applications for underground miner positions, offered to hire all persons who successfully completed the college coal-mining program. The college and the coal company created a successful cooperative program, alternating school and work.

Without exception, coal-mining technology programs in two-year colleges fit the definition of community programs. The colleges work closely with the regional coal companies to develop programs needed by the local mines or related industry. And because of this close cooperation in tailoring the programs to the needs of local mines and industry, it was difficult for the survey staff to categorize the coal-mining technology programs.

In all, 17 colleges with a combined total of 24 existing programs in coal-mining were identified. All but 3 programs were reported to have been established within the last five years. (See Table III.5.)

Of these 17 colleges, 5 are in the East, 5 are in the Midwest, and 4 are in the South. The two states having the greatest number of these colleges are West Virginia (5 colleges) and Illinois (3 colleges).

It was frequently difficult for the survey research staff and the college to determine whether or not a program led to a certificate or an associate degree. Many of the short courses and electrician and supervision certification preparation courses are or can eventually be placed in the degree track. Colleges generally were unsure about how many of the employed miners taking courses were seeking degrees. The survey identified 2,878 persons enrolled, 153 graduated

TABLE III.4

PETROLEUM TECHNOLOGY: INDUSTRIAL INVOLVEMENT IN COLLEGES WITH EXISTING AND PLANNED PROGRAMS

	12 Colleges with Existing Programs		9 Colleges with Planned Programs	
Industrial Involvement	*Number*	*Percent*	*Number*	*Percent*
Industry Involved	8	67	2	22
Use of industrial facilities	6	50	2	22
Use of industrial equipment	5	42	2	22
Use of industrial staff for instruction	6	50	2	22
Use of industrial staff for curriculum planning	7	58	2	22
Use of industry to train college instructors.	1	8	1	11
Use of college to train industry employees	3	25	—	—
Industry Not Involved	4	33	7	78

TABLE III.5

COAL-MINING TECHNOLOGY: COLLEGES AND THEIR EXISTING PROGRAMS, ENROLLMENT, AND GRADUATES

Regions	Colleges	Programs	Enrollment	1975 Graduates	Projected 1976 Graduates
East	5	7	466*	12	74*
South	4	6	453	25	88
Midwest	5	5	685	89	143
North Central	2	3	60	25	28
Southwest	1	3	1,214	2	10
TOTAL	17	24	2,878	153	343

*This figure is an estimate.

in 1975, and 343 who were projected to graduate in 1976.

Of the 17 colleges with programs, 8 are expanding their offerings. Twelve additional colleges are planning programs: 6 in the discussion stage, 2 in the preliminary stage, and 4 in the formal stage. (See Table III.6.)

TABLE III.6

COAL-MINING TECHNOLOGY: NEW COLLEGES PLANNING PROGRAMS AND STAGES OF PLANNING

		Program Planning Stage		
Regions	New Colleges	*Informal*	*Preliminary*	*Formal*
East	3	–	1	2
South	2	1	1	–
Midwest	3	3	–	–
North Central	2	1	–	1
Southwest	2	1	–	1
TOTAL	12	6	2	4

The start-up time for coal-mining technology programs seems to be considerably shorter than that for other energy-related technology programs. seven of the offerings are planned to begin in 1976 and two are slated for 1977.

In analyzing the West Virginia public and private college programs training coal miners, Duane A. Letcher, of the Mining Extension Service of West Virginia University, classified the instructional activities into three categories:[1]

- *Training:* Activities to improve the employee's present performance.

Education: Activities to improve the overall competence of the employee beyond the job now held.

Development: Activities to prepare the employee to adjust to the organization as it changes.

[1] Duane A. Letcher, *Identification and Structural Analysis of Instructional Programs for the Underground Coal Miner in West Virginia*, July 1975.

While most of the degree programs identified are "education" and "development" activities using Letcher's classification system, colleges are also providing extensive "training" activities for underground miners.

Each coal company is required to submit a training plan to the district office of the U.S. Mining Enforcement and Safety Administration (MESA) for approval. The community colleges are frequently included as part of the method for meeting the training objectives. Experienced miners with appropriate underground time can seek certification as electricians or become supervisors if they have completed training and can pass the required certification tests. Community colleges provide training for both certifications.

In only two states do state statutes require a minimum of 80 hours of pretraining before the new employee can go underground. The apprenticeship as a "red hat" under close supervision away from the face of the mine lasts 90 days. The local colleges make available a variety of courses each a few hours in length on all phases of mining and safety.

Six categories of coal-related programs were identified besides short training courses for employed miners. (See Table III.7.)

One- and two-year programs in mining technology are available for both full-time students and miners enrolled part-time. Mining management was listed as a complete program and as an option in mining technology. Two-year associate degree programs in mining engineering and mining technology designed for students to transfer to four-year colleges were identified.

Surface coal-mining and reclamation technology programs are available in geographical areas where surface coal-mining is prevalent. Surface coal mining does not have the strict training regulations that underground coal mining has, but the colleges work closely with the coal companies. Of the five colleges responding in the survey that had surface coal-mining technology programs, two also had reclamation technology programs. (See Table III.8.) One surface coal-mining program in the formal planning stage and two reclamation programs—one in the formal planning stage and one in the preliminary planning stage—were identified.

Three college coal-conversion technology programs being planned will train technicians in converting coal to a

TABLE III.7

TYPES OF COLLEGE COAL-MINING DEGREE PROGRAMS

Type	Length	Students	Program
Mining engineer	2 years	full-time	transfer emphasis
Mining technology	1 or 2 years	full- and part-time	terminal and transfer
Mining management	1 or 2 years	full- and part-time	terminal or transfer
Surface mining technology	1 or 2 years	full- and part-time	terminal
Mining reclamation technology	1 or 2 years	full- and part-time	terminal
Coal-conversion technology	1 or 2 years	still only in planning	still only in planning

TABLE III.8

SURFACE COAL-MINING AND RECLAMATION TECHNOLOGY: COLLEGES WITH EXISTING AND PLANNED PROGRAMS*

Regions	Colleges with Existing Programs	Colleges with Planned Programs		
		Informal	*Preliminary*	*Formal*
Surface Coal-Mining Programs				
South	1	–	–	–
Midwest	3	–	–	1
North Central	1	–	–	–
TOTAL	5	–	–	1
Reclamation Programs				
South	1	–	1	–
Midwest	1	–	–	1
TOTAL	2	–	1	1

*This table's data are also included in Tables III.5 and III.6.

fuel oil or a gas. (See Table III.9.) The formally planned program is in North Dakota and will train personnel to operate plants now on-line and under construction in converting lignite to a synthetic gas.

As mentioned previously, there is strong cooperation between the colleges and the local coal mines. To colleges with existing programs, industry made instructional staff available to 13 colleges (77 percent), facilities to 12 colleges (71 percent), equipment to 11 colleges (65 percent), and curriculum planning expertise to 10 colleges (59 per cent). (See Table III.10.)

Six of the 12 colleges planning programs (50 percent) are using local companies in curriculum planning. (See Table III.10.) A number of the colleges are also planning to use industrial facilities, equipment, and industry trained college instructors.

Nuclear Energy Technology

The commercial use of nuclear fission as an energy source has expanded rapidly since the first nuclear power plant was completed in 1957. In the United States as of June 30, 1975, 54 nuclear power reactors were operating, 61 were being built, and 104 were being planned. Forty-five of the reactors under construction are planned to be on-line by the end of 1980.[1]

Commercial nuclear reactor operators have always been required to be both highly trained and licensed. Training for licensing was conducted originally by the Atomic Energy Commission (now ERDA), and by the vendors that sold reactors to the utilities. Now ever more technical colleges, cooperating closely with the utilities, are providing initial training for reactor operators.

The Nuclear Regulatory Commission (NRC) is responsible for establishing the licensing requirements and conducting all operator-licensing tests. For all nuclear utility personnel other than reactor operators—general employees, quality assurance personnel, health physists, physical security personnel, nonlicensed technicians, and welders—the NRC evaluates the training.[1]

Eighteen colleges reported existing nuclear technology programs in the survey responses. Of these colleges, 3 will not graduate their first class until 1976.[2] Only 1 college has 2 different nuclear-related programs. Of the 14 programs resulting in associate degrees, 1 is a 30-month co-op program.[3] By comparison, there are 62 universities offering nuclear-engineering or engineering-with-nuclear-option programs.[4]

Although not compared in content, many of the college programs had similar titles: 13 titles were in nuclear technology, 2 were for reactor operators, 3 were in radiation technology, and 1 was in nuclear quality assurance. Of the 19 existing programs, 2 began in the early 1960's, 1 started in the late 1960's, and the rest began in the last five years.

[1] *Nuclear Reactors Built, Being Built, or Planned in the United States as of June 30, 1975*, a report prepared by the Division of Reactor Research and Development, Energy Research and Development Administration.

[1] W. A. Ruhlman, "Inspection of Training Activities by the NRC's Office of Inspection and Enforcement," in *Proceedings of the Second Symposium on Training of Nuclear Facility Personnel, May 1975* (Oak Ridge, Tenn.: Oak Ridge National Laboratory).

[2] Two included programs are located in colleges within the Pennsylvania State system that were not on the AACJC mailing lists. They were contacted by phone.

[3] *Barron's Guide to the Two-Year Colleges* lists eight institutions in the survey population with nuclear programs.

[4] John R. Doggette, *Nuclear Engineering–Enrollments and Degrees, 1975*, a report prepared by Oak Ridge Associated Universities (Washington, D.C.. Energy Research and Development Administration, September 1975).

Five hundred forty-two students were reported enrolled in the programs during the fall of 1975. Eighty three students were graduated during 1975, and 210 are projected to be graduated in 1976. (See Table III.11.)

Fourteen of the 18 colleges with nuclear energy technology programs are located east of the Mississippi River and were responsible for all but one of the 83 students graduated in 1975. Eight of the 18 colleges are in Southern states. Each of the states having public nuclear power utilities had at least one college with a nuclear energy technology program with one exception. the state of Illinois, which has the greatest number of utility reactors of all the states, had no college with a program.

Of the 19 planned programs in 17 other colleges, only 3 are in the formal planning stage. (See Table III.12.). According to letters received and telephone follow-ups by the survey staff, colleges located near sites of nuclear utilities planned or under construction are the source of possible new programs. The Office of Education has funded the Technical Education Research Center (Waco, Texas) to develop curriculum modules for nuclear energy technology programs and to help implement programs. Additional funding by the Office of Education is planned for some institution to produce curriculum modules for nuclear reactor operators.

Related nuclear industries were involved in the programs of 14 of the colleges. (See Table III.13.) Of those, 10 colleges use industrial equipment, 9 use industrial facilities, and 9 use industrial staff for curriculum planning.

The 42 ERDA prime contractors, the majority engaged in extensive nuclear research and development activities at 64 locations, have always worked closely with universities engaged in nuclear research and instruction. The support to universities was predicated on support of research related to

TABLE III.9

COAL-CONVERSION TECHNOLOGY: NEW COLLEGES PLANNING PROGRAMS AND STAGES OF PLANNING*

Regions	New Colleges	Program Planning Stage		
		Informal	*Preliminary*	*Formal*
East	1	–	1	–
Midwest	1	1	–	–
North Central	1	–	–	1
TOTAL	3	1	1	1

*This table's data are also included in Table III.6.

TABLE III.10

COAL-MINING TECHNOLOGY: INDUSTRIAL INVOLVEMENT IN COLLEGES WITH EXISTING AND PLANNED PROGRAMS

Industrial Involvement	17 Colleges with Existing Programs		12 Colleges with Planned Programs	
	Number	*Percent*	*Number*	*Percent*
Industry Involved	15	88	6	50
Use of industrial facilities	12	71	5	42
Use of industrial equipment	11	65	4	33
Use of industrial staff for instruction	13	77	4	33
Use of industrial staff for curriculum planning	10	59	6	50
Use of industry to train college instructors	3	18	1	8
Use of college to train industry employees	4	24	2	17
Industry Not Involved	2	12	6	50

TABLE III.11

NUCLEAR ENERGY TECHNOLOGY: COLLEGES AND THEIR EXISTING PROGRAMS, ENROLLMENT, AND GRADUATES

Regions	Colleges	Programs	Enrollment	1975 Graduates	*Projected 1976 Graduates
New England	2	2	53	19	33
East	3*	3	64	30	42
South	8	9	303	33	90
Midwest	1	1	38	—	—
Southwest	2	2	49	—	20
West	2	2	35	1	25
TOTAL	18	19	542	83	210

*Of these colleges, 2, each having 1 program, were not on the AACJC mailing list.

TABLE III.12

NUCLEAR ENERGY TECHNOLOGY: NEW COLLEGES PLANNING PROGRAMS AND STAGES OF PLANNING

Regions	New Colleges	Program Planning Stage		
		Informal	*Preliminary*	*Formal*
New England	1	—	1	—
East	5	3	1	1
South	2	1	1	1
Midwest	3	2	1	—
Southwest	3	3	—	—
West	3	3	—	1
TOTAL	17	12	4	3

ERDA's objectives and on the attraction of Ph.D.'s into the contractors' workforce.

Of the 18 community colleges with existing nuclear energy technology programs, ERDA contractors have been involved in the programs of only 4, three of which worked with two contractors in Oak Ridge, Tennessee. (See Table III.14.) The students and instructors at all 4 colleges have received instructional experiences using equipment within the ERDA facilities. Two summer programs were held for second-year students in 1972 and 1973. Of the 17 colleges planning programs, 1 reported having ERDA contractor professionals advising in curriculum planning.

Solar Energy Technology

Solar energy can be utilized in three technological processes. (1) photosynthesis/or heliochemical, (2) helioelectrical (converting solar energy to electric power using photovoltaic cells), and (3) heliothermal (concentrating solar energy for solar heating and cooling purposes).

Helioelectrical conversion is hindered by present costs of materials being 50 to 100 times too high to be competitive with conventional energy systems. Initial research will be conducted to acquire performance standards and test data on optimal system design with only a demonstration system prior to 1985.[1]

Solar thermal conversion also lacks performance standards and test data. To supply these, several small test facilities and pilot plants will be constructed by 1985. ERDA also plans to fund a solar energy research institute to be the leading center of expertise. However, as now planned, ERDA's research, development, and demonstration strategy will not create a noticeable demand for solar energy technicians within the next decade.[2]

[1] *Creating Energy Choices for the Future*, Vol. 2: *Program Implementation*, ERDA Report No. 48 (Washington, D.C.: Energy Research and Development Administration, 1975), pp. 33-41.

[2] *Energy Alternatives: A Comparative Analysis*, a report prepared by the Science and Public Policy Program, University of Oklahoma, May 1975, pp. 11-1 to 11-14.

Solar heating systems will become more popular as commercial applications expand in residential and private use. At present, estimates for a residential solar heating system are from $6,000 to $8,000. ERDA is funding a limited number of public institutions, including the institution of education, to implement solar heating systems.

TABLE III.13

NUCLEAR ENERGY TECHNOLOGY: INDUSTRIAL INVOLVEMENT IN COLLEGES WITH EXISTING AND PLANNED PROGRAMS

	18 Colleges with Existing Programs		17 Colleges with Planned Programs	
Industrial Involvement	*Number*	*Percent*	*Number*	*Percent*
Industry Involved	14	78	6	35
Use of industrial facilities	9	50	5	30
Use of industrial equipment	10	56	3	18
Use of industrial staff for instruction	5	28	4	24
Use of industrial staff for curriculum planning	9	50	4	24
Use of industry to train college instructors	1	6	—	—
Use of college to train industry employees	2	11	—	—
Industry Not Involved	4	22	11	65

TABLE III.14

NUCLEAR ENERGY TECHNOLOGY: THE ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION'S INVOLVEMENT IN COLLEGES WITH EXISTING AND PLANNED PROGRAMS

	18 Colleges with Existing Programs		17 Colleges with Planned Programs	
ERDA Involvement	*Number*	*Percent*	*Number*	*Percent*
ERDA Involved	4	22	1	6
Use of ERDA facilities	4	22	—	—
Use of ERDA equipment	4	22	—	—
Use of ERDA staff for instruction	1	6	—	—
Use of ERDA staff for curriculum planning	1	6	1	6
Use of ERDA to train college instructors	1	6	—	—
Use of ERDA for student work experiences	1	6	—	—
Other	1	6	1	6
ERDA or ERDA Contractors Not Involved	14	78	16	94

One college already has implemented a solar energy technology emphasis into its heating and air-conditioning program. (See Table III.15.) And 30 colleges reported to be planning solar energy technology programs. (See Table III.16.) Interest in programs was expressed by colleges in all sections of the country, with colleges in the Southwest planning ten programs.

Barron's Guide to the Two-Year Colleges lists more than 150 colleges as having programs in heating and air-conditioning (climate-control) technology. Courses in solar energy principles and solar thermal conversion system maintenance could be added where appropriate. The colleges funded to construct solar heating system facilities will be able to use them as training laboratories.

Colleges are cautioned not to establish expensive new programs that train students for technological occupations for which employment prospects are uncertain. The 30 planned solar energy technician programs would produce graduates far exceeding any projected demand. And in the near future, there will be no demand for solar technicians that could not be supplied by cross-training climate-control and electronics technicians.

Laser-Optics Technology

The survey included laser-optics technology programs because laser use in energy production research is expanding. For the fiscal year 1976, more than $50 million is projected to be spent on laser-fusion research by three ERDA contractors. But laser-fusion systems are estimated to be 20 years from a demonstration plant stage and, thus, are not considered to be a short-term energy alternative.

A great demand exists for the few persons being trained as laser-optics technicians, not only in laser-fusion research but also in industries involved in such areas as quality control, medical research, microcircuitry, and military applications. In 1975, only 26 laser-optics technicians were graduated, all from one college. (See Table III.17.)

In the survey, only four colleges reported having laser-optics technology programs, all resulting in associate degrees. Texas State Technical Institute (TSTI, in Waco) began the first laser-optics technology program in 1970 and expanded the training area to its Rio Grande campus in 1974. Formally affiliated with TSTI, Technical Education Research Center (TERC), a nonprofit research organization, is contracted with the Office of Education to develop laser-optics curricula and to help implement new programs, primarily in Massachusetts, New York, New Jersey, Florida, and Southern California. TERC has established a committee composed of laser industry representatives, including those of ERDA laboratories involved in laser research.

TSTI graduated the total 26 laser-optics technicians in 1975 and will, with its sister institute, graduate 41 of the total 59 laser-optics technicians projected to be graduated in 1976. The other two reported programs will not graduate their first classes until 1976 and 1977.

Eight colleges each reported having a planned laser-optics program. (See Table III.18.) The program of each college is to result in an associate degree except for that of one college, which already has an existing program. That

TABLE III.15

SOLAR ENERGY TECHNOLOGY:
COLLEGES AND THEIR EXISTING PROGRAMS, ENROLLMENT, AND GRADUATES

Regions	Colleges	Programs	Enrollment	1975 Graduates	Projected 1976 Graduates
Central	1	1	58	40	35

TABLE III.16

SOLAR ENERGY TECHNOLOGY:
NEW COLLEGES PLANNING PROGRAMS AND STAGES OF PLANNING

Regions	New Colleges	Program Planning Stage		
		Informal	*Preliminary*	*Formal*
New England	3	1	1	1
East	4	3	1	—
South	3	1	2	—
Midwest	2	—	2	—
Central	1	—	1	—
North Central	2	—	2	—
Southwest	10	8	2	—
West	5	4	1	—
TOTAL	30	17	12	1

TABLE III.17

LASER-OPTICS TECHNOLOGY:
COLLEGES AND THEIR EXISTING PROGRAMS, ENROLLMENT, AND GRADUATES

Regions	Colleges	Programs	Enrollment	1975 Graduates	Projected 1976 Graduates
Midwest	1	1	24	–	–
Southwest	2	2	110	26	41
West	1	1	80	–	18
TOTAL	4	4	214	26	59

TABLE III.18

LASER-OPTICS TECHNOLOGY:
NEW COLLEGES PLANNING PROGRAMS AND STAGES OF PLANNING

Regions	New Colleges	Program Planning Stage		
		Informal	*Preliminary*	*Formal*
New England	1	–	–	1
East	3	1	2	–
South	1	1	–	–
Midwest	1	1	–	–
Southwest	2	2	–	–
TOTAL	8	5	2	1

college's new program is to be a certificate one for laser-optics assemblers. Of the eight planned programs, one is in the formal planning stage, two are in the preliminary planning stage, and five are in the informal planning stage. Only four of the colleges reported tentative starting dates. 1977 for two colleges, 1978 for one college, and 1979 for the other college. Three of the colleges are in the East, two are in the Southwest, and one each is in New England, the Midwest, and the South.[1] None of the colleges reported industry to be involved in their present planning activities.

Geothermal Energy Technology

Geothermal energy, the heat in water and rock beneath the earth's surface, is available in the western one-third of the United States, including Alaska and Hawaii. However, geothermal energy has a limited potential for producing electricity when compared with that of nuclear energy or fossil energy and is most applicable to nonelectrical and non-transport related forms of energy. One study estimated that geothermal energy could supply 20 percent of those latter needs.[1]

A near-term objective of ERDA is to stimulate accelerated geothermal industry growth and to provide at least 10,000 to 15,000 megawatts of commercial electrical power and nonelectrical energy from hydrothermal resources by 1985.[2] No immediate demand for geothermal energy technicians is apparent other than that created by this ERDA research and demonstration effort.

No colleges reported to have existing programs for geothermal technicians. Six colleges, located close to geothermal energy sources, said they have planned programs. One program is in the formal planning stage, one program is in the preliminary planning stage, and four programs are in the informal planning stage. The formally planned program, re-

[1] TERC conducted its own interest survey in 1973 and reported to have received requests from over 450 educational institutions for more information.

[1] J. F. Kunze and A. S. Richardson, *National Program Definition Study for the Non Electrical Utilization of Geothermal Energy*, a report prepared by the Idaho National Engineering Lab (Washington, D.C.: Energy Research and Development Administration, June 1975).

[2] *Creating Energy Choices for the Future*, Vol. 2. *Program Implementation*, ERDA Report No. 48 (Washington, D.C., Energy Research and Development Administration, 1975), p. 47.

lated to an ERDA-funded geothermal project, is to begin at Lassen College in Susanville, California, in 1976. (See Table III.19.)

Only the two colleges beyond the informal stage have worked with geothermal-related industries or ERDA in program planning. (See Table III.20.) The two colleges are using industrial facilities, equipment, and professional staff.

Three of the colleges that reported having planned geothermal programs in the informal stage were similarly interested in solar energy technology programs. In letters accompanying the survey responses, each of these three colleges asserted it could institute a program in either area if the need existed.

Energy Technology

A variety of planned programs were classified under the label of energy technology. The programs are of two distinct types: (1) ones to give a person skills he can apply to a variety of applied energy occupations and (2) ones to explain and possibly support research in alternative energy resources.

Sixteen colleges reported as planning to initiate a combined total of 18 energy technician programs in 7 of the 8 geographical regions. (See Table III.21.) Two colleges each reported two different planned offerings. The only program in the formal planning stage is in Wyoming and is specifically designed to train in wind power technology. Five programs are in the preliminary planning stage, and 12 programs are in the informal planning stage.

Of the 16 colleges with planned energy technology programs, only 5 colleges reported industry to be involved in their program planning. (See Table III.22.) Of these colleges, 3 are using industrial staff in curriculum planning and 2 are using industrial equipment in related courses.

The planning of energy technician programs raise many potential dangers. During the great interest in environmental education from 1969 to 1971, many educational and nonprofit institutions were funded to develop environmental and ecology technicians. The programs attempted to provide multiple competence in air, solid waste, wastewater, and insecticides monitoring and frequently produced persons un-

TABLE III.19

GEOTHERMAL ENERGY TECHNOLOGY: NEW COLLEGES PLANNING PROGRAMS AND STAGES OF PLANNING*

Regions	New Colleges	Program Planning Stage		
		Informal	*Preliminary*	*Formal*
North Central	1	1	—	—
Southwest	1	1	—	—
West	4	2	1	1
TOTAL	6	4	1	1

*No college responding to the survey questionnaire reported having an existing program.

TABLE III.20

GEOTHERMAL ENERGY TECHNOLOGY: INDUSTRIAL OR THE ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION'S INVOLVEMENT IN COLLEGES WITH PLANNED PROGRAMS*

Industrial or ERDA Involvement	6 Colleges with Planned Programs	
	Number	*Percent*
Industry or ERDA Involved	2	33
Use of industrial or ERDA facilities	2	33
Use of industrial or ERDA equipment	2	33
Use of industrial or ERDA staff for instruction	2	33
Industry and ERDA Not Involved	4	67

*No college responding to the survey questionnaire reported having an existing program.

TABLE III.21

ENERGY TECHNOLOGY: NEW COLLEGES PLANNING PROGRAMS AND STAGES OF PLANNING*

Regions	New Colleges	Program Planning Stage		
		Informal	*Preliminary*	*Formal*
New England	3	3	–	–
East	3	1	3	–
South	4	3	1	–
Midwest	1	2	–	–
North Central	1	–	–	1
Southwest	2	2	–	–
West	2	1	1	–
TOTAL	16	12	5	1

*No college responding to the survey questionnaire reported having an existing program.

TABLE III.22

ENERGY TECHNOLOGY INDUSTRIAL INVOLVEMENT IN COLLEGES WITH PLANNED PROGRAMS*

Industrial Involvement	16 Colleges with Planned Programs	
	Number	*Percent*
Industry Involved	5	31
Use of industrial equipment	2	13
Use of industrial staff for instruction	1	6
Use of industrial staff for curriculum planning	3	19
Use of college to train industry employees	1	6
Industry Not Involved	11	69

*No college responding to the survey questionnaire reported having an existing program.

needed by industry, public utilities, or governmental monitoring bodies.

This is not to imply that energy technician programs in such areas as alternative energy sources, energy research, and energy reclamation from waste materials cannot become viable programs that fulfill local needs. But before introducing an energy technician program, any college should first determine that a need for technicians exists and that the college can supply the appropriate skills required by the employing industries.

Energy Conservation Technology

Energy conservation is based on two interrelated objectives: reducing energy consumption and using energy more efficiently. The American public has not yet been forced to alter their lifestyles substantially to conserve energy. A United Nations study found that the United States had the smallest reduction in energy consumption of any industrial nation following the Arab oil embargo. Expected policy and public acceptance of energy conservation measures that affect levels of commonplace services would require extensive technological alterations.

Three examples of survey responses illustrate how colleges are responding to energy conservation technology needs. The only existing energy conservation technology program was in natural resources conservation, a curriculum also reported as planned in two additional colleges. The college in New York, with this program, graduated 30 persons in 1975 and projects a graduating class of 22 in 1976. (See Table III.23.)

Some colleges reported modifying programs to incor-

TABLE III.23

ENERGY CONSERVATION TECHNOLOGY:
COLLEGES AND THEIR EXISTING PROGRAMS, ENROLLMENT, AND GRADUATES

Region	College	Program	Enrollment	1975 Graduates	Projected 1976 Graduates
East	1	1	92	30	22

porate energy conservation instruction. Three colleges reported alterations in their automotive technology curricula to instruct students on ways to improve engine efficiency. And two colleges are planning changes in building-technology courses to focus on alternative energy and construction techniques.

Thirteen colleges each have a planned energy conservation technology program. Of these programs, 10 are in the informal planning stage, 2 are in the preliminary planning stage, and 1 is in the formal planning stage. Seven of the eight sections of the country had planned programs. (See Table III.24.)

It is still to be ascertained if there is a need for energy conservation technicians. If so, should separate educational programs be instituted to train them, or should existing programs be modified? At least one thing is certain. a college should determine the kind of skills actually needed for employment before establishing an energy conservation technology program.

Electrical Energy Technology

The research staff intended to analyze electrical programs primarily related to power production and power transmission in the same manner as other energy technologies. However, only 32 colleges responding listed electricity or electronics programs, an insufficient number for analysis.

In contrast, within its 944-college population, *Barron's Guide to the Two-Year Colleges* in 1975 lists 352 electrical technology programs, of which 208 are classified as terminal certificate programs, 97 as transfer programs, and 47 as terminal and transfer programs.

The best available data on the existing electrical technology programs contained in the study are the Engineering Manpower Commission of the Engineers Joint Council. In a 423-college sample, the Commission reported that 103 colleges graduated 2,465 students in electrical programs in the year ending June 1974. (That study's low response rate emphasized the difficulty of acquiring technical-occupation supply data.)

If it is assumed that the two populations, the 352 electrical technology programs listed by *Barron's Guide* and the one surveyed by the Engineering Manpower Commission, are similar, it can be inferred that the number of graduates for 1974 would have been in the range of 5,500 to 8,400.

In sum, it would seem that the large number of existing electrical technology programs could accommodate any curriculum revisions and advances in the technology. The colleges have the capacity to meet increases in demand for technicians at both the regional and the national levels.

TABLE III.24

ENERGY CONSERVATION TECHNOLOGY:
NEW COLLEGES PLANNING PROGRAMS AND STAGES OF PLANNING

Regions	New Colleges	Program Planning Stage		
		Informal	*Preliminary*	*Formal*
New England	1	–	1	–
East	3	2	1	–
South	1	1	–	–
Midwest	4	3	–	1
North Central	1	1	–	–
Southwest	1	1	–	–
West	2	2	–	–
TOTAL	13	10	2	1

CHAPTER IV
Conclusion

The analysis confirms the premise of AACJC and ERDA in cosponsoring this study, that the AACJC-member and nonmember colleges are involved in and desire assistance in identifying energy-related technology occupational needs and establishing energy educational programs. AACJC and ERDA will cosponsor a national conference during 1976 on six energy-related technology areas. The invited colleges will discuss common activities to increase college and industrial cooperation and to encourage federal and state support to help solve energy-related manpower problems.

Of the colleges surveyed, the 62 colleges reporting existing energy programs and the 132 colleges reporting planned programs should provide the base of colleges to participate in proposed activities to determine educational programs needed for energy-related technology occupations and to help initiate the programs. The total of 511 institutions interested in attending an energy conference comes almost exclusively from public colleges.

The responding colleges indicated a recognization that energy-related occupational needs will reflect the nation's response to energy demands. At the present time, at the macro level only a small percentage of workers are employed or being trained for employment in energy-extraction or energy-production industries. Consequently, colleges wish to know whether energy needs will be felt within their geographical regions and, if so, whether either new occupational programs will be required or existing programs will need to be restructured.

Many hypotheses have been formulated about the effects of national energy policies on regional labor markets and on employment in certain industries. Educational institutions should be preparing students to accept having to relocate to continue employment because of changing economic conditions. Cross-training of displaced workers for employment in other geographical regions could eventually become a major responsibility of some colleges. However, until such energy policies are introduced, the changes will remain theoretical.

It can be assumed that a few of the institutions reporting to be planning energy, solar energy, and energy conservation programs were trying to preempt other schools in their region, because early planning in these areas could increase a college's chances for future state and federal funds.

With few exceptions, the existing energy-related technology programs are designed by the colleges to serve local clientele and to provide employees for local companies. The best examples of this are college coal-mining technology programs well attuned to the mining-company needs. Coal-related programs are being both expanded to new colleges and enlarged in existing colleges within a one- to two-year startup time. Upgrading employed miners' skills to improve their production or to enable them to obtain certification is often more important to the college, the coal industry, and students than having students complete the requirements for an associate degree.

The nuclear energy technology offerings are a mix of local and regional programs. The first colleges installing programs, seven to ten years ago, have saturated their local employment markets with graduates and have consequently developed nation-wide contacts to place other graduates. Most recently established nuclear technology programs tend to have been developed because of local nuclear-related em

ployers. And many programs being planned are responses to possible construction of nuclear reactors by utility companies.

Petroleum technology programs, with few exceptions, have been created within the last five years. They are designed mainly to meet local demands, and surplus graduates are placed nationally. In both recently established and planned programs, the curricular content seems to emphasize extraction techniques over refinery ones.

Laser-optics technology, growing in its application to energy research, has recently expanded into new colleges. TERC, presently funded by the Office of Education to develop curriculum modules and support new program implementation, believes that within the next four years there will be an adequate supply of graduates.

Research and demonstration projects for the other four energy categories analyzed (solar, geothermal, energy technology, and energy conservation) are increasing in both the public and private sectors. Extensive studies on the manpower required are needed. What will the manpower demand be in the short-run and in the long-run? What skills are required for research technicians and, ultimately, for assembly and maintenance technicians? Will new occupational categories be necessary, or can the technicians be educated within existing occupations? Although 68 colleges reported planned programs in these areas, the colleges indicated that they were concerned enough about the above issues to move cautiously in establishing these programs.

One question not addressed previously is how adequate colleges are in supplying graduates to meet present and future demands. The survey obtained information on this in the three major areas: petroleum technology, coal-mining technology, and nuclear energy technology.

From their petroleum technology programs, responding colleges project they will graduate an average of 10.5 students per college in 1975 and 12 students per college in 1976. (See Table IV.1) The number of graduates is expected to grow, because six colleges began their programs in 1975. Concern has been expressed by some colleges with petroleum programs in not being able to compete with four-year institutions for students. The average enrollment in petroleum technology in two-year colleges is only 31. However, given the number of college petroleum technology programs recently initiated and in planning in all sections of the nation, the colleges should be able to increase the number of graduates and establish more programs if there is a sufficient increase in demand.

In coal-mining technology, colleges are demonstrating their ability to expand their programs in response to the growing demand. Colleges with existing coal-mining programs had difficulty in computing their head count enrollment because of their many diverse offerings. The average number of graduates per college offering these programs in 1975 was only 9, with an expected increase in 1976 to 20. As explained earlier, many of the coal-mining technology programs are primarily designed to upgrade the skills of employed miners. The average enrollment of all mining technology students in the 17 colleges is 169, a figure which is known to be low. With 12 colleges planning programs, the number of miners served should greatly increase.

The 17 colleges with nuclear energy technology programs graduated only an average of 5 students in 1975, although the projection for 1976 is 12. Average enrollment in 1975 was only 32, some colleges expressing difficulty in attracting students into the field. However, with the large number of newly established college nuclear energy technology programs, many now with small enrollments, and with 17 colleges planning such programs, the number of graduates should increase in subsequent years.

The survey was not designed to provide information on the relative quality of existing programs in any energy-related technology. The economy of scale necessary to operate an energy training program with extraordinary start-up costs was another question the survey was not designed to answer. However, additional study should be done on both questions before recommendations are made on establishing additional energy-related technologies in the three major energy areas or in the emerging energy fields.

TABLE IV.1

THE THREE MAJOR ENERGY-RELATED TECHNOLOGY OCCUPATION AREAS: COLLEGES AND THEIR ENROLLMENT AND GRADUATES

Category	Petroleum Technology	Coal-Mining Technology	Nuclear Energy Technology
Colleges	12	17	18
Programs	13	24	19
Enrollment	375	2,878	542
Average enrollment per college	31	169	30
1975 graduates	126	153	83
Average graduates per college	10.5	9	5
1976 projected graduates	143	343	210
Average projected graduates per college	12	20	12

APPENDIX A

Survey Cover Letter and Questionnaire

American Association of Community and Junior Colleges

Dear President

The Energy Research and Development Administration (ERDA) has requested the support of the American Association of Community and Junior Colleges to disseminate information on the emerging energy technical manpower needs that will result from commercial activities on new energy approaches. ERDA is working closely with federal and state agencies and with energy industries to provide information and program development support to colleges and schools

The purpose of the enclosed form is twofold: first, to determine the existing types of energy related curriculums that community and junior colleges and technical institutes presently have or are planning, and secondly, to determine the degree of interest in and suggested format for a regional conference on energy needs.

The tentative format for the regional conferences is to have a series of meetings in various locations, two or three days in length. Participants from ERDA, other federal and state agencies, private industries and public utilities would present information on emerging occupational and education needs These needs would be primarily in the fossil fuels, nuclear energy and energy conservation fields. Participants from community and junior colleges and technical institutes would present their own energy-related programs, lead discussions and suggest followup activities. ERDA, as the federal agency with the primary energy mission, is interested in how it can be supportive to education institutions.

As a result of this series of conferences, ERDA would support the establishment of recommendations, work to develop curricula, determine equipment and facility needs, acquire industries support, plan programs for needed instructor training, and identify tentative student work experiences.

We would appreciate prompt attention to the attached questionnaire and suggestions on developing a conference format that would be most beneficial to community and junior colleges and technical institutes. Please return these materials in the envelope enclosed by November 17. Thank you for your assistance.

Sincerely yours,

Richard E. Wilson

Richard E. Wilson
Vice President for Programs

REW:chc

One Dupont Circle N.W. Suite 410 Washington D.C. 20036 202 293 7050

A SURVEY OF EMERGING ENERGY TECHNICAL TRAINING PROGRAMS AND NEEDS

American Association of Community and Junior Colleges
One Dupont Circle, N. W.
Washington, D. C. 20036

PLEASE RESPOND BY NOVEMBER 17, 1975

Control Code
Leave Blank
1 (1–10)

Address Label

Control Code
Leave Blank
2 (1–10)

PERSON TO BE CONTACTED IF QULSTIONS ARISE CONCERNING THIS SURVEY:

Last Name (11) First (15) Title (36–55) Phone (Include Area Code) (56–65)

WHAT ENERGY-RELATED DEGREE AND CERTIFICATE PROGRAMS DOLS YOUR INSTITUTION PRESENTLY HAVL? (Fossil, nuolgar, conservation of energy, solar, geothermal, laser and others. If your institution has an engineering technology program with an energy option, include it.)

(Complete for the Calendar Year)

Control Code
Leave Blank
3 (1–10)

Leave Blank (11–15)	Program Title (16–67)	Length in Months (68–69)	Year Program Started (19 70–71)	Total Program Enrollment (Head Count) CY 1975 (72–74)	Graduates CY 1975 (75–77)	Expected Graduates CY 1976 (78–80)
			19			
			19			
			19			
			19			

(Please list additional programs on separate sheet.)

WHAT ADDITIONAL ENERGY-RELATED DEGREE AND CERTIFICATE PROGRAMS ARE BEING DISCUSSED OR FORMALLY PLANNED? (Include those that are informally being discussed as well as those nearly operational.)

Control Code
Leave Blank

4 | | | | | | | | | |
1 10

Leave Blank	Program Title	Length in Months	Stage of Development (Check appropriate box)	Expected Beginning Date
11 15	16 73 74 75		76 Informal, in-house 77 Preliminary Planning 78 Formal Planning	19 79 80
Leave Blank	UG		76 Informal, in-house 77 Preliminary Planning 78 Formal Planning	19 79 80
Leave Blank			76 Informal, in-house 77 Preliminary Planning 78 Formal Planning	19 79 80
Leave Blank			76 Informal, in-house 77 Preliminary Planning 78 Formal Planning	19 79 80

(Please list additional programs on separate sheet.)

Control Code
Leave Blank

5 [ ][ ][ ][ ][ ][ ][ ][ ][ ]
1 10

WOULD A REPRESENTATIVE FROM YOUR INSTITUTION BE INTERESTED IN ATTENDING A REGIONAL CONFERENCE ON EMERGING ENERGY-RELATED TECHNICAL MANPOWER NEEDS IN THE LATE SPRING OR SUMMER?

Yes ☐ (9) No ☐ (10)

DOES THE FORMAT FOR THE TWO-TO-THREE-DAY REGIONAL CONFERENCES OUTLINED IN THE COVER LETTER SEEM SATISFACTORY TO YOUR NEEDS? (If no, please provide suggestions on improving the format on a separate sheet.)

Yes ☐ (9) No ☐ (10)

HAS YOUR INSTITUTION BEEN INVOLVED IN ANY COOPERATIVE PROGRAMS WITH THE ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION CONTRACTORS (formerly the Atomic Energy Commission and Department of the Interior Energy Research Centers)?

Yes ☐ No ☐

HAVE THESE ACTIVITIES BEEN RELATED TO ENERGY OCCUPATIONS?

Yes ☐ No ☐

IF YES, CHECK THE INVOLVED AREAS:

19 ☐ Use of Facilities
20 ☐ Use of Equipment
21 ☐ Use of Professional Staff as Instructors
22 ☐ Student Work Experiences
23 ☐ Instructor Training Program
24 ☐ Formal Training of Contractor Employees
25 ☐ Curriculum Planning
26 ☐ Other (please list) _____

PLEASE LIST CONTRACTOR(S) INVOLVED:

27 28 ☐☐ _____
29 30 ☐☐ _____
31 32 ☐☐ _____
33 34 ☐☐ _____

HAS YOUR INSTITUTION BEEN INVOLVED IN ANY COOPERATIVE PROGRAMS WITH ENERGY PRODUCING INDUSTRIES IN THE DEVELOPMENT OF MAJOR PROGRAMS OR SHORT COURSES?

Yes ☐ (51) No ☐ (52)

HAVE THESE ACTIVITIES BEEN RELATED TO ENERGY OCCUPATIONS?

Yes ☐ (53) No ☐ (54)

IF YES, CHECK THE INVOLVED AREAS:

55 ☐ Use of Facilities
56 ☐ Use of Equipment
57 ☐ Use of Professional Staff as Instructors
58 ☐ Use of Professional Staff as Curriculum Planning Resources
59 ☐ Instructor Training Programs
60 ☐ Formal Training of Contractor Employees
61 ☐ Other (please list) _____

PLEASE LIST ANY INDUSTRIES INVOLVED:

62 ☐ _____
63 ☐ _____
64 ☐ _____
65 ☐ _____

OTHER COMMENTS RELATIVE TO RESPONDING TO THE NEEDS OF COMMUNITY AND JUNIOR COLLEGES IN DEVELOPING ENERGY PROGRAMS WOULD BE APPRECIATED. (On separate sheet.)

APPENDIX B

Occupational Curricula Not Included Under Energy Technologies

Air pollution
Architect technology
Automotive technology
Chemical technology
Civil engineering technology
Climate control technology
Construction technology
Drafting technology
Electromechanical engineering
Electronics
Engineering—no option
Engineering certificate
Environmental engineering
Environmental marine science
Industrial engineering
Manufacturing technology
Marine propulsion
Marine science
Mechanical design
Mechanical engineering technology
Nuclear medicine
Plumbing and pipefitting
Pollution control technology
Practical architect—training
Practical construction training
Refrigeration and air conditioning
Solid waste technology
Traffic engineering
Urban planning
Water and wastewater technology
Welding technology

APPENDIX C

Institutions Having Existing Energy Programs[1]

I. PETROLEUM (OIL AND GAS) PROGRAMS

East
Butler County Community College
Butler, Pa.

South
Delgado Junior College
New Orleans, La.

Midwest
Hocking Technical College
Nelsonville, Ohio
Lincoln Trail College
Robinson, Ill.
Muskingum Area Technical College
Zanesville, Ohio
Northwestern Michigan College
Traverse City, Mich.

North Central
Casper College
Casper, Wy.

Southwest
Lee College
Baytown, Tex.
Midland College
Midland, Tex.
Western Texas College
Snyder, Tex.

West
Ventura College
Ventura, Calif.

Alaska
Tanana Valley Community College
Fairbanks, Alaska

II. COAL-MINING AND RELATED PROGRAMS

East
Beckley College
Beckley, W.V.
Bluefield State College
Bluefield, W.V.
Community and Technical College,
West Virginia Institute of Technology
Montgomery, W.V.
Fairmont State College
Fairmont, W.V.
Williamson Campus, Southern West Virginia
Community College
Williamson, W.V.

South
Madisonville Community College
Madisonville, Ky.
Mountain Empire Community College
Big Stone Gap, Va.
Southeast Community College
Cumberland, Ky.
Southwest Virginia Community College
Richlands, Va.

Midwest
Belmont Technical College
St. Clairsville, Ohio
Wabash Valley College
Mt. Carmel, Ill.
Indiana Vocational Technical College
Indianapolis, Ind.
Rend Lake College
Ina, Ill.
Southeastern Illinois College
Harrisburg, Ill.

North Central
Casper College
Casper, Wy.
Sheridan College
Sheridan, Wy.

Southwest
College of Eastern Utah
Price, Utah

III. NUCLEAR ENERGY PROGRAMS

New England
Hartford State Technical College
Hartford, Conn.
Wentworth Institute
Boston, Mass.

East
Altoona Campus, Pennsylvania State University
Altoona, Pa.
Community College of Beaver County
Monaca, Pa.
Hazleton Campus, Pennsylvania State University
Hazleton, Pa.

[1]No listing of institutions planning energy programs is included because of their tentative status and to prevent possible embarrassment. Schools were asked in the survey to list programs that they were informally planning and may not yet have taken before their respective education boards.

South
Aiken Technical Education Center
Aiken, S.C.
Central Florida Community College
Ocala, Fla.
Central Virginia Community College
Lynchburg, Va.
Chattanooga State Technical Community College
Chattanooga, Tenn.
Florence-Darlington Technical College
Florence, S.C.
Midlands Technical College
Columbia, S.C.
Roane State Community College
Harriman, Tenn.
Tri-County Technical College
Pendleton, S.C.

Midwest
Terra Technical College
Fremont, Ohio

Southwest
James Connally Campus, Texas State Technical Institute
Waco, Tex.
Rio Grande Campus, Texas State Technical Institute
Harlingen, Tex.

West
Chabot College
Hayward, Calif.

Shoreline Community College
Seattle, Wash.

IV. SOLAR ENERGY PROGRAMS

Central
Scott Community College
Bettendorf, Iowa

V. LASER-OPTICS PROGRAMS

Midwest
Vincennes University
Vincennes, Ind.

Southwest
James Connally Campus, Texas State Technical Institute
Waco, Tex.
Rio Grande Campus, Texas State Technical Institute
Harlingen, Tex.

West
San Jose City College
San Jose, Calif.

VI. ENERGY CONSERVATION PROGRAMS

East
Dutchess Community College
Poughkeepsie, N.Y.

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