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ABSTRACT

This report provides information about the number and characteristics of doctoral level engineers and scientists in primarily energy-related activities for 1975. The data included are part of an attempt to monitor the supply and demand of energy technology professionals. Chapter titles which indicate the types and arrangement of data are: (1) Introduction and Data Base Description; (2) Degree Specialities, Employment Fields, and Biographical Characteristics; (3) Primary Work Activities and Types of Employers; (4) Regional Location and Salaries; and (5) U.S. Government Funding Sources. Appended is the survey questionnaire used to gather these data and a list of doctoral degree specialties and employment fields. Most of the data are presented in tabular form with explanatory discussion in the text. A section presenting a summary of the data is given. (MR)

Energy-Related Doctoral Scientists and Engineers in the United States 1975

DOE/IR-0033

U.S. Department of Energy

Division of Manpower Assessment

November 1977

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FOREWORD

The pursuit of "a vigorous research and development program to provide renewable and other resources to meet U.S. energy needs in the next century" is an important objective of President Carter's National Energy Plan. A highly educated and motivated pool of engineers and scientists must be available for energy research and development if this objective is to be achieved.

The present report provides, for the first time, information about the number and characteristics of doctoral level engineers and scientists in primarily energy-related activities. These data for the year 1975 will become part of the data base for a program of continuing studies on the employment and utilization of all scientists and engineers involved in energy-related activities. Information from these studies will help indicate the actions necessary to ensure that adequate numbers of qualified doctoral level scientists and engineers are available when needed to develop the nation's energy resources and technologies.

Special recognition goes to Larry M. Blair, Oak Ridge Associated Universities, who is responsible for the analysis and preparation of this report; and to the National Academy of Sciences—National Research Council for their assistance in data tabulations.

Norman Seltzer, Director
Division of Manpower Assessment

HIGHLIGHTS — ENERGY-RELATED DOCTORAL SCIENTISTS AND ENGINEERS, 1975

Energy-Related and Total Doctoral Employment

Nearly 8 percent (20,850 of 263,000) of the employed doctoral scientists and engineers in the United States in 1975 indicated they spent a significant portion of their professional time in energy- and fuel-related activities.

Among the doctoral engineers and the earth, environment, and marine scientists, 22 percent and 20 percent, respectively, were energy-related.

Among the doctoral physical scientists, 12 percent were energy-related, but among doctoral life, social, and other scientists, only 2 percent were energy-related.

Degree Specialties and Employment Fields

Almost 80 percent of the energy-related scientists and engineers had doctorate degree specialties in engineering or physical science compared with approximately 40 percent of all doctoral scientists and engineers.

Seventy-three percent of the energy-related doctorates were working as either engineers or physical scientists compared with only 35 percent of the total doctoral population working as engineers or physical scientists.

High proportions of doctoral scientists and engineers employed in the following fields were engaged in energy-related activities: plasma physics (62 percent), thermodynamics and material properties chemistry (45 percent), geophysics (44 percent), applied geology (42 percent), nuclear engineering (68 percent), fuel technology/petroleum engineering (84 percent), and mining engineering (60 percent).

Field Switching

Both the total population of doctorates and the energy-related population reported that about four out of five individuals were working in the same employment field as their degree specialty.

Among the various degree specialties, however, differences existed between the energy-related population and the total doctoral population in the percentage working in the corresponding employment fields. For example, 89 percent of the energy-related population who earned their doctoral degree in engineering were employed as engineers compared with 84 percent of all doctorates; 65 percent of the energy-related population who earned their doctoral degree in mathematics were employed as mathematicians compared with 86 percent for all doctorates.

Primary Work Activity

Forty-five percent of the energy-related population reported research or development as their primary work activity versus 32 percent of all doctoral scientists and engineers.

Thirty percent of the energy-related population reported management or administration as their primary work activity versus 20 percent of all doctoral scientists and engineers.

Ten percent of the energy-related population reported teaching as their primary work activity versus 36 percent of all doctoral scientists and engineers.

Type of Employers

Among the energy-related population, 56 percent worked in business or industry and 28 percent worked in educational institutions; in the total doctoral popula-

tion, 25 percent worked in business or industry and 58 percent worked in educational institutions.

Geographic Location of Employment

The Southwest, Mountain, and Pacific regions had relatively more employment (40 percent) of the energy-related doctoral scientists and engineers than of the total population of doctoral scientists and engineers (28 percent). California had the most energy-related doctoral scientists and engineers with 3000 (14 percent), Texas was second with 1890 (9 percent).

Salaries

The median salary for all energy-related doctorates was 12 percent higher than the median salary for all doctoral scientists and engineers ($25,900 versus $23,100). Median salaries were higher for energy-related doctorates in all employment fields except civil engineering.

U.S. Government Support

Forty-seven percent of the energy-related doctorates received U.S. government support versus 43 percent for all doctoral scientists and engineers.

Twenty-four percent of the energy-related doctorates received support from the Energy Research and Development Administration (ERDA) compared with 4 percent in the total population of doctoral scientists and engineers. The National Science Foundation provided support to 8 percent and the Department of Defense to 7 percent of the energy-related doctorates who received U.S. government support.

ERDA at least partially supported 10,954 doctoral scientists and engineers in 1975. Physicists and engineers accounted for 33 percent and 30 percent, respectively, of the doctorates receiving ERDA support. Slightly over one-half of the doctorates receiving ERDA support were employed in educational institutions.

Minorities, Women, and Non-U.S. Citizens

Compared with all doctoral scientists and engineers, relatively fewer of the energy-related population indicated their race/ethnicity as white, black, American Indian, or Hispanic, and relatively more indicated Oriental or other Asian:

88.1 percent white among energy-related versus 89.4 percent among the total

0.5 percent black, American Indian, or Hispanic among energy-related versus 1.6 percent among the total

7.7 percent Oriental or other Asian among energy-related versus 5.0 percent among the total

Only 1.5 percent of the energy-related population were women compared with 8.5 percent for all doctoral scientists and engineers. Even in fields having higher percentages of women, the energy-related population had relatively fewer.

Nearly 9 percent of the energy-related doctorates were non-U.S. citizens versus approximately 6 percent in the total population of doctoral scientists and engineers.

A substantial portion of the differences in the percentages for minorities, women, and non-U.S. citizens can be attributed to the relative concentration of engineers and physical scientists within the energy-related population. There are relatively fewer blacks, Hispanics, American Indians, and women but relatively more Orientals, other Asians, and non-U.S. citizens in engineering and physical science.

CHAPTER 1.

Introduction and Data Base Description

In recent years, a growing concern has emerged over the adequacy of future energy resources. In response to this concern, the nation is currently expending considerable effort to analyze and debate the need for various policies and programs to influence the future mix of energy production, utilization, and conservation.

The United States Energy Research and Development Administration (ERDA) is developing an expanded data base to encompass the scientific, engineering, and technical personnel engaged in energy-related activities. These data are used for manpower research and to develop policy recommendations to help meet energy program needs, especially in research, development, and demonstration activities. This report provides information on one segment of energy-related manpower in the nation: doctoral level scientists and engineers who indicated that they devoted a significant proportion of their professional time to energy-related activities in 1975.

1.1 Data Source and Scope

This report was developed from data tabulations provided by the National Academy of Sciences-National Research Council (NAS-NRC).[1] The data were collected by NAS-NRC in a survey initiated in the spring 1975 with follow-ups during the summer and fall of the same year. This survey was sponsored by the National Science Foundation (NSF) and the National Institutes of Health (NIH).

The survey sample was drawn from a universe of doctoral scientists and engineers compiled by NRC. The universe included persons who received their doctorates from 1930 through 1974 in the natural and social sciences, mathematics and engineering, or who had their doctorate in other fields, e.g., business, education, arts, and humanities, but who were subsequently employed in scientific or engineering fields.[2]

Stratified sampling was used to establish the survey sample base. This permitted collecting relatively larger samples of small subgroups to obtain reliable estimates for all subgroups. The survey sample was approximately 15 percent of the total universe. The sample responses were inflated, according to the stratified sample sizes, to represent the total population of all doctoral scientists and engineers and the entire populations for each subgroup.

The survey indicated there were approximately 279,400 doctoral scientists and engineers in the United States at the beginning of 1975. The survey included information about doctoral degree specialties; employment fields; salaries; primary work activities; types of employers; sources of government support; and various biographical data, e.g., age, sex, and ethnicity. Reported salaries were regular salaries based on a 12-month period. (Salaries were converted by NRC to 12-

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[1] Unless otherwise noted, the data tabulations were provided by
Board on Human-Resource Data and Analysis
Commission on Human Resources
National Research Council
2101 Constitution Avenue
Washington, D.C. 20418

[2] For details of the NAS-NRC survey, including survey procedures and statements concerning the statistical significance of the sample data, see *Doctoral Scientists and Engineers in the United States, 1975 Profile*, 1976, Washington, D.C.: National Academy of Sciences.

month equivalents when necessary, e.g., 9- or 10-month salaries for college professors.)

Appendix A shows the survey questionnaire. The detailed doctoral degree specialties and employment fields, as used in the survey, are listed in Appendix B.

1.2 Description of Energy-Related Doctoral Data

In this report, *energy-related* is used to denote the population of doctoral scientists and engineers who indicated in the survey that during February 1975 they devoted a significant portion of their professional time to the energy and fuel problem area, one of several critical national interest problem areas from which respondents could choose. (The actual question from the survey is reproduced in Figure 1.) The survey did not collect information pertaining to the proportion of time spent in energy- and fuel-related activities nor to the segment of the energy field in which the respondent might have been involved, e.g., fossil, nuclear, or solar.

The survey indicated that approximately 8 percent (or 20,850) of the 263,000 employed doctoral scientists and engineers devoted a significant portion of their time to energy- and fuel-related activities in 1975. However, this survey number does not provide a complete count of doctoral scientists and engineers with energy- and fuel-related experience and training in the United States in 1975. Many individuals who indicated another area of critical national interest, or who did not indicate any area, may have devoted a lesser part of their time to energy- and fuel-related activities in 1975 or may have engaged in energy-related work in prior years. Moreover, many doctoral scientists and engineers who received funds from energy-related agencies, e.g., ERDA or the U.S. Bureau of Mines, may have indicated an area other than energy and fuel, e.g., health, environment, defense, or even food production.

The NAS-NRC survey of all doctoral scientists and engineers included employed, unemployed, and those not in the labor force, although tabulations on the energy-

19. Listed below are selected topics of critical national interest. If you devoted a significant proportion of your professional time to any of these problem areas in February, 1975, please check the box for the one on which you spent the MOST time.

Education:
- 1 ☐ Teaching
- 2 ☐ Other

- 3 ☐ Health
- 4 ☐ Defense
- 5 ☐ Environmental protection, pollution control
- 6 ☐ Space
- 7 ☐ Crime prevention and control
- 8 ☐ Food production and technology
- 9 ☐ Energy and fuel
- 10 ☐ Other mineral resources
- 11 ☐ Community development and services
- 12 ☐ Housing (planning, design, construction)
- 13 ☐ Transportation, communications
- 14 ☐ Other, specify: (28-29)

FIGURE 1. NAS-NRC Survey Question for Identifying Energy-Related Doctoral Scientists and Engineers, 1975

NOTE: 1975 Survey of Doctoral Scientists and Engineers, conducted by the National Research Council with the support of the National Science Foundation. See Appendix A for the complete questionnaire.

related populations were limited to the employed doctoral scientists and engineers. Approximately 91 percent of the total population of doctoral scientists and engineers were employed in 1975, so some persons trained or experienced in the energy field may have been overlooked in the 9 percent without jobs.

Finally, it should be noted that some of the subgroups in the energy-related populations were represented by fairly small samples. The accuracy of the count and characteristics of subgroups with small estimated populations should be treated with some caution.[1]

[1] Those subgroups with sample sizes so small that they are not statistically significant are noted in the tables.

CHAPTER 2.

Degree Specialties, Employment Fields, and Biographical Characteristics

Approximately 8 percent of the doctoral scientists and engineers indicated they were involved in energy-related activities (20,852 out of 262,991); however, in many employment fields and degree specialties the energy-related population accounted for much higher proportions of the doctorate population (Figures 2 and 3 and Tables 2-1a and 2-2a). In particular, the energy-related population accounted for just over 20 percent of the doctoral degrees and doctoral employment in engineering; approximately 20 percent in earth, environment, and marine sciences; and approximately 15 percent in physics (Figure 4).

In many of the more narrowly defined employment fields, e.g., chemical engineering, plasma physics, and applied geology, energy-related doctorates constituted from 30 percent to as much as 80 percent of the total doctoral population (Tables 2-1b, 2-1c, 2-2b, and 2-2c). More specifically, two employment areas (engineering and earth, environment, and marine sciences) each had five fields in which over 25 percent of those employed were involved in energy-related activities. The employment fields with the largest proportions of energy-related respondents were the engineering fields of mining (60 percent), nuclear (68 percent), and fuel technology/petroleum (84 percent). It should be noted that mining engineering is not shown separately in the tables in this section because less than 5 percent of the energy-

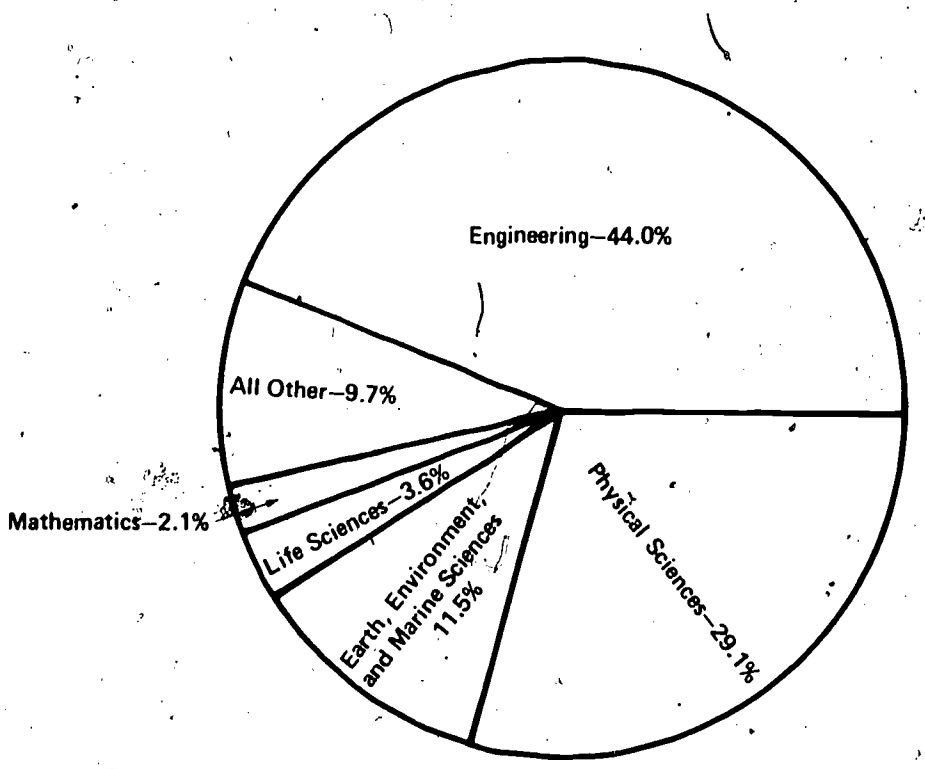


FIGURE 2. Employment Field Distribution
Energy-Related Doctoral Scientists and Engineers
1975 Employed Population

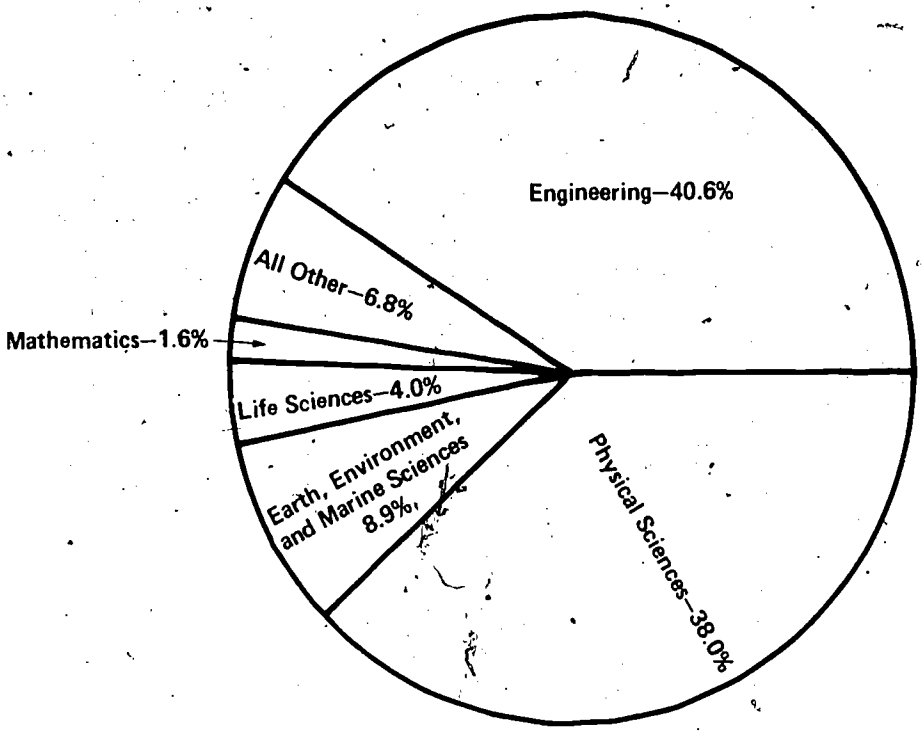


FIGURE 3. Degree Specialty Distribution Energy-Related Doctoral Scientists and Engineers 1975 Employed Population

related engineers were employed in or had degree specialties in mining engineering.

As described above, substantial proportions of the doctorates (15 percent to 80 percent) in many degree specialties and employment fields were involved in energy-related activities. Thus, programs and policies designed to significantly change energy research, development, production, and utilization can potentially cause major impacts in the work activities and labor markets for several types of doctoral scientists and engineers. Costs and timing for some energy-related programs could be adversely affected by shortages of doctoral scientists and engineers in several specific employment fields, at least in the short-run.

Let us briefly discuss the 16 percent to 40 percent of the mining, nuclear, and fuel technology/petroleum engineers who did not indicate they were energy-related. Part of this situation may have been the result of individuals who simply neglected to respond to the question. But most of those who did not indicate they were energy-related probably indicated another area as their principal activity, e.g., teaching or mineral resources. Among the nuclear engineers the nonenergy-related respondents could have been working in areas such as nuclear physics research or accelerators, which are not usually regarded as energy- or fuel-related.

The survey indicates that approximately 20 percent of the doctoral scientists and engineers were working in an employment field different from their degree specialty, e.g., a person with a doctorate in engineering working as a mathematician (Figure 5 and Table 2-3a). The range for energy-related doctorates reporting employment in the same field as their doctoral degree specialty was from 64 percent and 65 percent for degrees in physics and mathematics,[1] respectively, to 94 per-

[1] Mathematics includes various degree subspecialties and employment subfields, e.g., mathematical statistics, operations research, computing theory (see Appendix B for complete list).

cent for degrees in the earth, environment, and marine sciences. This means, for example, that slightly less than two-thirds (2200 out of 3400) of the energy-related doctorates with degrees in physics were working as physicists.

The data tabulations do not show the number of doctoral scientists and engineers who had switched from their specific degree subspecialty to a different employment subfield in the same general field, e.g., a person with a degree in nuclear structure physics working as a plasma physicist. However, within the energy-related population the data indicates that considerable numbers of doctorates must have switched from their degree subspecialty to a different employment subfield (Table 2-3e). Several energy-related employment subfields had two or three times as many doctorates employed as had degrees in the corresponding subspecialty (e.g., plasma physics and applied geology) while employment levels in other subfields were considerably less than the number of persons who had degrees in the corresponding subspecialty (e.g., nuclear structure physics and earth science). (See Table 2-3e.)

Similarly, the data for the engineering field indicate a large number of doctorates had to be working in an engineering field different from the one in which they received their degree (Table 2-3d). For instance, there were many more doctorates employed as fuel technology/petroleum engineers than had degrees in these fields.

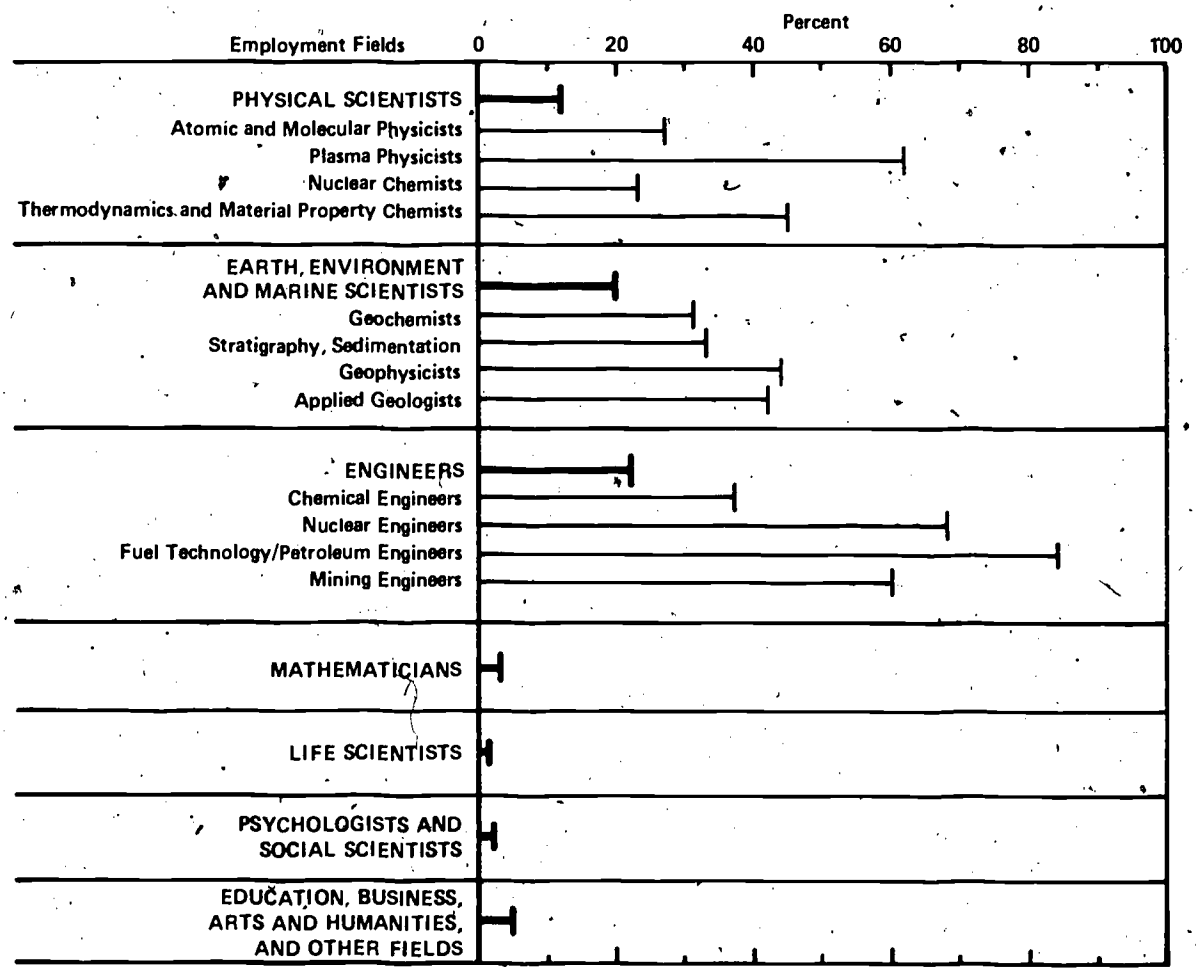
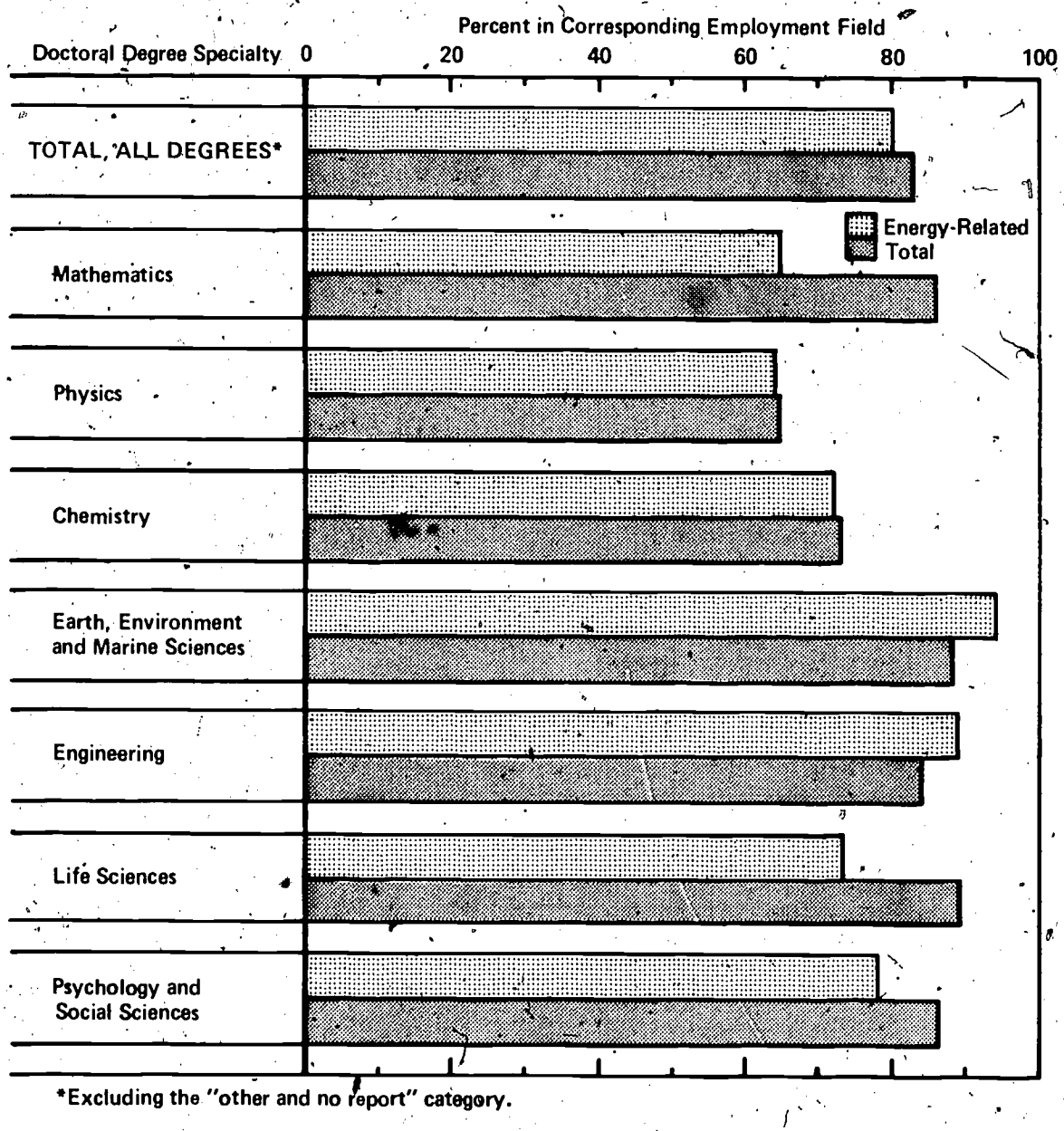


FIGURE 4. Energy-Related Employment as a Percentage of Total Employment Doctoral Scientists and Engineers, 1975



*Excluding the "other and no report" category.

FIGURE 5. Degree Specialties and Percentage Working in Corresponding Employment Fields, 1975 Doctoral Scientists and Engineers

Evidence from other sources indicates considerable employment of doctorates with chemical engineering degrees as fuel technology/petroleum engineers.[2]

Thus, the survey shows that one out of five doctoral scientists and engineers was working in an employment field different from his degree specialty. In addition, the survey data indicate that a large number of the energy-related doctorates were working in employment subfields different from their specific degree subspecialty. It is not possible to estimate what proportion of this field switching was forced

[2] Larry M. Blair and Gary de Mik. 1975. "Background Analysis and Data — Ph.D. Manpower." An unpublished report to ERDA. Oak Ridge: Oak Ridge Associated Universities. This study was conducted during the same period as the NAS survey.

(e.g., lack of adequate jobs in the field) and what proportion was voluntary (e.g., more interesting work, better pay). The essential point, however, is that the evidence shows that many doctoral scientists and engineers, in all degree specialties, have switched fields. New job opportunities will attract persons from other fields and will affect the relative supply of doctorates available in other employment fields. Allowances for field switching must, therefore, be considered in policy and planning activities.

It should be noted that without further knowledge of the interactions in the labor market for doctoral scientists and engineers, the employment field and degree specialty data cannot be used to develop relative supply and demand estimates; i.e., the data provide no clear-cut indications of job opportunities for various degree specialties.[1] As an example, among the energy-related population a large percentage of the doctorates in two employment fields — mathematics and the earth, environment, and marine sciences — earned their degree in other specialties. This would appear to indicate that a shortage of doctorates existed in these degree specialties, and, therefore, most doctorates with degree specialties in mathematics and earth, environment, and marine sciences would have found employment in their respective fields. This was actually the case in the earth, environment, and marine sciences where 94 percent of the doctorates in this degree specialty were employed in the field. However, 35 percent, a relatively high proportion, of the doctorates in mathematics were employed in fields other than mathematics.

The last set of tables in this chapter (2-4a and 2-4b) review various biographical data. The energy-related population compared with all doctoral scientists and engineers had a slightly lower percentage representation of whites, blacks, Hispanics, and American Indians and a somewhat higher percentage representation of Orientals and other Asians. The proportion of energy-related doctoral women (1.5 percent) was considerably smaller than among all doctoral scientists and engineers (8.6 percent). Non-U.S. citizens were relatively more numerous among the energy-related population (8.8 percent) than among all doctoral scientists and engineers (5.8 percent).

A substantial amount of the differences in the proportions of the various minority groups, women, and non-U.S. citizens among the energy-related population compared with all doctoral scientists and engineers was due to the relative concentration of physical scientists and engineers in the energy-related population. Persons of Oriental and other Asian heritage and non-U.S. citizens were more concentrated in the physical sciences and engineering while the percentage of women in these fields was quite small. These data reflect the virtual absence of minorities and women among the total population of doctoral scientists and engineers.

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[1] For a more detailed discussion of the problems in using the field switching data to develop labor market assessments, see *Nuclear Science: A Survey of Funding, Facilities, and Manpower*, 1975, Washington, D.C.: National Academy of Sciences, pp. 114-117.

2.1 DEGREE SPECIALTIES

TABLE 2-1a. Distribution of Degree Specialties
Energy-Related and All Doctoral Scientists and Engineers Employed Population, 1975

Doctoral Degree Specialty	*Energy-Related*	*Total*	*Percent Energy-Related in Specialty*
All Specialties, Total	20,852	262,991	7.9
Mathematics	335	15,290	2.2
Physics/Astronomy	3,422	23,659	14.5
Chemistry	4,514	40,272	11.2
Earth, Environment, and Marine Sciences	1,851	8,434	21.9
Engineering	8,475	40,059	21.2
Life Sciences	838	65,334	1.3
Psychology	76	28,054	0.3
Social Sciences	1,273	36,796	3.5
All Other (Arts and Humanities, Education, Business, and Other)	53	4,914	1.1
Degree Specialty Not Reported	15	179	—[a]

[a]The sample size was too small (less than five) to provide a usable estimate of the group's energy-related population in the employment field. That is, the estimate of the group's population in the employment field was not significantly different from the sample size at the 95-percent confidence level. For further discussion of sampling procedures and sampling errors for the survey, see *Doctoral Scientists and Engineers in the United States, 1975 Profile*, 1976, Washington, D.C.: National Academy of Sciences.

SOURCE: Department of Energy, based on National Academy of Science data.

Of the approximately 21,000 doctoral scientists and engineers who reported a significant part of their time in energy- or fuel-related activities in 1975, almost 80 percent reported their doctorate specialty in either physical sciences — physics and chemistry (38 percent) — or engineering (41 percent).

Approximately 8 percent of all doctorates reported spending a significant portion of their time in energy-related activities. The degree specialties of the energy-related population were proportionately more concentrated than the total population in physics; chemistry; engineering; and the earth, environment, and marine sciences.

TABLE 2-1b. Engineering Degree Specialties
Energy-Related and All Doctoral Scientists and Engineers
Employed Population, 1975

Engineering Doctoral Degree Specialty[a]	*Energy-Related*		*Total*		*Percent Energy-Related in Specialty*
	Number	*Percent*	*Number*	*Percent*	
Engineering, Total	8,475	100	40,059	100	21
Civil Engineering	567	7	3,351	8	17
Chemical Engineering	2,435	29	6,544	16	37
Electrical Engineering	793	9	8,014	20	10
Nuclear Engineering	544	6	813	2	67
Engineering Mechanics	429	5	2,735	7	16
Mechanical Engineering	1,204	14	4,540	11	27
Metallurgy and Physical Metallurgy	818	10	3,062	8	27
Other Engineering Specialties	1,685	20	11,000	28	15

[a]Each engineering specialty listed accounted for 5 percent or more of the energy-related engineering doctoral degrees.

SOURCE: Department of Energy, based on National Academy of Science data.

One out of five doctorates with degrees in engineering reported energy-related activities. As expected, those with nuclear engineering degree specialties were heavily concentrated in energy-related activities.

The chemical engineering degree specialty accounted for about three out of ten energy-related respondents with engineering degrees. Mechanical engineering was the second most commonly cited engineering degree specialty, with one out of seven engineering doctorates.

TABLE 2-1c. Doctoral Degree Subspecialties For Physics; Chemistry; and Earth, Environment, and Marine Sciences
Energy-Related and All Doctoral Scientists and Engineers Employed Population, 1975

Doctoral Degree Subspecialty[a]	Energy-Related		Total		Percent Energy-Related in Subspecialty
	Number	Percent	Number	Percent	
Physics, Total	3,422	100	23,659	100	15
Atomic and Molecular	357	10	2,388	10	15
Plasma	294	9	714	3	41
Elementary Particles	312	9	2,906	12	11
Nuclear Structure	632	18	3,263	14	19
Solid State	740	22	5,087	22	15
Physics, General	206	6	1,743	7	12
All Other Subspecialties	881	26	7,558	32	12
Chemistry, Total	4,514	100	40,272	100	11
Analytical	345	8	2,800	7	12
Inorganic	424	9	3,535	9	12
Organic	992	22	14,961	37	7
Physical	1,758	39	9,955	25	18
All Other Subspecialties	995	22	9,021	22	11
Earth, Environment, and Marine Sciences, Total	1,851	100	8,434	100	22
Stratigraphy, Sedimentation	426	23	1,125	13	38
Paleontology	99	5	693	8	14
Structural Geology	96	5	348	4	28
Applied Geology, Etc.	127	7	408	5	31
Earth Sciences, General	344	19	1,096	13	31
Earth Sciences, Other	406	22	1,993	24	20
All Other Subspecialties	353	19	2,771	33	13

[a]Each doctoral degree subspecialty listed accounted for 5 percent or more of the energy-related doctoral degrees in the specialty area.

SOURCE: Department of Energy, based on National Academy of Science data.

Two physics subspecialties — nuclear structure and solid state — accounted for 40 percent of all the energy-related population with physics degrees. Two subspecialties, physical chemistry and organic chemistry, alone accounted for over 60 percent of the energy-related doctorates with degrees in chemistry. For the earth, environment, and marine sciences, the two broadly defined earth science subspecialties (general and other) accounted for over 40 percent of the energy-related respondents. The largest single subspecialty was stratigraphy/sedimentation.

Over 40 percent of those with a degree subspecialty in plasma physics were in energy-related activities. The largest proportion of energy-related doctorates within the chemistry degree subspecialties was reported in physical chemistry. In the earth, environment, and marine sciences degree area, four subspecialties all had over 25 percent reporting energy-related activities.

TABLE 2-1d. Degree Specialties For Psychology, Social Sciences, Arts and Humanities, Education, and Other Fields
Energy-Related and All Doctoral Scientists and Engineers Employed Population, 1975

Doctoral Degree Specialty[a]	Energy-Related		Total		Percent Energy-Related in Specialty
	Number	Percent	Number	Percent	
Total, Psychology, Social Sciences, Arts and Humanities, Education, and Other Fields	1,402	100	69,943	100	2
Psychology	76	5	28,054	40	—[b]
Sociology	75	5	6,673	10	1
Economics/Econometrics	729	52	11,390	16	6
Political Science, Public Administration	189	13	8,063	12	2
International Relations	69	5	1,504	2	5
Social Sciences, Other	144	10	8,829	13	2
Other Degree Specialties	120	9	5,430	8	2

[a]Each specialty listed accounted for 5 percent or more of the energy-related doctoral scientists and engineers in the psychology, social sciences, arts and humanities, education, and other degree specialties group.
[b]Less than 0.5 percent.
SOURCE: Department of Energy, based on National Academy of Science data.

Only 2 percent of the population with degrees in psychology, social sciences, and other degree specialties reported significant energy-related activities. Those in the economics/econometrics degree specialty reported the largest proportion in energy-related activities; however, this was only 6 percent. Those with economics degrees also accounted for over one-half of the energy-related respondents in this group of degree specialties.

The "other degree specialties" includes those individuals who received a doctorate in nonscience areas, e.g., arts and humanities, education, or business, but who now work in an engineering or scientific field.

2.2 EMPLOYMENT FIELDS

TABLE 2-2a. Distribution By Employment Field
Energy-Related and All Doctoral Scientists and Engineers
Employed Population, 1975

Employment Field	*Energy-Related*	*Total*	*Percent Energy-Related in Field*
Total, All Fields	20,852	262,991	7.9
Mathematics	446	16,815	2.7
Physics/Astronomy	2,619	17,880	14.6
Chemistry	3,434	33,077	10.4
Earth, Environment, and Marine Sciences	2,402	12,149	19.8
Engineering	9,181	41,616	22.1
Life Sciences	748	64,793	1.2
Psychology	78	28,901	0.3
Social Sciences	1,091	31,380	3.5
Arts and Humanities	17	1,100	—[a]
Education, Business, and Other Fields	628	11,858	5.3
Not Reported	208	3,422	6.1

[a]Sample size too small to permit meaningful calculations of percentage distribution.
SOURCE: Department of Energy, based on National Academy of Science data.

Seventy-three percent of the energy-related population was employed in the engineering and physical science employment fields. The earth, environment, and marine sciences field accounted for over 11 percent of the energy-related population. Energy-related doctoral scientists and engineers accounted for 15 percent to 22 percent of the employed doctoral physicists; engineers; and earth, environment, and marine scientists.

TABLE 2-2b. Engineering Employment Fields
Energy-Related and All Doctoral Scientists and Engineers Employed Population, 1975

Engineering Employment Field[a]	Energy-Related		Total		Percent Energy-Related in Field
	Number	Percent	Number	Percent	
Engineering, Total	9,181	100	41,616	100	22
Civil	461	5	2,408	6	18
Chemical	1,921	21	5,133	12	37
Electrical	441	5	4,074	10	11
Nuclear	1,176	13	1,726	4	68
Mechanical	1,143	12	3,980	10	29
Metallurgy and Physical Metallurgy	533	6	2,166	5	25
Fuel Technology/Petroleum	635	7	759	2	84
Materials Science	411	5	1,878	5	22
All Other Fields	2,470	27	19,492	47	13

[a]Each field listed accounted for 5 percent or more of the total engineering employment.
SOURCE: Department of Energy, based on National Academy of Science data.

Chemical, nuclear, and mechanical were the three largest fields in energy-related engineering employment. Engineering employment in fuel technology/petroleum, metallurgy, and materials science each accounted for 5 percent to 7 percent of the energy-related engineering employment.

The energy-related respondents accounted for substantial portions of the totals in several fields. Two engineering fields — nuclear and fuel technology/petroleum — had 60 percent or more of the employed in energy-related activities. (Mining engineering, not shown separately, also had 60 percent employed in energy-related actiyities.) In three other engineering fields (chemical, mechanical, and metallurgy), between 25 percent and 37 percent of the doctorates reported energy-related activities.

TABLE 2-2c. Employment Subfields for Physics; Chemistry; and Earth, Environment, and Marine Sciences
Energy Related and All Doctoral Scientists and Engineers
Employed Population, 1975

Employment Subfield[a]	Energy-Related		Total		Percent Energy-Related in Subfield
	Number	Percent	Number	Percent	
Physics, Total	2,619	100	17,880	100	15
Atomic and Molecular	310	12	1,149	6	27
Plasma	629	24	1,013	6	62
Nuclear Structure	151	6	1,147	6	13
Solid State	512	20	3,114	17	16
Physics, General	274	10	2,847	16	10
All Other Physics Subfields	743	28	8,610	48	9
Chemistry, Total	3,434	100	33,077	100	10
Analytical	350	10	3,742	11	9
Inorganic	220	6	1,602	5	14
Organic	332	10	5,695	17	6
Physical	736	21	3,662	11	20
Thermodynamics and Material Properties	201	6	448	1	45
Polymers	372	11	4,304	13	9
Chemistry, General	175	5	2,247	7	8
All Other Chemistry Subfields	1,048	31	11,377	34	9
Earth, Environment, and Marine Sciences, Total	2,402	100	12,149	100	20
Geochemistry	197	8	644	5	31
Stratigraphy/Sedimentation	229	10	694	6	33
Geophysics (Solid Earth)	469	20	1,066	9	44
Applied Geology	496	21	1,175	10	42
Environment Science, General and Other	236	10	2,508	21	9
Earth Science, General and Other	278	11	1,175	10	24
All Other Subfields	497	21	4,887	40	10

[a]Each subfield listed accounted for 5 percent or more of the energy-related doctoral scientists for each employment field.
SOURCE: Department of Energy, based on National Academy of Science data.

Plasma physics and solid state physics were the largest employment subfields (44 percent combined) for energy-related physicists. Within the energy-related chemistry employment field, physical chemistry was the largest subfield. Geophysics and applied geology together accounted for just over 40 percent of the employment of energy-related doctorates in the earth, environment, and marine sciences areas.

Over three-fifths of the plasma physicists were energy-related. Within the earth, environment, and marine sciences employment field, two subfields (geophysics and applied geology) reported over 40 percent energy-related and another two subfields (geochemistry and stratigraphy/sedimentation) slightly over 30 percent energy-related. The fairly large subfield of physical chemistry had 20 percent reported as energy-related, and the relatively small subfield of thermodynamics and material properties had 45 percent reported as energy-related.

TABLE 2-2d. Employment Fields for Psychology, Social Sciences, Arts and Humanities, Education, and Other Fields
Energy-Related and All Doctoral Scientists and Engineers Employed Population, 1975

Employment Field[a]	Energy-Related		Total		Percent Energy-Related in Field
	Number	Percent	Number	Percent	
Total, Psychology, Social Sciences, Arts and Humanities, Education, and Other Fields	1,814	100	73,239	100	3
Economics/Econometrics	590	33	8,675	12	7
Political Science, Public Administration	171	9	6,876	9	3
International Relations	95	5	1,270	2	8
Social Sciences, Other	97	5	14,559	20	1
Business Administration	230	13	3,003	4	8
All Other Fields	631	35	38,856	53	2

[a]Each field listed accounted for 5 percent or more of the energy-related total employment in this group.
SOURCE: Department of Energy, based on National Academy of Science data.

Among the fields shown in Table 2-2d, one out of three of the energy-related doctorates (590) reported employment in economics. Another 230 reported employment in the business administration area.

2.3 COMPARISONS OF DEGREE SPECIALTIES AND EMPLOYMENT FIELDS

TABLE 2-3a. Degree Specialty and Corresponding Employment Field
Energy-Related and All Doctoral Scientists and Engineers
Employed population, 1975

Employment Field	Employment Field Total	Doctoral Degree Specialty: Mathematics	Physics	Chemistry	Earth, Environment, Marine	Engineering	Life Science	Psychology and Social Sciences	Other and No Report
Total Employed for Each Degree Specialty									
Energy-Related	20,852	335	3,422	4,514	1,851	8,475	838	1,349	68
All Doctorates	262,991	15,290	23,659	40,272	8,434	40,059	65,334	64,850	5,093
Mathematics									
Energy-Related	446	217	79	—	—	99	10	38	3
All Doctorates	16,815	13,180	948	242	30	1,323	104	441	547
Physics									
Energy-Related	2,619	9	2,203	188	14	186	12	—	7
All Doctorates	17,880	67	15,469	787	84	1,249	134	4	86
Chemistry									
Energy-Related	3,434	—	28	3,266	[illegible]	100	40	—	—
All Doctorates	33,077	3	294	29,698	[illegible]8	502	2,403	19	100
Earth, Environment, and Marine Sciences									
Energy-Related	2,402	18	200	132	1,744	178	94	30	6
All Doctorates	12,149	65	1,211	937	7,421	772	1,382	329	52
Engineering									
Energy-Related	9,181	60	740	732	21	7,555	13	44	16
All Doctorates	41,616	720	3,486	2,580	247	33,755	382	299	147
Life Science									
Energy-Related	748	—	13	9	11	19	613	71	12
All Doctorates	64,793	323	640	2,715	195	518	57,932	2,162	308
Psychology and Social Sciences									
Energy-RElated	1,169	—	14	17	1	49	7	1,057	24
All Doctorates	60,281	126	197	73	49	137	486	55,454	3,759
Other and No Report									
Energy-Related	853	31	145	170	60	289	49	109	—
All Doctorates	16,380	806	1,414	3,240	350	1,803	2,531	6,142	94

SOURCE: Department of Energy, based on National Academy of Science data.

TABLE 2-3b. Percentage of Doctoral Degree Specialty Reporting Same Employment Field
Energy-Related and All Doctoral Scientists and Engineers Employed Population, 1975

Doctoral Degree Specialty	Percent Reporting Same Employment Field	
	Energy-Related	All Doctorates
Total, All Degrees[a]	80	82
Mathematics	65	86
Physics	64	65
Chemistry	72	73
Earth, Environment, and Marine Sciences	94	88
Engineering	89	84
Life Sciences	73	89
Psychology and Social Sciences	78	86

[a]Not including "Other and No Report" category for doctoral degree specialty.
Source: Table 2-3a.
SOURCE: Department of Energy, based on National Academy of Science data.

Both the energy-related and all doctoral scientists and engineers reported approximately 80 percent of the degree specialties working in the corresponding employment field. However, among the individual degree specialties the percentages differed by 5 to 21 percentage points, except for physics and chemistry. The differences in the percentages were especially large in mathematics and life sciences; both of these degree specialties had considerably more switching to another employment field for the energy-related population than for all doctoral scientists and engineers.

Among the energy-related population, mathematicians, physicists, chemists, and life scientists all reported substantially more than the average percentage for employment outside their doctoral degree specialty. Those who earned their degree in mathematics, physics, and chemistry who were not employed in their degree specialty all reported engineering as the most common field of employment.

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Engineering	89	84
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[a]Not including "Other and No Report" category for doctoral degree specialty.
Source: Table 2-3a.
SOURCE: Department of Energy, based on National Academy of Science data.

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TABLE 2-3c. Percentage of Employment Field Reporting Same Degree Specialty *Energy-Related and All Doctoral Scientists and Engineers Employed Population, 1975*

Employment Field	*Percent Reporting Same Degree Specialty*	
	Energy-Related	*All Doctorates*
Total, All Employment Fields[a]	83	86
Mathematics	49	78
Physics	84	87
Chemistry	95	90
Earth, Environment, and Marine Sciences	73	61
Engineering	82	81
Life Sciences	82	89
Psychology and Social Sciences	90	92

[a]Not including "Other and No Report" for employment field.

Source: Table 2-3a.

SOURCE: Department of Energy, based on National Academy of Science data.

Over one-half of the energy-related doctorates employed as mathematicians received their doctorate degrees in specialties other than mathematics. The next highest percentage of doctorate degrees received in a specialty other than the employment field occurred in the earth, environment, and marine sciences group (27 percent).

TABLE 2-3d. Engineering Employment Fields and Degree Specialties
Energy-Related Doctora Scientists and Engineers Employed Population, 1975

Engineering Employment Field	Employment Field Total	Doctoral Degree Specialty							
		Mathematics	Physics	Chemistry	Earth Science	Engineering	Life Science	Social Sciences and Others	No Report
Total Engineering	9,181	60	740	732	21	7,555	13	54	6
Percent	100	1	8	8	—[a]	82	—[b]	1	—[b]
Civil	421			11		410			
Percent	100			—[b]		97			
Chemical	1,921	5	9	212		1,695			
Percent	100	—[b]	—[b]	11		88			
Electrical	441		30	19		392			
Percent	100		—[b]	—[b]		89			
Industrial, Manufacturing	57			5		52			
Percent	100			—[b]		91			
Nuclear	1,176	13	237	75		840	8	3	
Percent	100	—[b]	20	6		71	—[b]	—[b]	
Mechanical	1,143	9	53			1,081			
Percent	100	—[b]	5			95			
Fuel Technology/ Petroleum	635		37	182	15	389		12	
Percent	100		6	29	—[b]	61		—[b]	
Mining	139		8	16	2	113			
Percent	100		—[b]	—[b]	—[b]	81			
Materials Science	411		35	71	1	304			
Percent	100		9	17	—[b]	74			
All Other Engineering	2,837	33	331	141	3	2,279	5	39	6
Percent	100	1	12	5	—[b]	80	—[b]	1	—[b]

[a]Less than 0.5 percent.

[b]Sample size too small to permit meaningful calculations of percentage distribution.

SOURCE: Department of Energy, based on National Academy of Science data.

For all energy-related doctorates employed as engineers, 82 percent had an engineering degree, and civil, mechanical, and industrial/manufacturing engineering employment fields all reported over 90 percent with engineering degrees. Among the energy-related population, fuel technology/petroleum, nuclear, and materials science engineering employment fields reported the lowest percentages of doctoral degrees in engineering: 61 percent, 71 percent, and 74 percent, respectively. Persons with a doctorate in chemistry accounted for virtually all the energy-related employment in chemical engineering and industrial/manufacturing engineering not filled by those with an engineering degree, and also for sizable percentages of the fuel technology/petroleum, mining, and materials science engineering employment. Doctorates in physics accounted for sizable percentages of the energy-related employment of nuclear and "all other engineering."

TABLE 2-3e. Physical Sciences and Earth, Environment, and Marine Sciences: Number Reporting Each Degree Subspecialty and Number Reporting Each Employment Subfield
Energy-Related Doctoral Scientists and Engineers
Employed Population, 1975

PHYSICS

Area[b]	Number Reporting[a] Doctoral Subspecialty	Employment Subfield
Atomic and Molecular	357	310
Plasma	294	629
Elementary Particles	312	75
Nuclear Structure	632	151
Solid State	740	512
General	206	274

CHEMISTRY

Area[b]	Number Reporting[a] Doctoral Subspecialty	Employment Subfield
Analytical	345	350
Inorganic	424	220
Organic	992	332
Physical	1,758	736
Thermodynamics and Material Properties	0	201
Polymers	9	372
General	124	175

EARTH, ENVIRONMENT, AND MARINE SCIENCES

Area[b]	Number Reporting[a] Doctoral Subspecialty	Employment Subfield
Geochemistry	72	197
Stratigraphy/ Sedimentation	426	229
Paleontology	99	81
Structural Geology	96	112
Geophysics (Solid Earth)	46	469
Applied Geology	127	496
Environment Science	5	236
Earth Science	750	278

[a]It must be noted that the overlap between the number reporting a doctoral degree subspecialty and the number reporting an employment subfield in the same area is not known. That is, it is not possible to estimate, using the survey data, the number of doctoral degree subspecialty holders who were working in the same employment subfield.

[b]Each area listed accounted for at least 5 percent of the doctoral degrees in the specialty or 5 percent of the employment in the field.

SOURCE: Department of Energy, based on National Academy of Science data.

It is not possible from the tabulations available to show the number working in employment subfields who earned their doctorate in corresponding degree subspecialties in physics; chemistry; and earth, environment, and marine sciences. However, a comparison of the number in each degree subspecialty with the number in each corresponding employment subfield for the energy-related respondents may indicate the probable direction of field switching in these areas. (See Table 2-3e.)

In physics, four degree subspecialties (atomic and molecular, elementary particles, nuclear structure, and solid state) reported more doctorates working in energy-related activities than there were employed in the corresponding subfields. However, the situation was reversed for general physics and plasma physics — more employed in the subfields than there were doctorate degree holders.

Within the energy-related chemistry area, analytical chemistry had a virtual balance between reported doctorate degrees and employment; however, the other subfields had large differences between degrees and employment. For the energy-related respondents, inorganic chemistry, organic chemistry, and physical chemistry subfields all had two to three times more doctorate degrees reported than were employed. The chemistry subfields of thermodynamics/material properties, polymers, and general chemistry had substantially more employment than degree holders reported in energy-related activities.

Earth, environment, and marine sciences fields that had substantially more employment than doctorate degrees reported in energy-related areas included geochemistry, geophysics, applied geology, and environment science. The converse, substantially more doctorate degrees than employment, was reported in stratigraphy/sedimentation and earth science.

2.4 RACE/ETHNIC GROUPS, WOMEN, AND NON-U.S. CITIZENS EMPLOYMENT

TABLE 2-4a. Race/Ethnic Groups, Women, and Non-U.S. Citizens by Employment Field
Energy-Related Doctoral Scientists and Engineers
Employed Population, 1975

Employment Field	Energy-Related Total	Race/Ethnic Group							Women	Non-U.S. Citizens
		White	Black	American Indian	Hispanic	Oriental	Other Asian	Other and No Report		
Total, All Fields	20,852	18,375	52	13	52	1,309	299	752	314	1,837
Mathematics	446	399	[a]	[a]	[a]	[a]	[a]	[a]	13	37
Physical Science	6,053	5,580	[a]	[a]	32	215	51	144	111	445
Physics/Astronomy	2,619	2,341	[a]	[a]	[a]	138	34	88	40	193
Chemistry	3,434	3,239	[a]	[a]	[a]	77	[a]	56	71	252
Earth, Environment, Marine Sciences	2,402	2,268	[a]	[a]	[a]	42	[a]	86	25	119
Engineering	9,181	7,665	[a]	[a]	[a]	978	202	307	43	1,046
Civil	421	219	[a]	[a]	[a]	125	40	37	[a]	173
Chemical	1,921	1,631	[a]	[a]	[a]	187	41	43	[a]	181
Electrical	441	399	[a]	[a]	[a]	[a]	[a]	[a]	[a]	53
Nuclear	1,176	1,009	[a]	[a]	[a]	91	[a]	52	[a]	98
Mechanical	1,143	863	[a]	[a]	[a]	220	[a]	53	[a]	166
Fuel Technology/ Petroleum	635	568	[a]	[a]	[a]	41	[a]	[a]	[a]	[a]
All Other Engineering	3,444	2,976	[a]	[a]	[a]	305	69	90	23	349
Life Science	748	685	[a]	[a]	[a]	[a]	[a]	35	48	61
Psychology and Social Sciences	1,169	1,062	[a]	[a]	[a]	[a]	[a]	76	58	69
All Other Fields and No Report	853	716	[a]	[a]	[a]	38	[a]	85	[a]	60

[a]The sample size was too small (less than five in most cases) to provide a usable estimate of the group's energy-related population in the employment field.
SOURCE: Department of Energy, based on National Academy of Science data.

Approximately 2500 or 12 percent of the energy-related population belonged to a minority group or did not report their race/ethnicity. Persons reporting an Oriental heritage accounted for over one-half of the nonwhite population. In the engineering employment specialty, 16.5 percent or 1516 persons were in minority groups, and almost two-thirds of these were of Oriental heritage. Civil engineering had, by far, the largest percentage reporting nonwhite for race/ethnicity (48 percent).

Women accounted for about 1.5 percent of the energy-related employment in 1975. Although over 20 percent of the women were employed in chemistry, this represented only about 2 percent of all chemists.

Non-U.S. citizens accounted for almost 9 percent of the energy-related doctoral employment in 1975. Almost 14 percent of the agricultural scientists (part of life scientists) and over 11 percent of the engineers were non-U.S. citizens. Non-U.S. citizens accounted for 41 percent of the civil engineers.

TABLE 2-4b. Percentage of Employment Field by Race/Ethnic Groups, by Citizenship, and by Se
Energy-Related and All Doctoral Scientists and Engineers
Employed Population, 1975

Employment Field	Total	Race/Ethnicity (Percent Distribution)							Women (Percent of Total)	Non-U.S. Citizens (Percent of Total)
		White	Black	American Indian	Hispanic	Oriental	Other Asian	Other and No Report		
Total, All Fields										
Energy-Related	100	88.1	0.2	—[a]	0.2	6.3	1.4	3.6	1.5	8.8
All Doctorates	100	89.4	1.0	0.2	0.4	4.1	0.9	4.1	8.6	5.8
Mathematics										
Energy-Related	100	89.5				—[a]	—[a]	—[a]	2.9	8.3
All Doctorates	100	88.4	0.8	0.1	0.5	4.4	0.9	4.9	5.9	6.8
Physical Sciences										
Energy-Related	100	92.2	—[a]	—[a]	0.5	3.6	0.8	2.4	1.8	7.4
All Doctorates	100	89.5	0.9	0.1	0.3	4.5	1.0	3.6	4.4	6.9
Earth, Environment, and Marine Sciences										
Energy-Related	100	94.4			—[a]	1.7	—[a]	3.6	1.0	5.0
All Doctorates	100	92.9	0.3	—[a]	—[a]	1.9	0.7	4.0	2.8	6.5
Engineering										
Energy-Related	100	83.5	—[a]	—[a]	—[a]	10.7	2.2	3.3	0.5	11.4
All Doctorates	100	85.9	0.3	0.1	0.3	8.2	1.8	3.3	0.6	8.2
Life Sciences										
Energy-Related	100	91.6	—[a]			—[a]	—[a]	4.7	6.4	8.2
All Doctorates	100	89.8	1.1	0.1	0.4	4.0	0.8	3.8	11.2	5.8
Social Sciences and Psychology										
Energy-Related	100	90.8	—[a]		—[a]	—[a]	—[a]	6.5	5.0	5.9
All Doctorates	100	90.8	1.2	0.3	0.4	1.9	0.4	5.0	16.2	3.4
All Other Fields and No Report										
Energy-Related	100	83.9	—[a]			4.5		10.0	—[a]	7.0
All Doctorates	100	89.2	2.1	0.2	0.5	2.5	0.3	5.2	10.3	3.1

[a]Sample size was too small to provide an accurate estimate; see the footnote to Table 2-4a.

SOURCE: Department of Energy, based on National Academy of Science data.

The proportion of energy-related doctorates reporting white race/ethnicity was slightly less than for all scientists and engineers (Table 2-4b). The nonwhite race/ethnicity groups within the energy-related population were proportionately more concentrated in the Oriental and other Asian race/ethnicity groups. A substantial part of this difference in the proportions of race/ethnicity groups reported for the energy-related population versus all doctoral scientists and engineers can be traced to the concentration of energy-related employment among physicists, chemists, and engineers, all three groups having relatively low proportions of nonwhite race/ethnicity groups.

The proportion of women engaged in energy-related activities was only one-sixth (1.5 percent versus 8.6 percent) of the proportion reported for all doctoral scientists and engineers. Approximately 80 percent of this difference can be explained by the different proportions reported employed in energy-related activities for the major employment fields and for the specific fields within engineering, physics; chemistry; social sciences; and earth, environment, and marine sciences. However, the tabulations still indicate the number of women employed in the energy-related area was about one-half of what it would have been if the same percentage of women, by specific employment field, were found in the energy-related area as was reported among all doctorates.

The proportion of non-U.S. citizens employed in energy-related activities was somewhat higher (8.8 percent versus 5.8 percent) than that for all doctoral scientists and engineers. The overall higher percentage of non-U.S. citizens in energy-related activities results, to a large extent, from the concentration of the energy-related doctorates employed in physics, chemistry, and engineering, all three fields having higher than average concentrations of non-U.S. citizens in the total population of doctoral scientists and engineers.

Primary Work Activities and Types of Employers

The most common primary work activities cited (Table 3-1a) by the energy-related population were applied research (27 percent) and management of research and development (21 percent). Applied research was the most common primary work activity in eight of the ten employment fields for the energy-related population. Management of research and development was slightly concentrated among engineers and chemists. It should be noted that management could include anyone from small project supervisors to top level managers or administrators.

In comparison with all doctoral scientists and engineers, the energy-related population had a higher percentage reporting one of the management areas as their primary work activity, 20 percent and 30 percent, respectively. All of the percentage difference in management was reported in the area of management of research and development (see Figure 6.)

The energy-related population also reported (Table 3-1b) a higher percentage involved in total research and development (45 percent) than did all doctoral scientists and engineers (32 percent). This resulted from a much higher percentage of the energy-related population involved in applied research and a slightly higher percentage involved in development-offsetting a lower percentage of the energy-related population in basic research.

Part of the concentration of the energy-related population in applied research and in management of research and development may be explained by the relatively large proportion of engineers and chemists in the energy-related population; both of these employment fields have relatively high proportions involved in those two primary work activities. However, every employment field in the energy-related population reported a higher percentage in applied research and in the management of research and development than did the corresponding employment field among all doctoral scientists and engineers.

The higher proportions involved in management and in research and development among the energy-related population compared with all doctoral scientists and engineers resulted partly from the higher percentage of the energy-related

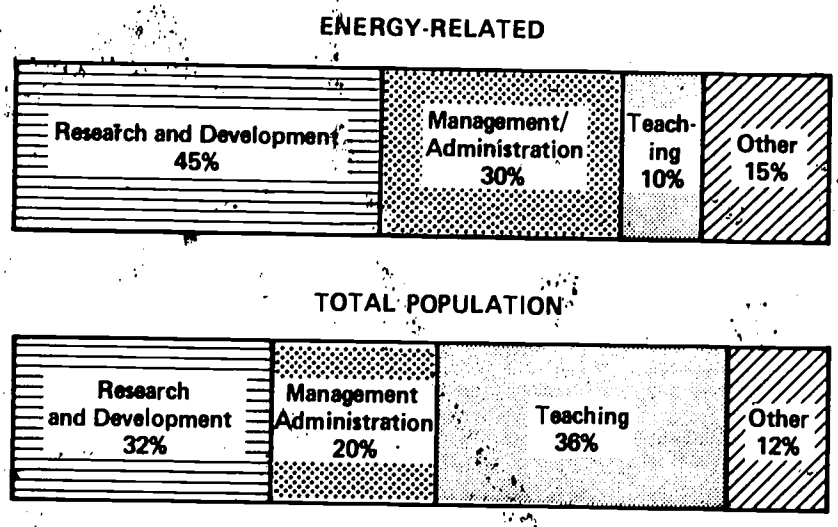

FIGURE 6. Primary Work Activity for Doctoral Scientists and Engineers, 1975

population employed in private business/industry (56 percent versus 25 percent of all doctorates) and the lower percentage of the energy-related population employed in educational institutions (28 percent versus 58 percent for all doctorates). Statistical analyses[1] indicated that those employment fields with relatively more of the energy-related population employed in private business/industry (and relatively fewer employed in educational institutions) in comparison with all doctorates in those fields tended to have higher proportions reporting management and research and development. Among all doctorates the relatively larger proportion employed in educational institutions provided a much higher proportion reporting teaching (36 percent versus only 10 percent of the energy-related population).

Within the energy-related population, the percentage of the population in each employment field reporting primary work activities as management, especially management of research and development, was related to the percentage of the population in the employment fields working in private business/industry and educational institutions.[2] For each employment field the proportion of the energy-related population involved in management had a strong, positive correlation with the percentage employed in private business/industry and a strong, negative correlation with the percentage employed in educational institutions. The same strong correlations were also found for the percentage involved in the more narrowly defined primary work activity of management of research and development.

The percentage distribution among employment fields of the energy-related population engaged in one of the research and development areas did not have any significant relationship to the percentage distribution by type of employer. That is, employment in private business/industry versus educational institutions did not correlate with the percentage of the energy-related respondents reporting one of the areas in research and development.

However, within the more narrowly defined primary work activities of basic research and applied research, the type of employer did have some relationship to the percentage of the population reporting the primary work activity. There was a fairly strong, positive correlation between the percentage of those in the employment field engaged in basic research and the percentage employed in educational institutions (and also a fairly strong, negative correlation to the percentage employed in private business/industry). That is, those employment fields with higher percentages employed in educational institutions (and lower percentages employed in private business/industry) tended to have relatively more of the energy-related population engaged primarily in basic research.

A weak, statistical relationship existed between the percentage engaged in applied research and the type of employer. The percentage in applied research had a weak, positive correlation with the percentage employed in private business/industry and a weak, negative correlation with the percentage employed in educational institutions.

Tables 3-1c and 3-1d (detailed engineering employment fields and primary work activities) show that the engineering fields tended to have the same basic pattern as

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[1] The statistical analyses were simple linear regressions of the form $y = a + bx$, where y was the difference by employment field between the percentage of the energy-related population and the percentage of all doctoral scientists and engineers reporting the primary work activity (either management or research and development) and x was the difference between the percentage of the energy-related population and the percentage of all doctoral scientists and engineers employed in private business/industry. The amount of variance explained was approximately 15 percent.

[2] The relationships were identified using simple linear regressions of the form $y = a + bx$, where y was the percentage of the employment field reporting the primary work activity and x was the percentage of the employment field working for private business/industry or for educational institutions. The simple statistical relationship indicated one-third to almost one-half of the variance in the percentage in management among the employment fields could be explained by the percentage distribution by type of employers.

the science fields across the primary work activities. Civil engineers contrasted rather strongly to the other engineers by reporting substantially lower percentages engaged in management and research. Almost all of the energy-related population primarily engaged in development and in design were engineers.

The second section in this chapter relates to the type of employers reported by the doctoral scientists and engineers (see Figure 7). As mentioned above, the majority of the energy-related population was employed in private business/industry (56 percent) and just over one-fourth (28 percent) in educational institutions (Table 3-2a). This contrasts sharply to the total population of scientists and engineers where nearly three-fifths were employed in educational institutions (58 percent) and one-fourth were employed in private business/industry (Table 3-2b).

The percentage distribution of types of employers for the energy-related doctorates varied somewhat across employment fields. In several fields over one-half of the energy-related employment was reported in educational institutions. In fact, the data showed a rather strong pattern of energy-related mathematicians; chemists; earth, environment, and marine scientists; and engineers employed in private business/industry with the other employment fields concentrated in education and the federal government. The "all other fields" employment group was concentrated in private business/industry. The "all other fields" category included scientists and engineers working as business managers or administrators, which probably accounts for the high percentage of the group employed in private business/industry.

The federal government employed over 20 percent of the energy-related population in four employment fields: earth, environment, and marine sciences; life science; economics; and psychology and other social sciences. All of these fields tended to relate strongly to public policy oriented issues and research, i.e., to the impact of energy on the community and workers, rather than to directly exploring questions of production and development of new energy sources and efficiencies.

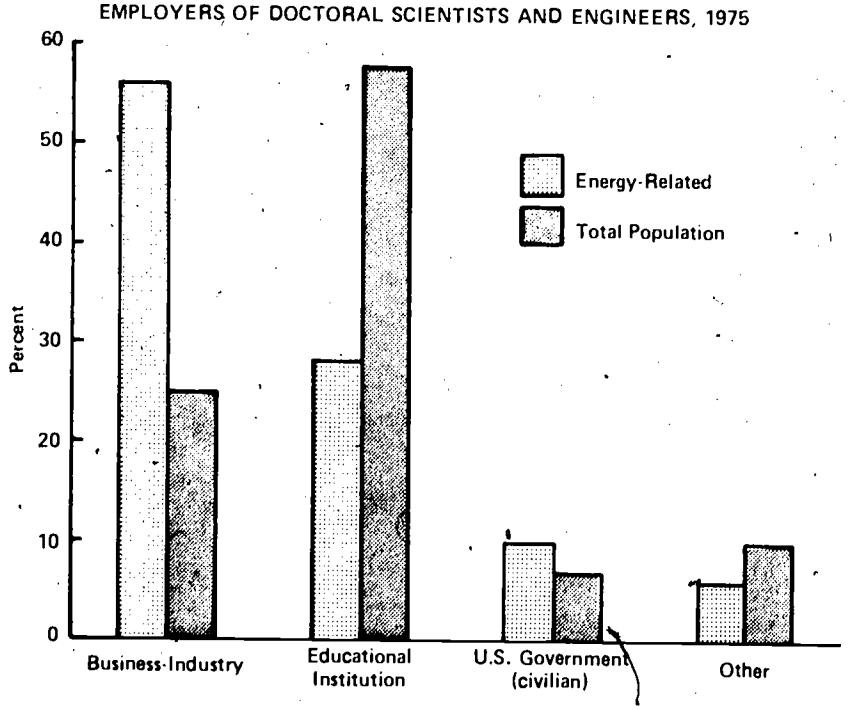

FIGURE 7. Employers of Doctoral Scientists and Engineers, 1975

3.1 EMPLOYMENT FIELD AND PRIMARY WORK ACTIVITY

TABLE 3-1a. Employment Field and Primary Work Activity
Energy-Related Doctoral Scientists and Engineers
Employed Population, 1975

Employment Field	Total	Management or Administration of			Research and Development						Other and No Report
		Research and Development	Other	Both	Basic Research	Applied Research	Development	Design	Teach	Consult	
Total, All Fields	20,852	4,313	1,344	553	2,559	5,568	1,332	497	2,069	1,014	1,603
Percent	100	21	6	3	12	27	6	2	10	5	8
Mathematics	446	41	8	11	52	120	67	0	31	55	61
Percent	100	9	—[a]	—[a]	12	27	15		7	12	14
Physics/Astronomy	2,619	359	24	39	822	913	35	6	298	20	103
Percent	100	14	—[a]	1	31	35	1	—[a]	11	—[a]	4
Chemistry	3,434	912	125	90	683	1,035	113	0	268	53	155
Percent	100	27	4	3	20	30	3		8	2	5
Earth, Environment, and Marine Sciences	2,402	440	211	107	351	789	37	0	163	136	168
Percent	100	18	9	4	15	33	2		7	6	7
Engineering	9,181	2,209	652	238	319	2,207	1,065	491	760	609	631
Percent	100	24	7	3	3	24	12	5	8	7	7
Life Sciences	748	98	15	0	202	179	13	0	150	11	80
Percent	100	13	—[a]		27	24	—[a]		20	—[a]	11
Economics/Econometrics	630	54	35	27	46	191	2	0	159	36	80
Percent	100	9	6	—[a]	7	30	—[a]		25	6	13
Psychology and Other Social Sciences	539	55	29	0	84	52	0	0	184	28	107
Percent	100	10	5		16	10			34	—[a]	20
Other Fields and No Report	853	145	245	41	0	82	0	0	56	66	218
Percent	100	17	29	5		10			7	8	26

[a]Sample size too small to permit meaningful calculations of percentage distribution.

SOURCE: Department of Energy, based on National Academy of Science data.

Research and development was the largest primary work activity for all the energy-related employment fields except for "psychology and other social sciences" and for "other fields and no report." Within the research and development area, applied research was the primary work activity for all but two employment fields.

Management or administration was the second most frequent work activity, in terms of percentage, for six employment fields.

Energy-related life scientists, economists/econometricians, and psychologists and other social scientists all reported sizable percentages in teaching as the primary work activity.

Engineers accounted for virtually all of the employment in design, almost 80 percent of the employment in development, and over 60 percent of the employment in consulting.

TABLE 3-1b. Percentage Distribution of Primary Work Activities by Employment Fields
Energy-Related and All Doctoral Scientists and Engineers Employed Population, 1975

Employment Field	Total	Management or Administration of			Research and Development			Design	Teach	Consult	Other and No Report
		Research and Development	Other	Both	Basic Research	Applied Research	Development				
Total, All Fields											
Energy-Related	100	21	6	3	12	27	6	2	10	5	8
All Doctorates	100	11	6	3	15	13	4	1	36	2	10
Mathematics											
Energy-Related	100	9	—[b]	—[b]	12	27	15	0	7	12	14
All Doctorates	100	5	4	2	11	7	6	—[a]	60	1	3
Physics/Astronomy											
Energy-Related	100	14	—[b]	1	31	35	1	—[b]	11	—[b]	4
All Doctorates	100	10	2	1	28	19	3	1	33	1	3
Chemistry											
Energy-Related	100	27	4	3	20	30	3	0	8	2	5
All Doctorates	100	19	3	2	18	19	4	—[b]	27	1	5
Earth, Environment, and Marine Sciences											
Energy-Related	100	18	9	4	15	33	2	0	7	6	7
All Doctorates	100	13	6	4	19	18	1	0	29	4	6
Engineering											
Energy-Related	100	24	7	3	3	24	12	5	8	7	7
All Doctorates	100	19	6	3	4	19	14	3	22	4	5
Life Sciences											
Energy-Related	100	13	—[b]	0	27	24	—[b]	0	20	—[b]	11
All Doctorates	100	10	4	2	28	13	1	—[a]	32	1	9
Economics/Econometrics											
Energy-Related	100	9	6	—[a]	7	30	—[b]	0	25	6	13
All Doctorates	100	8	7	3	6	13	—[b]	—[b]	53	3	7
Psychology and Other Social Sciences											
Energy-Related	100	10	5	0	16	10	0	0	34	—[b]	20
All Doctorates	100	5	7	3	7	5	—[a]	—[a]	51	3	19
Other Fields and No Report											
Energy-Related	100	17	29	5	0	10	0	0	7	8	26
All Doctorates	100	9	22	7	3	4	2	—[b]	29	3	21

[a] Less than 0.5 percent engaged in the primary work activity.

[b] Sample size too small to permit meaningful calculations of percentage distribution.

SOURCE: Department of Energy, based on National Academy of Science data.

Compared with all doctoral scientists and engineers, those involved in energy-related activities reported much higher percentages in both management of research and development and applied research and a much lower percentage in teaching as primary work activities. These basic patterns appear in all of the major employment fields.

Several employment fields differed substantially from the general pattern of primary work activities reported for energy-related and all doctoral scientists and engineers. Energy-related mathematicians reported much larger proportions in development and consulting. Energy-related chemists, physicists, and psychologists and other social scientists all reported relatively more doctorates involved in basic research.

TABLE 3-1c. Engineering Employment Field and Primary Work Activity
Energy-Related Doctoral Scientists and Engineers
Employed Population, 1975

Engineering Employment Field	Total	Management or Administration of			Research and Development			Design	Teach	Consult	Other and No Report
		Research and Development	Other	Both	Basic Research	Applied Research	Development				
Total, Engineering	9,181	2,209	652	238	319	2,207	1,065	491	760	609	631
Percent	100	24	7	3	3	24	12	5	8	7	7
Civil	421	38	7	23	0	30	39	123	36	82	43
Percent	100	9	—[a]	—[a]		7	9	29	9	19	10
Chemical	1,921	462	185	52	40	496	290	79	109	85	123
Percent	100	24	10	3	2	26	15	4	6	4	6
Electrical	441	88	62	15	0	63	44	26	77	20	46
Percent	100	20	14	—[a]		14	10	—[a]	17	—[a]	10
Nuclear	1,176	314	119	11	19	227	133	74	59	69	151
Percent	100	27	10	—[a]	—[a]	19	11	6	5	6	13
Mechanical	1,143	225	44	23	41	319	201	78	107	81	24
Percent	100	20	4	—[a]	4	28	18	7	9	7	—[a]
Fuel Technology/ Petroleum	635	183	79	12	12	153	18	11	45	27	95
Percent	100	29	12	—[a]	—[a]	24	—[a]	—[a]	7	—[a]	15
Mining	139	32	15	3	0	33	0	0	33	12	11
Percent	100	—[a]	—[a]	—[a]		24			24	—[a]	—[a]
Materials Science	411	179	0	8	40	140	20	0	14	10	0
Percent	100	44		—	10	34	—[a]		—[a]	—[a]	
All Other Engineering	2,894	688	141	91	167	746	320	100	280	223	138
Percent	100	24	5	3	6	26	11	3	10	8	5

[a]Sample size too small to permit meaningful calculations of percentage distribution.

SOURCE: Department of Energy, based on National Academy of Science data.

Management or administration was the most frequently cited primary work activity for five of the engineering fields. Research and development was the primary work activity for only three of the engineering fields — chemical, mechanical, and materials science — plus the "all other engineering" group. Applied research was the most frequent primary work activity within the research and development area for all of the engineering fields except civil. Among the engineering fields, electrical and mining had the largest percentages involved in teaching.

TABLE 3-1d. Percentage Distribution of Engineering Employment Fields by Primary Work Activities
Energy-Related and All Doctoral Scientists and Engineers
Employed Population, 1975

Engineering Employment Field	Management or Administration of			Research and Development						Other and No Report
	Research and Development	Other	Both	Basic Research	Applied Research	Development	Design	Teach	Consult	
Total, Engineering										
Energy-Related	24	7	3	3	24	12	5	8	7	7
All Doctorates	19	6	3	4	19	14	3	22	4	5
Civil										
Energy-Related	9	[a]	[a]	0	7	9	29	9	19	10
All Doctorates	9	6	3	2	7	2	8	48	9	6
Chemical										
Energy-Related	24	10	3	2	26	15	4	6	4	6
All Doctorates	20	10	5	3	18	16	3	15	3	7
Electrical										
Energy-Related	20	14	[a]	0	14	10	[a]	17	[a]	10
All Doctorates	14	4	2	4	17	13	3	38	1	4
Nuclear										
Energy-Related	27	10	[a]	[a]	19	11	6	5	6	13
All Doctorates	25	9	[a]	[a]	16	10	6	16	5	12
Mechanical										
Energy-Related	20	4	[a]	4	28	18	7	9	7	[a]
All Doctorates	16	5	2	3	20	14	2	31	3	3
Fuel Technology/Petroleum										
Energy-Related	29	12	[a]	[a]	24	[a]	[a]	7	[a]	15
All Doctorates	24	12	[a]	[a]	23	[a]	[a]	16	[a]	14
Mining										
Energy-Related	[a]	[a]	[a]	0	24	0	0	24	[a]	[a]
All Doctorates	28	[a]	[a]	0	18	[a]	0	26	[a]	[a]
Materials Science										
Energy-Related	44	0	[a]	10	34	[a]	0	[a]	[a]	0
All Doctorates	31	3	2	6	29	11	0	13	3	2
All Other Engineering										
Energy-Related	24	5	3	6	26	11	3	10	8	5
All Doctorates	20	6	4	5	21	16	2	18	4	4

[a]Sample size too small to permit meaningful calculations of percentage distribution.

SOURCE: Department of Energy, based on National Academy of Science data.

The energy-related engineering fields reported the same general patterns for primary work activities, with some variations, as were reported by the total population. Energy-related civil engineers reported relatively more in development, design, and consulting activities. Energy-related electrical engineers had a relatively lower percentage in applied research, and energy-related mining engineers relatively fewer in the management of research and development.

3.2 EMPLOYMENT FIELDS BY TYPES OF EMPLOYERS

TABLE 3-2a. Employment Field and Type of Employer
Energy-Related Doctoral Scientists and Engineers
Employed Population, 1975

Employment Field	Total	Business Or Industry	Educational Institution	U.S. Government Civilian	State and Local Governments	Nonprofit Organization	All Other Employers
Total, All Fields	20,852	11,744	5,845	1,985	165	1,031	82
Percent	100	56	28	10	1	5	—[a]
Mathematics	446	280	140	24	0	2	0
Percent	100	63	31	5		—[b]	
Physics/Astronomy	2,619	784	1,414	216	0	205	0
Percent	100	30	54	8		8	
Chemistry	3,434	2,238	777	216	0	188	15
Percent	100	65	23	6		5	—[b]
Earth, Environment, and Marine Sciences	2,402	1,324	465	489	57	57	10
Percent	100	55	19	20	2	2	—[b]
Engineering	9,181	6,371	1,797	598	40	355	20
Percent	100	69	20	7	—[a]	4	—[b]
Life Sciences	748	75	438	154	0	70	11
Percent	100	10	59	21		9	—[b]
Economics/Econometrics	630	173	250	128	16	51	12
Percent	100	27	40	20	—[b]	8	—[b]
Psychology and Other Social Sciences	539	55	354	109	19	2	0
Percent	100	10	66	20	—[b]	—[b]	
All Other Fields	645	355	165	27	33	65	0
Percent	100	55	26	4	5	10	
No Report	208	89	45	24	0	36	14
Percent	100	43	22	—[b]		17	—[b]

[a]Less than 0.5 percent.

[b]Sample size too small to permit meaningful calculations of percentage distribution.

SOURCE: Department of Energy, based on National Academy of Science data.

Over one-half of all the energy-related doctorates were employed in private business or industry. An additional 28 percent were employed as faculty or staff in educational institutions.

Considerable variation was reported among the various employment fields for the different types of employers. Educational institutions were the largest employers for physics, life sciences, economics, and psychology and other social sciences. The U.S. government employed over 20 percent of the doctorates in four employment fields. Engineering accounted for 35 percent of all employment in nonprofit organizations.

TABLE 3-2b. Percentage Distribution, Employment Field and Type of Employer
Energy-Related and All Doctoral Scientists and Engineers
Employed Population, 1975

Employment Field	*Total*	*Business Or Industry*	*Educational Institution*	*U.S. Government Civilian*	*State and Local Governments*	*Nonprofit Organization*	*All Other Employers*
Total, All Fields							
Energy-Related	100	56	28	10	1	5	—[a]
All Doctorates	100	25	58	7	2	3	5
Mathematics							
Energy-Related	100	63	31	5	0	—[b]	0
All Doctorates	100	14	79	5	—[a]	1	1
Physics/Astronomy							
Energy-Related	100	30	54	8	0	8	0
All Doctorates	100	21	62	11	—[b]	4	2
Chemistry							
Energy-Related	100	65	23	6	0	5	—[b]
All Doctorates	100	50	40	5	1	3	1
Earth, Environment, and Marine Sciences							
Energy-Related	100	55	19	20	2	2	—[b]
All Doctorates	100	24	49	18	4	4	1
Engineering							
Energy-Related	100	69	20	7	—[a]	4	—[b]
All Doctorates	100	52	35	7	1	3	2
Life Sciences							
Energy-Related	100	10	59	21	0	9	—[b]
All Doctorates	100	13	68	10	2	3	5
Economics/Econometrics							
Energy-Related	100	27	40	20	—[b]	8	—[b]
All Doctorates	100	12	69	11	1	4	4
Psychology and Other Social Sciences							
Energy-Related	100	10	66	20	—[b]	—[b]	0
All Doctorates	100	9	71	4	3	4	10
All Other Fields							
Energy-Related	100	55	26	4	5	10	0
All Doctorates	100	28	58	4	2	6	2
No Report							
Energy-Related	100	43	22	—[b]	0	17	—[b]
All Doctorates	100	29	48	4	2	7	10

[a]Less than 0.5 percent.

[b]Sample size too small to permit meaningful calculations of percentage distribution.

SOURCE: Department of Energy, based on National Academy of Science data.

Energy-related doctorates reported over 50 percent of their employment in business or industry while all doctorates reported over 50 percent of their employment in educational institutions. Considerable variation from the general pattern was reported among the employment fields. For instance, physics/astronomy, life sciences, economics, and psychology and other social sciences all had dissimilar percentages for energy-related and all doctorates employed in business or industry and in educational institutions.

TABLE 3-2c. Engineering Employment Fields and Types of Employers
Energy-Related Doctoral Scientists and Engineers
Employed Population, 1975

Engineering Employment Field	Total	Business Or Industry	Educational Institution	U.S. Government Civilian	State and Local Governments	Nonprofit Organization	All Other Employers
Total, Engineering	9,181	6,371	1,797	598	40	355	20
Percent	100	69	20	7	—[a]	4	—[b]
Civil	421	332	65	24	0	0	0
Percent	100	79	15	—[b]			
Chemical	1,921	1,633	199	43	0	46	0
Percent	100	85	10	2		2	
Electrical	441	241	179	21	0	0	0
Percent	100	55	41	—[a]			
Nuclear	1,176	755	256	98	12	55	0
Percent	100	64	22	8	—[b]	5	
Mechanical	1,143	712	235	124	0	72	0
Percent	100	62	21	11		6	
Fuel Technology/Petroleum	635	513	45	60	4	13	0
Percent	100	81	7	9	—[b]	—[b]	
Mining	139	49	57	33	0	0	0
Percent	100	35	41	—[b]			
Materials Science	411	256	86	18	0	51	0
Percent	100	62	21	—[b]		12	
All Other Engineering	2,894	1,880	675	177	24	118	20
Percent	100	65	23	6	—[b]	4	—[b]

[a] Less than 0.5 percent.

[b] Sample size too small to permit meaningful calculations of percentage distribution.

SOURCE: Department of Energy, based on National Academy of Science data.

Business or industry was the largest employer for all the engineering fields except mining, which reported educational institutions as the largest employer. The U.S. government employed almost one-fourth of the mining engineers, as well as a substantial number of nuclear, mechanical, and fuel technology/petroleum engineers. Materials science engineers reported by far the largest percentage employed in nonprofit organizations; however, chemical, nuclear, mechanical, and "all other engineers" also reported significant employment in nonprofit organizations.

Regional Location and Salaries

The energy-related population in states east of the Mississippi River accounted for 57 percent of the energy-related doctorates. However, compared with all doctoral scientists and engineers, the energy-related population was relatively concentrated in three western regions (Table 4-1a): the West South Central states, the Mountain states, and the Pacific states. These areas accounted for 40 percent of the energy-related population but only 28 percent of all doctoral scientists and engineers (see also Figure 8).

California had by far the largest energy-related population with just over 3000 (14 percent). Four other states — Texas, New York, Pennsylvania, and Illinois — had between 1400 and 1900 energy-related doctorates, and the District of Columbia had over 1100. These five states plus the District of Columbia accounted for slightly more than 50 percent of the energy-related population and approximately 40 percent of all doctoral scientists and engineers.

In several of the regions and states, 10 percent or more of the doctorates were energy-related (Table 4-1c). In the West South Central, Mountain, and Pacific regions, 10 percent to 15 percent of the doctoral scientists and engineers were energy-related; in two states — Oklahoma and New Mexico — 25 percent were energy-related; and in 10 other states 10 percent to 15 percent were energy-related.

As discussed in Chapter 2, when compared with all doctoral scientists and engineers the energy-related population was relatively concentrated in engineering; physical science; and the earth, environment, and marine sciences. The per-

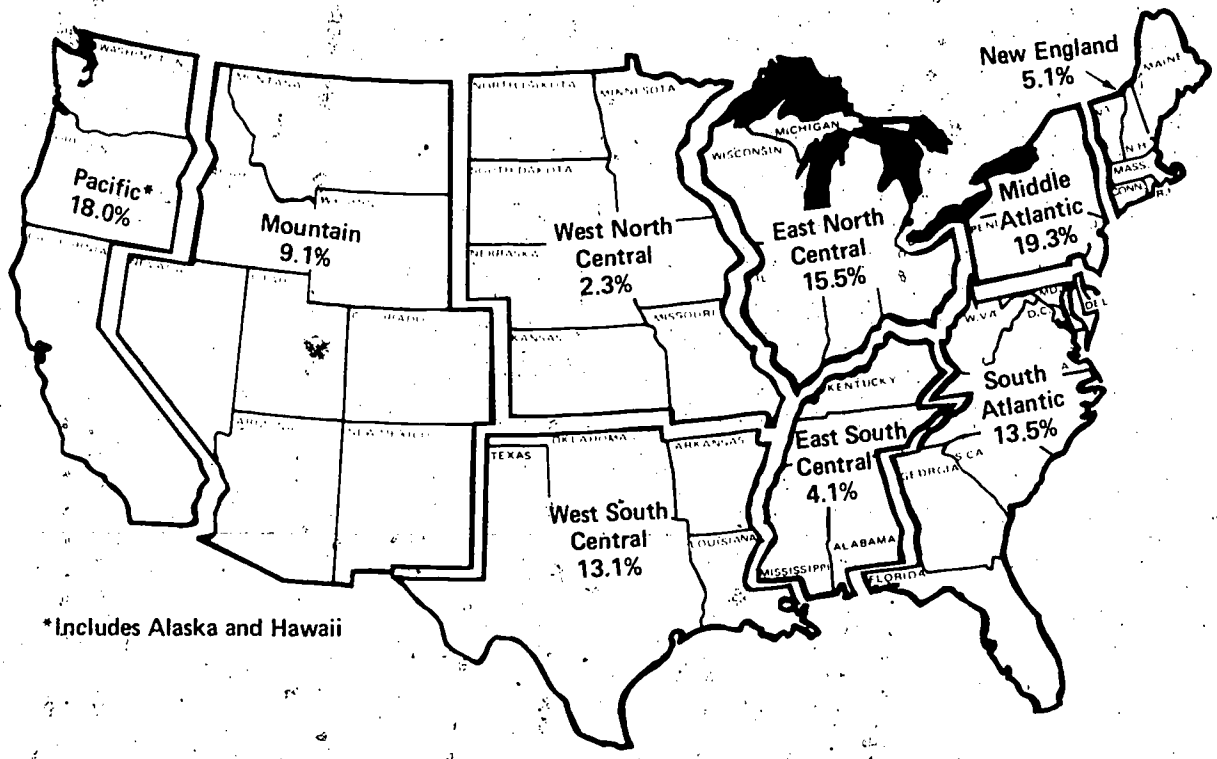

FIGURE 8. Geographic Distribution of Energy-Related Doctoral Scientists and Engineers, 1975

centage of engineers and chemists in the energy-related population was larger than in the total doctorate population in all nine regions while the percentage of physicists and earth, environment, and marine scientists in the energy-related population was larger in eight of nine regions and in seven of nine regions, respectively.

Over two-thirds (69 percent) of the energy-related earth, environment, and marine scientists were located in three western regions — West South Central (798), Mountain (362), and Pacific (500). These scientists accounted for about three out of ten of the energy-related doctorates in the West South Central region and about two out of ten in the Mountain region (Table 4-1b).

Much of the regional location of energy-related doctorates can be attributed to the concentration of the oil and natural gas industry in the West South Central states and to the presence, or absence, of ERDA multiprogram laboratories. The percentage of energy-related among all doctoral scientists and engineers in each region was strongly influenced by the number of doctorates employed in ERDA multiprogram laboratories in the region.[1] As suggested above, the concentration of the oil and gas industry in Texas and Oklahoma appears to explain the relatively high percentage of energy-related doctorates among all doctorates in these states and in the West South Central region; however, because of a lack of data it was impossible to establish this relationship by statistical analysis. Thus, the concentration of the petroleum industry and the presence of five of the eight ERDA-owned, contractor-operated multiprogram laboratories in the three western regions explains much of the relative concentration of energy-related doctorates in these regions.

The second part of this chapter provides information on salary levels. These data collected by NAS were regular salaries for a 12-month period; for college professors or others on 9- or 10-month contracts, NAS adjusted the salary to reflect a 12-month salary.

The median salary for energy-related doctorates was $25,900 and ranged from $22,300 for psychologists and other social scientists (excluding economists) to $30,300 for the "other fields" group that includes doctorates employed in business management and administration (Table 4-2a). The salary at the tenth percentile of all energy-related doctorates was $18,600 while it was $38,700 at the ninetieth percentile. Comparing tenth-percentile figures across the energy-related employment fields, engineers had the highest salary at $19,700 while economists had the highest salary at $55,700 for the ninetieth percentile.

In the energy-related population in general, chemists; engineers; economists; the earth, environment, and marine scientists; and persons employed in the "other fields" group had higher than average salaries for all percentile levels. Energy-related engineers' salaries varied substantially across the engineering employment fields with chemical, nuclear, fuel technology/petroleum, and materials science engineers reporting higher than average earnings.

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[1]The relationship was estimated using a simple linear regression of the form $y = a + bx$, where y was the ratio of the energy-related population divided by all doctorates in each region and x was the number of doctorates employed in the ERDA multiprogram laboratories in each region or the number of doctorates employed by ERDA in the case of the District of Columbia (Middle Atlantic region). The number of doctorates in ERDA multiprogram laboratories was taken from *Scientific-Engineering and Technician Manpower, Government-Owned Contractor-Operated Multi-Program Laboratories*, a report by Oak Ridge Associated Universities to the ERDA, July 1975. The data used in the report was collected approximately 3 months before the NAS survey. The distribution of ERDA multiprogram laboratories is New York — 1, Illinois — 1, Tennessee — 1, New Mexico — 2, California — 2, and Washington — 1. Except the West South Central region, approximately 90 percent of the variance in the percentage of energy-related doctorates among all doctorates across regions was related to the level of doctoral employment in the ERDA multiprogram laboratories by region.

As would be expected, the type of employer and management as a primary work activity strongly influenced the relative median salaries across employment fields for the energy-related population. The percentage employed in private business/industry had a strong, positive correlation with the median salary across employment fields, and the percentage employed in educational institutions had a strong, negative correlation with salary levels. The percentage involved in management as a primary work activity had a very strong, positive correlation with the salary levels across employment fields.[1]

A significant, positive correlation existed between the median salaries across the employment fields for the energy-related population and the percentage of the doctorates who had found employment in the same field as their degree specialty. While this might be interpreted as indicating the relative strength or weakness in demand for energy-related doctorates among the various employment fields, caution must be used as only approximately one-fourth of the variance in the median salaries across employment fields was related to the percentage of doctorates employed in the same field as the degree specialties.[2]

The median salary for the energy-related doctorates was 12 percent higher than for all doctoral scientists and engineers ($25,900 versus $23,100), with mathematicians; earth, environment, and marine scientists; and the "other fields" group reporting the largest differences in median salaries (Table 4-2b). Comparing salaries by percentiles, the tenth percentile salary for the energy-related population was 15 percent higher than for all doctorates, and the ninetieth percentile salary for the energy-related population was 10 percent higher than for all doctorates.

A fairly strong, positive correlation existed between the median salary of all doctorates in the employment field and the percentage of energy-related doctorates within the employment field. Over 40 percent of the variance in median salaries across employment fields was related to the percentage of energy-related doctorates in each field.[3]

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[1]Based on the results of simple linear regressions of the form $y = a+bx$, where y was the median salary of the energy-related population by employment field and x was the percentage employed in private business/industry or in educational institutions or reporting management as a primary work activity.

[2]Based on the results on a simple linear regression of the form $y = a+bx$, where y was the median salary by employment field and x was the percentage of doctorates employed in the same field as their doctorate degree specialty.

[3]Based on the results of a simple linear regression of the form $y = a+bx$, where y was the median salary of all doctorates in the employment field and x was the percentage of energy-related doctorates in the employment field.

4.1 EMPLOYMENT BY GEOGRAPHIC LOCATION

TABLE 4-1a. Employment by State and Region
Energy-Related and All Doctoral Scientists and Engineers
Employed Population, 1975

Region and State	Energy-Related Number	Energy-Related Percent	Total Percent
New England	1,035	5.0	7.7
Connecticut	328	1.6	1.8
Maine	31	0.1	0.4
Massachusetts	594	2.8	4.4
New Hampshire	1	—[a]	0.3
Rhode Island	54	0.3	0.5
Vermont	27	0.1	0.3
Middle Atlantic	4,032	19.3	19.9
New Jersey	933	4.5	4.2
New York	1,625	7.8	10.2
Pennsylvania	1,474	7.1	5.5
East North Central	3,240	15.5	16.4
Illinois	1,400	6.7	4.7
Indiana	198	0.9	2.1
Michigan	546	2.6	3.5
Ohio	975	4.7	4.3
Wisconsin	121	0.6	1.9
West North Central	481	2.3	6.2
Iowa	95	0.5	1.0
Kansas	44	0.2	0.9
Minnesota	96	0.5	1.7
Missouri	146	0.7	1.7
Nebraska	40	0.2	0.5
North Dakota	45	0.2	0.2
South Dakota	15	—[a]	0.2
South Atlantic	2,806	13.5	17.6
Delaware	281	1.3	1.2
District of Columbia	1,117	5.4	3.5
Florida	154	0.7	2.1
Georgia	200	1.0	1.7
Maryland	316	1.5	3.2
North Carolina	152	0.7	2.1
South Carolina	101	0.5	0.8
Virginia	394	1.9	2.7
West Virginia	91	0.4	0.5
East South Central	846	4.1	4.2
Alabama	104	0.5	1.0
Kentucky	87	0.4	0.9
Mississippi	33	0.2	0.6
Tennessee	622	3.0	1.7
West South Central	2,735	13.1	7.1
Arkansas	9	—[a]	0.4
Louisiana	225	1.1	1.2
Oklahoma	609	2.9	0.9
Texas	1,892	9.1	4.6
Mountain	1,905	9.1	3.0
Arizona	134	0.6	1.0
Colorado	557	2.7	1.9
Idaho	150	0.7	0.4
Montana	116	0.6	0.3
Nevada	1	—[a]	0.2
New Mexico	736	3.5	1.1
Utah	152	0.7	0.9
Wyoming	59	0.3	0.2
Pacific	3,756	18.0	14.6
Alaska	20	—[a]	0.1
California	3,002	14.4	11.4
Hawaii	13	—[a]	0.4
Oregon	116	0.6	1.0
Washington	605	2.9	1.7
U.S. Possessions	16	—[a]	0.3
All States	20,852	100.0	100.0

[a]Indicates the sample size was too small to provide an accurate estimate; see also the footnote to Table 2-4a.

SOURCE: Department of Energy, based on National Academy of Science data.

The three Middle Atlantic region states accounted for the largest percentage of energy-related employment among the regions while California had by far the largest energy-related employment for any individual state. Employment in the states east of the Mississippi River totaled 57 percent of the energy-related population; however, energy-related doctorates were relatively more concentrated in the western states. The three western regions — West South Central, Mountain, and Pacific — had 40 percent of the energy-related doctorates versus only 28 percent of all doctorates.

TABLE 4-1b. Employment Fields by Geographic Region
Energy-Related Doctoral Scientists and Engineers
Employed Population, 1975

Geographic Region[a]	Total	Mathematics	Physical Astronomy	Chemistry	Earth, Environment, and Marine	Engineering	Life Sciences	Psychology and Social Sciences	Other and No Report
New England	1,035	39	150	145	36	515	15	71	64
Percent	100	4	14	14	3	50	1	7	6
Middle Atlantic	4,032	63	416	833	193	2,109	81	151	186
Percent	100	2	10	21	5	52	2	4	5
East North Central	3,240	57	369	652	195	1,481	144	165	177
Percent	100	2	11	20	6	46	4	5	5
West North Central	481	15	56	97	35	180	34	25	39
Percent	100	—[b]	12	20	7	37	7	5	8
South Atlantic	2,806	60	419	430	268	992	156	344	137
Percent	100	2	15	15	10	35	6	12	5
East South Central	846	61	112	103	15	418	65	32	40
Percent	100	7	13	12	—[b]	49	8	—[b]	5
West South Central	2,735	55	82	397	798	1,226	29	77	71
Percent	100	2	3	15	29	45	1	3	3
Mountain	1,905	39	398	255	362	608	81	104	58
Percent	100	2	21	13	19	32	4	5	3
Pacific	3,756	57	617	522	500	1,642	143	194	81
Percent	100	2	16	14	13	44	4	5	2
U.S. Possessions	16	0	0	0	0	10	0	6	0
Percent	—[b]	—	—	—	—	—[b]	—	—[b]	—

[a]The states in each region are shown in Table 4-1a.

[b]Sample size was too small to permit meaningful calculations of percentage distribution.

SOURCE: Department of Energy, based on National Academy of Science data.

Employment in all regions was fairly diverse among the various fields, and each region generally reflected the national distribution among the employment fields. Engineering was the largest employment field in every region. Physics and chemistry were either the second or third largest employment fields in all regions except the West South Central and Mountain states. The West South Central region had a relatively low percentage for physics but had by far the highest percentage for earth, environment, and marine sciences. The Mountain states had the second highest percentage of employment in earth, environment, and marine sciences. In fact, two-thirds of energy-related earth, environment, and marine sciences doctoral employment was in the West South Central, Mountain, and Pacific regions.

TABLE 4-1c. Percentage Distribution, Employment Fields by Geographic Region
Energy-Related and All Doctoral Scientists and Engineers
Employed Population, 1975

Geographic Region[a]	Total	Mathematics	Physics/ Astronomy	Chemistry	Earth, Environment, and Marine	Engineering	Life Sciences	Psychology and Social Sciences	Other and No Report
New England									
Energy-Related	100	4	14	14	3	50	1	7	6
All Doctorates	100	6	9	11	4	17	21	25	7
Middle Atlantic									
Energy-Related	100	2	10	21	5	52	2	4	5
All Doctorates	100	7	6	16	3	17	20	24	6
East North Central									
Energy-Related	100	2	11	20	6	46	4	5	5
All Doctorates	100	6	6	15	3	15	24	24	6
West North Central									
Energy-Related	100	[b]	12	20	7	37	7	5	8
All Doctorates	100	7	3	12	3	11	36	22	6
South Atlantic									
Energy-Related	100	2	15	15	10	35	6	12	5
All Doctorates	100	6	7	12	5	14	27	22	6
East South Central									
Energy-Related	100	7	13	12	[b]	49	8	[b]	5
All Doctorates	100	6	6	11	3	14	30	24	5
West South Central									
Energy-Related	100	2	3	15	29	45	1	3	3
All Doctorates	100	7	5	12	8	19	26	18	6
Mountain									
Energy-Related	100	2	21	13	19	32	4	5	3
All Doctorates	100	6	10	8	10	16	24	19	6
Pacific									
Energy-Related	100	2	16	14	13	44	4	5	2
All Doctorates	100	6	8	9	6	18	23	23	6
U.S. Possessions									
Energy-Related	[b]					[b]		[b]	
All Doctorates	100	4	6	7	3	18	30	21	12

[a]The states in each region are listed in Table 4-1a.

[b]Sample size too small to permit meaningful calculations of percentage distribution.

SOURCE: Department of Energy, based on National Academy of Science data.

The East South Central region was the only one having a higher percentage of mathematicians among the energy-related doctorates than among all doctorates. Only the West South Central region had a smaller percentage of physicists among the energy-related than among all doctorates. Only two regions, New England and West South Central, had smaller percentages of earth, environment, and marine scientists among the energy-related than among all doctorates.

4.2 SALARIES BY EMPLOYMENT FIELDS

TABLE 4-2a. Employment Fields and Salary Percentiles
Energy-Related Doctoral Scientists and Engineers
Employed Population, 1975

Employment Field	*10th Percentile*	*25th Percentile*	*50th Percentile*[a]	*75th Percentile*	*90th Percentile*
Average, All Employment Fields	$18,600	$21,800	$25,900	$31,100	$38,700
Mathematics	18,200	22,000	24,800	30,600	38,900
Physics/Astronomy	18,200	20,700	24,400	29,700	36,200
Chemistry	18,300	22,800	26,600	31,500	40,000
Earth, Environment, and Marine Sciences	18,800	21,800	26,500	34,200	40,800
Engineering	19,600	22,200	26,000	30,900	37,800
Civil	18,700	20,200	22,100	28,200	32,900
Chemical	21,300	24,200	27,200	31,800	40,500
Electrical	18,900	21,300	24,900	32,800	42,000
Nuclear	20,000	23,400	26,200	30,700	36,400
Mechanical	18,400	20,400	24,000	28,500	32,100
Fuel Technology/Petroleum	22,500	25,600	28,800	36,100	42,200
Materials Science	20,500	24,000	27,000	31,300	37,100
Life Sciences	16,200	18,900	22,300	26,600	31,600
Economics/Econometrics	18,400	21,300	26,600	35,900	55,700
Psychology and Other Social Sciences	15,500	17,600	22,300	27,300	34,000
Other Fields	18,200	23,600	30,300	40,700	50,100

[a] The fiftieth percentile is the median salary for each employment field.
SOURCE: Department of Energy, based on National Academy of Science data.

There was a general trend in all employment fields for absolute salary differences to increase between each higher percentile listed. Civil and mechanical engineers had the smallest differences between the tenth and ninetieth percentiles while economics/econometrics had the largest difference between these two percentiles.

The lowest salaries at the tenth and twenty-fifth percentiles (presumably where newer doctorates were concentrated) were found in the life sciences and in psychology and other social sciences, while the highest salaries were in three engineering fields: chemical, fuel technology/petroleum, and materials science.

The difference between the lowest and highest salaries among the employment specialties at the tenth and twenty-fifth percentiles was about 45 percent. The difference between the lowest (civil engineering) and the highest salary ("other fields") for the median (fiftieth percentile) was 37percent; then the difference increased to 53 percent for the seventy-fifth percentile and to 76 percent for the ninetieth percentile.

TABLE 4-2b. Median Salary Comparisons by Employment Field
Energy-Related and all Doctoral Scientists and Engineers
Employed Population, 1975

Employed Field	Median Salary		Ratio of Energy-Related to Total
	Energy-Related	Total	
All Employment Fields	$25,900	$23,100	1.12
Mathematics	24,800	21,800	1.14
Physics/Astronomy	24,400	23,600	1.03
Chemistry	26,600	23,900	1.11
Earth, Environment, Marine Sciences	26,500	23,400	1.13
Engineering	26,000	25,100	1.03
Civil	22,100	22,800	0.97
Chemical	27,200	26,200	1.04
Electrical	24,900	24,400	1.02
Nuclear	26,200	25,500	1.03
Mechanical	24,000	23,800	1.01
Fuel Technology/Petroleum	28,800	27,900	1.03
Materials Science	27,000	27,300	1.02
Life Sciences	22,300	22,200	1.01
Economics/Econometrics	26,600	24,200	1.10
Psychology and Other Social Sciences	22,300	21,600	1.03
Other Fields	30,300	24,300	1.25

SOURCE: Department of Energy, based on National Academy of Sciences data.

The median salary for energy-related doctorates was approximately 12 percent higher than the median salary for all doctorates ($25,900 versus $23,100). Only civil engineers had a median salary for energy-related doctorates lower than for all doctorates.

U.S. Government Funding Sources

A slightly higher percentage of the energy-related doctorates received support from the U.S. government[1] than did all doctoral scientists and engineers (47 percent versus 43 percent; see Table 5-1a). All employment fields except engineering and earth, environment, and marine sciences had higher percentages receiving U.S. government support among the energy-related doctorates than among all doctoral scientists and engineers. Over 70 percent of the energy-related physicists and life scientists received U.S. government support. Among the energy-related engineers, three employment fields — civil, chemical, and fuel technology/petroleum — had fewer than 30 percent receiving U.S. government support. In the mining, nuclear, and materials science engineering fields, over 60 percent of the energy-related engineers received U.S. government support. (See Figure 9.)

By type of employer (Table 5-3), the energy-related population and all doctoral scientists and engineers reported widely varying percentages receiving U.S. government support, except those employed in private business/industry where both the energy-related and all doctorates reported just over 20 percent receiving U.S. government support. Over two-thirds (69 percent) of the energy-related doctorates employed by educational institutions received U.S. government support compared to only 42 percent of all doctorates employed by educational institutions.

Over 10,950 doctoral scientists and engineers received support from ERDA (Table 5-4b); of these, only 46 percent (5085) reported that they were energy-related. Among the doctorates receiving support from ERDA, less than 15 percent of the life scientists reported they were energy-related; less than 30 percent of the earth, environment, and marine scientists were energy-related; and approximately 40 percent of the physical scientists were energy-related. In contrast, almost 70 percent of the engineers who received support from ERDA were energy-related.

The doctorates who received ERDA support but did not indicate they were energy- and fuel-related may have indicated another area of critical national importance (see Figure 1), e.g., environment, teaching, health, mineral resources, defense, or even food production and technology. In the case of nuclear physics research and accelerator-related research, the survey respondents may not have checked any of the areas of critical national importance as none of the listed areas was appropriate to their work.

Twenty-four percent of the energy-related doctorates received support from ERDA compared with only 4 percent of all doctoral scientists and engineers (Table 5-1b). Ten percent or more of the energy-related doctorates in one or more employment field received at least partial support from the National Science Foundation, Environmental Protection Agency, Department of Interior, and Department of Defense. Focusing on those receiving ERDA support, 87 percent of the energy-related doctorates were either physical scientists or engineers versus approximately 69 percent of the nonenergy-related doctorates from these same fields.

Employment of ERDA-supported doctorates was concentrated in educational institutions — over 50 percent. Doctorates employed by private business/industry were the second most common recipients of ERDA support.

A comparison of the primary work activities supported by ERDA and other major U.S. government sources of support for the energy-related doctorates revealed 30 percent of the doctorates funded by ERDA were in management compared with 28 percent for the National Science Foundation, 35 percent for the

[1] It should be noted that the actual extent of the support received from the U.S. government could range from a minimal amount to full support; see question 20 in the questionnaire (Appendix A).

Department of Defense, and 29 percent for the Department of Interior. Fifty-seven percent of the doctorates funded by ERDA were in research and development compared with 46 percent for the National Science Foundation, 50 percent for the Department of Defense, and 51 percent for the Department of Interior.

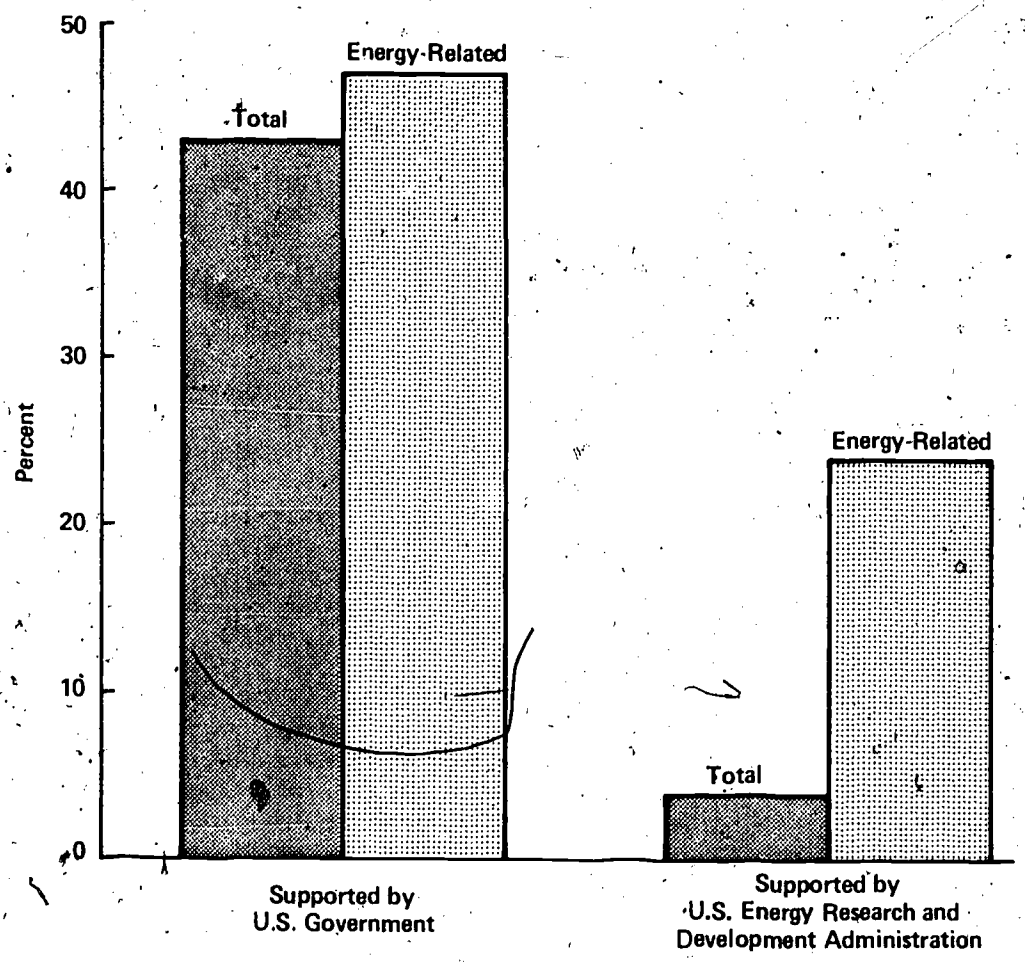

FIGURE 9. Percentage of Doctoral Scientists and Engineers Receiving U.S. Government Support, 1975

5.1 U.S. GOVERNMENT FUNDING SOURCES BY EMPLOYMENT FIELD

TABLE 5-1a. Percentage of U.S. Government Supported Personnel by Employment Field[a]
Energy-Related and All Doctoral Scientists and Engineers Employed Population, 1975

Employment Field	Percent Reporting U.S. Government Support	
	Energy-Related	All Doctoral Scientists and Engineers
Total, All Fields	47	43
Mathematics	55	27
Physics/Astronomy	77	63
Chemistry	37	28
Earth, Environment, and Marine Sciences	39	56
Total Engineering	43	48
Civil	29	44
Chemical	24	23
Electrical	46	47
Industrial, Manufacturing	54	27
Nuclear	64	64
Mechanical	41	42
Fuel Technology/Petroleum	20	21
Mining	62	50
Materials Science	75	48
All Other Engineering	50	57
Agricultural Science	76	61
Biology and Medical Science	70	56
Economics/Econometrics	40	33
Psychology and Other Social Sciences	52	33
Other Fields	33	23
Field Not Reported	30	26

[a]Indicates at least partial support or sponsorship of work activities by the U.S. government.
SOURCE: Department of Energy, based on National Academy of Science data.

The percentage of doctoral scientists and engineers receiving U.S. government support was only slightly higher among the energy-related than for the total population; however, the relative percentages varied considerably among employment fields. Energy-related mathematicians had twice the percentage receiving government support in comparison with all mathematicians. Energy-related earth, environment, and marine scientists, however, had only seven-tenths the percentage receiving U.S. government support as did all earth, environment, and marine scientists.

Energy-related engineers reported a slightly lower percentage receiving government support than did all doctoral engineers, but this was the result of lower percentages reported mainly by civil engineers and by the "all other engineering" group.

TABLE 5-1b. Employment Fields and U.S. Government Funding Sources
Energy-Related Doctoral Scientists and Engineers
Employed Population, 1975

Employment Field	Number Receiving U.S. Government Support							
	Energy-Related U.S. Govt Supported Total[a]	National Science Foundation	Environmental Protection Agency	ERDA (AEC)	Nuclear Regulatory Commission	Department of Interior	Department of Defense	All Other
Total, All Fields	9,810	1,765	493	5,085	699	982	1,395	2,757
Mathematics	246	49	9	149	20	13	51	38
Physics/Astronomy	2,027	386	17	1,410	80	22	313	371
Chemistry	1,286	279	29	699	68	53	295	231
Earth, Environment, and Marine Sciences	937	221	105	188	69	444	90	235
Engineering	3,966	526	193	2,281	404	319	580	1,031
Agricultural Sciences	201	0	49	0	0	64	0	162
Biology and Medical Science	340	126	11	166	21	15	0	150
Economics/Econometrics	252	75	14	23	0	0	11	188
Psychology and Other Social Sciences	279	54	27	45	28	14	25	204
Other Fields	213	44	27	114	9	38	18	94
Field Not Reported	63	5	12	10	0	0	12	53

[a]Indicates at least partial support or sponsorship of work activities by the U.S. government. Number of individuals reporting one or more sources of U.S. government funding support. Because some individuals reported multiple sources of U.S. government funding support, the sum of individuals reported for all agencies is larger than the total number receiving support.

SOURCE: Department of Energy, based on National Academy of Science data.

Slightly less than one-half of all energy-related doctoral scientists and engineers received some government support during 1975. Of those receiving government support, approximately one-half received it from ERDA, the most common source of government support for six of the employment fields. Agencies such as the Federal Energy Administration and the Federal Power Commission are included in the "all other" category of funding sources.

TABLE 5-1c. Engineering Employment Field and U.S. Government Funding Sources
Energy-Related Doctoral Engineers
Employed Population, 1975

Engineering Employment Field	Number Receiving U.S. Government Support							
	Energy-Related, U.S. Govt. Supported Total[a]	National Science Foundation	Environmental Protection Agency	ERDA (AEC)	Nuclear Regulatory Commission	Department of Interior	Department of Defense	All Other
Total, Engineering	3,966	526	193	2,281	404	319	580	1,031
Civil	123	10	0	54	32	29	7	39
Chemistry	453	57	29	299	10	70	36	67
Electrical	202	94	10	60	38	36	49	56
Industrial, Manufacturing	31	13	0	16	0	0	0	2
Nuclear	750	24	12	605	146	0	48	64
Mechanical	463	91	10	235	38	0	23	148
Fuel Technology/ Petroleum	124	0	8	46	0	8	42	40
Mining	86	10	0	19	0	78	0	0
Materials Science	310	37	0	204	36	9	53	49
All Other Engineering	1,424	190	124	743	104	89	322	566

[a]Indicates at least partial support or sponsorship of work activities by the U.S. government. Number of individuals reporting one or more sources of U.S. government funding support. Because some individuals reported multiple sources of U.S. government funding support, the sum of individuals reported for all agencies is larger than the total number receiving support.

SOURCE: Department of Energy, based on National Academy of Science data.

ERDA provided support for one-fourth of all energy-related engineers and for 58 percent of those who received U.S. government support. ERDA was the most common source of U.S. government support for all engineering fields, except electrical and mining, with support ranging from 13 percent for civil engineers to 51 percent for nuclear engineers.

5.2 U.S. GOVERNMENT FUNDING SOURCES BY PRIMARY WORK ACTIVITY

TABLE 5-2. U.S. Government Supported Personnel by Primary Work Activity
Energy-Related and All Doctoral Scientists and Engineers
Employed Population, 1975

Primary Work Activity	U.S. Government Supported[a]			
	Energy-Related		All Doctoral Scientists and Engineers	
	Number	Percent	Number	Percent
Total, All Activities	9,810	47	113,131	43
Management/Administration, Total	2,608	42	23,122	44
Management, Research and Development	2,131	49	14,854	51
Management, Other	319	24	5,098	32
Management, Both	158	29	3,170	42
Research and Development, Total	5,194	55	52,558	63
Basic Research	1,950	76	29,721	76
Applied Research	2,823	51	19,229	57
Development	421	32	3,608	36
Design	123	25	578	37
Teaching	839	41	25,347	27
Consulting	323	32	1,988	35
Other and No Report	723	45	9,538	38

[a]Indicates at least partial support or sponsorship of work activities by the U.S. government.
SOURCE: Department of Energy, based on National Academy of Science data.

For the three most common primary work activities reported by the energy-related respondents — management of research and development, basic research, and applied research — the percentages receiving U.S. government support were fairly close for the energy-related and all doctoral scientists and engineers. The largest differences in percentages receiving U.S. government support were reported in the "management, both" activity and in the design activity, both of which had much smaller percentages of energy-related doctorates receiving U.S. government support, and in the teaching activity where energy-related doctorates had a much larger percentage receiving U.S. government support.

Energy-related doctorates engaged in research and development had the largest percentage receiving U.S. government funds in 1975. ERDA was the most common source of U.S. government support in all of the primary work activities except teaching.

5.3 U.S. GOVERNMENT FUNDING SOURCES BY TYPE OF EMPLOYER

TABLE 5-3. U.S. Government Supported Personnel by Type of Employer
Energy-Related and All Doctoral Scientists and Engineers
Employed Population, 1975

Type of Employer	U.S. Government Supported[a]			
	Energy-Related		All Doctoral Scientists and Engineers	
	Number	Percent	Number	Percent
Total, All Employers	9,810	47	113,131	43
Business or Industry	2,757	23	14,442	22
Educational Institutions	4,060	69	64,151	42
U.S. Government, Civilian	1,985	100	19,477	100
State and Local Government	44	27	2,387	53
Nonprofit Organizations	904	88	6,179	73
Other Employers and No Report	60	73	6,495	62

[a]Indicates at least partial support or sponsorship of work activities by the U.S. government.
SOURCE: Department of Energy, based on National Academy of Science data.

Approximately one-fourth of the energy-related doctorates in business/industry and in state and local governments received U.S. government support. The percentage of energy-related doctorates that received U.S. government support for other types of employers was approximately 70 percent or above.

ERDA was the most common source of funding for energy-related doctorates in business/industry, educational institutions, and nonprofit organizations. Twenty-eight percent of the energy-related doctorates employed by the U.S. government worked for ERDA.

The percentages of energy-related doctorates and all doctoral scientists and engineers in business or industry who received U.S. government support were about the same. However, among the other types of employers (excluding the U.S. government), the percentage receiving support varied considerably between the energy-related and all doctorates. Educational institutions, nonprofit organizations, and the "other employers" group (health, military, international agencies, etc.) all had substantially higher percentages of energy-related employees receiving U.S. government support in comparison with all doctoral scientists and engineers.

5.4 U.S. ERDA FUNDED DOCTORATES

TABLE 5-4a. Distribution of ERDA Supported Personnel by Employment Field
Energy-Related and All Doctoral Scientists and Engineers
Employed Population, 1975

Employment Field	ERDA Supported [a]			
	Energy-Related		All Doctoral Scientists and Engineers	
	Number	Percent	Number	Percent
Total, ERDA Funded	5,085	100	10,954	100
Mathematics	149	3	353	3
Physics/Astronomy	1,410	28	3,590	33
Chemistry	699	14	1,509	14
Earth, Environment, and Marine Sciences	188	4	690	6
Total Engineering	2,281	45	3,324	30
Civil	54	1	75	1
Chemistry	299	6	358	3
Electrical	60	1	76	1
Industrial, Manufacturing	16	—[b]	16	—[b]
Nuclear	605	12	795	7
Mechanical	235	5	356	3
Fuel Technology/Petroleum	46	1	57	1
Mining	19	—[b]	19	—[b]
Materials Science	204	4	302	3
All Other Engineering	743	15	1,270	12
Agricultural Sciences	0		33	—[c]
Biological and Medical Science	166	3	1090	10
Economics/Econometrics	23	—[b]	43	—[c]
Psychology and Other Social Sciences	45	1	70	1
Other Fields	114	2	208	2
No Report	10	—[b]	44	—[c]

[a]Indicates at least partial support or sponsorship of work activities by ERDA.
[b]Sample size was too small to permit meaningful calculations for percentage distribution.
[c]Less than 0.5 percent.
SOURCE: Department of Energy, based on National Academy of Science data.

The distribution of ERDA support among the energy-related population was similar to the distribution of ERDA support among all scientists and engineers by employment field, primary work activity, and type of employer. The largest difference was reported in the engineering employment field. Within primary work activities, the largest differences were in basic research, applied research, and teaching.

The ERDA funded doctorates who did not indicate they were energy-related (5869 out of 10,954) were relatively concentrated: by employment field — medical and biological scientists; physical scientists; and earth, environment, and marine scientists; by type of employer — educational institutions and nonprofit organizations. As noted earlier, these ERDA funded doctorates who did not indicate they were energy-related may have indicated other areas of critical national importance (e.g., teaching, health, environment, mineral resources, defense, or food technology) or they may not have indicated any area (e.g., doctorates working in nuclear physics research or accelerator-related research).

TABLE 5-4b. Percentage of ERDA Supported Within Total U.S. Government Supported by Employment Field, Primary Work Activity, and Type of Employer *Energy-Related Doctoral Scientists and Engineers Employed Population, 1975*

Employment Field	*Energy-Related, U.S. Government Supported*	*Percent of U.S. Government Supported Receiving ERDA Funds*[a]
Total, All Fields	9,810	52
Mathematics	246	61
Physics/Astronomy	2,027	70
Chemistry	1,286	54
Earth, Environment, and Marine Sciences	937	20
Total, Engineering	3,966	58
Civil	123	44
Chemical	453	66
Electrical	202	30
Industrial, Manufacturing	31	52
Nuclear	750	81
Mechanical	463	51
Fuel Technology/ Petroleum	124	32
Mining	86	22
Materials Science	310	66
All Other Engineering	1,424	52
Agricultural Sciences	201	0
Biology and Medical Science	340	49
Economics/Econometrics	252	9
Psychology and Other Social Sciences	279	16
Other Fields	213	54
No Report	63	16

Primary Work Activity	*Energy-Related U.S. Government Supported*	*Percent of U.S. Government Supported Receiving ERDA Funds*[a]
Total, Management/ Administration	2,608	58
Management, Research and Development	2,131	61
Management, Other	319	34
Management, Both	158	59
Total, Research and Development	5,194	56
Basic Research	1,950	50
Applied Research	2,823	58
Development	421	65
Design	123	68
Teaching	839	25
Consulting	323	37
Other and No Report	723	37
TYPE OF EMPLOYER		
Business or Industry	2,757	63
Educational Institution	4,060	53
U.S. Government, Civilian	1,985	28
State and Local Government	44	32
Nonprofit Organization	904	68
Other Employers	60	12

[a]Percentage of individuals reporting one or more sources of U.S. government funding who received at least part of the U.S. government funding from ERDA.

SOURCE: Department of Energy, based on National Academy of Science data.

Over one-half of the U.S. government supported, energy-related doctorates employed as mathematicians, physicists, chemists, engineers, and in the "other fields" group received at least part of their support from ERDA.

ERDA supported over one-half of the U.S. government supported, energy-related doctorates in management/administration, research and development, and design. For the energy-related doctorates who received U.S. government support in business/industry, educational institutions, and nonprofit organizations, one-half to two-thirds received support from ERDA.

TABLE 5-4c. ERDA Funded and All U.S. Government Funded by Employment Field
All Doctoral Scientists and Engineers
Employed Population, 1975

Employment Field	*ERDA Funded*[a]	*Total U.S. Government Funded*[a]
Total, All Fields	10,954	113,131
Percent	100	100
Mathematics	353	4,608
Percent	3	4
Physics/Astronomy	3,590	11,304
Percent	33	10
Chemistry	1,509	9,303
Percent	14	8
Earth, Environment, and Marine	690	6,745
Percent	6	6
Engineering	3,324	20,145
Percent	30	18
Life Sciences	1,123	37,068
Percent	10	33
Psychology and Social Sciences	113	20,057
Percent	1	18
Other Fields	208	2,996
Percent	2	3
No Report	44	905
Percent	[b]	1

[a]Indicates at least partial support or sponsorship of work activities by U.S. government agencies.
[b]Less than 0.5 percent.

SOURCE: Department of Energy, based on National Academy of Science data.

The distribution of doctorates supported by ERDA was quite different from the distribution of doctorates funded by all U.S. government agencies. ERDA funded doctorates were relatively more concentrated in physics/astronomy and engineering and relatively less concentrated in life sciences and psychology and social sciences. ERDA provided funds to about three out of ten of all doctoral physicists who received funds from one or more U.S. government agency.

Questionnaire
1975 Survey of Doctoral Scientists and Engineers

APPENDIX A

1975 SURVEY OF DOCTORAL SCIENTISTS AND ENGINEERS

OMB No 099-R0294

CONDUCTED BY THE NATIONAL RESEARCH COUNCIL WITH THE SUPPORT OF THE NATIONAL SCIENCE FOUNDATION

THE ACCOMPANYING LETTER requests your assistance in this biennial survey of doctoral scientists and engineers – including the fields of the natural and social sciences, mathematics, and engineering.

PLEASE READ the instructions for each question carefully and answer by printing your reply or entering an 'X' in the appropriate box.

PLEASE CHECK the pre-printed information to be certain that it is correct and complete.

PLEASE RETURN the completed form in the enclosed envelope to the Commission on Human Resources, JH 638, National Research Council, 2101 Constitution Avenue, N.W., Washington, D.C. 20418.

NOTE: ALL INFORMATION YOU PROVIDE WILL BE TREATED AS CONFIDENTIAL AND USED IN GROUP COMPARISONS FOR RESEARCH PURPOSES ONLY.

(10)

If your name and address are incorrect, please enter correct information on the lines provided above. Include ZIP CODE.

If there is an alternate address through which you can always be reached, please provide it on the line below.

C/O Number Street City State ZIP CODE (11)

1. Date of Birth Mo Day Year (12-16)	2. State or Foreign Country of Birth (17-18)	3. Citizenship (19) USA Non-USA, specify country 0 ☐ 1 ☐ _____ (20-21)	4. Sex (22) 1 ☐ Male 2 ☐ Female

5. Racial/Ethnic Identification (23)

0 White/Caucasian
1 Black/Negro/Afro-American
2 American Indian
3 Mexican-American/Chicano
4 Puerto Rican-American
5 Oriental
6 ☐ Other Asian
7 ☐ Other, specify _____

6. List in the table below all collegiate and graduate degrees, excluding honorary degrees, that have been awarded to you. Please check the pre-printed information, including the number and name of the specialty from the list on page 3, to be certain that it is correct and complete.

Type of Degree	Granted Mo. Yr	Major Field (Use Specialties List) Name Number	Institution Name	City (or campus) & State
Bachelor's				
Master's				
Doctorate				
Other, Specify				

PLEASE NOTE that in items 7-10 information is requested for both the current year, as of the week of February 9-15, 1975, and last year, as of the week of February 10-16, 1974.

7. What was your employment status as of the periods indicated? (Check only one category in each year.)

	1974	1975
Employed full-time, science or engineering related position	1 ☐	1 ☐
Employed full-time, nonscience or nonengineering related position	2 ☐	2 ☐
Employed part-time, science or engineering related position	3 ☐	3 ☐
Employed part-time, nonscience or nonengineering related position	4 ☐	4 ☐
Postdoctoral appointment (fellowship, traineeship, research associateship, etc.)	5 ☐	5 ☐
Unemployed and seeking employment	6 ☐	6 ☐
Specify number of months unemployed: _____ (66-67)		
Unemployed and not seeking employment	7 ☐	7 ☐
Retired and not employed	8 ☐	8 ☐
Specify year of retirement: _____ (68-69)		
Other, specify: _____	9 ☐	9 ☐

(64) (65)

7a. If you were employed full-time during February 9-15, 1975, in a position unrelated to science or engineering, what was the MOST important reason for taking the position?

	1975
Prefer nonscience or nonengineering position	1 ☐
Promoted out of science or engineering position	2 ☐
Pay is better	3 ☐
Locational preference	4 ☐
Science or engineering position not available	5 ☐
Other, specify: _____	6 ☐

(70)

7b. If you were employed part-time during February 9-15, 1975, were you seeking full-time employment? 1 ☐ Yes 2 ☐ No (71)

Please do not write in this space

1 1 2-9 ctr # C
10 11
12 13 14 15 16
17 18 19 20 21
22 23
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24 25 26
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30 31 32 33 34 35
M
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39 40 41
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70 71

71

8. Which category below best describes the type of organization of your principal employment OR postdoctoral appointment?

(Check only one category in each year.)

	1974	1975
Business or industry	☐ 1	☐
Junior college, 2-year college, technical institute	☐ 2	☐
Medical school	☐ 3	☐
4-year college or university (other than medical school	☐ 4	☐
Elementary or secondary school	☐ 5	☐
Hospital or clinic	☐ 6	☐
U.S. military service, active duty (commissioned Corps, e.g., USPHS)	☐ 7	☐
U.S. government, civilian employee	☐ 8	☐
State government	☐ 9	☐
Local or other government, specify: _____	☐ 10	☐
International Agency	☐ 11	☐
Nonprofit organization, other than hospital, clinic, or educational institution	☐ 12	☐
Other, specify: _____	☐ 13	☐

(7-8) (9)

9. What were the primary (A) and secondary (B) work activities related to your position?

(Check only one box in each column.)

	1974 A	1974 B		1975 A	1975 B
Management or administration of:					
Research and development	☐	☐	1	☐	☐
Other than research and development	☐	☐	2	☐	☐
Both	☐	☐	3	☐	☐
Basic research	☐	☐	4	☐	☐
Applied research	☐	☐	5	☐	☐
Development of equipment, products, systems, data	☐	☐	6	☐	☐
Design	☐	☐	7	☐	☐
Teaching	☐	☐	8	☐	☐
Report or other technical writing, editing	☐	☐	9	☐	☐
Production	☐	☐	10	☐	☐
Consulting, specify: _____	☐	☐	11	☐	☐
Professional services to individuals	☐	☐	12	☐	☐
Quality control, inspection, testing	☐	☐	13	☐	☐
Sales, marketing, purchasing, estimating	☐	☐	14	☐	☐
Other, specify: _____	☐	☐	15	☐	☐

(10-13) (14-17)

10. Using Degree and Employment Specialties List on Page 4, select and enter both the number and title of the scientific specialty most closely related to your principal employment or postdoctoral appointment. Write in your specialty if it is not on the list.

	1974 Number	1974 Title of Specialty	1975 Number	1975 Title of Specialty
	(18-20)		(21-23)	

Please answer items 11 through 13 regarding your employment during the week of February 9-15, 1975.

11. What percent of time did you devote to each of the following activities?

	%
Management or administration of:	
Research and development	(24)
Other than research and development	(26)
Both	(28)
Basic research	(30)
Applied research	(32)
Development	(34)
Design	(36)
Teaching	(38)
Consulting	(40)
Other, specify: _____	(42)
TOTAL	100%

12. Please give the name of your principal employer (organization, company, etc., or, if self-employed, write "self"), and actual place of employment.

Name of Employer (44-49)

Number Street

City State ZIP Code (50-54)

13. What was the basic annual salary* associated with your principal professional employment during the week of February 9-15, 1975? If you were on a postdoctoral appointment (e.g., fellowship, traineeship, research associateship), what was your annual stipend plus allowances?

_____ per year (55-57)

*NOTE: Basic annual salary is your annual salary before deductions for income tax, social security, retirement, etc., but does not include bonuses, overtime, summer teaching, or other payment for professional work.

If academically employed:

a. Check whether salary was for ☐ 9-10 months or ☐ 11-12 months. (58)

b. Did you hold a tenured position during February 9-15, 1975? ☐ Yes 1 ☐ No. (59) If yes, what year was the tenure granted? _____ (60-61)

c. What is the rank of your position?

1 ☐ Professor
2 ☐ Associate Professor
3 ☐ Assistant Professor
4 ☐ Instructor
5 ☐ Lecturer
6 ☐ Dean
7 ☐ President or Chancellor
8 ☐ Other, specify: _____
9 ☐ Does not apply (82)

72 73 74 75

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1 2-9 ctr #

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44 45 46 47 48 49

50 51 52 53 54

55 56 57

58

59 60 61

82

14. How many years of professional work experience, including teaching, have you had? _____ Year(s) (63-64)

15. Have you ever held a postdoctoral appointment? 0 ☐ Yes 1 ☐ No (65)

If yes, list below the time periods of your most recent postdoctoral appointments.

Appointment	Starting Year	Total Months
Most Recent	_____ (66-67)	_____ (68-69)
Second Most Recent	_____ (70-71)	_____ (72-73)
Third Most Recent	_____ (74-75)	_____ (76-77)

How many other postdoctoral appointments have you held? _____ (78)

16. Have you ever been a full-time employee (excluding summer employment) of business or industry since earning your doctorate?

0 ☐ Yes 1 ☐ No (10)

If yes,

a. For how many years?
_____ Year(s) (11-12)

b. If you were employed by business or industry in February, 1975, check here ☐. If not, how many years ago did you leave your most recent business or industry employment?
_____ Year(s) (14-15)

17. Have you ever been a full-time employee (excluding summer employment) of an academic institution or organization since earning your doctorate?

0 ☐ Yes 1 ☐ No (16)

If yes,

a. For how many years?
_____ Year(s) (17-18)

b. If you were employed by an academic institution or organization in February, 1975, please check here ☐. If not, how many years ago did you leave your most recent academic employment?
_____ Year(s) (20-21)

18. Have you ever been a full-time employee (excluding summer employment) of government (federal, state, or local) since earning your doctorate?

0 ☐ Yes 1 ☐ No (22)

If yes,

a. For how many years?
_____ Year(s) (23-24)

b. If you were employed by government in February, 1975, check here ☐. If not, how many years ago did you leave your most recent government employment?
_____ Year(s) (26-27)

19. Listed below are selected topics of critical national interest. If you devoted a significant proportion of your professional time to any of these problem areas in February, 1975, please check the box for the one on which you spent the MOST time.

1 ☐ Education.
1 ☐ Teaching
2 ☐ Other
3 ☐ Health
4 ☐ Defense
5 ☐ Environmental protection, pollution control
6 ☐ Space
7 ☐ Crime prevention and control
8 ☐ Food production and technology
9 ☐ Energy and fuel
10 ☐ Other mineral resources
11 ☐ Community development and services
12 ☐ Housing (planning, design, construction)
13 ☐ Transportation, communications
14 ☐ Other, specify. _____ (28-29)

20. Was any of your work in February, 1975, supported or sponsored by U.S. Government funds?

0 ☐ Yes 1 ☐ No 2 ☐ Don't know (30)

If yes, which of the following federal agencies or departments were supporting the work? (Check all that apply.)

31 ☐ NASA
32 ☐ National Science Foundation
33 ☐ Environmental Protection Agency
34 ☐ Energy Research & Development Administration (AEC)
35 ☐ Nuclear Regulatory Commission (AEC)
36 ☐ Agency for International Development
37 ☐ Department of the Interior
38 ☐ National Institutes of Health, HEW
39 ☐ Alcohol, Drug Abuse & Mental Health Administration, HEW
40 ☐ Office of Education, HEW
41 ☐ Other HEW, specify: _____
42 ☐ Department of Defense
43 ☐ Department of Commerce
44 ☐ Department of Agriculture
45 ☐ Department of Transportation
46 ☐ Department of Justice
47 ☐ Department of Housing and Urban Development
48 ☐ Other agency or department, specify: _____
49 ☐ Don't know source agency

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31 32 33 34
35 36 37 38
39 40 41 42
43 44 45 46
47 48 49

APPENDIX B

List of Doctoral Degree Specialties and Employment Fields

DEGREE AND EMPLOYMENT SPECIALTIES LIST

MATHEMATICAL SCIENCES

000 - Algebra
010 - Analysis & Functional Analysis
020 - Geometry
030 - Logic
040 - Number Theory
052 - Probability
055 - Math, Statistics (see also 544, 670, 725, 729)
060 - Topology
080 - Computing Theory & Practice
082 - Operations Research (see also 477)
085 - Applied Mathematics
089 - Combinatorics & Finite Mathematics
091 - Physical Mathematics
098 - Mathematics, General
099 - Mathematics, Other*

ASTRONOMY

101 - Astronomy
102 - Astrophysics

PHYSICS

110 - Atomic & Molecular Physics
120 - Electromagnetism
130 - Mechanics
132 - Acoustics
134 - Fluids
135 - Plasma Physics
136 - Optics
138 - Thermal Physics
140 - Elementary Particles
150 - Nuclear Structure
160 - Solid State
198 - Physics, General
199 - Physics, Other*

CHEMISTRY

200 - Analytical
210 - Inorganic
215 - Synthetic Inorganic & Organometallic
220 - Organic
225 - Synthetic Organic & Natural Products
230 - Nuclear
240 - Physical
245 - Quantum
250 - Theoretical
255 - Structural
260 - Agricultural & Food
265 - Thermodynamics & Material Properties
270 - Pharmaceutical
275 - Polymers
280 - Biochemistry (see also 540)
285 - Chemical Dynamics
298 - Chemistry, General
299 - Chemistry, Other*

EARTH, ENVIRONMENTAL & MARINE SCIENCES

301 - Mineralogy, Petrology
305 - Geochemistry
310 - Stratigraphy, Sedimentation
320 - Paleontology
330 - Structural Geology
341 - Geophysics (Solid Earth)
350 - Geomorph., Glacial Geology
360 - Hydrology
370 - Oceanography
381 - Atmospheric Chemistry & Physics
382 - Atmospheric Dynamics
391 - Applied Geology, Geol. Engr., Econ. Geol.
388 - Environmental Sciences, General
389 - Environmental Sciences, Other*
397 - Marine Sciences, Other*
398 - Earth Sciences, General
399 - Earth Sciences, Other*

ENGINEERING

400 - Aeronautical & Astronautical
410 - Agricultural
415 - Biomedical
420 - Civil
430 - Chemical
435 - Ceramic
440 - Electrical
445 - Electronics
450 - Industrial, Manufacturing
455 - Nuclear
460 - Engineering Mechanics
465 - Engineering Physics
470 - Mechanical
475 - Metallurgy & Phys. Met. Engr.
477 - Operations Research, Systems (see also 082)
479 - Fuel Technology, Petrol Engr.
480 - Sanitary/Environmental
486 - Mining
497 - Materials Science Engr.
498 - Engineering, General
499 - Engineering, Other*

AGRICULTURAL SCIENCES

500 - Agronomy
501 - Agricultural Economics
502 - Animal Husbandry
504 - Fish & Wildlife
505 - Forestry
506 - Horticulture
507 - Soils & Soil Science
510 - Animal Sciences
511 - Phytopathology
517 - Food Science & Technology (see also 573)
518 - Agriculture, General
519 - Agriculture, Other*

MEDICAL SCIENCES

520 - Medicine & Surgery
522 - Public Health
523 - Veterinary Medicine
524 - Hospital Administration
527 - Parasitology
534 - Pathology
536 - Pharmacology
537 - Pharmacy
538 - Medical Sciences, General
539 - Medical Sciences, Other*

BIOLOGICAL SCIENCES

540 - Biochemistry (see also 280)
542 - Biophysics
543 - Biomathematics
544 - Biometrics, Biostatistics (see also 055, 670, 725, 729)
545 - Anatomy
546 - Cytology
547 - Embryology
548 - Immunology
550 - Botany
560 - Ecology
562 - Hydrobiology
564 - Microbiology & Bacteriology
566 - Physiology, Animal
567 - Physiology, Plant
569 - Zoology
570 - Genetics
571 - Entomology
572 - Molecular Biology
573 - Food Science & Technology (see also 517)
574 - Behavior/Ethology
578 - Biological Sciences, General
579 - Biological Sciences, Other*

PSYCHOLOGY

600 - Clinical
610 - Counseling & Guidance
620 - Developmental & Gerontological
630 - Educational
635 - School Psychology
641 - Experimental
642 - Comparative
643 - Physiological
650 - Industrial & Personnel
660 - Personality
670 - Psychometrics (see also 055, 544, 725, 729)
680 - Social
698 - Psychology, General
699 - Psychology, Other*

SOCIAL SCIENCES

700 - Anthropology
703 - Archeology
708 - Communications*
709 - Linguistics
710 - Sociology
720 - Economics (see also 501)
725 - Econometrics (see also 055, 544, 670, 729)
729 - Social Statistics (see also 055, 544, 670, 725)
740 - Geography
745 - Area Studies*
750 - Political Science, Public Administration
755 - International Relations
770 - Urban & Reg. Planning
775 - History & Phil. of Science
798 - Social Sciences, General
799 - Social Sciences, Other*

ARTS & HUMANITIES

841 - Fine & Applied Arts (including Music, Speech, Drama, etc.)
842 - History
843 - Philosophy, Religion, Theology
845 - Languages & Literature
846 - Other Arts and Humanities*

EDUCATION & OTHER PROFESSIONAL FIELDS

938 - Education*

882 - Business Administration
883 - Home Economics
884 - Journalism
885 - Speech and Hearing Sciences
886 - Law, Jurisprudence
887 - Social Work
891 - Library & Archival Science
898 - Professional Field, Other*

899 - OTHER FIELDS*

*Identify the specific field in the space provided on the questionnaire