MANPOWER ASSESSMENT BRIEF

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Doctoral Scientists and Engineers Involved in Energy R&D* by Gender and Ethnicity

SUMMARY

Nearly 29,000 doctoral scientists and engineers were involved in energy R&D in 1991.

Table 1. Doctoral S&Es in Energy R&D,
by Occupation, 1991

Occupation	Number
Physical Sciences	14,200
Engineering	10,200
Life Sciences	2,300
Mathematics/Statistics/ Computer Sciences	1,300
Social Sciences	900

Women accounted for 6 percent, and underrepresented population accounted for 3 percent of the doctoral science and engineering workforce in energy R&D in 1991.

Distribution by underrepresented population:

- 2% Hispanic American
- 1% African American
- 0.1% Native American

Women and underrepresented population accounted for higher percentages of the younger doctoral workforce in energy R&D.

Figure 1. Comparison of Younger to Older Doctoral
S&Es in Energy R&D

DOE funded 70 percent of all doctoral scientists and engineers in energy R&D in 1991.

- *Women and underrepresented population accounted for about the same percentage of scientists and engineers in DOE-funded R&D as in non-DOE-funded R&D.*
- *Asian Americans accounted for about 10 percent of the scientists and engineers in DOE-funded R&D and for about 20 percent in non-DOE-funded R&D.*

Approximately 2,000 job openings for new doctoral scientists and engineers are expected in energy R&D between 1994 and 2000.

- *Decreases in energy R&D are expected to cause doctoral employment to fall by over 17 percent during the 1994-2000 period.*
- *All of the 2,000 job openings are net replacement positions due to attrition from the existing energy R&D doctoral workforce (e.g., retirement, death, and workers switching occupations or leaving energy R&D) exceeding the decline in the level of employment.*

Increased opportunities exist for enhancing diversity among doctoral scientists and engineers in energy R&D over the 1993-2000 period.

- *Over the decade, the percentages of women and underrepresented population among new graduate doctoral scientists and engineers have increased.*
- *Based on expected job openings and the number of doctoral graduates, engineering and several physical science fields offer opportunities to increase the participation of women and underrepresented population in energy R&D activities.*

* Energy Research and Development (R&D) includes all R&D funded by the Department of Energy and energy/fuel R&D funded by the private sector, other government agencies, and other organizations.

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INTRODUCTION

The goals of the nation's R&D policies include maintaining current support in education, training, and research for the next generation of scientists and engineers (S&Es) and using R&D activities to strengthen the achievement of the goals for women and underrepresented population.¹

The future supply of scientists and engineers for the national economy is assured through diversity and outreach in advanced education. Department of Energy (DOE) university research programs help create and apply knowledge in support of the Department's missions. The successes of these efforts can be measured by the participation rates of women and of underrepresented population in education programs and in science and technology employment.²

DOCTORAL S&E INVOLVEMENT IN ENERGY R&D, 1991

Three Percent of Doctoral S&Es Engaged in Energy R&D Were From Underrepresented Population

In 1991, nearly 29,000 doctoral scientists and engineers were engaged in energy R&D (see Table 1). Nearly one out of every two Ph.D.s in energy R&D were physical scientists and one out of every three, engineers. Figure 2 shows how the doctoral science and engineering workforce in energy R&D is distributed by gender and ethnicity. Eighty-four percent of the doctoral S&Es were Caucasian, and ninety-four percent were male. Among other population groups, Asian Americans accounted for the largest portion with 13 percent of the total, followed by Hispanic Americans with two percent of the total, African Americans with one percent, and Native Americans with 0.1 percent.

Figure 2. Doctoral S&Es in Energy R&D by Gender and Ethnicity, 1991

Younger Doctoral S&Es in Energy R&D More Likely to be Women and Underrepresented Population

Table 2 compares the gender and ethnicity of younger doctoral scientists and engineers in the energy R&D workforce to the older workforce groups. Overall, the younger group in the doctoral S&E energy R&D workforce was two and a half times more likely to be women, and also more likely to be African or Hispanic Americans than the scientists and engineers in the older group. There are noticeable differences between the younger and the older workforce groups within several occupational groups. For example, in engineering, the younger energy R&D doctoral workforce were much more likely to be females and African or Hispanic Americans than is the case for the older group.

Table 2. Comparison by Occupational Group of Younger to Older S&E Doctorates in Energy R&D, 1991

Occupation	Younger Doctoral S&E Energy R&D Workforce, (Degrees 1983-1991)	Older Doctoral S&E Energy R&D Workforce, (Degrees before 1983)
Engineering		
Women	6 %	1 %
African Americans	3	1
Hispanic Americans	3	1
Native Americans	<0.1	<0.1
Physical Sciences		
Women	10 %	4 %
African Americans	1	0.1
Hispanic Americans	4	2
Native Americans	0.4	0.1
Life Sciences		
Women	26 %	15 %
African Americans	1	1
Hispanic Americans	<0.1	0.3
Native Americans	<0.1	<0.1
Math/Statistics/Computer Sciences		
Women	9 %	8 %
African Americans	<0.1	0.1
Hispanic Americans	0.5	1
Native Americans	<0.1	1
Social Sciences		
Women	17 %	11 %
African Americans	2	<0.1
Hispanic Americans	2	<0.1
Native Americans	<0.1	<0.1

Note: Ph.D. award estimates are for U.S. citizens and permanent residents only.

Source: Ph.D. awards are from National Research Council tables. Energy R&D Ph.D. workforce estimates come from National Science Foundation/Department of Energy Survey of Doctoral Scientists and Engineers.

Women S&E Ph.D.s in Energy R&D Concentrated in Physical and Life Sciences

Figure 3 illustrates how female Ph.D.s in the energy R&D science and engineering workforce are distributed across occupational groups. Nearly three out of every four female Ph.D.s in energy R&D were in the physical or life sciences. Conversely, male Ph.D.s in energy R&D were more than twice as likely as females to be in engineering fields.

Figure 3. Doctoral S&Es in Energy R&D: Occupational Distribution of Women, 1991

Doctoral S&Es in Energy R&D From Underrepresented Population Concentrated in Physical Sciences and Engineering

Figure 4 shows how Ph.D.s in energy R&D from underrepresented population are distributed across broad occupational groups. Most African Americans, Hispanic Americans, and Native Americans were concentrated in the physical sciences and engineering. This is similar to the distribution across occupational groups for Caucasians and Asian Americans.

DOE Funded 70 Percent of Doctoral S&Es in Energy R&D

Figure 5 provides the distribution of the doctoral energy R&D workforce by source of funding. Seven out of every ten doctoral scientists and engineers in energy R&D activities were funded by DOE. More than one out of every five doctoral scientists and engineers in energy R&D activities were funded by private sector, while the remainder of the non-DOE-funded energy researchers received their funding from other sources including other federal agencies, colleges and universities, and state and local government.

Figure 4. Doctoral S&Es in Energy R&D: Occupational Distribution of Underrepresented Population, 1991

Figure 5. Source of Funding for Doctoral S&Es in Energy R&D Activities, 1991

Similar Proportions of Women and Underrepresented Population in DOE-Funded Doctoral S&E Energy R&D as in Non-DOE-Funded Energy R&D

Figure 6 compares the gender and ethnicity of doctoral scientists and engineers in energy R&D by funding source. Six percent of all doctoral scientists and engineers in DOE-funded energy R&D activities were women compared to five percent in non-DOE-funded energy R&D activities. Also, the DOE-funded subset of the doctoral science and engineering energy R&D workforce had the same proportion of doctoral scientists and engineers from underrepresented population (nearly 3 percent) as the non-DOE-funded subset. However, the DOE-funded subset had a higher proportion of Caucasians and a lower proportion of Asian Americans.

Figure 6. Gender and Ethnicity of Doctoral S&Es in Energy R&D by Funding Source, 1991

Figure 7. Gender and Ethnicity of Graduate Students Supported by DOE R&D Funds to Colleges and Universities, FY 1993

About One-Half of DOE-Funded Graduate Students Supported by DOE Funds for Basic Research

Approximately 6,650 graduate students were supported by DOE R&D funding to colleges and universities in FY 1993.³ Nearly one-half of the graduate students were supported by DOE basic research funding. The remainder of the graduate students were supported by DOE R&D funding from a wide variety of DOE programs including solar and renewables R&D, energy efficiency and utilization R&D, nuclear energy R&D, and fossil energy R&D. Graduate students majoring in physics, chemistry, and biological sciences accounted for over one-half of the total number of DOE-funded graduate students in the educational pipeline.

The diversity of the students in the graduate science and engineering degree pipeline appears to be significantly greater than the current doctoral science and engineering energy R&D workforce. An estimated one out of every five graduate students supported by DOE R&D funds to colleges and universities were female (see Figure 7). Also, it was estimated that graduate students supported by DOE R&D funds to colleges and universities were more than twice as likely to be from underrepresented population as are doctoral scientists and engineers in the current doctoral energy R&D workforce.

FUTURE EMPLOYMENT AND JOB OPENINGS

Doctoral S&E Employment in Energy R&D Expected to Decrease Over 1994-2000 Period

During the period 1994 to 2000, the number of doctoral scientists and engineers employed in energy R&D is expected to shrink by 17 percent or about 5,500 positions.⁴

While privately funded energy R&D employment is expected to increase by about 10 percent, doctoral employment in DOE-sponsored energy R&D is scheduled to fall by 27 percent due to scheduled DOE R&D funding reductions. DOE R&D funding is expected to hold almost constant from 1994 to 1996, with the largest reductions scheduled for 1997 to 2000.

Figure 8 shows the projected employment decline by occupational group. Doctoral science and engineering employment should fall in all major occupational groups. The largest employment declines are expected to occur in the physical sciences and in engineering.

Figure 8. Employment Outlook for Doctoral S&Es in Energy R&D, 1994-2000

Job Openings for Doctoral S&Es in Energy R&D Over 1994-2000 Period Due to Replacement Needs

Even though the total number of doctoral scientists and engineers in energy R&D is expected to decline over the 1994-2000 period, approximately 7,500 jobs will be vacated as existing workers retire, die, or transfer out of energy R&D.

Thus, during the 1994-2000 period, about 2,000 net job openings for doctoral scientists and engineers are expected to occur in the energy R&D workforce. Most of these job openings will be filled by new graduates. The largest number of job openings are expected in the physical sciences and engineering (see Figure 9).

Figure 9. Doctoral S&E Job Openings as a Percent of 1994 Energy R&D Ph.D. Employment

TRENDS IN SCIENCE AND ENGINEERING DEGREES FOR WOMEN AND UNDERREPRESENTED POPULATION AND OPPORTUNITIES IN ENERGY R&D

Women and Underrepresented Population Account for Increasing Share of Doctoral S&E Degrees

The proportion of doctoral awards to women in science and engineering in general increased significantly from 1984 to 1993, from one in four to one in three (see Figure 10).

Also, there has been an increase in the percentage of Ph.D.s in most science and engineering disciplines awarded to underrepresented population over the 1984-1993 period (see Figure 11).

Table 3 provides the demographic composition of the 1993 doctoral graduating class. Considerable variation in the percentage of Ph.D.s awarded to women occurs across science and engineering fields. Nearly one-half of all

Figure 10. Trends in Doctoral S&E Awards to Women, 1984-1993

Figure 11. Trends in Doctoral S&E Awards to Underrepresented Population, 1984-1993

Table 3. Doctoral S&E Awards by Gender and Ethnicity, 1993

Major Degree Field	Number	Female	Native American	African American	Hispanic American
Engineering	2,691	13%	0.1%	2%	2%
Physical Sciences	2,832	23	0.3	2	3
Life Sciences	5,194	47	0.3	3	3
Math/Statistics/Computer Sciences	1,098	26	0.2	1	2
Social Sciences	2,399	42	0.2	6	4

doctoral awards in life sciences in 1993 were made to women. This contrasts strongly with the fields that are heavily utilized in energy R&D (engineering and the physical sciences) and helps explain the relatively low

participation rates of women in the doctoral energy R&D workforce. For example, in engineering, only 13 percent of recent doctoral awards were made to women in 1993 (an all-time high for engineering). Likewise, the percentage of Ph.D.s awarded to women in 1993 in the physical sciences (23 percent), while somewhat higher than in engineering, was still below the percentage among all science and engineering doctoral awards made to women in 1993.

Not as much variation in doctoral awards to underrepresented population occurs across science and engineering disciplines as is the case for women. Yet here too the rate of degree awards to underrepresented population in engineering and the physical sciences trails the overall rate of doctoral awards in science and engineering to underrepresented population, both currently and in the recent past.

Opportunities for Enhancing Diversity in Energy R&D Doctoral Workforce

The demographics of recent graduating classes increase the possibility of enhancing diversity in energy R&D employment for many science and engineering fields, especially for women. In Table 4 below, doctoral awards to

women and underrepresented population are compared to job openings by occupation. In the two major occupational groups heavily utilized in the conduct of energy R&D—engineering and physical sciences—opportunities exist for significantly increasing the diversity of the current doctoral workforce. These two occupational groups currently have lower percentages of women and underrepresented population in the energy R&D doctoral workforce than among recent graduates.

In engineering, the number of average annual job openings expected over the 1994-2000 period (100) is significantly less than the sum of engineering Ph.D.s awarded to women and underrepresented population (477) in 1993. This is also the case in the physical sciences, in which the sum of doctoral awards to women and underrepresented population in 1993 is more than 3 times the average annual number of job openings expected.

The energy R&D sector must compete with the rest of the economy for these graduates. Yet opportunities to increase the diversity of the current doctoral workforce in energy R&D exist as a result of the increasing diversity among the new doctoral science and engineering degree graduates.

Table 4. Comparison of Job Openings in the Energy R&D Doctoral Workforce and Doctoral Awards to Women and Underrepresented Population

Field	Average Annual Number of Job Openings, 1994-2000	Total Doctoral Awards, 1993 (US Citizens and Permanent Residents)	Doctoral Awards to Women, 1993 (US Citizens and Permanent Residents)	Doctoral Awards to Underrepresented Population, 1993
Engineering	100	2,691	360	477
Physical Sciences	250	2,832	662	110
Chemistry	100	1,400	413	86
Earth Sciences	100	516	130	22
Physics	Little or No Hiring	916	119	40
Mathematics/Statistics/ Computer Sciences	Little or No Hiring	1,098	280	39
Life Sciences	Little or No Hiring	5,194	2,438	321
Social Sciences	Little or No Hiring	2,399	1,008	240

Endnotes

1. John H. Gibbons and Leon E. Panetta, FY 1996 Research and Development (R&D) Priorities, Office of Management and Budget, Executive Office of the President, Washington, DC, May 12, 1994.
2. U.S. Department of Energy, Fueling a Competitive Economy: Strategic Plan, DOE/S-0108, April 1994.
3. Oak Ridge Institute for Science and Education, Estimates of the Number of Graduate Students Supported by Department of Energy R&D Funds to Universities and Colleges, FY 1993, August 1994.
4. U.S. Department of Energy, Office of Science Education Programs, Scientists and Engineers in Energy Activities, 1994-2000, Unpublished, Manpower Assessment Brief, April 1995.

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