National Geoscience and Engineering Manpower Issues for the Petroleum Industry

Lee Gerhard, Janice Sorensen, and Melanie Hathaway

Kansas Geological Survey
1930 Constant Avenue, Lawrence, Kansas 66047

Introduction

Global petroleum demand is up and rising. Oil prices are up. Recent cold winters in the United States and expanding economies in southwest Asia, China, and India have combined to create a global oil demand estimated to be about 73 million barrels per day for 1997. In contrast, in 1989, global consumption was about 60 million barrels per day. Domestic rig count in 1984 was 2713, dropping to 744 in 1987, and currently is about 860 rigs (Fig. 1). 500,000 petroleum industry jobs were lost from the oil price collapse of 1986 (API, 1997).

In the same time period, United States oil and lease condensate production, raised to 10.525 mmbopd by focused exploration and production efforts by the domestic industry to offset the threat of continued embargoes by OPEC, has fallen 20% to 8.4 mmbopd. United States imports have risen from 31% of supply to 52% in 1997, and averaged over 50% for 1996. Exported wealth from imported oil alone has decreased the standard of living of Americans and increased foreign ownership of American property and means of production (Gerhard, 1996).

In the near future, when the global market has tightened further, Americans are going to see major price increases and are going to have to compete for supply with other nations. At that time, a hue and cry will arise about why the domestic industry won't "turn on the wells" and produce more. Government agencies also expect instant response (GAO, 1997).

Knowledgeable people understand that there is a 5-7 year time gap between decisions to increase exploration budgets and resulting new oil production,

even when experienced technical staff are available. However, few have considered the long term effects of the 1986 petroleum jobs massacre and how the events of ten years ago will influence future energy policy and supplies.

There are not enough experienced geoscientists and petroleum technology people available to hire today. Any crisis in oil supply causing increases in domestic activity will be constrained by lack of qualified staff.

During the downturn, as jobs were lost, academic enrollments in geosciences and petroleum technology suffered. Academic institutions, faced with significant budget shortfalls owing to decreased enrollments and increased costs, dropped lower-productive curricula, such as geology and petroleum engineering, despite the well-known cyclicity of the petroleum job market. Even well-known schools dropped coursework in petroleum geology and related fields.

Two other trends developed in academia. For geologists, a rise in environmental industry job prospects dampened the downturn of enrollment in the science, but has not produced geologists who can make an easy transition to petroleum exploration. In geology graduate programs, there was an initial rise in enrollments because of lack of jobs for lower degree levels, and then a drop as the available pool of new baccalaureate students and retraining professionals decreased. Second, there was an increase in the percentage of non-U.S. residents who took advantage of the available openings in graduate programs, a trend common in all science and engineering programs today.

Equally disturbing is the loss of professional technical people such as drillers, toolpushers, and drilling superintendents. Those who lost their jobs in the downturn found other fields in which to work, and have not returned to the petroleum job market. With the decline from nearly 3000 active rotary rigs to about 750, there was a surplus of well-trained and experienced technical people. There is not now such a pool. The nation would probably be hard-pressed to field 1200 rigs in an emergency.

Many of the well-trained experienced geologists and geophysicists have founded their own consulting or independent practices and no longer have interest in working for corporate entities. The independent nature of the industry

and its practitioners suggests that large companies will have a difficult time recruiting and retaining experienced staff. There are few experienced "hands" left in the large companies to mentor young people through the maze of exploration and development concepts, many of which are learned on the job, not taught in universities.

A last problem is that many of the laid-off workers were World War II veterans, and have now retired from the workforce completely, a situation also affecting faculty in academic institutions.

What is the future manpower situation?

Enrollments in geology and petroleum engineering plummeted during the years following the initial decline in oil exploration starting in 1982. The price crash of 1986 accelerated the trend and by 1990 many curricula were in serious enrollment trouble.

There are more than 700 academic institutions offering some kind of geology course work in Canada or the United States. Of these 700 , only 51 have any faculty claiming competence or interest in petroleum geology. Of these 51, only 27 are four year or graduate degree-awarding colleges and have regularly appointed faculty with petroleum interests (AGI, 1997).

It has not been possible to separate petroleum geology students from other geology student enrollments, but it is possible to examine the total enrollments in geology, geophysics, and petroleum engineering over the last few years.

In 1990, there were only 1634 baccalaureate geology degrees awarded in the United States, an average of less than three graduates per program. 957 masters degrees awarded, reflecting the number of hold-over degree seekers from earlier baccalaureate graduations and students who could not find professional employment electing to extend their academic programs. 301 doctoral degrees were awarded (Fig. 2).

Increased interest in environmental geology stimulated by new federal and state regulations improved enrollments at the baccalaureate level each year

through 1994 (last data available), with the biggest jump between 1991 and 1992 (Fig. 2). By 1994 there were 2482 geology baccalaureate graduates, most planning on careers in environmental or geohydrology fields. This created a pool of potential graduate students that has not materialized, giving more credibility to the environmental employment assumption. Masters degrees awarded decreased from 1990 though 1993 and appears to have stabilized at about 800 (Fig. 2).

The boom and bust cycle is evident for the master's degree in geology seen from 1971 through 1994. (Fig. 2b). The master degree is the normal working degree for geologists in the petroleum industry.The number of masters degrees peaked in 1985, the year before the oil market crash, and dropped dramatically from about 1600 in 1985 to the current 800 level.

Doctoral graduations seem to be unaffected by other trends and remain between 300 and 350 per year.

In contrast, there are 29 United States and 3 Canadian schools offering petroleum engineering curricula, with an additional 10 United States and 2 Canadian petroleum technology programs. During 1990 these 29 United States programs graduated 307 baccalaureate degrees, 165 master's degrees, and 54 doctorates. In 1991, these totals dropped to 202, 118, and 28, respectively (Fig. 3), but each has gradually recovered, to 316, 167, and 45 in 1994.

Geophysics degrees mirror the geology trends, that is, baccalaureate degrees awarded have recovered to about 50, masters are significantly down (62 in 1994), and doctoral degrees are stable (Fig. 4).

In contrast with a developing industry view, the U.S. Department of Labor provides a view of employment in engineering and petroleum technology for the period of 1990-2005 (U. S.Department of Labor, 1992) (Fig. 5). They estimate that petroleum engineers will have essentially the same employment number in 2005 as 1990 (1%), oil field technicians will drop 2%, while geoscientists (geologists, geophysicists, oceanographers) will gain 22% more jobs. 1992 statistics do not reflect the current global firming of oil demand and probably do not reflect the economic growth in southeast Asia, much of which

has occurred since 1992. The report does reflect the growing demand for geoscientists in environmental jobs, we believe.

Discussion:

In summary, the supply of new graduates in geology, geophysics and petroleum engineering is probably nearly sufficient to meet petroleum needs, but many geologists are being siphoned off into other careers. There is clearly a new employment boom starting, and new scientists and engineers will be able to command solid compensation packages and have a choice of positions in the next few years. Despite growth trends, academic programs through the master's degree in geology and geophysics require about 6 years to complete, and increased enrollments in 1997 will not produce new employees until 2003. Most petroleum engineers work with a baccalaureate degree, and will be available for employment by 2001 or 2002.

Just as clearly, if the United States wished to jump start petroleum exploration and production programs, there are not enough new scientists and engineers available to staff the effort. Just as there is a 5-7 year lag time between inception of a major corporate exploration program and its resulting production, there is a 5-7 year gap between need for scientists and engineers and their availability.

One other problem exists for petroleum scientists and engineers. There are so few experienced employees left in major companies that real education about exploration and development of petroleum resources will lag as young people re-invent the technology and institutional knowledge that departed with the 500,000 jobs lost as a result of the 1986 industry crash. Between the lack of petroleum-experienced faculty in our academic institutions and the small number of teaching programs featuring petroleum coursework and the required hands-on mentoring necessary to success in petroleum exploration and development, it will a long time before the industry recovers from the mid-eighties debacle.

Computers, seismic advances, and new drilling technology will mitigate some of these personnel shortages, but interpreting drillstem tests, understanding relationships of petroleum systems and production, and old-fashioned creativity

are not taught in the classroom. There is an old industry axiom, that 10% of the geologists are responsible for finding 90% of the petroleum. It is difficult to see where the mentoring to create new members of the 10% group will arise.

Just as devastated in the downturn as scientists were the oil field technicians who make the system work. Drillers, toolpushers, rig hands, service company mud and chemical engineers, mud-loggers, core and sample analysts, and geophysical loggers have all found new jobs in new careers, and are lost to the industry. Von Flatern (1997) notes that "The shortages of oil industry personnel is nearing critical status in the US Gulf of Mexico."

He notes that employment in the industry went from 312.4 thousand in 1986 to 159.9 thousand today, cuts that improved quarterly profits but insured later restriction in new exploration and production programs. Gary Lee, vice president of human resources for Diamond Offshore (in Von Flatern, 1997) was quoted as saying, "The industry as a whole is experiencing a shortage of skilled people because we lost, in essence, a generation of people in the 1980's that just haven't come back or haven't been developed."

Although we have not yet been able to develop detailed information about availability of oil field technicians it appears that the 5-7 year time lag for scientists and engineers will be matched by about the same time lag to train new technicians, especially drillers, despite the 1992 U.S.Dept. Labor estimates.

Summary:

Whether federal manipulation or market forces created the 1986 oil price collapse is no longer material. We are faced with yet another "boom and bust" cycle in the petroleum industry, one that will likely follow historical trends. There is a shortage of personnel in the industry today, it is not being met by any dramatic increase in young people clamoring to share in the boom, and thus will likely persist longer than usual. I will still give the same advice to young people entering the profession of petroleum geology today as I did when I was a university professor: "You will make a lot of money working in the petroleum industry. Save a lot of it; you'll need it later."

References:

American Petroleum Insititute, 1997, Oil Company 1996 Earnings and Profitability: Public Affairs Group, Editorial and Special Issues Department, American Petroleum Insititute, background paper, 5 p.

Claudy, N. H., (ed.) 1996, Directory of Geoscience Departmetns, 1996-97, 35th edition: American Geological Institute, Arlington, VA, 570 p.

Government Accounting Office, 1997, Vulnerability to Oil Supply Disruptions: Executive Summary, GAO/ECED 97-3, 8 p.

National Science Foundation, 1996, Science and Engineering Degrees, 11966-94, NSF- 96-321, National Science Foundation, Arlington, VA, 97 p.

Snyder, T. D., Hoffman, C. M., and C. M. Geddes, 1996, Digest of Education Statistics 1996: U.S. Department of Education NCES 96-133, Washington, D.C., 523 p.

Society of Petroleum Engineers, 1996, Petroleum Engineering and Technology Schools, 1996-97 Academic Year: Society of Petroleum Engineers Education and Accreditation Committee, 103 p.

U.S. Department of Labor, 1992, Outlook 1990-2005: U.S. Department of Labor, Bureau of Labor Statistics, Bulletin 1042, Washington, DC, 144 p.

Von Flatern, R., 1997, Work Force Shortage Becoming Critical: Offshore magazine, Pennwell Publishing, Tulsa, OK, v. 57, n. 2, p. 32-35.

Figure captions:

Figure 1: Petroleum statistics from 1984-1996. Data from Oil and Gas Journal, 1984-1997. (a) United States demand vs. crude production. (b) history of United

States rig count. (c) Percent of petroleum demand imported by the United States. 1984 data for December only.

Figure 2: (a) Number of geology degrees awarded from 1990 through 1994, by degree level (NSF, 1996). (b) Number of master's degrees in geosciences awarded from 1971 to 1974, from Snyder et al, 1996. The master's degree is the normal working degree in the geosciences, and these data show the "boom and bust" cycle of geoscience academic enrollment related to the 1986 petroleum price crash and consequent employment reduction.

Figure 3: (a)Number of petroleum engineering degrees awarded from 1990 through 1994, by degree level (NSF, 1996). (b) Number of students enrolled in petroleum engineering, 1990-1996, by class level (SPE, 1996).

Figure 4: Number of geophysics degrees awarded from 1990 through 1994, by degree level (NSF, 1996).

Figure 5: Employment outlook for geoscientists, petroleum engineers and oil field technicians, 1990-2005. Employment in thousands. Data from U.S. Department of Labor (1992)

Figure 1a

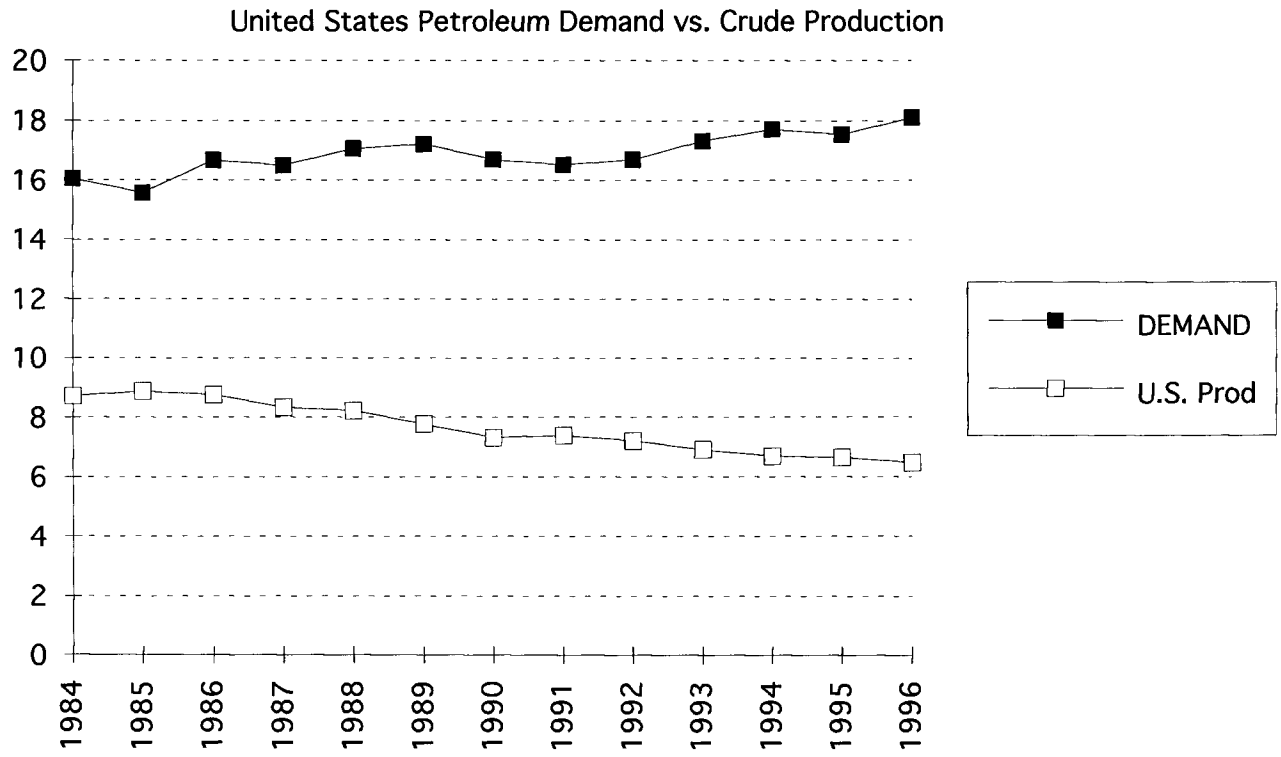

United States Petroleum Demand vs. Crude Production
20
18
16
14
12
10
8
6
4
2
0
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
DEMAND
U.S. Prod

Figure 1b

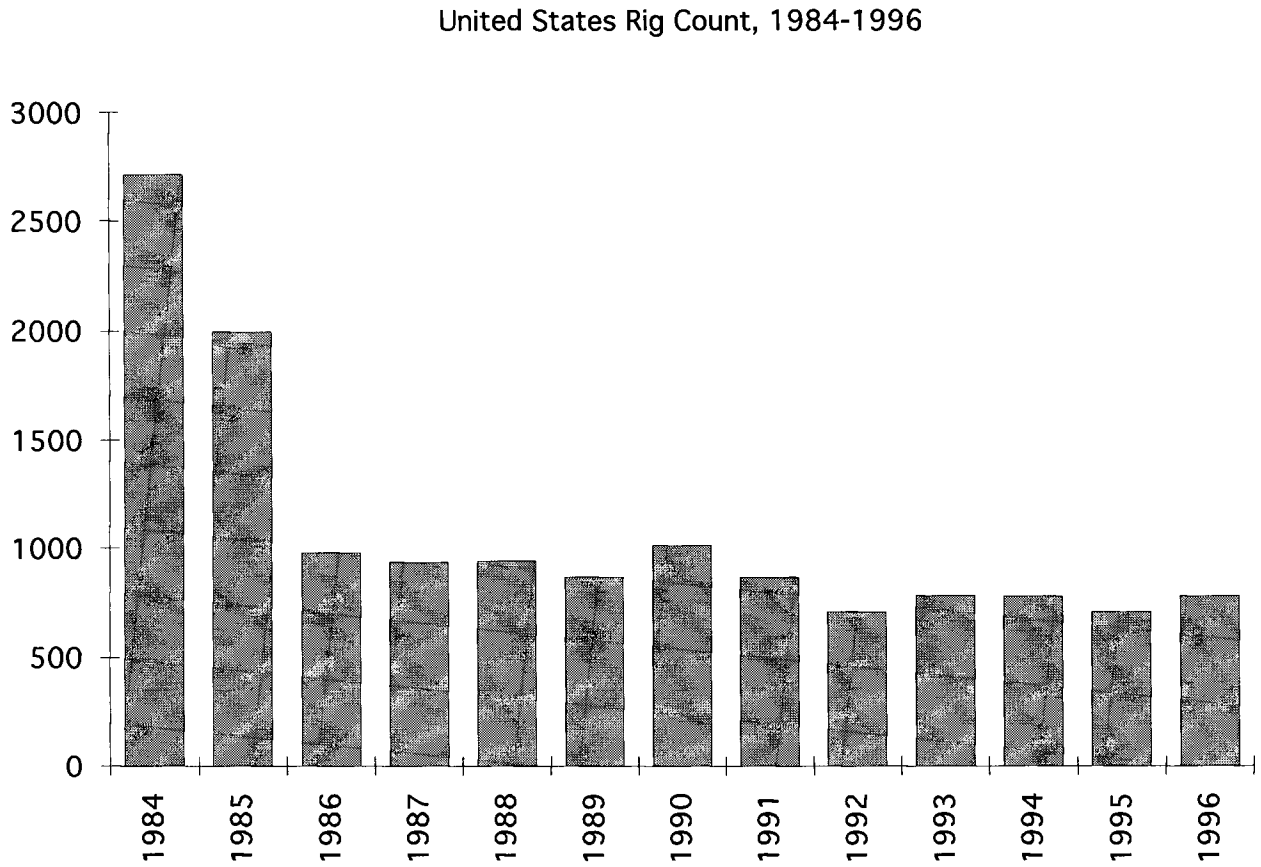

United States Rig Count, 1984-1996
3000
2500
2000
1500
1000
500
0
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996

Figure 1c

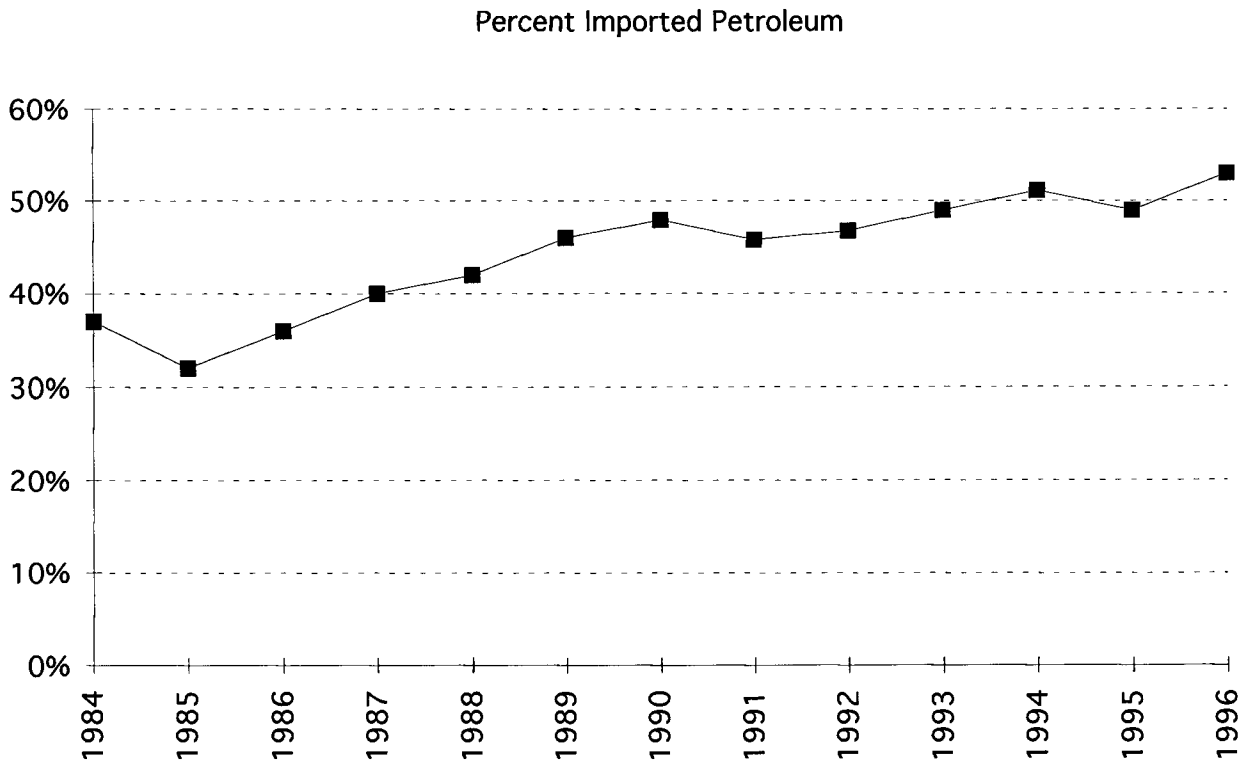

Percent Imported Petroleum
60%
50%
40%
30%
20%
10%
0%
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996

figure 2a

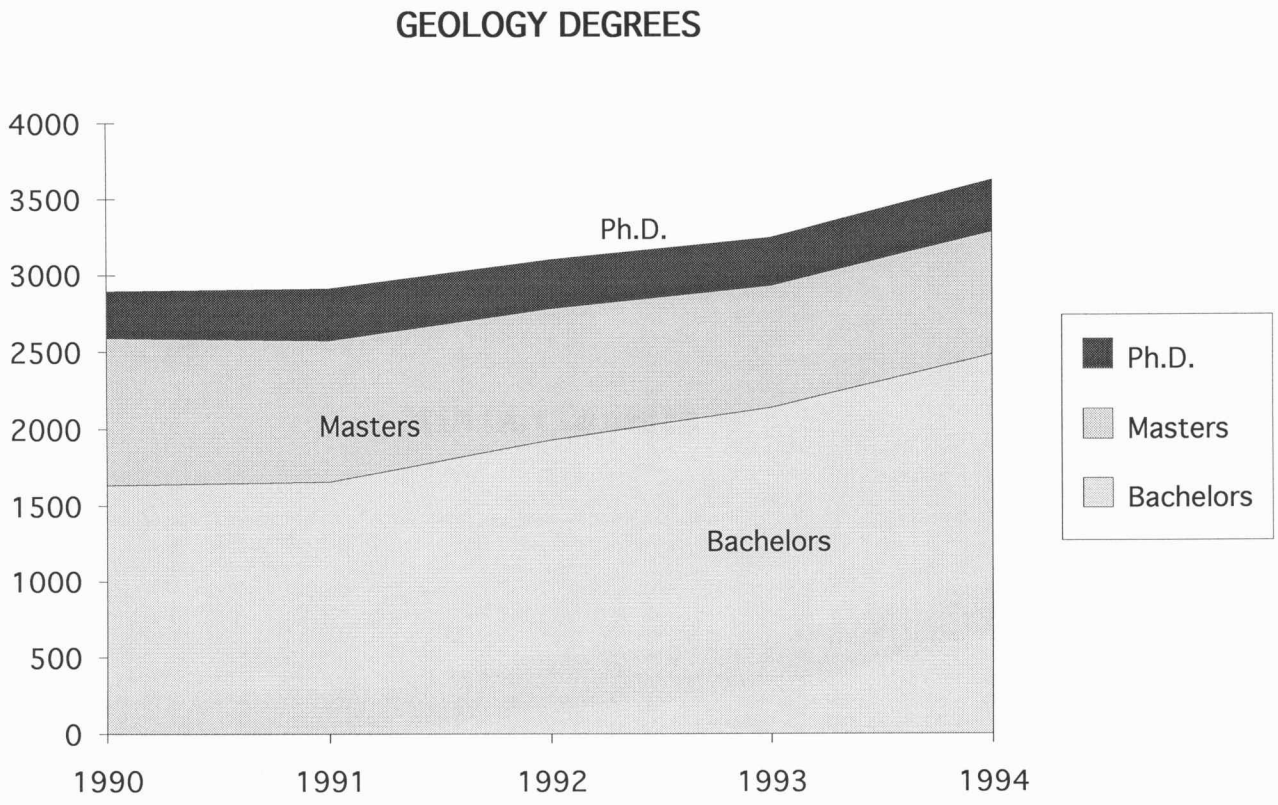

GEOLOGY DEGREES
4000
3500
3000
2500
2000
1500
1000
500
0
1990
1991
1992
1993
1994
Ph.D.
Masters
Bachelors
Ph.D.
Masters
Bachelors

Figure 2b

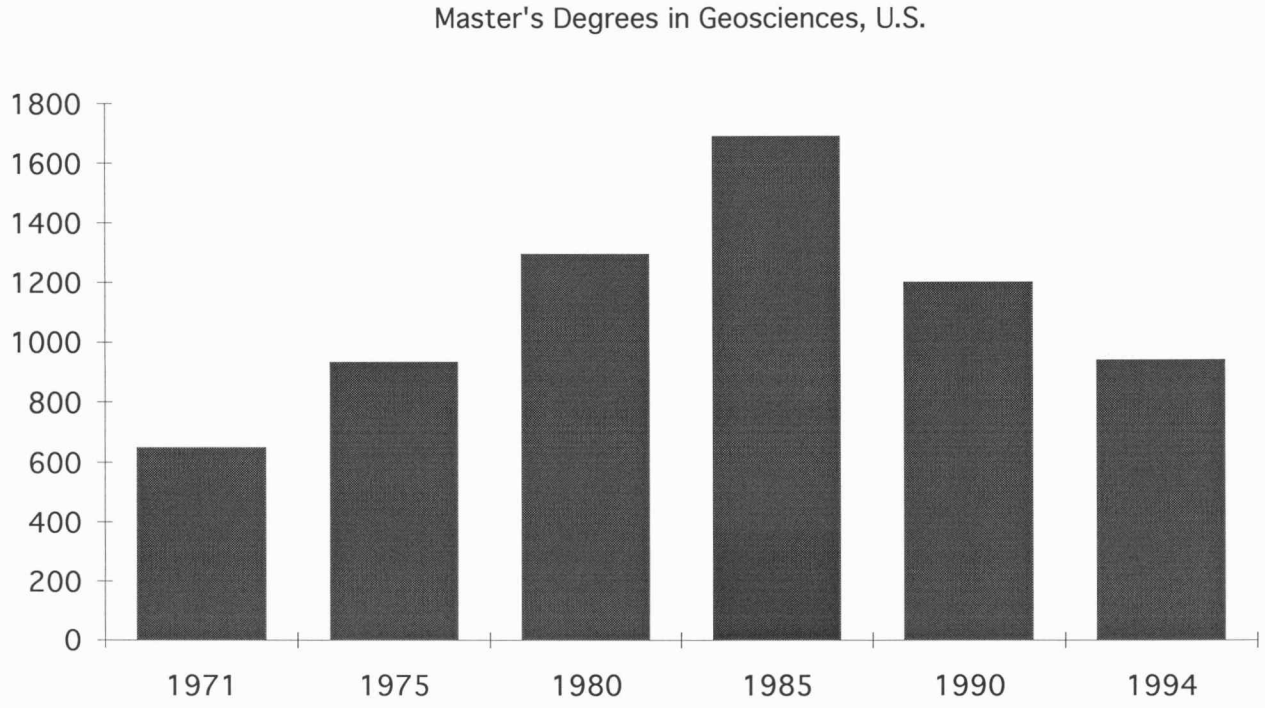

Master's Degrees in Geosciences, U.S.
1800
1600
1400
1200
1000
800
600
400
200
0
1971
1975
1980
1985
1990
1994

FIGURE 3a

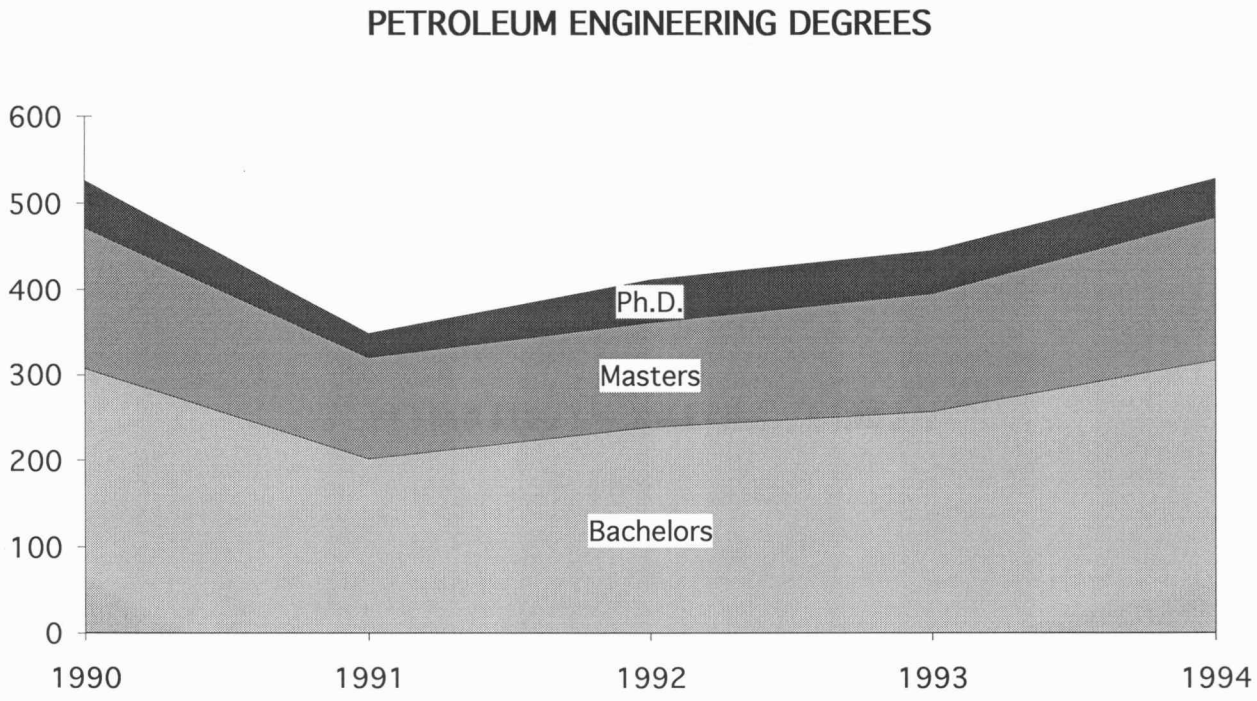

PETROLEUM ENGINEERING DEGREES
600
500
400
300
200
100
0
Ph.D.
Masters
Bachelors
1990
1991
1992
1993
1994

FIGURE 3b

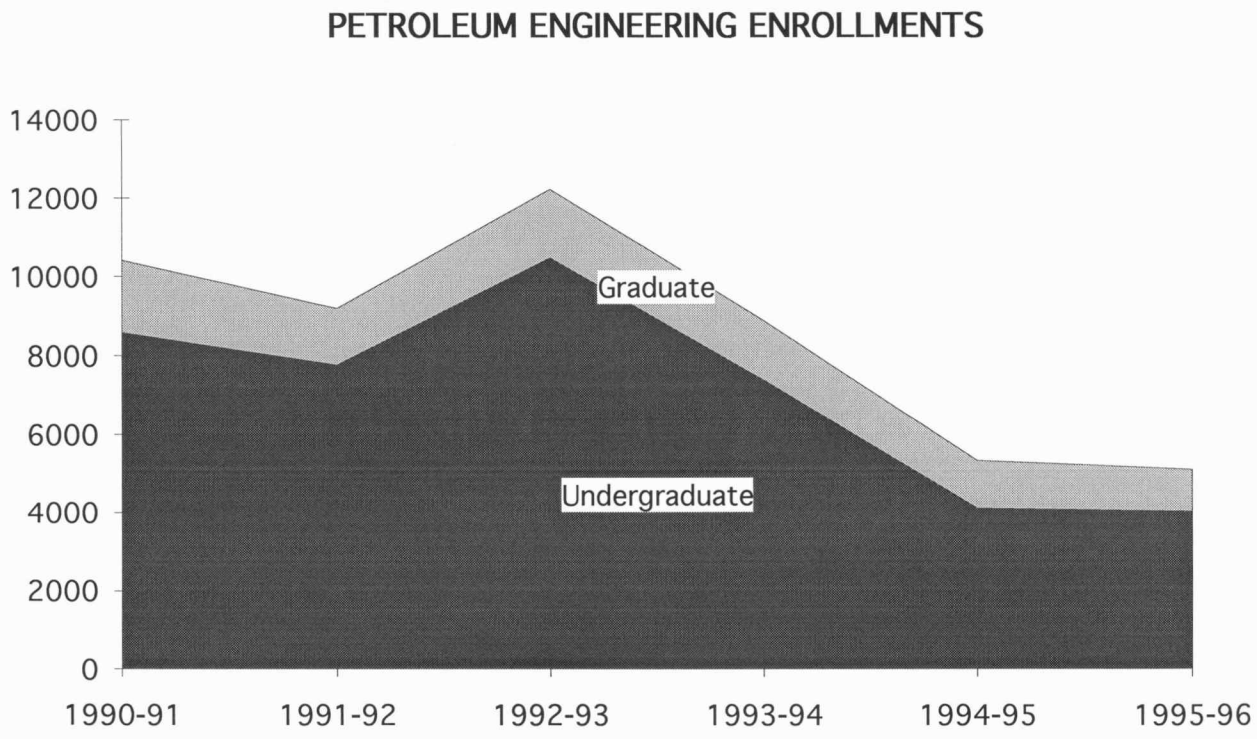

PETROLEUM ENGINEERING ENROLLMENTS
14000
12000
10000
8000
6000
4000
2000
0
Graduate
Undergraduate
1990-91
1991-92
1992-93
1993-94
1994-95
1995-96

FIGURE 4

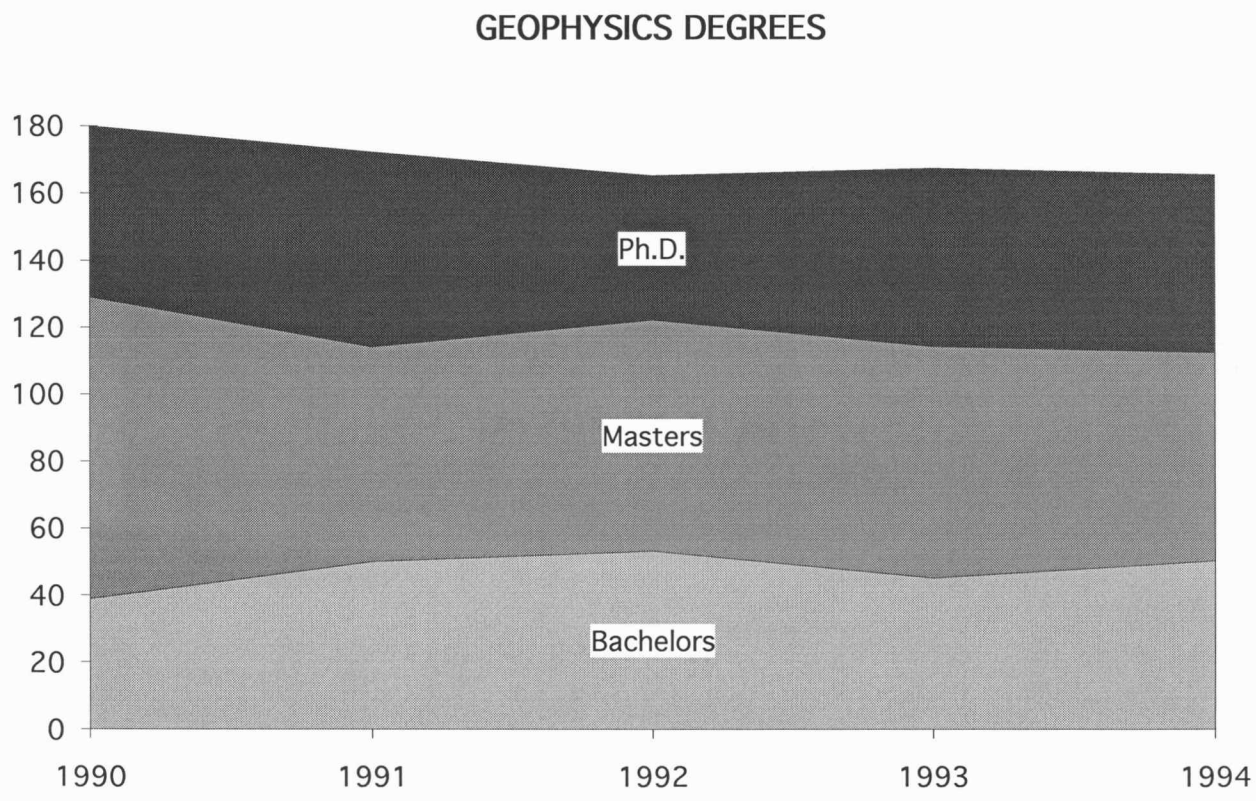
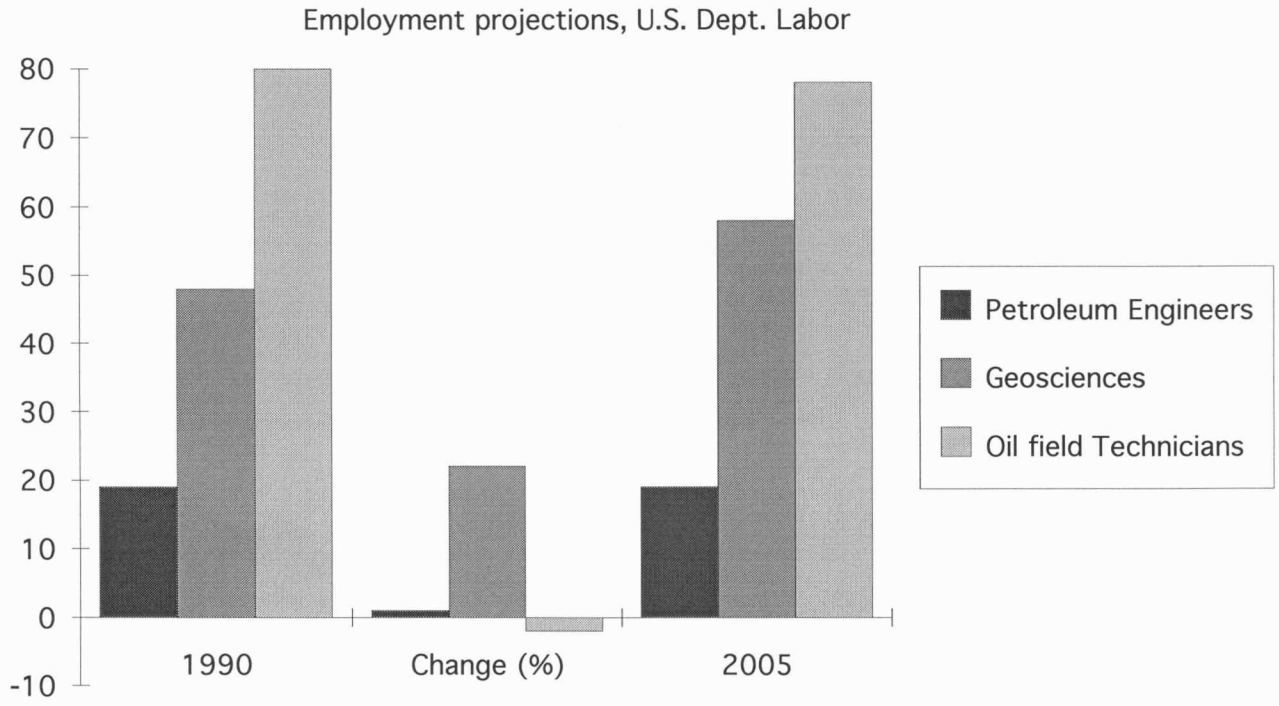

GEOPHYSICS DEGREES
180
160
140
120
100
80
60
40
20
0
Ph.D.
Masters
Bachelors
1990
1991
1992
1993
1994

Figure 5


Employment projections, U.S. Dept. Labor
80
70
60
50
40
30
20
10
0
-10
1990
Change (%)
2005
Petroleum Engineers
Geosciences
Oil field Technicians

Kansas Geological Survey
Open-file Report

Disclaimer

The Kansas Geological Survey does not guarantee this document to be free from errors or inaccuracies and disclaims any responsibility or liability for interpretations based on data used in the production of this document or decisions based thereon. This report is intended to make results of research available at the earliest possible date, but is not intended to constitute final or formal publication.