

Emerging Workforce Trends in the U.S. Energy and Mining Industries

As the baby boom generation is beginning to retire, the United States is facing the loss of a large number of experienced energy and mining workers in industry, academia, and the government. At the same time, the current educational system is not producing enough qualified workers to fill future jobs, which increasingly require science and math skills. Some innovative solutions are being pursued, but more action is needed if the nation is to maintain a skilled workforce able to supply energy and mineral needs.

The United States' high standard of living and importance in the global economy are built largely on mastery of technology and innovation, which, in turn, depends upon access to energy and mineral resources. The United States is the largest electric power producer, serving the world's largest economy. As shown in Figure 1, worldwide energy demand is expected to increase through 2035. The mining of nonfuel minerals, such as copper and platinum, is also important.



Source: Sherwood, 2011

Minerals are vital ingredients in a wide range of everyday products, the combined industries of which contributed \$2.2 trillion to the U.S. gross domestic product (GDP) in 2011.

This report summarizes available data [click here for more] on the current and projected future workforce for the U.S. energy and mining industries (including oil, natural gas, coal, nuclear, solar, wind, geothermal, carbon capture utilization and storage, and nonfuel mineral mining). The report also addresses challenges and opportunities for maintaining the workforce, including the “pipeline” from K-12 to post-secondary educational institutions

and programs, including community colleges, universities, vocational technical institutes, specialty training facilities and programs, and apprenticeship programs.

Workforce and Pipeline Trends

Workforce information and data are available from a range of sources, including federal, industry, industry association, professional society, and academic sources. No single entity collects, analyzes, and reports

data on all aspects of the energy and mining workforce. Instead, different entities collect and analyze data for their own particular purposes and using their own methods. This makes

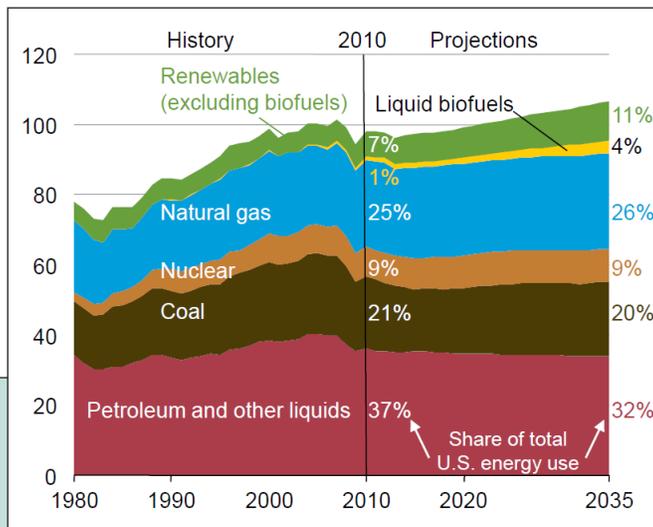


Figure 1. Growing Energy Demand. The Energy Information Administration is projecting a steady increase in U.S. demand for energy through 2035. An international increase is also expected.

Growing energy and mining sectors, combined with a current workforce that is aging and preparing to retire, are creating many new opportunities for young people interested in these fields.

direct comparisons of data from different sources difficult and imprecise, and combining data sets generally impossible.

Despite their substantial shortcomings, the available data and information do provide a clear indication of the general nature of the energy and mining workforce and the important trends, issues, and concerns related to it. The data indicate a bright present and future for energy and mining jobs. Demand for workers at all levels will remain strong for the foreseeable future and these jobs will continue to pay well.

Nonetheless, several factors pose a threat to maintain a sufficient energy and mining workforce, and their negative impacts will grow unless addressed. One major factor is that baby boomers comprise about a third of the U.S. workforce, and they are poised to retire in great numbers by the end of this decade. For example, projections from the Mine Safety and Health Administration show that 46 percent of its coal-sector workforce will be eligible to retire within 5 years. Not only are there too few younger workers in the pipeline to replace them (see Figure 2), but there is little time to capture the knowledge of experienced employees before they leave.

Another major crosscutting factor is that a strong foundation in science, technology, engineering, and math (STEM) skills is needed for many energy and mining jobs. However, the current pipeline of STEM-capable students and workers is inadequate to meet

workforce needs. Stem education begins in K-12, but the poor preparation of high school students is well known. High dropout rates and a lack of alternative pathways to high school graduation are also problems.

A common, serious problem is a faculty shortage, which impacts the oil and gas, mining, and geothermal workforces, and possibly eventually the carbon capture and storage workforce. Unless this is corrected, the nation risks losing its capacity to provide new science and engineering professionals for the workforce.

Pathways to Energy and Mining Careers

Industry-education partnerships, particularly at community colleges or in the first 2 years of higher education, have emerged as critical to the nation's energy and mining future. They are designed to create competency-based educational pathways to careers in industry. Successful models exist in manufacturing—closely aligned to the energy industry—and in several energy sectors (nuclear power, electrical transmission, and most recently, renewable energy).

Community colleges are proving to be the best vehicle for delivering the technician-level, skills-based education that the energy and mining industries need in a STEM technical workforce. They provide postsecondary education from 1-year certificates through associate's degrees, and are often the first 2 years of higher education leading to degrees in 4-year institutions.

The committee learned of a number of ongoing efforts by a variety of educational institutions that have established excellent pathways to address the workforce issues. Recognizing and emulating these 19 successful programs could help realize great benefits. Opportunities also exist to attract young people,

including ethnic minorities and women, into STEM programs and technical programs that lead to energy and mining careers.

Strategies for Addressing the Challenges

The report identifies a number of strategies that can help to address the looming shortage of U.S. energy and mining workers. [Click here for the committee's overarching findings and recommendations.](#)

Education Initiatives

Traditional routes to degrees in higher education do not adequately align curriculum to energy and mining industry

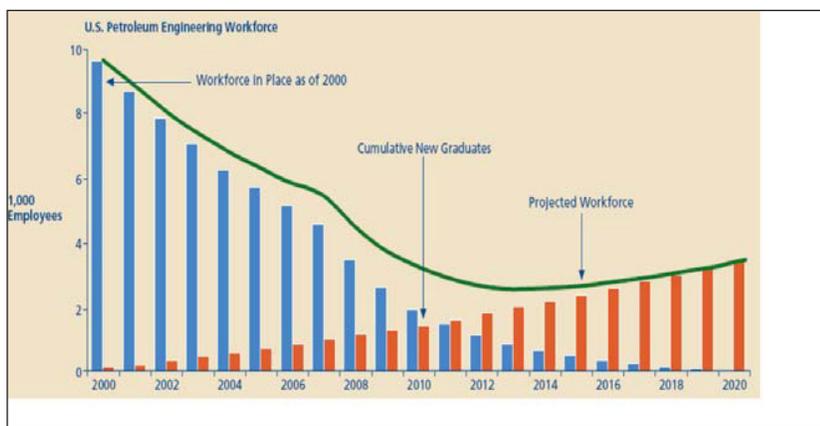


Figure 2. The U.S. petroleum industry is illustrative of the challenge. As vast numbers of engineers have retired, there are not enough graduates to replace them. Blue columns are the workforce in place as of 2000, red columns are cumulative new graduates, and the green curve is the projected workforce.

SOURCE: Sampath and Robinson, 2005

U.S. Report Card on Education

About 7,000 students drop out of high school every school day in the U.S., and about 1.3 million students do not graduate each year. Also, in 2011, only 25 percent of graduating high school seniors met or surpassed the four ACT College Readiness Benchmarks in the areas of science, math, reading, and English.

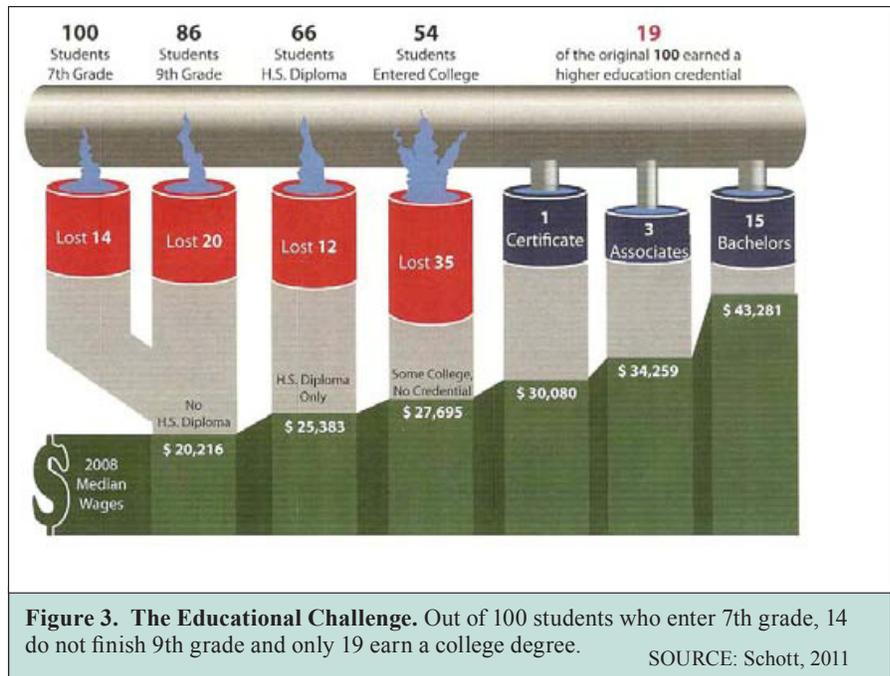
requirements, they are increasingly not affordable and accessible and, therefore, do not provide enough qualified STEM-educated workers and professionals to fulfil the nation's energy and mining workforce needs. The goal in addressing the shortfalls of the current education pipeline is to create an education system that can respond to changes in the economy more quickly and produce a more flexible, STEM-competent workforce.

Recommendation 1: The Department of Education, in collaboration with the Department of Labor, state departments of education, and national industry organizations, should convene (perhaps in workshops or as a working group) critical industry, government, and educational leaders to create and support new approaches that provide multiple pathways in higher education that take full advantage of the attributes of our higher education system. These models would benefit greatly from including, for example, the industry-education partnerships and community college programs described above.

Business-Education-Government Partnership

No one sector—government, industry, or education—can provide the needed energy and mining workforce on its own. University research also can contribute to workforce development by enhancing the education pipeline.

Recommendation 2: To address common goals and to provide a mechanism for industry's engagement with the education process and the graduates it produces, federal agencies (e.g., the National Science Foundation, Department of Energy, Department of Defense, National Institute for Occupational Safety and Health, and National Institutes of Health) should consider providing increased research funding to universities, with matching funding from industry,



with specific requirements to incorporate two outcomes from the research: (1) advancing technology or business processes to drive innovation and enrich graduate and undergraduate education; and (2) developing university faculty who work on the cutting edge of research to enhance the quality of higher education.

Energy and Mining Information for the Public

Building the best educational pathways in the world does not guarantee that more students will pursue energy and mining programs of study. A negative public perception of U.S. extractive industries due, for example, to concerns over pollution, noise, environmental degradation, and health issues, dissuades some from pursuing careers. Although renewable energy is generally seen as positive, issues such as questionable technology and market viability may be a deterrent. Information about all of these industries can educate the public about their importance to the nation and the career opportunities they offer.

Recommendation 3: National industry organizations, in partnership with educational institutions, should embark on a national campaign to create and provide accurate and timely information on the industries and their careers, educational and career navigation resources, and experiential learning opportunities to explore jobs and career paths in energy and mining.

Recommendation 4: In like fashion, national industry organizations and educational institutions should also embark on an informational campaign to educate students, parents, educators, and public

policy makers about the importance of the energy and mining industries to our economic and national security, the relevance of STEM education to jobs and careers in these industries, and job availability.

Data Needs

Although the federal (and other) databases provide an abundance of information on the energy and mining workforce, such as employment estimates and demographic information, the data currently available for addressing the energy and mining workforce are not sufficiently consistent, comprehensive and up-to-date for these rapidly evolving, technology-infused industries and they do not exist at a sufficient degree of granularity.

Recommendation 5: The Department of Labor, through its Bureau of Labor Statistics (BLS), should determine and pursue a more effective way to partner with industry, through its national industry associations, to more quickly and accurately reflect the fast-paced change of job and occupation titles and characteristics, as well as the levels of education and training required in 21st century jobs.

Recommendation 6: The BLS should work with industry and the Departments of Education and Labor to better define the STEM technical

workforce needed to support STEM professions in our economy so that appropriate and useful data can be identified, collected, and analyzed.

The Federal Workforce

Federal employees have a critical role in, and impact on, the success of the U.S. energy and mining industries. They link industry's ability to produce energy and minerals with civil society's concerns about these industries. However, the National Nuclear Security Administration reports that a majority of mission-critical employees are currently eligible or will be eligible for retirement in the next 4 years. Other federal agencies are facing a similar situation.

Recommendation 7: All involved federal agencies should review and revise recruitment, training, and employment arrangements for federal employees directly involved in minerals and energy policy, permitting, and production oversight to ensure the agencies' ability to attract and retain qualified federal workers. Industries involved in energy production and resource extraction should develop collaborative efforts to partner with government at all levels to develop solutions to the problem of recruiting and retaining quality public-sector employees.

Read or purchase this report and locate information on related reports at
<http://dels.nas.edu/besr>

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The National Academies appointed the above committee of experts to address the specific task requested by the U.S. Department of Energy. The members volunteered their time for this activity; their report is peer-reviewed and the final product signed off by both the committee members and the National Academies. This report brief was prepared by the National Research Council based on the committee's report.



For more information, contact the Board on Earth Sciences and Resources at (202) 334-2744 or visit <http://dels.nas.edu/besr>. Copies of *Emerging Workforce Trends in the U.S. Energy and Mining Industries: A Call to Action* are available for purchase from the National Academies Press, 500 Fifth Street, NW, Washington, D.C. 20001; (800) 624-6242; or as free PDFs at www.nap.edu.

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