In considering the breadth of information covered in this study, the committee chose to formulate the following set of overarching findings and recommendations to capture the key, fundamental themes contained in the full array of its findings and recommendations. The committee’s full findings and recommendations, along with the information and data to support them, are provided within the report. The overarching recommendations have equal importance and should be initiated as soon as possible. Indicated with each recommendation is the time frame expected for it to become fully operational after initiation. Short term is defined as 2 years or less, medium term as 2-5 years, and long term as more than 5 years. All are expected to continue for the long term.

Pathways

Traditional routes to degrees in higher education do not adequately align curriculum to energy and mining industry requirements, they are increasingly unaffordable and inaccessible 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, resulting in students equipped with multiple skills and levels of skills, preparing them to adjust more quickly to industry requirements and job availability by moving and advancing on career lattices.

Finding 1: Community colleges are providing important new pathways for supplying the energy and mining workforce by providing direct alignment among their programs of study, the credentials they bestow, and industry education and skill requirements.

Finding 2: With a direct alignment to industry education and skill requirements, the success of education programs can be measured by successful attainment of employment and advancement opportunities in the energy and mining industries.

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. Recognizing the differences in regional workforce requirements, these workshops and/or meetings should be convened in different parts of the country. These models would benefit greatly from including, for example:

- Community colleges integrating industry-recognized credentials, their learning standards, and content into associate degree programs, providing more “on” and “off” ramps to postsecondary education, resulting in stackable interim credentials with real value in the labor market, and leading to direct employment or continuing postsecondary educational opportunities; and

- Partnerships between 4-year colleges and universities and community colleges to create new pathways for STEM curriculum, with the first 2 years of STEM-related programs of study being offered at the community college and the second 2 years being offered at the university, thereby expanding the capacity of the critical university degree programs. (Short Term)
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.

Finding 3: Ensuring that the United States has the educated and skilled workforce necessary for the success of the energy and mining industries requires a strong partnership among business, education at all levels, and the government.

Finding 4: Technical research leads not only to innovation—the lifeblood of industry’s business success—but also to better education and educators.

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, DOE, 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. The engagement of both faculty and graduate students in this research will extend the pool of STEM-qualified faculty for all educational levels. (Short Term)

Energy and Mining Information for the Public

Importantly, building the best educational pathways in the world and the most qualified STEM faculty for our educational institutions does not mean that more students will pursue energy and mining programs of study. “Build it and they may not come.” The public perception of the mature extractive industries in the United States is often that they are environmentally damaging and their jobs are undesirable (due to concerns over pollution, noise, environmental degradation, and health issues, for example). This negative image dissuades some from pursuing careers in these industries. Also, although renewable energy is generally seen as positive, some negative perceptions (questionable technology viability, long-term existence, and cost-effectiveness, for example) exist that might dissuade people from joining those workforces. Information about all of these industries can educate the public about their importance to the nation and the career opportunities they offer. The government has a natural role to play in providing and disseminating such information as a complement to nongovernment sources. Information about these industries may also motivate students to pursue STEM courses and prepare for careers in energy and mining. For example, about 7,000 students drop out of high school every school day in the United States, 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.

Finding 5: Students mostly do not stay in STEM courses in K-12 that would prepare them for STEM postsecondary education or employment.

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. They should work with the Department of Labor and other government institutions to ensure that timely government information is included. (Short Term)

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 the opportunities available in these industries—again including timely government information. (Short Term)

Data

The nation cannot redesign its education programs and business–education partnerships to better provide a qualified energy and mining workforce without accurate data on occupations, jobs, and skill requirements.

Finding 6: 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.

Finding 7: To collect and analyze the data needed for effective energy and mining workforce decision making and policy making, it is critical to foster the collaboration of government data-gathering agencies with industries that gather data.

Recommendation 5: The Department of Labor, through its Bureau of Labor Statistics, 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. (Medium Term)

Recommendation 6: The Bureau of Labor Statistics 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. (Medium Term)

The Federal Workforce

Federal employees have a critical role in, and impact on, the success of the U.S. energy and mining industries. They are involved in all aspects of the energy and extractive industries, from initial access (through the permitting process), through production and the regulation of those activities, to closure and restoration during the reclamation process. Federal employees 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. MSHA projections show that 46 percent of their coal-sector workforce will be eligible to retire within 5 years, and they expect to lose 40 percent of their metal/nonmetal workforce in the same period.

Finding 8: Federal agencies involved in the energy and extractive industries are facing high retirement rates and there is an acute need to replace the departing federal workforce.

Finding 9: Because of the relatively restrictive personnel processes that federal agencies must follow and the relatively higher compensation offered by industry, it is difficult for federal agencies to hire and retain the employees they need.

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. (Medium Term)