



Chapter VIII

ENHANCING EMPLOYMENT AND WORKFORCE TRAINING

This chapter gives an overview of current and projected employment in and related to the energy sector and discusses programs to assist in meeting the demand for new workers going forward. The first section provides estimates of jobs in energy transmission and distribution and jobs related to energy systems overall, with forecasts out to 2030 for jobs supported by the energy industry. The second section discusses the impact of an aging workforce. The third section discusses specific energy workforce demands related to electricity, natural gas, and shared infrastructures. The remainder of the chapter discusses potential responses to address the demand for new energy workers. A number of data challenges in understanding employment in the energy sector are also discussed. The chapter concludes with a description of current Administration activities and plans, as well as a number of recommendations for further action.

FINDINGS IN BRIEF:

Enhancing Employment and Workforce Training

Approximately 1 million people were employed in energy transmission and distribution jobs in 2013. This represented almost 0.75 percent of U.S. civilian jobs. An additional 900,000 jobs were indirectly supported by energy transmission and distribution activity.

Projections indicate that, by 2030, the energy sector overall, including the transmission, storage, and distribution segment, will employ an additional 1.5 million workers. Most of these jobs will be in construction, installation and maintenance, and transportation, and approximately 200,000 more workers with computer and mathematics skills will be in demand.

Changes in the electricity sector, in particular, affect the number and types of energy jobs. New technologies are changing the skill sets in demand in the electricity workforce, creating opportunities that include utility management positions for smart grid programs, meter installers and service providers, intelligent transmission and distribution automation device producers, communications system products and services providers, and software system providers and integrators.

Accelerating methane abatement actions in the natural gas transmission, storage, and distribution system is projected to support a significant number of jobs. One study projects that an accelerated replacement timeline along with other measures could support 313,000 jobs throughout the economy.

New job-driven training strategies, reflecting a broader range of needed skills, will be required to meet the challenges of the future. Whether it is by expanding training curricula to use the latest educational tools and techniques, moving to a competency-based system of evaluating educational and training outcomes, or engaging new pools of potential talent (such as veterans), innovation in methods to attract and train the transmission, storage, and distribution infrastructure workforce of the future will be required.

Defining priorities in the area of jobs and workforce training and establishing effective programs requires good data. It is challenging both to define and quantify jobs in the energy industry because of how employment data in the United States are organized and published. This lack of information is especially critical in job categories experiencing high growth and rapid technological change, such as those dealing with infrastructure associated with the solar industry.

Estimates of Transmission and Distribution Jobs

Significant new investment in U.S. energy infrastructure is anticipated over the next few decades. The resulting changes in the transmission, storage, and distribution (TS&D) infrastructure—discussed throughout this report—will create new job opportunities for skilled workers. At the same time, the current TS&D infrastructure will need to be maintained. These factors, expansion of the energy sector, requirements for workers with new skills, and anticipated workforce retirements will create demand for new workers in energy-related jobs.

An analysis of jobs in the TS&D sectors performed to inform the Quadrennial Energy Review (QER) found that approximately 1 million people were employed in direct jobs and 900,000 in indirect jobs (see box for definitions), totaling just over 1 percent of U.S. civilian jobs (see Table 8-1).¹ An additional 2.0 million direct and 1.5 million indirect jobs were supported by the other energy industry sectors.^{a,b}

Table 8-1. Total U.S. Direct and Indirect Jobs in Energy T&D in 2013 (2015)²

Sector	Direct	Indirect	Total
Electricity T&D	506,882	441,963	948,845
Fuel T&D	470,204	436,087	906,291
Total Energy T&D Employment	977,086	878,050	1,855,136

Approximately 1 million people were employed in direct jobs and 900,000 in indirect jobs in energy-related sectors considered in the QER analysis, totaling just over 1 percent of U.S. civilian jobs.

Projections indicate that, by 2030, the full energy sector will support 1.5 million additional direct jobs—most of which will be in construction, installation and maintenance, and transportation—and an additional 1.8 million indirect jobs. Due to the technical nature of the energy workforce, a number of these employment opportunities will be open to workers with science and engineering backgrounds. Forecasts suggest that, by 2030, about 200,000 workers with skills in computers and mathematics and roughly an equal number of architects and engineers will be in demand.^{3,c}

Direct Jobs: Jobs created from economic activity associated with the investment or operation of the entity under consideration.

Indirect Jobs: Jobs created in directly affected businesses and other supply chain entities as a result of the investment or entity operation.

As with any transformation, employment in some occupations will decline as some infrastructures transition or become obsolete, while new employment opportunities will exist in both more established industries (e.g., oil and gas) and newer industries (e.g., renewable energy and the smart grid).

^a To obtain the estimate of 1.9 million jobs, the direct jobs were identified through Bureau of Labor Statistics Quarterly Census of Employment and Wages data and Railroad Retirement Board data. The Bureau of Labor Statistics data includes employment in U.S.-based establishments, including, for example, oil rigs in U.S. territorial waters. The indirect jobs were output from the IMPLAN model.

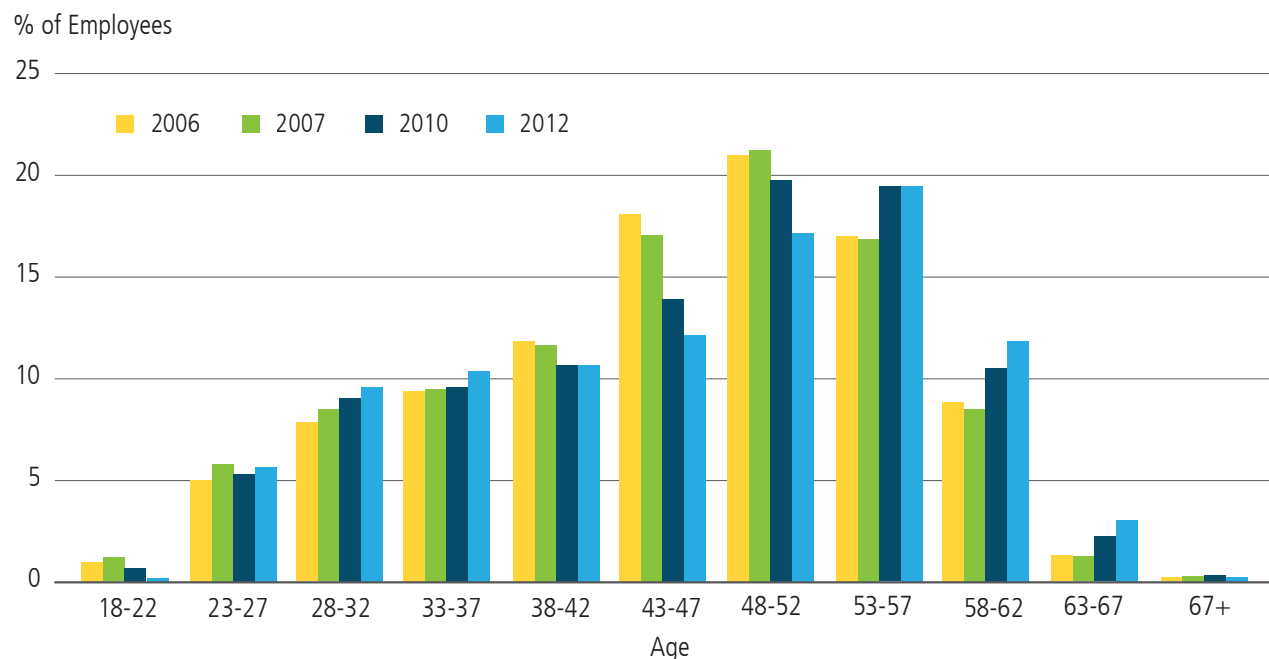
^b Jobs in energy storage are not as clearly defined, as what encompasses storage is sector and technology dependent. For this reason, this report only examined transmission and distribution jobs.

^c Due to data and other limitations, these findings are approximations. These estimates cover industries categorized as electricity generation, electricity transmission and distribution, fuels, extraction and production, fuel sales, and fuel transmission and distribution. This is imprecise, as it does not include energy efficiency or emerging industries that are not well covered in existing statistics, and it may include some jobs that do not count as energy jobs. This analysis is also limited by the fact that the skill mix of energy industries is based on historic data. Nonetheless, these data can provide guidance about the need for future training requirements in the energy industry.

Aging and Retiring Energy Workforce

In 2006, a consortium of energy utilities and trade associations created the Center for Energy Workforce Development to “work together to develop solutions to the coming workforce shortage in the utility industry.”⁴ The Center has developed a set of activities aimed at identifying gaps in the workforce pipeline, including general jobs skills (e.g., interpersonal skills and critical and analytical thinking) and industry-specific technical competencies (e.g., non-nuclear generation). According to a 2013 Center for Energy Workforce Development survey, 38 percent of the employees in the electric and gas utility sector may retire in the next decade (see Figure 8-1), creating demand for skilled technicians and engineers.⁵ The oldest group of employees is composed of electric transmission and distribution technicians. The industry has, however, seen an increase in younger employees, especially in line workers and engineers, which the Institute of Electrical and Electronics Engineers credits to progress made in workforce development efforts across the industry.⁶ While surveys of all U.S.-based occupations are not available, 38 percent is approximately 1.5 times the percentage reported in a related study for all U.S. occupations.⁷

Figure 8-1. Workforce Age Distribution in the Electric and Natural Gas Utilities by Percentage of Total Employees⁸



The largest percentages of utility employees are in the 48–52 and 53–57 age groups; 38 percent of electric and natural gas employees will be eligible to retire in the next decade.

Energy Sector Workforce Demands

The transformation of the energy economy; the need for enhancing resilience, reliability, and safety; and the need for managing dramatic changes in the current U.S. energy profile are resulting in shifting demands for skills across energy sectors. Some examples are provided in this section.

Electricity

The grid of the future will require a full spectrum of skills, including “utility management positions of smart grid programs (project office leadership, program support, quality assurance, planning, functional support, implementation operations and support, functional specialists), meter installers and service providers, intelligent T&D automation device producers, communications system products and services providers, and software system providers and integrators.”⁹

External analyses¹⁰ have identified industry demand for employees with both information technology and operational technology skills. For example, new skills are in demand for distribution-level grid operators to respond to increasing complexity in the networked and information technology-intensive system. Deployment of advanced metering technology in the transmission and distribution system requires two-way communication between the utility and each customer and/or the multitude of intelligent devices that will live on the grid. This, in turn, creates demand for many more network and radio engineers than utilities have employed in the past. Additionally, the resulting ‘big data’ challenges will create a demand for employees with data management, network management, and cybersecurity skills at the same time that other industries are demanding the same skills.¹¹

Maintaining reliability in the electricity sector will also drive demand for skilled workers. The Department of Energy (DOE) Electricity Advisory Committee, in a 2012 memorandum to the DOE Assistant Secretary for Electricity Delivery and Energy Reliability, noted the North American Electric Reliability Corporation’s concern that “reliability is at risk if the workforce lacks the necessary skills and knowledge or if workers are overtaxed by their responsibilities.”¹²

The modernization of the electricity sector is changing the employment opportunities available. For example, automated metering will vastly reduce the number of meter readers, while the demand for meter technicians will rise. Retraining employees to take higher-skilled positions will be critical.

Oil and Gas

An analysis of employment by IHS in the oil and gas sectors identified 919,000 direct jobs in 2010. The same analysis estimates that the number of jobs in the upstream and midstream oil and gas sectors will grow 11 percent (84,000 jobs) between 2010 and 2020 and 20 percent (155,000) between 2010 and 2030. An additional 227,000 job opportunities were projected due to replacements of existing employees in the upstream, midstream, and downstream oil and gas sectors between 2010 and 2020 and 503,000 opportunities between 2010 and 2030 were projected.¹³

In addition to an increase in the number of employment opportunities, the oil and gas sectors are also experiencing a shift in required skills as the nature of extraction and production becomes more complex and regulatory and technical requirements become more sophisticated. One study¹⁴ identified petroleum engineering faculty retirements as a cause for concern in maintaining a pipeline of qualified engineers over the next 20 years. Notably, a survey of petroleum engineering faculty indicated that approximately 37 percent were over 60 years of age in 2013, while another one-third were between 50 and 59 years old.

Natural Gas Pipelines

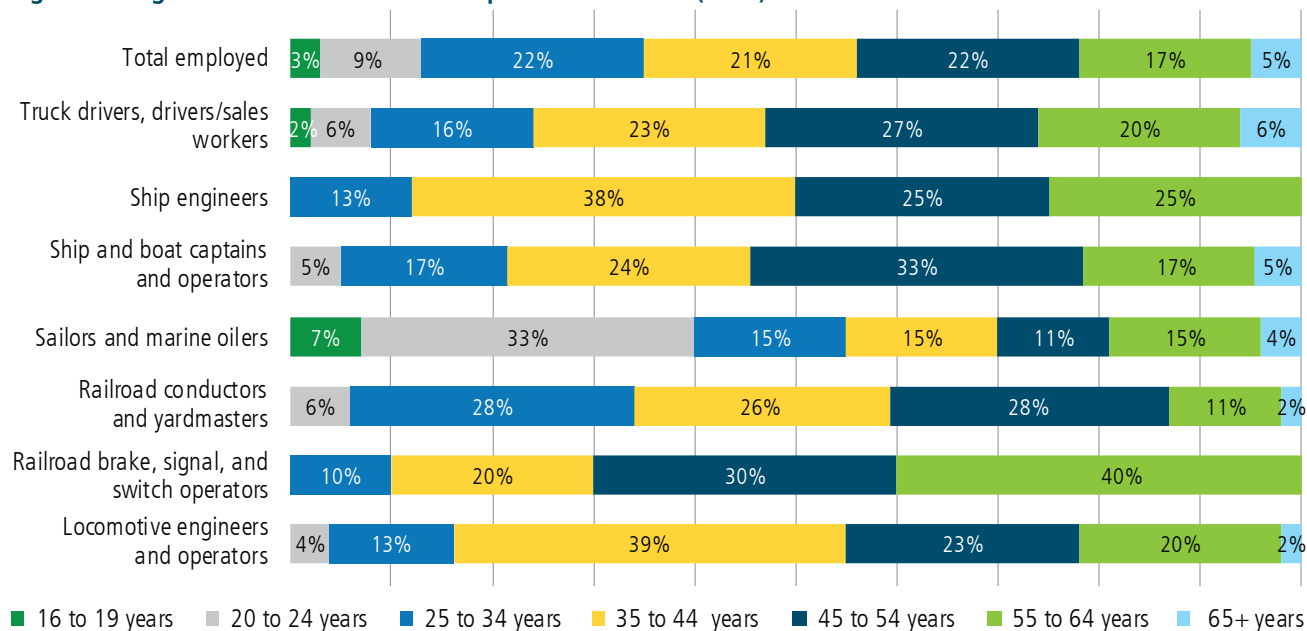
Improving safety and environmental management for natural gas TS&D could support a significant number of jobs. A BlueGreen Alliance analysis on the employment implications of public and private sector investments in methane abatement and infrastructure modernization within natural gas TS&D found that accelerated pipeline replacement (10-year time frame) could support 313,000 jobs throughout the economy. This number is sizable compared to the 63,000 jobs supported in the “business-as-usual” 30-year replacement timeline.

Shared Infrastructures

Employment profiles for shared freight transport modalities—rail, barge, ports, and trucks—are also increasingly important to the energy sector. The Bureau of Labor Statistics (BLS) indicates that 26 percent of the trucking workforce, 20 percent of the rail workforce, and 21 percent of the maritime workforce are aged 55 or older, compared to 22 percent in all U.S. industries (see Figure 8-2); although, individual occupations can

have an older workforce.¹⁵ BLS also projects that overall employment in select freight transport occupations^d will increase by 200,000 from 1.9 million to 2.1 million between 2012 and 2022. Replacing employees that are either exiting the workforce or moving to other occupations would create a demand for approximately 210,000 additional workers in these occupations, according to BLS experimental data and analysis being conducted in coordination with the Departments of Education, Labor, and Transportation.¹⁶

Figure 8-2. Age Distribution of Select Transportation Workers (2014)¹⁷



The percentage of transportation workers in rail and maritime positions over 45 years old exceeds the national average; the percentage of workers over the age of 55 in these occupations is comparable to the national average. While age information on tractor-trailer drivers is not available, BLS data indicate that the trucking workforce is older, on average, than other occupations. Numbers may not add to 100 due to rounding.

Workforce Training Strategies

Job-driven training strategies will vary by energy industry sector, but there are a number of common themes, including the following.

Assess Required Skills

In the future, many of the jobs in the energy industry, which include jobs in TS&D systems, will require a much more diverse set of skills than similar jobs in the past. It is difficult to assess exactly what skills will be in demand because new classes of jobs (e.g., smart grid designers and operators, cybersecurity experts, and smart building designers and operators) have not developed nationally accepted certifications. Industry-led skill assessments are critical to ensuring that private and public sector support is targeted to the highest-priority areas.

Expand Training Curricula and “Hands-On” Learning

Better use of the latest educational tools and techniques could assist in the training of new workers. Modern information technology tools enhance teaching methods, allowing individualized training that makes direct connections between abstraction and concrete problems using simulations and other tools. States, in particular, may benefit from access to specialized Federal technical programs and better coordination with Federal economic development resources to deploy these curricula and technologies.

^d Select occupation codes are for water transportation, rail transportation, and heavy tractor-trailer truck drivers: 53-3032, 53-4011, 53-4012, 53-4013, 53-4021, 53-4031, 53-5011, 53-5021, and 53-5031.

Move to Competency-Based Evaluations

There is growing interest in defining education and training goals not in terms of inputs (semester hours) but in terms of outputs (“competency-based evaluations”). Information technologies offer powerful new tools for measuring a wide range of skills using simulations and other methods. They also offer interesting opportunities for increasing the efficiency and quality of learning systems, in part, by tailoring instruction to the revealed skills and interests of each student.

Engage Veterans and Facilitate Their Entry into Energy Jobs

At a time when 200,000 veterans are leaving the military annually, recruiting and training them for energy jobs can reduce the skills gap in a critical set of industries. A shift to competency-based credentialing would be particularly useful for veterans because they enter the civilian workforce with a unique set of skills—skills that may not be recognized by civilian certifications (e.g., military time at sea is not recognized toward merchant marine requirements). As a result, veterans are often required to go through courses where they already know a large fraction of what is needed. As certifications and evaluations are developed for new energy skills, veteran engagement needs to be at the forefront.

Data Challenges

Defining priorities in the area of jobs and workforce training and establishing effective programs requires good data. It is challenging both to define and quantify jobs in the energy industry because of how employment data in the United States are organized and published. Employment data in the United States are usually organized and aggregated according to what industries produce or according to individual worker occupations. Even at the greatest possible level of employment data detail, it is not easy or straightforward to identify what portion of jobs in an industry or occupation is involved in energy.

BLS employment data are reported according to the North American Industry Classification System, which represents different types of economic activity. North American Industry Classification System data lack the specificity to identify what portion of jobs fall under an industry or occupation involved in energy. For example, the code for power and communication line and related structures construction includes workers primarily engaged in the construction of power lines and towers; power plants; and radio, television, and telecommunications transmitting/receiving towers.¹⁸ This kind of breadth encompasses multiple skill sets and is insufficiently detailed for jobs planning or workforce training assessments.

The lack of information is especially critical in categories experiencing high growth and rapid technological change. For instance, a recent BLS¹⁹ report counted 4,800 solar installer jobs in the solar industry at a time when the Solar Foundation’s annual jobs census identified more than 84,000 solar installers.²⁰ This large difference results from the fact that solar installation jobs are classified as “construction” under current BLS definitions. Energy generation, distribution, and consumption jobs have become embedded in so many different sectors of the economy and in so many ways that jobs that are primarily energy focused are attributed to the sector where they are housed. As a result, energy jobs are classified with traditional job skills identifiers—making the role that energy is playing in the American economy difficult to measure, understand, and plan for.

The North American Industry Classification System, managed jointly by the United States, Canada, and Mexico, is updated every 5 years to reflect changes in the North American economies. As part of that process, BLS is currently soliciting comments on new classifications for oil and gas production. Future changes may need to be incorporated as the energy sector continues to evolve.

Select Industry and Labor Energy Workforce Training/Development Resources

The fundamental shifts in the Nation's energy landscape extend to the workforce that constructs and operates the energy infrastructure. Changes can be seen in both traditional, direct energy-related fields jobs, as well as in a host of nontraditional energy occupations and sectors, including some where energy had not previously played a major role. A wide range of initiatives to build and train a competitive domestic energy workforce can be found throughout energy-relevant industry and labor organizations, colleges, trade schools, and state and local governments. The following examples are of industry- and labor-sponsored workforce resources:

The Center for Energy Workforce Development is a nonprofit consortium of electric natural gas and nuclear utilities and their associations. Working with contractors, unions, and educational institutions, the Center for Energy Workforce Development focuses on building a skilled workforce pipeline to meet future industry demands. Information can be found at www.cewd.org. The Center for Energy Workforce Development also operates the **Troops to Energy Jobs** websites, which help military veterans map military occupational specialties to energy industry jobs. Information can be found at www.troopstoenergyjobs.com.

The Solar Energy Industries Association's member-led **Installer Safety & Workforce Development Working Group** provides guidance and information to members regarding training opportunities, certifications, and more. Additionally, the Solar Energy Industries Association coordinates with training providers and certification organizations to provide information and guidance to members. Information can be found at www.seia.org/policy/health-safety/workforce-development.

The American Petroleum Institute hosts the **API-U Training** resource, which sponsors training programs and provides continuing education for oil and gas professionals, as well as courses for new entrants into the industry. Information can be found at www.api.org/events-and-training/api-u-training. The American Petroleum Institute has also developed the Oil and Gas Workforce portal to connect applicants with job opportunities in the industry. Information can be found at www.oilgasworkforce.com.

The Institute of Electrical and Electronics Engineers offers an array of education, career, and job-placement resources for technical professionals, as well as an analysis on workforce demands in energy and non-energy fields. Information can be found at www.ieee.org/education_careers.

The Association of American Railroads maintains resources, including videos and profiles of rail employees with military service, job fair listings, job boards, and websites where railroads advertise openings, as well as websites developed by railroads to connect with men and women in the military. Information can be found at www.aar.org/jobs.

Helmets to Hardhats is a nonprofit program that connects military veterans with training and career opportunities in the building trades, most of which are connected to federally recognized apprenticeship programs with trade organizations. Information can be found at www.helmetstohardhats.org.

The Utility Workers Union of America represents workers in the electric, gas, water, and nuclear industries. The Utility Workers Union of America's **Power 4 America Training Trust Fund** is used to recruit and train workers, with an associated online resource center that serves to track training and certification progress and provide access to apprenticeship and continuing education programs. Information can be found at www.power4america.org.

The North America's Building and Construction Trades Unions funds and operates an extensive workforce development, training, and craft apprenticeship infrastructure in a range of energy-related fields. This includes state-of-the-art construction training centers, mobile training centers, and welding booths. Information can be found at www.bctd.org. Members of North America's Building and Construction Trades Unions that also have energy-related workforce training trust funds include the International Brotherhood of Electrical Workers; the Laborers' International Union of North America; the United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States, Canada and Australia; and the International Union of Operating Engineers.

Examples of Administration Activities for Energy-Related Employment and Workforce Training

- The Administration's Ready to Work Initiative, led by the Office of the Vice President, and passage in 2014 of the Workforce Innovation and Opportunity Act have led to several important efforts in the energy sector. In addition to the significant investments in energy and advanced manufacturing workforce training described in this section, the newly formed Skills Working Group, an interagency task force of 13 Federal agencies chaired by the Secretary of Labor, has focused on the energy sector as one of six key opportunity areas for expanding apprenticeships, building career pathways to the middle class, and initiating place-based initiatives to expand opportunities to underserved communities.
- The President's Fiscal Year 2016 Budget proposed the POWER+ Plan to help these communities adapt to the changing energy landscape and build a better future. The POWER+ Plan invests in workers and jobs, addresses important legacy costs in coal country, and drives development of coal technology. This year, the Administration will make a down payment on the POWER+ Plan by beginning to implement a key part of the effort—the Partnerships for Opportunity and Workforce and Economic Revitalization initiative. The initiative will be a coordinated effort involving multiple Federal agencies, with the goal of effectively aligning, leveraging, and targeting a range of Federal economic and workforce development programs and resources to assist communities negatively impacted by changes in the coal industry and power sector.
- Through First Lady Michelle Obama and Dr. Jill Biden's Joining Forces initiative, businesses have hired nearly 700,000 veterans and military spouses, including energy companies, and 49 states have removed credentialing impediments for separating service members.
- In April 2015, the Department of Energy (DOE), in partnership with the Department of Defense, launched a Solar Ready Vets program at 10 military bases across the country. The program also includes participation from Camp Pendleton in California, Fort Carson in Colorado, and Naval Station Norfolk in Virginia—all of which announced pilot initiatives earlier this year and are serving as models for the Solar Ready Vets program—and Hill Air Force Base in Utah. The program will support DOE in meeting its goal to train 75,000 people to enter the solar workforce by 2020, some of whom will be veterans.
- DOE's technical and financial resources, primarily focused on the development and deployment of energy technology, are playing a significant role in the Skills Working Group. Those activities include identifying new opportunities for apprenticeships and career pathways, such as in the solar industry where DOE's SunShot Initiative worked with the industry to develop the Solar Instructors Training Network. The network created a training curriculum for teaching photovoltaic installation in community colleges and then successfully trained 800 faculty members in 400 institutions who in turn graduated 30,000 students.
- The Department of Labor has granted \$450 million in Trade Adjustment Assistance Community College and Career Training grants to nearly 270 community colleges across the country, including a concentration on energy and associated advanced manufacturing. Additionally, in December 2014, the Department of Labor announced the American Apprenticeship Grants Competition—a \$100-million grant program to launch apprenticeship models in high-growth fields, such as energy, and expand apprenticeship models that work. This initiative to expand "hands-on" learning is part of a broader goal to double the number of apprenticeships in the United States in the next 5 years.
- DOE has created its new Jobs Council, which brings together the diverse energy programs of the Department with its laboratories and technology resources to accelerate job creation across all energy sectors in partnership with other Federal agencies, the private sector, and state and local governments. Along with the SunShot Initiative, other successful programs in this area include the Carbon Fiber Consortium (a partnership of laboratories, materials companies, and educational institutions) and the Clean Energy Manufacturing Initiative (a crosscutting initiative focused on clean energy products and processes), among many others.
- DOE has been deeply engaged with both traditional and new energy sectors, developing curricula and/or certification standards for the solar, unconventional natural gas extraction, and building energy efficiency industries, for instance. For example, DOE's partnership with the National Institute of Building Sciences is working to establish a common certification for five specific energy management positions by establishing the Better Buildings Workforce Guidelines through the Commercial Workforce Credentialing Council. DOE's National Energy Technology Laboratory, based in Pittsburgh, Pennsylvania, partnered with Westmoreland Community College to develop an industry-specific initiative, ShaleNet, which utilized a three-dimensional simulator for use in training for the natural gas industry. This effort succeeded in graduating and placing thousands of new employees in that rapidly growing industry. In addition, through DOE's Office of Economic Impact and Diversity and its new Jobs Council, the Department's programs have focused on driving energy opportunities to traditionally underserved communities, as well as to veterans and other specific populations.

QER Recommendations

The challenges facing workforce training for jobs associated with TS&D infrastructure mirror the broader issues facing the energy sector as a whole. For this reason, current Administration activities and the QER recommendations described below have the potential to broadly benefit the entire energy sector beyond their benefits to workers associated with TS&D infrastructure. In order to build on the ongoing Administration-wide activities, we recommend the following:

Support an energy-job skills training system: As part of the interagency Skills Working Group with the Departments of Energy, Labor, and Education, the Administration should support actions for a national job-driven skills training system in the United States by providing new energy and advanced manufacturing curricula; designing new and enhanced apprenticeship programs; establishing industry-based credentialing standards for new technologies; and implementing innovative online learning systems, such as the National Training and Education Resource Web-based learning platform.

Expand support for an open-source learning community: DOE should develop, facilitate, and expand use of state-of-the-art courses in energy-related fields through a competition to solicit proposals from organizations that would maintain and continuously improve the National Training and Education Resource. The National Training and Education Resource platform can help colleges lacking sophisticated resources to build and deliver courses using state-of-the-art methods. It can provide a full set of tools, including course authoring, a three-dimensional world builder, a traditional learning and content management system, and support for multiple content types—including images, text, and multimedia—all within a course.

Coordinate efforts to accelerate the development of high-quality energy education programs: DOE should coordinate efforts to accelerate the development of energy and manufacturing curricula and apprenticeship programs with existing Department of Labor or National Science Foundation programs to (1) develop and deliver courses in energy and advanced manufacturing topics; and (2) provide technical support in the form of simulations, visualization tools, cognitive tutoring, and other resources in energy and manufacturing.

Facilitate national credentials for energy occupations: DOE should support and, as necessary, facilitate an industry-led process of defining needed skills in a number of emerging occupations. This would build on DOE's experience in the building retrofit space. These needed skills can be translated into specific certifications, including "stacked credentials" modeled after competency-based education.

Facilitate the transition of military veterans into the energy sector: DOE, in conjunction with the Department of Labor and the Department of Defense, should work with industry and other stakeholders to standardize the applicability of Military Occupation Codes to civilian jobs in energy sectors.

Reform energy employment data collection systems: DOE should establish an interagency working group—to include the Departments of Labor and Commerce—to reform existing data collection systems to provide consistent and complete definitions and quantification of energy jobs across all sectors of the economy. Because employment data is collected by the State Employment Security Agencies, the success of this initiative will necessarily require their engagement, as well as identifying and mitigating barriers to implementation.

RECOMMENDATIONS IN BRIEF:

Enhancing Employment and Workforce Training

Support an energy-job skills training system through the interagency Skills Working Group. The training system should include new curricula, apprenticeship programs, industry-based credentialing standards, and innovative online learning systems.

Expand support for an open-source learning community to develop, facilitate, and expand use of state-of-the-art courses in energy-related fields. These efforts should work to maintain and improve the National Training and Education Resource platform.

Coordinate efforts to accelerate the development of high-quality energy and manufacturing curricula and apprenticeship programs. The Department of Energy (DOE) should coordinate with existing Department of Labor and National Science Foundation programs.

Facilitate national credentials for energy occupations. DOE should support and facilitate an industry-led process of defining needed skills in a number of emerging occupations.

Facilitate the transition of military veterans into the energy sector. DOE should work with the Departments of Labor and Defense and stakeholders to standardize the applicability of Military Occupation Codes to civilian jobs in energy sectors.

Establish an interagency working group to reform existing energy jobs data collection systems. DOE should convene a group with the Departments of Labor and Commerce to provide complete and consistent definitions and quantification of energy jobs across all sectors of the economy.

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