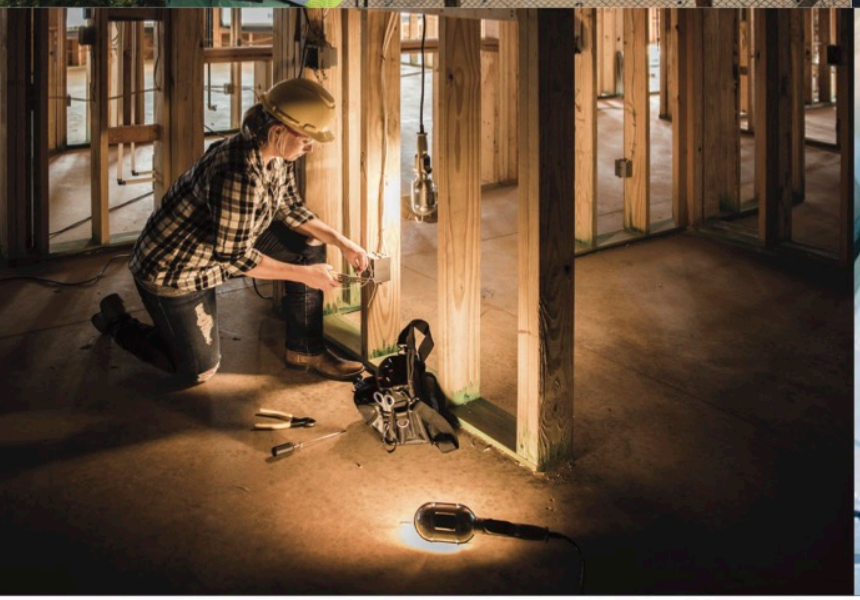
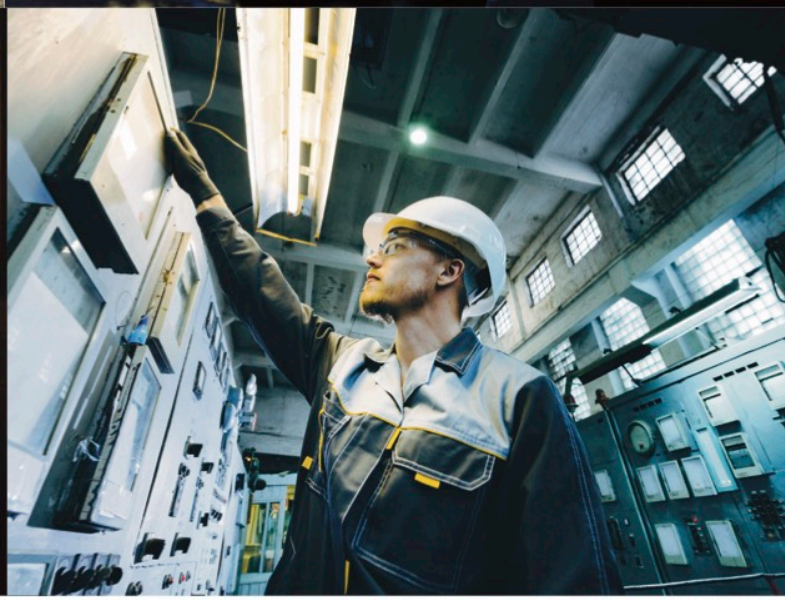
The 2019 U.S. Energy & Employment Report

A JOINT PROJECT OF NASEO & EFI





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About

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Additional Analysis + Reports

The USEER data base includes detailed data for the 53 separate technologies that comprise the five surveyed sectors. Each of these technologies is, in turn, divided into as many as seven industrial classifications. As a result, the USEER data base can provide an in-depth view of the hiring difficulty, in-demand occupations, and demographic composition of very specific portions of the energy and energy efficiency workforce in each state or in specific counties and, in some cases, portions of counties. In addition, the USEER data base can provide year-to-year comparisons in specific sectors, technologies, and industrial classifications at the state and county level. For information about additional analysis and reports, please contact:

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Governors' Introduction

On behalf of the states of Utah and Connecticut, we are delighted to introduce the 2019 U.S. Energy and Employment Report. Produced by the Energy Futures Initiative and the National Association of State Energy Officials, this seminal study equips states and their partners with the data they need to advance effective, informed, and robust energy policies and programs.

As you read through the report, we encourage you to think about the story the data tell about the communities where you live and work, as well as about our nation as a whole.

Gov. Gary Herbert

To us, the statistics are clear: the energy economy is not only growing, but evolving and thriving. Nationally, in 2018 the energy economy expanded by more than 150,000 net new jobs to now encompass 6.7 million people, representing nearly 5 percent of the U.S. economy.

Gov. Ned Lamont

Through wise policy that promotes energy affordability and resilience across a diverse and expanding portfolio, last year Utah continued to experience growth across major segments of our energy economy, including traditional and renewable resources. Thanks to the diligent work of the Utah Governor's Office of Energy Development and my energy advisor, Dr. Laura Nelson, Utah is now viewed as policy model for several U.S. states in advancing economic and environmental outcomes through public-private partnerships, international collaboration, research and development, education and stakeholder engagement of urban and rural communities across the state.

Connecticut is a national clean energy leader because we have invested in developing a skilled, nimble workforce that delivers high-quality energy services. We've built that pipeline of talent through educational partnerships, regional collaboration, and robust program investments. Connecticut's model proves that environmental sustainability and economic development go hand-in-hand, and benefit all families and businesses in the Constitution State.

Thank you for supporting, reading, and sharing your reactions to this year's U.S. Energy and Employment Report.

Gov. Gary Herbert, Utah

Gov. Ned Lamont, Connecticut

Preface

EFI, a nonprofit think tank based in Washington, D.C., and NASEO, a nonprofit association representing the 56 energy offices of the states, territories, and District of Columbia, are pleased to release the 2019 USEER to provide a consistent tool for states, trade associations, labor unions, and other stakeholders to track changes in energy and energy-related employment during a time of continued change in energy markets.

For many NASEO members, economic development and job creation provide the underpinning for their energy planning and policy development initiatives. Now in its fourth year of publication, the USEER offers a powerful tool for state policymakers to understand the impact of evolving energy markets; to help prepare their communities, infrastructure, and workforce for these changes; and to harness the economic and environmental benefits that result.

The U.S. Energy and Employment Report (USEER) was published in 2016 and 2017 by the U.S. Department of Energy (DOE) upon recommendation of the 2015 first installment of the Quadrennial Energy Review (QER), "to reform existing data collection systems to provide consistent and complete definitions and quantification of energy jobs across all sectors of the economy."[1] Previous editions of the USEER had addressed several gaps in energy employment data, including the following:

- business activities essential to the operation of traditional energy companies and utilities, including coal, natural gas, nuclear, and others, classified by the North American Industry Classification System (NAICS) within the business activities of other sectors
- jobs associated with the production of renewable energy such as wind, solar, and geothermal power
- jobs associated with energy efficiency

DOE elected to not undertake a similar report for 2018 or 2019.

[1] U.S. Department of Energy [DOE], *Quadrennial Energy Review: Energy Transmission, Storage, and Distribution Infrastructure* (Washington, D.C., 2015), 8-10, https://www.energy.gov/sites/prod/files/2015/07/f24/QER%20Full%20Report_TS%26D%20April%202015_0.pdf.

The 2018 and 2019 USEERs have been organized and implemented by the Energy Futures Initiative (EFI) and the National Association of State Energy Officials (NASEO) to provide continuity with the previous editions of the USEER in data collection and accuracy in year-to-year comparisons.

Accordingly, the 2019 USEER relies on the identical survey instrument developed by the DOE and approved by the Office of Management and Budget (OMB Control No. 1910-5179) for the 2017 USEER with the following additions:

- differentiation of jobs in oil and gas pipeline construction
- expansion of energy storage technologies
- an energy and energy efficiency jobs wage data survey to be published as a separate report

The data collection for the 2019 USEER was timed to ensure meaningful year-to-year comparisons with previous reports. In addition, the following organizational changes were made:

- separate chapters for Fuels and Electric Power Generation to provide greater detail on each subtechnology in these sectors
- new crosscuts on the oil, gas, coal, nuclear, and energy storage industries to provide data on their entire value chains

It is our hope that the 2019 USEER and future editions will be used to better inform federal, state, and local policymakers; academic decision-makers; and the private sector in developing integrated energy, security, economic development, and workforce plans. This kind of integration is key to maximizing the benefits of the nation's abundant energy resources, rapid pace of energy innovation, and dynamic energy markets. We further hope that the data presented in these and future reports will help advance the understanding of the economics of emerging energy industries. Creating a single and consistent measure of employment across the entire U.S. energy system is critical to that understanding.

Summary

Key Findings

The 2019 USEER analyzes the following five sectors of the U.S. economy:

- Fuels;
- Electric Power Generation;
- Transmission, Distribution and Storage;
- Energy Efficiency; and
- Motor Vehicles.

The first three of these sectors make up the Traditional Energy sector.

Based on a comprehensive analysis of employer data collected in the fourth quarter of 2018, the 2019 USEER finds that the Traditional Energy and Energy Efficiency sectors in 2018 employed approximately 6.7 million Americans or 4.6 percent of a workforce of roughly 147 million. Employment in these sectors increased in 2018 by 2.3 percent from the previous year, adding 151,700 net new jobs, nearly 7 percent of all new jobs nationwide.[2]

The Fuels sector employed 1,127,600, an increase of 52,000 or 4.8 percent in 2018.

- Petroleum fuels added the most jobs of any traditional energy sector, with 33,500 new positions, an increase of 5.9 percent.
- Natural gas extraction increased employment by 6.8 percent, adding 17,000 jobs.
- Coal mining and fuels production gained 650 jobs or 0.9 percent.
- Woody biomass jumped 5.5 percent, adding more than 1,700 jobs.

The Electric Power Generation sector employed 875,600 and declined by just under one percent, losing almost 8,300 jobs. Job losses in solar, nuclear and coal generation were partially offset by gains in natural gas, wind, and CHP.

[2] Due to differing time frames for the USEER report, the reports on employment in 2015, 2017, and 2018 reference BLS second quarter employment data, whereas the report on 2016 report uses BLS first quarter employment data. Energy employment growth in the period between the second quarter of 2017 and the second quarter of 2018 represented 7 percent of all employment growth in the United States. Unless otherwise stated, all increases or decreases described in this report for 2018 (whether whole numbers or percentages) are relative to 2017.

- Solar energy firms employed 242,000 employees who spent the majority of their time on solar.[3] An additional 93,000 employees spent less than half their time on solar-related work. The number of employees who spend the majority of their time on solar declined by 3.2 percent or more than 8,000 jobs in 2018.
- There were an additional 111,000 workers employed at wind energy firms across the nation in 2018, an increase of 3.5 percent or 3,700 jobs.
- All natural gas employment in Electric Power Generation increased by over 5,200 (4.9 percent), for almost 113,000 jobs, reflecting that gas now produces more electricity in the United States than any other fuel type.[4]
- Advanced/low emissions natural gas, wind, and CHP generation were the fastest growing new sources, increasing employment by more than 4,500 (7.0 percent), 3,700 (3.5 percent), and 2,000 (7.4 percent), respectively.
- Coal-fired generation employment declined by more than 6,600 jobs, or 7.2 percent.

Transmission, Distribution, and Storage (TDS) employed more than 2.3 million Americans, with just over 1 million working in retail trade (gasoline stations and fuel dealers). Excluding retail trade, this represents an increase of 33,000 new jobs or 2.6 percent.

- Utilities and construction were the two strongest industry sectors in Transmission, Distribution, and Storage, adding over 30,000 new jobs in 2018.
- Battery storage added over 9,500 new jobs for an 18% growth rate in 2018.
- Overall, 48 percent of respondent employers working in this sector reported that a majority of their revenues come from grid modernization or other utility-funded modernization projects, an increase of 10 percentage points over 2017.

Energy Efficiency employed 2.35 million Americans, in whole or in part, in the design, installation, and manufacture of Energy Efficiency products and services, adding 76,000 net jobs in 2018 (3.4 percent), an increase over the 67,000 jobs added in 2017.[5]

- Almost 1.3 million Energy Efficiency jobs are in the construction industry, a 1.6 percent increase, or almost 21,000, from 2017.
- 79 percent of employees who work on Energy Efficiency in the construction sector report spending at least half their time on Energy Efficiency-related work, virtually unchanged from the number reported

[3] The Solar Foundation 2018 *National Solar Jobs Census*/BW Research Partnership
[4] Text, charts, and tables in the 2019 report include revised 2017 employment totals for advanced and traditional natural gas generation based on additional available data from the Energy Information Administration.
[5] Energy Efficiency jobs are defined on Page 134.

last year (1.024 million) up from 797,500 in 2015 and 1.017 million in 2016.
- Energy Efficiency professional services added 35,000 jobs, an increase of 7.7 percent. Wholesale trade jobs in Energy Efficiency also expanded by 7.7 percent, adding almost 13,000 positions.
- Manufacturing jobs, producing ENERGY STAR® certified products and energy efficient building materials in the United States, increased by 6,000 jobs or 2 percent.

Motor Vehicles (including component parts) employed over 2.53 million workers, excluding automobile dealerships and retailers, adding 74,000 jobs in 2018, an increase of 3 percent.

- In 2018, almost 254,000 employees worked with alternative fuels vehicles, including natural gas, hybrids, plug-in hybrids, all-electric, and fuel cell/hydrogen vehicles, an increase of nearly 34,000 jobs.
- Hybrids, plug-in hybrids, and all-electric vehicles made up over 90 percent of this number, supporting 231,000 employees. The number of jobs supported by hydrogen or fuel cell vehicles declined, while jobs in all other alternative vehicle technologies increased.
- Over 486,000 employees of Motor Vehicles component parts companies are now contributing to more fuel-efficient vehicles, an increase of approximately 10,000 from 2017.
- More than one-fifth (22 percent) of all firms involved in Motor Vehicle component parts derive all their revenue from products that increase fuel economy for Motor Vehicles, a slight decrease from 2017.

Cross Cuts

The 2019 USEER provides 5 cross cutting analyses that look at the interrelations of jobs across the entire value chain of the natural gas, petroleum, coal and nuclear industries that were previously segregated in the Fuels, Electric Power Generation, and Transmission, Distribution and Storage chapters. In addition, another cross-cutting analysis looks at job comparisons between those Electric Power Generation technologies that consume fuels and those that do not.

The natural gas industry employs 625,369 Americans.

- Utilities employed 176,167.
- Mining and extraction employed 162,928.
- Construction employed 113,339.

The coal industry employs 197,418 Americans.

- Mining and extraction employed 55,905.
- Utilities employed 45,795.
- Wholesale trade employed 43,327.

The petroleum industry employs 799,531 Americans.

- Mining and extraction employs 308,681.
- Wholesale trade and distribution employs 170,945.
- Manufacturing employs 155,267.

The nuclear industry employs 72,146 Americans.

- Utilities employ 46,809.
- Professional services employ 14,374.
- Manufacturing employ 4,913.

In combination, the Electric Power Generation and Fuels sectors directly employed nearly 2 million workers in 2018, up 39,306, more than double the increase the year prior (2 percent).

- In 2018, 59 percent, or 1.2 million, of these employees worked in traditional coal, oil, and natural gas Electric Power Generation and Fuels
- 611,000 employees worked in zero emissions' generation technologies, including renewables and nuclear
- Another 189,000 worked in low-carbon emission technologies, including biofuels and advanced/low emissions gas.

Hiring and Demographics

Overall, firms covered by the survey anticipate roughly 4.6 percent employment growth for 2019.

- Energy Efficiency employers projected the highest growth rate in 2019 (7.8 percent),
- Electric Power Generation (7.1 percent);
- Transmission, Distribution, and Storage (3.2 percent),
- Fuels (3 percent),
- Motor Vehicles (2.2 percent).

Hiring difficulty was highlighted by virtually all sectors as a growing problem. Just under 77 percent of employers across these sectors (76.9 percent) reported difficulty hiring qualified workers over the last 12 months, an increase of nearly 7 percentage points from 2017. Almost three-in-ten employers (29 percent) noted it was very difficult (26 percent in 2017).

- Among construction employers in Energy Efficiency, one of the largest surveyed sectors with over 1.3 million workers, a majority (52%) of employers reported that it was very difficult to hire new employees. This sector also predicted over 8% growth in 2019.
- Lack of experience, training, or technical skills was almost universally cited as the top reason for hiring difficulty by employers across all five

surveyed sectors. The need for technical training and certifications was also frequently cited, implying the need for expanded investments in workforce training and closer coordination between employers and the workforce training system.

Demographically, the surveyed sectors fluctuate above and below national averages.

- Women are a smaller portion of the workforce in these sectors, ranging from 23 percent to 33 percent, compared to the overall economy, where women make up 47 percent of the workforce.
- However, two of these energy sectors—Electric Power Generation and Transmission, Distribution and Storage—are more racially diverse than the national workforce as a whole, at 31% and 30%, compared to the national average of 22%. The other three surveyed sectors—Fuels, Energy Efficiency, and Motor Vehicles—are each at 22%. This is, in part, because of the increased self-identification of employees belonging to "2 or more races."
- Veterans comprise from eight to 11 percent of these sectors—higher than the national average of 6 percent.
- Between 14 percent and 23 percent of this workforce is 55 years of age or older, compared to the national average of 23 percent; this proportion is significantly lower in Electric Power Generation and Energy Efficiency.
- Unionization rates for TDS, Energy Efficiency, and Motor Vehicles are equivalent to or exceed the national average, while Fuels and Electric Power Generation are below.

Conclusion

The year 2018 marked another year in the evolution of the U.S. energy system, one in which market forces, technology development and maturation, tax policy, and declining federal regulation (countered by increased regulation in some states) affected the changing profile of our energy workforce. In spite of one of the highest levels of employment in recent U.S. history, the traditional energy and energy efficiency sectors continued to outperform the economy as a whole, adding 152,000 new jobs.

Certain long-term trends accelerated, such as the continuing growth of the natural gas electric power generation and wind workforces, as their cost advantage pushed out older coal-fired units. However, the stability in coal EPG seen in 2017 gave way to continued declines with the loss of almost 7,000 jobs. Meanwhile, coal fuel jobs grew slightly, adding 650 jobs.

In the Fuels industry overall, oil and gas production added the most new jobs in the traditional energy sectors as efficiencies and increased prices brought thousands of workers back into the oil and gas fields of Texas, Oklahoma, North

Dakota, and Pennsylvania. Employment in oil and gas extraction and support services is at its highest level since its recent high in the fall of 2014.

Meanwhile, the shift in technologies continued to play out in EPG with solar employment declining for the second year in a row despite adding an additional 11.06 gigawatts of capacity. This decline was concentrated in a handful of states—California, Massachusetts, North Carolina, and Arizona. Other technologies that continued to register growth included CHP and smaller renewables such as geothermal. Nuclear EPG avoided potential closures in Illinois and New York, but employment declined slightly, losing 1500 jobs.

Investments in energy infrastructure continued to grow in 2018 with the number of construction companies reporting a majority of their revenues coming from utility investments increasing with an accompanying dramatic increase in construction jobs. Battery storage jobs experienced another significant increase, signaling the new importance of storage in a grid that relies more on distributed sources of generation.

Energy Efficiency employment continued its steady growth, even in a high employment environment, challenged by the toughest hiring climate found in the USEER survey. Construction firms employ the majority of Energy Efficiency employees and added over 21,000 jobs despite a majority of those employers saying it was very difficult to do so. The professional services sector of Energy Efficiency expanded by 35,000 personnel and now employs almost a half million Americans.

Alternative fuels and hybrid vehicles employment experienced a significant rebound from a year earlier adding 34,000 jobs, driven by release of the Tesla Model 3. However, the discontinuation of the Chevrolet Volt and a 35 percent increase in domestic sales of foreign manufactured alternative fuels vehicles in 2018 provide headwinds for future job growth. Overall, the Motor Vehicle industry had a banner year, increasing employment in 2018 by 74,000 jobs, two and one half times the increase in 2017.

Finally, the 2019 USEER will provide, in a separate report, comprehensive wage data on 79 different occupations throughout the five surveyed sectors. This report, to be issued in the second quarter of 2019 will allow for comparisons of wage and benefit levels by technology and geography throughout the energy, energy efficiency, and motor vehicles sectors.

Spotlight: "We are in the middle of an historic transition of the energy sector."

Alicia Barton, President and CEO, NYSERDA

The New York State Energy Research and Development Authority's (NYSERDA) mission is to "advance innovative energy solutions in ways that improve New York's economy and environment." Providing significant choices and opportunities for New Yorkers to pursue their own clean energy choices is integral to this mission and advancing the clean energy economy.

For the last three years NYSERDA has funded the collection of clean energy jobs data to facilitate that mission. This New York data is an important component of the 2019 USEER.

Alicia Barton, President and CEO, NYSERDA, spoke about the importance of jobs data to her organization's business, "We are in the middle of an historic transition of the energy sector. Policy makers in our state rely on jobs data to correlate meaningful progress towards our clean energy goals with sustainable economic growth opportunities for the benefit of all New Yorkers.

Installers from the Radiant Store in Troy, NY get a roof ready for solar thermal. (Photo courtesy: NYSERDA)

"We have seen tangible outcomes already. The insights we gained on the hiring difficulties in various energy subsectors from this data have led to our investment of $70 million in workforce training programs in our state. This, in turn, has led to employment that changes lives and drives economic growth that ripples throughout the economy from energy efficiency investments.

"One of our proudest accomplishments has been to target our workforce development systems to fulfill our agency's mission. Since energy efficiency job growth has been outpacing the economy as a whole, this has been a win-win for New Yorkers, our economy and our environment."

Methodology

The U.S. Energy and Employment Report is based on a 15-minute, supplemental survey[10] of approximately 30,000 employers that enriches the employment data published by the U.S. Bureau of Labor Statistics (BLS) in its Quarterly Census on Employment and Wages (QCEW). The QCEW is compiled by BLS from data provided by employers, who must report the monthly employment and the quarterly wages for all workers covered by unemployment insurance at either the state or federal level. BLS allocates these employment figures across 1,057 industry subsectors, according to each firm's primary business focus under the North American Industrial Classification System (NAICS). The NAICS system was established in 1997 and is used in the United States, Canada, and Mexico to describe their respective industries and businesses. Examples of major industrial sectors in the NAICS include Mining, Quarrying and Oil and Gas Extraction (NAICS Sector 21); Utilities (NAICS Sector 22); Manufacturing (NAICS Sector 31-33); and Professional, Scientific and Technical Services (NAICS Sector 54).

Each of the major industrial sectors in the NAICS is refined into subsectors and then into 4-digit codes for industry groups (such as Electric Power Generation, Transmission and Distribution – NAICS 2211) and further into 6-digit codes for specific industries (such as Solar Electric Power Generation – NAICS 221114). The QCEW classifies over 96 percent of the American workforce under this system. Among the workers excluded are some agricultural workers and workers who are sole proprietorships. For more information on the QCEW and the NAICS, please refer to their official websites at the U.S. Census Bureau, for NAICS,[11] and at the Bureau of Labor Statistics, for the QCEW.[12]

In order to achieve a deeper understanding of employment in any sector of the U.S. workforce, economists and statisticians have made use of supplemental surveys designed to ask specific questions of employers in targeted subsectors of the QCEW data. The USEER survey was created to gather additional data on the employers that are engaged in the energy sector, including the production, transmission, distribution, and consumption of energy in all its many forms. The USEER divides this employment into five sectors: Fuels; Electric Power Generation; Transmission, Distribution, and Storage; Energy Efficiency; and Motor Vehicles.

[10] The supplemental survey is included in Appendix B in this report.
[11] NAICS, www.census.gov/eos/www/naics/
[12] QCEW, www.bls.gov/cew/

Employment in each of these five sectors is not assigned to a discrete set of NAICS subsectors. Instead, it is spread across 186 of them, or approximately 18 percent of the total. Some of these subsectors are 100 percent energy-related, while others are only partially composed of energy employment. In addition, in some of these subsectors, employees are spending 100 percent of their time on energy-related work, while in others a given employee may spend 50 percent of his/her time on energy-related tasks and the balance on something entirely different. The USEER supplemental survey provides solutions to these data gaps.

Take, for instance, the example of construction employees who are employed by an outside contractor, but whose work takes place 365 days a year on the location of a nuclear power plant. Under the QCEW, such employees are counted as construction electricians, laborers, and pipefitters – without any specific relationship to the nuclear power plant to whose operations they are essential. Through its survey of the construction industry, the USEER determines how many employees of construction companies are actually involved in the production, transmission, distribution, and efficient use of energy. In this particular case, the USEER reassigns them to the nuclear generating sector. Without the USEER survey, we would not be able to determine that over 1.9 million construction laborers are employed by our country's energy businesses.

As mentioned, the USEER survey is administered annually to approximately 30,000 businesses, according to a stratified random sampling of businesses classified in 186 different NAICS industry codes at the six-digit level. These detailed NAICS codes are subsets of seven two-digit codes for broad industry sectors.

Table 1.

Two-Digit NAICS Codes for Sectors Containing Energy Employment with Examples of Their Component Industry Groups and Specific Industries

	Agriculture	Mining, Quarrying and Oil & Gas Extraction	Utilities	Construction	Manufacturing	Wholesale Trade	Professional Services
NAICS Sector Code	NAICS 11	NAICS 21	NAICS 22	NAICS 23	NAICS 31-33	NAICS 42	NAICS 54
4-Digit Example for Industry Group	1133 Logging	2111 Oil & Gas Extraction	2211 Electric Power Generation, Transmission and Distribution	2371 Utility System Construction	3241 Petroleum and Coal Products Manufacturing	4236 Household Appliances and Electric and Electronic Goods Merchant Wholesalers	5411 Legal Services

6-Digit Example for Specific Industry	111150 Corn Farming	212112 Bituminous Coal Underground Mining	221114 Solar Electric Power Generation	237130 Power and Communica-tion Line and Related Structures Construction	333611 Turbines and Turbine Generator Set Units Manufacturing	424710 Petroleum Bulk Stations and Terminals	541330 Engineering Services

The survey questions each of these employers about their employment in 53 different energy, energy efficiency, or motor vehicle technologies.

Table 2.

USEER Energy Technologies Included in the Survey Instrument

Electric Power Gen.	Fuels Production	Trans, Dist., Storage	Energy Efficiency	Motor Vehicles
Solar Photovoltaics	Coal	Traditional T & D	Energy Star Applian.	Gasoline & Diesel
Wind	Petroleum	Pumped Hydro	Efficient Lighting	Hybrid Electric
Geothermal	Natural Gas	Battery Storage	Traditional HVAC	Plug-in Hybrid
Bioenergy/Biomass	Other Fossil Fuels	Other Storage	Energy Star HVAC	All Electric
Low Impact Hydro	Corn Ethanol	Smart Grid	Renewable HVAC	Natural Gas
Traditional Hydro	Non-woody Biomass	Micro Grids	Adv. Build. Materials	Hydrogen
Natural Gas	Woody Biomass	Other Modernizing	Recycled Build. Mat.	Fuel Cell
Advanced Gas	Other Biofuels		Reduced water	
Nuclear	Nuclear Fuels			
Coal				
Petroleum/Oil				
CHP				

6

As the earlier example of the nuclear power and construction industry illustrates, many employees whose jobs are a direct and essential part of the U.S. energy system are not classified as such under the QCEW. This fact is not a shortcoming of the QCEW, simply a data gap that must be addressed to create an accurate picture of the size of the U.S. energy workforce, the employment and skills needs of its employers, and an understanding of its demographic makeup.

The evolution of American business models and the growth of new technologies has also contributed to the complexity of this problem. Vertically integrated companies have given way to specialty companies whose supply chains would once have been owned by a single entity. As a result, the direct employment relationship of such companies is lost.

New technologies frequently lead to new business models. Wind and solar generation are an excellent example, in that few generation projects are built by direct employees of utilities, under which most electric power generation employment is classified in QCEW. Consequently, understanding employment in new technology sectors requires a supplemental survey to understand which of the construction and professional services jobs, for instance, are actually electric power generation jobs.

The two tables below show how the problem of undercounting in these sectors is solved through administration of the USEER supplemental survey. Table 3 shows how different jobs were counted under Electric Power Generation in the 3rd Quarter of 2018 under the QCEW on a national level, as compared to the numbers reported by the 2019 USEER, which surveyed employers in that same quarter to determine how many construction, professional, and wholesale trade employees were actually working on Electric Power Generation but not as Utility employees.

Table 3.

Electric Power Generation Employment in the QCEW Compared to the USEER.

Fuel Source	QCEW-BLS	2019 USEER
Fossil Fuels	105,296	211,469
Nuclear	46,809	62,987
Wind	6,231	111,166
Solar	3,295	242,343 (93,000)*
CHP	1,673	29,245
Hydro	17,480	66,448
Geothermal	1,116	8,526
Biomass	2,029	12,976

*93,000 additional employees in solar spend less than 50 percent of their time on solar-related tasks.

Table 4. illustrates this same problem at the state level, in this case North Carolina. The state problem is further complicated by federal privacy rules that prohibit the release of data where the number of employers is too few to maintain the confidentiality of their responses. Consequently, the QCEW is unable to report on multiple generation technologies in that state, whereas the USEER reports on all but one. Neither the QCEW nor the USEER had adequate responses for CHP generation at the state level.

Table 4.

North Carolina Electric Power Generation Employment in the QCEW Compared to the USEER.

Fuel Source	QCEW-BLS	2019 USEER
Fossil Fuels	n/a	5,365
Nuclear	n/a	1,645
Wind	n/a	908
Solar	436	6,719 (2,193)*
CHP	n/a	n/a
Hydro	106	578
Geothermal	n/a	364
Biomass	49	1,531

*Parentheses include additional solar employees who spend less than 50 percent of their time on solar

Survey Content

The survey itself covers many other topics in addition to asking how many of a firm's employees work in one of the 53 technologies. The survey is administered by phone and on-line and asks the following:

- Employment numbers
- Employer hiring expectations for the next 12 months
- Hiring difficulty by technology and industrial classification over the last year
- High demand jobs and skills gaps
- Workforce demographics by race, ethnicity, gender, age, and veteran status
- Geographic location by state, county, congressional and legislative districts, and metropolitan statistical area of each technology and industrial classifications

Sectors

Prior editions of the USEER broke down the energy-related economy into four sectors: Fuels and Electric Power Generation; Transmission, Distribution, and Storage; Energy Efficiency; and Motor Vehicles. The 2019 USEER divides Fuels and Electric Power Generation into separate sectors, each with its own chapter, so this report now discusses the energy-related economy in terms of five sectors. In addition, the 2019 USEER has added several crosscutting sections that examine the relationship between aspects of these sectors and of some of the technologies that cut across several of them. For instance, the 2019 USEER contains a crosscut on the natural gas and oil industries, showing that their workforces take part in the Fuels, Electric Power Generation, and Transmission, Distribution, and Storage sectors. The 2019 USEER also contrasts the jobs in Electric Power Generation sector that require fuels with the jobs in that sector that do not.

As in the past, Energy Efficiency is largely, although not entirely, defined by standards arising from the EPA's ENERGY STAR program. For a more complete definition of Energy Efficiency jobs, see the introduction to the Energy Efficiency chapter.

Finally, the 2019 USEER again includes a chapter on the Motor Vehicle industry. Motor Vehicles consume 28 percent of all energy used in the United States in 2019. Consequently, it is important to continue the examination of how fuel efficiency and new technologies including electrification and fuel cells are affecting employment in that industry.

To read the USEER 2019 Supplemental Survey and for a complete technical discussion of the survey methodology, please see Appendix A and Appendix B, respectively.

Fuels

Fuels

Fuels employment encompasses work related to fuel extraction, mining, and processing, including petroleum refineries and firms that support coal mining, oil, and gas field machinery manufacturing. Workers across both the forestry and agriculture sectors who support fuel production with corn ethanol, biodiesels, and fuel wood are also included in the fuel employment data.

TRENDS

- **2018 Job Gain.** In 2018, the Fuels sector grew by approximately 52,000 jobs, or nearly 5 percent for a total of 1,127,553 jobs.
- **Oil and Gas Recovery.** Oil and natural gas employers added the most new jobs, nearly 51,000, employing 603,000 and 271,000 respectively.
- **Coal Growth.** Coal jobs increased by 650 jobs, totaling about 74,800.
- **Biofuels.** Woody biomass added 1,800 jobs, while corn ethanol also increased.
- **2019 Expectations.** Employers in the Fuels sector anticipate over 3 percent job growth in 2019, with most of the increase expected in oil and natural gas.

4.9%

Overall Fuels jobs growth in 2018

3.0%

Fuels employers predict 3% job growth in 2019

SNAPSHOT OF EMPLOYMENT

Figure 1.

Fuels Sector – Employment by Industry, 2017-2018

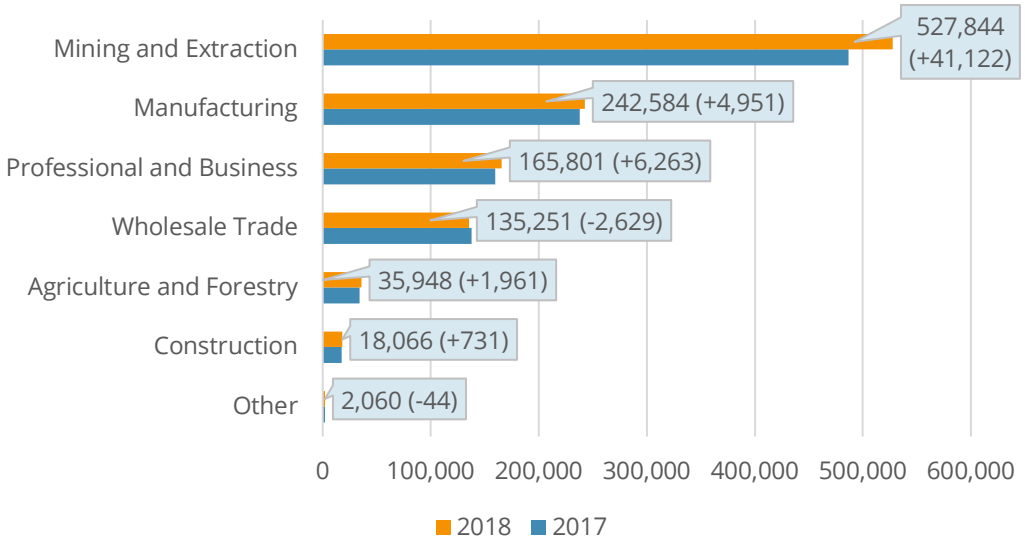
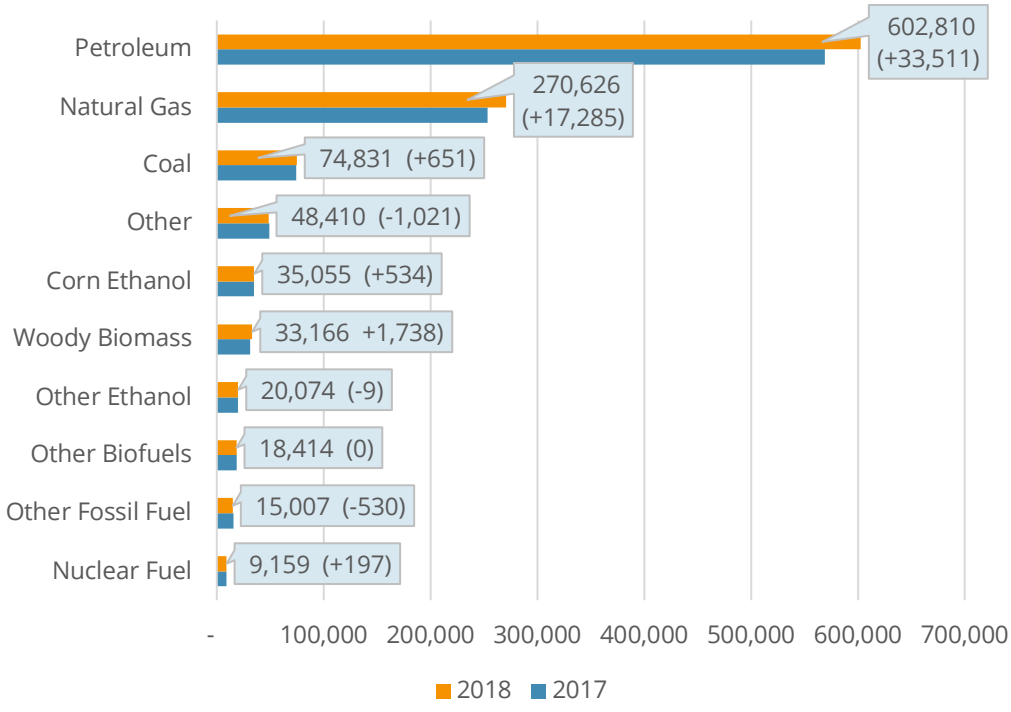


Figure 2.

Fuels Sector – Employment by Detailed Technology Application, 2017-2018



KEY TAKEAWAYS

- The major growth industry sector in Fuels was mining and extraction, which added 41,000 new jobs in 2018, reflecting the growth of oil and natural gas production.
- Fuels production employment in the United States includes coal, petroleum, natural gas, corn ethanol and a variety of other biofuels, nuclear fuel, and others.

Table 5.
Fuels Sector – Employment by Detailed Technology Application and Industry, Q2 2018

	Total	Agriculture	Mining + Extraction	Manufacturing	Wholesale Trade	Professional Services
Coal	74,831	--	55,905	10,194	1,007	7,700
Petroleum	602,810	--	308,681	149,142	58,622	66,947
Natural Gas	270,626	--	162,928	44,444	29,045	34,037
Other Fossil Fuel	15,007	--	--	2,923	6,870	5,103
Corn Ethanol	35,055	15,795	--	9,795	6,553	2,801
Other Ethanol	20,074	2,407	--	2,751	5,282	9,577
Woody Biomass	33,166	17,747	--	4,549	1,005	9,822
Other Biofuels	18,414	--	--	1,013	1,610	15,762
Nuclear Fuel	9,159	--	330	3,038	909	4,883
Other	48,410	--	--	14,737	24,348	9,169
TOTAL	1,127,552	35,949	527,844	242,586	135,251	165,801

HIRING DIFFICULTY

- **53 percent of mining and extraction employers in fuels** reported that it was somewhat difficult or very difficult to hire new employees. 16 percent reported it was very difficult.
- **76 percent of manufacturing employers** reported that it was either somewhat difficult or very difficult to hire new employees.
- **89 percent of professional and business services employers in fuels** reported that it was either difficult or somewhat difficult to hire new employees.

HIGHEST-DEMAND OCCUPATIONS IN FUELS

With significant growth in 2018 and predicted growth of 3 percent in 2019, fuels employers have identified below the occupations that each industry sector is having the greatest difficulty in filling.

Table 6.
Fuels Sector – Reported Occupations with Hiring Difficulty by Industry, Q4 2018

Mining & Extraction	Manufacturing	Wholesale Trade, Distribution, and Transport	Professional and Business Services	Other
Technicians or mechanical support (45%)	Technicians or mechanical support (46%)	Drivers/ dispatchers (39%)	Engineers/ scientists (63%)	Technicians or mechanical support (89%)
Electrician/ construction laborers (21%)	Drivers/ dispatchers (22%)	Sales, marketing, or customer service (28%)	Technicians or mechanical support (13%)	Drivers/ dispatchers (22%)
Drivers/ dispatchers (17%)	Electrician/ construction laborers (21%)	Management (directors, supervisors, vice presidents) (22%)	Electrician/ construction laborers (13%)	Electrician/ construction laborers (22%)

Spotlight: "We are at a critical inflection point in Pennsylvania."

Denise Brinley, Executive Director, Governor's Office of Energy, Pennsylvania

According to USEER data, Pennsylvania has added 6200 jobs in natural gas extraction and electric power generation in the last two years. Currently, almost 17,000 Pennsylvanians are employed in these two sectors.

As **Denise Brinley**, Executive Director of the Governor's Office of Energy in Pennsylvania, observed, "We are at a critical inflection point in Pennsylvania because of the volume of natural gas, the network of pipelines being built, and the importance of climate change. Simultaneously, we have had 14 coal plants with 6,000 MWs of capacity close since 2010. Nuclear power plants produce approximately 40% of the state's baseload electricity, and some are beginning to struggle financially, in part because of the low cost of natural gas. Every form of energy in our state is experiencing a transition.

"Natural gas has provided us with three primary waves of employment. The first was initiated in 2007 with natural gas drilling operations. The second is occurring now and is related to the construction of pipelines. We are now exploring the third, most sustainable future phase — how we can use our natural gas and liquids as a low-cost fuel and feedstock for manufacturers right here in Pennsylvania, which will help spur job creation. We currently export 80% of our natural gas and 100% of our ethane, and we would very much like to change that dynamic.

"We're also undergoing several other promising transitions in our energy economy. For example, Governor Wolf calls for emissions' reduction targets of 26% by 2025 and 80% by 2050."

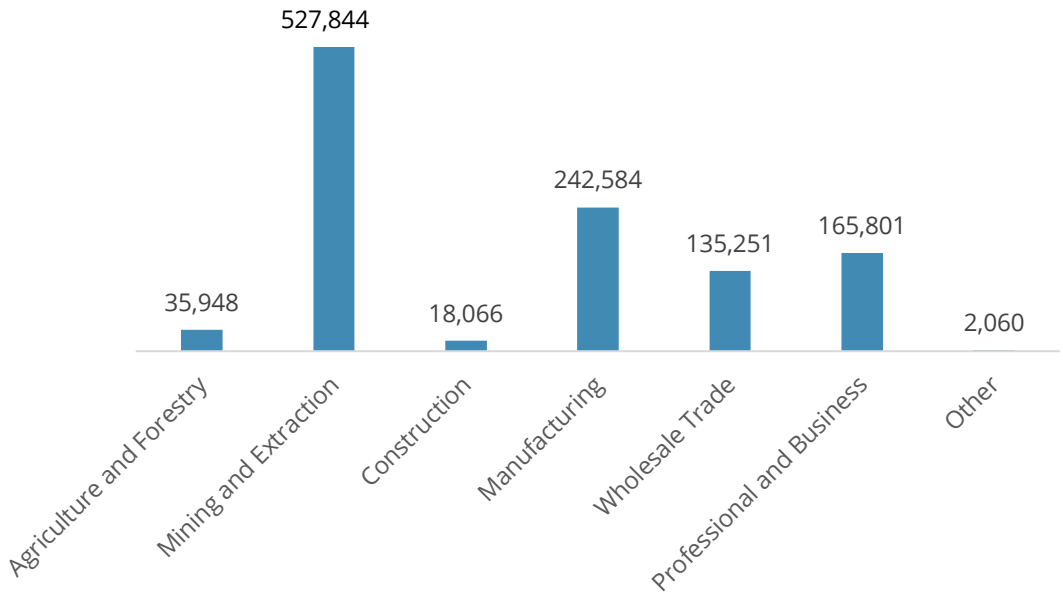
"We have a great example in Chester, Pennsylvania, where the construction of a pipeline to the Kimberly-Clark paper mill will result in the replacement of its coal-fired boiler with natural gas, making the facility economically more competitive while also reducing carbon emissions.

"We are also the first state to publish "energy scenarios," where we've postulated that we harness opportunities with natural gas to the benefit of the entire state economy while managing our emissions' reductions through a combination of carbon pricing and carbon capture and sequestration. Our energy diversity is our strength."

Introduction

The Fuels sector employed 1,127,553 workers in 2018, compared to the previous year's level of almost 1,075,000 jobs. This represents a jump in employment of nearly 5 percent. Oil and gas extraction and support services reached its recent peak employment in the fall of 2014 with 541,000 jobs, while coal mining and extraction reached its recent peak in 2012 with just under 90,000 jobs. In the second quarter of 2018, these comparable BLS employment figures were at 471,609 and 55,905 respectively.[13]

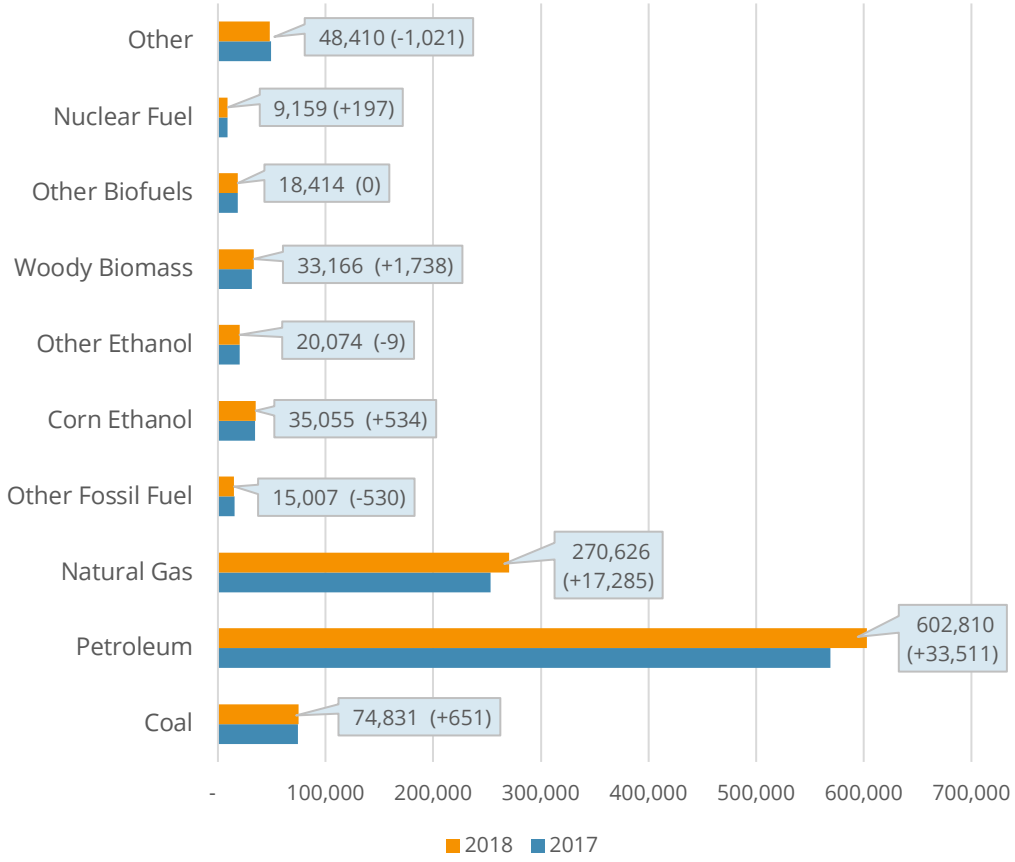
Figure 3.
Fuels Sector – Employment by Industry, Q2 2018



As shown in Figure 4, the 2019 USEER found large increases in 2018 for both petroleum production jobs (more than 33,000 additional jobs, for a total of 602,810 jobs) and natural gas production jobs (more than 17,000 additional jobs, for a total of 270,626 jobs). Overall, employers in the Fuels sector project to see employment increase by 3 percent in 2019.

[13] Job figures from BLS QCEW data, not USEER extrapolated employment, since comparable USEER data does not exist for 2012 and 2014.

Figure 4.
Fuels Sector – Employment by Detailed Technology Application, 2017-2018



Manufacturing employers in the Fuels sector expect an increase in employment of over 4 percent in 2019, while professional business services project to increase employment by over 5 percent during the same time period, as shown in Figure 5.

Figure 5.

Fuels Sector – Expected Employment Growth by Industry (Q4 2018 – Q4 2019

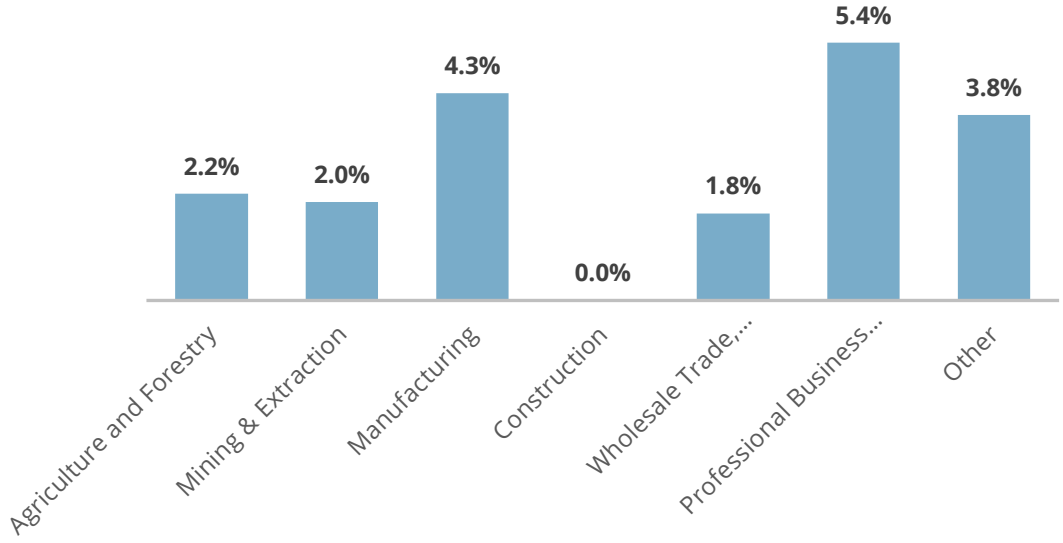
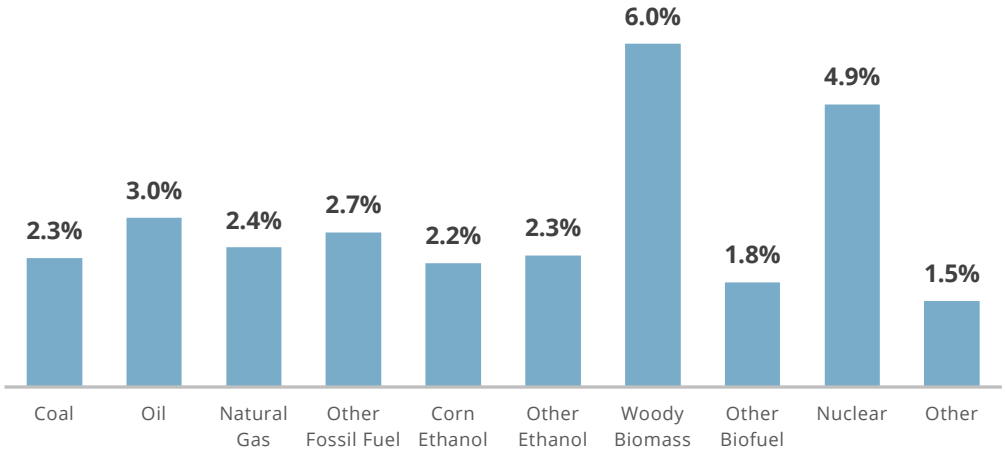


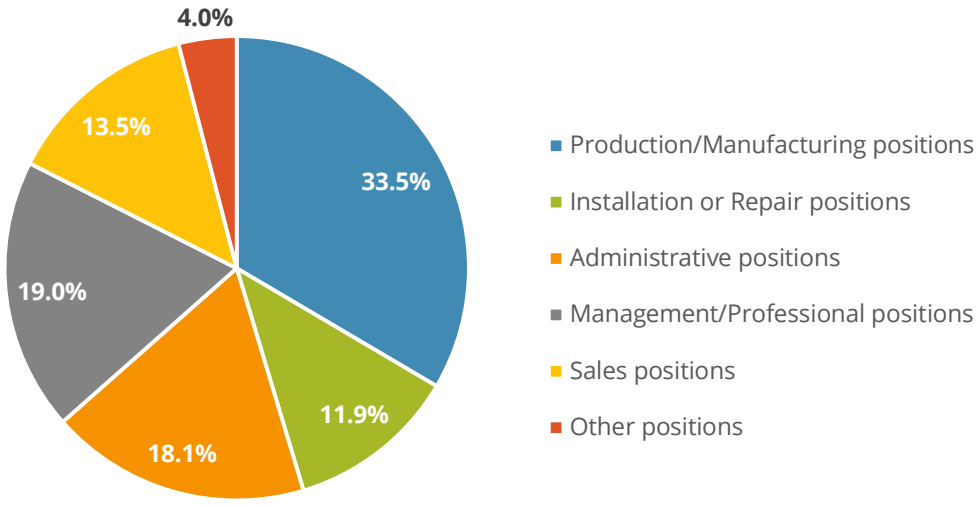
Figure 6.

Fuels Sector – Expected Employment Growth by Detailed Technology (Q4 2018 - Q4 2019)



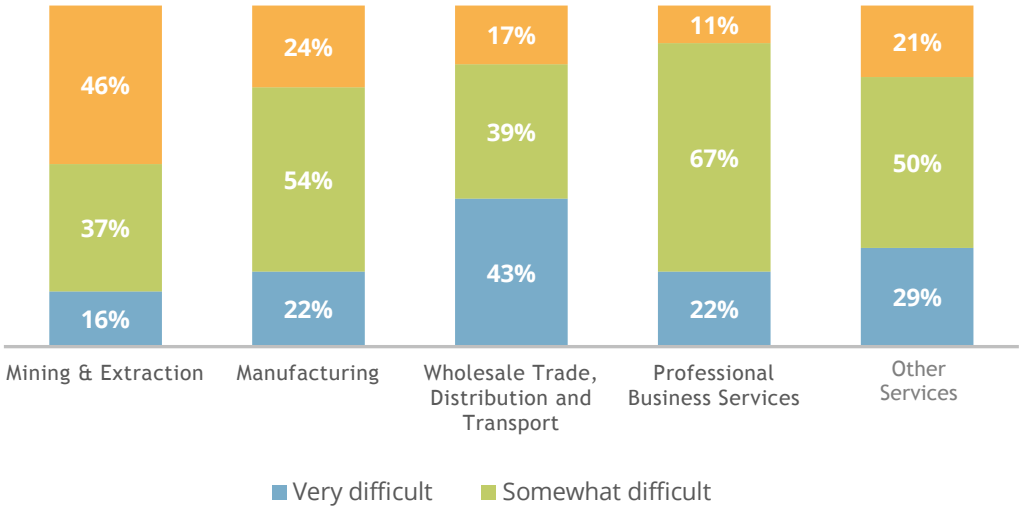
FUELS – WORKFORCE CHARACTERISTICS

Figure 7.
Fuels Sector – Occupational Distribution, Q4 2018



Mining and extraction, the largest segment of petroleum fuels employment, reported a hiring-difficulty score that was one of the lower such scores across all energy sectors–only 53 percent of employers in that industry sector reported that hiring was either somewhat difficult (37 percent) or very difficult (15 percent). Manufacturing, the second largest segment, reported that 76 percent of employers found hiring new employees either somewhat difficult or very difficult.

Figure 8.
Fuels Sector – Hiring Difficulty by Industry, Q4 2018



Fuels sector employers, across most industry sectors, mentioned lack of experience, training, or technical skills as the number one reason for reported hiring difficulty over the previous year. Other significant reasons for reported hiring difficulty were location and insufficient non-technical skills.

Table 7.
Fuels Sector – Reasons for Hiring Difficulty by Industry, Q4 2018

Mining & Extraction	Manufacturing	Wholesale Trade, Distribution, and Transport	Professional and Business Services	Other
Lack of experience, training, or technical skills (42%)	Lack of experience, training, or technical skills (40%)	Insufficient non-technical skills (32%)	Lack of experience, training, or technical skills (63%)	Location (40%)
Insufficient non-technical skills (19%)	Insufficient non-technical skills (21%)	Insufficient qualifications, certifications, education (26%)	Insufficient non-technical skills (13%)	Lack of experience, training, or technical skills (30%)
Difficulty finding industry-specific knowledge, skills, and interest (17%)	Insufficient qualifications, certifications, education (21%)	Cannot provide competitive wages (26%)	Insufficient qualifications, certifications, education (13%)	Difficulty finding industry-specific knowledge, skills, and interest (20%)

More than six in ten (63 percent) professional and business services employers within Fuels who reported difficulty in hiring also reported engineers/scientists as the occupation that was the most difficult to hire for. Technicians or mechanical support was another notably difficult position to hire for.

Table 8 lists the most difficult occupations to hire for by industry within the Fuels sector, as reported by employers in 2018.

Table 8.
Fuels Sector – Reported Occupations with Hiring Difficulty by Industry, Q4 2018

Mining & Extraction	Manufacturing	Wholesale Trade, Distribution, and Transport	Professional and Business Services	Other
Technicians or mechanical support (45%)	Technicians or mechanical support (46%)	Drivers/dispatchers (39%)	Engineers/ scientists (63%)	Technicians or mechanical support (89%)
Electrician/ construction laborers (21%)	Drivers/ dispatchers (22%)	Sales, marketing, or customer service (28%)	Technicians or mechanical support (13%)	Drivers/ dispatchers (22%)
Drivers/ dispatchers (17%)	Electrician/ construction laborers (21%)	Management (directors, supervisors, vice presidents) (22%)	Electrician/ construction laborers (13%)	Electrician/ construction laborers (22%)

Women made up only 24 percent of employment in the Fuels sector. While the Fuels sector had lower proportions of both black or African American and Hispanic or Latino employees, compared to national workforce averages, the sector's overall racial diversity was equal to the national average of 22 percent. The Fuels sector exceeded the national average for veterans hiring at 11 percent.

Table 9.
Fuels Sector – Demographics, Q4 2018

	Fuels		National Workforce Averages[14]
Male	853,800	76%	53%
Female	273,753	24%	47%
Hispanic or Latino	133,945	12%	17%
Not Hispanic or Latino	993,608	88%	83%
American Indian or Alaska Native	20,025	2%	1%
Asian	61,723	5%	6%
Black or African American	59,100	5%	12%
Native Hawaiian or other Pacific Islander	8,195	1%	>1%
White	879,778	78%	78%
Two or more races[15]	98,732	9%	2%
Veterans	122,859	11%	6%
55 and over	261,286	23%	23%
Union	36,066	3%	11%

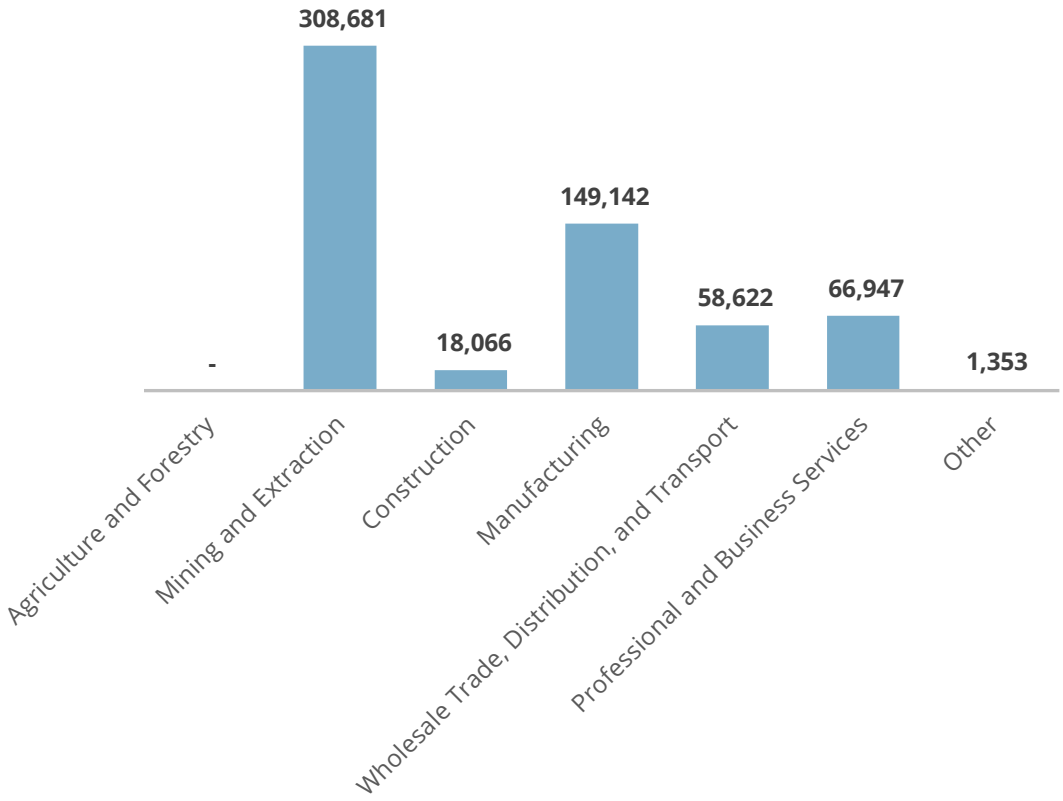
[14] All demographic information except union membership from 2017 data in "Labor Force Statistics from the Current Population Survey," Bureau of Labor Statistics, U.S. Department of Labor, https://www.bls.gov/cps/demographics.htm. Information on union membership is from "Table 3: Union affiliation of employed wage and salary workers by occupation and industry, 2016-17 annual averages," in U.S. Department of Labor, Bureau of Labor Statistics, "Union Members Summary," news release, January 19, 2018, https://www.bls.gov/news.release/union2.nr0.htm.

[15] While federal guidelines were followed in administering the demographic questions, respondents may have reported two or more races as including Hispanic or Latino ethnicity, inappropriately inflating the total and deflating other racial categories.

PETROLEUM FUELS

Petroleum fuels employed a total of 602,810 workers across the nation in 2018. Over the course of 2018, petroleum fuels jobs grew by 33,500 jobs, or almost 6 percent. Mining and extraction supported over half of the oil industry, while manufacturing made up nearly 25 percent of oil fuels employment in 2018.

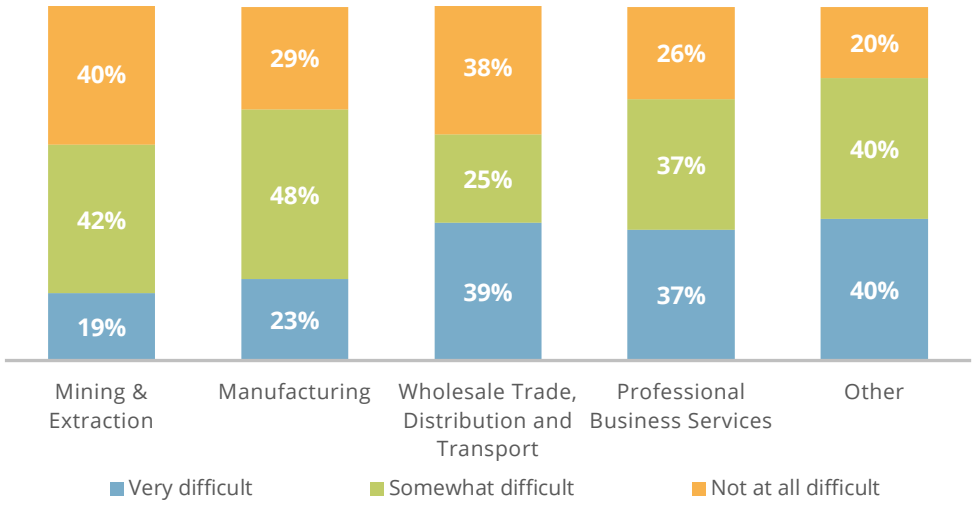
Figure 9.
Petroleum Fuels – Employment by Industry



Employers in industries important to petroleum fuels experienced varying degrees of difficulty in hiring new workers in 2018—61 percent of mining and extraction employers reported that hiring new workers was somewhat difficult or very difficult, 71 percent of manufacturing employers reported hiring was somewhat difficult or very difficult (with 23 percent noting it has been very difficult), and 74 percent of professional business services employers reported that hiring was somewhat difficult or somewhat difficult or very difficult (with 37 percent reporting that hiring was very difficult).[16]

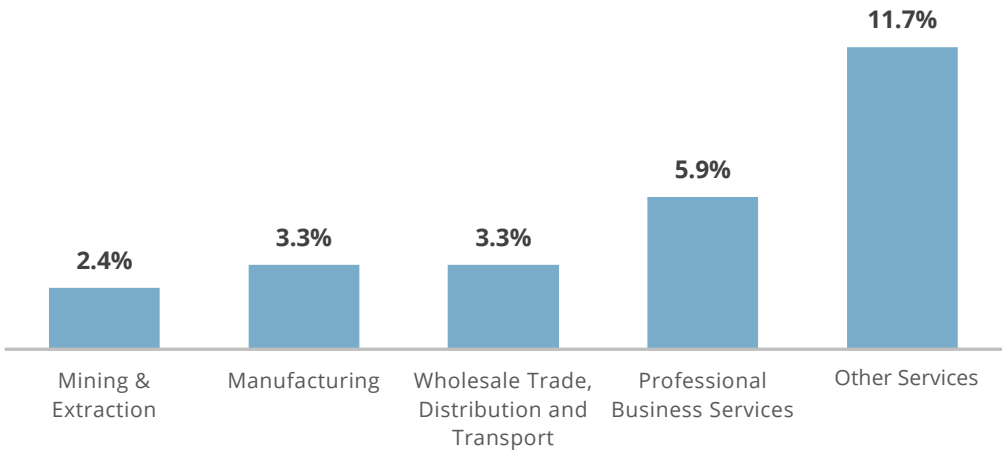
[16] Some industries are omitted from this discussion due to their small sample size in the data contributing to Figure 10. Conclusions have been made only about industries with sufficient sample size.

Figure 10.
Petroleum Fuels – Hiring Difficulty by Industry



Employers in the petroleum fuels industry expect 3 percent growth in 2019. This is led by the professional business services sector, which expects almost 6 percent growth.

Figure 11.
Petroleum Fuels – Expected Employment Growth by Industry



Petroleum fuels had a low number of female employees in 2018, representing only 23 percent of the workforce. Along with women, black or African American and Hispanic or Latino workers also fell short of national workforce averages. However, the overall racial diversity of the petroleum fuels workforce was equivalent to the national average of 22 percent.

Table 10.

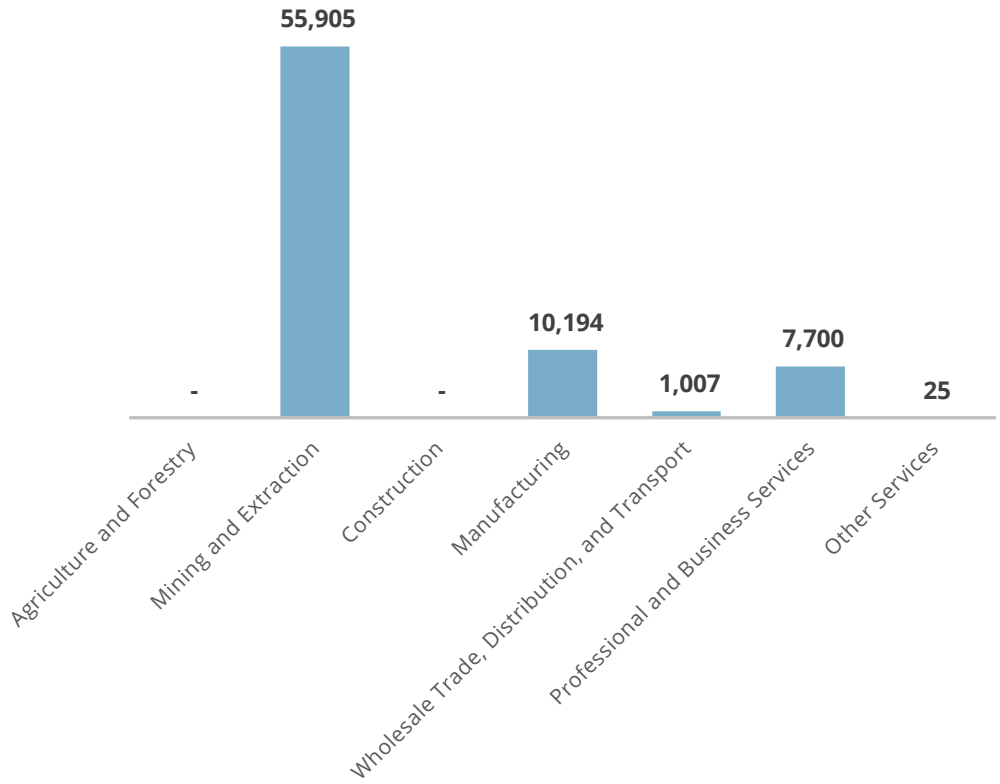
Petroleum Fuels – Demographics, Q4 2018

	Oil		National Workforce Averages
Male	464,164	77%	53%
Female	138,646	23%	47%
Hispanic or Latino	78,100	13%	17%
Not Hispanic or Latino	524,711	87%	83%
American Indian or Alaska Native	12,062	2%	1%
Asian	37,702	6%	6%
Black or African American	35,406	6%	12%
Native Hawaiian or other Pacific Islander	5,256	1%	>1%
White	461,721	77%	78%
Two or more races	50,663	8%	2%
Veterans	60,883	10%	6%
55 and over	134,851	22%	23%
Union	12,373	2%	11%

COAL FUELS

Coal fuels employed a total of 74,831 workers in the U.S. in 2018. Over the course of 2018, coal jobs increased by 650 jobs, or 0.9 percent. Mining and extraction jobs supported nearly 75 percent of coal fuels employment in 2018, while manufacturing made up nearly 14 percent. Additional Wholesale Trade, Distribution and Transport jobs that directly support the coal industry are included in the Transmission, Distribution, and Storage chapter and the Coal Industry crosscut on page 118.

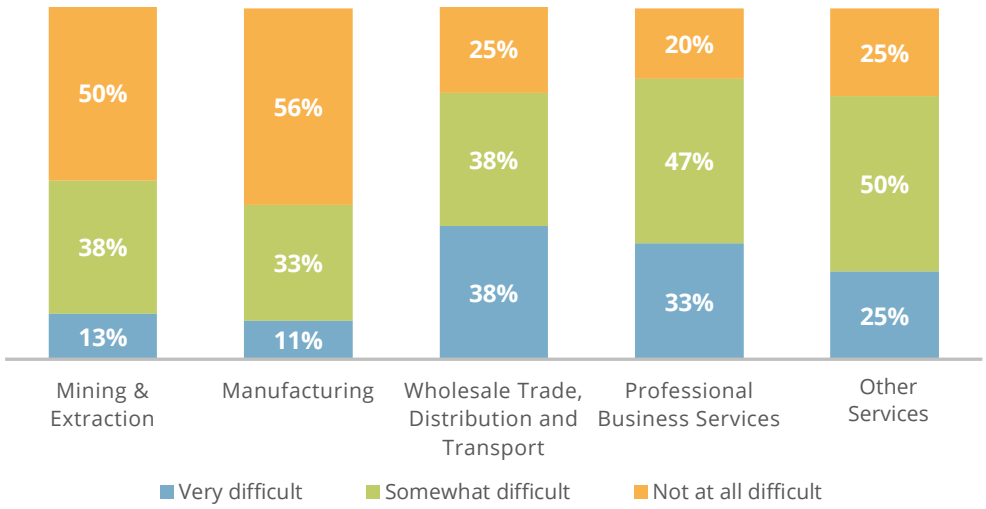
Figure 12.
Coal Fuels – Employment by Industry



Hiring has generally not been difficult for two industry sectors supporting coal fuels–56 percent of manufacturing employers and 50 percent of mining and extraction employers in coal fuels reported that hiring new workers has not been difficult during 2018. By contrast, 80 percent of professional business services employers reported that hiring was somewhat difficult or very difficult (with 33 percent reporting hiring to have been very difficult).[17]

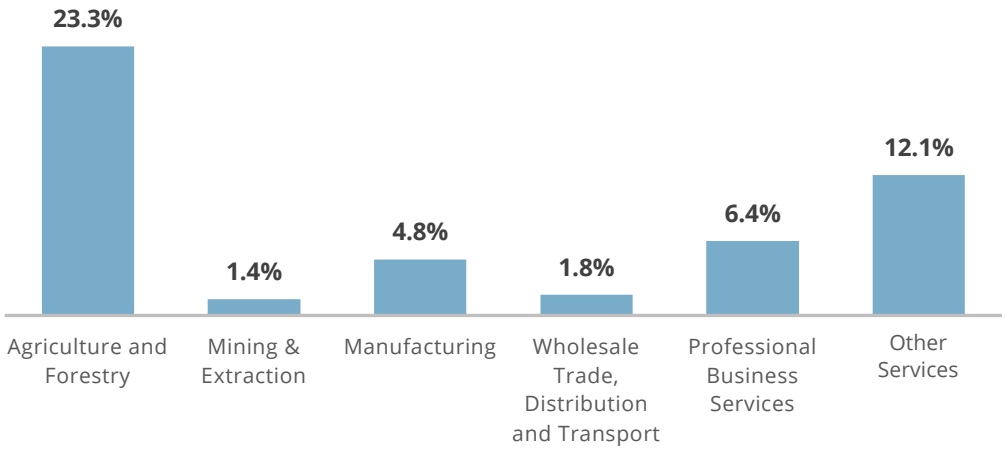
[17] Some industries are omitted from this discussion due to their small sample size in the data contributing to Figure 13. Conclusions have been made only about industries with sufficient sample size.

Figure 13.
Coal Fuels – Hiring Difficulty by Industry



Employers in the coal fuels industry expect around 2.5 percent growth in 2019. This is led by the professional business services sector, which expects over 6 percent growth.

Figure 14.
Coal Fuels – Expected Employment Growth by Industry



Coal fuels had a low number of female employees in 2018, representing only 22 percent of the workforce. Similarly, black or African American, Hispanic or Latino, and Asian workers also fell short of national workforce averages, making coal fuels one of the least diverse industries.

Table 11.

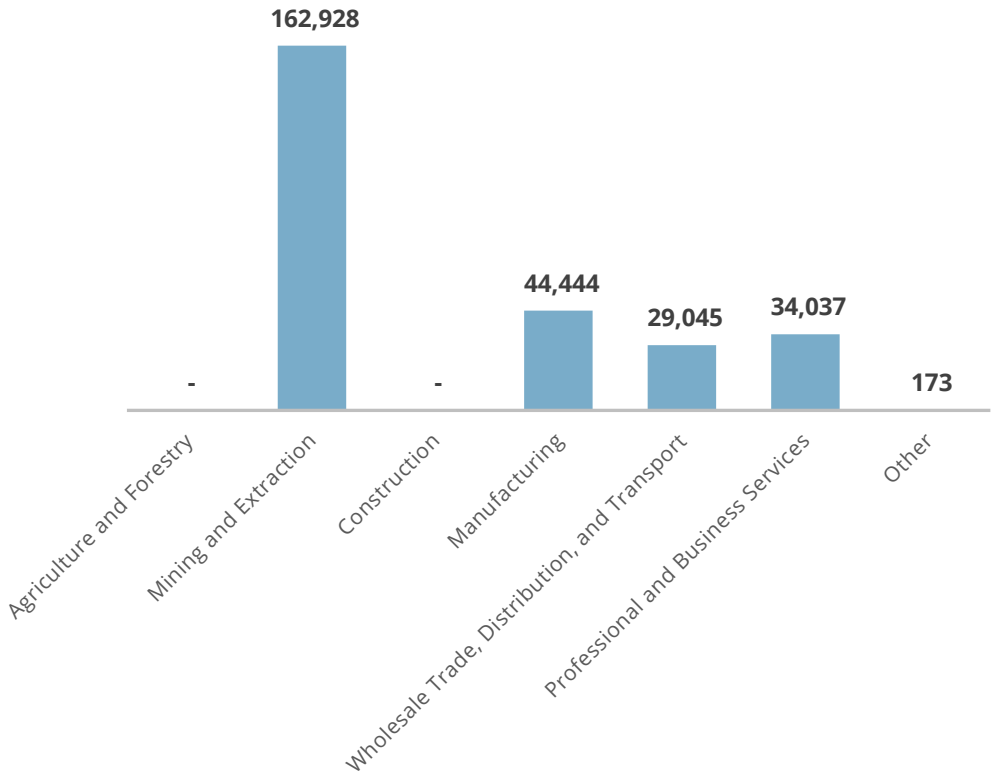
Coal Fuels – Demographics, Q4 2018

	Coal		National Workforce Averages
Male	58,247	78%	53%
Female	16,584	22%	47%
Hispanic or Latino	8,146	11%	17%
Not Hispanic or Latino	66,685	89%	83%
American Indian or Alaska Native	1,572	2%	1%
Asian	2,262	3%	6%
Black or African American	2,814	4%	12%
Native Hawaiian or other Pacific Islander	337	0%	>1%
White	62,834	84%	78%
Two or more races	5,012	7%	2%
Veterans	7,109	9%	6%
55 and over	21,047	28%	23%
Union	888	1%	11%

NATURAL GAS FUELS

Natural gas fuels employed a total of 270,626 workers across the nation in 2018. Over the course of 2018, natural gas jobs grew significantly, by over 17,000 new jobs or by nearly 7 percent. Mining and extraction jobs supported over 60 percent of the natural gas fuels industry, while manufacturing made up over 16 percent of natural gas fuels employment in 2018.

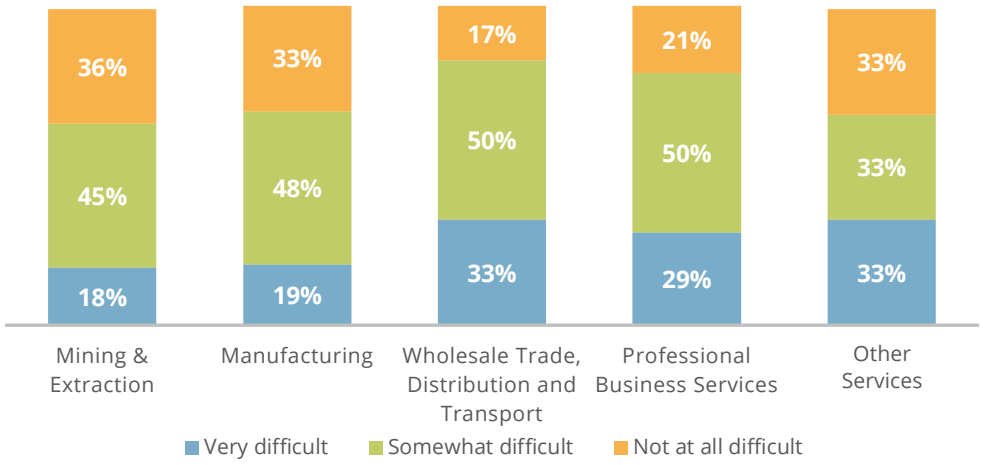
Figure 15.
Natural Gas Fuels – Employment by Industry



Thirty-six percent of mining and extraction employers reported that hiring new workers has not been difficult during 2018. In contrast, 83 percent of wholesale trade, distribution, and transport employers reported that hiring was somewhat difficult or very difficult in 2018 (with 33 percent reporting that hiring was very difficult).[18]

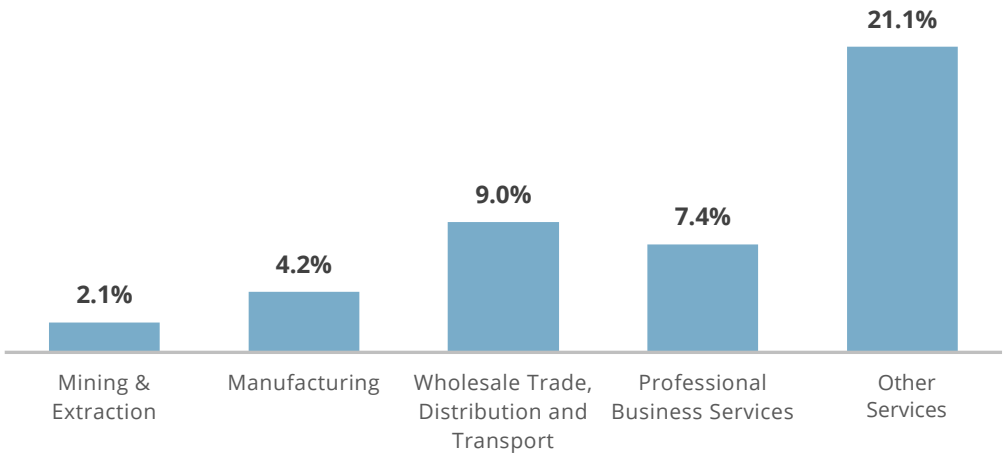
[18] Some industries are omitted from this discussion due to their small sample size in the data contributing to Figure 16. Conclusions have been made only about industries with sufficient sample size.

Figure 16.
Natural Gas Fuels – Hiring Difficulty by Industry



Employers in the natural gas fuels industry expect nearly 4 percent growth in 2019. This is led by the wholesale trade, distribution, and transport sector, which expects 9 percent growth, and the professional business services sector, which expects over 7 percent growth.

Figure 17.
Natural Gas Fuels – Expected Employment Growth by Industry



Natural gas fuels had a relatively low number of female employees in 2018, representing only 25 percent of the workforce. Similarly, black or African American, Hispanic or Latino, and Asian workers also were below national workforce averages. However, at 23 percent, the overall racial diversity of the natural gas fuels workforce was equivalent to the national average of 22 percent.

Table 12.

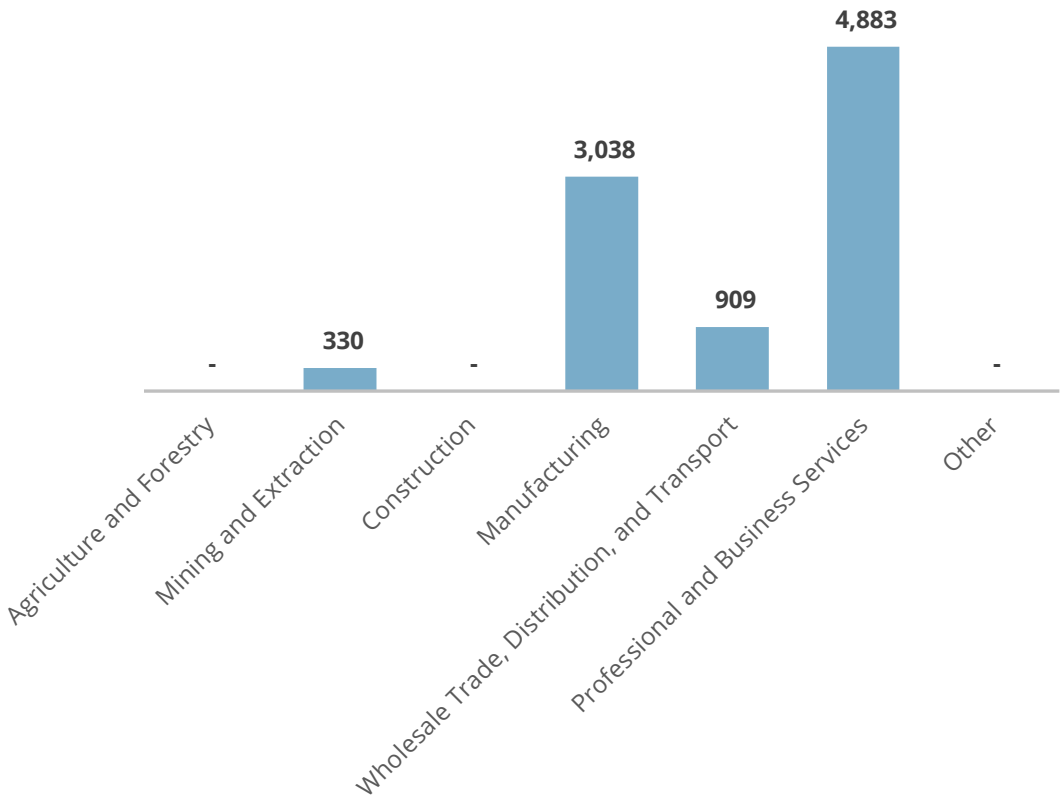
Natural Gas Fuels – Demographics, Q4 2018

	Natural Gas		National Workforce Averages
Male	202,749	75%	53%
Female	67,877	25%	47%
Hispanic or Latino	31,383	12%	17%
Not Hispanic or Latino	239,244	88%	83%
American Indian or Alaska Native	4,744	2%	1%
Asian	11,063	4%	6%
Black or African American	12,516	5%	12%
Native Hawaiian or other Pacific Islander	1,307	0%	>1%
White	207,697	77%	78%
Two or more races	33,299	12%	2%
Veterans	25,317	9%	6%
55 and over	63,388	23%	23%
Union	8,155	3%	11%

NUCLEAR FUELS

Nuclear fuels employed a total of 9,159 workers in the U.S. in 2018. Over the course of 2018, nuclear jobs grew by nearly 200 new positions, or over 2 percent. Professional business services supported over 53 percent of the nuclear fuels industry, while manufacturing made up over 33 percent of nuclear fuels employment in 2018.

Figure 18.
Nuclear Fuels – Employment by Industry



In 2018, 50 percent of manufacturing employers in nuclear fuels reported that hiring was very difficult. In contrast, 50 percent of professional services employers reported that their hiring in 2018 was only somewhat difficult.[19]

[19] Some industries are omitted from this discussion due to their small sample size in the data contributing to Figure 18. Conclusions have been made only about industries with sufficient sample size.

Nuclear fuels employers are expecting over 7 percent job growth in 2019. Most of that growth is expected in manufacturing.

The nuclear fuels sector had a relatively high proportion of female employees in 2018, representing almost one-third of the workforce. Although below national averages in several areas, the nuclear fuels sector is more diverse than the national workforce. The number of Asian workers and those reporting two or more races in the nuclear fuels industry is notably above national workforce averages. Veterans make up 9 percent of the workforce, 50 percent higher than the national average.

Table 13.

Nuclear Fuels – Demographics, Q4 2018

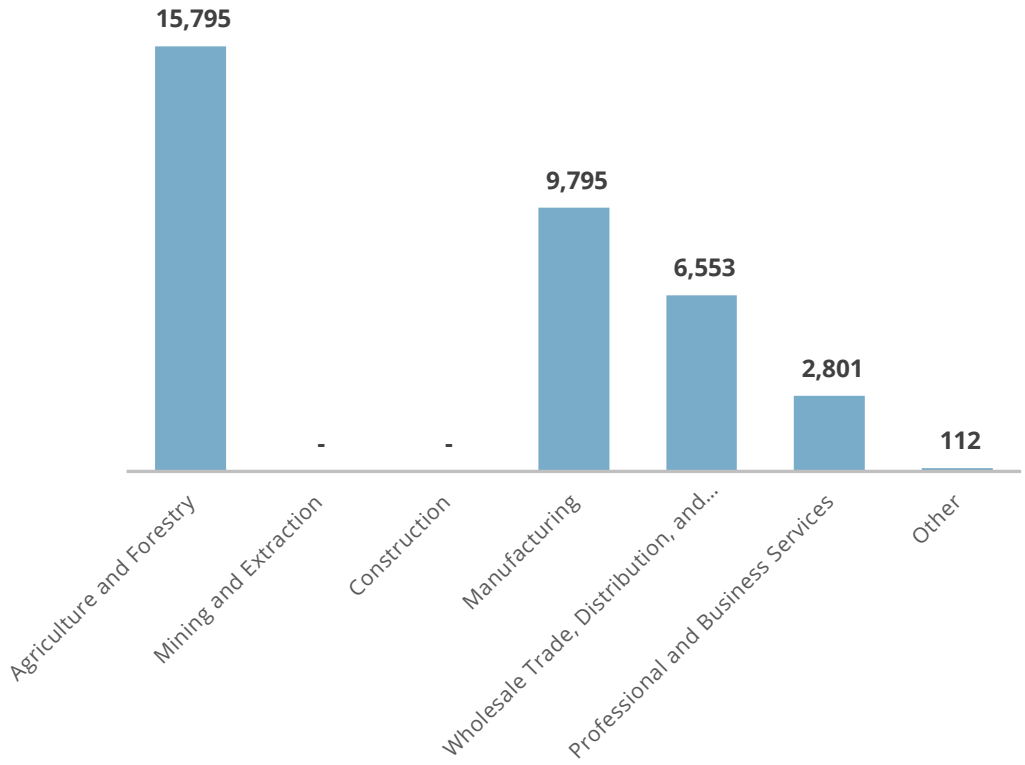
	Nuclear Fuels		National Workforce Averages
Male	6,243	68%	53%
Female	2,916	32%	47%
Hispanic or Latino	1,330	15%	17%
Not Hispanic or Latino	7,829	85%	83%
American Indian or Alaska Native	102	1%	1%
Asian	838	9%	6%
Black or African American	606	7%	12%
Native Hawaiian or other Pacific Islander	92	1%	>1%
White	6,048	66%	78%
Two or more races	1,473	16%	2%
Veterans	849	9%	6%
55 and over	1,517	17%	23%
Union	584	6%	11%

CORN ETHANOL FUELS

Corn ethanol fuels employment represented about 3 percent of the U.S. Fuels workforce in 2018, accounting for 35,055 jobs, and added about 500 jobs in 2018. The sector is primarily composed of agriculture; manufacturing; and wholesale trade, distribution, and transport. Together these three industries accounted for more than 91 percent of workers, followed by professional and business services at 8 percent.

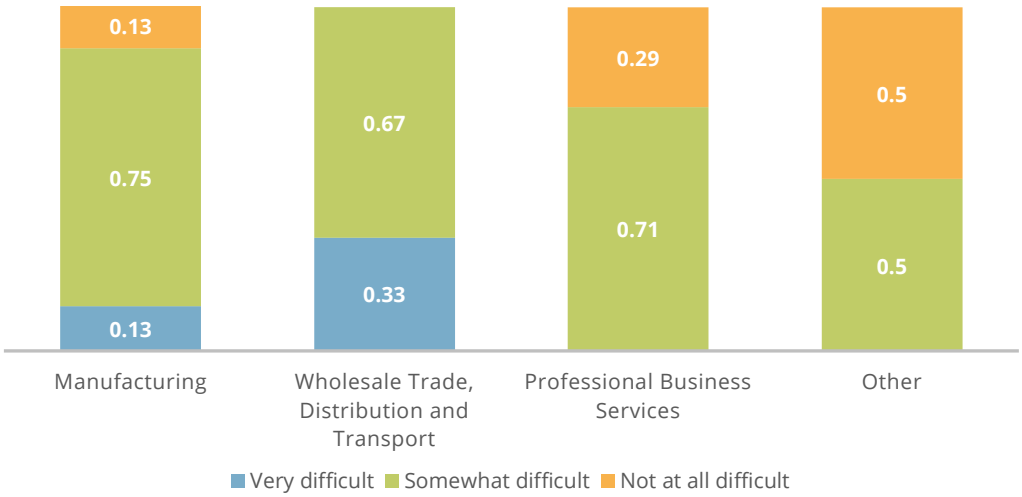
Figure 19.

Corn Ethanol Fuels – Employment by Industry



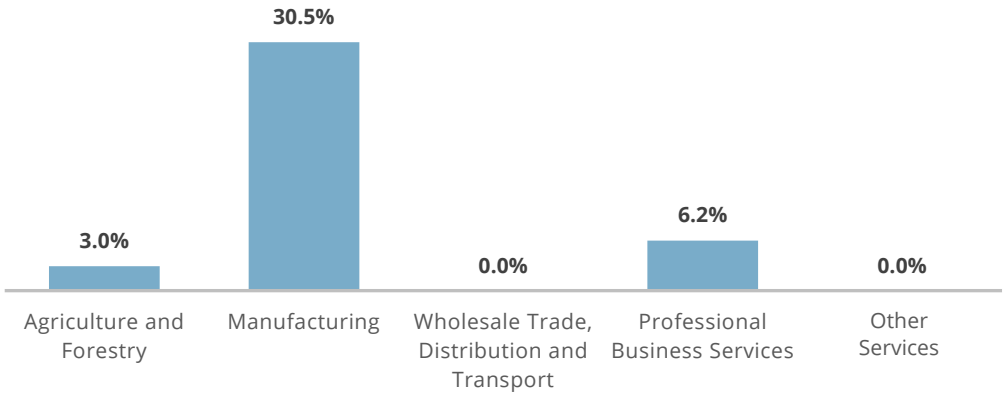
In 2018, 88 percent of manufacturing employers in corn ethanol, its second largest sector, reported that hiring was somewhat difficult or very difficult (although only 13 percent reported that hiring was very difficult). In addition, 71 percent of professional business services employers reported that hiring new workers was somewhat difficult in 2018.

Figure 20.
Corn Ethanol Fuels – Hiring Difficulty by Industry



Employers in the corn ethanol fuels industry expect more than 10 percent growth in 2019. Employers in the manufacturing sector expect over 30 percent growth, and the professional business services sector expects over 6 percent growth.[20]

Figure 21.
Corn Ethanol Fuels – Expected Employment Growth by Industry



About three in ten workers in corn ethanol fuels were women, and less than one in ten were Hispanic or Latino. This technology also has a small proportion of Asian and Black or African American workers. However, it is disproportionately older, with 27 percent of employees over age 55. A very high percentage (21 percent) are veterans.

[20] Some industries are omitted from this discussion due to their small sample size in the data contributing to Figure 21. Conclusions have been made only about industries with sufficient sample size.

Table 14.

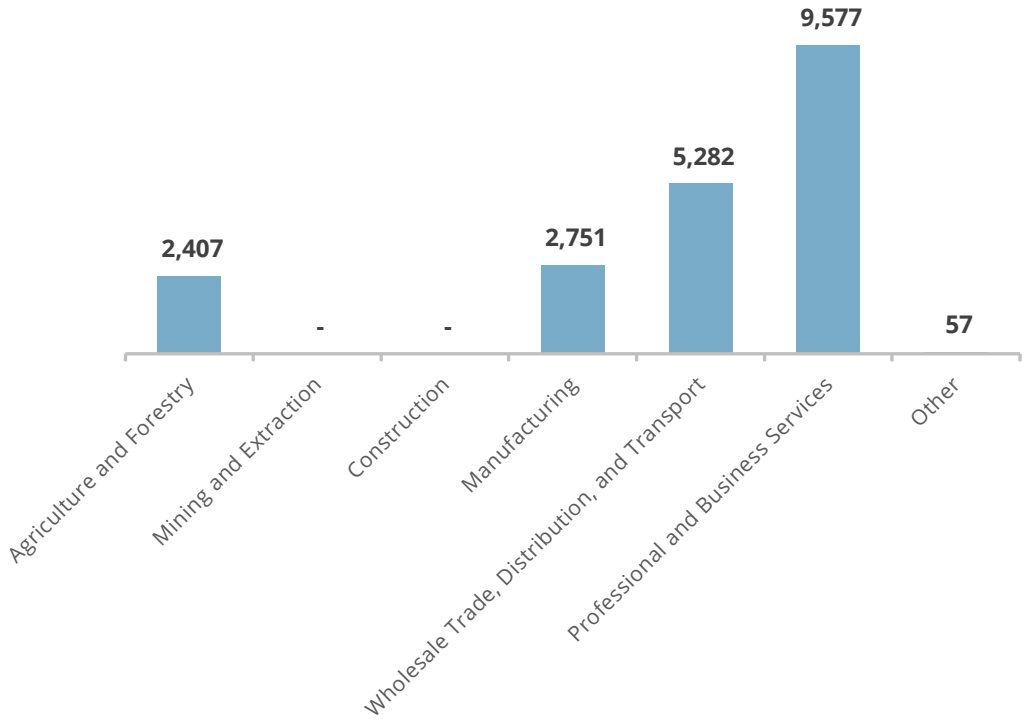
Corn Ethanol Fuels — Demographics, Q4 2018

	Corn Ethanol		National Workforce Averages
Male	24,552	70%	53%
Female	10,503	30%	47%
Hispanic or Latino	3,242	9%	17%
Not Hispanic or Latino	31,814	91%	83%
American Indian or Alaska Native	276	1%	1%
Asian	2,091	6%	6%
Black or African American	1,811	5%	12%
Native Hawaiian or other Pacific Islander	257	1%	>1%
White	28,557	81%	78%
Two or more races	2,063	6%	2%
Veterans	7,345	21%	6%
55 and over	9,417	27%	23%
Union	2,831	8%	11%

OTHER ETHANOL AND NON-WOODY BIOMASS FUELS, INCLUDING BIODIESEL

Other ethanol and non-woody biomass, including biodiesel[21], employed almost 2 percent of the Fuels workforce in 2018, providing 20,074 jobs. Because non-woody biomass represents a small portion of U.S. fuel supply, most of this employment was concentrated in professional and business services–likely research and development–and wholesale trade.

Figure 22.
Other Ethanol and Non-Woody Biomass Fuels (Including Biodiesel) — Employment by Industry



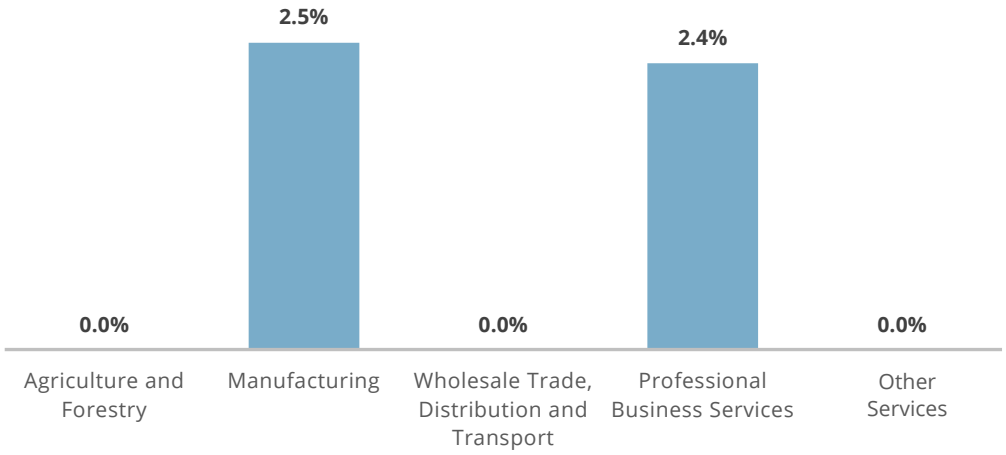
In 2018, all employers in wholesale trade, distribution, and transport reported that all hiring was very difficult.[22]

[21] Other Ethanol/Non-Woody Biomass Fuel, including Biodiesel is fuel made from materials other than cornstarch, such as straw, manure, vegetable oil, and animal fats.
[22] Some industries are omitted from this discussion due to their small sample size in the data contributing to Figure 22. Conclusions have been made only about industries with sufficient sample size.

Other ethanol and non-woody biomass fuels employers are expecting 1.5 percent job growth in 2019, with that hiring concentrated in manufacturing and professional services.

Figure 23.

Other Ethanol and Non-Woody Biomass Fuels (Including Biodiesel) – Expected Employment Growth by Industry



Almost a third of the workers supporting these fuels were women and 13 percent were Hispanic or Latino. However, other ethanol and non-woody biomass employers were more diverse, in total, than the overall workforce, exceeding national averages for employment of American Indians, Asians, and those reporting two or more races.

Table 15.

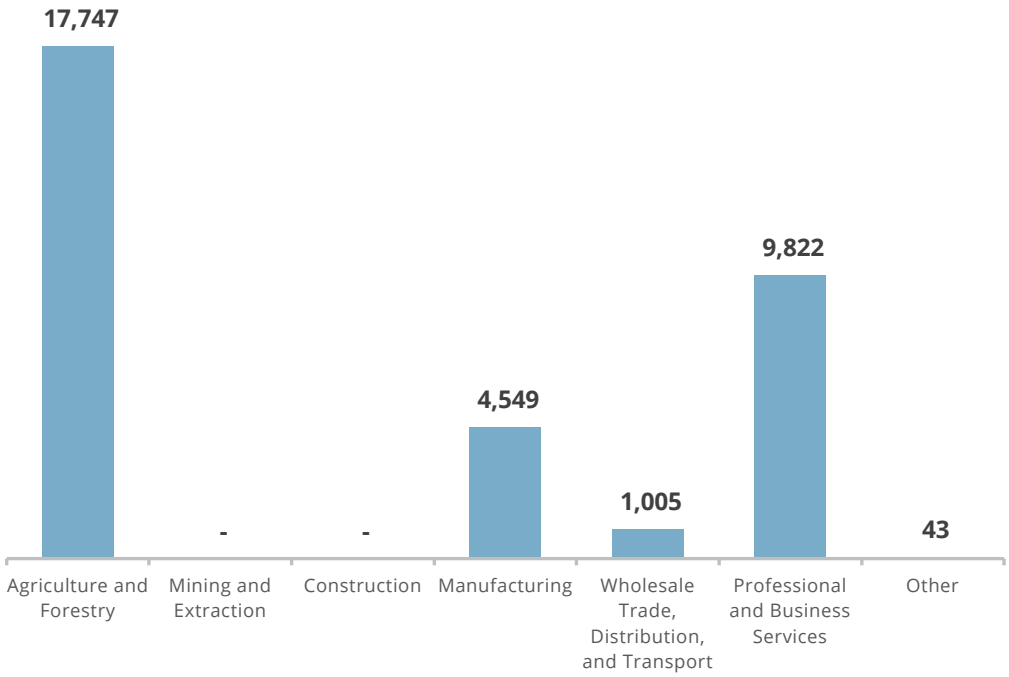
Other Ethanol and Non-Woody Biomass Fuels (Including Biodiesel) — Demographics, Q4 2018

	Fuels		National Workforce Averages
Male	13,603	68%	53%
Female	6,471	32%	47%
Hispanic or Latino	2,682	13%	17%
Not Hispanic or Latino	17,392	87%	83%
American Indian or Alaska Native	338	2%	1%
Asian	1,692	8%	6%
Black or African American	1,582	8%	12%
Native Hawaiian or other Pacific Islander	310	2%	>1%
White	14,989	75%	78%
Two or more races	1,163	6%	2%
Veterans	1,865	9%	6%
55 and over	2,897	14%	23%
Union	878	4%	11%

WOODY BIOMASS FUEL FOR ENERGY AND CELLULOSIC BIOFUELS

Woody biomass fuel for energy and cellulosic biofuels[23] supported 33,166 jobs across the United States in 2018, just under 3 percent of the Fuels workforce, and added over 1,700 jobs in 2018. Over half of the employment in woody biomass fuels was found in agriculture, followed by professional services; these two industries accounted for 83 percent of employment.

Figure 24.
Woody Biomass Fuel for Energy and Cellulosic Biofuel – Employment by Industry



For 2018, 71 percent of professional services employers reported it was somewhat difficult to hire.[24] No data was available for agricultural or logging firms.

[23] While the survey question asked of respondents covered both woody biomass fuel for energy and cellulosic biofuels, all employment data reported is in woody biomass fuel for energy. Woody Biomass or Cellulosic Biofuel are fuels developed from the by-product of management, restoration, and hazardous fuel reduction treatments, as well as the product of natural disasters, including trees and woody plants (limbs, tops, needles, leaves, and other woody parts, grown in a forest, woodland, or rangeland environment).
[24] Some industries are omitted from this discussion due to their small sample size in the data contributing to Figure 24. Conclusions have been made only about industries with sufficient sample size.

Woody biomass fuels employers are expecting over 8 percent job growth in 2019.

The workforce for woody biomass fuels is less diverse than the nation as a whole with 6 percent of the workforce reported to be Hispanic or Latino, 5 percent Asian, and 4 percent Black or African American. Similar to corn ethanol employers, a high percentage of employees–17 percent–are veterans and the workforce is older than the national average.

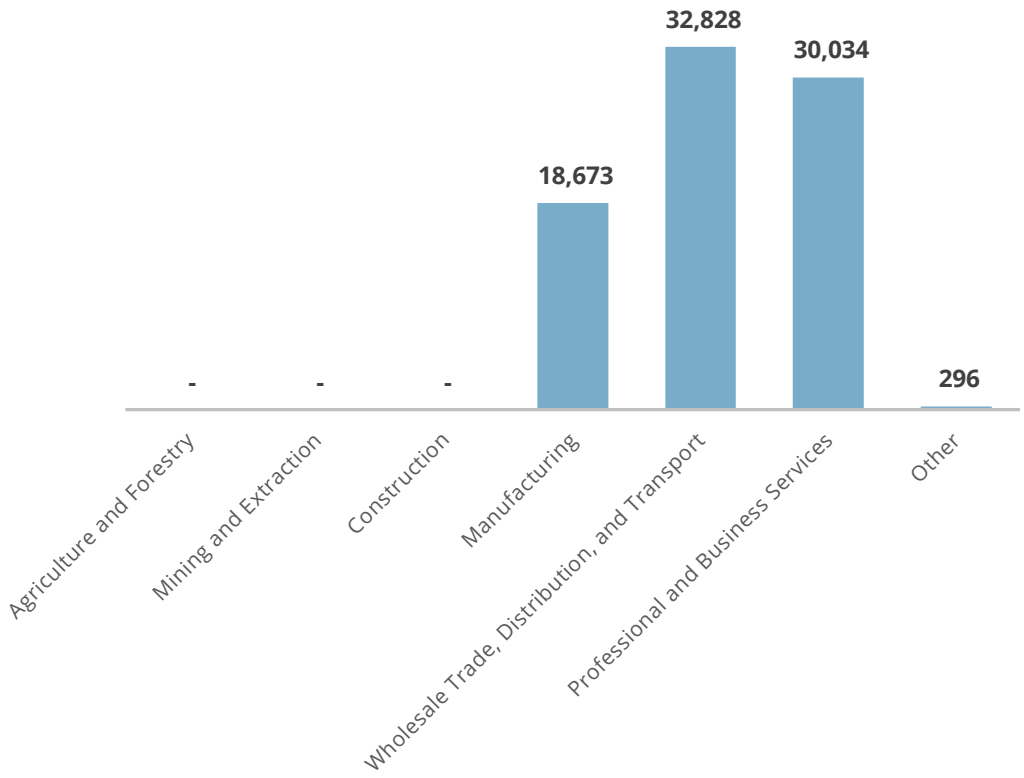
Table 16.
Woody Biomass Fuel for Energy and Cellulosic Biofuel — Demographics, Q4 2018

	Woody Biomass Fuels		National Workforce Averages
Male	23,942	72%	53%
Female	9,224	28%	47%
Hispanic or Latino	1,921	6%	17%
Not Hispanic or Latino	31,245	94%	83%
American Indian or Alaska Native	289	1%	1%
Asian	1,736	5%	6%
Black or African American	1,410	4%	12%
Native Hawaiian or other Pacific Islander	157	0%	>1%
White	27,881	84%	78%
Two or more races	1,694	5%	2%
Veterans	5,627	17%	6%
55 and over	8,048	24%	23%
Union	2,863	9%	11%

OTHER FUELS

Other fuels[26] comprised 81,831 jobs across the United States in 2018, just over 7 percent of the Fuels workforce. Over 40 percent of that employment was found in wholesale trade, distribution, and transport, followed by professional services with almost 37 percent of the workforce.

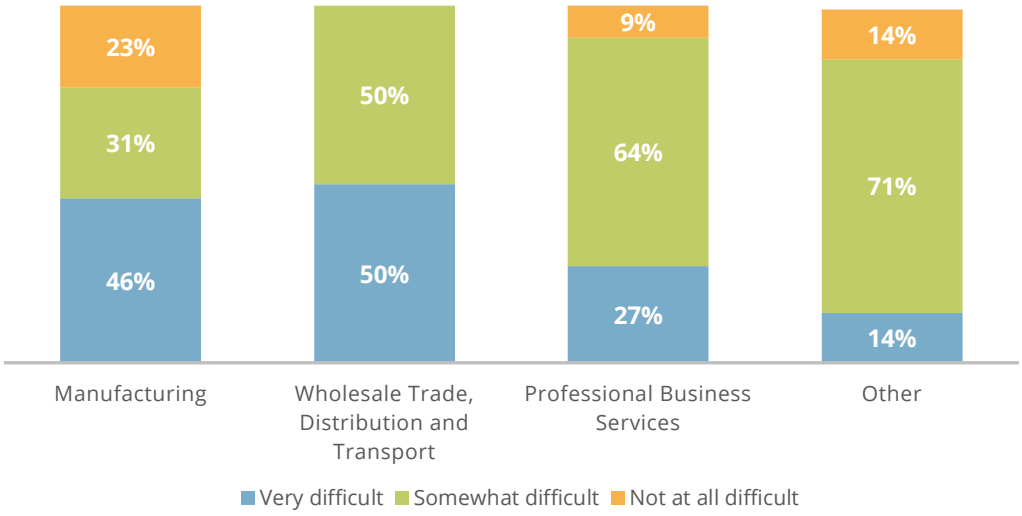
Figure 25.
Other Fuels – Employment by Industry



Employers reported significant difficulty in hiring in other fuels in 2018, with 91 percent of professional business services employers reporting that hiring has been somewhat difficult or very difficult, and 77 percent of manufacturers reporting similarly.[27]

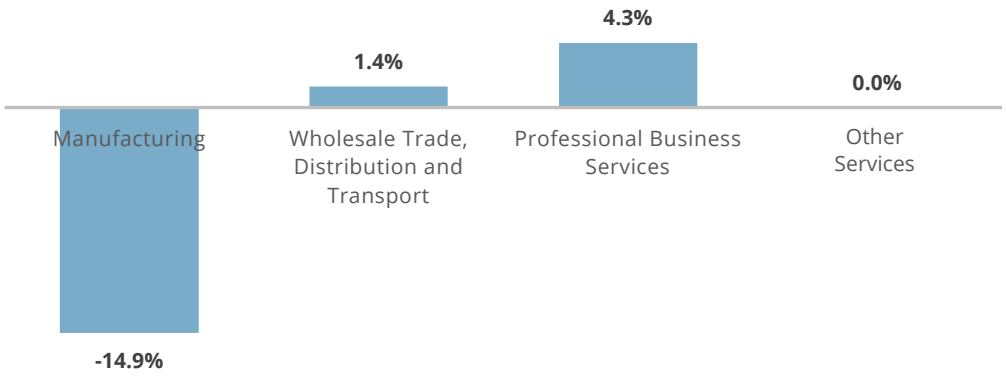
[26] Includes other fossil fuels, other biofuels, and all other fuels. All other fuels includes employers that are not able to assign their workers to a single detailed technology application.
[27] Some industries are omitted from this discussion due to their small sample size in the data contributing to Figure 26. Conclusions have been made only about industries with sufficient sample size.

Figure 26.
Other Fuels – Hiring Difficulty by Industry



Employers in other fuels expect -1 percent growth in 2019, making this the only component of the Fuels sector that is expected to shrink. This is influenced by the enormous lack of confidence found in the manufacturing industry. However, the professional business services sector expects over 4 percent growth.

Figure 27.
Other Fuels – Expected Employment Growth by Industry



The workforce for other fuels is less diverse, with 9 percent of the workforce reported to be Hispanic or Latino, 5 percent Asian, and 4 percent Black or African American. It is also older and with a higher percentage of veterans than the workforce as a whole.

Table 17.

Other Fuels — Demographics, Q4 2018

	Other Fuels		National Workforce Averages
Male	60,403	74%	53%
Female	21,428	26%	47%
Hispanic or Latino	7,094	9%	17%
Not Hispanic or Latino	74,737	91%	83%
American Indian or Alaska Native	659	1%	1%
Asian	4,220	5%	6%
Black or African American	2,884	4%	12%
Native Hawaiian or other Pacific Islander	467	1%	>1%
White	70,336	86%	78%
Two or more races	3,265	4%	2%
Veterans	13,865	17%	6%
55 and over	20,122	25%	23%
Union	7,493	9%	11%

Electric Power Generation

Electric Power Generation

Electric Power Generation (EPG) covers all utility and non-utility employment across electric generating technologies, including fossil fuels, nuclear, and renewable energy technologies. Also included in the employment totals are any firms engaged in facility construction, turbine and other generation equipment manufacturing, and wholesale parts distribution for all electric generation technologies.

TRENDS

- **2018 Job Loss.** In 2018, the Electric Power Generation sector dropped 8,258 jobs, declining by almost 1 percent to a total of 875,585 jobs.
- **Technology Shifts.** Advanced natural gas added the most new jobs, 4,500, while solar contracted, losing 8,000 jobs. Other technologies that grew included wind, combined heat and power, and geothermal. Nuclear and coal declined.
- **2019 Expectations.** Electric Power Generation employers anticipated 7.1 percent job growth in 2019, with most of the increase expected in renewable construction.

-0.9%

Electric Power Generation job growth in 2018

7.1%

EPG employers predict 7.1% job growth in 2019

SNAPSHOT OF EMPLOYMENT

Figure 28.

Electric Power Generation Sector – Employment by Industry, 2017-2018

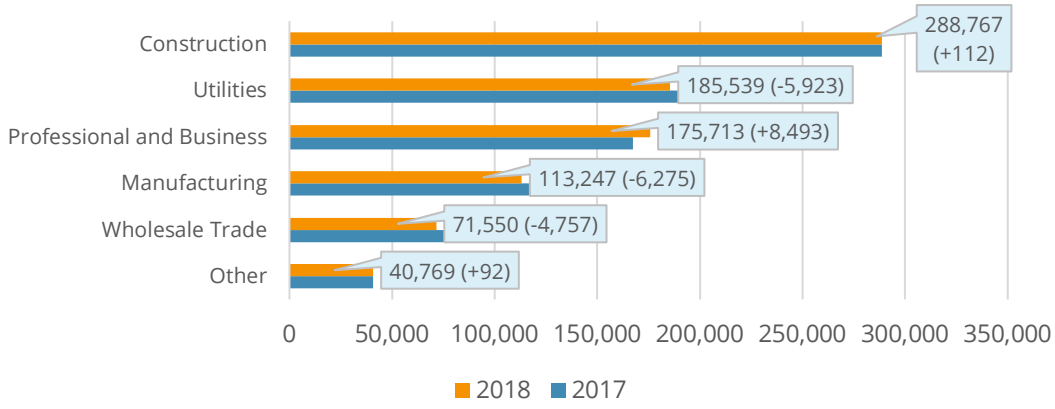
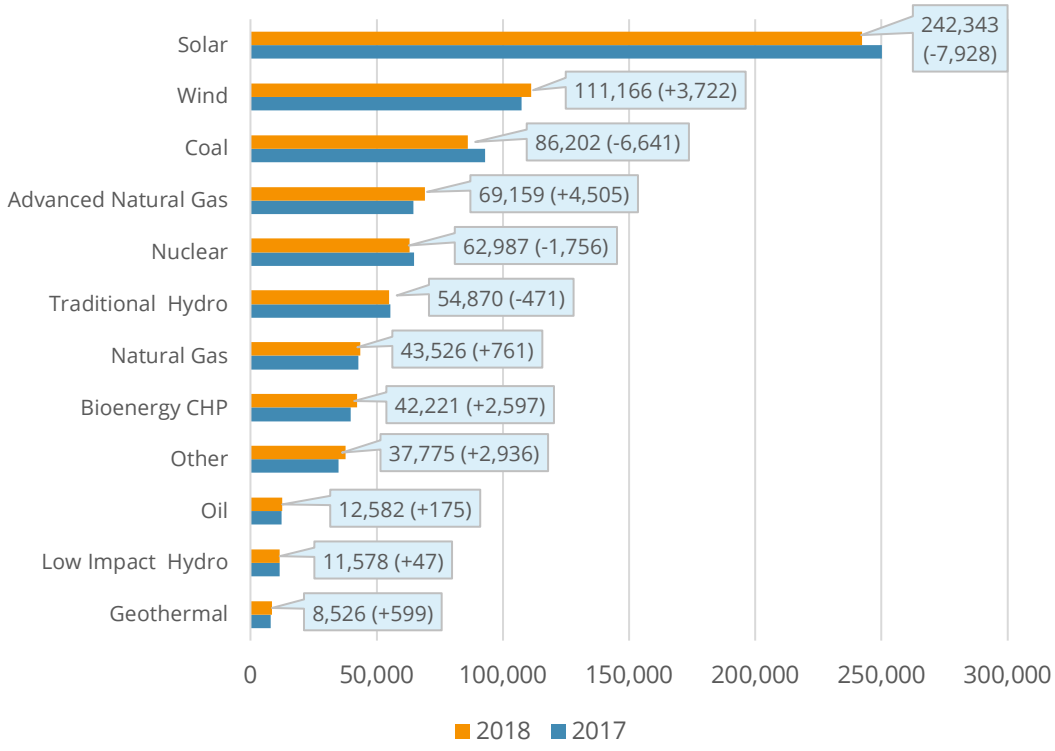


Figure 29.

Electric Power Generation Sector – Employment by Detailed Technology Application, 2017-2018[28]



[28] Text, charts, and tables in the 2019 report include revised 2017 employment totals for advanced and traditional natural gas generation based on additional available data from the Energy Information Administration.

KEY TAKEAWAYS

- While solar EPG has the most jobs overall, the utility sector of the Electric Power Generation sector is dominated by natural gas, coal, and nuclear power, which produce over 80 percent of the nation's electricity.
- Natural gas and advanced natural gas, combined–with over 112,000 jobs–have exceeded coal, both in employment and gigawatts produced.
- Solar and wind are number one and two in the construction industry with 177,000 and 37,000 jobs respectively. Natural gas was third with 10,000.

Table 18.
Electric Power Generation Sector — Employment by Detailed Technology Application and Industry, Q2 2018[29]

	Total	Utilities	Construction	Manufacturing	Wholesale Trade	Professional Services	Other Services
Majority-Time Solar Employment	**242,343**	3,295	122,026	33,726	23,938	36,293	23,064
Wind	**111,166**	6,231	36,706	26,490	11,783	27,058	2,898
Coal	**86,202**	45,795	8,639	1,079	5,935	23,749	1,005
Adv Nat Gas	**69,159**	41,780	9,378	2,771	4,824	9,505	900
Nuclear	**62,987**	46,809	2,195	1,875	2,531	9,491	86
Trad Hydro	**54,870**	17,480	8,850	14,415	5,821	8,070	234
Natural Gas	**43,526**	17,242	10,337	3,582	3,072	8,165	1,128
Other	**37,775**	1,610	18,564	3,718	2,177	11,008	698
CHP	**29,245**	1,673	4,241	2,058	3,805	17,274	195
Concentrated	**25,411**	-	20,361	1,224	1,433	2,073	320
Bio	**12,976**	2,029	5,644	1,107	558	3,199	439
Oil	**12,582**	479	-	5,851	1,922	4,180	149
Low Hydro	**11,578**	-	1,876	3,463	2,023	4,144	72
Geo	**8,526**	1,116	5,016	298	339	1,727	29
TOTAL	**1,117,927**	**188,834**	**410,791**	**146,972**	**95,487**	**212,005**	**63,834**

[29] Majority-time solar employment includes all employees who spend 50 percent or more of their time on solar-related work. An additional 92,649 employees spent less than 50 percent of their time on solar. The category of industry employment differs slightly from several categories used by The Solar Foundation to classify employment (installation and development, operations and maintenance, sales and distribution, manufacturing, and other).

HIRING DIFFICULTY

- **85 percent of construction employers in electric power generation** reported that it was somewhat difficult or very difficult to hire new employees, with 30 percent reporting that it was very difficult.
- **76 percent of manufacturing employers** reported that it was either somewhat difficult or very difficult to hire new employees.
- **In contrast, only 63 percent of utility employers in electric power generation** reported that it was either somewhat difficult or very difficult to hire new employees, and only 19 percent reported that it was very difficult.

HIGHEST-DEMAND OCCUPATIONS IN ELECTRIC POWER GENERATION

With significant growth in 2018 and predicted growth of over 6,000 new jobs in 2019, electric power generation employers have identified below the occupations that each industry sector is having the greatest difficulty in filling.

Table 19.
Electric Power Generation Sector — Reported Occupations with Hiring Difficulty by Industry, Q4 2018

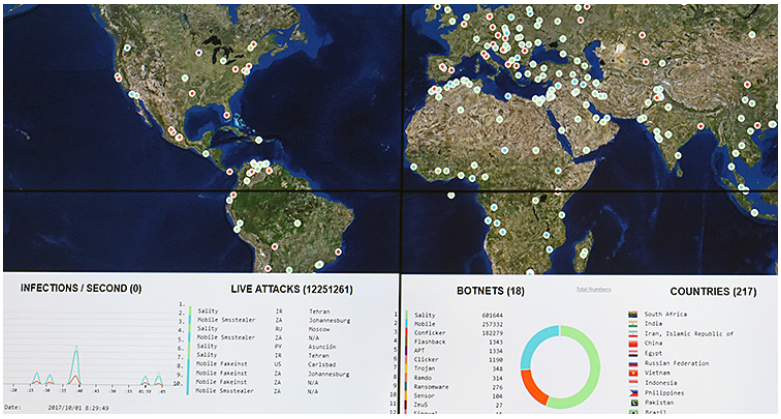
Utilities	Construction	Manufacturing	Wholesale Trade, Distribution, and Transport	Professional and Business Services	Other
Technicians or mechanical support (49%)	Installation workers (34%)	Engineers/ scientists (44%)	Sales, marketing, or customer service represent-atives (45%)	Management (directors, supervisors, vice presidents) (36%)	Technicians or mechanical support (39%)
Electrician/ construction laborers (31%)	Sales, marketing, or customer service represent-atives (31%)	Sales, marketing, or customer service represent-atives (23%)	Management (directors, supervisors, vice presidents) (19%)	Engineers/ scientists (33%)	Management (directors, supervisors, vice presidents) (23%)
Engineers/ scientists (23%)	Electrician/ construction laborers (29%)	Management (directors, supervisors, vice presidents) (16%)	Technicians or mechanical support (19%)	Sales, marketing, or customer service represent-atives (16%)	Engineers/ scientists (23%)

Spotlight: "For a utility, a cyber-attack doesn't just hurt us; it can turn out the lights for everybody."

Jim Somborovich, Senior Director of Cyber Security, Xcel Energy

"The reliability of the electricity system underpins virtually every sector of the modern U.S. economy," said the most recent Quadrennial Energy Review from the U.S. Department of Energy.

Xcel Energy serves parts of eight states, providing electricity to 3.6 million customers and natural gas service to 2 million customers. In response to questions on the changing utility workforce, Jim Somborovich, Senior Director of Cyber Security at Xcel, spoke of the rapid growth of cyber employment. "Two years ago, it was me and 25 others. At the end of this year, we will have tripled our cyber workforce."



"Cyber skills are in high demand throughout the economy and we've had to grow in a negative unemployment environment for cyber. Some positions are harder than others to fill, so we have adopted several different strategies.

"We have gone after really junior people with the intent to train them ourselves. For these hires we've developed a 4-to-6-week training program and are preparing a skills assessment tool to help with their eligibility for promotions.

"We've also concentrated on recruiting exiting service members. Xcel has an excellent record with 10% of all new hires coming from the military. In cyber that number is 19%.

"One of our most important challenges is protecting the grid. For those positions we need people with both operational technology (OT) experience as well as IT experience. We have moved people internally with significant OT experience into cyber and used them to train our IT cyber specialists and vice versa.

"The demand for cyber is mindboggling. Remember, that for a utility a cyber attack doesn't just hurt us; it can turn out the lights for everybody."

ELECTRIC POWER GENERATION MIX

The electric power generation mix in the United States continues to evolve, accelerated by the transition from coal-fired power plants to natural gas and the increase in lower carbon sources of power generation.[30] This transition has involved a significant build-out of new power generation facilities in the United States.

Figure 31 shows net generation of electricity from utility-scale (i.e., one megawatt or greater) facilities in all sectors of the U.S. economy. Electricity generation from coal sources declined by 39 percent between 2006 and 2017, while electricity generation from natural gas increased by 56 percent and from solar by over 10,000 percent–from 508,000 MWh to nearly 53,000,000 MWh. As noted, this solar growth only includes utility-scale facilities, as reliable data on smaller distributed facilities, such as rooftop systems, was not available until recently. In 2017, distributed solar PV generation increased 23 percent nationwide, while estimated total solar PV generation–both utility-scale and distributed generation–increased nationwide by 27 percent.[31]

The shifts in electric generation sources over the last several years are mirrored in the sector's changing employment profile, as the share of natural gas, solar, wind, and CHP have increased. It is important to note, however, that the majority of U.S. electrical generation continues to come from fossil fuels (coal, oil, and natural gas). In addition, under latest EIA modeling in the Annual Energy Outlook 2018, in 2050 fossil fuels will still account for 78.5 percent of total U.S. energy production for all uses in the transportation, industrial, and building sectors.[32]

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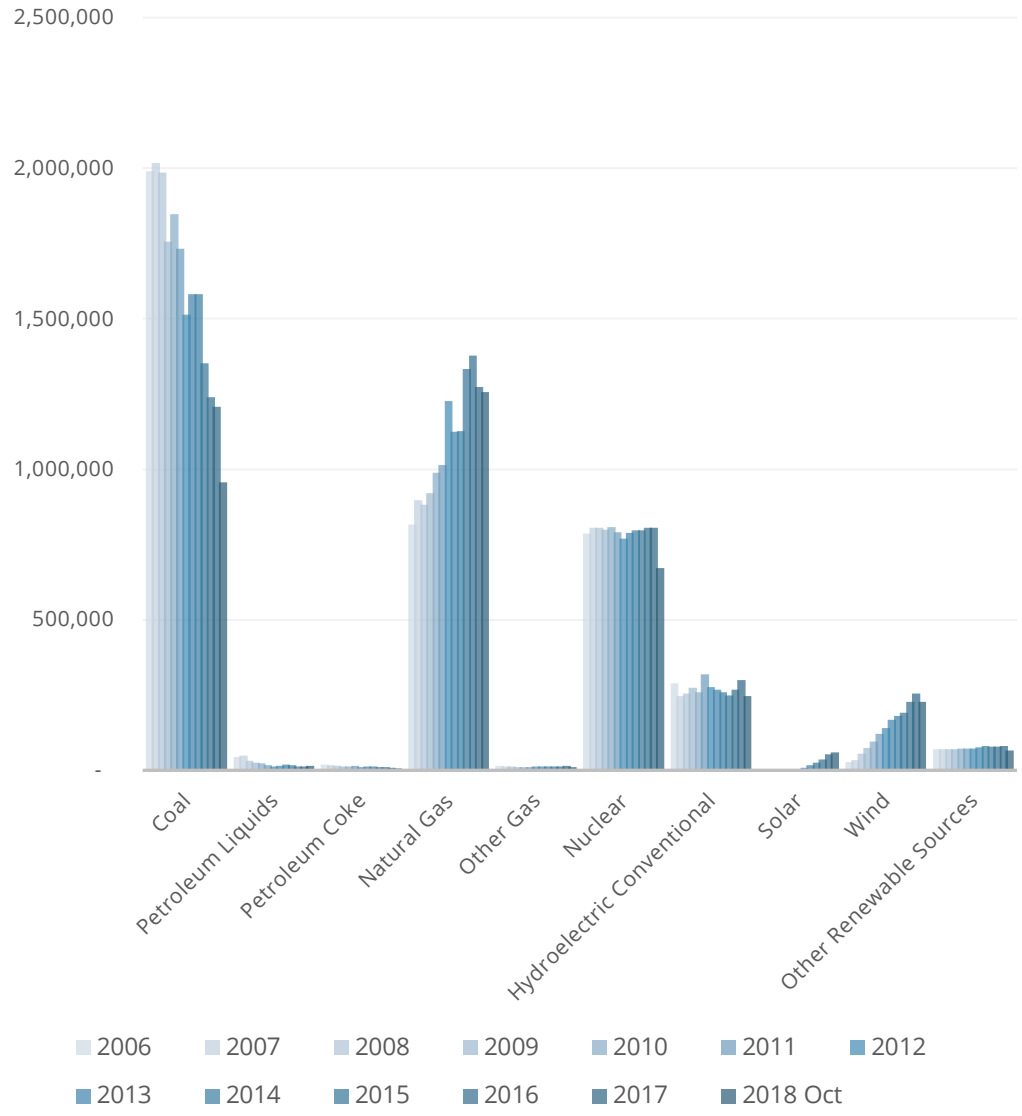
[30] Coal is a combustible black or dark brown rock consisting mainly of carbonized plant matter, found mainly in underground deposits and widely used as fuel. Natural gas is a flammable gas, consisting largely of methane and other hydrocarbons, occurring naturally underground (often in association with petroleum) and used as fuel.

[31] EIA, *Electric Power Monthly,* March 23, 2018, Table 1.1.A., https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_1_01_a. Data on distributed solar generation from annual totals for 2016 and 2017 for Small Scale Generation: Estimated Solar Photovoltaic and data on total solar PV from annual totals for 2016 and 2017 for Generation from Utility and Small Scale Facilities: Estimated Total Solar Photovoltaic.

[32] EIA, *Annual Energy Outlook 2018,* February 2018, Table A1, https://www.eia.gov/outlooks/aeo/data/browser/#/?id=1-AEO2018&region=0-0&cases=ref2018&start=2016&end=2050&f=A&linechart=ref2018-d121317a.6-1-AEO2018~ref2018-d121317a.3-1-AEO2018~ref2018-d121317a.4-1-AEO2018~ref2018-d121317a.5-1-AEO2018&ctype=linechart&sourcekey=0. Data in table for production in 2050 of crude oil and lease condensate, natural gas plant liquids, dry natural gas, and coal, combined and taken as a percentage of total production.

Figure 31.
Change in Net Generation of Electricity by Energy Source (Thousand MWh), 2006-2018



Electric Power Generation employment was 875,585 jobs in 2018, down nearly 1 percent from the previous year's 883,842 workers[33], but employers report a projected 6.5 percent growth in 2019. Most of these new jobs are reported in the construction industry and are comprised of employees installing and building generation capacity additions.

[33] This number has been revised to account for 2016 coal generation employment in NAICS 4238, Machinery, Equipment, and Supplies Merchant Wholesalers.

ELECTRIC POWER GENERATION WORKFORCE CHARACTERISTICS

The largest component (33 percent) of the Electric Power Generation workforce is construction, underscoring the importance of the construction industry to maintaining our electrical system. Construction is followed by sizable groups of utility workers (21 percent) and professional service employees (20 percent). Manufacturing is also a significant component, with almost 13 percent.

Figure 32.

Electric Power Generation Sector — Employment by Industry, Q2 2018

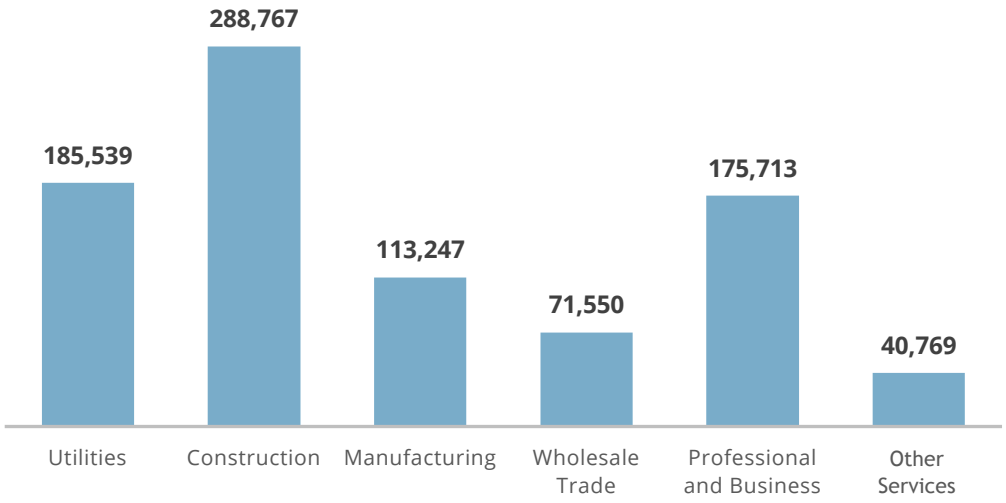
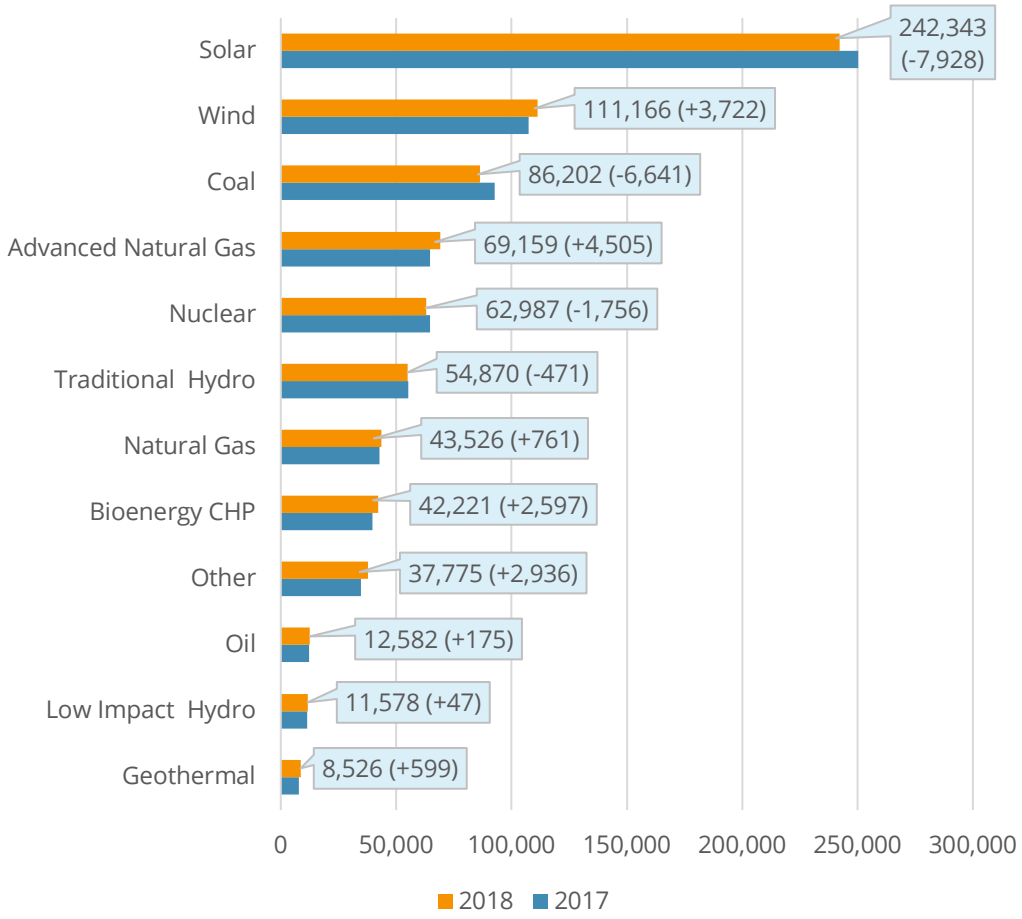


Figure 33.
Electric Power Generation Sector —
Employment by Detailed Technology Application, 2017-2018[34]



Construction, the largest segment of Electric Power Generation employment, anticipates more than 8.5 percent growth in 2019, while the next largest segments, utilities and professional services, predict 3.9 percent and almost 7.5 percent increases, respectively.

[34] Text, charts, and tables in the 2019 report include revised 2017 employment totals for advanced and traditional natural gas generation based on additional available data from the Energy Information Administration.

Figure 36.
Electric Power Generation Sector —
Expected Employment Growth by Industry (Q4 2018 – Q4 2019)

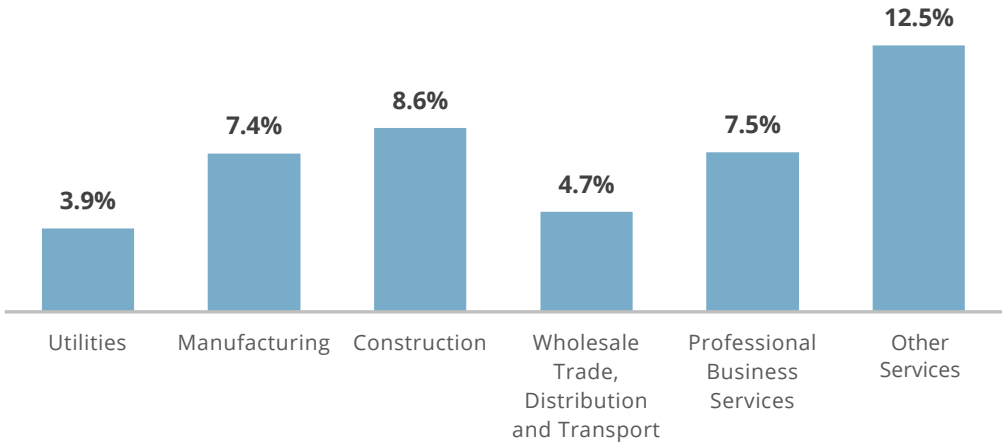
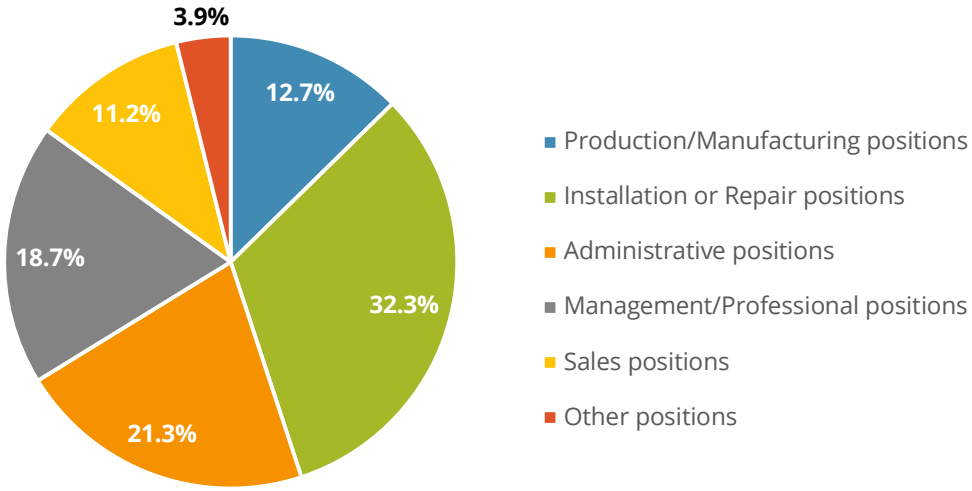


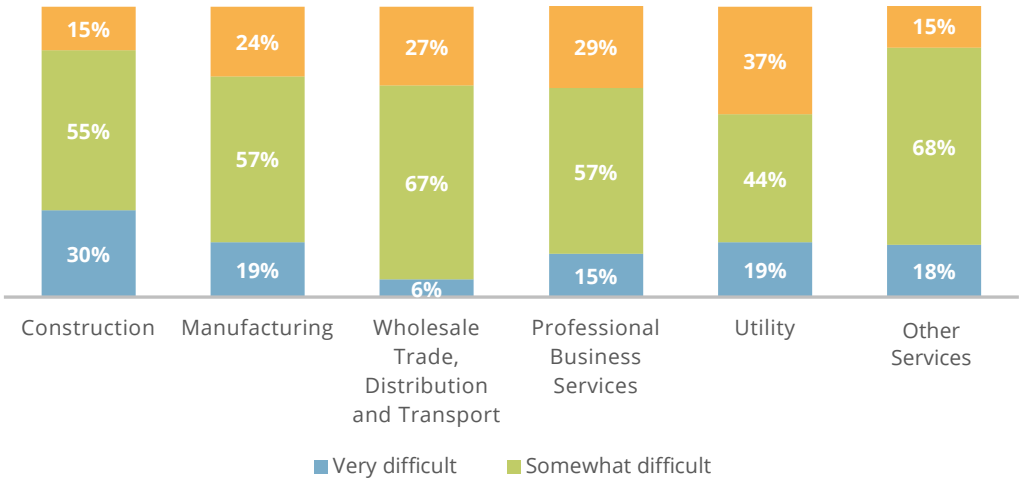
Figure 35.
Electric Power Generation Sector — Occupational Distribution, Q4 2018



Almost one-third (32 percent) of employment in Electric Power Generation in 2018 was within installation or repair positions. Management/professional positions (21 percent) and administrative positions (19 percent) each comprised around one-fifth of Electric Power Generation employment.

In 2018, construction firms reported the greatest hiring difficulty among industry sectors in Electric Power Generation, with 85 percent of companies indicating it was either somewhat difficult (55 percent) or very difficult (30 percent) to find new employees. Utilities and professional service employers reported comparable figures for these two categories of 63 percent and 72 percent, respectively. Utilities have consistently been more successful at hiring new employees.

Figure 37.
Electric Power Generation Sector — Hiring Difficulty by Industry, Q4 2018



Electric Power Generation employers mentioned lack of experience, training, or technical skills as the number one reason for reported hiring difficulty over the previous year across all industry sectors.

Table 20.
Electric Power Generation Sector — Reasons for Hiring Difficulty by Industry, Q4 2018

Utilities	Construction	Manufacturing	Wholesale Trade, Distribution, and Transport	Professional and Business Services	Other
Lack of experience, training, or technical skills (40%)	Lack of experience, training, or technical skills (50%)	Lack of experience, training, or technical skills (46%)	Lack of experience, training, or technical skills (44%)	Lack of experience, training, or technical skills (50%)	Lack of experience, training, or technical skills (67%)
Location (30%)	Difficulty finding industry-specific knowledge, skills, and interest (20%)	Competition/ small applicant pool (25%)	Difficulty finding industry-specific knowledge, skills, and interest (29%)	Difficulty finding industry-specific knowledge, skills, and interest (28%)	Location (20%)
Difficulty finding industry-specific knowledge, skills, and interest (21%)	Competition/ small applicant pool (18%)	Location (20%)	Location (21%)	Competition/ small applicant pool (20%)	Competition/ small applicant pool (17%)

Electric Power Generation employers reported that technicians or mechanical support, sales, installation workers, engineers, marketing, or customer service representatives, and management were among the most difficult positions to hire for over the course of 2018.

Table 21.
Electric Power Generation Sector —
Reported Occupations with Hiring Difficulty by Industry, Q4 2018

Utilities	Construction	Manufacturing	Wholesale Trade, Distribution, and Transport	Professional and Business Services	Other
Technicians or mechanical support (49%)	Installation workers (34%)	Engineers/ scientists (44%)	Sales, marketing, or customer service represent-atives (45%)	Management (directors, supervisors, vice presidents) (36%)	Technicians or mechanical support (39%)
Electrician/ construction laborers (31%)	Sales, marketing, or customer service represent-atives (31%)	Sales, marketing, or customer service represent-atives (23%)	Management (directors, supervisors, vice presidents) (19%)	Engineers/ scientists (33%)	Management (directors, supervisors, vice presidents) (23%)
Engineers/ scientists (23%)	Electrician/ construction laborers (29%)	Management (directors, supervisors, vice presidents) (16%)	Technicians or mechanical support (19%)	Sales, marketing, or customer service represent-atives (16%)	Engineers/ scientists (23%)

In 2018, the Electric Power Generation sector employed fewer women than the national workforce average. However, Electric Power Generation is racially more diverse than the workforce as a whole and exceeds the national average for Hispanic or Latino, and Asian employees. Electric Power Generation had only 14 percent of its employees over age 55 in 2018, far below the national average. Electric Power Generation exceeded the national average for veterans hiring at 9 percent.

Table 22.
Electric Power Generation Sector – Demographics, Q4 2018

	Electric Power Generation		National Workforce Averages[35]
Male	586,305	67%	53%
Female	289,279	33%	47%
Hispanic or Latino	163,610	19%	17%
Not Hispanic or Latino	711,974	81%	83%
American Indian or Alaska Native	10,685	1%	1%
Asian	88,046	10%	6%
Black or African American	75,240	9%	12%
Native Hawaiian or other Pacific Islander	10,660	1%	>1%
White	604,404	69%	78%
Two or more races[36]	86,550	10%	2%
Veterans	77,168	9%	6%
55 and over	122,865	14%	23%
Union	55,620	6%	11%

[35] All demographic information except union membership from 2017 data in "Labor Force Statistics from the Current Population Survey," Bureau of Labor Statistics, U.S. Department of Labor, https://www.bls.gov/cps/demographics.htm. Information on union membership is from "Table 3: Union affiliation of employed wage and salary workers by occupation and industry, 2016-17 annual averages," in U.S. Department of Labor, Bureau of Labor Statistics, "Union Members Summary," news release, January 19, 2018, https://www.bls.gov/news.release/union2.nr0.htm.

[36] While federal guidelines were followed in administering the demographic questions, respondents may have reported two or more races as including Hispanic or Latino ethnicity, inappropriately inflating the total and deflating other racial categories.

SOLAR ELECTRIC POWER GENERATION

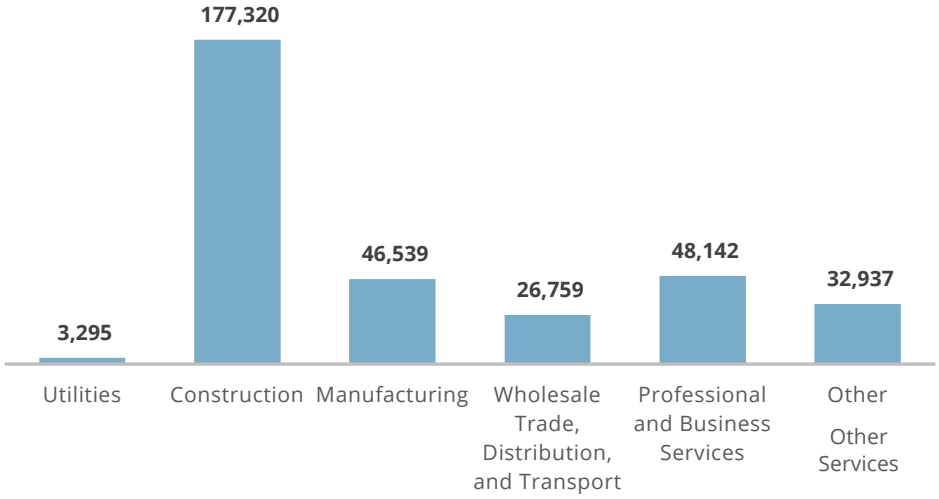
The solar EPG industry is an example of the inability of BLS labor market data to completely capture employment in emerging industries (such as solar) and those that cut across multiple sectors (such as Energy Efficiency). For 2018, the BLS reported that utilities employed just under 3,300 workers for solar-specific generation. However, this figure does not include many jobs in the construction or other value-chain industries for solar projects even when they are financed, owned, or directed by utilities. The data suggest that utilities are directly responsible for at least 25 percent of the solar jobs in the United States, but no other NAICS codes yet exist for solar electric generation. Existing labor market data therefore dramatically underestimate the additional workers engaged in solar-related work.

In 2018, there were 242,343 Americans who spent 50 percent or more of their time working to manufacture, install, distribute, or provide professional services to solar technologies across the nation. Another 92,649 employees spent less than half their time on solar work.[37] That represents a reduction of 3.2 percent or just under 8,000 jobs for workers who spent a majority of their time on solar. Another 7,000 jobs were lost by employees who spent a minority of their time on solar tasks.

The majority of solar employment in 2018 is found in construction and installation activities, totaling 177,320 jobs, followed by professional business services with over 48,000 workers and manufacturing with about 46,500.[38]

[37] The Solar Foundation, National Solar Jobs Census 2018, 9.
[38] This division of solar jobs by industry, including the data in Figure 38, includes both those employees who spend more than 50% of their time and less than 50% of their time on solar activities.

Figure 38.
Solar Electric Power Generation – Employment by Industry



Currently, a majority of U.S. photovoltaic (PV) solar electric power generation is from utility-scale facilities, as shown in Figure 40–roughly 56,179 thousand MWh compared to 25,847 thousand MWh of distributed solar generation in 2018.[39] In 2018, more than 56 percent of U.S. solar workers were spending the majority of their time working on residential-scale projects, as shown in Figure 39.

Figure 40.
Estimated Percentage of Solar Generation Installed

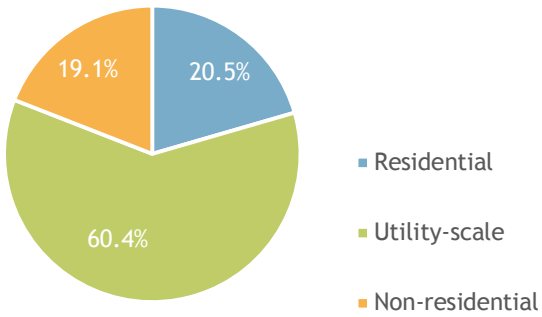
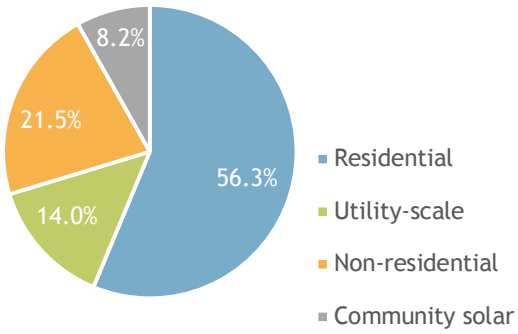


Figure 39.
Majority-Time Solar Employees by Type of Project – 2018

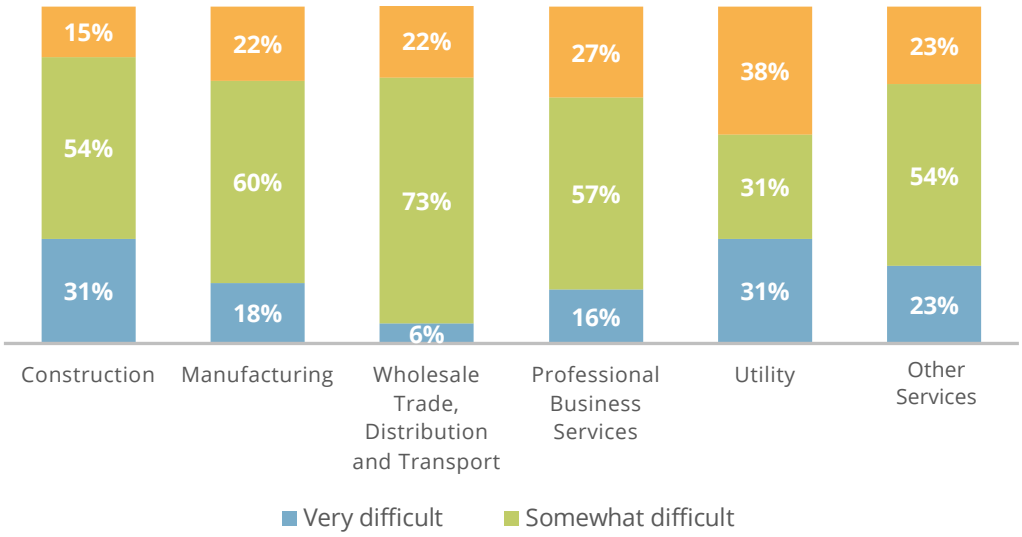


[39] EIA, *Electric Power Monthly,* Table 1.1.A. Data for 2017 for Generation at Utility Facilities: Solar Photovoltaic and Small Scale Generation: Estimated Solar Photovoltaic.

In 2018, 85 percent of construction employers engaged in the solar industry who employ the majority of the solar workforce, reported that hiring was either somewhat difficult or very difficult. 73 percent and 78 percent of professional services and manufacturing employers respectively also reported that hiring was somewhat difficult or very difficult in 2018.

Figure 41.

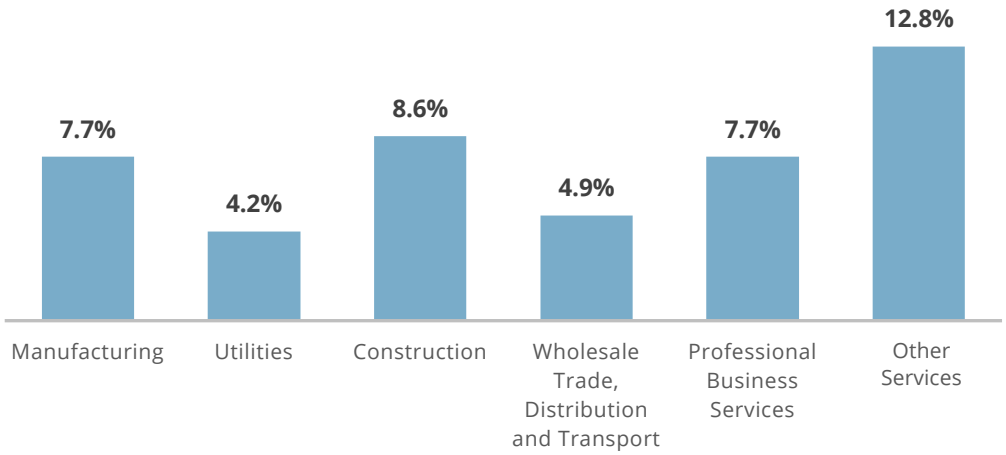
Solar Electric Power Generation — Hiring Difficulty by Industry



In spite of two straight years of decline, solar employers reported that they expect to increase employment by 8.4 percent in 2019. Most solar employment supports PV technologies, with a small portion–7.6 percent–of workers supporting concentrating solar power (CSP) technologies.[40]

[40] The terms "PV" and "CSP" refer to specific solar electricity production technologies. When references are made to either distributed generation or utility-scale generation, these include both solar PV and CSP technologies.

Figure 42.
Solar Electric Power Generation — Expected Employment Growth by Industry



About one-third of the solar workforce in 2018 was female. Overall, the solar work force is racially more diverse than the national workforce. Roughly two in ten workers are Hispanic or Latino, and one in ten are Asian. Black or African American employees are under-represented. Both PV and CSP technologies employed veterans at a higher rate than the national workforce.

Table 23.

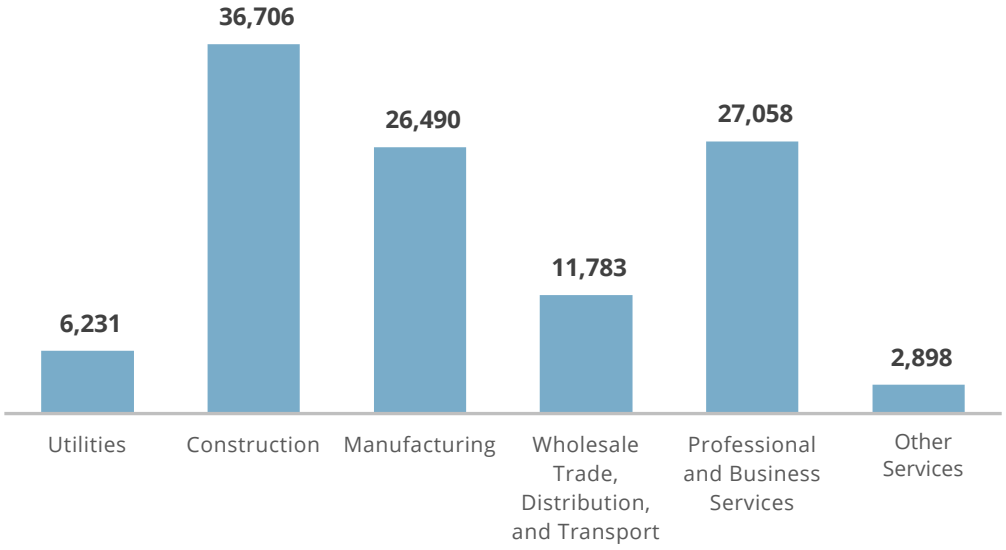
Solar Electric Power Generation – Demographics, Q4 2018

Demographics	Solar Photovoltaic	Concentrating Solar Power	National Workforce Averages
Male	69%	67%	53%
Female	31%	33%	47%
Hispanic or Latino	20%	22%	17%
Not Hispanic or Latino	80%	78%	83%
American Indian or Alaska Native	1%	1%	1%
Asian	10%	9%	6%
Black or African American	7%	7%	12%
Native Hawaiian or other Pacific Islander	1%	1%	>1%
White	71%	69%	78%
Two or more races	10%	12%	2%
Veterans	9%	8%	6%
55 and over	12%	9%	23%
Union	4%	4%	11%

WIND ELECTRIC POWER GENERATION

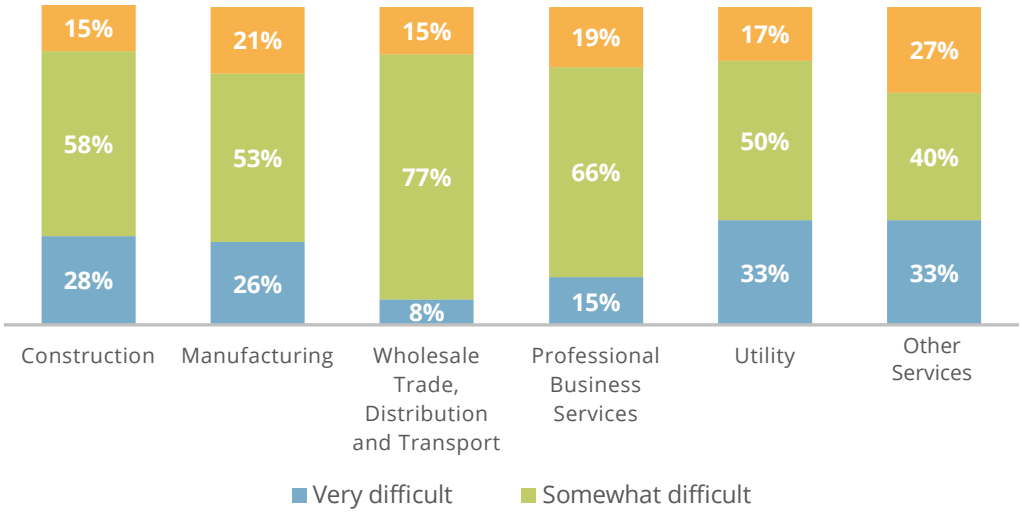
Wind EPG provides the third largest share of employment in the Electric Power Generation sector (behind solar and natural gas generation). In 2018, firms that support the U.S. wind EPG sector employed a total of 111,166 workers–a 4 percent increase from 2017. Similar to solar EPG, the largest share of employment was in construction; this industry sector accounted for 33 percent of all wind EPG workers in 2017, followed by professional services at 24 percent and manufacturing at 24 percent.

Figure 43.
Wind Electric Power Generation – Employment by Industry Sector



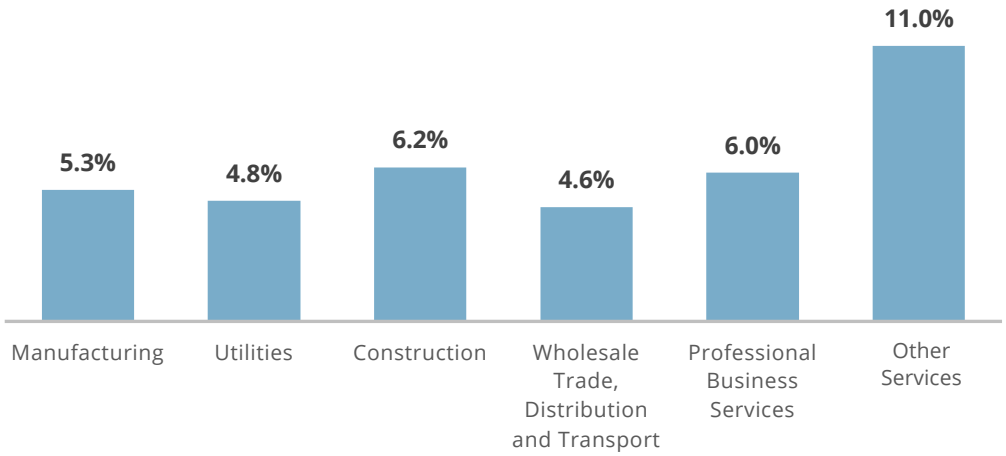
In 2018, 86 percent of construction employers in the wind sector reported that hiring new workers was somewhat difficult or very difficult (with 28 percent reporting that hiring was very difficult). The next two largest segments of the wind industry–professional services and manufacturing–reported overall hiring difficulty of 81 percent and 79 percent, respectively.

Figure 44.
Wind Electric Power Generation – Hiring Difficulty by Industry



Employers in the wind EPG industry expect almost 5 percent growth in 2019. This is led by the construction sector, which expects over 6 percent growth.

Figure 45.
Wind Electric Power Generation — Expected Employment Growth by Industry



Wind EPG has a demographic distribution that is nearly identical to solar EPG, with a slightly higher proportion of workers who are 55 years and older in age. Wind EPG is also more racially diverse than the national workforce, with higher levels of Hispanic or Latino and Asian workers. One out of 10 workers is a veteran.

Table 24.

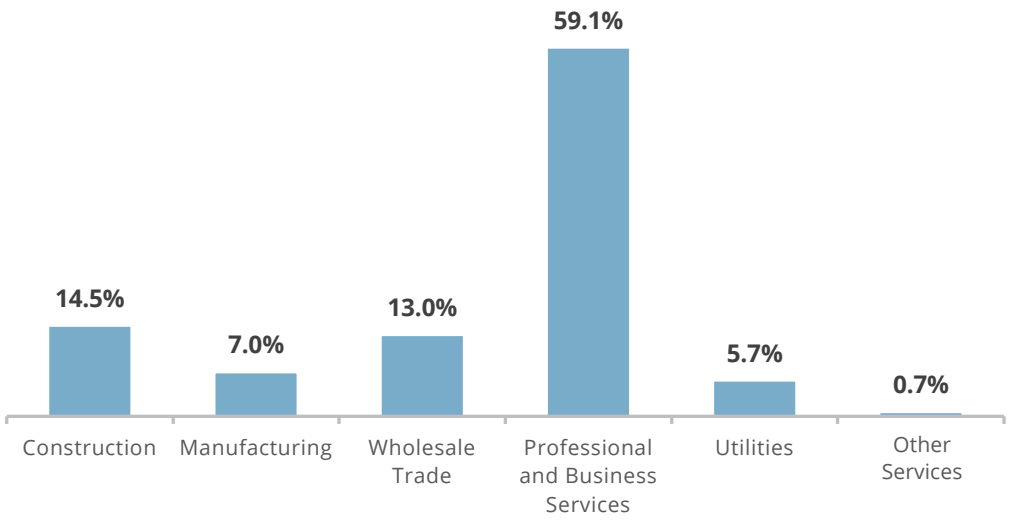
Wind Electric Power Generation — Demographics, Q4 2018

Demographics	Wind		National Workforce Averages
Male	75,403	68%	53%
Female	35,763	32%	47%
Hispanic or Latino	23,015	21%	17%
Not Hispanic or Latino	88,151	79%	83%
American Indian or Alaska Native	1,359	1%	1%
Asian	11,206	10%	6%
Black or African American	8,466	8%	12%
Native Hawaiian or other Pacific Islander	1,532	1%	>1%
White	75,582	68%	78%
Two or more races	13,021	12%	2%
Veterans	10,956	10%	6%
55 and over	16,574	15%	23%
Union	5,320	5%	11%

COMBINED HEAT AND POWER GENERATION

Combined heat and power (CHP) generation technologies employed 29,245 workers, or about 2 percent of the employment in Electric Power Generation, in 2018. In 2018, this industry added 2.000 jobs, which is over 7 percent growth from 2017. With small generation capacities and significant overlap with other sectors (many companies with CHP report according to their underlying fuel source), employment in CHP is mostly comprised of professional service workers. This industry category accounted for 59 percent of CHP jobs in 2018, followed by the construction industry at 15 percent.

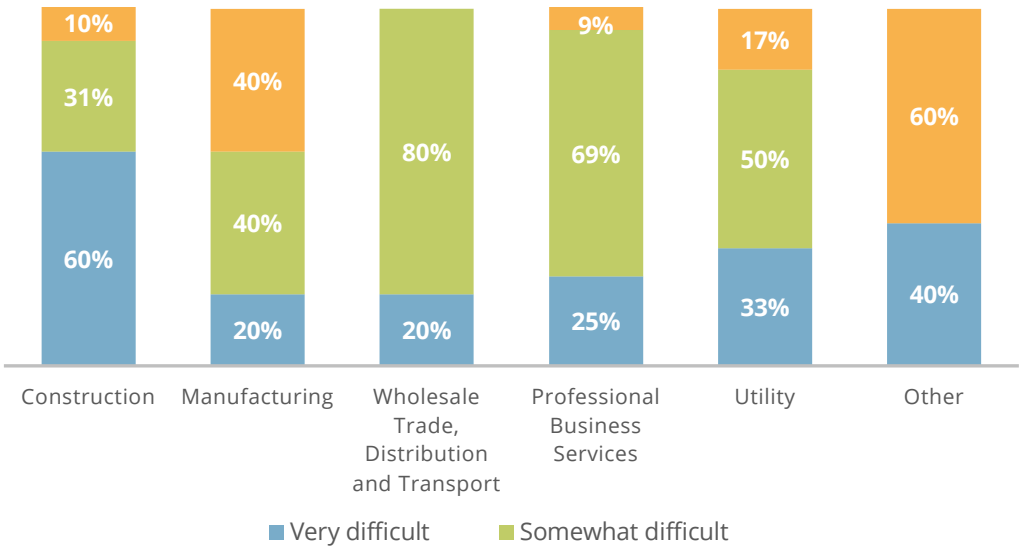
Figure 46.
Combined Heat and Power Generation — Employment by Industry



In 2018, 91 percent of CHP professional and business services employers reported that hiring new workers was somewhat difficult or very difficult (with 25 percent reporting that hiring was very difficult). Similarly, 90 percent of CHP construction employers reported that hiring in 2018 was somewhat difficult or very difficult (with 60 percent reporting that hiring was very difficult).[41]

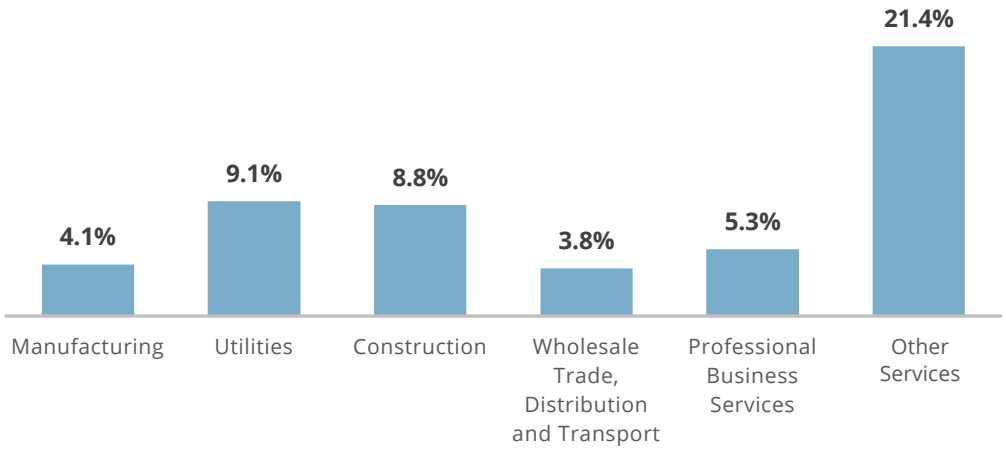
[41] Some industries are omitted from this discussion due to their small sample size in the data contributing to Figure 47. Conclusions have been made only about industries with sufficient sample size.

Figure 47.
Combined Heat and Power Generation – Hiring Difficulty by Industry



Employers in the CHP generation industry expect almost 4 percent growth in 2019. This is led by the utilities sector, which expects over 9 percent growth, and the construction sector, which expects almost 9 percent growth. The professional and business services, the largest sector, anticipates 5.3 percent growth.

Figure 48.
Combined Heat and Power Generation — Expected Employment Growth by Industry



Almost a third of the CHP workforce in 2018 was comprised of women, it is also more racially diverse than the workforce as a whole, with 29 percent racial minorities, compared to 22 percent nationally.

Table 25.

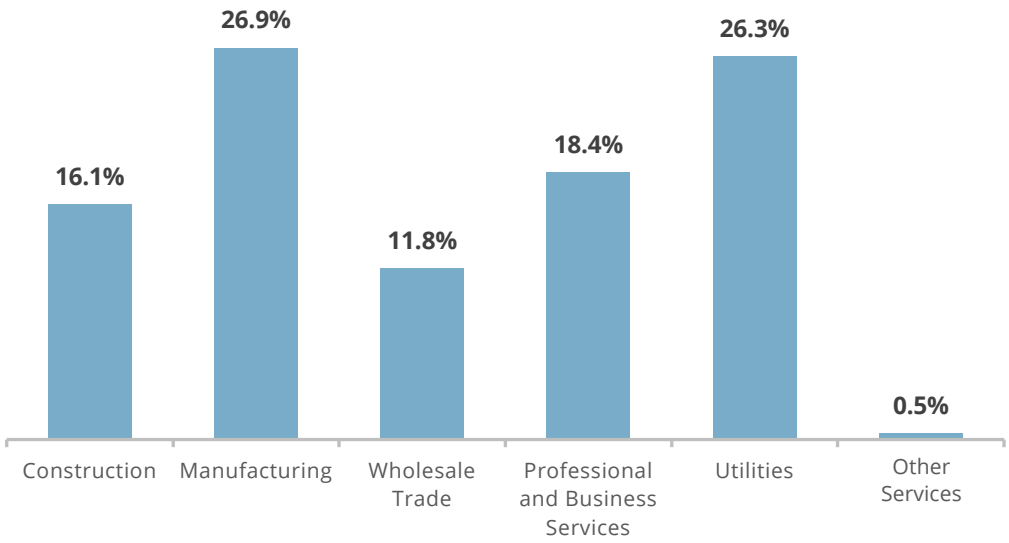
Combined Heat and Power Generation — Demographics, Q4 2018

Demographics	CHP		National Workforce Averages
Male	19,775	68%	53%
Female	9,470	32%	47%
Hispanic or Latino	5,256	18%	17%
Not Hispanic or Latino	23,989	82%	83%
American Indian or Alaska Native	278	1%	1%
Asian	2,614	9%	6%
Black or African American	2,163	7%	12%
Native Hawaiian or other Pacific Islander	268	1%	>1%
White	20,787	71%	78%
Two or more races	3,135	11%	2%
Veterans	3,460	12%	6%
55 and over	6,238	21%	23%
Union	2,475	8%	11%

HYDROELECTRIC POWER GENERATION

Hydroelectric power generation employed a total of 66,448 workers[42] across the nation in 2018. Most of this employment (54,870 workers, or 83 percent) was in traditional hydroelectric generation technologies, while the remainder was in low-impact hydroelectric technologies (11,578 workers). Manufacturing and utilities each made up over 26 percent of hydroelectric generation employment in 2018, while professional business services supported over 18 percent and construction supported over 16 percent of employment.

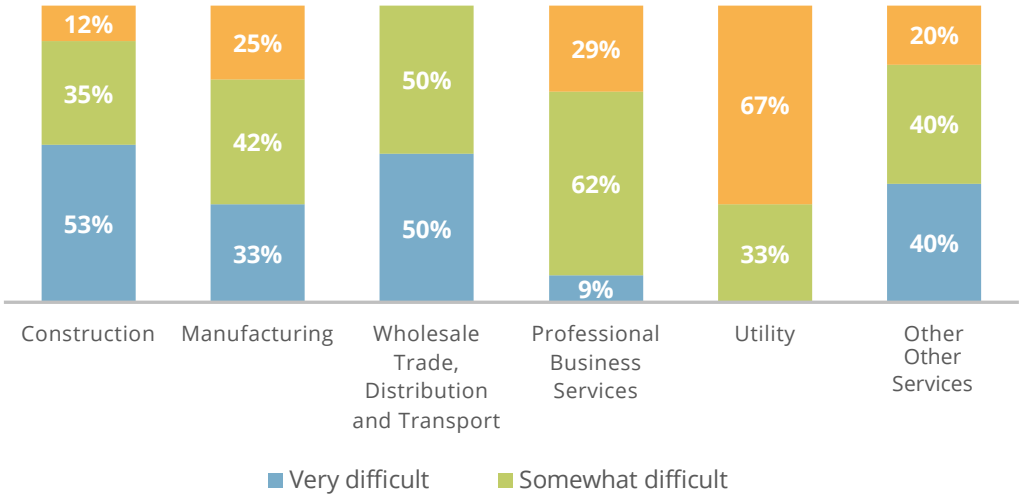
Figure 49.
Hydroelectric Power Generation — Employment by Industry



In 2018, 88 percent of construction employers reported that hiring new workers was somewhat difficult or very difficult (with 53 percent reporting that hiring was very difficult). A smaller percentage of professional business services employers (71 percent) reported that hiring was somewhat difficult or very difficult, and only 9 percent of them reported hiring to have been very difficult. Utilities, consistent with other technologies, reported an easier time hiring new employees, with only 33 percent reporting hiring as somewhat difficult and none as very difficult.[43]

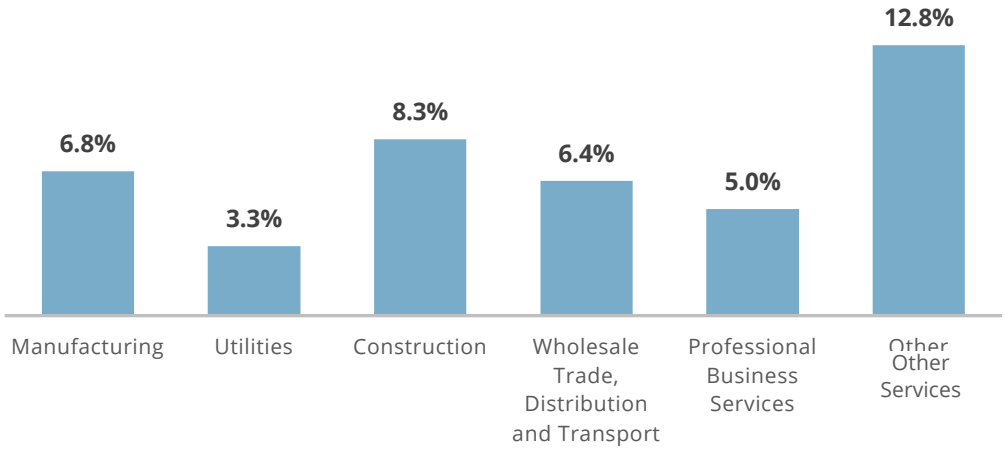
[42] Methodology was revised in 2016 to capture subcontractor employment in Traditional Hydro, so employment totals are not reflective of growth year over year. Primary Traditional Hydro employers reported a minimal decline of -4.2 percent between 2015 and 2016.
[43] Some industries are omitted from this discussion due to their small sample size in the data contributing to Figure 50. Conclusions have been made only about industries with sufficient sample size.

Figure 50.
Hydroelectric Power Generation — Hiring Difficulty by Industry



Overall, hydroelectric employers anticipate 5.8 percent growth in 2019. Utilities and manufacturing, the two largest segments, expect to grow by 6.8 percent and 3.3 percent, respectively.

Figure 51.
Hydroelectric Power Generation — Expected Employment Growth by Industry



Hydroelectric power generation had about a third female employees in 2018 in both low-impact hydroelectric generation and traditional hydroelectric generation technologies. These technologies are also more diverse than the national workforce average, with higher representation in 2018 across Hispanic or Latino workers as well as Asian workers. Veterans employment also exceeded the national average.

Table 26.

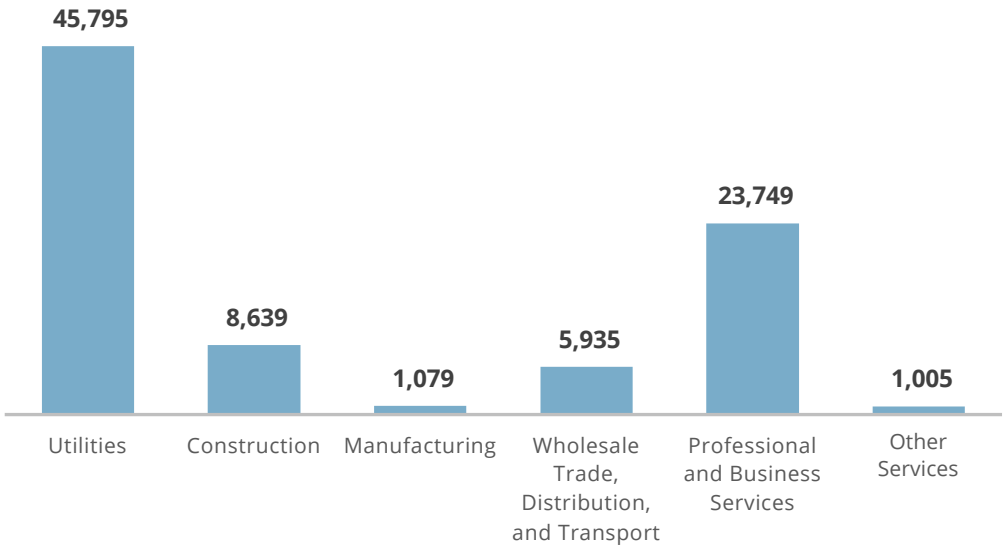
Hydroelectric Power Generation — Demographics, Q4 2018

Demographics	Low-impact Hydroelectric Generation		Traditional Hydroelectric Generation		National Workforce Averages
Male	7,926	68%	36,478	66%	53%
Female	3,652	32%	18,392	34%	47%
Hispanic or Latino	2,331	20%	9,592	17%	17%
Not Hispanic or Latino	9,247	80%	45,278	83%	83%
American Indian or Alaska Native	189	2%	739	1%	1%
Asian	1,183	10%	5,921	11%	6%
Black or African American	902	8%	5,550	10%	12%
Native Hawaiian or other Pacific Islander	150	1%	675	1%	>1%
White	8,079	70%	37,130	68%	78%
Two or more races	1,075	9%	4,854	9%	2%
Veterans	1,264	11%	4,685	9%	6%
55 and over	1,898	16%	8,848	16%	23%
Union	464	4%	3,272	6%	11%

COAL ELECTRIC POWER GENERATION

Coal-fired EPG employed a total of 86,202 workers[44] across the nation in 2018. This is a 7 percent decrease in jobs from 2017. Utilities held over half of coal EPG jobs in 2018, with professional business services making up almost 28 percent of the industry.

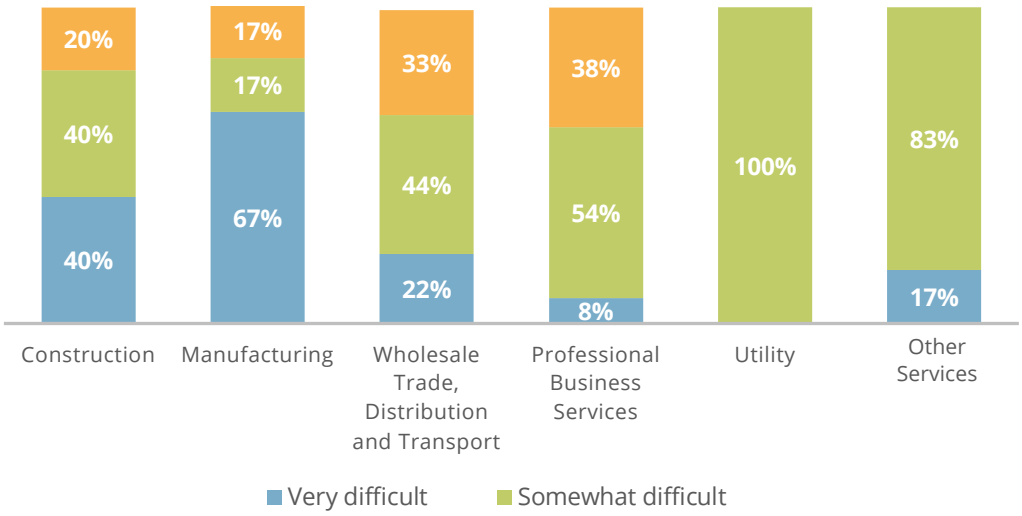
Figure 52.
Coal Electric Power Generation — Employment by Industry



No utilities reported that it was very difficult to hire in 2018. Only 8 percent of professional business services employers reported that hiring new workers was very difficult. The segment with greatest difficulty in hiring in 2018 was construction, in which 40 percent of firms reported that hiring was very difficult.[45]

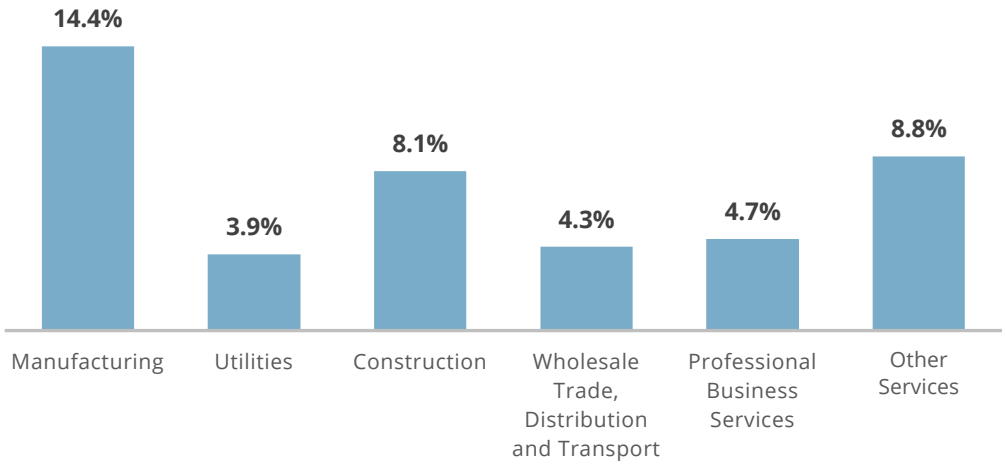
[44] Methodology was revised in 2016 to capture subcontractor employment in Traditional Hydro, so employment totals are not reflective of growth year over year. Primary Traditional Hydro employers reported a minimal decline of -4.2 percent between 2015 and 2016.
[45] Some industries are omitted from this discussion due to their small sample size in the data contributing to Figure 53. Conclusions have been made only about industries with sufficient sample size.

Figure 53.
Coal Electric Power Generation — Hiring Difficulty by Industry



In spite of job losses in 2018, employers in the coal EPG industry expect almost 5 percent growth in 2019. This is led by the manufacturing sector, which expects over 14 percent growth, and the construction sector, which expects over 8 percent growth. Utilities, the largest sector, expect 3.9 percent growth

Figure 54.
Coal Electric Power Generation – Expected Employment Growth by Industry



Coal EPG had over one-third female employees in 2018–(36 percent). Coal generation is also more racially diverse than the national workforce, employing 31 percent minorities. Almost one in 10 employees is unionized.

Table 27.

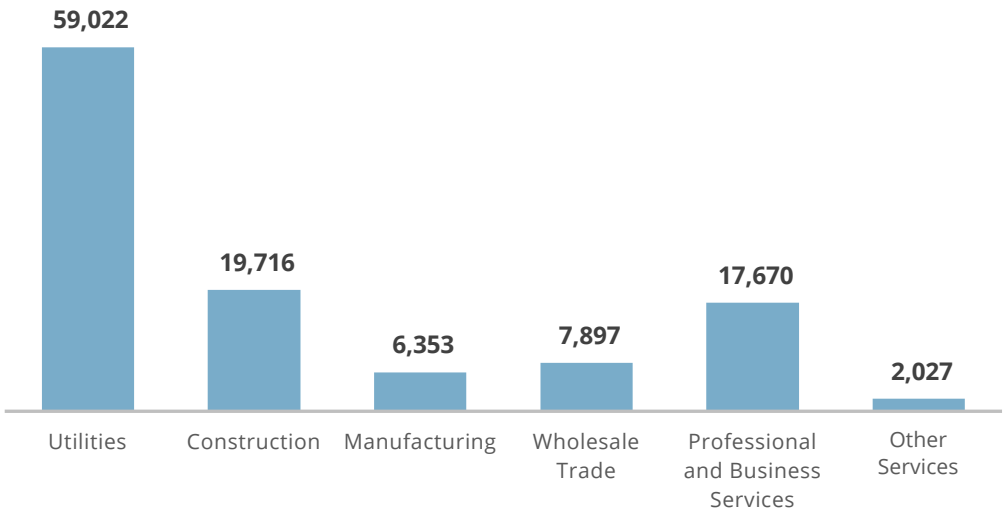
Coal Electric Power Generation – Demographics, Q4 2018

	Coal Generation		National Workforce Averages
Male	55,496	64%	53%
Female	30,706	36%	47%
Hispanic or Latino	12,703	15%	17%
Not Hispanic or Latino	73,499	85%	83%
American Indian or Alaska Native	1,025	1%	1%
Asian	9,091	11%	6%
Black or African American	9,399	11%	12%
Native Hawaiian or other Pacific Islander	788	1%	>1%
White	59,515	69%	78%
Two or more races	6,384	7%	2%
Veterans	5,971	7%	6%
55 and over	14,322	17%	23%
Union	8,092	9%	11%

NATURAL GAS ELECTRIC POWER GENERATION

Natural gas EPG employed a total of 112,685 workers across the nation in 2018; of these, 69,159 jobs, or 61 percent, are in the category of advanced/low emissions natural gas generation. Over the past year, over 5,000 jobs were added by natural gas EPG–an almost 5 percent increase. Utilities provided over half of natural gas power generation jobs in 2018, with construction and professional business services making up 17 percent and 16 percent of the industry, respectively.

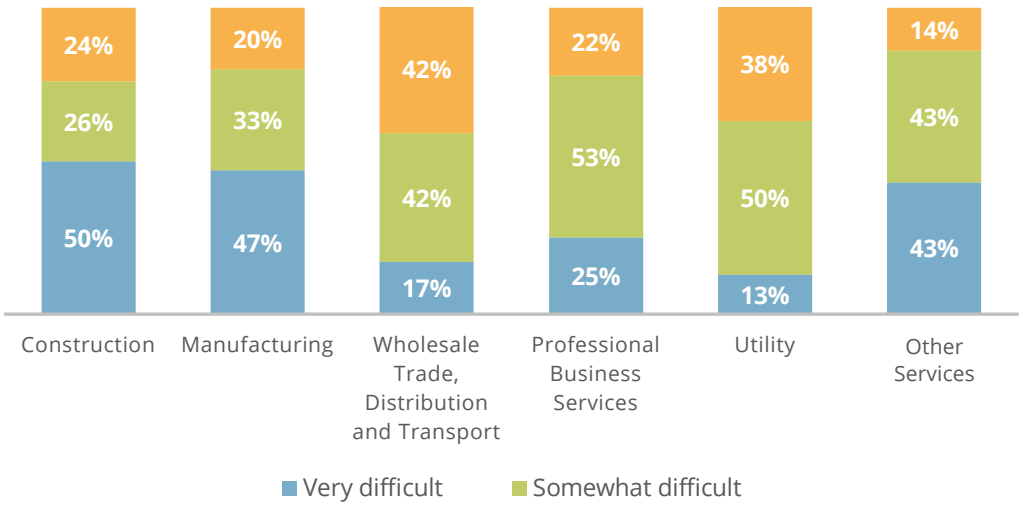
Figure 55.
Natural Gas Electric Power Generation – Employment by Industry



Utilities, the largest sector of natural gas EPG, reported the easiest hiring with only 13 percent reporting that it was very difficult. By comparison, 76 percent of construction employers report that hiring during 2018 was somewhat difficult or very difficult (with 50 percent reporting it was very difficult). Similarly, 78 percent of professional and business services employers reported that hiring new workers in 2018 was somewhat difficult or very difficult.[46]

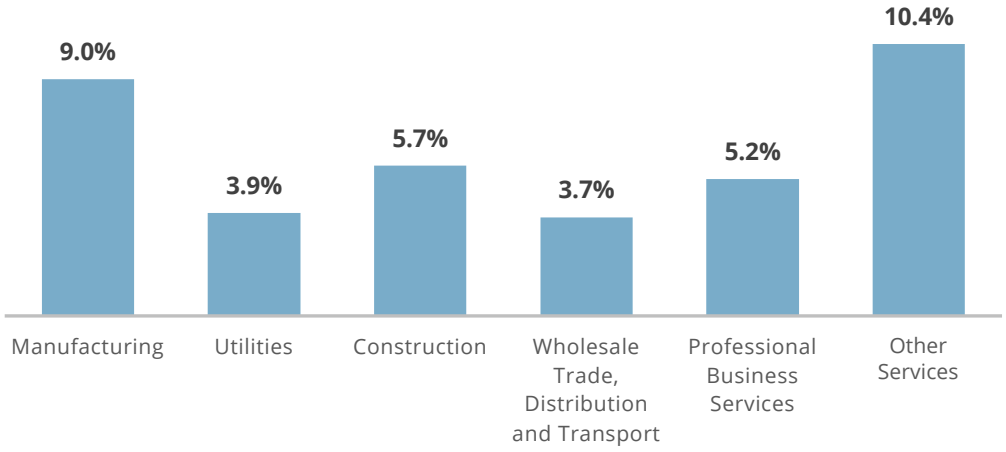
[46] Some industries are omitted from this discussion due to their small sample size in the data contributing to Figure 56. Conclusions have been made only about industries with sufficient sample size.

Figure 56.
Natural Gas Electric Power Generation – Hiring Difficulty by Industry



Employers in the natural gas EPG industry expect over 5 percent growth in 2019. This is led by the manufacturing sector, which expects over 9 percent growth, and the construction sector, which expects almost 6 percent growth.

Figure 57.
Natural Gas Electric Power Generation – Expected Employment Growth by Industry



Natural gas EPG, compared to the EPG sector as a whole, had a proportionally high number of female employees in 2018–over one-third (37 percent). Natural gas EPG is more racially diverse than the national workforce, employing 35 percent racial minorities, the second highest in the electric power generation sector. Eight percent of its employees are veterans, exceeding the national average by two percentage points. Eleven percent are unionized.

Table 28.

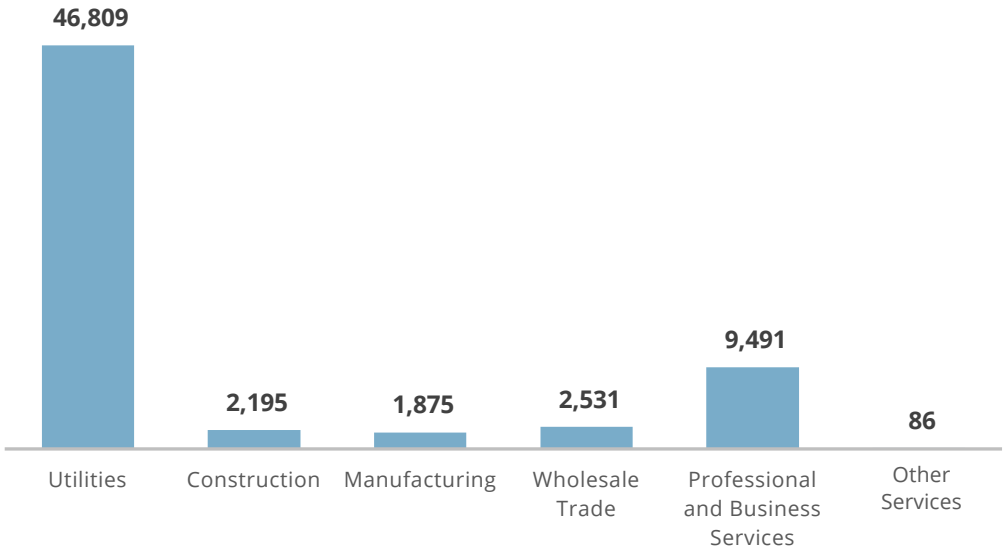
Natural Gas Electric Power Generation – Demographics, Q4 2018

	Natural Gas Generation		National Workforce Averages
Male	71,290	63%	53%
Female	41,395	37%	47%
Hispanic or Latino	18,985	17%	17%
Not Hispanic or Latino	93,700	83%	83%
American Indian or Alaska Native	1,476	1%	1%
Asian	11,807	10%	6%
Black or African American	11,905	11%	12%
Native Hawaiian or other Pacific Islander	1,166	1%	>1%
White	73,595	65%	78%
Two or more races	12,737	11%	2%
Veterans	9,307	8%	6%
55 and over	16,657	15%	23%
Union	12,550	11%	11%

NUCLEAR ELECTRIC POWER GENERATION

Nuclear EPG employed a total of 62,987 workers across the nation in 2018. Over the past year, over 1,700 jobs were lost from nuclear generation–an almost 3 percent decrease in employment. Almost 75 percent of nuclear power generation jobs were in the utility industry in 2018.

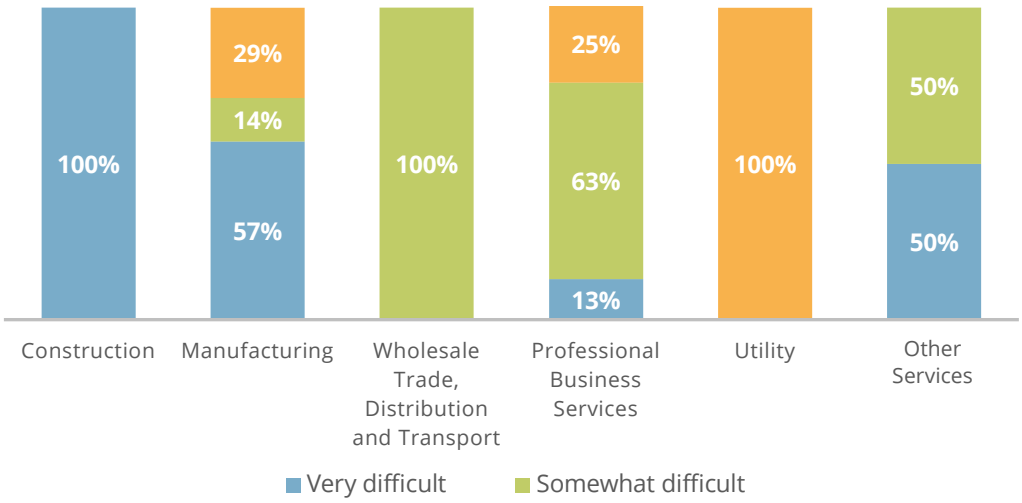
Figure 58.
Nuclear Electric Power Generation – Employment by Industry



Utilities in the nuclear generation sector reported little difficulty in hiring in 2018. However, virtually all construction firms reported that it was very difficult. In 2018, 76 percent of professional and business services employers reported that hiring new workers was somewhat difficult or very difficult. [47]

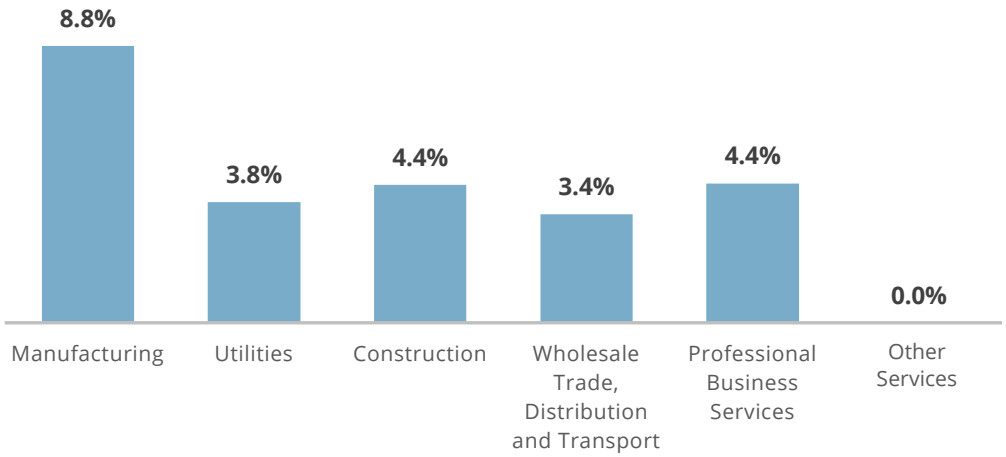
[47] Some industries are omitted from this discussion due to their small sample size in the data contributing to Figure 59. Conclusions have been made only about industries with sufficient sample size.

Figure 59.
Nuclear Electric Power Generation – Hiring Difficulty by Industry



Employers in the nuclear EPG industry expect over 4 percent growth in 2019. This is led by the manufacturing sector, which expects almost 9 percent growth.

Figure 60.
Nuclear Electric Power Generation – Expected Employment Growth by Industry



Nuclear EPG, compared to the EPG sector as a whole, had a proportionally high number of female employees in 2018–over one-third (38 percent), the highest of any generation technology. Nuclear EPG is the most racially diverse of all generation technologies, employing 36 percent racial minorities, compared to 22 percent in the national workforce. It also employs the highest level of black or African American workers at 12 percent, equal to the national workforce. One in ten nuclear generation workers is unionized.

Table 29.

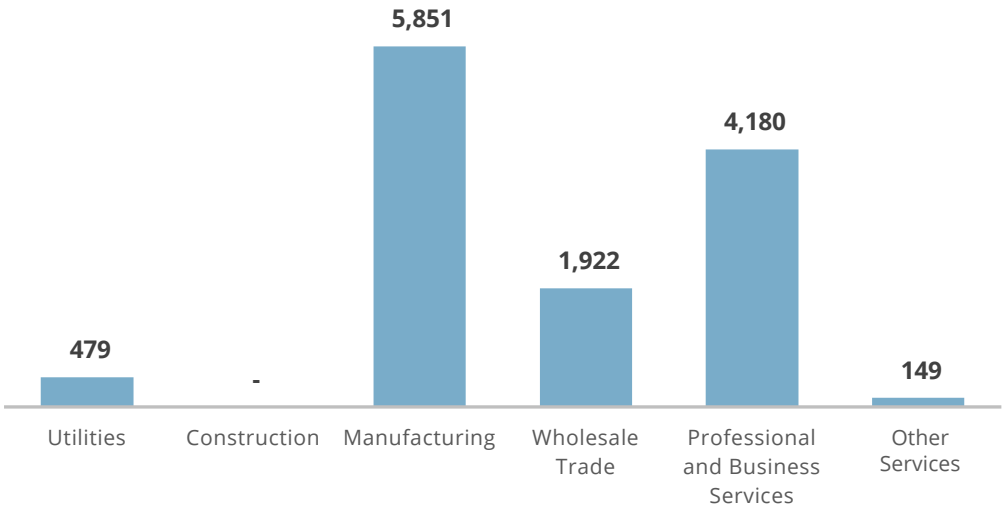
Nuclear Electric Power Generation – Demographics, Q4 2018

	Nuclear Generation		National Workforce Averages
Male	39,078	62%	53%
Female	23,909	38%	47%
Hispanic or Latino	9,681	15%	17%
Not Hispanic or Latino	53,306	85%	83%
American Indian or Alaska Native	820	1%	1%
Asian	6,791	11%	6%
Black or African American	7,327	12%	12%
Native Hawaiian or other Pacific Islander	585	1%	>1%
White	40,593	64%	78%
Two or more races	6,871	11%	2%
Veterans	3,650	6%	6%
55 and over	8,899	14%	23%
Union	6,185	10%	11%

OIL ELECTRIC POWER GENERATION

Oil EPG employed a total of 12,582 workers across the nation in 2018. Over the past year, 165 jobs were created for oil generation–a 1 percent increase in employment. Manufacturing accounted for almost 47 percent of oil power generation jobs in 2018, while professional business services supported over 33 percent.

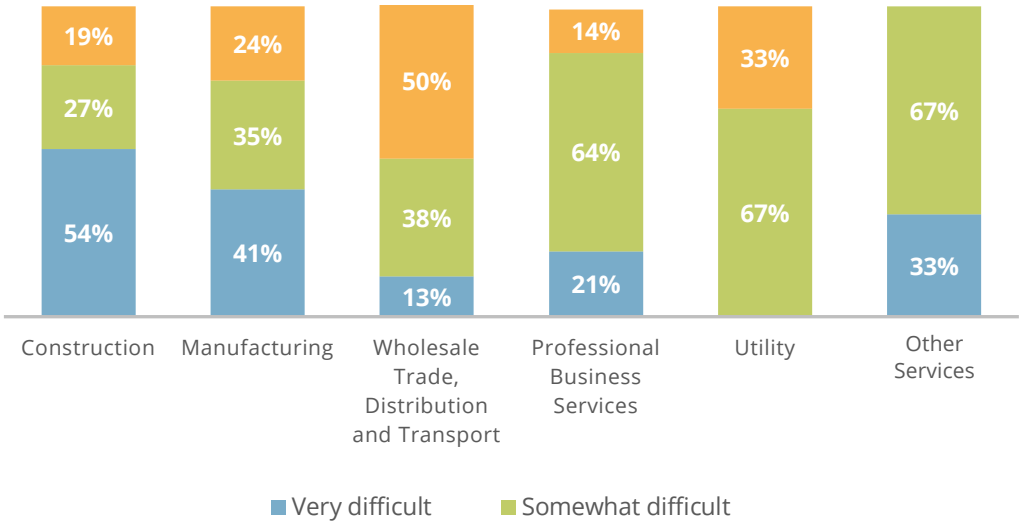
Figure 61.
Oil Electric Power Generation – Employment by Industry



In 2018, 76 percent of manufacturing employers, the largest segment, reported that it was somewhat difficult or very difficult to hire employees. Similarly, 85 percent of professional business services employers reported that hiring new workers in 2018 was either somewhat difficult or very difficult. [48]

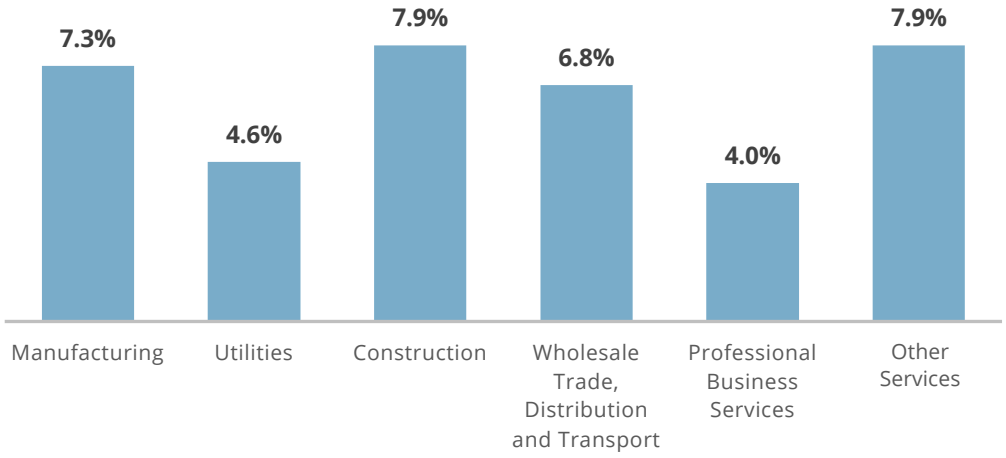
[48] Some industries are omitted from this discussion due to their small sample size in the data contributing to Figure 62. Conclusions have been made only about industries with sufficient sample size.

Figure 62.
Oil Electric Power Generation – Hiring Difficulty by Industry



Employers in the oil EPG industry expect over 6 percent growth in 2019. the manufacturing sector that predicts over 7 percent growth.

Figure 63.
Oil Electric Power Generation – Expected Employment Growth by Industry



Oil EPG has a workforce that is 31 percent women. Similar to many other generation technologies, it is more racially diverse than the national workforce, with 32 percent racial minorities.

Table 30.

Oil Electric Power Generation – Demographics, Q4 2018

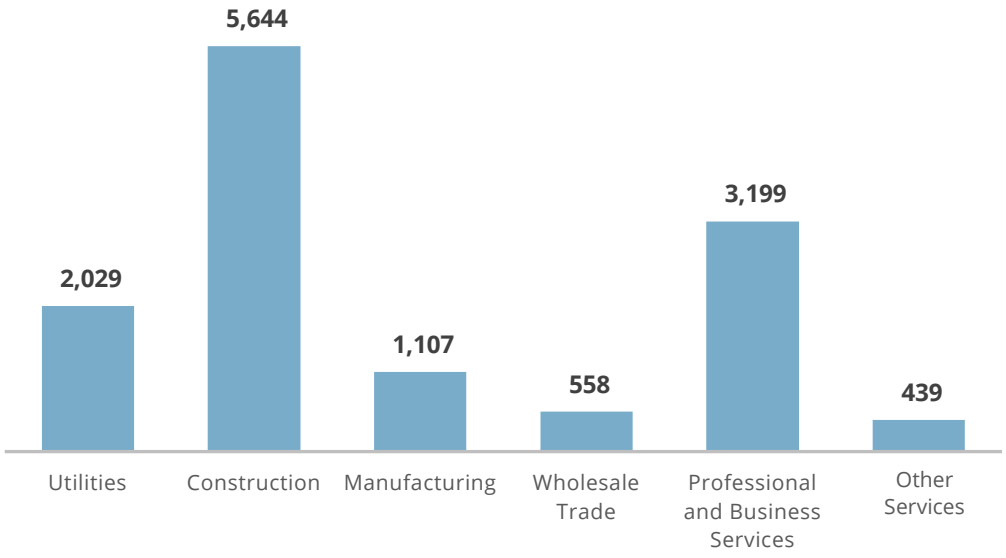
	Oil Generation		National Workforce Averages
Male	8,694	69%	53%
Female	3,888	31%	47%
Hispanic or Latino	2,475	20%	17%
Not Hispanic or Latino	10,107	80%	83%
American Indian or Alaska Native	166	1%	1%
Asian	1,404	11%	6%
Black or African American	1,019	8%	12%
Native Hawaiian or other Pacific Islander	160	1%	>1%
White	8,575	68%	78%
Two or more races	1,258	10%	2%
Veterans	1,085	9%	6%
55 and over	1,796	14%	23%
Union	367	3%	11%

BIOMASS ELECTRIC POWER GENERATION

Biomass EPG employed a total of 12,976 workers across the nation in 2018. Over the past year, 591 jobs were created for biomass generation–a 4.6 percent increase in employment. Construction captured over 43 percent of biomass power generation jobs in 2018, while professional business services supported almost 25 percent.

Figure 64.

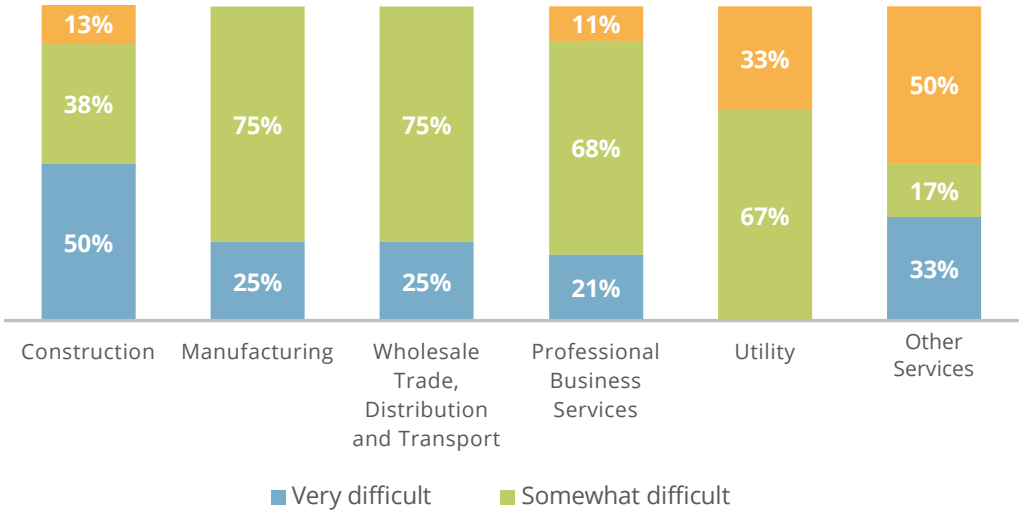
Biomass Electric Power Generation – Employment by Industry



In 2018, 88 percent of construction employers reported that hiring was somewhat difficult or very difficult (with 50 percent reporting that hiring was very difficult). Similarly, 89 percent of professional business services employers reported that hiring new workers in 2018 was either somewhat difficult or very difficult. In contrast, while 67 percent of utilities reported that hiring in 2018 was somewhat difficult, none reported that it had been very difficult.[49]

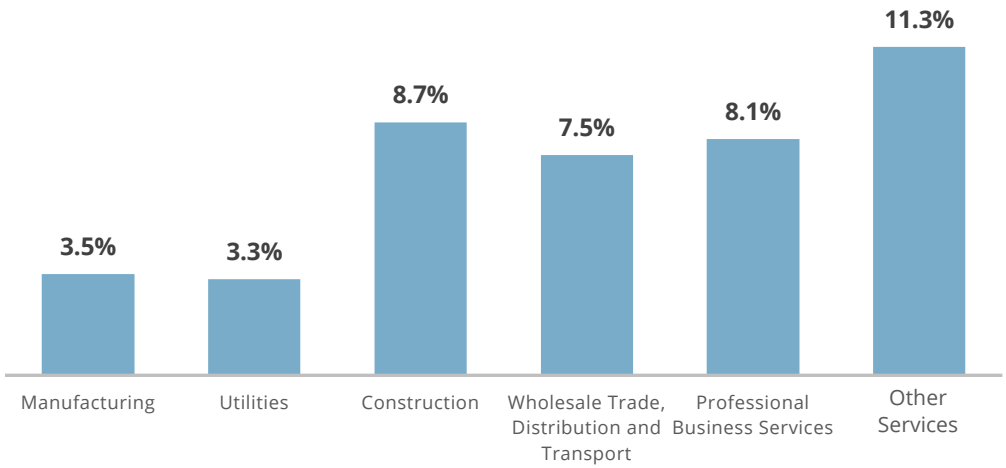
[49] Some industries are omitted from this discussion due to their small sample size in the data contributing to Figure 65. Conclusions have been made only about industries with sufficient sample size.

Figure 65.
Biomass Electric Power Generation – Hiring Difficulty by Industry



Employers in the biomass EPG industry expect over 5 percent growth in 2019. This is led by the construction sector and the professional business services sectors, which both predict over 7 percent growth.

Figure 66.
Biomass Electric Power Generation – Expected Employment Growth by Industry



Biomass EPG has a workforce that is 32 percent female workers. Similar to most of the electric power generation workforce, it is more racially diverse than the national workforce, employing 28 percent racial minorities.

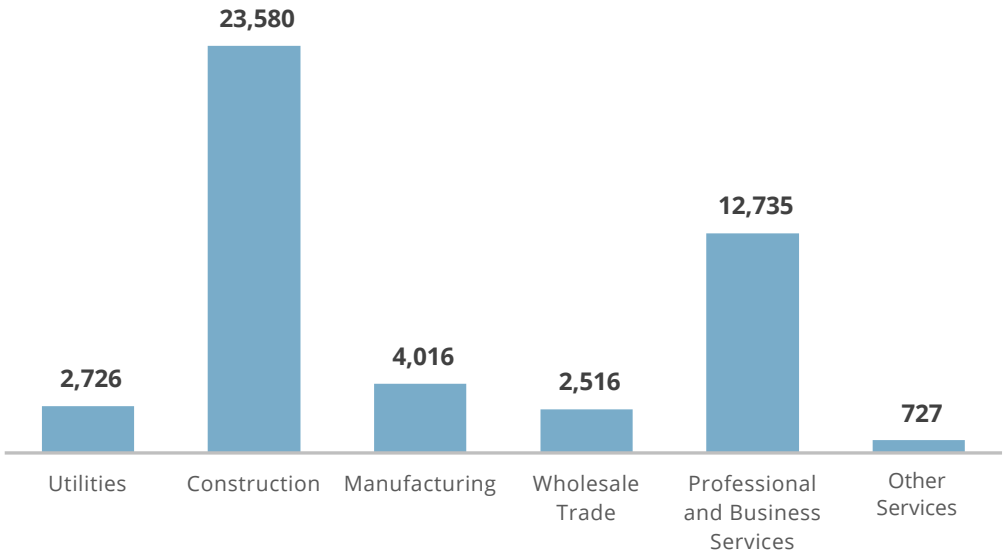
Table 31.
Biomass Electric Power Generation – Demographics, Q4 2018

	Biomass Generation		National Workforce Averages
Male	8,809	68%	53%
Female	4,167	32%	47%
Hispanic or Latino	2,265	17%	17%
Not Hispanic or Latino	10,711	83%	83%
American Indian or Alaska Native	153	1%	1%
Asian	1,309	10%	6%
Black or African American	1,002	8%	12%
Native Hawaiian or other Pacific Islander	159	1%	>1%
White	9,367	72%	78%
Two or more races	987	8%	2%
Veterans	1,671	13%	6%
55 and over	3,052	24%	23%
Union	1,143	9%	11%

OTHER ELECTRIC POWER GENERATION

Other EPG[50] technologies employed a total of 37,775 workers across the nation in 2018. Over the past year, almost 3,000 jobs were created for other generation technologies– a greater than 8 percent increase in employment. Construction accounted over half of other EPG jobs in 2018, while professional business services supported almost 28 percent.

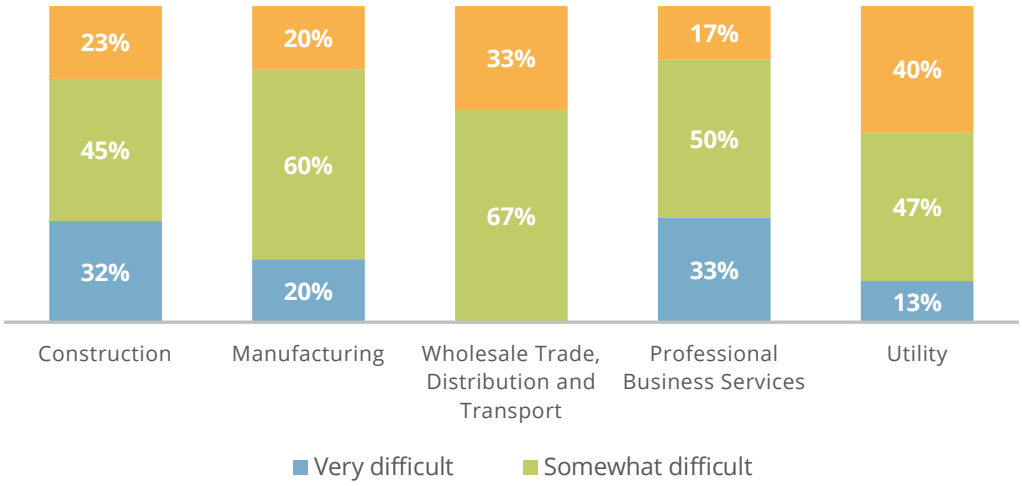
Figure 67.
Other Electric Power Generation – Employment by Industry



In 2018, 77 percent of construction employers reported that hiring was somewhat difficult or very difficult (with 32 percent claiming that it was very difficult). Similarly, 83 percent of professional and business services employer reported that hiring in 2018 was somewhat difficult or very difficult. However, only 60 percent of utilities employers reported that hiring new workers in 2018 was somewhat difficult or very difficult. [51]

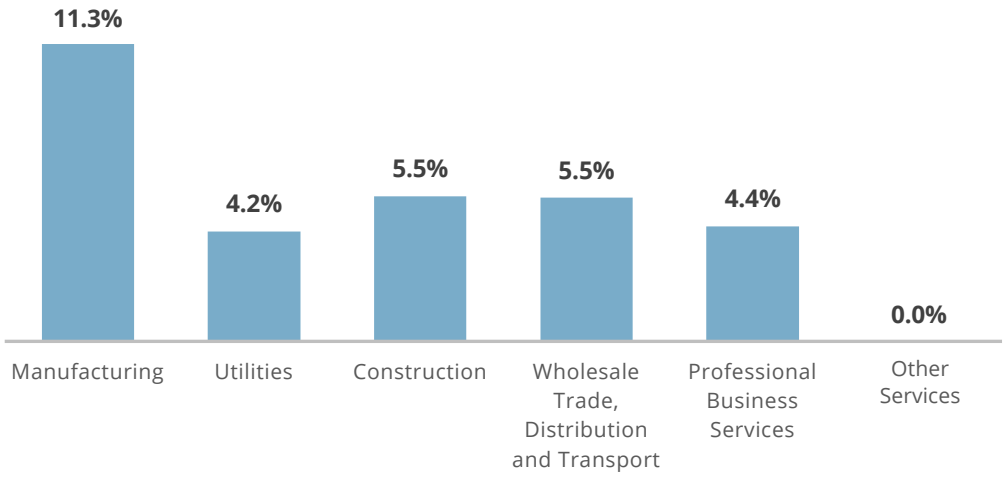
[50] Includes generation from incineration of other fuels (waste, etc.), tidal generation, and employment that can not be classified into a single category.
[51] Some industries are omitted from this discussion due to their small sample size in the data contributing to Figure 63. Conclusions have been made only about industries with sufficient sample size.

Figure 68.
Other Electric Power Generation – Hiring Difficulty by Industry



Employers in the other EPG industry expect over 6 percent growth in 2019. This will be led by the manufacturing sector, which predicts over 11 percent growth.

Figure 69.
Other Electric Power Generation – Expected Employment Growth by Industry



The workforce profile of other EPG is similar to electric power generation profiles generally. Other EPG has a workforce that is 32 percent female employees, while it is more racially diverse than the national workforce–with 28 percent racial minorities, compared to a national average of 22 percent.

Table 32.

Other Electric Power Generation – Demographics, Q4 2018

	Other Generation		National Workforce Averages
Male	31,578	68%	53%
Female	14,723	32%	47%
Hispanic or Latino	8,901	19%	17%
Not Hispanic or Latino	37,400	81%	83%
American Indian or Alaska Native	529	1%	1%
Asian	4,730	10%	6%
Black or African American	3,268	7%	12%
Native Hawaiian or other Pacific Islander	595	1%	>1%
White	33,521	72%	78%
Two or more races	3,659	8%	2%
Veterans	4,236	9%	6%
55 and over	5,907	13%	23%
Union	2,217	5%	11%

ELECTRIC POWER GENERATION AND FUELS EMPLOYMENT CROSSCUT

In Table 33, data on Electric Power Generation and Fuels technologies are combined to better understand the employment characteristics and trends of each. Some generation technologies, such as natural gas or nuclear power, require the use of fuels while others, such as wind or hydropower, do not. In addition, some fuels, such as coal and nuclear fuel, are used primarily for electric power generation while others such as oil and natural gas have multiple purposes.

For example, advanced natural-gas-powered electricity generation and nuclear-powered electricity generation are technology applications that employ roughly the same number of workers, while the underlying technologies used in natural gas and nuclear energy systems are significantly different, as are the associated employment numbers for all energy uses of these resources.

Table 33.

Electric Power Generation and Fuels Employment by Major Energy Technology Application and Detailed Technology Application

	Electric Power Generation	Fuels	Total
Oil/Petroleum	12,282	602,810	615,092
Natural Gas	112,685	-	383,311
Traditional Gas	43,526	270,626	314,152
Advanced Gas	69,159	-	69,159
Majority-Time Solar Employment*	242,343	-	242,343
Coal	86,202	74,831	161,033
Bioenergy	12,976	106,709	119,685
Corn Ethanol	-	35,055	35,055
Other Ethanol/ Non-Woody Biomass, including Biodiesel	-	20,074	20,074
Woody Biomass Fuel for Energy and Cellulosic Biofuels	-	33,166	33,166
Other Biofuels	-	18,414	18,414
Wind	111,166	-	111,166
Other Generation/ Other Fuels	37,775	63,417	101,192
Nuclear	62,987	9,159	72,146
Hydroelectric Generation	66,448	-	66,448
Low Impact Hydroelectric Generation	11,578	-	11,578
Traditional Hydropower	54,870	-	54,870
CHP	29,245	-	29,245
Geothermal	8,526	-	8,526

*** Note:** An additional 92,649 employees spent less than 50 percent of their time on solar.

Transmission, Distribution & Storage

Transmission, Distribution and Storage

Transmission, Distribution, and Storage (TDS) infrastructure for electric power and fuel links energy supplies to intermediate and end users. It includes the following:

- 2.6 million miles of interstate and intrastate pipelines
- 414 natural gas storage facilities
- 330 ports handling crude petroleum and refined petroleum products
- 140,000 miles of railways that handle crude petroleum, refined petroleum products, liquefied natural gas (LNG), and coal
- 642,000 miles of high-voltage transmission lines
- 6.3 million miles of distribution lines[52]

TRENDS

- **2018 TDS Employment:** Excluding retail employees in gas stations and fuel dealers, 1,365,887 workers were employed in Transmission, Distribution, and Storage, adding 33,000 new jobs.

- **2019 Expectations:** TDS employers predict 3.2 percent job growth in 2019, led by professional and business services employers who anticipate 5.5 percent growth, followed by wholesale trade, distribution, and transport and other services at 5.4 percent and 4.9 percent respectively.

- **Key Industry Sectors:** The construction sector employed 35 percent of all TDS workers, while the utility industry employed another 31 percent.

2.5%

Job growth, or 33,000 jobs, was reported in TDS in 2018, exclusive of gas stations

3.2%

Job growth predicted by TDS employers in 2019

[52] DOE, Quadrennial Energy Review: Energy Transmission, Storage, and Distribution Infrastructure, 1-2.

SNAPSHOT OF EMPLOYMENT

Figure 70.

TDS Sector – Employment by Industry, 2017-2018

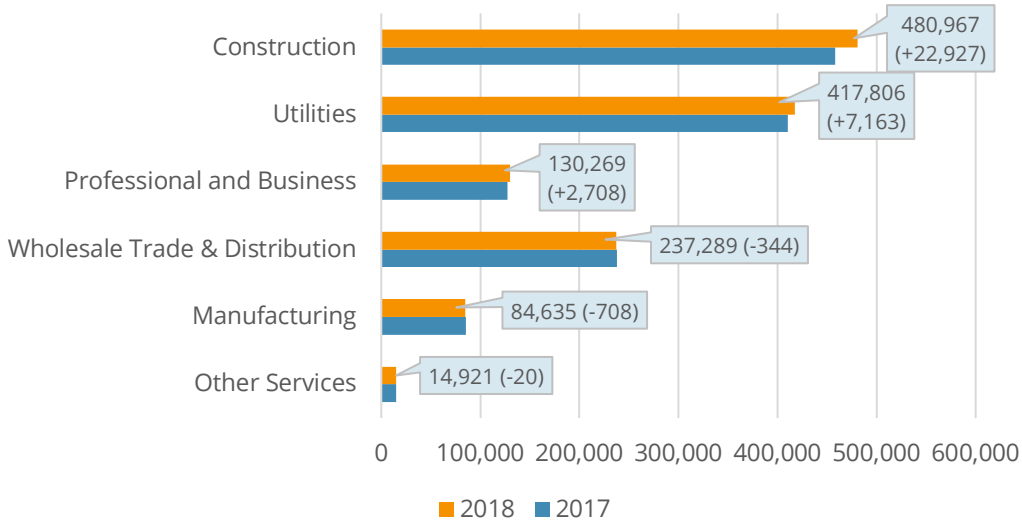
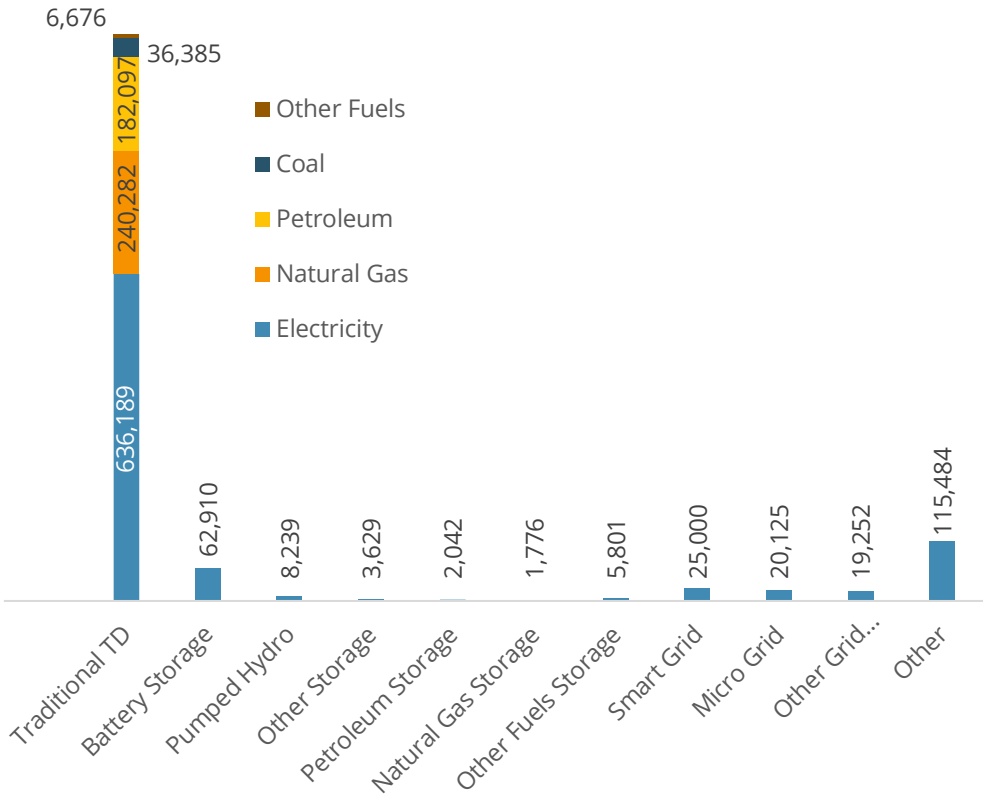


Figure 71.

TDS Sector – Employment by Detailed Technology Application, 2017-2018



KEY TAKEAWAYS

- **Construction firms employed 480,967 Americans** in TDS, a 5 percent increase from 2017. Utilities employed 417,806 workers across the United States in 2018, up 2 percent from 2017 and just over half of energy utility employment nationwide. While TDS manufacturing employment declined by 1 percent in 2018, manufacturers predicted that number would grow by 2.3 percent in 2019. Wholesale trade, which declined by 2 percent in 2018, includes nearly 138,000 employees involved in the transport of commodity energy products by rail, truck, air, and water.
- **Utility investments.** Overall, 48 percent of respondent employers working in Transmission, Distribution, and Storage reported that a majority of their revenues come from grid modernization or other utility-funded modernization projects (an increase from the 37.8 percent proportion reported in 2017).
- **Fuels employment.** The transmission, distribution, and storage of fuels employed 468,383 workers in the sector in 2018. Of these, 242,058 work with natural gas, 184,139 work with petroleum, and 36,385 work with coal fuels.

Table 34.
TDS Sector – TDS Employment by Detailed Technology Application and Industry, Q2 2018[53]

	Total	Utilities	Constr-uction	Manufact-uring	Wholesale Trade, Distribution, + Transport[54]	Professional Services	Pipeline Transport	Other Services
Traditional Transmission + Distribution Electricity	636,189	300,661	167,489	44,456	35,841	75,795	--	11,898
Traditional Transmission + Distribution Petroleum	182,097	--	71,727	--	90,792	--	19,578	--
Traditional Transmission + Distribution Natural Gas	240,282	117,145	93,049	--	--	--	30,088	--
Traditional Transmission + Distribution Coal	36,385	--	--	--	36,385	--	--	--
Traditional Transmission + Distribution Other Fuels	6,676	--	--	--	6,676	--	--	--
Pumped Hydro	8,239	--	3,322	2,508	272	1,386	667	85
Battery Storage	62,910	--	30,188	12,645	7,654	11,316	--	1,108
Other Storage	4,031	--	1,488	1,599	50	806	--	88
Petroleum Storage	2,042		1,264	274	31	--	--	471
Natural Gas Storage	1,776		575	301	214	675	--	12
Other Fuels Storage	1,983	--	1,322	--	<10	601	--	59
Smart Grid	25,000	--	11,738	1,735	1,505	9,840	--	183
Micro Grid	20,125	--	11,454	3,629	1,619	2,906	--	517
Other Grid Modernization	19,252	--	14,439	1,842	266	2,463	--	242
Other	115,082	--	72,912	15,646	1,784	24,481	--	258
TOTAL	**1,362,069**	**417,806**	**480,967**	**84,635**	**183,089**	**130,269**	**50,333**	**14,921**

[53] Employers in the "other" category typically work across multiple technology applications and workers are unable to be assigned to a single technology.
[54] Traditional transmission and distribution of petroleum, natural gas, and coal only includes commodity flow employment.

HIRING DIFFICULTY

- **79 percent of TDS construction employers** reported that it was somewhat difficult or very difficult to hire new employees in 2018 (with 34 percent reporting that hiring was very difficult).
- **74 percent of professional and business services** employers reported that it was either somewhat difficult or very difficult to hire new employees.
- **By comparison, among utilities, a smaller percentage–56 percent–** reported that it was somewhat difficult or very difficult to hire new employees (with only 12 percent of utilities reporting that hiring was very difficult).

HIGHEST-DEMAND OCCUPATIONS IN TDS

More than half the construction employers that hired workers in 2018 reported that electricians and construction laborers were the most difficult to hire.

Table 35.
TDS Sector – Reported Occupations with Hiring Difficulty by Industry, Q4 2018

Utilities	Construction	Manufacturing	Wholesale Trade, Distribution, and Transport	Professional and Business Services	Other
Electrician/ construction laborers (36%)	Electrician/ construction laborers (56%)	Engineers/ scientists (45%)	Technician or mechanical support (38%)	Sales, marketing, or customer service represent-atives (31%)	Sales, marketing, or customer service representatives (40%)
Technician or mechanical support (25%)	Technician or mechanical support (36%)	Technician or mechanical support (35%)	Sales, marketing, or customer service representatives (38%)	Engineers/ scientists (31%)	Management (directors, supervisors, vice presidents) (40%)
Management (directors, supervisors, vice presidents) (21%)	Drivers/ dispatchers (10%)	Sales, marketing, or customer service represent-atives (30%)	Electrician/ construction workers (24%)	Management (directors, supervisors, vice presidents) (21%)	Operations or business development (20%)

Spotlight: "Public agencies have the opportunity to create a pathway forward that is embedded with equity and opportunity."

Madeline Janis, Executive Director, Jobs to Move America

"A moment of transition can be fear-inducing, or it can be a moment of opportunity," states Madeline Janis, co-founder and executive director of Jobs to Move America. "The clean energy transition is creating fear among existing workers in the fossil fuel sector, a fear which can be alleviated by implementing a much more specific framework around good jobs and equity."

Jobs to Move America is a national non-profit organization dedicated to harnessing government procurement to realize equity; to promote environmental sustainability; to further open, democratic government; and to achieve an inclusive, diverse workforce that lifts people into middle-class jobs.

A key leverage point in achieving this mission, notes Janis, is in public purchasing and spending. Jobs to Move America's U.S. Employment Plan offers a multi-point, "all-in" strategy to ensure a just and equitable transition. Recommended strategies include providing training and technology access for transitioning workers; selecting equipment manufacturers that prioritize local communities and equity in their operations and hiring practices; and deploying new technologies in the communities most affected by environmental and economic injustice.

Elisangela "Lisa" Oliveira is a bridge painter for the New York City Department of Transportation.

Photo by Deanne Fitzmaurice

"Public agencies have the opportunity to create a pathway forward that is embedded with equity and opportunity, at minimal cost, if any."

The Los Angeles County Metropolitan Transportation Authority, the second-largest transit agency in the country, applied Jobs to Move America's principles in voting to transition its fleet of over 2,200 buses to zero emission electric buses by 2030. The roll-out of the electric buses will be prioritized in environmental justice communities.

INTRODUCTION

For purposes of the USEER, Transmission, Distribution, and Storage encompasses the employment associated with constructing, operating, and maintaining this energy infrastructure. It includes workers associated with the entire network of power lines that transmit electricity from generating stations to customers, as well as activities that support power and pipeline construction, fuel distribution and transport, and the manufacture of electrical transmission equipment.

Several NAICS codes actively track employment across utility transmission, including natural gas distribution, electrical transmission line construction, and fossil fuel pipeline transportation. This year, for the first time in a USEER report, traditional transmission and distribution technologies were split between electricity and fuels. Also included this year is employment for the storage of fuels. The TDS sector's remaining employment is found within energy-related industry subsectors in construction, manufacturing, wholesale trade, professional and business services, and other services.

In the broadest possible sense, Transmission, Distribution, and Storage could also encompass the final retail sale of gasoline and other liquid fuels to consumers. Retail sales of gasoline and liquid fuels dealers employ a significant number of workers–in 2018, there were 1,014,007 such employees (down 2,000 since 2017), comprising workers in gasoline stations with convenience stores (838,746 employees), other gasoline stations (103,976 employees), and fuel dealers (71,285 employees).[55] These employees are part of the larger universe of 15,775,096 employees in retail trade in the United States in 2018.[56] For purposes of the 2019 USEER, though, this retail trade employment is not included in the scope of this chapter on Transmission, Distribution, and Storage (or in the associated state fact sheets on energy employment that accompany this report). Workers associated with the wholesale trade and distribution of energy commodities, though, are within the scope of this chapter.

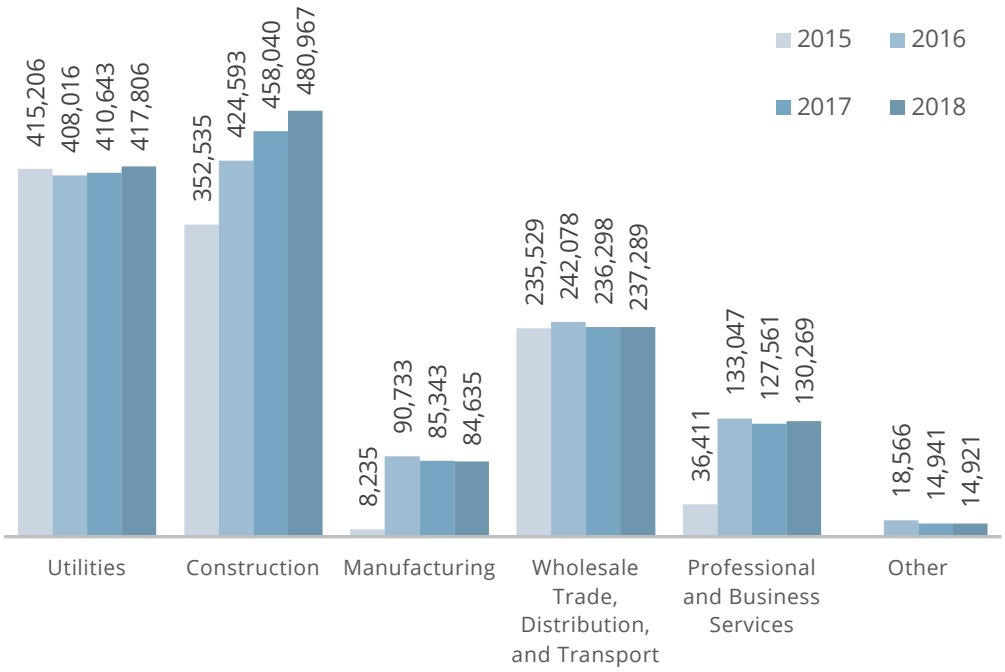
[55] BLS, QCEW, 2018 Second Quarter, U.S. Total June Employment for NAICS 44711, NAICS 44719, and NAICS 45431.
[56] BLS, QCEW, 2018 Second Quarter, U.S. Total June Employment for NAICS 44-45.

SUMMARY

Transmission, Distribution, and Storage, plus the retail workers discussed above, employed just under 2.38 million Americans in 2018. Excluding these retail employees, 1,365,887 workers were employed in the TDS sector. As shown in Figure 72,[57] about 66 percent of this employment was across utilities and construction firms,[58] including 35 percent in construction companies that construct pipeline and other infrastructure that support the Transmission, Distribution, and Storage, including both fuels and electricity.[59] Overall, 48 percent of respondent employers working in the TDS sector reported that a majority of their revenues come from grid modernization or other utility-funded modernization projects (an increase from the 37.8 percent proportion reported in 2017). Employers project to increase their hiring of workers by just over 3 percent in 2019.

Figure 72.

TDS Sector – Employment by Industry Sectors, Q2 2015 - Q2 2018



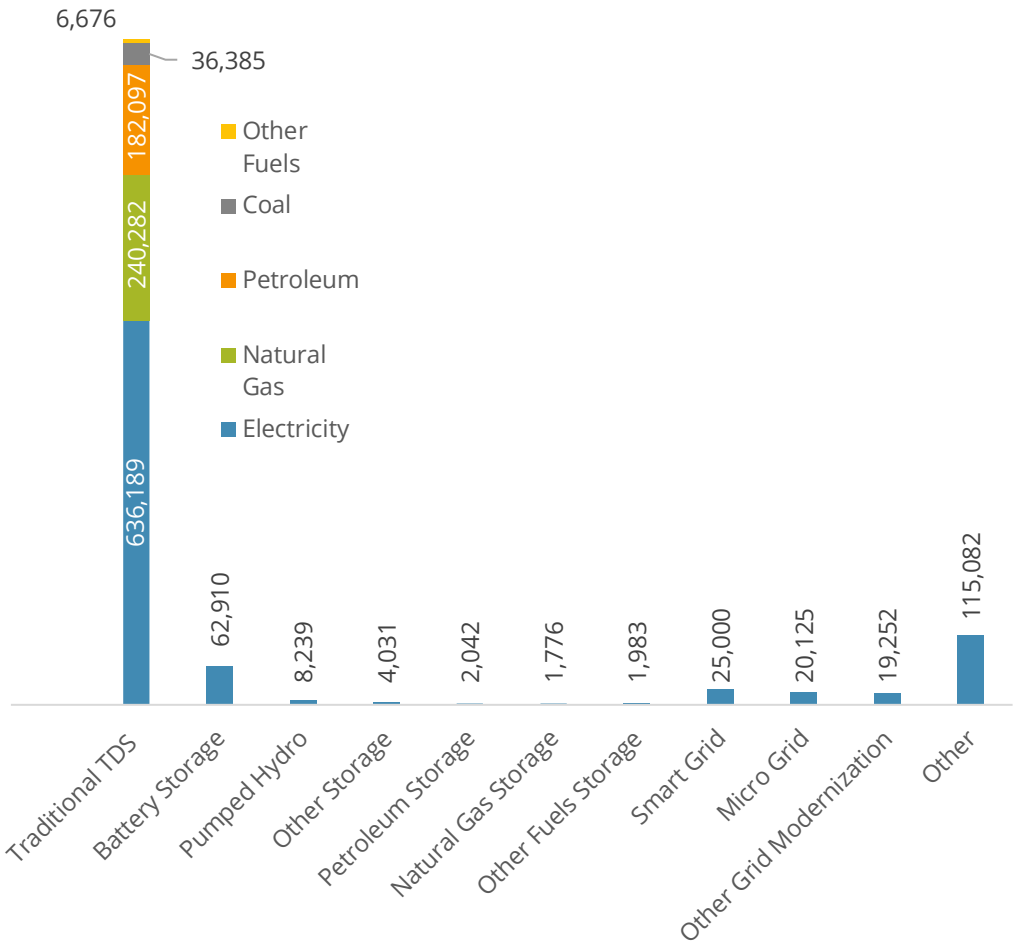
[57] It should be noted that any changes in the manufacturing industry are not directly comparable to employment totals for 2015 in the 2016 USEER. The 2017 USEER, 2018 USEER, and 2019 USEER significantly improved the methodology and scope used, to capture more manufacturing jobs. As a result, changes in the methodology account for most of the apparent and observed growth in 2016, compared to 2015 data.
[58] Hydrogen and fuel cell technologies are split among motor vehicles, storage, and other generation, depending on application–however, the numbers were too small to report separately within the latter two categories.
[59] This includes transportation employment, which is calculated using commodity flow data and employment data on rail, truck, air, and sea transportation.

TRANSMISSION, DISTRIBUTION, AND STORAGE EMPLOYMENT BY DETAILED TECHNOLOGY APPLICATION

In 2018, 71 percent of Transmission, Distribution, and Storage employees worked to manufacture, construct, repair, and operate traditional electrical and natural gas transmission and distribution. This includes natural gas pipeline and power line construction. Approximately 81,000 workers were employed with storage technologies (including pumped hydro-storage)[60] in 2018, while 64,400 worked with smart grid,[61] micro grid, or other grid technologies. About 137,200 employees were involved with the transport of fuel via rail, air, water, or truck, and an additional 115,100 worked on other detailed technology applications within Transmission, Distribution, and Storage.[62]

[60] Hydro-storage is included in this section when it is separate from hydropower generation, which is included in the generation and fuels chapter.
[61] Defined as employees that work on an electricity supply network that uses digital communications technology to detect and react to local changes in usage
[62] Fossil fuel commodity flows via air, rail, water, and truck transportation are included using the Quadrennial Energy Review methodology – these employment figures are relative to the percentage of fuels being transported. These include jobs supported by oil and coal train and truck transportation, for instance. The employment generated from commodity flow data is grouped into the "other" category as these employers were not directly surveyed. Total "other" employment is 252,633.

Figure 73.
TDS Sector – Employment by Detailed Technology, 2018



Professional and business services firms within Transmission, Distribution, and Storage reported expected growth of 5.6 percent by the end of 2019, as shown in Figure 74.[63]

[63] The data in Figure 74 does not include commodity flow employers, as they were not surveyed for 2019 USEER.

Figure 74.

TDS Sector – Expected Employment Growth by Industry (Q4 2018 – Q4 2019)

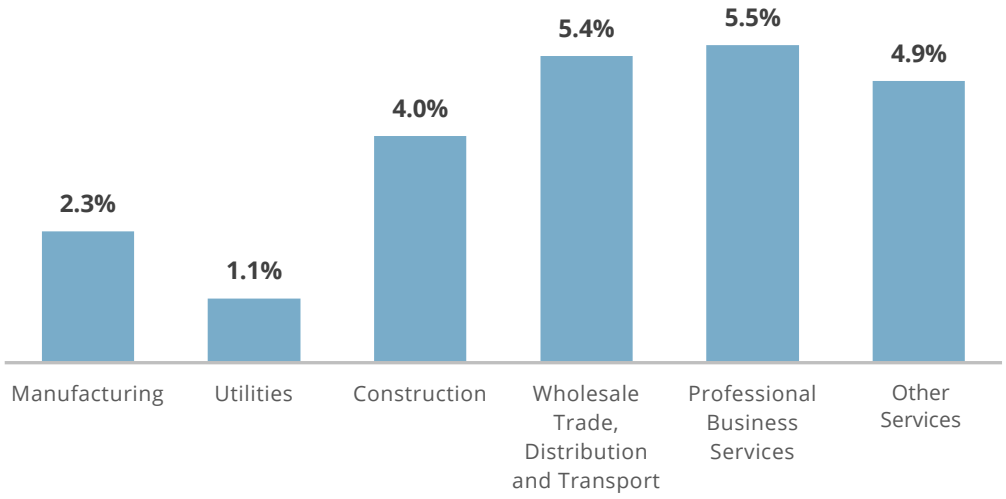
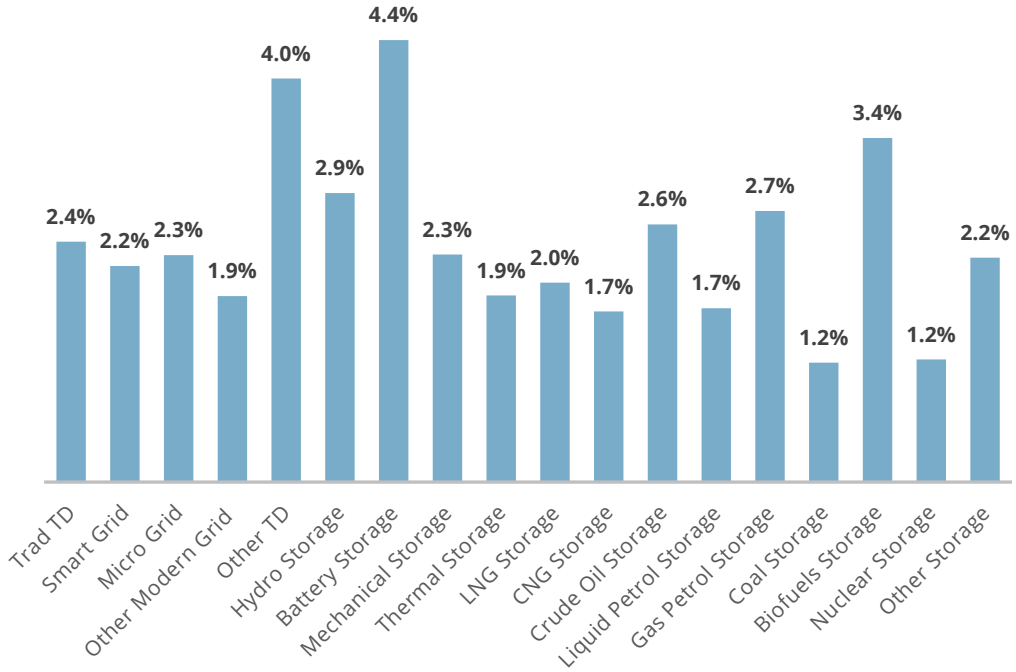


Figure 75.

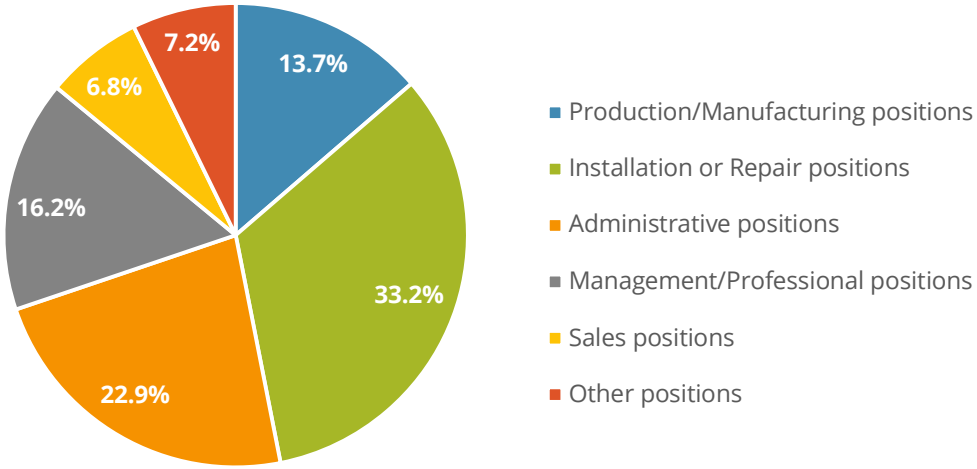
TDS Sector – Expected Employment Growth by Detailed Technology (2018-2019)



TRANSMISSION, DISTRIBUTION, AND STORAGE – WORKFORCE CHARACTERISTICS

One-third (33 percent) of Transmission, Distribution, and Storage workers were employed in installation or repair positions in 2018. Twenty-three percent of workers were employed in administrative positions.

Figure 76.
TDS Sector – Occupational Distribution, Q4 2018



Manufacturing firms in TDS reported the highest overall hiring difficulty in 2018, followed by construction, and professional and business services. Construction, which makes up the largest percentage of TDS employment (35 percent), reported the largest number of employers stating that it was very difficult to hire new employees in 2018 (34 percent). However, this was down by 13 percentage points from 2017. Utilities, with 31 percent of TDS employees, continued to experience the least difficulty in hiring.

Figure 78.
TDS Sector – Hiring Difficulty by Industry

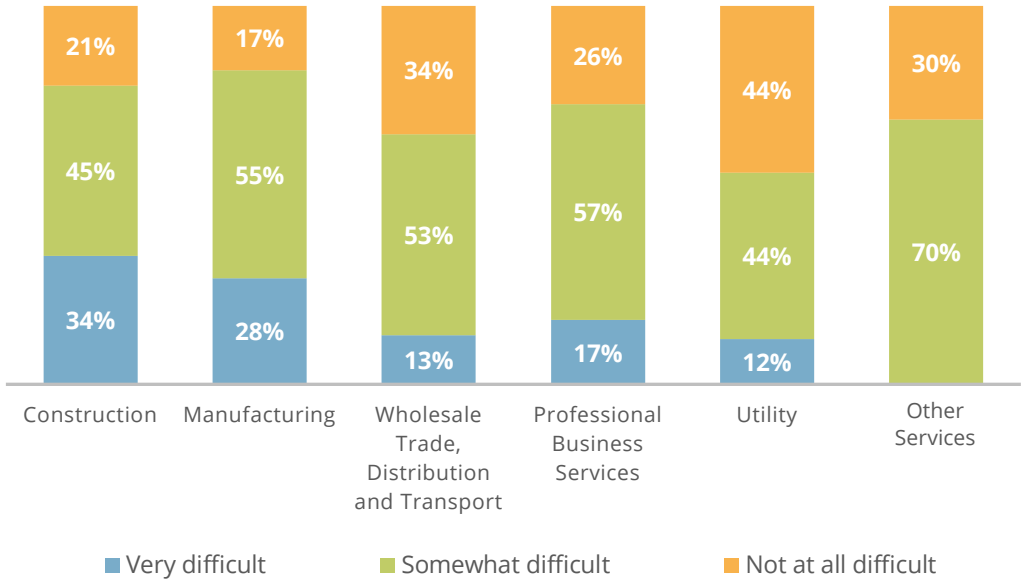
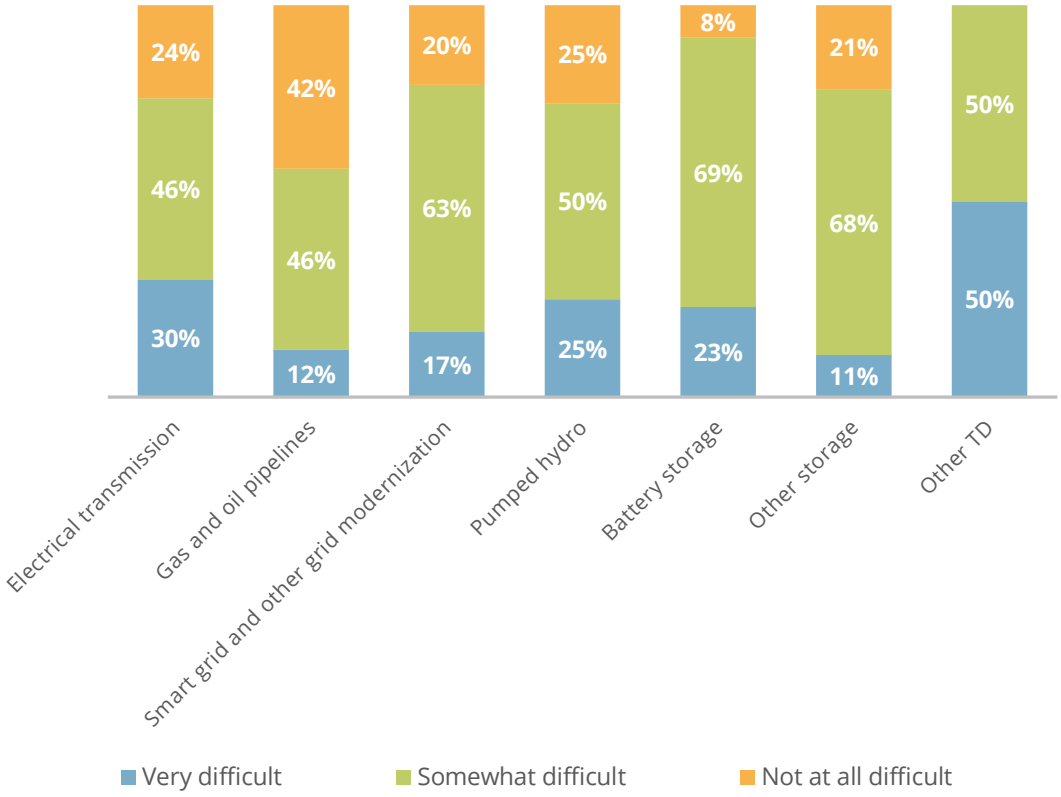


Figure 77.
TDS Sector – Hiring Difficulty by Technology, Q4 2018



Transmission, Distribution, and Storage industry sectors reported lack of experience, training, or technical skills as the number one reason for reported hiring difficulty.

Table 36.
TDS Sector – Reasons for Hiring Difficulty by Industry, Q4 2018

Utilities	Construction	Manufacturing	Wholesale Trade, Distribution, and Transport	Professional and Business Services	Other
Lack of experience, training, or technical skills (36%)	Lack of experience, training, or technical skills (53%)	Lack of experience, training, or technical skills (36%)	Lack of experience, training, or technical skills (53%)	Lack of experience, training, or technical skills (53%)	Lack of experience, training, or technical skills (50%)
Location (28%)	Insufficient non-technical skills (26%)	Insufficient non-technical skills (32%)	Insufficient qualifications, certifications, education (21%)	Insufficient qualifications, certifications, education (33%)	Competition/ small applicant pool (33%)
Insufficient qualifications, certifications, education (21%)	Insufficient qualifications, certifications, education (24%)	Location (23%)	Insufficient non-technical skills (16%)	Insufficient non-technical skills (13%)	Difficulty finding industry-specific knowledge, skills, and interest (33%)

Utilities and construction firms that had hiring difficulty in 2018 cited electricians and/or construction laborers as the most difficult occupational category to hire for.

Table 37.

TDS Sector – Reported Occupations with Hiring Difficulty by Industry, Q4 2018

Utilities	Construction	Manufacturing	Wholesale Trade, Distribution, and Transport	Professional and Business Services	Other
Electrician/ construction laborers (36%)	Electrician/ construction laborers (56%)	Engineers/ scientists (45%)	Technician or mechanical support (38%)	Sales, marketing, or customer service representatives (31%)	Sales, marketing, or customer service representatives (40%)
Technician or mechanical support (25%)	Technician or mechanical support (36%)	Technician or mechanical support (35%)	Sales, marketing, or customer service representatives (38%)	Engineers/ scientists (31%)	Management (directors, supervisors, vice presidents) (40%)
Management (directors, supervisors, vice presidents) (21%)	Drivers/ dispatchers (10%)	Sales, marketing, or customer service representatives (30%)	Electrician/ construction workers (24%)	Management (directors, supervisors, vice presidents) (21%)	Operations or business development (20%)

Just under a quarter of Transmission, Distribution, and Storage employees across the nation in 2018 were women. Eighteen percent of employees were Hispanic or Latino, slightly higher than the national workforce average. While African American employment was below the national average, overall racial diversity was 8 percentage points above the national workforce average. Unionization rates in TDS are almost 50 percent higher than the national workforce average. As noted earlier in connection with Figure 74, commodity flow employment is not included in this section as commodity flow employers were not directly surveyed for the 2019 USEER.

Table 38.

TDS Sector – Demographics, Q4 2018

Demographic	Employees	Percent of Sector	National Workforce Averages
Male	927,292	76%	53%
Female	300,874	24%	47%
Hispanic or Latino	216,276	18%	17%
Not Hispanic or Latino	1,011,890	82%	83%
American Indian or Alaska Native	25,929	2%	1%
Asian	101,854	8%	6%
Black or African American	101,993	8%	12%
Native Hawaiian or other Islander	9,483	1%	>1%
White	864,198	70%	78%
Two or more races	124,709	10%	2%
Veterans	100,031	8%	6%
55 and over	242,032	20%	23%
Union	194,552	16%	11%

NATURAL GAS INDUSTRY CROSSCUT

The natural gas industry has employment in three of the 2019 USEER chapters– Fuels, Electric Power Generation, and Transmission, Distribution, and Storage. For detailed information on hiring trends and demographic makeup, see the sections in these chapters beginning on pages 33, 80, and 106.

In total, the 2019 USEER finds that the natural gas industry employs 625,369 Americans, spread through the industrial sectors in Table 39 below. Overall, natural gas industry employment grew by 6.2 percent in 2018.

The largest industry sectors in the natural gas industry were the following:

- Utilities–176,167 jobs
- Mining and Extraction–162,928 jobs
- Construction–113,339 jobs

The fastest growing industry sectors for natural gas were the following:

- Mining and Extraction –11.5 percent growth
- Construction – 8.0 percent growth
- Professional and Business Services – 6.7 percent growth

The industry sectors that added the most jobs in natural gas were the following:

- Mining and Extraction – 16,816 jobs
- Construction – 8,373 jobs
- Utilities – 7,754 jobs

Table 39.
Natural Gas Industry Employment by Detailed Technology Application and Industry, Q2 2018[64]

	Total	Mining and Extraction	Utilities	Constr-uction	Manufact-uring	Wholesale Trade, Distribution, + Transport (including Pipeline)	Professional and Business Services	Other Services
Fuels	270,626	162,928	--	--	44,444	29,045	34,037	173
Conventional Gas Generation	43,526	--	17,242	10,337	3,582	3,072	8,165	1,128
Advanced Gas	69,159	--	41,780	9,378	2,771	4,824	9,505	900
Fuel Transmission + Distribution	240,282	--	117,145	93,049	--	30,088	--	--
Storage	1,776	--	--	575	301	214	675	12
TOTAL	**625,369**	**162,928**	**176,167**	**113,339**	**51,098**	**67,243**	**52,382**	**2,213**

[64] Text, charts, and tables in the 2019 report include revised 2017 employment totals for advanced and traditional natural gas generation based on additional available data from the Energy Information Administration.

SNAPSHOT OF THE NATURAL GAS INDUSTRY

- Contribution to GDP in 2018: $199.13 billion.[65]
- Overall employment: 625,369
- 1,362,996 GWh of natural gas generation through November 2018[66]
- End-use consumption of natural gas through November 2018: 5.9 percent by lease and plant fuel, 2.7 percent by pipeline and distribution use, 14.9 percent residential, 10.9 percent deliveries to commercial consumers, 27.9 percent industrial, 0.1 percent vehicle fuel, 37.6 percent deliveries to electric power consumers
- 1,197,155,000 metric tons of carbon dioxide emissions through September 2018[67]

WORKFORCE TRENDS

Overall difficulty hiring

- 75.7 percent of natural gas firms have had difficulty in hiring in 2018; 32.1 percent have reported hiring was very difficult.

Most difficult industries

- Construction (81.4 percent) and "other" (81.8 percent) industries have had the most difficulty hiring for natural gas in 2018.
    - 50.7 percent of construction firms reported that hiring has been very difficult.

Most difficult occupations

- Technical/mechanical support was the most difficult occupation to hire for in 2018, cited twice as much (40.7 percent) as the next most cited occupation.
    - Other occupations that were noted as being difficult to hire for include electricians/construction laborers (21.1 percent), management (16.7 percent), and engineers/scientists (15.3 percent).

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[65] Source: GDP estimates are developed by BW Research Partnership using Bureau of Economic Analysis (BEA) RIMS II data and data collected in the employer survey.
[66] Source: U.S. Energy Information Association, Monthly Energy Review, Table 1.1. Net Generation by Energy Source: Total (All Sectors), January 2018-November 2018
[67] Source: U.S. Energy Information Association, Monthly Energy Review, Table 12.1. Carbon Dioxide Emissions from Energy Consumption by Source, January 2018-September 2018

Reasons for difficulty

- The most frequently cited reasons for hiring difficulty among firms dealing with natural gas were lack of experience, training, or technical skills (46.3 percent), insufficient non-technical skills (22.2 percent), insufficient qualifications (certifications or education) (16.7 percent), and competition/small applicant pool (15.7 percent).

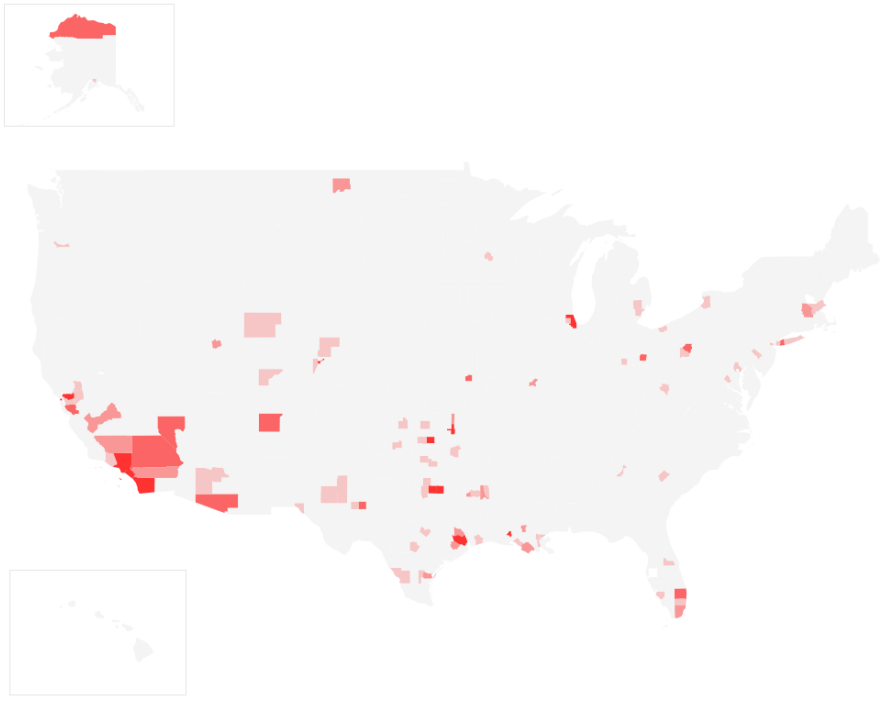
Wage distribution[68]

- The average reported median full-time hourly wage for all entry level workers in the natural gas industry is $18.20/hour.
- The average reported median full-time hourly wage for all mid-wage workers is $26.03/hour.
- The average reported median full-time hourly wage for the highest earners in the industry is $39.92/hour.

Top wage jobs in industry

- Top wage earners in the natural gas industry include executive management (averaging $64.62/hour), general or operations specialties managers (averaging $52.78/hour), engineers (averaging $49.21/hour), accountants/auditors (averaging $46.88/hour), and boilermakers (averaging $36.81/hour).

Figure 79.
National Heat Map Showing Distribution of Natural Gas Jobs



[68] Source: Employer reported Q4 2018 wages and May 2017 BLS OES wages.

COAL INDUSTRY CROSSCUT

The coal industry has employment in three of the 2019 USEER chapters–Fuels, Electric Power Generation, and Transmission, Distribution, and Storage. For detailed information on hiring trends and demographic makeup see the sections in these chapters beginning on pages 30, 77, and 106.

In total, the 2019 USEER finds that the coal industry employs 197,418 Americans, spread through the industrial sectors in Table 40 below. Overall, coal industry employment declined by 3 percent in 2018.

The largest industry sectors in coal industry were the following:

- Mining and extraction employed 55,905.
- Utilities employed 45,795.
- Wholesale trade employed 43,327.

The fastest growing industry sectors for coal were the following:

- Professional and Business Services – 6.3 percent growth
- Other Services – 4.2 percent growth
- Construction – 3.4 percent growth

The industry sectors that added the most jobs in coal were the following:

- Professional and Business Services – 1,851 jobs
- Construction – 288 jobs
- Manufacturing – 212 jobs

Table 40.
Coal Industry Employment by Detailed Technology Application and Industry, Q2 2018

	Total	Mining and Extraction	Utilities	Constr-uction	Manufact -uring	Wholesale Trade, Distribution, + Transport	Professional and Business Services	Other Services
Fuels	74,831	55,905	--	--	10,194	1,007	7,700	25
Coal Generation	86,202	--	45,795	8,639	1,079	5,935	23,749	1,005
Fuel Transmission + Distribution	36,385	--	--	--	--	36,385	--	--
TOTAL	**197,418**	**55,905**	**45,795**	**8,639**	**11,273**	**43,327**	**31,449**	**1,030**

SNAPSHOT OF THE COAL INDUSTRY

- Contribution to GDP in 2018: $66.08 billion.[69]
- Overall employment: 197,418
- 1,049,299 GWh of coal generation through November 2018[70]
- End-use consumption for coal through October 2018: 74.5 percent by electric utilities, 25.0 percent independent power, 0.01 percent commercial, and 0.4 percent for industrial
- 953,461,000 metric tons of carbon dioxide emissions through September 2018[71]

WORKFORCE TRENDS

Overall difficulty hiring

- 74.2 percent of coal firms have had difficulty in hiring in 2018; 31.5 percent have noted that hiring was very difficult.

Most difficult industries

- Construction (87.5 percent) and wholesale trade (75.0 percent) industries have had the most difficulty with hiring in 2018.
    - 54.2 percent of construction firms have reported that hiring has been very difficult.

Most difficult occupations

- Technician/mechanical support (34.8 percent), electrician/construction laborers (21.3 percent), engineers/scientists (19.1 percent), and management (16.9 percent) were cited as the most difficult occupations to hire for among coal firms in 2018.

[69] Source: GDP estimates are developed by BW Research Partnership using Bureau of Economic Analysis (BEA) RIMS II data and data collected in the employer survey.
[70] Source: U.S. Energy Information Association, Table 1.1. Net Generation by Energy Source: Total (All Sectors), 2008-November 2018
[71] Source: U.S. Energy Information Association, Monthly Energy Review, Table 12.1. Carbon Dioxide Emissions from Energy Consumption by Source, January 2018-September 2018

Reasons for difficulty

- Most (44.0 percent) of coal firms cited lack of experience, training, or technical skills as a reason for hiring difficulty.
    - Other reasons that were frequently cited are insufficient qualifications (certifications or education) (23.1 percent), insufficient non-technical skills (19.8 percent), and difficulty finding industry-specific knowledge, skills, and interest (16.5 percent).

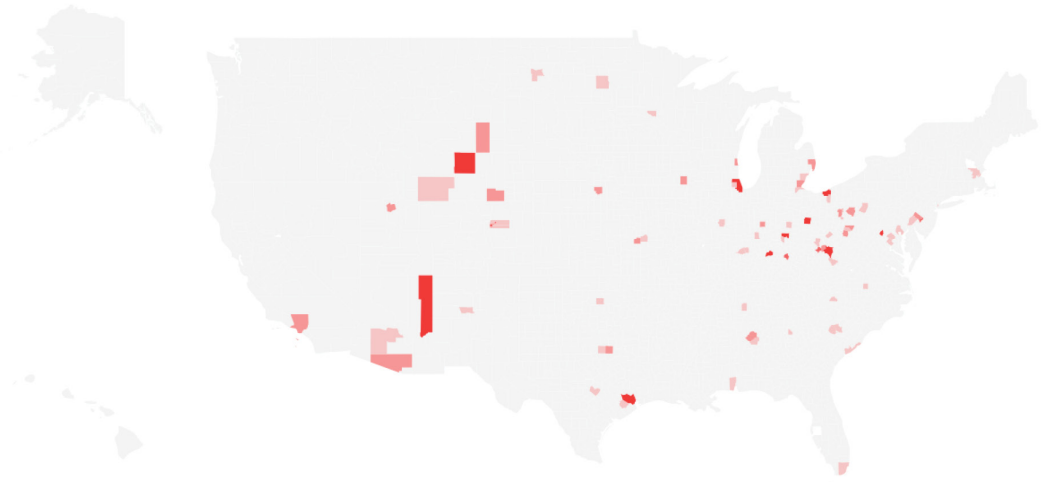
Wage distribution[72]

- The average reported median full-time hourly wage for all entry level workers in the coal industry is $17.53/hour.
- The average reported median full-time hourly wage for all mid-wage workers is $26.25/hour.
- The average reported median full-time hourly wage for the highest earners in the industry is $40.53/hour.
- The average coal worker receives a higher median wage than both natural gas and petroleum workers.

Top wage jobs in industry

- Top wage earners in the coal industry include executive management (averaging $58.73/hour), operations specialties managers (averaging $50.78/hour), construction managers (averaging $44.43/hour), boilermakers (averaging $36.81/hour) and power plant operators (averaging $36.26/hour).

Figure 80.
National Heat Map Showing Distribution of Coal Jobs



[72] Source: Employer reported Q4 2018 wages and May 2017 BLS OES wages.

PETROLEUM INDUSTRY CROSSCUT

The petroleum industry has employment in three of the 2019 USEER chapters–Fuels, Electric Power Generation, and Transmission, Distribution, and Storage. For detailed information on hiring trends and demographic makeup see the sections in these chapters beginning on pages 27, 86, and 106.

In total, the 2019 USEER finds that the petroleum industry employs 799,531 Americans, spread through the industrial sectors in Table 41 below. Overall, the industry employment grew by 5.3 percent in 2018.

The largest industry sectors in the petroleum industry were the following:

- Mining and Extraction–308,681 jobs
- Wholesale Trade, Distribution, and Transport–170,945 jobs
- Manufacturing–155,267 jobs

The fastest growing industry sectors for petroleum were the following:

- Other Services – 28.7 percent growth
- Mining and Extraction – 9.0 percent growth
- Construction – 8.1 percent growth

The industry sectors that added the most jobs in petroleum were the following:

- Mining and Extraction – 25,471 jobs
- Construction – 6,725 jobs
- Professional and Business Services – 3,963 jobs

Table 41.
Petroleum Industry Employment by Detailed Technology Application and Industry, Q2 2018

	Total	Mining and Extraction	Utilities	Construction	Manufacturing	Wholesale Trade, Distribution, + Transport	Professional and Business Services	Other Services
Fuels	602,810	308,681	--	18,066	149,142	58,622	66,947	1,353
Oil & Other Petrol Generation	12,582	--	479	--	5,851	1,922	4,180	149
Fuel Transmission + Distribution	182,097	--	--	71,727	--	110,370	--	--
Storage	2,042	--	--	1,264	274	31	--	471
TOTAL	**799,531**	**308,681**	**479**	**91,057**	**155,267**	**170,945**	**71,127**	**1,973**

SNAPSHOT OF THE PETROLEUM INDUSTRY

- Contribution to GDP in 2018: $372.29 billion.[73]
- Overall employment: 799,531
- 22,793 GWh of petroleum generation through November 2018[74]
- End-use consumption for petroleum through September 2018: 25.2 percent industrial, 2.7 percent residential, 2.3 percent commercial, 69.2 percent transportation, 0.6 percent electric power
- 1,780,798,000 metric tons of carbon dioxide emissions through Sept. 2018[75]

WORKFORCE TRENDS

Overall Difficulty Hiring

- 77.2 percent of petroleum firms have had difficulty in hiring in 2018; 32.4 percent note that hiring was very difficult.

Most difficult industries

- Construction (85.3 percent) and wholesale trade (81.9 percent) industries have seen the most difficulty hiring
    - 58.3 percent of construction firms have noted that hiring has been very difficult.

Most difficult occupations

- The most difficult occupation to hire for is technician/mechanical support (62.0 percent), cited over twice as much as the next most cited occupation.
    - Other occupations that are noted as being difficult to hire for are sales, marketing, or customer service (23.2 percent), management (13.2 percent), and electrician/construction laborers (11.7 percent).

Reasons for difficulty

The most frequently cited reasons for the hiring difficulty were lack of experience (49.2 percent), insufficient non-technical skills (25.2 percent), competition/small applicant pool (16.3 percent), and insufficient qualifications (certifications or education) (16.1 percent).

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[73] Source: GDP estimates are developed by BW Research Partnership using Bureau of Economic Analysis (BEA) RIMS II data and data collected in the employer survey.
[74] Source: U.S. Energy Information Association, Table 1.1. Net Generation by Energy Source: Total (All Sectors), 2008-November 2018, petroleum liquids and coke
[75] Source: U.S. Energy Information Association, Monthly Energy Review, Table 12.1. Carbon Dioxide Emissions from Energy Consumption by Source, January 2018-September 2018

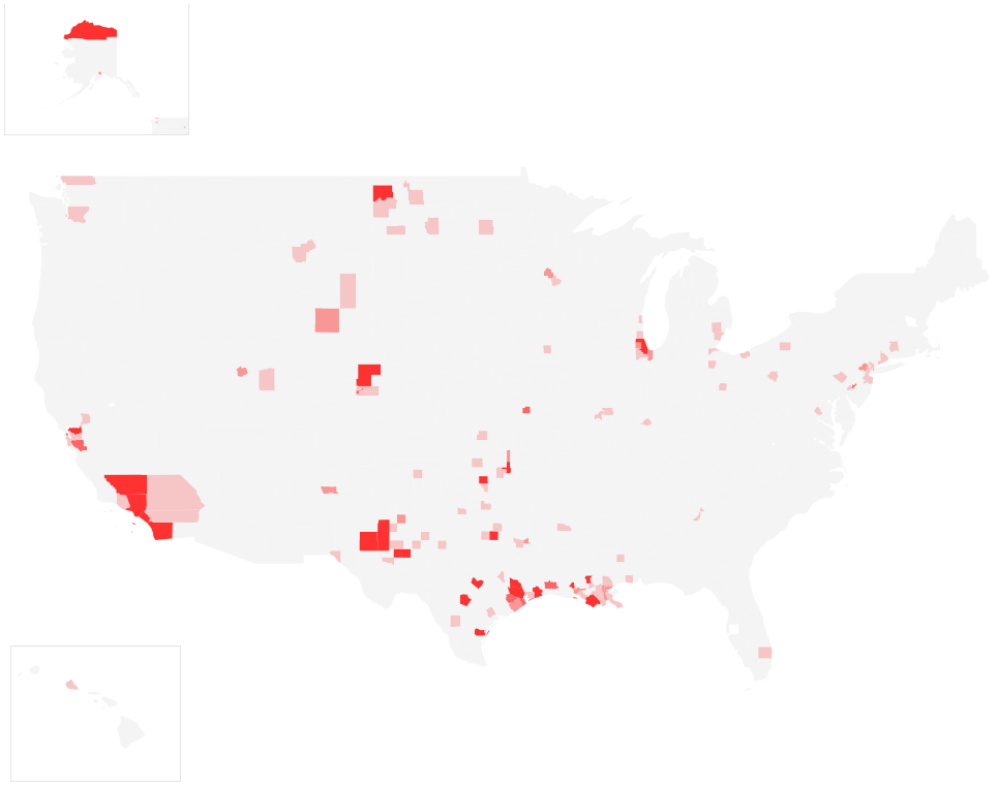
Wage distribution[76]

- The average reported median full-time hourly wage for all entry level workers in the petroleum industry is $17.75/hour.
- The average reported median full-time hourly wage for all mid-wage workers is $25.99/hour.
- The average reported median full-time hourly wage for the highest earners in the industry is $39.59/hour.

Top wage jobs in industry

- Top wage earners in the petroleum industry include executive management (averaging $56.15/hour), operations specialties managers (averaging $49.74/hour), engineers (averaging $46.92/hour), boilermakers (averaging $36.81/hour), and first-line supervisors of mechanics, installers, and repairers (averaging $32.77/hour).

Figure 81.
National Heat Map Showing Distribution of Petroleum Jobs



[76] Source: Employer reported Q4 2018 wages and May 2017 BLS OES wages.

NUCLEAR INDUSTRY CROSSCUT

The nuclear industry has employment in two of the 2019 USEER chapters–Fuels and Electric Power Generation. For detailed information on hiring trends and demographic makeup see the sections in these chapters beginning on pages 36 and 83.

In total, the 2019 USEER finds that the nuclear industry employs 72,146 Americans, spread through the industrial sectors in Table 42 below. Overall, nuclear industry employment declined by 2.1 percent in 2018.

The largest industry sectors in the nuclear industry were the following:

- Utilities employ 46,809.
- Professional services employ 14,374.
- Manufacturing employ 4,913.

The fastest growing industry sectors for nuclear were the following:

- Other Services – 13.2 percent growth
- Manufacturing – 3.6 percent growth
- Wholesale Trade, Distribution, and Transport – 1.5 percent growth

The industry sectors that added the most jobs in nuclear were the following:

- Manufacturing – 172 jobs
- Wholesale Trade, Distribution, and Transport – 50 jobs
- Professional and Business Services – 39 jobs

Table 42.
Nuclear Industry Employment by Detailed Technology Application and Industry, Q2 2018

	Total	Mining and Extraction	Utilities	Construction	Manufact-uring	Wholesale Trade, Distribution, + Transport	Professional Services	Other
Fuels	9,159	330	--	--	3,038	909	4,883	--
Nuclear Genera-tion	62,987	--	46,809	2,195	1,875	2,531	9,491	86
TOTAL	**72,146**	**330**	**46,809**	**2,195**	**4,913**	**3,440**	**14,374**	**86**

SNAPSHOT OF THE NUCLEAR INDUSTRY

- Contribution to GDP in 2018: $33.46 billion.[77]
- Overall employment: 72,146 jobs
- 735,420 GWh of nuclear generation through November 2018[78]

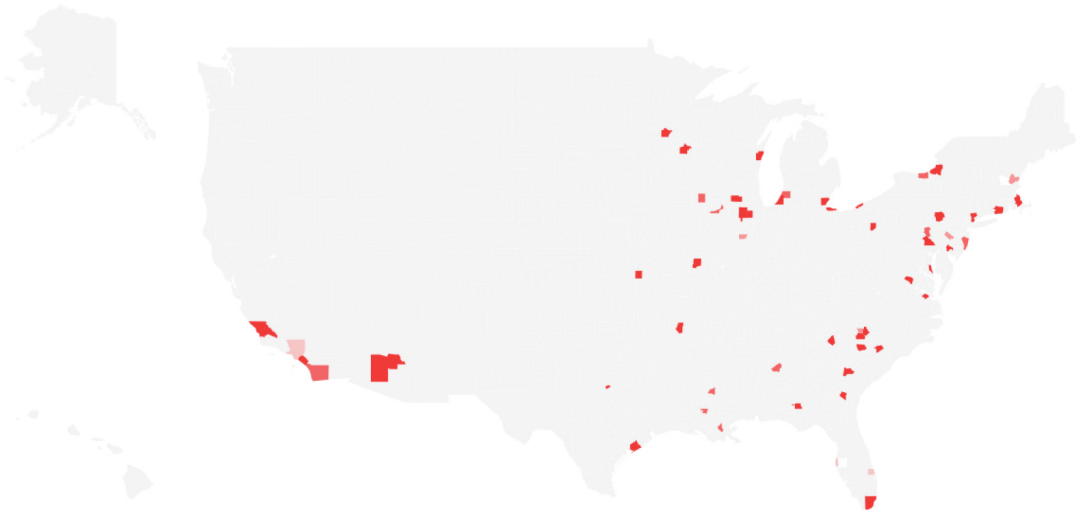
Wage Distribution[79]

- The average reported median full-time hourly wage for all entry level workers in the nuclear industry is $22.09/hour.
- The average reported median full-time hourly wage for all mid-wage workers is $35.47/hour.
- The average reported median full-time hourly wage for the highest earners in the industry is $55.40/hour.

Top wage jobs in industry

- Top wage earners in the nuclear industry include executive management (averaging $88.11/hour), computer and information systems managers (averaging $52.78/hour), physicists (averaging $57.13/hour), and nuclear engineers (averaging $50.87/hour).

Figure 82.
National Heat Map Showing Distribution of Nuclear Jobs



[77] Source: GDP estimates are developed by BW Research Partnership using Bureau of Economic Analysis (BEA) RIMS II data and data collected in the employer survey.
[78] Source: U.S. Energy Information Association, Table 1.1. Net Generation by Energy Source: Total (All Sectors), 2008-November 2018
[79] Bureau of Labor Statistics Occupational Employment Statistics; Economic Modeling Specialists, Inc.

STORAGE INDUSTRY

The storage industry has employment in one of the 2019 USEER chapters, Transmission, Distribution, and Storage. For detailed information on hiring trends and demographic makeup see the section beginning on page 106.

In total, the 2019 USEER finds that the storage industry employs 80,982 Americans, spread through the construction, manufacturing, wholesale trade, distribution, and transport, professional and business services, and other services in Table 43 below. Battery storage increased by 17.9 percent in 2018, driven by manufacturing employment.

SNAPSHOT OF THE STORAGE INDUSTRY

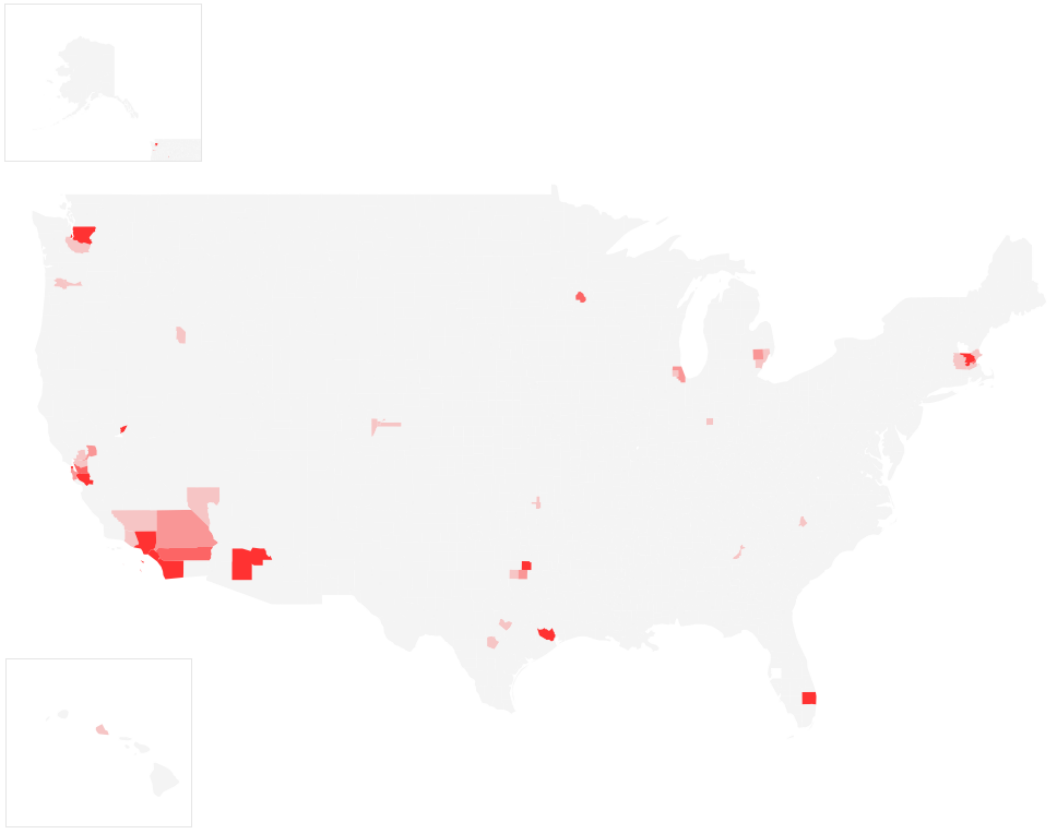
- Overall employment: 80,982 jobs

Table 43.
Storage Industry Employment by Detailed Technology Application and Industry, Q2 2018

	Total	Utilities	Construction	Manufact-uring	Wholesale Trade, Distribution, + Transport[80]	Professional Services	Pipeline Transport	Other Services
Pumped Hydro	8,239	--	3,322	2,508	272	1,386	667	85
Battery Storage	62,910	--	30,188	12,645	7,654	11,316	--	1,108
Other Storage	4,031	--	1,488	1,599	50	806	--	88
Petroleum Storage	2,042		1,264	274	31	--	--	471
Natural Gas Storage	1,776		575	301	214	675	--	12
Other Fuels Storage	1,983	--	1,322	--	<10	601	--	59
TOTAL	**80,981**	**0**	**38,159**	**17,327**	**8,221**	**14,784**	**667**	**1,823**

[80] Traditional transmission and distribution of petroleum, natural gas, and coal only includes commodity flow employment.

Figure 83.
National Heat Map Showing Distribution of Storage Jobs



Energy Efficiency

Energy Efficiency

Energy Efficiency employment covers both the production and installation of energy-saving products and the provision of services that reduce end-use energy consumption. These jobs, as specified in the current survey, include the manufacture of ENERGY STAR®-labeled products, as well as building design and contracting services that provide insulation, improve natural lighting, and reduce overall energy consumption across homes and businesses.[81]

TRENDS

- **2018 Job Growth.** In 2018, the Energy Efficiency sector continued to produce the most new jobs of any energy sector–over 76,000–with 2,324,866 jobs in total. Demand growth for efficient technology and building upgrades has driven expansion across many traditional industries including construction trades (which added almost 21,000 jobs) and professional services (which added 35,000 employees).
- **2019 Expectations.** Energy Efficiency employers report a projected growth rate for employment in 2019 of almost 8 percent. Construction employers, in particular, report expected Energy Efficiency job growth of 8.8 percent by the end of 2019.

3.4%

Energy Efficiency job growth in 2018.

7.8%

Employers predict 7.8% Energy Efficiency job growth in 2019.

- **Key Occupations:** The majority (nearly 56 percent) of Energy Efficiency employees worked at construction firms in 2018, installing or servicing Energy Efficiency goods or performing Energy Efficiency related services.[82] Approximately one in five workers in the Energy Efficiency sector worked in professional and business services.

[81] Estimates do not include retail employment. ENERGY STAR is a registered trademark of the U.S. Environmental Protection Agency.
[82] Building control equipment includes electrical equipment to automate, manage, or otherwise control mechanical and electrical building components such as lighting, ventilation, and power systems equipment.

SNAPSHOT OF EMPLOYMENT

Figure 84.
Energy Efficiency Sector – Employment by Industry, 2017-2018

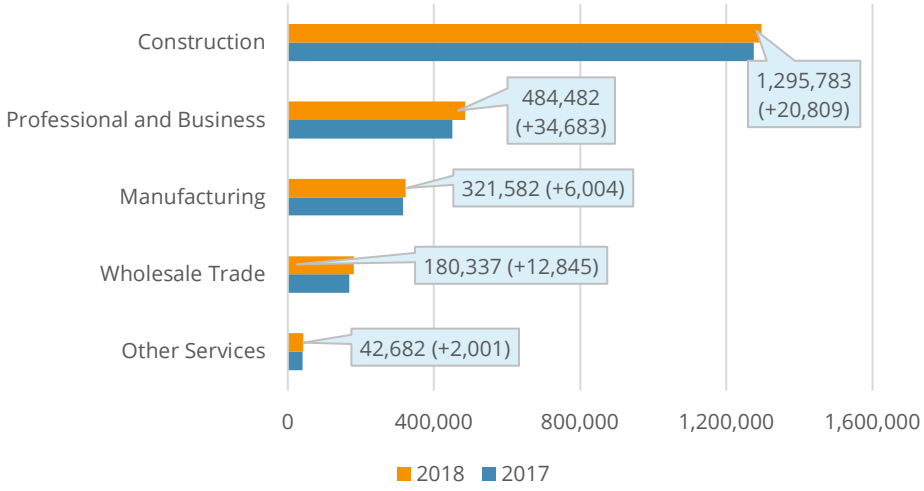
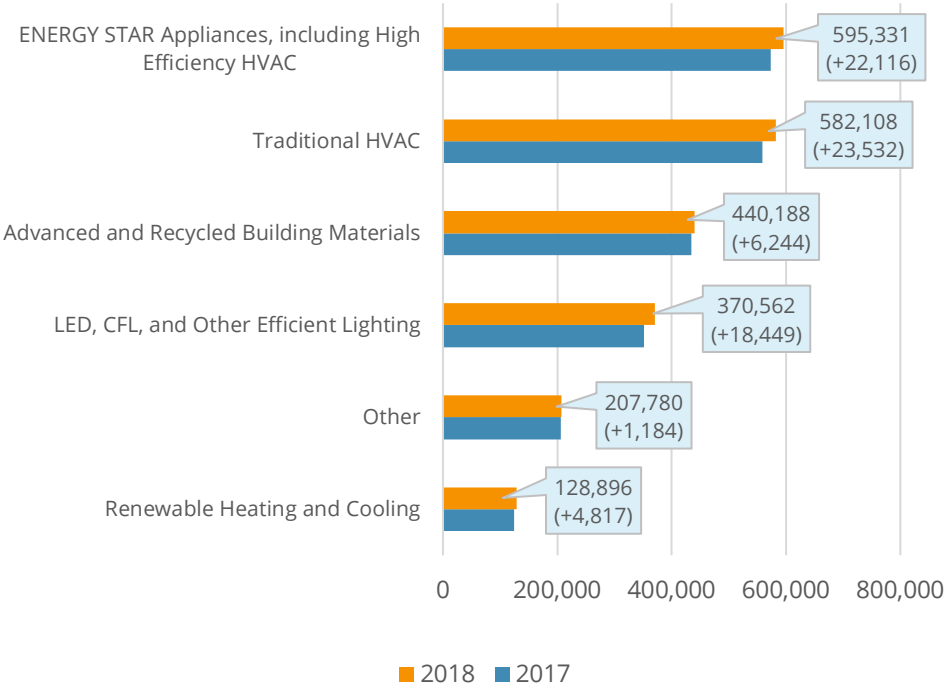


Figure 85.
Energy Efficiency Sector – Employment by Detailed Technology, 2017-2018



KEY TAKEAWAYS

- The manufacture of energy efficiency products, including those certified by ENERGY STAR, represented a sizeable portion of employment in 2018, with just under 14 percent of the total Energy Efficiency workforce. This represents an increase of 2 percent from 2017, or approximately 6,000 new jobs.
- Professional and business services added 34,700 new jobs. Construction added nearly 21,000 jobs in 2018. Construction firms working in the Energy Efficiency sector reported that 79 percent of their employees spend a majority of their time working with energy efficiency technologies, nearly even with the 80.3 percent reported in 2017.

Table 44.
Energy Efficiency Sector – Employment by Detailed Technology Application and Industry, Q2 2018

	Total	Construction	Manu-facturing	Wholesale Trade	Professional Services	Other Services
ENERGY STAR Appliances	167,828	86,547	17,350	12,852	46,671	4,408
LED, CFL and Other Efficient Lighting	370,562	184,471	49,408	39,266	93,901	3,517
Traditional HVAC goods, control systems, and services	582,108	322,181	33,023	54,354	156,326	16,224
ENERGY STAR/ High Efficiency heating and cooling equipment	427,503	275,285	74,791	26,362	46,421	4,644
Renewable Heating and Cooling (including Solar Thermal)	128,896	82,513	7,823	7,865	29,909	785
Advanced Building Materials/Insulation	357,765	204,245	74,377	22,462	54,297	2,384
Recycled building materials	82,423	46,921	11,844	2,801	17,849	3,007
Reduced water consumption products and appliances	91,555	58,069	6,109	5,291	20,728	1,358
Other	116,225	35,550	46,856	9,086	18,379	6,354
TOTAL	**2,324,865**	**1,295,782**	**321,581**	**180,339**	**484,481**	**42,681**

HIRING DIFFICULTY

- **84 percent of construction employers in energy efficiency** reported that it was somewhat difficult or very difficult to hire new employees in 2018 (with 52 percent reporting that it was very difficult, increasing from 47.3 percent in 2017).
- **82 percent of professional and business employers in energy efficiency** reported that it was either somewhat difficult or very difficult to hire new employees.
- **72 percent of energy efficiency manufacturing employers** reported that it was either somewhat or very difficult to hire new employees.

HIGHEST-DEMAND OCCUPATIONS IN ENERGY EFFICIENCY

With significant growth in 2017 and predicted growth of 180,000 new jobs in 2019, energy efficiency employers have identified below the occupations that each industry sector is having the greatest difficulty in filling.

Table 45.
Energy Efficiency Sector – Reported Occupations with Hiring Difficulty by Industry, Q4 2018

Construction	Manufacturing	Wholesale Trade, Distribution, and Transport	Professional and Business Services
Technician or mechanical support (42%)	Sales, marketing, or customer service representatives (24%)	Sales, marketing, or customer service representatives (67%)	Engineers/scientists (28%)
Electricians (41%)	Technician or mechanical support (21%)	Technician or mechanical support (25%)	Management (directors, supervisors, vice presidents) (21%)
Installation workers (27%)	Engineers/scientists (21%)	Management (directors, supervisors, vice presidents) (19%)	Designers or architects (18%)

Spotlight: "We don't need to choose between good jobs and a clean environment. We can and will have both."

Leo Gerard, International President, United Steelworkers

The United Steelworkers is North America's largest manufacturing union, representing 1.2 million active and retired members in the U.S. and Canada.

Leo Gerard, International President, United Steelworkers observed, "The cheapest way to get carbon out of the atmosphere and create jobs is through energy efficiency. I've been saying this for a long time. If we retrofitted every public school in America, if we retrofitted every government building, and then if we started on all our commercial buildings, we'd create millions of construction jobs.

"And when we start retrofitting our buildings, we create demand for the steel, the aluminum and the cement that puts our Steelworkers back to work. We have hundreds of thousands of miles of old transmission and distribution pipes that are leaking methane and others that are leaking clean water and wasting the energy that operates our filtration plants.

"All these investments will pay for themselves, clean up the environment and create jobs. I've said it for a long time and I'll say it again. We don't need to choose between good jobs and a clean environment. We can and will have both."

INTRODUCTION

There are no individual NAICS codes that can be entirely allocated to Energy Efficiency employment. Thus, BLS has no specific data sets that exclusively count jobs in this sector. A key component of the USEER employer survey is the ENERGY STAR program, which was founded twenty-five years ago.

The ENERGY STAR program is recognized by over 90 percent of American households, while 40 percent of Fortune 500 companies rely on ENERGY STAR to deliver energy-saving solutions.

ENERGY STAR sets definitions of efficiency leadership for 75 different residential and commercial products that in turn cover over 60,000 individual product models. Identifying the jobs that produce and install these products is one of the key tasks of the USEER survey. However, ENERGY STAR also administers three additional programs for commercial buildings, industrial plants, and new and existing homes. While the USEER survey counts these jobs in its interviews with construction and maintenance firms, the jobs are not necessarily identified with ENERGY STAR. Future additions of the USEER will specifically seek to address this gap.

In addition to identifying jobs that manufacture ENERGY STAR labeled products, the USEER identifies employment in building design and contracting services that provide insulation, improve natural lighting, and reduce overall energy consumption across homes and businesses.[83] The USEER Energy Efficiency employment figures include only work with these efficient technologies or building design and retrofits. The report does not capture employment related to energy-efficient manufacturing processes. It does capture employment associated with CHP and waste-heat to power (WHP), though these technologies are included in the Electric Power Generation chapter. In the meantime, please see the recently released Energy Productivity and Economic Prosperity Index for more information on manufacturing process efficiency.[84]

Demand growth for efficient technology and building upgrades has driven expansion across many traditional industries, including construction trades, appliance manufacturing, building materials, lighting, and other energy-saving goods and services. As such, Energy Efficiency workers are found across many subsets of traditional industries.

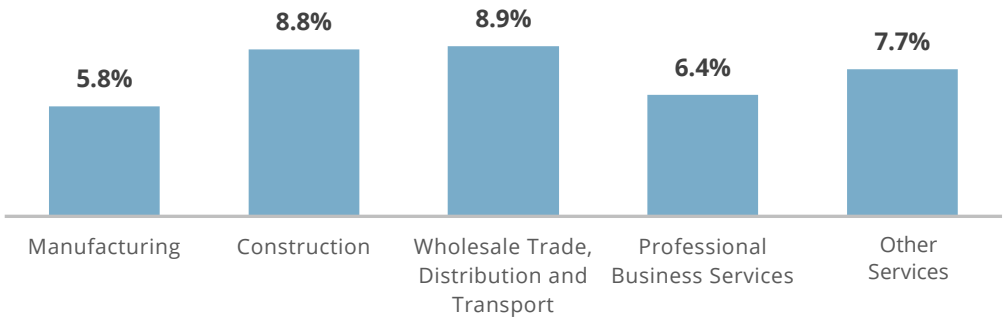
[83] Estimates do not include retail employment.
[84] Kornelis Blok, Paul Hofheinz, and John Kerkoven, *The 2015 Energy Productivity and Economic Prosperity Index* (Brussels: Lisbon Council for Economic Competitiveness and Social Renewal, 2015), https://lisboncouncil.net/publication/publication/121.html.

SUMMARY

Energy Efficiency employment grew in 2018 by just over 3 percent from 2017. The 2018 USEER has identified approximately 2.32 million workers across the construction, manufacturing, wholesale trade, professional and business services, and other services industries that spent some or all of their time working with energy-efficient technologies and services in 2018, as defined earlier in this report. At least 595,000 of these employees were directly involved in producing or installing ENERGY STAR certified appliances; ENERGY STAR certified heating and cooling equipment; or similarly highly efficient heating, ventilation, and air-conditioning (HVAC) equipment. Future editions of the USEER will identify additional ENERGY STAR jobs related to the program's commercial building, industrial, and new and existing home programs.

Energy Efficiency employers report a projected growth rate for employment in 2019 of nearly 8 percent. Construction employers, in particular, report expected Energy Efficiency job growth of 8.8 percent by the end of 2019.

Figure 86.
Energy Efficiency Sector – Expected Employment Growth by Major Industry (Q4 2018 – Q4 2019)



The majority, nearly 56 percent, of Energy Efficiency employees worked for firms in the construction sector in 2018, installing or servicing Energy Efficiency goods or performing Energy Efficiency related services.[85] Approximately one in five workers in the Energy Efficiency sector worked in professional and business services. The manufacture of ENERGY STAR certified products represented a sizable portion of employment in 2017, with just under 14 percent of the total Energy Efficiency workforce. This represents an increase of 2 percent from 2017.

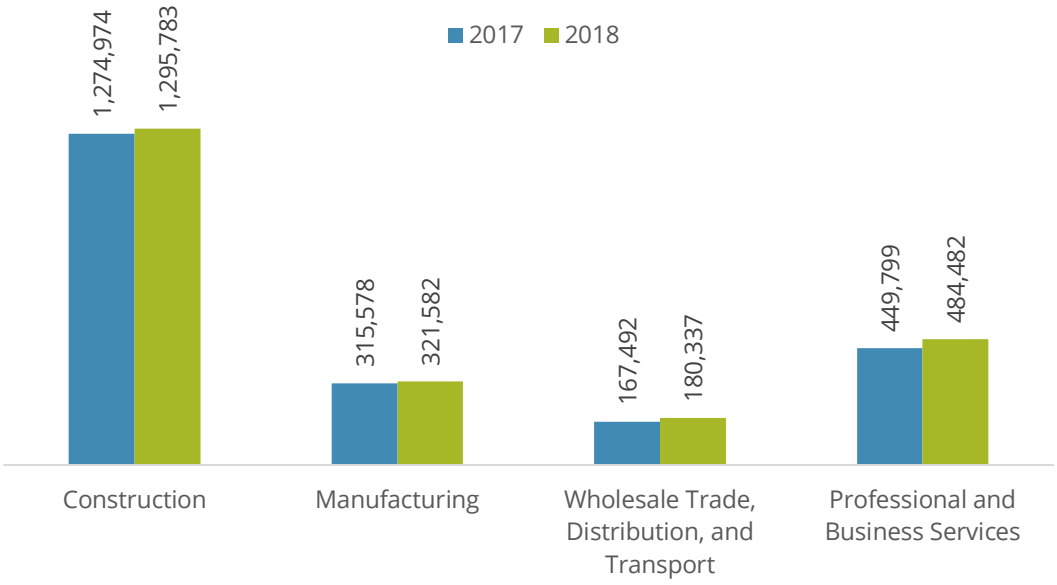
[85] Building control equipment includes electrical equipment to automate, manage, or otherwise control mechanical and electrical building components such as lighting, ventilation, and power systems equipment.

The 2019 USEER does not cover retail trade, but BLS data finds that retail trade industries that sell and distribute ENERGY STAR appliances and building materials (as well as non-qualifying appliances and building materials) employ approximately 4.7 million Americans across several different sectors.[86]

The market penetration–and resulting manufacture and sales–of certified ENERGY STAR products continues to increase.[87] The penetration and revenues from ENERGY STAR products varies significantly. For example, in 2017, only 3 percent of ceiling fans with lights, 21 percent of computer workstations, 38 percent to 40 percent of clothes dryers, and 18 percent to 59 percent of commercial cooking equipment meet ENERGY STAR guidelines. However, between 44 percent and 46 percent of refrigerators (commercial and residential, respectively), and 70 percent of LED bulbs, 88 percent of dehumidifiers, 90 percent of notebook computers, and 99 percent of multifunction printers are certified ENERGY STAR products.[88] A table of products tracked by the EPA is available in Appendix C.

Figure 87.

Energy Efficiency Sector – Employment by Major Industry Sectors, Q2 2018



[86] These industries include Household Appliance Stores (443141), Electronics Stores (443142), Building Material and Supplies Dealers (4441), Department Stores (452210), and Warehouse Clubs and Supercenters (452311). These are retail establishments that are not defined by their sale of ENERGY STAR appliances or EE products. Some are defined by their sale of appliances in general (i.e., those under NAICS 4431) but even these are not the sole retailers of EE products – they could be general retailers as well such as big box stores that sell wide varieties of items.

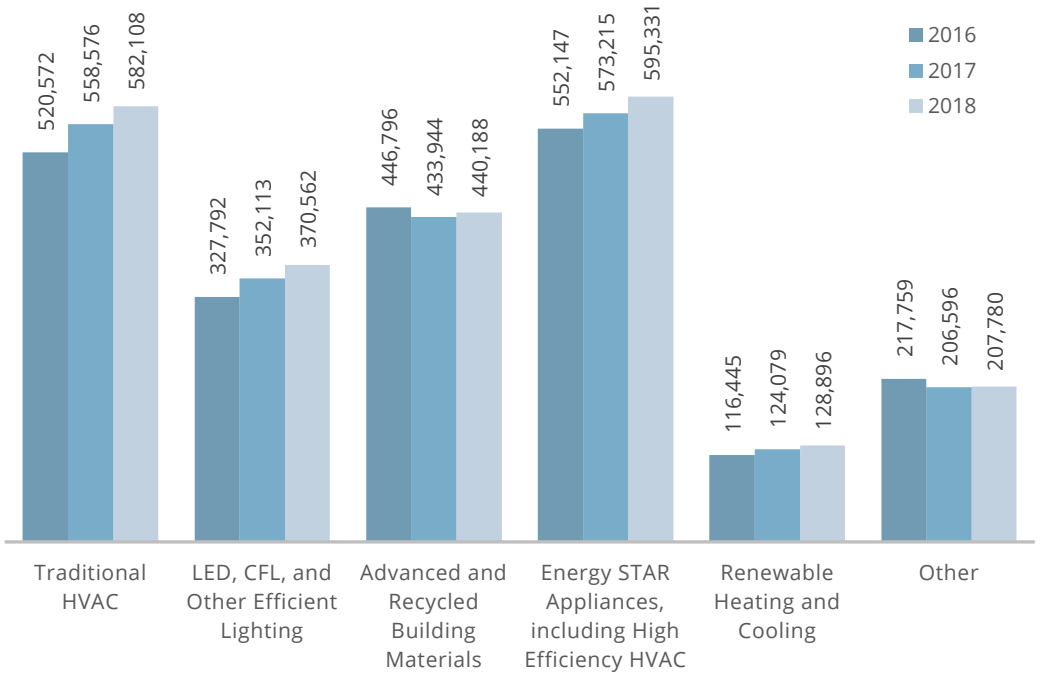
[87] This trend can be generally seen by comparing recent annual editions of the *ENERGY STAR Unit Shipment and Market Penetration Report*, available at https://www.energystar.gov/index.cfm?c=partners.unit_shipment_data_archives. When an ENERGY STAR specification for a particular product type is strengthened, there is sometimes a decrease in the market penetration of the products meeting that higher specification in the following year.

[88] EPA, *ENERGY STAR Unit Shipment and Market Penetration Report: Calendar Year 2017 Summary* (Washington, D.C., 2018), https://www.energystar.gov/ia/partners/downloads/unit_shipment_data/2017/2017%20Unit%20Shipment%20Data%20Summary%20Report.pdf?8fd5-1967.

ENERGY EFFICIENCY EMPLOYMENT BY DETAILED TECHNOLOGY APPLICATION

As depicted in Figure 88, ENERGY STAR appliances, including high efficiency heating and cooling equipment, was the largest category of employment in the Energy Efficiency sector, employing just over a quarter of the Energy Efficiency workforce in 2018. The second largest category of employment was the traditional HVAC industry, with just under a quarter of the sector's employment in 2018. These employees spent a majority of their time working with traditional HVAC goods and services, but a portion of their time was also dedicated to energy-efficient technologies. This is an important distinction, particularly with installers, because the majority of these employees would also have specific training in high-efficiency HVAC systems.[89] The third largest category of employment was advanced building materials, followed by energy efficient lighting. The Other category in Figure 88 includes reduced water consumption products and appliances.

Figure 88.
Energy Efficiency Sector – Employment by Detailed Technology Application (Q2 2016 - Q2 2018)



[89] Unlike the installation and repair of ENERGY STAR appliances, such as dishwashers, refrigerators, or other energy-efficient products, high-efficiency HVAC systems often have very specific certifications or training requirements in order to properly install and maintain the equipment. Manufacturers often require such certifications for warranty purposes, and EPA has a specific credentialing program for ENERGY STAR heating and cooling (see: http://www.energystar.gov/index.cfm?c=bldrs_lenders_raters.nh_hvac_contractors_become).

Construction firms working in the Energy Efficiency sector reported that 79 percent of their workers spend at least 50 percent of their time on energy efficiency-related work. This was down slightly from 80.3 percent in 2017 after two years of very rapid growth in 2016 and 2017.

Construction workers across the Energy Efficiency sector are primarily engaged in both traditional HVAC and high efficiency heating and cooling equipment; together, these two technology applications accounted for 46 percent of construction-related work in the Energy Efficiency sector in 2018. Advanced and recycled building materials and insulation technologies also supported a significant amount of construction employment–over 251,100 jobs. The manufacturing industry is heavily concentrated in high efficiency heating and cooling equipment as well as advanced and recycled building materials and insulation–approximately 157,400 manufacturing employees or half of efficiency-related manufacturing work in 2018. About three in ten workers in the wholesale trade industry and nearly a third in professional and business services were mostly working with traditional HVAC goods.

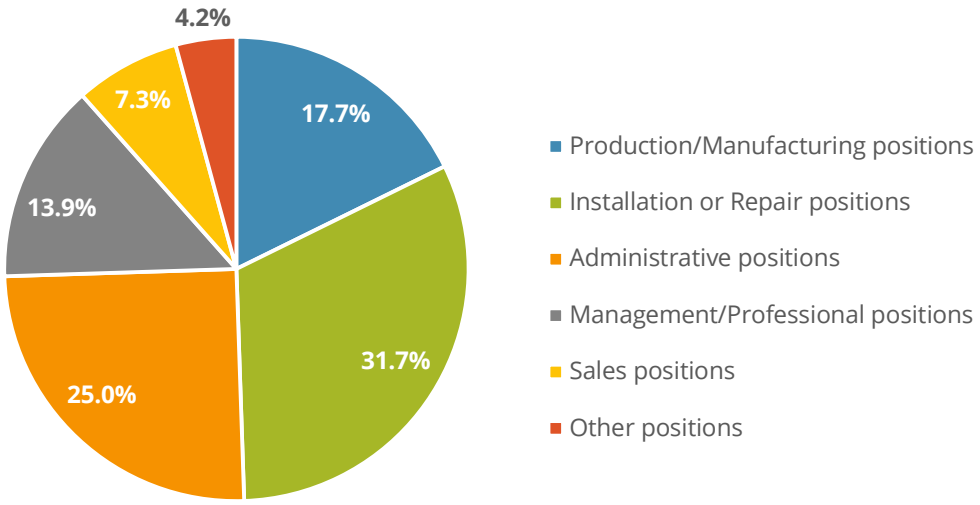
Table 46.
Energy Efficiency Sector – Employment by Detailed Technology Application and Industry, Q2 2018

	Total	Construction	Manufact-uring	Wholesale Trade	Professional Services	Other
ENERGY STAR Appliances	167,828	86,547	17,350	12,852	46,671	4,408
LED, CFL and Other Efficient Lighting	370,562	184,471	49,408	39,266	93,901	3,517
Traditional HVAC goods, control systems, and services	582,108	322,181	33,023	54,354	156,326	16,224
ENERGY STAR/ High Efficiency heating and cooling equipment	427,503	275,285	74,791	26,362	46,421	4,644
Renewable Heating and Cooling (including Solar Thermal)	128,896	82,513	7,823	7,865	29,909	785
Advanced Building Materials/ Insulation	357,765	204,245	74,377	22,462	54,297	2,384
Recycled building materials	82,423	46,921	11,844	2,801	17,849	3,007
Reduced water consumption products and appliances	91,555	58,069	6,109	5,291	20,728	1,358
Other	116,225	35,550	46,856	9,086	18,379	6,354
TOTAL	2,324,865	1,295,782	321,581	180,339	484,481	42,681

ENERGY EFFICIENCY – WORKFORCE CHARACTERISTICS

Nearly 32 percent of all workers in Energy Efficiency were employed in installation or repair positions in 2018, followed by administrative positions (25 percent).

Figure 89.
Energy Efficiency Sector – Occupational Distribution, Q4 2018



In the Energy Efficiency sector, 84 percent of employers in construction and 82 percent of professional and business services reported some difficulty finding qualified job applicants. Seventy percent or more of Energy Efficiency employers in all industries reported at least some difficulty in hiring. Energy Efficiency construction, the largest single segment of the traditional and energy efficiency sectors with over 1.2 million employees, also reported the single highest degree of difficulty in hiring new employees.

Figure 90.
Energy Efficiency Sector – Hiring Difficulty by Industry, Q4 2018

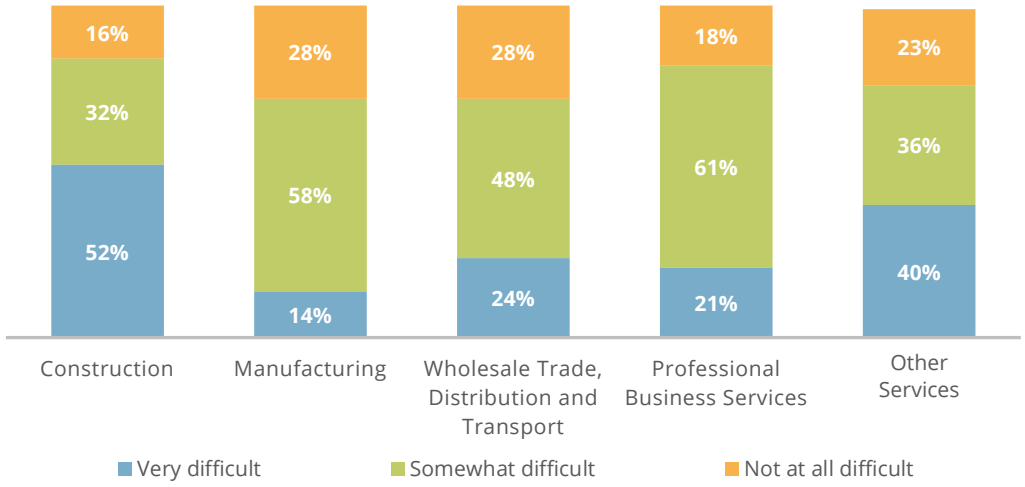
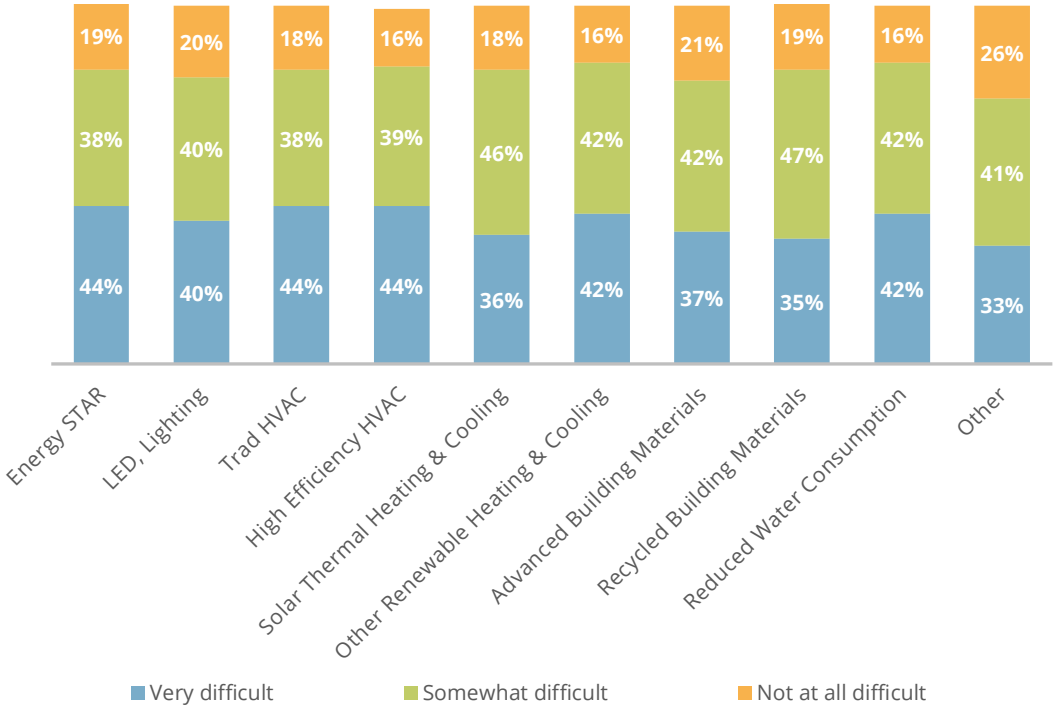


Figure 91.
Energy Efficiency Sector – Hiring Difficulty by Technology, Q4 2018



Employers in Energy Efficiency with hiring difficulty indicated that lack of experience, training, or technical skills were the reason for the largest share of difficulty finding qualified applicants.

Table 47.

Energy Efficiency Sector – Reasons for Hiring Difficulty by Industry, Q4 2018

Construction	Manufacturing	Wholesale Trade, Distribution, and Transport	Professional and Business Services
Lack of experience, training, or technical skills (48%)	Lack of experience, training, or technical skills (55%)	Lack of experience, training, or technical skills (49%)	Lack of experience, training, or technical skills (40%)
Competition/ small applicant pool (24%)	Insufficient non-technical skills (39%)	Insufficient non-technical skills (27%)	Competition/ small applicant pool (22%)
Insufficient non-technical skills (24%)	Difficulty finding industry-specific knowledge, skills, and interest (18%)	Competition/ small applicant pool (19%)	Insufficient qualifications, certifications, education (19%)

The following table lists the occupations by industry that Energy Efficiency employers mentioned were the most difficult to fill in 2018.

Table 48.

Energy Efficiency – Reported Occupations with Hiring Difficulty by Industry, Q4 2018

Construction	Manufacturing	Wholesale Trade, Distribution, and Transport	Professional and Business Services
Technician or mechanical support (42%)	Sales, marketing, or customer service representatives (24%)	Sales, marketing, or customer service representatives (67%)	Engineers/ scientists (28%)
Electricians (41%)	Technician or mechanical support (21%)	Technician or mechanical support (25%)	Management (directors, supervisors, vice presidents) (21%)
Installation workers (27%)	Engineers/scientists (21%)	Management (directors, supervisors, vice presidents) (19%)	Designers or architects (18%)

Less than a quarter of employees in 2018 were reported to be women (24 percent – half the proportion when compared to national workforce averages), and there were fewer Black or African American workers and slightly fewer Hispanic or Latino and Asian workers compared to the national workforce average. However, overall racial diversity in the energy efficiency workforce was equivalent to the national workforce. Unionization rates in the Energy Efficiency sector in 2018 were equivalent to the national average at 11 percent.

Table 49.

Energy Efficiency Sector – Demographics, Q4 2018

Demographic	Employees	Percent of Sector	National Workforce Averages
Male	1,767,865	76%	53%
Female	557,000	24%	47%
Hispanic or Latino	365,427	16%	17%
Not Hispanic or Latino	1,959,438	84%	83%
American Indian or Alaska Native	32,553	1%	1%
Asian	120,540	5%	6%
Black or African American	175,914	8%	12%
Native Hawaiian or other Pacific Islander	26,716	1%	>1%
White	1,811,682	78%	78%
Two or more races	157,460	7%	2%
Veterans	235,384	10%	6%
55 and over	327,072	14%	23%
Union	251,785	11%	11%

Motor Vehicles & Component Parts

Motor Vehicles & Component Parts

Though not considered a sector of the Traditional Energy industry, the Motor Vehicles and Component Parts sector,[90] which include cars, light-duty and heavy-duty trucks, trailers, and component parts of the foregoing, are included in this report, given both the high energy consumption of their manufacture and their contribution to end-use energy consumption.

TRENDS

- **2017 Job Growth.** The Motor Vehicles and Component Parts sector employed 2,536,382 Americans in 2018, adding 74,000 employees to the number employed in 2017. This figure excludes dealerships and retailers, which employed nearly two million additional workers.
- **Alternative fuels vehicles and hybrids.** Within the overal total for the sector, alternative fuels vehicles and hybrids employed 253,598 workers in 2018, an increase of nearly 34,000 in 2018 after a significant decline in 2017.
- **Fuel economy**. Over 486,000 employees in the component parts segment of the sector (or 43 percent of component parts employees) work with products that contribute to fuel economy.
- **2019 Expectations.** Motor Vehicles and Component Parts employers anticipate 2.2 percent growth in 2019.

3.0%

Motor Vehicle job growth in 2018.

2.2%

Employers predict 2.2% Motor Vehicles job growth in 2019.

[90] Motor Vehicle and Component Parts employers are defined as any firm that contributes to the manufacture, wholesale distribution, transport, and repair and maintenance of gasoline, diesel, hybrid, electric, natural gas, hydrogen and fuel cell, or other vehicle technologies.

SNAPSHOT OF EMPLOYMENT

Figure 93.

Motor Vehicle and Component Parts Sector – Employment by Industry, 2017-2018

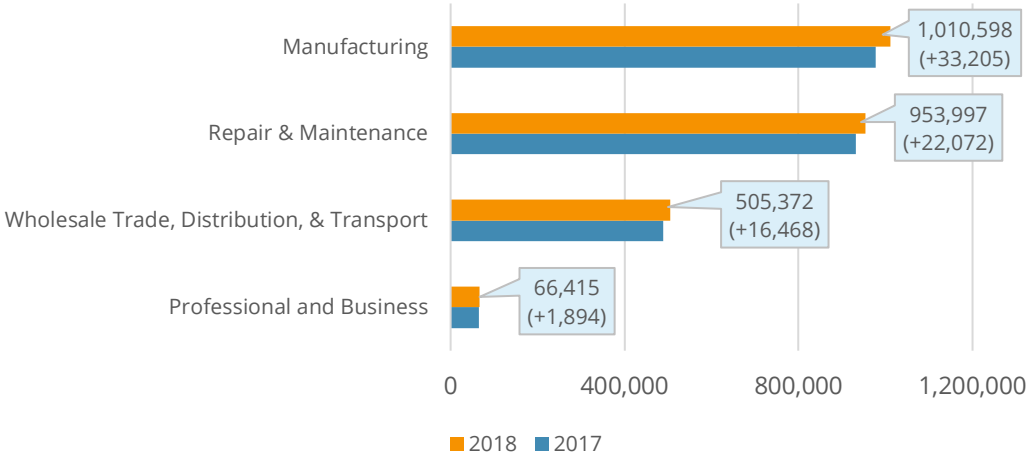
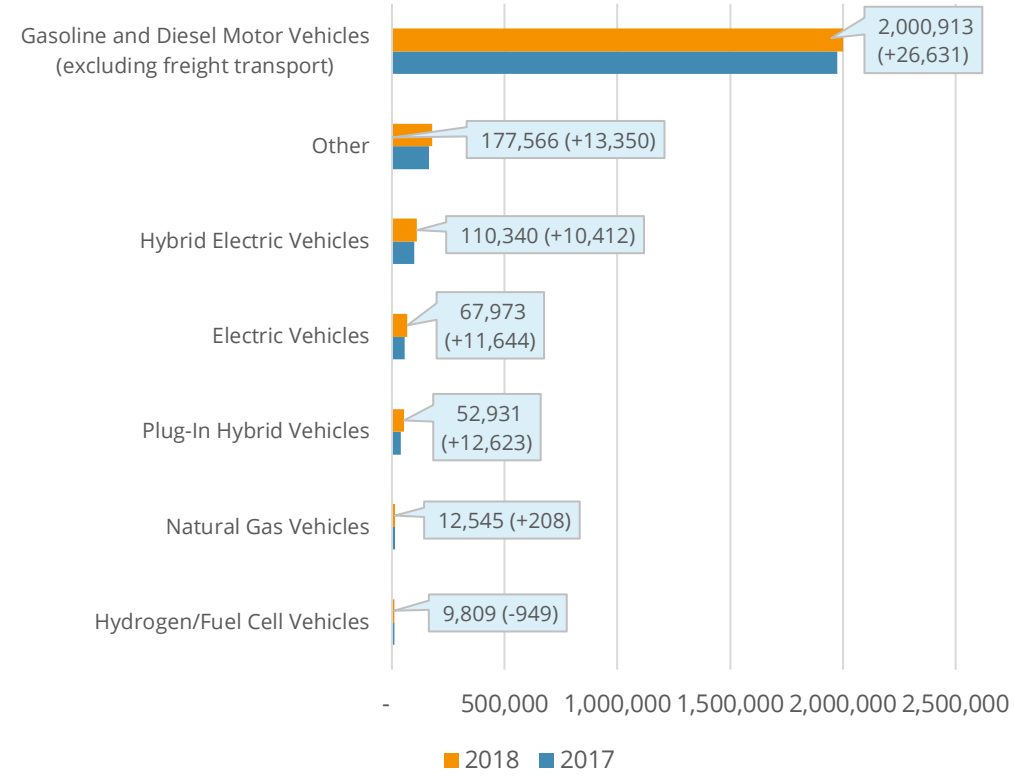


Figure 92.

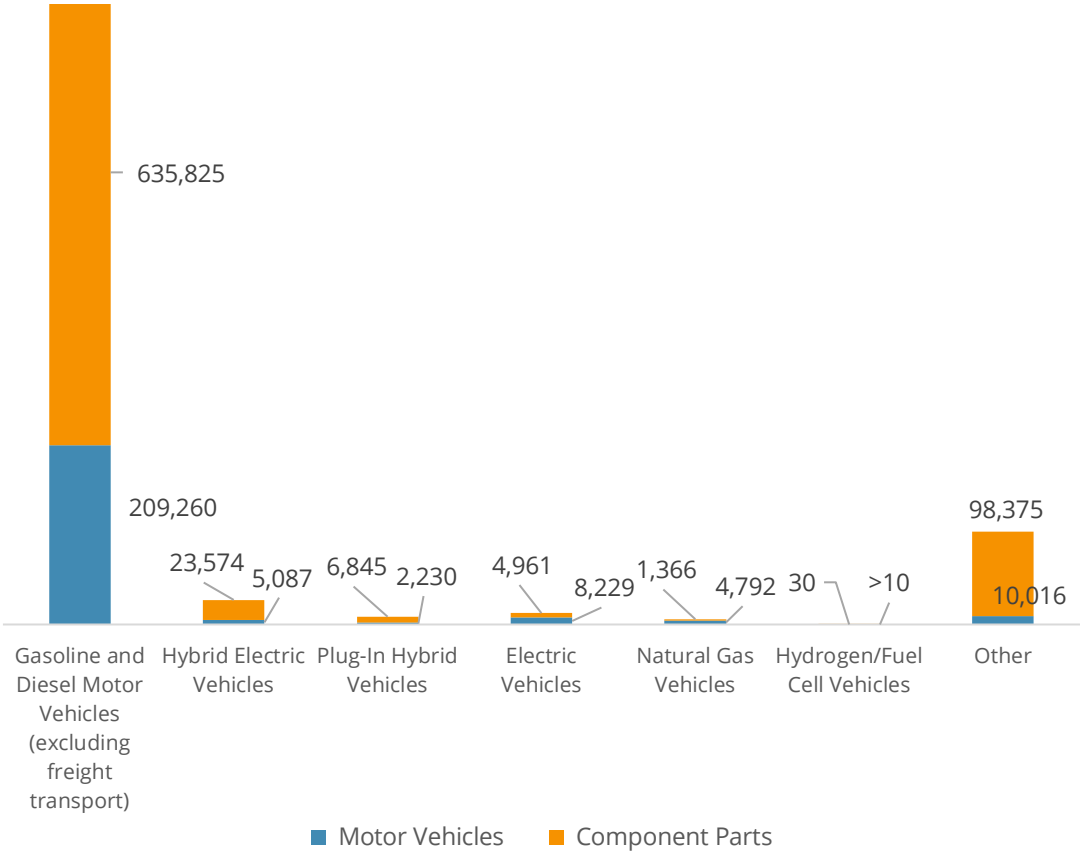
Motor Vehicles and Component Parts Sector – Employment by Detailed Technology, 2017-2018



ALTERNATIVE FUELS VEHICLES AND HYBRIDS

- Alternative fuels vehicles and hybrids include hybrid electric, plug-in hybrid, electric, natural gas, and hydrogen and fuel cell vehicles.
- 10 percent of employees in the Motor Vehicles and Component Parts sector (or 253,599 employees) worked on alternative fuels vehicles.[91]
- 82 percent of employees in the sector worked with gasoline and diesel fueled motor vehicles.
- 4 percent worked in transport.
- 3 percent worked in professional services.

Figure 94.
Motor Vehicles and Component Parts Sector – Manufacturing Employment by Detailed Technology Application, Q2 2018



[91] Percentage is taken from Motor Vehicle employment exclusive of commodity flow employment.

- The above chart shows the division of manufacturing employment in each technology between component parts and other occupations.[92]
- The domestic manufacture of alternative fuels vehicles and hybrids grew between 2017 and 2018 in most technologies, with hybrids adding almost 8,000 manufacturing jobs and plug-in and all electric vehicles adding 3,100.
- However, domestic sales of electric and plug-in vehicles rose by over 81 percent in 2018, according to Inside EV.[93]

HIRING DIFFICULTY

- **79 percent of other services employers** in motor vehicles reported that it was either somewhat or very difficult to hire new employees.
- **78 percent of manufacturing employers in motor vehicles** reported that it was somewhat difficult or very difficult to hire new employees. 36 percent reported it was very difficult.
- **77 percent of professional and business services employers in motor vehicles** reported it was somewhat difficult to hire new employees.

[92] Of the 376 employees within hydrogen and fuel cell vehicles that worked on component parts, fewer than 10 employees were focused on motor vehicles manufacturing.
[93] Steven Loveday, "December 2018 U.S. Plug-In EV Sales Report Card," *InsideEVs*, January 5, 2019, https://insideevs.com/december-2018-u-s-plug-in-ev-sales-report-card/

HIGHEST-DEMAND OCCUPATIONS IN MOTOR VEHICLES

With 3 percent growth in 2018 and predicted growth of almost 54,000 new jobs in 2019, motor vehicle employers have identified below the occupations that each sector is having the greatest difficulty in filling.

Table 50.
Motor Vehicles and Component Parts – Reported Occupations with Hiring Difficulty by Industry, Q4 2018

Manufacturing	Wholesale Trade, Distribution, and Transport	Professional and Business Services	Other
Technician or mechanical support (52%)	Technician or mechanical support (46%)	Management (directors, supervisors, vice presidents) (30%)	Technician or mechanical support (80%)
Electrician/ construction workers (28%)	Drivers/dispatchers (25%)	Other (50%)	Sales, marketing, or customer service representatives (32%)
Manufacturing or production positions (12%)	Sales, marketing, or customer service representatives (20%)	Electrician/ construction workers (17%)	Management (directors, supervisors, vice presidents) (11%)

Spotlight: "Southwest Michigan is experiencing an extreme shortage of workers."

Melinda Ellsworth, VP of Investor Relations and Corporate Communications, Kaiser Aluminum

Kaiser Aluminum is a leading producer of highly engineered aluminum products for aerospace, general engineering, and automotive applications. Aluminum is inherently sustainable, indefinitely recyclable and one of the most effective materials to achieve fuel efficiency standards.

In 2010, Kaiser opened a state-of-the-art rod and bar extrusion facility in Kalamazoo, Michigan, in the heart of its market with access to a good talent pool and educational resources. The business has continued to grow with the growth in automotive extrusion applications as vehicle light weighting for fuel efficiency drove greater conversion of components from steel to aluminum. The facility produces aluminum extrusions for anti-lock braking systems, control arm assemblies and drive-train applications.

The 2019 USEER reported that 78% of motor vehicles' manufacturers found it was difficult to hire new employees. "Southwest Michigan is experiencing an extreme shortage of workers due to a historically low 3.4% unemployment rate," said Melinda Ellsworth, VP of Investor Relations and Corporate Communications. "We are competing to attract talent with other manufacturers who are also hiring — many well-known and highly regarded employers. Although the shortage of workers poses a challenge, it has been especially challenging with the shortage of skilled trades workers."

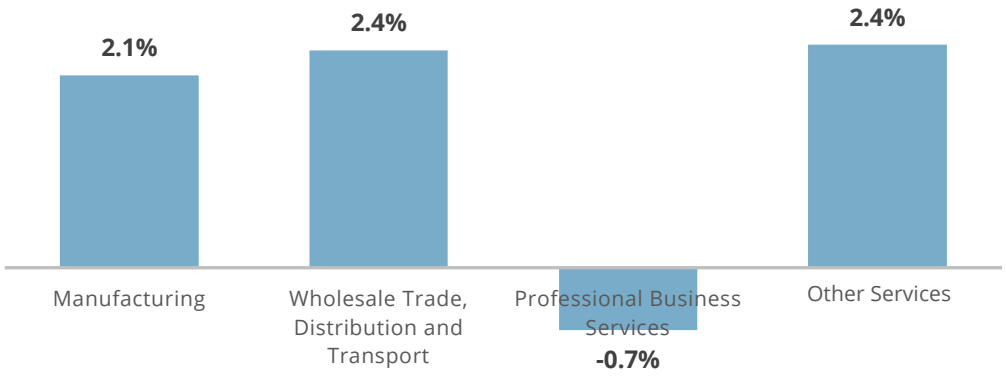
Several initiatives to entice applicants include employee referral programs. Other programs include sign-on bonuses for maintenance technicians; partnerships with community colleges/other organizations; expanding the recruiting efforts outside the local areas, offering in certain situations, full relocation; pursuing candidates outside the traditional manufacturing experience pool and continuing to focus on training and development employees.

INTRODUCTION

Three NAICS subsectors[94] capture Motor Vehicles finished product manufacturing, including automobiles, and light- and heavy-duty trucks, parts, body, and trailer manufacturing. Together these three detailed industry sectors employed 1,010,598 workers in 2018. Motor vehicle and parts wholesalers and air, rail, water, or truck motor vehicle transport represent detailed NAICS subsectors within Wholesale Trade and Distribution, and the QCEW reports the total number of workers who are employed by these firms in 2018 to be 505,372. Similarly, motor vehicle repair[95] and maintenance is captured by a single NAICS industry code within the overall repair and maintenance industry sector; motor vehicle repair and maintenance firms employed 953,997 workers in 2018. Professional and business services are not motor vehicle-specific, but the USEER survey identified 66,415 workers who spent at least some time supporting the Motor Vehicles sector in 2017. Nearly three in five (59 percent) of these professional and business services employees spent the majority of their time supporting the Motor Vehicle and Component Parts sector, with 55 percent spending all of their time on this work.

Employers in the Motor Vehicles and Component Parts sector report projected growth of 2.2 percent through the end of 2019. Manufacturing, the largest industry in the Motor Vehicle and Component Parts sector, predicted 2.1% growth in 2019 or over 20,000 jobs. Professional and business services employers expect their workforce to decline by one percent.

Figure 95.
Motor Vehicles and Component Parts Sector – Expected Employment Growth by Industry (Q4 2018 – Q4 2019



[94] NAICS 3361, 3362, and 3363.
[95] The official term for the NAICS category is Automotive Repair and Maintenance, which includes repair and maintenance for light-duty and heavy-duty trucks. This is inconsistent with Manufacturing NAICS, which includes delineations for light-duty and heavy-duty truck manufacturing.

ALTERNATIVE FUEL VEHICLES AND HYBRIDS

While the repair and maintenance industry sector actively works with alternative fuel vehicles and hybrids, there is difficulty delineating primary employment by fuel type for these firms, so it should be noted that employment totals included for repair are based on best efforts by respondents to allocate their workforce by fuel type.[96]

Of the 2,432,078 Motor Vehicles and Component Parts jobs in 2018 (exclusive of the 104,304 employees that were involved in the transport of motor vehicles),[97] 10 percent, or 253,598, focused on alternative fuel vehicles and hybrids, while 82 percent worked with traditional gasoline- and diesel-fueled motor vehicles.

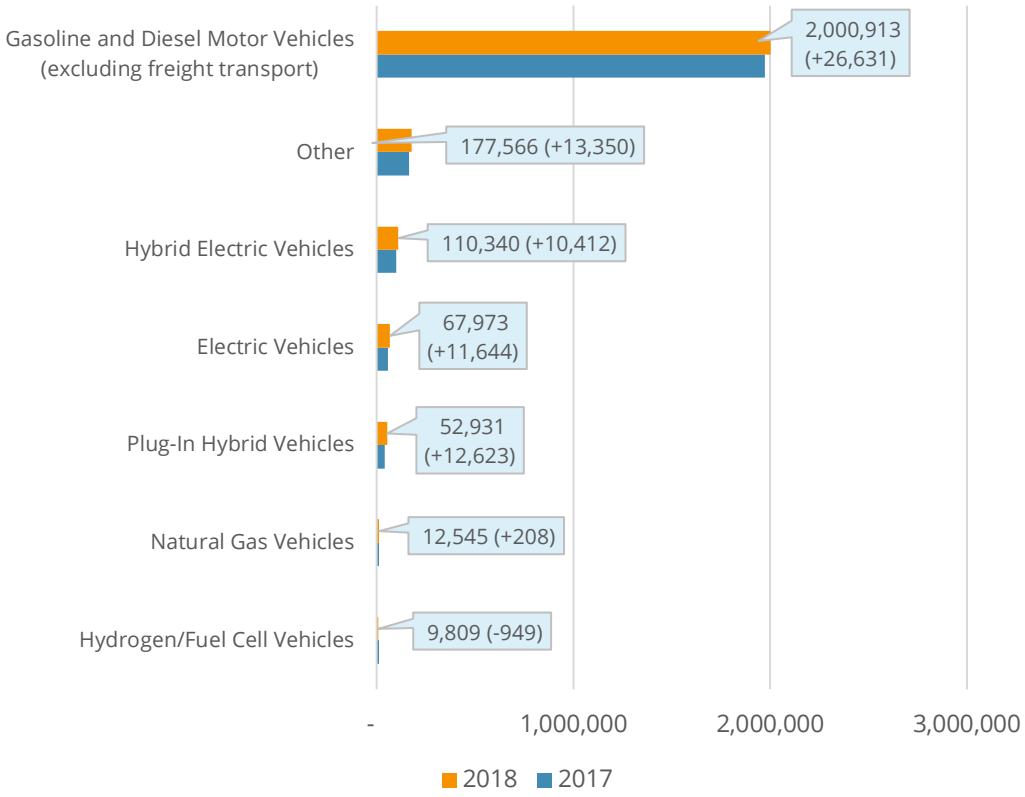
In addition, USEER data identified 43 percent of component parts manufacturing in 2018, or more than 486,000 jobs, that produce parts that increase fuel economy in the United States. Note that there is some overlap between those who work with alternative fuel vehicles and those that produce parts that increase fuel economy.

In addition to the Motor Vehicles and Component Parts industries included in this 2019 USEER, several other transportation industries use alternative fuel technologies, focus on fuel economy, or both. These include aerospace product and parts manufacturing; railroad and rolling stock manufacturing; ship and boat building; industrial truck, trailer, and stacker manufacturing; and other transportation equipment manufacturing.

These manufacturing industries employed a total of more than 699,400 workers nationwide in 2018. They encompass a wide range of detailed industries ranging from boat building to guided missile manufacturing. Approximately 486,000 of these jobs (72 percent) are found in aviation and aerospace industries.

[96] This analysis was conducted for the chapter; however, it is recognized that Motor Vehicle repair and maintenance establishments may have difficulty assigning primary employment to a worker who is involved in vehicles regardless of fuel type. More research is required into the Motor Vehicle repair and maintenance industry sector in order to understand employment intensity for alternative fuel vehicles.
[97] Extrapolated employment from commodity flow data for motor vehicles.

Figure 96.
Motor Vehicles and Component Parts Sector – Employment by Detailed Technology, Q2 2018

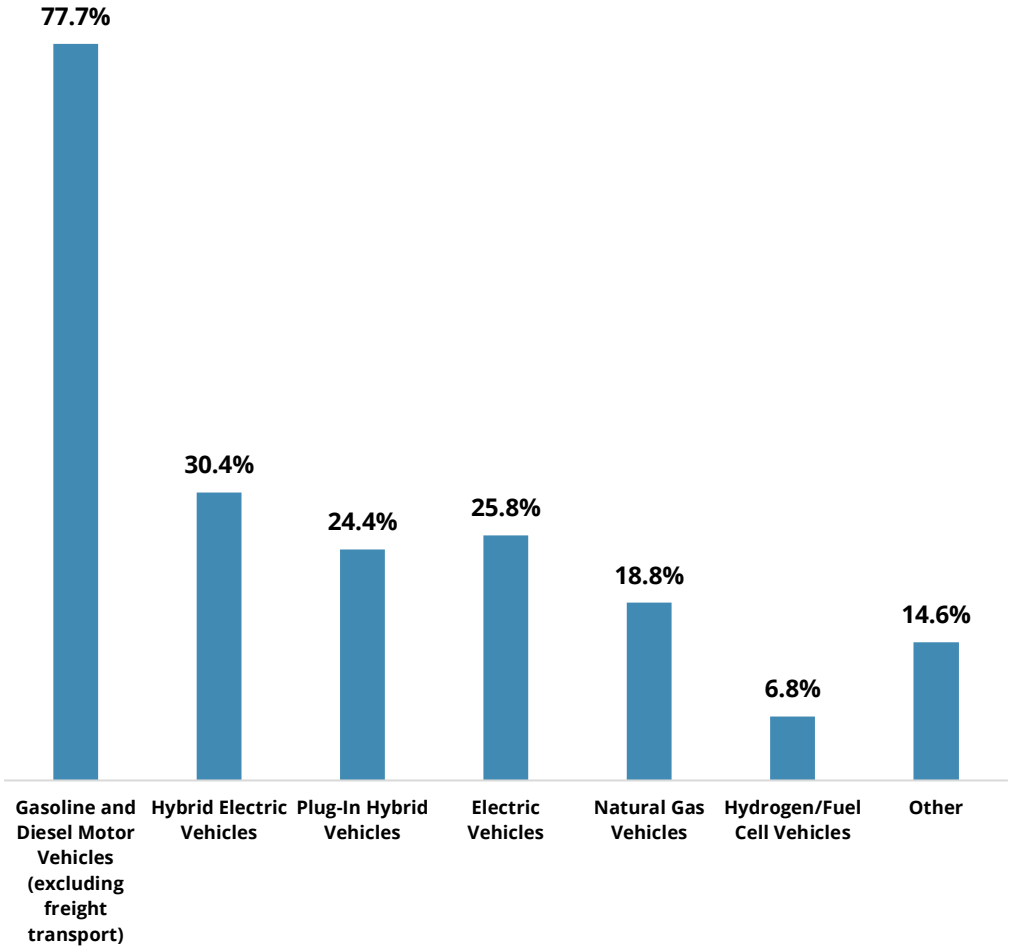


As shown in Figure 97, approximately eight out of ten (78 percent) Motor Vehicle parts firms offered parts in 2017 for gasoline and diesel motor vehicles, while more than 30 percent offered component parts for hybrid electric vehicles.[98]

[98] Firms were permitted to offer multiple responses, percentages sum to over 100 percent.

Figure 97.

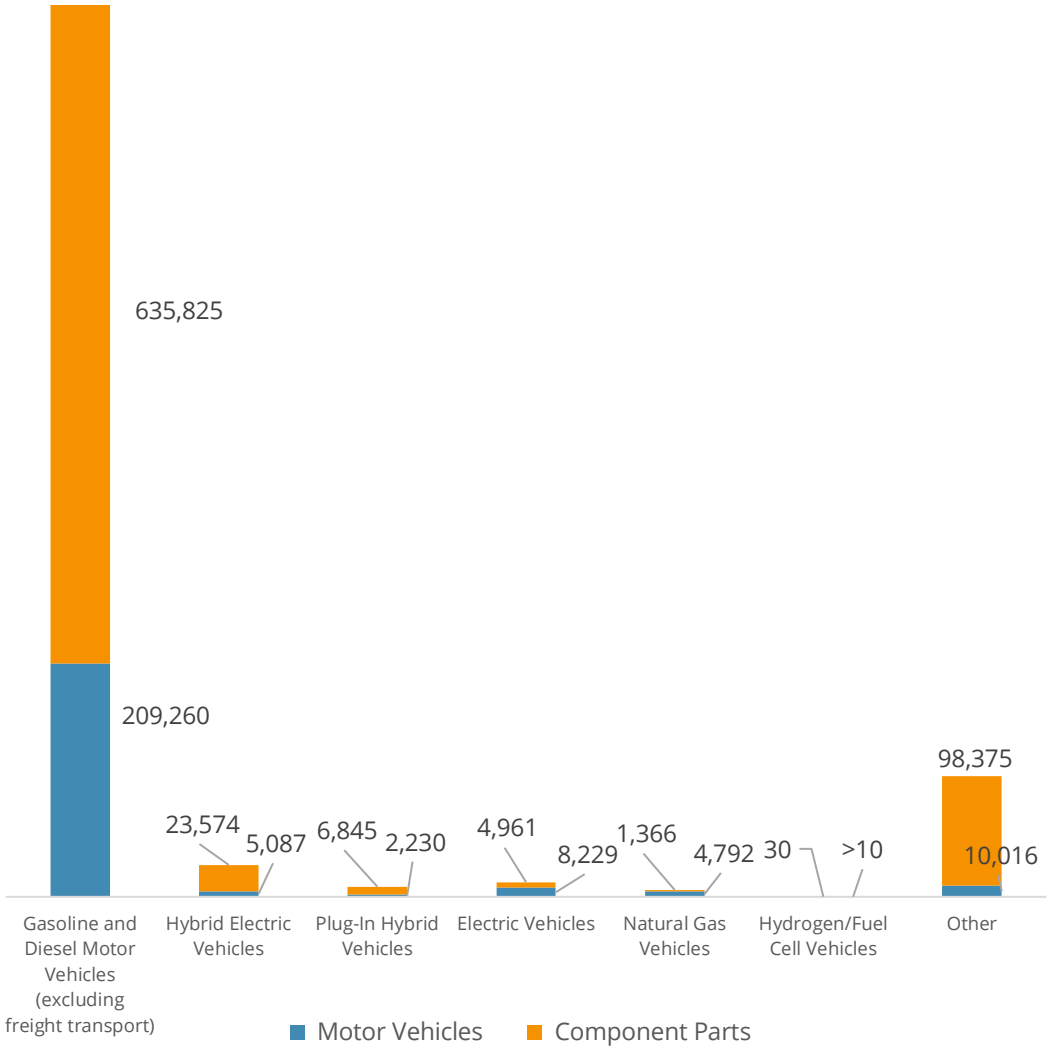
Parts Offered by Type of Fuel Used, Component Parts



MANUFACTURING

In 2018, gasoline and diesel motor vehicles represented nearly 84 percent of all manufacturing employment in Motor Vehicles and Component Parts (down slightly from 85 percent in 2017). Six percent of manufacturing employment, or 57,116 jobs was focused on alternative fuel vehicles and hybrids, while 11 percent was categorized within "other/multiple." Of the 376 employees within hydrogen and fuel cell vehicles that worked on component parts, fewer than 10 employees were focused on motor vehicles manufacturing.

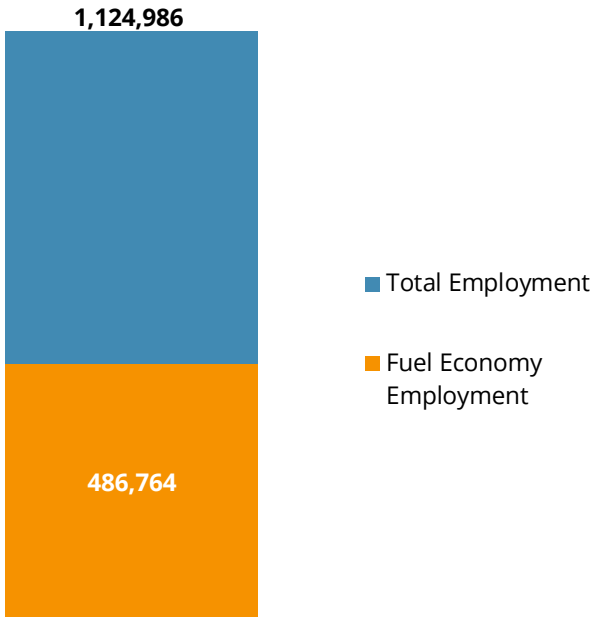
Figure 98.
Motor Vehicles and Component Parts Sector – Manufacturing Employment by Detailed Technology Application, Q2 2018



COMPONENT PARTS AND FUEL ECONOMY

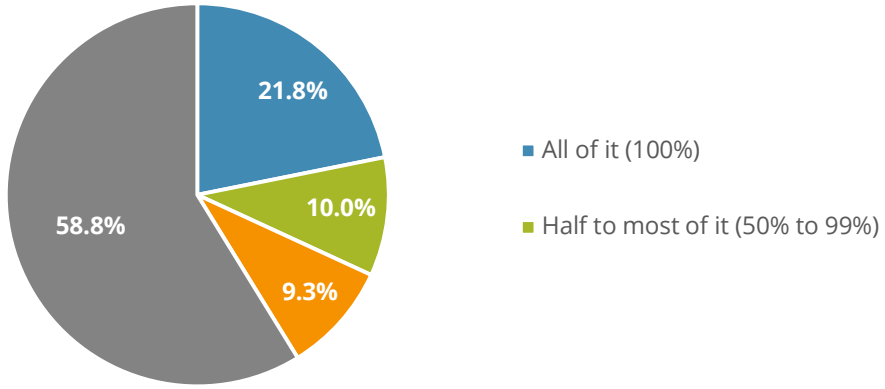
In 2018, over 486,000 Component Parts employees worked with parts that increase fuel economy for vehicles. This represents 43 percent of the 1,124,986 workers employed in the Component Parts segment of the sector in that year. The Component Parts segment includes firms focused on vehicle engine and drive parts, exhaust system parts, vehicle body parts, and other vehicle parts (including some battery production). This does not include mining and extraction for minerals used in vehicle parts production; high-strength, lightweight steel or rolled aluminum manufacturing; or production equipment manufacturing.

Figure 99.
Fuel Economy Employment in Component Parts, Q2 2018



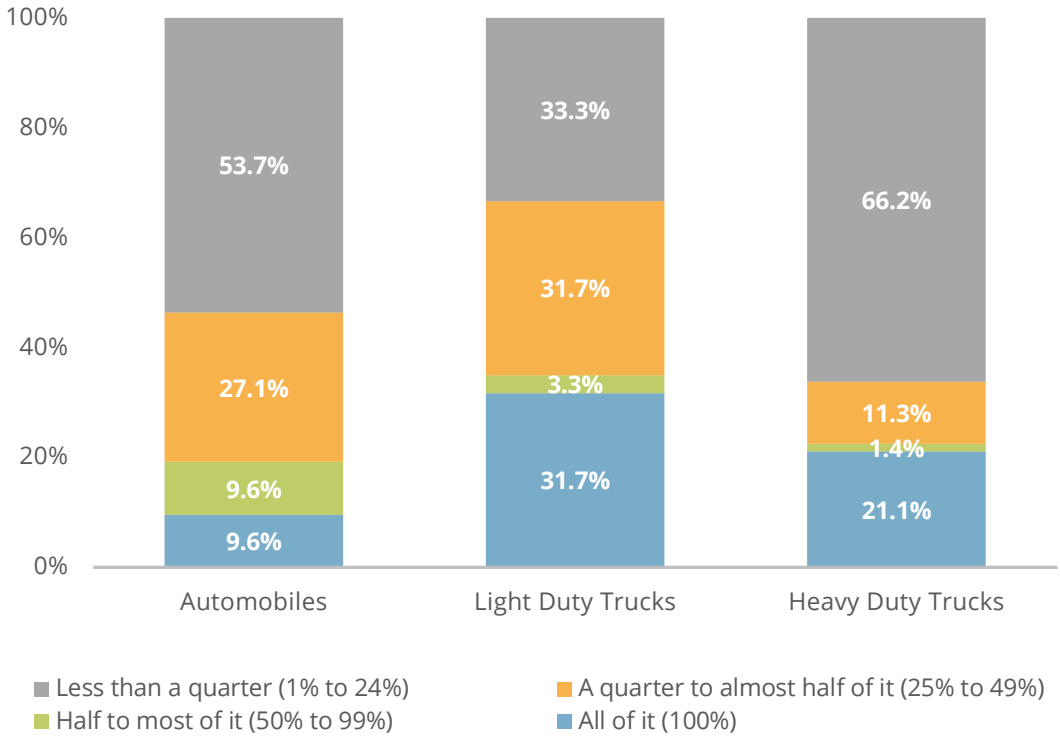
More than one-fifth (22 percent) of firms that were involved in the Component Parts segment in 2018 indicated that they derived all of their revenue from products that increase fuel economy for these vehicles. This was a slight decrease over the proportion of firms attributing all of their revenue to products that increase fuel economy in 2017 (23 percent).

Figure 100.
Revenue Attributable to Products that Increase Fuel Economy



A larger proportion of surveyed firms that primarily provide parts for light-duty trucks received all of their revenue in 2018 from products that increase fuel economy (32 percent), in comparison to firms that are mainly focused on heavy-duty trucks (21 percent) or automobiles (10 percent).

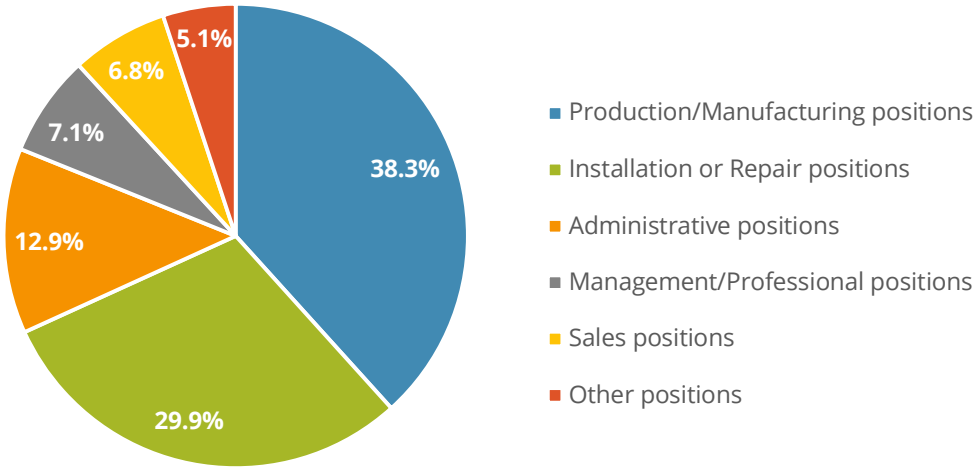
Figure 101.
Revenue Attributable to Products that Increase Fuel Economy by Primary Vehicle Type



MOTOR VEHICLES AND COMPONENT PARTS – WORKFORCE CHARACTERISTICS

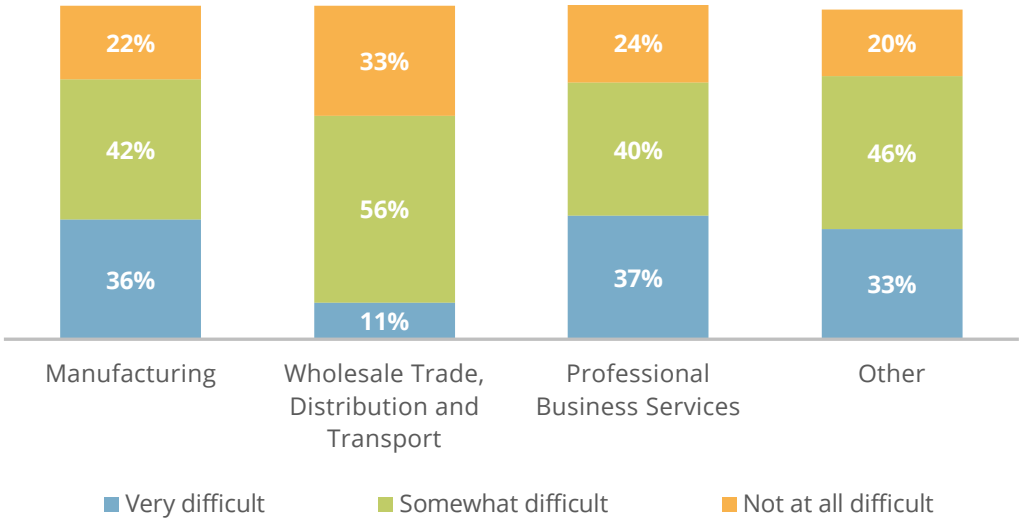
In 2018, over two-thirds of employees in Motor Vehicles and Component Parts were classified as workers in production/manufacturing positions (38 percent) or installation or repair positions (30 percent).

Figure 102.
Motor Vehicles and Component Parts Sector – Occupational Distribution, Q4 2018



Other services firms reported the highest levels of overall hiring difficulty (79 percent) in 2018. More than one-third of employers in professional and business services and manufacturing indicated that it was “very difficult” finding qualified applicants for positions at their firm.

Figure 103.
Motor Vehicles and Component Parts Sector – Hiring Difficulty by Industry, Q4 2018



Lack of experience, training, or technical skills was the number one reason for hiring difficulty as reported by manufacturing, wholesale trade, distribution, and transport, and other services firms in Motor Vehicles and Component Parts. Two-thirds of professional and business services employers that experienced hiring difficult cited difficulty finding industry-specific knowledge, skills, and interest as the primary reason.

Table 51.
Motor Vehicles and Component Parts Sector – Reasons for Hiring Difficulty by Industry, Q4 2018

Manufacturing	Wholesale Trade, Distribution, and Transport	Professional and Business Services	Other
Lack of experience, training, or technical skills (43%)	Lack of experience, training, or technical skills (38%)	Difficulty finding industry-specific knowledge, skills, and interest (67%)	Lack of experience, training, or technical skills (54%)
Insufficient non-technical skills (33%)	Insufficient non-technical skills (37%)	Lack of experience, training, or technical skills (43%)	Insufficient non-technical skills (28%)
Competition/small applicant pool (16%)	Competition/small applicant pool (16%)	Cannot pass employment screening (33%)	Competition/small applicant pool (16%)

The following table lists the occupations that contribute to the most hiring difficulty for employers within Motor Vehicles and Component Parts, by industry.

Table 52.

Motor Vehicles and Component Parts Sector – Reported Occupations with Hiring Difficulty by Industry, Q4 2018

Manufacturing	Wholesale Trade, Distribution, and Transport	Professional and Business Services	Other
Technician or mechanical support (52%)	Technician or mechanical support (46%)	Management (directors, supervisors, vice presidents) (30%)	Technician or mechanical support (80%)
Electrician/ construction workers (28%)	Drivers/dispatchers (25%)	Other (50%)	Sales, marketing, or customer service representatives (32%)
Manufacturing or production positions (12%)	Sales, marketing, or customer service representatives (20%)	Electrician/ construction workers (17%)	Management (directors, supervisors, vice presidents) (11%)

Over one-fifth of all workers in Motor Vehicles in 2018 were women (23 percent). Workers 55 years of age or older represented 20 percent of the workforce, a decline from 2017 (22 percent reported in 2017). The Motor Vehicles industry is more unionized than the workforce generally.

Table 53.

Motor Vehicles and Component Parts Sector – Demographics, Q4 2018

	Employees	Percent of Sector	National Workforce Averages
Male	1,882,023	77%	53%
Female	550,055	23%	47%
Hispanic or Latino	414,757	17%	17%
Not Hispanic or Latino	2,017,321	83%	83%
American Indian or Alaska Native	37,996	2%	1%
Asian	118,012	5%	6%
Black or African American	190,867	8%	12%
Native Hawaiian or other Pacific Islander	13,017	1%	>1%
White	1,895,483	78%	78%
Two or more races	176,702	7%	2%
Veterans	219,560	9%	6%
55 and over	481,518	20%	23%
Union	321,717	13%	11%