

2020 U.S. Energy & Employment Report

A Joint Project
of NASEO & EFI



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The National Association of State Energy Officials (NASEO) a nonprofit association representing the 56 energy offices of the states, territories, and District of Columbia, and the Energy Futures Initiative (EFI), a nonprofit think tank based in Washington, D.C., are pleased to release the 2020 U.S. Energy and Employment Report (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 fifth 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 2020 USEER was prepared under a Memorandum of Understanding between NASEO and EFI, and a contract between EFI and BW Research Partnership. The underlying methodology of the survey is identical to that used in the primary data collected on behalf of the U.S. Department of Energy (DOE) for the 2017 U.S. Energy and Employment Report and secondary data from the United States Department of Labor's Quarterly Census of Employment and Wages for the second quarter of 2019. The survey instrument was amended for the 2020 USEER to include additional questions about ENERGY STAR products and services, energy storage, utility energy efficiency programs, and pipeline products. Neither EFI nor NASEO, nor any of their employees, nor any of their contractors, subcontractors, or their employees makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or any third party's use or the results of such use of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights.

The USEER was first published in 2016 and 2017 by 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." 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

* Department of Energy, *Quadrennial Energy Review: Energy Transmission, Storage, and Distribution Infrastructure* (Washington, DC: DOE, 2015), p. 8-10.

The 2018, 2019, and 2020 USEERs have been organized and implemented by EFI and NASEO to provide continuity with the previous editions of the USEER in data collection and accuracy in year-to-year comparisons.

Accordingly, the 2020 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
- detailed questions on specific ENERGY STAR products and its commercial, residential and industrial building construction programs
- a question on internal utility-run energy efficiency programs

The data collection for the 2020 USEER was timed to ensure meaningful year-to-year comparisons with previous reports. In addition, the following organizational changes were made from the original USEER:

- 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
- a five-year summary of key trends in the Traditional Energy, Energy Efficiency, and Motor Vehicles sectors from 2016-2020

It is our hope that the 2020 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.

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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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KEY FINDINGS

ENERGY SECTORS

The 2020 USEER analyzes the following five sectors of the U.S. economy:

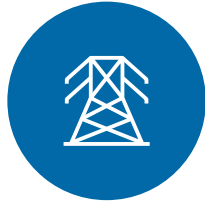
TRADITIONAL



Fuels



Electric Power Generation



Transmission, Distribution and Storage



Energy Efficiency



Motor Vehicles

Employment in these sectors increased in 2019 by **1.8 percent** from the previous year



Traditional Energy and Energy Efficiency sectors in 2019 employed approximately

6.8 MILLION AMERICANS

or **4.6 percent** of a workforce of roughly **149 million**

Employment in these sectors added

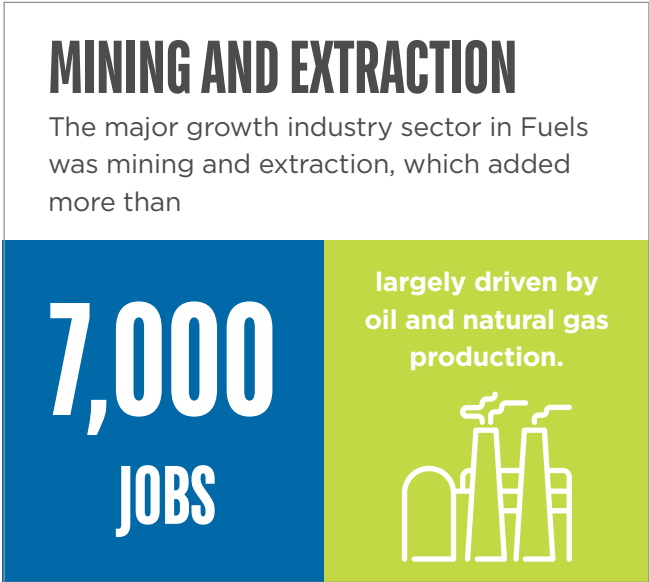
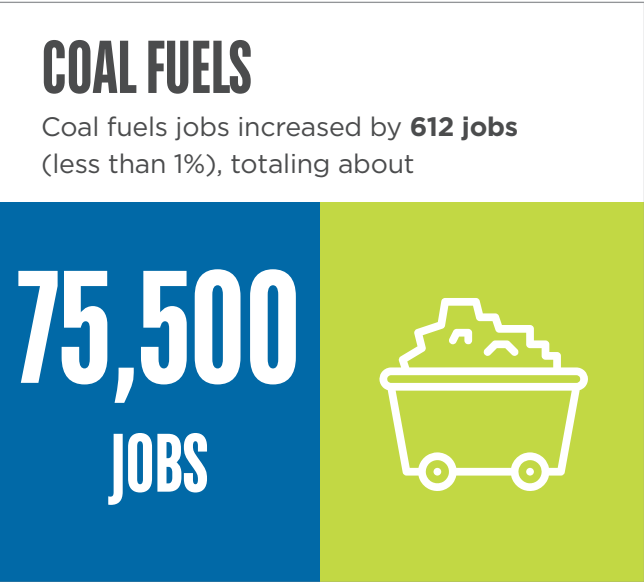
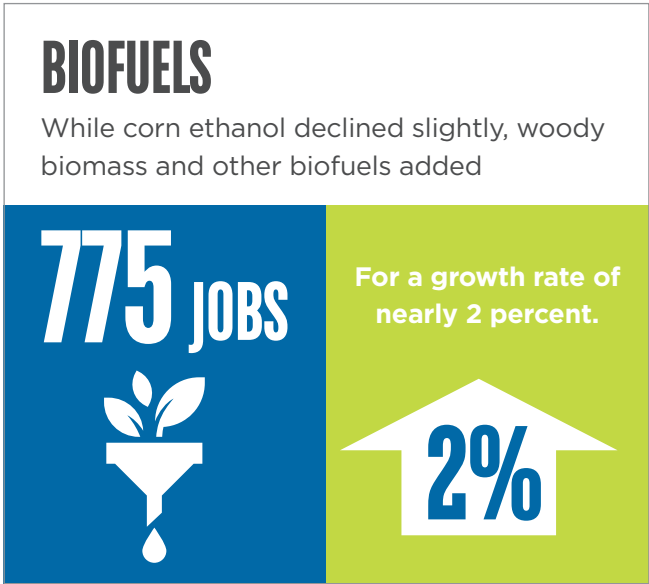
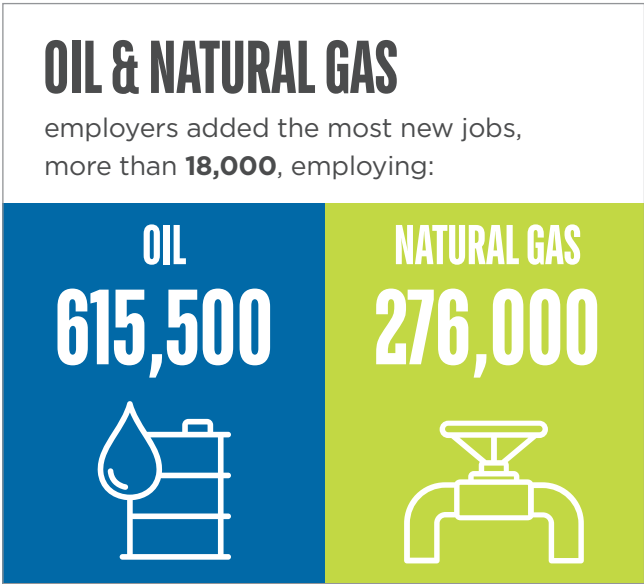
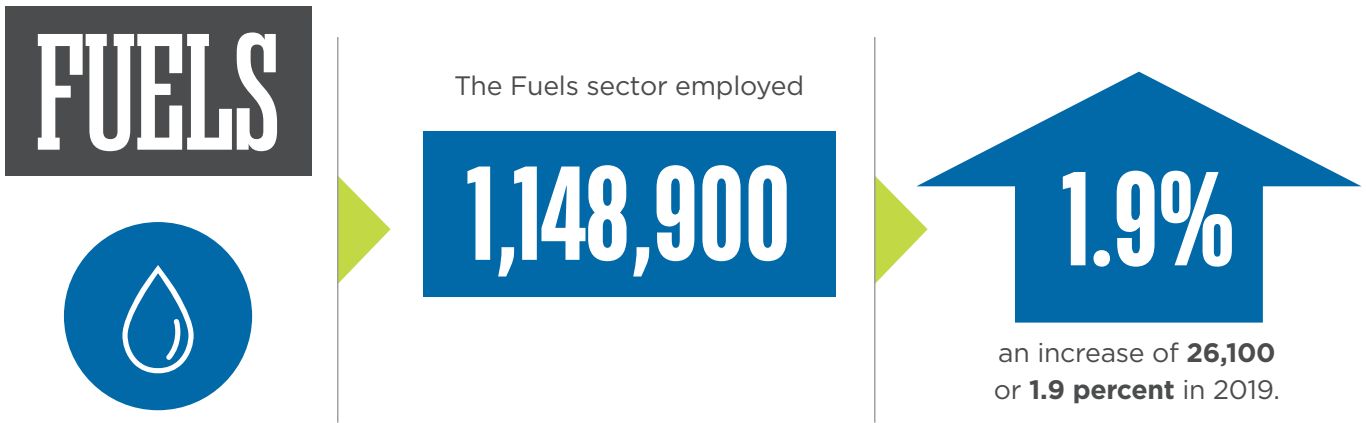


120,300 JOBS

over **7 percent** of all new jobs nationwide.¹

Based on a comprehensive analysis of employer data collected in the fourth quarter of 2019.

¹ Due to differing time frames for the USEER report, the reports on employment in 2015, 2017, 2018, and 2019 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 2018 and the second quarter of 2019 represented 7 percent of all employment growth in the United States. Unless otherwise stated, all increases or decreases described in this report for 2019 (whether whole numbers or percentages) are relative to 2018.



ELECTRIC POWER



The Electric Power Generation sector employed

896,800*

and grew by almost 2 and a half percent, gaining over **21,200 jobs**. Job losses in nuclear and coal generation were offset by increases in natural gas, solar, wind, CHP, hydro, and geothermal.

NATURAL GAS



Natural gas employment, traditional and advanced/low emissions combined, in Electric Power Generation increased by more than **9,100**



for almost

122,000 jobs

reflecting that **gas now exceeds coal** in both employment and gigawatts produced.

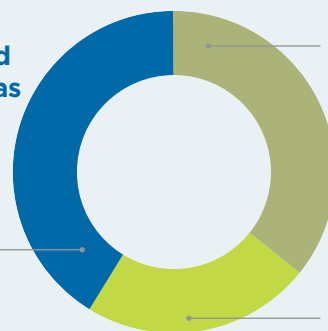
6,500

of those new jobs were in **advanced/low emissions technologies**.

FASTING GROWING SECTORS

Advanced/low emissions natural gas, solar, and wind generation were the fastest growing new sources, increasing employment by more than:

Advanced Natural Gas
6,500
+9.4%



SOLAR



Solar energy firms employed

248,000

employees who spent the majority of their time on solar.² An additional **97,400** employees spent less than half their time on solar-related work. The number of employees who spend the majority of their time on solar increased by **2.3 percent** or nearly **5,700 jobs** in 2019.

WIND



Wind energy companies hired an additional **3,600** employees for a total of

114,800

an increase of



COAL



Coal-fired generation employment declined by just under **7,700 jobs**, nearly **8 percent**.

² The Solar Foundation 2019 National Solar Jobs Census/BW Research Partnership. The category of industry employment differs slightly from several categories used by The Solar Foundation to classify employment.

* Includes 97,359 solar employees who spend less than 50 percent of their time on solar.

TRANSMISSION, DISTRIBUTION AND STORAGE



Transmission, Distribution, and Storage (TDS) employed more than

2.4
MILLION*

Americans with just over **1 million** working in retail trade (gasoline stations and fuel dealers).



Excluding retail trade, this represents an increase of

+17,800

new jobs or



CONSTRUCTION

Construction firms employed nearly **499,000** Americans in TDS, a **4 percent** increase from 2018.

499,000

an increase of



TRANSMISSION, DISTRIBUTION, AND STORAGE (TDS)

TDS employment in utilities remained virtually unchanged since 2018, employing

417,600



GRID MODERNIZATION

Overall, **42 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,

a decrease of



over 2018



ENERGY EFFICIENCY

Energy Efficiency employed

2.38
MILLION

in the design, installation,
and manufacture of Energy
Efficiency products and
services



Energy Efficiency
employers added 54,000
net jobs in 2019

54,000

+3.4%

PROFESSIONAL SERVICES AND WHOLESALE TRADE

Energy Efficiency professional services and wholesale trade both observed increases in employment:

PROFESSIONAL SERVICES

15,000



+3.1%

WHOLESALE TRADE

6,500

+3.6%

ENERGY STAR

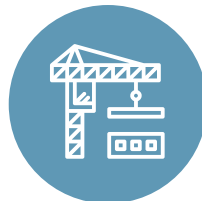
The manufacture, installation, design, wholesale distribution, and other services related to ENERGY STAR products employed almost **827,000** Americans in 2019.



CONSTRUCTION

78%

of employees who work on Energy Efficiency in the construction sector report spending the majority of their time on Energy Efficiency-related work, virtually unchanged from the **79 percent** in 2018.



1.3 MILLION

Energy Efficiency jobs are in the construction industry, a **2.1 percent** increase, or **27,600**, from 2018.

MOTOR VEHICLES



Motor Vehicles (including component parts) employed over

2.55 MILLION

adding

20,000 JOBS

a slight increase of just under 1 percent.

ALTERNATIVE FUELS VEHICLES

In 2019, over

266,300

employees worked with alternative fuels vehicles, including natural gas, hybrids, plug-in hybrids, all-electric, and fuel cell/hydrogen vehicles, a decline of **2 percent** or **5,300** jobs.

(Note that alternative fuels vehicles numbers were revised up for 2017 and 2018 in the Motor Vehicles chapter.)



HYBRIDS PLUG-IN HYBRIDS AND ALL-ELECTRIC

Hybrids, plug-in hybrids, and all-electric vehicles made up over 90 percent of this number, supporting more than

242,700

employees. Electric vehicles jobs declined by 9.8 percent and plug-in hybrid jobs declined by 2.5 percent in 2019.



FUEL ECONOMY

Nearly **494,000**

employees (44%), an increase of 8,000, work with component parts that contribute to fuel economy.



COMPONENT PARTS

More than one-fifth

22%

of component parts firms derived all of their revenue from products that increase fuel economy for motor vehicles.



CROSS CUTS

The 2020 USEER provides four 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, a fifth cross cutting analysis looks at job comparisons between those Electric Power Generation technologies that consume fuels and those that do not.

NATURAL GAS

industry employs

636,042

up 1.7 percent.



Number of jobs:

Utilities
183,612



Mining and
Extraction
165,602



Construction
109,576



PETROLEUM

industry employs

824,290

up 3.1 percent.



Number of jobs:

Mining and
Extraction
313,591



Wholesale
Trade,
Distribution,
and Transport
172,796



Manufacturing
157,911

COAL



The coal
industry employs

185,689

down
5.9 percent.

Mining and
Extraction
55,669



Wholesale Trade,
Distribution, and Transport
37,670

Utilities
38,158



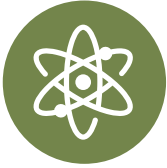
CROSS CUTS

NUCLEAR

industry employs

70,323

down 2.5 percent.



Number of jobs:

Utilities
44,366



Professional
and Business
Services
14,757



Manufacturing
4,979

ELECTRIC POWER GENERATION AND FUELS



directly employed over

2 MILLION*

up 42,584 (a 2.1 percent).

TRADITIONAL FOSSIL FUEL SECTORS

In 2019, 62 percent, or 1.2 million,

1.2 MILLION

of these employees worked in traditional coal, oil, and natural gas Electric Power Generation and Fuels, two percentage points below 2018



ZERO EMISSIONS

509,697

worked in zero emissions' generation technologies, including solar, wind, hydro, geothermal, and nuclear.



LOW EMISSIONS

227,096

worked in low-carbon emissions technologies, including biofuels, CHP, and advanced/low emissions gas.



*This number does not include 97,359 employees who spend less than 50% of their time on solar.

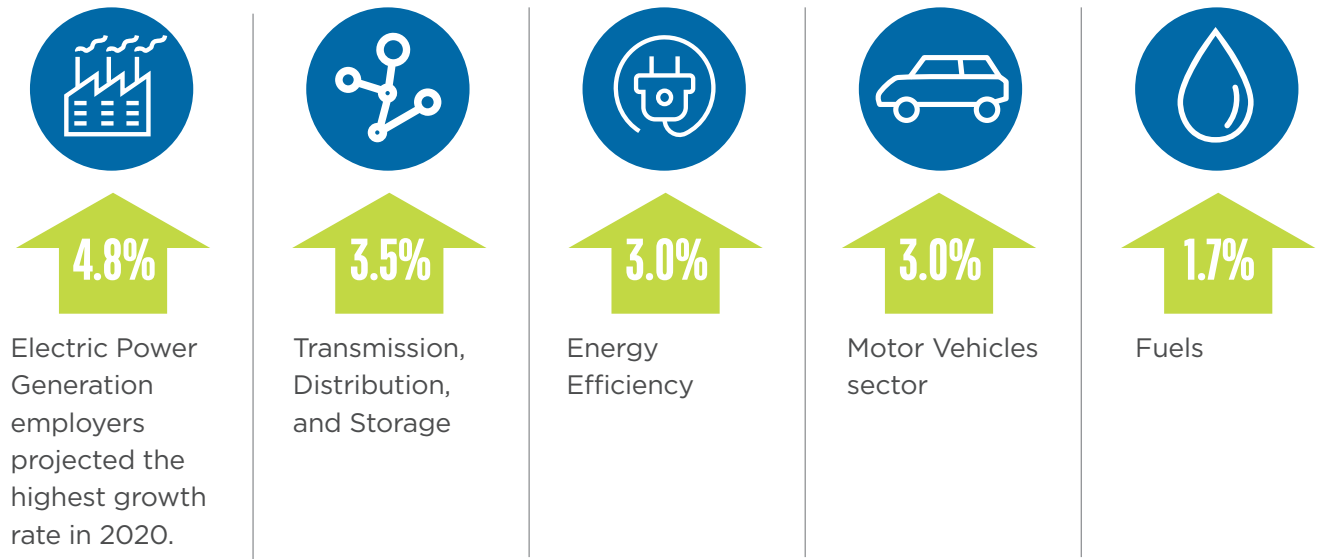
HIRING AND DEMOGRAPHICS

PROJECTIONS



Overall, firms covered by the survey anticipate roughly 3.1 percent employment growth for 2020, down from 4.6 percent projected growth last year.

Projected growth rate in 2020



Hiring difficulty was highlighted by virtually all sectors as a growing problem. Just over 84 percent of employers across these sectors (84.4 percent) reported difficulty hiring qualified workers over the last 12 months, an increase of over 7 percentage points from 2018 and a total of 14 percentage points since 2017. Almost three-in-ten employers (29 percent) noted it was very difficult (no change from 2018).



Among construction employers in Energy Efficiency, one of the largest surveyed sectors with over 1.3 million workers, 91% of employers reported that it was somewhat difficult or very difficult to hire new employees. However, those reporting it was very difficult declined from 52 percent in 2018 to 45 percent in 2019.



Lack of experience, training, or technical skills were again cited as the top reasons 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.

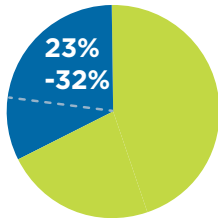
HIRING AND DEMOGRAPHICS

DEMOGRAPHICS

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

WOMEN

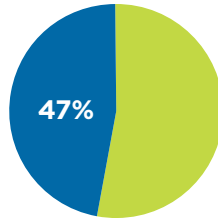
Women in US Energy Workforce



Women are a smaller portion of the workforce in these sectors, ranging from **23 percent** to **32 percent**, ...



Women in US Workforce



... compared to the overall economy, where women make up **47 percent** of the workforce.

VETERANS

Veterans comprise from **8 to 10 percent** of these sectors—higher than the national average of **6 percent**.



55 OR OLDER



Between **13 percent** and **21 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.

DIVERSITY

However, a majority of these energy sectors are more racially diverse than the national workforce as a whole even though specific racial categories are frequently underrepresented.



This is, in part, because of the increased self-identification of employees belonging to “2 or more races.”

UNIONS

Unionization rates for TDS, Electric Power Generation, Energy Efficiency, and Motor Vehicles exceed the national private sector average, while only Fuels is below.

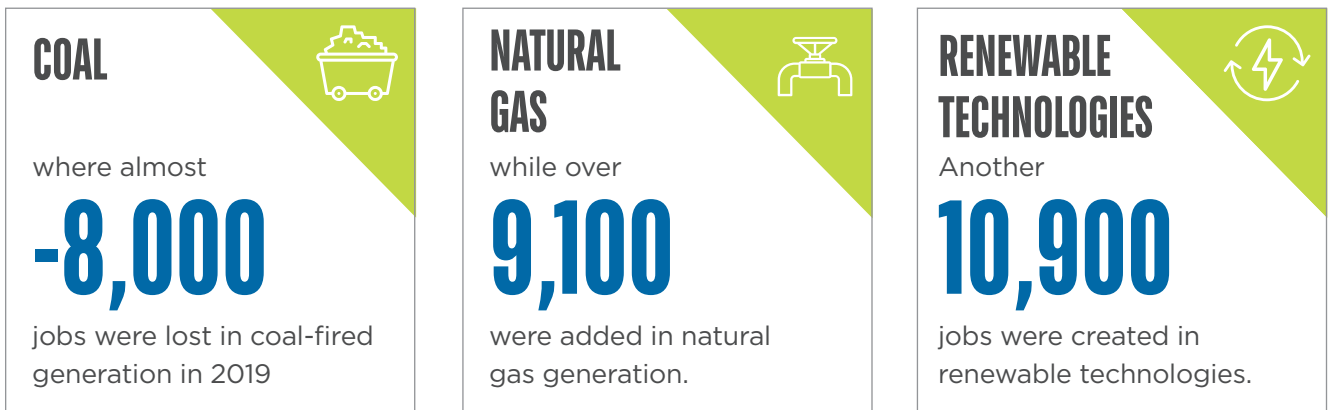
CONCLUSION

In 2019 America's Traditional Energy, Energy Efficiency, and Motor Vehicles sectors continued to outperform the rest of the American economy in job growth, accounting for **8 percent** of all new employment opportunities, while making up only **5.6 percent** of the workforce.



CHANGING TECHNOLOGY

As with other sectors of the economy, changing technology has driven much of this growth while also being responsible for disruption and job loss within specific subsectors. This trend was most notable in the Electric Power Generation sector



A valuable aspect of the USEER is its capacity to identify such labor market trends so that policy makers can address them.

ENERGY EFFICIENCY



One of the most important contributions

of the USEER over the last five years has been its success in defining and quantifying jobs in Energy Efficiency.

Starting in the mid-1970's, the U.S. economy started to see a decoupling of energy consumption from economic growth. Today 30 states have energy efficiency standards or voluntary policies and **75 percent** of all utilities operate energy efficiency programs.

The result has been the creation of an Energy Efficiency sector that employs

2,380,000 in one of our most dynamic sectors.

CONCLUSION

ENERGY STAR

This year's USEER has also performed a deeper examination of the Environmental Protection Agency's ENERGY STAR program to link the jobs that are responsible for supplying the products and services that make up this remarkable effort.



Known throughout the world as the benchmark that has introduced energy efficiency as both an economic and social value, the USEER determined that almost

827,000

Americans have jobs that are providing those products and services.

ENERGY EFFICIENCY

MOTOR VEHICLE MANUFACTURING



Energy efficiency is also at the heart of the CAFE standards that have redefined the U.S. Motor Vehicles' industry. Since the current standards were adopted in 2012, the manufacturing sector of Motor Vehicles in the U.S. has added over

220,000

jobs, rebuilding the industry from the Great Recession.

FUEL EFFICIENCY



44 percent of the Motor Vehicles parts' industry have jobs that are contributing to producing vehicles that help achieve those fuel efficiency standards. 22 percent of these companies make 100 percent of their profits from fuel efficiency.

494,000

Americans in the MV Component Parts industry contribute to fuel efficiency.

65,000 NEW JOBS PRODUCING ENERGY



In 2019, our traditional energy sectors—Fuels, Generation, and TDS—added 65,000 new jobs, producing oil, natural gas, electricity from many sources, and the systems that distribute them. Meanwhile, the efforts to make the usage of that energy more efficient in our built environment and our Motor Vehicles added another 62,000 jobs, matching the traditional energy jobs almost one for one.

62,000

New jobs conserving energy.

**Energy production and energy efficiency go hand in hand.
Both are dynamic job creators at the core of a 21st Century economy.**

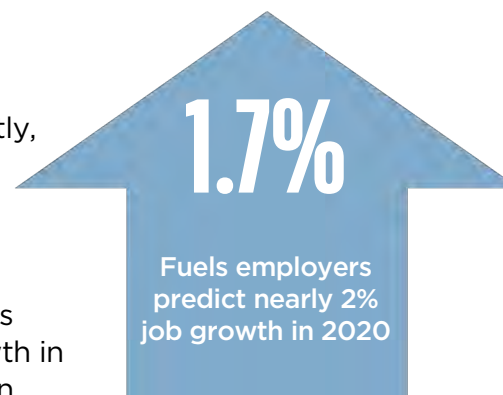
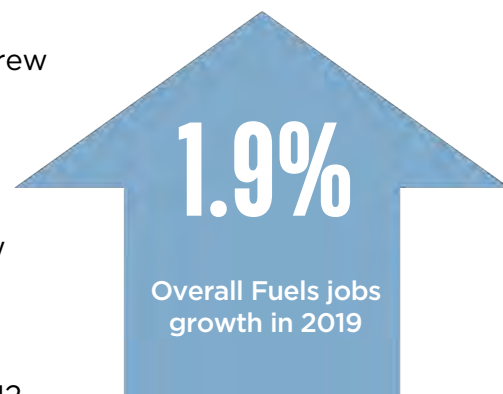


FUELS

Fuels employment encompasses all 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

- 2019 Job Gain.** In 2019, the Fuels sector grew by approximately 26,100 jobs, or about 2 percent for a total of 1,148,893 jobs.
- Oil and Gas Growth Continues.** Oil and natural gas employers added the most new jobs, more than 18,000, employing 615,500 and 276,000 respectively.
- Coal Stable.** Coal fuels jobs increased by 612 jobs (less than 1 percent), totaling about 75,500.
- Biofuels.** While corn ethanol declined slightly, woody biomass and other biofuels added 775 jobs, for a growth rate of nearly 2 percent.
- 2020 Expectations.** Employers in the Fuels sector anticipate nearly 2 percent job growth in 2020, with most of the increase expected in natural gas.



Employment Snapshot

Figure 1.
Fuels Sector - Employment by Industry, 2018-2019

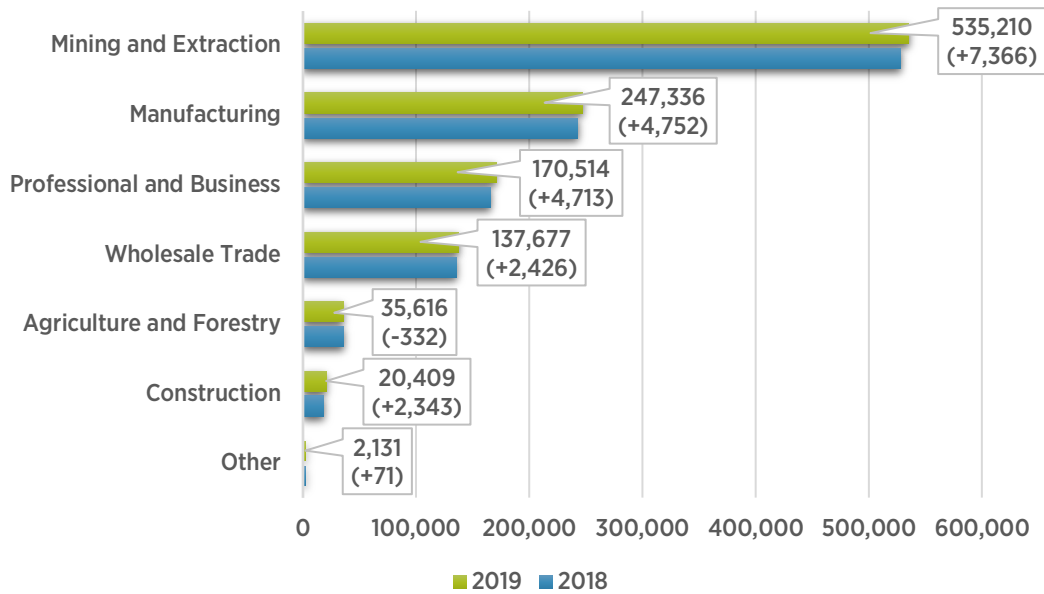
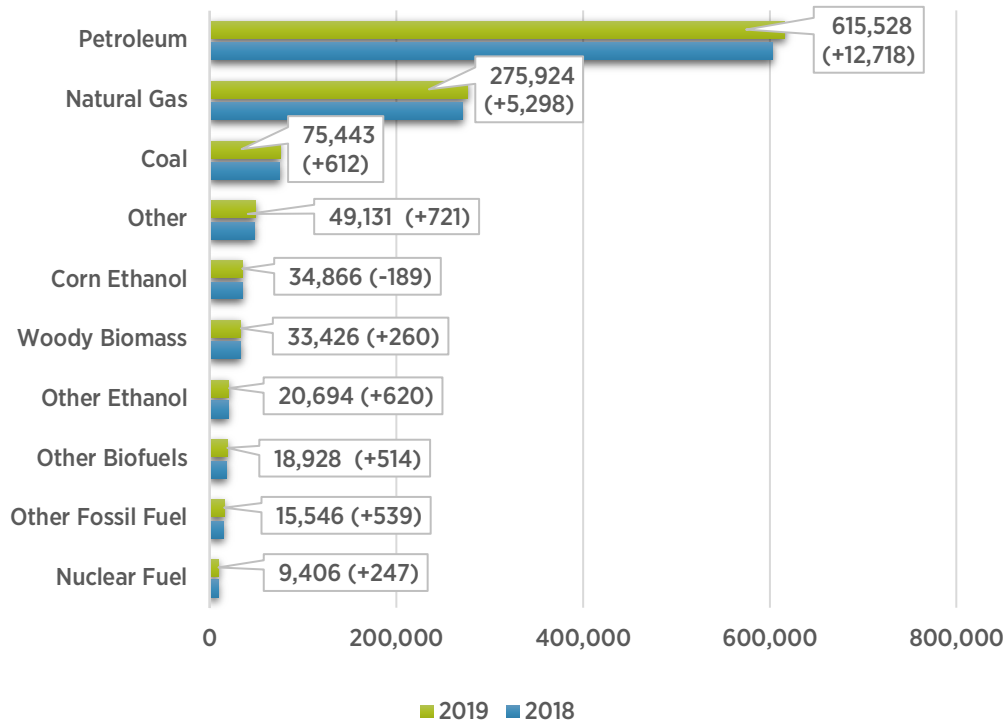


Figure 2.
Fuels Sector - Employment by Detailed Technology Application, 2018-2019



Key Takeaways

- The major growth industry sector in Fuels was mining and extraction, which added more than 7,000 new jobs in 2019, largely driven by 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. Coal numbers include both thermal and metallurgical coal.

Table 1. ¹
Fuels Sector - Employment by Detailed Technology Application and Industry, Q2 2019

	TOTAL	AGRI-CULTURE	MINING + EXTRACTION	CONSTR- UCTION	MANU- FACTURING	WHOLESALE TRADE	PROFESSIONAL SERVICES	OTHER SERVICES
Coal	75,443	0	55,669	-	10,643	1,031	8,075	25
Petroleum	615,528	0	313,591	20,409	151,846	59,563	68,726	1,393
Natural Gas	275,924	0	165,602	-	45,276	29,633	35,235	178
Other Fossil Fuel	15,546	0	0	-	3,061	7,205	5,169	112
Corn Ethanol	34,866	15,419	0	-	9,968	6,493	2,873	113
Other Ethanol	20,694	2,531	0	-	2,838	5,462	9,789	74
Woody Biomass	33,426	17,665	0	-	4,593	1,028	10,096	45
Other Biofuels	18,928	0	0	-	1,112	1,655	16,128	34
Nuclear Fuel	9,406	0	348	-	3,078	929	5,052	-
Other ²	49,131	0	0	-	14,922	24,680	9,372	157
TOTAL	1,148,893	35,616	535,210	20,409	247,336	137,677	170,514	2,131

¹ Column and row totals may differ due to rounding

² Other fuels includes employers that are not able to assign their workers to a single detailed technology application.

Hiring Difficulty

- **50 percent of mining and extraction employers in fuels** reported that it was somewhat difficult or very difficult to hire new employees. 33 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.
- **50 percent of professional and business services employers in fuels** reported that it was not at all difficult to hire new employees.

Highest-Demand Occupations in Fuels

With growth of nearly 2 percent in 2019 and predicted growth of 1.7 percent in 2020, fuels employers have identified below the occupations that each industry sector is having the greatest difficulty in filling.

Table 2.
Fuels Sector – Reported Occupations with Hiring Difficulty by Industry, Q2 2019

Mining & Extraction	Manufacturing	Wholesale Trade, Distribution, and Transport	Professional and Business Services	Other
Drivers/dispatchers (25%)	Engineers (37%)	Drivers/dispatchers (67%)	Engineers/scientists (60%)	Drivers/dispatchers (60%)
Electrician/construction workers (25%)	Management (directors, supervisors, vice presidents) (24%)	Management (directors, supervisors, vice presidents) (25%)	Technicians or mechanical support (20%)	Electricians (40%)
Other (25%)	Manufacturing or production positions (25%)	Sales, marketing, or customer service (25%)	Consultants (20%)	Technicians or mechanical support (20%)

SPOTLIGHT

Chris Reilly, Sr.

Manager, Workforce Development and Education Programs, Tesla



Chris Reilly went to work for Tesla almost three years ago, concentrating on building the workforce development systems to support the opening of the first “Gigafactory” in North America, designed to produce battery packs and electric motors for Tesla vehicles, just outside of Sparks, NV. He is now responsible for the development of talent pipeline programs across the company.

“As a state, Nevada has a rich history of gaming, tourism, and mining, but the recession following 2008 created a significant focus on diversifying the economy to include industries like advanced manufacturing and data center technology. Then, as Tesla announced the Gigafactory coming to Nevada in 2014, this diversification spurred a growth in STEM jobs in the state that is projected to be 40 percent higher than in non-STEM jobs through 2024. On top of that, we were seeing 150+ other companies moving to Northern Nevada and unemployment around 4 percent, so we needed to think differently about what our pipeline would look like.

“The first area we focused on was retraining. We partnered with the Governor’s Office of Economic Development to create the Gigafactory Gateway scholarship program as part of its Workforce Innovations for a New Nevada (WINN) fund, which now has over 200 Tesla team members from all different industries taking classes in automation and robotics while working full time to level up their skillsets in automated manufacturing. We are seeing team members who have been engaged in this program staying at Tesla longer, getting promoted faster, and receiving better

As part of our agreement with the state to build Gigafactory, we committed to invest \$37.5M in Nevada K-12 education. This gave us an incredible opportunity to work with the Department of Education to support the development of the next generation of engineers in Nevada, and we are doing this through investments in robotics and sustainability programming.

reviews. Local teachers at the college have badge access to host office hours and proctor tests at Gigafactory for our team members, and it's a great partnership.

"Next was starting to build new talent pipelines. We created the Manufacturing Development Program to attract and train students right out of high school. This is a program where students get a full-time production associate role at Tesla while earning 20 credits in automation and robotics from a community college. Students work with a partner nonprofit to find housing, have access to 7-day shuttle service, and we host information sessions for students and parents throughout the year to learn more about the program. Instead of solely worrying about the unemployment rate locally, this helps us build a program that opens up opportunity to reach the 30,000 Nevada seniors that graduate each year. We piloted this program in Nevada with 13 students, and, based on feedback from managers, we now hire 50-60 students each year, many who have been promoted. We're now working on launching the program in California and New York.

"The third focus was to think about these talent pipelines longer term. As part of our agreement with the state to build Gigafactory, we committed to invest \$37.5M in Nevada K-12 education. This gave us an incredible opportunity to work with the Department of Education to support the development of the next generation of engineers in Nevada, and we are doing this through investments in robotics and sustainability programming. We are also partnering with other employers and nonprofits across all major industries in this effort, as it is to our collective benefit to have robotics programs at every school in the state, coaching these critical skillsets. We're currently investing in 4 categories: innovative programs, teacher development, infrastructure, and pathways to employment.

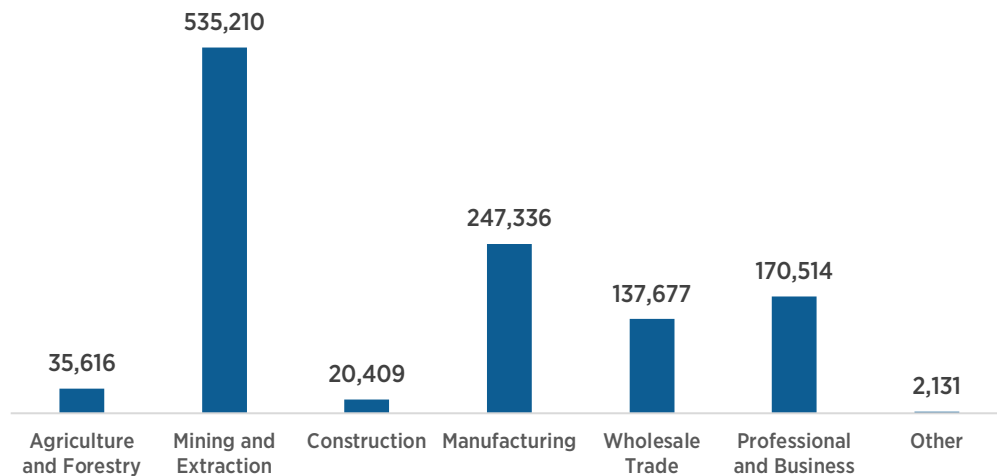
"Beyond our work in Nevada around manufacturing, we are building programs across all major areas of our business. Electric vehicle manufacturing and technology is still fairly new, so we launched the Tesla START program at select community colleges across the United States to provide students the opportunity to learn about servicing electric vehicles and start a career at a Tesla Service Center when they graduate. It's an intensive 12-week training course that helps students develop technical expertise and earn certifications through in-class theory and hands-on labs.

"As we continue to develop curriculum over time, our goal is to make our efforts accessible and available to teachers everywhere. Similar to how we've open sourced our patents to encourage other automakers to produce electric vehicles, we hope our education initiatives serve as an example over the longer term as other regions look to work together in similar ways."

Introduction

The Fuels sector employed 1,148,893 workers in 2019, compared to the previous year’s level of 1,127,553 jobs. This represents a jump in employment of nearly 2 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 2019, these comparable Bureau of Labor Statistics (BLS) employment figures were at 479,193 and 55,669 respectively.³ Nuclear mining and extraction employed another 348.

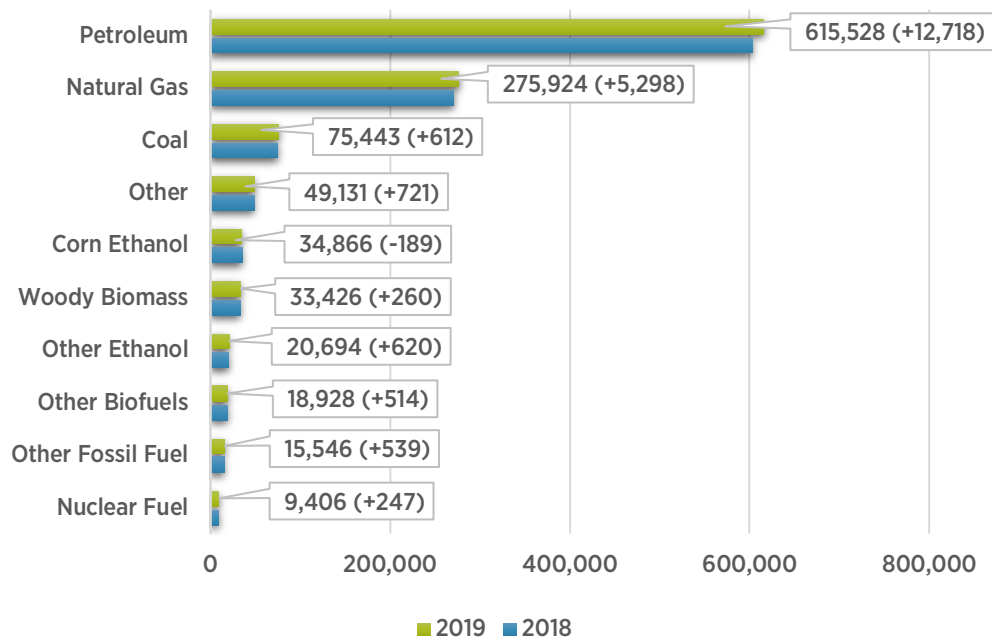
Figure 3.
Fuels Sector - Employment by Industry, Q2 2019



As shown in Figure 4, the 2020 USEER found large increases in 2019 for both petroleum production jobs (more than 12,700 additional jobs, for a total of 615,528 jobs) and natural gas production jobs (nearly 5,300 additional jobs, for a total of 275,924 jobs). Overall, employers in the Fuels sector project to see employment increase by almost 2 percent in 2020.

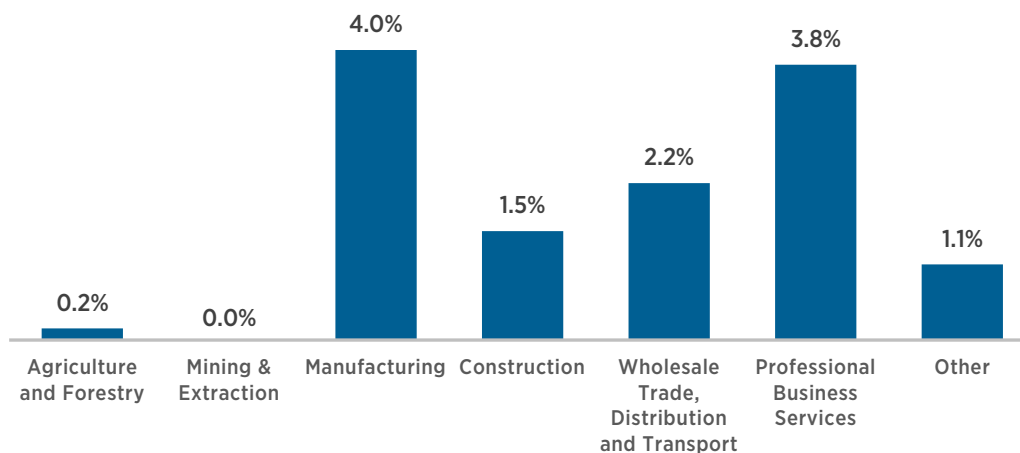
³ Job figures from BLS Quarterly Census of Employment and Wages (QCEW) data, not USEER extrapolated employment, since comparable USEER data does not exist for 2012 and 2014.

Figure 4.
Fuels Sector - Employment by Detailed Technology Application, 2018-2019



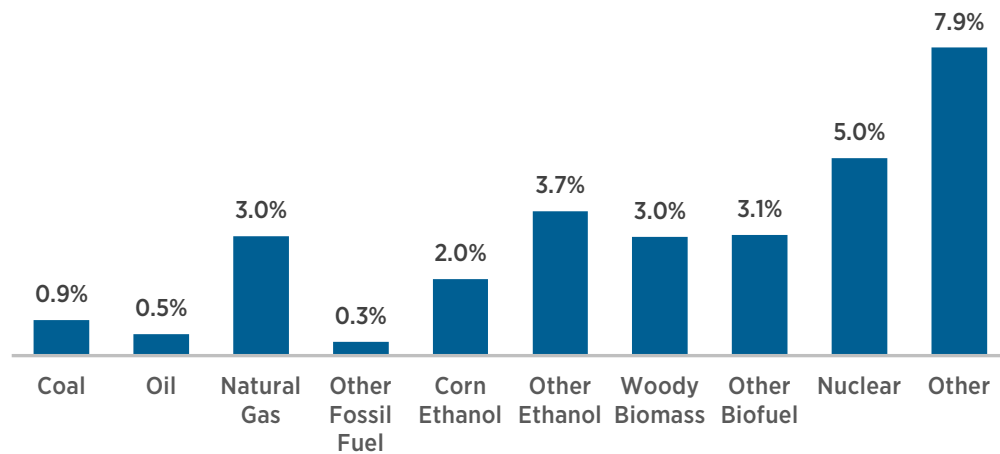
Manufacturing employers and professional services firms in the Fuels sector each expect an increase in employment of 4 percent in 2019, as shown in Figure 5.

Figure 5.
Fuels Sector - Expected Employment Growth by Industry (Q4 2019 - Q4 2020)



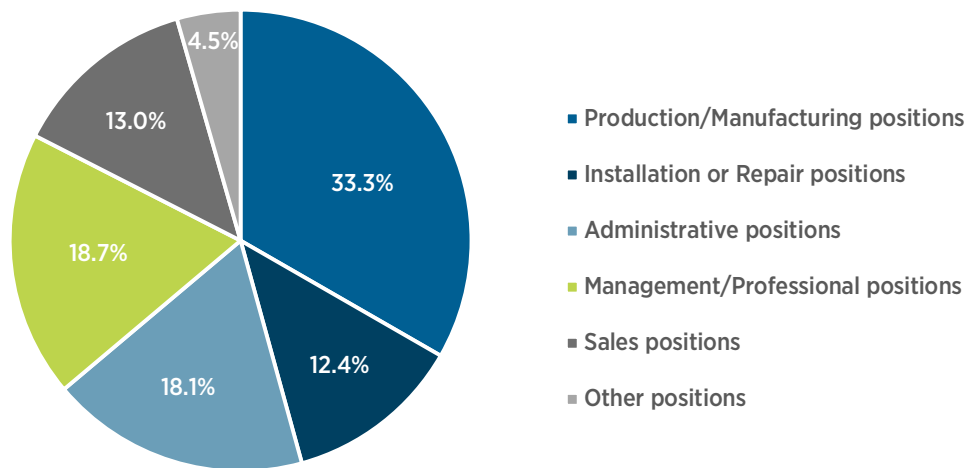
Oil and gas, the largest detailed technologies in Fuels, predict continued growth in 2020, as do ethanol and biofuels.

Figure 6.
Fuels Sector - Expected Employment Growth by Detailed Technology (Q4 2019 - Q4 2020)



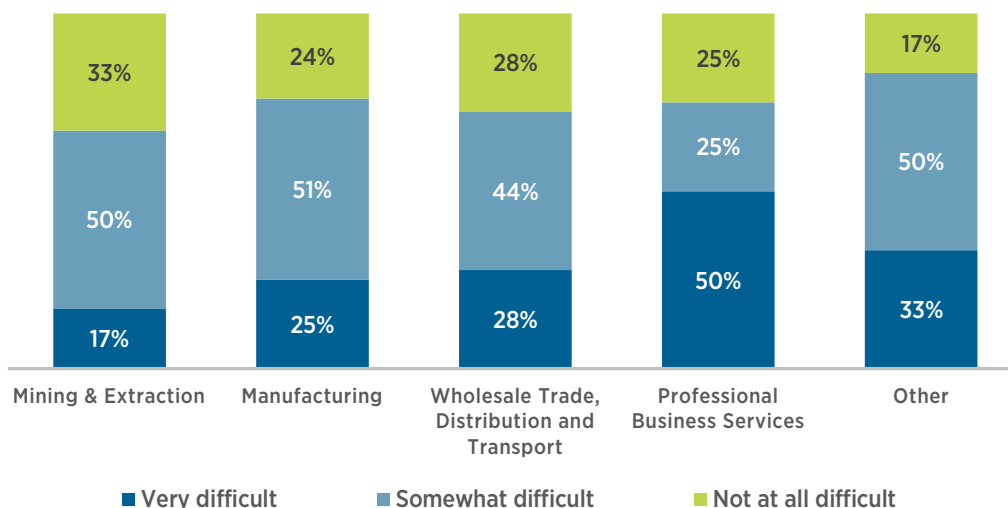
Fuels - Workforce Characteristics

Figure 7.
Fuels Sector - Occupational Distribution, Q4 2019



While mining and extraction employers have historically reported lower levels of difficulty hiring qualified candidates, it is notable that the percentage of employers reporting such difficulty has risen 14 percentage points over 2018, to more than two-thirds of employers (67 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 2019



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

Table 3.
Fuels Sector – Reasons for Hiring Difficulty by Industry, Q4 2019

Mining & Extraction	Manufacturing	Wholesale Trade, Distribution, and Transport	Professional and Business Services	Other
Competition/ small applicant pool (75%)	Lack of experience, training, or technical skills (39%)	Competition/ small applicant pool (42%)	Competition/ small applicant pool (50%)	Insufficient qualifications (certifications or education) (60%)
Insufficient non-technical skills (25%)	Insufficient non-technical skills (18%)	Difficulty finding industry-specific knowledge, skills, and interest (25%)	Lack of experience, training, or technical skills (33%)	Cannot pass employment screening (60%)
Lack of experience, training, or technical skills (25%)	Competition/ small applicant pool (18%)	Insufficient non-technical skills (17%)	Difficulty finding industry-specific knowledge, skills, and interest (33%)	Insufficient non-technical skills (20%)

Six in ten 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 the second year in a row. Drivers/dispatchers was another notably difficult position to hire for.

Table 3 lists the most difficult occupations to hire for by industry within the Fuels sector, as reported by employers in 2018.

Table 4.
Fuels Sector - Reported Occupations with Hiring Difficulty by Industry, Q4 2019

Mining & Extraction	Manufacturing	Wholesale Trade, Distribution, and Transport	Professional and Business Services	Other
Drivers/dispatchers (25%)	Engineers/scientists (37%)	Drivers/dispatchers (67%)	Engineers/scientists (60%)	Drivers/dispatchers (60%)
Electrician/construction workers (25%)	Management (directors, supervisors, vice presidents) (24%)	Management (directors, supervisors, vice presidents) (25%)	Technicians or mechanical support (20%)	Electricians (40%)
Other (25%)	Manufacturing or production positions (25%)	Sales, marketing, or customer service (25%)	Consultants (20%)	Technicians or mechanical support (20%)

Women made up only 25 percent of employment in the Fuels sector (up 1 percent from last year). The Fuels sector had lower proportions of both black or African American and Hispanic or Latino employees, compared to national workforce averages. Overall, though, the sector’s overall racial diversity was above the national average of 22 percent. The Fuels sector’s percentage of employment of veterans (at 10 percent) exceeded the national average for veterans hiring.

Table 5.
Fuels Sector – Demographics, Q4 2019

Demographic	Employees	Percent of Sector	National Workforce Averages ⁴
Male	859,684	75%	53%
Female	289,209	25%	47%
Hispanic or Latino	133,376	12%	18%
Not Hispanic or Latino	1,015,517	88%	82%
American Indian or Alaska Native	18,937	2%	>1%
Asian	60,606	5%	6%
Black or African American	77,487	7%	12%
Native Hawaiian or other Pacific Islander	8,425	1%	>1%
White	889,130	77%	78%
Two or more races ⁵	94,308	8%	2%
Veterans	114,279	10%	6%
55 and over	242,575	21%	23%
Union	35,352	3%	6%

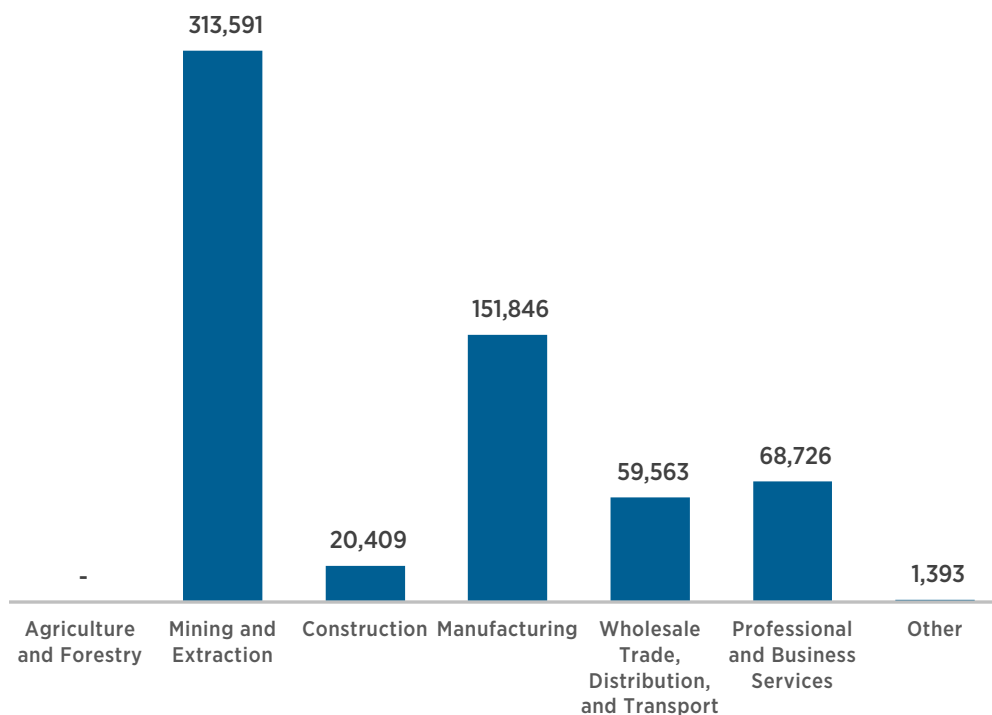
⁴ All demographic information in this table and subsequent demographic tables in this report (except union membership) are from 2019 data in “Labor Force Statistics from the Current Population Survey,” Bureau of Labor Statistics, U.S. Department of Labor, <https://www.bls.gov/cps/demographics.htm>. Information on private union membership is from “Table 3: Union affiliation of employed wage and salary workers by occupation and industry, 2018-19 annual averages,” in U.S. Department of Labor, Bureau of Labor Statistics, “Union Members Summary,” news release, January 22, 2020, <https://www.bls.gov/news.release/union2.nr0.htm>.

⁵ 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 615,528 workers across the nation in 2019. Over the course of 2019, petroleum fuels jobs grew by 12,718 jobs, or more than 2 percent. Mining and extraction accounted for more than half of the industry, while manufacturing made up nearly 25 percent of petroleum fuels employment in 2019.

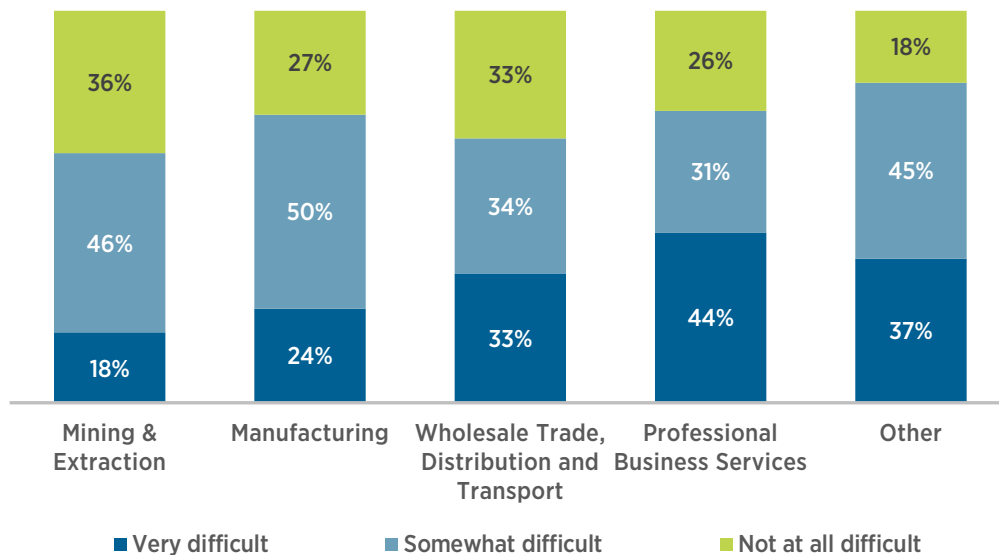
Figure 9.
Petroleum Fuels – Employment by Industry



Employers in the petroleum fuels industrial sectors experienced increasing degrees of difficulty in hiring new workers in 2019--64 percent of mining and extraction employers reported that hiring new workers was somewhat difficult or very difficult, 74 percent of manufacturing employers reported hiring was somewhat difficult or very difficult (with 24 percent noting it has been very difficult), and 75 percent of professional business services employers reported that hiring was somewhat difficult or very difficult (with 44 percent reporting that hiring was very difficult).⁶

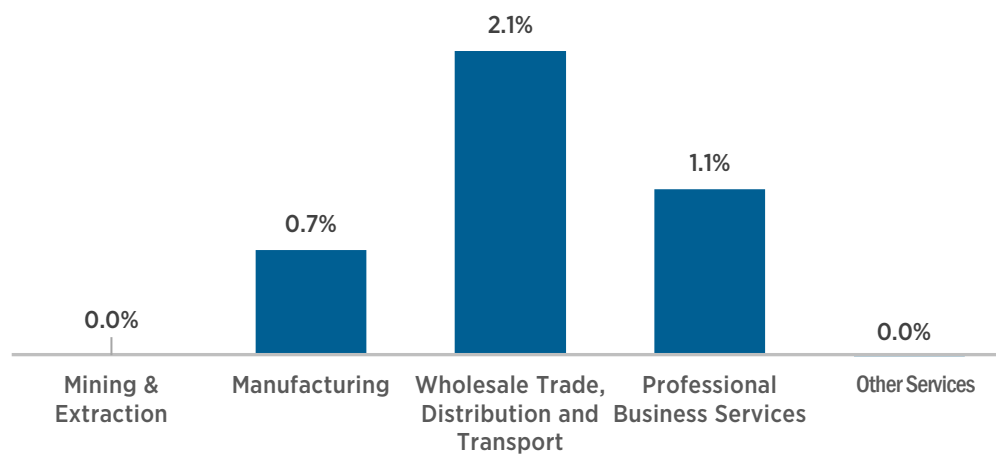
⁶ Some industries are omitted from this discussion due to their small sample size in the data contributing to Figure 10. Conclusions have been made only about industries with sufficient sample size.

Figure 10.
Petroleum Fuels – Hiring Difficulty by Industry



Employers in petroleum fuels expect less than 1 percent growth in 2020. This is led by the wholesale trade, distribution, and transport sector, which expects more than 2 percent growth. Notably, mining and extraction, the largest sector, which added almost 5,000 jobs in 2019, expects no additional growth in 2020.

Figure 11.
Petroleum Fuels – Expected Employment Growth by Industry



In 2019, female employees made up 24 percent of the workforce. Black or African American and Hispanic or Latino workers were also below national workforce averages. However, the overall racial diversity of the petroleum fuels workforce exceeded the national average of 22 percent.

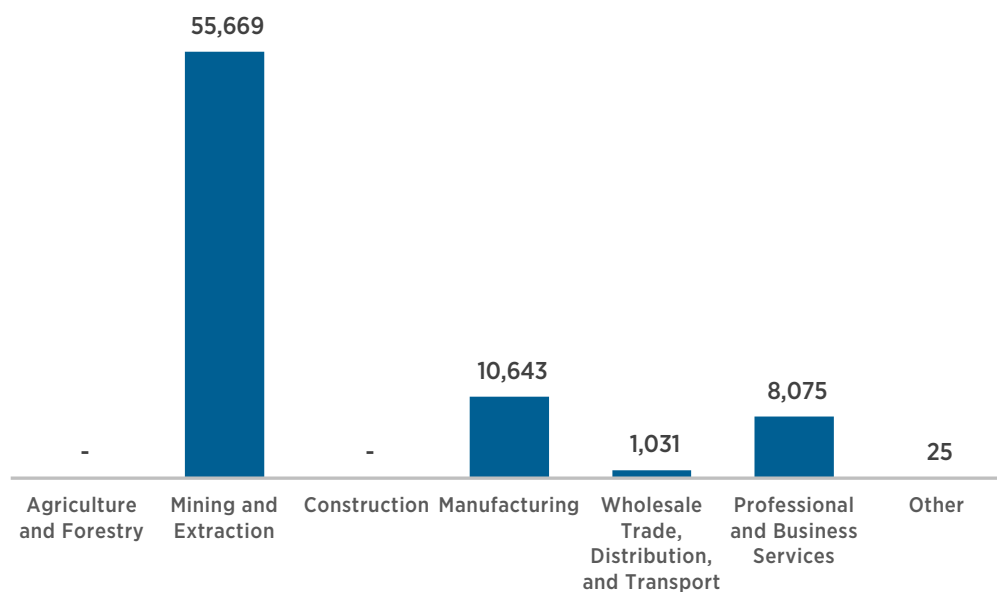
Table 6.
Petroleum Fuels – Demographics, Q4 2018

Demographic	Employees	Percent of Sector	National Workforce Averages
Male	467,208	76%	53%
Female	148,320	24%	47%
Hispanic or Latino	78,100	13%	18%
Not Hispanic or Latino	537,428	87%	82%
American Indian or Alaska Native	11,387	2%	>1%
Asian	36,420	6%	6%
Black or African American	47,494	8%	12%
Native Hawaiian or other Pacific Islander	5,263	1%	>1%
White	466,331	76%	78%
Two or more races	48,633	8%	2%
Veterans	56,563	9%	6%
55 and over	125,329	20%	23%
Union	12,289	2%	6%

Coal Fuels

Coal fuels employed a total of 75,443 workers in the United States in 2019, increasing by 612 jobs, or 0.8 percent. Mining and extraction jobs supported nearly 74 percent of coal fuels employment in 2019, while manufacturing made up more than 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 110.

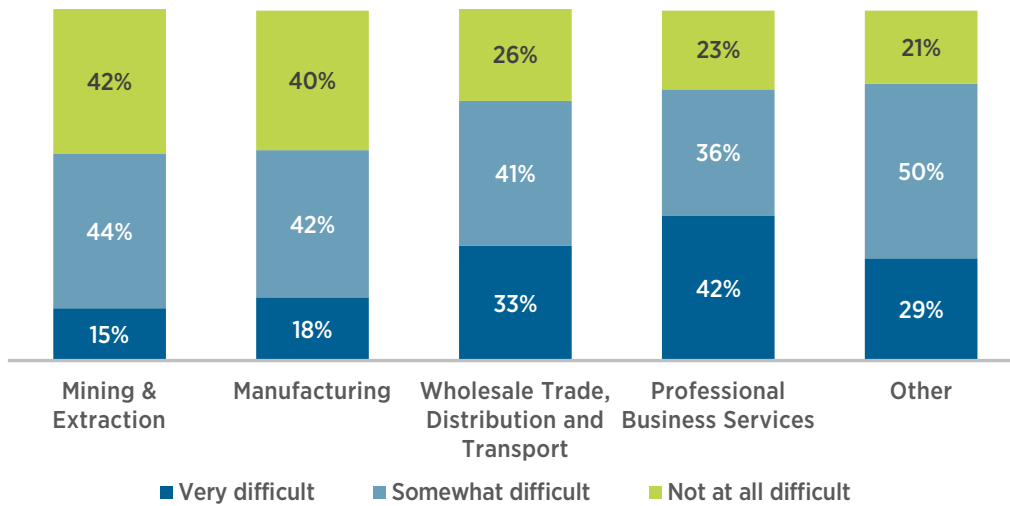
Figure 12.
Coal Fuels - Employment by Industry



Hiring difficulty increased in 2019 for the two largest industry sectors in coal fuels. 59 percent of mining and extraction employers in coal fuels reported that hiring new workers was very difficult or somewhat difficult during 2019—up 8 percentage points from 2018. 60 percent of manufacturing employers also reported that it was very difficult or somewhat difficult, an increase of 16 percentage points. By contrast, 74 percent of wholesale trade, distribution, and transport employers reported that hiring was somewhat difficult or very difficult (with 33 percent reporting hiring to have been very difficult).⁷

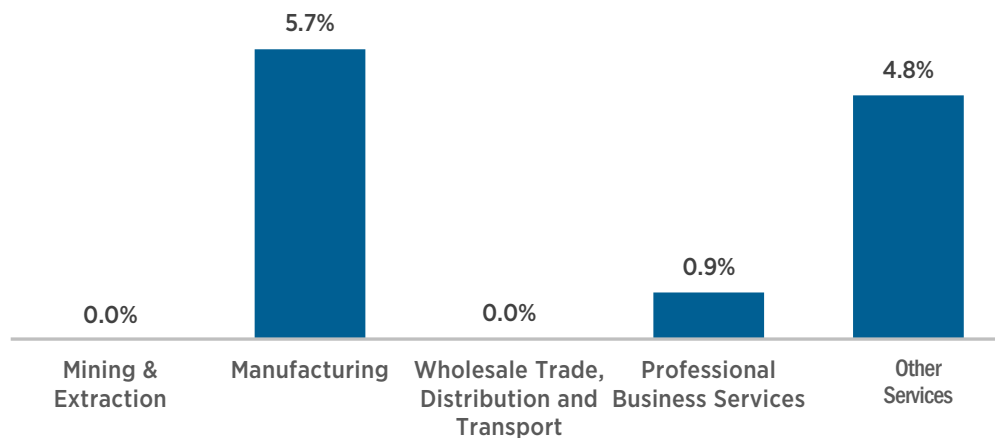
⁷ Some industries are omitted from this discussion due to their small sample size in the data contributing to Figure 13. Conclusions have been made only about industries with sufficient sample size.

Figure 13.
Coal Fuels - Hiring Difficulty by Industry



Employers in the coal fuels industry expect around 1 percent growth in 2020. This is led by the manufacturing sector, which expects nearly 6 percent growth. However, the largest sector, mining and extraction, anticipates no additional growth.

Figure 14.
Coal Fuels - Expected Employment Growth by Industry



Women represented 23 percent of the coal fuels workforce in 2019, up a percentage point. Black or African American, Hispanic or Latino, and Asian workers were also below national workforce averages.

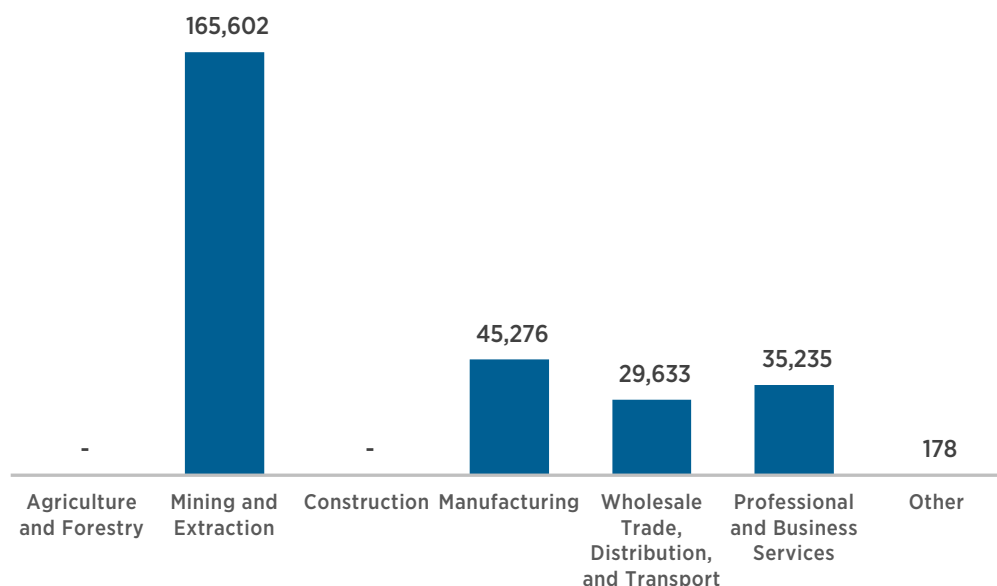
Table 7.
Coal Fuels - Demographics, Q4 2019

Demographic	Employees	Percent of Sector	National Workforce Averages
Male	57,749	77%	53%
Female	17,694	23%	47%
Hispanic or Latino	7,625	10%	18%
Not Hispanic or Latino	67,818	90%	82%
American Indian or Alaska Native	1,456	2%	>1%
Asian	2,678	4%	6%
Black or African American	2,910	4%	12%
Native Hawaiian or other Pacific Islander	345	0%	>1%
White	63,377	84%	78%
Two or more races	4,677	6%	2%
Veterans	6,555	9%	6%
55 and over	19,185	25%	23%
Union	853	1%	6%

Natural Gas Fuels

Natural gas fuels employed a total of 275,924 workers across the nation in 2019, increasing by nearly 5,300 new jobs or nearly 2 percent. Mining and extraction jobs comprised 60 percent of the natural gas fuels industry, while manufacturing made up more than 16 percent of natural gas fuels employment in 2019.

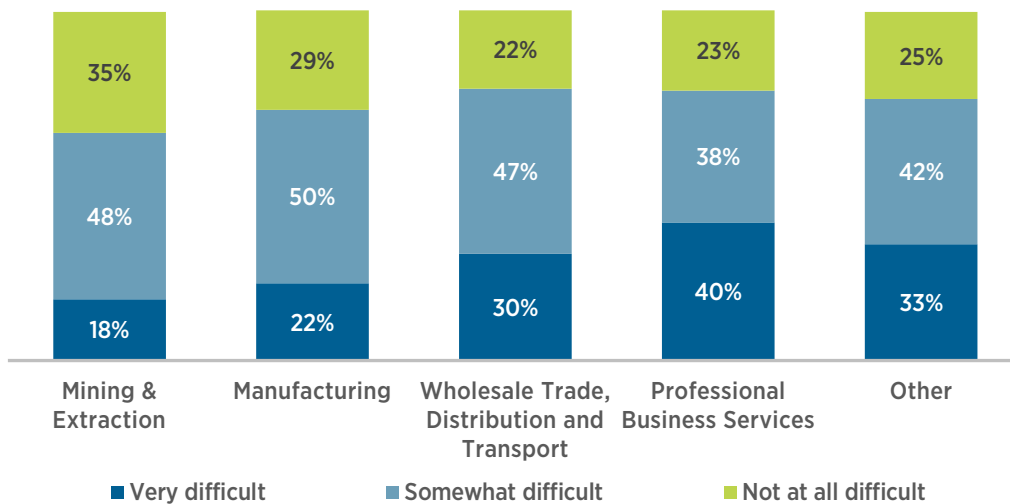
Figure 15.
Natural Gas Fuels – Employment by Industry



The major sectors in natural gas fuels reported increased difficulty in hiring in 2019. In the largest sector, mining and extraction, 66 percent of employers reported that hiring new workers had been difficult or very difficult during 2019—an increase of 3 percentage points. Manufacturing difficulty rose by 5 percentage points to 72 percent.⁸

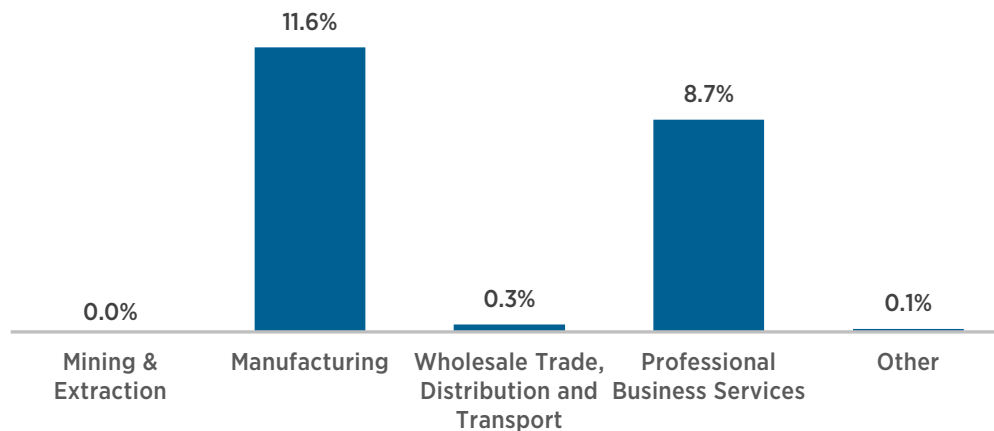
⁸ Some industries are omitted from this discussion due to their small sample size in the data contributing to Figure 16. Conclusions have been made only about industries with sufficient sample size.

Figure 16.
Natural Gas Fuels – Hiring Difficulty by Industry



Employers in the natural gas fuels industry expect 3 percent growth in 2020. This is led by the manufacturing sector, which expects nearly 12 percent growth, and the professional business services sector, which expects nearly 9 percent growth. Like both petroleum and coal, however, mining and extraction, the largest sector, does not predict additional growth in 2020.

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



Women represented 26 percent of the natural gas fuels workforce. Black or African American, Hispanic or Latino, and Asian workers were below national workforce averages. However, at 24 percent, the overall racial diversity of the natural gas fuels workforce exceeded the national average of 22 percent.

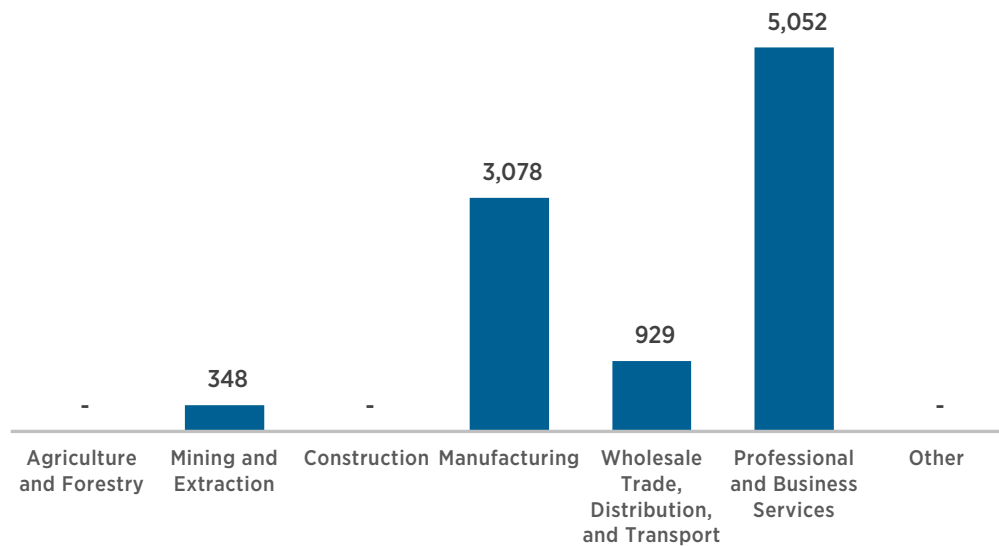
Table 8.
Natural Gas Fuels – Demographics, Q4 2019

Demographic	Employees	Percent of Sector	National Workforce Averages
Male	203,992	74%	53%
Female	71,932	26%	47%
Hispanic or Latino	31,383	11%	18%
Not Hispanic or Latino	244,541	89%	82%
American Indian or Alaska Native	4,438	2%	>1%
Asian	11,305	4%	6%
Black or African American	18,233	7%	12%
Native Hawaiian or other Pacific Islander	1,391	1%	>1%
White	209,102	76%	78%
Two or more races	31,453	11%	2%
Veterans	23,595	9%	6%
55 and over	58,968	21%	23%
Union	8,012	3%	6%

Nuclear Fuels

Nuclear fuels employed a total of 9,406 workers in the United States in 2019. Over the course of 2019, nuclear fuels jobs grew by nearly 250 new positions, or almost 3 percent. Professional business services supported nearly 54 percent of the nuclear fuels industry, adding the majority of new jobs, while manufacturing made up nearly 33 percent of nuclear fuels employment in 2019.

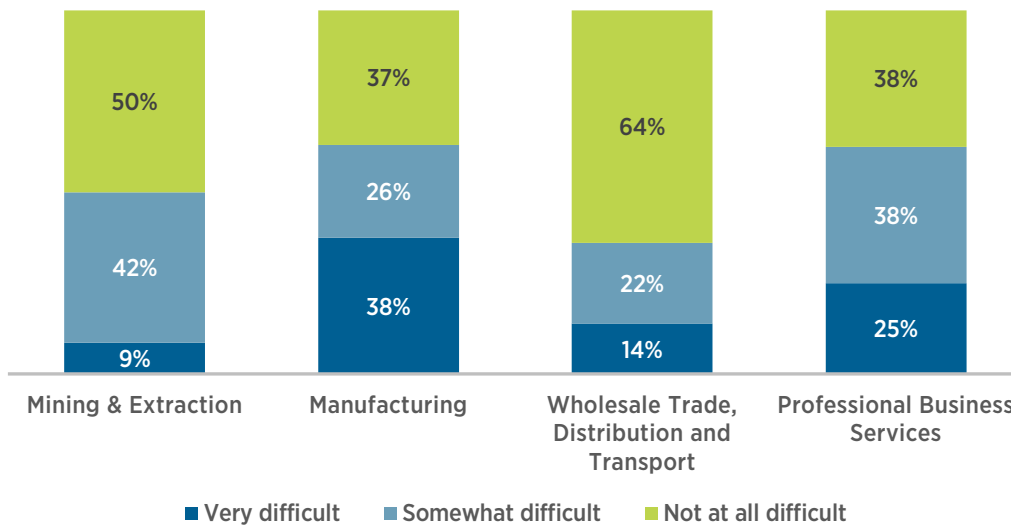
Figure 18.
Nuclear Fuels - Employment by Industry



In 2019, the two largest sectors of nuclear fuels—professional and business services and manufacturing—reported similar overall difficulties in hiring at 63 percent and 64 percent, although manufacturing reported a higher percentage of “very difficult” responses.⁹

⁹ 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.

Figure 19.
Nuclear Fuels – Hiring Difficulty by Industry



Nuclear fuels employers are expecting 5 percent job growth in 2020. All that growth is driven by professional business services.

Figure 20.
Nuclear Fuels – Expected Employment Growth by Industry



In 2019, women represented 30 percent of the nuclear fuels workforce. Although below national averages in several categories, 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.

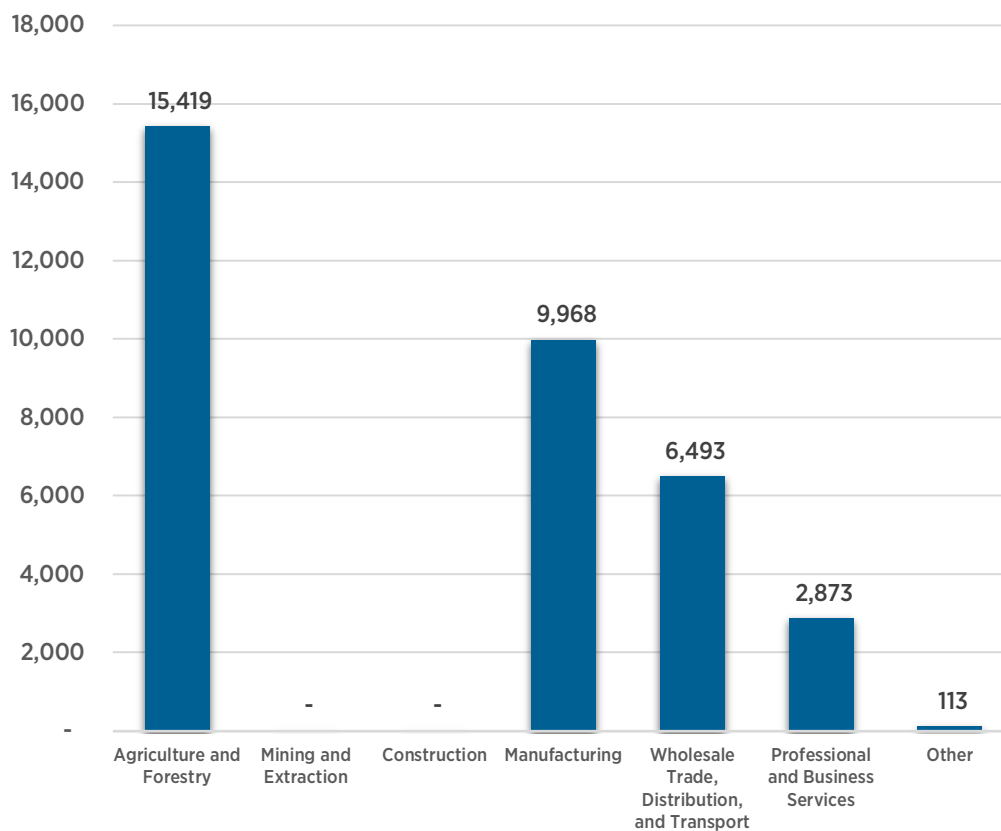
Table 9.
Nuclear Fuels – Demographics, Q4 2019

Demographic	Employees	Percent of Sector	National Workforce Averages
Male	6,547	70%	53%
Female	2,859	30%	47%
Hispanic or Latino	1,330	14%	18%
Not Hispanic or Latino	8,076	86%	82%
American Indian or Alaska Native	97	1%	>1%
Asian	806	9%	6%
Black or African American	603	6%	12%
Native Hawaiian or other Pacific Islander	85	1%	>1%
White	6,452	69%	78%
Two or more races	1,364	15%	2%
Veterans	863	9%	6%
55 and over	1,458	16%	23%
Union	542	6%	6%

Corn Ethanol Fuels

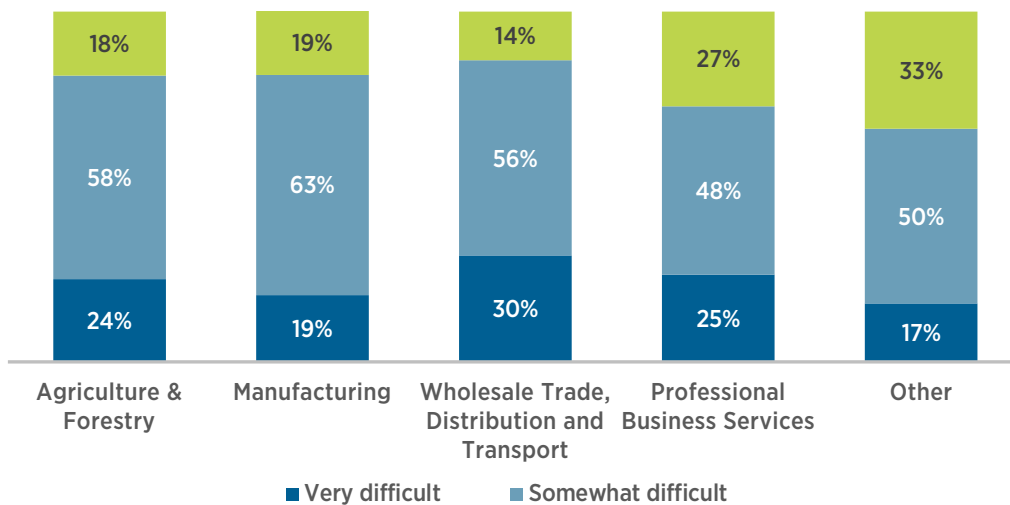
Corn ethanol fuels employment represented 3 percent of the U.S. Fuels workforce in 2019, accounting for 34,866 jobs, and lost about 190 jobs last year. The largest industrial sector is agriculture, followed by manufacturing and wholesale trade, distribution, and transport. Together these three industries accounted for more than 91 percent of workers, followed by professional and business services at more than 8 percent.

Figure 21.
Corn Ethanol Fuels - Employment by Industry



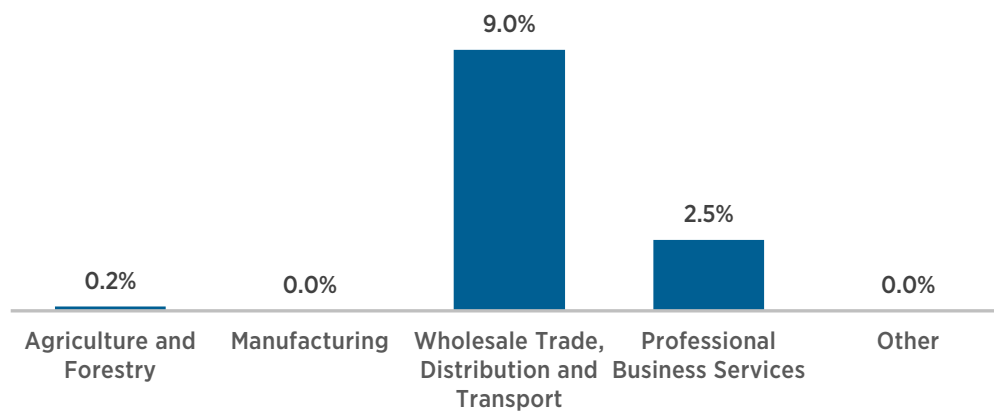
In 2019, 82 percent of agriculture and forestry employers in corn ethanol, its largest sector, reported that hiring was somewhat difficult or very difficult. In addition, 82 percent of wholesale manufacturing employers reported that hiring new workers was somewhat difficult or very difficult in 2019.

Figure 22.
Corn Ethanol Fuels - Hiring Difficulty by Industry



Employers in the corn ethanol fuels industry expect 2 percent growth in 2020 with much of that anticipated by employers in the wholesale trade, distribution, and transport sector who expect 9 percent growth. The professional business services sector expects 2.5 percent growth.¹⁰

Figure 23.
Corn Ethanol Fuels - Expected Employment Growth by Industry



In 2019, women represented 30 percent of the corn ethanol fuels workforce. Black or African American, Hispanic or Latino, and Asian workers were also below national workforce averages. A very high percentage (19 percent) of corn ethanol fuel workers are veterans.

¹⁰ Some industries are omitted from this discussion due to their small sample size in the data contributing to Figure 23. Conclusions have been made only about industries with sufficient sample size.

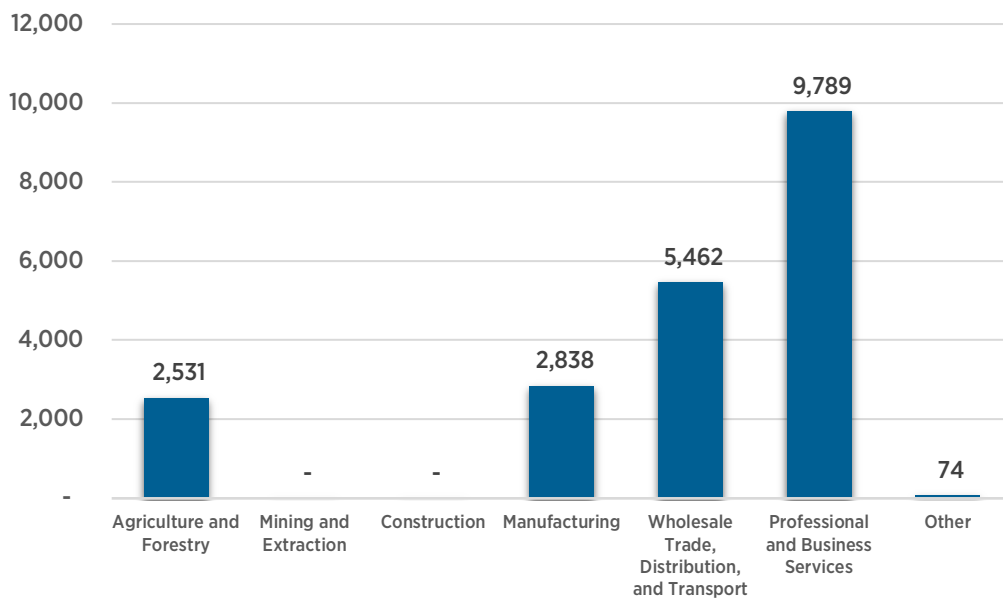
Table 10.
Corn Ethanol Fuels — Demographics, Q4 2019

Demographic	Employees	Percent of Sector	National Workforce Averages
Male	24,506	70%	53%
Female	10,361	30%	47%
Hispanic or Latino	3,242	9%	18%
Not Hispanic or Latino	31,625	91%	82%
American Indian or Alaska Native	280	1%	>1%
Asian	1,964	6%	6%
Black or African American	1,973	6%	12%
Native Hawaiian or other Pacific Islander	241	1%	>1%
White	28,460	82%	78%
Two or more races	1,950	6%	2%
Veterans	6,674	19%	6%
55 and over	8,502	24%	23%
Union	2,537	7%	6%

Other Ethanol and Non-Woody Biomass Fuels, including Biodiesel

Other ethanol and non-woody biomass, including biodiesel¹¹, employed almost 2 percent of the Fuels workforce in 2018, providing 20,694 jobs, an increase of 620 jobs or 3 percent. 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 24.
Other Ethanol and Non-Woody Biomass Fuels (Including Biodiesel) – Employment by Industry



In 2019, 86 percent of employers in wholesale trade, distribution, and transport reported that hiring was somewhat difficult or very difficult (with 64 percent reporting hiring to have been somewhat difficult).

¹¹ 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.

Figure 25.
Other Ethanol and Non-Woody Biomass Fuels (Including Biodiesel) – Hiring Difficulty by Industry



Other ethanol and non-woody biomass fuels employers are expecting nearly 4 percent job growth in 2020, with that hiring concentrated in wholesale trade, distribution, and transport and in professional services.

Figure 26.
Other Ethanol and Non-Woody Biomass Fuels (Including Biodiesel) – Expected Employment Growth by Industry



In 2019, women represented 33 percent of the other ethanol and non-woody biomass fuels workforce. Overall, other ethanol and non-woody biomass employers were more diverse than the national workforce, exceeding averages for employment of American Indians, Asians, Native Hawaiians or other Pacific Islanders, and those reporting two or more races.

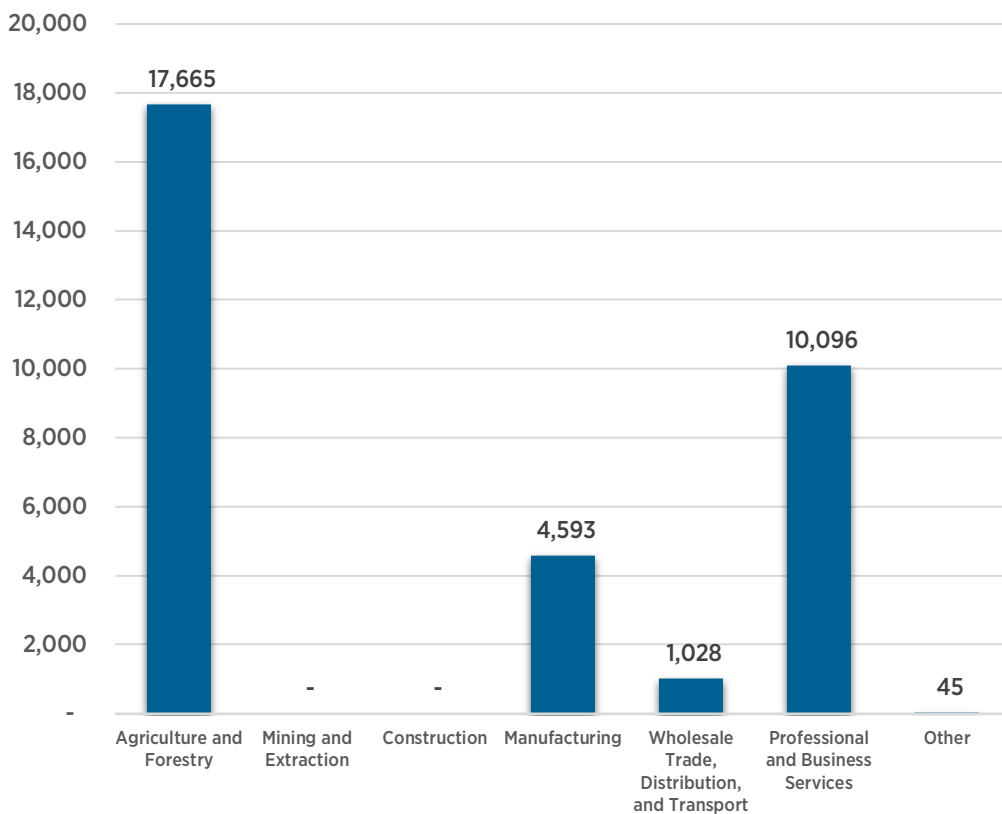
Table 11.
Other Ethanol and Non-Woody Biomass Fuels (Including Biodiesel) –
Demographics, Q4 2019

Demographic	Employees	Percent of Sector	National Workforce Averages
Male	13,898	67%	53%
Female	6,797	33%	47%
Hispanic or Latino	2,682	13%	18%
Not Hispanic or Latino	18,013	87%	82%
American Indian or Alaska Native	322	2%	>1%
Asian	1,614	8%	6%
Black or African American	1,810	9%	12%
Native Hawaiian or other Pacific Islander	328	2%	>1%
White	15,475	75%	78%
Two or more races	1,145	6%	2%
Veterans	1,766	9%	6%
55 and over	2,762	13%	23%
Union	868	4%	6%

Woody Biomass Fuel for Energy and Cellulosic Biofuels

Woody biomass fuel for energy and cellulosic biofuels¹² supported 33,426 jobs across the United States in 2019, nearly 3 percent of the Fuels workforce, and added 260 jobs in 2019. More than half of the employment in woody biomass fuels was found in agriculture, followed by professional services at 30 percent; these two industries accounted for 83 percent of employment.

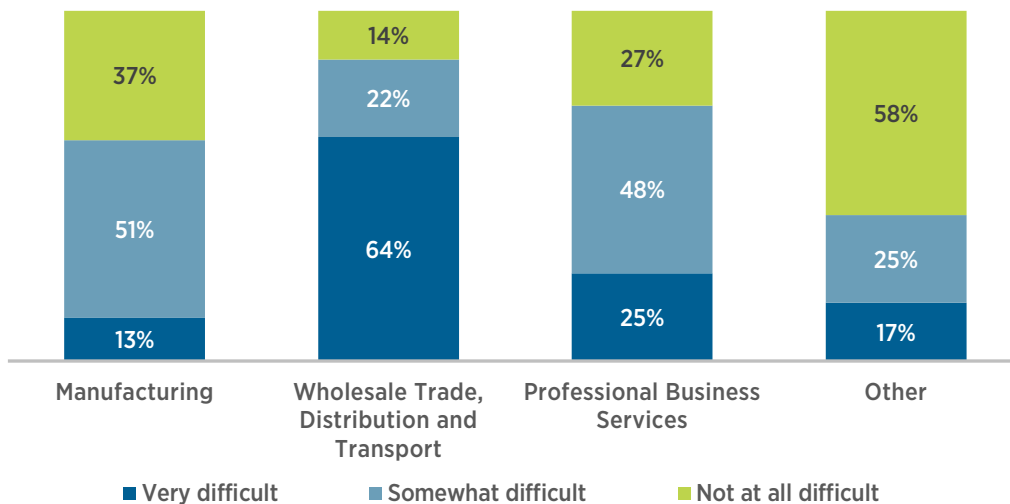
Figure 27.
Woody Biomass Fuel for Energy and Cellulosic Biofuel - Employment by Industry



For 2019, 73 percent of professional services employers, the second largest industrial sector, reported it was somewhat difficult or very difficult to hire (with 25 percent reporting hiring to have been very difficult). No data was available for agricultural or logging firms.

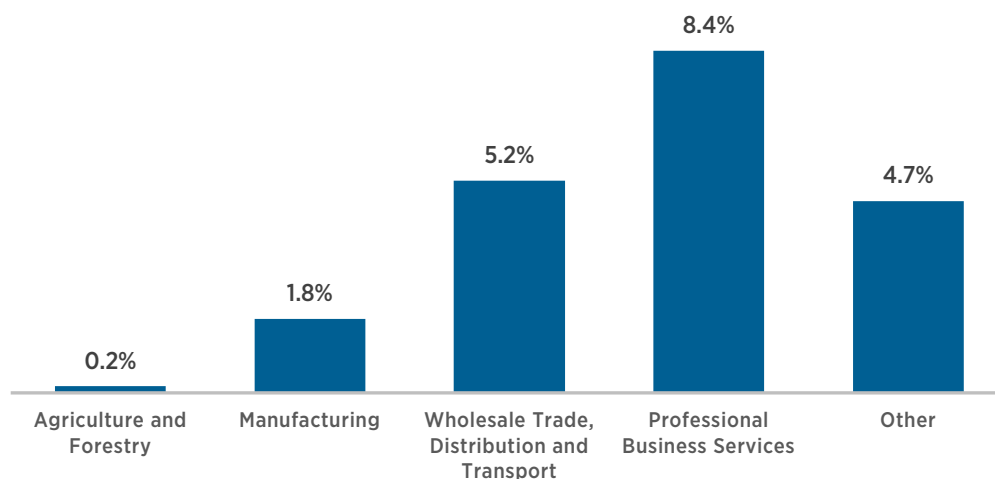
¹² While the survey question asked of respondents covered both woody biomass fuel for energy and cellulosic biofuels, all employment data reported is in woody biomass fuel for energy. Woody Biomass or Cellulosic Biofuel are fuels developed from the by-product of management, restoration, and hazardous 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).

Figure 28.
Woody Biomass Fuel for Energy and Cellulosic Biofuel – Hiring Difficulty by Industry



Woody biomass fuels employers are expecting 3 percent job growth in 2020, led by professional business services. However, the largest sector, agriculture and forestry, expects flat growth in 2020.

Figure 29.
Woody Biomass Fuel for Energy and Cellulosic Biofuel – Expected Employment Growth by Industry



In 2019, women represented 28 percent of the woody biomass fuels workforce. Overall, 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—16 percent—are veterans.

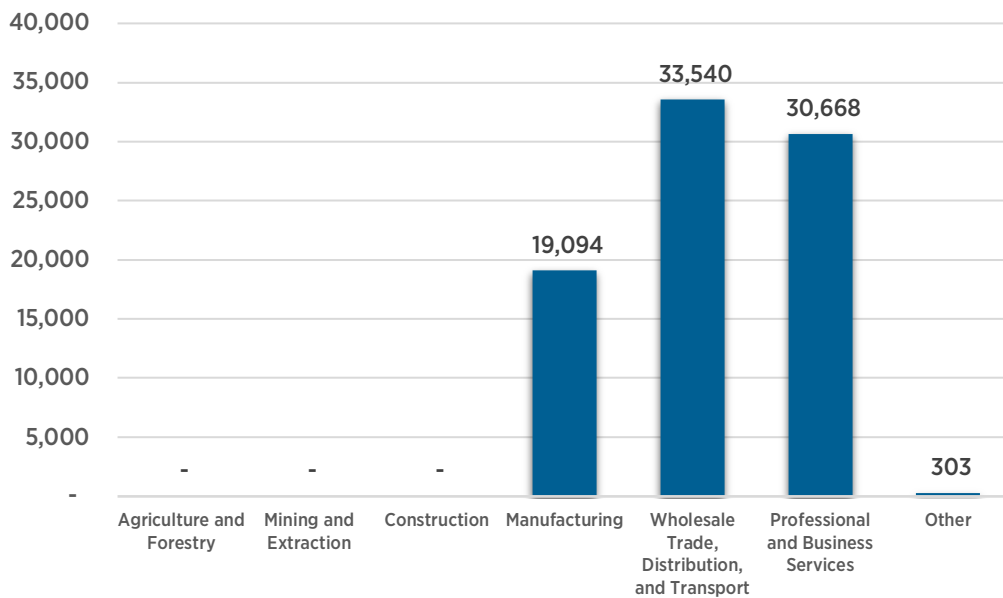
Table 12.
Woody Biomass Fuel for Energy and Cellulosic Biofuel – Demographics, Q4 2019

Demographic	Employees	Percent of Sector	National Workforce Averages
Male	24,072	72%	53%
Female	9,355	28%	47%
Hispanic or Latino	1,921	6%	18%
Not Hispanic or Latino	31,505	94%	82%
American Indian or Alaska Native	285	1%	>1%
Asian	1,666	5%	6%
Black or African American	1,341	4%	12%
Native Hawaiian or other Pacific Islander	224	1%	>1%
White	28,260	85%	78%
Two or more races	1,651	5%	2%
Veterans	5,199	16%	6%
55 and over	7,379	22%	23%
Union	2,597	8%	6%

Other Fuels

Other fuels¹³ comprised 83,605 jobs across the United States in 2019, over 7 percent of the Fuels workforce, adding 1,774 jobs. More than 40 percent of that employment was found in wholesale trade, distribution, and transport, followed by professional services with nearly 37 percent of the workforce

Figure 30.
Other Fuels - Employment by Industry

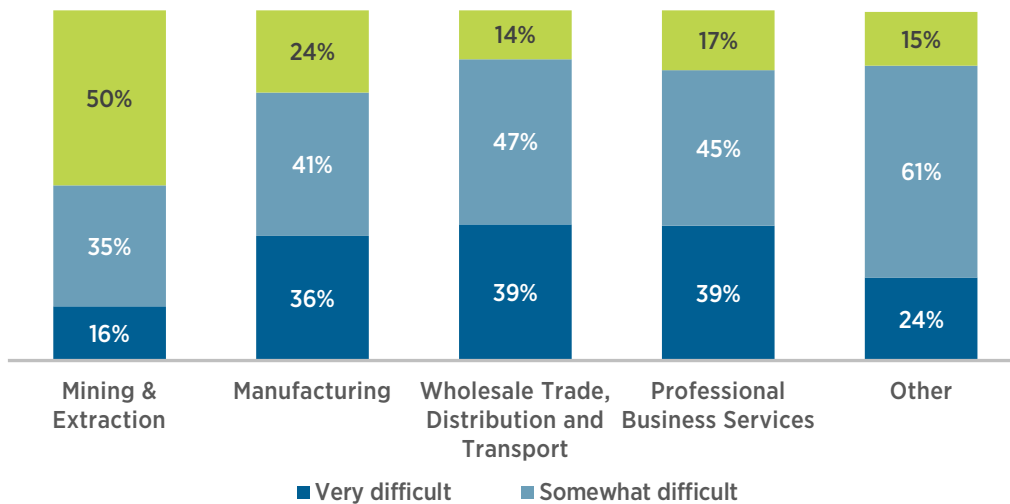


Employers reported significant difficulty in hiring in other fuels in 2019, with 86 percent of wholesale trade, distribution, and transport employers reporting that hiring has been somewhat difficult or very difficult (with 39 percent reporting hiring to have been very difficult), and 83 percent of professional service employers reporting similarly.¹⁴

¹³ 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.

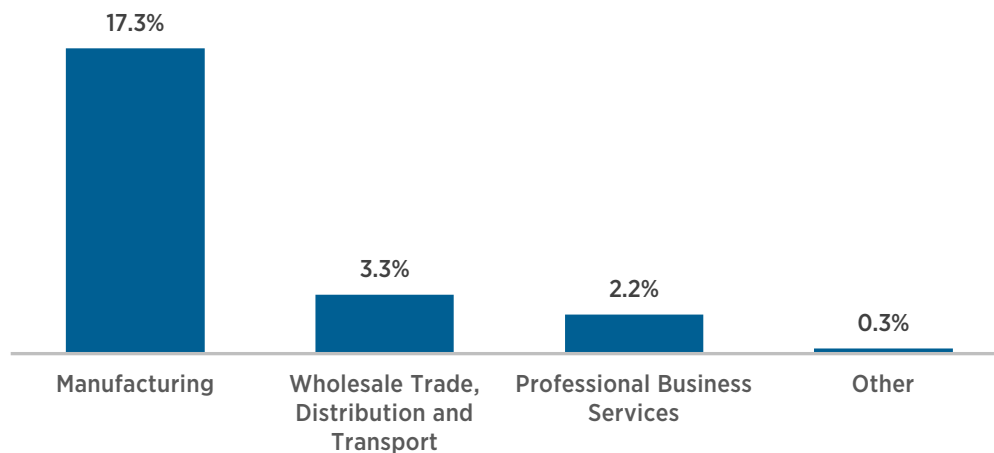
¹⁴ Some industries are omitted from this discussion due to their small sample size in the data contributing to Figure 31. Conclusions have been made only about industries with sufficient sample size.

Figure 31.
Other Fuels - Hiring Difficulty by Industry



Employers in other fuels expect more than 5 percent growth in 2020. This is influenced by the confidence shown by the manufacturing industry which added over 400 jobs in 2019. The wholesale trade, distribution, and transport sector also expects over 3 percent growth.

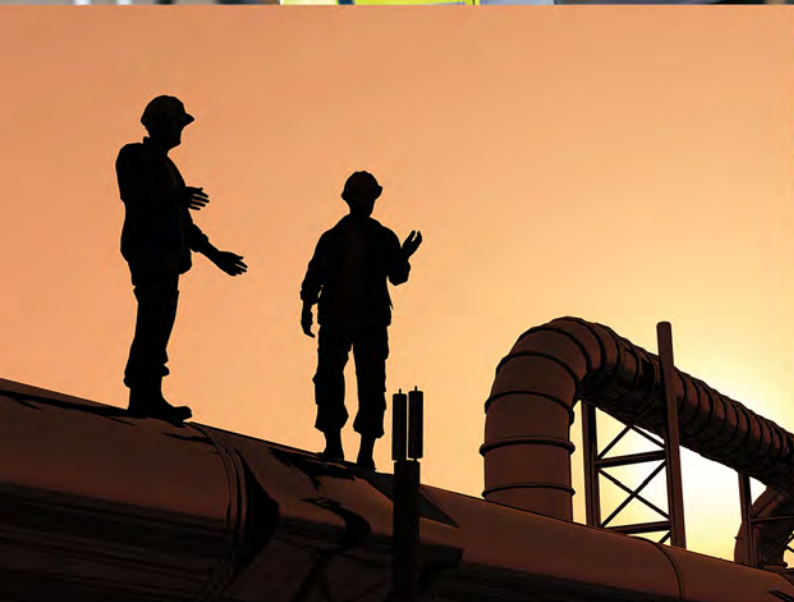
Figure 32.
Other Fuels - Expected Employment Growth by Industry



In 2019, women represented 26 percent of the other fuels workforce. Overall, the workforce for other fuels is less diverse than the national workforce. It also has a much higher percentage of veterans than the national workforce average.

Table 13.
Other Fuels - Demographics, Q4 2019

Demographic	Employees	Percent of Sector	National Workforce Averages
Male	61,712	74%	53%
Female	21,893	26%	47%
Hispanic or Latino	7,094	8%	18%
Not Hispanic or Latino	76,511	92%	82%
American Indian or Alaska Native	671	1%	>1%
Asian	4,153	5%	6%
Black or African American	3,122	4%	12%
Native Hawaiian or other Pacific Islander	549	1%	>1%
White	71,674	86%	78%
Two or more races	3,435	4%	2%
Veterans	13,064	16%	6%
55 and over	18,991	23%	23%
Union	7,653	9%	6%



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, operations and maintenance, and wholesale parts distribution for all electric generation technologies.

Trends

- 2019 Job Gain.** In 2019, the Electric Power Generation sector gained 21,245 jobs, increasing by more than 2 percent to a total of 896,830 jobs, reversing a decline in 2018.
- Technology Shifts.** Advanced and traditional natural gas added the most new jobs, 9,100, while majority-time solar followed, gaining 5,700 jobs. Other technologies that grew included wind, combined heat and power, hydro, and geothermal. Nuclear and coal generation declined.
- Electric Power Generation Mix.** From 2006 to 2018, net electricity generation from natural gas increased by 86 percent while net generation from coal declined by 42 percent. In 2018 and 2019, coal generation employment declined by over 14 percent, losing over 13,000 jobs.
- 2020 Expectations.** Electric Power Generation employers anticipated 4.8 percent job growth in 2020, with most of the increase expected in renewable generation construction.



2.4%

Electric Power
Generation job
growth in 2019



4.8%

EPG employers
predict 4.8% job
growth in 2020

Employment Snapshot

Figure 34.
Electric Power Generation Sector - Employment by Industry, 2018-2019

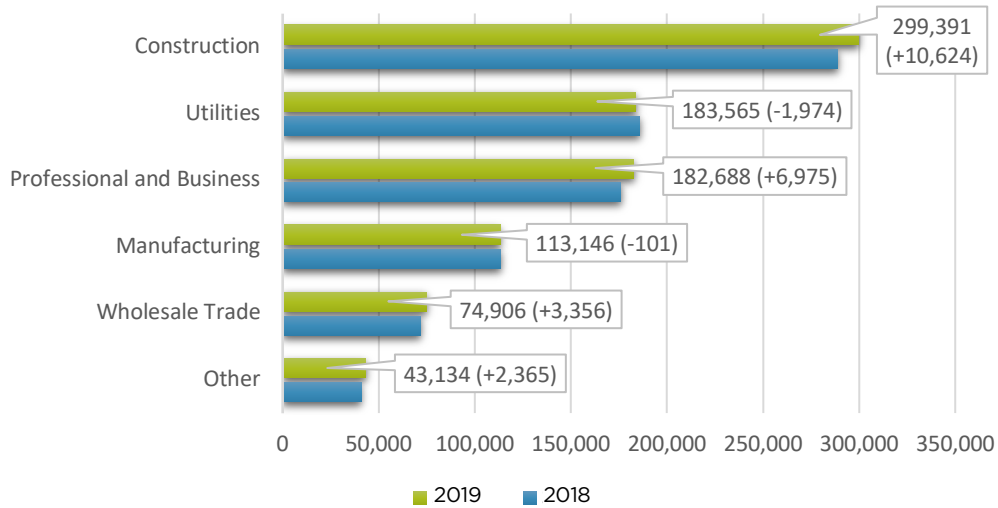
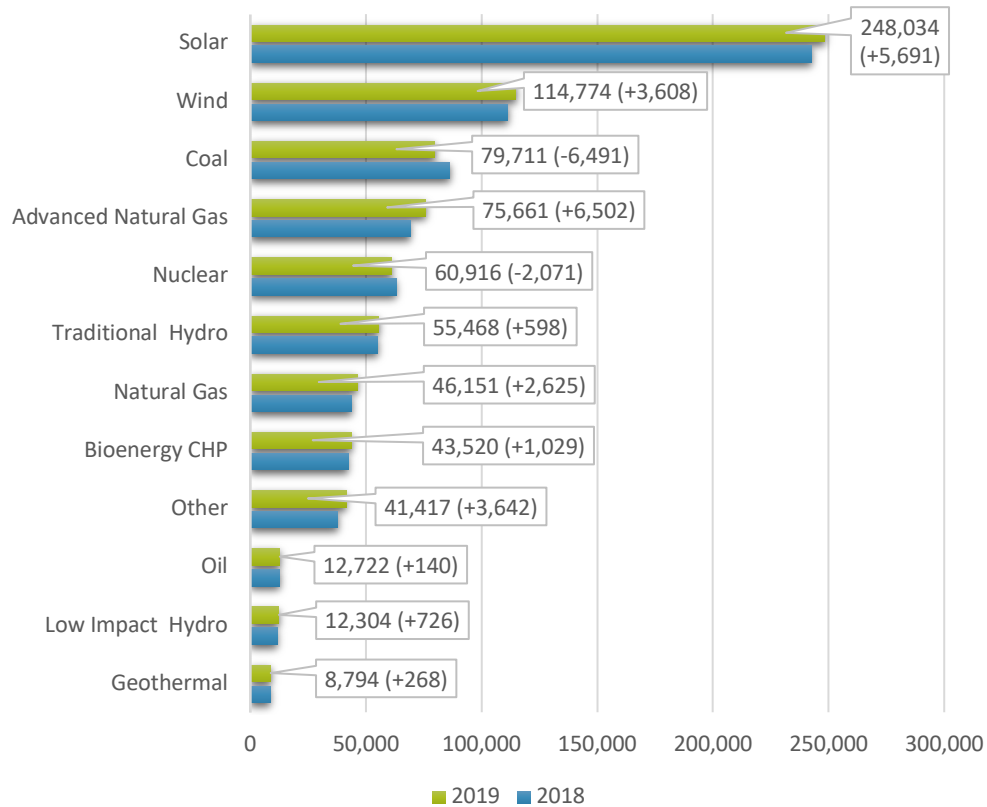


Figure 33.
Electric Power Generation Sector - Employment by Detailed Technology Application, 2018-2019



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 nearly 82 percent of the nation's electricity.
- Natural gas and advanced natural gas combined—with nearly 122,000 jobs—have exceeded coal, both in employment and gigawatt hours produced.
- Solar and wind technologies rank first and second in the construction industry with 127,000 and 38,000 jobs respectively. Advanced natural gas and natural gas together ranked third, with nearly 20,000 jobs combined.

Table 14.¹⁵
Electric Power Generation Sector – Employment by Detailed Technology Application and Industry, Q2 2019^{16,17}

	Total	Utilities	Construction	Manufacturing	Wholesale Trade	Professional Services	Other Services
Majority-Time Solar Employment							
Solar	248,034	3,682	126,979	34,243	23,913	37,479	21,738
Wind	114,774	6,360	37,910	26,408	12,305	28,873	2,918
Geo	8,794	1,095	5,184	295	361	1,830	29
Bio	13,178	1,897	5,809	1,133	576	3,317	446
Low Hydro	12,304		1,913	3,440	2,593	4,283	75
Trad Hydro	55,468	17,464	8,934	14,458	6,075	8,301	236
Adv Nat Gas	75,661	47,224	9,638	2,791	4,983	10,118	907
Nuclear	60,916	44,366	2,217	1,901	2,639	9,705	89
Coal	79,711	38,158	8,847	1,083	6,104	24,508	1,011
Oil	12,722	474	-	5,790	2,012	4,306	139
Natural Gas	46,151	19,276	10,551	3,635	3,180	8,371	1,139
CHP	30,342	1,608	4,361	2,100	3,944	18,133	196
Other	41,417	1,961	20,119	3,788	3,083	11,777	690
TOTAL	799,742	183,565	242,462	101,065	74,906	182,688	43,134

¹⁵ Column and row totals may differ due to rounding

¹⁶ Majority-time solar employment includes all employees who spend 50 percent or more of their time on solar-related work. 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).

¹⁷ The totals for each value chain reflect only solar employment for majority time employees.

Hiring Difficulty

- **90 percent of construction employers in electric power generation** reported that it was somewhat difficult or very difficult to hire new employees, with 29 percent reporting that it was very difficult.
- **84 percent of manufacturing employers** reported that it was either somewhat difficult or very difficult to hire new employees.
- **93 percent of utility employers in electric power generation** reported that it was either somewhat difficult or very difficult to hire new employees, an increase of 30 percentage points. However, only 7 percent of those reported that it was very difficult.

Highest-Demand Occupations In Electric Power Generation

With significant growth in 2019 and predicted growth of nearly 43,000 new jobs in 2020, electric power generation employers have identified the occupations that each industry sector is having the greatest difficulty in filling.

Table 15.
Electric Power Generation Sector – Reported Occupations with Hiring Difficulty by Industry, Q4 2019

Utilities	Construction	Manufacturing	Wholesale Trade, Distribution, and Transport	Professional and Business Services	Other
Technicians or mechanical support (58%)	Installation workers (33%)	Management (directors, supervisors, vice presidents) (39%)	Management (directors, supervisors, vice presidents) (41%)	Management (directors, supervisors, vice presidents) (44%)	Technicians or mechanical support (43%)
Engineers/scientists (42%)	Sales, marketing, or customer service rep (31%)	Engineers/scientists (35%)	Operations or business development (29%)	Engineers/scientists (28%)	Management (directors, supervisors, vice presidents) (43%)
Electrician/construction workers (25%)	Electrician/construction workers (31%)	Sales, marketing, or customer service rep (30%)	Sales, marketing, or customer service rep (24%)	Sales, marketing, or customer service rep (15%)	Engineers/scientists (43%)

SPOTLIGHT

MJ Horner

Senior Director of Talent Strategy and Transformation, Xcel Energy



Xcel Energy is a gas and electric utility with operations in Colorado, Minnesota, Wisconsin, North and South Dakota, Michigan, Texas, and New Mexico. In 2019, Xcel announced its intention to deliver 100 percent carbon free electricity by 2050. MJ Horner is the Senior Director of Talent Strategy and Transformation at Xcel.

“Over the last five years, Xcel has hired on average 1,000 new employees per year while this has increased by about 200 in the last year. Many of our new hires are hired into apprenticeships and intern programs. Our over 600 apprentices participate in about forty different apprenticeship programs which are all negotiated with our unions, registered with the states, and are two, three, and four-year programs. These include occupations such as line workers, mechanics, garage mechanics, field technicians, and welders.

“Our internships are for both high school and college students. The high school internships, such as Step Up, Right Track, and Denver Public Schools last for approximately eight weeks in the summer. We typically have 30-40 high school interns across our service territory each summer. We have a very robust internship program for college students, primarily in engineering and IT. We have approximately 300-330 at any time. Approximately 180 of them stay throughout the year. They are an important pipeline for hiring in our company.

We think a lot about the energy transition that is underway in America. We have announced our intention to deliver 100 percent carbon-free electricity by 2050. How we manage this transition is very important. We know that there will be fewer power plant jobs in the future but more jobs with data and grid management and customer service.

“We also think a lot about the energy transition that is underway in America. We have announced our intention to deliver 100 percent carbon-free electricity by 2050. How we manage this transition is very important.

We know that there will be fewer power plant jobs in the future but more jobs with data and grid management and customer service. Consequently, we are starting to spend a lot of time thinking about how to determine future needed skills and how we assess skills to determine if or how we might need to re-skill our existing workforce.

“Data scientists are roles that are quickly emerging, becoming more challenging to fill, and are predicted to be some of the most competitive jobs to fill in the near future. We use them in occupations as varied as the analysis of drone-harvested data to Human Resources. In HR, data scientists are working to provide leadership and HR partners with data that can help them make data-driven decisions about the workforce. We are starting build use cases to use data in many different ways to determine things such as to pinpoint the difficulties in hiring, determine our most effective recruiting sources, predict attrition, determine factors contributing to attrition and identify commonalities in safety incidents.”

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.¹⁸ This transition has involved a significant build-out of new power generation facilities in the United States.

Figure 35 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 42 percent between 2006 and 2018,¹⁹ while electricity generation from natural gas increased by 86 percent and from solar by over 12,000 percent—from 508,000 MWh of solar generation to nearly 64,000,000 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 2019, distributed solar PV generation increased 19 percent nationwide, while estimated total solar PV generation—both utility-scale and distributed generation—increased nationwide by 15 percent.²⁰

The shifts in electric generation sources over the last several years are mirrored in the sector's changing employment profile, as the shares of natural gas, solar, wind, and CHP employment 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). While under the latest EIA modeling in the *Annual Energy Outlook 2020*, the share of U.S. electricity produced from fossil fuels will fall to 47.5 percent by 2050, fossil fuels will still account for 76.6 percent of overall U.S. energy consumption in that year.²²

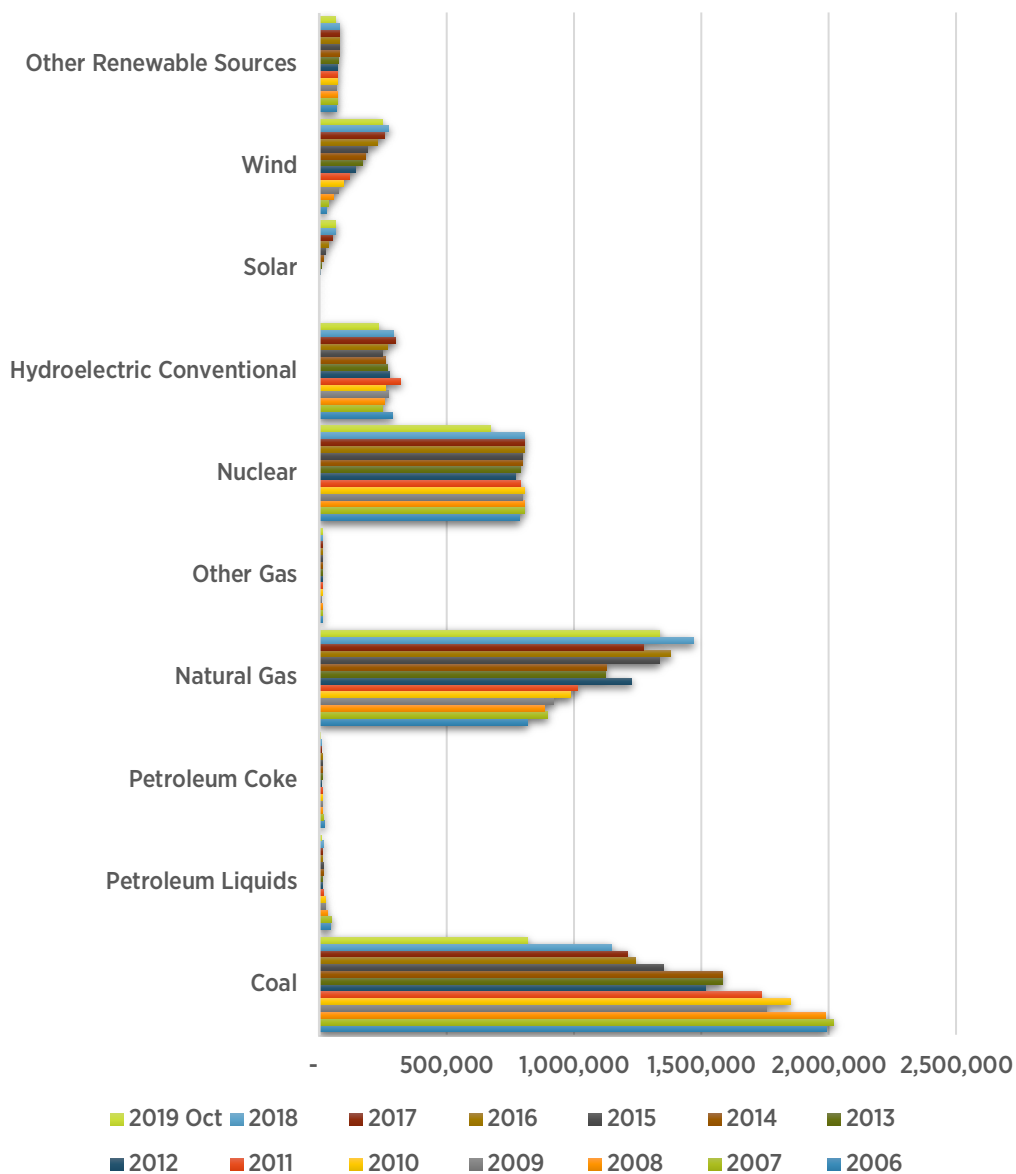
¹⁸ Coal is a combustible black or dark brown rock consisting mainly of carbonized plant matter, found mainly in underground deposits and widely used as fuel. Natural gas is a flammable gas, consisting largely of methane and other hydrocarbons, occurring naturally underground (often in association with petroleum) and used as fuel.

¹⁹ 2019 generation data is only available through October.

²⁰ EIA, *Electric Power Monthly*, December 17, 2019, Table 1.1.A., Data on distributed solar generation from Rolling 12 Months Ending in October for 2018 and 2019 for Small Scale Generation: Estimated Solar Photovoltaic and data on total solar PV from Rolling 12 Months Ending in October for 2018 and 2019 for Generation from Utility and Small Scale Facilities: Estimated Total Solar Photovoltaic.

²² EIA, *Annual Energy Outlook 2020*, January 2020, reference Case, Tble 2.

Figure 35.
Change in Net Generation of Electricity by Energy Source (Thousand MWh),
2006-2019



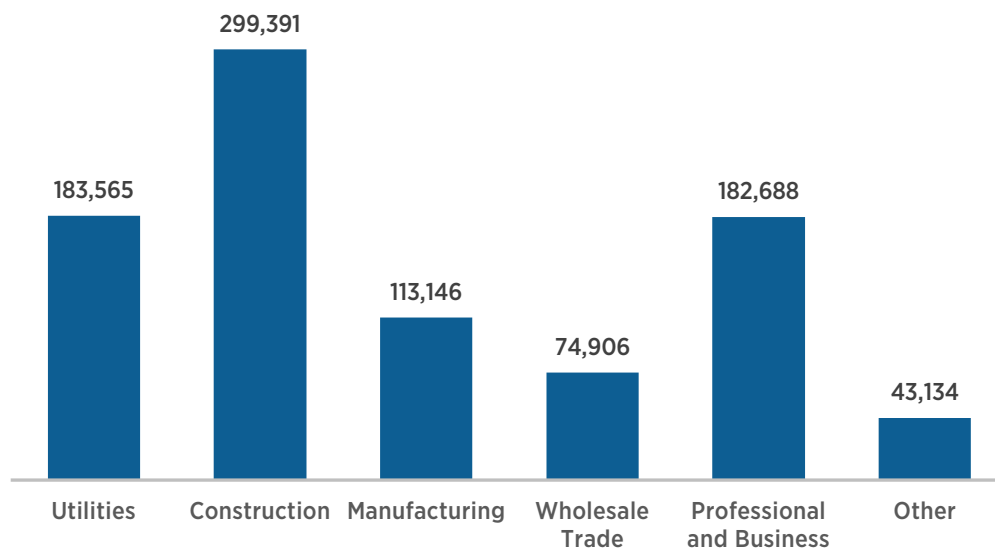
Electric Power Generation accounted for 896,830 jobs in 2019, up more than 2 percent from the previous year’s 875,585 workers²³, and employers report a projected 4.8 percent growth in 2020. Roughly half of these new jobs are reported in the construction industry and are comprised of employees installing and building generation capacity additions.

²³ This number has been revised to account for 2016 coal generation employment in NAICS 4238, Machinery, Equipment, and Supplies Merchant Wholesalers. It also includes 97,359 solar employees who spent less than 50% of their time on solar.

Electric Power Generation – Workforce Characteristics

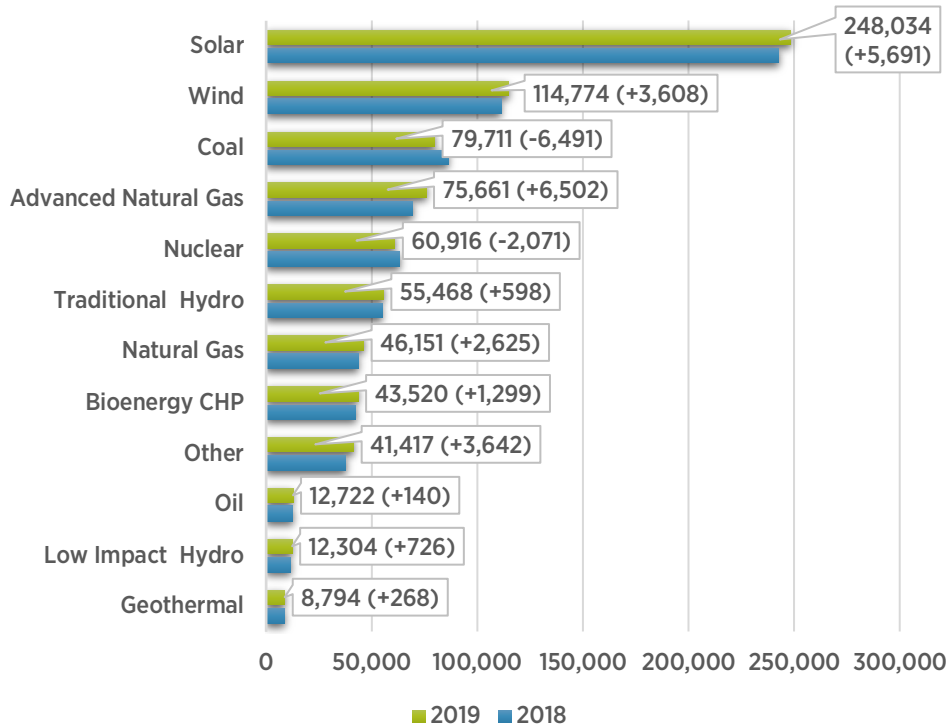
The largest component (33 percent) of the Electric Power Generation workforce is construction, underscoring the importance of the construction industry to maintaining our electrical system. Construction is followed by sizable groups of utility workers (21 percent) and professional and business service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

Figure 36.
Electric Power Generation Sector – Employment by Industry, Q2 2019



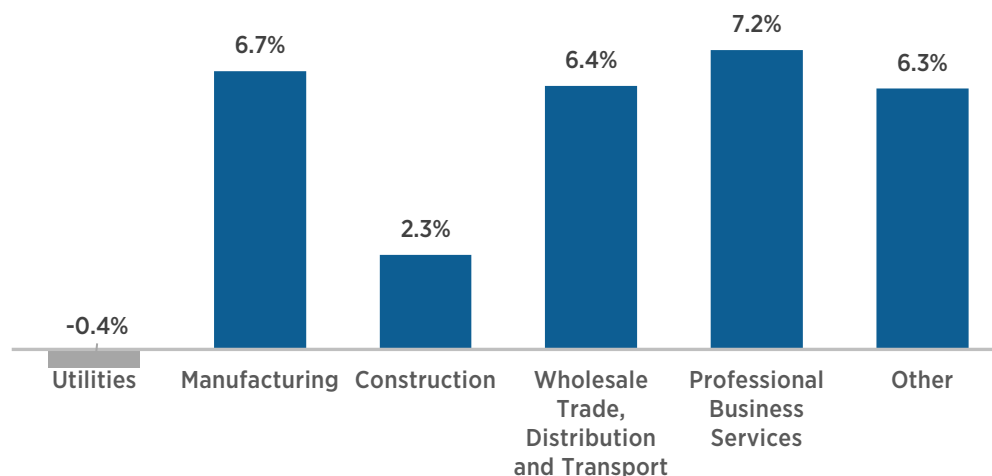
In 2019 employment in the following EPG technologies grew: natural gas, solar, wind, CHP, hydro, bioenergy, and geothermal. At the same time employment declined in coal-fired and nuclear generation. Natural gas generation produced the most new jobs with over 70% of those in advanced/low emissions technologies.

Figure 37.
Electric Power Generation Sector – Employment by Detailed Technology Application, 2018-2019



Construction, the largest segment of Electric Power Generation employment, anticipates 2.3 percent growth in 2020, while the next largest segments, utilities and professional services, predict -0.4 percent and 7.2 percent growth, respectively. Manufacturing expects a strong 6.7 percent increase in 2020.

Figure 38.
Electric Power Generation Sector – Expected Employment Growth by Industry (Q4 2019 – Q4 2020)



In 2019, utilities reported the greatest hiring difficulty among industry sectors in Electric Power Generation, with 93 percent of companies indicating it was either somewhat difficult (86 percent) or very difficult (7 percent) to find new employees. Construction and manufacturing employers reported comparable figures for these two categories of 90 percent and 84 percent, respectively. However, both construction (29 percent very difficult) and manufacturing (29 percent very difficult) employers were four times more likely than utility employers (7 percent very difficult) to report finding and hiring qualified candidates very difficult.

Almost one-third (32 percent) of employment in Electric Power Generation in 2019 was within installation or repair positions. Management/professional positions (19 percent) and administrative positions (21 percent) each comprised around one-fifth of Electric Power Generation employment.

Figure 39.
Electric Power Generation Sector – Occupational Distribution, Q4 2019

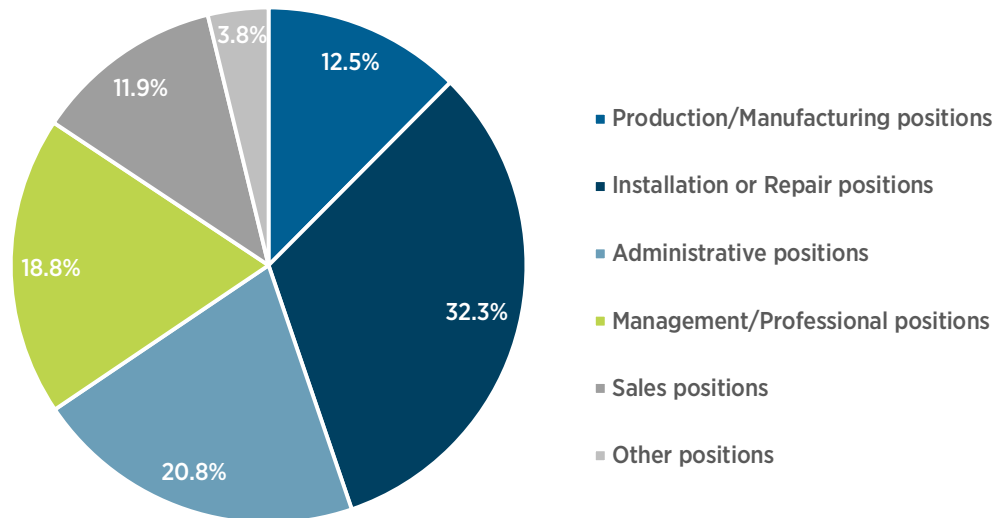
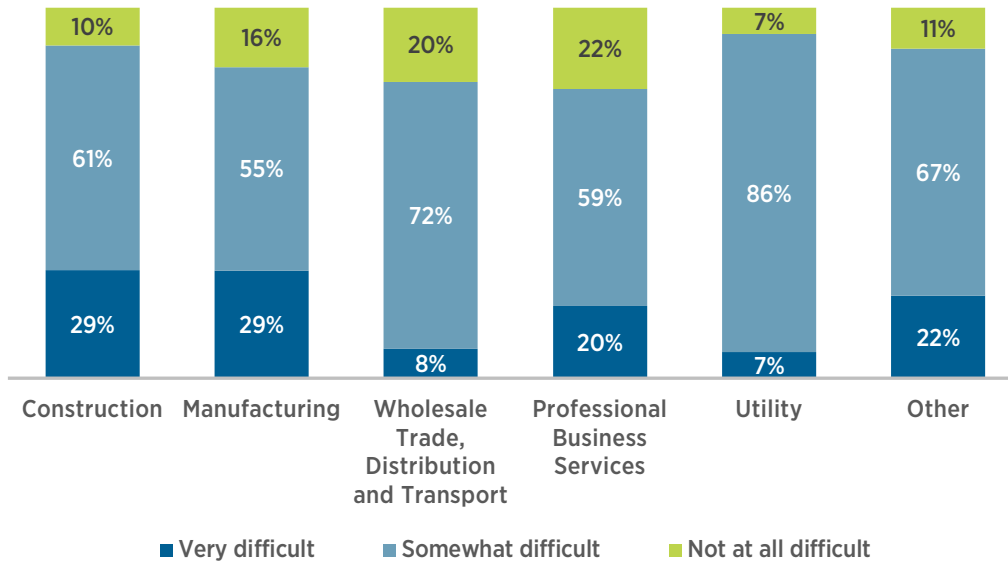


Figure 40.
Electric Power Generation Sector – Hiring Difficulty by Industry, Q4 2019



Electric Power Generation employers identified lack of experience, training, or technical skills as the number one reason for hiring difficulty over the previous year across all but one industry sectors. Competition and small applicant pools emerged for the first time as the second leading barrier to hiring.

SPOTLIGHT

Missy Henriksen

Executive Director, Center for Energy Workforce Development



Founded in 2006, the Center for Energy Workforce Development (CEWD) is a non-profit consortium of utilities and their trade associations in the electric, gas, and nuclear industries that has led the energy industry's efforts to solve critical workforce issues, including an aging workforce, veterans recruitment, new curricula development, diversity, and changing technology. Missy Henriksen is Executive Director, CEWD.

“When CEWD was first started, 50 percent of the utility workforce was eligible to retire in the next five years. We had no steady stream of talent for specific skillsets. Our goal was to identify critical jobs, determine the best way to recruit and train, and then develop pipelines. CEWD established boot camps for lineworkers, for instance, to determine if job prospects are comfortable climbing, and if they have the right skills and attitude before putting them through a rigorous training program. For skilled technicians, candidates would need a two-year degree. For engineers, they would need at least four. CEWD then built state energy workforce consortia in states across the country to implement the plans, recognizing the unique employment needs in each region.

The industry's biggest workforce issue today is skills. New jobs in utilities used to be like the old jobs. Now the modernization of infrastructure and the change in generation mix are requiring new skills that are changing on two and five-year cycles.

“Retirement rates are now on pace with national norms for other industries and business leaders in the energy field no longer predict a mass attrition bubble. The industry's biggest workforce issue today is skills. New jobs in utilities used to be like the old jobs. Now the modernization of infrastructure and the change in generation mix are requiring new skills that are changing on two- and five-year cycles. However, industry certificate programs take four years, and we now need to predict new

skills several years out. These challenges are coupled with how best to train people in an increasingly technical world, leading many to consider training through artificial intelligence and augmented reality.

“In addition to having the right technical skills, today’s employees need to be critical thinkers, problem solvers and have the ability to thrive in team environments. A whole transformation of the industry is taking place that will require a higher level of skills that, in turn, are adaptable to future needs.

“Career specialties most likely to be impacted by technology include support jobs like HR, IT, and customer service. Today, utilities have data that was never before available, and they are using that to enhance customer experiences, like individualized plans and automated interface. Many such services can be provided by ‘chatbox,’ instead of phone consultation. As we look to changes in this office skills, we are also seeing advances in how technology is used in field positions. The energy industry uses all skills associated with STEM learning.

“As a result of CEWD’s work, our field force has stabilized, and we have developed pipelines for recruitment. Many of our new challenges are in information technology, operations technology and cybersecurity.”

Table 16.
Electric Power Generation Sector – Reasons for Hiring Difficulty by Industry, Q4 2019

Utilities	Construction	Manufacturing	Wholesale Trade, Distribution, and Transport	Professional and Business Services	Other
Lack of experience, training, or technical skills (54%)	Lack of experience, training, or technical skills (44%)	Lack of experience, training, or technical skills (40%)	Lack of experience, training, or technical skills (44%)	Lack of experience, training, or technical skills (40%)	Difficulty finding industry-specific knowledge, skills, and interest (38%)
Location (46%)	Competition/ small applicant pool (36%)	Competition / small applicant pool (28%)	Competition / small applicant pool (28%)	Competition / small applicant pool (32%)	Insufficient non-technical skills (work ethic, dependability, critical thinking) (25%)
Difficulty finding industry-specific knowledge, skills, and interest (23%)	Difficulty finding industry-specific knowledge, skills, and interest (20%)	Economy/ structural problem (24%)	Difficulty finding industry-specific knowledge, skills, and interest (22%)	Difficulty finding industry-specific knowledge, skills, and interest (28%)	Lack of experience, training, or technical skills (25%)

Electric Power Generation employers reported that management, installation workers, and technicians or mechanical support were among the most difficult positions to hire for over the course of 2019.

Table 17.
Electric Power Generation Sector – Reported Occupations with Hiring Difficulty
by Industry, Q4 2019

Utilities	Construction	Manufacturing	Wholesale Trade, Distribution, and Transport	Professional and Business Services	Other
Technicians or mechanical support (58%)	Installation workers (33%)	Management (directors, supervisors, vice presidents) (39%)	Management (directors, supervisors, vice presidents) (41%)	Management (directors, supervisors, vice presidents) (44%)	Technicians or mechanical support (43%)
Engineers/scientists (42%)	Sales, marketing, or customer service representatives (31%)	Engineers/scientists (35%)	Operations or business development (29%)	Engineers/scientists (28%)	Management (directors, supervisors, vice presidents) (43%)
Electrician/construction workers (25%)	Electrician/construction workers (31%)	Sales, marketing, or customer service rep (30%)	Sales, marketing, or customer service rep (24%)	Sales, marketing, or customer service rep (15%)	Engineers/scientists (43%)

In 2019, women represented 32 percent of the Electric Power Generation workforce. However, Electric Power Generation is racially more diverse than the workforce as a whole and exceeds the national average for Asian employees. Electric Power Generation had only 14 percent of its employees over age 55 in 2019, far below the national average. Electric Power Generation exceeded the national average for veterans hiring at 9 percent. Union membership, at 7 percent, is roughly equivalent to the national private sector average of 6.2 percent.

Table 18.
Electric Power Generation Sector – Demographics, Q4 2019

Demographic	Employees	Percent of Sector	National Workforce Averages ²⁴
Male	607,630	68%	53%
Female	289,200	32%	47%
Hispanic or Latino	164,294	18%	18%
Not Hispanic or Latino	732,536	82%	82%
American Indian or Alaska Native	10,644	1%	>1%
Asian	87,995	10%	6%
Black or African American	79,311	9%	12%
Native Hawaiian or other Pacific Islander	10,382	1%	>1%
White	621,053	69%	78%
Two or more races ²⁵	87,446	10%	2%
Veterans	77,627	9%	6%
55 and over	124,274	14%	23%
Union	63,171	7%	6%

²⁴ 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>.

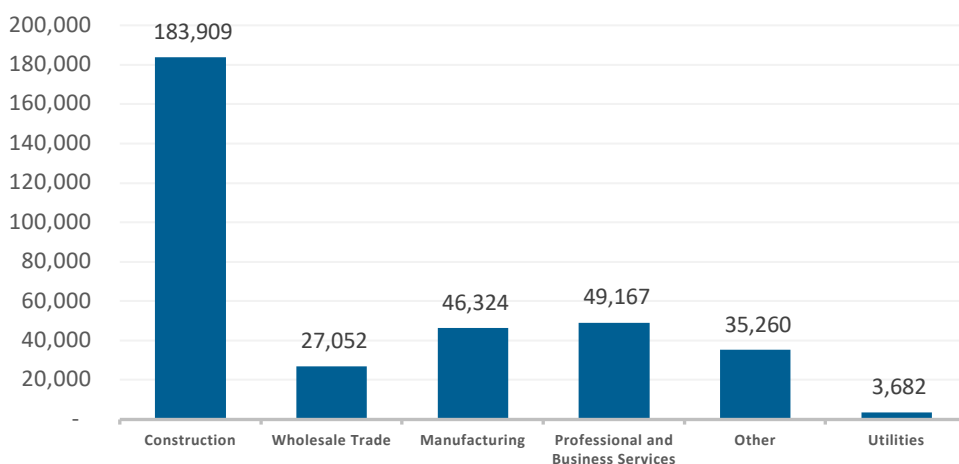
²⁵ While federal guidelines were followed in administering the demographic questions, respondents may have reported two or more races as including Hispanic or Latino ethnicity, inappropriately inflating the total and deflating other racial categories.

Solar Electric Power Generation

In 2019, there were 248,034 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 97,359 employees spent less than half their time on solar work.²⁶ That represents an increase of 2.3 percent or nearly 5,700 jobs for workers who spent a majority of their time on solar. Another 4,700 jobs were gained by employees who spent a minority of their time on solar tasks. This is a notable rebound from two consecutive years of solar declines. The majority of solar employment in 2019 is found in construction and installation activities, totaling 183,909 jobs, followed by professional business services with 49,167 workers and manufacturing with 46,324, a slight decline in 2019.²⁷

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 2019, the BLS Quarterly Census of Employment and Wages (QCEW) reported that utilities employed just over 3,600 workers for solar-specific generation in the United States. However, this figure does not include any jobs in the construction or other value-chain industries for solar projects even when they are financed, owned, or directed by utilities. The data find that utilities are directly responsible for only 1.5 percent of the solar jobs in the United States, since 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.

Figure 41.
Solar Electric Power Generation – Employment by Industry



²⁶ The Solar Foundation, *National Solar Jobs Census 2019* (Washington, DC: Solar Foundation, 2020), 15. USEER solar data does not include solar jobs in Puerto Rico which are included in the National Solar Jobs Census.

²⁷ This division of solar jobs by industry, including the data in Figure 4441, includes both those employees who spend more than 50 percent of their time and less than 50 percent of their time on solar activities.

Figure 43.
Estimated Percentage of Solar Generation Installed – 2019

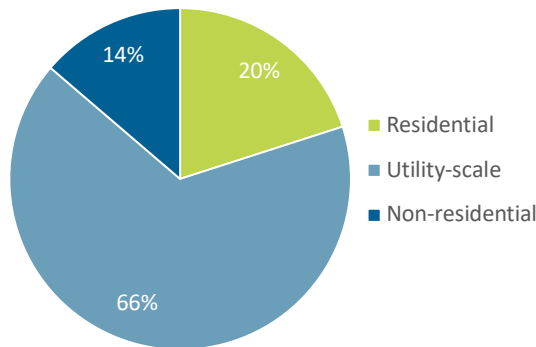
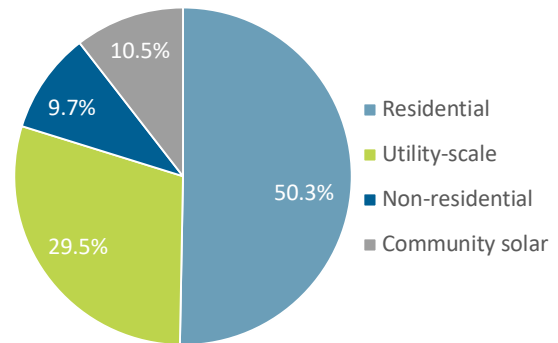


Figure 42.
Majority-Time Solar Employees by Type of Project – 2019



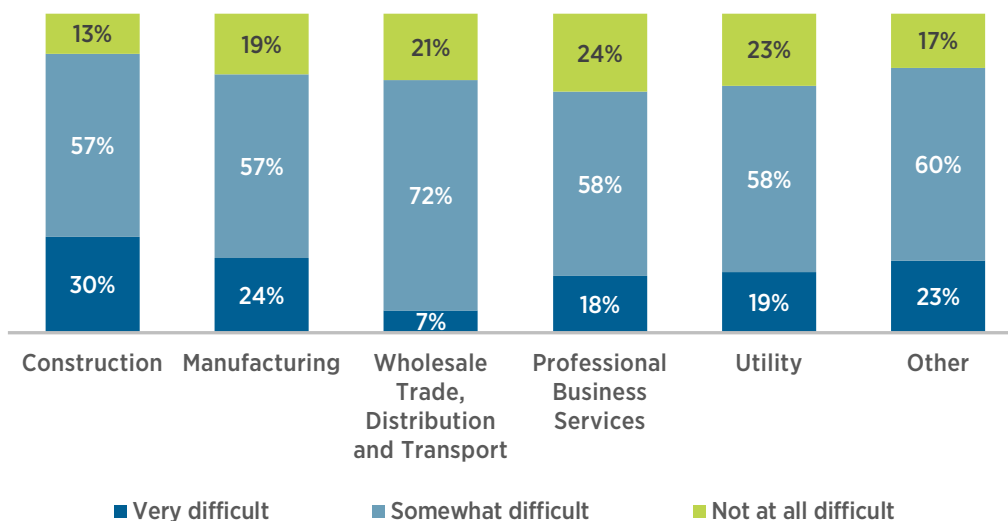
Currently, a majority of U.S. photovoltaic (PV) solar electric power generation is from utility-scale facilities, as shown in Figure 4342—roughly 67,672 thousand MWh compared to 34,509 thousand MWh of distributed solar generation in 2019.²⁸

In 2019, about half of U.S. solar workers were spending the majority of their time working on residential-scale projects, as shown in Figure 4243. This represents a decline of 6 percentage points in 2019, while the percentage of employees working on utility-scale projects doubled from 14 percent in 2018 to 29.5 percent in 2019.

In 2019, 87 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. 76 percent and 81 percent of professional services and manufacturing employers respectively also reported that hiring was somewhat difficult or very difficult in 2019.

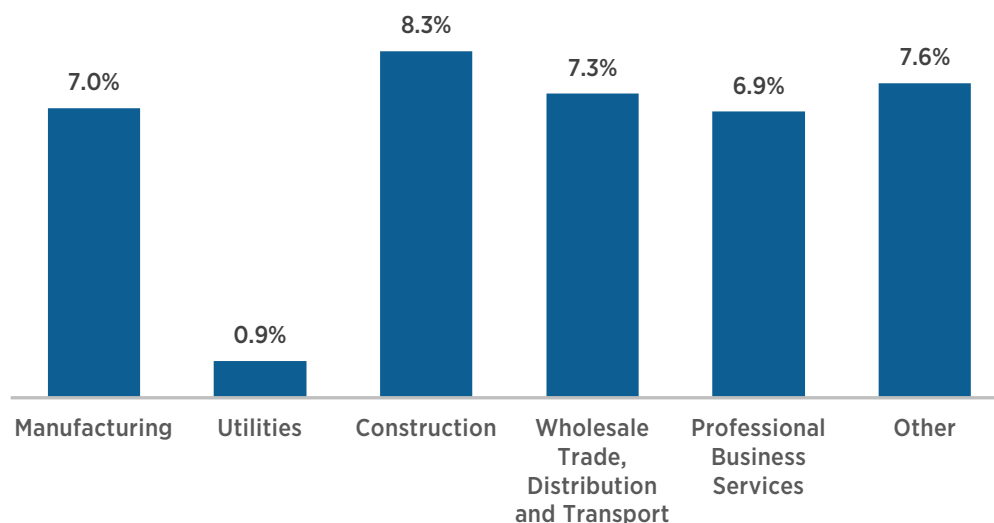
²⁸ EIA, *Electric Power Monthly*, Table 1.1.A. Rolling 12 Months Ending in October. Data for 2019 for Generation at Utility Facilities: Solar Photovoltaic and Small Scale Generation: Estimated Solar Photovoltaic. Table 1.2.E for Residential subset of Small Scale Solar Photovoltaic Generation.

Figure 45.
Solar Electric Power Generation – Hiring Difficulty by Industry



This year’s jump in solar employment after two consecutive years of declines gives solar employers optimism. Solar employers reported that they expect to increase employment by 7.2 percent in 2020. Most solar electric power generation employment supports PV technologies, with a small portion—7.4 percent—of workers supporting concentrated solar power (CSP) technologies.²⁹

Figure 46.
Solar Electric Power Generation – Expected Employment Growth by Industry



²⁹ 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.

In 2019, women represented about 30 percent of the solar workforce. 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, however, are underrepresented. Meanwhile, both PV and CSP technologies employed veterans at a higher rate than the national workforce. At 4 percent, the solar workforce is less unionized than the national private sector average of 6.2 percent.

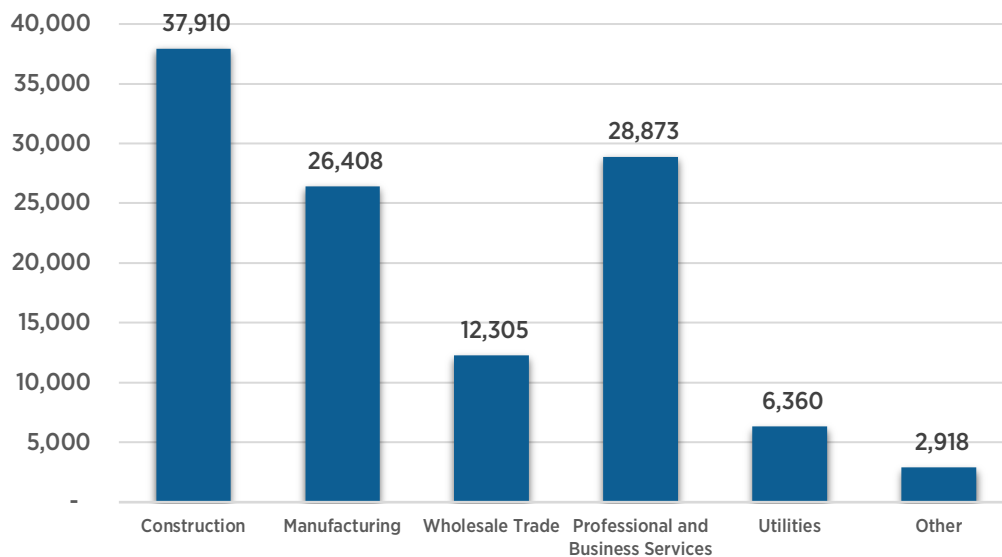
Table 19.
Solar Electric Power Generation - Demographics, Q4 2019

Demographic	Solar Photovoltaic	Concentrating Solar Power	National Workforce Averages
Male	70%	68%	53%
Female	30%	32%	47%
Hispanic or Latino	20%	21%	18%
Not Hispanic or Latino	80%	79%	82%
American Indian or Alaska Native	1%	1%	>1%
Asian	9%	9%	6%
Black or African American	8%	7%	12%
Native Hawaiian or other Pacific Islander	1%	1%	>1%
White	71%	70%	78%
Two or more races	9%	11%	2%
Veterans	9%	8%	6%
55 and over	11%	9%	23%
Union	4%	6%	6%

Wind Electric Power Generation

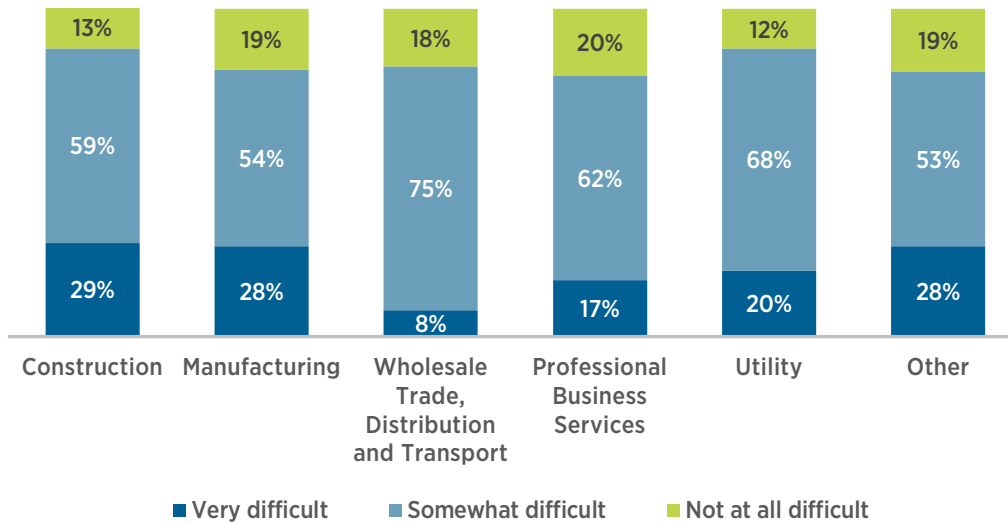
Wind EPG provides the third largest share of employment in the Electric Power Generation sector (behind solar and conventional and advanced natural gas generation). In 2019, firms that support the U.S. wind EPG sector employed a total of 114,774 workers — a 3 percent increase from 2018. Like solar EPG, the largest share of employment was in construction; this industry sector accounted for 33 percent of all wind EPG workers in 2019, followed by professional services at 25 percent and manufacturing at 23 percent.

Figure 47.
Wind Electric Power Generation – Employment by Industry Sector



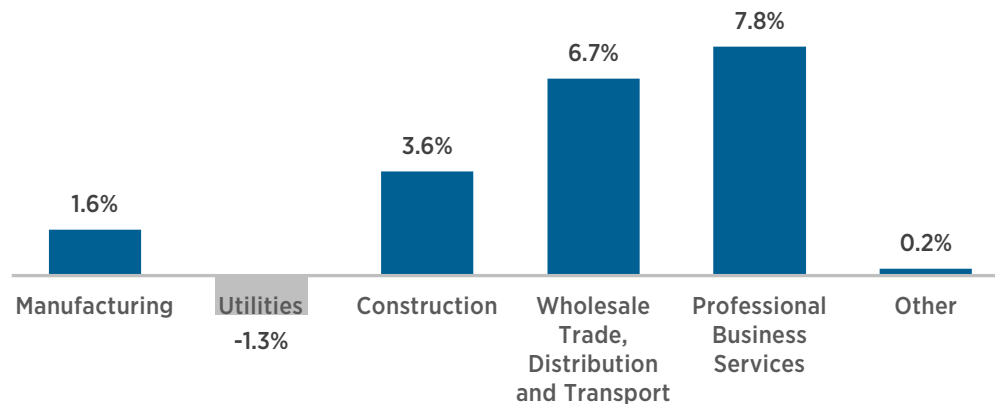
In 2019, 87 percent of construction employers in the wind sector reported that hiring new workers was somewhat difficult or very difficult (with 29 percent reporting that hiring was very difficult). The next two largest segments of the wind industry—professional services and manufacturing—reported overall hiring difficulty of 80 percent and 81 percent, respectively.

Figure 48.
Wind Electric Power Generation – Hiring Difficulty by Industry



Employers in the wind EPG industry expect more than 4 percent growth in 2020. This is led by the professional services sector, which expects nearly 8 percent growth.

Figure 49.
Wind Electric Power Generation – Expected Employment Growth by Industry



Wind EPG has a demographic distribution that is nearly identical to solar EPG. In 2019, women represented 31 percent of the wind EPG workforce. Wind EPG is also more racially diverse than the national workforce, with higher levels of Hispanic or Latino and Asian workers. Approximately 1 out of 10 workers is a veteran, considerably higher than the national average. Unionization rates are at 6 percent, roughly equivalent to the national private sector average of 6.2 percent.

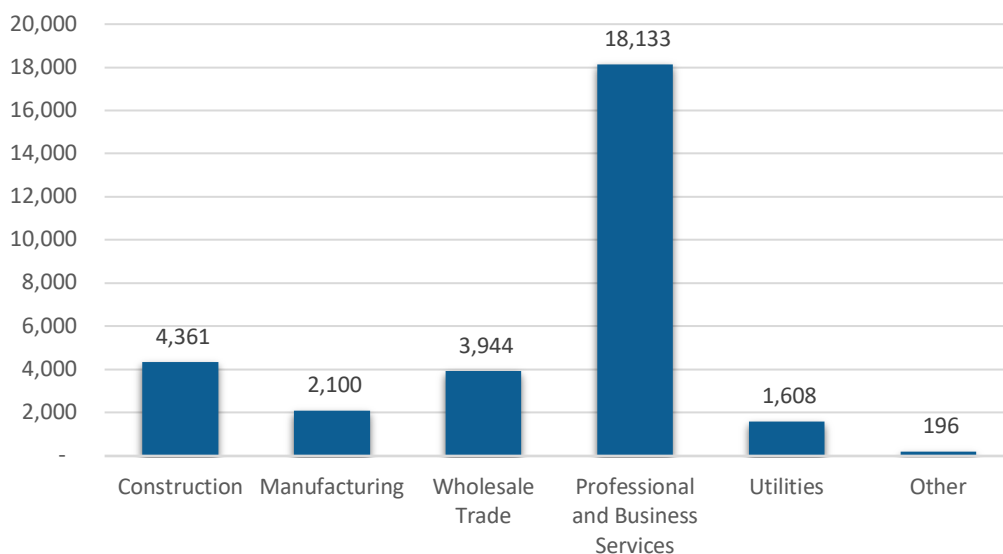
Table 20.
Wind Electric Power Generation – Demographics, Q4 2019

Demographic	Employees	Percent of Sector	National Workforce Averages
Male	78,739	69%	53%
Female	36,035	31%	47%
Hispanic or Latino	22,480	20%	18%
Not Hispanic or Latino	92,294	80%	82%
American Indian or Alaska Native	1,359	1%	>1%
Asian	11,371	10%	6%
Black or African American	9,118	8%	12%
Native Hawaiian or other Pacific Islander	1,470	1%	>1%
White	79,035	69%	78%
Two or more races	12,421	11%	2%
Veterans	10,888	9%	6%
55 and over	16,733	15%	23%
Union	7,243	6%	6%

Combined Heat and Power Generation

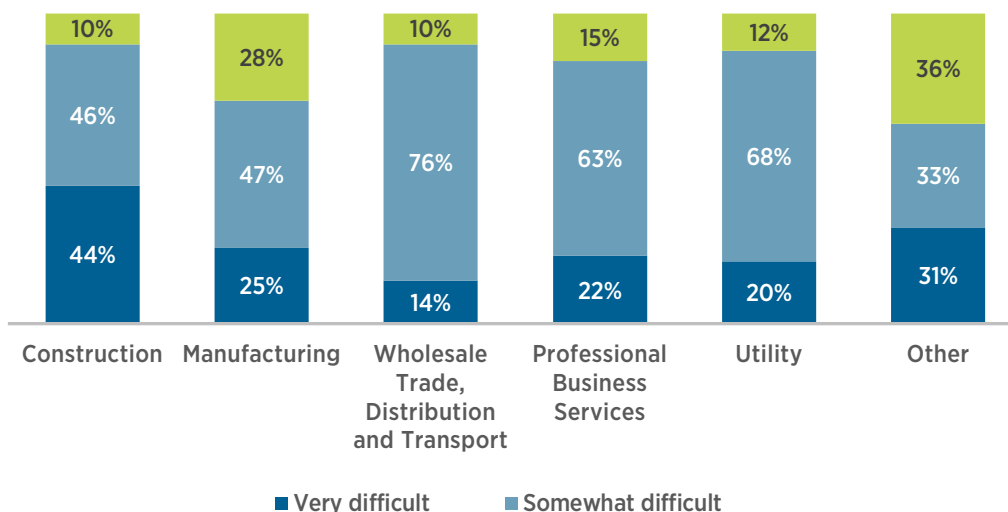
Combined heat and power (CHP) generation technologies employed 30,342 workers, or slightly more than 3 percent of employment in Electric Power Generation. In 2019, this industry added nearly 1,100 jobs, an almost 4 percent increase over 2018. With small generation capacities and significant overlap with 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 60 percent of CHP jobs in 2019, followed by the construction industry at more than 14 percent.

Figure 50.
Combined Heat and Power Generation – Employment by Industry



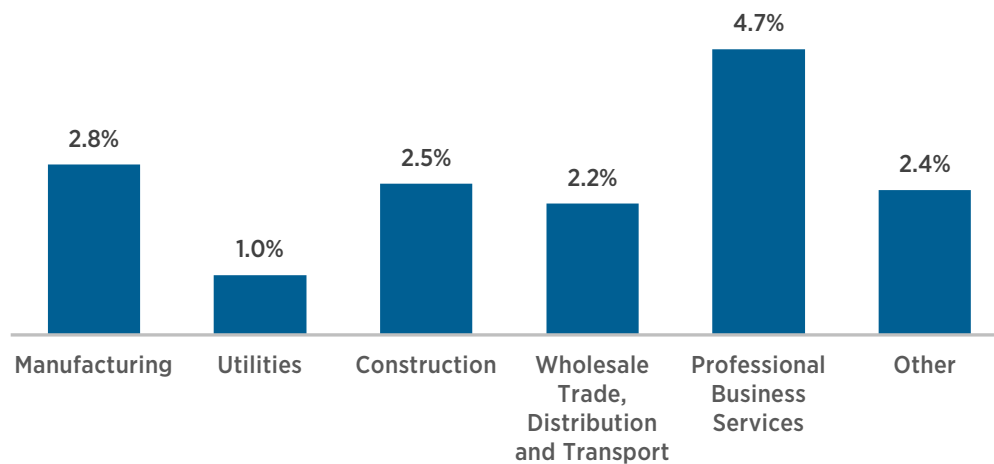
In 2019, 85 percent of CHP professional and business services employers reported that hiring new workers was somewhat difficult or very difficult (with 22 percent reporting that hiring was very difficult). 90 percent of CHP wholesale trade, distribution, and transport employers reported that hiring in 2019 was somewhat difficult or very difficult. Similarly, 90 percent of construction employers reported that hiring in 2019 was somewhat difficult or very difficult (with 44 percent reporting that hiring was very difficult).

Figure 51.
Combined Heat and Power Generation – Hiring Difficulty by Industry



Employers in the CHP generation industry expect almost 4 percent growth in 2020. This is led by the professional services sector, the largest sector, which expects nearly 5 percent growth.

Figure 52.
Combined Heat and Power Generation – Expected Employment Growth by Industry



In 2019, women represented 32 percent of the CHP workforce. As with most other EPG technologies, CHP is also more racially diverse than the workforce as a whole, with racial minorities comprising 28 percent of employment, compared to 22 percent nationally. Unionization rates at 9 percent are well above the national private sector rate of 6.2 percent.

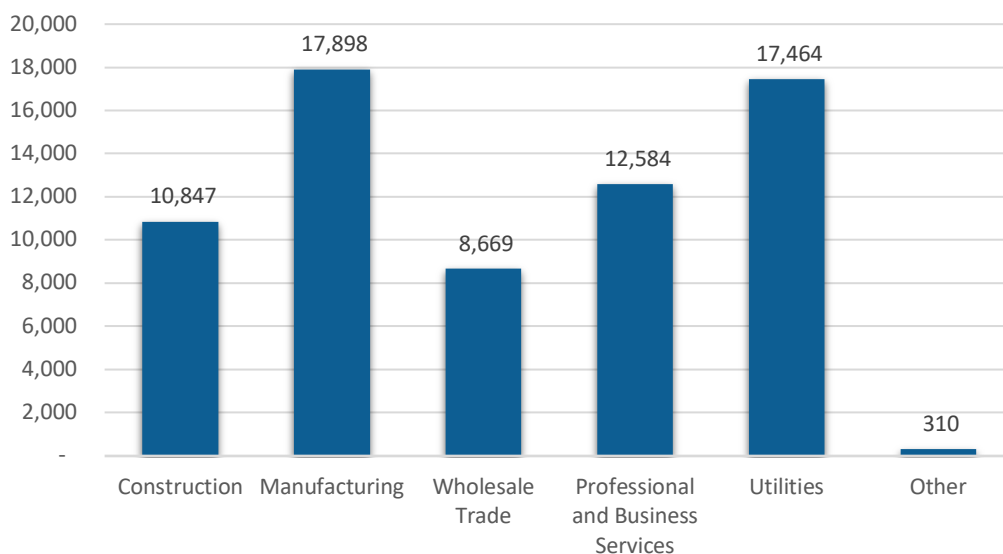
Table 21.
Combined Heat and Power Generation – Demographics, Q4 2019

Demographic	Employees	Percent of Sector	National Workforce Averages
Male	20,701	68%	53%
Female	9,641	32%	47%
Hispanic or Latino	5,271	17%	18%
Not Hispanic or Latino	25,071	83%	82%
American Indian or Alaska Native	281	1%	>1%
Asian	2,685	9%	6%
Black or African American	2,316	8%	12%
Native Hawaiian or other Pacific Islander	260	1%	>1%
White	21,785	72%	78%
Two or more races	3,014	10%	2%
Veterans	3,544	12%	6%
55 and over	6,312	21%	23%
Union	2,802	9%	6%

Hydroelectric Power Generation

Hydroelectric power generation employed a total of 67,772 workers³⁰ across the nation in 2019. Most of this employment (55,468 workers, or 82 percent) was in traditional hydroelectric generation technologies, while the remainder was in low-impact hydroelectric technologies (12,304 workers). Each of these sectors grew in 2019, adding 598 and 726 jobs respectively. Manufacturing and utilities each made up 26 percent of hydroelectric generation employment in 2019, while professional business services supported nearly 19 percent and construction supported 16 percent of employment.

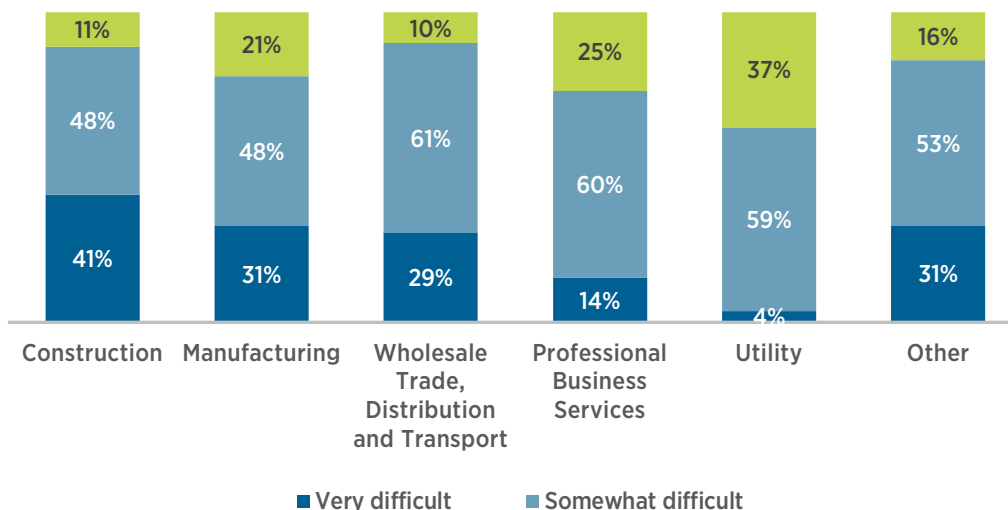
Figure 53.
Hydroelectric Power Generation – Employment by Industry



In 2019, 89 percent of construction employers reported that hiring new workers was somewhat difficult or very difficult (with 41 percent reporting that hiring was very difficult). A smaller percentage of professional business services employers (75 percent) reported that hiring was somewhat difficult or very difficult, and only 14 percent of them reported hiring to have been very difficult. Utilities reported an easier time hiring new employees, with only 63 percent reporting hiring as somewhat difficult and 4 percent reporting hiring as very difficult. However, this was markedly more difficult than 2018, when 67 percent of utility employers reported no difficulty in hiring.

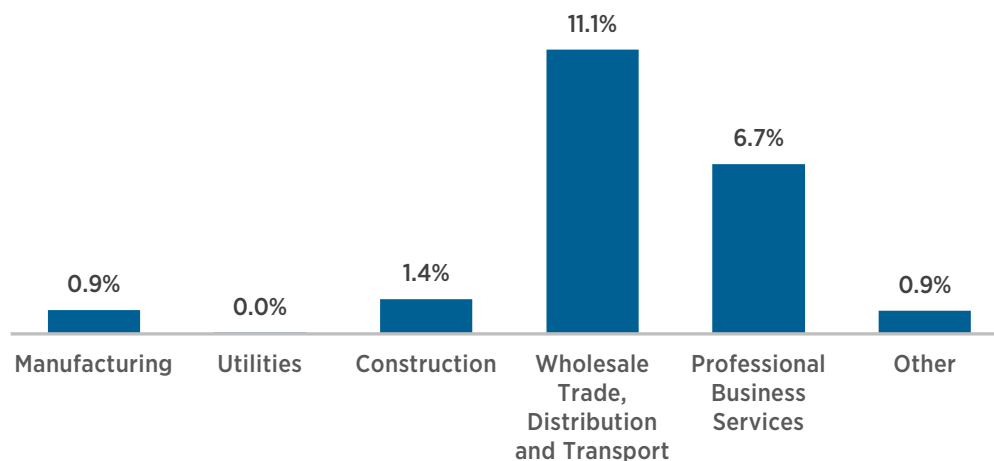
³⁰ Methodology was revised in 2016 to capture subcontractor employment in Traditional Hydro, so employment totals are not reflective of growth year over year. Primary Traditional Hydro employers reported a minimal decline of -4.2 percent between 2015 and 2016.

Figure 54.
Hydroelectric Power Generation – Hiring Difficulty by Industry



Overall, hydroelectric employers anticipate 3.1 percent growth in 2020. Wholesale trade, distribution, and transport expects to grow more than 11 percent while manufacturing, the largest segment, expects less than 1 percent growth.

Figure 55.
Hydroelectric Power Generation – Expected Employment Growth by Industry



In 2019, women represented 32 percent of the hydroelectric power generation workforce. These technologies—both traditional and low impact—are more diverse than the national workforce average, with higher representation in 2019 across American Indian or Alaska Native workers as well as Asian workers. More low-impact hydroelectric generation workers were Hispanic or Latino than the national workforce average in 2019. The share of veterans employment also exceeded the national average. Unionization rates are slightly above the national average in the private sector of 6.2 percent.

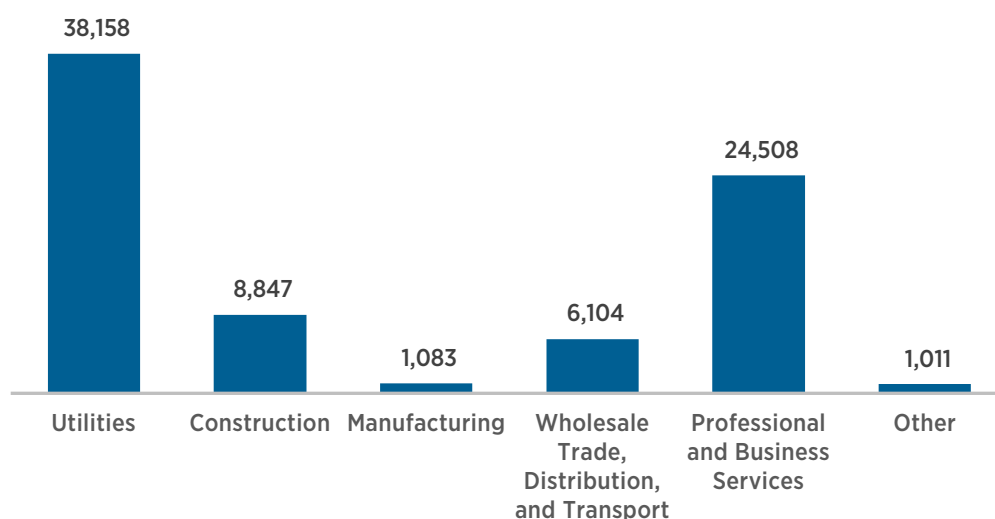
Table 22.
Hydroelectric Power Generation – Demographics, Q4 2019

Demographics	Low-impact Hydroelectric Generation		Traditional Hydroelectric Generation		National Workforce Averages
Male	8,501	69%	37,618	68%	53%
Female	3,803	31%	17,850	32%	47%
Hispanic or Latino	2,342	19%	9,132	16%	18%
Not Hispanic or Latino	9,962	81%	46,336	84%	82%
American Indian or Alaska Native	185	2%	686	1%	>1%
Asian	1,253	10%	5,803	10%	6%
Black or African American	1,002	8%	6,025	11%	12%
Native Hawaiian or other Pacific Islander	144	1%	618	1%	>1%
White	8,688	71%	37,872	68%	78%
Two or more races	1,031	8%	4,464	8%	2%
Veterans	1,396	11%	4,796	9%	6%
55 and over	2,112	17%	9,195	17%	23%
Union	829	7%	4,021	7%	6%

Coal Electric Power Generation

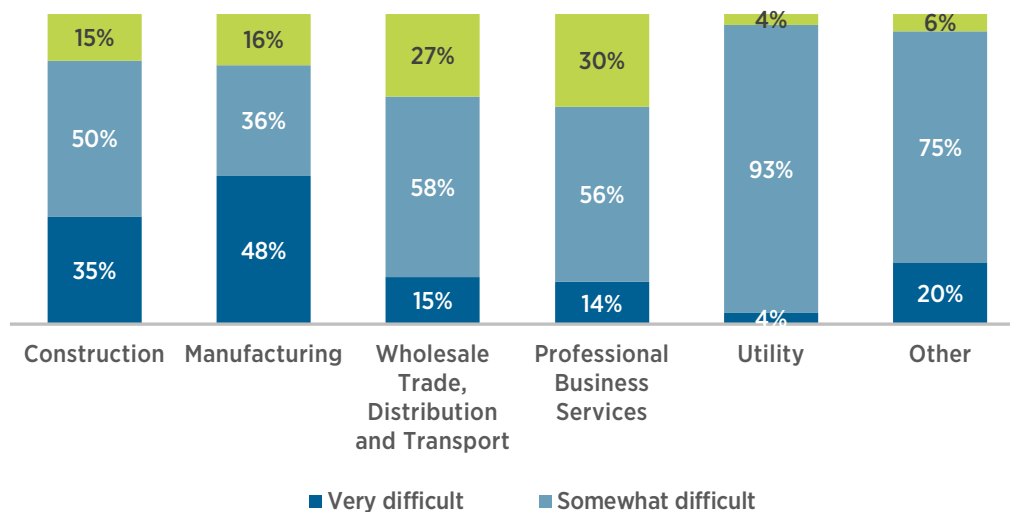
Coal-fired EPG employed a total of 79,711 workers across the nation in 2019. This is a nearly 8 percent decrease in jobs from 2018. Utilities held almost half (48 percent) of coal EPG jobs in 2019, losing nearly 7,700 workers in 2019. Professional and business services made up 31 percent of the industry.

Figure 56.
Coal Electric Power Generation - Employment by Industry



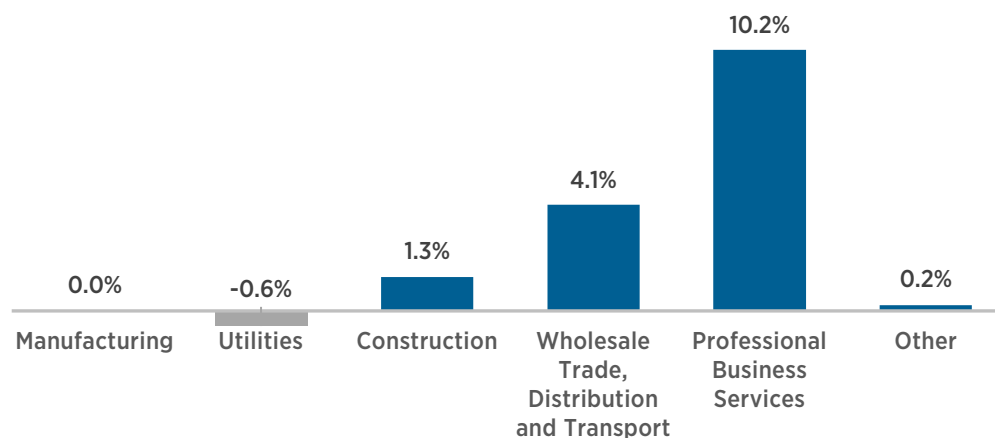
Utilities reported a slight increase in hiring difficulty in 2019 with 4 percent of employers reporting it was very difficult. Only 14 percent of professional business services employers reported that hiring new workers was very difficult. Construction employers continued to report hiring difficult with 35 percent saying it was very difficult and 50 percent saying it was somewhat difficult.

Figure 57.
Coal Electric Power Generation – Hiring Difficulty by Industry



Despite job losses in 2019, employers in the coal EPG industry expect more than 3 percent growth in 2020. This is led by the professional services sector, which added several hundred jobs in 2018 and expects over 10 percent growth, followed by wholesale trade, distribution, and transport at 4 percent. Utilities, the largest sector, expects employment declines, and manufacturing expects no growth.

Figure 58.
Coal Electric Power Generation – Expected Employment Growth by Industry



In 2019, women represented 34 percent of Coal EPG employees. Coal generation is also more racially diverse than the national workforce, employing 30 percent minorities. The unionization rate is 10 percent, higher than the private sector national average of 6.2 percent.

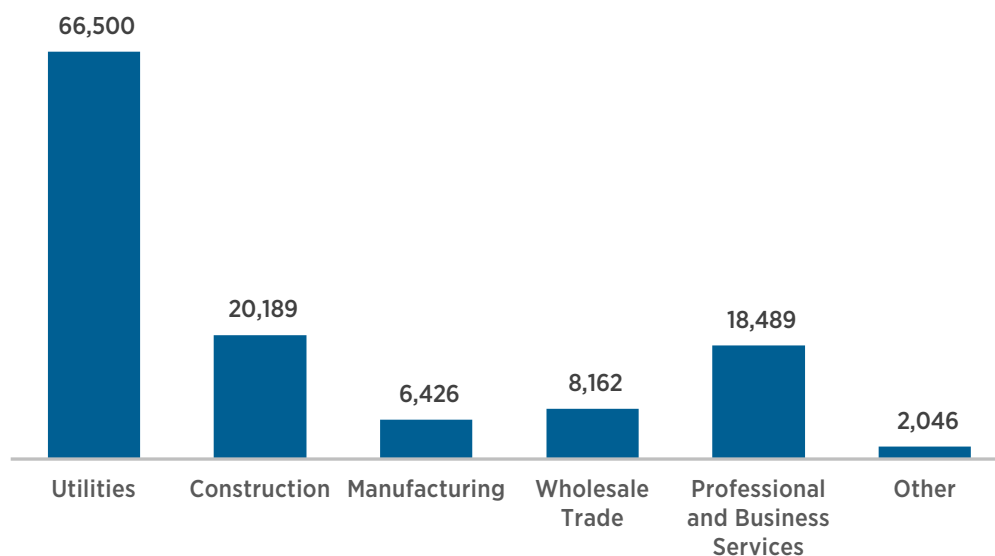
Table 23.
Coal Electric Power Generation – Demographics, Q4 2019

Demographic	Employees	Percent of Sector	National Workforce Averages
Male	52,331	66%	53%
Female	27,379	34%	47%
Hispanic or Latino	11,181	14%	18%
Not Hispanic or Latino	68,530	86%	82%
American Indian or Alaska Native	877	1%	>1%
Asian	8,046	10%	6%
Black or African American	8,856	11%	12%
Native Hawaiian or other Pacific Islander	666	1%	>1%
White	55,740	70%	78%
Two or more races	5,526	7%	2%
Veterans	5,741	7%	6%
55 and over	13,591	17%	23%
Union	7,895	10%	6%

Natural Gas Electric Power Generation

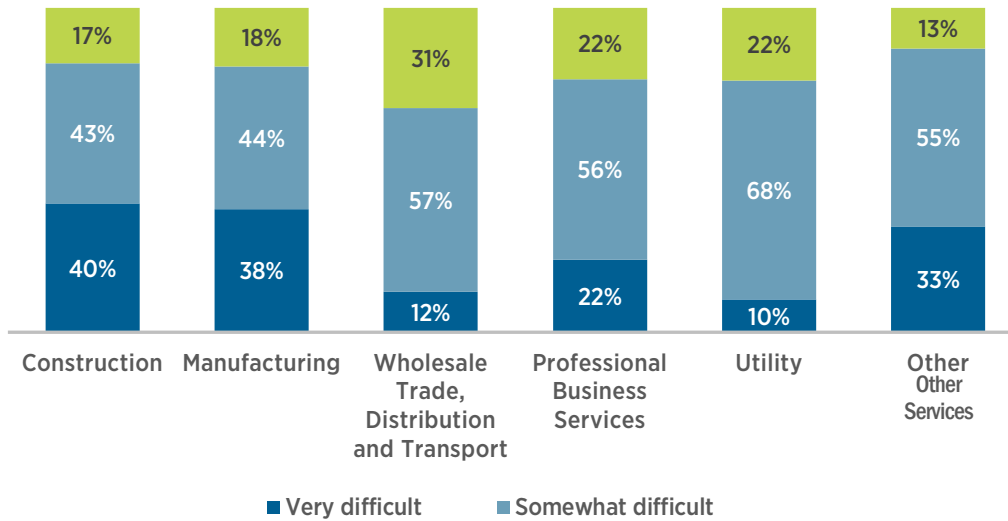
Natural gas EPG employed a total of 121,812 workers across the nation in 2019; of these, 75,661 jobs, or 62 percent, are in the category of advanced/low emissions natural gas generation. Over the past year, more than 9,100 jobs were added by natural gas EPG—an 8 percent increase and exceeding the predicted increase of 5 percent. Utilities provided over half of natural gas power generation jobs in 2019, with construction and professional business services making up 17 percent and 15 percent of the industry, respectively.

Figure 59.
Natural Gas Electric Power Generation – Employment by Industry



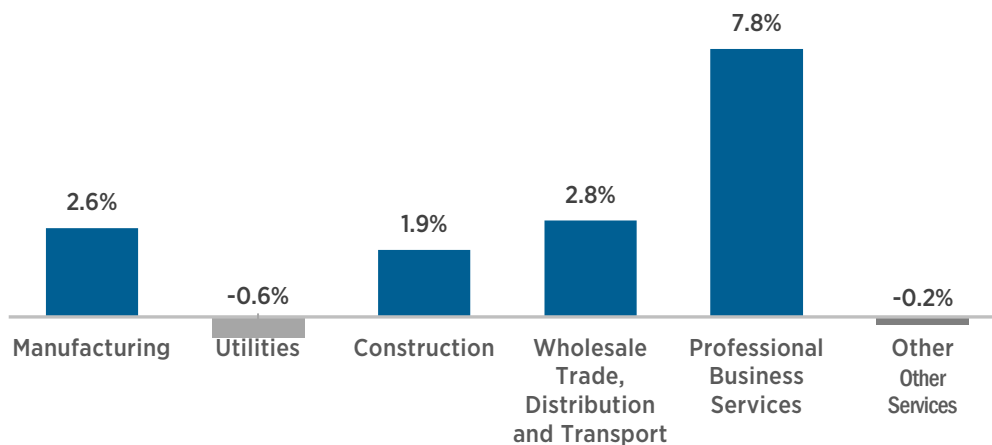
Utilities, the largest sector of natural gas EPG, reported the least intensity in hiring difficulty, with only 10 percent reporting that it was very difficult. By comparison, 40 percent of construction employers report that hiring during 2019 was very difficult (with 83 percent reporting it was either very or somewhat difficult). Similarly, 78 percent of professional and business services employers reported that hiring new workers in 2019 was somewhat or very difficult.

Figure 60.
Natural Gas Electric Power Generation – Hiring Difficulty by Industry



Employers in the natural gas EPG industry expect almost 2 percent growth in 2019. This is led by the professional services sector, which expects nearly 8 percent growth. However, the utilities sector, the largest, expects to contract slightly.

Figure 61.
Natural Gas Electric Power Generation – Expected Employment Growth by Industry



In 2009, women represented 36 percent of the natural gas EPG workforce. Natural gas EPG is more racially diverse than the national workforce, employing 36 percent racial minorities, the highest in the electric power generation sector. Eight percent of the sector’s employees are veterans, exceeding the national average by 2 percentage points. Eleven percent of employees are unionized, almost double the national private sector average of 6.2 percent.

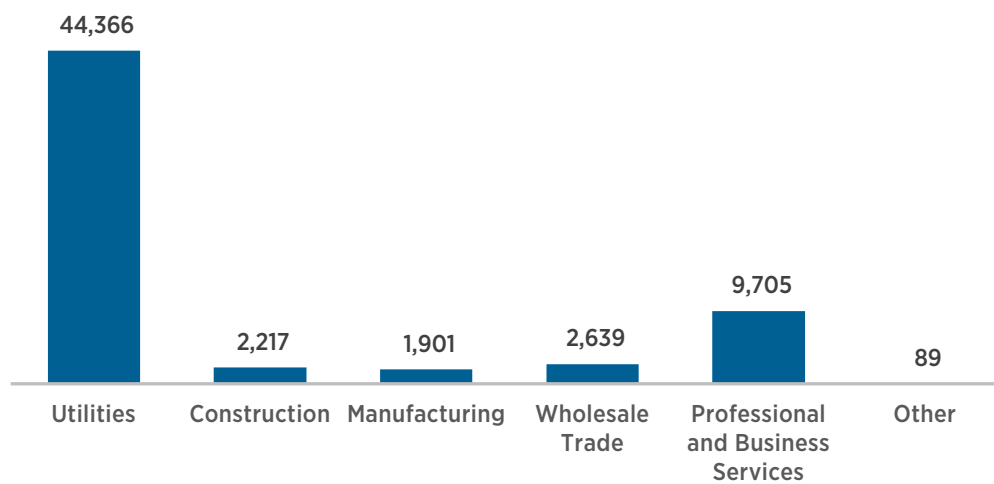
Table 24.
Natural Gas Electric Power Generation – Demographics, Q4 2019

Demographic	Employees	Percent of Sector	National Workforce Averages
Male	77,403	64%	53%
Female	44,409	36%	47%
Hispanic or Latino	21,723	18%	18%
Not Hispanic or Latino	100,089	82%	82%
American Indian or Alaska Native	1,511	1%	>1%
Asian	12,282	10%	6%
Black or African American	12,425	10%	12%
Native Hawaiian or other Pacific Islander	1,180	1%	>1%
White	77,509	64%	78%
Two or more races	16,905	14%	2%
Veterans	10,288	8%	6%
55 and over	17,709	15%	23%
Union	13,944	11%	6%

Nuclear Electric Power Generation

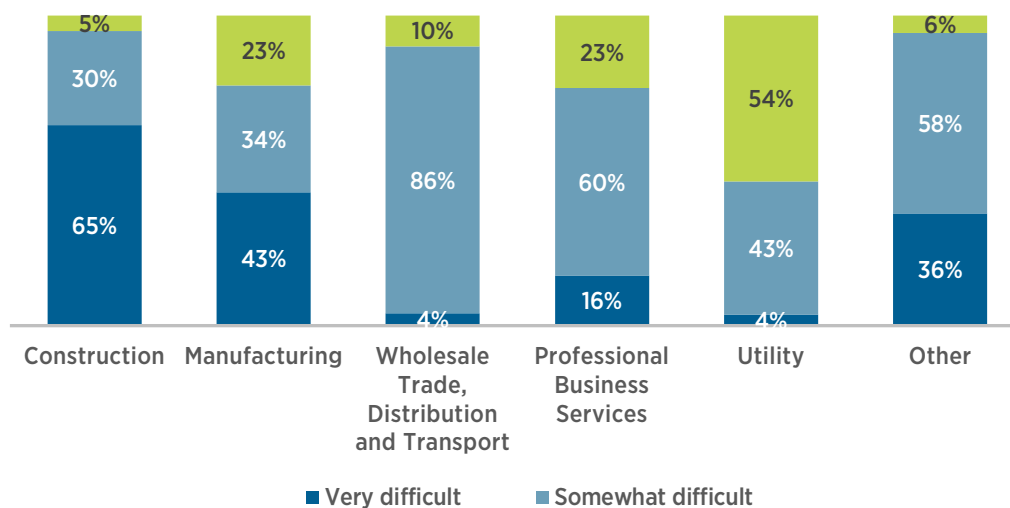
Nuclear EPG employed a total of 60,916 workers across the nation in 2019. Over the past year, over 2,000 jobs were lost from nuclear generation—a decrease in employment of more than 3 percent. Almost 73 percent of nuclear EPG jobs are in utilities.

Figure 62.
Nuclear Electric Power Generation – Employment by Industry



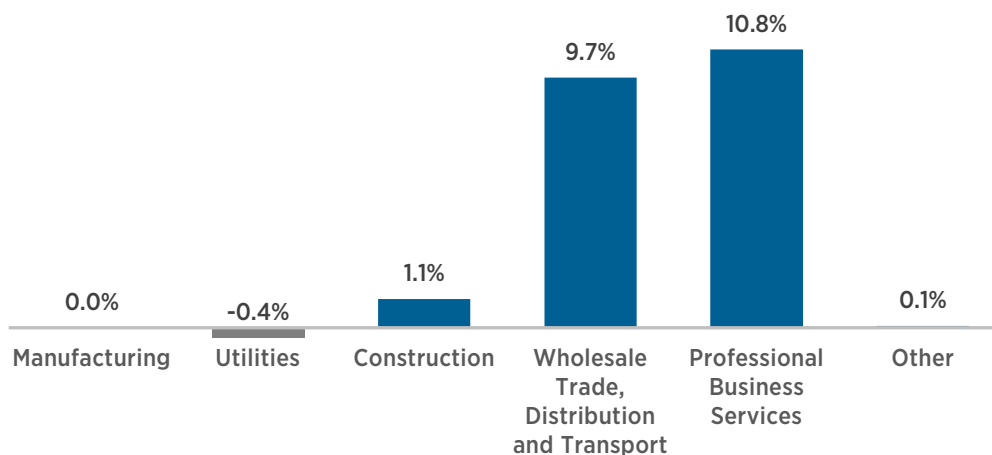
Utilities in the nuclear generation sector reported little difficulty in hiring in 2019, with 54 percent reporting no difficulty at all. However, virtually all construction firms (95 percent) reported that it was somewhat difficult or very difficult (with 65 percent reporting hiring to have been very difficult). In 2019, 77 percent of professional and business services employers reported that hiring new workers was somewhat difficult or very difficult.

Figure 63.
Nuclear Electric Power Generation – Hiring Difficulty by Industry



Employers in the nuclear EPG industry expect nearly 2 percent growth in 2020. This is led by the professional services sector, which expects almost 11 percent growth, and the wholesale trade, distribution, and transport at nearly 10 percent. However, the utility sector, the largest, expects continued contraction.

Figure 64.
Nuclear Electric Power Generation – Expected Employment Growth by Industry



In 2019, women represented 36 percent of the nuclear EPG workforce, tied with natural gas EPG for the highest of all generation technologies. Nuclear EPG is also one of the most racially diverse of all generation technologies, employing 34 percent racial minorities, compared to 22 percent in the national workforce. It also employs the highest level of black or African American workers, compared to other generation technologies, at 12 percent, equal to the national workforce. Unionization rates are 12 percent, double the national private sector average of 6.2 percent.

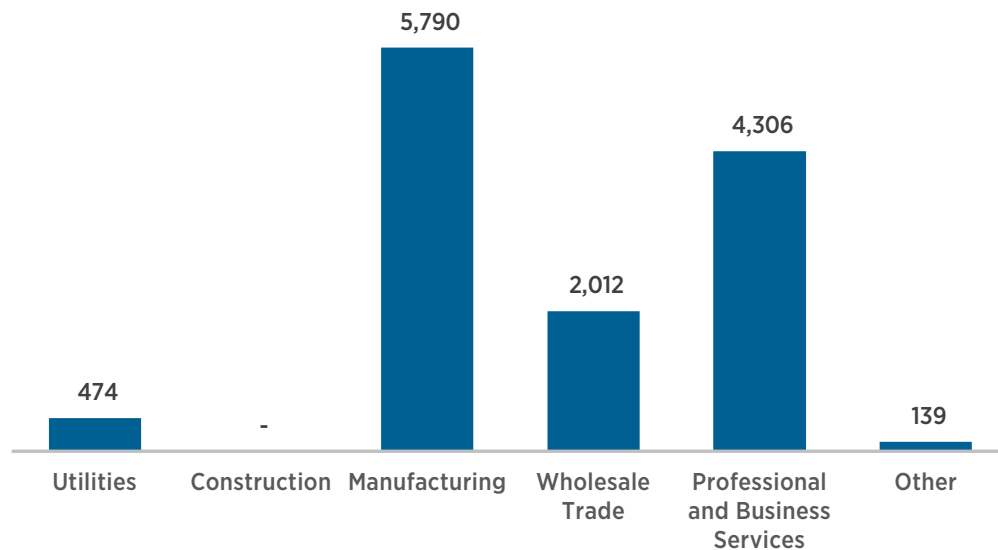
Table 25.
Nuclear Electric Power Generation – Demographics, Q4 2019

Demographic	Employees	Percent of Sector	National Workforce Averages
Male	39,079	64%	53%
Female	21,838	36%	47%
Hispanic or Latino	8,878	15%	18%
Not Hispanic or Latino	52,038	85%	82%
American Indian or Alaska Native	728	1%	>1%
Asian	6,328	10%	6%
Black or African American	7,398	12%	12%
Native Hawaiian or other Pacific Islander	510	1%	>1%
White	39,933	66%	78%
Two or more races	6,020	10%	2%
Veterans	3,646	6%	6%
55 and over	8,803	14%	23%
Union	7,443	12%	6%

Oil Electric Power Generation

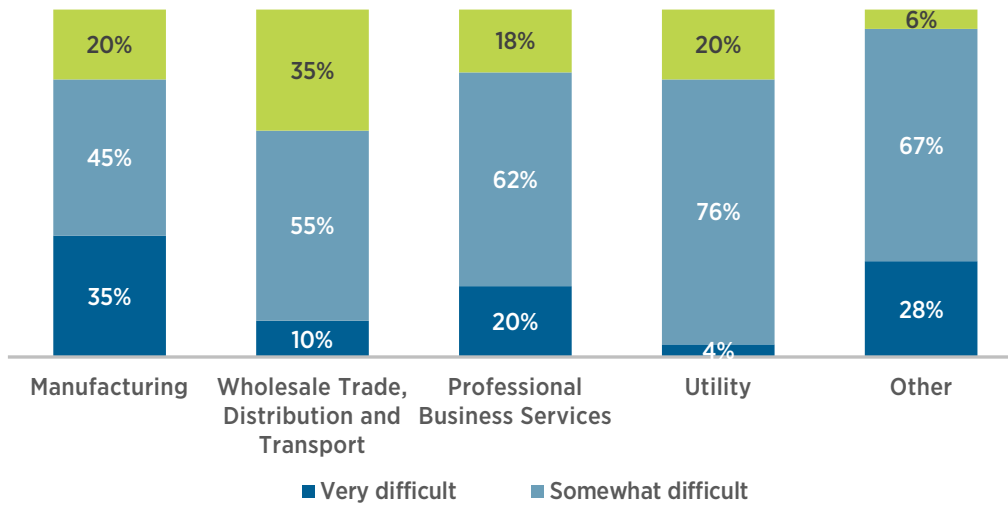
Oil EPG employed a total of 12,722 workers across the nation in 2019. Over the past year, 140 jobs were created for oil generation — a 1 percent increase in employment. Manufacturing accounted for almost 46 percent of oil power generation jobs in 2019, while professional and business services supported 34 percent.

Figure 65.
Oil Electric Power Generation — Employment by Industry



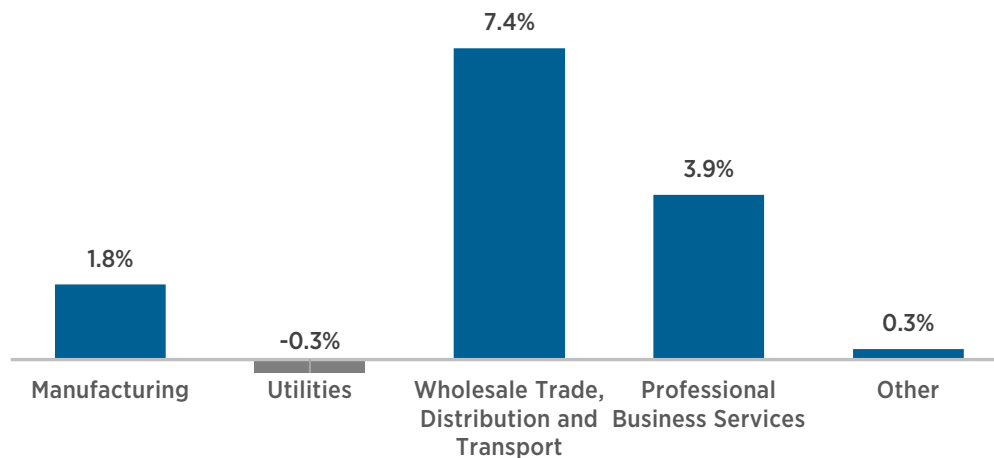
In 2019, 80 percent of manufacturing employers, the largest segment, reported that it was somewhat difficult or very difficult to hire employees. Similarly, 82 percent of professional and business services employers reported that hiring new workers in 2019 was either somewhat difficult or very difficult.

Figure 66.
Oil Electric Power Generation – Hiring Difficulty by Industry



Employers in the oil EPG industry expect over 3 percent growth in 2019. This is led by the professional and business services and wholesale trade, distribution, and transport sectors, which predict 4 percent and over 7 percent growth, respectively.

Figure 67.
Oil Electric Power Generation – Expected Employment Growth by Industry



In 2009, women represented 29 percent of the oil EPG workforce. Similar to many other generation technologies, it is more racially diverse than the national workforce, with 30 percent racial minorities. Unionization rates, at 4 percent, are below the national private sector average of 6.2 percent.

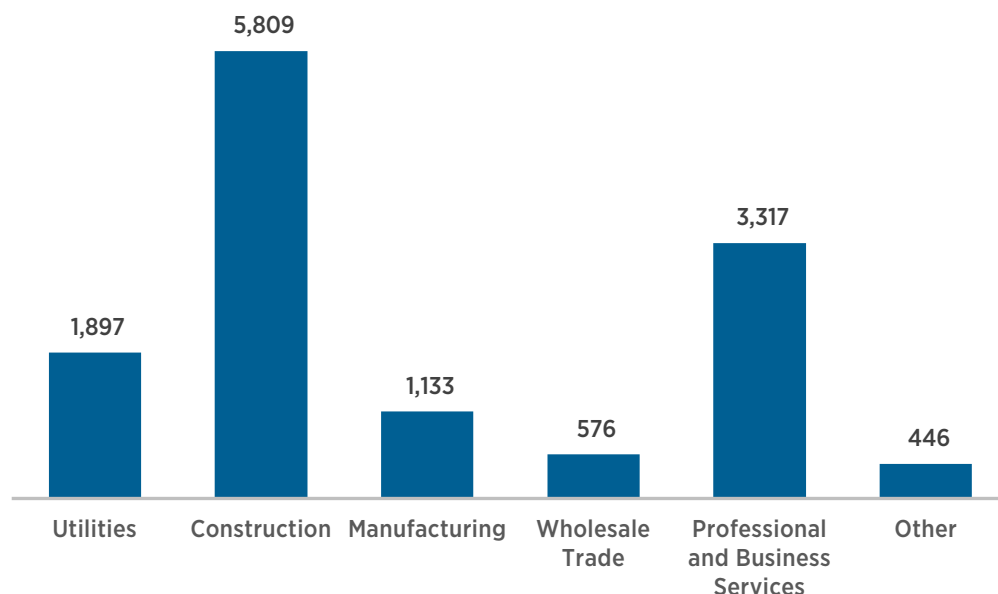
Table 26.
Oil Electric Power Generation – Demographics, Q4 2019

Demographic	Employees	Percent of Sector	National Workforce Averages
Male	8,981	71%	53%
Female	3,741	29%	47%
Hispanic or Latino	2,343	18%	18%
Not Hispanic or Latino	10,379	82%	82%
American Indian or Alaska Native	157	1%	>1%
Asian	1,331	10%	6%
Black or African American	1,045	8%	12%
Native Hawaiian or other Pacific Islander	146	1%	>1%
White	8,881	70%	78%
Two or more races	1,161	9%	2%
Veterans	1,103	9%	6%
55 and over	1,904	15%	23%
Union	519	4%	6%

Biomass Electric Power Generation

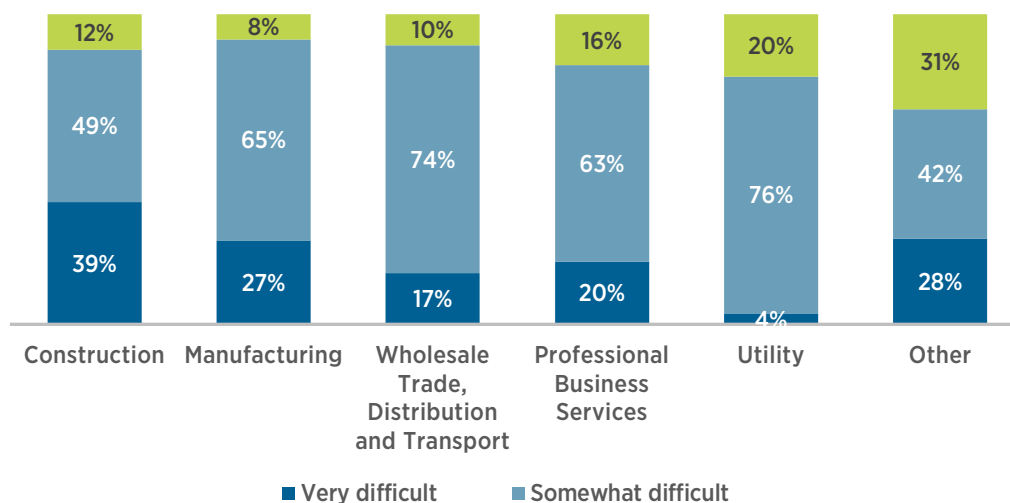
Biomass EPG employed a total of 13,178 workers across the nation in 2019. Over the past year, 202 jobs were created for biomass generation—a 1.6 percent increase in employment. Construction captured over 44 percent of biomass power generation jobs in 2019, while professional business services supported just over 25 percent.

Figure 68.
Biomass Electric Power Generation - Employment by Industry



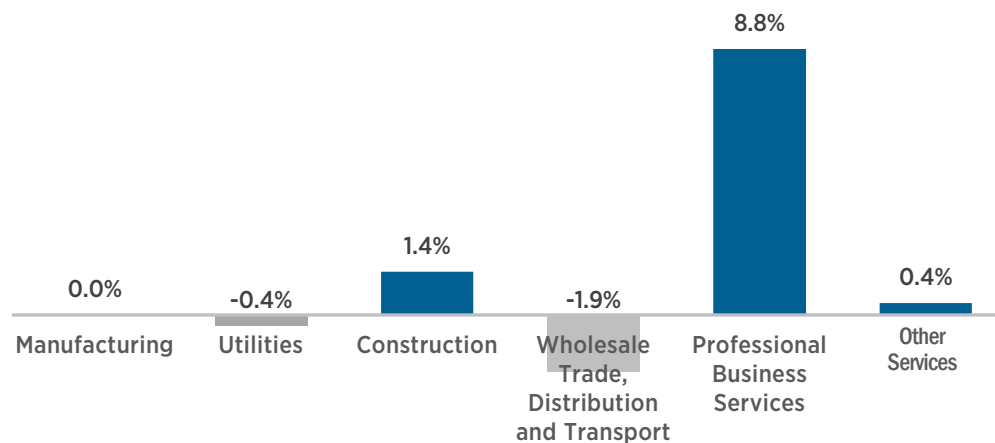
In 2019, 92 percent of manufacturing employers reported that hiring was somewhat difficult or very difficult. 88 percent of construction employers, the largest sector, reported that hiring was somewhat difficult or very difficult (with 39 percent reporting that hiring was very difficult). Similarly, 84 percent of professional business services employers reported that hiring new workers in 2019 was either somewhat difficult or very difficult. In contrast, only 4 percent of utilities reported that hiring in 2019 was very difficult.

Figure 69.
Biomass Electric Power Generation - Hiring Difficulty by Industry



Employers in the biomass EPG industry expect nearly 3 percent growth in 2020. This is led by the professional business services sector, which predicts almost 9 percent growth. Utilities and the wholesale trade, distribution, and transport sectors predict employment declines.

Figure 70.
Biomass Electric Power Generation - Expected Employment Growth by Industry



In 2019, women represented 31 percent of the biomass EPG workforce. Similar to most of the electric power generation workforce, it is more racially diverse than the national workforce, employing 29 percent racial minorities. Unionization rates are 10 percent, higher than the national private sector rate of 6.2 percent.

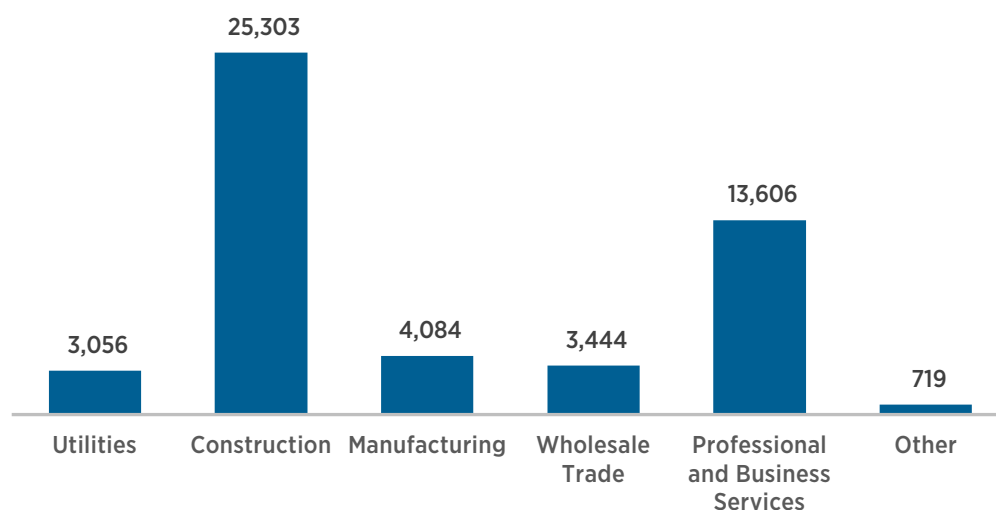
Table 27.
Biomass Electric Power Generation - Demographics, Q4 2019

Demographic	Employees	Percent of Sector	National Workforce Averages
Male	9,046	69%	53%
Female	4,132	31%	47%
Hispanic or Latino	2,156	16%	18%
Not Hispanic or Latino	11,022	84%	82%
American Indian or Alaska Native	157	1%	>1%
Asian	1,292	10%	6%
Black or African American	1,257	10%	12%
Native Hawaiian or other Pacific Islander	153	1%	>1%
White	9,410	71%	78%
Two or more races	910	7%	2%
Veterans	1,617	12%	6%
55 and over	2,987	23%	23%
Union	1,299	10%	6%

Other Electric Power Generation

Other EPG³¹ technologies employed a total of 50,212 workers across the nation in 2019. Over the past year, almost 4,000 jobs were created for other generation technologies — a greater than 8 percent increase in employment. Construction accounted for over half of other EPG jobs in 2019, while professional business services supported more than 27 percent.

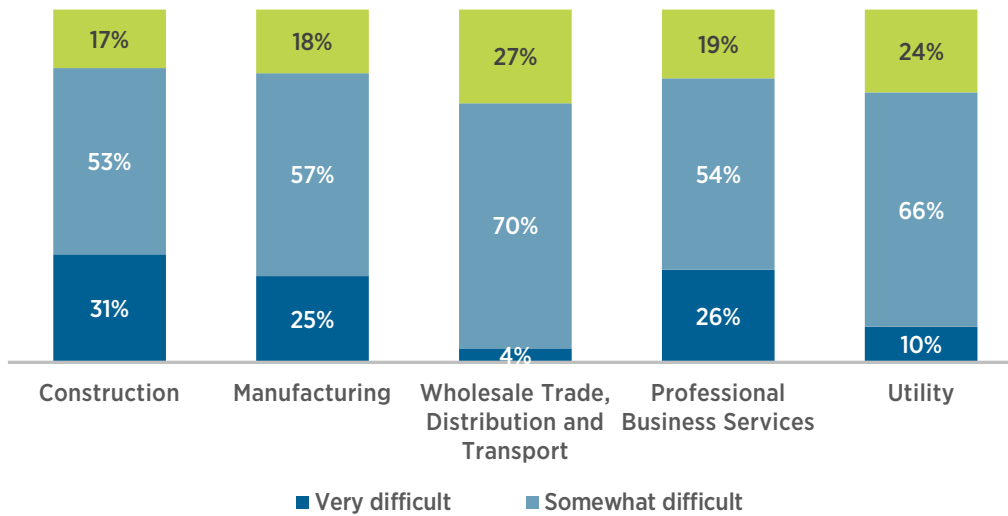
Figure 71.
Other Electric Power Generation - Employment by Industry



In 2019, 83 percent of construction employers, the largest sector, reported that hiring was somewhat difficult or very difficult (with 31 percent claiming that it was very difficult). Similarly, 81 percent of professional and business services employers, the second largest sector, reported that hiring in 2019 was somewhat difficult or very difficult.

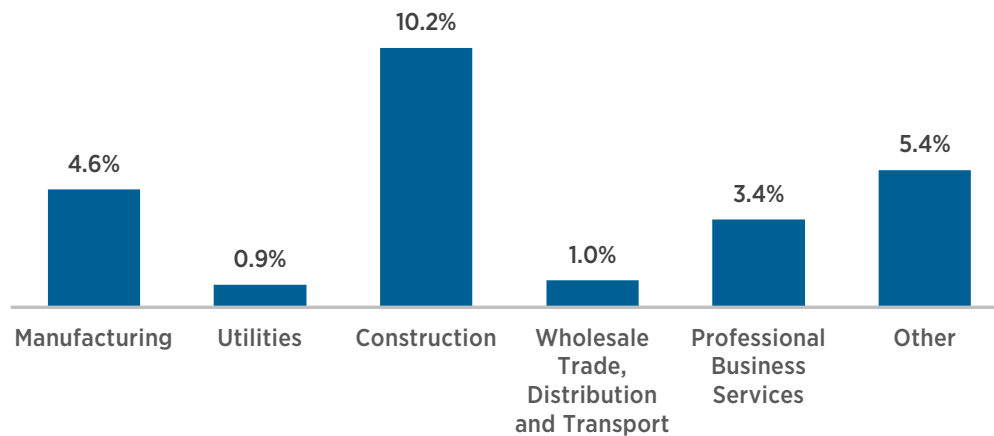
³¹ Includes generation from incineration of other fuels (waste, etc.), tidal generation, and employment that cannot be classified into a single category. The numbers in this section are the sum of the employment numbers under "Geo" and "Other" in Table 14.

Figure 72.
Other Electric Power Generation - Hiring Difficulty by Industry



Employers in the other EPG industry expect nearly 7 percent growth in 2020. This will be led by the construction sector, which predicts over 10 percent growth.

Figure 73.
Other Electric Power Generation - Expected Employment Growth by Industry



In 2009, women represented 31 percent of the other EPG workforce. Like most EPG technologies, other EPG is more racially diverse than the national workforce at 28 percent racial minorities. Unionization rates are at 4 percent, below the national private sector average of 6.2 percent.

Table 28.
Other Electric Power Generation - Demographics, Q4 2019

Demographic	Employees	Percent of Sector	National Workforce Averages
Male	34,421	69%	53%
Female	15,791	31%	47%
Hispanic or Latino	9,774	19%	18%
Not Hispanic or Latino	40,438	81%	82%
American Indian or Alaska Native	598	1%	>1%
Asian	5,282	11%	6%
Black or African American	3,495	7%	12%
Native Hawaiian or other Pacific Islander	649	1%	>1%
White	36,093	72%	78%
Two or more races	4,094	8%	2%
Veterans	4,224	8%	6%
55 and over	5,994	12%	23%
Union	2,192	4%	6%

Electric Power Generation and Fuels Employment Crosscut

In Table 29, 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 nuclear fuel, are used primarily for electric power generation, while others, such as coal, oil and natural gas, have multiple purposes.

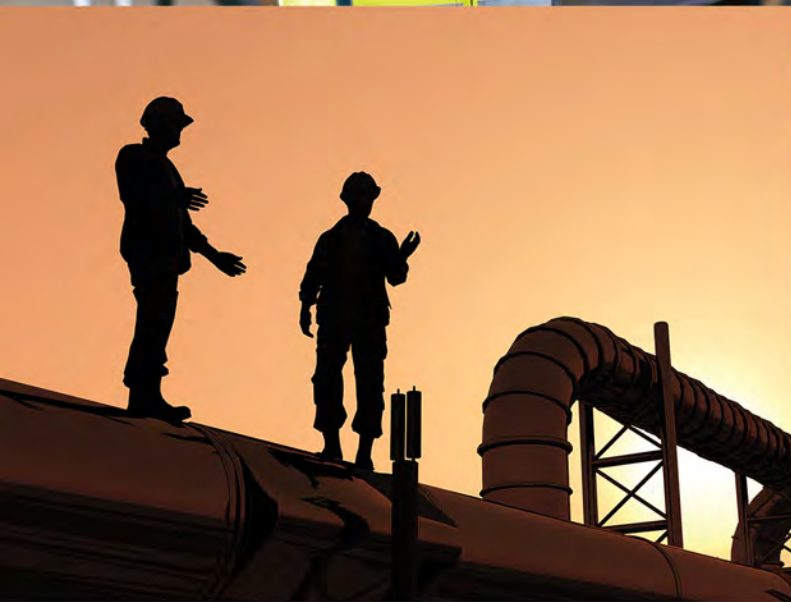
For example, advanced natural-gas-powered electricity generation and nuclear-powered electricity generation are technology applications that employ roughly the same number of workers, while the underlying technologies used in natural gas and nuclear energy systems are significantly different, as are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

Table 29.
Electric Power Generation and Fuels Employment by Major Energy Technology Application and Detailed Technology Application³²

	Electric Power Generation	Fuels	Total
Oil/Petroleum	12,722	615,528	628,250
Natural Gas	121,812	275,924	397,736
Traditional Gas	46,151	275,924	322,074
Advanced Gas	75,661	-	75,661
Majority-Time Solar Employment*	248,034		248,034
Coal	79,711	75,443	155,154
Bioenergy	13,178	107,915	121,093
Corn Ethanol	-	34,866	34,866
Other Ethanol/ Non-Woody Biomass, including Biodiesel	-	20,694	20,694
Woody Biomass Fuel for Energy and Cellulosic Biofuels	-	33,426	33,426
Other Biofuels	-	18,928	18,928
Wind	114,774	-	114,774
Other Generation/ Other Fuels	41,417	64,677	106,094
Nuclear	60,916	9,406	70,323
Hydroelectric Generation	67,772	-	67,772
Low Impact Hydroelectric Generation	12,304	-	12,304
Traditional Hydropower	55,468	-	55,468
CHP	30,342	-	30,342
Geothermal	8,794	-	8,794

*Note: An additional 97,359 employees spent less than 50 percent of their time on solar.

³² Column and row totals may differ due to rounding



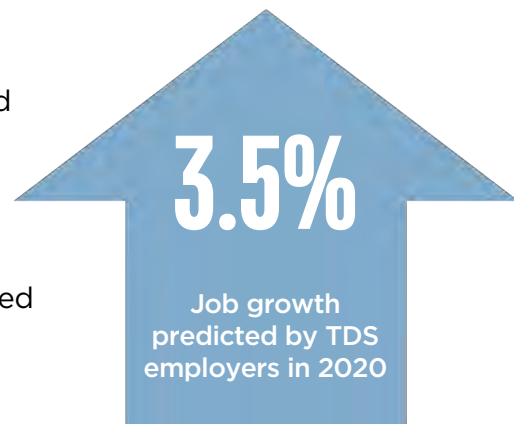
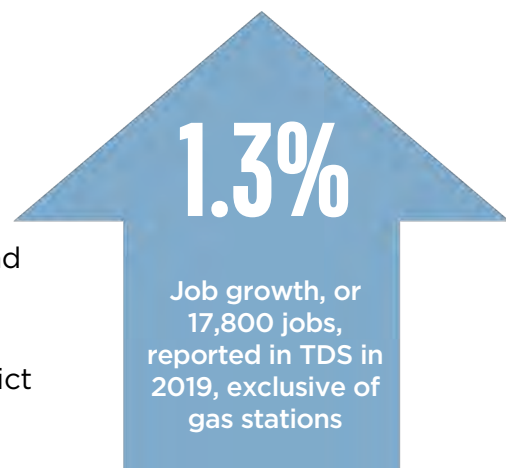
TRANSMISSION, DISTRIBUTION & STORAGE

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 lines³³

Trends

- **2019 TDS Employment:** Excluding retail employees in gas stations and fuel dealers, 1,383,646 workers were employed in Transmission, Distribution, and Storage, adding 17,800 new jobs.
- **2020 Expectations:** TDS employers predict 3.5 percent job growth in 2020, led by construction firms who anticipate 6.7 percent growth, followed by professional and business services and manufacturing employers who anticipate 7.6 percent and 3.5 percent growth, respectively.
- **Key Industry Sectors:** The construction sector employed 36 percent of all TDS workers, while the utility industry employed another 30 percent



³³ Department of Energy [DOE], Quadrennial Energy Review: Energy Transmission, Storage, and Distribution Infrastructure (Washington, DC: DOE, 2015), 1-2.

Employment Snapshot

Figure 74.
TDS Sector - Employment by Industry, 2018-2019

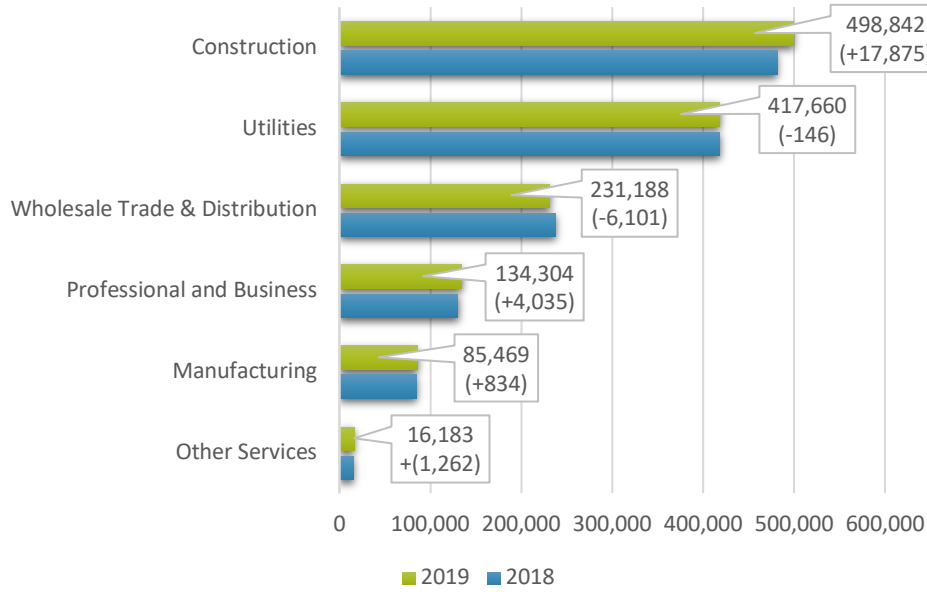
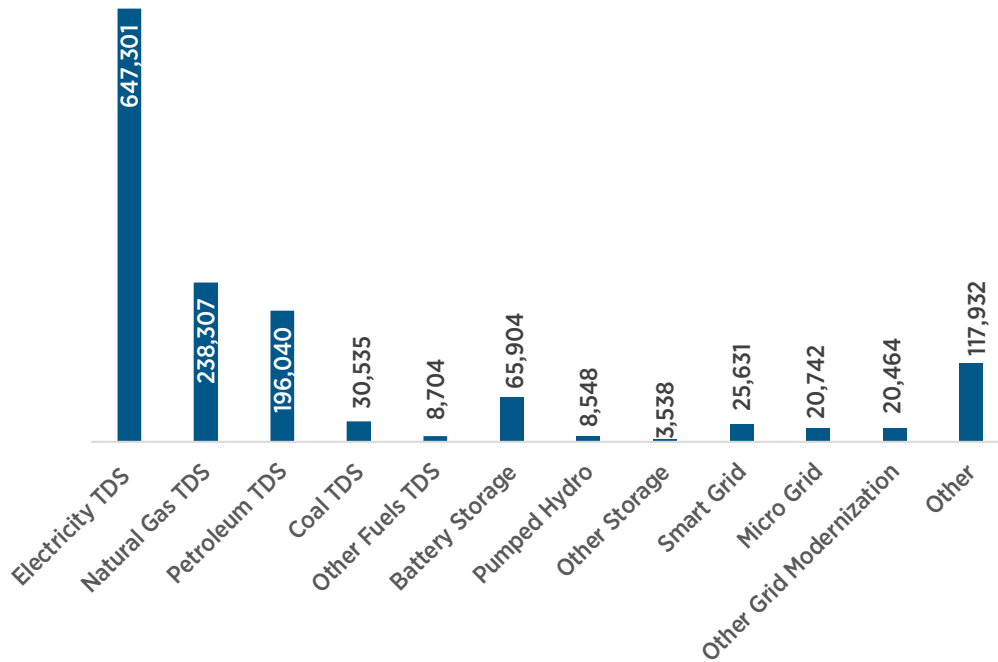


Figure 75.
TDS Sector - Employment by Detailed Technology Application, 2019



Key Takeaways

- **Construction firms employed 498,842 Americans** in TDS, a 4 percent increase from 2018, consistent with employers' expectations. Utilities employed 417,660 workers across the United States in 2019, virtually unchanged from 2018. TDS manufacturing employment grew 1 percent in 2019, while employers expect the industry to continue growing in 2020 by 3.5 percent.
- **Wholesale trade and distribution employers** predicted 5 percent growth in 2019, but continued to decline, dropping nearly 3 percent following a 2 percent drop in 2018. Wholesale trade, distribution, and transport includes nearly 129,300 employees involved in the transport of commodity energy products by rail, truck, air, and water.
- **Utility investments.** Overall, 42 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 (a decrease from the 48 percent reported in 2018).
- **Fuels employment.** The transmission, distribution, and storage of fuels employed 473,586 workers in the sector in 2019. Of these, 238,307 work with natural gas, 196,040 work with petroleum, and 30,535 work with coal.

Table 30.
TDS Sector – TDS Employment by Detailed Technology Application and Industry, Q2 2019^{34,35}

	Total	Utilities	Construction	Manufacturing	Wholesale Trade, Distribution, + Transport ³⁶	Professional Services	Pipeline Transport	Other Services
Traditional Transmission + Distribution Electricity	647,301	300,548	173,689	44,323	38,122	77,597	--	13,022
Traditional Transmission + Distribution Petroleum	194,014	--	82,822	--	90,791	--	20,400	--
Traditional Transmission + Distribution Natural Gas	236,580	117,112	88,824	--	--	--	30,644	--
Traditional Transmission + Distribution Coal	30,535	--	--	--	30,535	--	--	--
Traditional Transmission + Distribution Other Fuels	6,145	--	--	--	6,145	--	--	--
Pumped Hydro	8,548	--	3,364	2,614	261	1,419	804	87
Battery Storage	65,904	--	31,776	13,190	7,920	11,813	--	1,205
Other Storage	3,538	--	896	1,745	49	751	--	97
Petroleum Storage	2,026	--	1,237	275	31	1	--	481
Natural Gas Storage	1,727	--	563	285	214	653	--	12
Other Fuels Storage	2,559	--	1,871	--	2	626	--	60
Smart Grid	25,631	--	11,992	1,734	1,534	10,187	--	185
Micro Grid	20,742	--	11,989	3,578	1,652	3,001	--	522
Other Grid Modernization	20,464	--	15,445	1,969	272	2,533	--	245
Other	117,932	--	74,373	15,756	1,809	25,726	--	268
TOTAL	1,383,647	417,660	498,841	85,469	179,337	134,306	51,848	16,183

³⁴ Employers in the “other” category typically work across multiple technology applications and workers are unable to be assigned to a single technology.

³⁵ Column and row totals may differ due to rounding

³⁶ Traditional transmission and distribution of petroleum, natural gas, and coal only includes commodity flow employment.

Hiring Difficulty

- **80 percent of TDS construction** employers reported that it was somewhat difficult or very difficult to hire new employees in 2019 (with 27 percent reporting that hiring was very difficult).
- **75 percent of professional and business services** employers reported that it was either somewhat difficult or very difficult to hire new employees.
- **76 percent of utilities** employers reported that it was somewhat difficult or very difficult to hire new employees (with 35 percent of utilities reporting that hiring was very difficult).

Highest-Demand Occupations In TDS

Construction firms reported that installation workers were the hardest to hire (40 percent), followed by electricians and construction workers (30 percent). Utilities identified engineers/scientists as the hardest to hire (38 percent), followed by technicians or mechanical support (23 percent).

Table 31.
TDS Sector – Reported Occupations with Hiring Difficulty by Industry, Q4 2019

Utilities	Construction	Manufacturing	Wholesale Trade, Distribution, and Transport	Professional and Business Services	Other
Engineers/scientists (38%)	Installation workers (40%)	Engineers/scientists (60%)	Sales, marketing, or customer service representatives (31%)	Engineers/scientists (50%)	Technician or mechanical support (55%)
Technician or mechanical support (23%)	Electrician/construction workers (30%)	IT/ software or web developers (40%)	Management (directors, supervisors, vice presidents) (29%)	Management (directors, supervisors, vice presidents) (30%)	Installation workers (21%)
Electrician/construction workers (15%)	Engineers/scientists (20%)	Technician or mechanical support (20%)	Technician or mechanical support (23%)	IT/ software or web developers (20%)	Management (directors, supervisors, vice presidents) (16%)

SPOTLIGHT

Mike Mulvaney

Director of Energy and Infrastructure, United Association of Plumbers, Fitters, Welders and Service Techs



The United Association of Plumbers, Fitters, Welders and Service Techs (UA) represents 360,000 members in the United States and Canada who build much of the complex energy infrastructure in the United States, including pipelines, natural gas and nuclear power plants, refineries, and smart grid components. Mike Mulvaney is the Director of Energy and Infrastructure for the UA.

“The UA operates 244 training centers in the U.S. with at least one in every state. Our apprenticeships last for five years and include both on-the-job training and 300 hours of classroom work. We have multiple crafts in our union with roughly 60 percent common skills and 40 percent unique to the given trade. For instance, welding is important to all our crafts, but we have over 100 different welding certifications.

“Today we have 60,000 apprentices with greater demand every day. The U.S. could put 40,000 welders to work today. The demand for HVAC work, refrigeration, energy efficiency, it’s all growing rapidly.

“In recent years, we’ve seen the age of our apprentices increase to their late 20s. It used to be that you graduated from high school on Friday and entered our apprenticeship program on Monday. But high school counselors today are always encouraging kids to go to college, instead of acknowledging that the trades provide a very good living. Some of our pipeline welders make \$150,000 to \$200,000 a year.

It used to be that you graduated from high school on Friday and entered our apprenticeship program on Monday. But high school counselors today are always encouraging kids to go to college, instead of acknowledging that the trades provide a very good living. Some of our pipeline welders make \$150,000 to \$200,000 a year.

“We do lots of work in the energy space. It used to be that 30 percent was in coal and 22 percent in natural gas. That’s shifted, so that 40 percent of our work is in natural gas and 20 percent in coal. We are also starting to see the second phase of the shale gas revolution which is the growth of the petrochemical industry. We have 3,000 people working today on the Shell cracker plant in western Pennsylvania.

“We are also seeing big increases in energy efficiency technologies. We are just in the first or second inning of “smart buildings.” Our apprenticeship programs are always leaning into new technologies. Rain-water harvesting is something we’ve recently started a program for. We also are teaching in new ways, for instance, we have a virtual welding class that can be done remotely over a computer. I expect we’ll see wearable technologies within the next five years that will allow us to lift 150 pounds over our heads on construction sites.

“The UA is changing and it’s growing. We are part of our energy future.”

Introduction

For the purpose 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. As in last year's 2019 USEER, 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.

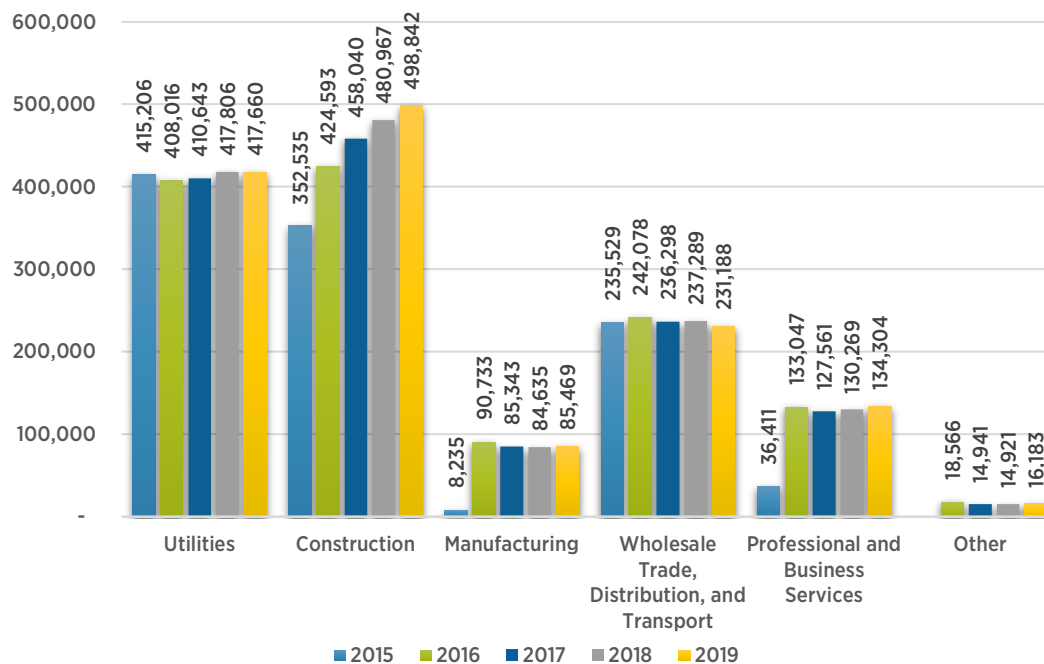
In the broadest possible sense, Transmission, Distribution, and Storage could also encompass the final retail sale of gasoline and other liquid fuels to consumers. Retail sales of gasoline and liquid fuels dealers employ a significant number of workers—in 2019, there were 1,019,979 such employees (up 6,000 since 2018), comprising workers in gasoline stations with convenience stores (846,848 employees), other gasoline stations (101,613 employees), and fuel dealers (71,518 employees).³⁷ These employees are part of the larger universe of 15,548,459 employees in retail trade in the United States in 2019.³⁸ For purposes of the 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.

³⁷ BLS, QCEW, 2019 Second Quarter, U.S. Total June Employment for NAICS 44711, NAICS 44719, and NAICS 45431.

³⁸ BLS, QCEW, 2019 Second Quarter, U.S. Total June Employment for NAICS 44-45.

Transmission, Distribution, and Storage, plus the retail workers discussed above, employed just over 2.4 million Americans in 2019. Excluding these retail employees, 1,383,646 workers were employed in the TDS sector. As shown in Figure 76,³⁹ about 66 percent of this employment was across utilities and construction firms,⁴⁰ including 36 percent in construction companies that construct pipeline and other infrastructure that support the Transmission, Distribution, and Storage, including both fuels and electricity.⁴¹ Construction firms have continued substantial employment gains, adding nearly 18,000 new jobs over the last year for 4 percent growth, totaling 74,300 new jobs or 17 percent growth since 2016. Overall, 42 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 (a decrease from the 48 percent proportion reported in 2018). TDS employers project employment growth of 4 percent in 2020.

Figure 76.
TDS Sector – Employment by Industry Sectors, Q2 2015 - Q2 2019



³⁹ 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, 2019 USEER, and 2020 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.

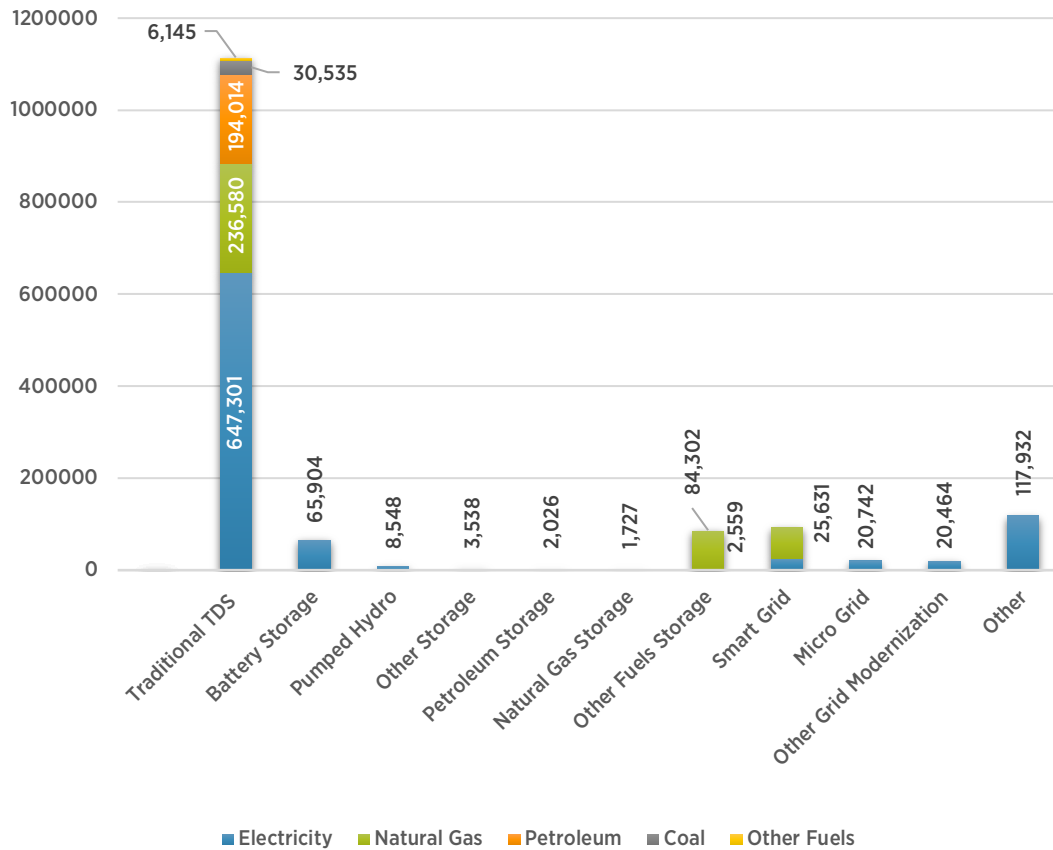
⁴⁰ Hydrogen and fuel cell technologies are split among motor vehicles, storage, and other generation, depending on application—however, the numbers were too small to report separately within the latter two categories.

⁴¹ 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 2019, about 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 84,300 workers were employed with storage technologies (including pumped hydro-storage)⁴² in 2019, while 66,800 worked with smart grid,⁴³ micro grid, or other grid technologies. About 129,300 employees were involved with the transport of fuel via rail, air, water, or truck, and an additional 118,100 worked on other detailed technology applications within Transmission, Distribution, and Storage.⁴⁴

Figure 77.
TDS Sector - Employment by Detailed Technology, 2019



⁴² Hydro-storage is included in this section when it is separate from hydropower generation, which is included in the generation and fuels chapter.

⁴³ Defined as employees that work on an electricity supply network that uses digital communications technology to detect and react to local changes in usage.

⁴⁴ 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 247,184.

Construction firms, the largest sector of TDS employment, expect growth of 6.7 percent in 2020, as shown in Figure 7877.⁴⁵ However, utilities, the second largest sector, predict declines in TDS employment. However, other sectors expect continued growth.

Figure 78.
TDS Sector - Expected Employment Growth by Industry (Q4 2019 - Q4 2020)

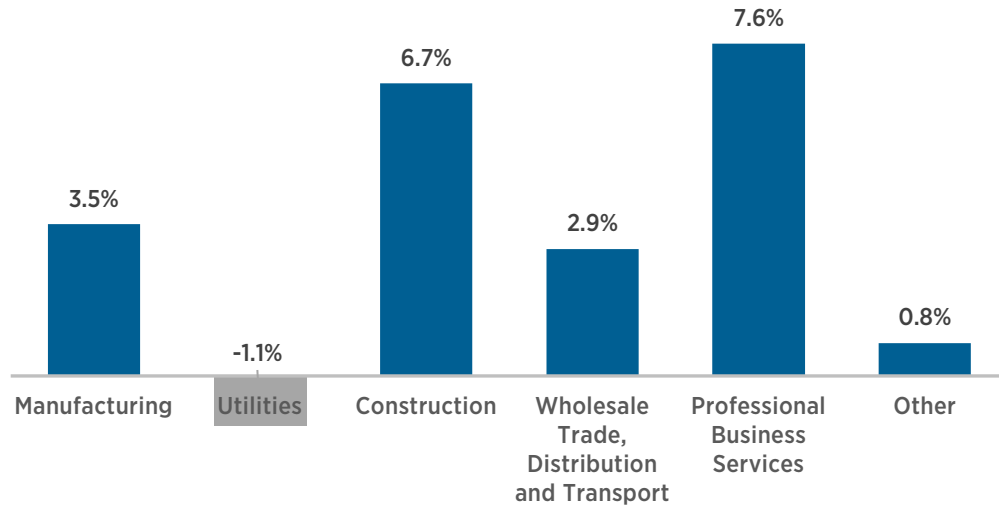
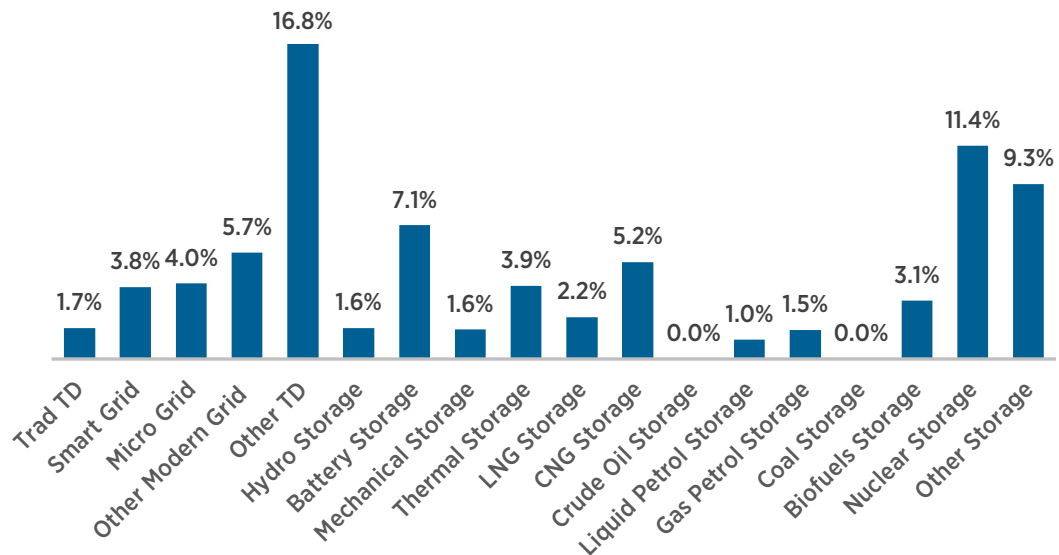


Figure 79.
TDS Sector - Expected Employment Growth by Detailed Technology (2019-2020)

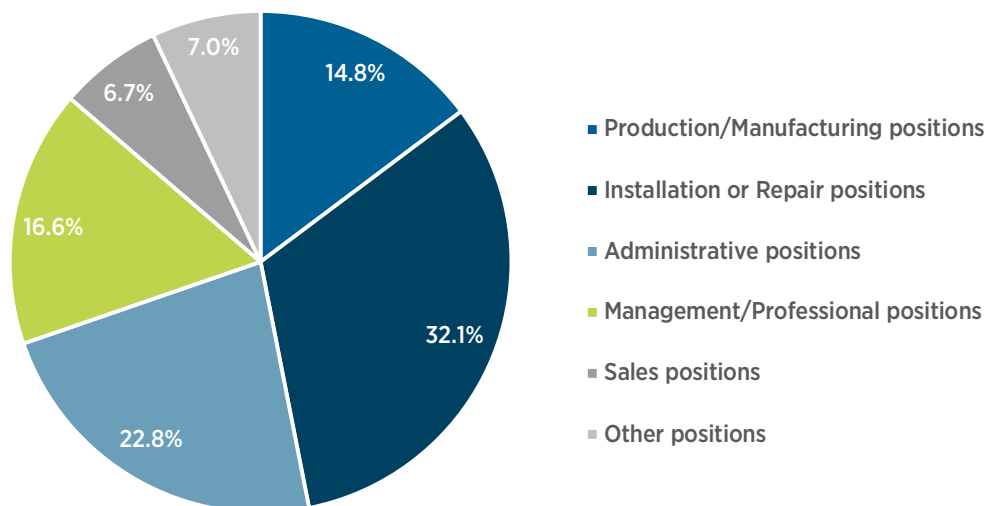


⁴⁵ The data in Figure 7877 does not include commodity flow employers, as they were not surveyed for 2020 USEER.

Transmission, Distribution, and Storage – Workforce Characteristics

Nearly one-third (32 percent) of Transmission, Distribution, and Storage workers were employed in installation or repair positions in 2019. Twenty-three percent of workers were employed in administrative positions.

Figure 80.
TDS Sector – Occupational Distribution, Q4 2019



Manufacturing firms in TDS reported the highest overall hiring difficulty in 2019, followed by construction, and wholesale trade, distribution, and transport. Construction, which makes up the largest percentage of TDS employment (36 percent), reported 27 percent of employers stating that it was very difficult to hire new employees in 2019. This was down by 7 percentage points from 2018, continuing its decrease from 2017. Utilities, the second largest TDS industry sector, saw a significant increase in the percent of employers reporting that it was very difficult to hire new employees, rising from 12 percent in 2018 to 35 percent in 2019.

Figure 81.
TDS Sector - Hiring Difficulty by Industry

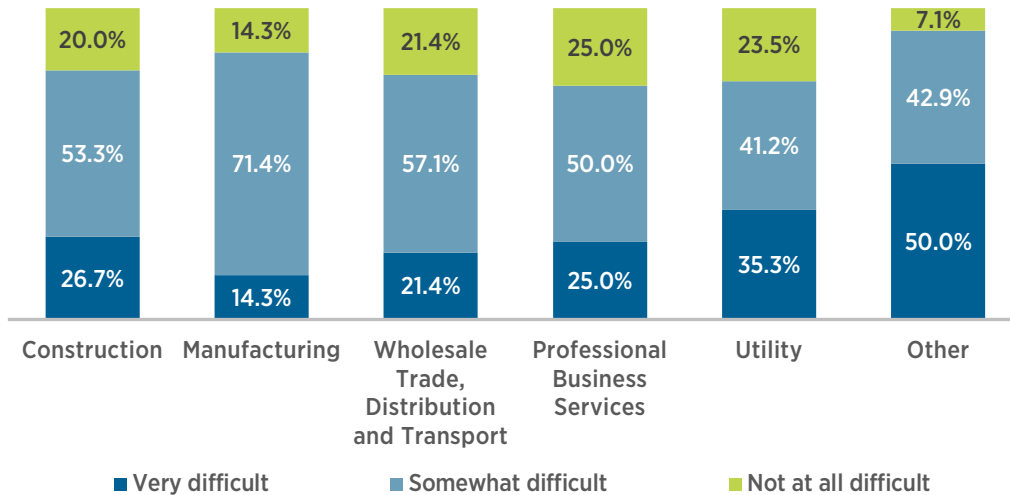
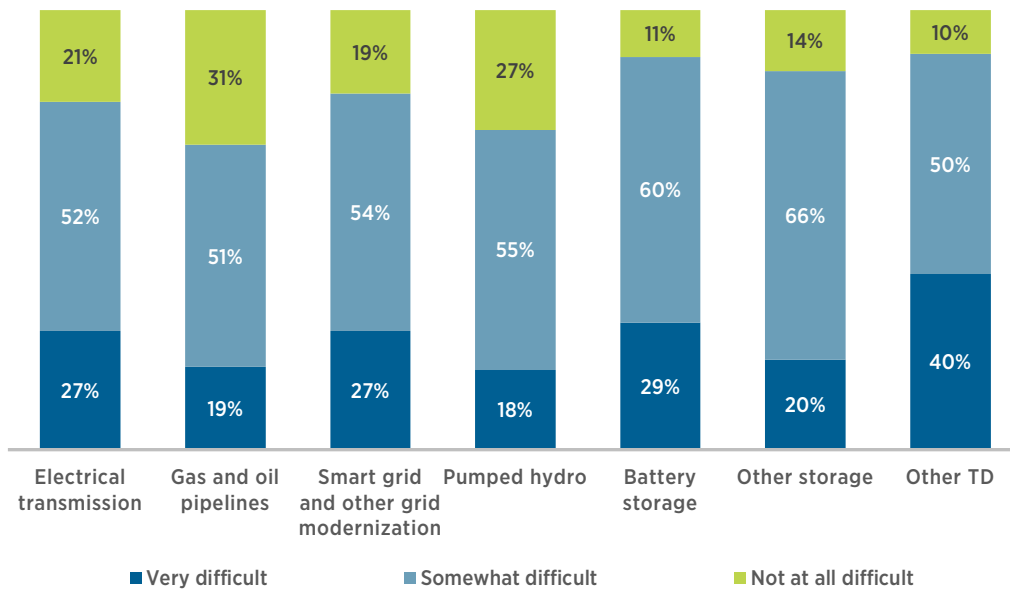


Figure 82.
TDS Sector - Hiring Difficulty by Technology, Q4 2019



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

Table 32.
TDS Sector – Reasons for Hiring Difficulty by Industry, Q4 2019

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 cited engineers and scientists as the most difficult occupations to fill in 2019, while construction firms identified installation workers as the most difficult. In 2018, both industry sectors named electricians and construction workers as the hardest to hire.

Table 33.
TDS Sector – Reported Occupations with Hiring Difficulty by Industry, Q4 2019

Utilities	Construction	Manufacturing	Wholesale Trade, Distribution, and Transport	Professional and Business Services	Other
Engineers/scientists (38%)	Installation workers (40%)	Engineers/scientists (60%)	Sales, marketing, or customer service representatives (31%)	Engineers/scientists (50%)	Technician or mechanical support (55%)
Technician or mechanical support (23%)	Electrician/construction workers (30%)	IT/software or web developers (40%)	Management (directors, supervisors, vice presidents) (29%)	Management (directors, supervisors, vice presidents) (30%)	Installation workers (21%)
Electrician/construction workers (15%)	Engineers/scientists (20%)	Technician or mechanical support (20%)	Technician or mechanical support (23%)	IT/software or web developers (20%)	Management (directors, supervisors, vice presidents) (16%)

In 2019, women represented 24 percent of the TDS workforce. Seventeen percent of employees were Hispanic or Latino, equal to the national workforce average. Although African American employment was below the national average, overall racial diversity was 9 percentage points above the national workforce average. Unionization rates in TDS are 17 percent, almost triple the national private sector rate of 6.2 percent. (As noted earlier in connection with Figure 7877, commodity flow employment is not included in this section as commodity flow employers were not directly surveyed for the 2019 USEER.)

Table 34.
TDS Sector – Demographics, Q4 2019

Demographic	Employees	Percent of Sector	National Workforce Averages
Male	948,805	76%	53%
Female	305,589	24%	47%
Hispanic or Latino	208,229	17%	18%
Not Hispanic or Latino	1,046,165	83%	82%
American Indian or Alaska Native	26,744	2%	>1%
Asian	107,844	9%	6%
Black or African American	121,879	10%	12%
Native Hawaiian or other Islander	9,955	1%	>1%
White	871,500	69%	78%
Two or more races	116,472	9%	2%
Veterans	94,279	8%	6%
55 and over	227,901	18%	23%
Union	211,431	17%	6%

Natural Gas Industry Crosscut

The natural gas industry has employment in three of the 2020 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 20, 72, and 99.

In total, the 2020 USEER finds that the natural gas industry employs 636,042 Americans, spread through the industrial sectors in Table 35 below. Overall, natural gas industry employment grew by 1.7 percent in 2019, following 6.2 percent growth in 2018.

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

- Utilities - 183,612 jobs
- Mining and Extraction - 165,602 jobs
- Construction - 109,576 jobs

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

- Utilities - 4.2 percent growth
- Professional and Business Services - 3.8 percent growth
- Wholesale Trade, Distribution, and Transport - 2.1 percent growth

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

- Utilities - 7,445 jobs
- Mining and Extraction - 2,674 jobs
- Professional and Business Services - 1,995 jobs

Table 35.
Natural Gas Industry Employment by Detailed Technology Application and Industry, Q2 2019⁴⁶

	Total	Mining and Extraction	Utilities	Construction	Manufacturing	Wholesale Trade, Distribution, + Transport (including Pipeline)	Professional and Business Services	Other Services
Fuels	275,924	165,602	--	--	45,276	29,633	35,235	178
Conventional Gas Generation	46,151	--	19,276	10,551	3,635	3,180	8,371	1,139
Advanced Gas	75,661	--	47,224	9,638	2,791	4,983	10,118	907
Fuel Transmission + Distribution	236,580	--	117,112	88,824	--	30,644	--	--
Storage	1,727	--	--	563	285	214	653	12
TOTAL	636,042	165,602	183,612	109,576	51,986	68,653	54,377	2,236

Snapshot of the Natural Gas Industry

- Contribution to GDP in 2019: \$222.98 billion⁴⁷
- Overall employment: 636,042
- 1,452,665 GWh of natural gas generation through November 2019⁴⁸
- End-use consumption of natural gas through November 2019: 6.1 percent by lease and plant fuel, 2.9 percent by pipeline and distribution use, 15.1 percent residential, 11.0 percent deliveries to commercial consumers, 27.4 percent industrial, 0.2 percent vehicle fuel, 37.4 percent deliveries to electric power consumers
- 1,366,704,000 metric tons of carbon dioxide emissions through October 2019⁴⁹

⁴⁶ Column and row totals may differ due to rounding

⁴⁷ 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.

⁴⁸ Source: U.S. Energy Information Association, Monthly Energy Review, Table 1.1. Net Generation by Energy Source: Total (All Sectors), January 2019–November 2019.

⁴⁹ Source: U.S. Energy Information Association, Monthly Energy Review, Table 12.1. Carbon Dioxide Emissions from Energy Consumption by Source, January 2019–October 2019.

Workforce Trends

OVERALL DIFFICULTY HIRING

77.4 percent of natural gas firms have had difficulty in hiring in 2019, up from 75.7 percent in 2018; 30.2 percent have reported hiring was very difficult.

MOST DIFFICULT INDUSTRIES

- Construction (82.8 percent), “other” (81.4 percent), and professional and business services (81.2 percent) industries have had the most difficulty hiring for natural gas in 2019.
 - 44.1 percent of construction firms reported that hiring has been very difficult.

MOST DIFFICULT OCCUPATIONS

- Technician or mechanical support and engineers/scientists were the most difficult occupations to hire for in 2019 (29.5 percent).
 - Other occupations that were noted as being difficult to hire for include management (21.1 percent) and electricians/construction workers (13.1 percent).

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 (41.9 percent), competition/small applicant pool (30.6 percent), and difficulty finding industry-specific knowledge, skills, and interest (22.6 percent).

WAGE DISTRIBUTION⁵⁰

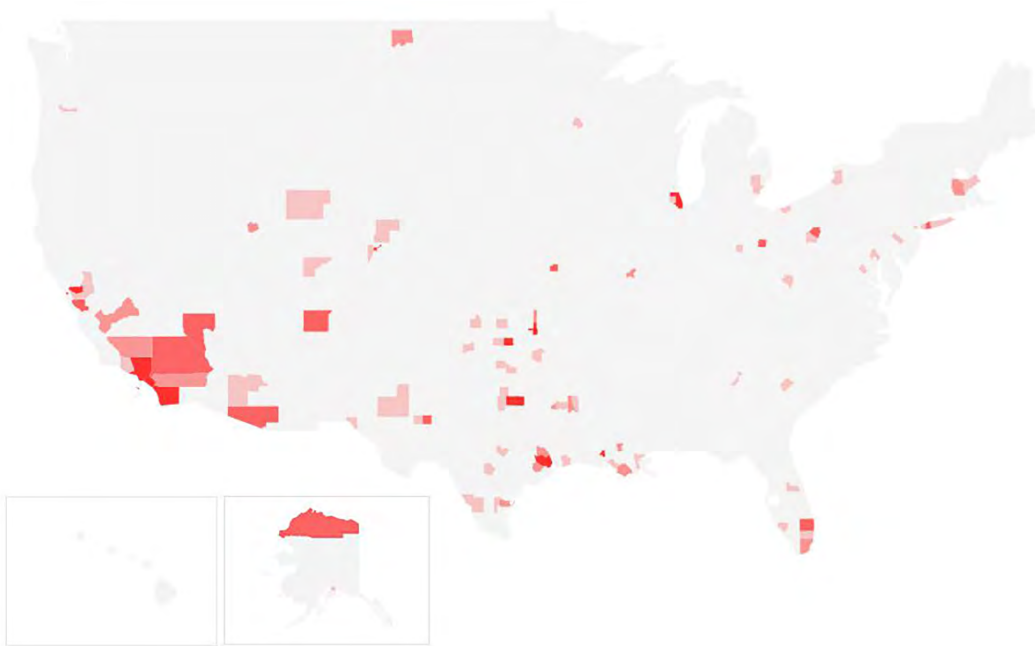
- The average reported median full-time hourly wage for all entry level workers in the natural gas industry is \$19.99/hour.
- The average reported median full-time hourly wage for all mid-wage workers is \$27.24/hour.
- The average reported median full-time hourly wage for the highest earners in the industry is \$39.19/hour.

TOP WAGE JOBS IN INDUSTRY

- Top wage earners in the natural gas industry include executive management (averaging \$66.54/hour), general or operations specialties managers (averaging \$46.66/hour), petroleum engineers (averaging \$45.70/hour), and environmental scientists and geoscientists (averaging \$45.63/hour).

⁵⁰ Source: Employer-reported Q4 2019 wages and May 2018 BLS OES wages.

Figure 83.
National Heat Map Showing Distribution of Natural Gas Jobs



Coal Industry Crosscut

The coal industry has employment in three of the 2020 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 17, 69, and 99.

In total, the 2020 USEER finds that the coal industry employs 185,689 Americans, spread through the industrial sectors in Table 36 below. Overall, coal industry employment declined by 5.9 percent in 2019, following a 3 percent decline in 2018.

Coal: Current Trends for Employment

The number of jobs in coal-fired electric power generation totals 79,711, a decline of 13,132 in 2018 and 2019, or roughly 14 percent. Meanwhile, almost 1,300 jobs were created in the production of coal fuels during that same two-year period, totaling 75,443.

What are the current trends and expectations for employment in these two closely related sectors? Coal generating capacity peaked in the United States in 2011 at 318 Gigawatts (GW). Since 2010, 102 GW of coal-fired units have been retired. According to the Energy Information Administration's (EIA) Annual Energy Outlook 2020 (AEO2020), roughly 20 GW of coal-fired power plants were retired during 2018 (13GW) and 2019 (7GW), the primary source of employment loss. In addition, capacity utilization shrank in many other less efficient coal plants in response to the growing dispatch of more cost-effective renewables and natural gas.

Interestingly, these coal plant closures did not lead to an immediate corresponding loss in coal fuels. Several factors explain this phenomenon. First has been the relative growth of metallurgical (met) coal mining since 2010 as the U.S. and European steel industries recovered from the Great Recession. Second, coal exports, particularly met coal, have increased in recent years. U.S. mines are the primary source of the met coal that is required to convert iron ore in blast furnaces and the Basic Oxygen Process which is used in 75 percent of European steel production. In the United States, by comparison, two-thirds of steel production comes from scrap steel, re-melted in electric arc furnaces. Third, coal fuels production has seen a relative decline in labor productivity over the last decade, a result of diminished mine quality and the increasing proportion of met coal. These three factors appear to have offset the job loss from the declining market for thermal coal in the electric power generation sector.

Nonetheless, domestically consumed thermal coal is the primary product mined in the United States, making up between 81 percent and 93 percent of coal production in recent years. The remaining 7 to 19 percent is composed of met coal, thermal coal used for industrial applications, or coal exports. For instance, in 2017, 664 million tons of coal were consumed in coal-fired power plants in the United States, while 110 million additional tons were produced for use in domestic metallurgical applications, thermal industrial uses, or for exports (both met and thermal).

The EIA AEO2020 examines these trends under several different scenarios to try to provide insight into how both known public policies and market forces might affect energy production and usage. However, plant owners have already announced the closure of an additional 17 GW of coal-fired generation by 2025.

The largest industry sectors in coal industry were the following:

- Mining and Extraction – 55,669 jobs
- Utilities – 38,158 jobs
- Wholesale Trade, Distribution, and Transport – 37,670 jobs

The fastest growing industry sectors for coal were the following:

- Manufacturing – 4.0 percent growth
- Professional and Business Services – 3.6 percent growth
- Construction – 2.4 percent growth

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

- Professional and Business Services – 1,133 jobs
- Manufacturing – 453 jobs
- Construction – 208 jobs

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

- Utilities – (7,637) jobs
- Wholesale Trade – (5,657) jobs

Table 36.
Coal Industry Employment by Detailed Technology Application and Industry, Q2 2019⁵¹

	Total	Mining and Extraction	Utilities	Construction	Manufacturing	Wholesale Trade, Distribution, + Transport	Professional and Business Services	Other Services
Fuels	75,443	55,669	--	--	10,643	1,031	8,075	25
Coal Generation	79,711	--	38,158	8,847	1,083	6,104	24,508	1,011
Fuel Transmission + Distribution	30,535	--	--	--	--	30,535	--	--
TOTAL	185,689	55,669	38,158	8,847	11,726	37,670	32,582	1,036

Snapshot of the Coal Industry

- Contribution to GDP in 2018: \$53.92 billion.⁵²
- Overall employment: 185,689
- 893,735 GWh of coal generation through November 2019⁵³
- End-use consumption for coal through October 2018: 91.8 percent by the electric power sector, 8.0 percent by the industrial sector, and 0.1 percent by the commercial sector
- 914,968,000 metric tons of carbon dioxide emissions through October 2019⁵⁴

Workforce Trends

OVERALL DIFFICULTY HIRING

- 76.0 percent of coal firms have had difficulty in hiring in 2019; 29.2 percent have noted that hiring was very difficult.

MOST DIFFICULT INDUSTRIES

- Construction (83.3 percent) and wholesale trade (80.0 percent) industries have had the most difficulty with hiring in 2019.

⁵¹ Column and row totals may differ due to rounding

⁵² 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.

⁵³ Source: U.S. Energy Information Association, Table 1.1. Net Generation by Energy Source: Total (All Sectors), 2008-November 2019.

⁵⁴ Source: U.S. Energy Information Association, Monthly Energy Review, Table 12.1. Carbon Dioxide Emissions from Energy Consumption by Source, January 2019--October 2019.

- 50.0 percent of construction firms have reported that hiring has been very difficult.

MOST DIFFICULT OCCUPATIONS

- Engineers/scientists (43.5 percent), technician or mechanical support (39.1 percent), management (26.1 percent), and electrician/construction workers (17.4 percent) were cited as the most difficult occupations to hire for among coal firms in 2019.

REASONS FOR DIFFICULTY

- Most (45.4 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 difficulty finding industry-specific knowledge, skills, and interest (20.8 percent), and economy/structural problem (20.8 percent).

WAGE DISTRIBUTION⁵⁵

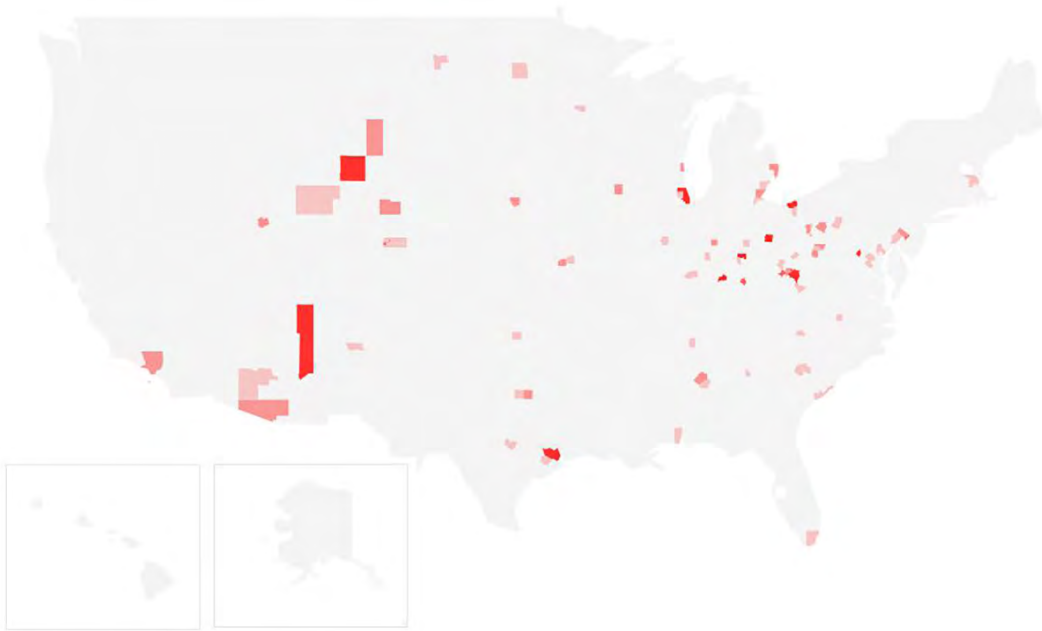
- The average reported median full-time hourly wage for all entry level workers in the coal industry is \$18.41/hour.
- The average reported median full-time hourly wage for all mid-wage workers is \$28.48/hour.
- The average reported median full-time hourly wage for the highest earners in the industry is \$42.07/hour.

TOP WAGE JOBS IN INDUSTRY

- Top wage earners in the coal industry include executive management (averaging \$64.93/hour), operations specialties managers (averaging \$53.87/hour), construction managers (averaging \$53.37/hour), and petroleum engineers (averaging \$44.78/hour).

⁵⁵ Source: Employer-reported Q4 2019 wages and May 2018 BLS OES wages.

Figure 84.
National Heat Map Showing Distribution of Coal Jobs



Petroleum Industry Crosscut

The petroleum industry has employment in three of the 2020 USEER chapters—Fuels, Electric Power Generation, and Transmission, Distribution, and Storage. For detailed information on hiring trends and demographic makeup see sections in these chapters beginning on pages 14, 78, and 99.

In total, the 2020 USEER finds that the petroleum industry employs 824,290 Americans, spread through the industrial sectors in Table 37 below. Overall, the industry employment grew by 3.1 percent in 2019, following a 5.3 percent increase in 2018.

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

- Mining and Extraction — 313,591 jobs
- Wholesale Trade, Distribution, and Transport — 172,796 jobs
- Manufacturing — 157,911 jobs

The fastest growing industry sectors for petroleum were the following:

- Construction — 14.7 percent growth
- Professional and Business Services — 2.7 percent growth
- Other Services — 2.0 percent growth

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

- Construction — 13,411 jobs
- Mining and Extraction — 4,910 jobs
- Manufacturing — 2,644 jobs

Table 37.
Petroleum Industry Employment by Detailed Technology Application and Industry, Q2 2019

	Total	Mining and Extraction	Utilities	Construction	Manufacturing	Wholesale Trade, Distribution, + Transport	Professional and Business Services	Other Services
Fuels	615,528	313,591	--	20,409	151,846	59,563	68,726	1,393
Oil & Other Petrol Generation	12,722	--	474	--	5,790	2,012	4,306	139
Fuel Transmission + Distribution	194,014	--	--	82,822	--	111,191	--	--
Storage	2,026	--	--	1,237	275	30	--	481
TOTAL	824,290 ⁵⁶	313,591	474	104,468	157,911	172,796	73,032	2,013

⁵⁶ Column and row totals may differ due to rounding

Snapshot of the Petroleum Industry

- Contribution to GDP in 2018: \$497.52 billion⁵⁷
- Overall employment: 824,290
- 17,184 GWh of petroleum generation through November 2019⁵⁸
- End-use consumption for petroleum through October 2019: 26.6 percent industrial, 2.1 percent residential, 2.0 percent commercial, 69.0 percent transportation, 0.3 percent electric power
- 1,961,094,000 metric tons of carbon dioxide emissions through October 2019⁵⁹

Workforce Trends

OVERALL DIFFICULTY HIRING

- 78.6 percent of petroleum firms have had difficulty in hiring in 2019; 32.3 percent note that hiring was very difficult.

MOST DIFFICULT INDUSTRIES

- Construction (86.5 percent) and wholesale trade (80.5 percent) industries have seen the most difficulty hiring
 - 53.9 percent of construction firms have noted that hiring has been very difficult.

MOST DIFFICULT OCCUPATIONS

- The most difficult occupation to hire for is technician or mechanical support and engineers/scientists (27.6 percent).
 - Other occupations that are noted as being difficult to hire for are drivers/dispatchers (22.4 percent), management (19.0 percent), and sales, marketing, or customer service (15.5 percent).

REASONS FOR DIFFICULTY

- The most frequently cited reasons for the hiring difficulty were lack of experience, training, or technical skills (31.7 percent), competition/small applicant pool (30.0 percent), insufficient non-technical skills (18.3 percent), and insufficient qualifications (certifications or education) (18.3 percent).

⁵⁷ 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.

⁵⁸ Source: U.S. Energy Information Association, Table 1.1. Net Generation by Energy Source: Total (All Sectors), 2008-November 2018, petroleum liquids and coke

⁵⁹ Source: U.S. Energy Information Association, Monthly Energy Review, Table 12.1. Carbon Dioxide Emissions from Energy Consumption by Source, January 2019-October 2019

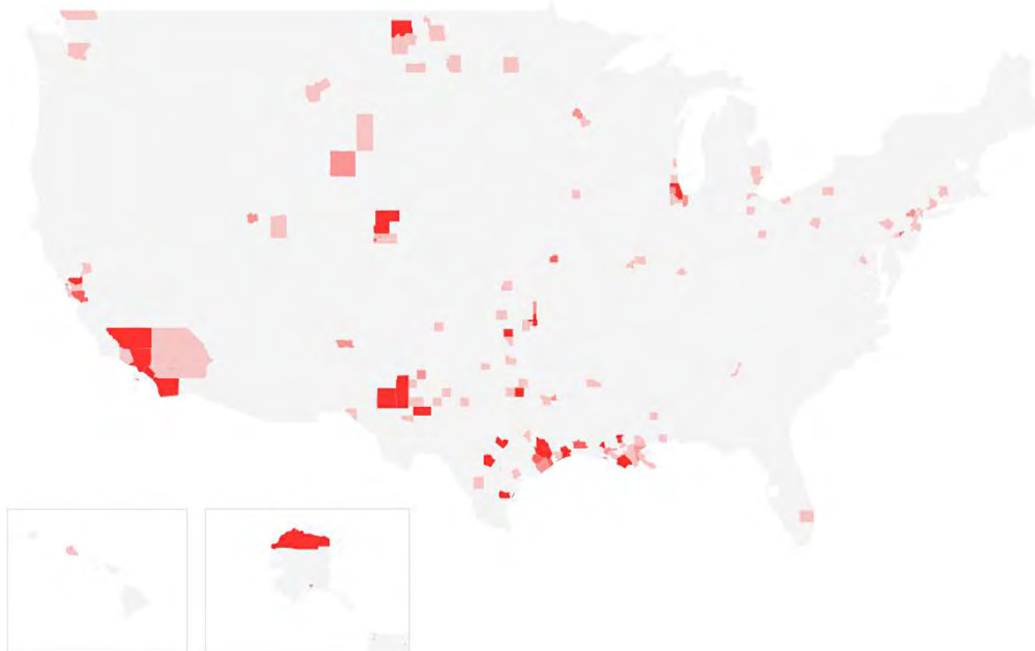
WAGE DISTRIBUTION⁶⁰

- The average reported median full-time hourly wage for all entry level workers in the petroleum industry is \$19.98/hour.
- The average reported median full-time hourly wage for all mid-wage workers is \$26.67/hour.
- The average reported median full-time hourly wage for the highest earners in the industry is \$38.06/hour.

TOP WAGE JOBS IN INDUSTRY

- Top wage earners in the petroleum industry include executive management (averaging \$65.09/hour), petroleum engineers (averaging \$46.33/hour), environmental scientists and geoscientists (averaging \$46.20/hour), and information security analysts (averaging \$41.63/hour).

Figure 85.
National Heat Map Showing Distribution of Petroleum Jobs



⁶⁰ Source: Employer-reported Q4 2019 wages and May 2018 BLS OES wages.

Nuclear Industry Crosscut

The nuclear industry has employment in two of the 2020 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 23 and 75.

In total, the 2020 USEER finds that the nuclear industry employs 70,323 Americans, spread through the industrial sectors in Table 38 below. Overall, nuclear industry employment declined by 2.5 percent in 2019, following a drop of 2.1 percent in 2018.

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

- Utilities – 44,366 jobs
- Professional and Business Services – 14,757 jobs
- Manufacturing – 4,979 jobs

The fastest growing industry sectors for nuclear were the following:

- Mining and Extraction – 5.5 percent growth
- Wholesale Trade, Distribution, and Transport – 3.7 percent growth
- Other Services – 3.5 percent growth

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

- Professional and Business Services – 383 jobs
- Wholesale Trade, Distribution, and Transport – 128 jobs
- Manufacturing – 66 jobs

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

- Utilities – (2,443)

Table 38.
Nuclear Industry Employment by Detailed Technology Application and Industry, Q2 2019⁶¹

	Total	Mining and Extraction	Utilities	Construction	Manufacturing	Wholesale Trade, Distribution, + Transport	Professional Services	Other
Fuels	9,406	348	--	--	3,078	929	5,052	--
Nuclear Generation	60,916	--	44,366	2,217	1,901	2,639	9,705	89
TOTAL	70,323	348	44,366	2,217	4,979	3,568	14,757	89

⁶¹ Column and row totals may differ due to rounding

Snapshot of the Nuclear Industry

- Contribution to GDP in 2018: \$39.07 billion⁶²
- Overall employment: 70,323 jobs
- 736,164 GWh of nuclear generation through November 2019⁶³

Workforce Trends

OVERALL DIFFICULTY HIRING

- 70.4 percent of nuclear firms have had difficulty in hiring in 2019; 25.3 percent note that hiring was very difficult.

MOST DIFFICULT OCCUPATIONS

- The most difficult occupation to hire for is engineers/scientists (30.2 percent).
 - Other occupations that are noted as being difficult to hire for are management (23.4 percent), technician or mechanical support (21.4 percent), and electricians/construction workers (16.2 percent).

REASONS FOR DIFFICULTY

- The most frequently cited reasons for the hiring difficulty were insufficient qualifications (certifications or education) (30.2 percent), insufficient non-technical skills (28.6 percent), and lack of experience, training, or technical skills (25.6 percent).

Wage distribution⁶⁴

- The average reported median full-time hourly wage for all entry level workers in the nuclear industry is \$22.56/hour.
- The average reported median full-time hourly wage for all mid-wage workers is \$36.46/hour.
- The average reported median full-time hourly wage for the highest earners in the industry is \$54.86/hour.

Top wage jobs in industry

- Top wage earners in the nuclear industry include executive management (averaging \$71.20/hour), general and operations

⁶² 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.

⁶³ Source: U.S. Energy Information Association, Table 1.1. Net Generation by Energy Source: Total (All Sectors), 2008-November 2019.

⁶⁴ Source: Employer reported Q4 2019 wages and May 2018 BLS OES wages.

managers (averaging \$67.53/hour), construction managers (averaging \$64.32/hour), engineers (averaging \$49.99/hour), and environmental scientists and geoscientists (averaging \$46.51/hour).

Figure 86.
National Heat Map Showing Distribution of Nuclear Jobs



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 99.

In total, the 2020 USEER finds that the storage industry employs 84,301 Americans, an increase of 4.1 percent over 2018. The storage industry is spread through the construction, manufacturing, wholesale trade, distribution, and transport, professional and business services, and other services as broken down in Table 39 below. It also includes several technologies and fuel types.

Snapshot of the Storage Industry

- Overall employment: 84,301 jobs
- Battery storage, the largest technology, increased by 4.8 percent in 2019, driven by construction and manufacturing employment

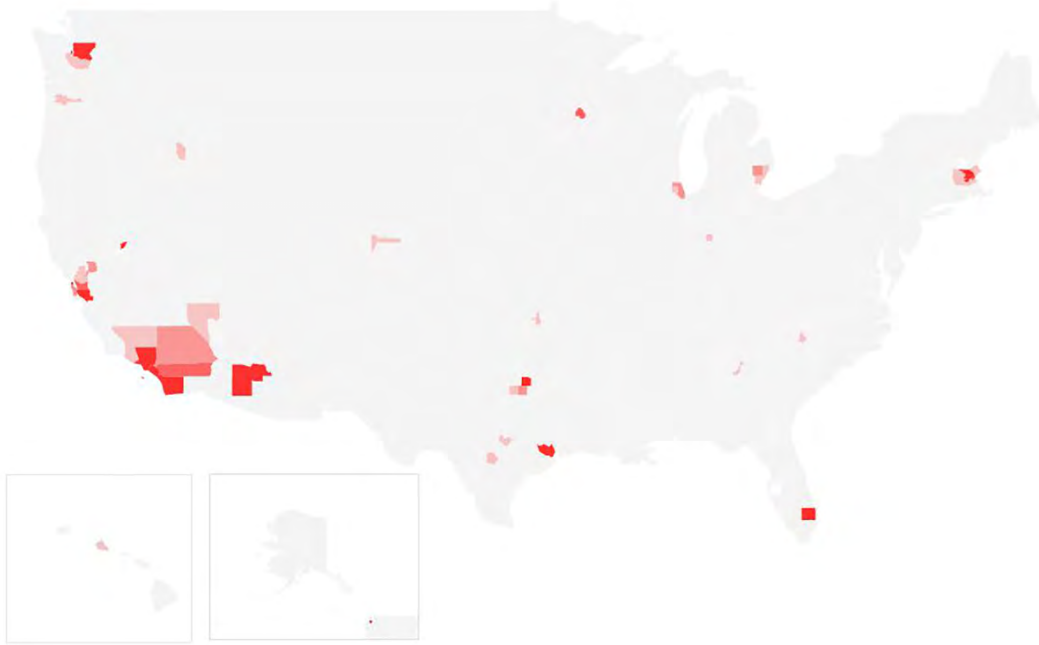
Table 39.
Storage Industry Employment by Detailed Technology Application and Industry, Q2 2019⁶⁵

	Total	Utilities	Construction	Manufacturing	Wholesale Trade, Distribution, + Transport ⁶⁶	Professional Services	Pipeline Transport	Other Services
Pumped Hydro	8,548	--	3,364	2,614	261	1,419	804	87
Battery Storage	65,904	--	31,776	13,190	7,920	11,813	--	1,205
Other Storage	4,031	--	1,473	1,745	50	791	--	97
Petroleum Storage	2,026	--	1,237	275	30	--	--	481
Natural Gas Storage	1,727	--	563	285	214	653	--	12
Other Fuels Storage	2,065	--	1,294	--	<10	586	--	60
TOTAL	84,301	--	39,708	18,109	8,476	15,262	804	1,942

⁶⁵ Column and row totals may differ due to rounding

⁶⁶ Traditional transmission and distribution of petroleum, natural gas, and coal only includes commodity flow employment.

Figure 87.
National Heat Map Showing Distribution of Storage Jobs



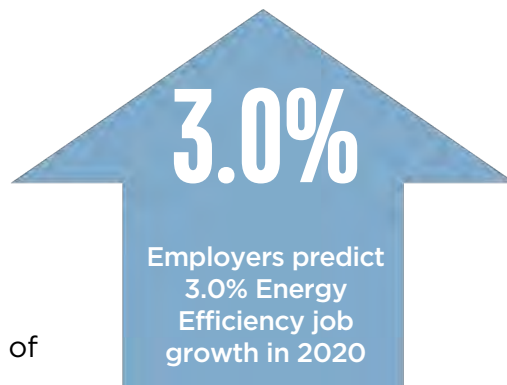
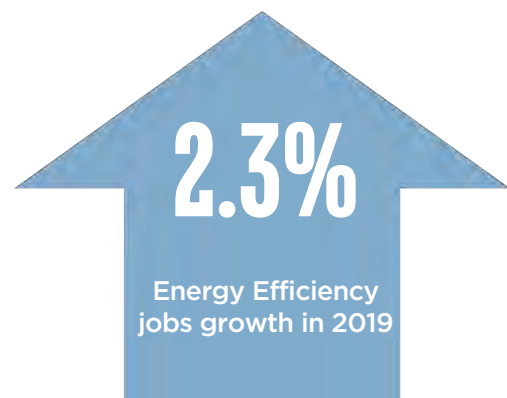


ENERGY EFFICIENCY

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.⁶⁷

Trends

- 2019 Job Growth.** In 2019, the Energy Efficiency sector continued to produce the most new jobs of any energy sector—more than 54,000—with 2,378,893 jobs in total. Demand growth for efficient technology and building upgrades has driven expansion across many traditional industries including construction trades (which added more than 27,600 jobs) and professional services (which added nearly 14,800 employees).
- 2020 Expectations.** Energy Efficiency employers report a projected growth rate for employment in 2020 of 3 percent or nearly 71,000 new jobs. Construction employers report expected Energy Efficiency job growth of 3.6 percent (48,000 jobs) by the end of 2020.
- Key Occupations:** The majority (56 percent) of Energy Efficiency employees worked at construction firms in 2019, installing or servicing Energy Efficiency goods or performing Energy Efficiency related services.⁶⁸ 21 percent of workers in the Energy Efficiency sector were employed in professional and business services.



⁶⁷ Estimates do not include retail employment. ENERGY STAR® is a registered trademark of the U.S. Environmental Protection Agency.

⁶⁸ 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.

Employment Snapshot

Figure 88.
Energy Efficiency Sector - Employment by Industry, 2018-2019

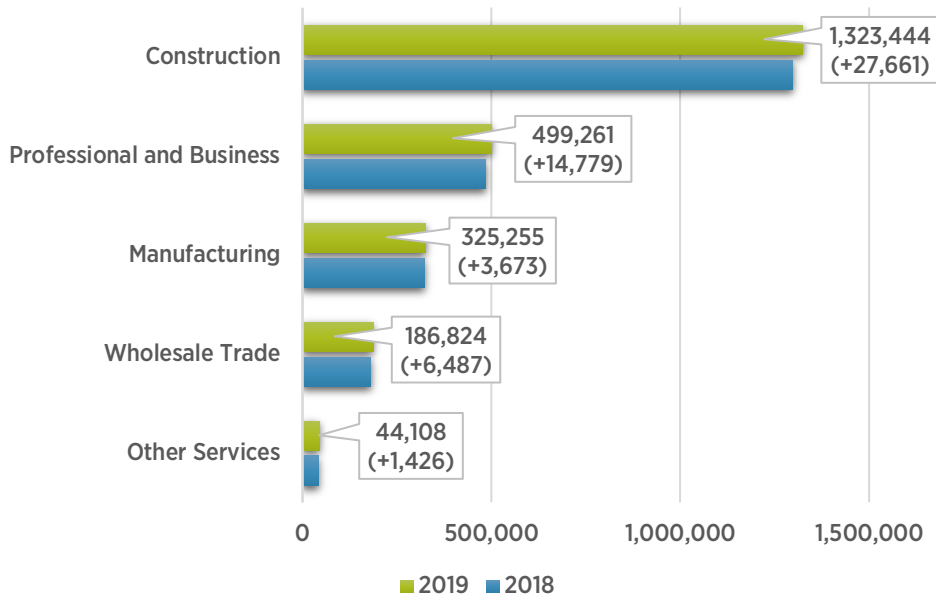
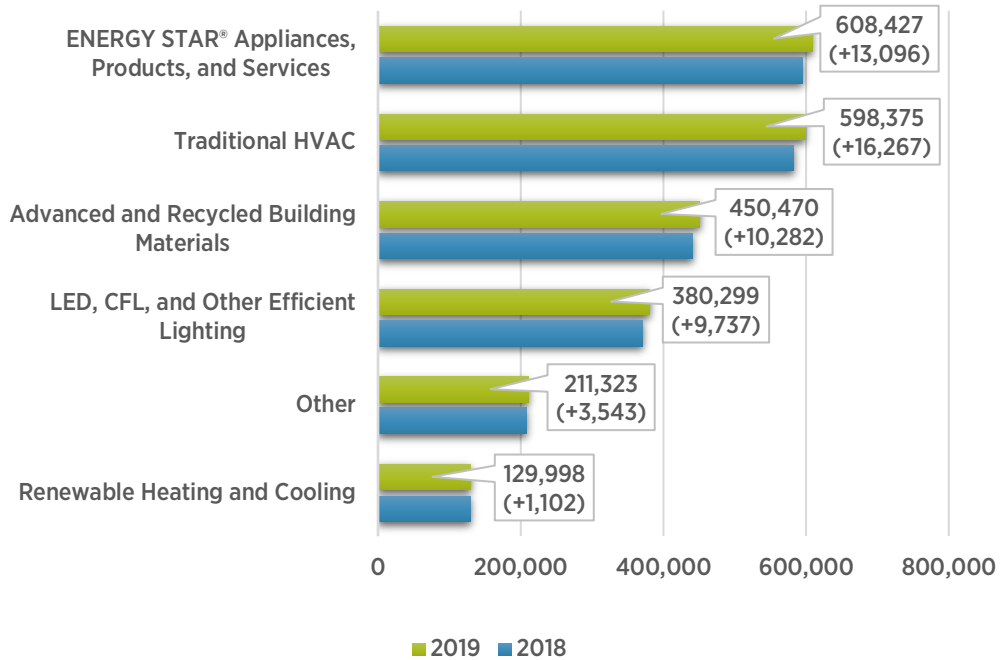


Figure 89.
Energy Efficiency Sector - Employment by Detailed Technology, 2018-2019



Key Takeaways

- The manufacture, installation, design, wholesale distribution, and other services related to ENERGY STAR products employed over 826,500 Americans in 2019.
- The manufacture of Energy Efficiency products employed over 325,000 or almost 14 percent of the sector.
- Professional and business services added 14,800 new jobs. Construction added more than 27,600 jobs in 2019. Construction firms working in the Energy Efficiency sector reported that 78 percent of their employees spend a majority of their time working with energy efficiency technologies, nearly even with the 79 percent reported in 2018.

Table 40.
Energy Efficiency Sector – Employment by Detailed Technology Application and Industry, Q2 2019⁶⁹

	Total	Construction	Manu- facturing	Wholesale Trade	Professional Services	Other Services
ENERGY STAR Certified Appliances (not including HVAC)	142,272	73,135	13,234	12,325	39,840	3,738
ENERGY STAR Certified Heating, Ventilation, and Cooling (HVAC)	282,028	198,478	39,262	18,594	22,488	3,206
Other high efficiency HVAC that are out of scope for ENERGY STAR certification ⁷⁰	154,263	81,775	36,523	8,464	25,975	1,527
Traditional HVAC goods, control systems, and services	598,375	330,269	32,649	56,743	161,872	16,843
ENERGY STAR certified water heaters	21,685	15,451	368	1,433	4,340	92
ENERGY STAR Certified Electronics ⁷¹	6,969	154	3,912	1,522	267	1,114
ENERGY STAR Certified Windows, Doors and Skylights	26,448	14,449	1,234	2,328	8,050	386
ENERGY STAR Certified Roofing	34,982	23,244	7,301	1,218	2,910	309
ENERGY STAR Certified Insulation	118,101	104,286	7,511	1,110	4,988	207
Air sealing	72,191	39,107	2,469	17,458	12,899	258
ENERGY STAR Certified Commercial Food Service Equipment	29,864	14,732	4,411	948	9,025	748
ENERGY STAR Certified Data Center Equipment	10,949	1,539	3,912	3,045	227	2,228
ENERGY STAR Certified LED lighting	153,293	62,767	13,917	17,676	55,876	3,056
Other LED, CFL, and efficient lighting	227,007	124,739	37,113	23,305	41,277	573
Other renewable heating and cooling ⁷²	108,313	69,033	7,370	6,687	24,488	736
Advanced building materials/insulation	114,886	28,898	56,782	1,164	26,754	1,288
Recycled building materials	83,862	47,673	12,112	2,808	18,203	3,066
Reduced water consumption products and appliances	93,361	59,213	6,055	5,430	21,269	1,394
Other	100,044	34,502	39,119	4,567	18,514	3,342
TOTAL	2,378,893	1,323,444	325,255	186,824	499,261	44,108

⁶⁹ Column and row totals may differ due to rounding

⁷⁰ Includes indirect evaporative coolers, air to water heat pumps, energy recovery systems, etc.

⁷¹ Includes TVs, telephones, audio/video, etc.

⁷² Includes solar thermal, geothermal, biomass, heat pumps, etc.

Hiring Difficulty

- **91 percent of construction employers in energy efficiency** reported that it was somewhat difficult or very difficult to hire new employees in 2019 (with 45 percent reporting that it was very difficult, decreasing from 52 percent in 2018).
- **80 percent of professional and business services employers in energy efficiency** reported that it was either somewhat difficult or very difficult to hire new employees.
- **87 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 2018 and predicted growth of 71,000 new jobs in 2020, energy efficiency employers have identified below the occupations that each industry sector is having the greatest difficulty in filling.

Table 41.
Energy Efficiency Sector – Reported Occupations with Hiring Difficulty by Industry, Q4 2019

Construction	Manufacturing	Wholesale Trade, Distribution, and Transport	Professional and Business Services
Installation workers (49%)	Manufacturing or production positions (41%)	Sales, marketing, or customer service representatives (50%)	Engineers/scientists (35%)
Technician or mechanical support (48%)	Engineers/scientists (35%)	Technician or mechanical support (33%)	Management (directors, supervisors, vice presidents) (26%)
Sales, marketing, or customer service representatives (14%)	Sales, marketing, or customer service representatives (29%)	Management (directors, supervisors, vice presidents) (25%)	Inspectors (23%)

SPOTLIGHT

Marc Norberg

Assistant to the General
President of SMART



The Sheet Metal, Air, Rail, and Transportation Workers' Union (SMART) operates 160 training centers for its apprentices throughout the United States. Some 10,000 apprentices are learning new energy efficiency installation techniques, building energy management software, and other technologies on any given day. Marc Norberg is the Assistant to the General President of SMART.

“Every one of our construction members does 100 percent energy efficiency work. That’s what we do. Candidates for apprenticeships are put on a list. and when an employer needs someone he contacts the Joint Apprenticeship Program. In contracts there are provisions on the ratio of journeymen to apprentices. There is a wide range of utilization. We also keep an extensive list of journeymen for upgrade training. In some contracts there are requirements to upgrade. Ultimately, the best way to keep employed is to keep skills current.

“We are constantly evaluating new technologies, especially through our National Energy Management Institute (NEMI), a labor-management collaborative trust that is always looking over the horizon. NEMI also helps us think through the role of automation in our industry. For instance, we’ve developed a program on modularization. Instead of installing an entire system, piece by piece, on site, we engage in “bundling” or “racking” in the shop which makes jobs safer and more efficient. NEMI is also training our apprentices and journeymen in lean manufacturing.

Today, our apprentices are generally older, in their late 20s. Often times they have a college education but haven’t been able to get employment in their preferred degree. Our union is also much more diverse. Forty years ago, we were a white man’s country club, but today we also do a lot of recruitment of women.

“We have noticed today that our apprentices are generally older, in their late 20’s. Often times they have a college education but haven’t been able to get employment in their preferred degree. Our union is also much more diverse. 40 years ago, we were a white man’s country club, but today we also do a lot of recruitment of women.

“We are on the cutting edge of “smart cities” and how to use data management in pursuit of energy efficiency. We are joined at the hip with companies like Johnson Controls in learning how to install and manage software systems for energy management.”

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 28 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 70,000 individual product models. Identifying the jobs that produce and install these products is one of the key tasks of the USEER survey. This year, the 2020 USEER provides more specific data on the scope of these jobs.

ENERGY STAR also administers three additional programs for commercial buildings, and apartments. While the USEER survey does not specifically calculate total jobs associated with these programs, it does identify their construction and maintenance employment. 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. However, in the 2020 USEER we did provide information about a wider range of ENERGY STAR products.

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.⁷³ 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. Note also that the USEER EE numbers do not include the direct employees of utility companies who supervise, design, or implement internal efficiency programs. Please see our special survey on page XX for an accounting of these employees. Finally, the USEER 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 Energy Productivity and Economic Prosperity Index for more information on manufacturing process efficiency.⁷⁴

⁷³ Estimates do not include retail employment.

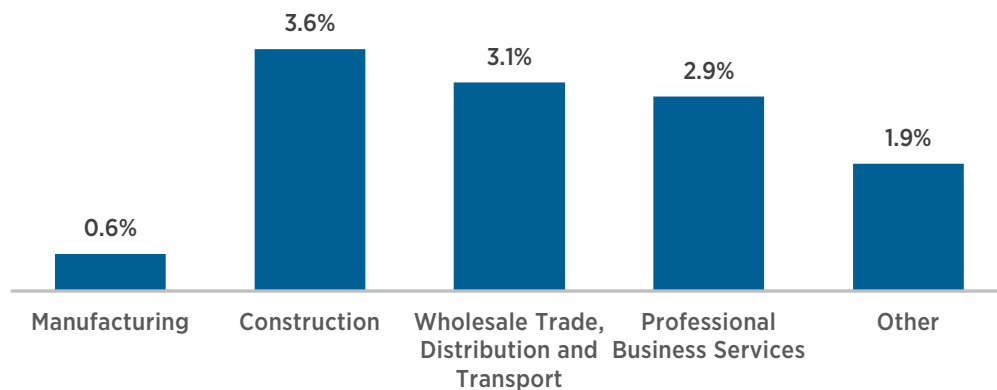
⁷⁴ Kornelis Blok, Paul Hofheinz, and John Kerkoven, *The 2015 Energy Productivity and Economic Prosperity Index* (Brussels: Lisbon Council for Economic Competitiveness and Social Renewal, 2015), <https://lisboncouncil.net/publication/publication/121.html>.

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.

Energy Efficiency employment grew in 2019 by just over 2 percent from 2018. The 2020 USEER has identified approximately 2.38 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 2019, as defined earlier in this report. Over 826,000 of these employees were directly involved in the manufacture, installation, design, wholesale distribution or other services of ENERGY STAR products. Later in this chapter, 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 2020 of 3 percent. Construction employers, the largest sector, expect Energy Efficiency job growth of 3.6 percent by the end of 2020.

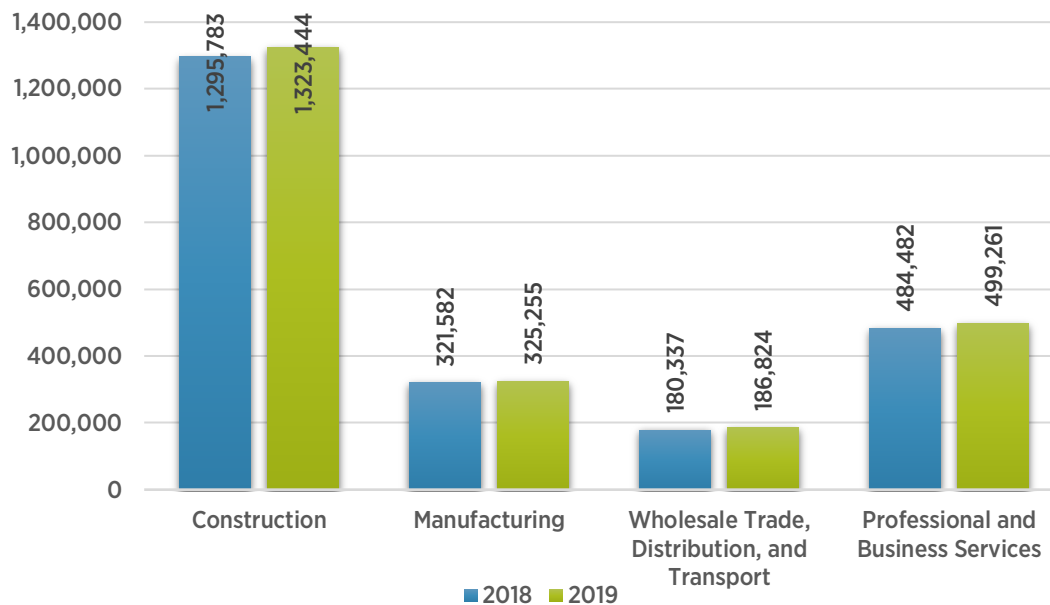
Figure 90.
Energy Efficiency Sector – Expected Employment Growth by Major Industry (Q4 2019 – Q4 2020)



The majority, 56 percent, of Energy Efficiency employees worked for firms in the construction sector in 2019, installing or servicing Energy Efficiency goods or performing Energy Efficiency related services.⁷⁵ More than one in five workers in the Energy Efficiency sector worked in professional and business services. The manufacture of Energy Efficiency products represented a sizable portion of employment in 2019, with 14 percent of the total Energy Efficiency workforce. This represents an increase of 1 percent from 2018. ENERGY STAR product manufacturing employed 95,062 of the 325,255 Energy Efficiency manufacturing work force, or a little less than 30 percent.

⁷⁵ 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.

Figure 91.
Energy Efficiency Sector – Employment by Major Industry Sectors, Q2 2019



The 2020 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 4.1 million Americans across several different sectors.⁷⁶

The manufacturer and sales of certified ENERGY STAR products in 2018 represented a market value of more than \$100 billion and included more than 600 million certified products, of which 300 million were light bulbs. In addition to the volume of goods, the variety of ENERGY STAR products contributes to the relevance across a broad number of industries, with product categories including HVAC, lighting, building products, appliances, commercial food service equipment, lighting, and others.⁷⁷ A table of products covered by the U.S. Environmental Protection Agency (EPA) ENERGY STAR program is available in Appendix C.⁷⁸

⁷⁶ 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 Energy Efficiency 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 Energy Efficiency products—they could be general retailers as well such as big box stores that sell wide varieties of items.

⁷⁷ 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.

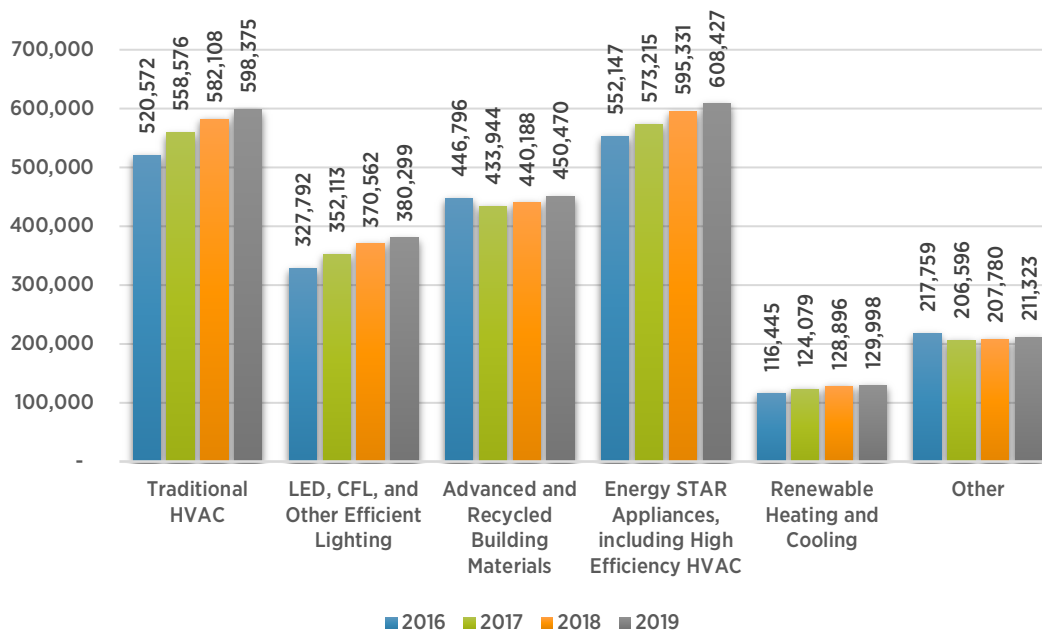
⁷⁸ EPA, *ENERGY STAR Unit Shipment and Market Penetration Report: Calendar Year 2018 Summary* (Washington, D.C., 2019), <https://www.energystar.gov/sites/default/files/asset/document/2018%20Unit%20Shipment%20Data%20Summary%20Report%20.pdf>.

Energy Efficiency Employment by Detailed Technology Application

To illustrate historic trends in Energy Efficiency employment by major technology, we have distributed a number of ENERGY STAR products into broader categories. For instance, ENERGY STAR LED lighting is included with Other LED Lighting, CFL's and Other Efficient Lighting. ENERGY STAR certified building products and insulation are included with Advanced and Recycled Building Products.

As depicted in Figure 9291, ENERGY STAR appliances, including high efficiency heating and cooling equipment, was the largest category of employment in the Energy Efficiency sector, employing 26 percent of the Energy Efficiency workforce in 2019. These workers all spend the majority of their time working with these technologies. The second largest category of employment was the traditional HVAC industry, with a quarter of the sector's employment in 2019. 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.⁸¹

Figure 92.
Energy Efficiency Sector - Employment by Detailed Technology Application (Q2 2016 - Q2 2019)



⁸¹ 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).

The third largest category of employment was advanced building materials, followed by energy efficient lighting. The Other category in Figure 9291 includes reduced water consumption products and appliances.

Construction firms working in the Energy Efficiency sector reported that 78 percent of their employees spend at least 50 percent of their time on energy efficiency-related work. This is about even with the 79 percent reported in 2018, and a slight decline from 80 percent in 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 2019. Advanced and recycled building materials and insulation technologies also supported a significant amount of construction employment—nearly 258,100 jobs.
- The two largest detailed technologies in the Energy Efficiency manufacturing sector are high efficiency heating and cooling equipment and advanced and recycled building products.
- Three in ten workers in the wholesale trade industry and nearly one-third in professional and business services were mostly working with traditional HVAC goods.

Table 42.
Energy Efficiency Sector – Employment by Detailed Technology Application and Industry, Q2 2019

	Total	Construction	Manufacturing	Wholesale Trade	Professional Services	Other Services
ENERGY STAR Certified Appliances (not including HVAC)	142,272	73,135	13,234	12,325	39,840	3,738
ENERGY STAR Certified Heating, Ventilation, and Cooling (HVAC)	282,028	198,478	39,262	18,594	22,488	3,206
Other high efficiency HVAC that are out of scope for ENERGY STAR certification ⁸³	154,263	81,775	36,523	8,464	25,975	1,527
Traditional HVAC goods, control systems, and services	598,375	330,269	32,649	56,743	161,872	16,843
ENERGY STAR certified water heaters	21,685	15,451	368	1,433	4,340	92
ENERGY STAR Certified Electronics ⁸⁵	6,969	154	3,912	1,522	267	1,114
ENERGY STAR Certified Windows, Doors and Skylights	26,448	14,449	1,234	2,328	8,050	386
ENERGY STAR Certified Roofing	34,982	23,244	7,301	1,218	2,910	309
ENERGY STAR Certified Insulation	118,101	104,286	7,511	1,110	4,988	207
Air sealing	72,191	39,107	2,469	17,458	12,899	258
ENERGY STAR Certified Commercial Food Service Equipment	29,864	14,732	4,411	948	9,025	748
ENERGY STAR Certified Data Center Equipment	10,949	1,539	3,912	3,045	227	2,228
ENERGY STAR Certified LED lighting	153,293	62,767	13,917	17,676	55,876	3,056
Other LED, CFL, and efficient lighting	227,007	124,739	37,113	23,305	41,277	573
Other renewable heating and cooling ⁸⁷	108,313	69,033	7,370	6,687	24,488	736
Advanced building materials/insulation	114,886	28,898	56,782	1,164	26,754	1,288
Recycled building materials	83,862	47,673	12,112	2,808	18,203	3,066
Reduced water consumption products and appliances	93,361	59,213	6,055	5,430	21,269	1,394
Other	100,044	34,502	39,119	4,567	18,514	3,342

⁸³ Includes indirect evaporative coolers, air to water heat pumps, energy recovery systems, etc.

⁸⁵ Includes TVs, telephones, audio/video, etc.

⁸⁷ Includes solar thermal, geothermal, biomass, heat pumps, etc.

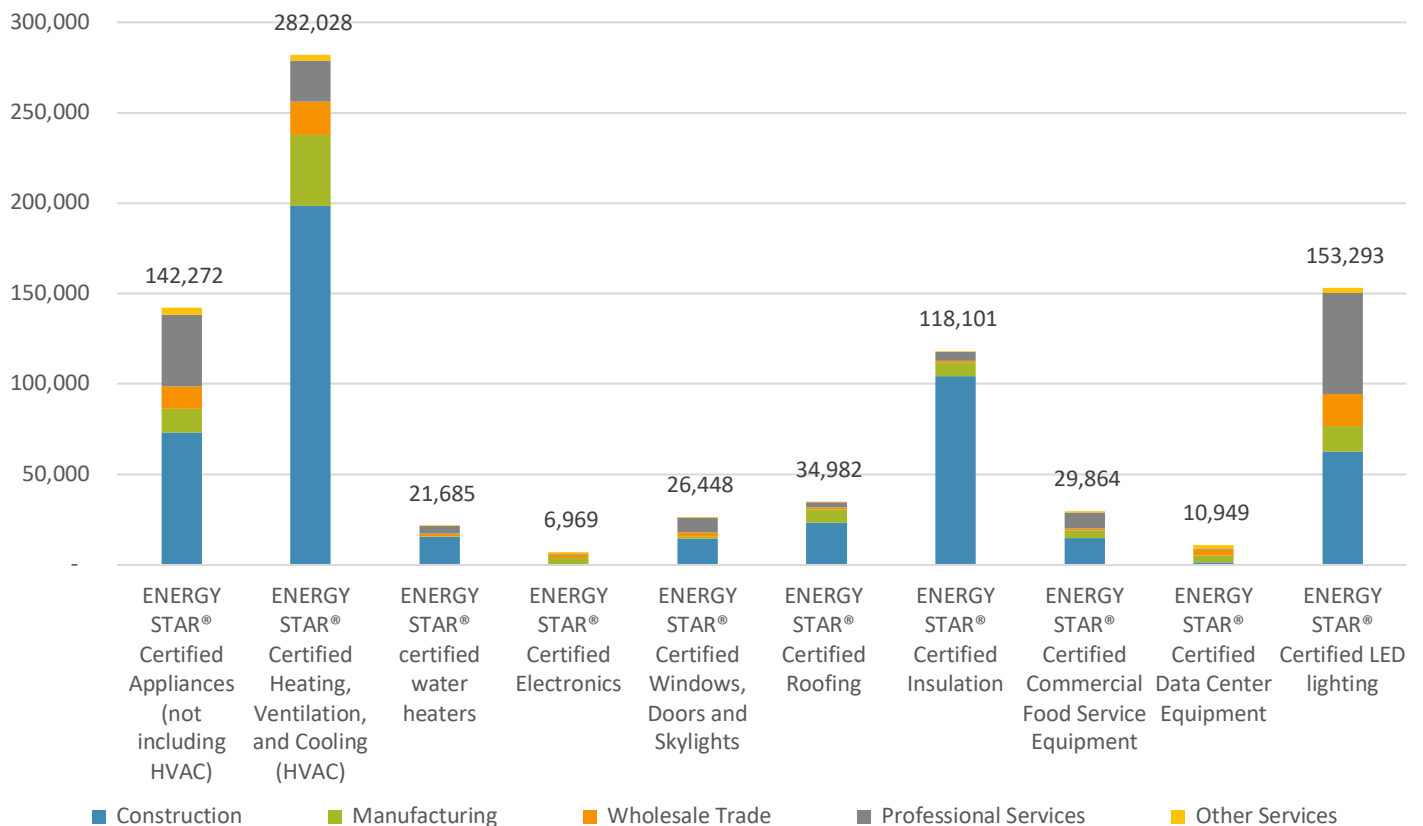
ENERGY STAR Jobs Profile

The 2020 USEER includes a more detailed analysis of the jobs associated with producing ENERGY STAR products and services than in previous years. Spread across multiple technologies in the manufacture, installation, design, wholesale distribution, and other services, the USEER finds that the ENERGY STAR program was responsible for over 826,500 American jobs in 2019.

The additional detailed technologies included in this edition of the USEER are ENERGY STAR-certified residential electronics, roofing, windows, doors and skylights, insulation, LED lighting, commercial food service equipment, water heaters, and data center equipment. ENERGY STAR-certified appliances and HVAC systems were already counted separately.

In addition, the 2020 USEER identified up to 486,300 construction workers who were engaged in the ENERGY STAR-certified residential, industrial, and commercial building programs. Figure 9392 below details the ten ENERGY STAR technologies and their industrial sectors.

Figure 93.
Energy Efficiency Sector – Employment by ENERGY STAR® Detailed Technology Applications and Industry, Q2 2019



ENERGY STAR Commercial, Industrial, and Residential Buildings and Homes

According to the EPA, ENERGY STAR is “the government-backed symbol for energy efficiency, providing simple, credible, and unbiased information that consumers and businesses rely on to make well-informed decisions.” ENERGY STAR maintains certification programs for energy-efficient buildings, industrial plants, homes, and apartments.

Since 1995, ENERGY STAR’s Residential New Construction program has established requirements for the certification of energy-efficient homes and apartments. ENERGY STAR certified homes are at least 10% more energy efficient than homes built to code and achieve a 20% improvement on average. Third-party Home Energy Rating Companies provide independent verification that a home or apartment meetings all applicable ENERGY STAR program requirements.

ENERGY STAR for Commercial Buildings relies on tracking of existing building performance. For eligible buildings, the online ENERGY STAR Portfolio Manager will assist in calculating a 1-100 ENERGY STAR score for a facility’s energy performance. Buildings must maintain a minimum score of 75 to receive ENERGY STAR certification.

In addition to the certification available for existing buildings, during the building design and construction process, a developer can submit their designs for scoring based on energy modeling software, after which they will receive a “Designed to Earn the ENERGY STAR” recognition or, alternatively, feedback on how to improve energy performance. Then, after construction is completed and the building is operating, a facility’s owner/manager has the option to seek ENERGY STAR certification on the basis of its operational energy performance. The responsible party must confirm after a 12-month period that energy performance standards were maintained as expected to earn its first ENERGY STAR certification.

31 percent of construction firms who perform Energy Efficiency work are engaged in the construction of ENERGY STAR certified new home construction. Approximately 46 percent of the workers at these firms, or about 231,300 employees, work on ENERGY STAR certified new home construction. This represents 3 percent of all construction employment in the US.⁸⁸

36 percent of construction firms who perform Energy Efficiency work are engaged in ENERGY STAR certified buildings and industrial plants. At these construction firms, nearly 44 percent of employees work on ENERGY STAR certified buildings and plants, representing more than 255,000 jobs. This

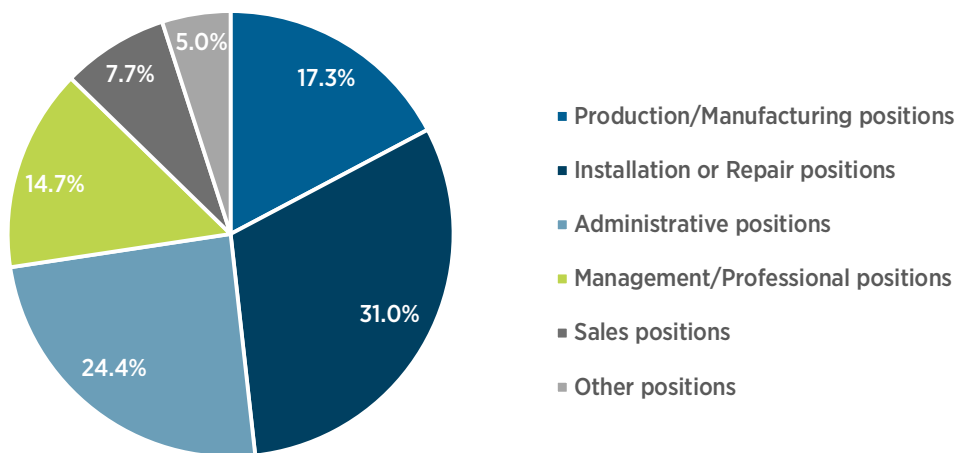
⁸⁸ BLS, Quarterly Census of Employment and Wages. NAICS 23. 2019, Q2, all ownerships June employment.

represents more than 3 percent of all construction employment in the United States.⁹⁰

Energy Efficiency – Workforce Characteristics

- 31 percent of all workers in Energy Efficiency were employed in installation or repair positions in 2019, followed by administrative positions (over 24 percent).

Figure 94.
Energy Efficiency Sector – Occupational Distribution, Q4 2019



- 91 percent of employers in construction, the largest sector in Energy Efficiency, reported finding qualified job applicants as somewhat or very difficult. However, those reporting it was very difficult declined from 51 percent in 2018 to 45 percent in 2019.
- 80 percent of professional and business service employers reported that it was somewhat or very difficult to hire new employees.
- Manufacturers in Energy Efficiency reported 87 percent combined difficulty in hiring.

⁹⁰ Ibid.

Figure 96.
Energy Efficiency Sector - Hiring Difficulty by Industry, Q4 2019

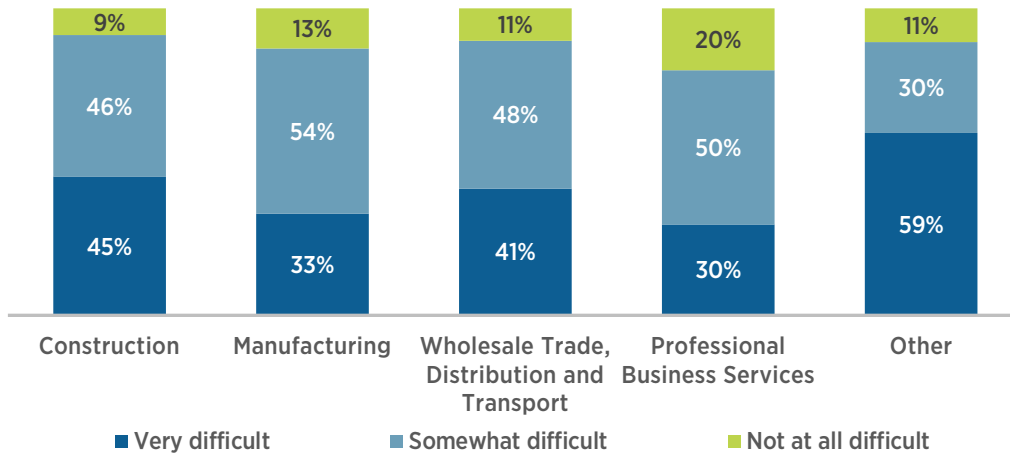
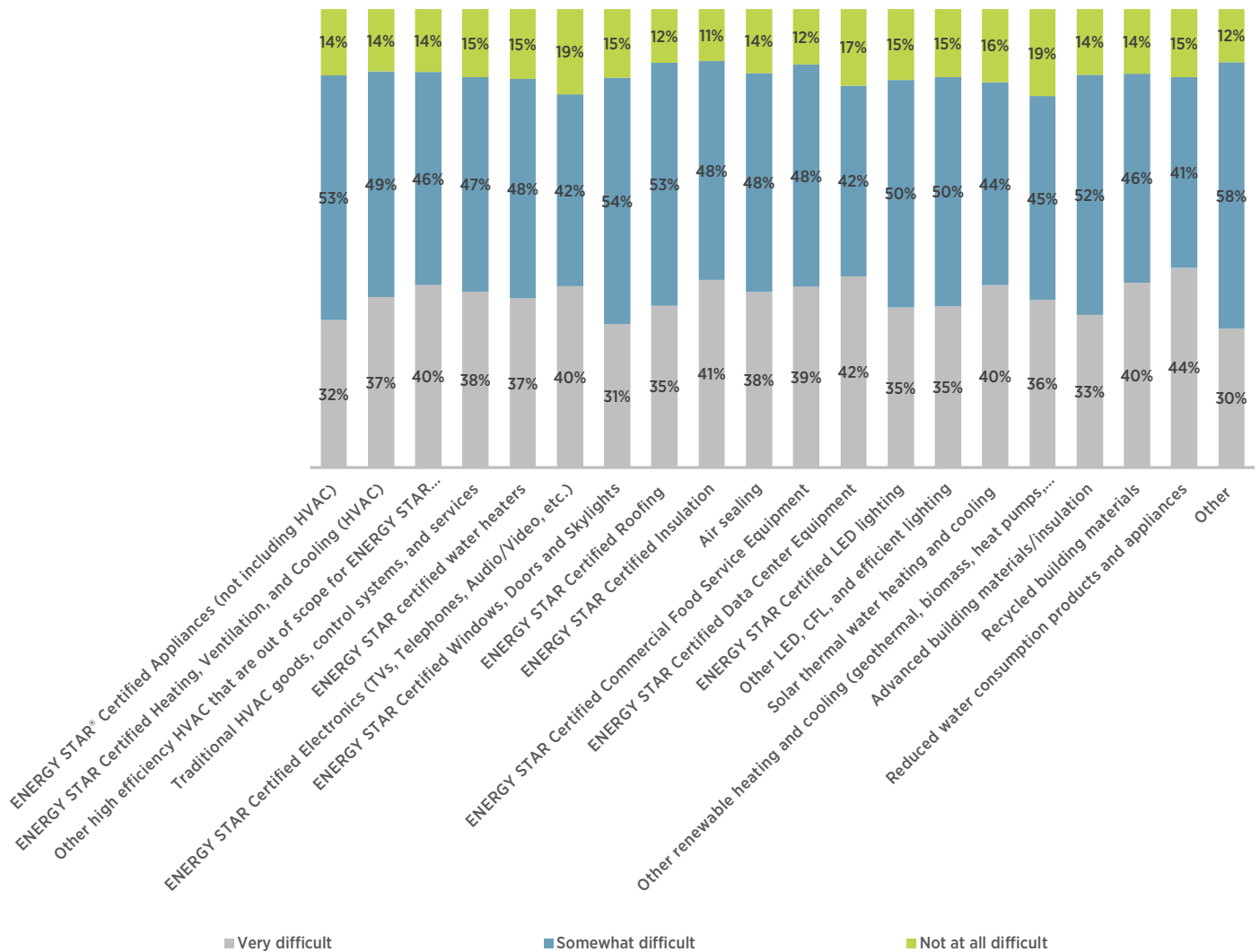


Figure 95.
Energy Efficiency Sector - Hiring Difficulty by Technology, Q4 2019



Regardless of industry sector, employers in Energy Efficiency all cited lack of experience, training, or technical skills as the primary reason for hiring difficulty.

Table 43.
Energy Efficiency Sector – Reasons for Hiring Difficulty by Industry, Q4 2019

Construction	Manufacturing	Wholesale Trade, Distribution, and Transport	Professional and Business Services
Lack of experience, training, or technical skills (60%)	Lack of experience, training, or technical skills (48%)	Lack of experience, training, or technical skills (58%)	Lack of experience, training, or technical skills (47%)
Insufficient non-technical skills (work ethic, dependability, critical thinking) (26%)	Difficulty finding industry-specific knowledge, skills, and interest (38%)	Insufficient non-technical skills (42%)	Difficulty finding industry-specific knowledge, skills, and interest (28%)
Competition/ small applicant pool (25%)	Cannot provide competitive wages (29%)	Competition/ small applicant pool (25%)	Competition/ small applicant pool (26%)

- Construction employers in Energy Efficiency identified installation workers and technicians or mechanical support as the most difficult to hire.
- Professional and business services identified engineers and scientists.

Table 44.
Energy Efficiency – Reported Occupations with Hiring Difficulty by Industry, Q4 2019

Construction	Manufacturing	Wholesale Trade, Distribution, and Transport	Professional and Business Services
Installation workers (49%)	Manufacturing or production positions (41%)	Sales, marketing, or customer service representatives (50%)	Engineers/scientists (35%)
Technician or mechanical support (48%)	Engineers/scientists (35%)	Technician or mechanical support (33%)	Management (directors, supervisors, vice presidents) (26%)
Sales, marketing, or customer service representatives (14%)	Sales, marketing, or customer service representatives (29%)	Management (directors, supervisors, vice presidents) (25%)	Inspectors (23%)

Utility Energy Efficiency Programs

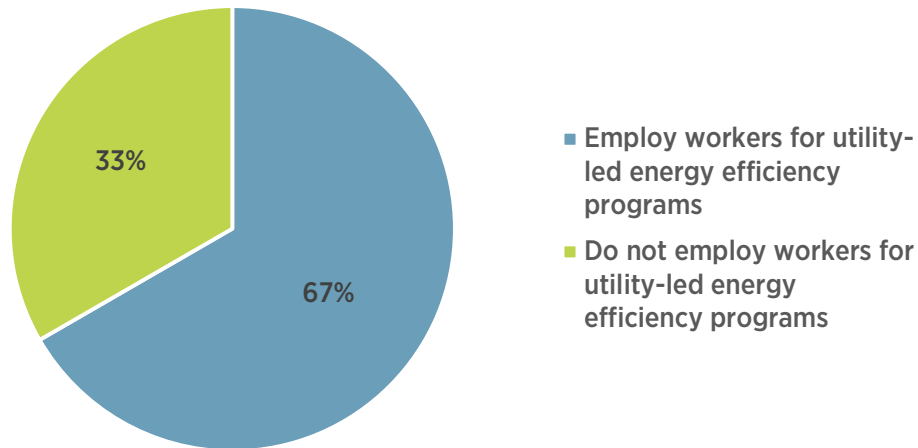
Many electric and gas utilities in the United States sponsor or manage residential, commercial, and industrial energy efficiency programs. However, the direct employees of these utilities who administer their programs are not included in the USEER Energy Efficiency job numbers. Instead, they are included in the numbers reported for “utility” employees in either the Electric Power Generation or TDS sectors. This year, the 2020 USEER performed an additional survey to determine how many of the 601,200 employees working directly for utilities are engaged in delivering energy efficiency services through these programs.

Residential programs often include free or low-cost home energy audits in which utility-provided energy specialists analyze home energy performance and provide suggestions for improvement. Sometimes these auditors work directly for the utility; in other situations, they are employed by a utility-funded contractor. In some cases, utilities run call centers to encourage participation, while in others they might also employ a contractor. Utilities also provide rebates or financial incentives for property owners to take specific energy efficiency measures, including upgrades to HVAC systems, the installation of energy-efficient lighting and appliances, or weatherization. Commercial and industrial energy efficiency programs are also supported by gas and electric utilities. Again, these programs can be run internally by the utilities or in partnership with utility-funded contractors who provide engineering, financial, and regulatory support.

Two-thirds of electric and gas utilities (NAICS 2211) in the United States employ workers who administer, manage, evaluate, or otherwise support utility-led energy efficiency programs, rebates, and other activities. The 2020 USEER survey determined that approximately 20,700 employees, who work directly for these utilities are engaged in this energy efficiency work.⁹¹ This represents 3.4 percent of total employment in the electric and natural gas utility sector. However, this figure does not include those employees involved in utility-funded energy efficiency programs who work for contractors. Those employees are included in the overall energy efficiency numbers and are classified according to their primary industrial sector and detailed technology.

⁹¹ NAICS 2211

Figure 97.
Utilities that Employ Workers who Administer, Manage, Evaluate, or Otherwise Work Directly on Energy Efficiency Programs, Rebates, and Other Activities



- In 2019, women represented 25 percent of the workforce in the Energy Efficiency Sector.
- Overall, the Energy Efficiency sector is slightly more diverse than the national average at 23 percent. However, there are fewer Black or African American workers and slightly fewer Hispanic or Latino workers compared to the national workforce average.
- Unionization rates in the Energy Efficiency sector in 2019, at 10 percent, were significantly higher than the national private sector average.

Table 45.
Energy Efficiency Sector – Demographics, Q4 2019

Demographic	Employees	Percent of Sector	National Workforce Averages
Male	1,795,634	75%	53%
Female	583,258	25%	47%
Hispanic or Latino	367,790	15%	18%
Not Hispanic or Latino	2,011,103	85%	82%
American Indian or Alaska Native	32,334	1%	>1%
Asian	135,445	6%	6%
Black or African American	189,413	8%	12%
Native Hawaiian or other Pacific Islander	26,461	1%	>1%
White	1,835,594	77%	78%
Two or more races	159,647	7%	2%
Veterans	224,223	9%	6%
55 and over	320,884	13%	23%
Union	241,353	10%	6%

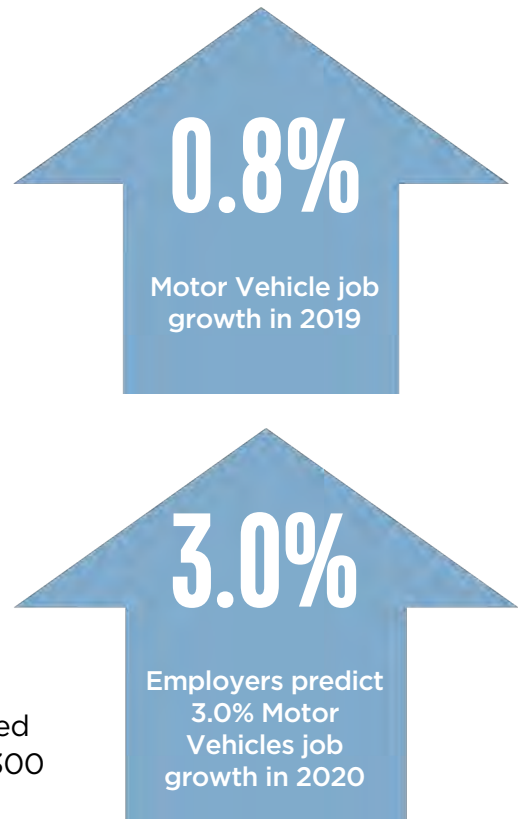


MOTOR VEHICLES + COMPONENT PARTS

Though not considered a sector of the Traditional Energy industry, the Motor Vehicles and Component Parts sector,⁹² 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

- 2019 Overall Job Growth.** The Motor Vehicles and Component Parts sector employed 2,556,492 Americans in 2019, adding more than 20,000 workers to the number employed in 2018. This figure excludes dealerships and retailers, which employed more than two million additional workers.
- Manufacturing stable.** Manufacturing employment, the largest industry sector in Motor Vehicles and Component Parts, contracted only slightly from 1,010,598 to 1,007,138 workers in 2019.
- Alternative fuels vehicles and hybrids.** Within the overall total for the sector, alternative fuels vehicles and hybrids employed 266,384 workers in 2019, a decline of over 5,300 jobs.⁹³
- Fuel economy.** Nearly 494,000 employees (44 percent), an increase of 8,000, work in the component parts segment of the sector with products that contribute to fuel economy.
- 2020 Expectations.** Motor Vehicles and Component Parts employers anticipate 3.0 percent growth in 2020.



⁹² 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.

⁹³ Alternative fuels vehicles numbers have been revised for 2017 and 2018. See Table 4747 for complete information.

Employment Snapshot

Figure 98.
Motor Vehicle and Component Parts Sector -
Employment by Industry, 2018-2019

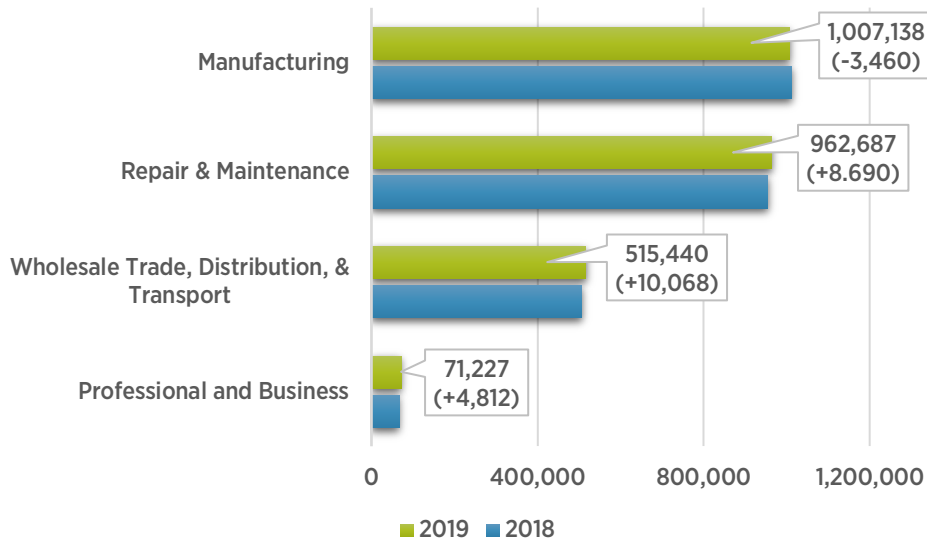
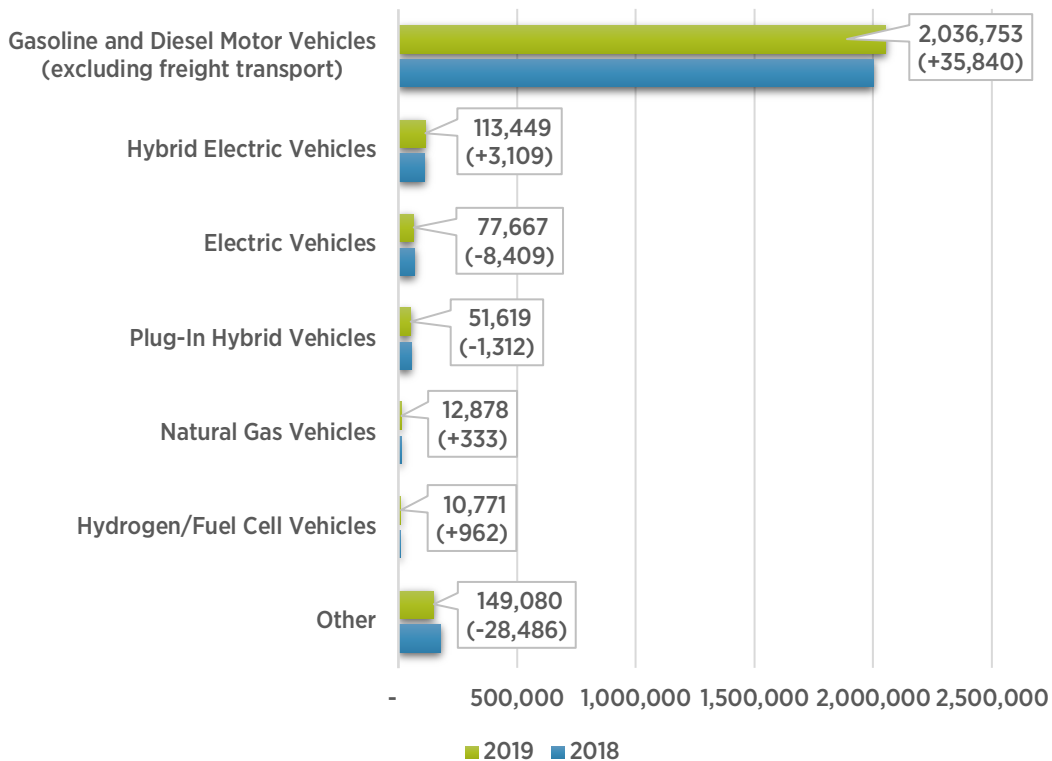


Figure 99.
Motor Vehicles and Component Parts Sector -
Employment by Detailed Technology, 2018-2019

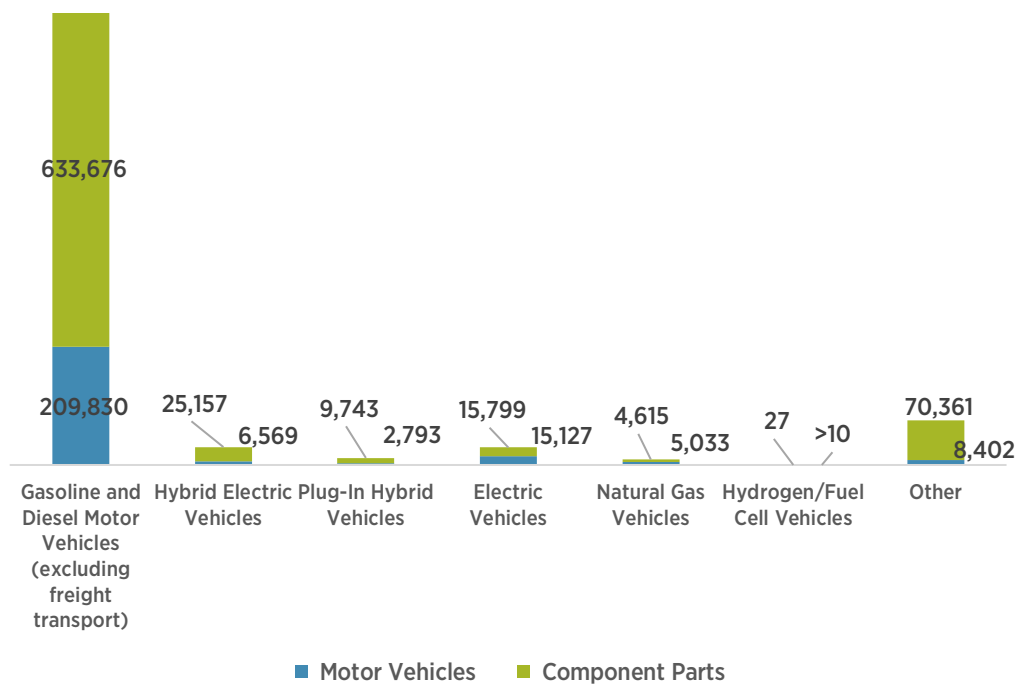


Alternative Fuels Vehicles and Hybrids

- 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 266,384 employees) worked on alternative fuels vehicles.⁹⁴
- 84 percent of employees in the sector worked with gasoline and diesel fueled motor vehicles.

Figure 100.

Motor Vehicles and Component Parts Sector - Manufacturing Employment by Detailed Technology Application, Q2 2019



- Figure 100 shows the division of manufacturing employment in each technology between component parts and other occupations.⁹⁵
- The domestic manufacture of alternative fuels vehicles and hybrids grew between 2018 and 2019 in most technologies, with hybrids adding almost 3,000 manufacturing jobs and plug-in and all electric vehicles adding 6,200. However, overall employment in plug-in and all electric vehicles declined by almost 4,900.
- Domestic sales of electric and plug-in vehicles dropped by 9 percent in 2019, according to Inside EV.⁹⁶

⁹⁴ Percentage is taken from Motor Vehicle employment exclusive of commodity flow employment.

⁹⁵ 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.

⁹⁶ Steven Loveday, "Final UPDATE: Quarterly Plug-In EV Sales Scorecard," *InsideEVs*, January 17, 2020, <https://insideevs.com/news/343998/monthly-plug-in-ev-sales-scorecard/>.

Hiring Difficulty

- **Six in ten repair and maintenance employers** in motor vehicles reported that it was very difficult to hire new employees.
- **Hiring difficulty eased for manufacturing employers in motor vehicles** with two-thirds reporting that it was somewhat difficult or very difficult to hire new employees, down from 78 percent in 2018.
- **50 percent of professional and business services employers in motor vehicles** reported that it was not at all difficult to hire new employees, up from 24 percent.

Highest-Demand Occupations in Motor Vehicles

With less than 1 percent growth in 2019 and predicted growth of almost 77,000 new jobs in 2020, motor vehicle employers have identified below the occupations that each sector is having the greatest difficulty in filling.

Table 46.
Motor Vehicles and Component Parts – Reported Occupations with Hiring Difficulty by Industry, Q4 2019

Manufacturing	Wholesale Trade, Distribution, and Transport	Professional and Business Services	Repair & Maintenance
Technician or mechanical support (40%)	Drivers/ dispatchers (50%)	Management (directors, supervisors, vice presidents) (67%)	Technician or mechanical support (80%)
Engineers/ scientists (40%)	Sales, marketing, or customer service representatives (33%)	Engineers/ scientists (67%)	Sales, marketing, or customer service representatives (33%)
Management (directors, supervisors, vice presidents) (20%)	Technician or mechanical support (17%)	Electrician/ construction workers (33%)	Administrative support (13%)

SPOTLIGHT

Josh Nassar

Legislative Director,
United Autoworkers

The United Autoworkers (UAW) is the primary union representing workers in the motor vehicles industry in the U.S. Josh Nassar is the Legislative Director of the UAW.



“There is clearly a transformation taking place in the vehicles’ industry, both in the U.S. and globally, with electrification. We think that it’s very important that these new jobs be located in the United States and that their content is also manufactured domestically. If automakers are given tax subsidy to help finance this transformation, there should be strings attached.

“Job quality is very important to maintaining the middle class in America. Over the last 15 years, pay in auto jobs overall (union and non-union) declined by 20%, when adjusted for inflation. That’s what was so important about last year’s auto negotiations. We need to improve job quality if we’re going to restore equality.

“African-Americans have been especially impacted by the decline in auto jobs which is another reason why it’s so important to manage the transformation of the industry in a way that restores job quality.

“If we provide government subsidies to an industry, then we need to have labor standards and real disclosure on how many of their workers are temporary, what the safety standards are, and where the supply chain jobs are located. We know that the loss of jobs in producing parts for internal combustion engines will be significant. That’s why it’s so important that the new jobs pay well and be located in America.

Job quality is very important to maintaining the middle class in America. Over the last 15 years, pay in auto jobs overall (union and non-union) declined by 20%, when adjusted for inflation. We need to improve job quality if we’re going to restore equality.

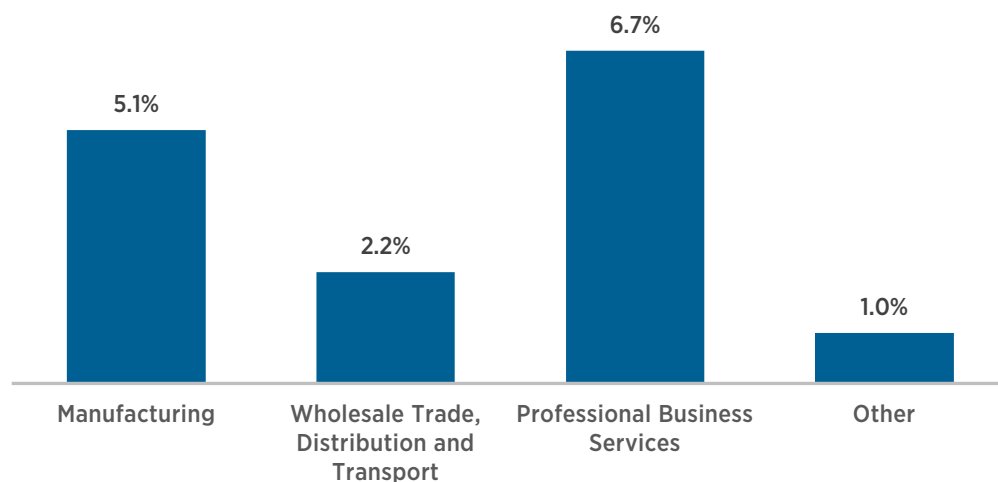
“On robotics, we’re not seeing a “cliff effect” as if there are no more workers and only robots. You still need people to manage the machines, especially when they break down. For a long period of time automation has cost jobs, but it’s not as if there aren’t any new jobs being created. What’s most important is that we have an industrial policy. Will we be ahead of the curve and will the jobs be in the U.S. or not?”

Introduction

Three NAICS subsectors⁹⁷ 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 1,007,132 workers in 2019. 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 515,440. Similarly, motor vehicle repair⁹⁸ 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 962,687 workers in 2019. Professional and business services are not motor vehicle-specific, but the USEER survey identified 71,227 workers who spent at least some time supporting the Motor Vehicles sector in 2019. Nearly two-thirds of these professional and business services employees spent the majority of their time supporting the Motor Vehicle and Component Parts sector.

Employers in the Motor Vehicles and Component Parts sector report projected growth of 3 percent through the end of 2020. Manufacturing, the largest industry in the Motor Vehicle and Component Parts sector, predicted 5 percent growth in 2020 or over 51,000 jobs. Professional and business services employers expect their workforce to grow nearly 7 percent.

Figure 101.
Motor Vehicles and Component Parts Sector – Expected Employment Growth by Industry (Q4 2019 – Q4 2020)



⁹⁸ 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.⁹⁹

Of the 2,452,217 Motor Vehicles and Component Parts jobs in 2019 (exclusive of the 104,275 employees that were involved in the transport of motor vehicles),¹⁰⁰ 10 percent, or 253,102, focused on alternative fuel vehicles and hybrids, while 84 percent worked with traditional gasoline- and diesel-fueled motor vehicles.

In addition, USEER data identified 44 percent of component parts manufacturing in 2019, or nearly 494,000 jobs, that produce parts that increase fuel economy in the United States. This represents nearly 8,000 additional jobs. 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 2020 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 807,500 workers nationwide in 2019. Approximately 539,000 of these jobs (67 percent) are found in aviation and aerospace industries.

⁹⁹ 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.

¹⁰⁰ Extrapolated employment from commodity flow data for motor vehicles.

Figure 103.
Motor Vehicles and Component Parts Sector – Employment by Detailed Technology, Q2 2019

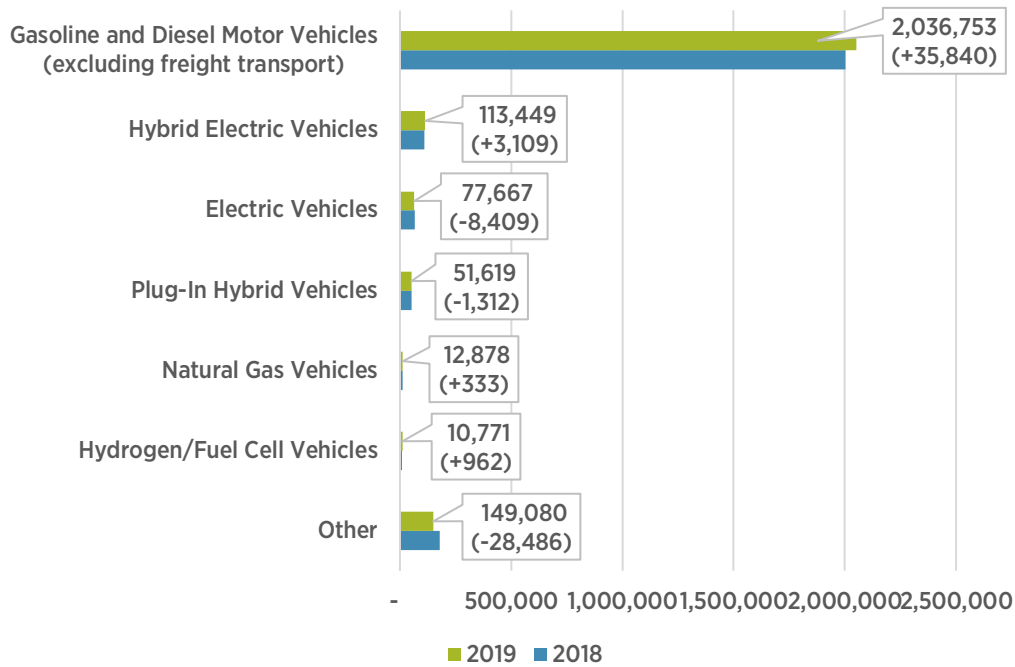
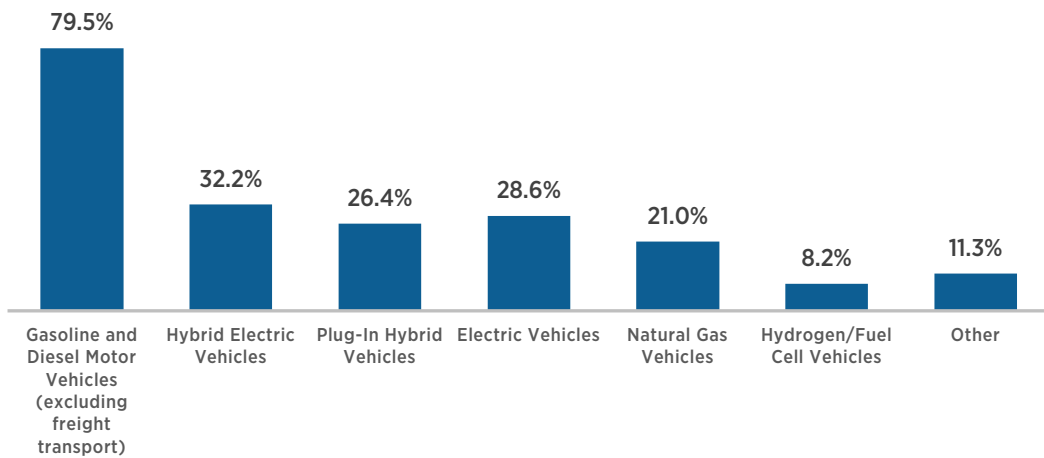


Figure 102.
Percentage of Component Parts Firms Offering Parts for Each Fuel Technology



As shown in Figure 102, eight out of ten Motor Vehicle parts firms offered parts in 2019 for gasoline and diesel motor vehicles, while nearly one-third offered component parts for hybrid electric vehicles. 101

¹⁰¹ Firms were permitted to offer multiple responses, percentages sum to over 100 percent.

Restatement of Alternative Fuels Vehicles Jobs, 2017-2019

As a result of additional research and interviews, the USEER has revised upward the number of jobs reported in alternative fuels vehicles in 2017 and 2018, as shown in Table 4747 below. The addition of over 13,000 jobs in 2017 means that the decline in alternative fuels vehicles that year was less than originally reported in the 2018 USEER, roughly 27,000. Similarly, the rebound in 2018 was slightly larger, adding 39,000 jobs, instead of the 34,000 reported in the 2019 USEER. All of these jobs were properly attributed to the Motor Vehicles sector but had not been identified as professional and business service positions for alternative fuels vehicle companies.

Table 47.
Original and Revised Employment Figures for Alternative Fuels Vehicles.

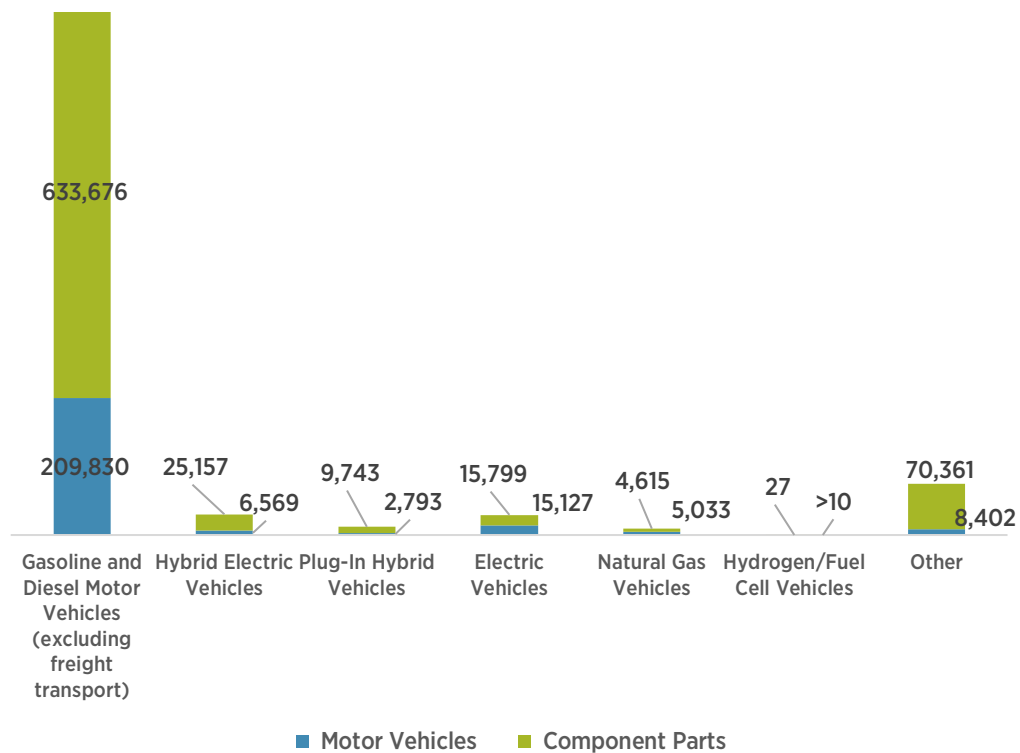
Original	2017	2018	2019
Gasoline and Diesel Motor Vehicles (excluding freight transport)	1,974,282	2,000,913	2,050,034
Hybrid Electric Vehicles	99,929	110,340	113,449
Electric Vehicles	56,329	67,973	64,386
Plug-In Hybrid Vehicles	40,308	52,931	51,619
Natural Gas Vehicles	12,338	12,545	12,878
Hydrogen/Fuel Cell Vehicles	10,758	9,809	10,771
Other	164,216	177,566	149,080
Freight Transport	104,584	104,304	104,275
TOTAL	2,462,743	2,536,382	2,556,492

Revised	2017	2018	2019
Gasoline and Diesel Motor Vehicles (excluding freight transport)	1,974,282	2,000,913	2,036,753
Hybrid Electric Vehicles	99,929	110,340	113,449
Electric Vehicles	69,250	86,076	77,667
Plug-In Hybrid Vehicles	40,308	52,931	51,619
Natural Gas Vehicles	12,338	12,545	12,878
Hydrogen/Fuel Cell Vehicles	10,758	9,809	10,771
Other	151,295	159,463	149,080
Freight Transport	104,584	104,304	104,275
TOTAL	2,462,743	2,536,382	2,556,492

Manufacturing

In 2019, gasoline and diesel motor vehicles represented 84 percent of all manufacturing employment in Motor Vehicles and Component Parts. Seven percent of manufacturing employment, or 69,863 jobs were focused on alternative fuel vehicles and hybrids, up 22 percent, more than 12,700 jobs, from 2018. Fewer than 40 employees were focused on hydrogen or fuel cell motor vehicle and component part manufacturing.

Figure 104.
Motor Vehicles and Component Parts Sector - Manufacturing Employment by Detailed Technology Application, Q2 2019



Component Parts and Fuel Economy

In 2019, nearly 494,000 Component Parts employees worked with parts that increase fuel economy for vehicles, up almost 8,000 from 2018. This represents 44 percent of the 1,126,365 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.

More than one-fifth (22 percent) of firms that were involved in the Component Parts segment in 2019 indicated that they derived all their revenue from products that increase fuel economy for these vehicles. In total, one-third of firms derive the majority (half or more) of their revenue from products that increase fuel economy.

Figure 105.
Fuel Economy Employment in Component Parts, Q2 2019

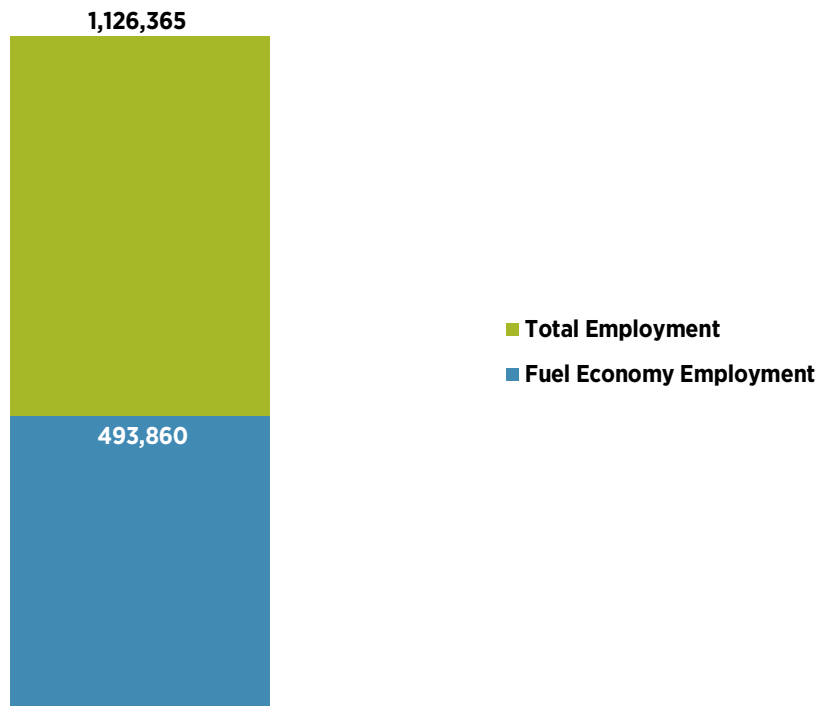
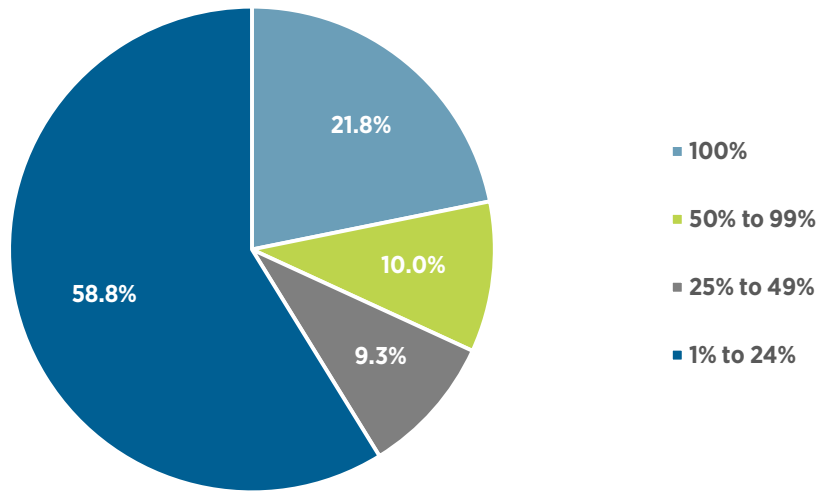
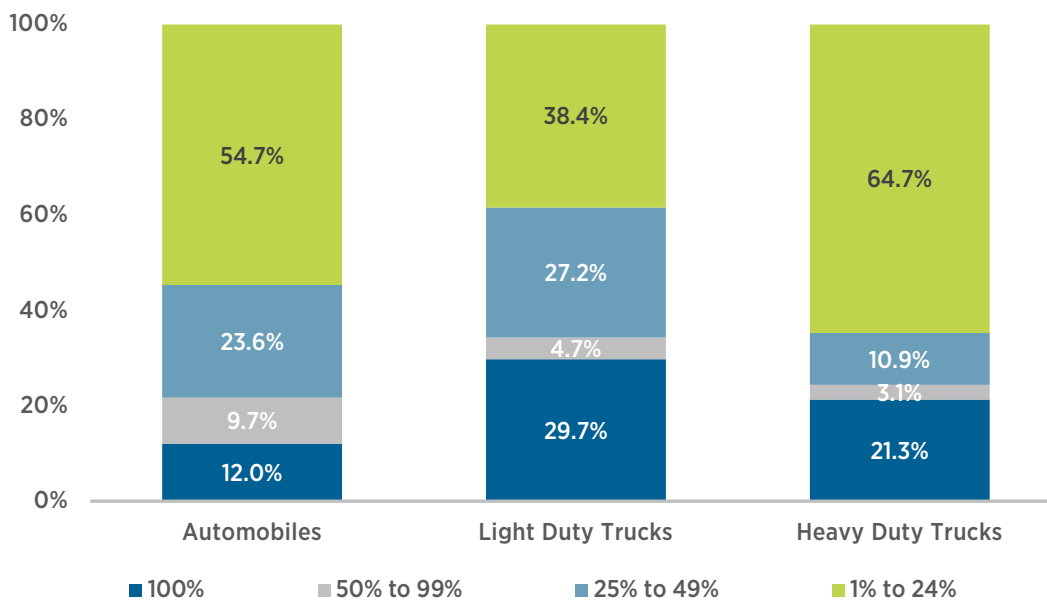


Figure 106.
Revenue Attributable to Products that Increase Fuel Economy



Among firms that primarily provide parts for light-duty trucks, 30 percent received all their revenue in 2019 from products that increase fuel economy. In comparison, among parts firms that are mainly focused on heavy-duty trucks, 21 percent received all their revenues from products that increase fuel economy. The comparable figure for automobile parts firms was 12 percent.

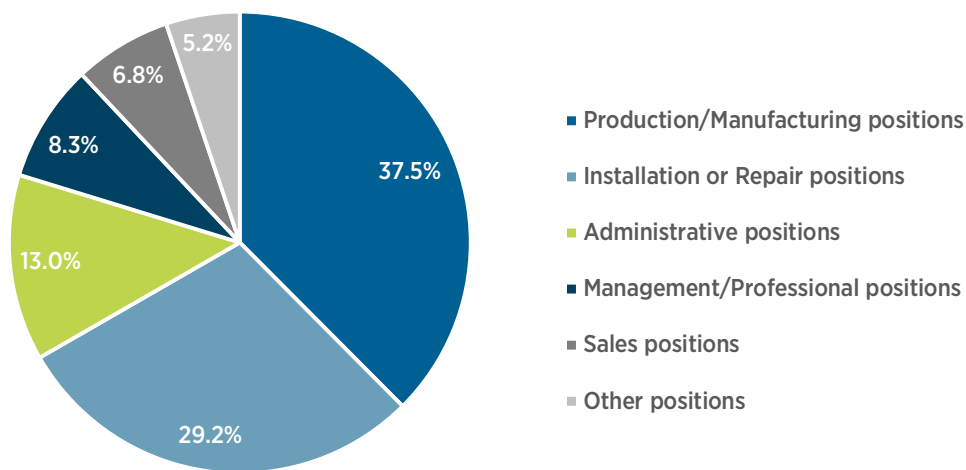
Figure 107.
Revenue Attributable to Products that Increase Fuel Economy by Primary Vehicle Type



Motor Vehicles and Component Parts – Workforce Characteristics

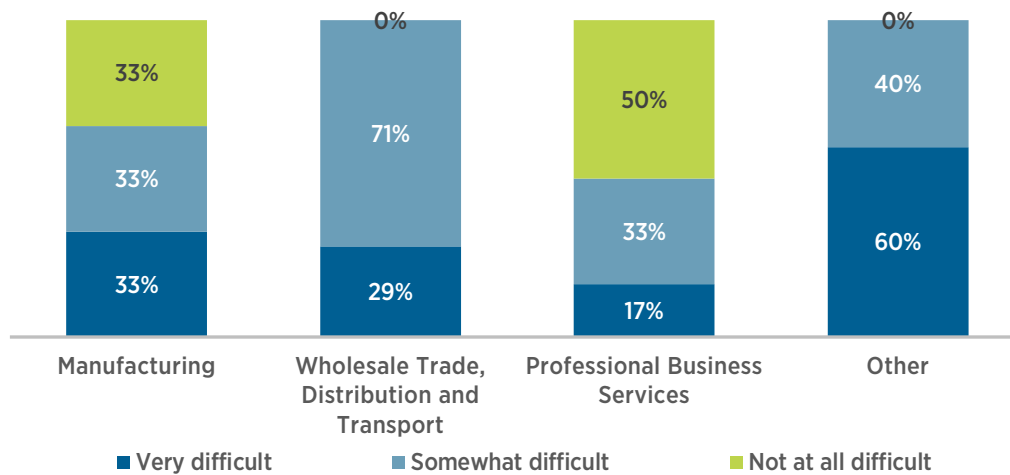
In 2019, over two-thirds of employees in Motor Vehicles and Component Parts were classified as workers in production/manufacturing positions (38 percent) or installation or repair positions (29 percent).

Figure 108.
Motor Vehicles and Component Parts Sector – Occupational Distribution, Q4 2019



- Hiring difficulty eased for manufacturing employers in motor vehicles with two-thirds reporting that it was somewhat difficult or very difficult to hire new employees, down from 78 percent in 2018.
- Six in ten repair and maintenance employers in motor vehicles reported that it was very difficult to hire new employees.
- 50 percent of professional and business services employers in motor vehicles reported that it was not at all difficult to hire new employees up from 24 percent.

Figure 109.
Motor Vehicles and Component Parts Sector – Hiring Difficulty by Industry, Q4 2019



- Lack of non-technical skills for potential employees was the number one reason for hiring difficulty as reported by manufacturing and repair & maintenance firms in Motor Vehicles and Component Parts.
- Two-thirds of professional and business services employers that experienced hiring difficult cited competition/small applicant pool as the primary reason for hiring difficulty.
- 60 percent of wholesale trade, distribution, and transport employers cited difficulty finding workers with sufficient qualifications as the primary reason.

Table 48.
Motor Vehicles and Component Parts Sector – Reasons for Hiring Difficulty by Industry, Q4 2019

Manufacturing	Wholesale Trade, Distribution, and Transport	Professional and Business Services	Repair & Maintenance
Insufficient non-technical skills (33%)	Insufficient qualifications (certifications or education) (60%)	Competition/small applicant pool (67%)	Insufficient non-technical skills (47%)
Lack of experience, training, or technical skills (33%)	Insufficient non-technical skills (40%)	Cannot provide competitive wages (33%)	Competition/small applicant pool (40%)
Difficulty finding industry-specific knowledge, skills, and interest (17%)	Lack of experience, training, or technical skills (40%)	Difficulty finding industry-specific knowledge, skills, and interest (33%)	Difficulty finding industry-specific knowledge, skills, and interest (27%)

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

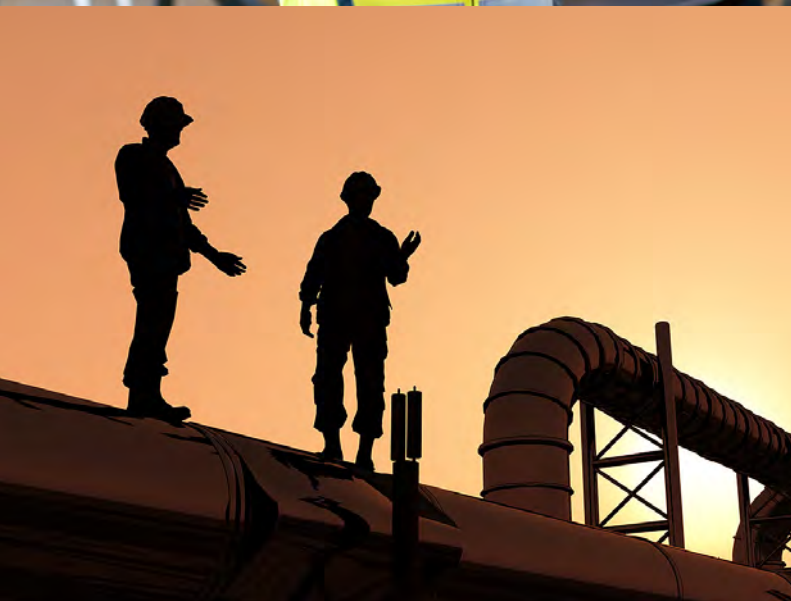
Table 49.
Motor Vehicles and Component Parts Sector – Reported Occupations with Hiring Difficulty by Industry, Q4 2019

Manufacturing	Wholesale Trade, Distribution, and Transport	Professional and Business Services	Repair & Maintenance
Technician or mechanical support (40%)	Drivers/ dispatchers (50%)	Management (directors, supervisors, vice presidents) (67%)	Technician or mechanical support (80%)
Engineers/ scientists (40%)	Sales, marketing, or customer service representatives (33%)	Engineers/ scientists (67%)	Sales, marketing, or customer service representatives (33%)
Management (directors, supervisors, vice presidents) (20%)	Technician or mechanical support (17%)	Electrician /construction workers (33%)	Administrative support (13%)

- In 2019, women represented 23 percent of employees in the Motor Vehicles sector.
- Overall, the Motor Vehicles sector is as equally diverse as the U.S. workforce.
- While Black or African American workers are underrepresented in the industry as a whole, at 8 percent, they make up a larger proportion of its manufacturing sector at 14 percent.
- The Motor Vehicles industry is twice as unionized at 13 percent as the private sector workforce overall at 6.2 percent.

Table 50.
Motor Vehicles and Component Parts Sector – Demographics, Q4 2019

Demographic	Employees	Percent of Sector	National Workforce Averages
Male	1,886,066	77%	53%
Female	566,151	23%	47%
Hispanic or Latino	423,412	17%	18%
Not Hispanic or Latino	2,028,804	83%	82%
American Indian or Alaska Native	37,772	2%	>1%
Asian	118,731	5%	6%
Black or African American	198,293	8%	12%
Native Hawaiian or other Pacific Islander	15,569	1%	>1%
White	1,892,006	77%	78%
Two or more races	189,845	8%	2%
Veterans	214,807	9%	6%
55 and over	470,584	19%	23%
Union	306,819	13%	6%



FIVE-YEAR TRENDS

THE USEER: 2016-2020

The USEER: 2016-2020

The 2020 USEER is the fifth iteration of the annual energy and employment report. This section serves as a summary analysis of the past 5 years of US energy and employment data.

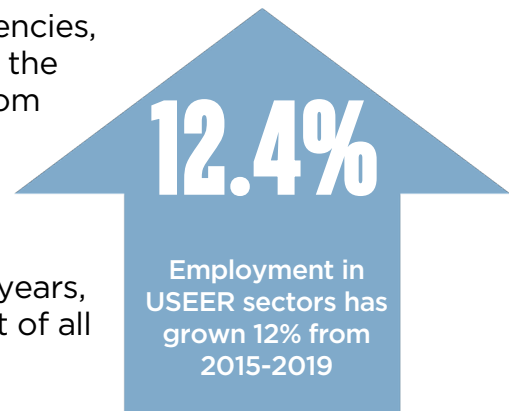
Included are the five major energy, energy efficiency, and motor vehicles technologies, the first three of which comprise the Traditional Energy sector:

- Fuels
- Electric Power Generation (EPG)
- Transmission, Distribution, and Storage (TDS)
- Energy Efficiency (EE)
- Motor Vehicles (MV) including Component Parts

In 2019, U.S. energy, energy efficiency, and motor vehicles firms employed more than 8.27 million Americans, comprising 5.4 percent of the U.S. workforce.

■ The traditional sectors—focused on the production of fuels and electricity and their transmission and distribution to end users—employ 3.3 million Americans. Meanwhile, the downstream sectors of energy efficiency and motor vehicles focused increasingly during the last five years on reducing consumption of the fuels and electricity produced upstream.

■ In spite of these contradictory tendencies, employment in these five sectors of the economy has grown 12.4 percent from 2015-2019, outpacing the general economy’s employment growth rate (6.0 percent).¹ In total, these sectors added nearly 915,000 jobs to the US economy over the past 5 years, representing more than 10.7 percent of all new employment.



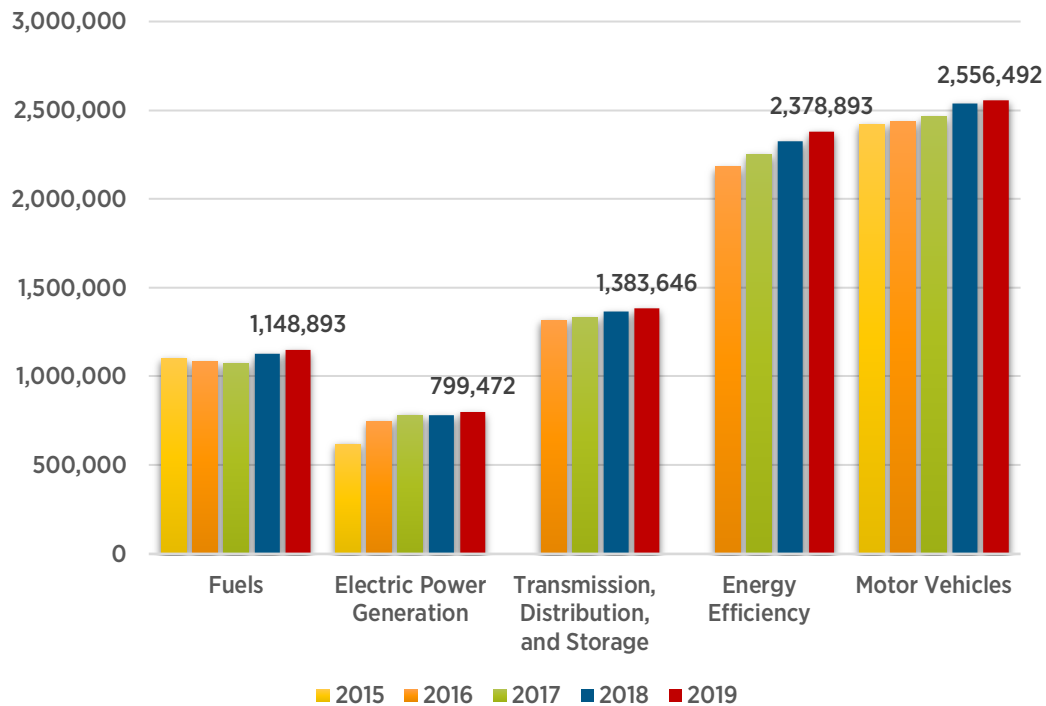
■ The decoupling of energy consumption from job growth is one of the important trends noted in the 2016-2020 USEERs. A second trend is the fact that the deployment of new technologies in all five sectors has driven net job growth,

¹ BLS QCEW Q2 2019.

even while the displacement of old technologies has led to job loss in specific subsectors. The transition from coal-fired generation as the largest source of electricity in the United States in 2015 to natural gas in 2017 is the clearest example of such displacement and will be explored later in this summary.

Finally, the role of energy efficiency, both in the built environment and in transportation, cannot be overstated as a contributor to job growth. While fuel efficiency jobs data in the motor vehicles sector was not collected in 2015, energy efficiency and fuel efficiency contributed to over 400,000 new jobs in the last five years.

Figure 1.
Employment by Major Technology, 2015-2019²



Note: EPG figures do not include less-than-50-percent solar jobs. In 2019, there were 97,359 such jobs.

² 2015 data for EE and TDS have been omitted due to methodological changes between 2015 and 2016, rendering those data incomparable to future data.

Fuels

Fuels sector employment grew more than 4 percent from 2015-2019, adding more than 46,000 new jobs. This growth rate is slightly lower than for the national economy. More than other sectors, fuels employment is affected by global commodity prices which have fluctuated significantly since the introduction of hydraulic fracturing and horizontal drilling. These two technologies are leading the United States to once again become a net energy exporter.³

In its 2020 Annual Energy Outlook, the Energy Information Administration (EIA) projects that U.S. production in these energy sectors will grow significantly, but that U.S. energy consumption will grow moderately, assuming current laws and regulations continue.⁴ Although production in petroleum and natural gas has risen rapidly in the last decade, employment has grown more slowly as productivity has increased, in part as a reaction to sharp global price declines that have forced efficiency initiatives.

Petroleum drives the U.S. fuel economy, employing more than 53 percent of the Fuels sector or more than 615,500 people. However, since petroleum and natural gas fuels are frequently produced jointly, it can sometimes be difficult to differentiate between jobs in these two sectors. In 2017, the Bureau of Labor Statistics redefined the distinction between the mining and extraction jobs in petroleum and natural gas, leading to a relative increase in petroleum jobs and a similar decline in natural gas. However, when petroleum and natural gas fuels jobs are combined to eliminate the effect of this redefinition, the two fuels have gone from 818,000 jobs in 2015 to 891,000 in 2019, a growth rate of 8.9 percent. As mentioned, this growth in production coincided with overall price declines.

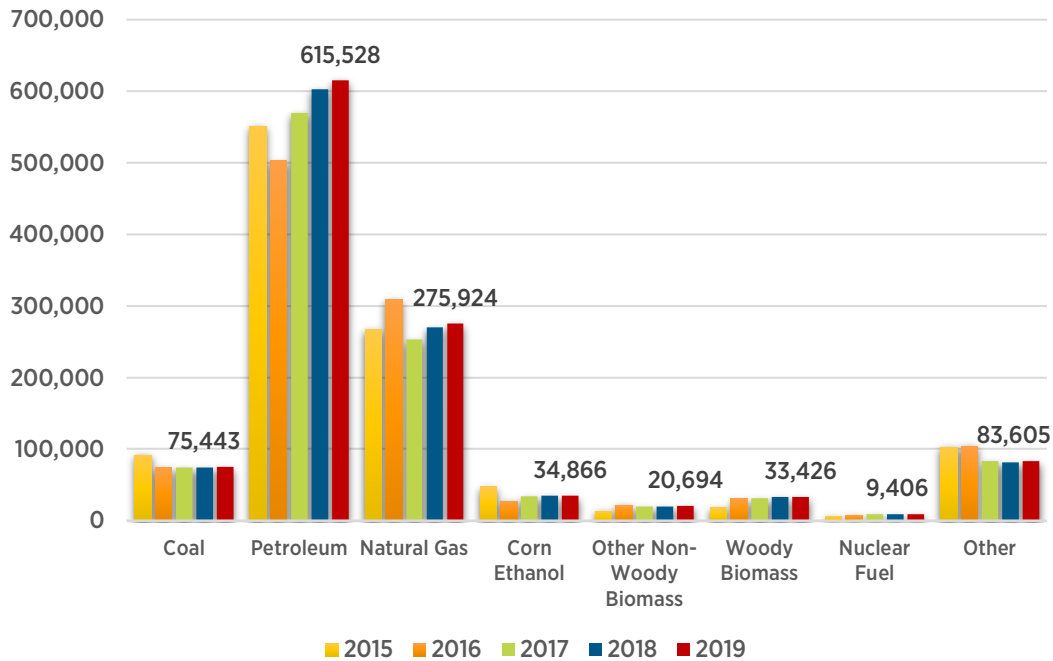
Not surprisingly, coal fuels have seen a sharp 18 percent decline over the same time period, shedding 17,000 jobs. Much of this decline was driven by the closures of coal-fired generation, discussed elsewhere in the 2020 USEER report, and its replacement by natural gas and renewable generation. Together, fossil fuels (coal, petroleum, natural gas) employed 84 percent of Fuels workers, or nearly 967,000 employees in 2019. As reported in the USEER state profiles, 535,000 of these employees are engaged in mining and extraction and 88 percent of those live in just 10 states, underscoring the long-term difficulty in responding to changing energy production.

³ Department of Energy, Energy Information Administration [EIA], *Annual Energy Outlook 2020 With Projections to 2050* [AEO2020] (Washington, DC: EIA, 2020), 11.

⁴ EIA, AEO2020, 10

While alternative fuel technologies do not maintain similar market share, some categories have undergone relatively rapid growth since 2015 while others have declined. Biomass fuels, (non-woody and woody combined) employed 54,100 workers in 2019 and grew 65 percent since 2015. However, corn ethanol employment declined by over 12,000 jobs, or 26 percent.

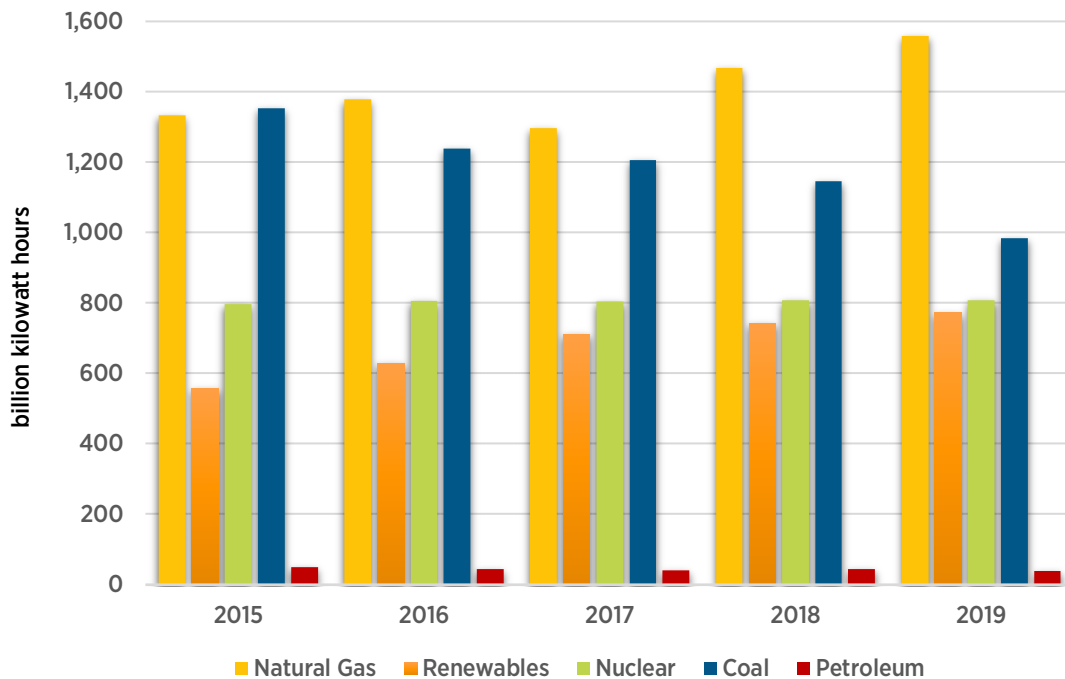
Figure 2.
Fuels Employment by Detailed Technology, 2015-2019



Electric Power Generation

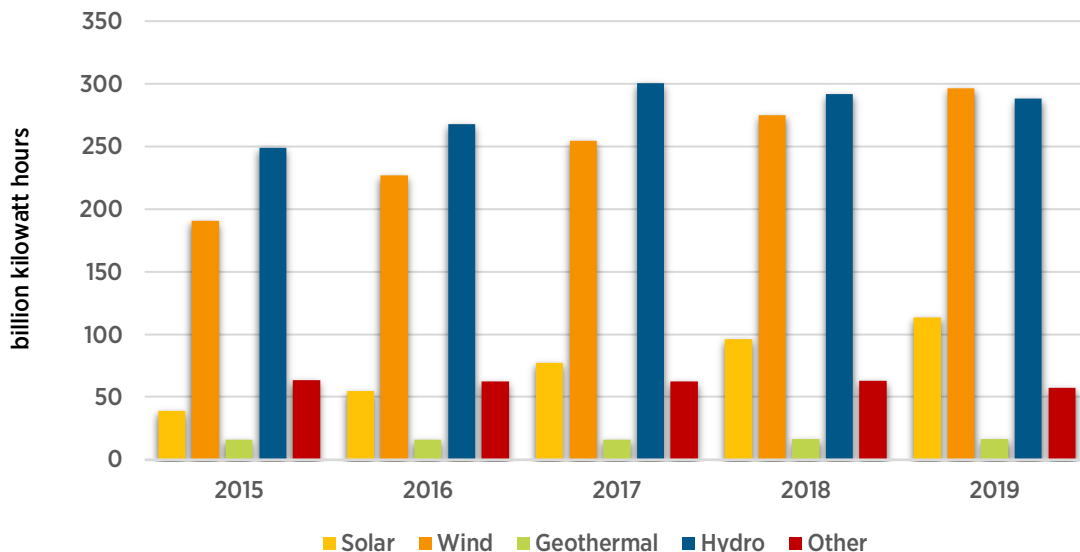
During the last five years, Electric Power Generation has experienced a significant shift in generation sources. In 2015, coal and natural gas each generated 33 percent of the electricity produced in the United States. Five years later, natural gas had increased to 39 percent while coal had fallen to 24 percent. In addition, the share of electricity generated from renewable sources had risen from 14 percent to 19 percent. Within the renewables sector, half of that growth came from wind, with the remaining half split between solar and hydro. Wind and hydro each produce slightly more than 7 percent of the nation’s electricity, while solar produces slightly less than 3 percent.⁵

Figure 3.
Electric Power Generation by Fuel Type, 2015-2019



⁵ EFI calculation from data at EIA, AEO2020, 62.

Figure 4.
Renewable Electric Power Generation, 2015-2019



This transition in generation sources has been reflected in the employment shifts in the sector. USEER employment data for 2015 is incomplete and thus, cannot provide a reliable baseline for all sectors.⁶ However, in 2015, the EPG sector employed 622,000 Americans. Over the next five years, the sector added over 177,000 jobs with the increases in employment centered, at first, in solar and then in natural gas, wind, CHP, and other low carbon technologies. Today, the sector employs 799,000 Americans.

Solar jobs, which had grown rapidly in the preceding six years, were relatively stagnant from 2016-2019, losing jobs in 2017 and 2018 and bouncing back in 2019. Currently, solar employs 248,000, down from its high point of 260,000 in 2016.

Job loss was most pronounced in coal-fired generation, which lost more than 13,000 jobs in 2018 and 2019, declining from 92,000 in 2016 to 79,000 in 2019. Natural gas, now the largest fuel source for electricity generation, added 33,600 jobs in the last four years and employs 122,000. Advanced, low-emissions natural gas actually added almost 40,000 new jobs, but traditional natural gas technologies declined.

Wind, which surpassed hydro as the largest producer of renewable electricity in 2019, added 16,000 new jobs in the last four years and now employs 115,000 while traditional and low-impact hydro employ 68,000 combined. Other low-emission technologies, including biofuels generation, geothermal, and CHP, all experienced growth.

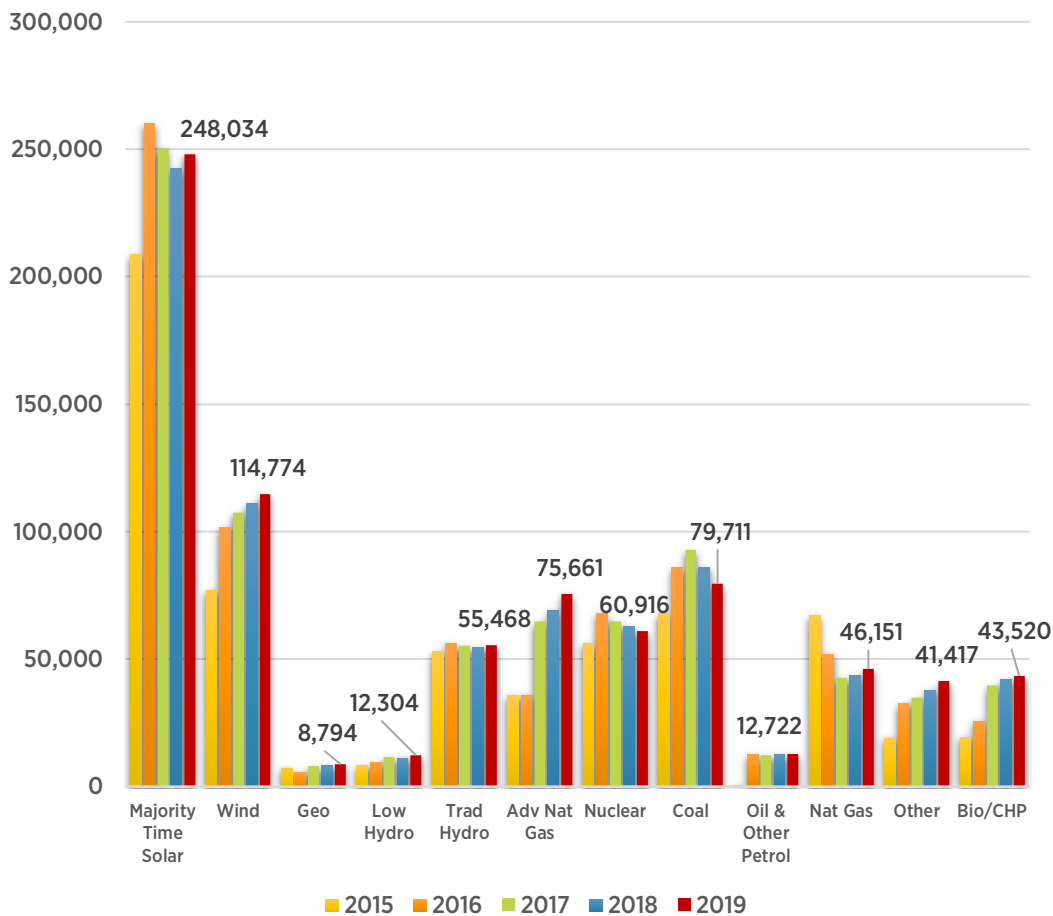
⁶ The 2016 USEER did not distinguish between different fossil fuel generation. It also combined majority time and less than majority time solar jobs. Subsequent editions of the USEER differentiated between these two. The 2020 USEER uses majority time solar jobs only for overall generation employment comparisons.

Nuclear generation shares with renewables the most zero-emission electricity production at 19 percent. Nuclear generation employment has continued to decline slowly over the last four years, losing 7,200 jobs.

At the state level these shifts in technology employment were experienced unevenly in different parts of the country, underscoring the economic and community difficulties associated with an energy transition.

In 2019, for instance, a majority of solar employment was found in just five states—California, Massachusetts, New York, Florida, and Texas. Meanwhile, 83 percent of the job losses in coal-fired generation were concentrated in 15 states. One state, Ohio, lost almost 25 percent of those jobs.

Figure 5.
EPG Employment by Detailed Technology, 2015-2019



Transmission, Distribution, and Storage

Employment growth in the Transmission, Distribution and Storage (TDS) sector has been driven by several key factors, including the expansion of domestic oil and gas production, the deployment of new renewable resources, grid modernization, the introduction of smart technologies, and a rising demand for energy storage. Unlike the EPG sector, where new technologies are displacing the old, in TDS, the new technologies represent the expansion of — or augmentation to — existing infrastructure. As a result, there has been steady employment growth over the last five years with little resulting dislocation.

As with EPG, improvements in the USEER survey in 2016 prevent exact comparisons between 2015 and 2019, since that survey expanded the number of manufacturing jobs included in the results by over 80,000. Nonetheless, TDS added the second most jobs from 2015 to 2019, with more than 156,000 new jobs, or nearly 13 percent growth. Currently, 1.38 million Americans work in this sector. (As described elsewhere in this report, this number does not include retail jobs such as gasoline stations.)

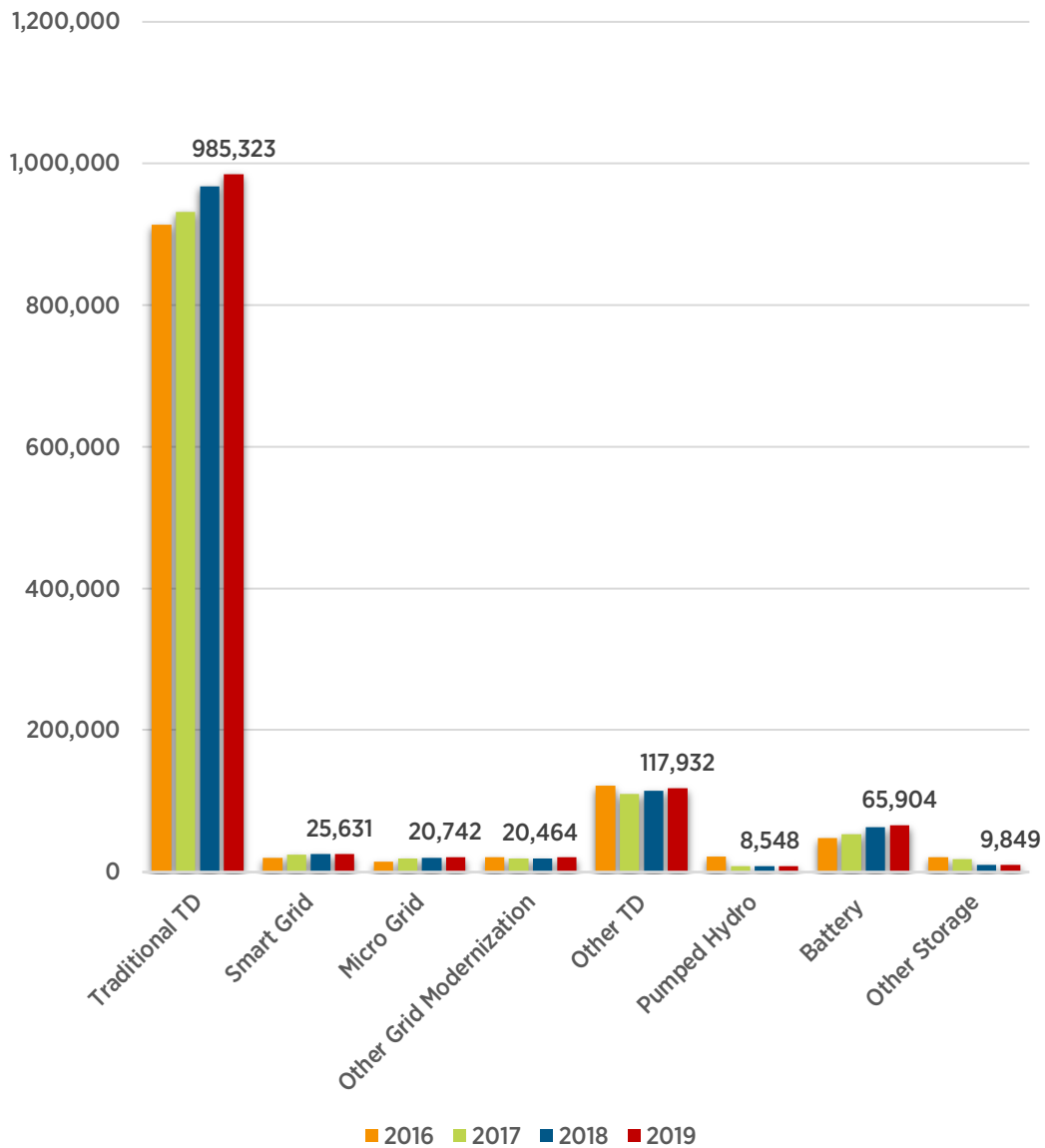
TDS employees are more heavily concentrated in the construction and utilities industries (at 40 and 33 percent, respectively) than EPG workers (at 37 and 22 percent). This, of course, reflects that 79 percent, or more than 985,300 TDS employees, build or maintain electrical transmission and distribution lines or oil and gas pipeline systems. Traditional TDS has grown 8 percent since 2016,⁷ adding 71,900 workers to the TDS workforce.

In 2018 and 2019, 48 and 42 percent of construction firms respectively reported that a majority of their revenues came from grid modernization or other utility-funded projects, reflecting the close reliance of these industry and workforce sectors on each other. A majority of the new jobs created in TDS from 2016 to 2019, 74,200, were in construction.

Smart grid and micro grid technologies have also experienced rapid employment growth since 2016, growing 30 and 39 percent respectively. Smart grid and micro grid technologies added a combined 11,700 jobs to the TDS sector. Battery storage has also experienced strong growth since 2016, adding 18,300 new jobs, or 38 percent growth, for a total of 65,900 workers in 2019.

⁷ Methodological changes to the USEER survey instrument in 2016 allowed for disaggregation of several detailed technologies. For this reason, comparison of detailed technologies in TDS are limited to 2016-2019.

Figure 6.
TDS Employment by Detailed Technology, 2016-2019



Note: Does not include commodity flow employment that works to transport fuels by rail, truck, air, or water (129,252 employees in 2019).

Energy Efficiency

Energy Efficiency employment grew the most significantly of the five surveyed sectors over the past 5 years, adding just over 400,000 jobs.

Its growth rate of 20 percent was over three times that of the overall economy. Today, the EE sector employs nearly 2.38 million Americans.

Many factors have contributed to the continued growth of energy efficiency jobs over the last five years. First, are the high number of states—30—that have active energy efficiency standards or voluntary programs. Seven of these were enacted or renewed in the last five years.⁸ Second, 75 percent of utilities now administer energy efficiency programs at the local level, encouraging the deployment of new appliances, lighting systems, insulation, and HVAC equipment.

At the federal level, over 50 new energy efficiency standards were adopted by the Department of Energy, while the EPA expanded its ENERGY STAR® residential and commercial building certification programs. Today, 231,000 construction workers work on ENERGY STAR certified residential home construction, while 255,000 construction employees work on ENERGY STAR certified commercial and industrial projects.

Another important trend is the increasing number of employees that construction firms report spending the majority of their time working with energy efficiency technologies. As of 2019, 56 percent of EE workers were employed in the construction industry. In 2015, the number of these employees working the majority of their time with energy efficiency technologies was 64.8 percent. By 2019, the number had risen to 78 percent. The largest jump occurred in 2016, when the number of employees doing energy efficiency work for traditional HVAC companies dropped sharply and rose significantly for those working with ENERGY STAR appliances, including HVAC systems.

Employment across detailed technologies in the EE sector has been relatively stable across the last four years with most technologies showing growth. In reviewing residential building energy consumption, the EIA projects a 17 percent residential energy decrease from 2019 to 2050 in its *Annual Energy Outlook 2020*, explaining, "The main factors contributing to this decline include gains in appliance efficiency, onsite electricity generation (e.g., solar photovoltaic), utility energy efficiency rebates, rising residential natural gas prices, lower space heating demand, and a continued population shift to warmer regions."⁹ EIA expects similar

⁸ [https://www.eia.gov/todayinenergy/detail.php?id=32332'](https://www.eia.gov/todayinenergy/detail.php?id=32332)

⁹ EIA, AEO2020, 118.

declines over the next decade in commercial energy intensity with the largest impact coming from the deployment of efficient lighting systems.

ENERGY STAR Appliances (including HVAC) and Traditional HVAC employed 26 and 25 percent of total EE workers in 2019 and added 56,300 and 77,800 jobs respectively between 2016 and 2019. Efficient Lighting technologies added 52,500 jobs during that same four-year period. One of the most important industry sectors of growth between 2016 and 2019 has been the Professional and Business Services sector which added 113,000 jobs.

Figure 7.
EE Employment by Detailed Technology, 2016-2019

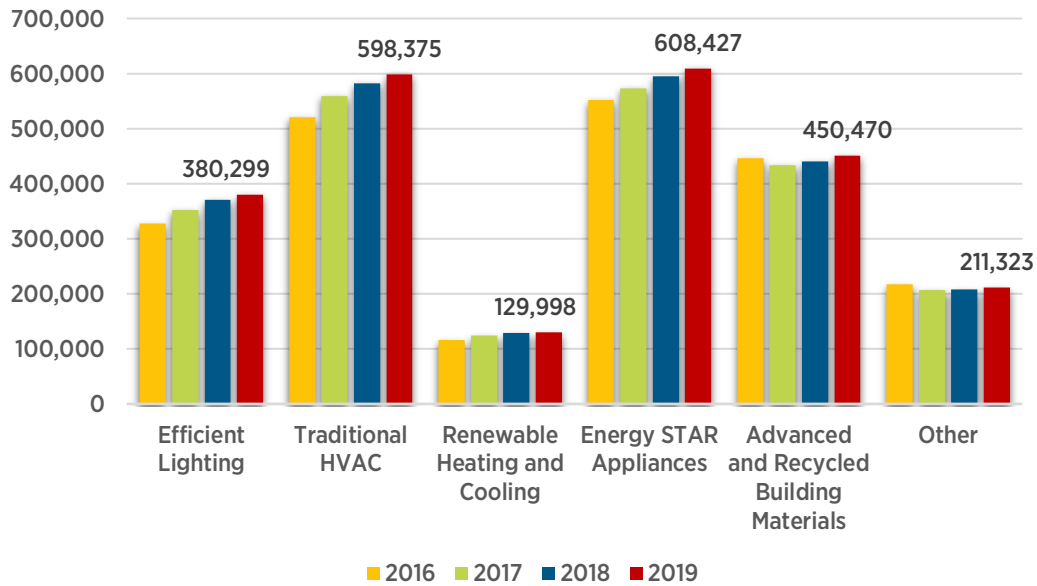
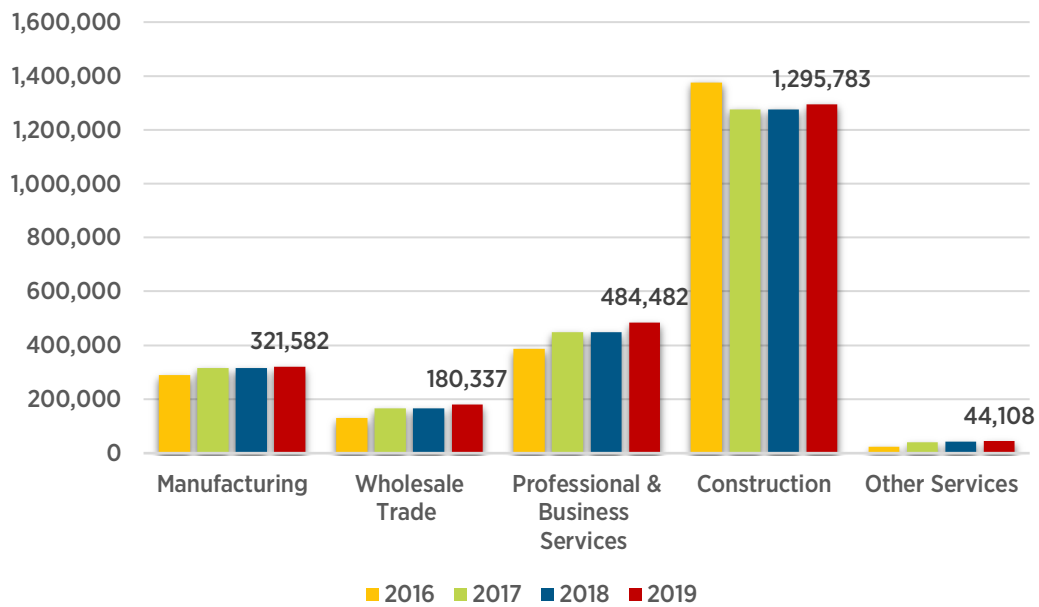


Figure 8.
EE Employment by Industry, 2016-2019



Motor Vehicles and Component Parts

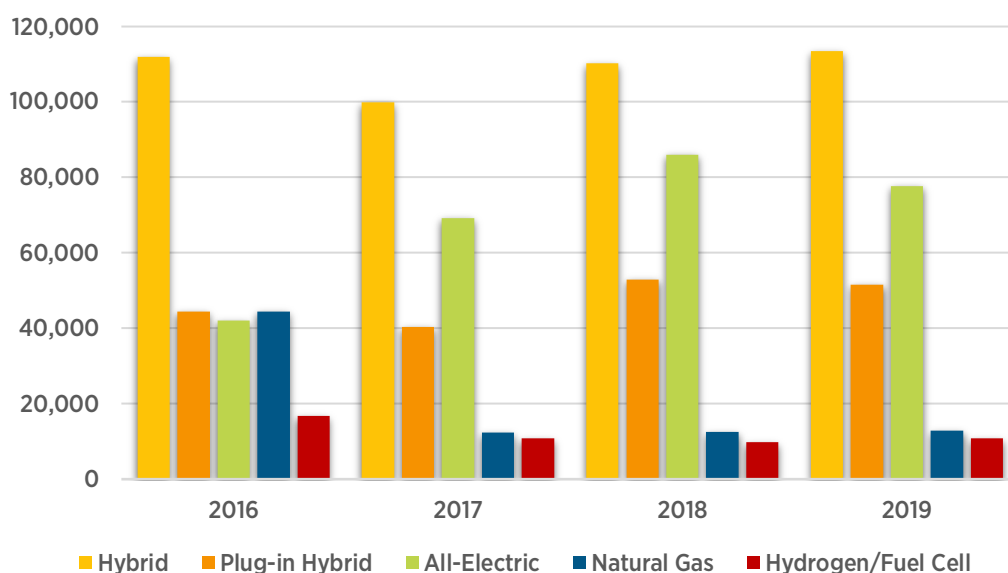
Motor Vehicles, the largest surveyed sector, employed 2.56 million Americans in 2019. Since 2015, the sector added 134,300 jobs representing just over 5.5 percent growth.

The preceding decade has been one of the most dynamic in the global motor vehicles industry since its inception with record production coinciding with dramatic technology shifts. In 2012, the United States adopted the most aggressive fuel economy standards in the world, while in 2019 multiple global automotive companies—Toyota, Ford, GM, Volvo, VW, and Tesla, among others—made announcements about vehicle electrification timelines and/or multiple new EV model introductions and production expansions.

One of the goals of the USEER was to track how the introduction of fuel economy measures including new technologies, light-weighting, materials substitution, and the growth of EVs, hybrids, plug-ins, and other alternative fuels vehicles would affect jobs in the overall industry.

Between 2015 and 2019, the Motor Vehicles industry added 76,000 alternative fuels vehicles jobs, rising from 190,300 to 266,400. During the last four years, the USEER tracked the shifts in domestic production of five specific vehicle types—all electric vehicles, plug-in hybrids, hybrids, natural gas, and hydrogen/fuel cells. Of those categories, the all-electric vehicles showed the most job growth, adding 36,000 jobs.

Figure 9.
Alternative Fuels Vehicles Jobs, 2015-2019

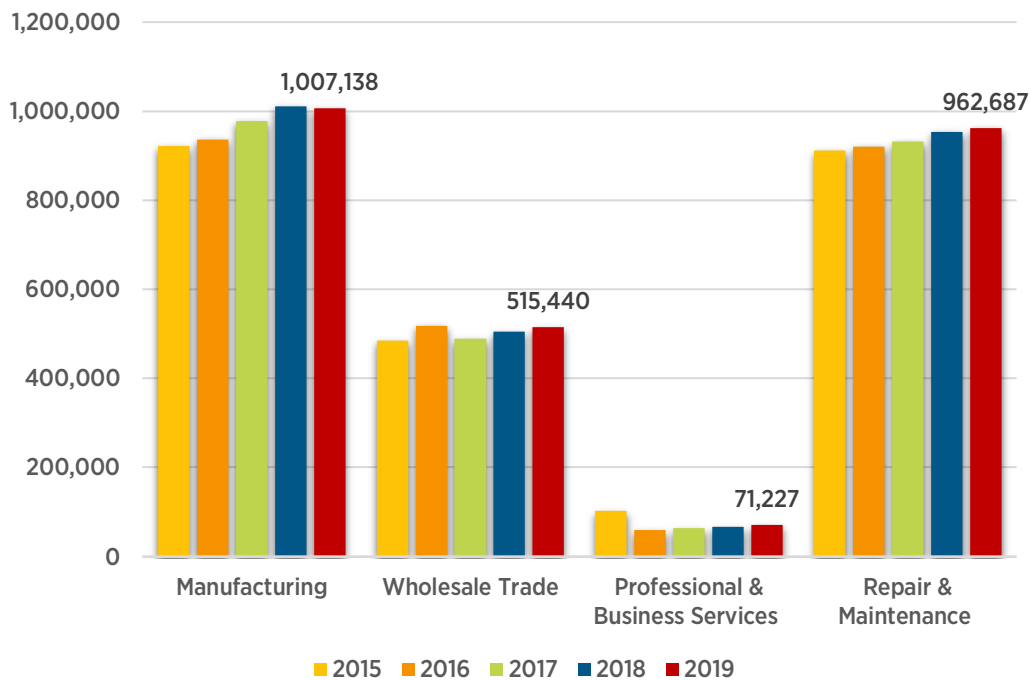


In 2016, the USEER also started tracking the number of jobs in the Component Parts sector that contributed to achieving the 2012 fuel economy standards. In 2016 that number was 489,000, or 44 percent of all jobs in component parts. That number has fluctuated up and down, annually, by 3 percent and now stands at 494,000.

One clear conclusion to draw from the changes in Motor Vehicles employment over the last decade, since the end of the Great Recession, is that fuel efficiency and electrification technologies have helped rejuvenate job growth in the sector. Motor Vehicle manufacturing has added approximately 220,000 jobs since 2010 with 86,000 of those coming during the last five years, well after the introduction of the new fuel efficiency standards.

Repair and Maintenance is the other major sector of the Motor Vehicles industry, comprising 39 percent of the jobs. It has also experienced significant growth, adding over 61,500 jobs.

Figure 10.
MV Employment by Industry, 2015-2019



Appendix A: Discussion of USEER Methodology

I. Survey Overview

The 2020 USEER methodology relies on the most recently available data from the BLS QCEW (QCEW, second quarter 2019), together with a detailed supplemental survey of business establishments across the United States designed and conducted by BW Research Partnership on behalf of NASEO and EFI. During a time of rapid change in energy technology and business employment structure, supplemental surveys are an important tool to capture developing trends. Taken together, the BLS and survey data provide the most comprehensive calculation of energy-related employment available. The methodology has been used for local, state, and federal energy related data collection and analysis for nearly a decade, including the Solar Foundation's *National Solar Jobs Census* series, clean energy reports for state agencies in the Commonwealth of Massachusetts, New York State, State of Vermont, and State of Rhode Island, and numerous nonprofit agencies across the United States.

The 2020 USEER survey uses a stratified sampling plan that is representative by industry code (NAICS or ANAICS)¹, establishment size, and geography to determine the proportion of establishments that work with specific energy-related technologies, as well as the proportion of workers in such establishments that work with the same. These data are then analyzed and applied to existing public data published by the BLS, effectively constraining the potential universe of energy establishments and employment.

The 2019 USEER survey was administered by telephone (more than 140,000 outbound calls) and by web, with more than 47,000 emails sent to participants throughout the United States. This year, more than 49,000 letters were sent to potential participants. The letter included a survey url for access to the web survey and a phone number to call if the respondent wanted to complete the survey over the phone. Respondents also had the option of waiting for an email or a phone call. The phone survey was conducted by ReconMR. The web instrument was programmed internally, and each respondent was required to use a unique ID in order to prevent duplication.

The sample was split into two categories, referred to as the known and unknown universes. The known universe includes establishments that have previously been identified as energy-related, either in prior research or in some other manner, such as membership in an industry association or

¹ ANAICS is a term used by BLS, most notably in the Green Goods and Services (GGS) survey, which means Allocation NAICS, and refers to the industries included in the aggregation of industries likely to participate in said activities. https://www.bls.gov/ggs/ggs_technote_extended.pdf

participation in government programs. These establishments were surveyed census-style, and their associated establishment and employment totals were removed from the unknown universe for both sampling and for resulting employment calculations and estimates.

The unknown universe included tens of thousands of businesses in potentially energy-related NAICS codes, across agriculture, mining and extraction, utilities, construction, manufacturing, wholesale trade, distribution (including pipeline distribution), professional services, and repair and maintenance. Each of these segments and their total reported establishments (within the BLS QCEW) were carefully analyzed by size (employment) and state to develop representative clusters for sampling. In total, approximately 25,000 business establishments participated in the survey effort, with approximately 8,200 providing full responses to the survey. These responses were used to develop incidence rates among industries (by state) as well as to apportion employment across various industry categories in ways currently not provided by state and federal labor market information agencies. The margin of error for incidence in the index is +/-0.62 percent at a 95 percent confidence interval.

For several industries, particularly transportation of goods, the USEER uses the methodology developed by the DOE and the National Renewable Energy Laboratory for the first installment of the QER. Proportion of employment was calculated by dividing commodity shipments by value (in millions of dollars) for coal, fuel oil, gas, motor vehicles, petroleum, and other coal and petroleum products out of total commodity value at the state level by truck, rail, air, and water transport. This proportion was applied to NAICS employment for truck transportation (NAICS 484), water transportation (NAICS 483), air transportation (NAICS 481), and Railroad Retirement Board employment for rail transportation at the state level. With this analysis, truck transportation represents the majority of energy-related transportation employment (67 percent), followed by rail (23 percent), water (9 percent), and air (1 percent).

Of important note, the USEER expressly excludes any employment in retail trade NAICS codes. This excludes motor vehicle dealerships, appliance and hardware stores, and other retail establishments. Where relevant, separate reference is made to retail employment (gasoline stations and other liquid fuels dealers).

All data in the USEER rely on the BLS QCEW data for the end of the second quarter of 2019. The USEER survey was administered between September 24, 2019 and November 21, 2019 and averaged 14 minutes in length.

II. Methodology Discussion

Employment data collected by the BLS provide information on many, but not all, energy-related job categories. Most notably, BLS does not collect data on employment levels by energy technology across business segments. For instance, residential solar installation establishments are typically labeled as electrical contractors (together with all other traditional electrical businesses) without being identified specifically as solar companies. Petroleum-engineering firms are included in engineering services, with civil, mechanical, and other engineers, while electric vehicle prototype manufacturers are combined with gasoline and diesel-fueled vehicle manufacturing. As a result, BLS employment data does not capture the full scope of energy employment trends.²

Given the complex relationship between energy and the overall economy, the 2020 USEER investigates, with a special supplemental survey, the three Traditional Energy sectors—Electric Power Generation, Fuels and Transmission, Distribution, and Storage—followed by individual analyses of employment in two important energy end-use sectors—Energy Efficiency and Motor Vehicles. The spread of business activities within each of the four analyzed sectors presents additional taxonomic challenges, as early-stage research and development, repair and maintenance, or professional and technical services vary across energy, energy efficiency, and manufacturing. Natural gas business activities, for instance, differ from business activities relating to advanced building materials and solar photovoltaic (PV) materials.

Historically, the BLS has conducted supplemental surveys to acquire more complete information on new industries, specific demographic profiles within the workforce, or new labor force trends such as the role of contingent workers. In this way, significant modification to the current BLS structure of industry and occupational classifications is avoided by capturing the required energy employment data using a supplemental survey tool based on existing BLS data and classifications.

The 2020 USEER relies on such a comprehensive survey of 25,000 business representatives across the United States, conducted by BW Research Partnership on behalf of NASEO and EFI. The survey data are used to filter and analyze the concentration, intensity, and distribution of various energy technologies and activities throughout traditional industry sectors, using second-quarter 2019 employment data from the BLS QCEW. USEER data also provides an additional layer of information to track sector-specific growth potential, obstacles, and opportunities. The data presented in the USEER are not intended to remove, replace, or replicate existing data from the BLS QCEW, but instead to reorganize categories and provide insight for policymakers and the public regarding

² DOE, Quadrennial Energy Review: Energy Transmission, Storage, and Distribution Infrastructure, 8-7.

trends in energy employment, energy production, and energy consumption across the United States.

The USEER provides data for direct employment only and does not attempt to estimate indirect employment or induced employment related to the analyzed sectors. Many employment studies, such as those included in chapter 8 of the first installment of the QER, generate employment estimates that rely on input/output modeling. These studies typically define an activity based on reported expenditures or expenditures and associated levels of employment reported by a defined industry or activity, such as U.S. solar PV installation. In this example, solar PV installation firm employment would be the “direct” jobs. Most studies go at least one step further, identifying “indirect” employment, which includes the supply chain or other support services to the industry. In the solar example, these would include U.S. manufacturing jobs related to producing PV equipment used in domestic installations (and their suppliers and vendors) as well as consulting, tax, legal, and other professional services to support domestic PV installation companies. Another typical calculation is “induced” jobs, which includes jobs created or supported by wages paid and other benefits provided by employers of direct and indirect employees.

In the USEER, by comparison, the direct job category of interest is defined as the solar industry generally, including utility-scale solar, residential, and commercial installations, as well as the manufacturing, professional services, and wholesale trade that make up the sector. However, the indirect jobs that support this industry are not included, such as polysilicon production (the raw material used in solar panels), aluminum production and extrusion activities for frame manufacturing, or other aspects of the solar energy value chain. Induced jobs—those created throughout the economy as a result of the spending of wages by the employees whose income derives, in whole or part, from this industry—are also not included.

For this survey, a Qualifying Firm is—

An organization with employees in the United States that is directly involved with researching, developing, producing, manufacturing, distributing, selling, implementing, installing, or repairing components, goods or services related to Electric Power Generation; Electric Power Transmission, Distribution, and Storage; Energy Efficiency, including Heating, Cooling and Building Envelope; Fuels, including Extraction, Processing, Production, and Distribution; and Transportation, including Motor Vehicles. This also includes supporting services such as consulting, finance, tax, and legal services related to energy, fuels, energy efficiency, or motor vehicles.

Qualifying Workers are—

Employees of a qualifying firm that spend some portion of their time supporting the qualifying energy, energy-efficiency, or motor vehicle portion of the business.³

This report provides detail into levels of employment activity that include both “a portion of their time” and “a majority of their time” when referencing qualifying workers. This is especially true within the Energy Efficiency sector where the employing construction or repair firms frequently are engaged in both traditional energy-related construction or installation as well as in high-efficiency activities that qualify for ENERGY STAR designation.

Primary energy consumption⁴ in the United States is divided among four sectors: Electric Power Sector (37.7 percent), Residential and Commercial Buildings (10.8 percent), Industrial (23.1 percent), and Transportation (28.5 percent). This distribution of energy consumption by sector is based on total 2019 estimates published by the Energy Information Administration (EIA).⁵

End-use electricity consumption, in turn, is divided with 74.5 percent consumed by Residential and Commercial Buildings, 25.3 percent by Industrial; and 0.2 percent by Transportation.⁶ Thus, Residential and Commercial Buildings consumed 38.8 percent of all energy (an amount consisting of their direct energy end-use, their electricity end-use, and the electrical system energy losses allocated to the sector by EIA).⁷

As with the 2019 report, the 2020 USEER identifies jobs that manufacture ENERGY STAR appliances and other ENERGY STAR labeled products, as well as employment in building design and contracting services that provide insulation, improve natural lighting, and reduce overall energy consumption across homes and businesses.⁸ The 2020 USEER includes a new section that disaggregates ENERGY STAR technologies more thoroughly, further highlighting the employment impacts of the program. Also included are breakouts related to the ENERGY STAR Residential New Construction and Commercial and Industrial building programs. Finally, employment related to Energy Efficiency programs at utilities are

³ Data presented in this report exclude retail employees. Qualifying Workers in energy will be referenced as energy-related jobs. Where “portion of their time” includes employees whose activities are less than 50 percent of their time, specific reference will be made of that fact.

⁴ Primary energy consumption is the direct consumption of energy at its first point of use. Importantly, this does not include consumption of electricity, so that primary energy consumption in the Residential and Commercial Building sector includes direct use of fuels like natural gas for heating, but not electricity used for lighting and cooling.

⁵ EIA, *Monthly Energy Review*, Table 2.1. Percentages are based on primary energy consumption in 2019 through October and do not add up to 100.0 percent due to rounding.

⁶ EIA, *Monthly Energy Review*, Table 7.6. Percentages of retail electricity sales in 2019 through October.

⁷ EIA, *Monthly Energy Review*, Table 2.1. Percentage based on total energy consumption in 2019 through October.

⁸ Estimates do not include retail employment.

quantified. For a more complete definition of Energy Efficiency jobs, see the introduction to the Energy Efficiency chapter.

Motor Vehicles are included in this report primarily due to their intensive use of energy and contribution to carbon emissions.⁹ This report delineates employment between traditional gas and diesel motor vehicles, hybrid and plug-in hybrid, all-electric, natural gas, hydrogen, and fuel cell technologies, as well as Motor Vehicle component parts for such vehicles. USEER also includes an estimate for Motor Vehicle component parts that contribute to increased fuel economy. It does not, however, cover all sectors of transportation, such as aviation and maritime transportation. According to the EIA, the transportation sector accounted for 28.5 percent of U.S. primary energy consumption in 2019;¹⁰ in 2019, 69.2 percent of overall U.S. petroleum consumption was attributable to the transportation sector.¹¹

BW Research Partnership, an independent research organization, collected and analyzed data at the direction of EFI and NASEO. The data set includes technology, value-chain, and energy employment data to the county-level in all 50 U.S. states and the District of Columbia. In a time of rapid change in energy technologies across the board, continued refinement of supplemental surveys will continue to be an important tool in analyzing existing BLS data sets.

Another benefit of using the QCEW framework and supplemental survey is the ability to understand and report the concentration of energy-related activities within traditional industries, such as construction, manufacturing, and utilities. This helps to illustrate the significant impact that energy and energy-related activities have on the overall economy. The impacts to the various selected industries are illustrated briefly below.¹²

⁹ The USEER covers motor vehicle employment across vehicle parts manufacturing, automotive repair and maintenance, as well as vehicle, parts, and supplies wholesalers, including air, rail, water, and truck transportation of motor vehicle parts and supplies. It does not capture jobs associated with the final assembly of some transportation equipment such as forklifts and golf carts.

¹⁰ EIA, *Monthly Energy Review*, Table 2.1.

¹¹ EIA, *Monthly Energy Review*, Table 3.7c. Percentage calculated using the sum of sector totals in Tables 3.7a through 3.7c.

¹² Because the USEER uses modeling to estimate fuel-stock employment in agriculture and forestry, and because these industry codes are not effectively captured by QCEW, no estimate is made as to the percent of the total industry captured by the USEER.

Appendix B: USEER Detailed Technology Definitions

FUELS

Coal Fuel — a combustible black or dark brown rock consisting mainly of carbonized plant matter, found mainly in underground deposits and widely used as fuel.

Petroleum Fuel — a liquid mixture of hydrocarbons that is present in certain rock strata and can be extracted and refined to produce fuels including gasoline, kerosene, and diesel oil; oil.

Natural Gas Fuel — flammable gas, consisting largely of methane and other hydrocarbons, occurring naturally underground (often in association with petroleum) and used as fuel.

Other Fossil Fuel — a natural fuel such as coal or gas, formed in the geological past from the remains of living organisms.

Corn Ethanol Fuel — ethanol produced from corn that is used as a biomass.

Other Ethanol/Non-Woody Biomass Fuel, including Biodiesel — fuel made from other materials such as straw, manure, vegetable oil, animal fats, etc.

Woody Biomass/Cellulosic Biofuel — fuel 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)

Other Biofuels — other fuel derived directly from living matter.

Nuclear Fuel — a substance that will sustain a fission chain reaction so that it can be used as a source of nuclear energy.

ELECTRIC POWER GENERATION

Solar Photovoltaic Electric Generation — generating electrical power by converting solar radiation into direct current electricity using semiconductors that exhibit the photovoltaic effect.

Concentrated Solar Electric Generation — generating solar power by using mirrors or lenses to concentrate a large area of sunlight, or solar thermal energy, onto a small area.

Wind Generation — converting the wind's kinetic energy into electrical power.

Geothermal Generation — using steam produced from reservoirs of hot water found a few miles or more below the Earth's surface to produce electricity.

Bioenergy/Biomass Generation — generating electricity from materials derived from biological sources or any organic material which has stored sunlight in the form of chemical energy.

Low-Impact Hydroelectric Generation— similar to traditional, but certification criteria are aimed at ensuring that the certified dam adequately protects or mitigates its impacts in eight key resource areas: river flows, water quality, fish passage and protection, watersheds, threatened and endangered species, cultural resources, and public access and recreation opportunities. The eighth criterion requires that the dam not have been recommended for removal (LIHI - Low Impact Hydropower Institute).

Traditional Hydroelectric Generation — electricity generated by hydropower; the production of electrical power through the use of the gravitational force of falling or flowing water.

Advanced/Low Emission Natural Gas - efficient, low emission, leak free natural gas, including systems that use any of the following technologies High Efficiency Compressor, Advanced Low NOx Combustion Technology, First Application of Closed Loop Steam Cooling in an Industrial Gas Turbine, Advanced Turbine Blade and Vane Materials, High Temperature TBC and Abradable Coatings, Advanced Row 4 Turbine Blades, 3-D Aero Technology, Advanced Brush Seal.

Nuclear Generation — converting atomic energy into usable power.

Coal Generation - the burning of thermal coal to create electricity.

Oil and other Petroleum Generation — the burning of oil or other petroleum to create electricity.

Natural Gas Generation, other than Advanced Natural Gas Generation — the burning of natural gas to create electricity.

Combined Heat and Power — generating electricity and useful thermal energy in a single, integrated system. Heat that is normally wasted in conventional power generation is recovered as useful energy

Other Generation — includes generation from incineration of other fuels (waste, etc.), tidal generation, and employment that cannot be classified into a single detailed technology.

TRANSMISSION, DISTRIBUTION, AND STORAGE

Traditional Transmission and Distribution — allows electricity, petroleum, and natural gas to move across the country through infrastructure commonly referred to as “poles, pipes, and wires.”

Smart Grid — an electricity supply network that uses digital communications technology to detect and react to local changes in usage.

Micro Grids — a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid.

Other Grid Modernization — other modernization of the Nation’s electricity transmission and distribution system to maintain a reliable and secure electricity infrastructure that can meet future demand growth.

Other Transmission and Distribution — includes commodity flows (air, rail, water, and truck transport of fuels), system efficiency, software that supports all transmission and distribution, site selection, disaster response plans (DRP), incident response plans (IRP), etc., including employment that cannot be classified into a single detailed technology.

Pumped Hydro Storage — hydroelectric energy storage used by electric power systems for load balancing. The method stores energy in the form of gravitational potential energy of water, pumped from a lower elevation reservoir to a higher elevation.

Battery Storage — using a cell or connected group of cells to convert chemical energy into electrical energy by reversible chemical reactions and that may be recharged by passing a current through it in the direction opposite to that of its discharge

Mechanical Storage — uses kinetic or gravitational forces to store energy. Includes flywheels, compressed air, etc.

Thermal Storage — temporary storage of energy for later use when heating or cooling is needed.

ENERGY EFFICIENCY

ENERGY STAR Appliances - appliances that meet the international ENERGY STAR standard for energy efficient consumer products originated in the United States.

LED, CFL and Other Efficient Lighting - energy efficient lighting sources.

Traditional HVAC goods, control systems, and services — heating, ventilation, and air conditioning systems (HVAC), including building retro-commissioning and retrofits connected to heating and cooling.

ENERGY STAR/ High AFUE HVAC — HVAC that meets the international ENERGY STAR standard for energy efficient consumer products originated in the United States or has high Average Fuel Utilization Efficiency (AFUE) rating of 90 or greater or 15 SEER or greater.

Renewable Heating and Cooling — refers to establishments that are involved with heating, ventilation and air conditioning (HVAC) from Renewable Energy sources or work that increases the Energy Efficiency of HVAC systems (solar thermal — uses the sun's energy to generate thermal energy).

Advanced Building Materials/Insulation — all materials that represent advances in efficiency over the traditional materials.

Reduced water consumption products and appliances — high efficiency (HE) washing machines, faucet aerators, low flow shower heads, etc.

Other Energy Efficiency - includes variable speed pumps, other design services not specific to a detailed technology, software not specific to a detailed technology, energy auditing, rating, monitoring, metering, and leak detection, policy and non-profit work not specific to a detailed technology, consulting not specific to a detailed technology, LEED certification, phase-change materials, etc.

MOTOR VEHICLES AND COMPONENT PARTS

Gasoline and Diesel Motor Vehicles (excluding freight transport) — vehicles that run on gasoline and diesel internal combustion engines.

Hybrid Electric Vehicles — use two or more distinct types of power, such as internal combustion engine + electric motor.

Plug-In Hybrid Vehicles — a hybrid electric vehicle that uses two or more distinct types of power, such as internal combustion engine and an electric motor that is powered by rechargeable batteries, or another energy storage device, that can be recharged by plugging it in to an external source of electric power.

Electric Vehicles — a vehicle which uses one or more electric motors for propulsion with no onboard generator or non-electric motor.

Natural Gas Vehicles — an alternative fuel vehicle that uses compressed natural gas (CNG) or liquefied natural gas (LNG) as a cleaner alternative to other fossil fuels.

Hydrogen Vehicles — uses hydrogen as its onboard fuel for motive power.

Fuel Cell Vehicles — a type of hybrid vehicle which uses a fuel cell, instead of an engine, in combination with a storage device, such as a battery, to power its on-board electric motor.

Appendix C: USEER 2019 Employer Survey

Introduction:

Hello, my name is _____ and I am calling on behalf of the National Association of State Energy Officials, or NASEO. We are conducting a national survey about the energy, energy-related, and advanced manufacturing industries. May I please speak to the person most knowledgeable about staffing at [organization]?

Is now a convenient time?

This survey uses specific terms to describe various technologies and activities. If you require any definitions for clarification, please ask me at any time.

(If needed): This important survey addresses businesses that research, develop, manufacture, install or work with products that generate, distribute or save energy.

(If needed): This includes organizations involved in fossil and renewable energy production, energy efficiency products and services, motor vehicles, solar, wind, fossil and other energy sources, and other energy related products and services.

(If needed): Your individual responses will not be published; only aggregated information will be used in reporting the survey results.

(If needed): The survey should take approximately 15-30 minutes of your time. Your participation will help determine how investments of time and money should be made to support the industry and prepare the present and future labor pool.

(If needed): If you have any questions about NASEO's involvement in this survey, please contact David Terry at [insert phone]

.....

- A. Does your organization have at least one location with employees in the United States? (Please count yourself as an employee if you are an owner-operated business or sole proprietor).

- 1 Yes [CONTINUE]
- 2 No [TERMINATE]

For this survey, please only answer for your current business location. If your organization has other U.S. locations, please do not include their data. What is the zip code of your current location? [SHOW ADDRESS FROM SAMPLE FILE]

_____ (Accept all five-digit responses)

(DON'T READ) Have check box for Refused (Terminate if Refused)

- B. Is your organization involved, in whole or part, with an activity related to energy? (PAUSE, IF UNSURE OR NO READ REMAINDER OF QUESTION, IF YES GO TO SC) We define this as being directly involved with researching, developing, producing, manufacturing, distributing, selling, implementing, installing, or repairing components, goods or services related to Electric Power Generation; Electric Power Transmission, Distribution, and Storage; Energy Efficiency, Including Heating, Cooling and Building Envelope; Fuels, including Extraction, Processing, Production, and Distribution; and Transportation, including Motor Vehicles. This also includes supporting services such as consulting, finance, tax, and legal services related to energy.

- 1 Yes [CONTINUE]
- 2 No [TERMINATE]
- 3 Not sure [TERMINATE]

- C. Which of the following industries describes your organization's work?
[ALLOW MULTIPLE RESPONSES] [IF NEEDED: If your organization is involved in energy research or professional services for the industry, please select the options that are most relevant to your organization.]

- 1. Electric Power Generation
- 2. Electric Power Transmission and Distribution
- 3. Storage
- 4. Energy Efficiency, Including Heating, Cooling and Building Envelope (IF NEEDED THIS INCLUDES THERMAL OR HOT WATER SOLAR)
- 5. Fuels
- 6. Transportation Vehicles, including Motor Vehicles (IF NEEDED: Including industrial vehicles, such as forklifts, and recreational vehicles, such as golf carts)
- 7. Component Parts for Transportation Vehicles
- 8. Carbon Capture and Storage
- 9. Other (Specify _____) TERMINATE
- 10. DK/NA TERMINATE

[ASK SCREENER D IF SC COUNT>1]

- D. Which do you consider your organization's **primary** industry, based on the majority of labor hours performed at your location? [PIPE IN SC CATEGORIES, ACCEPT ONE]
1. Electric Power Generation
 2. Electric Power Transmission and Distribution
 3. Storage
 4. Energy Efficiency, Including Heating, Cooling and Building Envelope (IF NEEDED THIS INCLUDES THERMAL OR HOT WATER SOLAR)
 5. Fuels
 6. Transportation, including Motor Vehicles (IF NEEDED: Including industrial vehicles, such as forklifts, and recreational vehicles, such as golf carts)
 7. Component Parts for Transportation Vehicles
 8. Carbon Capture and Storage

CREATE **SDPRIME** FROM SC IF SC COUNT=1, OR SD IF SC COUNT>1

- E. [ASK FOR EACH SC] Which of the following [INSERT SC RESPONSE] technologies is your organization directly engaged with? [READ LIST, ALLOW MULTIPLE RESPONSES]

A. Electric Power Generation (IF SC=1) [RANDOMIZE]

1. Solar Photovoltaic Electric Generation [SET SOLAR=1]
2. Concentrated Solar Electric Generation [SET SOLAR=1]
3. Wind Generation
4. Geothermal Generation
5. Bioenergy/Biomass Generation
6. Low-Impact Hydroelectric Generation including Wave/Kinetic Generation
7. Traditional Hydroelectric Generation
8. Advanced/Low Emission Natural Gas
9. Nuclear Generation
10. Coal Generation
11. Oil and other Petroleum Generation
12. Natural Gas Generation
13. Combined Heat and Power
14. Other Generation (Specify)

B. Electric Power Transmission and Distribution (IF SC=2) [RANDOMIZE]

1. Traditional Transmission and Distribution
2. Smart Grid
3. Micro Grids
4. Other Grid Modernization
5. Other (Specify)

C. Storage (IF SC=3) [RANDOMIZE] [IF SEA=1, "(including battery storage for solar generation)"]

1. Pumped hydro-power storage
2. Battery storage [IF SEA=1, "(including battery storage for solar generation)"]
3. Mechanical storage (flywheels, compressed air energy storage, etc.)
4. Thermal storage
5. Liquefied natural gas
6. Compressed natural gas

7. Crude oil
8. Refined petroleum fuels (liquid)
9. Refined petroleum fuels (gas)
10. Coal storage (piles, domes, etc.)
11. Biofuels, including ethanol and biodiesel
12. Nuclear fuel
13. Other gas fuel (Specify)
14. Other liquid fuel (Specify)
15. Other Storage
16. Other (Specify)

IF SEC=2, ASK C_2 AND C_3

C_2. What type of Battery Storage do you work with? [READ LIST, ALLOW MULTIPLE RESPONSES] [RANDOMIZE]

1. Lithium batteries
2. Lead-based batteries
3. Other solid-electrode batteries (Specify)
4. Vanadium redox flow batteries
5. Other flow batteries (Specify)

D. Energy Efficiency, Including Heating, Cooling and Building Envelope (IF SC=4) [RANDOMIZE]

1. ENERGY STAR® Certified Appliances (not including HVAC)
2. ENERGY STAR Certified Heating, Ventilation, and Cooling (HVAC)
3. Other high efficiency HVAC that are out of scope for ENERGY STAR certification (e.g. indirect evaporative coolers, air to water heat pumps, energy recovery systems, etc.)
4. Traditional HVAC goods, control systems, and services
5. ENERGY STAR certified water heaters
6. ENERGY STAR Certified Electronics (TVs, Telephones, Audio/Video, etc.)
7. ENERGY STAR Certified Windows, Doors and Skylights
8. ENERGY STAR Certified Roofing
9. ENERGY STAR Certified Insulation
10. Air sealing
11. ENERGY STAR Certified Commercial Food Service Equipment
12. ENERGY STAR Certified Data Center Equipment
13. ENERGY STAR Certified LED lighting
14. Other LED, CFL, and efficient lighting
15. Solar thermal water heating and cooling [SET SOLAR=1]
16. Other renewable heating and cooling (geothermal, biomass, heat pumps, etc.)
17. Advanced building materials/insulation
18. Recycled building materials
19. Reduced water consumption products and appliances
20. Other (Specify)

E. Fuels (IF SC=5) [RANDOMIZE]

1. Coal
2. Petroleum
3. Natural Gas
4. Other Fossil Fuel
5. Corn Ethanol
6. Other Ethanol/Non-Woody Biomass, including Biodiesel
7. Woody Biomass/Cellulosic Biofuel

8. Other Biofuels
9. Nuclear Fuel
10. Other (Specify)

F. Transportation Vehicles, Including Motor Vehicles (IF SC=6) [RANDOMIZE]

1. Gasoline and Diesel Motor Vehicles (excluding freight transport)
2. Hybrid Electric Vehicles
3. Plug-In Hybrid Vehicles
4. Electric Vehicles
5. Natural Gas Vehicles
6. Hydrogen Vehicles
7. Fuel Cell Vehicles
8. Other (Specify _____)

G. Component Parts for Transportation Vehicles (IF SC=7) [RANDOMIZE]

1. Transportation Vehicle Engine & Drive Parts
2. Transportation Vehicle Exhaust System Parts
3. Transportation Vehicle Body Parts
4. Other Transportation Vehicle Parts (Specify _____)

SET SOLAR=1 IF SEA=1 OR 2, OR TSF=1, AND SED=5

IF SE TOTAL>1, ASK SEPRIME, IF NOT, SKIP

SEPRIME. Which of the following technologies is your organization *PRIMARILY* engaged with?

[PIPE-IN RESPONSES FROM SEA-SEG]

[IF RESPONDENT ONLY IDENTIFIES WITH ONE INDUSTRY AT SCREENER E (QC), USE THAT INDUSTRY FOR THE REMAINDER OF THE SURVEY IN PLACE OF "ENERGY" / IF MORE THAN ONE, CONTINUE TO USE "ENERGY." EXCEPTION — IF THE ONLY SELECTION AT SCREENER C IS "OTHER" OR "DK/NA," USE "ENERGY"]

F. Which of the following industry descriptions describe your organization's focus as it relates to the [energy/ SC] industry? [ALLOW MULTIPLE RESPONSES]

1. An organization that manufactures and/or assembles [energy/ SC] goods or produces components that go into energy products
2. An organization that conducts research and development and related services for [energy/ SC]
3. An organization involved in the wholesale trade and distribution of [energy/ SC] products and services
4. An organization that installs [energy/ SC] systems or provides services for installation of [energy/ SC] systems
5. A public or private utility
6. An organization that provides consulting, engineering, finance, legal, or other professional services related to energy
7. An organization that conducts operations and maintenance (O&M) for [energy/ SC] systems
8. Other support services (Specify: _____)
9. Other (Specify: _____)
10. (DON'T READ) Not sure

[ASK SCREENER G IF MORE THAN ONE SELECTED AT SCREENER F]

- G. Which do you consider your organization's **primary** focus as it relates to the [energy/ SC] industry, based on the labor hours performed at your location
1. An organization that manufactures and/or assembles [energy/ SC] goods or produces components that go into energy products
 2. An organization that conducts research and development and related services for [energy/ SC]
 3. An organization involved in the wholesale trade and distribution of [energy/ SC] products and services
 4. An organization that installs [energy/ SC] systems or provides services for installation of [energy/ SC] systems
 5. A public or private utility
 6. An organization that provides consulting, engineering, finance, legal, or other professional services related to energy
 7. An organization that conducts operations and maintenance (O&M) for [energy/ SC] systems
 8. Other support services (Specify: _____)
 9. Other (Specify: _____)
 10. (DON'T READ) Not sure

SET SGPRIME BASED ON SCREENER G RESPONSE OR SCREENER F RESPONSE IF SCREENER F COUNT=1

IF SGPRIME=4, ASK SCREENER H, OTHERWISE SKIP

- H. Does your organization work on ENERGY STAR certified new home construction?
1. Yes
 2. No
 3. DK/NA
- I. Does your organization work on ENERGY STAR certified buildings and plants (commercial and industrial)?
- a. Yes
 - b. No
 - c. DK/NA
- J. Does your organization have an energy manager or director responsible for energy management at one or more facilities?
- a. Yes
 - b. No
 - c. DK/NA

IF SGPRIME=5, ASK SCREENER K

- K. Does your organization employ workers that are in charge of administering, managing, evaluating, or otherwise working on utility-led energy efficiency programs, rebates, and other activities?
 - a. Yes
 - b. No
 - c. DK/NA

.....
 For this survey, we will just be asking about the employees that work from or directly report to your current location.

- 1. Including all full-time and part-time employees, how many **permanent** employees work at or from your current location?

Record # of employees _____

(DON'T READ) Have check box for Refused

- 2. Based on [Take Q1 #] full-time and part-time permanent employees at your location, how many employees do you expect to have at your location 12 months from now?

- 1 More [record # _____]
- 2 Fewer [record # _____]
- 3 (DON'T READ) Same number
- 4 (DON'T READ) Refused

[If amount differs by 10% or more in either direction, ask:]
 Just to confirm, you currently have ____ permanent employees at your current location and you expect to have ____ (more/fewer) employees, for a total of ____ permanent employees 12 months from now.

- 3. Of the [Take Q1 #] full time and part-time permanent employees at your current location, how many of these workers support the [energy/ SC] portion of your business? Please note that your response should include administrative staff supporting the energy portion of your business.

Record # of employees _____

(DON'T READ) Have check box for Refused

[IF NEEDED: SUPPORT WORKERS ARE DEFINED AS THOSE INDIVIDUALS THAT SPEND ANY AMOUNT OF TIME, DIRECTLY WORKING ON ENERGY RELATED PROJECTS INCLUDING ADMINSTRATIVE SUPPORT WORKERS]

[Q3 SHOULD BE LESS THAN OR EQUAL TO Q1 — BUILD IN CHECK]

- 4. Of your [Take Q3 #] energy staff at your location (office staff and in the field), please classify them into the area where they spent most of their time over the last 12 months. Please count each employee only once.

- a. In-state within your region/metropolitan area [Record #] _____
- b. In-state outside your region/metropolitan area [Record #] _____
- c. Out-of-state [Record #] _____

5. How many full-time and part-time **permanent** employees did you have working at your current location 12 months ago that supported the [energy/ SC] portion of your business?

Record # of employees _____
 (DON'T READ) Have check box for Refused

6. Based on [Take Q3 #] full-time and part-time permanent employees at your location that support the [energy/SC] portion of your business, how many employees do you expect to have at your location 12 months from now?

- 1 More [record # _____]
- 2 Fewer [record # _____]
- 3 (DON'T READ) Same number
- 4 (DON'T READ) Refused

Just to confirm, you currently have ____ permanent employees supporting the energy portion of your business and you expect that number to be ____ (more/fewer) 12 months from now, for a total of ____

7. Thinking of your [INSERT Q3] energy employees, how many spend at least 50% of their time supporting the energy portion of your business?

8. Thinking of your [Q3 ANSWER] energy employees, how many spend all of their time supporting the energy portion of your business?

Record: _____

SECTION 2 – Workforce Profile Questions

If SC COUNT > 1 response, ASK Q9

9. Thinking of your [Take Q3] [energy/ SC] workers at your location, please classify them in the following categories. Please count each employee only once and categorize them in the area where they spend the most time.

PIPE IN SCREENER C RESPONSES

Record # of employees _____

If SC COUNT > 1 response and Q7>0, ASK Q10

10. Thinking of your [Take Q7] [energy/ SC] workers that spend at least 50% of their time supporting the energy portion of your business, please classify them in the following categories. Please count each employee only once and categorize them in the area where they spend the most time.

PIPE IN SCREENER C RESPONSES AND EMPLOYMENT FROM Q8

Record # of employees _____

BUILD CHECK SO TOTAL MUST = Q7

IF SC = 1 and Screener E.A > 1 response, ASK Q11 OTHERWISE SKIP

USE Q3 IN PLACE OF Q9 IF SELECTED COUNT AT SCREENER C WAS ONE (ONE CHOICE)

11. Thinking of your [PIPE IN Q9/Q3 GENERATION ANSWER] energy generation workers at your location, please classify them in the following categories. Please count each employee only once and categorize them in the technology area where they spend the most time.

PIPE IN SCREENER E.A RESPONSES

Record # of employees _____

IF SC = 2 and Screener E.B > 1 response, ASK Q12 OTHERWISE SKIP

12. Thinking of your [PIPE IN Q8/Q3 ELECTRIC POWER TRANSMISSION AND DISTRIBUTION ANSWER] energy transmission, distribution, and storage workers at your location, please classify them in the following categories. Please count each employee only once and categorize them in the technology area where they spend the most time.

PIPE IN SCREENER E.B RESPONSES

Record # of employees _____

IF SC = 3 and Screener E.C > 1 response, ASK Q12 OTHERWISE SKIP

13. Thinking of your [PIPE IN Q9/Q3 STORAGE ANSWER] storage workers at your location, please classify them in the following categories. Please count each employee only once and categorize them in the technology area where they spend the most time.

PIPE IN SCREENER E.C RESPONSES

Record # of employees _____

IF Q13_2(BATTERY STORAGE)>0, ASK Q14

14. Thinking of your [PIPE IN Q13_2 #] battery storage workers at your location, please classify in them in the following categories. Please count each employee only once and categorize them in the battery storage application category where they spend the most time.

1. Consumer devices [Record # of employees]
2. Vehicles or other transportation [Record # of employees]
3. Buildings or industrial facilities [Record # of employees]
4. Electric Grid [Record # of employees]
5. Other (Specify) [Record # of employees]

IF SC = 4 and Screener E.D > 1 response, ASK Q15 OTHERWISE SKIP

15. Thinking of your [PIPE IN Q9/Q3 ENERGY EFFICIENCY, INCLUDING HEATING, COOLING AND BUILDING ENVELOPE ANSWER] energy efficiency, including heating, cooling and building envelope, workers at your location, please classify them in the following categories. Please count each employee only once and categorize them in the technology area where they spend the most time.

PIPE IN SCREENER E.D RESPONSES

Record # of employees _____

IF SC = 5 and Screener E.E > 1 response, ASK Q16 OTHERWISE SKIP

16. Thinking of your [PIPE IN Q9/Q3 FUELS ANSWER] fuels-related workers at your location, please classify them in the following categories. Please count each employee only once and categorize them in the technology area where they spend the most time.

PIPE IN SCREENER E.E RESPONSES

Record # of employees _____

IF SC = 6 and Screener E.F > 1 response, ASK Q17 OTHERWISE SKIP

17. Thinking of your [PIPE IN Q9/Q3 TRANSPORTATION VEHICLES ANSWER] motor-vehicle related workers at your location, please classify them in the following categories. Please count each employee only once and categorize them in the technology area where they spend the most time.

PIPE IN SCREENER E.F RESPONSES

Record # of employees _____

IF SC = 5 and Screener E.G > 1 response, ASK Q18 OTHERWISE SKIP

18. Thinking of your [PIPE IN Q9/Q3 COMPONENT PARTS ANSWER] energy generation workers at your location, please classify them in the following categories. Please count each employee only once and categorize them in the technology area where they spend the most time.

PIPE IN SCREENER E.G RESPONSES

Record # of employees _____

Demographic questions

19. Thinking of your [Take Q3] [energy/ SC] employees, how many are:

- a) Male: Record # employees _____
- b) Female: Record # of employees _____
- c) Gender non-binary: Record # of employees _____
- d) (DON'T READ) Refused

Q19 a+b must = Q3

20. Thinking of your [Take Q3] [energy/ SC] employees, please indicate the ethnicity:

- (a) Hispanic
- (b) Not Hispanic or Latinx
- (c) (DON'T READ) Refused

Q20 a+b must = Q3

21. Thinking of your [Take Q3][energy/SC] employees, please indicate the race and choose all that apply:

- a) American Indian or Alaskan Native: Record # of employees _____
- b) Asian: Record # of employees _____
- c) Black or African American: Record # of employees _____
- d) Native Hawaiian or other Pacific Islander: Record # of employees _____
- e) White Record # of employees _____
- f) Two or more races: Record # of employees _____
- g) (DON'T READ) Refused

Q21 a-f must = Q3

22. Thinking of your [Take Q3] [energy/ SC] employees, how many are:

- a) Veterans of the U.S. Armed Forces Record # of employees _____
- b) 55 and over Record # of employees _____
- c) Union members Record # of employees _____
- d) (DON'T READ) Refused

23. Thinking of the current [Take Q3] [energy/ SC] employees at your location, how many are in the following occupational categories?

(Please only assign one category to each employee that supports the [energy/ SC] portion of your business. If they fall into more than one category, please assign them to the category in which they devote more of their time.)

- a. Production/Manufacturing positions (includes assembly workers and those involved in the design, quality control and manufacturing process)

Record # of employees _____
(DON'T READ) Have check box for Refused

- b. Installation or repair positions (includes technicians, building trades people, and supervisors that are working at project site)

Record # of employees _____
(DON'T READ) Have check box for Refused

- c. Administrative positions (includes customer service representatives, clerks, office and operations support)

Record # of employees _____
(DON'T READ) Have check box for Refused

- d. Management/Professional positions (**does not include** those supervisors that spend a majority of their time at project sites or sales managers)

Record # of employees _____
(DON'T READ) Have check box for Refused

- e. Sales positions (includes cost estimators, sales representatives and sales managers)

Record # of employees _____
(DON'T READ) Have check box for Refused

f. Other (Specify: _____)

Record # of employees _____
 (DON'T READ) Have check box for Refused

(CREATE INTERNAL CONTROL SO Q23 A+B+C+D+E+F EQUALS Q3]

SECTION 3 – Workforce Development & Training Needs

24. How many energy workers have you hired over the last 12 months, either for new positions or to replace former workers?

Record _____

IF Q24>0, ask Q25-28 otherwise SKIP

25. Thinking of the [Insert Q24] energy workers that you have hired at your location over the last 12 months, please indicate your level of difficulty finding qualified applicants to fill the positions.

1. Very difficult
2. Somewhat difficult
3. Not at all difficult
4. DK/NA

IF Q25 = 1 or 2 ask Q26 and Q27, otherwise SKIP

26. What are the two most significant reasons for the reported difficulty? _____

27. Please provide the two most difficult positions for your organization to fill at your location.

28. You reported [insert Q24] additional workers at your organization over the last 12 months. Of these [insert Q24] positions, how many:

- a. Were newly created positions?
 Record # of employees _____
- b. Were existing employees that added energy responsibilities?
 Record # of employees _____
- c. Were hired to replace workers due to turnover or retirement?
 Record # of employees _____
- d. Were positions that required previous work experience related to the position?
 Record # of employees _____
- e. Required a bachelors degree or beyond: _____
 Record # of employees _____

- f. Required an associate degree or academic certificate from an accredited college, but not a bachelors degree: _____
Record # of employees _____
- g. Required a vocational or technical postsecondary certificate or credential: _____
Record # of employees _____

SECTION 3 – Business Questions

27. The following is a list of factors that may contribute to difficulty growing a profitable business. Please rate the significance of each factor. [READ ITEM, THEN SAY] is it very significant, somewhat significant, or not at all significant. [RANDOMIZE]

- a. Lack of capital
- b. Lack of qualified talent
- c. Poor demand
- d. Cost or supply of materials
- e. Permitting delays
- f. Interconnection delays
- g. Policy challenges

28. Please provide any other factors contributing to difficulty growing a profitable business not included above, including any specific policy challenges.]

29. Thinking about your organization's energy related suppliers and vendors, what percent are located (Use numbers to indicate percentages, for instance 20=20%):

- a. In the United States (Enter %) _____
- b. Outside of the United States (Enter %) _____ (WEB ONLY SPECIFY COUNTRIES _____)
- c. DK/NA

IF Q29b>0, ASK Q30

30. What components do you source from suppliers and vendors outside of the United States?

31. Thinking about your organization's energy related customers, what percent are located:

1. In-State (Enter %) _____
2. In a bordering state but out of state (Enter %) _____
3. In the United States, but outside of a bordering state (Enter %) _____
4. Outside of the United States (Enter %) _____ (WEB ONLY SPECIFY COUNTRIES _____)
5. DK/NA

SECTION 5 – Revenue Questions

Ask Q32 if SGPRIME = 3 or 4

32. Can you name any specific rebates or incentives that can reduce the cost of selling, distributing or installing energy for your customers? [Record up to 3]

Record: ____

33. Approximately how much of your organization's work at your current location, in terms of total gross revenue, is related to energy?

Record \$: _____

ASK Q34 if SE has multiple responses, otherwise SKIP

34. Approximately how much of your organization's work at your current location, in terms of total gross revenue, is related to each of the following products or services? (Use numbers to indicate percentages, for instance 20=20%)

1. INSERT SE RESPONSE 1 ____%
2. INSERT SE RESPONSE 2 ____%
3. INSERT SE RESPONSE 3 ____%
4. ...
5. All other revenue not related to energy ____%

Q34 total must equal 100%

SECTION 8 – Technology Specific Questions

ASK Q29 if SDPRIME = 1 & SGPRIME DOES NOT = 5 otherwise SKIP

29. How much of your firm's work, as a percentage of your total gross energy revenue, is attributed to utility projects, including those funded by or owned by utilities?

1. All of it (100%)
2. Half to most of it (50% to 99%)
3. A quarter to almost half of it (25% to 49%)
4. Less than a quarter (1% to 24%)
5. (DON'T READ) DK/NA

ASK Q30 if SDPRIME = 2 and SGPRIME DOES NOT = 5, otherwise SKIP

30. How much of your firm's work, as a percentage of your total revenue related to transportation and distribution of energy, is attributed to utility grid modernization projects, including those funded by or owned by utilities?

1. All of it (100%)
2. Half to most of it (50% to 99%)
3. A quarter to almost half of it (25% to 49%)
4. Less than a quarter (1% to 24%)
5. (DON'T READ) DK/NA

ASK SECTION 6 IF SOLAR=1

SECTION 6 – Solar Questions

IF SGPRIME=1, ASK S1

- S1. Which solar energy components are manufactured at your location? (select all that apply)
[RANDOMIZE]
1. Wafers
 2. Cells
 3. Modules
 4. Inverters
 5. Mounting Structures
 6. Battery Storage
 7. Cables/conduits/wires
 8. Monitoring Systems
 9. Trackers
 10. Other (Specify: _____)
 11. (DON'T READ) Not sure

IF SGPRIME=4, ASK S2 – S7

- S2. Does your location install residential, non-residential, community solar, and/or utility-scale solar systems?
- a) Residential (installed on a single-family home) Y/N
 - b) Non-residential (installed on commercial, industrial, agricultural, school, government, and nonprofit buildings) Y/N
 - c) Community Solar (installations of local solar facilities shared by multiple community subscribers) Y/N
 - d) Utility-scale (installation in which the offtaker of power is a utility-scale or wholesale power market) Y/N
- S3. How many kilowatts (kW) of solar energy has your location installed over the last 12 months? Installed is defined as a completed installation project and does not include projects that have not yet been completed. (NOTE if respondent answers in *megawatts* rather than *kilowatts*, data can be entered as such but please confirm the units the respondent is reporting).

Record ____ kW ____ MW

IF S2= MULTIPLE RESPONSES, ASK S4 and S5 OTHERWISE SKIP

- S4. How many kilowatts (kW) has your location installed in each category? (NOTE if respondent answers in *megawatts* rather than *kilowatts*, data can be entered as such but please confirm the units the respondent is reporting).

[PIPE IN S2 Categories]

- a.) Residential: Record ____ kW ____ MW
- b.) Non-residential: Record ____ kW ____ MW

- c.) Community Solar: Record _____ kW _____ MW
- d.) Utility-scale: Record _____ kW _____ MW

ASK S5-S7 IF Q10_1+Q10_2+Q13_5>0

S5. What percentage of employees work in the following installation categories?

[PIPE IN S2 Categories]

- a.) Residential: [Record %] _____
- b.) Non-residential: [Record %] _____
- c.) Community Solar: [Record %] _____
- d.) Utility-scale: [Record %] _____

S6. Thinking of your [PIPE IN SOLAR EMPLOYMENT] solar staff working in the field, how many work in the following areas relative to your location?

(Please only assign one category to each employee that supports solar portion of your business. If they fall into more than one category, please assign them to the category in which they devote more of their time.)

- a. In the field as non-electrician installers [Record #] _____
- b. In the field as electrician installers [Record #] _____
- c. In the field on operations and maintenance [Record #] _____
- d. On site evaluation, design, and permitting [Record #] _____
- e. On finance, sales, or administrative processes [Record #] _____

S7. Of your installation workers, what percentage are required by state laws to hold either an electrician license or specialty solar license?

[Record %] _____

S8. How do you perceive the licensing requirements in your state impacts the pricing you are able to offer your solar customers?

- a) Impacts very negatively (i.e. increases the cost our customers must pay)
- b) Impacts somewhat negatively
- c) Does not impact positively or negatively (i.e. does not impact the cost our customers must pay)
- d) Impacts somewhat positively
- e) Impacts very positively (i.e. decreases the cost our customers must pay)

IF SEC=2, ASK S9 & S10

S9. Does your location offer residential, non-residential, and/or utility-scale battery storage systems to be collocated with solar systems?

- | | | |
|---------------------|-----|-----|
| a.) Residential | | Y/N |
| b.) Non-residential | Y/N | |
| c.) Utility-scale | | Y/N |

- S10. How many kilowatts (kW) of battery storage collocated with solar systems has your location installed over the last 12 months? (Note if respondent answers in *megawatts* rather than *kilowatts*, data can be entered as such but please confirm the units the respondent is reporting).

Record _____kW____MW

IF SGPRIME=4, ASK S12

- S12. What percent of your employees work primarily in battery storage, including administrative support?

[Record %]_____

- S13. What percentage of your firm's work is outsourced or contracted to a third-party?

[Record %]_____

SUBSECTION FOR SOLAR – WAGE

IF SGPRIME=4, ASK S14 & S15

- S14. Thinking of your full-time employees who are unlicensed installers at your firm, what is the average hourly wage for entry-level installer, mid-level installer, and senior/crew-lead level employees?

- a. Entry-level (Enter \$)_____
- b. Mid-level (Enter \$)_____
- c. Senior/supervisor (Enter \$)_____

- S15. Thinking of your full-time employees who are licensed electrician installers at your firm, what is the average hourly wage for entry-level installer, mid-level installer, and senior/crew-lead level employees?

- a. Entry-level (Enter \$)_____
- b. Mid-level (Enter \$)_____
- c. Senior/supervisor (Enter \$)_____

IF SGPRIME=1, ASK S16

- S16. Thinking of your production/assembly workers at your firm, what is the average hourly wage for entry-level, mid-level, and senior/foreman level employees?

- d. Entry-level (Enter \$)_____
- e. Mid-level (Enter \$)_____
- f. Senior/foreman (Enter \$)_____

IF Q24>0, ASK S17

- S17. You reported [insert Q24] additional workers at your organization over the last 12 months. Of these [insert Q24] positions, how many:

- a. Required an electrician license?
Record # of employees _____
- b. Required specialty solar license?
Record # of employees _____
- c. Required another license?
Record # of employees _____

SECTION 7 – Motor Vehicles & Component Parts

ASK Q31 & 32 if SC=7, OTHERWISE SKIP

ASK Q31 IF SF=1

31. Does your firm manufacture products that are intended to help achieve increasing fuel economy standards, such as:

1. Efficient engines
2. Drivetrains
3. Lightweight materials
4. Low rolling resistant tires
5. Other (Specify)

32. Of your firm's gross revenue related to component parts for transportation vehicles, how much is earned from products that increase fuel economy for vehicles?

1. All of it (100%)
2. Half to most of it (50% to 99%)
3. A quarter to almost half of it (25% to 49%)
4. Less than a quarter (1% to 24%)
5. (DON'T READ) DK/NA

ASK Q33 if SC = 6, otherwise SKIP

33. With which of the following types of transportation vehicles does your firm primarily design, manufacture, sell, repair, or otherwise work with? [SELECT ONE]

1. Automobiles
2. Light Duty Vehicles
3. Heavy Duty Vehicles
4. Industrial Vehicles, such as forklifts
5. Recreational Vehicles, such as golf carts
6. Rail
7. Other (specify _____)

ASK Q34-Q36 if SC = 7, otherwise SKIP

34. Does your firm manufacture, design, sell, and/or distribute parts solely used for alternative vehicles, or vehicles with a fuel source other than gasoline or diesel?

1. Yes
2. No
3. Don't know/ Refused

ASK Q35 IF Q34=1, otherwise SKIP

35. How much of your firm’s work, as a percentage of your total revenue, is attributed to parts solely used for alternative vehicles, or vehicles with a fuel source other than gasoline or diesel?

1. All of it (100%)
2. Half to most of it (50% to 99%)
3. A quarter to almost half of it (25% to 49%)
4. Less than a quarter (1% to 24%)
5. (DON'T READ) DK/NA

36. Thinking of the type of fuel used, does your organization offer parts for any of the following types of transportation vehicles? [ALLOW MULTIPLE]

1. Gasoline and Diesel Motor Vehicles (excluding freight transport)
2. Hybrid Electric Vehicles
3. Plug-In Hybrid Vehicles
4. Electric Vehicles
5. Natural Gas Vehicles
6. Hydrogen Vehicles
7. Fuel Cell Vehicles
8. Other (Specify _____)

IF SCREENER H=1, ASK Q45

37. How many of your [Take Q3#] energy employees work on ENERGY STAR certified new home construction?

Record # of employees: _____

IF SCREENER I=1, ASK Q46

38. How many of your [Take Q3#] energy employees work on ENERGY STAR certified buildings and plants (commercial and industrial)?

Record # of employees: _____

IF SCREENER K=1, ASK Q47

39. How many of your [Take Q3#] energy employees work on administering, managing, evaluating, or otherwise working on utility-led energy efficiency programs, rebates, and other activities?

Record # of employees: _____

IF SOLAR=1, ASK S19 & S20

S22. May The Solar Foundation contact you for follow up if needed?

1. Yes
2. No

S23. Would you like to receive a free copy of the U.S. Solar Market Insight 2018 Year in Review Full Report produced by the Solar Energy Industries Association (SEIA) and Wood MacKenzie Research?

1. Yes
2. No

Thank you for completing the survey. Since it sometimes becomes necessary for the project manager to confirm responses to certain questions, please verify your contact information.

da. First and Last Name (Interview note enter 99 for REF)

1. First Name

2. Last name

db. Position (Interview note enter 99 for REF)

dc. Phone (Interviewer Note 9999999999 for REF)

dd. Email (Interview note enter 99 for REF)

de. Organization Name (Interview note enter 99 for REF)

df. Organization Street Address (Interview note enter 99 for REF)

dg. Organization City (Interview note enter 99 for REF)

dh. Organization State (Interview note enter 99 for REF)

di. Organization Zip (Interviewer Note 99999 for REF)

Thank you very much for your time.

HOW DID THE CALL END?

- 1 COMPLETED INTERVIEW
- 2 SURVEY SAID THEY DID NOT QUALIFY
- 3 CALLBACK NEEDED, PARTIAL
- 4 REFUSAL
- 5 SOMETHING ELSE

PLEASE DISPOSITION CALL CORRECTLY.

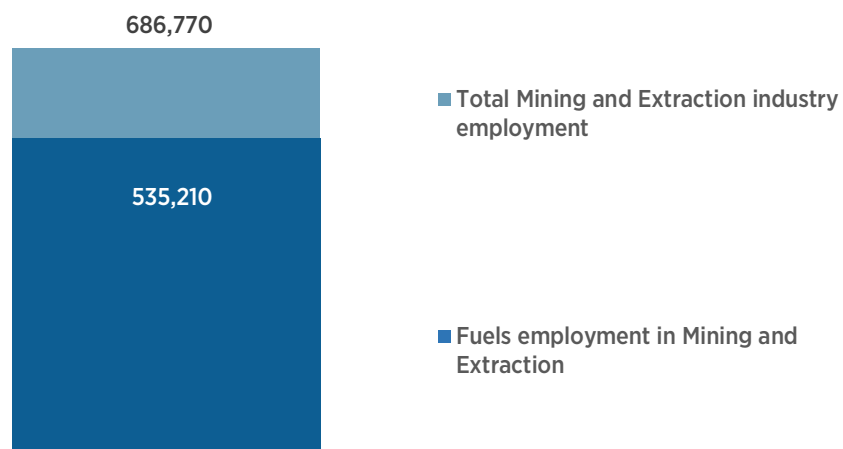
Thank you for your time!

Appendix D: Summary of Energy-Related Employment within Existing Industries by NAICS Codes

NAICS 21: Mining, Quarrying, and Oil and Gas Extraction (Mining and Extraction)

The 2020 USEER survey finds that 535,210 (100 percent in fuels) were associated with the mining and extraction of oil, gas, coal, and nuclear fuel stock in 2019. This represents 78 percent of the total mining and extraction jobs (686,770) in the United States in that year, including support activities for mining (NAICS 213).

Figure 1.
Energy-Related Employment in NAICS 21

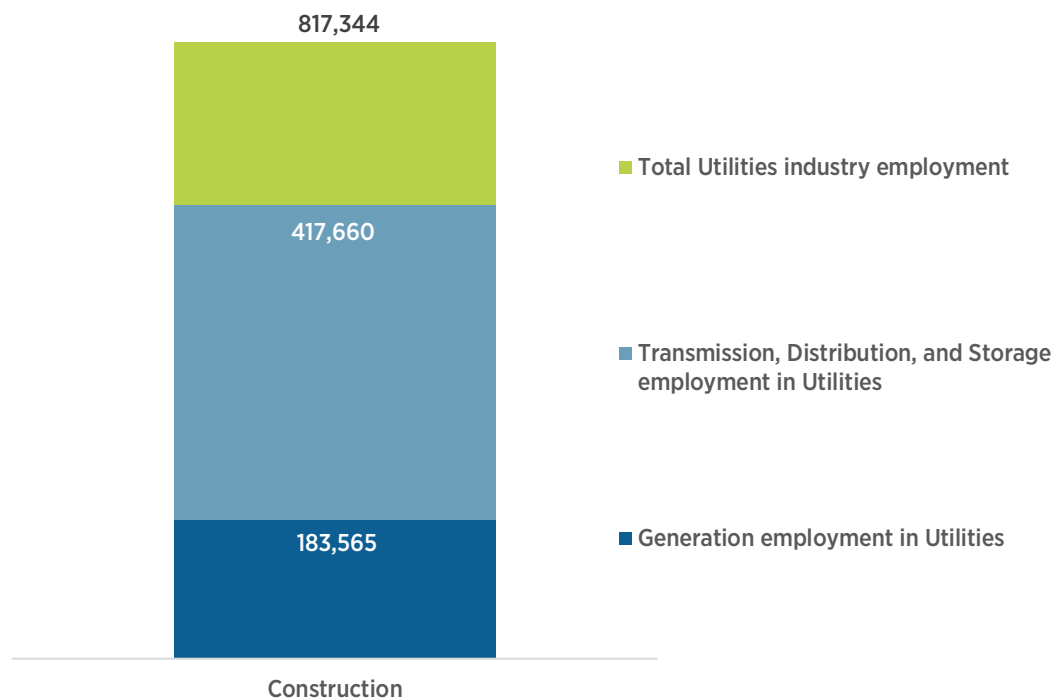


NAICS 22: Utilities

According to the standard industry definitions used by the Census Bureau, the utilities sector comprises establishments engaged in the provision of the following utility services: electric power, natural gas, steam supply, water supply, and sewage removal. Within this sector, the specific activities associated with the utility services provided vary by utility—electric power includes generation, transmission, and distribution; natural gas includes distribution; steam supply includes provision and/or distribution (natural gas transmission lines, however, are included under NAICS 486 Pipeline Transportation); water supply includes treatment and distribution; and sewage removal includes collection, treatment, and disposal of waste through sewer systems and sewage treatment facilities.¹³ This includes generating plants, but excludes waste management services.

Across the United States, utilities employed 817,344 in 2019, with nearly three-quarters working in energy generation, transmission, or distribution.

Figure 2.
Energy-Related Employment in NAICS 22

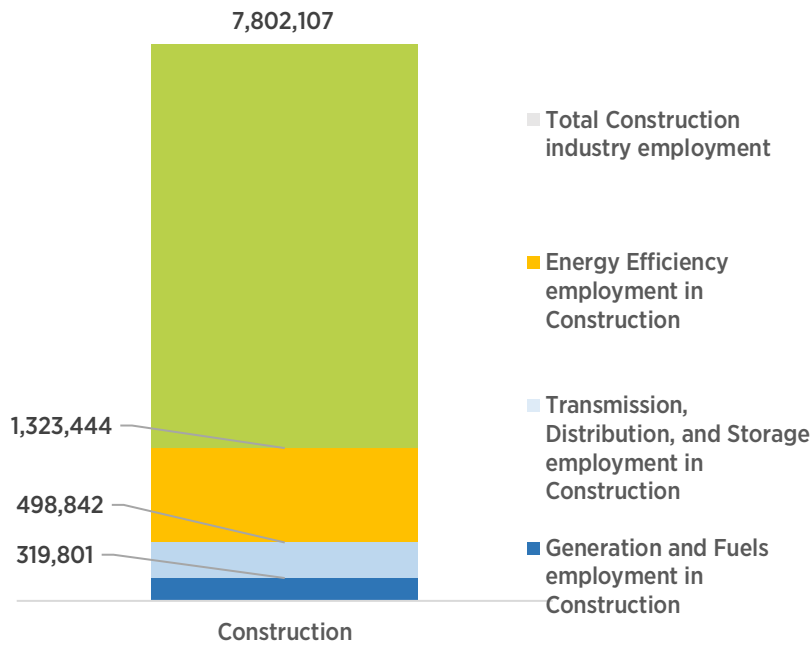


¹³ "Sector 22 - Utilities: The Sector as a Whole," 2017 NAICS Definition, North American Industry Classification System, U.S. Census Bureau, U.S. Department of Commerce, accessed April 13, 2018, <https://www.census.gov/cgi-bin/sssd/naics/naicsrch?code=22&search=2017%20NAICS%20Search>.

NAICS 23: Construction

Energy-related activities contribute significant employment in the construction industry. In 2019, Electric Power Generation and Fuels, and Transmission, Distribution, and Storage represented more than 10 percent of total construction employment in the United States, while Energy Efficiency activities supported an additional 17 percent of the construction workforce.

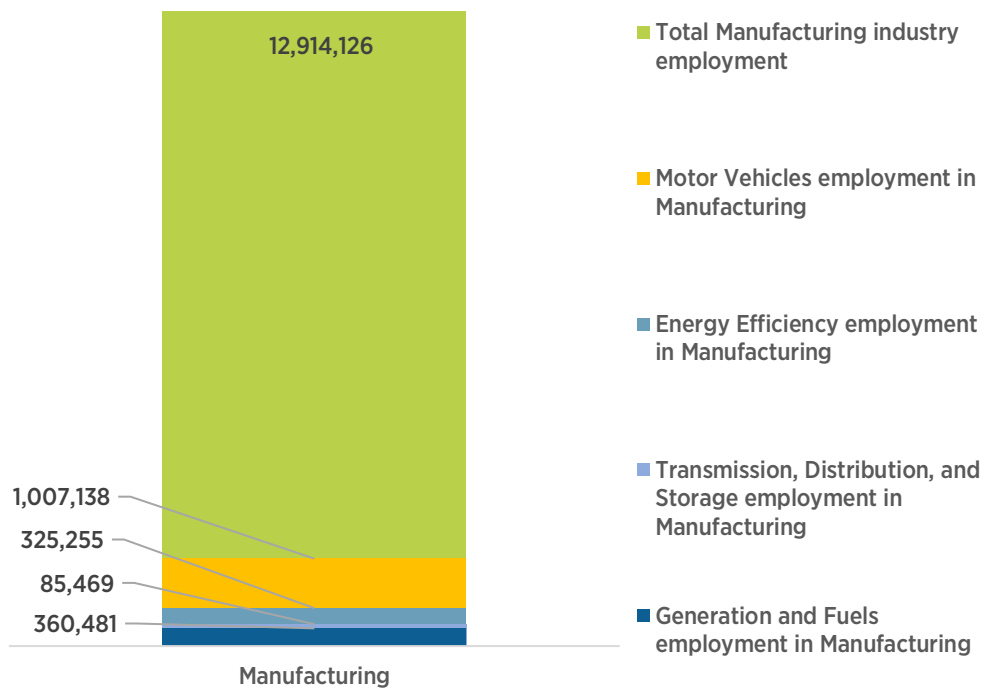
Figure 3.
Energy-Related Employment in NAICS 23



NAICS 31-33: Manufacturing

Manufacturing is an important component of the energy economy, and includes petroleum refining, nuclear enrichment, and component and finished product assembly of solar panels, wind and gas turbines, and mining equipment. In addition to the totals reported in USEER, many additional manufacturing jobs are affected by energy efficiency in their manufacturing processes but are not tracked herein. Traditional Energy sectors (Electric Power Generation and Fuels and Transmission, Distribution, and Storage) accounted for about 3.2 percent of all manufacturing jobs in the United States in 2019. Energy Efficiency product manufacturing (composed of ENERGY STAR products and energy-related building materials, such as insulation) added an additional 2.5 percent and Motor Vehicle and parts manufacturers added a further 7.8 percent.

Figure 4.
Energy Related Employment in NAICS 31-33



NAICS 42, 486, and Commodity Flow Data: Wholesale Trade, Distribution, and Transport (“Wholesale Trade”)

Wholesale trade, distribution, and transport includes wholesale equipment and supplies merchant wholesalers of goods that are linked to the energy industry (including motor vehicles and motor vehicle parts and building materials). Also included in this NAICS category is all employment related to the pipeline transportation of fuels and the transport (via truck, rail, air, and water) of energy commodities such as coal, fuel oil, gas, motor vehicles, and petroleum.

NAICS 51, 52, 53, 54, 55 and 56: Information (Software, etc.), Finance, Insurance, Professional and Business Services (Professional and Business Services)

Professional and business services provide support for energy-related activity in the United States. Firms from this sector are primarily involved in software development and other information services; finance and insurance; real estate and rental and leasing; professional, scientific and technical services; management of companies and enterprises and administrative support; and waste management and remediation services.

NAICS 81: Other Services (Repair and Maintenance/Other)

Other services are important to the energy economy, including repair and maintenance and nonprofit activity. Motor Vehicles accounted for over one-fifth (20.7 percent) of the workforce in the larger industry in 2019, driven by employment in automotive repair and maintenance. Generation and Fuels combined for 1 percent of the overall workforce in other services.

Appendix E: Electric Power Generation and Fuels Employment by Industry

Agriculture and Forestry

The QCEW does not capture a significant portion of agricultural labor. The BLS estimates that its methodologies exclude the majority of agricultural workers (52 percent) due to the nature of the industry. In addition, forestry and logging employment is highly seasonal and relies heavily on unreported subcontractors. The 2019 USEER estimates employment in these segments using a customized model based on inputs on fuel stocks generated by the U.S. Department of Agriculture Economic Research Service (ERS).¹⁴ Based on these inputs, an estimated 35,600 agriculture and forestry employees worked in 2019 to support fuel production.¹⁵

Mining, Extraction, and Utility Generation

About 78 percent of all mining and extraction employment in the United States in 2019 was for fuels used in energy production—this translates to more than 535,000 workers in the second quarter of 2019. These workers support the Fuels industry through crude petroleum¹⁶ and natural gas extraction, as well as surface and underground coal mining.¹⁷

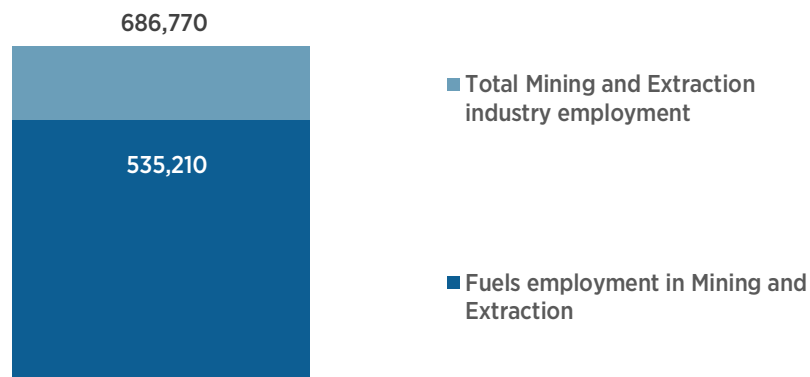
¹⁴ These data can be found in “U.S. Bioenergy Statistics,” Economic Research Service, U.S. Department of Agriculture, <https://www.ers.usda.gov/data-products/us-bioenergy-statistics/>.

¹⁵ Energy and fuel-related agricultural employment was derived using three different calculations for fuelwood, corn ethanol, and biodiesel. The BLS QCEW cover exclusions were used to develop a factor for agricultural worker exclusions and this factor was applied to employment for the NAICS codes specific to each of the three fuel types. Additionally, a technology-specific percentage was derived from ERS estimates for the percentage of total wood, corn, and biodiesel produced that is used for fuel. This percentage was applied together with the exclusion factor to the second-quarter 2019 QCEW employment data for fuelwood NAICS (113110, 113310, 115310), corn ethanol (11115), and biodiesel (11111) to determine the number of workers that are supporting agricultural fuel production.

¹⁶ Petroleum is a liquid mixture of hydrocarbons that is present in certain rock strata and can be extracted and refined to produce fuels including gasoline, kerosene, and diesel oil.

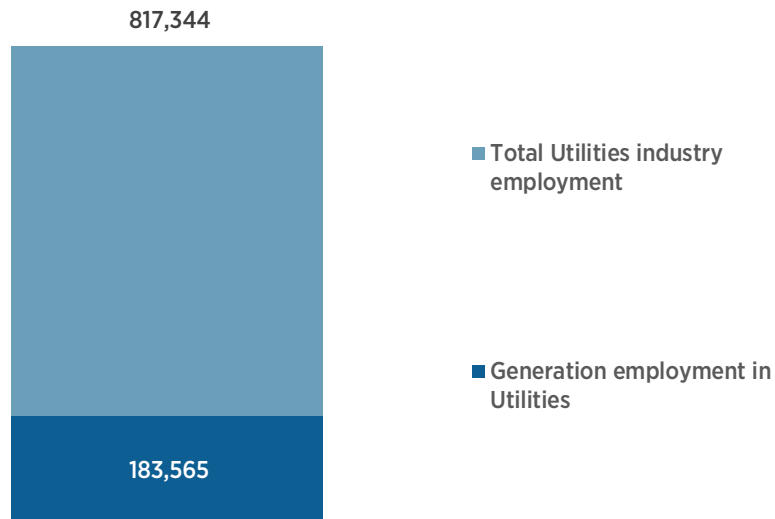
¹⁷ These support workers are specific to fuel mining and extraction, and do not include support for other mining and extraction activities.

Figure 5.
Mining and Extraction Employment, Q2 2019



Electric utility generation (in which the generating equipment is operated by the utility) employed a total of 183,565 workers across hydroelectric, fossil fuel, nuclear, solar, wind, geothermal, biomass, steam and air-conditioning supply (including CHP), and other electric power generation. It is important to note that utility generation employment excludes any utilities that support water supply and irrigation systems or sewage treatment. It also excludes non-utility owned or operated generation from wind, solar, CHP, biomass, nuclear, or fossil fuels.

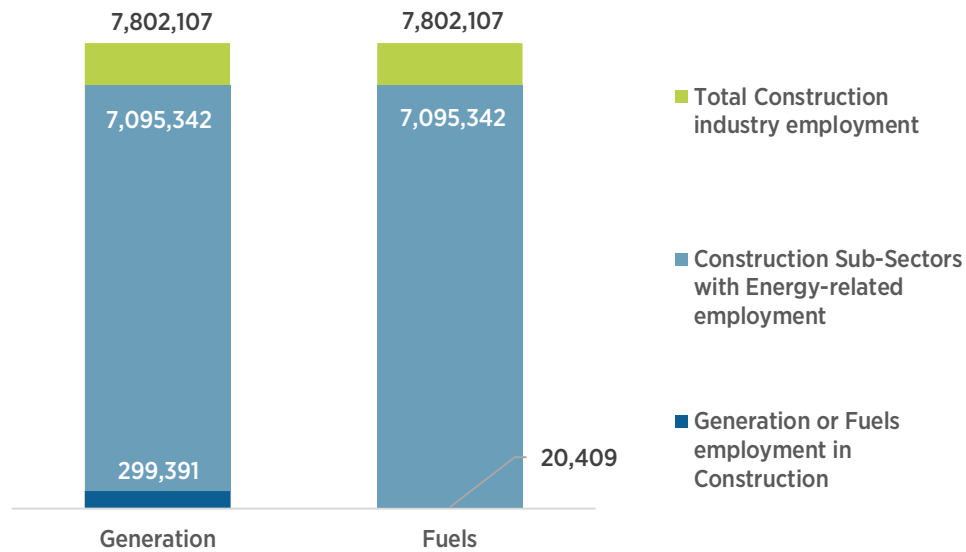
Figure 6.
Utilities Employment, Q2 2019



Construction

Out of 7.8 million construction workers in the United States, roughly ninety-one percent of employment in 2019 was contained in construction subsectors with workers that support energy generation technologies. Within these subsectors, there were 319,801 construction workers that supported both Electric Generation and Fuels production technologies. Ninety-four percent of these employees were engaged in the construction and installation of new electric generation technologies.

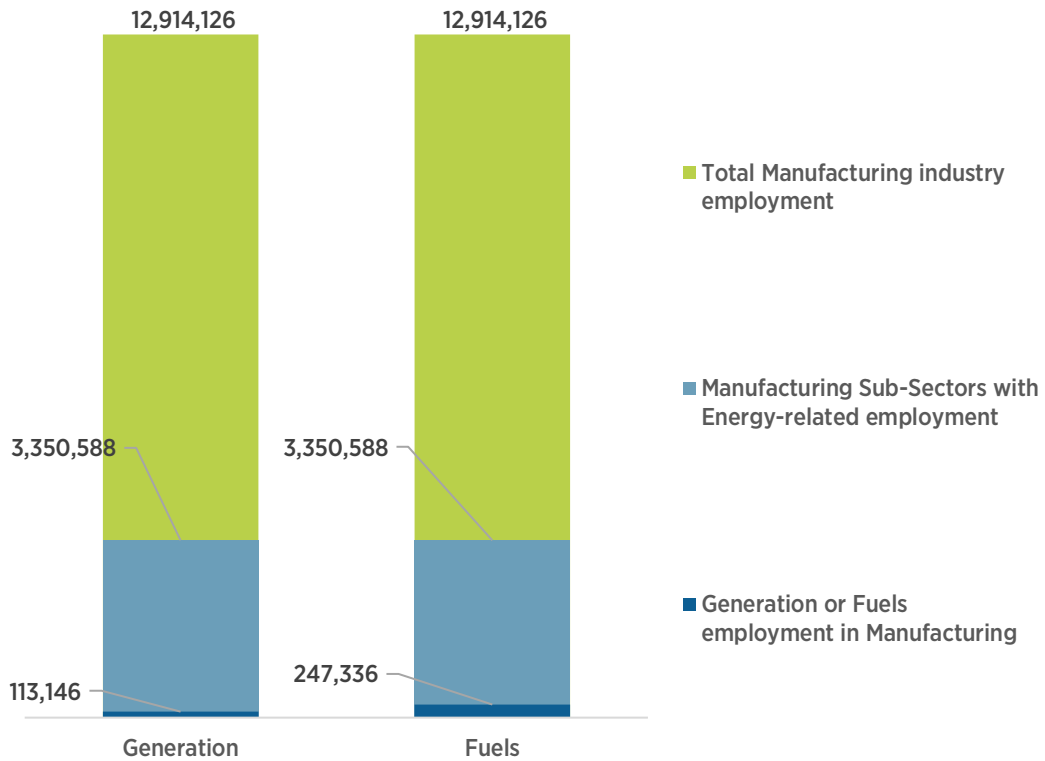
Figure 7.
Construction Employment, Q2 2019



Manufacturing

The national manufacturing industry employed more than 12.9 million workers in 2019. About 25.9 percent of that overall manufacturing employment was comprised of subsectors that could support Electric Power Generation and Fuels technologies, including petrochemical, turbine, and generator manufacturing. These detailed industries accounted for nearly 3,351,000 workers in 2019, more than 7 percent of which supported Fuels. Electric Power Generation and Fuels manufacturers include those firms working on PV arrays, turbine generators, oil and gas field machinery, and other motor or generator manufacturing.

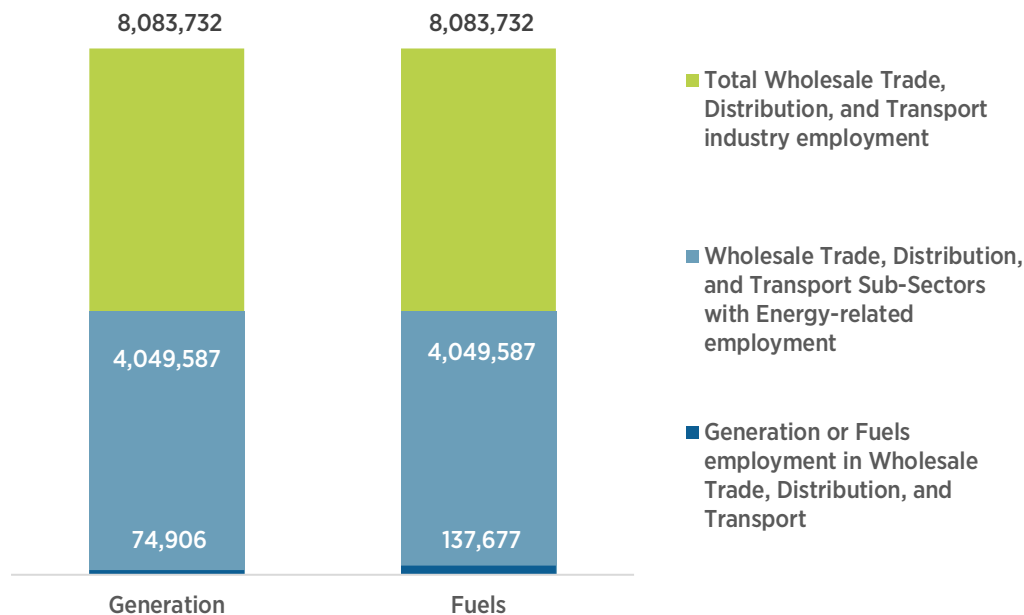
Figure 8.
Manufacturing Employment, Q2 2019



Wholesale Trade

Of the over eight million wholesale trade, distribution, and transport workers in the United States, about 50 percent were working in detailed industries that could support Electric Power Generation and Fuel activities, including electric equipment, chemical, and petroleum merchant wholesalers. Within these wholesale trade, distribution, and transport industries, about 74,906 workers and 137,677 workers, respectively, spent some amount of their time in 2019 supporting the wholesale trade, distribution, and transport of materials or technologies that could support Electric Power Generation and Fuels applications.¹⁸

Figure 9.
Wholesale Trade, Distribution, and Transport Employment, Q2 2019

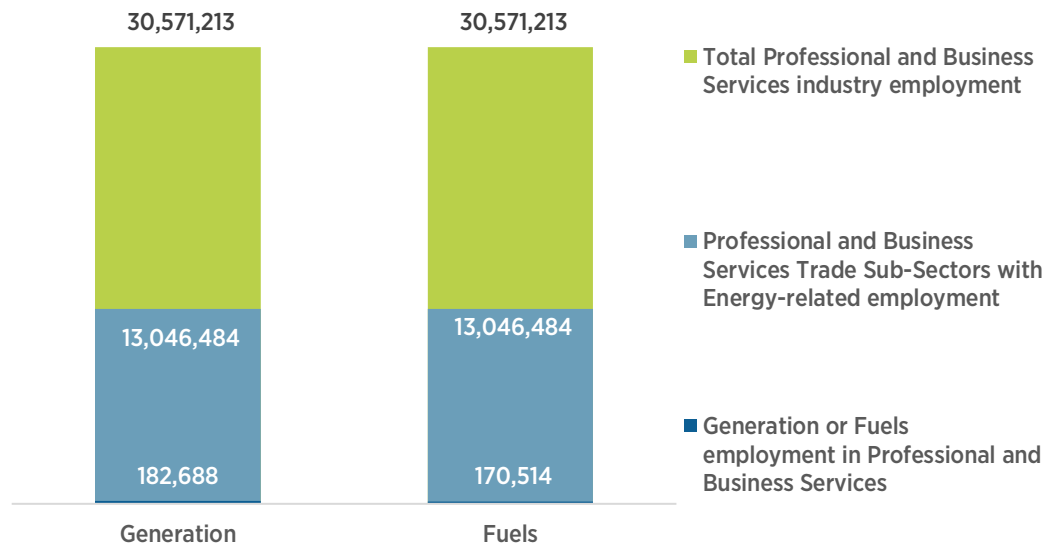


¹⁸ Transmission and trade of fuels are included in the Transmission, Distribution, and Storage chapter.

Professional and Business Services

The professional and business service industry in the United States employed more than 30 million workers in 2019. Within this aggregate industry, several detailed industries supported generation and fuel operations with software, legal services, biotechnology research, architecture, and engineering. Of the more than 13 million jobs in these energy-related professional service industries in 2019, about 182,700 and 170,500 respectively supported Electric Power Generation and Fuels technologies.

Figure 10.
Professional and Business Services Employment, Q2 2019



Appendix F: Transmission, Distribution, and Storage Employment by Industry

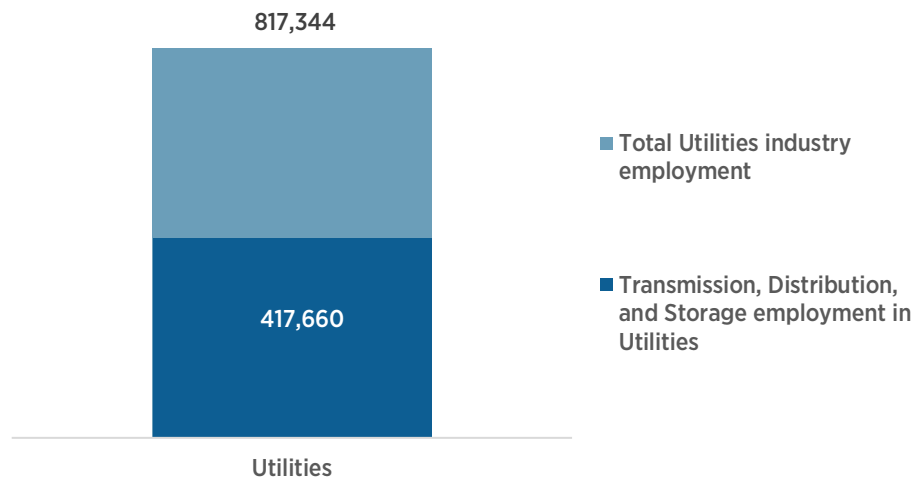
As noted above, Transmission, Distribution, and Storage employed 1,383,646 workers in 2019.

Using survey data, the following sections illustrate a breakdown of sector-wide employment within five broad high-level industry classifications, including construction and manufacturing.

Utilities

Utility companies¹⁹ that employ transmission and distribution workers are captured entirely by their respective detailed NAICS classifications by BLS. Electric power transmission, control, and distribution, natural gas distribution, and steam and air-conditioning supply together employed 417,660 Transmission, Distribution, and Storage workers across U.S. utility generation firms in 2019, roughly flat from 2018. This number represents just over half of energy utility employment nationwide.

Figure 11.
Utilities Employment, Q2 2019

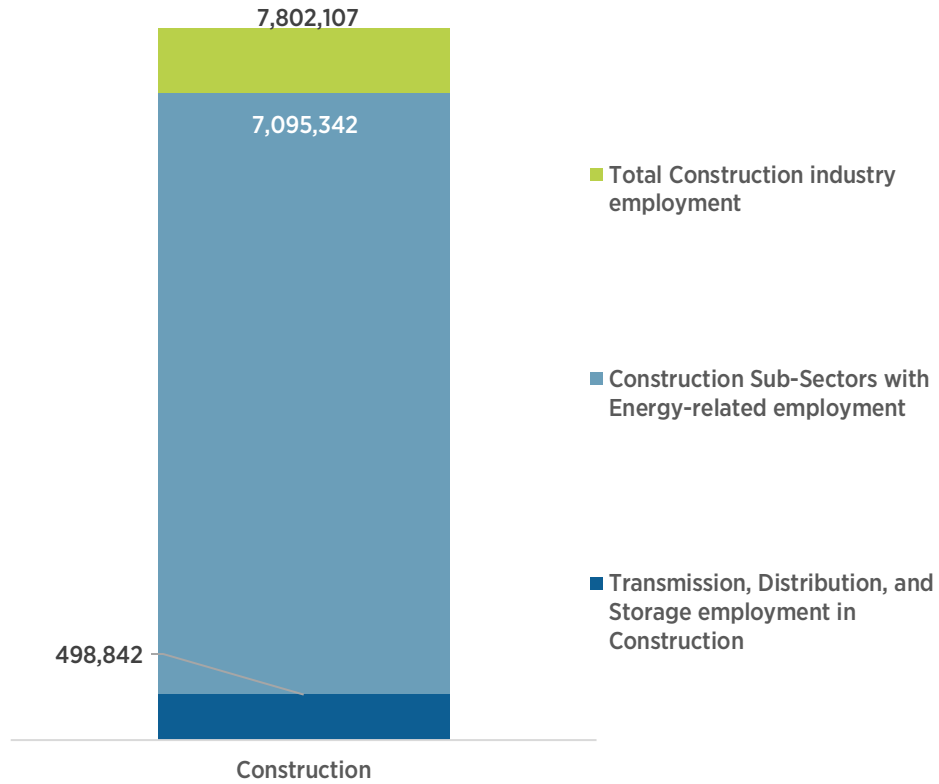


¹⁹ As with all other industries in this report, this chapter relies on NAICS definitions. Utility-scale power generators, for example, are classified as utilities regardless of ownership or regulation.

Construction

Construction firms contributed the most employment to Transmission, Distribution, and Storage activities in 2019, with 498,842 jobs. This work included pipeline and electric transmission and distribution activity, as well as the development of smart and micro grids.

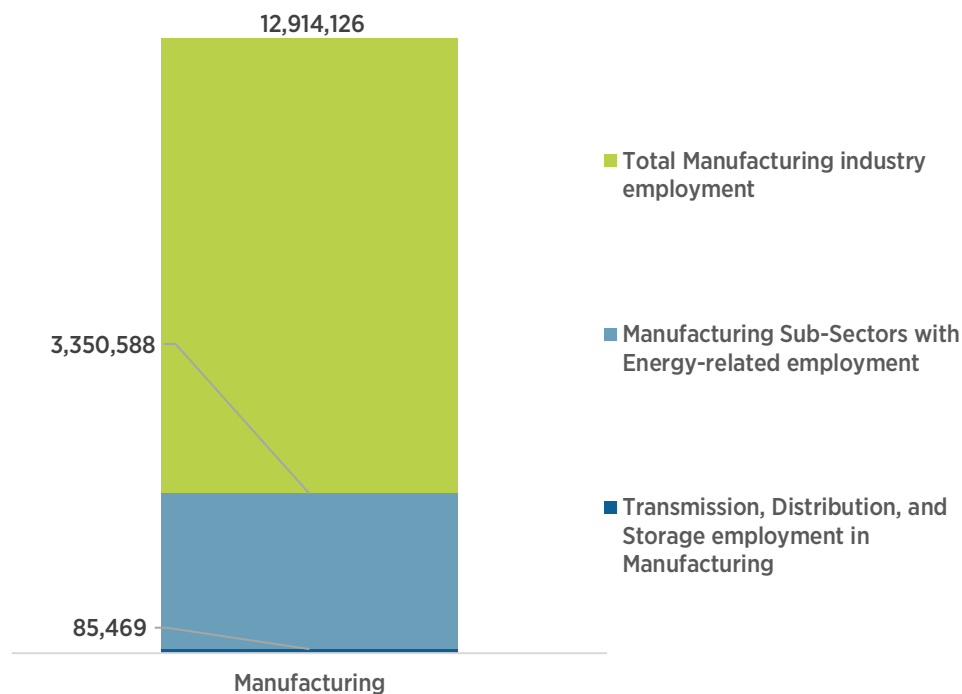
Figure 12.
Construction Employment, Q2 2019



Manufacturing

The manufacturing jobs in Transmission, Distribution, and Storage are found within several energy-related detailed manufacturing industries. These include bulk manufacturing firms that assemble storage batteries, current-carrying wiring devices, air and gas compressors, sheet metal, and other electrical and non-electrical equipment or components. Of the nation's 12.9 million total manufacturing jobs in 2019, almost 26 percent or 3.35 million were contained within such energy-related detailed industries that may support transmission-related infrastructure and 2.6 percent of those, or approximately 85,500 workers, produced products for Transmission, Distribution, and Storage in 2019.

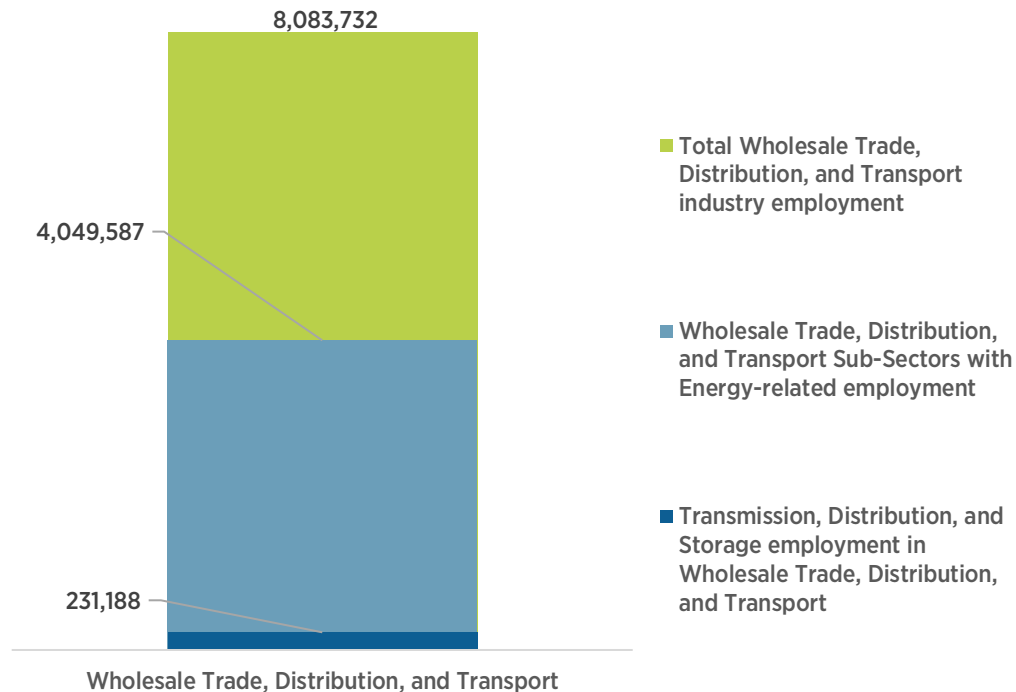
Figure 13.
Manufacturing Employment, Q2 2019



Wholesale Trade

Several industry codes used by BLS capture employment entirely dedicated to the transport of crude oil, natural gas, and other refined petroleum products. About 129,200 jobs were included for 2019 by identifying proportional employment from energy-related commodity data for truck, rail, air, and water transport using the methodology from the first installment of the QER.²⁰ An additional 50,088 jobs identified by the survey are contained within detailed wholesale industries such as electrical equipment, wiring, appliance, and electronics merchant wholesalers. Together, fossil fuel transport and electrical equipment wholesalers employed more than 231,100 Transmission, Distribution, and Storage workers in 2019.²¹

Figure 14.
Wholesale Trade, Q2 2019



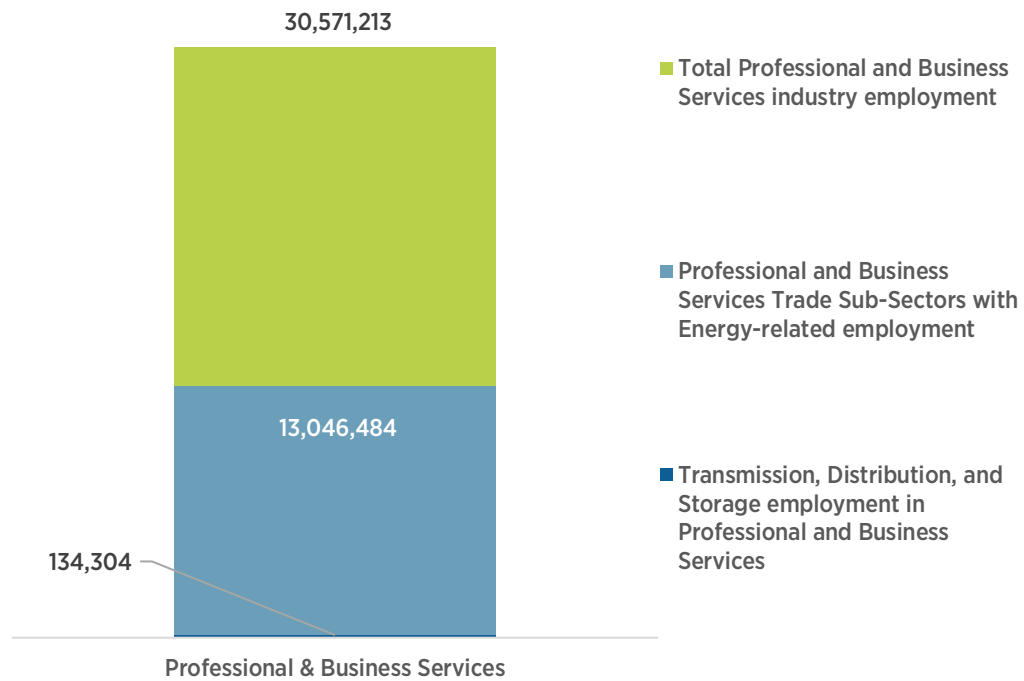
²⁰ For the methodology, see Appendix A: Survey and Analysis Methods.

²¹ This employment figure excludes raw material and component manufacturers; the limitations of a survey-based approach prevents accurate data collection for suppliers that are significantly upstream.

Professional and Business Services

A very small portion (1.0 percent) of energy-related professional and business services support Transmission, Distribution, and Storage infrastructure and technology. Of the nearly 13.1 million workers in these detailed industry codes, the USEER identified about 134,304 workers who spend some of their time supporting these technologies in 2019.

Figure 15.
Professional and Business Services Employment, Q2 2019

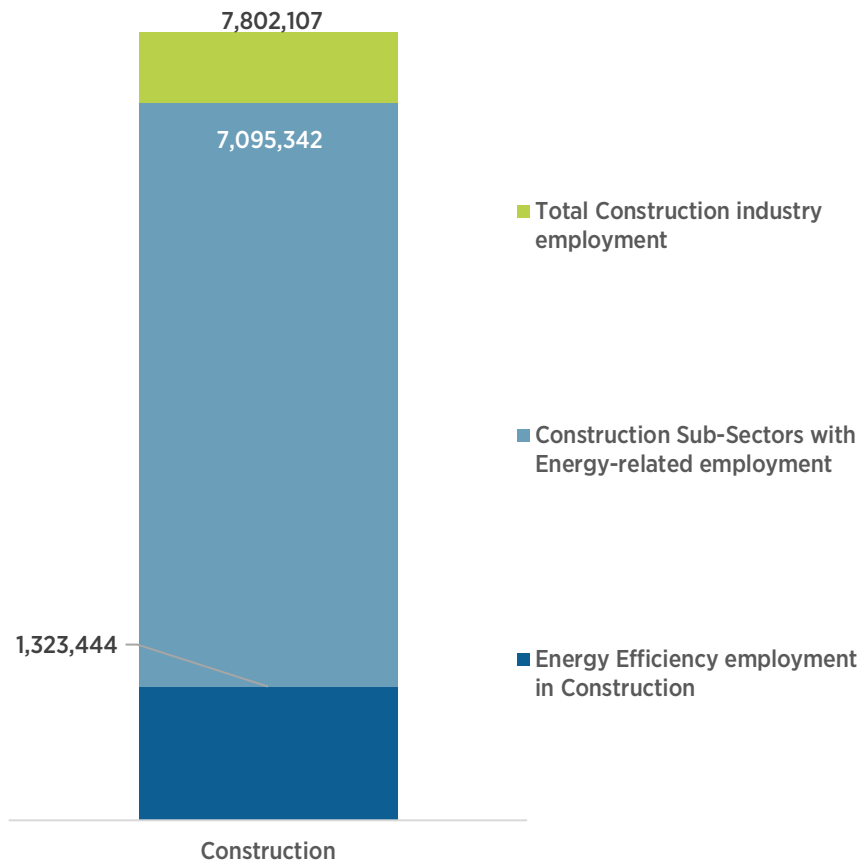


Appendix G: Energy Efficiency Employment by Industry

Construction

The majority of Energy Efficiency employment (56 percent) identified with USEER data is found across construction firms (1.323 million). Of the 7.8 million construction workers in the United States, about 17 percent worked in 2019 to support the construction or installation of energy-efficient technologies.

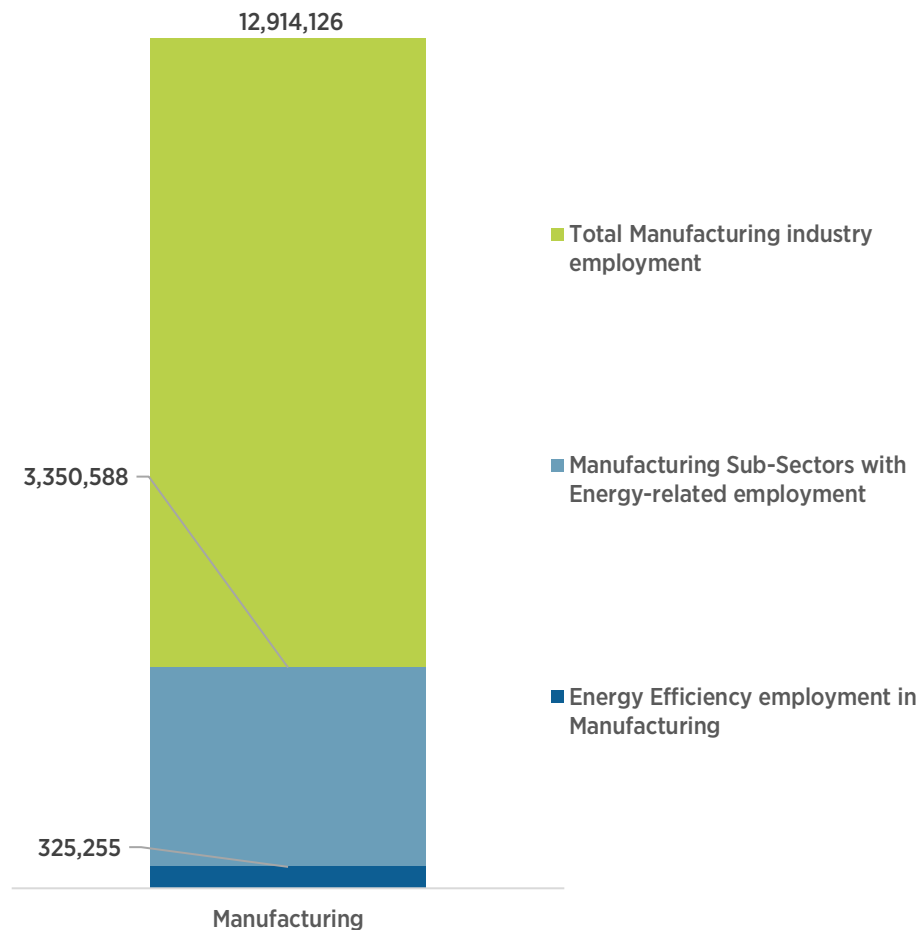
Figure 16.
Construction Employment, Q2 2019



Manufacturing

Manufacturing activity is a sizable portion of the U.S. energy efficiency sector. The jobs included in this chapter refer only to the manufacture of ENERGY STAR-rated appliances or other products such as energy-efficient building and lighting services. They do not include process efficiency (e.g., manufacturers that produce goods using energy-efficient equipment, machinery, or processes). Of the 3,350,588 jobs found in relevant energy manufacturing subsectors in 2019—such as lighting, household appliances, or HVAC equipment manufacturing—about 325,255 workers manufactured energy-efficient products as defined in this chapter.

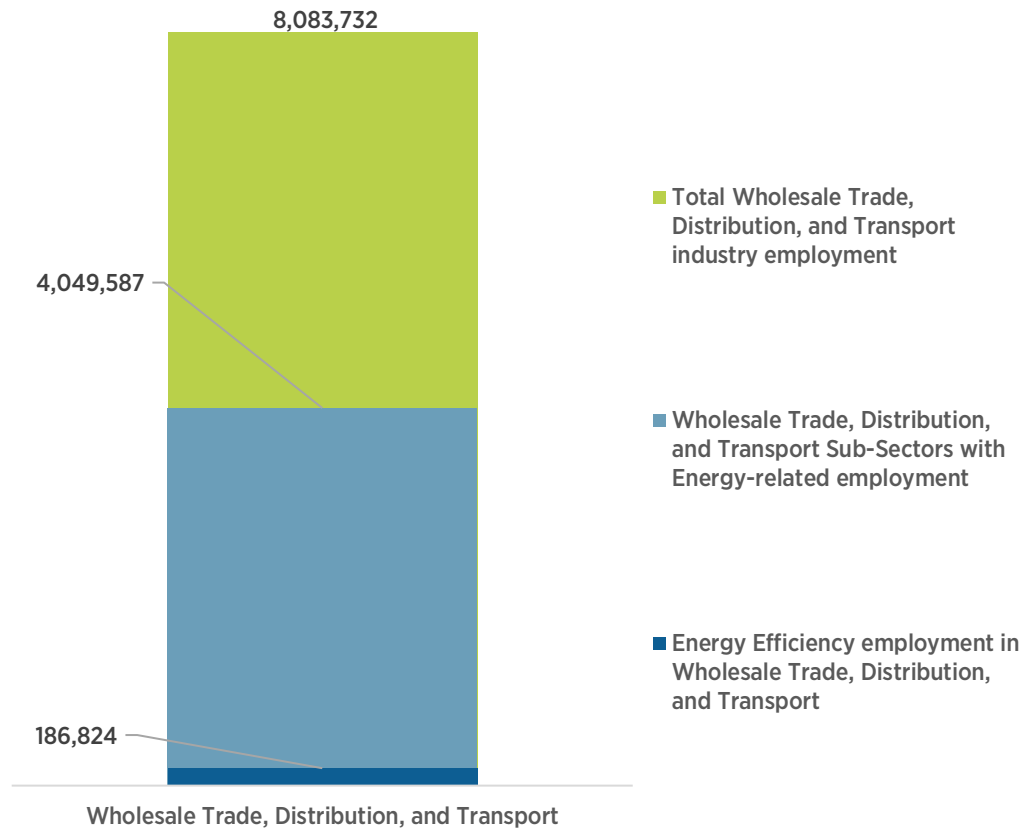
Figure 17.
Manufacturing Employment, Q2 2019



Wholesale Trade

Approximately 50 percent of the eight million wholesale trade, distribution, and transport jobs across the nation were within trade subsectors that support energy-related employment. Of these 4 million jobs, USEER survey data identified about 4.6 percent of workers that were engaged in efficiency-related work in 2019.

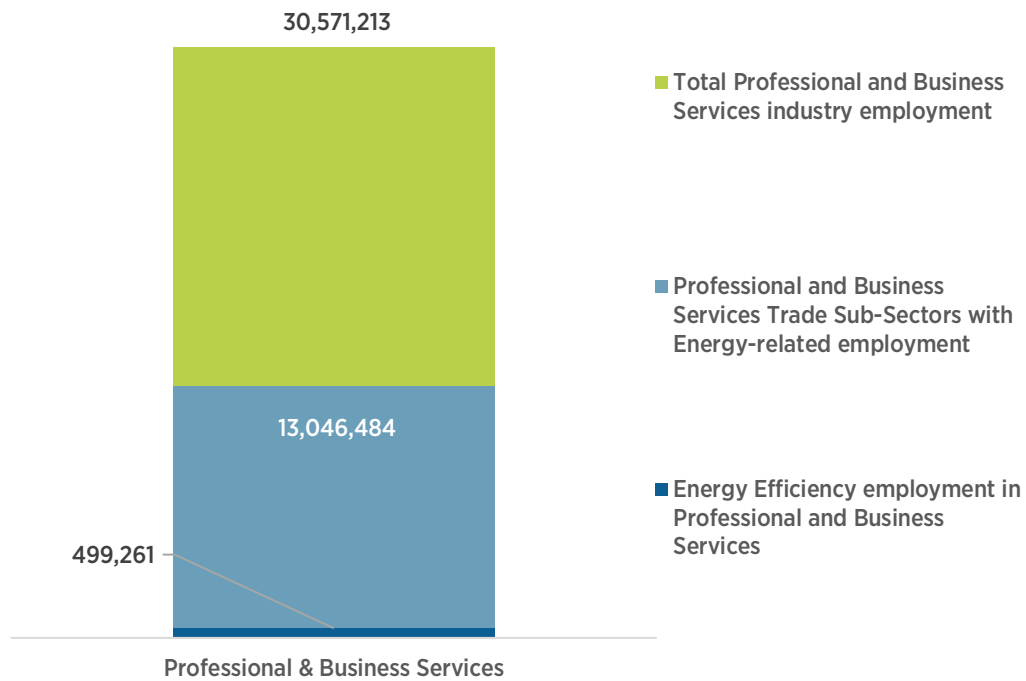
Figure 18.
Wholesale Trade Employment, Q2 2019



Professional and Business Services

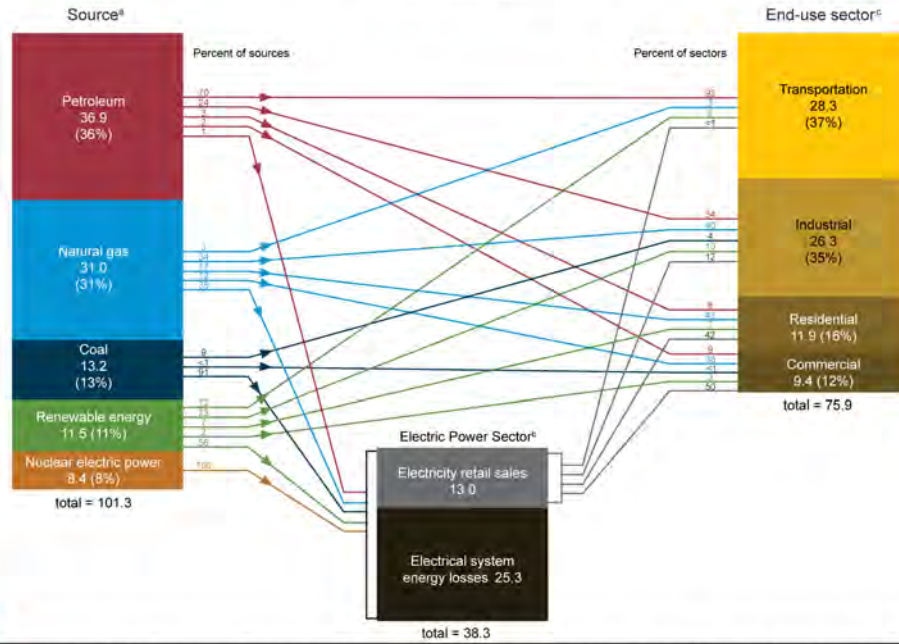
Forty-three percent of professional and business service jobs may support the energy industry through activities including software development, finance, management, and legal services. Of these detailed subsectors, USEER survey data identified nearly 4 percent of employees, or 499,261, who worked to support energy-efficient products and services in 2019.

Figure 19.
Professional and Business Services Employment, Q2 2019



Appendix H: Primary Energy Consumption by Source and Sector, 2018 (Quadrillion Btu)

U.S. energy consumption by source and sector, 2018
(Quadrillion Btu)



^a Primary energy consumption. Each energy source is measured in different physical units and converted to common British thermal units (Btu). See U.S. Energy Information Administration (EIA), *Monthly Energy Review*, Appendix A. Noncombustible renewable energy sources are converted to Btu using the "Fossil Fuel Equivalency Approach", see EIA's *Monthly Energy Review*, Appendix E.

^b The electric power sector includes electricity-only and combined-heat-and-power (CHP) plants whose primary business is to sell electricity, or electricity and heat, to the public. Energy consumed by these plants reflects the approximate heat rates for electricity in EIA's *Monthly Energy Review*, Appendix A. The total includes the heat content of electricity net imports, not shown separately. Electrical system energy losses are calculated as the primary energy consumed by the electric power sector minus the heat

content of electricity retail sales. See Note 1, "Electrical System Energy Losses," at the end of EIA's *Monthly Energy Review*, Section 2.

^c End-use sector consumption of primary energy and electricity retail sales, excluding electrical system energy losses from electricity retail sales. Industrial and commercial sectors consumption includes primary energy consumption by combined-heat-and-power (CHP) and electricity-only plants contained within the sector.

Note: Sum of components may not equal total due to independent rounding. All source and end-use sector consumption data include other energy losses from energy use, transformation, and distribution not separately identified. See "Extended Chart Notes" on next page.

Sources: EIA, *Monthly Energy Review* (April 2019), Tables 1.3, 1.4a, 1.4b, and 2.1-2.6.

Appendix I: ENERGY STAR® Unit Shipment and Market Penetration Report Calendar Year 2017 Summary

For more details:

https://www.energystar.gov/ia/partners/downloads/unit_shipment_data/2017/2017%20Unit%20Shipment%20Data%20Summary%20Report.pdf?f4d7-c3cd

ENERGY STAR® Unit Shipment and Market Penetration Report Calendar Year 2017 Summary

This is the 16th year in which EPA has collected unit shipment data for the ENERGY STAR Program from program partners and/or their representative associations and used it to project the market penetration of ENERGY STAR certified products.

Data:

For 2017, data was collected for the following ENERGY STAR certified products:

- | | |
|--|---|
| • Audio/Video | • Displays |
| • Boilers | • Furnaces |
| • Central Air Conditioners and Air-Source Heat Pumps | • Geothermal Heat Pumps |
| • Ceiling Fans | • Imaging Equipment |
| • Clothes Dryers | • Lamps |
| • Clothes Washers | • Laboratory Grade Refrigerators and Freezers |
| • Commercial Boilers | • Light Commercial HVAC |
| • Commercial Dishwashers | • Luminaires |
| • Commercial Fryers | • Pool Pumps |
| • Commercial Griddles | • Refrigerators and Freezers |
| • Commercial Hot Food Holding Cabinet | • Room Air Cleaners |
| • Commercial Ice Machines | • Room Air Conditioners |
| • Commercial Ovens | • Set-Top Boxes |
| • Commercial Refrigerators and Freezers | • Set-Top Box Service Providers |
| • Commercial Steam Cookers | • Small Network Equipment |
| • Commercial Water Heaters | • Telephony |
| • Computer Servers | • Televisions |
| • Computers | • Uninterruptible Power Supplies |
| • Connected Thermostats | • Vending Machines |
| • Data Center Storage | • Ventilating Fans |
| • Decorative Light Strings | • Water Coolers |
| • Dehumidifiers | • Water Heaters |
| • Dishwashers | |