# U.S. Energy and Employment Report

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NASEO
National Association of State Energy Officials

ENERGY FUTURES INITIATIVE

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*Photos courtesy of the International Brotherhood of Boilermakers (pages 1,12, and 18)*

# About

This work was prepared under a Memorandum of Understanding between the Energy Futures Initiative (EFI) and the National Association of State Energy Officials (NASEO) and a contract between EFI and BW Research Partnership. The survey instrument and underlying methodology is identical to that used in the primary data collected on behalf of the U.S. Department of Energy (OMB Control No. 1910-5179) 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 2017. 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.

# Report Inquiries

For inquiries regarding this report, please contact:

**David Ellis**
Director, Communications and Policy Strategy
**Energy Futures Initiative**
Ddellis@energyfuturesinitiative.org
202-770-8804 (Cell)
202-688-0042 (0ffice)
www.energyfuturesinitiative.org

**Sandy Fazeli**
Managing Director
**National Association of State Energy Officials**
sfazeli@naseo.org
703-299-8800 x 117
www.naseo.org

# 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 over year comparisons in specific sectors, technologies, and industrial classifications at the state and county level.

For information about additional analysis and reports, please contact:

**Energy Futures Initiative:**
**Jeanette Pablo**
General Counsel and Senior Associate
Tel: 202–688-0048
Email: JMPablo@EnergyFuturesInitiative.org

**National Association of State Energy Officials:**
**Sandy Fazeli**
Managing Director
Tel: 703-299- 8800 x 117
Email:SFazeli@NASEO.org

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# Preface

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

- business activities essential to the operation of traditional energy companies 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; and
- jobs associated with energy efficiency.

DOE elected to not undertake a similar report for a 2018 release.

The 2018 USEER has been organized and implemented by the Energy Futures Initiative (EFI) and the National Association of State Energy Officials (NASEO) to provide continuity with the previous editions of the USEER in data collection and the accuracy of year-to-year comparisons. Accordingly, the 2018 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. The data collection for the 2018 USEER was also timed to ensure meaningful year-to-year comparisons with previous reports.

EFI, a nonprofit think tank based in Washington, D.C., and NASEO, a nonprofit association representing the 56 energy offices of the states, territories, and District of Columbia, are pleased to release the 2018 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 rapid change in energy markets. To the greatest extent possible, we have simply updated the job numbers, charts, and employer responses in the 2017 USEER with current survey responses collected in the 4th quarter of 2017. Where necessary, we have provided new, explanatory text.

For many NASEO members, economic development and job creation provide the underpinning for their energy planning and policy development initiatives. Now in its third 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.

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

It is our hope that the 2018 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.

# Executive Summary

# Key Findings

Based on a comprehensive analysis of employer data collected in the fourth quarter of 2017, the 2018 USEER finds that the Traditional Energy and Energy Efficiency sectors in 2017 employed approximately 6.5 million Americans out of a workforce of approximately 145 million. Employment in these sectors increased in 2017 by over 2 percent from the previous year, adding 133,000 net new jobs, nearly 7 percent of all new jobs nationwide.[2]

The 2018 USEER analyzes the following four sectors of the U.S. economy:

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

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

Electric Power Generation and Fuels directly employed more than 1.9 million workers in 2017, up 15,000 jobs from 2016. In 2017, 55 percent, or 1.1 million, of these employees worked in traditional coal, oil, and gas Electric Power Generation and Fuels, while almost 800,000 workers were employed in low-carbon emission generation technologies, including renewables, nuclear, and advanced/low-emission natural gas.

- Within this low-emission category, natural gas, wind, and combined heat and power (CHP) employment increased in 2017, while solar employment declined.
- Solar energy firms employed, in whole or in part, 350,000 individuals in 2017, with more than 250,000 of those employees spending the majority of their time on solar[3] That represents a reduction of 6 percent or 24,000 jobs in solar in 2017, with 9,000 of those reductions in utility-scale solar energy and 15,000 in residential solar energy.
- There were an additional 107,000 workers employed at wind energy firms across the nation in 2017, an increase of just under 6 percent.
- Natural gas employment in Electric Power Generation increased by over 19,000, reflecting that gas now produces more electricity in the United States than any other fuel type.
- Bioenergy and CHP Generation were the fastest growing new sources, increasing employment by over 4000 and 9000 each or 55 percent and 51 percent.
- Coal-fired generation employment held steady at 92,000 jobs.
- Jobs in oil and natural gas extraction and coal mining each increased slightly with oil growing by 1.5 percent.
- Corn ethanol production added almost 6,000 jobs, an increase of over 20 percent.

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[2] Due to differing time frames for the USEER report, the reports on employment in 2015 and 2017 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 first quarter of 2016 and the second quarter of 2017 represented 2.3 percent of all employment growth in the United States. Unless otherwise stated, all increases or decreases described in this report for 2017 (whether whole numbers or percentages) are relative to 2016.

[3] The Solar Foundation 2017 *National Solar Jobs Census*/BW Research Partnership

Transmission, Distribution, and Storage employed more than 2.3 million Americans, with just over 1 million working in retail trade (gasoline stations and fuel dealers) and another 869,000 working across utilities and construction. This represents a net increase of 50,000 jobs.

- Utilities and construction were the two strongest industry sectors in Transmission, Distribution, and Storage, adding over 36,000 new jobs in 2017.
- Excluding the retail trade sector, Transmission, Wholesale Trade, Distribution and Storage firms —our country's energy infrastructure—added a net 16,000 jobs.
- Battery storage added almost 6,000 new jobs for a 12 percent growth rate in 2017.
- Overall, 38 percent of respondent employers working in this sector reported that a majority of their revenues come from grid modernization or other utility-funded modernization projects, an increase of 6.5 percentage points over 2016.

Energy Efficiency employed 2.25 million Americans, in whole or in part, in the design, installation, and manufacture of Energy Efficiency products and services, adding 67,000 net jobs in 2017. Energy Efficiency employment is defined as the production or installation of energy efficiency products certified by the Environmental Protection Agency (EPA) ENERGY STAR[4] program or installed pursuant to the ENERGY STAR program guidelines or supporting services.

- Almost 1.3 million Energy Efficiency jobs are in the construction industry, a decline from 2016. However, Energy Efficiency jobs in manufacturing, trade, and professional services all grew, more than offsetting the decline in construction.
- Construction firms involved in the Energy Efficiency sector continued to experience an increase in the number of their workers who spend at least 50 percent of their time on Energy Efficiency-related work, rising from approximately 797,500 in 2015 to 1.017 million in 2016 and now to nearly 1.024 million in 2017.
- Energy Efficiency professional services added 63,000 jobs.
- Manufacturing jobs, producing ENERGY STAR certified products and energy efficient building materials in the United States, increased by 27,000 jobs or 9 percent.

Motor Vehicles (including component parts) employed over 2.46 million workers, excluding automobile dealerships, adding 29,000 jobs in 2017.

- In 2017, almost 220,000 employees worked with alternative fuels vehicles, including natural gas, hybrids, plug-in hybrids, all-electric, and fuel cell/hydrogen vehicles, a decline of almost 40,000 jobs.
- Hybrids, plug-in hybrids, and all-electric vehicles made up over 90 percent of this number, supporting 197,000 employees. The number of jobs supported by hybrid and plug-in hybrids both declined, while jobs supported by all-electric vehicles rose sharply.

[4] ENERGY STAR is a registered trademark of the EPA.

- Over 476,000 employees of Motor Vehicles component parts companies are now contributing to more fuel-efficient vehicles, a slight decline from 2016.
- Almost one-quarter (23 percent) of all firms involved in Motor Vehicle component parts derive all their revenue from products that increase fuel economy for Motor Vehicles, a significant increase.
- At least 650,000 jobs (26 percent) in the Motor Vehicles sector are focused on increasing fuel economy or transitioning to alternative fuels.[5]

Overall, firms covered by the survey anticipate roughly 6.2 percent employment growth for 2018. Energy Efficiency employers project the highest growth rate over 2018 (9 percent), followed by Electric Power Generation (8 percent); Motor Vehicles (almost 7 percent, including a 6 percent increase in manufacturing), Transmission, Distribution, and Storage (3 percent), and the Fuels sector (2 percent).

These energy-related sectors are relatively less diverse compared to the overall national workforce. Women are a smaller portion of the workforce in these sectors, ranging from 23 percent to 32 percent, compared to the overall economy, where women make up 47 percent of the workforce. The percentage of ethnic and racial minorities is generally lower than the national average for Hispanic or Latino workers (10 percent to 19 percent in energy-related sectors, compared to 17 percent in the overall economy) and Black or African American workers (5 to 9 percent in energy-related sectors, compared to 12 percent in the overall economy). Veterans, however, comprise from nine to 11 percent of these sectors—higher than the national average of 6 percent. Between 11 percent and 24 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.

Just over 70 percent of employers across these sectors (70.2 percent) reported difficulty hiring qualified workers over the last 12 months, a decline of 3 percentage points from 2016; 26 percent continued to note it was "very difficult."

# Methodology

The USEER provides a quantitative lens with which to evaluate the employment impact of new energy technologies, shifting fuels deployment, and evolving transmission and distribution systems. It also presents a unique snapshot of energy efficiency employment in key sectors of the economy, including construction and manufacturing. Finally, the report illustrates how fuel efficiency as well as new technologies and materials affect employment in the motor vehicle industry.

The USEER examines four sectors of the economy: Electric Power Generation and Fuels; Transmission, Distribution, and Storage; Energy Efficiency; and Motor Vehicles. The first two of these sectors—Electric Power Generation and Fuels and Transmission,

[5] This number assumes that the percentage of employment working on component parts to improve fuel economy is the same for gasoline/diesel vehicles and alternative fuel vehicles.

Distribution, and Storage—make up what are generally considered the Traditional Energy sectors. Energy Efficiency cuts across a range of occupations, especially construction and professional services, but includes manufacturing as well. The Motor Vehicles industry is included because its products play a special role in modern society's use of energy—with transportation in 2017 representing 70.6 percent of U.S. daily petroleum consumption and 28.8 percent of total U.S. energy use.[6] For this reason, a complete report on energy and employment should describe how the motor vehicle industry is changing by vehicle fuel type and efficiency. The 2018 USEER also covers the component parts industry for Motor Vehicles, to understand the role of fuel efficiency on employment throughout the supply chain for Motor Vehicles.

Current labor market data from the Bureau of Labor Statistics (BLS) Quarterly Census of Employment and Wages (QCEW) track employment across many energy production, transmission, and distribution subsectors. These include, for example, utility generation; oil, gas, and coal extraction; electrical generation manufacturing[7]; and transmission. One challenge to using QCEW data to track energy jobs is that the industry classification structure used in data collection for the QCEW places some of the nation's energy and energy efficiency work in broad and non-energy-specific industry classifications, including construction, wholesale trade, and professional services. Within these latter classifications, some subsectors contain both energy-related and non-energy-related jobs. Analyzing these industry subsectors is particularly important, though, in understanding employment trends in newer technologies such as wind, solar, geothermal, biomass, and hydrogen and fuel cells, as well as new energy infrastructure, including electricity storage and the smart grid.[8] The same problem exists in established technologies where, for example, the jobs created by the construction of a new gas-fired power plant are classified as construction, manufacturing, and professional services positions. These industry subsector analyses also provide insight into the distribution of the Energy Efficiency workforce as well as the role of new technologies in a rapidly evolving Motor Vehicles industry.

To enhance QCEW data, BLS conducts two supplemental surveys. The first is the Multiple Worksite Report (MWR), which is collected each quarter to disaggregate the employment and wages of numerous establishments owned by a single employer into their individual worksite locations. This survey allows the employment and wages for each worksite location to be placed in their correct industrial and geographical category, thereby improving the accuracy of QCEW data. Thus, with the MWR, new business births and deaths, and their associated employment are identified each quarter in a timely manner. This rapid identification of births and deaths improves the QCEW. The second survey is the Annual Refiling Survey (ARS), which is conducted each year to update the classification codes (industrial, geographical, and ownership) currently assigned to the

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[6] U.S. Department of Energy, Energy Information Administration [EIA], *Monthly Energy Review*, March 27, 2018, Tables 3.7a through 3.7c and Table 2.1, https://www.eia.gov/totalenergy/data/monthly/pdf/mer.pdf.

[7] Includes the manufacture of solar PV panels, wind turbines, etc., and components for other generation technologies.

[8] The report does not detail employment related to power generation from hydrogen and fuel cells. Fuel cell manufacturing and employment have experienced a high rate of growth in the production of fuel cells for stationary, CHP, and backup applications. These new areas of employment growth may be addressed in future reports.

establishments in the QCEW. The ARS and code updates ensure the accuracy of detailed industry and geographic (such as county-level) data.[9]

In a time of rapid technological change that affects how society produces and uses energy, the approaches described above—including subsector analyses and additional data collection—are helpful in understanding the relationship between energy and employment. As with the 2017 USEERs, the 2018 USEER relies on a unique supplemental survey, created and conducted by BW Research and approved by the Office of Management and Budget and U.S. Department of Energy, to identify energy-related employment within key subsectors of the broader industries as classified by the BLS and to assign them into their component energy and energy efficiency sectors. The BW Research Survey (BWRSS) and associated analysis are not a replacement for existing BLS employment data; instead, they provide an additional lens with which to refine and evaluate the role of Traditional Energy, Energy Efficiency, and Motor Vehicles within the labor market as a whole. (For more information on the BW Research Supplemental Survey, please see Appendix A.)

It is important to note that the employment figures reported in the USEER refer only to direct employment and not to indirect employment or induced employment.[10] The methodology for this report is consistent with prior releases, using DOE definitions and programs, as well as with current QCEW and other BLS practices.

It is also important to note that the USEER is not a policy or scenario analysis. It does not attempt to measure the impacts of various energy policy approaches on employment. For example, if the ENERGY STAR program were to be discontinued, this report explicitly does not claim that the efficiency jobs identified as associated with ENERGY STAR products would be destroyed. Instead, the USEER acts more like a jobs census, seeking to clearly identify and quantify employment in various occupations, some of which (particularly in Energy Efficiency) do not have existing industrial categories in federal government data and which have thus not been included in federal government statistics.

The USEER provides a unique, snapshot of the intersection of our energy and employment systems. Future reports will be expanded and deepened to record this dynamic interaction between technology, energy, and employment in our nation's economy.

[10] A direct job is created by the firm specific to the industry, while indirect jobs support these firms via supply or contracting services. Induced jobs are a result of the economic impact of direct and indirect employees spending their earnings.

# Introduction

# Overview

The U.S. energy system continues to evolve. Technological innovation, expanded production, gains in efficiency, and changing business models have resulted in changes in employment that are increasingly difficult to track. The diversity and breadth of energy industries across the United States create significant challenges for economic modeling and traditional labor market data collection. While many of its segments, such as utility-scale power generation, fossil fuel extraction, and electric and gas transmission and distribution, are inarguably part of the energy sector, other activities (such as storage technologies and energy efficiency products and services) are difficult to define and isolate from other sectors of the economy.

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.[11]

Given the complex relationship between energy and the overall economy, the 2018 USEER utilized the BWRSS to investigate[12] the two Traditional Energy sectors—Electric Power Generation and 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 2018 USEER relies on the BWRSS, a comprehensive survey of 23,000 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 2017 employment data from

[11] DOE, Quadrennial Energy Review: Energy Transmission, Storage, and Distribution Infrastructure, 8-7.

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 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.[13]

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 consumption[14] in the United States is divided among four sectors: Electric Power Sector (38.2 percent), Residential and Commercial Buildings (10.6 percent), Industrial (22.4 percent), and Transportation (28.7 percent). This distribution of energy consumption by sector is based on total 2017 estimates published by the Energy Information Administration (EIA).[15]

End-use electricity consumption, in turn, is divided with 74.1 percent consumed by Residential and Commercial Buildings, 25.7 percent by Industrial; and 0.2 percent by Transportation.[16] Thus, Residential and Commercial Buildings consumed 38.9 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).[17]

As with the 2017 report, the 2018 USEER captures only energy efficiency products certified by the EPA ENERGY STAR program or installed pursuant to the ENERGY STAR program guidelines. Thus, the Energy Efficiency employment figures encompass work with efficient technologies or building design and retrofits. The USEER does not capture employment related to energy-efficient manufacturing processes (such as a manufacturing engineer designing process improvements to reduce energy consumption) or energy efficiency in the production of electricity itself. Future USEERs may address this gap; in the meantime, the Energy Productivity and Economic Prosperity Index provides insight into these areas.[18]

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[13] 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.

[14] 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.

[15] EIA, *Monthly Energy Review*, Table 2.1. Percentages are based on primary energy consumption in 2017 and do not add up to 100.0 percent due to rounding.

[16] EIA, *Monthly Energy Review*, Table 7.6. Percentages of retail electricity sales in 2017.

[17] EIA, *Monthly Energy Review*, Table 2.1. Percentage based on total energy consumption in 2017.

[18] Kornelis Blok, Paul Hofheinz, and John Kerkhoven, The 2015 Energy Productivity and Economic Prosperity Index: How Efficiency Will Drive Growth, Create Jobs and Spread Wellbeing Throughout Society (Brussels: The Lisbon Council for Economic Competitiveness and Social Renewal, 2015), https://www.ecofys.com/files/files/the-2015-energy-productivity-and-economic-prosperity-index.pdf.

Motor Vehicles are included in this report primarily due to their intensive use of energy and contribution to carbon emissions.[19] 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. For the first time this year, 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 28.7 percent of U.S. primary energy consumption in 2017;[20] in 2017, 70.6 percent of overall U.S. petroleum consumption was attributable to the transportation sector.[21]

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 BWRSS 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.[22]

# Energy-Related Employment Within Existing Industries, by NAICS Codes

### NAICS 21: Mining, Quarrying, and Oil and Gas Extraction (Mining and Extraction)

The 2018 USEER survey finds that 486,459 jobs (100 percent in fuels) were associated with the mining and extraction of oil, gas, coal, and nuclear fuel stock in 2017. This represents 77 percent of the total mining and extraction jobs (629,453) in the United States in that year, including support activities for mining (NAICS 213).

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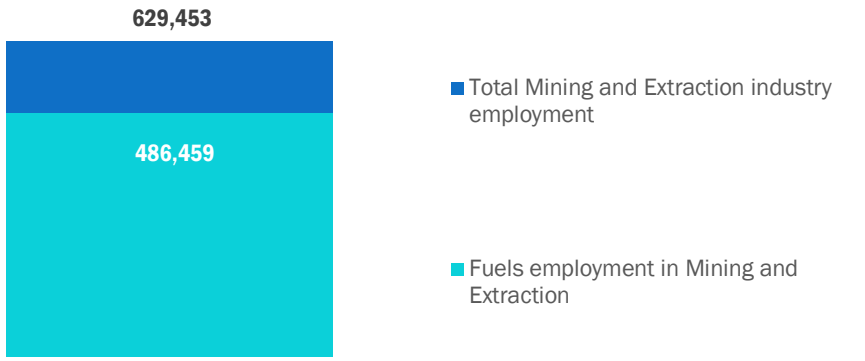
[19] The USEER covers motor vehicle employment across vehicle parts manufacturing, automotive repair and maintenance, as well as vehicle, parts, and supplies wholesalers, including air, rail, water, and truck transportation of motor vehicle parts and supplies. It does not capture jobs associated with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

[20] EIA, Monthly Energy Review, Table 2.1.

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

[22] 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.

Figure 1.
Energy-Related Employment in NAICS 21

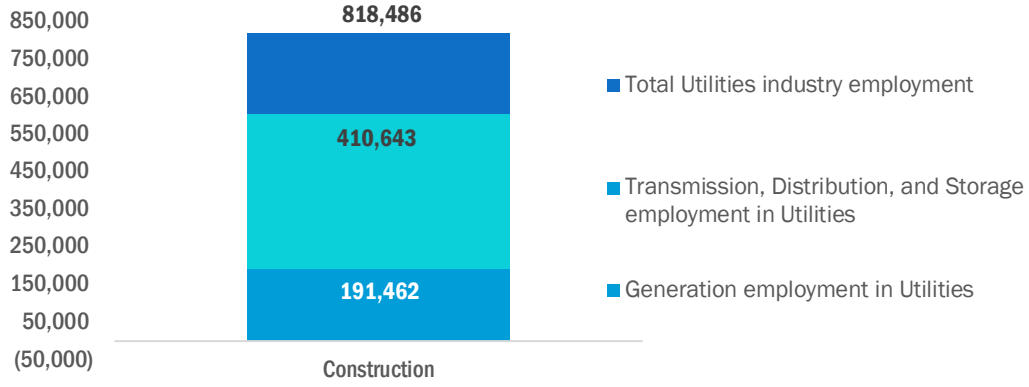



## NAICS 22: Utilities

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.[23] This includes generating plants, but excludes waste management services.

Across the United States, utilities employed 818,486 in 2017, with nearly three-quarters working in energy generation, transmission, or distribution.

Figure 2.
Energy-Related Employment in NAICS 22

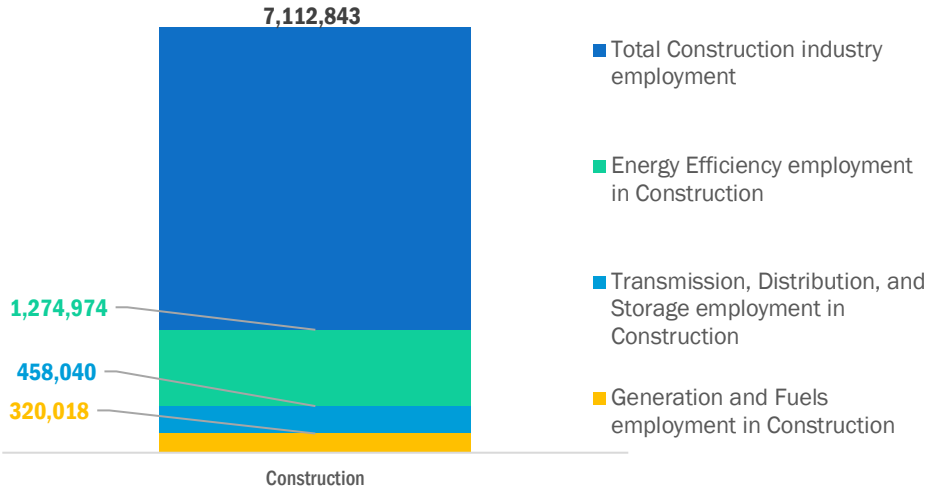



[23] "Sector 22 – Utilities: The Sector as a Whole," 2017 NAICS Definition, North American Industry Classification System, U.S. Census Bureau, U.S. Department of Commerce, accessed April 13, 2018, https://www.census.gov/cgi-bin/sssd/naics/naicsrch?code=22&search=2017%20NAICS%20Search.

## NAICS 23: Construction

Energy-related activities contribute significant employment in the construction industry. In 2017, Electric Power Generation and Fuels, and Transmission, Distribution, and Storage represented approximately 11 percent of total construction employment in the United States, while Energy Efficiency activities supported an additional 18 percent of the construction workforce.

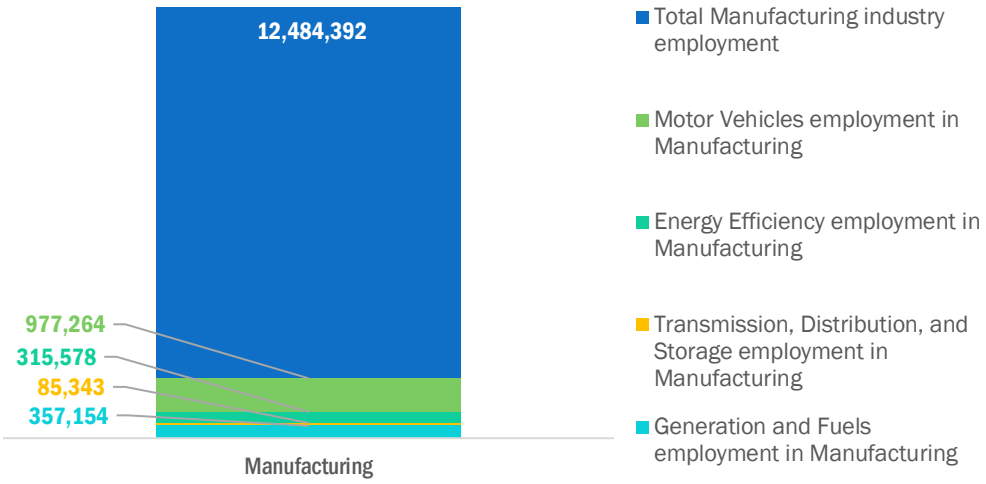
**Figure 3.**
**Energy-Related Employment in NAICS 23**




## 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 3.5 percent of all manufacturing jobs in the United States in 2017. 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. In 2017, Energy Efficiency contributed approximately 1.4 percent of the workforce in this large, diverse sector.

### 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 (20.9 percent) of the workforce in the larger industry in 2017, driven by employment in automotive repair and maintenance. Generation and Fuels combined for just under 1 percent of the overall workforce in other services.

# How to Use this Report

The 2018 USEER is organized into four chapters. The first two chapters—representing Electric Power Generation and Fuels and Transmission, Distribution, and Storage—describe Traditional Energy jobs, from fuel extraction to processing, generation, transmission, and distribution. These chapters include fossil, nuclear, and renewable energy sources and their value chains. The report also includes two sectors selected for their importance to energy demand: Energy Efficiency and Motor Vehicles.

Using the NAICS framework and building the sample frame using establishment totals from the QCEW allows for more accurate and efficient data collection and analysis. Further, it accommodates changes in business models. If a utility, for example, outsources a portion of its activities to a construction firm, USEER's methodology allows for those jobs to continue to be counted and tracked.

At the same time, employment is allocated based on NAICS industries only. In the utility-outsourcing example used above, the USEER would still count the jobs as energy employment but would allocate those jobs to construction rather than utilities. Because the supplemental survey captures employment across a wide range of activities and industries, the report includes more than a million jobs that would not otherwise be identified as part of the Traditional Energy sectors.

The BWRSS is conducted using a stratified sampling method, which relies on survey quotas based on specific characteristics of companies, to ensure representation. BW Research uses three characteristics in this sampling plan: (1) NAICS industry, (2) state location, and (3) company size. (For more information on the BWRSS, please see Appendix A.)

# Electric Power Generation & Fuels

# Introduction

Electric Power Generation and Fuels employment covers the entire range of business activities that support both fuel extraction and production, as well as utility-scale and distributed electric power generation. For purposes of clarity, Electric Power Generation and Fuels are disaggregated for further analysis in the 2018 USEER. Some industries such as natural gas and petroleum include employment in Electric Power Generation, Fuels, and Transmission and Distribution. However, the Transmission and Distribution numbers have not been disaggregated by fuel type and are included in a separate chapter.

- Electric Power Generation 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, as well as wholesale parts distribution of all electric generation technologies.
- Fuels employment encompasses all work related to fuel extraction and mining, including petroleum refineries and firms that support coal mining, oil, and gas field machinery manufacturing. Workers across both the forestry and agriculture industries that support fuel production with corn ethanol, biodiesels, and fuel wood are also included in the fuel employment estimates.

Electric Power Generation and Fuels employment is embedded within a range of industries across the United States. It is important to note that while some of these industries, such as fossil fuel power generation or natural gas distribution, are wholly focused on energy-related activities, others work across a wider range of technologies, such as construction, professional and business services, manufacturing, and wholesale trade. Such industries are important to understanding components of the emerging generation and fuel technology spheres that are not captured through the electric power generation and fuel extraction NAICS codes alone. This is particularly true of renewable electricity generation. In the wind and solar industries, for instance, much of the generation capacity is owned by development companies or by building owners, not utilities. Thus, employment related to this generation appears under other NAICS codes than those that typically capture utility employment. As another example, a subset of semiconductor manufacturers produces solar panels, while other semiconductor manufacturers assemble computer components or medical equipment. In both these examples, using federal labor market data alone could provide a misleading picture of generation-related employment. Inclusion of these additional industries in their entirety in energy employment data would result in exaggerated employment figures, while their exclusion would underestimate the true size of the workforce related to the energy sector.

Establishments that are engaged in or support the Electric Power Generation industry employed 883,842 workers in 2017; establishments working with Fuels employed 1,074,935 workers. The Electric Power Generation sector is largely comprised of construction workers and utility employees. Of the just over one million jobs supported by the Fuels sector in 2017, about 45 percent were in the mining and extraction industries, followed by manufacturing at 22 percent of total Fuels employment.

# Summary

The electric 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.[24] This transition has involved a significant build-out of new power generation facilities in the United States. According to the EIA, more than 27 gigawatts (GW) of electricity generating capacity was added to the national power grid over the course of 2016; this is the largest amount of added capacity since 2012. There was a net gain of 15 GW in 2016, after accounting for the retirement of 12 GW of capacity. The majority of these additions came from natural gas (9 GW), followed by wind (8.7 GW) and solar (7.7 GW). Together, these three sources made up 93 percent of total additions.[25] At the end of 2016, natural gas accounted for the largest share of overall U.S. generating capacity at 42 percent. Over the five years between 2010 and 2016, utility-scale solar installations have grown at an average rate of 72 percent each year; this is faster than any other generating technology.[26]

[24] 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.
[25] EIA, "U.S. Electric Generating Capacity Increase in 2016 Was Largest Net Change Since 2011," *Today in Energy*, February 27, 2017, https://www.eia.gov/todayinenergy/detail.php?id=30112.
[26] EIA, "Utility-Scale Solar Has Grown Rapidly Over the Past Five Years," *Today in Energy*, May 4, 2017, https://www.eia.gov/todayinenergy/detail.php?id=31072.

Figure 5 shows net generation of electricity from utility-scale (i.e., 1 megawatt or greater) facilities in all sectors of the U.S. economy. Electricity generation from coal sources declined by 39 percent between 2006 and 2017, while electricity generation from natural gas increased by 57 percent and from solar by over 10,000 percent—from 508,000 MWh to nearly 53,000,000 MWh. As noted, this solar growth only includes utility-scale facilities, as reliable data on smaller distributed facilities was not available until recently. Between 2016 and 2017, distributed solar PV generation increased 28 percent nationwide, while estimated total solar PV generation—both utility-scale and distributed generation—increased nationwide by 43 percent from 2016 to 2017.[27]

The shifts among electric generation sources over the last several years are mirrored in the sector's changing employment profile, as the share of natural gas, solar, wind, and CHP have increased. It is important to note, however, that the majority of U.S. electrical generation continues to come from fossil fuels (coal, oil, and natural gas). Under latest EIA modeling in the Annual Energy Outlook 2018, fossil fuels will still account for 78.5 percent of total U.S. energy production in 2050.[28]

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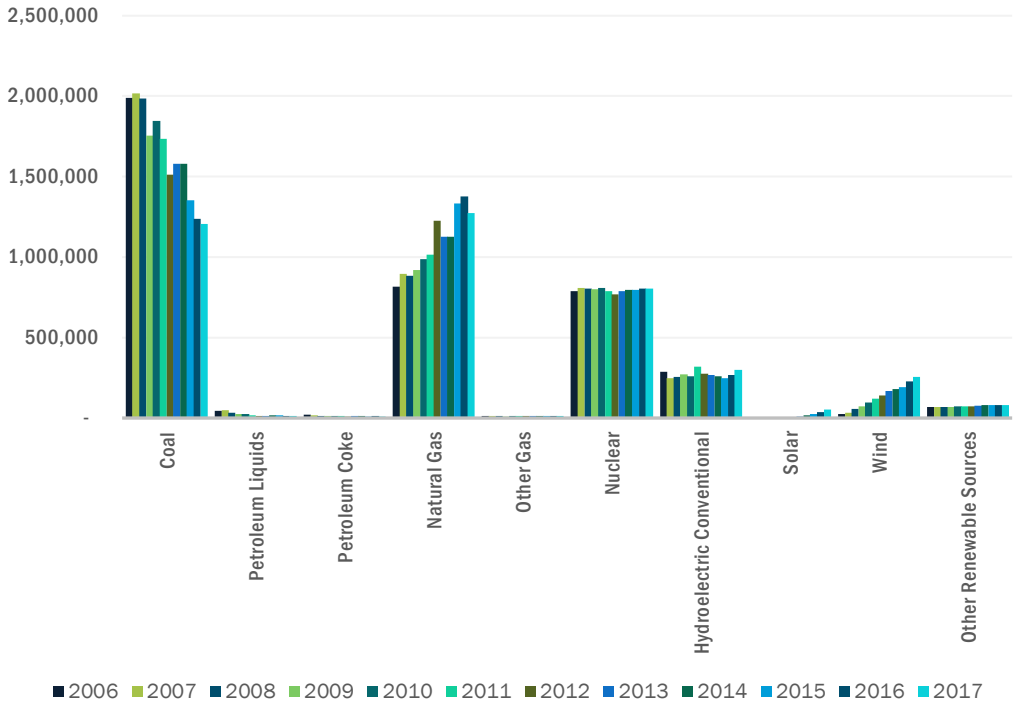
[27] EIA, *Electric Power Monthly,* March 23, 2018, Table 1.1.A., https://www.eia.gov/electricity/monthly/epm_table_grapher. php?t=epmt_1_01_a. Data on distributed solar generation from annual totals for 2016 and 2017 for Small Scale Generation: Estimated Solar Photovoltaic and data on total solar PV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

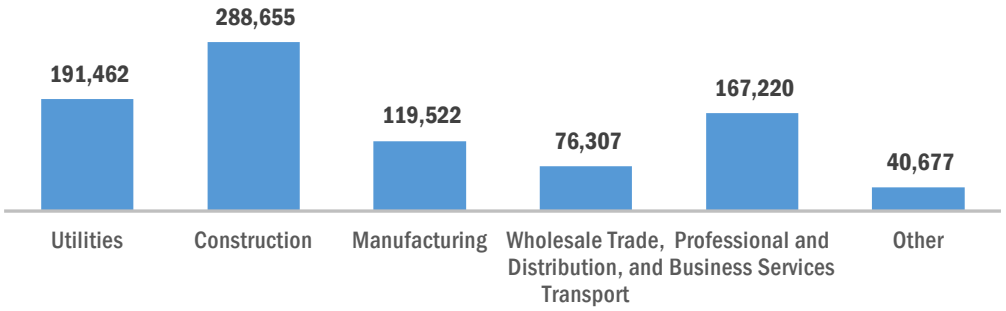
[28] EIA, *Annual Energy Outlook 2018,* February 2018, Table A1, https://www.eia.gov/outlooks/aeo/data/browser/#/?id=1-AEO2018&region=0-0&cases=ref2018&start=2016&end=2050&f=A&linechart=ref2018-d121317a.6-1-AEO2018~ref2018-d121317a.3-1-AEO2018~ref2018-d121317a.4-1-AEO2018~ref2018-d121317a.5-1-AEO2018&ctype=linechart&sourcekey=0.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

## Figure 5.
### Change in Net Generation by Energy Source (Thousand MWh), 2006 – 2017[29]




This transition has resulted in employment gains across Electric Power Generation, with a particular impact on the construction industry. Electric Power Generation employment was 883,842 jobs in 2017, up nearly 2 percent from the previous year's 867,434 workers[30], and employers report a projected 8 percent growth over 2018. Most of these new jobs are classified by BLS to the construction industry and are comprised of employees installing and building new renewable energy capacity additions.

## Figure 6.
### Generation Employment by Industry, Q2 2017



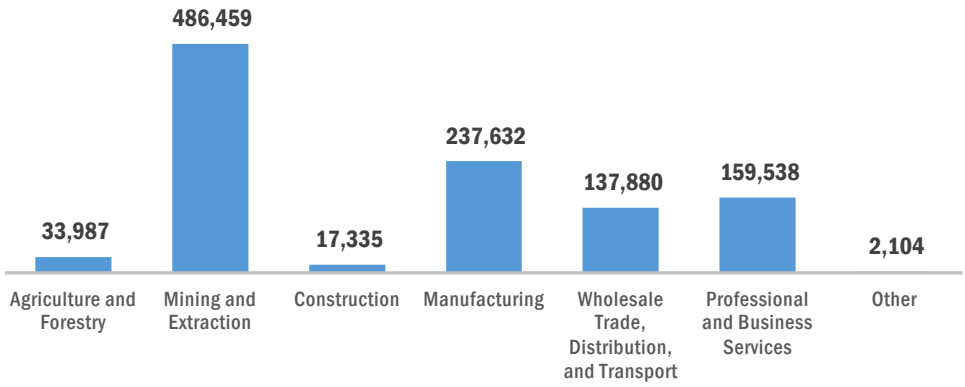

[29] EIA, *Monthly Energy Review*, Table 7.2a. .
[30] This number has been revised to account for 2016 coal generation employment in NAICS 4238, Machinery, Equipment, and Supplies Merchant Wholesalers.

Other firms (other services, etc.) in Electric Power Generation report projected growth of nearly 13 percent by the end of 2018. Utilities (which include regulated utilities and independent power producers in the NAICS definitions used by the BLS and Census Bureau) expect to have unchanged employment through the end of 2018.

**Figure 7.**
**Expected Employment Growth by Industry Q4 2017 – Q4 2018**


The Fuels sector employed 1,074,935 workers in 2017, compared to the previous year's level of over 1,081,000 jobs. This represents a decline in employment of less than 1 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 2017, these comparable BLS employment figures were at 370,700 and 51,500 respectively.[31] The 2018 USEER found modest increases in both petroleum production jobs (more than 9,000 additional jobs, for a total of 510,014 jobs in 2017) and natural gas production jobs (more than 2,000 additional jobs, for a total of 312,364 jobs). Overall, Fuels employers project to see employment increase by 2 percent over 2018.

**Figure 8.**
**Fuels Employment by Industry, Q2 2017**

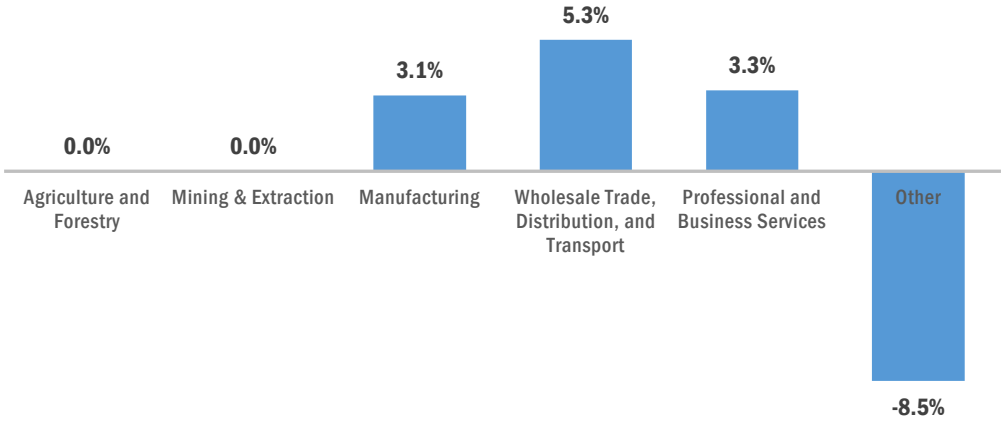



Other (other services, etc.) employers (primarily Repair and Maintenance) in Fuels project a decline in employment of nearly 9 percent over 2018 while wholesale trade,

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

distribution, and transport expect to increase employment by over 5 percent over the same time period.

**Figure 9.**
**Expected Employment Growth by Industry Q4 2017 – Q4 2018**




# 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 2018 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).[32]

Based on these inputs, an estimated 34,000 agriculture and forestry employees worked in 2017 to support fuel production.[33]

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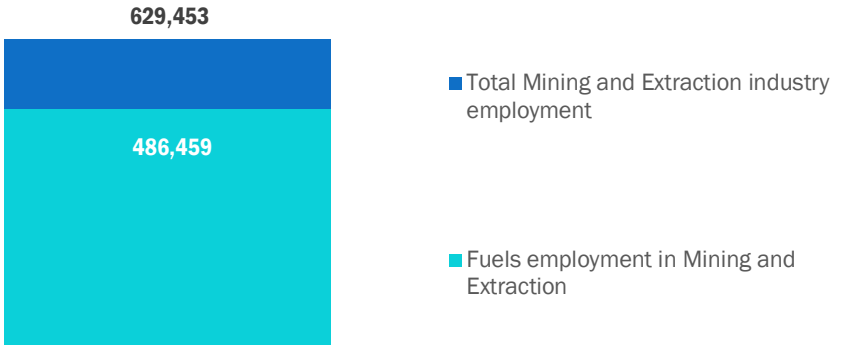
[32] These data can be found in "U.S. Bioenergy Statistics," Economic Research Service, U.S. Department of Agriculture, https://www.ers.usda.gov/data-products/us-bioenergy-statistics/.

[33] 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 2017 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.

## Mining, Extraction, and Utility Generation

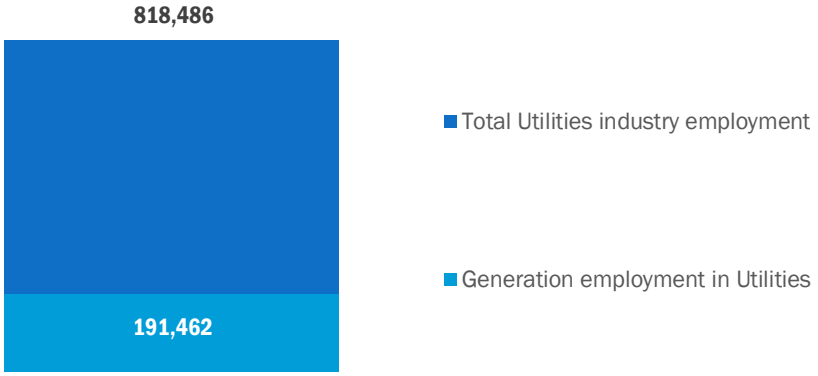
About 77 percent of all mining and extraction employment in the United States in 2017 was for fuels used in energy production—this translates to roughly 486,000 workers in the second quarter of 2017. These workers support the Fuels industry through crude petroleum[34] and natural gas extraction, as well as surface and underground coal mining.[35]

**Figure 10.**
Mining and Extraction Employment, Q2 2017




Electric utility generation (in which the generating equipment is operated by the utility) employed a total of 191,462 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 11.**
Utilities Employment, Q2 2017

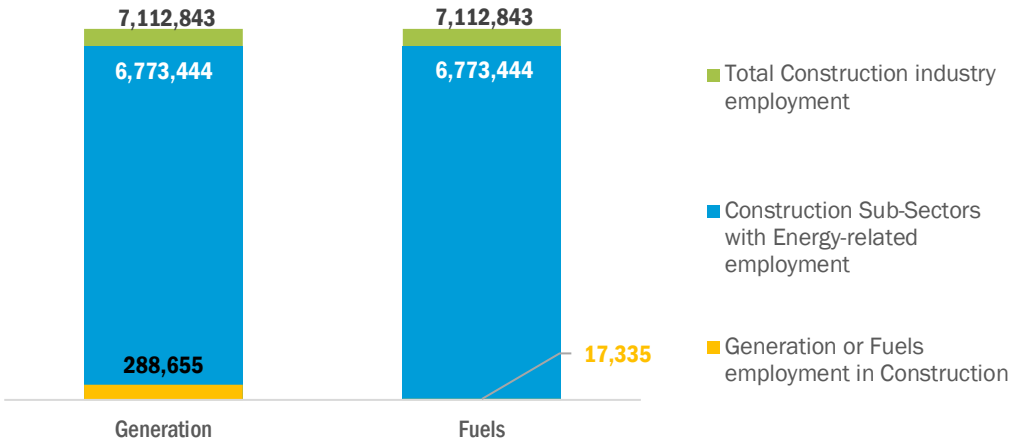



[34] Petroleum is a liquid mixture of hydrocarbons that is present in certain rock strata and can be extracted and refined to produce fuels including gasoline, kerosene, and diesel oil.
[35] These support workers are specific to fuel mining and extraction, and do not include support for other mining and extraction activities.

## Construction

Out of 7.1 million construction workers in the United States, roughly one-tenth of employment in 2017 was contained in construction subsectors with workers that support electricity generating technologies. Within these subsectors, there were 305,990 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.

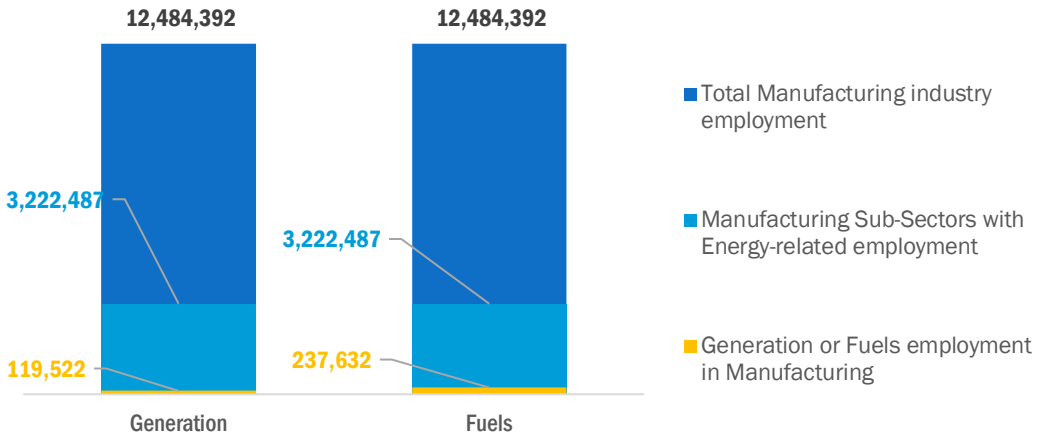
**Figure 12.**
Construction Employment, Q2 2017




## Manufacturing

The national manufacturing industry employed nearly 12.5 million workers in 2017. About 25.8 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 3,223,000 workers in 2017, 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.

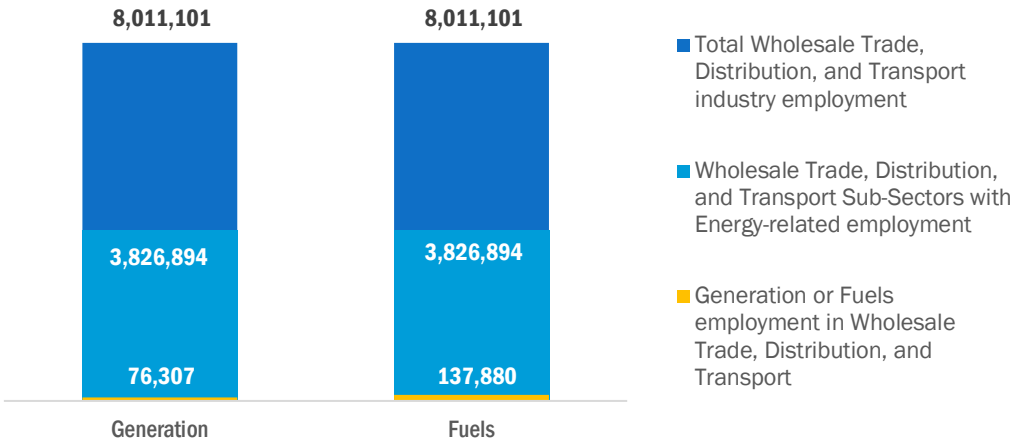
Figure 13.
Manufacturing Employment, Q2 2017




## Wholesale Trade

Of the over eight million wholesale trade, distribution, and transport workers in the United States, about 47 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 76,307 workers and 137,880 workers, respectively, spent some amount of their time in 2017 supporting the wholesale trade, distribution, and transport of materials or technologies that could support Electric Power Generation and Fuels applications.[36]

Figure 14.
Wholesale Trade, Distribution, and Transport Employment, Q2 2017

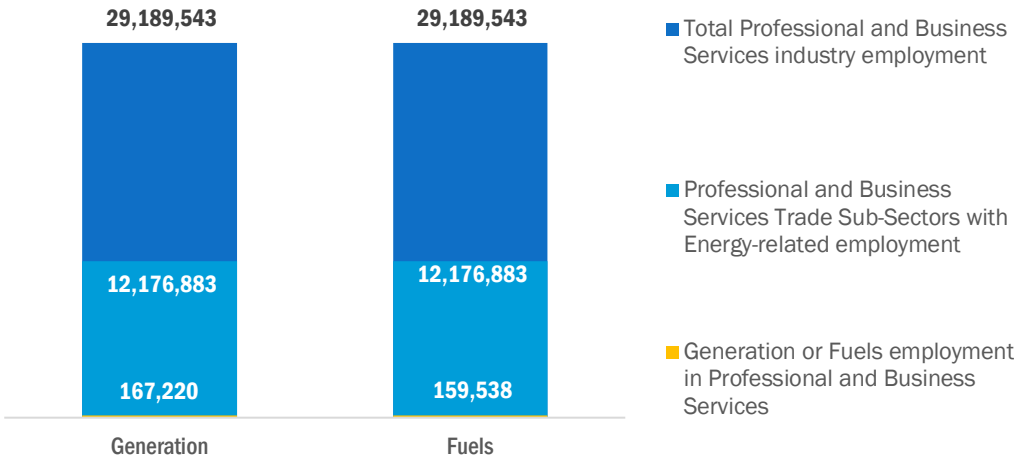



[36] Transmission and trade of fuels are included in the Transmission, Distribution, and Storage chapter.

## Professional and Business Services

The professional and business service industry in the United States employed more than 29 million workers in 2017. Within this aggregate industry, several detailed industries supported generation and fuel operations with software, legal services, biotechnology research, architecture, and engineering. Of the nearly 12.2 million jobs in these energy-related professional service industries in 2017, about 167,200 and 159,500 respectively supported Electric Power Generation and Fuels technologies.

**Figure 15.**
Professional and Business Services Employment, Q2 2017




# Electric Power Generation and Fuels Employment by Detailed Technology Application

In the sections below, Electric Power Generation and Fuels are broken down into detailed technology applications to better understand the employment characteristics and trends of each of these two major technology applications. However, for

accurate employment comparisons between different technologies, it is necessary to combine the Electric Power Generation and Fuels. For example, 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. (See Table 1 for a full comparison of employment.)

## Electric Power Generation

Employment related to solar power applications accounts for the largest share of workers in Electric Power Generation. This is largely due to the construction related to the significant buildout of new solar generation capacity. Electric Power Generation applications based on solar technologies, both PV and concentrating solar power (CSP), employed almost 350,000 workers in 2017, or 40 percent of the Electric Power Generation workforce. This was followed by fossil fuel generation employment, which accounted for 19 percent of total Electric Power Generation employment in 2017 and supported 171,635 workers in jobs related to coal, oil, and natural gas generation technologies.[37]

Solar Electric Power Generation employment dropped in 2017, marking the first time this subsector experienced job loss since the Solar Foundation began counting employment in 2010 (See Figure 16).[38]

### Table 1.
### Generation and Fuels Employment by Major Energy Technology Application and Detailed Technology Application

| | Electric Power Generation | Fuels | Total |
|---|---|---|---|
| **Solar** | 349,725 | - | 349,725 |
| **Wind** | 107,444 | - | 107,444 |
| **Geothermal** | 7,927 | - | 7,927 |
| **CHP** | 27,239 | | 27,239 |
| **Bioenergy** | 12,385 | 104,446 | 116,831 |
| **Corn Ethanol** | - | 34,522 | 34,522 |
| **Other Ethanol/Non-Woody Biomass, including Biodiesel** | - | 20,083 | 20,083 |
| **Woody Biomass Fuel for Energy and Cellulosic Biofuels** | - | 31,428 | 31,428 |
| **Other Biofuels** | - | 18,414 | 18,414 |
| **Low Impact Hydroelectric Generation** | 11,531 | - | 11,531 |
| **Traditional Hydropower** | 55,341 | - | 55,341 |
| **Nuclear** | 64,743 | 8,962 | 73,705 |
| **Coal** | 92,843 | 74,180 | 167,023 |
| **Natural Gas** | 66,385 | 312,364 | 378,749 |
| **Oil/Petroleum** | 12,407 | 510,015 | 522,422 |
| **Advanced Gas** | 41,034 | - | 41,034 |

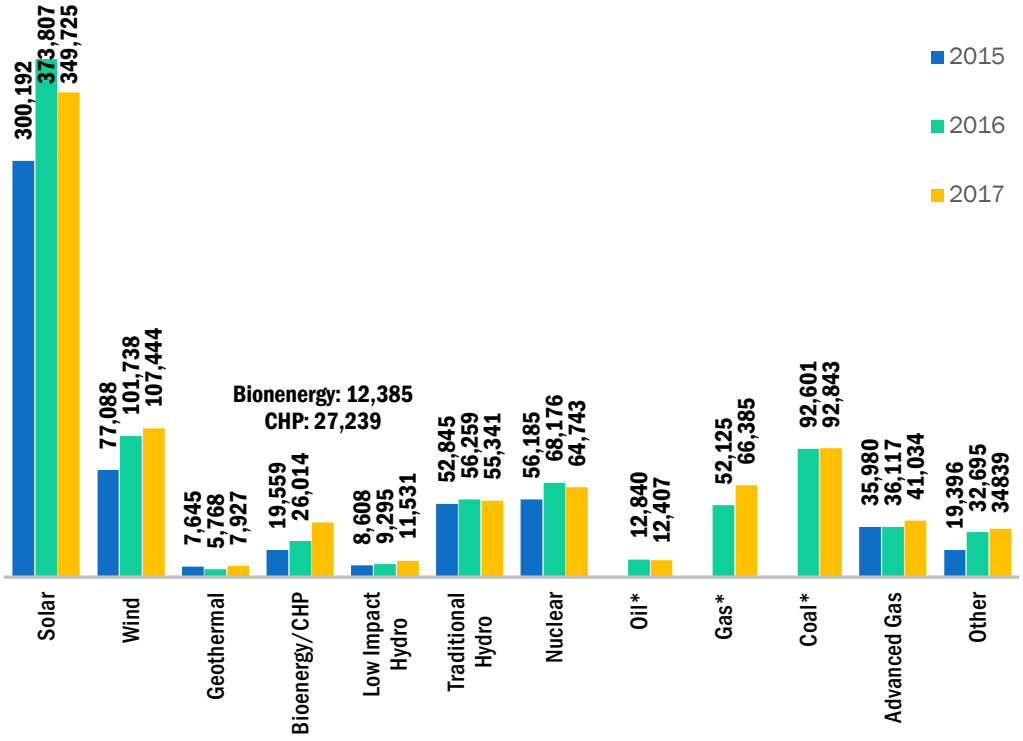
[37] It is important to note that these figures include all employees who spend some portion of their time on a specific technology.

[38] The Solar Foundation has been producing annual solar reports since 2010, using a substantially similar methodology to this report. See https://tsfcensus.org for more information. The Solar Foundation 2017 *National Solar Jobs Census*/BW Research Partnership

| | | | |
|---|---|---|---|
| Other Generation/Other Fuels | 34,839 | 64,968 | 99,807 |

Figure 16.

Electric Power Generation Employment by Detailed Technology Application, Q2 2015 - Q2 2017[39]




* Fossil-fuel electric generation was not disaggregated into oil, gas, and coal in data for 2015. In 2015, it accounted for 135,898 total employees, compared to 157,566 total employees for these categories in 2016 and 171,635 total employees in 2017.

## Fuels

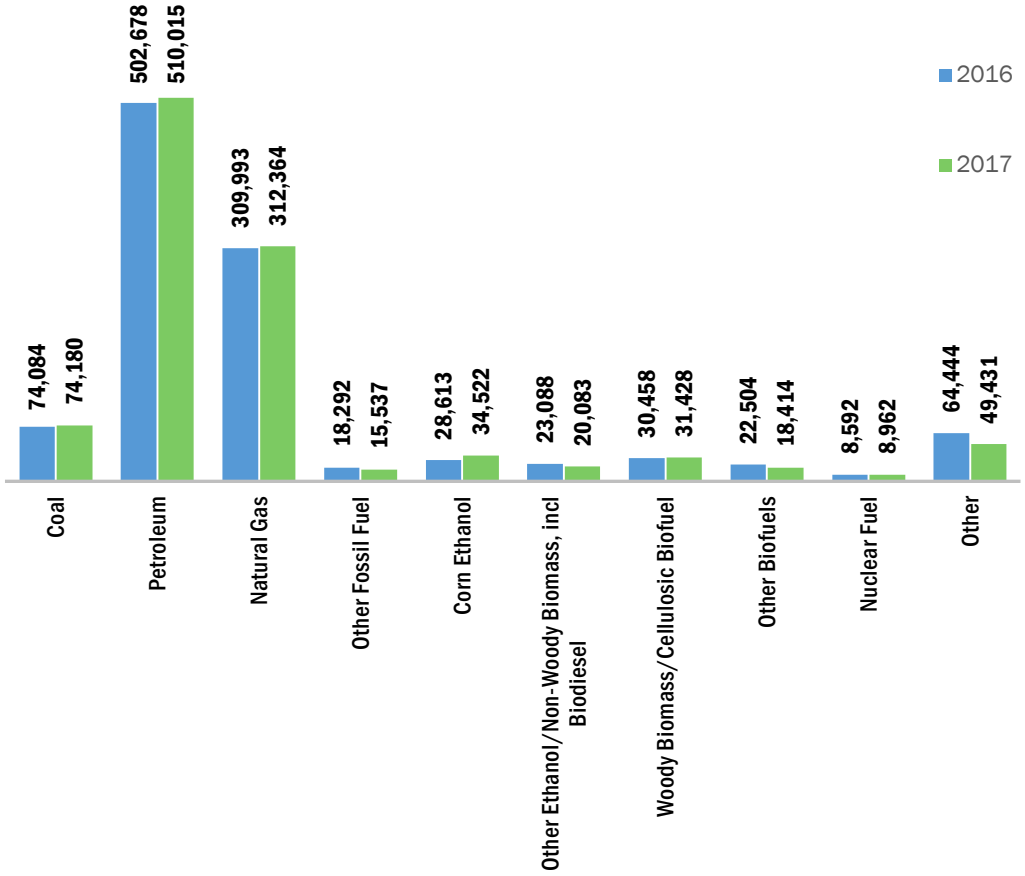
Of the over one million workers in the Fuels sector in 2017, almost half (47 percent) were working with petroleum fuels, followed by 29 percent in natural gas—or 510,015 and 312,364 workers respectively.[40]

[39] In this 2018 USEER, Bioenergy is broken out into Bioenergy and CHP. The aggregates for 2015 and 2016 are displayed in the chart to provide a year-to-year comparison to the aggregate number for 2017: 39,624. Employment in 2017 for Bioenergy and CHP, taken separately, is shown above the bars. As in the 2017 USEER, fossil fuel electric generation was delineated into Oil, Natural Gas, and Coal; comparable aggregates given in the chart note. "Advanced Gas" is 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, or Advanced Brush Seal. Coal generation numbers were revised for 2016 to account for a proportion of NAICS 4238 (Machinery, Equipment, and Supplies Merchant Wholesalers) supplying components for coal generation.

[40] Respondents for 2018 USEER were asked to place energy workers into the detailed technology applications where they were most involved. Since petroleum and natural gas are extracted at the same time, workers in mining and extraction could spend a large portion of their time working concurrently in petroleum and natural gas.

Figure 17.

Fuels Employment by Detailed Technology Application, Q2 2016 – Q2 2017 [41]




# Electric Power Generation and Fuels – Workforce Characteristics

In 2017, Electric Power Generation employed more women than any other surveyed sector. And, Electric Power Generation is generally more ethnically diverse than the workforce as a whole, exceeding the national average for Hispanic or Latino, Asian, and Native American employees. However, Electric Power Generation had only 11 percent of its employees over age 55 in 2017, far below the national average, while Fuels was close to average at 23 percent. Fuels had a higher proportion of employees that are white when

[41] Data collection was unable to capture the verbatim responses for those who selected "other." These are typically employers who work across multiple technologies and could not assign their workers to a single detailed technology application. Future surveys will provide an open-end field for the respondent to report their primary detailed category.

compared to national workforce averages. Both Electric Power Generation and Fuels exceeded the national average for veterans hiring at 10 percent.

## Table 2.
## Demographics – Electric Power Generation and Fuels, Q4 2017

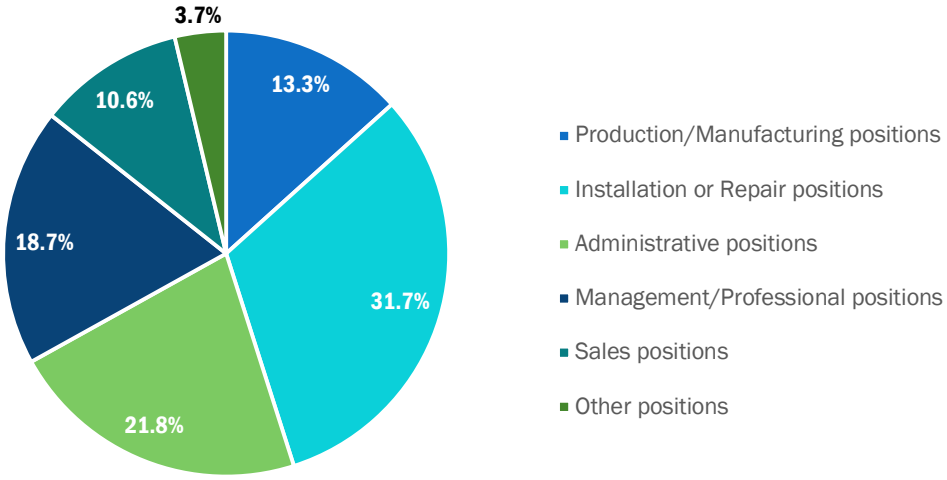
| Demographics | Electric Power Generation | | Fuels | | National Workforce Averages[42] |
|---|---|---|---|---|---|
| **Male** | 599,587 | 68% | 816,579 | 76% | 53% |
| **Female** | 284,255 | 32% | 258,356 | 24% | 47% |
| **Hispanic or Latino** | 164,152 | 19% | 105,791 | 10% | 17% |
| **Not Hispanic or Latino** | 719,690 | 81% | 969,144 | 90% | 83% |
| **American Indian or Alaska Native** | 15,649 | 2% | 17,784 | 2% | 1% |
| **Asian** | 80,221 | 9% | 27,746 | 3% | 6% |
| **Black or African American** | 76,985 | 9% | 53,488 | 5% | 12% |
| **Native Hawaiian or other Pacific Islander** | 13,672 | 2% | 2,669 | 0% | >1% |
| **White** | 615,696 | 70% | 903,045 | 84% | 78% |
| **Two or more races[43]** | 81,620 | 9% | 70,202 | 7% | 2% |
| **Veterans** | 85,533 | 10% | 102,623 | 10% | 6% |
| **55 and over** | 93,234 | 11% | 255,304 | 24% | 23% |
| **Union** | 36,170 | 4% | 31,555 | 3% | 11% |

The largest proportion of workers in Electric Power Generation were classified in 2017 as installation or repair positions (32 percent), followed by administrative positions (22 percent), and management/professional positions (19 percent).

[42] 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.

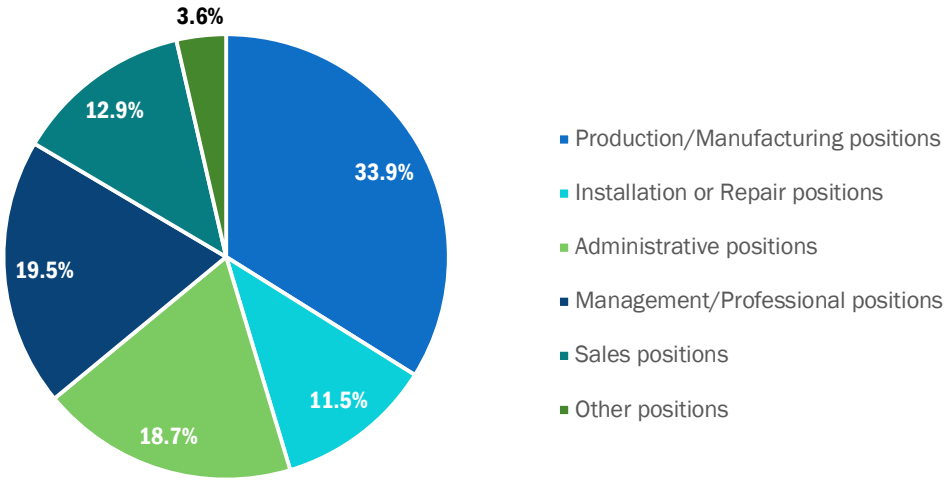
[43] While federal guidelines were followed in administering the demographic questions, respondents may have reported two or more races as including Hispanic or Latino ethnicity, inappropriately inflating the total and deflating other racial categories.

## Figure 18.
### Occupational Distribution - Electric Power Generation, Q4 2017




More than a third (34 percent) of employment in Fuels in 2017 was within production/ manufacturing positions. Management/professional positions (19 percent) and administrative positions (19 percent) each comprised just under a fifth of Fuels employment.

## Figure 19.
### Occupational Distribution - Fuels, Q4 2017




In 2017, construction firms reported the greatest hiring difficulty among industry sectors in Electric Power Generation, followed by manufacturing and wholesale trade. The industry sectors in Fuels that reported the greatest hiring difficulty in that year included wholesale trade, professional and business services, and manufacturing.

Figure 20.
Hiring Difficulty by Industry – Electric Power Generation, Q4 2017

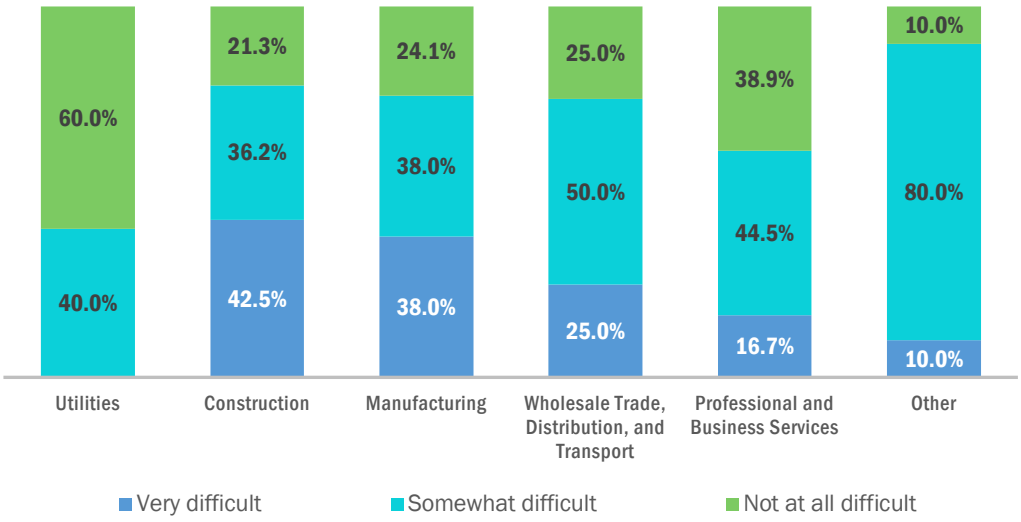
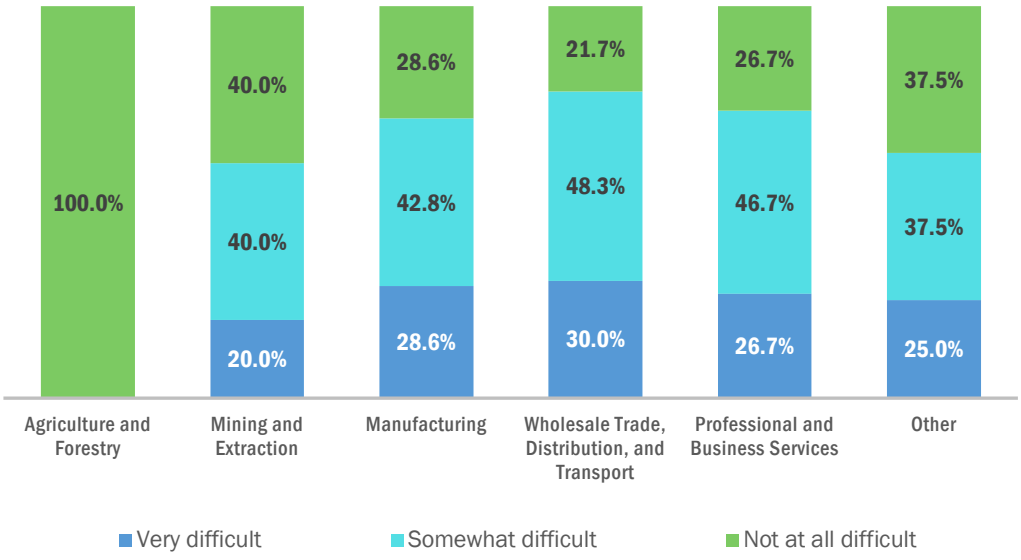



Figure 21.
Hiring Difficulty by Industry – Fuels, Q4 2017




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

## Table 3.
## Reasons for Hiring Difficulty by Industry – Electric Power Generation, Q4 2017

| Utilities | Construction | Manufacturing | Wholesale Trade, Distribution, and Transport | Professional and Business Services | Other |
|---|---|---|---|---|---|
| **Lack of experience, training, or technical skills (75%)** | Lack of experience, training, or technical skills (56%) | Lack of experience, training, or technical skills (45%) | Lack of experience, training, or technical skills (58%) | Lack of experience, training, or technical skills (45%) | Lack of experience, training, or technical skills (50%) |
| **Cannot pass employment screening (25%)** | Insufficient non-technical skills (44%) | Insufficient qualifications, certifications, education (35%) | Competition/ small applicant pool (33%) | Insufficient non-technical skills (45%) | Cannot pass employment screening (40%) |
| | Insufficient qualifications, certifications, education (22%) | Competition/ small applicant pool (35%) | Insufficient qualifications, certifications, education (25%) | Competition/ small applicant pool (36%) | Cannot provide competitive wages (20%) |

## Table 4.
## Reasons for Hiring Difficulty by Industry – Fuels, Q4 2017

| Mining & Extraction | Manufacturing | Wholesale Trade, Distribution, and Transport | Professional and Business Services | Other |
|---|---|---|---|---|
| **Lack of experience, training, or technical skills (67%)** | Lack of experience, training, or technical skills (60%) | Lack of experience, training, or technical skills (35%) | Lack of experience, training, or technical skills (50%) | Lack of experience, training, or technical skills (83%) |
| **Insufficient qualifications, certifications, education (50%)** | Insufficient non-technical skills (33%) | Insufficient qualifications, certifications, education (30%) | Insufficient qualifications, certifications, education (20%) | Insufficient non-technical skills (50%) |
| **Difficulty finding industry-specific knowledge, skills, and interest (17%)** | Competition/ small applicant pool (33%) | Insufficient non-technical skills (28%) | Insufficient non-technical skills (20%) | Insufficient qualifications, certifications, education (17%) |

More than four in ten (45 percent) professional and business services employers within Electric Power Generation with hiring difficulty reported engineers as the occupation that was the most difficult to hire for.

Table 5.
Reported Occupations with Hiring Difficulty by Industry – Electric Power Generation, Q4 2017

| Utilities | Construction | Manufacturing | Wholesale Trade, Distribution, and Transport | Professional and Business Services | Other |
|---|---|---|---|---|---|
| **Electricians (67%)** | Installation workers (36%) | Managers, directors, or supervisors (39%) | Sales, marketing, or customer service representatives (42%) | Engineers (45%) | Technicians or technical support (60%) |
| **Operations or business development (67%)** | Electricians (30%) | Manufacturing or production positions (26%) | Technicians or technical support (21%) | Administrative support (27%) | Sales, marketing, or customer service representatives (20%) |
| **Other (33%)** | Technicians or technical support (23%) | Installation workers (26%) | Engineers (21%) | Managers, directors, or supervisors (18%) | Finance positions or accountants (20%) |

Table 6 lists the most difficult occupations to hire for by industry within the Fuels sector, as reported by employers in 2017.

Table 6.
Reported Occupations with Hiring Difficulty by Industry – Fuels, Q4 2017

| Mining & Extraction | Manufacturing | Wholesale Trade, Distribution, and Transport | Professional and Business Services | Other |
|---|---|---|---|---|
| **Drivers (50%)** | Manufacturing or production positions (69%) | Sales, marketing, or customer service representatives (32%) | Administrative support (40%) | Drivers (33%) |
| **Technicians or technical support (33%)** | Technicians or technical support (13%) | Drivers (27%) | Technicians or technical support (20%) | Technicians or technical support (17%) |
| **Administrative support (17%)** | Installation workers (13%) | Managers, directors, or supervisors (18%) | Engineers (10%) | Managers, directors, or supervisors (17%) |

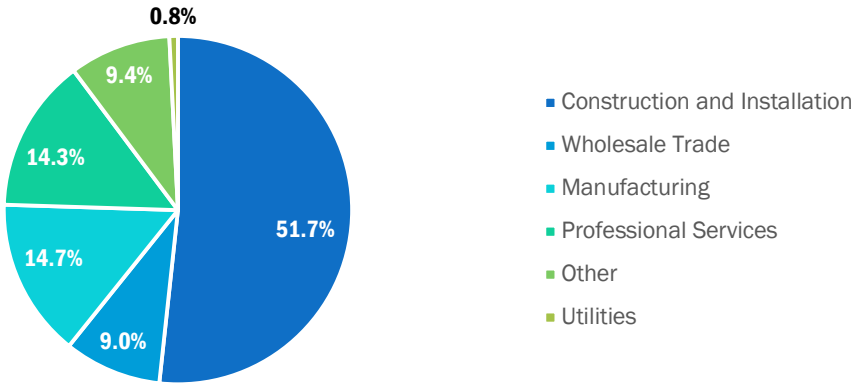
## Solar Electric Power Generation

The solar sector is an example of the inability of BLS labor market data to completely capture employment across PV and CSP technologies. For 2017, the BLS reported that utilities employed just under 2,800 workers for solar-specific generation. However, this figure does

not count any jobs in the construction or other value-chain industries for projects financed, owned, or directed by utilities. The data suggest that utilities are directly responsible for at least 25 percent of the solar jobs in the United States, but no other NAICS codes yet exist for solar electric generation. Existing labor market data therefore dramatically underestimate the additional workers engaged in solar-related work. In 2017, there were 349,725 Americans who spent some portion of their time working to manufacture, install, distribute, or provide professional services to solar technologies across the nation; of these, roughly seven in ten workers—or about 250,271—spent at least half of their time supporting the solar portion of business.[44] That represents a reduction of 6 percent or 24,000 jobs in solar in 2017, with 9,000 of those reductions in utility-scale solar energy and 15,000 in residential solar energy. Among workers who spend the majority of their time on solar, the reduction was 3.8% or just under 10,000 jobs.

Solar employers reported that they expect to increase employment by 5 percent in 2018. Most solar employment supports PV technologies, with a small portion—7.5 percent—of workers supporting CSP technologies.[45]

**Figure 22.**
**Solar Electric Power Generation Employment by Industry**




Construction/installation represents the largest share of employment in Solar Electric Generation—more than half of all workers—followed by manufacturing and then professional services.

In 2016, the Solar Energy Industries Association reported that recent solar capacity additions have predominantly been in non-residential solar PV generation. This fact is reflected in the employment growth in the project development subsector (the only sector to increase employment between 2016 and 2017) in Figure 23 between 2016 and 2017, as project development typically involves non-residential and utility-scale projects.

**Figure 23.**

[44] The Solar Foundation 2017 *National Solar Jobs Census*/BW Research Partnership
[45] The terms "PV" and "CSP" solar 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.

## Solar Employment Growth by Industry, 2010-2017[46]

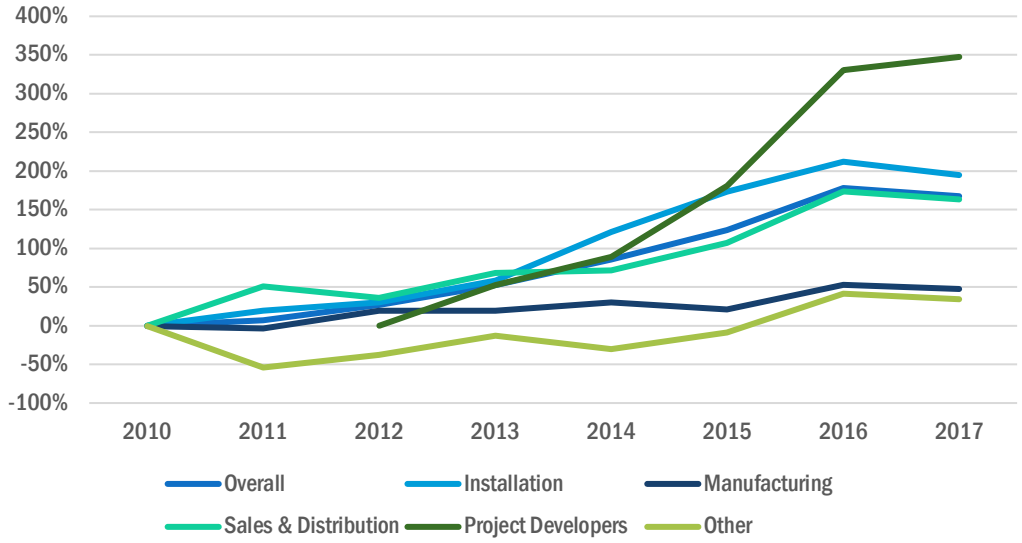
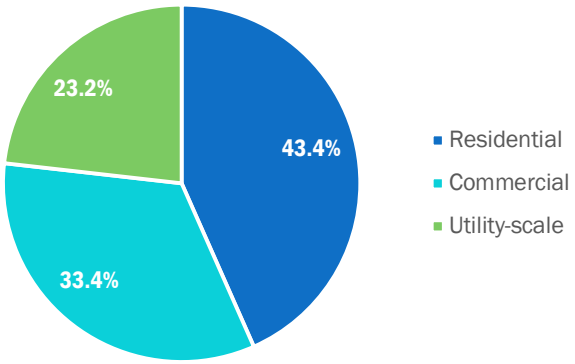



**Figure 24.**
**Percentage of Solar Electric Power Generation Workers at Different Project Scales**




Currently, a majority of U.S. PV generation is from utility-scale facilities owned or operated by utilities—roughly 49,688 thousand MWh compared to 24,139 thousand MWh of distributed solar generation in 2017.[47] In 2017, more than half of U.S. solar workers were spending the majority of their time working on commercial or utility-scale projects.

About a third of the solar workforce in 2017 was female, roughly two in ten workers are Hispanic or Latino, and under one in ten are Asian or are Black or African American. In In 2017, solar projects involving PV technologies had a higher concentration of workers aged 55 and over, compared to CSP technologies.

[46] Data from the Solar Foundation *National Solar Jobs Census* series, available for 2010 to 2017 at https://www.thesolarfoundation.org/national/.
[47] EIA, *Electric Power Monthly,* Table 1.1.A. Data for 2017 for Generation at Utility Facilities: Solar Photovoltaic and Small Scale Generation: Estimated Solar Photovoltaic.

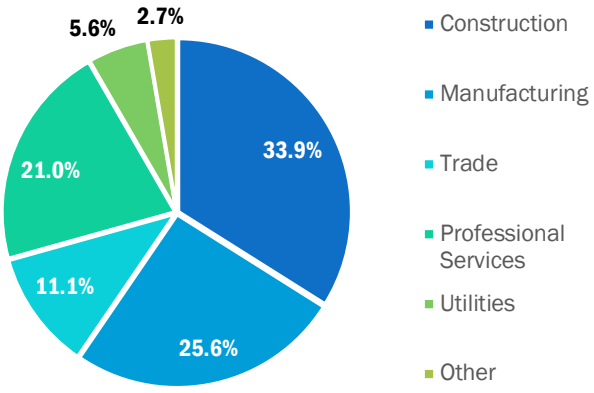
Table 7.
Demographics – Solar Electric Power Generation, Q4 2017

| Demographics | Solar Photovoltaic | Concentrating Solar Power | National Workforce Averages |
|---|---|---|---|
| Male | 69.0% | 67.4% | 53% |
| Female | 31.0% | 32.6% | 47% |
| Hispanic or Latino | 20.4% | 21.0% | 17% |
| Not Hispanic or Latino | 79.6% | 79.0% | 83% |
| American Indian or Alaska Native | 1.2% | 1.1% | 1% |
| Asian | 9.8% | 9.7% | 6% |
| Black or African American | 7.2% | 6.8% | 12% |
| Native Hawaiian or other Pacific Islander | 1.4% | 1.5% | >1% |
| White | 71.9% | 73.2% | 78% |
| Two or more races | 8.5% | 7.7% | 2% |
| Veterans | 9.6% | 7.9% | 6% |
| 55 and over | 11.4% | 8.1% | 23% |
| Union | 3.8% | 3.5% | 11% |

## Wind Electric Power Generation

Wind generation provides the third largest share of Electric Power Generation employment (behind solar and fossil generation). In 2017, firms that support the U.S. wind technology sector employed a total of 107,444 workers—a 6 percent increase over 2016. Over 2018, wind employers reported projected growth of just under four percent (3.7 percent). Similar to the solar sector, the largest share of employment was in construction; this industry sector accounted for 34 percent of all wind electric generation workers in 2017, followed by manufacturing at 26 percent and professional services at 21 percent.

Figure 25.
Wind Electric Power Generation Employment by Industry Sector



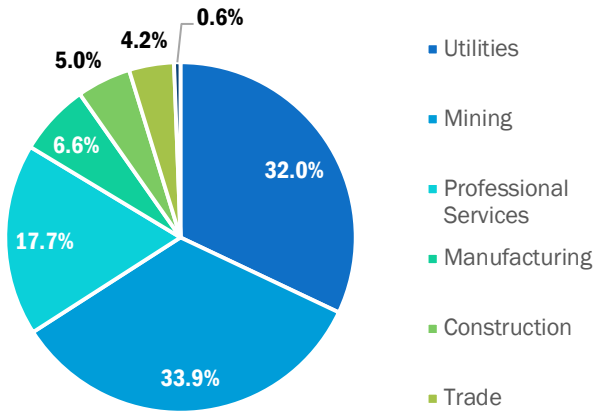

The sector has a nearly identical demographic distribution as the solar sector, with a slightly higher proportion of workers who are 55 years and older in age.

Table 8.
Demographics – Wind Electric Power Generation, Q4 2017

| Demographics | Wind | National Workforce Averages |
|---|---|---|
| Male | 67.9% | 53% |
| Female | 32.1% | 47% |
| Hispanic or Latino | 20.0% | 17% |
| Not Hispanic or Latino | 80.0% | 83% |
| American Indian or Alaska Native | 1.3% | 1% |
| Asian | 10.4% | 6% |
| Black or African American | 7.8% | 12% |
| Native Hawaiian or other Pacific Islander | 1.4% | >1% |
| White | 70.2% | 78% |
| Two or more races | 9.0% | 2% |
| Veterans | 10.3% | 6% |
| 55 and over | 13.8% | 23% |
| Union | 4.3% | 11% |

## Coal Electric Power Generation and Fuels

Figure 26.
Coal Electric Power Generation and Fuels Employment by Industry




Coal electric power generation employed a total of 92,843 workers in 2017, or 44 percent of all fossil fuel generation employees (including advanced, low-emission natural gas). This number was virtually unchanged from 2016. In addition to the electric generation segment, coal fuels supported another 74,180 jobs in 2017, or about 7 percent of the nationwide Fuels workforce.[48] This is an increase over 2016 of 96 jobs.[49] Together, these two sectors employed 167,023 Americans across the country. In 2017, coal accounted for 30 percent of utility-scale net

[48] This figure includes coal mining (for energy), support services for the coal mining sector, and manufacturing, professional and business services, and other activities that support coal mining.
[49] Includes a correction from the 2016 USEER.

generation; this was the second largest source of electricity, after natural gas (32 percent). Within fossil fuels, coal accounted for 48 percent of fossil fuel generation capacity in 2017, while natural gas accounted for 51 percent and petroleum liquids comprised less than 1 percent. The amount of coal in the national energy generation mix has declined by 39 percent from 2006 to 2017.[50]

USEER research based on data in the QCEW has identified approximately 56,900 additional jobs in 2017 that directly supported the coal industry (both Electric Power Generation and Fuels) in professional and business services, manufacturing, and other sectors. Comparable data is not available prior to 2016.

Coal electric power generation is more diverse than coal fuels, with 37 percent of the workforce in 2017 reported to be women, 15 percent Hispanic or Latino, and more than one in ten workers are either Asian or are Black or African American. Fourteen percent of workers in coal electric generation are 55 years of age of older, compared to just over 30 percent in coal fuels.

### Table 9.
### Demographics – Coal Electric Power Generation and Fuels, Q4 2017

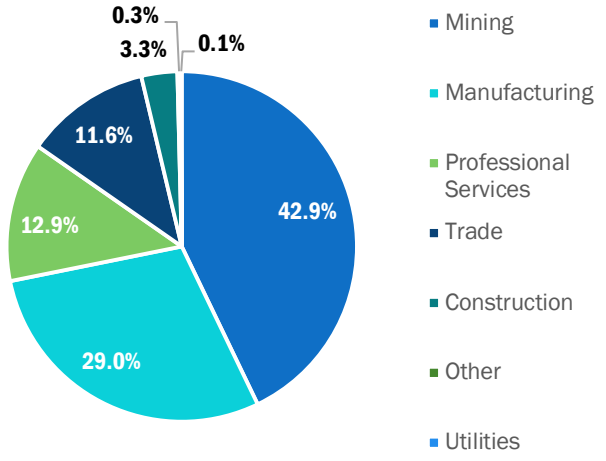
| Demographics | Coal Electric Generation | Coal Fuels | National Workforce Averages |
|---|---|---|---|
| Male | 63.3% | 78.4% | 53% |
| Female | 36.7% | 21.6% | 47% |
| Hispanic or Latino | 14.9% | 12.0% | 17% |
| Not Hispanic or Latino | 85.1% | 88.0% | 83% |
| American Indian or Alaska Native | 1.3% | 2.0% | 1% |
| Asian | 10.6% | 3.0% | 6% |
| Black or African American | 10.8% | 3.6% | 12% |
| Native Hawaiian or other Pacific Islander | 1.0% | 0.4% | >1% |
| White | 68.7% | 84.1% | 78% |
| Two or more races | 7.7% | 6.9% | 2% |
| Veterans | 6.5% | 10.2% | 6% |
| 55 and over | 13.5% | 30.3% | 23% |
| Union | 9.3% | 0.9% | 11% |

[50] EIA, *Monthly Energy Review*, Table 7.2a. Calculated from table data.

## Oil Electric Power Generation and Petroleum Fuels

Petroleum liquids accounted for less than 1 percent of all utility-scale generation in the United States in 2017, and have declined as a source of total net generation by 67 percent since 2006.[51] Petroleum liquids represented the smallest source of employment within fossil fuel electric power generation, supporting 12,407 jobs in 2017, or roughly 6 percent of the workers across coal, oil, and natural gas (including advanced natural gas) electric Power generation. On the other hand, petroleum was the largest Fuels employer in the United States in 2017, with 510,015 workers or 47 percent of the entire Fuels workforce. Together, oil electric power generation and petroleum fuels employed more than 522,000 workers nationwide in 2017.

**Figure 27.**
**Oil Electric Power Generation and Fuels Employment by Industry**




Much of employment is spread across the mining and extraction, manufacturing, professional services, and wholesale trade, industries. Mining and extraction was the largest portion of employment in 2017, with just under 43 percent of oil and petroleum employees, followed by manufacturing with 29 percent of total employment.

As with coal electric power generation, the oil electric power generation sector is more diverse than its corresponding petroleum fuels sector—in 2017, nearly a third of its workers were women, and two in ten employees were Hispanic or Latino, followed by Asian (11 percent) and Black or African American (8 percent). There was a fairly high proportion of individuals who are 55 years of age or older working with petroleum fuels in 2017—almost 24 percent—and more than a quarter of the workforce was female.

[51] EIA, *Monthly Energy Review*, Table 7.2a. Calculated from annual data for electricity net generation from petroleum for 2006 and 2017.

Table 10.
Demographics – Oil Electric Power Generation and Petroleum Fuels, Q4 2017

| Demographics | Oil Electric Generation | Petroleum Fuels | National Workforce Averages |
|---|---|---|---|
| Male | 68.5% | 74.0% | 53% |
| Female | 31.5% | 26.0% | 47% |
| Hispanic or Latino | 19.9% | 16.3% | 17% |
| Not Hispanic or Latino | 80.1% | 83.7% | 83% |
| American Indian or Alaska Native | 1.4% | 1.8% | 1% |
| Asian | 11.0% | 6.3% | 6% |
| Black or African American | 8.3% | 5.9% | 12% |
| Native Hawaiian or other Pacific Islander | 1.4% | 0.9% | >1% |
| White | 67.7% | 76.7% | 78% |
| Two or more races | 10.1% | 8.5% | 2% |
| Veterans | 9.2% | 10.9% | 6% |
| 55 and over | 14.7% | 23.9% | 23% |
| Union | 3.0% | 1.6% | 11% |

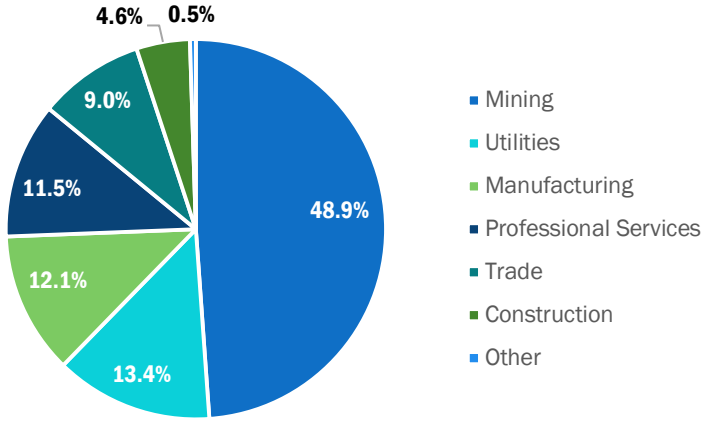
## Natural Gas Electric Power Generation and Fuels

While total coal mining employment declined from 2009 to 2017, over the same time employment in the U.S. oil and gas extraction industry (including support services)[52] grew by 16 percent, from 369,691 workers to 429,059 total jobs.[53] Natural gas electric power generation workers accounted for 47 percent of all fossil fuel electric power generation employment in 2017; the amount of electric power generated from natural gas in all industry sectors has grown from 816,441 thousand MWh of utility-scale net generation in 2006 to 1,272,864 thousand MWh in 2017—56 percent growth from 2006 to 2017.[54]

Natural gas electric power generation (including advanced natural gas technologies) employed a total of 107,419 workers in 2017; this was more than coal electric power generation (92,843 workers), and represented far more workers than oil electric power generation (12,407 workers). Natural gas electric power generation employers expect employment growth of just under 5 percent over 2018. Natural gas fuels are the second largest category of Fuels employment, after petroleum. This area of technology application supported 312,364 jobs in 2017, accounting for nearly three in ten workers in

[52] Includes oil and gas extraction (NAICS 211), drilling oil and gas wells (213111), and support activities for oil and gas operations (NAICS 213112).
[53] Bureau of Labor Statistics [BLS], Quarterly Census of Employment and Wages [QCEW], U.S. Total June Employment Data for the NAICS codes in the preceding footnote for 2009 and 2017.
[54] EIA, *Monthly Energy Review*, Table 7.2a. Annual data for electricity net generation from natural gas for 2006 and 2017.

Figure 28.
Natural Gas Electric Power Generation and Fuels Employment by Industry




the Fuels sector. Together, natural gas electric power generation and fuels supported 419,782 jobs nationwide in 2017. Most of this employment was found in mining and extraction, followed by utilities and manufacturing.

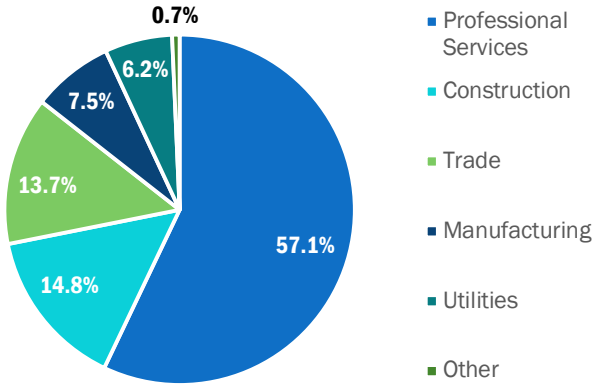
Natural gas generation is more diverse than the Fuels sector—almost four in ten workers in 2017 in natural gas electricity generation were female, and 16 percent were Hispanic of Latino. The fuels sector had a higher proportion of workers who are 55 years of age and older (25 percent) in 2017, while generation had more unionized workers (11 percent).

Table 11.
Demographics – Natural Gas Electric Power Generation and Fuels, Q4 2017

| Demographics | Natural Gas Electric Generation | Natural Gas Fuels | National Workforce Averages |
|---|---|---|---|
| Male | 63.0% | 76.7% | 53% |
| Female | 37.0% | 23.3% | 47% |
| Hispanic or Latino | 15.8% | 13.5% | 17% |
| Not Hispanic or Latino | 84.2% | 86.5% | 83% |
| American Indian or Alaska Native | 1.4% | 1.9% | 1% |
| Asian | 10.9% | 3.8% | 6% |
| Black or African American | 11.0% | 4.8% | 12% |
| Native Hawaiian or other Pacific Islander | 1.1% | 0.5% | >1% |
| White | 67.2% | 82.0% | 78% |
| Two or more races | 8.4% | 7.1% | 2% |
| Veterans | 8.1% | 9.3% | 6% |
| 55 and over | 15.1% | 24.6% | 23% |
| Union | 10.8% | 1.0% | 11% |

## Combined Heat and Power Generation

Figure 29.
Combined Heat and Power Generation Employment by Industry



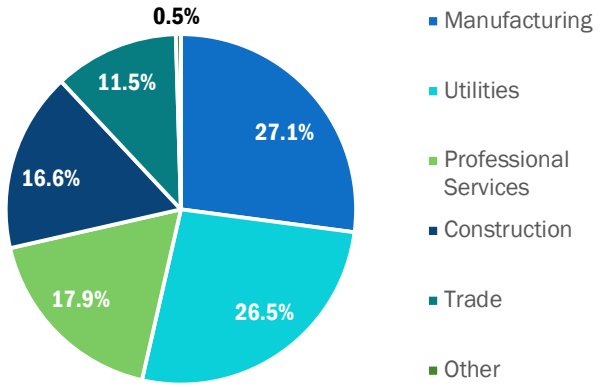

CHP generation technologies employed at least 27,239 workers, or about 2 percent of the employment in Electric Power Generation, in 2017. With small generation capacities and significant overlap with other sectors (many companies with CHP report according to their underlying fuel source), employment in CHP is mostly comprised of professional service workers; this industry category accounted for 57 percent of jobs in 2017, followed by the construction industry at 15 percent. Almost a third of the workforce in 2017 was comprised of women, while 17 percent of workers are Hispanic or Latino, and one in ten were reported to be of Asian descent.

Table 12.
Demographics – Combined Heat and Power Generation, Q4 2017

| Demographics | CHP | National Workforce Averages |
|---|---|---|
| Male | 67.8% | 53% |
| Female | 32.2% | 47% |
| Hispanic or Latino | 16.6% | 17% |
| Not Hispanic or Latino | 83.4% | 83% |
| American Indian or Alaska Native | 0.9% | 1% |
| Asian | 9.4% | 6% |
| Black or African American | 7.7% | 12% |
| Native Hawaiian or other Pacific Islander | 1.0% | >1% |
| White | 74.5% | 78% |
| Two or more races | 6.4% | 2% |
| Veterans | 12.4% | 6% |
| 55 and over | 22.5% | 23% |
| Union | 8.2% | 11% |

## Hydroelectric Power Generation

Figure 30.
Hydroelectric Power Generation Employment by Industry




Hydroelectric power generation employed a total of 66,871 workers[55] across the nation in 2017. Most of this employment —83 percent (55,341 workers)— was in traditional hydroelectric generation technologies, while the remainder was in low-impact hydroelectric technologies (11,531 workers). Employment was fairly evenly spread across the manufacturing, utilities, professional services, and construction industries in 2017— each supported at least 16 percent of total employment.

Table 13.
Demographics – Hydroelectric Power Generation, Q4 2017

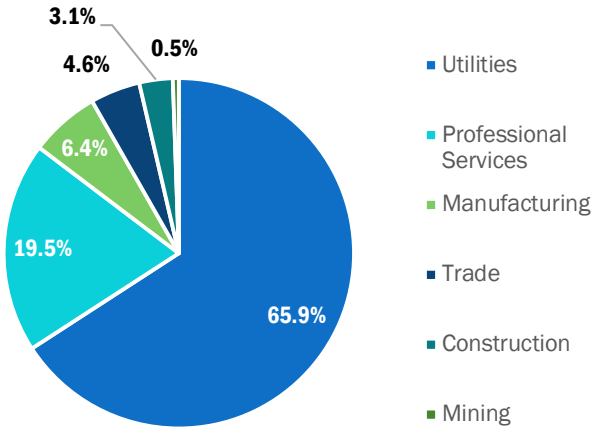
| Demographics | Low-impact Hydroelectric Generation | Traditional Hydroelectric Generation | National Workforce Averages |
|---|---|---|---|
| Male | 68.3% | 65.5% | 53% |
| Female | 31.7% | 34.5% | 47% |
| Hispanic or Latino | 19.7% | 18.6% | 17% |
| Not Hispanic or Latino | 80.3% | 81.4% | 83% |
| American Indian or Alaska Native | 1.2% | 1.4% | 1% |
| Asian | 10.3% | 11.0% | 6% |
| Black or African American | 8.0% | 9.7% | 12% |
| Native Hawaiian or other Pacific Islander | 1.3% | 1.3% | >1% |
| White | 70.4% | 67.1% | 78% |
| Two or more races | 8.8% | 9.5% | 2% |
| Veterans | 12.1% | 8.2% | 6% |
| 55 and over | 18.0% | 12.7% | 23% |
| Union | 4.4% | 5.6% | 11% |

[55] 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.

The sector had a proportionally high number of female employees in 2017, with about a third each in both low-impact hydroelectric generation and traditional hydroelectric generation technologies. These technologies are also more diverse than the national average, with higher representation in 2017 across Hispanic or Latino workers as well as Asian workers.

## Nuclear Electric Power Generation and Fuels

**Figure 31.**
**Nuclear Electric Power Generation and Fuels Employment by Industry**




Nuclear generation technologies employed 64,743 workers across the United States in 2017, or 7 percent of Electric Power Generation, with an additional 8,962 workers who supported nuclear fuels.[56] Utilities accounted for about 66 percent of nuclear generation employment, followed by about 20 percent in the professional services industry. Nuclear generation had a relatively high proportion of female workers in 2017, with almost four in ten employees reported to be women.

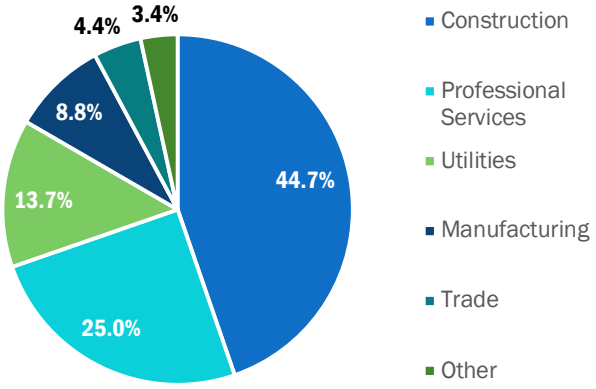
[56] A nuclear fuel is a substance that will sustain a fission chain reaction so that it can be used as a source of nuclear energy.

Table 14.
Demographics – Nuclear Electric Power Generation and Fuels, Q4 2017

| Demographics | Nuclear Electric Generation | Nuclear Fuels | National Workforce Averages |
|---|---|---|---|
| Male | 61.7% | 69.5% | 53% |
| Female | 38.3% | 30.5% | 47% |
| Hispanic or Latino | 14.4% | 17.4% | 17% |
| Not Hispanic or Latino | 85.6% | 82.6% | 83% |
| American Indian or Alaska Native | 1.4% | 1.2% | 1% |
| Asian | 11.1% | 10.0% | 6% |
| Black or African American | 11.8% | 7.1% | 12% |
| Native Hawaiian or other Pacific Islander | 1.0% | 1.1% | >1% |
| White | 66.3% | 72.2% | 78% |
| Two or more races | 8.3% | 8.3% | 2% |
| Veterans | 5.0% | 8.5% | 6% |
| 55 and over | 11.4% | 16.5% | 23% |
| Union | 9.1% | 3.8% | 11% |

## Bioenergy/Biomass Electric Power Generation and Biofuels

Figure 32.
Bioenergy/Biomass Electric Power Generation Employment by Industry



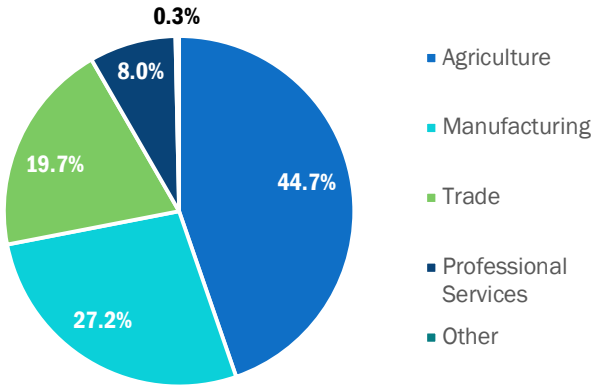

Bioenergy electric power generation and biofuels employed a total of 116,831 workers in 2017. The generation sector is a small component of the overall bioenergy and biofuel workforce. Only 12,385 of these individuals worked exclusively with bioenergy or biomass electric generation technologies, while the remainder worked across each of the fuel technologies discussed below. The largest share of employment for bioenergy and biomass electric power generation in 2017 was in the construction industry, followed by professional services.

In 2017, bioenergy/biomass electric generation technologies employed more women (proportionally) than each of the individual biofuel technologies. The generation sector

was also more diverse than each of the component fuels, employing a higher proportion of both Hispanic or Latino and Asian individuals.

## Corn Ethanol Fuels

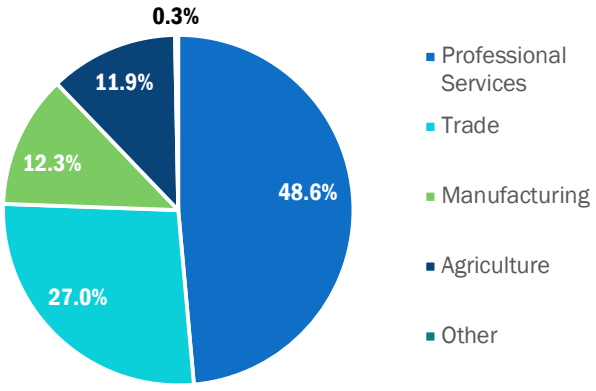
**Figure 33.**
**Corn Ethanol Fuels Employment by Industry**




Corn ethanol fuels employment represented about 3 percent of the U.S. Fuels workforce in 2017, accounting for 34,522 jobs. The sector is primarily composed of agriculture, manufacturing, and wholesale trade—together these three industries accounted for more than 90 percent of workers, followed by professional and business services at 8 percent. About three in ten workers were women, and over one in ten were Hispanic or Latino. This technology has a small proportion of Asian and Black or African American workers, but 29 percent of employees were 55 years of age or older.

## Other Ethanol and Non-Woody Biomass Fuels, including Biodiesel

**Figure 34.**
**Other Ethanol and Non-Woody Biomass Fuels (Including Biodiesel) Employment by Industry**

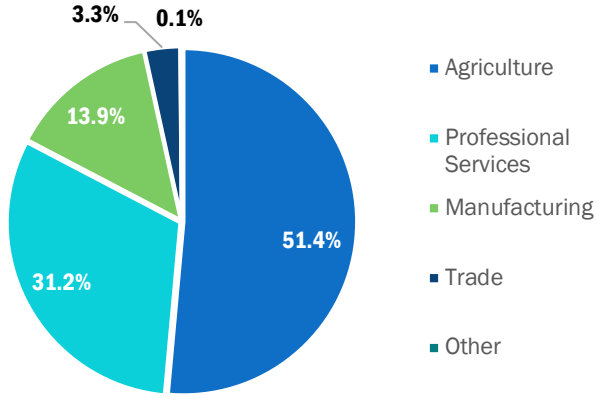



Other ethanol and non-woody biomass, including biodiesel[57], employed approximately 2 percent of the Fuels workforce in 2017; this equated to 20,083 jobs. Because non-woody biomass represents a small portion of U.S. fuel supply, most of this employment was concentrated in professional and business services—likely research and development—and wholesale trade. Almost a third of these workers were women and 16 percent were Hispanic or Latino.

[57] 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.

## Woody Biomass Fuel for Energy and Cellulosic Biofuels

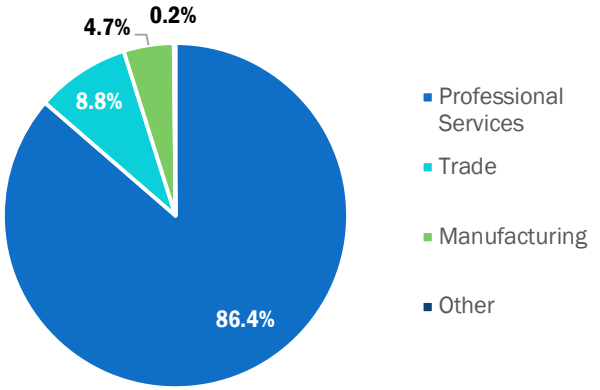
Figure 35.
Woody Biomass Fuel for Energy and Cellulosic Biofuel Employment by Industry




Woody biomass fuel for energy and cellulosic biofuels[58] supported 31,428 jobs across the United States in 2017, just under 3 percent of the Fuels workforce. Over half of that employment in woody biomass fuels was found in agriculture, followed by professional services; these two industries accounted for 83 percent of employment. With respect to diversity, only 8 percent of the workforce was reported to be Hispanic or Latino, 5 percent was Asian, and 3 percent was Black or African American.

## Other Biofuels

Figure 36.
Biofuels Employment by Industry




This category captures a wide range of other biofuel[59]activity, including early-stage research and development. Most of the fuels in this category are not yet in wide commercial production, and include algal biofuel, syngas, bioheat blends, landfill gas, and advanced biofuels. Together, work on these technologies employed a total of 18,414 workers across the nation in 2017. Because most are still in early-stage research and development, the majority of employment was concentrated in professional services, such as engineering and research or finance.

[58] 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).
[59] Other biofuels are any other fuel derived directly from living matter.

Table 15.
Demographics – Bioenergy/Biomass Electric Power Generation and Biofuels, Q4 2017

| Demographics | Bioenergy/ Biomass Electric Generation | Corn Ethanol | Other Ethanol/Non-Woody Biomass, including Biodiesel | Woody Biomass Fuel for Energy and Cellulosic Biofuel | Other Biofuels | National Workforce Averages |
|---|---|---|---|---|---|---|
| Male | 67.2% | 70.3% | 68.5% | 71.3% | 68.9% | 53% |
| Female | 32.8% | 29.7% | 31.5% | 28.7% | 31.1% | 47% |
| Hispanic or Latino | 18.3% | 12.6% | 16.0% | 8.1% | 14.3% | 17% |
| Not Hispanic or Latino | 81.7% | 87.4% | 84.0% | 91.9% | 85.7% | 83% |
| American Indian or Alaska Native | 1.1% | 0.8% | 0.8% | 0.5% | 0.8% | 1% |
| Asian | 10.0% | 5.9% | 8.1% | 5.0% | 9.2% | 6% |
| Black or African American | 7.6% | 5.5% | 7.9% | 3.3% | 6.7% | 12% |
| Native Hawaiian or other Pacific Islander | 1.3% | 0.8% | 0.9% | 0.5% | 0.7% | >1% |
| White | 72.3% | 81.1% | 76.3% | 86.9% | 77.4% | 78% |
| Two or more races | 7.7% | 5.9% | 6.0% | 3.7% | 5.2% | 2% |
| Veterans | 13.7% | 23.1% | 10.2% | 18.6% | 6.8% | 6% |
| 55 and over | 19.3% | 29.0% | 15.7% | 26.5% | 16.1% | 23% |
| Union | 8.7% | 8.8% | 4.7% | 9.6% | 5.6% | 11% |

# Electric Power and Fuel Transmission, Distribution & Storage

# Introduction

Transmission, Distribution, and Storage infrastructure links energy supplies, energy carriers, or energy by-products to intermediate and end users of energy. This infrastructure—an essential part of the U.S. energy system—is vast, complex, and interdependent. The first installment of the QER contained the following description of its scope:

> It includes approximately 2.6 million miles of interstate and intrastate pipelines; 414 natural gas storage facilities; 330 ports handling crude petroleum and refined petroleum products; and more than 140,000 miles of railways that handle crude petroleum, refined petroleum products, liquefied natural gas (LNG), and coal. The electrical component of the Nation's [Transmission, Storage, and Distribution] infrastructure links more than 19,000 individual generators with a capacity of 1 megawatt or more (sited at more than 7,000 operational power plants), with more than 642,000 miles of high-voltage transmission lines and 6.3 million miles of distribution lines.[60]

For purposes of the USEER, Transmission, Distribution, and Storage encompasses the employment associated with constructing, operating, and maintaining this 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. Since the provision of electricity is fundamentally dependent on its source of supply, transmission and distribution is often thought of in conjunction with utility generation. However, the designation of business activity is variable across these sectors. While Electric Power Generation and Fuels rely more heavily on mining, agriculture, and semiconductor manufacturers, electrical supply also depends on the transport of fuels and the construction of power lines. In addition to its role in providing our electrical supply, the transport of fuels also supports motor vehicle use and the non-electric production of heat for commercial and residential use.

Several NAICS codes actively track employment across utility transmission, including natural gas distribution, as well as electrical transmission line construction and fossil fuel pipeline transportation. Neither BLS, nor USEER data currently differentiate between pipeline employment for different products such as petroleum, natural gas, or CO2. Future editions of the USEER will be able to make that distinction. The sector's remaining employment is found within energy-related industry subsectors in construction, manufacturing, and wholesale trade.

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 2017, there were 1,016,590 such employees, comprising workers in gasoline stations with

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

convenience stores (839,786 employees), other gasoline stations (105,801 employees), and fuel dealers (71,003 employees).[61] These employees are part of the larger universe of 15,827,159 employees in retail trade in the United States in 2017.[62] For purposes of the 2018 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.

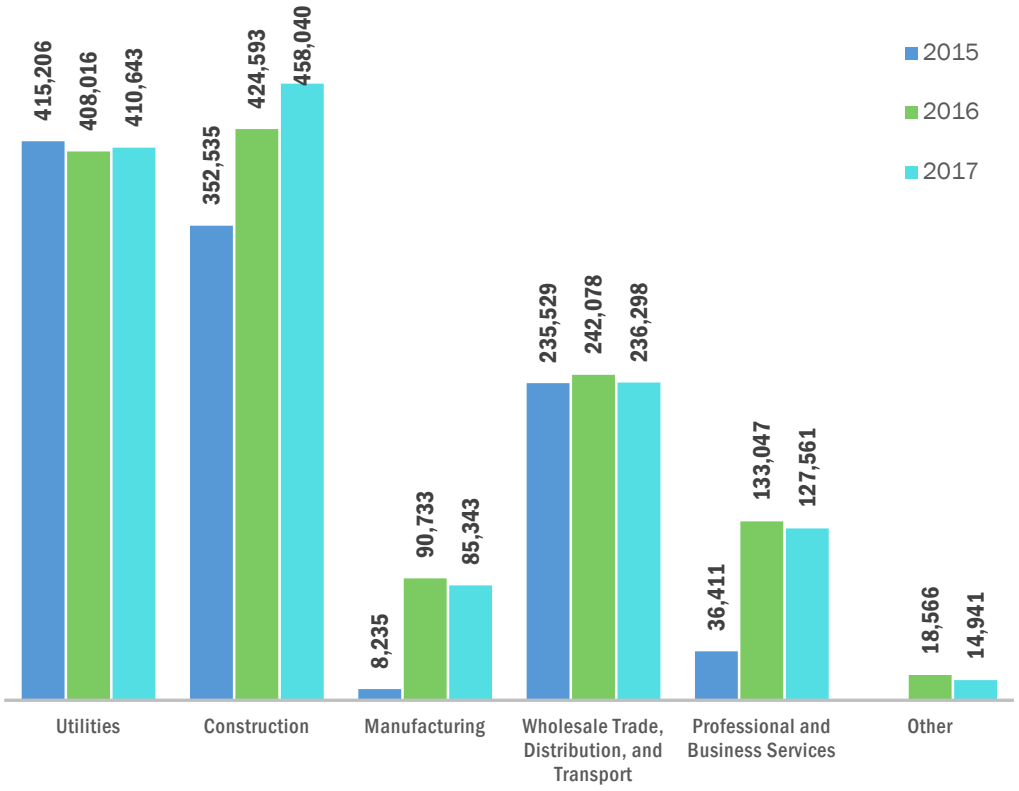
# Summary

Transmission, Distribution, and Storage, plus the retail workers discussed above, employed just under 2.35 million Americans in 2017. Excluding these retail employees, 1,332,826 workers were employed in Transmission, Distribution, and Storage. About 65 percent of this employment was across utilities and construction firms,[63] including 34 percent in construction companies that construct pipeline and other infrastructure that support Transmission, Distribution, and Storage, including both fuels and electricity.[64] Overall, 37.8 percent of respondent employers working in Transmission, Distribution, and Storage reported that a majority of their revenues come from grid modernization or other utility-funded modernization projects (an increase from the 31.5 percent proportion reported in 2016). Employers project to increase their hiring of workers by just under 4 percent in 2018.

[61] BLS, QCEW, 2017 Second Quarter, U.S. Total June Employment for NAICS 44711, NAICS 44719, and NAICS 45431.
[62] BLS, QCEW, 2017 Second Quarter, U.S. Total June Employment for NAICS 44-45.
[63] 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.
[64] This includes transportation employment which is calculated using commodity flow data and employment data on rail, truck, air, and sea transportation.

Figure 37.

Transmission, Distribution, and Storage Employment by Industry Sectors, Q2 2015 - Q2 2017[65]




# Transmission, Distribution, and Storage Employment by Industry

As noted above, Transmission, Distribution, and Storage employed 1,332,826 workers in 2017.

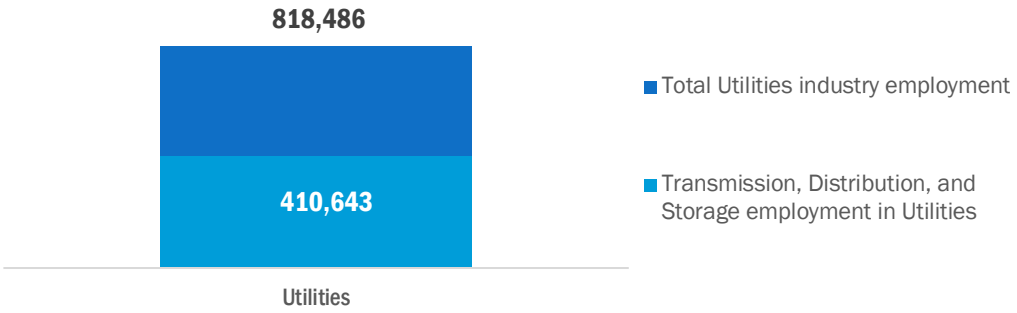
Using survey data, the following sections illustrate a breakdown of sector-wide employment within five broad high-level industry classifications, including construction and manufacturing.

[65] It should be noted that any changes in the manufacturing industry are not directly comparable to employment totals for 2015 in the 2016 USEER report. The 2017 USEER and 2018 USEER significantly improved its methodology and scope to capture more manufacturing jobs. As a result, changes in the methodology account for the majority of the apparent and observed growth in 2016, compared to 2015 data.

## Utilities

Utility companies[66] 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 410,643 Transmission, Distribution, and Storage workers across U.S. utility generation firms in 2017, up slightly from 2016. This number represents just over half of energy utility employment nationwide.

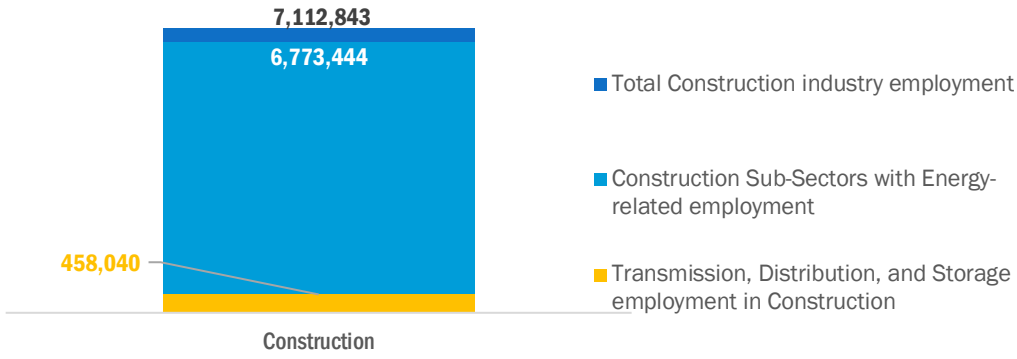
### Figure 38.
Utilities Employment, Q2 2017




## Construction

Construction firms contributed the most employment to Transmission, Distribution, and Storage activities in 2017, with 458,040 jobs, an 8 percent increase from 2016. This work included pipeline and electric transmission and distribution activity, as well as the development of smart and micro grids. In fact, a third of construction firms working in Transmission, Distribution, and Storage reported that more than half of their revenues comes from grid modernization or other utility-funded modernization projects (an increase over 2016).

### Figure 39.
Construction Employment, Q2 2017



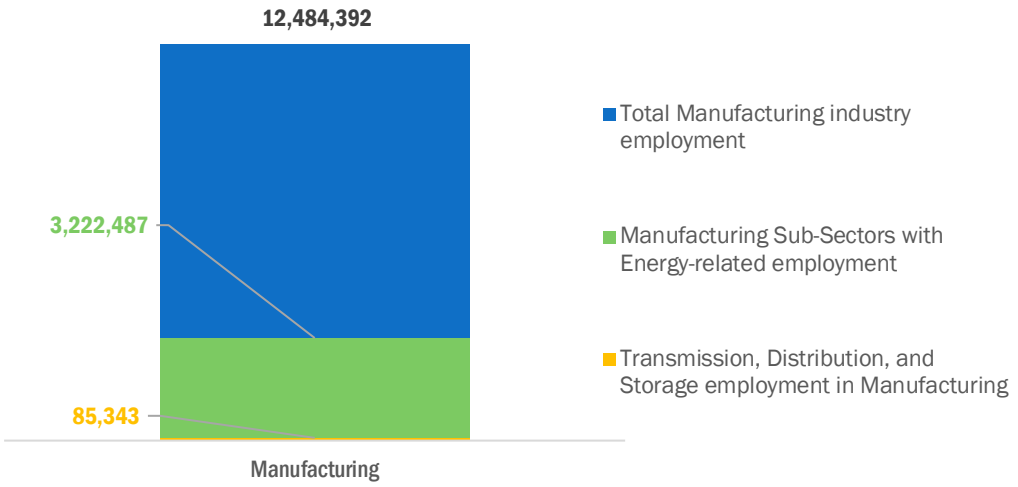

[66] As with all other industries in this report, this chapter relies on NAICS definitions. Utility-scale power generators, for example, are classified as utilities regardless of ownership or regulation.

## Manufacturing

The manufacturing of Transmission, Distribution, and Storage technologies is not entirely captured by a single NAICS classification in BLS data, and, as with other manufacturing data, are traditionally more difficult to classify. The 2017 USEER and 2018 USEER significantly improved methodology and scope to capture more of these manufacturing jobs that were not found in the 2016 USEER. As a result, comparisons to the 2015 data found in the 2016 USEER are not recommended, as change in methodology accounts for the majority of the growth seen between 2015 and 2016. Overall employment for manufacturing firms in Transmission, Distribution, and Storage decreased by 6 percent from 2016 to 2017.

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 nearly 12.5 million total manufacturing jobs in 2017, almost 26 percent or 3.2 million were contained within such energy-related detailed industries that may support transmission-related infrastructure and 3 percent of those, or approximately 85,000 workers, produced products for Transmission, Distribution, and Storage in 2017.

**Figure 40.**
**Manufacturing Employment, Q2 2017**



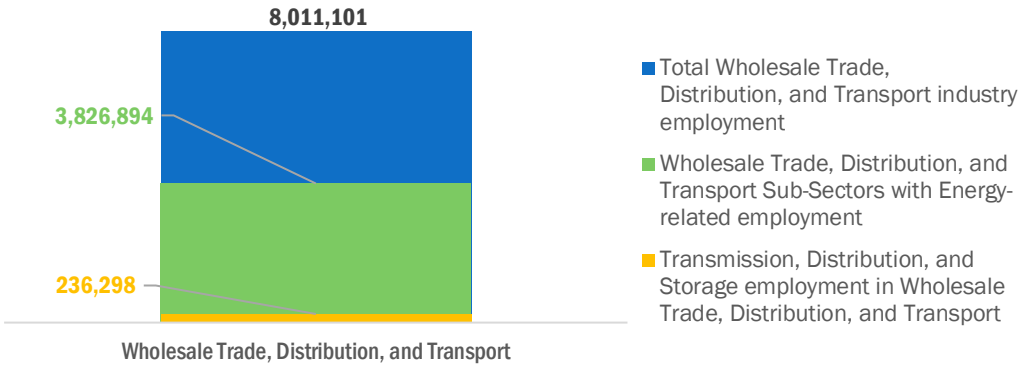

## Wholesale Trade

Several industry codes used by BLS capture employment entirely dedicated to the transport of crude oil, natural gas, and other refined petroleum products. About 137,100 jobs were included for 2017 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.[67] An additional 50,189 jobs identified by the survey are contained within detailed

[67] For the methodology, see Appendix A: Survey and Analysis Methods.

wholesale industries such as electrical equipment, wiring, appliance, and electronics merchant wholesalers. Together, fossil fuel transport and electrical equipment wholesalers employed more than 236,000 Transmission, Distribution, and Storage workers in 2017.[68]

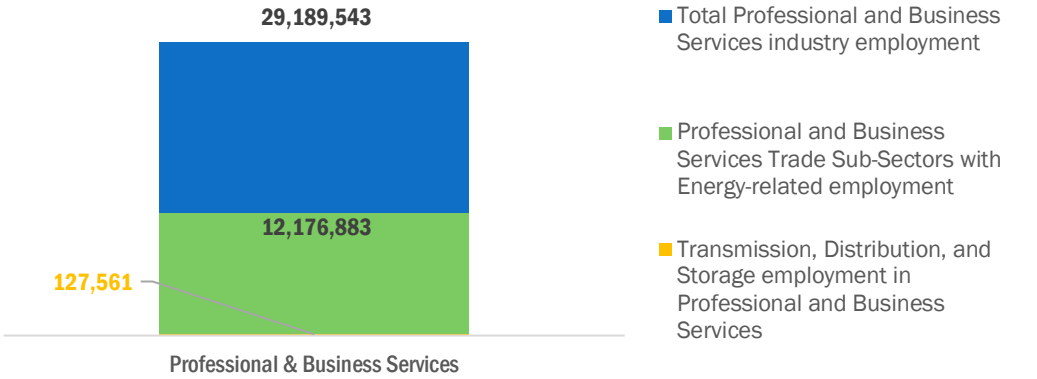
**Figure 41.**
**Wholesale Trade, Q2 2017**




## 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 12.2 million workers in these detailed industry codes, the USEER identified about 127,561 workers who spend some of their time supporting these technologies in 2017. More than three-quarters (76.6 percent) of professional and business service employees spent the majority of their time on work related to Transmission, Distribution, and Storage in 2017 (up from 64 percent in 2016); about half (51.5 percent) spent all of their time supporting these technologies.

**Figure 42.**
**Professional and Business Services Employment, Q2 2017**



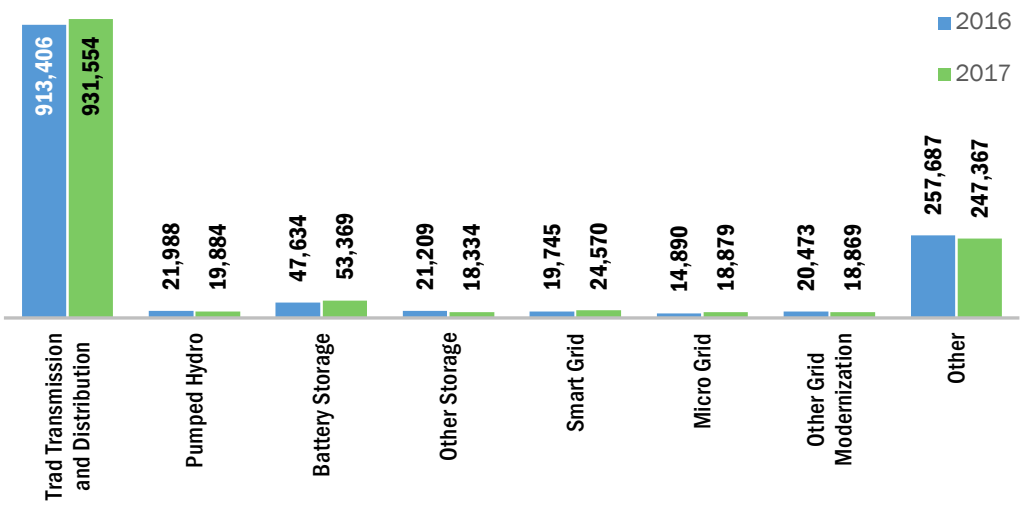

[68] This employment figure excludes raw material and component manufacturers; the limitations of a survey-based approach prevents accurate data collection for suppliers that are significantly upstream.

# Transmission, Distribution, and Storage Employment by Detailed Technology Application

Seventy percent of Transmission, Distribution, and Storage employees work to manufacture, construct, repair, and operate traditional electrical and gas transmission and distribution. This includes not only fossil fuel pipeline transportation, but also pipeline and power line construction as well as natural gas distribution. Approximately 91,600 workers were employed with storage technologies (including hydro-storage)[69] in 2017, while 62,300 worked with smart grid,[70] micro grid, or other grid technologies. About 137,200 employees were involved with the transport of fuel via rail, air, water, or truck, and an additional 110,202 worked on other detailed technology applications within Transmission, Distribution, and Storage.[71]

**Figure 43.**

**Employment by Transmission, Distribution, and Storage Detailed Technology Applications, Q1 2016 - Q2 2017**[72]




Manufacturing firms within Transmission, Distribution, and Storage reported expected growth of nearly 7 percent by the end of 2018.

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

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

[71] 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 247,367.

[72] Data collection was unable to capture the verbatim responses for the remainder of those who selected "other" (remaining "other" employment without commodity flows). These are typically employers who work across multiple technology applications and could not assign their workers to a single technology. Future surveys will provide an open-end field for the respondent to report their primary detailed technology application.

Figure 44.
Expected Employment Growth by Industry Q4 2017 – Q4 2018[73]


# Transmission, Distribution, and Storage – Workforce Characteristics

Just under a quarter of Transmission, Distribution, and Storage employees across the nation in 2017 were women. Seventeen percent of employees were Hispanic or Latino, matching the proportion for national workforce averages. Commodity flow employment is not included in this section as commodity flow employers were not directly surveyed for the 2018 USEER.

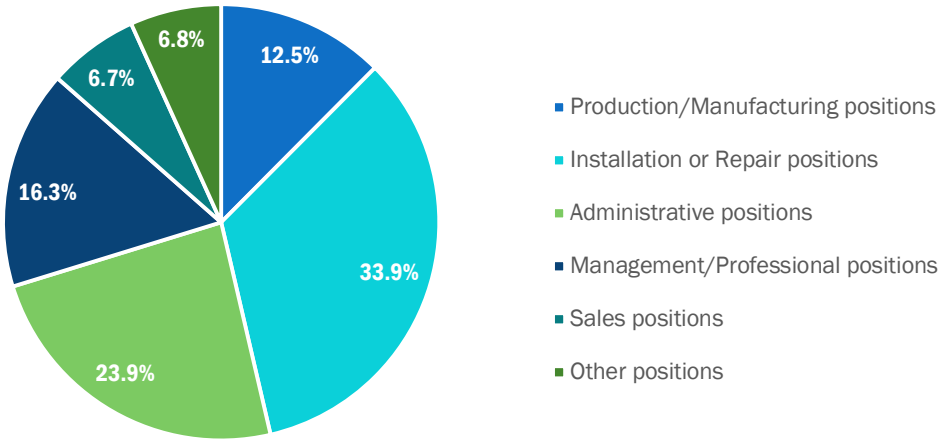
Table 16.
Demographics – Transmission, Distribution, and Storage, Q4 2017

| Demographic | Employees | Percent of Sector | National Workforce Averages |
|---|---|---|---|
| Male | 904,678 | 76% | 53% |
| Female | 290,982 | 24% | 47% |
| Hispanic or Latino | 207,949 | 17% | 17% |
| Not Hispanic or Latino | 987,711 | 83% | 83% |
| American Indian or Alaska Native | 21,916 | 2% | 1% |
| Asian | 94,933 | 8% | 6% |
| Black or African American | 97,084 | 8% | 12% |
| Native Hawaiian or other Pacific Islander | 7,807 | 1% | >1% |
| White | 854,224 | 71% | 78% |
| Two or more races | 119,696 | 10% | 2% |
| Veterans | 103,797 | 9% | 6% |
| 55 and over | 252,822 | 21% | 23% |
| Union | 204,458 | 17% | 11% |

[73] This does not include commodity flow employers, as they were not surveyed for 2018 USEER.

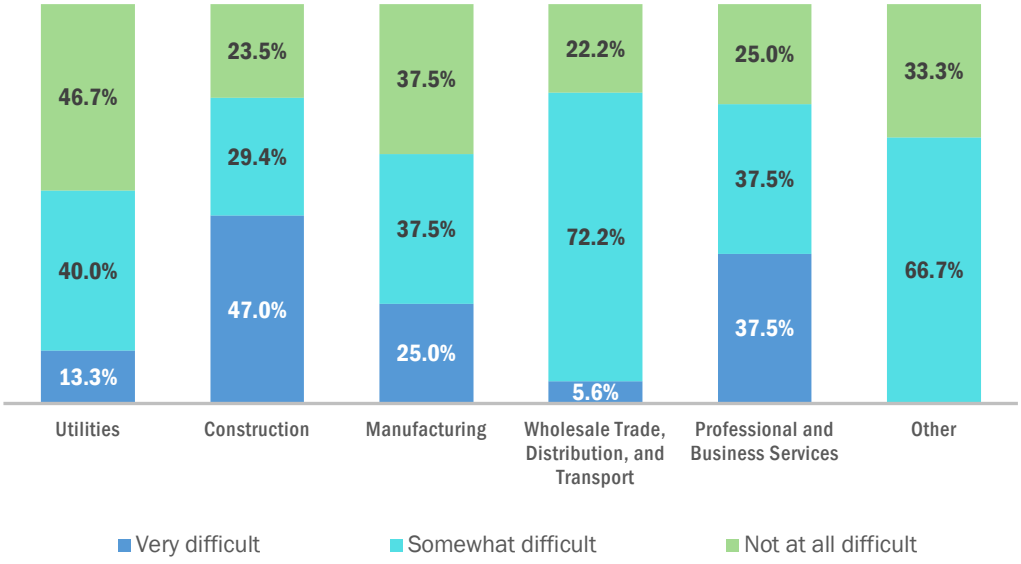
More than a third (34 percent) of Transmission, Distribution, and Storage workers were employed in installation or repair positions in 2017. Nearly a quarter of workers were employed in administrative positions.

**Figure 45.**
**Occupational Distribution – Transmission, Distribution, and Storage, Q4 2017**




Wholesale trade, distribution, and transport firms reported the most overall hiring difficulty in 2017, followed by construction, and professional and business services.

**Figure 46.**
**Hiring Difficulty by Industry - Transmission, Distribution, and Storage, Q4 2017**




Transmission, Distribution, and Storage industry sectors reported either insufficient qualifications, certifications, and/or education, lack of experience, training, or technical skills, or competition and/or small applicant pool as the number one reason for reported hiring difficulty.

## Table 17.
### Reasons for Hiring Difficulty by Industry – Transmission, Distribution, and Storage, Q4 2017

| Utilities | Construction | Manufacturing | Wholesale Trade, Distribution, and Transport | Professional and Business Services | Other |
|---|---|---|---|---|---|
| **Lack of experience, training, or technical skills (63%)** | Insufficient qualifications, certifications, education (46%) | Competition/ small applicant pool (80%) | Lack of experience, training, or technical skills (85%) | Lack of experience, training, or technical skills (50%) | Lack of experience, training, or technical skills (40%) |
| **Insufficient qualifications, certifications, education (25%)** | Lack of experience, training, or technical skills (38%) | Insufficient qualifications, certifications, education (40%) | Insufficient non-technical skills (54%) | Competition/ small applicant pool (33%) | Difficulty finding industry-specific knowledge, skills, and interest (40%) |
| **Competition/ small applicant pool (25%)** | Competition/ small applicant pool (31%) | Lack of experience, training, or technical skills (40%) | Insufficient qualifications, certifications, education (15%) | Cannot provide competitive wages (33%) | Competition/ small applicant pool (13%) |

Utilities, wholesale trade, distribution, and transport, professional and business services, and "other" firms that had hiring difficulty in 2017 cited managers, directors, or supervisors as the most difficult occupational category to hire for.

## Table 18.
### Reported Occupations with Hiring Difficulty by Industry – Transmission, Distribution, and Storage, Q4 2017

| Utilities | Construction | Manufacturing | Wholesale Trade, Distribution, and Transport | Professional and Business Services | Other |
|---|---|---|---|---|---|
| **Managers, directors, or supervisors (45%)** | Electricians (38%) | Manufacturing or production positions (80%) | Managers, directors, or supervisors (46%) | Managers, directors, or supervisors (50%) | Managers, directors, or supervisors (40%) |
| **Engineers (36%)** | Technician or technical support (31%) | Engineers (40%) | Technician or technical support (38%) | Engineers (50%) | Software or web developers (40%) |
| **Electricians (27%)** | Installation workers (8%) | Administrative support (20%) | Sales, marketing, or customer service representatives (31%) | Technician or technical support (33%) | Technician or technical support (20%) |

# Energy Efficiency

# 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. Energy Efficiency employment covers both the production of energy-saving products and the provision of services that reduce end-use energy consumption. These services include not only the manufacture of ENERGY STAR appliances and other ENERGY STAR labeled products, but also building design and contracting services that provide insulation, improve natural lighting, and reduce overall energy consumption across homes and businesses.[74] However, the USEER only captures employment with certified[75] energy efficiency products or those installed according to ENERGY STAR guidelines, as well as advanced building materials such as insulation. The USEER Energy Efficiency employment figures include only work with these efficient technologies or building design and retrofits. The report does not capture employment related to energy-efficient manufacturing processes. It does capture employment associated with CHP and waste-heat to power (WHP), though these technologies are included in the Electric Power Generation and Fuels chapter. In the meantime, please see the recently released Energy Productivity and Economic Prosperity Index for more information on manufacturing process efficiency.[76]

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.

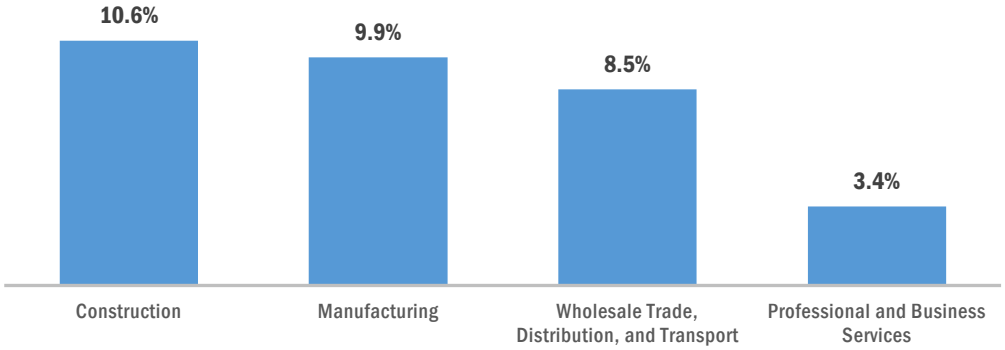
The 2018 USEER has identified approximately 2.25 million workers across the construction, manufacturing, wholesale trade, professional and business services, and other services industries that spent some or all of their time working with energy-efficient technologies and services in 2017, as defined earlier in this report. Energy Efficiency employment grew by just over 3 percent from 2016 to 2017.

# Summary

Energy Efficiency employers report a projected growth rate for employment in 2018 of about 9 percent. Construction employers, in particular, report expected Energy Efficiency job growth of 11 percent by the end of 2018.

[74] Estimates do not include retail employment.
[75] "Certified" means certification by the EPA ENERGY STAR Program.
[76] Blok et al., The 2015 Energy Productivity and Economic Prosperity Index.

Figure 47.
Expected Employment Growth by Major Industry Q4 2017 – Q4 2018




The majority, nearly 57 percent, of Energy Efficiency employees worked at construction firms in 2017, installing or servicing Energy Efficiency goods or performing Energy Efficiency related services.[77] Approximately one in five workers in the Energy Efficiency sector worked in professional and business services.

The manufacture of ENERGY STAR certified products represented a sizeable portion of employment in 2017, with just over 14 percent of the total Energy Efficiency workforce. This represents an increase of 9 percent from 2016.

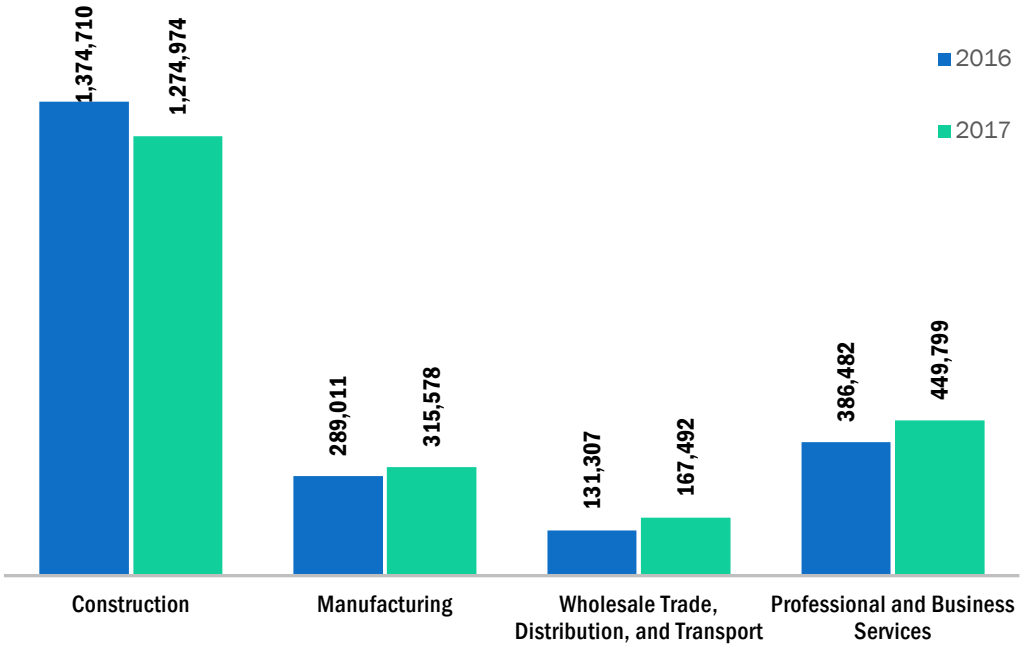
The 2018 USEER does not cover retail trade, but BLS data finds that retail trade industries that sell and distribute ENERGY STAR appliances and building materials (as well as non-qualifying appliances and building materials) employ approximately 4.2 million Americans across several different sectors.[78]

The market penetration—and resulting manufacture and sales of—certified ENERGY STAR products continues to increase.[79] The penetration and revenues from ENERGY STAR products varies significantly. For example, in 2016, only 5 percent of ceiling fans with lights, 21 percent of computer workstations, 31 percent to 35 percent of clothes dryers, and 26 percent to 59 percent of commercial cooking equipment meet ENERGY STAR guidelines. However, between 48 percent and 69 percent of refrigerators (residential and commercial, respectively), and 80 percent of compact fluorescent bulbs (CFLs), 63 percent of dehumidifiers, 81 percent of notebook computers, and 100 percent

[77] 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.
[78] These industries include Household Appliance Stores (443141), Electronics Stores (443142), Building Material and Supplies Dealers (4441), Department Stores (452210), and Warehouse Clubs and Supercenters. These are retail establishments that are not defined by their sale of ENERGY STAR appliances or EE products. Some are defined by their sale of appliances in general (i.e., those under NAICS 4431) but even these are not the sole retailers of EE products – they could be general retailers as well such as big box stores that sell wide varieties of items.
[79] 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.

of multifunction printers are certified ENERGY STAR products.[80] A table of products tracked by the EPA is available in Appendix C.

**Figure 48.**
**Energy Efficiency Employment by Major Industry Sectors, Q2 2017**



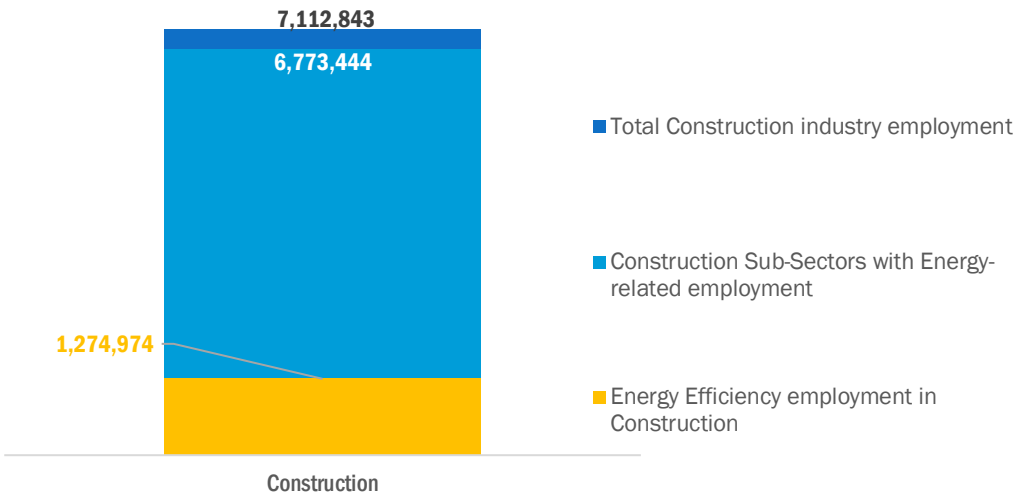

# Energy Efficiency Employment by Industry

## Construction

The majority of Energy Efficiency employment (57 percent) identified with USEER data is found across construction firms (1.27 million). Of the 7.1 million construction workers in the United States, about 18 percent worked in 2017 to support the construction or installation of energy-efficient technologies.

[80] EPA, *ENERGY STAR Unit Shipment and Market Penetration Report: Calendar Year 2016 Summary* (Washington, D.C., 2017), https://www.energystar.gov/ia/partners/downloads/unit_shipment_data/2016_USD_Summary_Report.pdf?cf49-26d3.

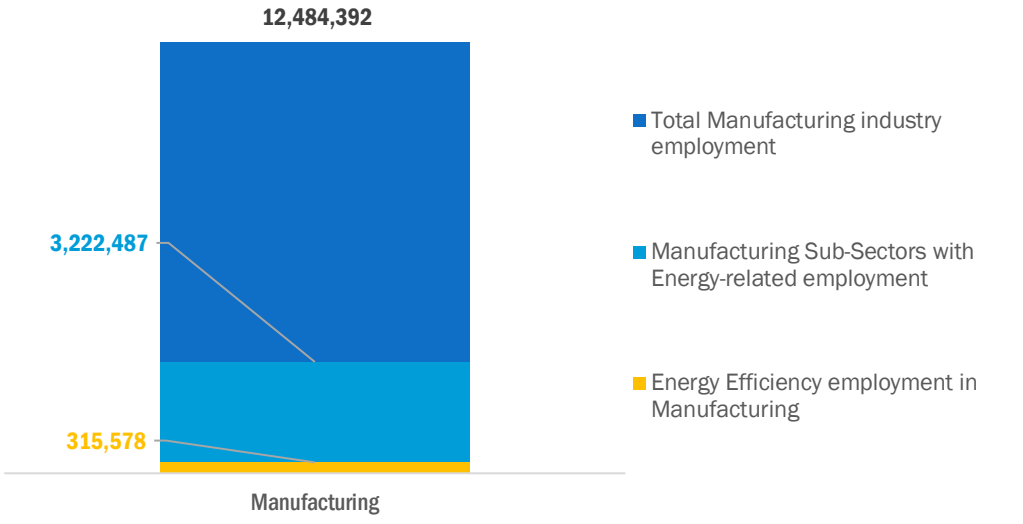
Figure 49.
Construction Employment, Q2 2017




## Manufacturing

Manufacturing activity is a sizeable 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 3,222,487 jobs found in relevant energy manufacturing subsectors in 2017—such as lighting, household appliances, or HVAC equipment manufacturing—about 315,578 workers manufactured energy-efficient products as defined in this chapter.

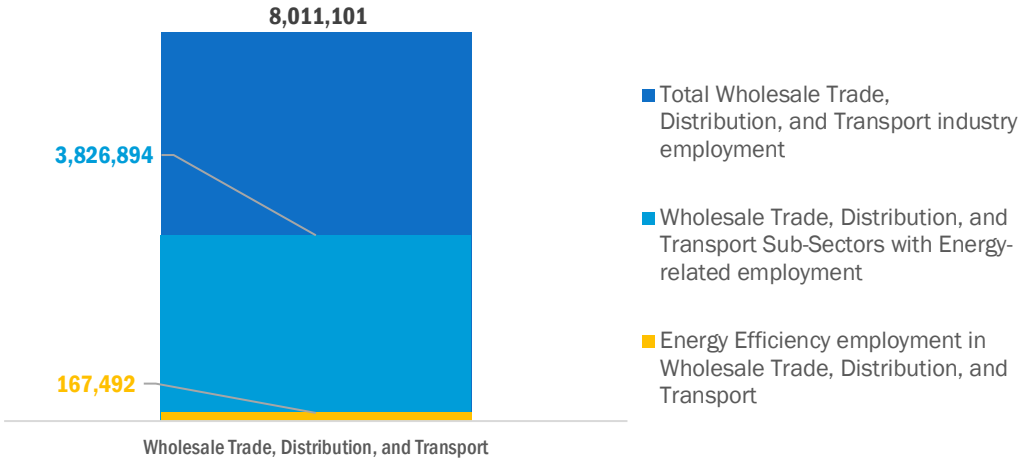
Figure 50.
Manufacturing Employment, Q2 2017



## Wholesale Trade

Approximately 48 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 3.8 million jobs, USEER survey data identified about 4 percent of workers that were engaged in efficiency-related work in 2017.

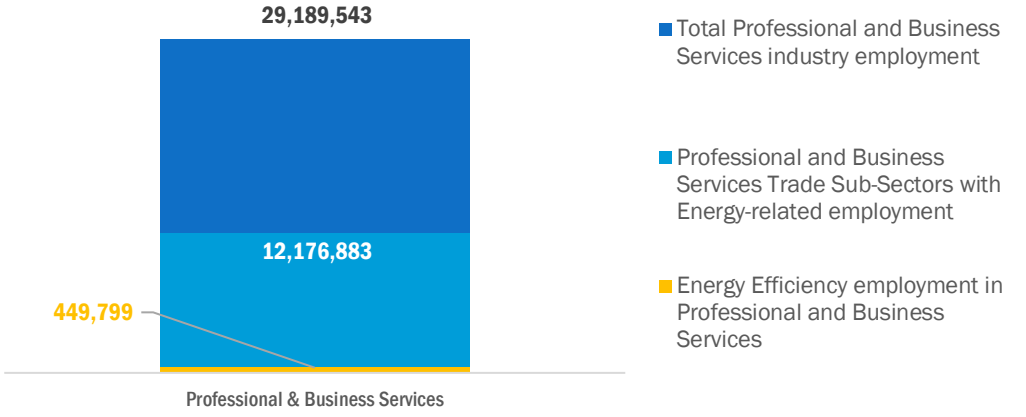
### Figure 51.
### Wholesale Trade Employment, Q2 2017




## Professional and Business Services

Forty-two 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 449,800, who worked to support energy-efficient products and services in 2017.

### Figure 52.
### Professional and Business Services Employment, Q2 2017



# Energy Efficiency Employment by Detailed Technology Application

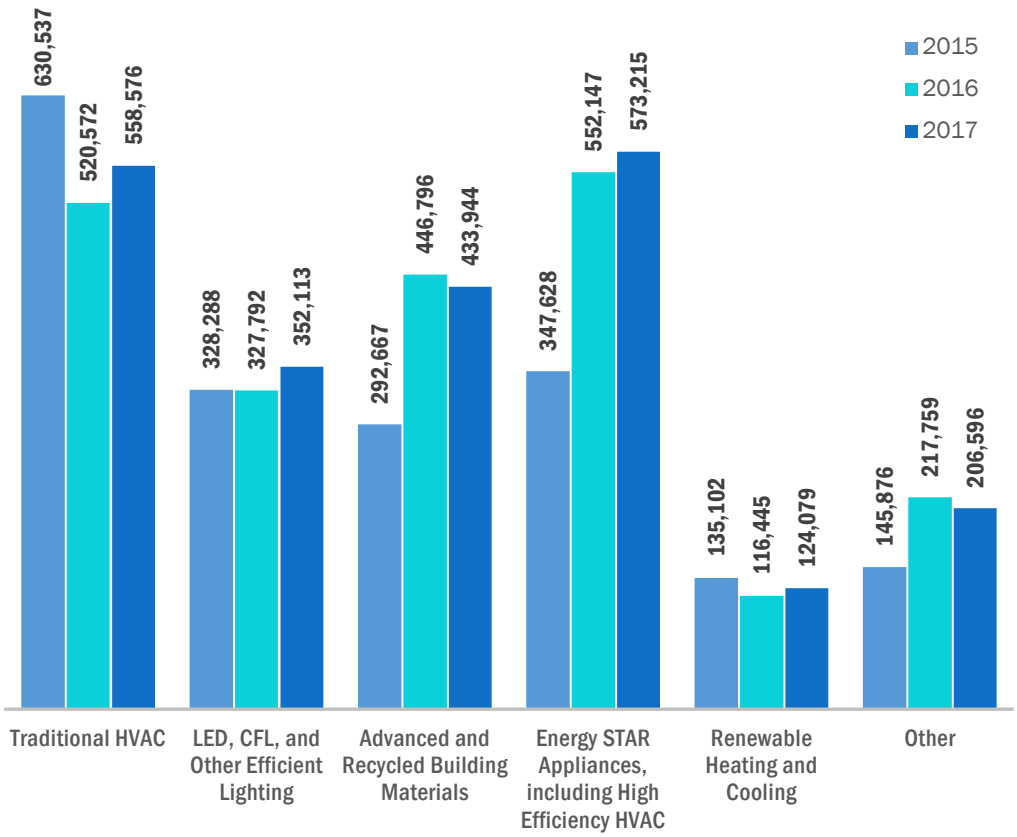
ENERGY STAR appliances, including high efficiency heating and cooling equipment, employed just over a quarter of the Energy Efficiency workforce in 2017. The second largest category of employment was found in the traditional heating, ventilation, or air-conditioning (HVAC) industry, with just under a quarter (25 percent) of the sector's employment in 2017. 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] The third largest category of employment was advanced building materials, followed by energy-efficient lighting.

In addition, construction firms working in the Energy Efficiency sector, experienced an increase in the percentage of their workers who spend at least 50 percent of their time on energy efficiency-related work, from 74.0 percent in 2016 to 80.3 percent in 2017. Although the total number of energy efficiency construction workers decreased, the amount of time each worker spent on efficiency-related work increased. As a result, the number of construction workers who spend the majority of their time on energy efficiency-related work increased by 6,500 from 2016 to 2017, underscoring the increasing adoption of these technologies.

[81] Unlike the installation and repair of ENERGY STAR appliance, 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).

Figure 53.

Energy Efficiency Employment by Detailed Technology Application (Q2 2015 - Q2 2017)[82]




Construction workers across the Energy Efficiency sector are primarily engaged in both traditional HVAC and high efficient heating and cooling equipment. Together, these two technology applications accounted for 46 percent of construction-related work in the Energy Efficiency sector in 2017. Advanced and recycled building materials and insulation technologies also supported a significant amount of construction employment—over 249,300 jobs. The manufacturing industry is heavily concentrated in high efficiency heating and cooling equipment as well as advanced and recycled building materials and insulation—approximately 157,400 manufacturing employees or nearly 50 percent of efficiency-related manufacturing work in 2017. About three in ten workers in the wholesale trade industry and nearly a third in professional services were mostly working with traditional HVAC goods.

[82] The "other" category for the chart includes reduced water consumption products and appliances.

Table 19.
Energy Efficiency Employment by Detailed Technology Application and Industry, Q2 2017

| | Total | Construction | Manufacturing | Wholesale Trade | Professional Services | Other |
|---|---|---|---|---|---|---|
| ENERGY STAR Appliances | 159,820 | 86,154 | 16,918 | 12,046 | 40,461 | 4,242 |
| LED, CFL and Other Efficient Lighting | 352,113 | 182,537 | 45,489 | 34,903 | 86,015 | 3,169 |
| Traditional HVAC goods, control systems, and services | 558,576 | 313,280 | 33,547 | 50,562 | 145,684 | 15,503 |
| ENERGY STAR/ High Efficiency heating and cooling equipment | 413,395 | 270,263 | 72,404 | 25,512 | 40,774 | 4,443 |
| Renewable Heating and Cooling (including Solar Thermal) | 124,079 | 79,962 | 7,593 | 7,305 | 28,453 | 766 |
| Advanced Building Materials/Insulation | 350,918 | 201,150 | 73,314 | 20,628 | 53,581 | 2,246 |
| Recycled building materials | 83,027 | 48,191 | 11,778 | 2,678 | 17,508 | 2,871 |
| Reduced water consumption products and appliances | 91,005 | 58,303 | 6,087 | 5,172 | 20,151 | 1,292 |
| Other | 115,591 | 35,134 | 48,448 | 8,686 | 17,172 | 6,151 |

# Energy Efficiency – Workforce Characteristics

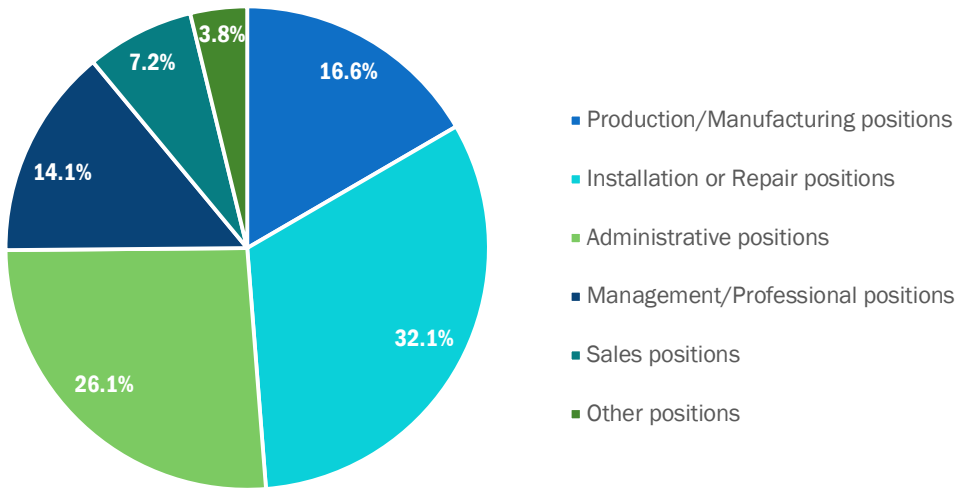
The Energy Efficiency workforce is less diverse than the national workforce; less than a quarter of employees in 2017 were reported to be women (23 percent – half the proportion when compared to national workforce averages), and there were fewer Black or African American workers and slightly fewer Hispanic or Latino and Asian workers compared to the national average.

Table 20.
Demographics – Energy Efficiency, Q4 2017

| Demographic | Employees | Percent of Sector | National Workforce Averages |
|---|---|---|---|
| Male | 1,723,732 | 77% | 53% |
| Female | 524,792 | 23% | 47% |
| Hispanic or Latino | 337,402 | 15% | 17% |
| Not Hispanic or Latino | 1,911,122 | 85% | 83% |
| American Indian or Alaska Native | 32,288 | 1% | 1% |
| Asian | 107,276 | 5% | 6% |
| Black or African American | 176,303 | 8% | 12% |
| Native Hawaiian or other Pacific Islander | 25,166 | 1% | >1% |
| White | 1,748,399 | 78% | 78% |
| Two or more races | 159,092 | 7% | 2% |
| Veterans | 238,162 | 11% | 6% |
| 55 and over | 317,194 | 14% | 23% |
| Union | 239,364 | 11% | 11% |

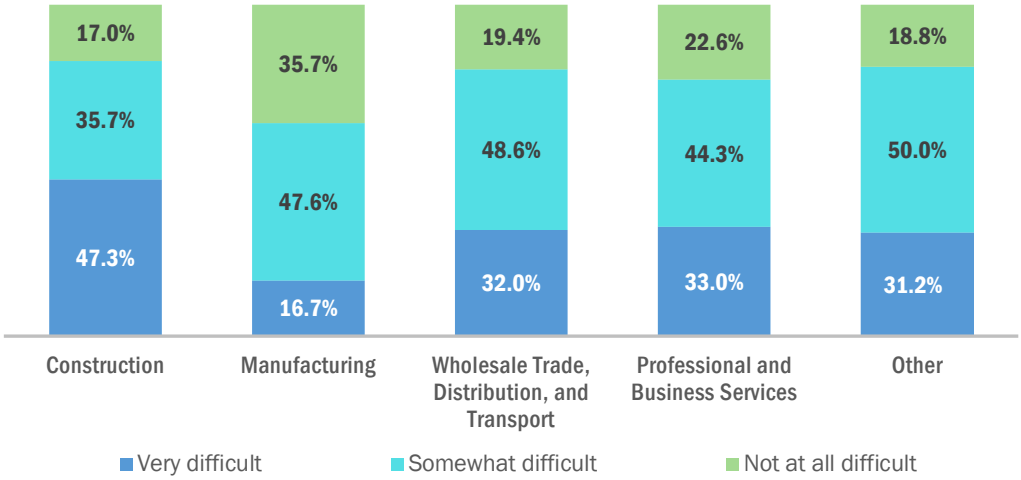
The majority of workers in Energy Efficiency were employed in installation or repair positions (32 percent) or administrative positions (26 percent) in 2017. Nearly 17 percent of workers were classified as production/manufacturing positions.

Figure 54.
Occupational Distribution – Energy Efficiency, Q4 2017



In the Energy Efficiency sector, over 80 percent of employers in construction, "other," and wholesale trade, distribution, and transport reported at least some difficulty finding qualified job applicants. Sixty percent or more of Energy Efficiency employers in each of the industries reported at least some difficulty in hiring.

Figure 55.
Hiring Difficulty by Industry – Energy Efficiency, Q4 2017




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

Table 21.
Reasons for Hiring Difficulty by Industry – Energy Efficiency, Q4 2017

| Construction | Manufacturing | Wholesale Trade, Distribution, and Transport | Professional and Business Services |
|---|---|---|---|
| **Lack of experience, training, or technical skills (64%)** | Lack of experience, training, or technical skills (56%) | Lack of experience, training, or technical skills (62%) | Lack of experience, training, or technical skills (58%) |
| **Insufficient non-technical skills (38%)** | Insufficient qualifications, certifications, education (37%) | Insufficient non-technical skills (28%) | Competition/ small applicant pool (28%) |
| **Insufficient qualifications, certifications, education (18%)** | Insufficient non-technical skills (19%) | Competition/ small applicant pool (23%) | Insufficient qualifications, certifications, education (25%) |

The following table lists the occupations by industry that Energy Efficiency employers mentioned were the most difficult to fill in 2017.

## Table 22.
## Reported Occupations with Hiring Difficulty by Industry – Energy Efficiency, Q4 2017

| Construction | Manufacturing | Wholesale Trade, Distribution, and Transport | Professional and Business Services |
|---|---|---|---|
| **Technician or technical support (49%)** | Manufacturing or production positions (41%) | Sales, marketing, or customer service representatives (47%) | Engineers (38%) |
| **Installation workers (37%)** | Electricians (22%) | Technician or technical support (33%) | Designers or architects (20%) |
| **Electricians (21%)** | Sales, marketing, or customer service representatives (19%) | Administrative support (14%) | Managers, directors, or supervisors (16%) |

# Motor Vehicles

# Introduction

Though not considered a sector of the Traditional Energy industry, Motor Vehicles,[83] which include cars, light-duty and heavy-duty trucks, and component parts, is included in this report, given both their high energy consumption during production and their contribution to end-use energy consumption. The Motor Vehicle sector is a large and complex component of the U.S. economy that is only partially captured in existing industry codes. Further complicating the use of existing labor market data is that the NAICS classification system is inconsistent with classifications used by the DOE and the EPA, creating significant confusion in understanding the data.[84]

Several NAICS industry codes capture motor vehicle and parts manufacturing, automotive repair and maintenance, and wholesale trade, which comprise the Motor Vehicles and Component Parts sector. However, some employment is also embedded within industry subsectors including electrical equipment manufacturing, raw materials, goods transportation, warehousing, and professional services. In addition, this report provides employment data by fuel type, including gas and diesel vehicles, hybrid, electric, natural gas, as well as hydrogen and fuel cell technologies. It also analyzes how the component parts sector contributes to increasing the fuel economy of vehicles.

As with most other sections of the 2018 USEER, raw materials and retail trade are excluded from the data, and employment totals refer to workers that spend some or all of their time working with a specific technology. Also, to be consistent with other chapters, employment is categorized by the establishment's NAICS code, meaning that research and development, professional and management positions, and all other non-assembly jobs are included in the manufacturing total if the establishment is primarily focused on producing vehicles or component parts.

At least 650,000 jobs in the Motor Vehicle sector are focused on increasing fuel economy or transitioning to alternative fuels.[85] This figure does not include manufacture, sale, or repair of fuel-efficient vehicles, only component parts. This is a significant exclusion given that a recent study found that 58 percent of cars manufactured in the United States meet current CAFE standards and 52 percent achieved at least 23 miles per gallon.[86]

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

[84] NAICS segments the manufacture of motor vehicles into automobiles, light-duty trucks and utility vehicles, and heavy-duty trucks. EPA uses weight to classify motor vehicles into light-duty, medium-duty, and heavy-duty.

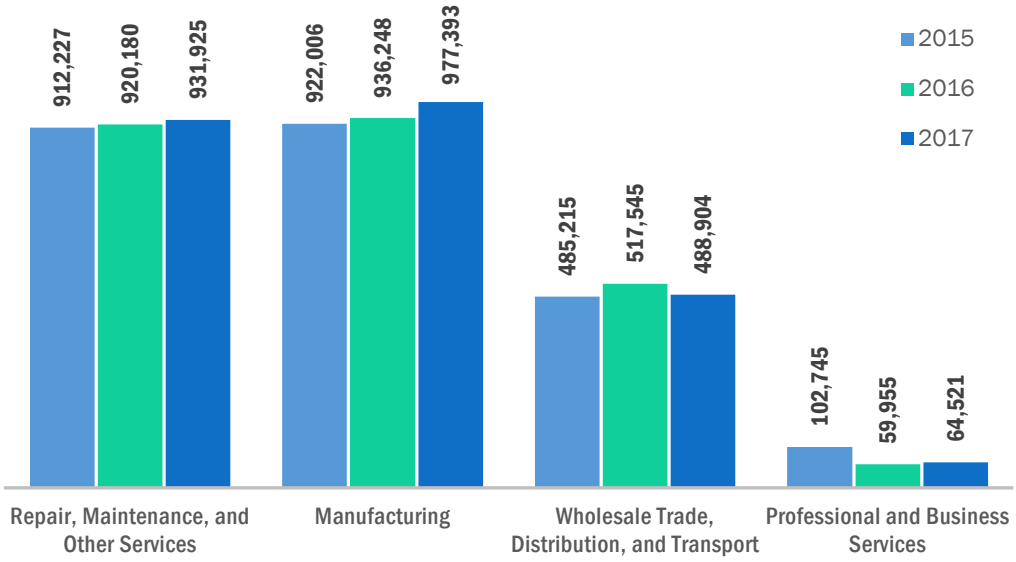
[85] This number assumes that the percentage of employment working on component parts to improve fuel economy is the same for gasoline/diesel and alternative fuel vehicles.

[86] Jack Gillis, Stephen Brobeck, and Mark Cooper, *Automakers Are on the Road to Meeting Fuel Efficiency Standards* (Washington, D.C., Consumer Federation of America, 2016), 2, https://consumerfed.org/wp-content/uploads/2016/04/2016-Fuel-Economy-Report-April-25-2016.pdf.

# Summary

The U.S. Motor Vehicles sector employed roughly 2.46 million Americans in 2017, increasing by nearly 29,000 employees over 2016. This is exclusive of dealerships and retailers, which employed nearly two million additional workers. About 39.7 percent of employment in the Motor Vehicle sector is engaged in manufacturing while 37.8 percent of employment is concentrated in repair and maintenance. Vehicle repair and maintenance includes all related services for automobiles, trucks, and other road transportation vehicles, such as motor homes, travel trailers, and campers. Approximately 19.9 percent of employees support the sector through wholesale trade; these include both direct transport of motor vehicle parts and supplies via air, rail, water, or truck, as well as merchant wholesalers for motor vehicle parts and supplies.

**Figure 56.**
**Motor Vehicle Employment by Industry Sectors, Q2 2015 - Q2 2017**




Three NAICS subsectors[87] capture Motor Vehicles finished product manufacturing, including automobiles, and light- and heavy-duty trucks, parts, body, and trailer manufacturing; together these detailed industry sectors employed 977,393 workers in 2017. 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 2017 to be 488,904. Similarly, motor vehicle repair[88] 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 931,925 workers in 2017.

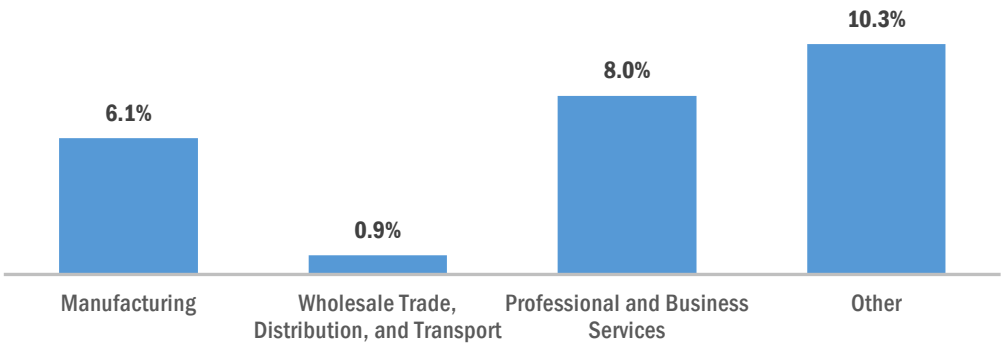
[87] NAICS 3361, 3362, and 3363.

[88] 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.

Professional and business services are not motor vehicle-specific, but the USEER survey identified about 64,521 workers who spent at least some time supporting the Motor Vehicles sector in 2017. Nearly three in five (59 percent) employees spent the majority of their time supporting Motor Vehicle subsectors, while 45 percent spent all of their time on this work.

Employers in the Motor Vehicles sector report projected growth of 6.7 percent through the end of 2018. Within the sector, "other" firms expect to grow by 10 percent. Professional and Business Services employers expect their workforce to expand by 8 percent.

**Figure 57.**
**Expected Employment Growth by Industry Q4 2017 – Q4 2018**




The 2018 USEER finds that just over 9 percent of the Motor Vehicle and Component Parts sector employment worked on alternative fuel vehicles in 2017, representing 219,611 jobs nationwide. In the second case, USEER data identified 44 percent of component parts manufacturing in 2017, or more than 476,000 jobs, that produce parts that increase fuel economy in the United States. Note that there is some overlap between these two figures.

In addition to the Motor Vehicles and Component Parts industries included in this 2018 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 703,000 workers nationwide in 2017. They encompass a wide range of detailed industries ranging from boat building to guided missile manufacturing—approximately 486,000 of the jobs (69.1 percent) are found in aviation and aerospace industries.

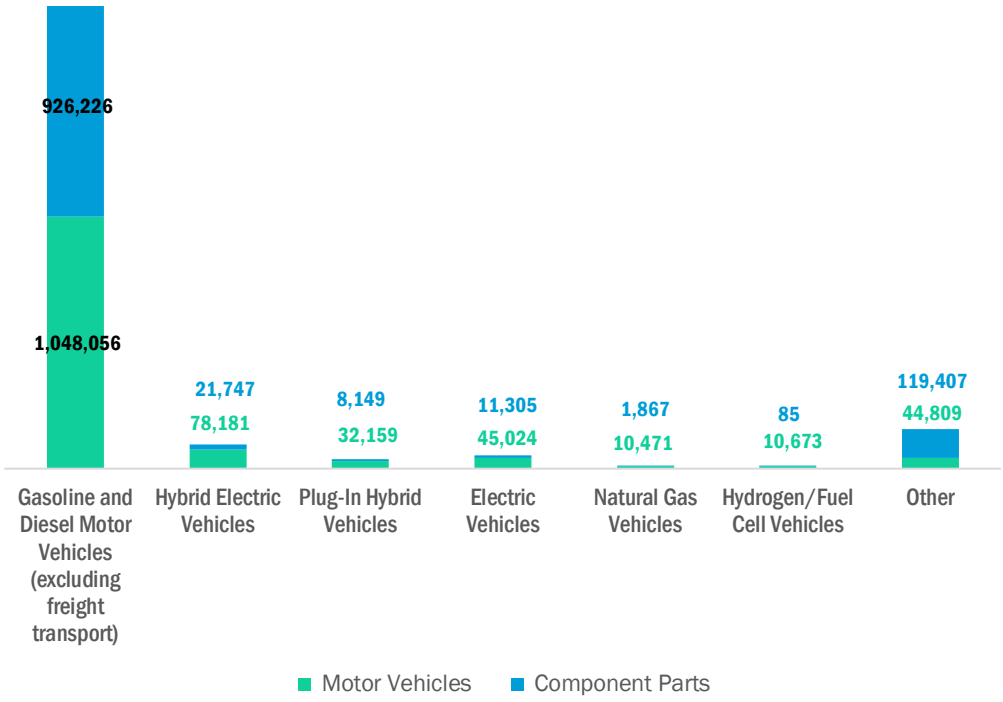
# Alternative Fuel Vehicles

While the repair and maintenance industry sector actively works with alternative fuel vehicles, 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 respondents' best efforts to allocate their workforce by fuel type.[89]

Of the 2,358,159 Motor Vehicles jobs in 2017 (exclusive of the 104,584 employees that were involved in the transport of motor vehicles),[90] 9 percent, or 219,661, focused on alternative fuel vehicles, while 84 percent worked with gasoline and diesel fueled motor vehicles.

**Figure 58.**
**Motor Vehicles and Component Parts Employment by Detailed Technology Application, Q2 2017**

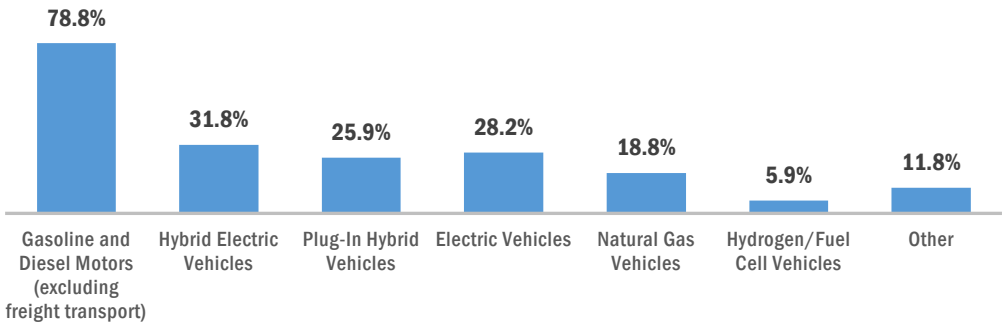



Approximately eight out of ten (79 percent) Motor Vehicle parts firms offered parts in 2017 for gasoline and diesel motor vehicles, while more than 30 percent offered component parts for hybrid electric vehicles.

[89] 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.
[90] Extrapolated employment from commodity flow data for motor vehicles.

Figure 59.

Parts Offered by Type of Fuel Used, Component Parts[91]

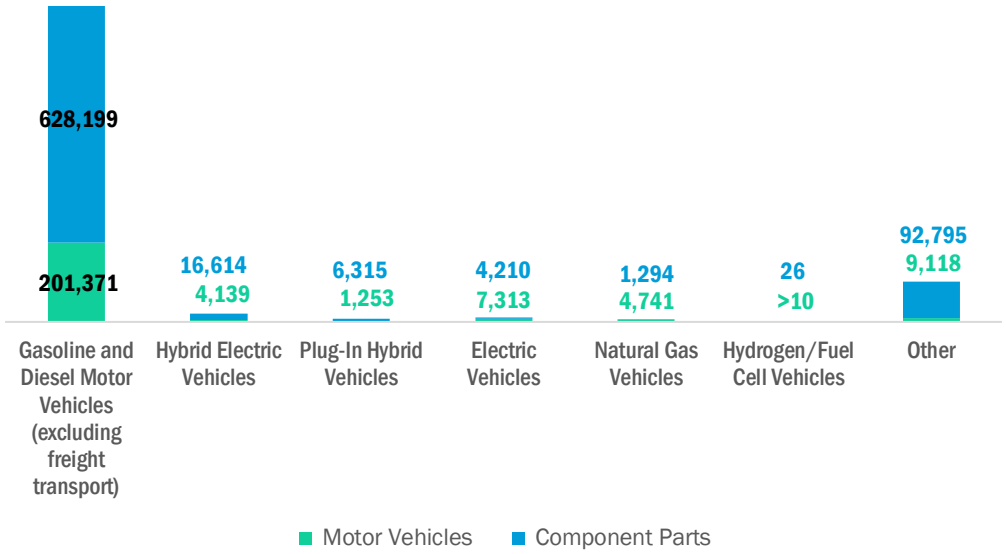



# Manufacturing

Gasoline and diesel motor vehicles represented nearly 85 percent of all Motor Vehicles and Component Parts manufacturing by employment in 2017 (up slightly from 84 percent in 2016). Five percent of manufacturing employment, or 45,911 jobs, in the sector in 2017 was focused on alternative fuel categories, while 10 percent was categorized within "other/multiple."

Figure 60.

Motor Vehicles and Component Parts Manufacturing Employment by Detailed Technology Application, Q2 2017[92]



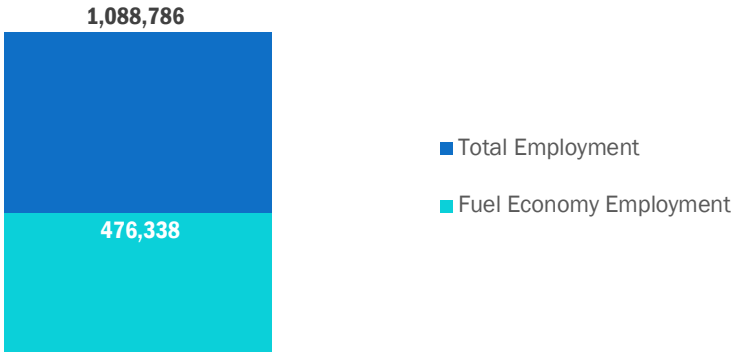

[91] Firms were permitted to offer multiple responses, percentages sum to over 100 percent.

[92] Of the 376 employees within hydrogen and fuel cell vehicles that worked on component parts, fewer than 10 employees were focused on motor vehicles manufacturing.

# Motor Vehicle Parts and Fuel Economy

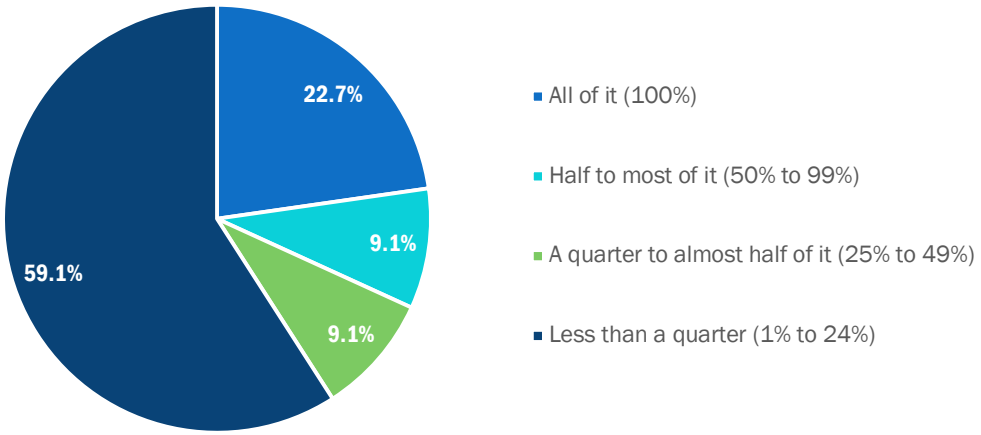
More than 476,000 Component Parts employees worked in 2017 with parts that increase fuel economy for vehicles. This represents 44 percent of the 1,088,786 workers employed in the sector in that year. The Component Parts sector includes firms focused on vehicle engine and drive parts, exhaust system parts, vehicle body parts, and other vehicle parts (including some battery production). This does not include mining and extraction for elements used in vehicle parts production, rolled aluminum manufacturing, or production equipment manufacturing.

**Figure 61.**
**Fuel Economy Employment in Component Parts, Q2 2017**



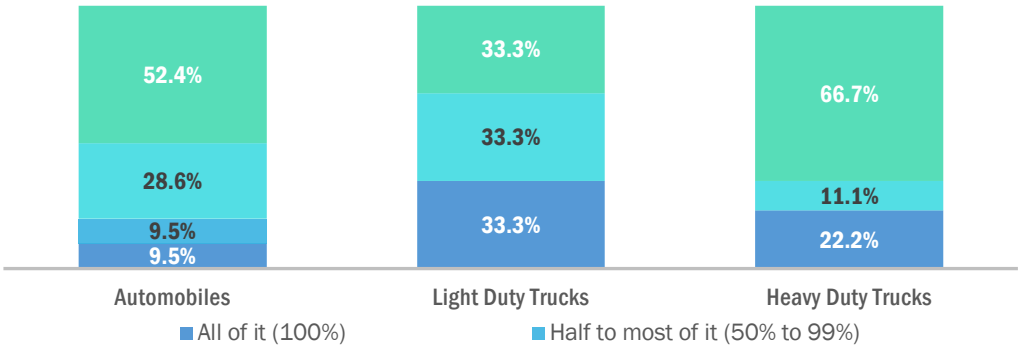

Across all component parts, more than one-fifth (23 percent) of firms that were involved in Motor Vehicle parts in 2017 indicated that they derived all of their revenue from products that increase fuel economy for these vehicles. This was an increase over the proportion of firms attributing all of their revenue to products that increase fuel economy in 2016 (17 percent).

**Figure 62.**
**Revenue Attributable to Products that Increase Fuel Economy**



A larger proportion of surveyed firms that primarily provide parts for light-duty trucks received all of their revenue in 2017 from products that increase fuel economy (33 percent), in comparison to firms that are mainly focused on heavy-duty trucks (22 percent) or automobiles (10 percent).

Figure 63.
Revenue Attributable to Products that Increase Fuel Economy by Primary Vehicle Type




# Motor Vehicles – Workforce Characteristics

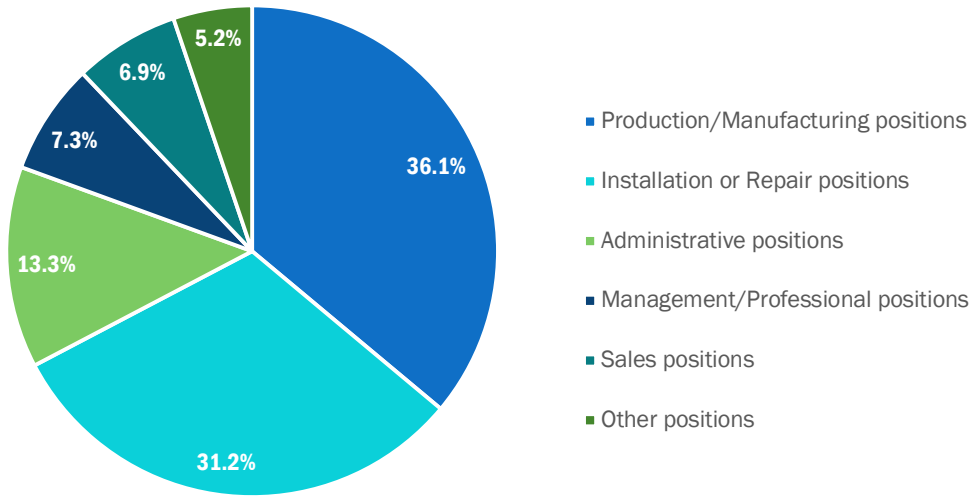
Over one-fifth of all workers in Motor Vehicles in 2017 were women (23 percent). Workers 55 years of age or older (22 percent) represented about a fifth of the workforce, a decline from 2016 (28 percent reported in 2016).

Table 23.
Demographics – Motor Vehicles and Component Parts, Q4 2017

| | Employees | Percent of Sector | National Workforce Averages |
|---|---|---|---|
| Male | 1,815,826 | 77% | 53% |
| Female | 542,333 | 23% | 47% |
| Hispanic or Latino | 246,850 | 10% | 17% |
| Not Hispanic or Latino | 2,111,309 | 90% | 83% |
| American Indian or Alaska Native | 33,108 | 1% | 1% |
| Asian | 119,802 | 5% | 6% |
| Black or African American | 180,031 | 8% | 12% |
| Native Hawaiian or other Pacific Islander | 10,926 | 0% | >1% |
| White | 1,832,239 | 78% | 78% |
| Two or more races | 182,053 | 8% | 2% |
| Veterans | 231,123 | 10% | 6% |
| 55 and over | 507,704 | 22% | 23% |
| Union | 344,779 | 15% | 11% |

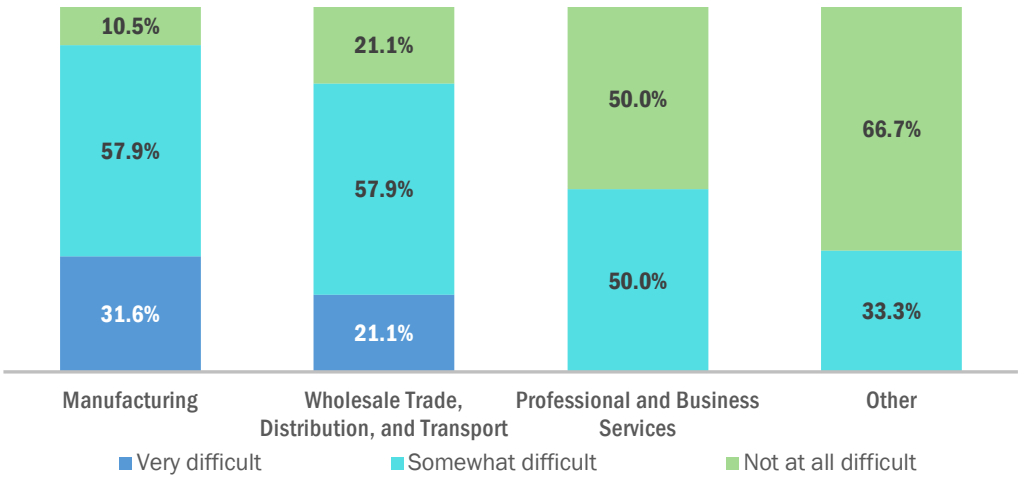
More than two-thirds of employees in 2017 were classified as workers in production/manufacturing positions (36 percent) or installation or repair positions (31 percent) within Motor Vehicles and Component Parts.

**Figure 64.**
**Occupational Distribution – Motor Vehicles and Component Parts, Q4 2017**




Manufacturing firms reported the highest levels of overall hiring difficulty (89 percent) in 2017. Nearly one-third (32 percent) of manufacturing employers indicated that it was "very difficult" finding qualified applicants for positions at their firm.

**Figure 65.**
**Hiring Difficulty by Industry – Motor Vehicles and Component Parts, Q4 2017**




Lack of experience, training, or technical skills was the number one reason for hiring difficulty as reported by wholesale trade, distribution, and transport, and "other" firms in

Motor Vehicles and Component Parts. Half of manufacturing employers that experienced hiring difficult cited insufficient qualifications, certifications, and/or education as a reason.

### Table 24.
### Reasons for Hiring Difficulty by Industry – Motor Vehicles and Component Parts, Q4 2017

| Manufacturing | Wholesale Trade, Distribution, and Transport | Professional and Business Services | Other |
|---|---|---|---|
| **Insufficient qualifications, certifications, education (50%)** | Lack of experience, training, or technical skills (53%) | Insufficient non-technical skills (50%) | Lack of experience, training, or technical skills (57%) |
| **Lack of experience, training, or technical skills (50%)** | Competition/ small applicant pool (33%) | Insufficient qualifications, certifications, education (33%) | Insufficient non-technical skills (37%) |
| **Location (25%)** | Insufficient qualifications, certifications, education (13%) | Lack of experience, training, or technical skills (33%) | Insufficient qualifications, certifications, education (23%) |

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

### Table 25.
### Reported Occupations with Hiring Difficulty by Industry – Motor Vehicles and Component Parts, Q4 2017

| Manufacturing | Wholesale Trade, Distribution, and Transport | Professional and Business Services | Other |
|---|---|---|---|
| **Manufacturing or production positions (35%)** | Technician or technical support (73%) | Consultants (33%) | Managers, directors, or supervisors (30%) |
| **Engineers (29%)** | Sales, marketing, or customer service representatives (47%) | Engineers (33%) | Engineers (27%) |
| **Technician or technical support (29%)** | Engineers (13%) | Sales, marketing, or customer service representatives (33%) | Technician or technical support (24%) |

# Conclusions

In the 2017 USEER, the DOE concluded that—

> [T]he country's Traditional Energy, Energy Efficiency, and Motor Vehicle sectors have contributed significant gains to the U.S. economy and now represent more than 6 percent of all jobs nationwide. Rebuilding our energy infrastructure and modernizing the grid, diversifying our energy mix, and increasing our energy efficiency in both our built environment and motor vehicles, America's labor markets are being revitalized by our new energy and transportation technologies.
>
> But within this overall story of growth is also an uneven trajectory where some states experience new jobs and others grapple with decline. States such as California and Texas, which have abundant solar, wind, and fossil fuel resources, have shown dramatic employment gains, despite some losses linked to low fossil fuel prices. Coal-dependent states, such as West Virginia and Wyoming, have seen declines in employment since 2015. This is the challenge that the 2017 USEER and its successor reports are designed to address at the national and local level. Evidence-based approaches are essential to ensuring a competitive energy economy and a workforce that is adaptable to meet 21st Century challenges. The data in the 2017 USEER provides federal, state, and local leaders critical labor market metrics to realize this vision.[93]

Looking back over 2017, we can see that the challenges posed by geographic inequities have stabilized to some extent. Employment in coal-fired generation has remained constant. Coal mining jobs, particularly for metallurgical coal, have increased slightly. However, jobs for natural gas have continued to outpace job growth in other generation technologies as natural gas has become the largest source of electrical generation in the United States and the largest source of new generation. At the same time wind and solar have continued to expand new capacity at almost the same rate as natural gas.

Within this context, however, solar jobs have declined for the first time in several years, with almost two-thirds of the decline in two states, California and Massachusetts. The reasons for this decline are still unclear, but could include an increase in labor productivity, market saturation for residential solar, and/or concern over solar panel tariffs. Meanwhile, extraction jobs in oil and natural gas have remained stable, even growing slightly, while output has increased, in a low-price environment. Other bright spots include the increased employment in battery storage and CHP.

The growth of energy efficiency jobs and the penetration of energy efficiency technologies continues to be an important indicator of economic development opportunities and increasing competitiveness for American industries. This is particularly evident in the construction and manufacturing sectors. The production and installation of energy efficiency equipment and materials continue their rapid deployment across the United States. The increased utilization of these technologies in the construction industry,

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[93] DOE, U.S. Energy and Employment Report: January 2017 (Washington, D.C., 2017), 80.

where 80 percent of firms now use these technologies for a majority of their revenues, up from 64 percent just 2 years ago, is an indicator of the speed of adoption.

In the Motor Vehicles industry, the lower cost of traditional fuels and popularity of SUV's and cross-overs appears to have stalled the growth of employment in alternative fuels' vehicles while employment also shifted from hybrids and plug-in electrics to all-electrics.

All these trends, some at cross purposes, indicate the challenges to align labor market supply with technology shifts while dynamic energy markets also face regulatory uncertainty. That is why detailed, objective employment data is so important to provide guidance to policymakers. We hope the perspective provided by the 2018 USEER data provides one of the tools necessary for the many energy stakeholders, policymakers, academic and training institutions, and regulators navigating this terrain.

# Appendix A: Survey and Analysis Methods

The 2018 USEER methodology relies on the most recently available data from the BLS QCEW (QCEW, second quarter 2017), 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 BW Research Partnership 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 BW Research Partnership survey uses a stratified sampling plan that is representative by industry code (NAICS or ANAICS)[94], 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 BW Research Partnership survey was administered by telephone (more than 400,000 outbound calls) and by web, with more than 40,000 emails sent to participants throughout the United States. The phone survey was conducted by I/H/R Research. 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 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 includes hundreds of thousands of businesses in potentially energy-related NAICS codes, across agriculture, mining, utilities, construction, manufacturing, wholesale trade, 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 23,000 business establishments participated in the survey effort, with approximately 5,500 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

[94] 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

by state and federal labor market information agencies. The margin of error for incidence in the index is +/-0.64 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 (63 percent), followed by rail (27 percent), water (9 percent), and air (1 percent).

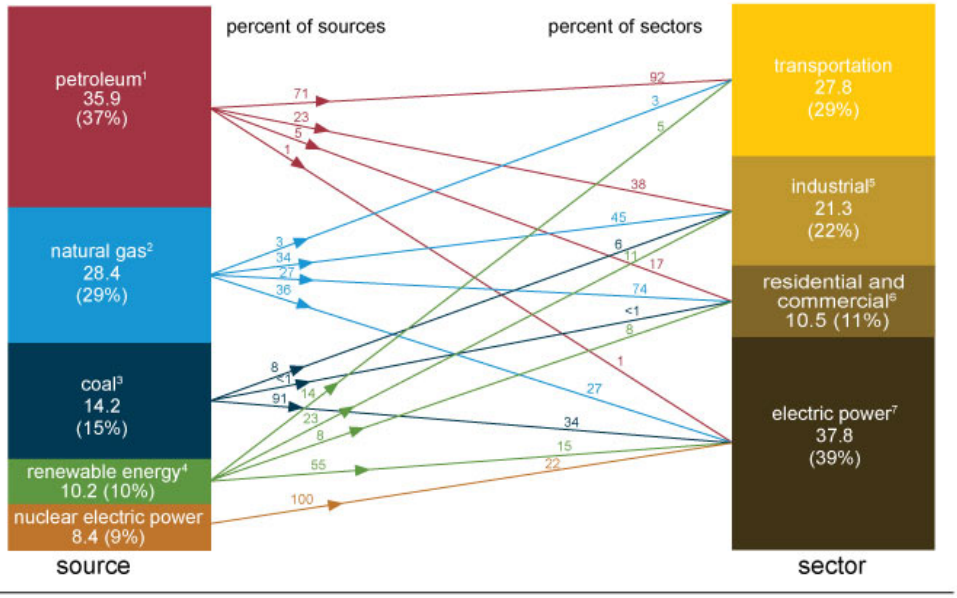
Of important note, the USEER expressly excludes any employment in retail trade NAICS codes. This excludes motor vehicle dealerships, appliance and hardware stores, and other retail establishments. Where relevant, separate reference is made to retail employment (gasoline stations and other liquid fuels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

All data in the USEER rely on the BLS QCEW data for the end of the second quarter of 2017. The USEER survey was administered between November 1, 2017 and January 19, 2018 and averaged 14.5 minutes in length.

# Appendix B: Primary Energy Consumption by Source and Sector, 2016 (Quadrillion Btu)

**U.S. primary energy consumption by source and sector, 2016**

Total = 97.4 quadrillion British thermal units (Btu)




[1] Does not include biofuels that have been blended with petroleum—biofuels are included in "Renewable Energy."
[2] Excludes supplemental gaseous fuels.
[3] Includes -0.02 quadrillion Btu of coal coke net imports.
[4] Conventional hydroelectric power, geothermal, solar, wind, and biomass.
[5] Includes industrial combined-heat-and-power (CHP) and industrial electricity-only plants.
[6] Includes commercial combined-heat-and-power (CHP) and commercial electricity-only plants.
[7] Electricity-only and combined-heat-and-power (CHP) plants whose primary business is to sell electricity, or electricity and heat, to the public. Includes 0.24 quadrillion Btu of electricity net imports not shown under "Source."

Notes: • Primary energy is energy in the form that it is accounted for in a statistical energy balance, before any transformation to secondary or tertiary forms of energy occurs (for example, coal before it is used to generate electricity). • The source total may not equal the sector total because of differences in the heat contents of total, end-use, and electric power sector consumption of natural gas. • Data are preliminary. • Values are derived from source data prior to rounding. • Sum of components may not equal total due to independent rounding.

Sources: U.S. Energy Information Administration, *Monthly Energy Review* (April 2017), Tables 1.3, 1.4a, 1.4b, and 2.1–2.6.

# Appendix C: ENERGY STAR Unit Shipment and Market Penetration Report Calendar Year 2016 Summary

## ENERGY STAR® Unit Shipment and Market Penetration Report Calendar Year 2016 Summary

This is the 15th 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 2016, data was collected for the following ENERGY STAR certified products:

- Audio/Video
- Boilers
- Ceiling Fans
- Central Air Conditioners and Air-Source Heat Pumps (CAC/ASHPs)
- Clothes Dryers
- Clothes Washers
- Commercial Dishwashers
- Commercial Fryers
- Commercial Griddles
- Commercial Hot Food Holding Cabinets
- Commercial Ice Machines
- Commercial Ovens
- Commercial Refrigerators and Freezers
- Commercial Steam Cookers
- Commercial Water Heaters
- Computer Servers
- Computers
- Data Center Storage
- Decorative Light Strings (DLS)
- Dehumidifiers
- Dishwashers
- Displays
- Furnaces
- Geothermal Heat Pumps
- Imaging Equipment
- Lamps
- Light Commercial HVAC
- Luminaires
- Pool Pumps
- Refrigerators and Freezers
- Roof Products
- Room Air Cleaners
- Room Air Conditioners
- Set-top Boxes
- Set-top Box Service Providers
- Small Network Equipment
- Telephony
- Televisions
- Uninterruptible Power Supplies
- Vending Machines
- Ventilating Fans
- Water Coolers
- Water Heaters

For more details:
https://www.energystar.gov/ia/partners/downloads/unit_shipment_data/2016_USD_Summary_Report.pdf?8fd5-1967