2022

Pennsylvania Clean Energy Employment Report

PRODUCED FOR THE PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL PROTECTION ENERGY PROGRAMS OFFICE

[bw] RESEARCH PARTNERSHIP

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Executive Summary

The 2022 Pennsylvania Clean Energy Employment Report presents data on the trends in clean energy industry jobs statewide from Q4 2020 to Q4 2021.

The clean energy labor market in Pennsylvania totaled just over 94,600 workers at the end of 2021. From Q4 2020 to Q4 2021, clean energy jobs grew by 5.1 percent, attracting 4,613 jobs to the industry. Clean energy jobs took a significant hit during the first year of the COVID-19 pandemic (represented in data from Q4 2019 to Q4 2020). While clean energy job growth returned from Q4 2020 to Q4 2021, the growth did not reach levels seen prior to the pandemic.

Key Findings

CLEAN ENERGY EMPLOYMENT

After the loss of jobs due to the Coronavirus (COVID-19) pandemic, the clean energy industry began to rebound. During the first year of the pandemic (from Q4 2019- Q4 2020), Pennsylvania's overall labor market declined by 6.7 percent—a loss of roughly 425,700 jobs. The clean energy sector shed roughly 7,200 workers during this time, representing almost two percent of total jobs lost between Q4 2019 and Q4 2020. Between Q4 2020 and Q4 2021, Pennsylvania's clean energy industry started its rebound. Clean energy jobs grew by 5.1 percent, attracting 4,613 jobs back to the industry.[1]

However, this job growth wasn't enough for a full recovery, and 2021 clean energy employment in Pennsylvania remained comparable to 2018 levels. Despite the rebounding growth, Pennsylvania totaled just over 94,600 workers at the end of 2021, a slight increase over the 2018 levels of clean energy employment, which were at 94,245.

Pennsylvania's clean energy economy growth outpaced the overall economic growth and energy employment growth statewide, nationwide clean energy economic growth, and neighboring clean energy labor markets. From Q4 2020 through Q4 2021, Pennsylvania's clean energy economy grew by 5.1 percent, while during the same period, U.S. clean energy sector jobs grew 4.8 percent. The clean energy industry also grew slightly faster than Pennsylvania's overall labor market. Between the end of Q4 2020 and Q4 2021, Pennsylvania's job market grew by 4.1 percent. Clean energy job growth accounted for roughly two percent of new job additions during this recovery period. Pennsylvania's clean energy sector also rebounded at a faster pace compared to Rhode Island, Connecticut, and Massachusetts.[2]

Between Q4 2020 and Q4 2021, FTE clean energy workers increased by 5.1 percent, or almost 3,200 jobs. There were a total of almost 9,800 FTE clean energy jobs, or 17.5 percent more than in the 2017 baseline.

[1] Overall economywide labor market data for Pennsylvania is taken from JobsEQ Quarterly Data Series. Data accessed August 2022.
[2] Department of Energy. 2022 U.S. Energy and Employment Report. https://www.energy.gov/sites/default/files/2022-06/USEER%202022%20National%20Report_1.pdf.

All clean energy technology sectors grew in the 12 months from Q4 2020 to Q4 2021, but the energy efficiency sector experienced the largest absolute number of job increases, which added almost 2,400 new workers to energy efficiency companies. The largest absolute growth was seen in the HVAC subsector,[3] which accounted for about three in ten energy efficiency workers at the end of 2021. Traditional HVAC employment increased by 3.7 percent, or about 669 jobs. At a similar magnitude, the high efficiency HVAC and renewable heating and cooling subsector saw an increase of 3.7 percent, adding 560 jobs.

Alternative transportation saw the largest relative job increases, increasing by 26.8 percent overall, for a gain of just over 1,000 new workers in the sector. [4] The largest absolute growth was in electric vehicles and plug-in hybrid vehicles; they added roughly 880 new jobs combined in the sector. The hydrogen and fuel-cell vehicle subsector had the largest relative growth, increasing by 48 percent, and adding roughly 158 new jobs.

Demographically, Pennsylvania's clean energy economy remained a source of jobs for Hispanic or Latinx, Asian, and Veteran residents across the commonwealth from Q4 2020 to Q4 2021. Pennsylvania's clean energy economy was 76 percent male and 73 percent White from Q4 2020 to Q4 2021, as compared to the statewide demographics of 52 percent male and 81 percent White. While Hispanic or Latinx residents made up 6.1 percent of the Pennsylvania population, they comprised almost 14 percent of the clean energy workforce. While Pennsylvania had a demographic of 3.8 percent Asian residents, the clean energy workforce was made up of 7.4 percent Asian residents. Similarly, Veterans made up only 5.2 percent of overall Pennsylvania residents but represented almost 10 percent of the clean energy workforce from Q4 2020 to Q4 2021.

CLEAN ENERGY SUPPLY CHAIN

CONSTRUCTION AND MANUFACTURING CONTINUE TO BE THE LARGEST SEGMENTS OF THE COMMONWEALTH'S CLEAN ENERGY ACTIVITY BY VALUE CHAIN (SEE

Figure 6). Despite the fact that construction and manufacturing saw the heaviest job losses from Q4 2019 to Q4 2020, these segments continued to account for the largest overall employment by segment. From Q4 2020 to Q4 2021 they accounted for the largest relative growth.

More than a third of companies are building equipment contractors (36.8 percent). Given the significant workforce concentration in energy efficiency and construction activities, it is not surprising that building equipment contractors top the list of activities for clean energy companies in Pennsylvania. Building equipment contractors are primarily engaged in installing, servicing, maintaining, or repairing building equipment. Roughly three in ten companies are conducting work across the following industries: plumbing and heating equipment wholesale, electric power generation and transmission, residential building construction, utility system construction, management and scientific consulting, architectural and engineering services, household appliance wholesale, and nonresidential building construction.

[3] Traditional HVAC workers are individuals that spend a portion of their labor hours on energy efficient HVAC technologies, but the majority of time on traditional HVAC technologies, while high efficiency HVAC workers spend the majority of their labor hours working with efficient HVAC technologies.

[4] Alternative transportation is comprised of workers that support the manufacture, sales, repair and maintenance, and professional business support—like legal, financial, engineering, or consulting services—of alternative transportation technologies.

Six counties across the state are home to more than half of all clean energy companies. Out of a total inventory of 856 clean energy companies across the commonwealth, 53.5 percent of companies are found in the following six counties: Montgomery, Allegheny, Chester, Philadelphia, Lancaster, and Bucks County. In the database of 856 companies, 14 counties did not have any representation of clean energy firms.

LABOR UNION ENGAGEMENT

The following are key findings and themes from the executive interviews conducted with union stakeholders in Pennsylvania. For more information and detail, please see Supplemental Analysis: Exploring the Role of Unions in the Clean Energy Transition, beginning on page 27.

Overall Opinion of Unions and Union Engagement

A clean energy transition is viewed mostly negatively by the building and construction trades in Pennsylvania and many union members in energy-connected work; advocates of labor and climate collaboration are pessimistic about near-term opportunities.

For many unions, clean energy is not considered a promising alternative to the status quo energy landscape. Economic issues were cited primarily to account for this perspective, alongside localized fossil-fuel related concerns, and the impact of a transition on the unions themselves.

Acceptance of fossil fuels, or at least a broader "all of the above" strategy, is a critical starting point for any discussion with Pennsylvania energy and building trade unions.

Any strategy to integrate unions more directly into clean energy, and create more support for a transition, should begin with supportive government policy.

Belief in climate change and an acceptance of a need to transition to clean energy are not driving issues for unions.

Policy interventions to support a clean energy transition in the commonwealth have been met with skepticism and concern by unions.

Climate and clean energy advocates, especially environmentalists, are viewed poorly by Pennsylvania organized labor.

Opportunities to Engage and Partner with Unions

Opportunities that could grow interest in clean energy among unions in the commonwealth and a broader acceptance of a transition to clean energy center around specific technologies that could create in-roads with union members due to job growth and/or transferability of job skills.

There was some limited support for the idea that clean energy could increase the size of union membership, although most interviewees were skeptical.

Clean energy is also perceived as unlikely to be a direct contributor in addressing diversity and access issues within unions, although in some locations it could have marginal impact.

Several unions could become future collaborators, beyond the traditionally engaged unions, but there was no consensus.

There was receptivity to a broader discussion of the role of union training programs in supporting clean energy.

'Just Transition' is a problematic term and concept with unions.

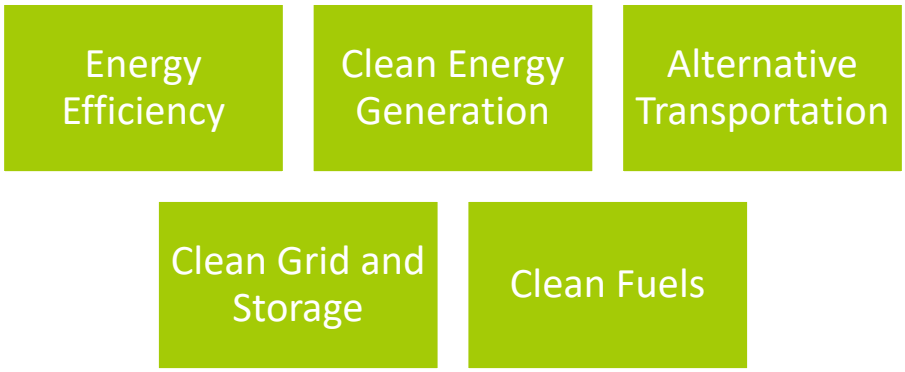
One first step with unions could be simply to flesh out what a transition of some variety would look like.

Introduction

The Pennsylvania Department of Environmental Protection (DEP) commissioned BW Research to produce this follow-up to the 2021 Clean Energy Employment Report, tracking clean energy jobs across the commonwealth for each major technology sector featured in Figure 1 and their component sub-technologies.[5] In addition to job estimates by technology and subtechnology, the report details clean energy employment by value chain segment and county. This year's report follows the global Coronavirus (COVID-19) pandemic; together with historical clean energy employment figures, 2021 data provide valuable information for the economic recovery of Pennsylvania's clean energy labor market.

All data are based on the 2022 United States Energy and Employment Report (USEER) data collection effort, funded by the United States Department of Energy.[6] For a broader analysis of all energy-related employment across both fossil fuel and renewable energy resources, please refer to the 2022 Pennsylvania Energy Employment Report.

FIGURE 1. CLEAN ENERGY SECTORS



About the Pennsylvania Department of Environmental Protection & Energy Programs Office

The DEP works to protect the commonwealth's air, land, and water from pollution; restore these natural resources; and provide for Pennsylvanians' health and safety through a cleaner environment. Advancing this mission, the DEP Energy Programs Office is the primary entity under the Governor's jurisdiction responsible for programs that promote knowledge and use of energy efficiency and energy conservation technologies as well as indigenous, clean, alternative fuels, including energy production and use technologies.

One of the core functions of the Energy Programs Office is to work with partners to gather data and develop resources to help policy makers, planners, and other leaders in Pennsylvania make informed and best-outcome energy decisions. To inform statewide planning and decision-making, BW Research was commissioned to build upon last year's Clean Energy Industry Report.

[5] Clean energy employment is defined by the Energy Programs Office. For a list of sub-technologies that are considered clean energy-related for the purposes of this report, please refer to Appendix A.
[6] https://www.usenergyjobs.org/

About BW Research Partnership

BW Research is a full-service consulting and research firm that specializes in workforce and economic development for public entities, including workforce investment boards, economic development agencies, cities, counties, and educational institutions. BW Research has substantial experience in developing customized research projects and a deep understanding of the clean energy sector and its employers, workforce, and supply chain dynamics. BW Research has designed and conducted over 500 studies for public, private, and not-for-profit agencies throughout the United States and internationally.

***Acknowledgments*:** This material is based upon work supported by the United States Department of Energy, Office of Energy Efficiency and Renewable Energy, under State Energy Program Award Number DE-EE0009485.

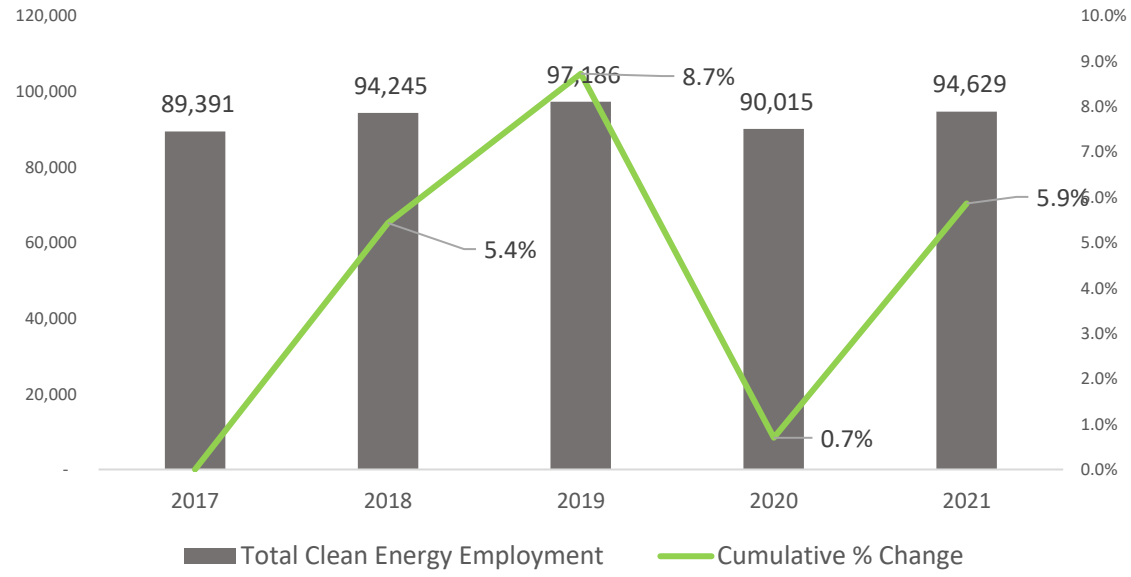
Pennsylvania Clean Energy Employment Overview

Overall Clean Energy Jobs

At the end of 2021, the clean energy labor market in Pennsylvania totaled just over 94,600 workers. Compared to 2017, clean energy jobs grew by almost six percent over four years. Clean energy jobs took a significant hit during the first year of the COVID-19 pandemic. Between Q4 2019 and Q4 2020, clean energy firms shed almost 7,200 jobs for a decline of 7.4 percent in 12 months. In the following year, from Q4 2020 to Q4 2021, clean energy jobs grew by 5.1 percent, attracting 4,613 jobs back to the industry. While the jobs started coming back from Q4 2020 to Q4 2021, they still did not return to the levels seen prior to the pandemic.

Job losses in the clean energy sector were comparable to the overall statewide economy from Q4 2019 to Q4 2020. During this time, the statewide labor market declined by 6.7 percent—a loss of about 425,700 jobs. The clean energy sector accounted for roughly two percent of these total job losses.[7] Following the height of the pandemic, the overall state economy grew by 4.1 percent for an increase of roughly 243,200 jobs from Q4 2020 to Q4 2021.[8] Clean energy jobs comprised two percent of those new jobs returned to the overall labor market.

FIGURE 2. CLEAN ENERGY EMPLOYMENT IN PENNSYLVANIA, 2017-2021



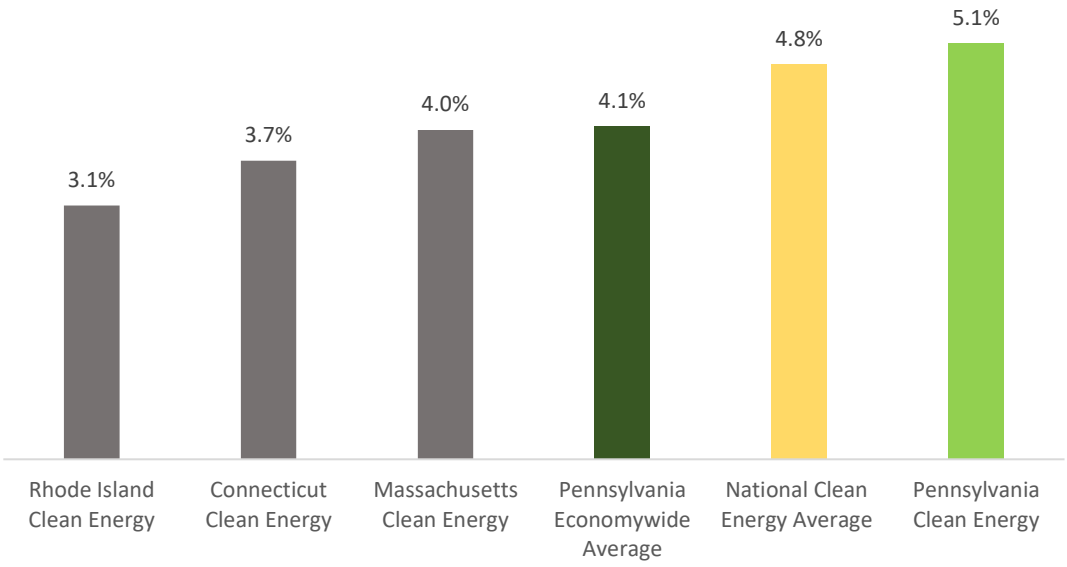
[7] Total state-level employment is from the Bureau of Labor Statistics, Quarterly Census of Employment and Wages. Data was accessed in May 2021.

[8] Overall economywide labor market data for Pennsylvania is taken from JobsEQ Quarterly Data Series. Data accessed August 2022.

Clean energy employment gains in Pennsylvania were slightly higher compared to the national clean energy average and other states in the region, such as Massachusetts and Rhode Island. Nationally, clean energy jobs increased by 4.8 percent, compared to a rate of 5.1 percent in Pennsylvania. In Massachusetts and Rhode Island, clean energy employment increased in a range from 3-4 percent.

Clean energy job gains in Pennsylvania were one percentage point higher than the commonwealth's economywide job gain of 4.1 percent.

FIGURE 3. EMPLOYMENT CHANGE COMPARISONS, 2020-2021

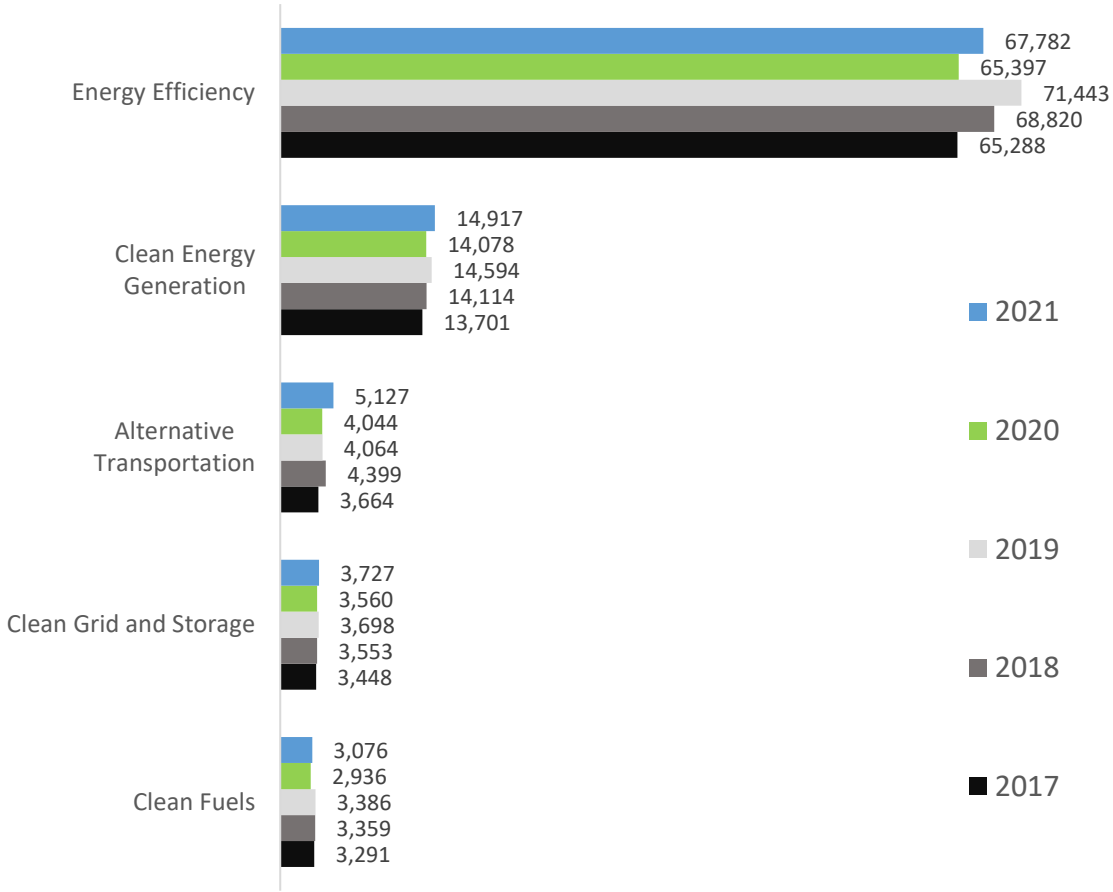


All clean energy technology sectors grew in the 12 months from Q4 2020 to Q4 2021, with the energy efficiency sector experiencing the largest absolute job increases and alternative transportation with the largest relative job increases.

In total, energy efficiency firms increased their ranks by 2,384 from 2020 through 2021, an increase of 3.6 percent (after having lost just over 6,000 jobs between the last quarters of 2019 and 2020). The alternative transportation sector saw employment increase by 26.8 percent, or 1,083 total jobs, while clean energy generation firms grew by just over 800 workers for an increase of six percent.

Clean grid and storage firms gained about 170 jobs—a 4.7 percent increase— while clean fuels gained 140 jobs for an increase of 4.8 percent.

FIGURE 4. CLEAN ENERGY EMPLOYMENT BY SECTOR, 2017-2021

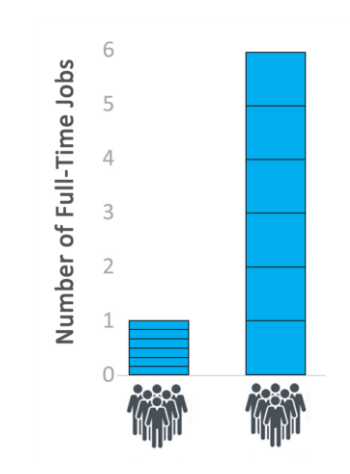


Full-Time Equivalent Clean Energy Jobs

Full-time equivalent (FTE) clean energy jobs represent a subset of total clean energy jobs from Figure 2 in the previous section. FTE jobs are a useful metric to identify the extent of clean energy activity—installation, manufacturing, trade, or professional services—occurring in a state. An increase in FTE jobs indicates that more clean energy workers are dedicating an increasing amount of their work week, or labor hours, to clean energy-specific activities. For instance, a traditional HVAC worker might have spent only a quarter of their work week installing or maintaining energy efficient HVAC technologies in 2017. Due to a growing demand for efficient heat pumps, that traditional HVAC worker would likely now be spending the majority of labor hours in a work week installing high efficiency heat pumps. This increase in clean energy-related activity per worker translates to more full-time equivalent clean energy jobs.[9]

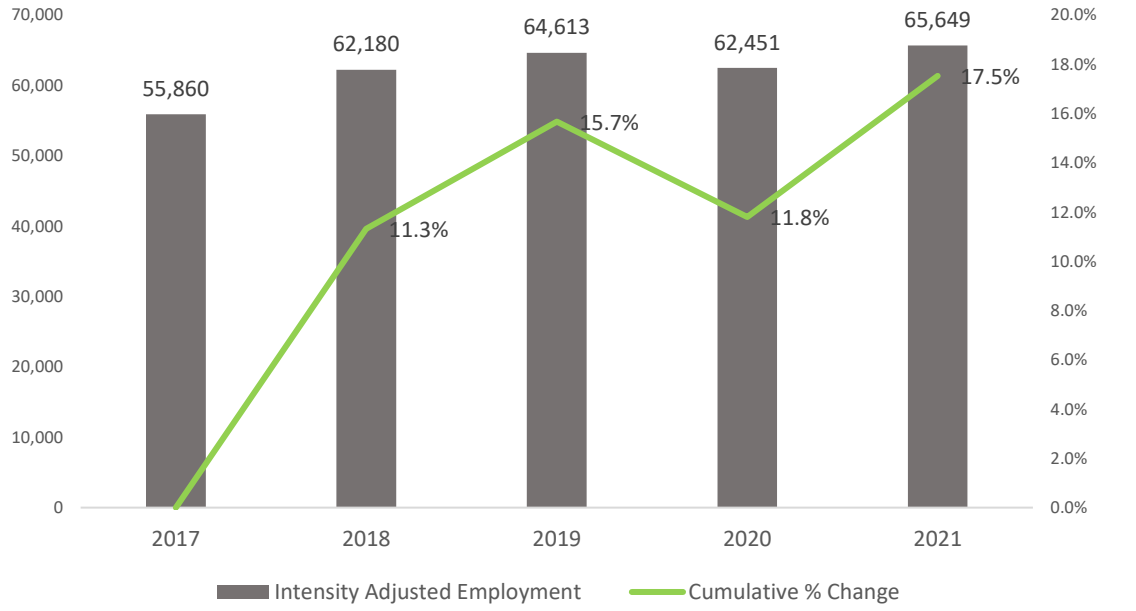
Between Q4 2020 and Q4 2021, FTE clean energy workers increased by 5.1 percent, or almost 3,200 jobs. Compared to 2017, FTE clean energy jobs have increased by almost 9,800, or 17.5 percent above the 2017 baseline.

An example can illustrate the importance of tracking FTE clean energy employment. If an HVAC firm had 6 installers in 2018 who occasionally installed heat pumps, and now has 6 installers who exclusively do so, there would be no change in the total number of clean energy workers reported. However, because the number of labor hours working with heat pumps has increased, FTE jobs would show a corresponding increase.



[9] This metric measures the proportion of total labor hours dedicated to clean energy activities and is unrelated to the total number of hours worked in a week. A part-time clean energy employee who works 20 hours a week with 100 percent of these hours dedicated to clean energy activities would be counted as one FTE clean energy job.

FIGURE 5. INTENSITY-ADJUSTED CLEAN ENERGY EMPLOYMENT (FULL-TIME EQUIVALENT WORKERS), 2017-2021[10]



[10] FTE clean energy jobs were extrapolated using a combination of state-level and census region data and weighted according to how much time workers were reported to spend on clean energy activities (0-49 percent, 50-99 percent, or 100 percent). For a full description of this methodology, please refer to Appendix B.

Clean Energy Value Chain Employment

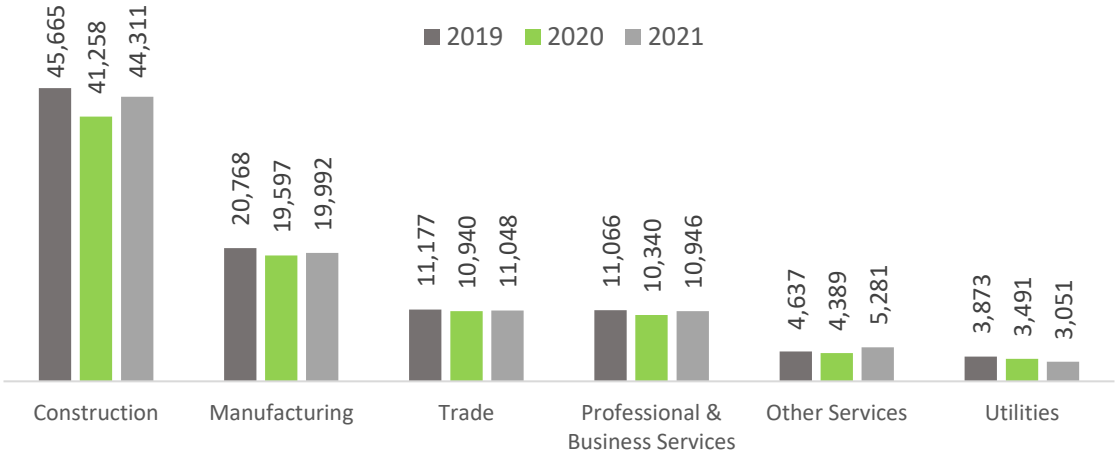
Value chain jobs examine the clean energy economy by identifying the industries in which clean energy activities are concentrated in Pennsylvania. The major value chain segments examined include construction[11], manufacturing[12], wholesale trade[13], professional and business services[14], other services[15], and utilities.

CONSTRUCTION AND MANUFACTURING CONTINUED TO ACCOUNT FOR THE MAJORITY OF CLEAN ENERGY ACTIVITY IN THE COMMONWEALTH (SEE
Figure 6). Between Q4 2019 and Q4 2020, these two sectors saw the most job losses, but from Q4 2020 to Q4 2021, construction continued to account for the largest growth.

From Q4 2020 to Q4 2021, construction saw an increase in jobs of 7.4 percent, or just over 3,000 jobs. Manufacturing saw an increase of two percent, or 396 jobs.

Professional and business services saw an increase of 605 jobs, or 5.9 percent, and other services saw an increase of 891 jobs, or 20.3 percent. Trade increased by 108 jobs, or one percent. Utilities saw a decline of 440 jobs, or 12.6 percent.

FIGURE 6. CLEAN ENERGY EMPLOYMENT BY VALUE CHAIN SEGMENT, 2019-2021



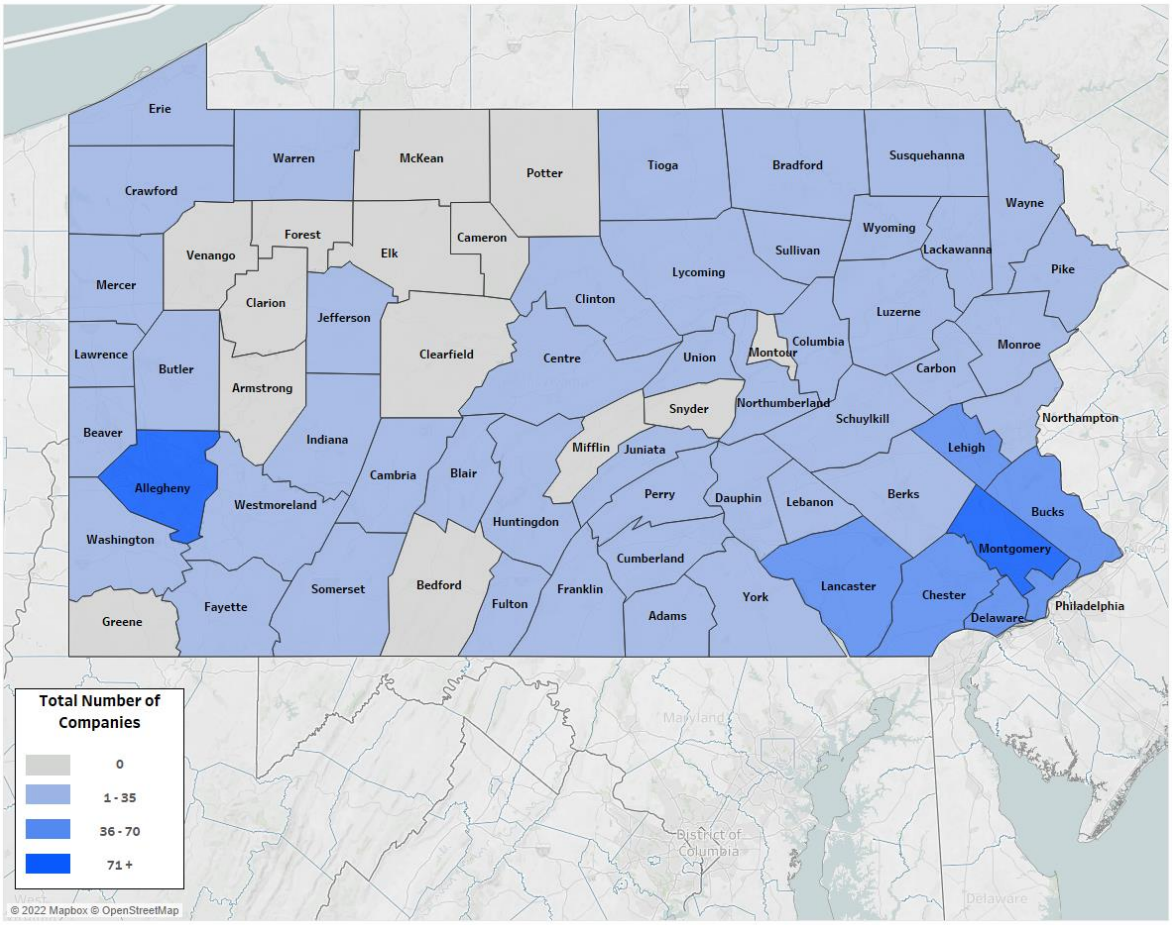
[11] Construction is comprised of all workers engaged in residential, commercial, and industrial building construction, contracting and electrical work, insulation and weatherization, or plumbing and heating, air conditioning, and ventilation work.
[12] Manufacturing encompasses petrochemical, industrial gas, ethyl alcohol, or other basic organic chemical manufacturing as well as heating and air conditioning equipment manufacturing, engine and compressor manufacturing, semiconductor manufacturing, and energy efficient product, appliance, or lighting manufacturing, as well as motor vehicle and parts manufacturing.
[13] Wholesale trade includes fuel dealers, motor vehicle and parts wholesalers, electrical equipment and household appliance wholesalers, and other wholesale related to clean energy products and technologies.
[14] Professional business services include all finance, legal, consulting, engineering, research, or architectural support.
[15] Other services is largely comprised of automotive repair and maintenance, but also includes organizational and non-profit work such as environment and conservation organizations, business associations, or advocacy organizations.

SUPPLEMENTAL ANALYSIS: CLEAN ENERGY VALUE CHAIN ANALYSIS

The research team conducted a more granular analysis of the clean energy value chain by compiling a list of all companies in Pennsylvania that are currently conducting clean energy work. The inventory includes a total of 856 companies across the Commonwealth of Pennsylvania.

The top counties that are home to at least seven percent each of clean energy companies include: Montgomery, Allegheny, Chester, Philadelphia, Lancaster, and Bucks County. Altogether, these six regions are home to just over half of all clean energy companies across Pennsylvania (53.5 percent). In the database of 856 companies, 14 counties did not have any representation of clean energy firms.

FIGURE 7. CLEAN ENERGY COMPANY CONCENTRATION BY COUNTY, 2021



More than a third of companies are building equipment contractors (36.8 percent), which is unsurprising, given that the energy efficiency sector employs the largest number of clean energy workers across the commonwealth. Building equipment contractors are primarily engaged in installing, servicing, maintaining, or repairing building equipment.

Roughly three in ten companies are conducting work across the following industries: plumbing and heating equipment wholesale, electric power generation and transmission, residential building construction, utility system construction, management and scientific consulting, architectural and engineering services, household appliance wholesale, and nonresidential building construction.

The "all other" category includes industries that have less than 15 companies each and account for less than two percent each of all clean energy companies in Pennsylvania.

FIGURE 8. CLEAN ENERGY COMPANIES BY DETAILED VALUE CHAIN, 2021

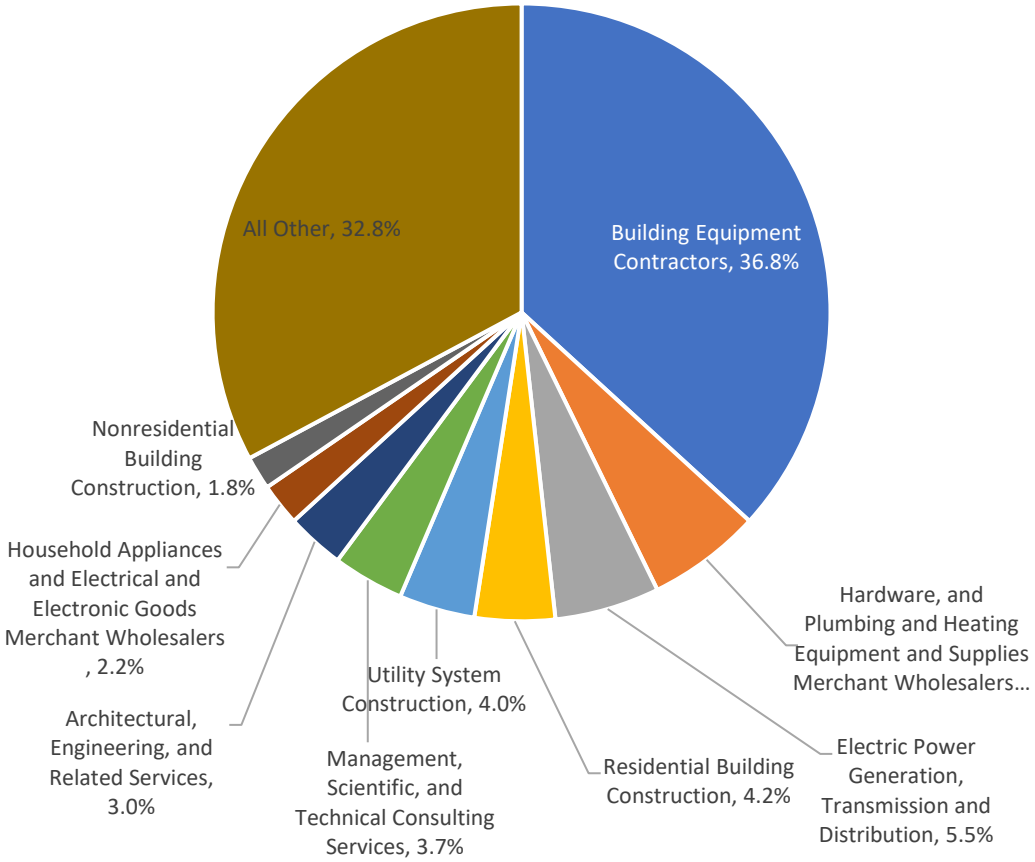


TABLE 1. CLEAN ENERGY COMPANIES BY DETAILED VALUE CHAIN, 2021

Detailed Value Chain	Percent of Total	Total Number of Companies
Building Equipment Contractors	36.8%	315
Hardware, and Plumbing and Heating Equipment and Supplies Merchant Wholesalers	6.0%	51
Electric Power Generation, Transmission and Distribution	5.5%	47
Residential Building Construction	4.2%	36
Utility System Construction	4.0%	34
Management, Scientific, and Technical Consulting Services	3.7%	32
Architectural, Engineering, and Related Services	3.0%	26
Household Appliances and Electrical and Electronic Goods Merchant Wholesalers	2.2%	19
Nonresidential Building Construction	1.8%	15
All Other	32.8%	281

Detailed Clean Energy Sector Employment

Energy Efficiency

The energy efficiency sector encompasses all workers that are involved in the research, manufacture, sales, installation, repair, or professional service support of technologies and services designed to improve the efficiency of commercial, residential, and industrial buildings. Such sub-technologies include ENERGY STAR® appliances, lighting, and HVAC systems, advanced building materials and insulation technologies, solar thermal water heating and cooling, and other energy efficient technologies like recycled building materials or reduced water consumption products and appliances.

The American Council for an Energy-Efficient Economy (ACEEE) ranked Pennsylvania 19th in the nation in its support of energy efficiency policies and programs.[16]

The largest subtechnology within Pennsylvania's energy efficiency sector, traditional HVAC,[17] accounted for about three in ten energy efficiency workers at the end of 2021. Traditional HVAC employment increased by 3.7 percent, or about 669 jobs. Following traditional HVAC, the high efficiency HVAC and renewable heating and cooling subtechnology[18] accounted for about two in ten clean energy workers at the end of 2021. This subtechnology increased by 3.7 percent as well, for a job increase of 560 workers.

Energy efficiency workers that spent most of their labor hours working with ENERGY STAR appliances and efficient lighting technologies comprised 20.9 percent of the energy efficiency labor force, followed by advanced building materials workers (18.7 percent) and other energy efficiency workers (9.5 percent).[19] Between Q4 2020 and Q4 2021, ENERGY STAR and efficient lighting businesses increased their workforce by 3.3 percent, or 459 jobs, followed by advanced building materials, which increased by 2.2 percent, or roughly 278 workers.

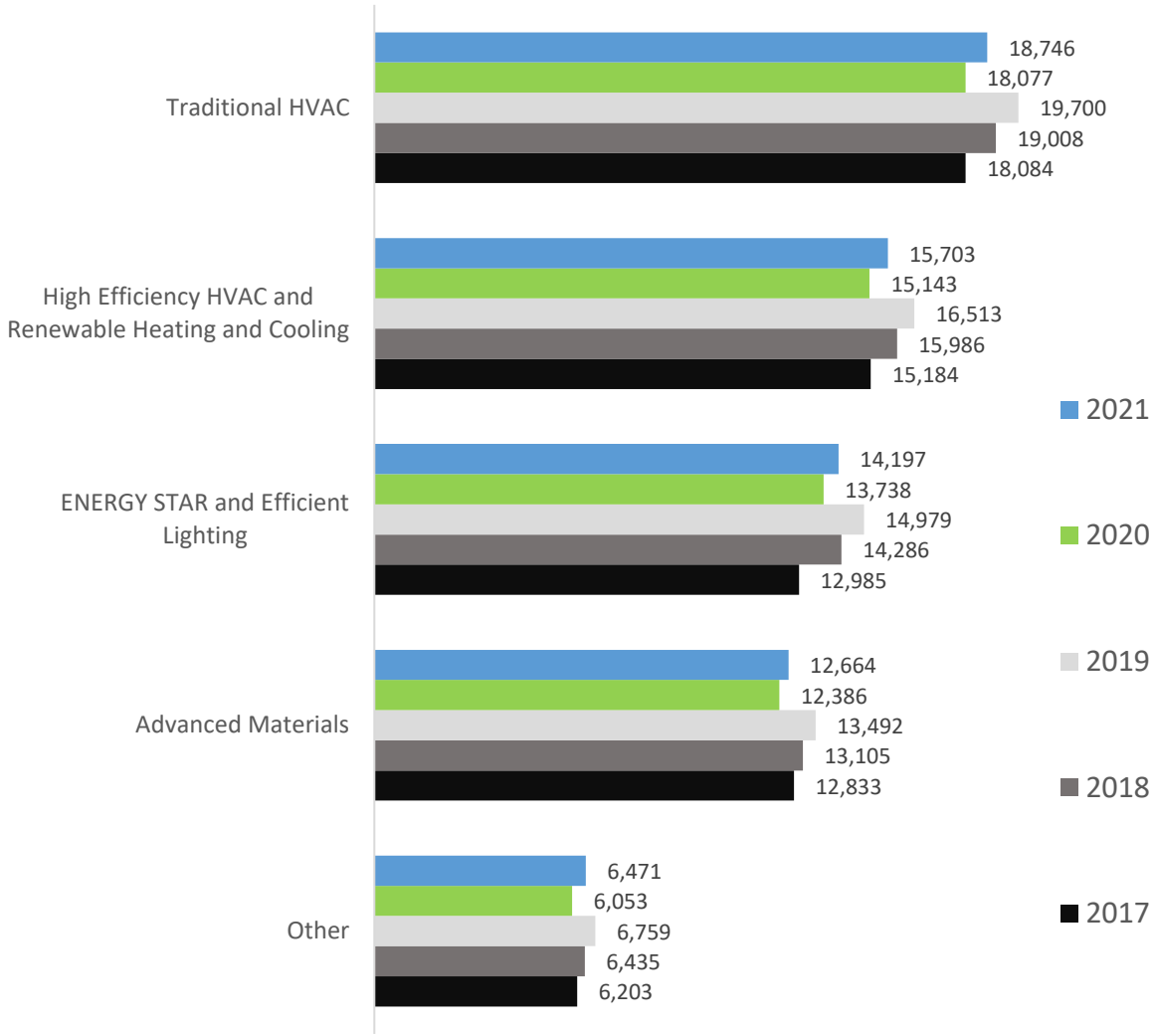
[16] https://www.usgbc.org/articles/new-aceee-state-scorecard-rankings-reflect-challenging-year, 2020. Given the impacts of the COVID-19 pandemic on energy efficiency programs in 2020, ACEEE decided to forgo a formal Scorecard ranking in 2021.

[17] Traditional HVAC workers are individuals that spend a portion of their labor hours on energy efficient HVAC technologies, but the majority of time on traditional HVAC technologies, while high efficiency HVAC workers spend the majority of their labor hours working with efficient HVAC technologies.

[18] Renewable heating and cooling workers are involved with heating, ventilation, and air conditioning (HVAC) from renewable energy sources, including solar thermal, or other work that increases the energy efficiency of HVAC systems.

[19] The "other" energy efficiency subtechnology includes variable speed pumps, other design services not specific to a detailed technology, software not specific to a detailed technology, energy auditing, rating, monitoring, metering, and leak detection, policy, consulting, and non-profit work not specific to a detailed technology, LEED certification, or phase change materials.

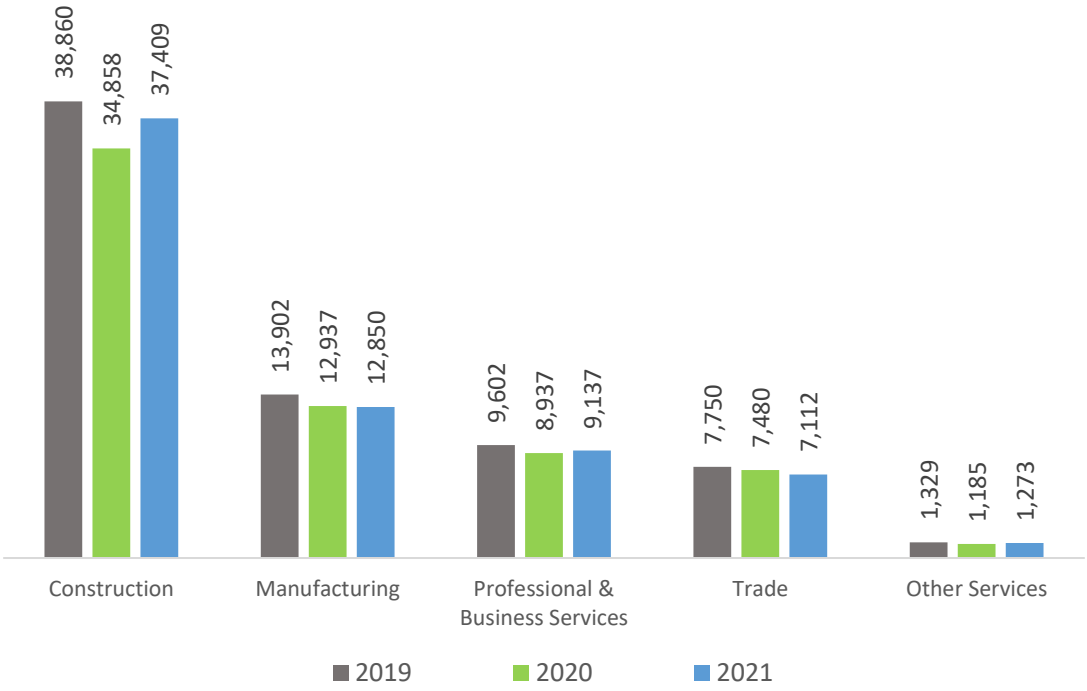
FIGURE 9. ENERGY EFFICIENCY EMPLOYMENT BY SUBTECHNOLOGY, 2017-2021



In general, the energy efficiency sector in Pennsylvania was mostly comprised of construction workers; 55.2 percent of all jobs in energy efficiency were construction jobs, and 19 percent were found in the manufacturing industry.

Energy efficiency construction increased by about 2,551 jobs, or 7.3 percent, followed by professional and business services, which increased by 201 jobs—a 2.2 percent increase. Manufacturing saw a decrease of 87 jobs, just under 1 percent, and trade saw a decrease of 367 jobs, or roughly 5 percent.

FIGURE 10. ENERGY EFFICIENCY JOBS BY VALUE CHAIN, 2019-2021



Clean Energy Generation

Clean energy generation jobs encompass all workers engaged in the research, development, production, manufacture, sales, installation, maintenance, repair, or professional service support of carbon-free electricity generating technologies. Such clean energy generation technologies include solar, wind, geothermal, bioenergy, hydropower, and nuclear electric power generation.

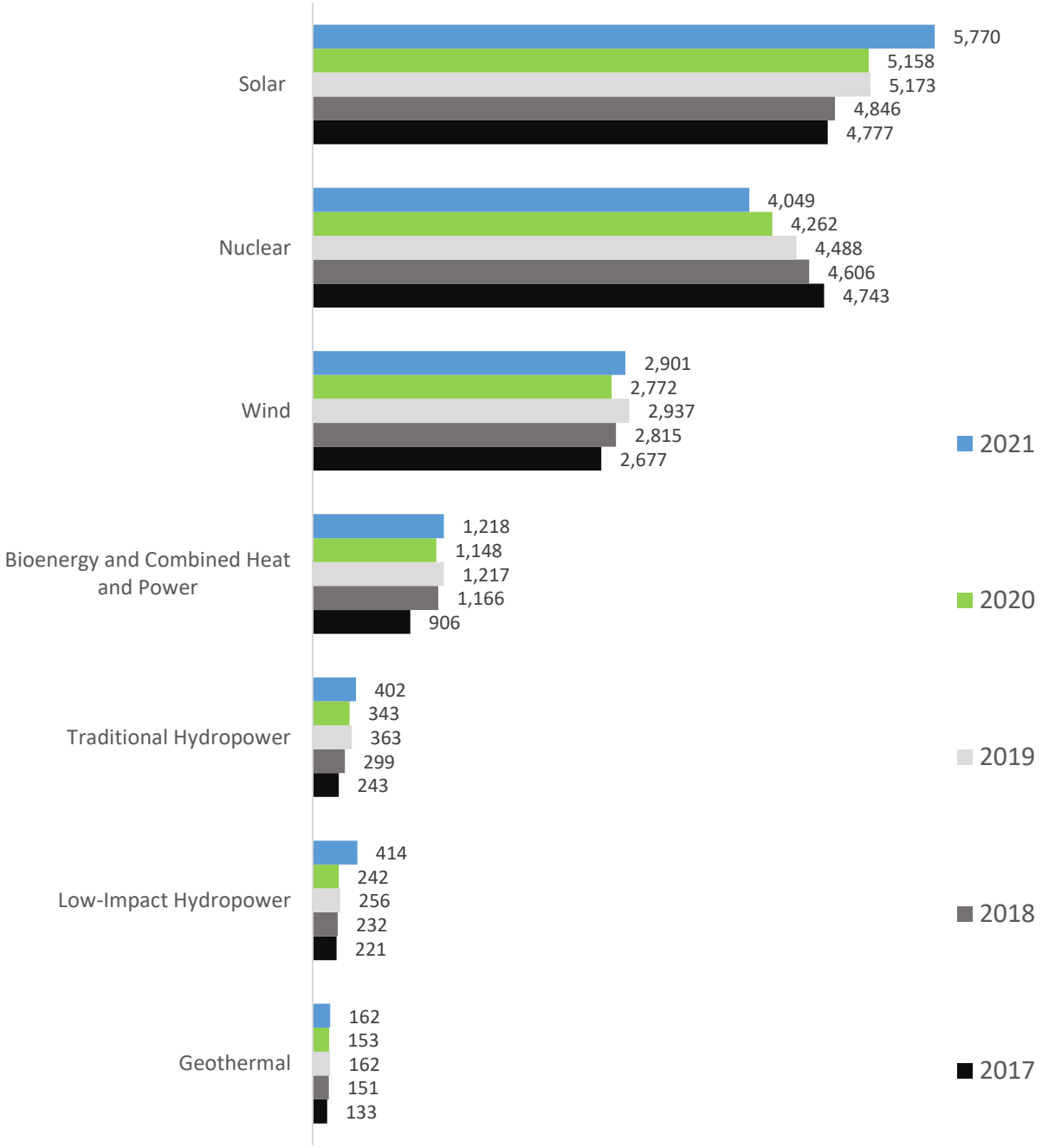
Clean energy generation jobs in Pennsylvania were mostly concentrated across solar, nuclear, and wind generation firms. Solar workers accounted for the largest share of clean energy generation workers—38.7 percent of the clean energy generation labor force. From Q4 2020 to Q4 2021, Pennsylvania's solar firms grew by 11.9 percent, totaling 612 new workers. Pennsylvania's solar market remained strong through the COVID-19 pandemic. During the first year of the pandemic, employment in Pennsylvania's solar sector remained flat, declining by less than half a percent or fewer than 20 jobs.[20] Comparatively, across the nation, solar jobs declined by eight percent or almost 28,000 workers between 2019 and 2020.[21]

The nuclear generation workforce in Pennsylvania continued its steady decline, dating back to 2017. Overall, between 2017 and 2021, nuclear electric power generation jobs declined by just over 14 percent, or roughly 690 jobs. Between Q4 2020 and Q4 2021, this subtechnology declined by an additional five percent, or almost 213 jobs. The closure of Three Mile Island—a nuclear power plant in Pennsylvania—in September 2019 and the national shift towards more natural gas and renewable electric generation capacities signal continued job losses in the sector. The trending decline of nuclear generation jobs is also a national phenomenon.

Low-impact hydropower employment increased by 71 percent, with a total of 172 new jobs in the subsector. Wind energy employment in Pennsylvania increased by 4.7 percent, or just under 130 workers. The remaining clean energy generation sub-technologies all gained fewer than 100 jobs.

[20] The change in employment for solar is within the margin of error and thus can be considered relatively flat or no change in employment from 2019 to 2020.
[21] United States Energy and Employment Report, 2021. https://www.usenergyjobs.org/.

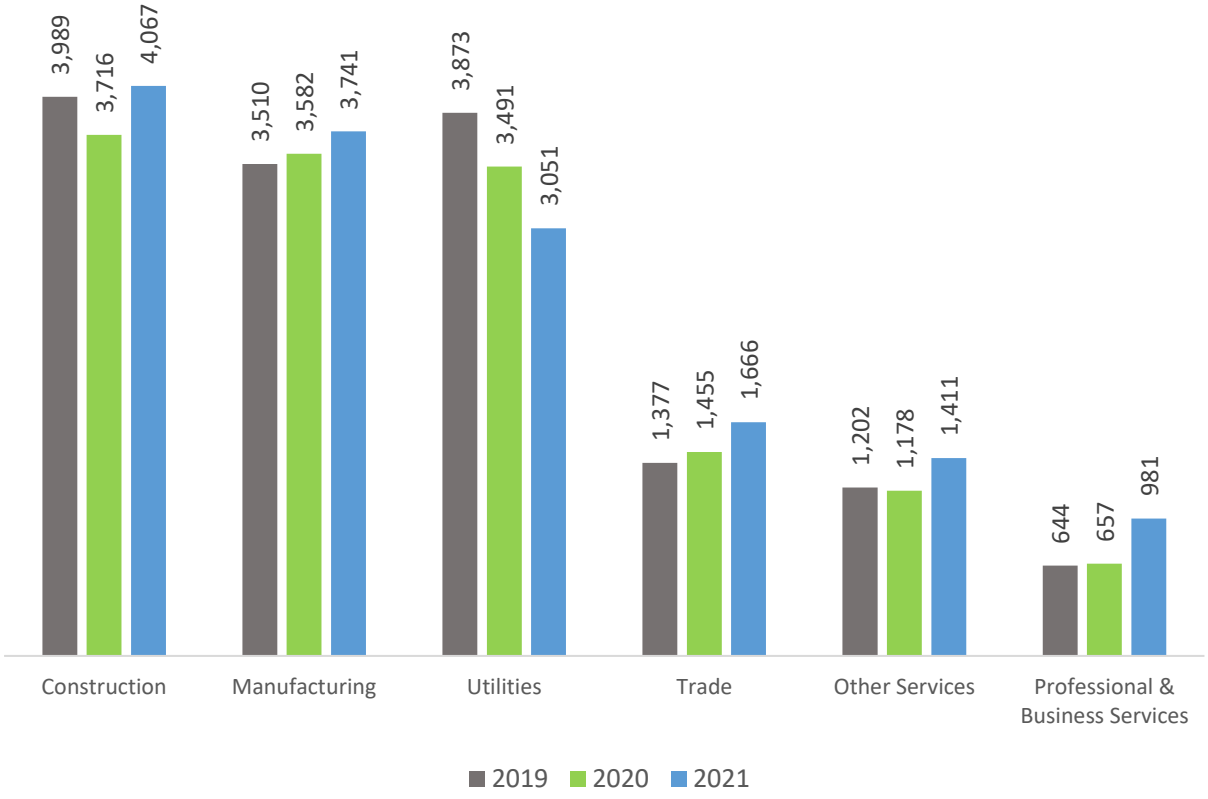
FIGURE 11. CLEAN ENERGY GENERATION EMPLOYMENT BY SUBTECHNOLOGY, 2017-2021



Activity in the clean energy generation sector was comprised largely of construction (27.3 percent), manufacturing (25.1 percent), and utilities (20.5 percent). During the start of the COVID pandemic, between Q4 2019 and Q4 2020, the utilities sector shed the highest number of jobs, declining by almost 10 percent or roughly 380 workers. From Q4 2020 to Q4 2021 that decline continued, losing 12.6 percent of workers, or roughly 440 jobs. Clean energy generation construction firms gained 351 jobs, for an increase of 9.4 percent in 12 months. Clean energy generation professional and business services grew rapidly from 2020 through2021, increasing by 49.3 percent, or 324 jobs.

Clean energy generation manufacturing grew by 4.4 percent, or about 158 jobs, while wholesale trade also saw an increase of almost 211 jobs—a growth of 14.5 percent.

FIGURE 12. CLEAN ENERGY GENERATION JOBS BY VALUE CHAIN, 2019-2021



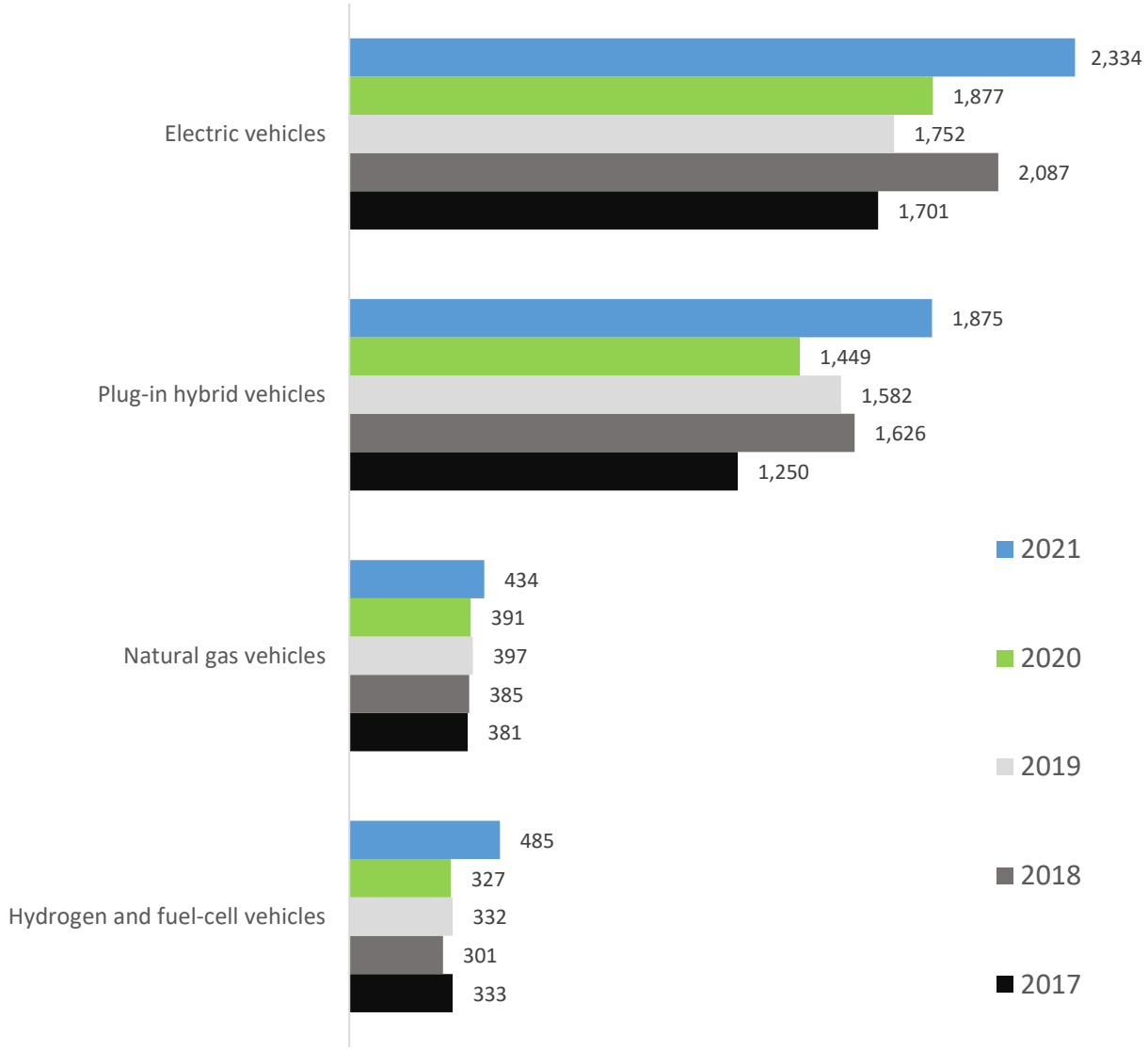
Alternative Transportation

The alternative transportation sector is comprised of workers that support the manufacture, sales, repair and maintenance, and professional business support—like legal, financial, engineering, or consulting services—of alternative transportation technologies. Alternative transportation includes technologies like plug-in hybrid, electric, natural gas, hydrogen, and fuel cell vehicles.

Jobs in the alternative transportation sector were mostly found in electric and plug-in hybrid vehicles. Electric vehicle companies—which manufacture, sell, service, or conduct research on vehicles that use one or more electric motors for propulsion with no onboard generator or non-electric motor—accounted for 45.5 percent of alternative transportation workers, or about 2,334 jobs, at the end of 2021. Electric vehicles saw employment growth even during the first year of the COVID-19 pandemic between Q4 2019 and Q4 2020. From Q4 2020 to Q4 2021, the subsector continued to grow by 24 percent, increasing by 457 jobs.

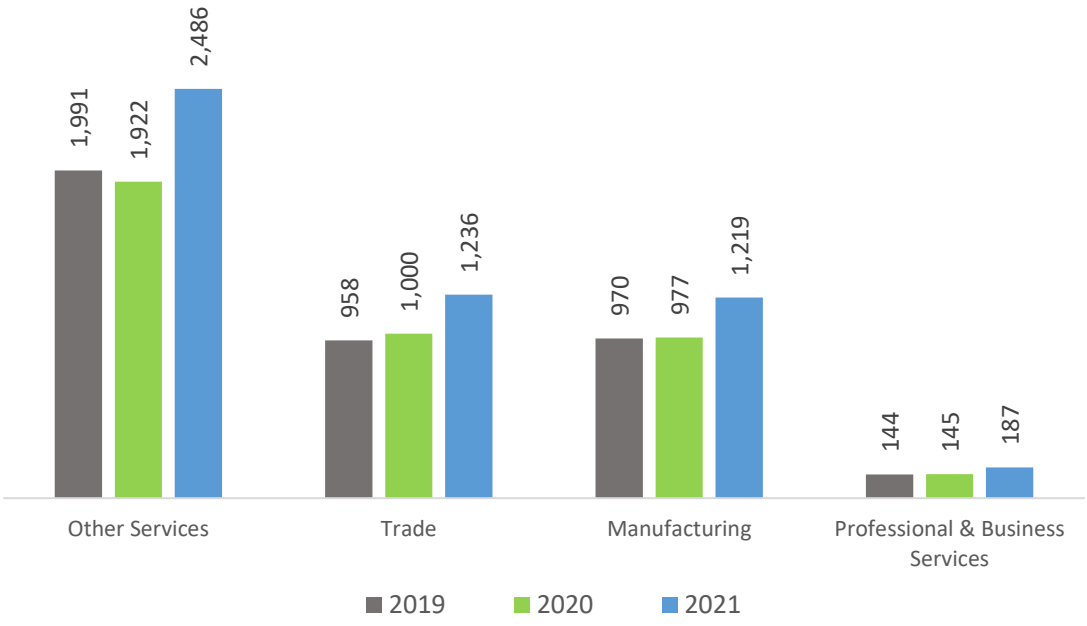
Pennsylvania also had significant employment in the plug-in hybrid sector at the end of 2021. Plug-in hybrid vehicles use two or more distinct types of power, such as internal combustion engines and electric motors that are powered by rechargeable batteries or another energy storage device that can be recharged by plugging it in to an external source of electric power. These firms accounted for 36.6 percent of workers in alternative transportation, or about 1,875 jobs, at the end of 2021. Between Q4 2020 and Q4 2021, Pennsylvania's plug-in hybrid workforce increased by 29 percent, resulting in the gain of roughly 426 jobs.

FIGURE 13. ALTERNATIVE TRANSPORTATION EMPLOYMENT BY SUBTECHNOLOGY, 2017-2021



Alternative transportation activity remained concentrated in the other services industry sector, which largely consisted of automotive repair and maintenance. Between Q4 2020 and Q4 2021, automotive repair and maintenance jobs increased by 29.4 percent, or 564 workers. Professional and business services within the alternative transportation sector grew by 28.3 percent, or 41 jobs. Wholesale trade in the alternative transportation sector increased by about 23.6 percent, or 236 jobs, over the same time, while alternative transportation manufacturing jobs grew by 24.8 percent, for an additional 242 workers.

FIGURE 14. ALTERNATIVE TRANSPORTATION JOBS BY VALUE CHAIN, 2019-2021

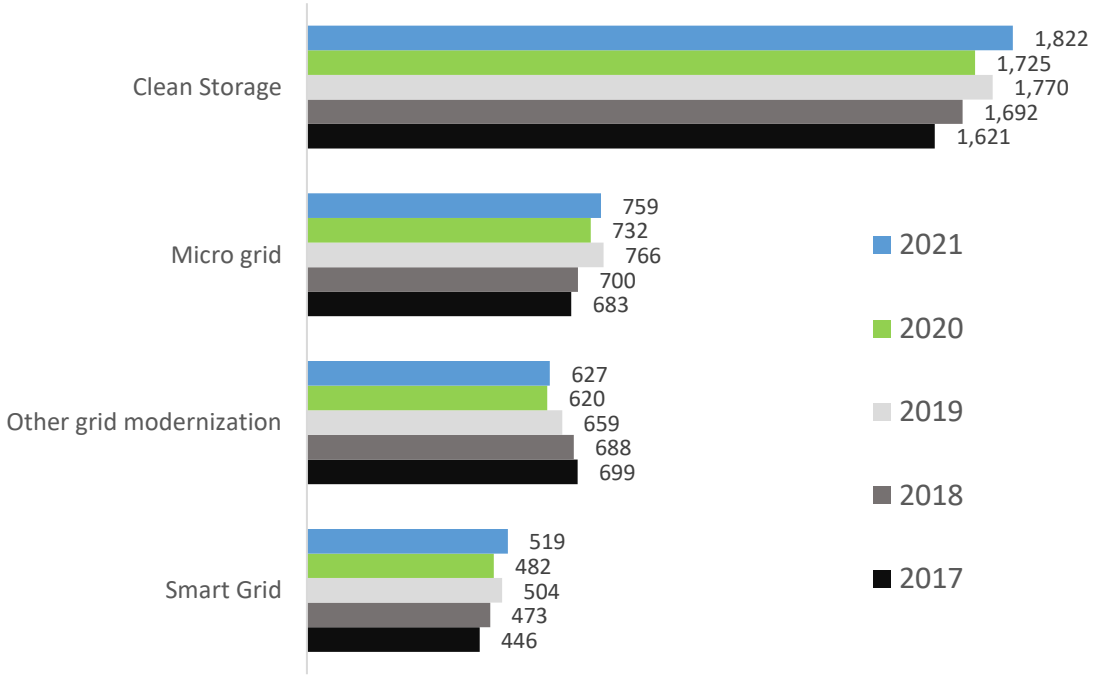


Clean Grid and Storage

In this report, clean grid and storage workers include any individual that supports the deployment (construction), manufacture, wholesale trade, or legal, financial, and engineering services of the following technologies: smart grid, microgrids, and other grid modernization technologies such as electric vehicle charging infrastructure and clean storage technologies.

Clean storage—which includes pumped hydropower storage[22], battery storage[23], mechanical storage[24], thermal storage[25], biofuel storage (including ethanol and biodiesel), and nuclear fuel storage—accounted for almost half (48.9 percent) of the clean grid and storage workforce in Pennsylvania. The clean storage industry increased by 5.6 percent, from 1,725 to 1,822 workers between Q4 2020 and Q4 2021. Microgrid[26] firms employed roughly 760 workers across the state and increased by 3.6 percent, or 27 jobs. Smart grid[27] employment increased by 7.5 percent, equating to the gain of roughly 36 jobs.

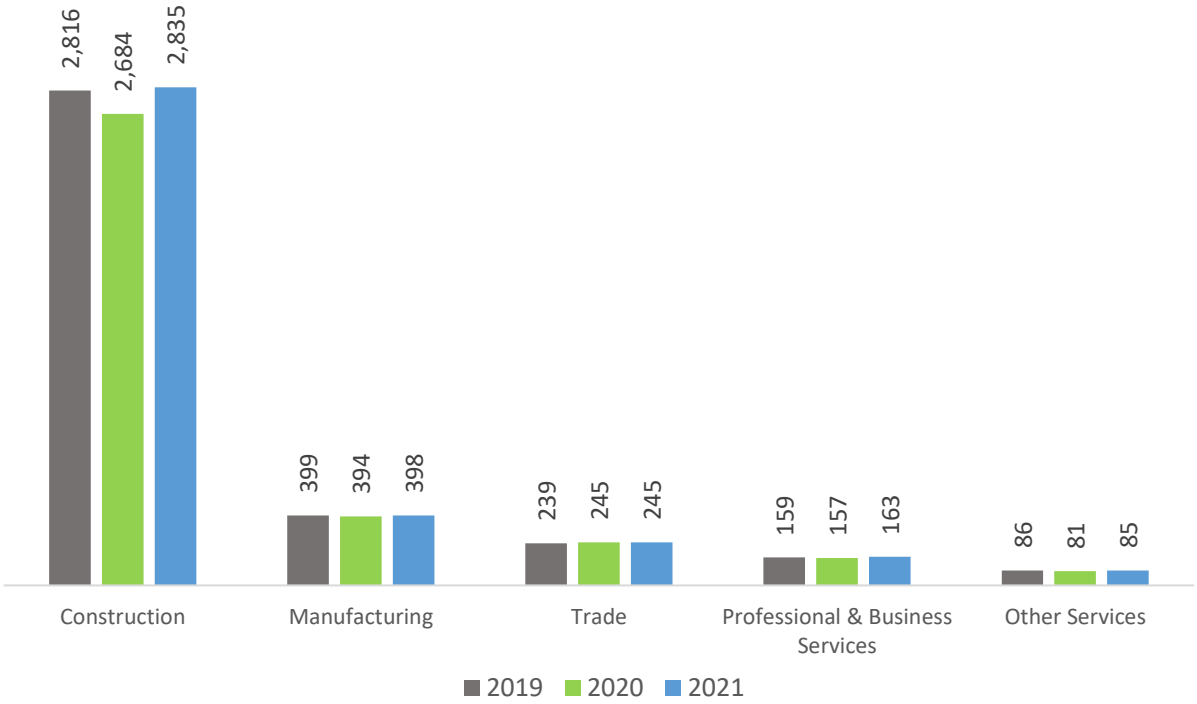
FIGURE 15. CLEAN GRID AND STORAGE EMPLOYMENT BY SUBTECHNOLOGY, 2017-2021



[22] Hydroelectric energy storage used by electric power systems for load balancing. This method stores the gravitational potential energy of water pumped from a lower elevation reservoir to a higher elevation.
[23] This includes battery storage for solar generation and lithium batteries, lead-based batteries, other solid-electrode batteries, vanadium redox flow batteries, and other flow batteries.
[24] This includes flywheels and compressed air energy storage.
[25] Temporary storage of energy for later use when heating or cooling is needed.
[26] Microgrids are a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that act as a single controllable entity with respect to the grid.
[27] A smart grid is an electricity supply network that uses digital communications technology to detect and react to local changes in usage.

Clean grid and storage activity in Pennsylvania remain mostly concentrated in the construction industry. Just over three-quarters (76.1 percent) of the clean grid and storage workforce was engaged in the installation, maintenance, or repair of clean grid and storage technologies across the state. Between Q4 2020 and Q4 2021, clean grid and storage construction saw jobs increase by 5.6 percent, for a gain of just over 152 jobs. The remaining four value chain segments were flat throughout the year.[28]

FIGURE 16. CLEAN GRID AND STORAGE JOBS BY VALUE CHAIN, 2019-2021



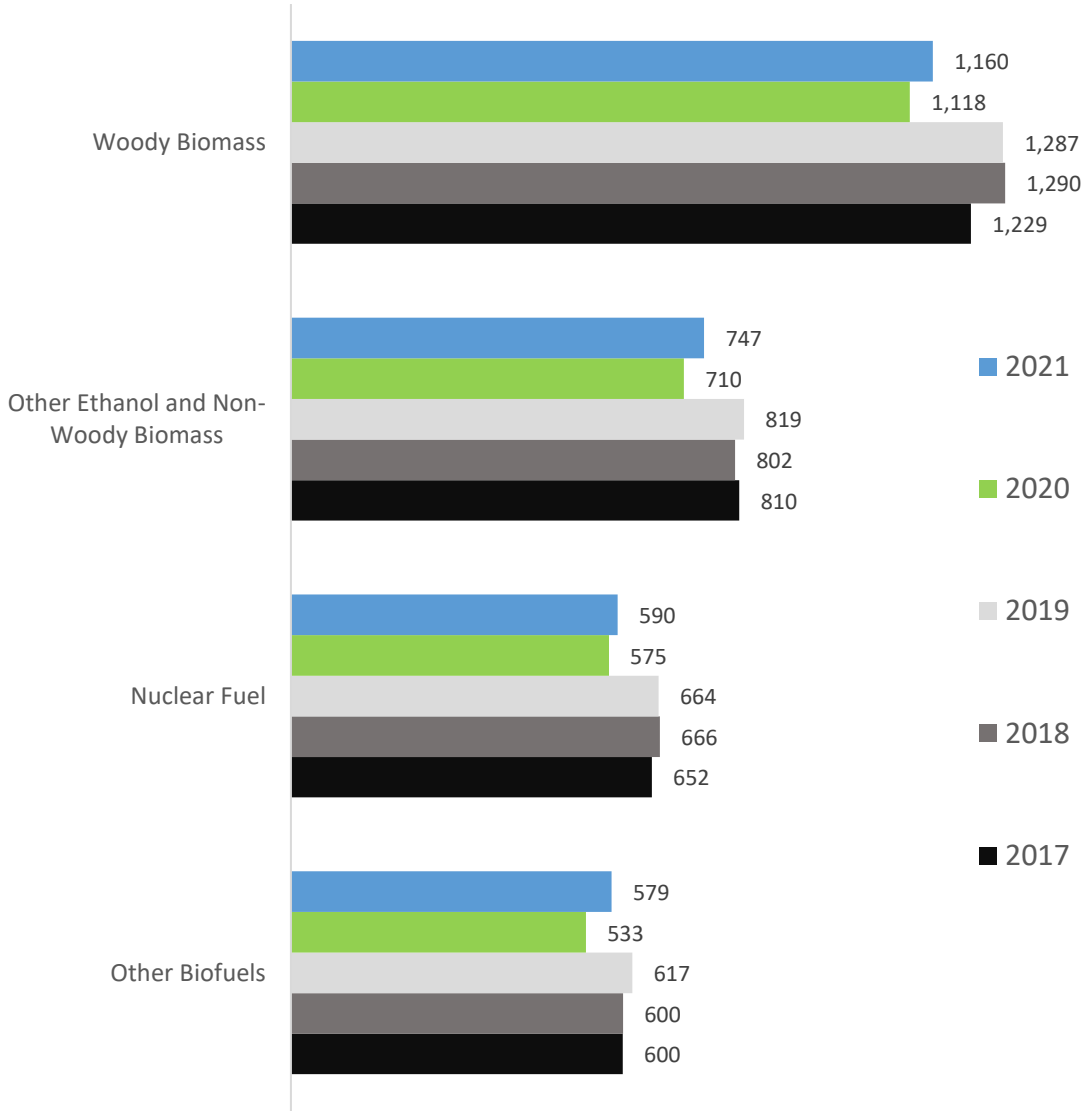
[28] The change in employment for these segments is within the margin of error and thus can be considered relatively flat or no change in employment from 2019 to 2020 and 2020 through 2021.

Clean Fuels

The clean fuels sector includes all workers involved in the production, distribution and sales, or professional and business service support for clean fuels and clean fuel technologies that use woody biomass, nuclear fuels, and other biofuels.

Collectively, the clean fuels sector gained 140 jobs from Q4 2020 through Q4 2021, after a loss of 450 jobs between Q4 2019 and Q4 2020. All sub-technologies increased by roughly three to nine percent from Q4 2020 to Q4 2021, with other biofuel growing the most—roughly 46 jobs gained—followed by other ethanol and non-woody biomass, which gained about 37 jobs, woody biomass (a gain of 42 jobs), and nuclear fuel (a gain of roughly 16 jobs).

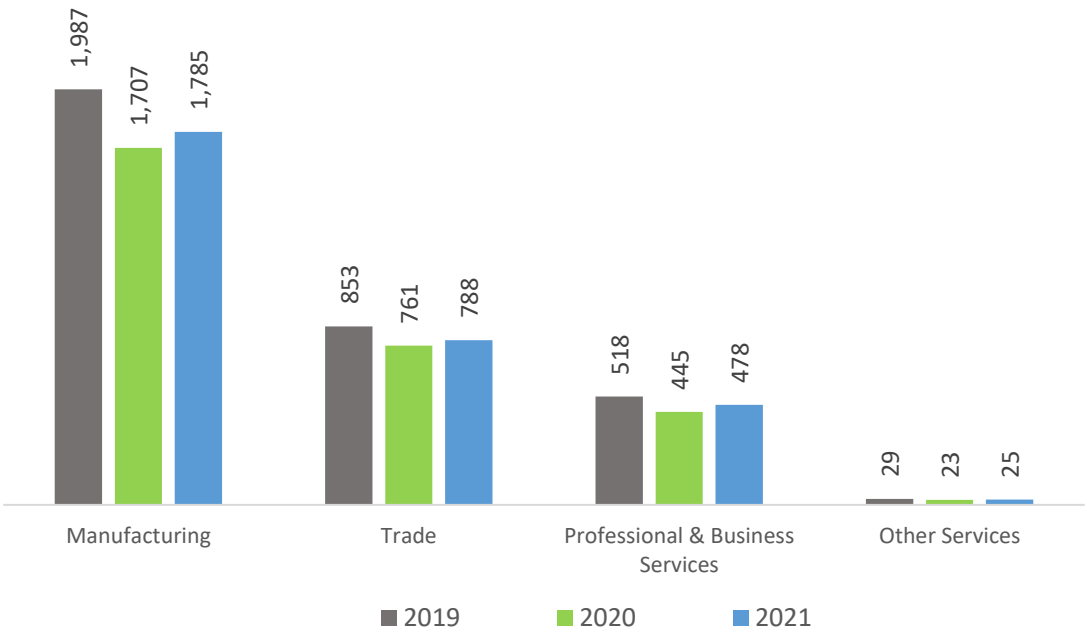
FIGURE 17. CLEAN FUELS EMPLOYMENT BY SUBTECHNOLOGY, 2017-2021



Clean fuels manufacturing remained strong in Pennsylvania by the end of 2021. Over half (58 percent) of the clean fuels sector was dedicated to manufacturing. A portion of the clean fuels manufacturing jobs was the result of the state's biodiesel manufacturing plants and biodigesters[29], as well as the eight wood pellet manufacturing plants, which support a combined annual capacity of about 368,000 tons.

Clean fuels manufacturing increased by 4.6 percent between Q4 2020 and Q4 2021, a gain of 78 jobs. Wholesale trade in the clean fuels sector gained 27 workers for an increase of 3.6 percent over the same time. Professional and business services increased by 7.5 percent, or about 33 workers, while employment in other services remained flat.[30]

FIGURE 18. CLEAN FUELS JOBS BY VALUE CHAIN, 2019-2021



[29] "The state also has two biodiesel manufacturing plants that can produce 90 million gallons annually. In 2019, Pennsylvania was the eighth-largest biodiesel-consuming state at nearly 51 million gallons", U.S. Energy Information Administration (EIA). Pennsylvania State Profile and Estimates. Last Updated October 2021.

[30] The change in employment for other services is within the margin of error and thus can be considered relatively flat or no change in employment from 2020 to 2021.

Clean Energy Demographics

Pennsylvania's clean energy economy remained a source of jobs for Hispanic or Latinx, Asian, and veteran residents across the state. Pennsylvania's clean energy economy was 76 percent male and 73 percent White from Q4 2020 to Q4 2021, as compared to the statewide demographics of 52 percent male and 81 percent White. While Hispanic or Latinx residents made up 6.1 percent of Pennsylvania's population, they composed almost 14 percent of the clean energy workforce. While Pennsylvania had a demographic of 3.8 percent Asian residents, the clean energy workforce was made up of 7.4 percent Asian residents. Similarly, Veterans made up only 5.2 percent of overall Pennsylvania residents but represented almost 10 percent of the clean energy workforce from Q4 2020 to Q4 2021. Pennsylvania's clean energy sector had a slightly higher proportion of Black or African American workers (10.1 percent) compared to the national clean energy sector average (8.5 percent), though it was lower than the statewide average of 12 percent.

TABLE 2. CLEAN ENERGY WORKFORCE DEMOGRAPHICS, 2021[31]

	PA Clean Energy Overall	*PA State Average*	*US CE Workforce (including Nuclear)*	*US Overall Workforce*
Male	75.9%	52.1%	72.8%	53.0%
Female	24.1%	47.9%	27.2%	47.0%
Hispanic or Latinx	13.7%	6.1%	16.4%	18.0%
Not Hispanic or Latinx	86.3%	93.9%	83.6%	82.0%
American Indian or Alaska Native	1.4%	0.4%	1.4%	1.0%
Asian	7.4%	3.8%	7.5%	6.6%
Black or African American	10.1%	12.0%	8.5%	12.3%
Native Hawaiian or other Pacific Islander	0.7%	0.1%	1.1%	0.3%
White	73.5%	81.5%	74.3%	77.5%
Two or more races	6.9%	2.1%	7.3%	1.9%
Veterans	9.9%	5.2%	8.8%	5.6%
55 and over	17.6%	26.8%	13.4%	23.6%

[31] Demographic data is pulled from the United States Energy and Employment Report 2022 (USEER 2022) as well as JobsEQ workforce demographics for workers across all industries in Pennsylvania.

Supplemental Analysis: Exploring the Role of Unions in the Clean Energy Transition

Overview

The Pennsylvania Department of Environment Protection (DEP) engaged BW Research to develop a deeper understanding of how unions were approaching the clean energy transition in Pennsylvania. Between July and September 2022, the research team conducted outreach with extensive follow-up to secure the interviews. Importantly for this research, BW Research sought a breadth of different perspectives regarding the energy transition, representing a wide range of unions.

Ultimately, The BW team spoke with eight individuals representing laborers, electricians, ironworkers, and insulators, as well as advocates and others with direct experience working for or with unions. In doing so, BW Research gathered qualitative data on organized labor's perspective regarding the clean energy industry's impact on unions and workers and communities in the commonwealth. This research also revealed resources and programs that might benefit union members, as well as policies or actions they were concerned about.

The following are general themes which emerged from the discussions. This section only highlights the key findings, but for a full accounting of quotes, please see Appendix D.

Key Findings

OVERALL OPINION OF UNIONS & UNION ENGAGEMENT

A clean energy transition is viewed mostly negatively by the building and construction trades in Pennsylvania and many union members in energy-connected work; advocates of labor and climate collaboration are pessimistic about near-term opportunities. One consistently heard refrain is that "labor is not a monolith" in terms of its opinions on clean energy. In Pennsylvania, however, there seem to be only a few segments of organized labor moving towards optimism regarding clean energy. Unions who are still seeing steady work in fossil fuels are unlikely to support clean energy and climate legislation. Other members who are already experiencing the impact of a shift away from coal are resigned to this dynamic but not ready for a transition to clean energy. The limited few unions that believe they would see gains are mildly positive, but mostly in the context of gaining access to new clean energy jobs, not in terms of transitioning other jobs to clean energy.

For many unions, clean energy is not considered a promising alternative to the status quo energy landscape. Economic issues were cited primarily to account for this perspective, alongside localized fossil-fuel related concerns and the impact of a transition on the unions themselves. Economic issues are paramount for union members, and their willingness to support and engage with clean energy depends upon the perception of the immediate and near-term impact on their membership. Interviewees noted that wages are significantly lower in clean energy, that clean energy jobs (and skills required) are non-comparable to existing fossil jobs, and that many clean energy jobs are jobs that change locations or last for specific periods of time, with limited stability and geographic concentration. Local economic interests remain pre-eminent to most unions, and in Pennsylvania, those interests intersect closely with

fossil fuel. Trade unions do not see clean energy as a viable replacement for their jobs, with negative impacts for union stability.

Acceptance of fossil fuels, or at least a broader "all of the above" strategy, is a critical starting point for any discussion with Pennsylvania energy and building trade unions. Support for fossil fuel development and exports is extremely strong and currently non-negotiable among a critical mass of unions, and there are several reasons for that. The history of extraction, process, and delivery of fossil fuels, coupled with its current economic impact on the commonwealth, create a deep attachment to those fuels, even beyond the real-world impact. And for several building trades, fossil fuels provide the bedrock job growth and stability. Working with fossil companies can be a better experience than less union-friendly renewable companies. The fossil fuel sector of the economy is well organized (compared to a baseline of other industries), and efforts by climate advocates to reduce the commonwealth's reliance on fossil fuels are being received poorly. Even pro-renewables unions must include an "all of the above" framing**.**

Any strategy to integrate unions more directly into clean energy and create more support for a transition should begin with supportive government policy. Putting the onus on unions and climate advocates and industry to overcome deep rooted challenges was described by one interviewee as "unfair". Government at federal and state levels could move the conversation forward by stepping in to address and overcome union and workforce roadblocks. These types of policies would include wage requirements, benefit and labor standards, and increased opportunities to organize. New York and New Jersey provide supportive case studies.[32] A recent government-led procurement that did not include prevailing wage and labor interests was highlighted by several interviewees as a step backwards that damaged trust, although it was resolved in a more positive fashion.

Belief in climate change and an acceptance of a need to transition to clean energy are not driving issues for unions. Interviewees highlighted that from a legal perspective, union leaders are bound to focus on members' economic needs and that personal climate beliefs would not supersede that. However, others felt there were opportunities to highlight the impact of climate change on jobs and budgets if unions wanted to take a leading role.

The Regional Greenhouse Gas Initiative (RGGI) was raised independently in repeated conversations as a sore spot for unions in the state. While the actual impact of RGGI may be limited to specific unions, the perceived broader impact on jobs and the economy and the narrative around unfairness to Pennsylvania are causing challenges for renewables advocates and unions aligned on renewables.

Climate and clean energy advocates, especially environmentalists, are viewed poorly by Pennsylvania organized labor. There is room for learning and understanding on both sides.

OPPORTUNITIES TO ENGAGE & PARTNER WITH UNIONS

Opportunities that could grow interest in clean energy among unions in the commonwealth and a broader acceptance of a transition to clean energy center around specific technologies that could create in-roads with union members due to job growth and/or transferability of job skills. Energy efficiency was highlighted, as were carbon capture, hydrogen, small nuclear, EVs, and community solar. Launching

[32] For New Jersey, reference: https://www.nj.gov/governor/climateaction/documents/CGE%20Roadmap.pdf. See discussion on high-quality jobs, page 34, and union training programs starting page 45. For New York, reference: https://www.ilr.cornell.edu/worker-institute/labor-leading-climate/nys-passes-labor-standards-clean-energy-work. See passage of labor standards for 2021 budget, and more generally Climate Jobs New York which has several resources and references.

or promoting initiatives around these technologies could foster new conversations. Policies that support those technologies could be aligned with worker-focused policies. Others described opportunities to engage unions through messaging and approaches that resonated more with their membership. Relationship building remains crucial to any union engagement. Bipartisan collaborations in state office are starting to emerge, which could serve as interesting new models.

There was some limited support for the idea that clean energy could increase the size of union membership, although most interviewees were skeptical. For example, IBEW and LIUNA see significant potential opportunities in solar, and the insulators are excited about energy efficiency. However, other interviewees felt that generally clean energy did not promise much opportunity for union growth.

Clean energy is also perceived as unlikely to directly contribute to addressing diversity and access issues within unions, although in some locations it could have marginal impact. Generally, interviewees felt the opportunities clean energy could provide to diversify unions would be region-specific, and likely ancillary.

Several unions could become future collaborators, beyond the traditionally engaged unions, but there was no consensus. This included operating engineers, plumbers, and boilermakers. However, even more supportive unions such as IBEW were described as being not uniform in their support.

There was receptivity to a broader discussion of the role of union training programs in supporting clean energy. Interviewees felt that developing training programs could boost union support and that comprehensive training programs could expand one-off clean energy jobs into clean energy careers. Several initiatives were highlighted as providing different models, as well needing to think through other elements of facilitating strong training programs for clean energy such as geographic targeting, demand creation, and outside funding of wraparound services.

'Just Transition' is a problematic term and concept with unions. All interviewees strongly advised ceasing use of the term "Just Transition" if union engagement is any priority. There were strong sentiments expressed about its history, its lack of success and lack of specificity, and its negative impact on other organizing and advocacy efforts.

One first step with unions could be simply to flesh out how a transition of some variety would look. This could include details that explain it, examples that demonstrate it, and an increasing understanding of the importance of supportive federal policy as a foundation for any transition.

Appendix A: Clean Energy Technology List

A clean energy job is defined as any worker that is directly involved with the research, development, production, manufacturing, distribution, sales, implementation, installation, or repair of components, goods, or services related to the following sectors of Clean Energy Generation; Clean Grid and Storage; Energy Efficiency; Clean Fuels; and Alternative Transportation. These jobs also include supporting services such as consulting, finance, tax, and legal services related to energy.

CLEAN ENERGY GENERATION

- Solar Photovoltaic Electric Generation
- Concentrated Solar Electric Generation
- Wind Generation
- Geothermal Generation
- Bioenergy/Biomass Generation
- Low-Impact Hydroelectric Generation, including wave/kinetic generation
- Traditional Hydroelectric Generation
- Nuclear Generation

CLEAN GRID & STORAGE

Electric Power Transmission and Distribution

- Smart Grid
- Microgrids
- Other Grid Modernization

Storage

- Pumped Hydropower Storage
- Battery Storage, including battery storage for solar generation
    - Lithium Batteries
    - Lead-Based Batteries
    - Other Solid-Electrode Batteries
    - Vanadium Redox Flow Batteries
    - Other Flow Batteries
- Mechanical Storage, including flywheels, compressed air energy storage, etc.
- Thermal Storage
- Biofuels, including ethanol and biodiesel
- Nuclear Fuel

ENERGY EFFICIENCY

- Traditional HVAC goods, control systems, and services
- High Efficiency HVAC and Renewable Heating and Cooling
    - ENERGY STAR Certified Heating Ventilation and Air Conditioning (HVAC), including boilers and furnaces with an AFUE rating of 90 or greater and air and central air conditioning units of 15 SEER or greater
    - Solar Thermal Water Heating and Cooling
    - Other Renewable Heating and Cooling (geothermal, biomass, heat pumps, etc.)

- ENERGY STAR® and Efficient Lighting
    - ENERGY STAR Certified Appliances, excluding HVAC
    - ENERGY STAR Certified Electronics (TVs, Telephones, Audio/Video, etc.)
    - ENERGY STAR Certified Windows and Doors
    - ENERGY STAR Certified Roofing
    - ENERGY STAR Certified Seal and Insulation
    - ENERGY STAR Certified Commercial Food Service Equipment
    - ENERGY STAR Certified Data Center Equipment
    - ENERGY STAR Certified LED Lighting
    - Other LED, CFL, and Efficient Lighting
- Advanced Building Materials/Insulation
- Other Energy Efficiency
    - Recycled Building Materials
    - Reduced Water Consumption Products and Appliances

CLEAN FUELS

- Other Ethanol/Non-Woody Biomass, including Biodiesel
- Woody Biomass/Cellulosic Biofuel
- Other Biofuels
- Nuclear Fuel

ALTERNATIVE TRANSPORTATION

- Plug-In Hybrid Vehicles
- Electric Vehicles
- Natural Gas Vehicles
- Hydrogen Vehicles
- Fuel Cell Vehicles

Appendix B: Research Methodology

EMPLOYMENT, HIRING, & DEMOGRAPHIC DATA

Data for the 2022 Pennsylvania Clean Energy Industry Report is taken from the U.S. Energy and Employment Report (USEER). The survey was administered by phone and web. The phone survey was conducted by ReconMR, and the web instrument was programmed internally. Each respondent was required to use a unique ID in order to prevent duplication.

The 2022 USEER survey in Pennsylvania resulted in more than 11,000 calls, nearly 3,300 emails, and more than 1,300 physical letter invites mailed to potential respondents. Approximately 840 business establishments participated in the survey. These responses were used to develop incidence rates among industries as well as to apportion employment across various industry categories in ways currently not provided by state and federal labor market information agencies. The margin of error is +/-3.37 percent at a 95 percent confidence level.

The full research methodology for USEER may be found at: https://www.energy.gov/media/275711

FULL-TIME EQUIVALENT JOBS

Full-time Equivalent (FTE) jobs are extrapolated using state employment thresholds by technology weighted on census division and previous year's data. Employment thresholds are survey data from questions asking what percent of a firm's employment spends at least 50% of their time working on clean energy related activities and what percent spends all their time. Using the adjusted thresholds, employment by state is then split into three groups: those that spend all (100%) of their time on energy related activities, those that spend a majority (50-99%) of their time, and those that spend less than a majority (0-49%) of their time. These employment groups are weighted 0.25 on the less than a majority group, 0.75 on the majority group, and 1 on the 100% group. FTE jobs are the sum of these products.

Appendix C: Clean Energy Jobs by County

The following table provides clean energy employment data by county for total clean energy jobs, clean energy generation jobs, and energy efficiency jobs in Q4 2021. It should be noted that because data collection in Q4 2021 did not include county-level employment, the proportions from last year are applied to the most recent job totals.

County Name	Total Clean Energy Jobs	Clean Energy Generation	Energy Efficiency
Allegheny County	12,706	2,530	9,288
Philadelphia County	9,191	1,160	7,126
Montgomery County	9,085	1,304	6,734
Lehigh County	7,588	201	6,580
Bucks County	5,122	955	3,511
Chester County	4,742	541	3,479
Lancaster County	4,476	933	3,082
York County	3,567	788	2,308
Delaware County	3,248	447	2,375
Berks County	3,293	1,494	1,651
Dauphin County	2,162	459	1,451
Westmoreland County	2,172	362	1,552
Cumberland County	1,777	168	1,307
Erie County	1,543	412	1,036
Butler County	1,466	141	1,079
Luzerne County	1,450	155	1,104
Washington County	1,431	77	1,118
Northampton County	1,250	73	971
Lackawanna County	1,209	119	793
Centre County	1,006	222	703
Beaver County	879	469	385
Blair County	767	57	520
Lycoming County	684	63	490
Franklin County	648	33	472
Lebanon County	600	83	382
Cambria County	577	61	417
Schuylkill County	541	91	347
Jefferson County	508	326	134
Mercer County	478	21	335
Adams County	474	177	254
Fayette County	458	34	291
Monroe County	437	29	317
Lawrence County	434	32	344
Somerset County	399	34	243

Northumberland County	393	46	216
Indiana County	362	41	249
Clearfield County	287	28	174
Columbia County	275	43	188
Crawford County	274	71	158
Bedford County	247	15	179
Carbon County	240	39	95
Greene County	226	10	169
Tioga County	230	15	123
Wayne County	226	12	184
Clinton County	214	28	107
Snyder County	204	15	139
Bradford County	187	10	132
Union County	178	79	97
Armstrong County	162	21	111
Venango County	159	16	108
Clarion County	156	26	91
McKean County	145	14	112
Huntingdon County	137	18	91
Mifflin County	135	12	90
Elk County	121	5	93
Perry County	122	7	80
Wyoming County	111	14	74
Susquehanna County	112	13	85
Pike County	103	21	67
Montour County	103	6	44
Warren County	96	10	55
Juniata County	63	6	44
Fulton County	59	10	31
Potter County	58	5	21
Sullivan County	23	10	13
Forest County	11	1	9
Cameron County	9	1	7
N/A	2,832	198	2,167
TOTAL	**94,629**	**14,917**	**67,782**

Appendix D: Labor Union Interview Quotes

OVERALL OPINION OF UNIONS & UNION ENGAGEMENT

A clean energy transition is viewed mostly negatively by the building and construction trades in Pennsylvania and many union members in energy-connected work; advocates of labor and climate collaboration are pessimistic about near-term opportunities.

"Wind and solar are not exciting to unions."

"At best, unions look at clean energy as a supplement to what we're doing. Any new energy jobs should be labor."

"I've been reassessing my theory of change. I used to think we can't win on climate unless labor is on board. After 17 years in this fight, I believe we have to win on climate, whether labor is on board on not."

"Unions know their membership has declined. There are a select few thoughtful ones are trying to address it and create partnerships."

"I have to prepare my membership and change their mindset. They're not going to be going to the same location for 40 years and then retiring. But it's not easy."

For many unions, clean energy is not considered a promising alternative to the status quo energy landscape. Economic issues were cited primarily to account for this perspective, alongside localized fossil-fuel related concerns and the impact of a transition on the unions themselves.

"No trade unions are looking at clean energy as a fair replacement of their jobs – not the same wages, not the same skills."

"They've left out the building trades. The wages are awful. The starting wage for solar installation cuts out a lot of union workers. They can't compete for $17 an hour."

"Jobs can be frankly not great in solar. Just move stuff around, put it together – not real technical. It's a default to lower wage jobs."

"It's contract work that moves around a lot. We don't see the man hours in constructing solar or wind farms, nor is there recurring work."

"How do you replace a fossil fuel job with these jobs 1 for 1?"

"No one has talked to the power plant guys – this is an apples and oranges environment requiring less technical skills. They are not trained to do any of these clean energy jobs."

"All of the coal miners doing those reclamation projects – it's not the same work, and therefore not the same union. This means mine workers, if they get lucky enough to stay in a unionized sector, have to

switch to other unions… That's maybe good for the workers, and those unions, by not the mineworkers union."

"In Western Pennsylvania there were a number of union members who lost their jobs… during the coal transition. We partnered with a local voc-tec program to develop a heavy equipment program to train up for a coal reclamation site. This was a one-time training program for 70 members that featured outside funding. 12 ended up with new jobs. We don't view this as a success. Sure, we saw some individual success, but we lost a lot of… members who were no longer in our union."

Acceptance of fossil fuels, or at least a broader "all of the above" strategy, is a critical starting point for any discussion with Pennsylvania energy and building trade unions.

"Coal still has an outsized influence on the state and labor movement but it's fading into the background. Oil and gas definitely are not. They're digging their heels in on oil and gas."

"The building trades and energy unions go to the rest of the labor unions and say you need to be in solidarity with us about fossil fuels. Those not following the climate issue closely say, ok."

"Some locals are great. But any community with a fossil powerplant forget it. Leadership doesn't want to be facilitating a conversation."

"We've had millions of man hours in Pennsylvania pipelines for 10 years – these are robust jobs with good wages. These kinds of employers are willing to pay our rates, they know what unions bring – it's a steady supply of jobs with minimum of hassle."

"A lot of our members are turned off by the renewables conversation. They think other people are telling them they 'know what's best for them.'"

"Unions are using API [American Petroleum Institute] talking points. It's a tight relationship – they fund labor meetings and conferences – and it's tough to break through."

Any strategy to integrate unions more directly into clean energy and create more support for a transition should begin with supportive government policy.

"When companies fail to support unions – then we need the stick of policy in the background."

"I just don't see negotiations helping – it has to be policy driven. With deregulation of energy market – it created a wild west – can't put toothpaste in the tube."

"Lots of companies need legislation to build renewables or convert buildings. It's all driven by policies. This is a leverage point for strong labor standards."

"Everything should have apprenticeship language attached and Davis Bacon."

"We have to fight at the state level to make it easier to organize, to get laws that promote renewables with prevailing wage and union-certified training programs. Then unions have to go in and organize the workers."

"New Jersey and New York have gone to labor and worked with them to help bring labor into the game with these renewable initiatives, with project labor agreements on industries and prevailing wage laws. Pennsylvania hasn't done that."

"One thing that I'm hopeful about – the federal government has tied in labor standards to its clean energy policy. We're used to be left out in the cold for new technologies. This makes our work a lot easier to convince our members."

Belief in climate change and an acceptance of a need to transition to clean energy are not driving issues for unions.

"We understand change is happening, and we know the world is going to transition. But my folks don't think the solutions are realistic."

"Everyone believes in climate change – you can see it right now that it's happening. I'm not going to be a denier. But I'm not looking to educate my members."

"Climate change is so politicized – maybe 50% of members believe. The question is, why bother?"

"In their defense, labor leaders are bound by law to represent the interest of those who pay union dues today, along with culture and practice. This is what we do, we represent the interests of the people on the job."

"Impact of climate change is a true job killer. More work needs to be done on this – this will be move labor because it directly speaks to their self-interest."

"If union leadership ok's the conversation, it'll happen. And when it does, I would love to help with those conversations."

The Regional Greenhouse Gas Initiative (RGGI) was raised independently in repeated conversations as a sore spot for unions in the state.

"RGGI is a flashpoint for certain unions. Information got distorted but in places where we thought we had support, anything that was perceived to take away fossil jobs was frowned upon by some of our previous allies."

"Building trades are less than enthusiastic about RGGI initiative – this is a big issue. The state may be surprised by this."

"The biggest concern with unions and key decision-makers is with fossil fuels and a policy such as RGGI – will cause plans to shut down and jobs lost in critical areas."

"The majority of states in RGGI are different than Pennsylvania. They have nothing like our energy mix and status. It's not just the jobs, it's a big part of our economy."

"It's made life hell for solar – when we don't even need RGGI."

"RGGI brings on more natural gas which will benefit renewables. But it takes down coal. This is an easy wound to open up."

Climate and clean energy advocates, especially environmentalists, are viewed poorly by Pennsylvania organized labor.

"I was at a protest recently that had union members on one side and climate advocates on another and climate advocates started chanting 'your jobs don't matter' at the union guys. That's not good."

"Climate activists need to understand the constraints of labor. They need the right messaging. They need to be able to speak to labor in ways that address their self-interest. Need to be talking about jobs and work. Not about 420PPM. That doesn't mean a lot to your average working person. Come up out of your silos."

"A lot of times, we've found ourselves at odds with folks in the environmental movement. Developers will claim more expensive labor locks out environmental justice and disadvantaged workers. We would like to address that. I talk to a lot of folks who all want high-quality jobs. We should be able to walk and chew gum at the same time."

"There's a tension in this idea that increasing the cost of labor reduces the amount of greenhouse gas emissions we can get. It leads to a race to the bottom. We need a mind-shift of how people approach jobs and the environment."

"A lot of this is about messaging. I'm sorry, but enviros need a wake-up call with what they're saying."

"There's needs to be some healing."

OPPORTUNITIES TO ENGAGE & PARTNER WITH UNIONS

Opportunities that could grow interest in clean energy among unions in the commonwealth and a broader acceptance of a transition to clean energy center around specific technologies that could create in-roads with union members due to job growth and/or transferability of job skills.

"Renewable energy advocates have tended to lump energy efficiency in clean energy. It's all clean energy at the end of the day but there's daylight."

"Converting buildings into green buildings and LEED-certified projects could increase union membership for those unions who could participate in that work."

"The split between commercial and residential work needs to be more distinguished in the discourse. The smaller stuff is always going to be hard [for unions] but commercial energy efficiency, big renewable projects – it's a place where there's a chance."

"There's a ton of opportunity for insulators in building efficiency and industrial efficiency. We do energy audits and thermography all the time. We say the insulators union was the first green trade. There's so many little things to do with gas that would be more efficient than going to solar power and windmills."

"We would like to see carbon capture develop more. We obviously have a vested interest in the powerplants. Our friends at the boilermakers – they've lost a chunk of their market share, and this would be huge for them and for us."

"While there's a lot of hype and requirements in using these technologies at large scale – it requires a lot of the piping and mechanical trades – and there's a lot of opportunity in that. You are staying in a complementary industry which needs pipes, buildings, pumps, processing. I don't see how this gets seen as a negative by any labor group."

"Unions love carbon capture because it will allow for more extraction and burning of fossil fuels."

"There's a future in small modular nuclear reactors. It's exciting. Wyoming and Washington are looking at it and there's interest in Pennsylvania."

"EVs and EV infrastructure could expand the unionized workforce but to what level? That's an interesting question to answer."

"Community solar is in the middle – it doesn't have the same barriers as utility scale and residential solar. It requires legislation to get done. It's new. These all create interesting opportunities for unions and solar to come together."

"If you have a couple of good examples where unions are benefiting from these projects – that there were prevailing wage, with higher rates, that could help show people there are projects where they will pay our rates."

"Building relationships remains foundational. Publicly everyone has to stake out clear positions, but privately there's much more thoughtful discourse."

"Unions need to know climate change is a dagger pointed at the heart of the union. I always tell them 'you need healthy state and federal and local budgets and climate change is going to devastate those budgets and your source of bargaining power. Climate change is a job killer'. It allows for a different framing."

There was some limited support for the idea that clean energy could increase the size of union membership, although most interviewees were skeptical.

"[We] ramped up for the solar program – brought on 90 new apprentices. It's just an organizing campaign for us. But doesn't seem to be all that realistic for other unions."

"We don't see renewables as a main driver of our organizing efforts. The projects are short in duration and really hard to track. It's a traveling roadshow – up in months, on to the next."

"We could see renewables contribute to union growth if it's supplemented with other things. So, EV build-out accompanied by electric infrastructure. Or an increase in manufacturing these things in the U.S. But the construction of facilities? No, just not that many jobs."

"For my trade no. For electricians maybe. With exceptions of the electricians, I just don't see renewables growing unions."

Clean energy is also perceived as unlikely to directly contribute to addressing diversity and access issues within unions, although in some locations it could have marginal impact.

"I don't see the two as connected. We have been trying to diversify our ranks. Easiest way is to go to local high schools and ensure that our locals look like the communities they live."

"The success stories – when you look at our workforce – it's younger and more diverse than even 10 years ago. Not sure if the driver will be clean energy, versus local unions just getting with the program."

"What's they're doing with the CEJA [Clean Energy Jobs Act] bill in Illinois is interesting. There's a requirement for REC contracts to be used for eligible minority contractors. It will be rough start and they are not ready to be union. But it's an interesting, concerted effort by the state."

"It always depends on the region – if it's about solar in central PA then it won't improve diversity in unions, but in Philadelphia, sure."

Several unions could become future collaborators, beyond the traditionally engaged unions, but there was no consensus.

"Operating engineers tend to be fossil fuel but they're an interesting group – there's some other states where engagement is happening."

"In some other states we work with the plumbers – there's opportunities. Plumbers put solar hot water on the headquarters forever ago."

"Boilermakers are in a weird space – losing lots of fossil and nuclear. They might be open."

"Energy workers (steel, mine, utility) and building trades – about 15 on this spectrum that don't focus on solving the climate crisis. Then you have a few mostly smaller unions on the left. This leaves in the middle – about 30 unions that haven't done anything."

There was receptivity to a broader discussion of the role of union training programs in supporting clean energy.

"You will get more support from unions if you engage them in trainings."

"We need to stop thinking about training or transitioning people for individual roles like a 'solar worker' where they can only work on solar. Training an electrician makes a worker who can move around in different fields."

"Unions have a huge ability to do tactical training… all of us have Federal Department of Labor approved apprenticeships that have been in place a long time. It's not necessary to duplicate this. We have a huge infrastructure and capacity in place. To increase the workforce as necessary – it's a small lift to make this training program."

"There's a small initiative in New York City – the Good Jobs Challenge – pairing community groups, high schools, and [union] pre-apprenticeships. It's early, still in framework, but promising."

"Need to be strategic about offering training programs where the jobs are. Folks in these union jobs don't want to leave their communities."

"Education and training are helpful, but it doesn't matter without enough unionized renewable jobs."

"Wraparound services are critical for apprenticeships, and we don't have funding for that. [We cover] all costs through membership, but additional funding would help us reach out to a broader group of folks."

'Just Transition' is a problematic term and concept with unions.

"25 years ago, steelworkers worked with a bunch of tribal lands and communities of color to develop a just transition framework. It became a buzzword that was co-opted by enviros and turned into what it wasn't, then used to entice unions to conversation around climate change."

"Not a lot of critical or clear ideas behind just transition."

"It's crazy talk. There's a lot of work before they can just transition to make the technologies feasible."

"It's tying social justice issues onto environment that are ill-informed and perceived poorly by members. There's this huge desire for it on the left that is centered in what are appropriate values and the right thing in society."

"The term can be insulting at times. It was coined in the steel industries in 80s. But you just created unemployed coders. They never created a need for you, just a new skill set that you weren't able to put to use."

"Nobody has seen any of these investments in the counties where the fossil fuel is already going away."

"There's been so much damage done with the concept of just transition. Change is coming. We won't be relying on fossil fuels. But the concept and idea is painful. We need to restart and rebrand."

"We haven't had a just transition program in America, ever."

"I'm dealing with this all the time. I talk to environmentalists and government entities, and they use it, and then I work with my colleagues, and they just don't see it this way."

"You won't have a just transition if its fast."

One first step with unions could be simply to flesh out how a transition of some variety would look.

"There is not a lot of understanding of what a transition can look like. There's no examples to use or fall back on to explain."

"A miner hasn't seen his neighbor make that jump. Folks going to work right now can't see this future, can't see themselves in it."

"We need to get into the granularity – what jobs are available, how would the framework work, what does this look like?"

"What traditional fossil communities have made these energy transitions?"

"This can't happen at the state level. We need a robust and national strategy that wins the hearts and minds of working people."

"In Europe they can transition to renewables with support of unions because no worker in Europe has to worry about health care and college. We don't have the social safety net. This requires a comprehensive transition plan. We need a government-funded program – five years of wage and benefit parity."