NEW YORK STATE

NYSERDA
New York State Energy Research and Development Authority

2024

New York Clean Energy Industry Report

LETTER FROM NYSERDA PRESIDENT AND CEO

Dear Partners and Friends,

I am happy to share with you NYSERDA's 2024 New York Clean Energy Industry Report. This comprehensive data-driven overview of New York State's clean energy landscape highlights trends and the clear progress we've made in advancing a vibrant, clean energy economy and a zero-emissions electric grid.

Overall, this report, which captures data through the end of 2023, tells a story of continued growth, with New York adding 7,700 jobs in the clean energy sector last year alone—bringing the State to more than 178,000 clean energy workers and representing the largest employment gain in any single year since NYSERDA's clean energy job tracking began.

I'm encouraged by these figures as they demonstrate real job opportunities created year after year for more and more New Yorkers.

Of course, I am grateful for Governor Kathy Hochul's unwavering support and leadership, which has been instrumental in enabling our State to sustain this momentum.

As our energy transition progresses, we are simultaneously growing New York's supply chain industry, stimulating the economy, and creating quality jobs. In fact, this year's analysis shows New York's clean energy economy grew 5% from 2022 to 2023, which is more than double the statewide economic growth rate. Notably, within clean and alternative transportation, electric vehicle charging jobs saw an impressive 27% growth over the previous year.

Other key findings from this year's report include:

- Nearly 4,000 jobs added in the building decarbonization and energy efficiency sector.
- The renewable electric power generation sector also grew with over 1,400 new jobs.
- Clean energy wages are higher, on average, than non-clean energy; and nine in ten clean energy employers offer healthcare benefits.
- Two-thirds of surveyed workers reported being very satisfied with their careers and were more confident about receiving a promotion in the next 12 months than their non-clean energy counterparts.

As we look ahead, New York remains committed to supporting domestic manufacturing of clean energy technologies and building out the clean energy supply chain to foster even more jobs statewide.

With each passing year, the work we do today provides for greater economic growth in the future.

I encourage you to review this report to better understand how the clean energy industry is making a significant difference in improving New Yorkers' lives.

Best,

Doreen M. Harris

Doreen M. Harris
President and CEO, NYSERDA

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EXECUTIVE SUMMARY

INTRODUCTION

The 2024 New York Clean Energy Industry Report is the eighth edition of annual reports tracking clean energy employment across New York State. The report was commissioned by the New York State Energy Research and Development Authority (NYSERDA) to better understand the composition of the clean energy economy. This year's report underscores the continued growth of clean energy jobs throughout the State and includes a deep dive into the EV charging infrastructure workforce. The data in this report comes from multiple sources, including the 2024 United States Energy and Employment Report developed by the U.S. Department of Energy, supplemental surveys of businesses and workers, economic impact modeling, and additional secondary data.

KEY FINDINGS

1

New York's clean energy industry added the greatest number of jobs since tracking began in 2016 with approximately 7,700 new jobs in one year. Clean energy employment also grew more than twice as fast as the overall statewide economy between 2022 and 2023 (Figure 1).

New York's clean energy economy grew at a rate of about 5 percent over the past year compared to 2 percent for the overall statewide economy (Figure 3). Clean energy employment in New York grew at the same rate as the national clean energy employment average (5 percent) and faster than many other neighboring states (Figure 2).

2

The building decarbonization and energy efficiency sector added the largest number of jobs this year, surpassing its pre-pandemic level.

Building decarbonization and energy efficiency added nearly 4,000 jobs between 2022 and 2023 and continues to be the largest technology sector by employment. Clean and alternative fuels transportation employment grew at the fastest rate of any technology (16 percent), equating 2,100 additional jobs (Figure 4).

3 EV charging jobs grew significantly over the past year (27 percent), predominantly within installation and professional and business services, which support the installation and maintenance of EV chargers (Figure 19).

Additionally, over half of New York companies involved in EV charging expect to have more permanent employees in the next 12 months. Despite this appetite for growth, the training and education systems needed to support this workforce are still forming. A review of training offerings found only 14 EV charging-specific training programs, and most identified training programs were provided solely online. New York will need to expand its EV charging training and education offerings to grow the workforce and expand the accessibility of these courses to a larger population of workers.

4 Union membership is higher for clean energy workers in New York (12 percent) than the national average (9 percent).

New York clean energy unionization rates are highest among utility workers (19 percent) and workers involved in installation (15 percent) (Table 3). Higher unionization rates can mean that there are more high-quality jobs within clean energy that offer family-sustaining wages and benefits.

5 Clean energy workers tended to have higher wages and benefit rates than their peers working in non clean energy roles.

The median wages for clean energy workers were on average 7 percent higher than their peers in other industries. Importantly, this wage premium tended to be greatest among workers on the lower end of the wage spectrum. Clean energy workers earning the 25th percentile of wages receive hourly wages 12 percent higher than their peers on average (Table 4). Healthcare benefit rates were also higher among surveyed occupations, with an average of nine-in-ten clean energy employers offering healthcare benefits compared to 72 percent for the same set of occupations economywide (Table 6).

6 More than 1,900 training and education programs throughout the State were available to prepare clean energy workers.

The most common areas of focus for these programs were electrical, construction and engineering trades, operations, and maintenance, as well as heating, ventilation, air conditioning, and refrigeration (HVAC/R). Training centers tended to be concentrated near population areas (Figure 53), though access to training for rural job seekers—particularly in disadvantaged communities—is an important workforce objective.

7 Clean energy workers tended to be more satisfied with their career than non-clean energy workers.

Nearly two-thirds (65 percent) of surveyed clean energy workers reported being "very satisfied" with their job compared to 52 percent of their non-clean energy counterparts (Figure 54). Clean energy workers were also much more confident they would receive a promotion within the next twelve months. More than half (56 percent) reported they were "very confident" they will get a promotion in the next 12 months, compared to only 37 percent of non-clean energy workers (Figure 55).

8 Clean energy continued to be a driver of job creation and economic activity—both within the industry and outside of it.

The addition of nearly 7,700 new clean energy jobs in 2023 lead to the creation of 3,200 indirect jobs throughout the supply chain and 3,700 additional jobs induced in other industries as new workers spent their incomes throughout the State economy, and as clean energy employers increased their demand for additional products and services to support clean energy work. In total, additional clean energy activity in 2023 added over $2 billion to Gross State Product (Table 11).

9 The value of investments into clean energy companies continued to rise alongside the total number of investments.

From 2021 to 2023 the three-year rolling average of investments into clean energy companies reached nearly $4 billion. This represents a 71 percent increase from the previous three-year period from 2020 to 2022. The number of individual investment deals also increased during this time by six percent (Figure 67).

CLEAN ENERGY INDUSTRY OVERVIEW

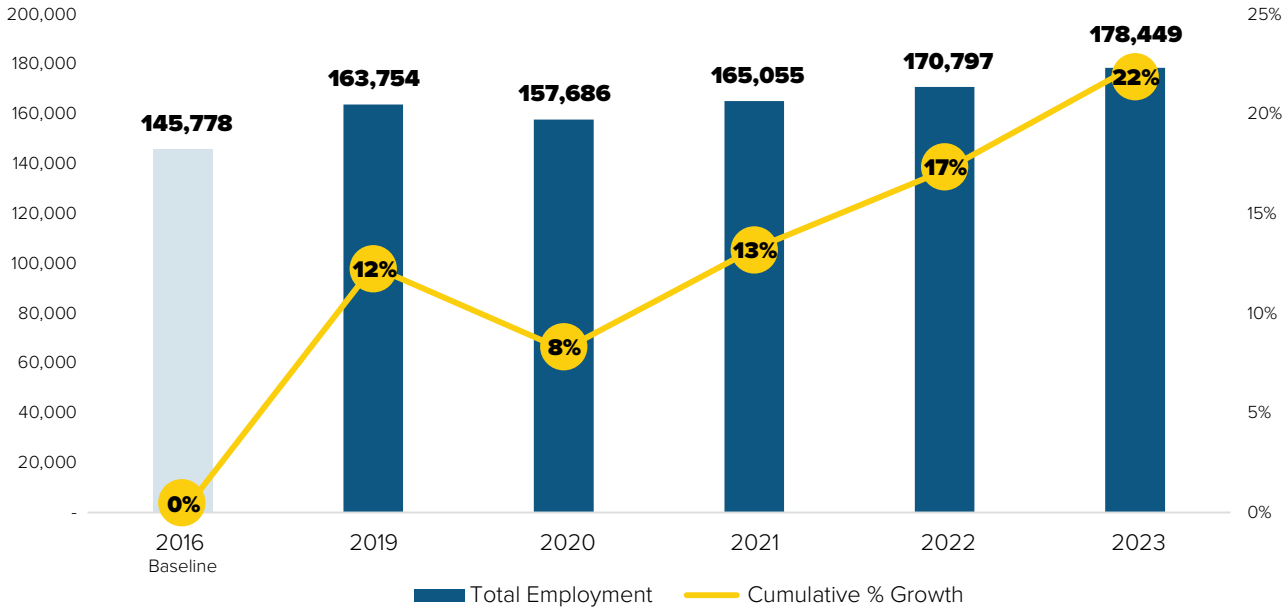
TOTAL CLEAN ENERGY EMPLOYMENT

178,000

New York had over 178,000 clean energy workers in the last quarter of 2023.

This was an increase of 7,700 workers since 2022 and represents the State's largest year-over-year addition of total new workers. These jobs marked a 5 percent growth of New York's clean energy industry in just one year (Figure 1).

FIGURE 1. CLEAN ENERGY EMPLOYMENT IN NEW YORK, 2016-2023

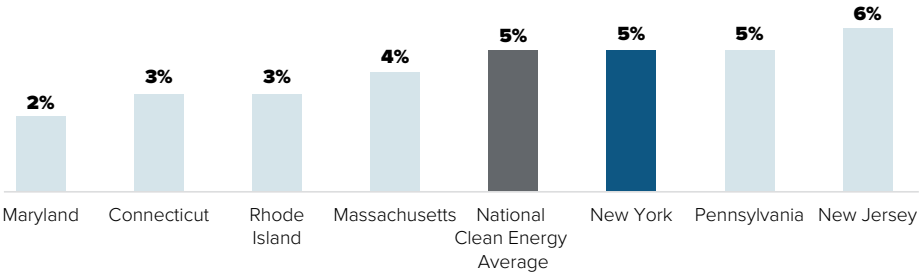


Clean energy employment growth was more than double the overall employment growth rate in New York and matched the national average of clean energy growth.

New York has the third-largest number of clean energy workers in the nation and is one of the more mature clean energy markets.

The State ranked 25th out of all states in clean energy employment growth, surpassing the neighboring state of Massachusetts and tying with Pennsylvania (Figure 2).

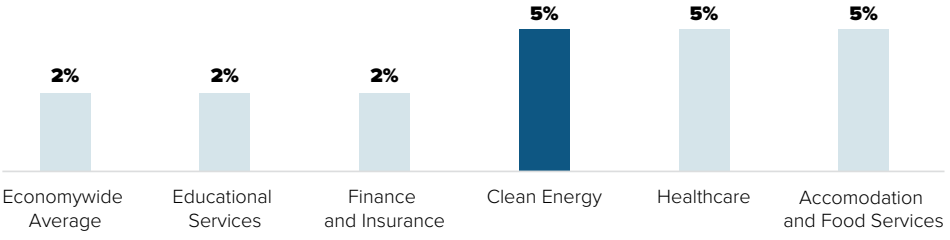
FIGURE 2. CLEAN ENERGY EMPLOYMENT CHANGE BY STATE, 2022 TO 2023



The clean energy industry employment growth rates far exceeded growth rates in other industries in New York.

The Educational Services industry, as well as the Finance and Insurance industry saw growth rates of 2 percent over the past year, compared to 5 percent in clean energy. Healthcare and Accommodation and Food Services are two industries that grew at a slightly faster pace during this time than clean energy (Figure 3).

FIGURE 3. EMPLOYMENT CHANGE BY INDUSTRY IN NEW YORK, 2022 TO 2023[1]



Four of the five clean energy sectors grew in 2023.

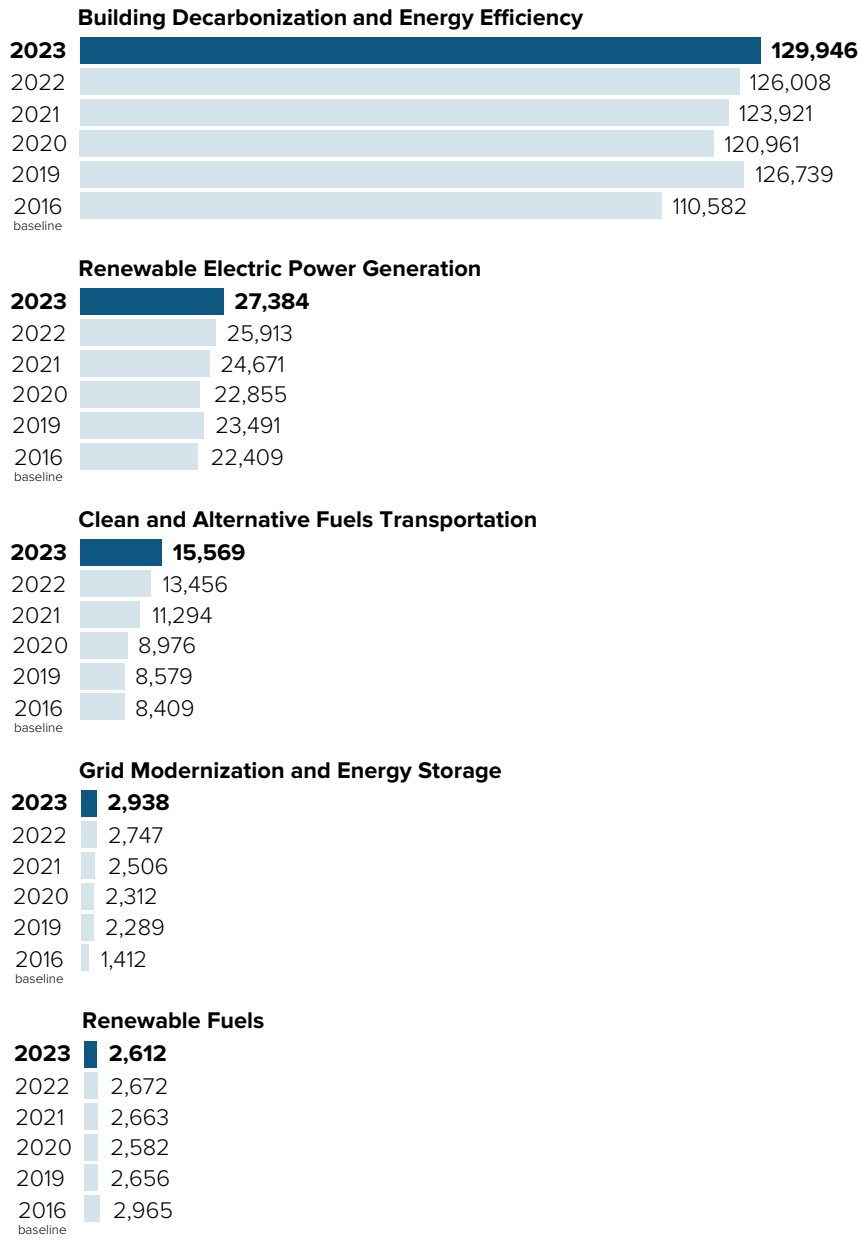
The greatest percentage growth was in the clean and alternative fuels transportation sector at 16 percent, translating to over 2,100 additional jobs.

The next fastest growing sector was grid modernization and energy storage (7 percent), with nearly 200 new jobs.

The greatest number of jobs gained in 2023 was in building decarbonization and energy efficiency, which added almost 4,000 jobs representing a 3 percent growth rate. The sector surpassed its pre-pandemic levels and reached almost 130,000 jobs—3,200 more jobs than the sector had in 2019.

The only sector to decrease in employment over the past year was renewable fuels with a 2 percent decrease in 2023, a loss of approximately 60 jobs (Figure 4).

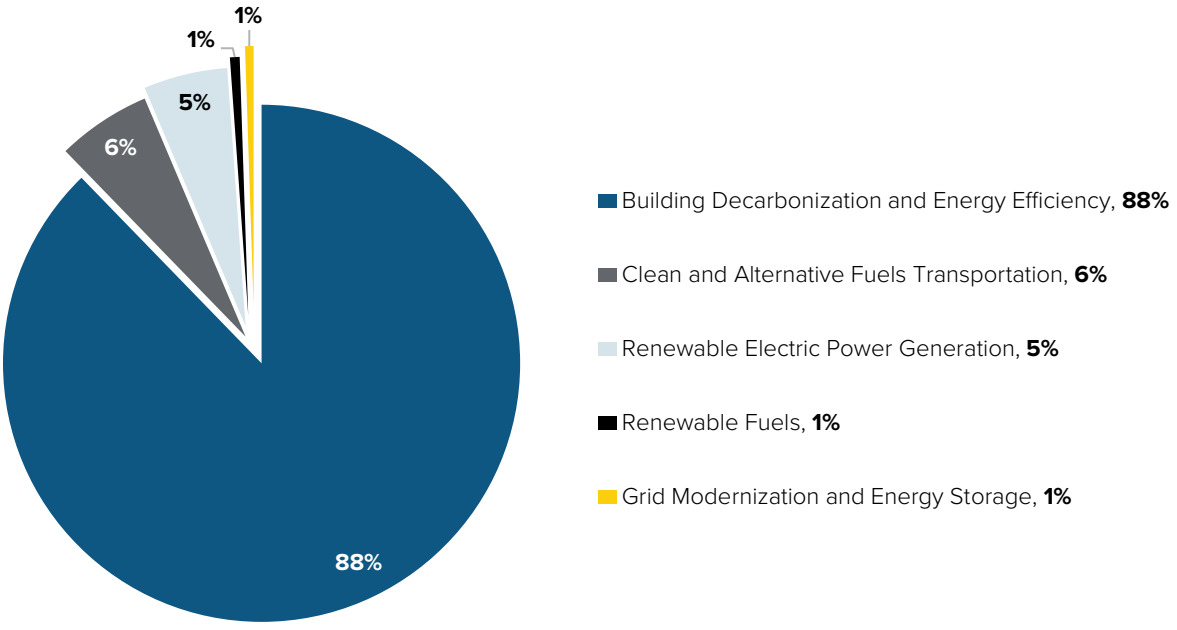
FIGURE 4. CLEAN ENERGY EMPLOYMENT BY SECTOR, 2016-2023



Building decarbonization and energy efficiency continues to account for a majority (88 percent) of clean energy establishments within New York State.[2]

Clean and alternative fuels transportation (6 percent), and renewable electric power generation (5 percent) account for the next largest shares (Figure 5). Building decarbonization and energy efficiency accounts for a large portion of business establishments because much of this sector consists of smaller contractors with fewer employees compared to firms in some other industries, such as renewable electric power generation, which tend to consist of fewer, larger projects.

FIGURE 5. CLEAN ENERGY ESTABLISHMENTS BY SECTOR, 2023

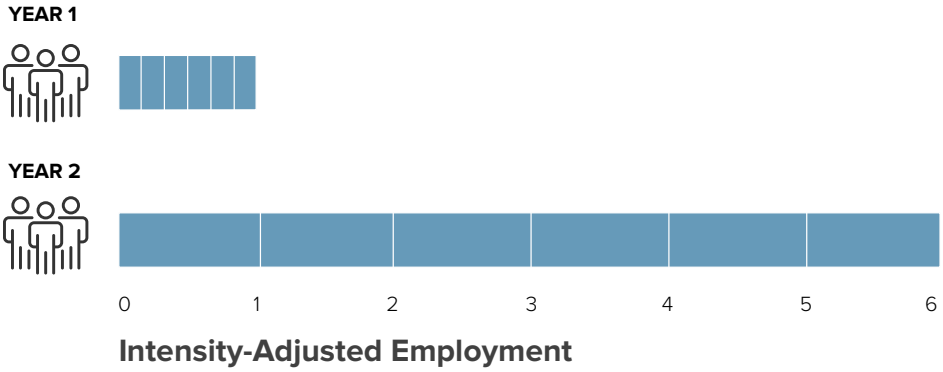


CLEAN ENERGY EMPLOYMENT INTENSITY

Intensity-adjusted clean energy job metrics are used to identify the concentration, or intensity, of clean energy activities. The clean energy employment featured in the previous section of this report includes all workers that dedicate any amount of their labor hours or work week to clean energy goods and services. As such, an electrician who spends only a quarter of their work week installing or servicing solar panels is counted as a clean energy worker in Figure 1. The intensity-adjusted clean energy employment metric weights each of these jobs according to how much time workers were reported to spend on clean energy activities; the categories include less than half of their labor hours, half to the majority of their labor hours, or all of their labor hours.[3]

An increase in total employment would indicate that there are more workers in the overall labor market servicing clean energy technologies, while an increase in intensity-adjusted employment indicates that these workers are dedicating a larger proportion of their work week and labor hours to clean energy-specific activities. This increased activity could be the result of increased consumer demand, policy support, or financial incentives spurring market demand for clean energy goods and services. For instance, a traditional HVAC worker might have spent only a third of their work week installing or maintaining energy efficient HVAC technologies in 2016. If a state began offering rebates in 2017 for highly efficient heat pumps, that traditional HVAC worker would likely spend more of their labor hours or work week installing high-efficiency heat pumps. This increase in activity per worker would not necessarily result in overall job growth in Figure 1 but would be captured as an increase in intensity-adjusted clean energy employment shown below.

FIGURE 6. EXAMPLE OF INTENSITY-ADJUSTED CLEAN ENERGY EMPLOYMENT[4]



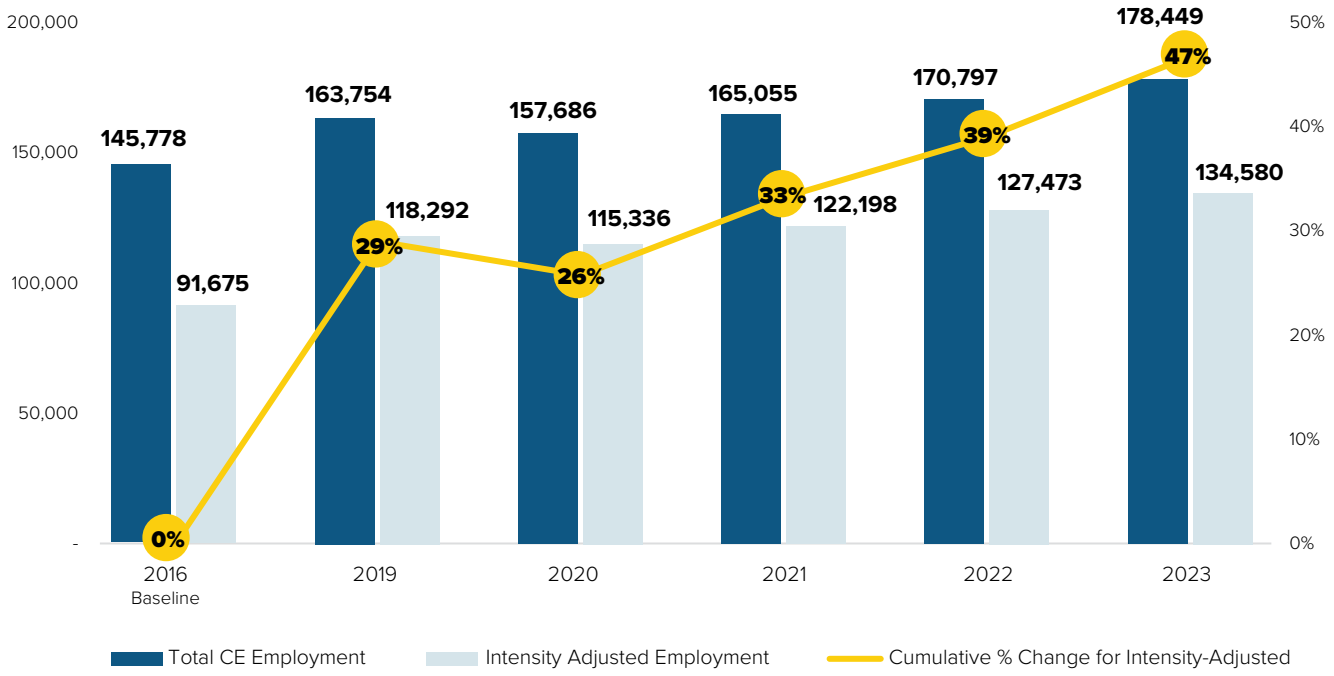
AN EXAMPLE CAN ILLUSTRATE THE IMPORTANCE OF TRACKING INTENSITY-ADJUSTED CLEAN ENERGY EMPLOYMENT.

If an HVAC firm had six installers in year one who occasionally installed heat pumps, and now has six 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, intensity-adjusted jobs would show a corresponding increase.

Intensity-adjusted employment continues to grow quickly across New York.

Intensity-adjusted employment grew by 6 percent between 2022 and 2023, which is the third-fastest year-over-year change since employment tracking began in 2016 (Figure 7). Since 2016, intensity adjusted employment has grown by 47 percent, which means that intensity of clean energy workers continues to increase even as the total number of workers increases.

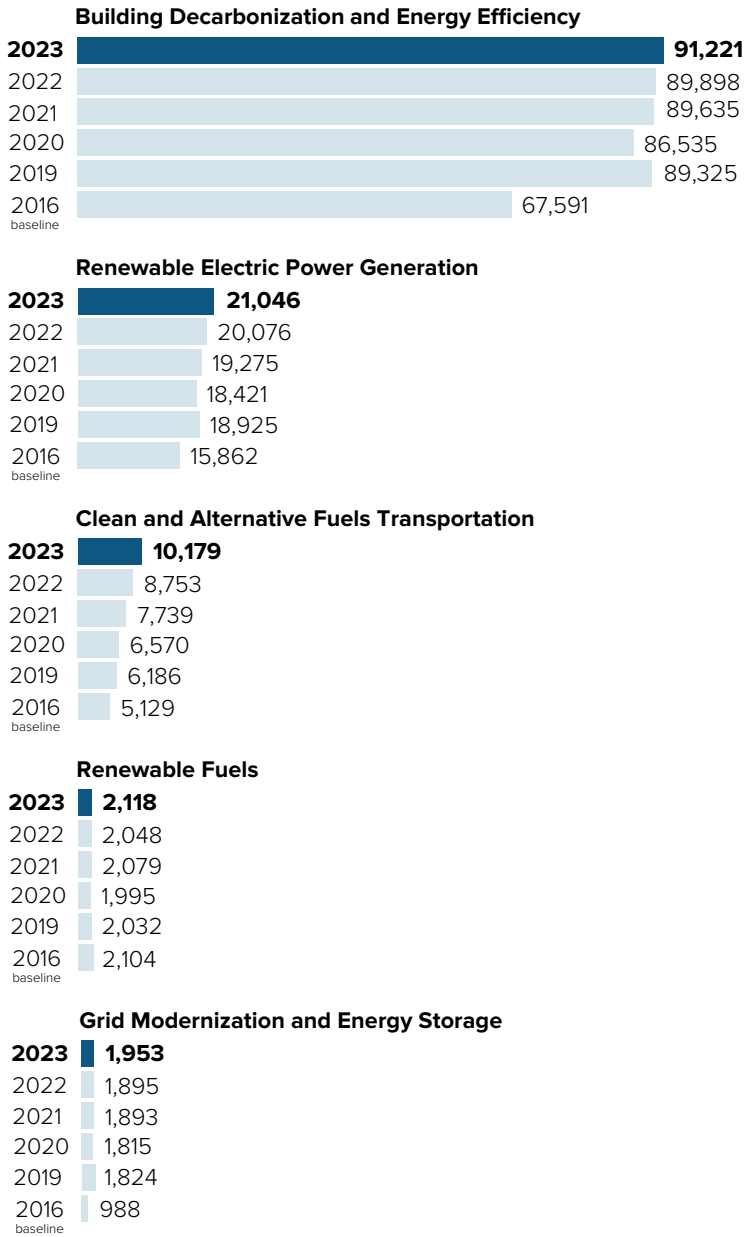
FIGURE 7. INTENSITY-ADJUSTED CLEAN ENERGY EMPLOYMENT, 2016-2023



Intensity-adjusted employment increased across all sub-sectors in 2023.

Clean and alternative fuels transportation intensity-adjusted employment grew at the fastest rate (16 percent) followed by renewable electric power generation (5 percent) (Figure 8).

FIGURE 8. ENERGY-INTENSITY ADJUSTED CLEAN ENERGY EMPLOYMENT BY SECTOR, 2016-2023



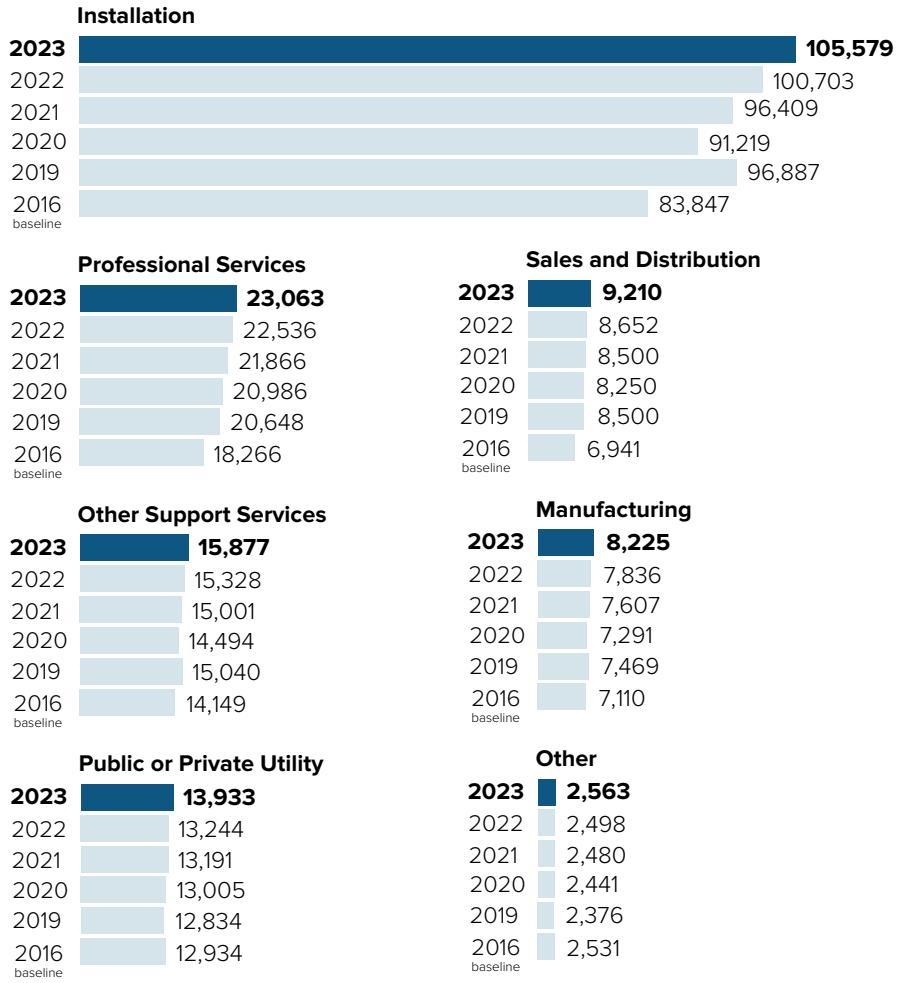
CLEAN ENERGY VALUE CHAIN EMPLOYMENT

The following section provides an overview of clean energy employment such as construction, manufacturing, wholesale trade, professional and business services, other support services, other industries, and utilities.

Installation jobs saw the largest absolute increase in the number of workers.

This segment grew by nearly 4,900 workers in 2023, accounting for 64 percent of all employment growth during this time. However, sales and distribution (6 percent), manufacturing (5 percent), and public or private utilities (5 percent) saw similar or slightly faster growth rates (Figure 9).

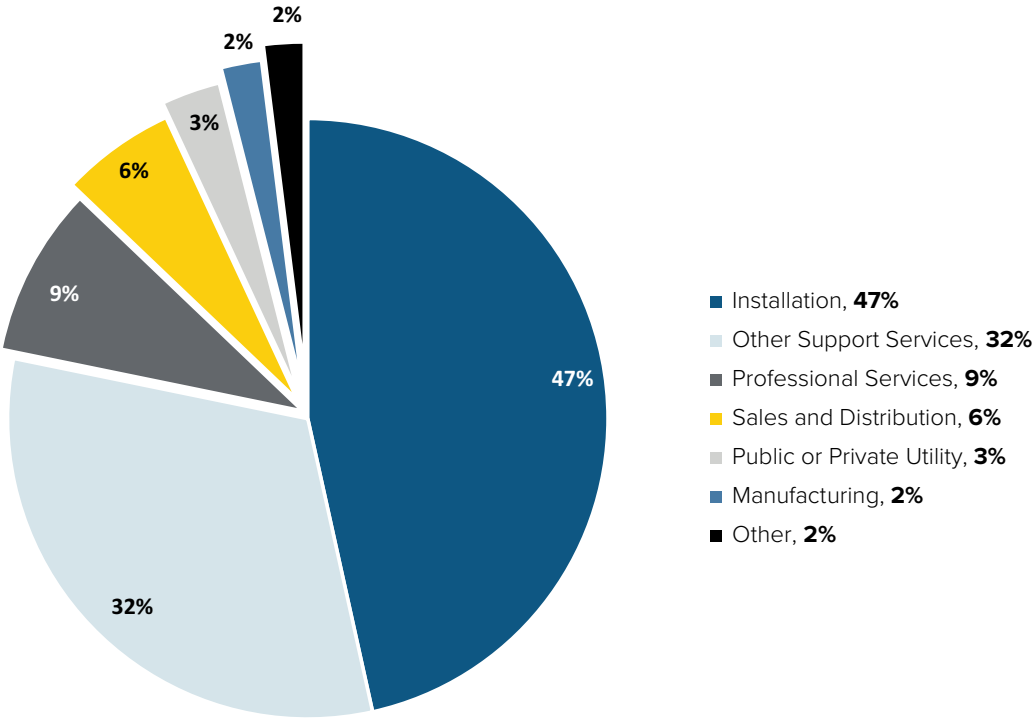
FIGURE 9. CLEAN ENERGY EMPLOYMENT BY VALUE CHAIN SEGMENT, 2016-2023[5]



Installation firms account for nearly half (47 percent) of all clean energy establishments.

Other support services also account for about a third of all clean energy establishments (32 percent). Professional services, sales and distribution, public or private utilities, manufacturing, and 'other' collectively account for fewer than one in four (22 percent) of clean energy establishments in New York (Figure 10).

FIGURE 10. CLEAN ENERGY ESTABLISHMENTS BY VALUE CHAIN, 2023[6]



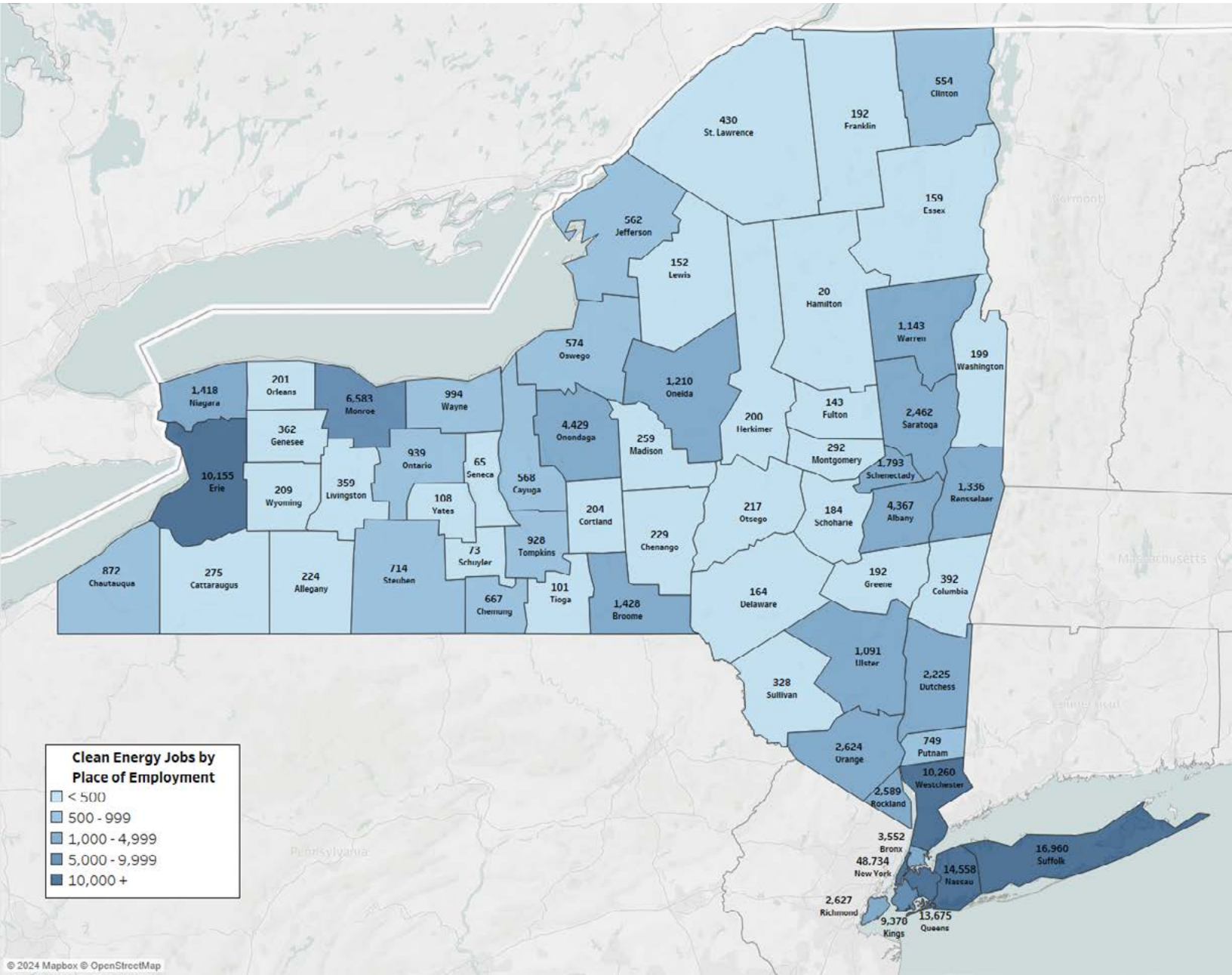
GEOGRAPHY OF CLEAN ENERGY JOBS AND WORKERS

Understanding where clean energy jobs are and where clean energy workers live provides important insight into the availability and intersection of talent and economic opportunity. This section looks both at where jobs are located and where clean energy workers live to better understand the geography of clean energy jobs and the workers who have them.

Clean energy jobs fuel local economies throughout the State.

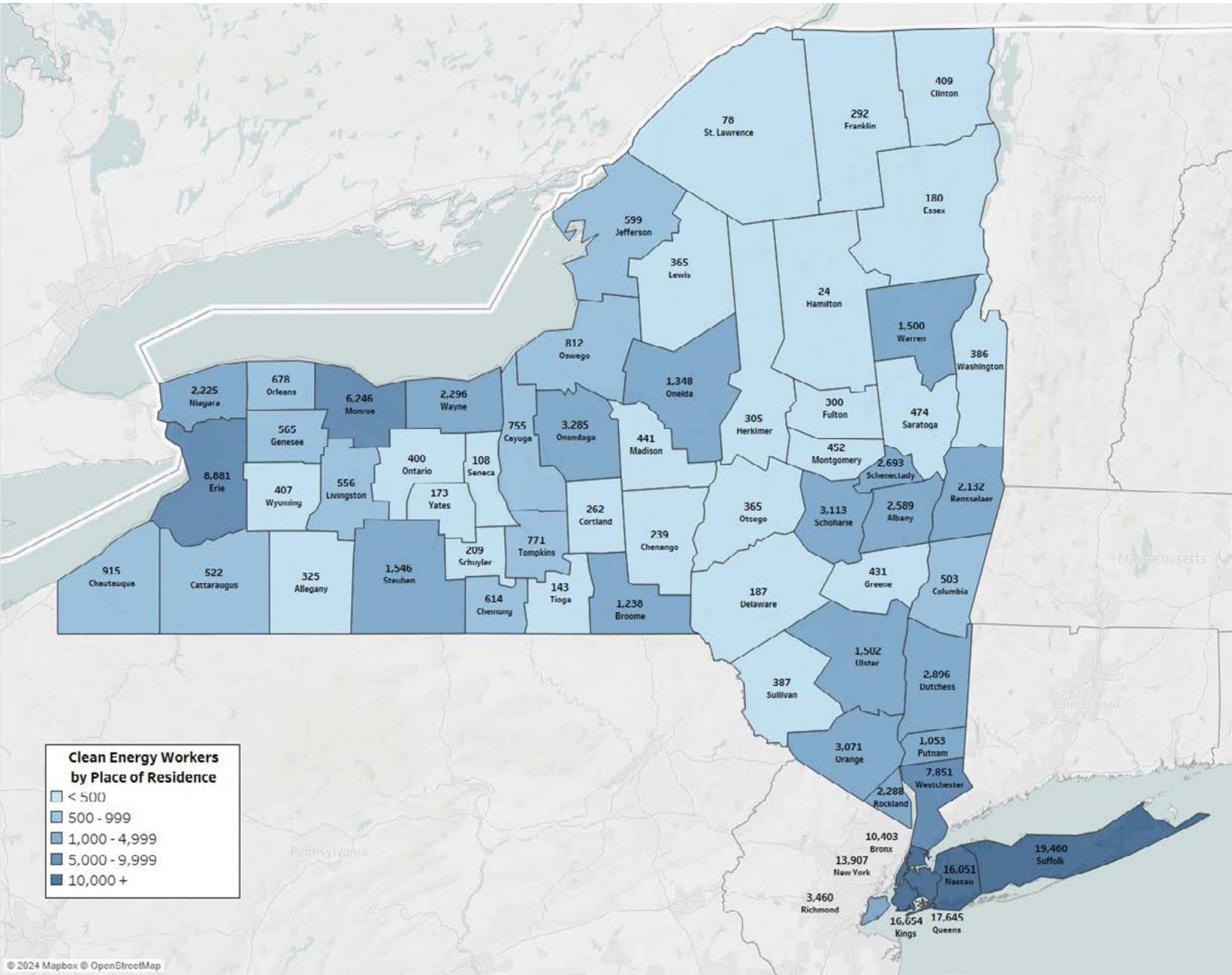
Clean energy jobs can be found across all counties in New York. Twenty-four counties have 1,000 or more clean energy jobs, and only three out of the State's 62 counties have fewer than 100 clean energy jobs (Figure 11).

FIGURE 11. CLEAN ENERGY JOBS (PLACE OF EMPLOYMENT) BY COUNTY, 2023



Similarly, clean energy workers reside all over New York. Twenty-six counties have 1,000 or more residents who work in clean energy, while only two counties have fewer than 100 residents who work in clean energy (Figure 12).

FIGURE 12. PLACE OF RESIDENCE FOR CLEAN ENERGY WORKERS BY COUNTY, 2023



DETAILED CLEAN ENERGY SECTOR EMPLOYMENT

BUILDING DECARBONIZATION AND ENERGY EFFICIENCY

The building decarbonization and energy efficiency sector comprises workers involved in various activities including research, manufacturing, sales, installation, repair, and professional service support.[7]

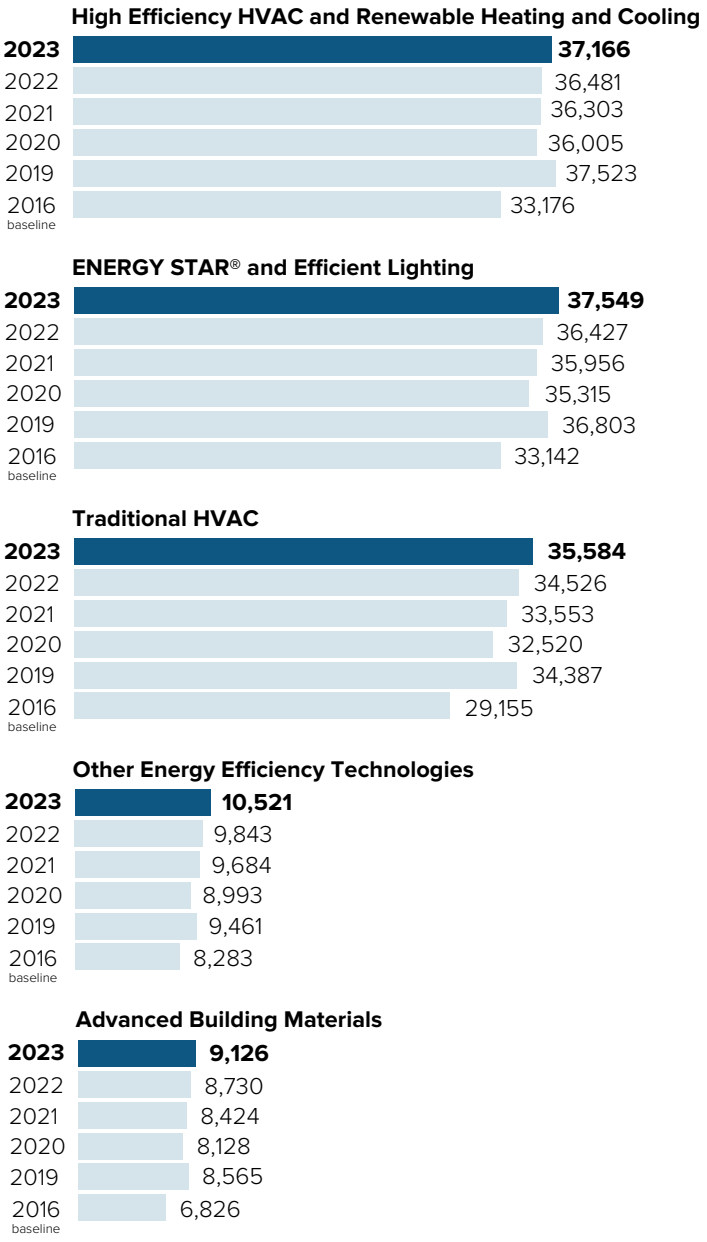
Its primary objective is to decarbonize and improve the efficiency of residential, commercial, and industrial buildings through the development and implementation of technologies and services.

Sub-technologies within this sector encompass ENERGY STAR® appliances, lighting, all HVAC systems, advanced building materials (including insulation technologies), solar thermal water heating and cooling, as well as other energy-efficient technologies and processes such as recycled building materials and reduced water consumption products and appliances.

Strong growth in building decarbonization and energy efficiency can be seen across all sub-technologies.

ENERGY STAR appliances and efficient lighting, and traditional HVAC added the greatest number of jobs with about 1,100 new jobs each. Other energy efficiency technologies saw the fastest growth rate during this time (7 percent), followed by advanced building materials (5 percent) (Figure 13).

FIGURE 13. BUILDING DECARBONIZATION AND ENERGY EFFICIENCY EMPLOYMENT BY SUB-TECHNOLOGY, 2016-2023[8]



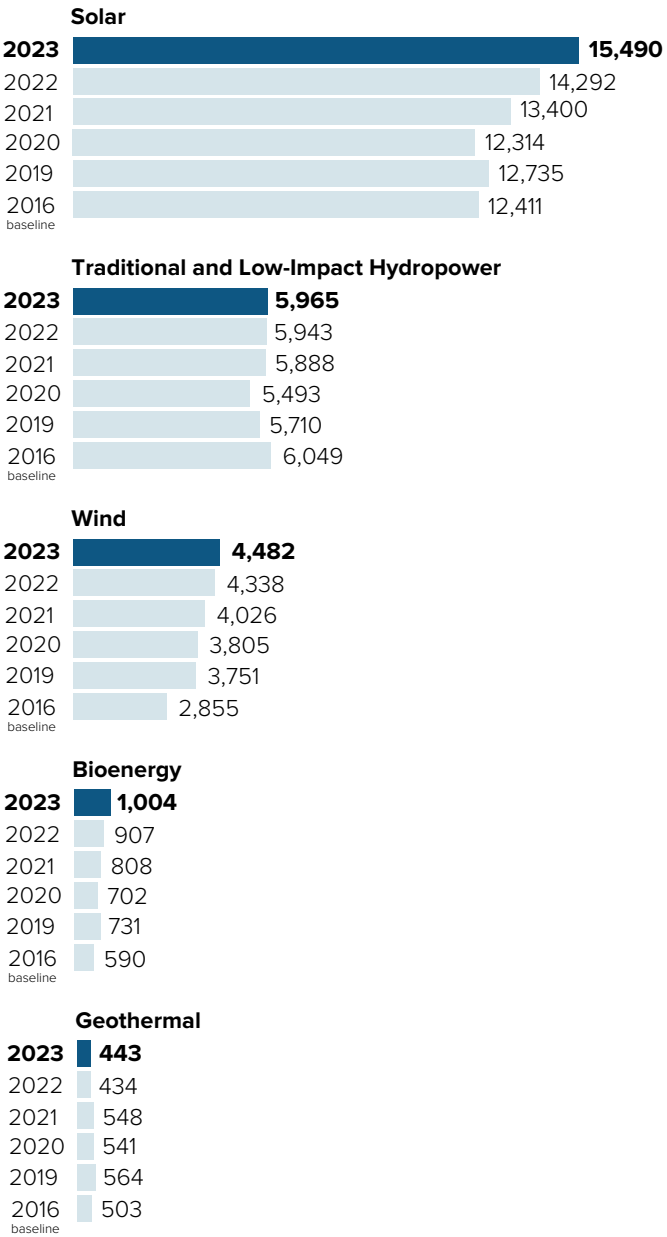
RENEWABLE ELECTRIC POWER GENERATION

Renewable electric power generation jobs include individuals involved in various aspects of research, development, production, manufacturing, sales, installation, maintenance, repair, and professional service support of electricity generation technologies that are free of carbon emissions. These technologies encompass solar power, wind power, geothermal energy, bioenergy, and hydropower.

Solar continues to be the largest source of renewable electric power generation employment.

The sub-technology added the greatest number of jobs in 2023, growing by 1,200 new workers. Wind was the next largest job-adder, growing by about 150 jobs over this time. Bioenergy grew at the fastest rate (11 percent), followed by solar (8 percent) (Figure 14).

FIGURE 14. RENEWABLE ELECTRIC POWER GENERATION EMPLOYMENT BY SUB-TECHNOLOGY, 2016-2023[9]



PROGRAM SPOTLIGHT:

IRON WORKERS LOCALS 40 & 361 TRAINING PROGRAM

The Iron Workers Locals 40 and 361, located in Queens, New York, have designed a training program to prepare more than 100 individuals for occupations in New York's offshore wind industry.

Leveraging funding from NYSERDA's New York State Offshore Wind Training Institute – Workforce Training and Skills Development funding opportunity, the training program addresses projected offshore wind workforce gaps and prepares workers for high-growth jobs concentrated in the manufacturing/production, construction/extraction, and induced industries.

The Iron Workers' training program is critical to meeting New York's clean energy goals established by the Climate Act to support the development of at least 9,000 MW of offshore wind by 2035, enough to power up to six million homes.

"The Iron Workers of Locals 40 and 361 are proud to partner with NYSERDA to help train New York State residents for the skills they will need to build our future and theirs. Not only will they be building New York's new power supply, they will also be supporting our State's economy with a true middle-class tax paying career. It's a win-win for our students and New York State."

– Bryan M. Brady II, Director of Training, Iron Workers Locals 40 & 361

Training the Offshore Wind Workforce

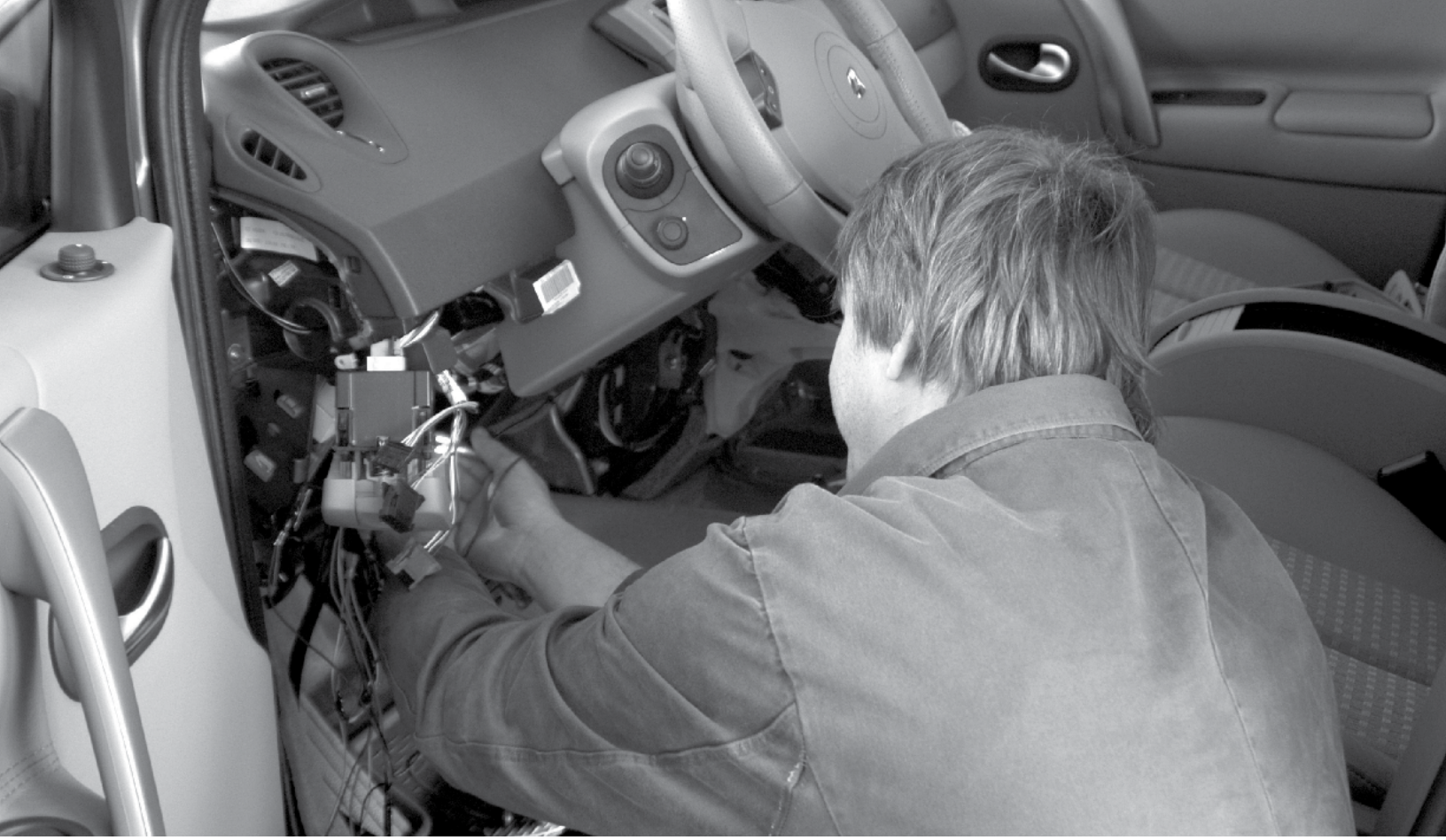
As part of the training program, Iron Workers Locals 40 and 361 will:

- **Acquire equipment, curriculum, and licenses necessary to provide Global Wind Organization (GWO) Basic Safety Training.**
- **Contract with a third party approved by GWO to upskill five members to become instructors.**
- **Train and GWO certify an additional 110 members.**
- **Develop curricula to support in-demand courses for members.**

Registered Apprenticeship Program

This training program will be incorporated into Iron Workers' registered apprenticeship program, which involves 600 hours of classroom training, and 4,000 hours of on-the-job- training before participants graduate.

Additionally, this program will become an ongoing offering at Iron Workers' Astoria facility, with the annual number of trainees expected to increase each year to reach an internal goal of 500 members trained by the end of 2026.



CLEAN AND ALTERNATIVE FUELS TRANSPORTATION

The clean and alternative fuels transportation sector encompasses individuals involved in various value chain segments of clean and alternative fuels vehicle technologies, including manufacturing, sales, repair, and maintenance, as well as professional business support services such as legal, financial, engineering, and consulting services. Clean and alternative fuels transportation refers to a range of technologies, including electric, plug-in hybrid, hybrid electric, natural gas, hydrogen, and fuel cell vehicles.

The clean and alternative fuels transportation sector and its sub-technologies saw notable growth between 2022 and 2023.

Hybrid electric transportation added almost 1,200 jobs over the past year at a growth rate of 19 percent.

Electric (over 600 additional jobs at 16 percent) and hydrogen and fuel cell (120 additional jobs at 18 percent) sub-technologies also saw substantial growth (Figure 15). The growth experienced by this sector may be fueled by higher rates of EV and hybrid vehicle registrations in the State (Figure 16).

FIGURE 15. CLEAN AND ALTERNATIVE FUELS TRANSPORTATION EMPLOYMENT BY SUB-TECHNOLOGY, 2016-2023[10]

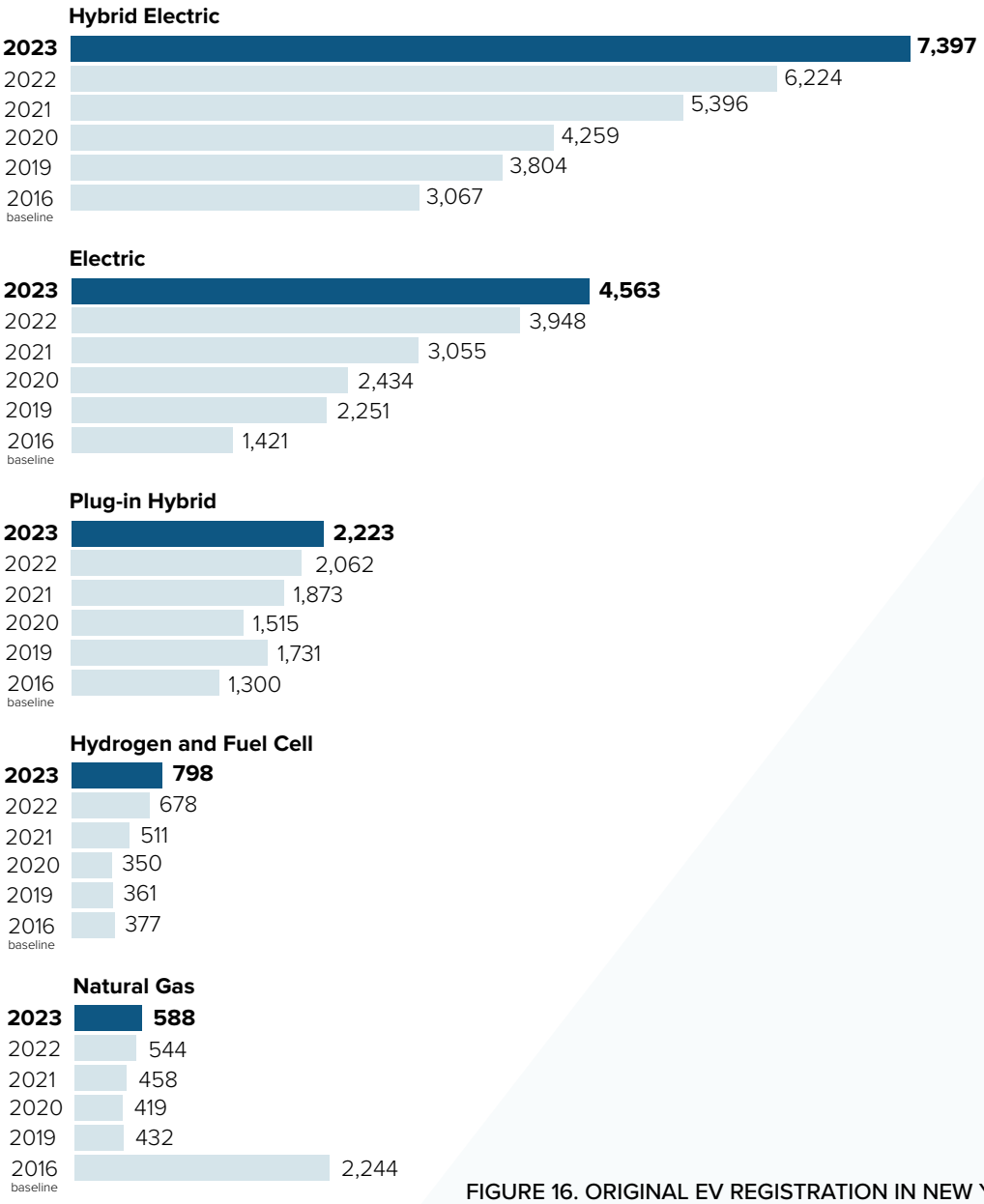
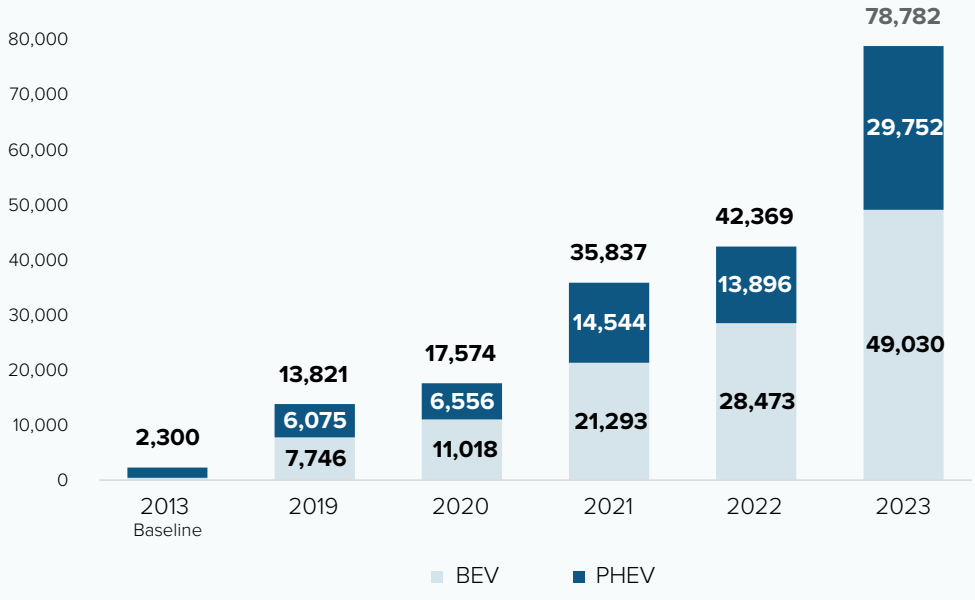


FIGURE 16. ORIGINAL EV REGISTRATION IN NEW YORK STATE, 2013-2023



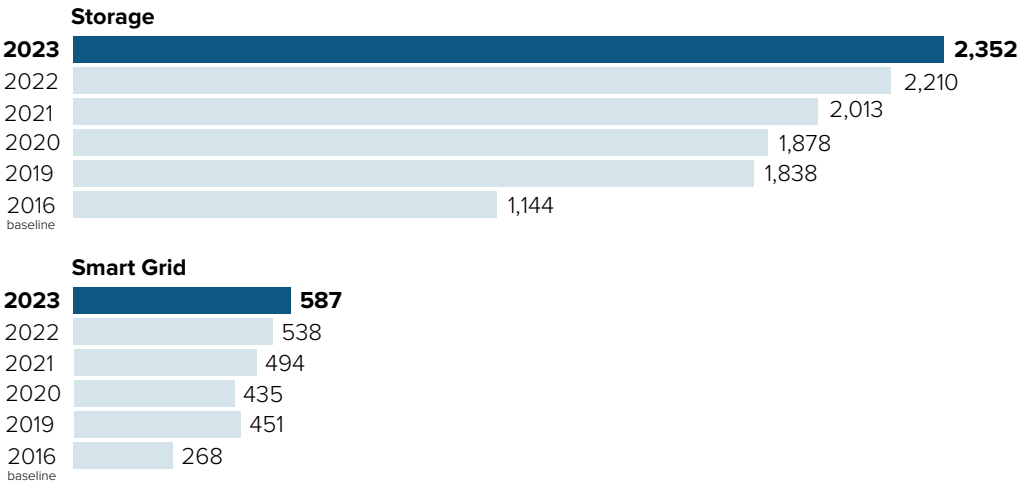
GRID MODERNIZATION AND ENERGY STORAGE

Grid modernization and energy storage encompasses workers involved in supporting the construction, manufacturing, wholesale trade, as well as legal, financial, and engineering services related to smart grid and energy storage technologies.[11]

This sector continues to grow steadily, particularly within energy storage.

Storage has more than doubled in size since tracking began in 2016. Storage added nearly 150 jobs in 2023, a growth rate of 6 percent. Smart grid grew at an even faster rate (9 percent), adding about 50 jobs over the past year (Figure 17).

FIGURE 17. GRID MODERNIZATION & ENERGY STORAGE EMPLOYMENT BY SUB-TECHNOLOGY, 2016-2023



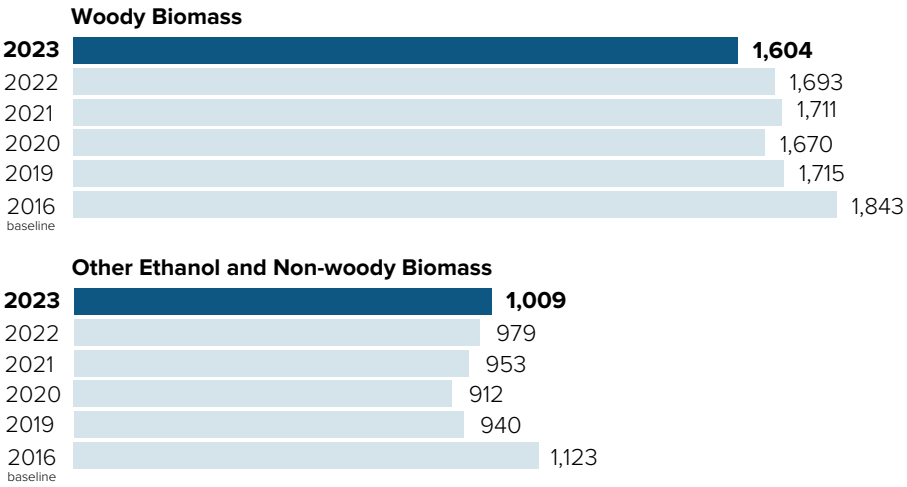
RENEWABLE FUELS

The renewable fuels sector includes all workers involved in the production, distribution and sales, or professional and business service support for renewable fuels and renewable fuel technologies that use woody and non-woody biomass.

Other ethanol and non-woody biomass saw a moderate increase in employment of about 30 jobs (3 percent) between 2022 and 2023.

Woody biomass employment declined during this time, shedding about 100 jobs with a decrease in employment of negative 5 percent (Figure 18).

FIGURE 18. RENEWABLE FUELS EMPLOYMENT BY SUB-TECHNOLOGY, 2016-2023[12]



DEEP DIVE ON EV CHARGING

EV charging represents a small but fast-growing share of the employment growth seen in the clean and alternative fuels transportation sector in recent years.

EV charging jobs grew 26 percent in 2023 alone, and nearly 40 percent since 2022.

As of June 2024, there are an estimated 14,000 EV chargers in New York, but that number will need to grow drastically as the number of EVs on the road increases.[13] The National Renewable Energy Laboratory estimates that the U.S. will need 28 million EV charging ports by 2030.[14] Building and maintaining EV charging station infrastructure in New York to meet this demand will require a substantial increase in the number of workers that can design, manufacture, sell, install, maintain, and operate charging stations.

New York has identified the transition to electric vehicles as one of the key strategies to reduce transportation emissions.[15]

State requirements for zero emission passenger vehicles and trucks, and minimum requirements for EV-ready parking spaces in new parking facilities will further accelerate the need for EV charging infrastructure and jobs.[16, 17]

This deep dive looks at the current state of the EV charging workforce in New York and identifies current training opportunities for the sector's workforce. To get insights into the current EV charging workforce, BW Research surveyed 181 different employers in New York that stated that they worked with EV chargers in some capacity.[18, 19] EV charging is typically one work area within a larger firm. Many of these employers are likely involved in other sectors of the clean energy economy and may also work on other technologies as a greater share of their activities.

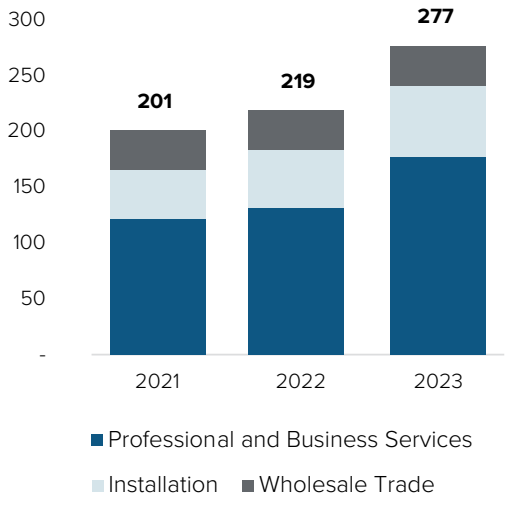
EMPLOYMENT BY MARKET SEGMENT

EV charging jobs exist across three major value chain segments: installation; professional services, which includes industries such as legal and architectural consulting; and wholesale trade, which consists of the distribution and sale of EV charging products in bulk. EV charging employment in 2023 totaled 277 jobs between these three value chain segments, a 38 percent increase since 2021 (Figure 19).[20]

Professional services jobs make up the largest share of EV charging employment in New York, representing nearly two-thirds (64 percent) of the EV charging industry.

Between 2021 and 2023, this sector grew an estimated 46 percent, adding nearly 60 jobs. Installation jobs account for the next-largest share of employment (23 percent) and grew by 48 percent between 2021 and 2023. Employment in wholesale trade makes up the smallest share of New York's EV charging jobs and has remained relatively constant through 2023.

FIGURE 19. NEW YORK EV CHARGING JOBS[21]



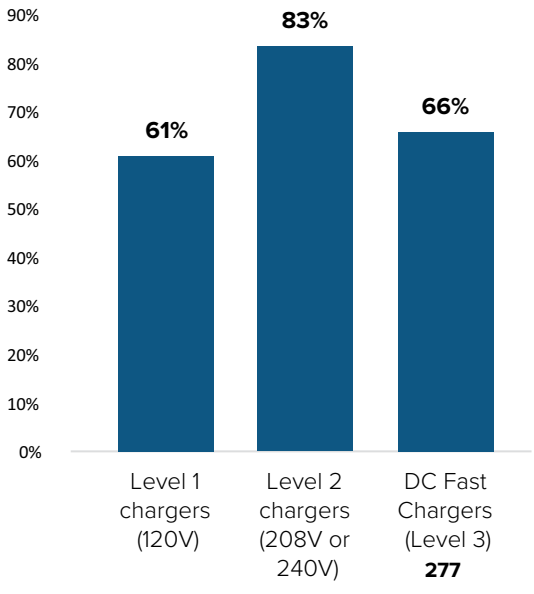
EMPLOYMENT BY CHARGER TYPE

There are three levels of EV chargers which play different—but all very important—roles in supporting New York's EV charging network. Level 1 chargers are typically used in private residences and charge very slowly. Level 2 chargers are typically used in residential or small commercial spaces and are higher voltage, faster chargers. DC Fast Chargers (DCFC or Level 3) are the highest voltage, fastest, and most expensive chargers and are used along highways and key travel junctions. Of the 28 million chargers projected for the U.S., an estimated 25.7 million will be Level 1 and Level 2 chargers at private residences, 2.1 million Level 2 chargers will be at multifamily residences and in public places, and nearly 200,000 will be DC fast chargers at public charging stations.[22]

The most common type of charging stations surveyed employers in New York work on are Level 2 chargers (208V or 240V).

Consistent with the projected types of chargers needed, approximately 83 percent of surveyed employers work on Level 2 chargers, followed by DC Fast chargers (Level 3) at 66 percent, and Level 1 chargers (120V) at 61 percent (Figure 20).

FIGURE 20. TYPES OF CHARGING STATIONS RESPONDENTS WORK ON

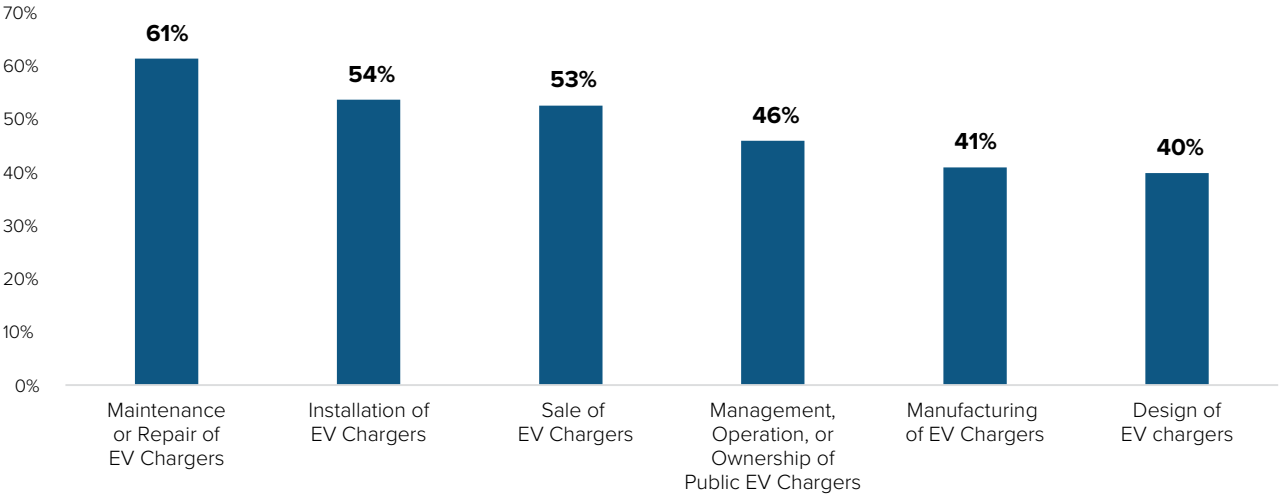


EV CHARGING FIRMS BY VALUE CHAIN SEGMENT

As part of the supplemental survey to EV charging businesses, respondents were asked to identify which parts of the value chain they operate in as well as where their primary EV charging-related operations are in.[23]

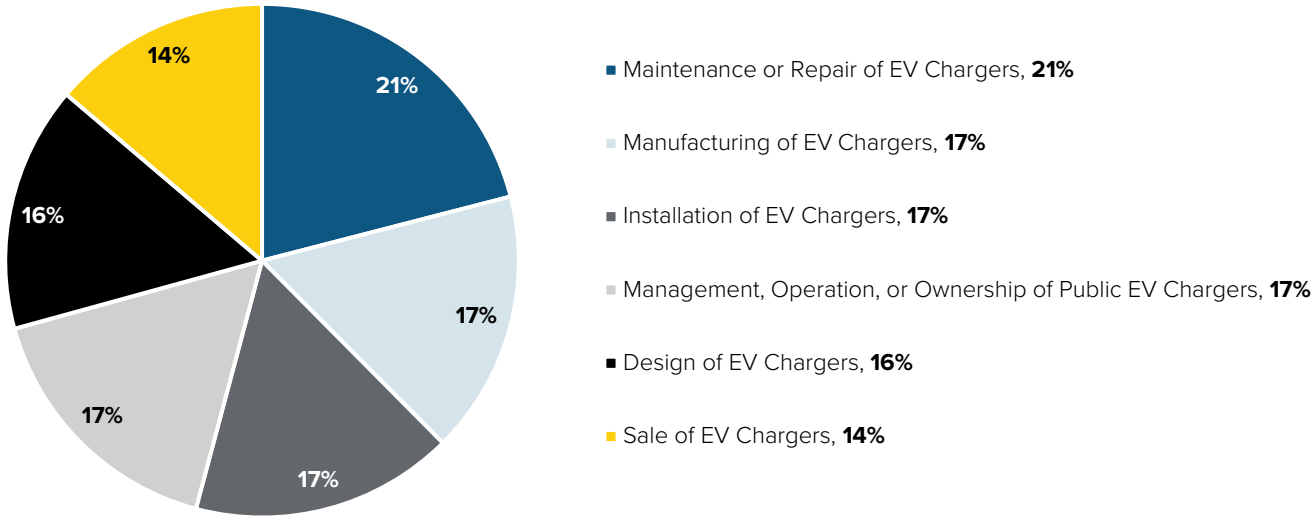
Most businesses (69 percent) worked across more than one segment of the value chain. The most common selections were the maintenance or repair of EV chargers at 61 percent, followed by installation at 54 percent, and sales at 53 percent (Figure 21).

FIGURE 21. SURVEYED FIRMS' VALUE CHAIN SEGMENTS OF OPERATION, WITH MULTIPLE RESPONSES ALLOWED



When asked about which value chain segment they primarily operate within, firms were somewhat evenly distributed across segments. The most common value chain segment firms operated within was maintenance or repair (21 percent) followed by manufacturing, installation, and management sectors, each representing 17 percent of businesses (Figure 22).

FIGURE 22. SURVEYED FIRMS' PRIMARY VALUE CHAIN SEGMENT



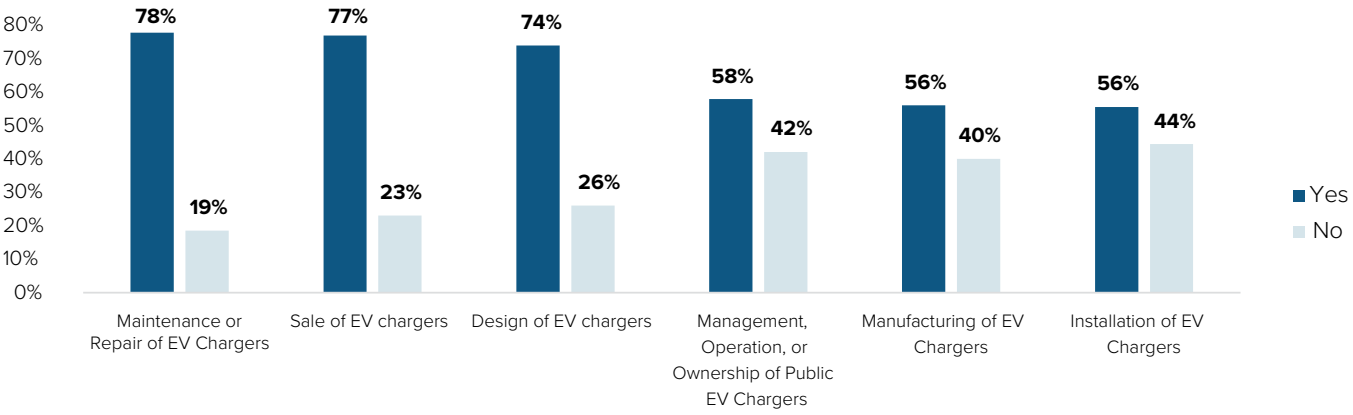
REQUIRED AND PREFERRED SKILLS BY VALUE CHAIN SEGMENT

Across surveyed EV charging employers, the top five most frequently identified occupations are Electricians, Electrical Power-Line Installers and Repairers, Customer Representatives, General and Operations Managers, and General Office Clerks.

Nearly two-thirds (66 percent) of surveyed EV charging employers identified a need for industry-specific knowledge and skills for their workers. Employers in the design, sales, and maintenance or repair sectors require industry-specific skills at higher rates (between 74 percent to 78 percent) than other sectors (Figure 23).

Some of the most frequently mentioned industry-specific skills include knowledge of electronics, customer service, critical thinking, and analysis. However, required skills varied greatly across different segments of the EV charging workforce, as displayed throughout the remainder of this section.

FIGURE 23. ARE THERE ANY INDUSTRY-SPECIFIC KNOWLEDGE OR SKILLS THAT ARE REQUIRED FOR YOUR WORKERS?



DESIGN

Businesses with a primary focus in the design of EV chargers indicated Electrical Engineers as the most common occupation, with over three-fourths of surveyed employers (79 percent) indicating employing this occupation at their location. The next most common occupations at design locations are Mechanical Engineers at 57 percent and Electronics Engineers at 54 percent (Figure 24).

When EV design employers were asked to identify what knowledge and skills are required for workers, well over half (63 percent) indicated knowledge of electrical skills, electronics materials, and computer-aided design are necessary. Other key knowledge and skills identified include on-the-job experience or training (19 percent), certification or license (15 percent), and apprenticeship, trade school, or degree/diploma (11 percent) (Figure 25).

FIGURE 24. OCCUPATIONS EMPLOYED AT DESIGN LOCATIONS

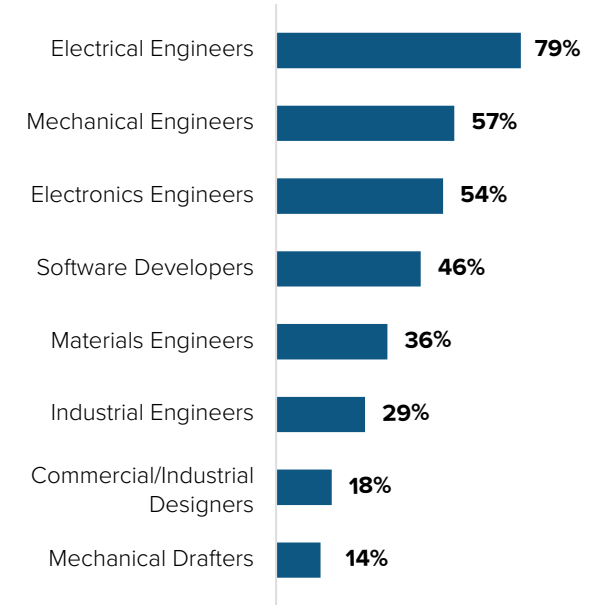
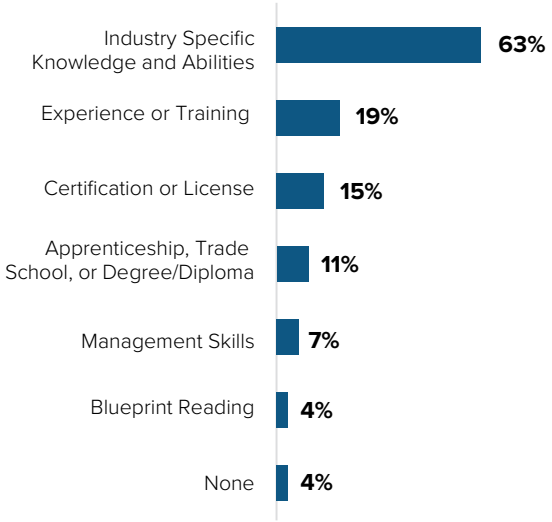


FIGURE 25. KNOWLEDGE OR SKILLS REQUIRED FOR DESIGN WORKERS



COMMON SKILLS

Electrical

Engineering

Manufacturing

Machinery/Mechanics

Graphic Design

COMMON CERTIFICATIONS

College Degree

Professional Engineer License

Electronics Certification (such as IPC-A-610)

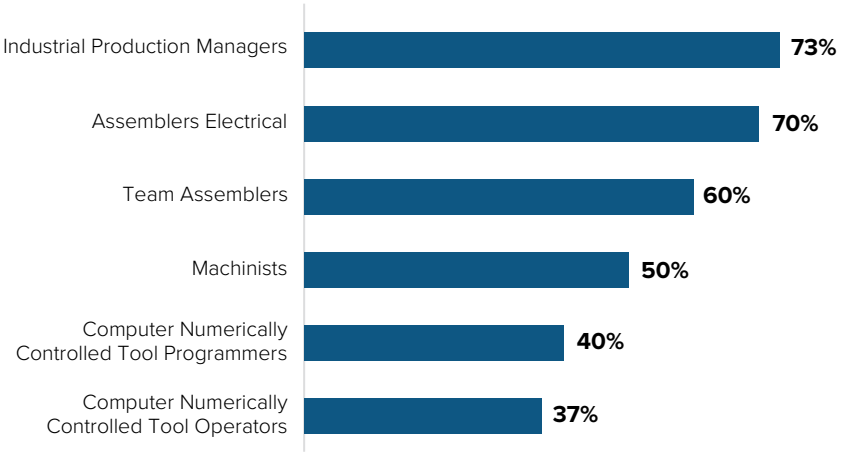
Mechanic/Machinery Certification

Electrician Certification

MANUFACTURING

Industrial Production Managers are the most employed occupation among EV companies involved in manufacturing, present at almost three-fourths (73 percent) of manufacturing locations. The next most common occupations are Electrical Assemblers (70 percent), Team Assemblers (60 percent), and Machinists (50 percent) (Figure 26).

FIGURE 26. OCCUPATIONS EMPLOYED AT MANUFACTURING LOCATIONS



COMMON SKILLS

Electrical

Production

Safety

Electrical Tool Operations

Mechanical

COMMON CERTIFICATIONS

College Degree

Production and Industry Certifications

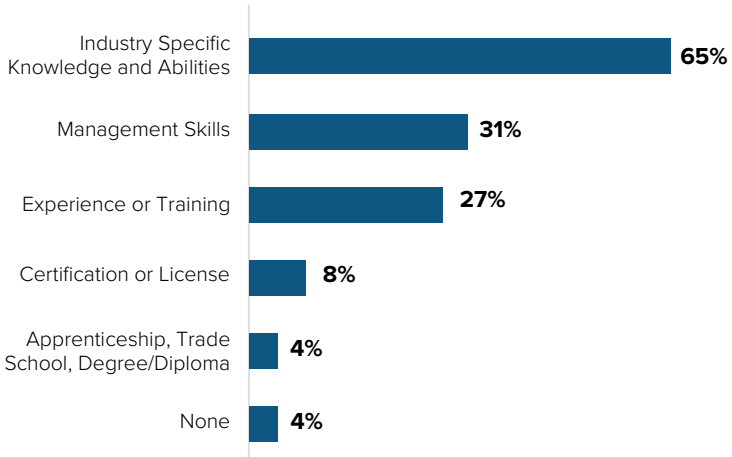
Electrician Certification

Certified Internet Web Professional (CIW)

Product Management Certification

Almost two-thirds of manufacturing employers (65 percent) require additional industry specific knowledge and abilities for workers, including knowledge of production processes, safety codes, and use of electrical and hand tools. Three out of ten (31 percent) manufacturing employers require workers to have operations management skills, especially in product management, and over a quarter (27 percent) require experience or training (Figure 27).

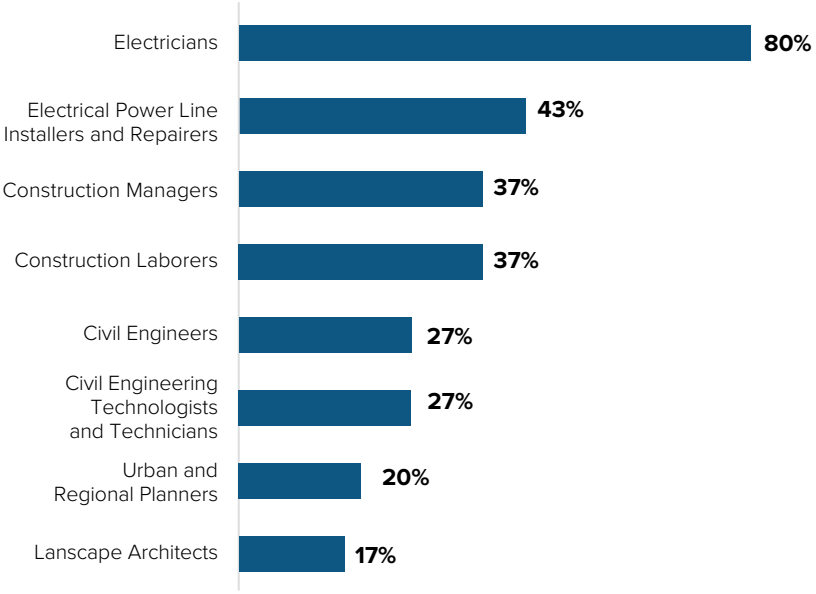
FIGURE 27. KNOWLEDGE OR SKILLS REQUIRED FOR MANUFACTURING WORKERS



INSTALLATION

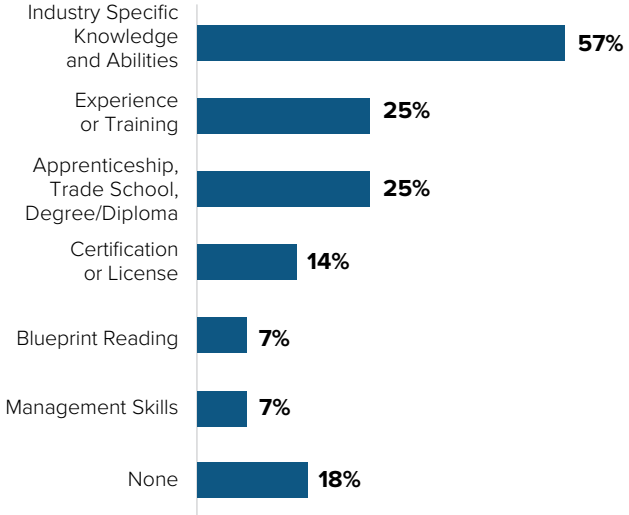
Electricians are the most common occupation among EV locations primarily involved in installation, with four-fifths of employers reporting this occupation at their locations. Electricians are present at installation businesses at a percentage nearly double that of the next most identified occupation. Electrical Power-Line Installers and Repairers are found at 43 percent of locations, which are likely only to be required for higher-voltage electrical work. (Figure 28)

FIGURE 28. OCCUPATIONS EMPLOYED AT INSTALLATION LOCATIONS



Industry-specific knowledge and abilities, including architecture, landscape, engineering, electrical circuits, and hand tools were the most identified skills and abilities needed for installation workers. A quarter (25 percent) of employers also identified needing experience or training, as well as apprenticeship, trade school, or a degree/diploma to work at their location (Figure 29).

FIGURE 29. KNOWLEDGE OR SKILLS REQUIRED FOR INSTALLATION WORKERS



COMMON SKILLS

Electrical

Installation

Power Tool Operations

Safety

COMMON CERTIFICATIONS

Electrician Certification

College Degree

Supply Chain and Inventory Management Certifications

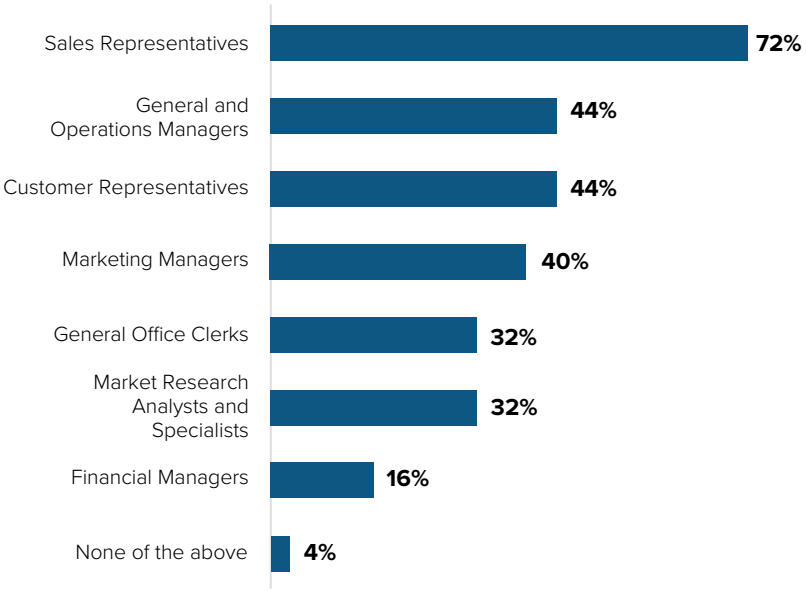
Occupational Safety and Health Administration (OSHA) Certification

Driver's License

SALES

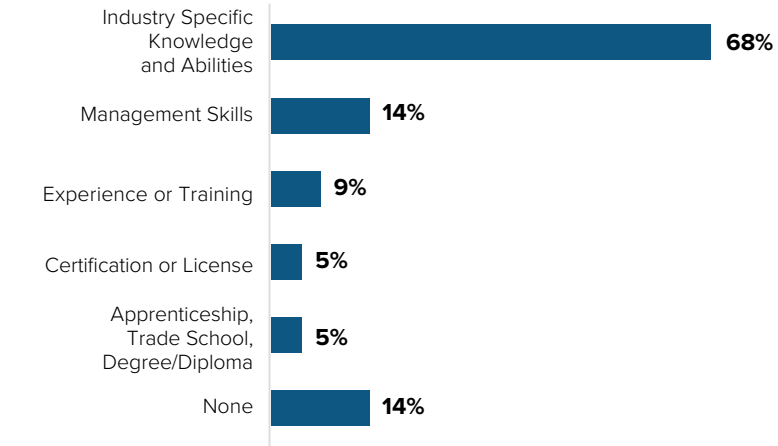
The most common occupation of businesses involved in the sale of EV charging were Sales Representatives (72 percent). The next most-common occupations were General and Operations Managers, along with Customer Representatives, both being identified by 44 percent of sales locations (Figure 30).

FIGURE 30. OCCUPATIONS EMPLOYED AT SALES LOCATIONS



Nearly seven out of ten (68 percent) of sales locations identified industry specific skills and abilities as requirements for employment, including product knowledge, sales, and marketing. The next most identified skill set was management skills, at a 14 percent response rate (Figure 31).

FIGURE 31. KNOWLEDGE OR SKILLS REQUIRED FOR SALES WORKERS



COMMON SKILLS

Sales "Mindset"

Communication

Product Knowledge

Customer Service

Market Understanding

COMMON CERTIFICATIONS

College Degree

Sales Management Certification

Business Planner Qualification Certificate

Project Management Professional (PMP)

Market Research Certificate

MAINTENANCE

The most frequently identified occupation among maintenance and repair employers was Electricians (76 percent). Over half of locations also reported employing Civil Engineering Technologist and Technicians (53 percent) and Electrical Power-Line Installers and Repairers (53 percent) (Figure 32). While Electricians and Electrical Power-Line Installers and Repairers primarily focus on electrical wiring and grid connection, Civil Engineering Technologist, and Technicians (sometimes referred to as 'EV Charging Technicians') are responsible for fixing challenges with software, hardware, and network connectivity.

COMMON SKILLS

Engineering

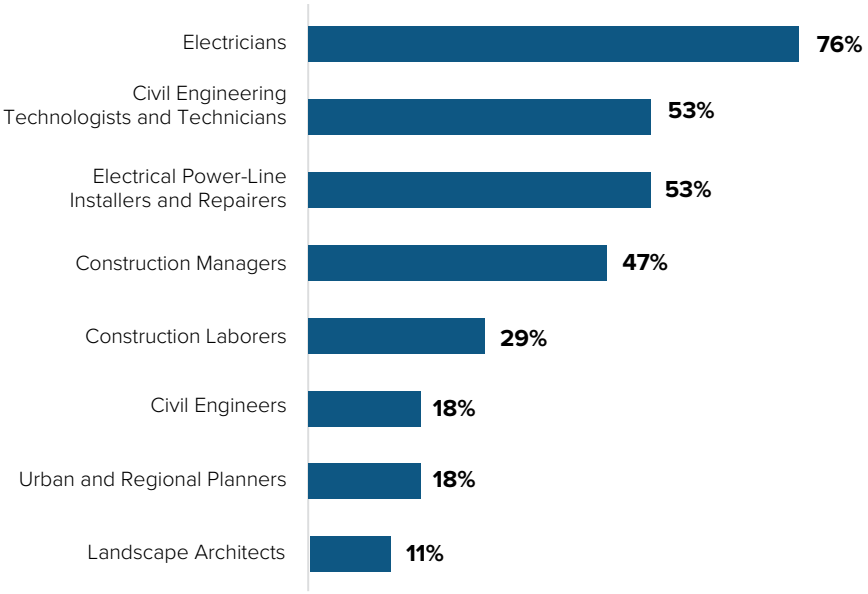
Electrical and Wiring

Power Tool and Technology Operations

Safety

Diagnostics

FIGURE 32. OCCUPATIONS EMPLOYED AT MAINTENANCE OR REPAIR LOCATIONS



COMMON CERTIFICATIONS

Electrician Certification

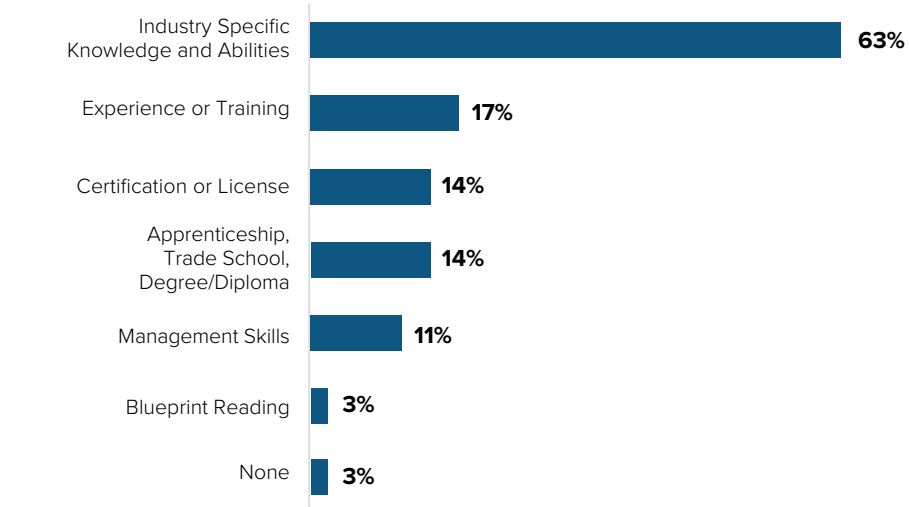
College Degree

Engineering Certificate

Environment Management Certification

Following the pattern of other value chain segments, maintenance and repair locations find industry specific knowledge and abilities to be the most identified knowledge and skills required for workers, at 63 percent, over three times more than any other type of knowledge. Industry specific knowledge and skills includes construction tools, project management, landscape, and engineering. The next-most identified type of knowledge is experience or training at 17 percent, followed by experience or training, as well as certification or license, both at 14 percent (Figure 33).

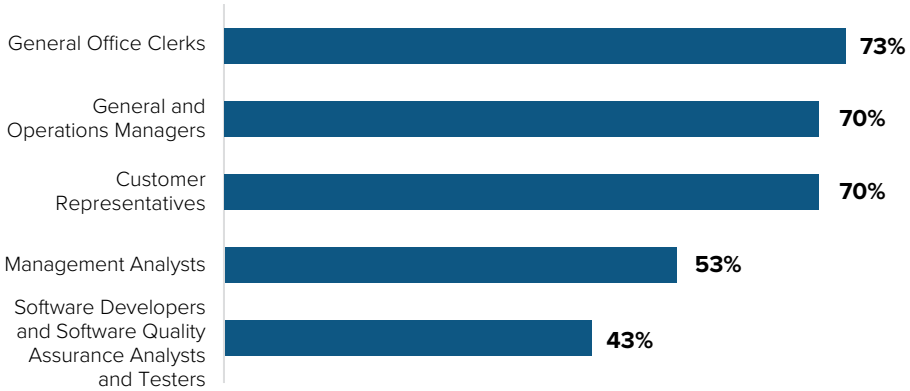
FIGURE 33. KNOWLEDGE OR SKILLS REQUIRED FOR MAINTENANCE OR REPAIR WORKERS



MANAGEMENT, OPERATION, OR OWNERSHIP OF PUBLIC EV CHARGERS

Almost three-fourths (73 percent) of businesses in the management, operation and ownership segment of EV charging stated they employ General Office Clerks. The second- and third-most identified occupations are General and Operations Managers as well as Customer Representatives. Over half of the businesses also reported employing Management Analysts (53 percent) (Figure 34)

FIGURE 34. OCCUPATIONS EMPLOYED AT MANAGEMENT, OPERATION, OR OWNERSHIP LOCATIONS



COMMON SKILLS

Operations Analysis

Technology

Organization

Computer

Communication

COMMON CERTIFICATIONS

College Degree

Office and People Management Certifications

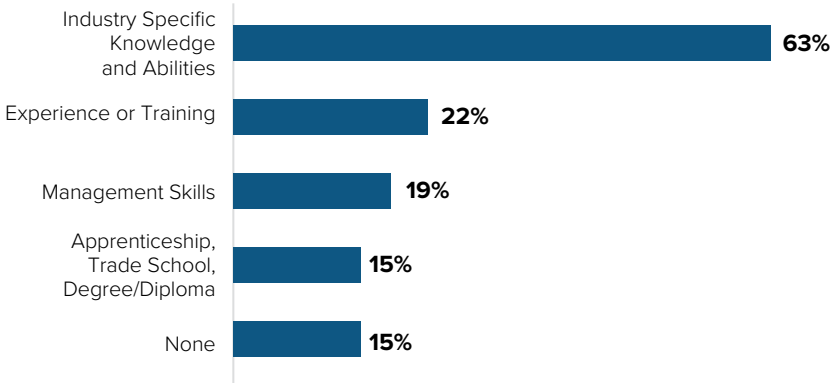
Sales and Business Certifications

Resource Management Certification

Administrative Management Certification

As with all the EV charging segments analyzed, industry specific knowledge and abilities are the most prominent knowledge or skills required for management, operation, and ownership employers, identified as important by 63 percent of businesses. These industry specific skills and abilities include customer service, computer skills, and office management abilities. The next most important knowledge or skills for this industry's workers include experience or training (22 percent) and management skills (19 percent) (Figure 35).

FIGURE 35. KNOWLEDGE OR SKILLS REQUIRED FOR MANAGEMENT, OPERATION, OR OWNERSHIP WORKERS



Appendix C: EV Charging Occupations includes information about the most common occupation for each sector of the EV charging market. This appendix includes median wages, required or preferred locations, and career pathways leading into and beyond these roles.

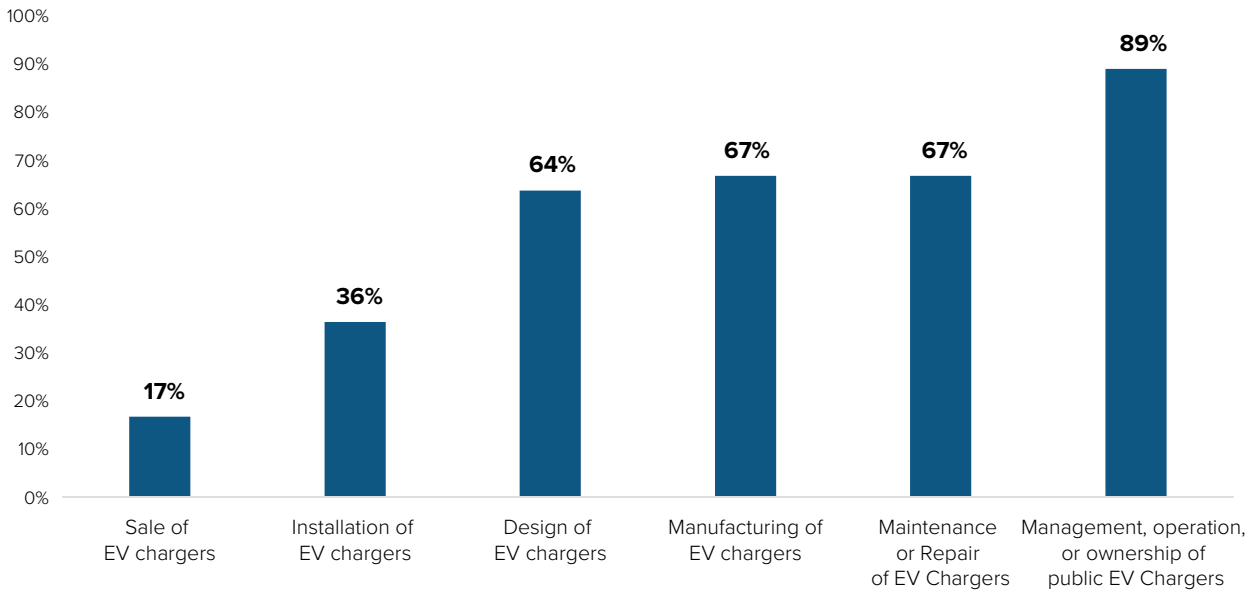
EMPLOYMENT GROWTH EXPECTATIONS

EV charging employers expect the industry in New York to continue to grow as the demand for chargers increases.

Employers were asked to indicate their current number of employees, and the anticipated number of employees within 12 months, with over half of surveyed employers anticipating new permanent employees.

Within the next twelve months, management, operation, or ownership businesses most frequently expect to see this employment growth, with 89 percent of respondents expecting to gain employees. Approximately two-thirds of maintenance or repair, manufacturing, and design firms also expect growth in the next year, at 67 percent, 67 percent, and 64 percent of firms, respectively (Figure 36).

FIGURE 36. EV CHARGING BUSINESSES THAT EXPECT EMPLOYMENT GAINS IN 12 MONTHS

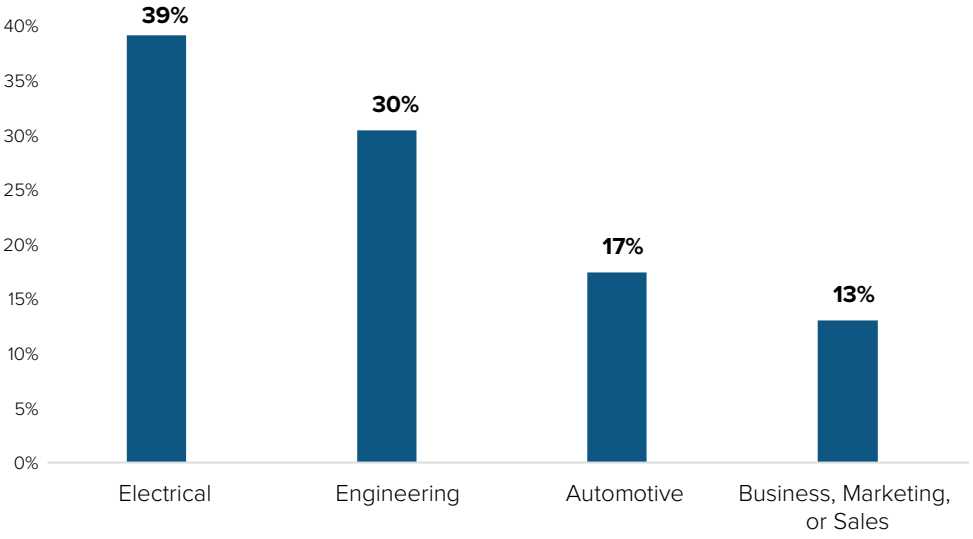


EV CHARGING WORKFORCE RECRUITMENT AND TRAINING

RECRUITMENT TRENDS

About one quarter (25 percent) of the 181 surveyed employers indicated that they recruit workers from specific industries and backgrounds. Of those employers, the four identified industries they recruit from most frequently include electrical (39 percent), engineering (30 percent), automotive (17 percent), and business, marketing, or sales (13 percent) (Figure 37).

FIGURE 37. ARE THERE PARTICULAR INDUSTRIES OR BACKGROUNDS THAT YOU TRY TO RECRUIT FROM?



The majority of surveyed employers (80 percent) do not recruit directly from education and training programs to find talent (Figure 38).

Of those employers, 30 percent identified the primary reason for not working with these providers as being "not sure about the quality of the programs," followed by 29 percent identifying they "do not hire enough workers to need direct engagement with providers" (Figure 39). Among the 14 percent of employers who do work with education and training providers, four-year colleges and web-based recruiting platforms were the two most common partnership organizations. As the industry grows, it will become increasingly important to directly connect training providers with employers potentially looking to hire. Advisory committees hosted through community colleges or increased work-based learning programs within education and training programs can help bridge the gap between employers and the trained talent they need.

FIGURE 38. DO YOU WORK WITH ANY EDUCATION OR TRAINING PROGRAMS TO FIND TALENT?

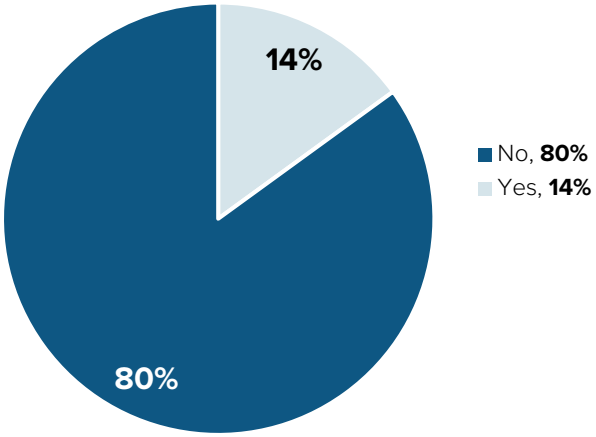
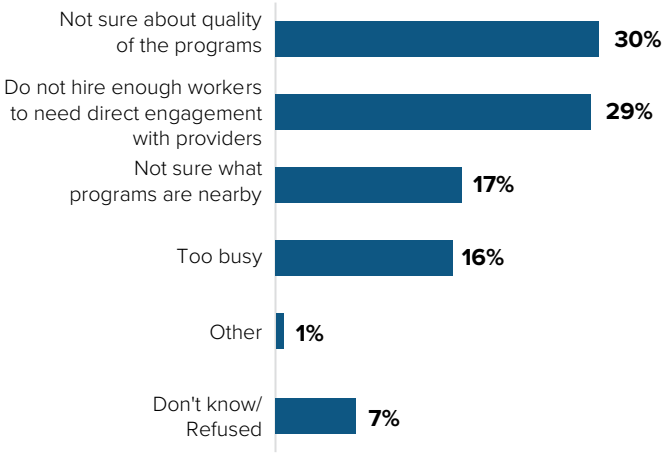


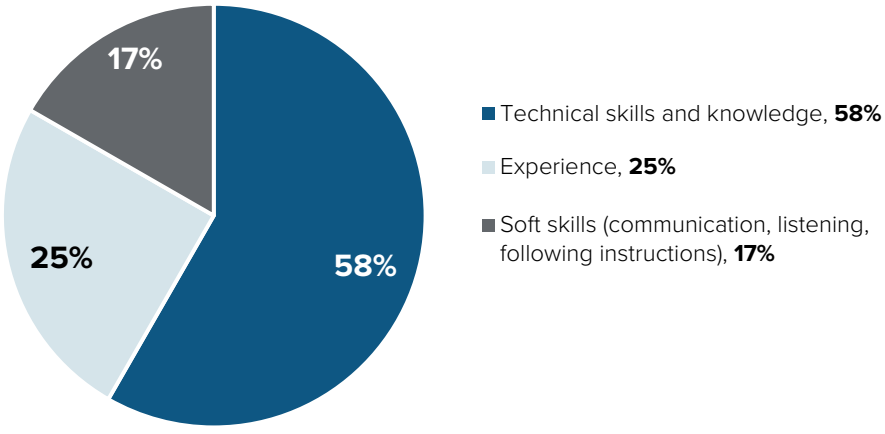
FIGURE 39. WHY DO YOU NOT WORK DIRECTLY WITH TRAINING AND EDUCATION PROVIDERS TO FIND TALENT?



Of all the employers surveyed, 19 percent stated that applicants coming from community colleges, apprenticeships, or other job training programs are missing or deficient in needed skills.

Of this 19 percent of employers, the most commonly stated missing skills included technical skills and knowledge (58 percent), experience (25 percent), and soft skills (17 percent) (Figure 40).

FIGURE 40. WHAT SKILLS ARE APPLICANTS TYPICALLY MISSING OR DEFICIENT IN?



Workforce Training Infrastructure

The research team developed a list of training and education programs focusing specifically on EV charging infrastructure based on review of education and training databases, education provider websites, and industry associations. This exercise yielded fourteen total programs within New York specifically relevant to EV charging infrastructure in New York (Table 1).[24]

TABLE 1. RELEVANT EV CHARGING TRAINING PROGRAMS BY OCCUPATION[25]

Occupation	Number of Programs
Engineers	**7**
Electricians	**7**
Technicians	**3**
Operations, Management, or Sales	**3**

Of the fourteen programs identified, ten are offered completely online, one is offered through an IBEW apprenticeship, and three are internship opportunities available through EV charging companies within New York. The programs tailored to engineers, electricians, and technicians are hosted by international engineering firms (such as SAE International), charging manufacturers such as ChargePoint, and non-profit organizations such as ChargerHelp! Only two of these programs are offered through public institutions.

The low number of public training programs that expressly contain curriculum relevant to EV charging stations may be because the industry is still relatively new and much of the training around maintenance and software troubleshooting occurs through in-house programs at charging station manufacturing companies that have bespoke software and subsequently have bespoke training for that software.

Training programs expressly related to EV charging stations tend to focus on maintenance and safety.

The basics of EVs and charging stations are foundational components of all these training programs, as is OSHA-related safety curriculum and specific electrical and high voltage safety, in particular the NFPA 70E certification. Some programs also included introductory information about manufacturing, assembly, and quality control, though most programs did not include advanced manufacturing topics like lean manufacturing, robotics, or additive manufacturing. Battery chemistry was discussed in seven out of the eleven identified programs, which reflects that understanding how EV batteries work is useful for EV charging workers, even those who aren't working directly with batteries (Table 2).

TABLE 2. COMPONENTS OF EV CHARGING STATION TRAINING PROGRAMS

Training Components	Number of Programs
EV Basics	**11**
EV Charging Station Basics	**11**
OSHA/ Safety	**11**
Electrical Safety (NFPA 70E)	**10**
Soldering	**9**
Introduction to Assembly	**9**
Quality Control	**9**
Wireless Connectivity	**8**
Battery Chemistry	**7**
Payment Systems Troubleshooting	**3**
Customer Service/Service Call Basics	**3**
Charger Networking	**2**
Lean manufacturing	**1**
Robotics	**1**
Automation and Smart Manufacturing (IoT/Digital Twin)	**0**
Additive Manufacturing	**0**

SAMPLE CHARGER FIELD TECHNICIAN CURRICULUM

This section highlights the specific components of one full range EV charging field technician training program to highlight the key aspects of EV technician curriculum and offer insight about the basic content that could be included as educational institutions or training providers develop new programs.

The SAE International Electric Vehicle Supply Equipment Field Technician Body of Knowledge and Certification provides a detailed curriculum required for field technicians who repair EV Charging stations.[26]

The curriculum includes seven domains of study:

1. **Codes, standards, and regulations** including the National Electric Code, OSHA 10, and the National Fire Protection Association (NFPA) 70E training.
2. **Electrical energy fundamentals** including an understanding of currents, circuits, and schematics.
3. **Electric vehicles and batteries** including the basics of battery storage and the different types of charging connectors.
4. **Charging stations and electric vehicle supply equipment (EVSE) basics** including station components and configurations, as well as communication and networking equipment.
5. **Commissioning** including construction site and manufacturer requirements.
6. **Preventative maintenance** including site inspection and analysis of system data.
7. **Corrective maintenance** including troubleshooting, repair, and report writing.

PROGRAM SPOTLIGHT:

LIVINGSTON ENERGY ON-THE-JOB TRAINING AND CLEAN ENERGY INTERNSHIP

NYSERDA's Workforce Development and Training Programs support businesses with hiring and training new workers in key clean energy sectors, including the EV charging industry. NYSERDA's On-the-Job Training Program and Clean Energy Internship Program have provided roughly $360,000 in funding for Lynkwell (formerly Livingston Energy Group), an EV charging company within a New York-based energy technology company, to hire and train new workers and interns.

Lynkwell delivers solutions for every component of the entire electric vehicle charging ecosystem, including the provision of turnkey deployment services, equipment construction, software engineering, energy asset integration, grid development, network operation and management, grant funding, project financing, and public education and outreach. With the support of NYSERDA, they have hired and trained 10 full-time employees and 29 interns, including Sales and Service Consultants, EV Support Specialists, Software Developer Interns, Project Management Interns, and Service and Support Specialists.

> *"The internship was a life-changing experience for me. Lynkwell partnered with my Capital Region BOCES CTE school and encouraged my class to consider internships. I started as a NYSERDA intern immediately after my high school graduation and was able to apply the skills I learned to solve real-world EV industry problems. Today, I am a full-time employee working every day with people who want to drive change through technology."*
>
> *— William Kruk, Software Engineer with Lynkwell (formerly Livingston Energy Group)*

PROGRAM SPOTLIGHT:

SOULFUL SYNERGY

Soulful Synergy, a New York-based consultancy offering workforce development services for underserved communities, is delivering training supported by NYSERDA on installing, designing, and operating Electric Vehicle Charging Equipment (EVCE). The training program consists of three intensive virtual sessions: Transportation Electrification Basics, Electric Vehicle Charging Equipment Site Feasibility, and EVCE Installation and Managed Charging. Together, these sessions prepare participants to facilitate the adoption of electric vehicles and the installation of EVCE at their facilities and provides the opportunity for real-world experiences in conducting feasibility studies to evaluate EVCE installation plans.

The training is available for free to New York residents currently involved in EVCE installations or similar projects, and courses are available in English and Spanish. Soulful Synergy is aiming to provide training to 1,000 individuals over the course of two years and has trained nearly 400 individuals as of summer of 2024. Participants in the training represent a diverse group of New York State workers, from entry-level to more experienced professionals in roles such as bus drivers, electrical installers, engineers, project managers, sustainability directors, maintenance workers, facilities managers, parking attendants, and many more.

> *"Soulful Synergy is proud to partner with NYSERDA to deliver our Transportation Electrification Training program. Our program is empowering participants with the skills and knowledge they need to drive the future of clean energy transportation. By equipping individuals with real-world experience and industry-specific training, we are not only preparing them for high-demand roles in the electrification sector, aiding in the installation and adoption of electric vehicle charging equipment (EVCE), but also helping to build a more sustainable future for our State."*
>
> *— Dwayne R. Norris, Co-Founder & COO of Soulful Synergy, LLC*


SOULFUL
SYNERGY
SOULFUL
SYNERGY


CLEAN
ENERGY
UNIONIZATION

Labor unions are organizations that are designed to empower and protect workers and workers' rights, ensuring that they have a voice in corporate and industry decisions.

Union rates vary greatly by state and by industry. Nationally, union membership is five times higher among the public sector (33 percent) than the private sector (6 percent). In New York, 21 percent of workers are members of unions, roughly double the national average.[27]

This section highlights the unionization rates among the clean energy workforce by value chain to showcase the extent and variation of unionization within clean energy and across parts of the value chain.

Public or private utility has the highest unionization rate of any clean energy value chain segment in the State, with a nearly 20 percent average membership rate.

The value chain segment with the lowest unionization rate is sales and distribution, at 3 percent. Overall, New York's clean energy workforce is 12 percent unionized. Though this rate is lower than the State average, it is higher than the national clean energy average (about 9 percent), as well as higher in several value chain segment segments including public or private utility and installation (Table 3).

TABLE 3. UNIONIZATION RATE IN NEW YORK CLEAN ENERGY BY VALUE CHAIN, 2023

	Average Membership Rate[28]	Average Coverage Rate[29]
Installation	**15%**	**15%**
Professional Services	**3%**	**5%**
Public or Private Utility	**19%**	**20%**
Manufacturing	**12%**	**14%**
Sales & Distribution	**3%**	**3%**
Other Support Services	**3%**	**5%**
Other	**5%**	**7%**
Total	**12%**	**13%**

PROGRAM SPOTLIGHT:

BOILERMAKER NORTHEAST AREA APPRENTICESHIP PROGRAM

Clean energy projects throughout New York State require aluminum and stainless-steel welders to perform highly specialized forms of welding. The Northeast Area Boilermakers Apprenticeship Program is enhancing Boilermakers Local 5's existing welding training to train and certify 126 apprentices from priority populations from across the State over a two-year period.

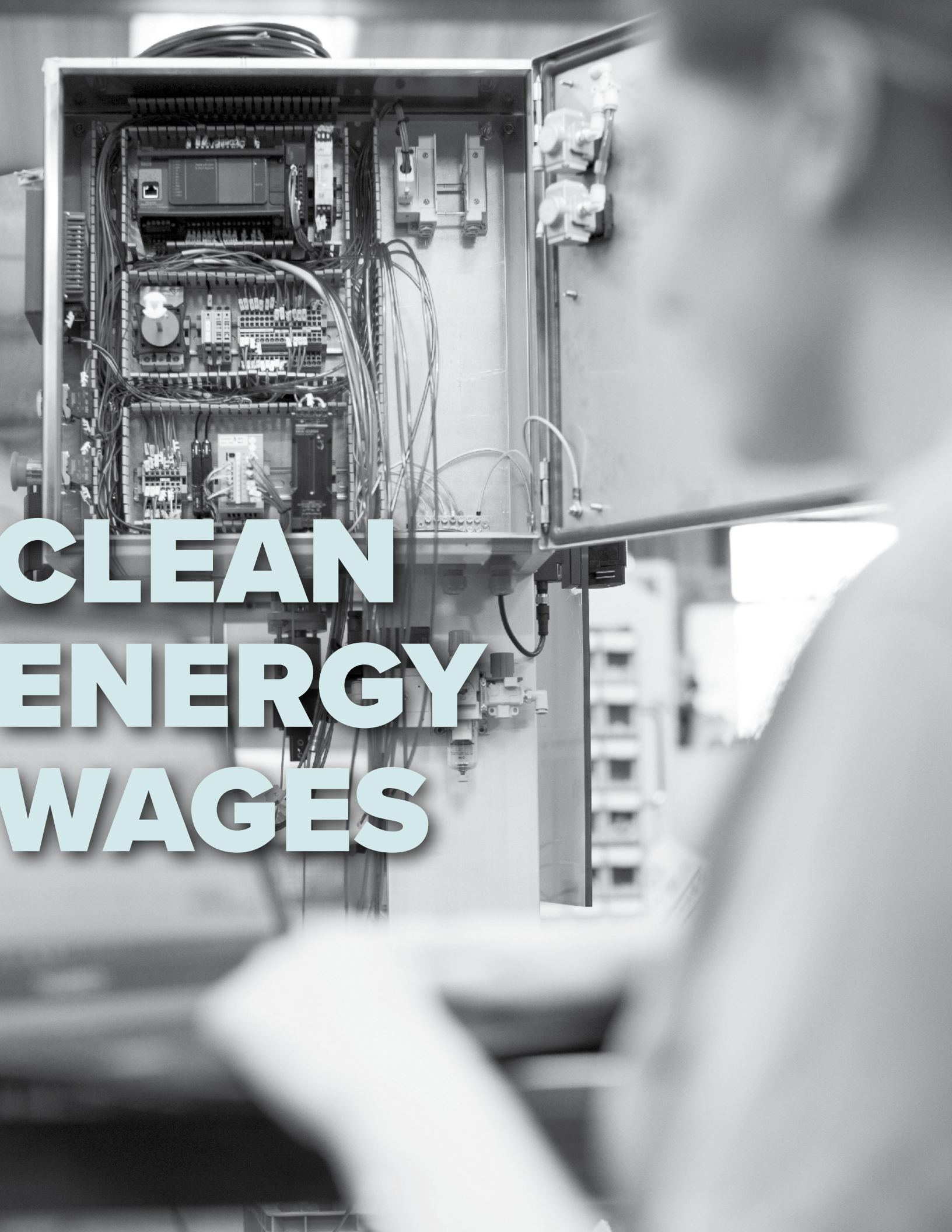
Apprentices from Albany, Oswego, Orchard Park, and Floral Park, are being trained in advanced aluminum and stainless-steel welding processes. These workers will in turn be qualified to work on New York clean energy projects including hydropower, green hydrogen storage, nuclear, and long duration energy storage.

As part of the NYSERDA funded training program, participants will also receive three week-long trainings in the following specializations:

- **Aluminum Gas Metal Arc Welding**
- **Stainless Shielded Metal Arc Welding**
- **Stainless Gas Tungsten Arc Welding**

"Training the future generation of Boilermakers to be safe and productive workers in the transition to clean energy has come with challenges. The funding NYSERDA provides makes it possible for us to purchase training equipment to perform jobsite skills and welding processes that were previously unavailable to us."

– Jason Dupuis, Administrator of the Boilermakers Northeast Area Apprenticeship Program


CLEAN
ENERGY
WAGES

Clean energy workers commonly have a wage premium compared to other workers in their occupational category, especially for those newer in the clean energy field.[30]

Entry-level clean energy employees have an average wage premium of 12 percent, with over three-quarters (77 percent) of the occupations offering wage premiums. These numbers decrease as workers gain experience, with 65 percent of median-level clean energy workers in the tested occupations having wage premiums, and 53 percent of the most experienced workers in the tested occupations with a wage premium (Table 4).

TABLE 4. SUMMARY CLEAN ENERGY WAGE PREMIUM STATISTICS

	Hourly 25th Percentile Wage	Hourly 50th Percentile Wage	Hourly 75th Percentile Wage
Share of Tested Occupations with a Clean Energy Wage Premium	**77%**	**65%**	**53%**
Average Premium	**12%**	**7%**	**3%**
Median Premium	**14%**	**7%**	**0%**

Ten occupations that are important to New York's clean energy transition are showcased in Table 5, nine of which have median wages over the statewide overall median wage of $27.33 per hour.[31, 32]

The average median wage for these ten occupations is $38.19, which is above the living wage for a single adult with no children, as well as over $20 above minimum wage.[33, 34, 35]

The occupation with the highest premiums are Building Operators, Building Control Technicians, Maintenance and Repair Workers, with premiums being over 50 percent for all experience levels.

TABLE 5. WAGES OF TEN PROMINENT CLEAN ENERGY OCCUPATIONS

SOC	SOC Name	Hourly 25th Percentile Wage	Hourly 50th Percentile Wage	Hourly 75th Percentile Wage	Hourly 25th Percentile Wage Premium	Hourly 50th Percentile Wage Premium	Hourly 75th Percentile Wage Premium
49-9071	Building Operators / Building Control Technicians / Maintenance and Repair Workers	$31.41	$39.72	$54.74	54%	55%	68%
47-2070	Construction Equipment Operators	$33.38	$44.70	$56.49	22%	23%	10%
17-3000	Drafters, Engineering Technicians, and Mapping Technicians	$31.96	$37.97	$48.05	20%	13%	16%
47-2060	Construction Laborers	$25.64	$33.22	$41.36	19%	18%	7%
49-9020	Heating, Air Conditioning, and Refrigeration Mechanics and Installers	$31.06	$37.19	$41.12	19%	7%	-2%
47-2110	Electricians	$32.75	$43.98	$55.17	16%	16%	-1%
47-2030	Carpenters	$28.39	$36.33	$42.03	14%	12%	-11%
49-9050	Electrical Power-Line Installers and Repairers	$39.26	$46.84	$54.50	2%	-2%	-3%
47-2150	Plumbers, Pipefitters, and Steamfitters	$28.84	$35.18	$47.40	0%	-8%	-16%
47-2131	Insulation Workers, Floor, Ceiling, and Wall	$23.98	$26.75	$32.81	-1%	-19%	-24%

CLEAN ENERGY BENEFITS

Healthcare coverage access among clean energy occupations has risen in the last year.

Nine in ten (90 percent) clean energy employers across the 43 occupations surveyed offer healthcare coverage in 2023, compared to 86 percent of employers in 2022 (Table 6).[36] Clean energy occupational healthcare access is much higher than the overall occupational average nationally of 72 percent.[37]

TABLE 6. NATIONAL HEALTHCARE COVERAGE RATES AMONG CLEAN ENERGY OCCUPATIONS

	Healthcare Coverage, 2022	Healthcare Coverage, 2023
Average	**86%**	**90%**
Median	**86%**	**91%**

TABLE 7. NATIONAL HEALTHCARE COVERAGE RATES AMONG TEN PROMINENT CLEAN ENERGY OCCUPATIONS

SOC	Industry	Description	Healthcare Coverage
49-9071	**Installation, Maintenance, and Repair**	**Building Operators / Building Control Technicians / Maintenance and Repair Workers**	**92%**
49-9020	**Installation, Maintenance, and Repair**	**Heating, Air Conditioning, and Refrigeration Mechanics and Installers**	**92%**
49-9050	**Installation, Maintenance, and Repair**	**Electrical Power-Line Installers and Repairers**	**92%**
51-4120	**Production**	**Welders, Cutters, Solderers, and Brazers**	**91%**
47-2110	**Construction and Extraction**	**Electricians**	**87%**
47-2150	**Construction and Extraction**	**Plumbers, Pipefitters, and Steamfitters**	**87%**
47-2073	**Construction and Extraction**	**Operating Engineers and Other Construction Equipment Operators**	**87%**
47-2131	**Construction and Extraction**	**Insulation Workers, Floor, Ceiling, and Wall**	**83%**
47-2030	**Construction and Extraction**	**Carpenters**	**83%**
47-2060	**Construction and Extraction**	**Construction Laborers**	**81%**

PREVAILING WAGES AND BENEFITS

Prevailing wage rates are higher than median wage rates in over half of the construction-related jobs analyzed.

According to New York State Labor Law, contractors must adhere to prevailing wage and benefit rates for certain workers on all public work projects, some publicly funded private projects, and certain renewable energy projects.[38, 39] This supports fair worker compensation and prevents contractors from underbidding competitors by offering lower wages. Table 8 provides a comparison of prevailing wage rates and median wages for various construction-related occupations in New York State that are relevant to clean energy.[40]

Median prevailing wages appear much higher than median wages for the same jobs, with exceptions for Commercial Divers and Pile Driver Operators, Lineman Electricians, Building/Residential Electricians, and Building/Sheeter Ironworkers.[41] Lower prevailing wages in these cases might be due to increased demand driving up market wages or prevailing wages being set before the recent significant wage increases. At an economywide level, wages in New York State have increased considerably in the wake of the COVID-19 pandemic. Between 2019 and 2023, average wages increased 21 percent, suggesting a relatively sudden period of high demand for workers which pushes up wages.[42]

TABLE 8. MEDIAN PREVAILING WAGE COMPARED TO MEDIAN HOURLY WAGE, BY OCCUPATION

SOC Code	Occupation	Specialization	Median Hourly Prevailing Wage*	Median Hourly Wage[43]	Absolute Difference	Percent Difference[44]
47-2073	Operating Engineer	Building, Dredges, Cranes, Marine Construction	$53.11	$37.34	$15.77	30%
47-2152	Plumber	Building, Construction	$50.69	$38.19	$12.50	25%
49-9044	Carpenter - Millwright	Millwright	$43.55	$35.37	$8.18	19%
49-9021	Plumber	HVAC, Refrigeration	$42.68	$34.70	$7.98	19%
47-2061	Laborer	Basic, Building	$36.11	$28.13	$7.98	22%
47-2131	Insulator - Heat & Frost	Insulator, Asbestos Worker	$38.50	$32.82	$5.68	15%
47-2031	Carpenter	Building, Residential	$37.70	$32.37	$5.33	14%
47-2111	Electrician	Building, Residential	$33.83	$37.95	-$4.12	-12%
49-9051	Electrician-Lineman	Technician Installer/ Repairman	$43.89	$54.62	-$10.73	-24%
47-2072	Carpenter - Piledriver	Piledriver	$31.75	$43.75	-$12.00	-38%
47-2221	Ironworker	Building, Sheeter	$33.40	$45.92	-$12.52	-37%
49-9092	Carpenter - Diver	Diver - Wet Day, Dry Day	$51.10	$70.45	-$19.35	-38%

New York State Labor Law requires employers provide minimum supplemental benefits for workers on projects subject to prevailing wages.

By enforcing these minimum benefit rates, workers typically receive a more complete compensation package than they might without prevailing wage requirements. Table 9 shows the average and median cash value of minimum supplemental benefit rates for construction-related jobs in New York State. Also included are the minimum and maximum benefits under prevailing wages, however these are not limits. Union contracts often receive greater pay and benefits than prevailing wage minimums. Additionally, these cash values do not account for the entirety of some benefits packages.

TABLE 9. PREVAILING SUPPLEMENTAL BENEFITS

SOC Code	Occupation	Specialization	Median Hourly Supplemental Benefits*	Min Hourly Supplemental Benefits*	Max Hourly Supplemental Benefits*
47-2152	Plumber	Building, Construction	$37.37	$28.64	$50.75
47-2073	Operating Engineer	Building, Dredges, Cranes, Marine Construction	$33.25	$12.00	$40.90
47-2221	Ironworker	Building, Sheeter	$32.13	$30.83	$88.60
47-2031	Carpenter	Building, Residential	$29.60	$21.66	$44.31
49-9021	Plumber	HVAC, Refrigeration	$28.47	$26.90	$36.07
47-2131	Insulator - Heat and Frost	Insulator, Asbestos Worker	$25.64	$25.09	$25.64
47-2061	Laborer	Basic, Building	$25.49	$20.62	$52.23
49-9044	Carpenter - Millwright	Millwright	$23.90	$21.29	$44.31
49-9092	Carpenter - Diver	Diver - Wet Day, Dry Day	$23.59	$21.24	$31.30
47-2072	Carpenter - Piledriver	Piledriver	$21.89	$21.16	$45.34
47-2111	Electrician	Building, Residential,	$18.88	$6.92	$59.39
49-9051	Electrician-Lineman	Technician, Installer/ Repairman	$18.30	$5.70	$30.90


CLEAN
ENERGY
HIRING

Virtually all clean energy employers within New York reported at least some hiring difficulty in 2023, but the severity of hiring difficulty decreased significantly.

Nearly three-quarters (73 percent) reported it was "somewhat difficult" to hire additional workers, and another 26 percent stated that it was "very difficult." Compared to other states and Washington D.C., New York falls in the middle, ranking 26th for the highest percentage of employers finding hiring "very difficult."

Hiring difficulty has increased over the last three years, with only one percent reporting "no difficulty" in 2023, compared to 7 percent in 2022 and ten percent in 2021 (Figure 41). However, about one quarter (26 percent) reported it was "very difficult' to hire new employees in 2023, which is dramatically lower than the 45 percent of employers that felt this way in 2022 (Figure 42).

FIGURE 41. EMPLOYER-REPORTED HIRING DIFFICULTY, 2021-2023

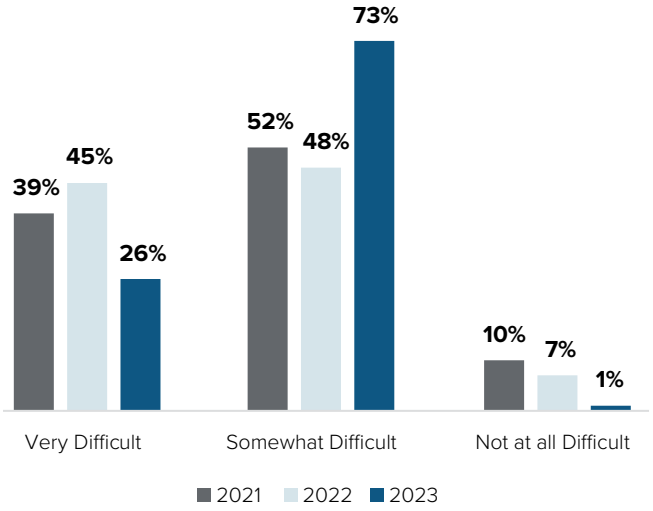
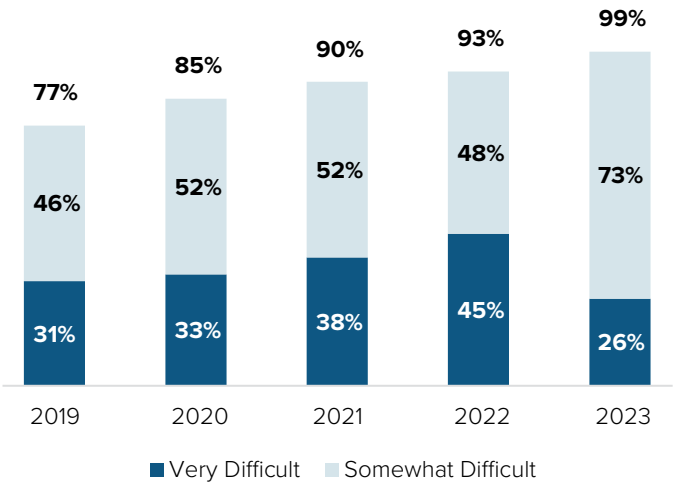
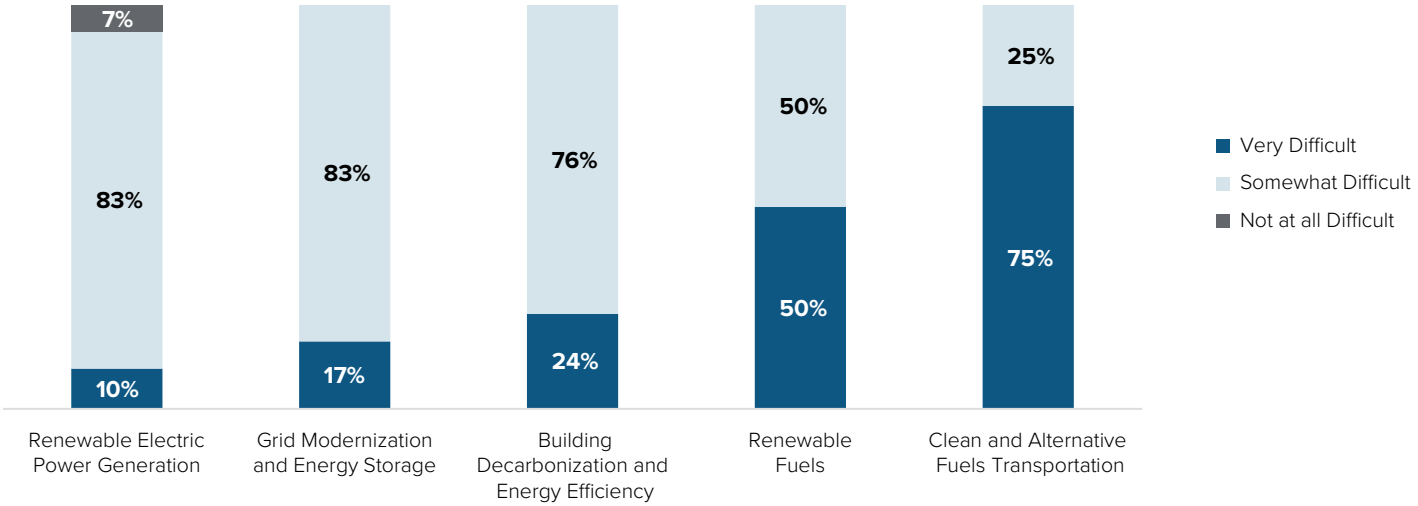


FIGURE 42.SEVERITY OF EMPLOYER-REPORTED HIRING DIFFICULTY, 2019-2023



Clean and alternative fuels transportation and renewable fuels were the technology sectors where employers reported the greatest relative challenge in hiring; 75 percent and 50 percent of employers in these technologies, respectively, reported it was "very difficult" to hire new clean energy employees (Figure 43).

FIGURE 43. EMPLOYER-REPORTED HIRING DIFFICULTY BY TECHNOLOGY, 2023



CLEAN ENERGY DEMO-GRAPHICS

The racial and ethnic demographics of the clean energy workforce remained constant between 2022 and 2023.

After seeing a marginal increase in the share of female and non-white workers within the clean energy sector between 2021 and 2022, the share of these workers remained roughly flat in 2023.

When compared to New York State's broader economy, female, Hispanic/Latino/a/x, Black, and Asian respondents were underrepresented within clean energy, though the share of Hispanic/Latino/a/x and Asian workers in clean energy has increased since tracking began in 2019 (Table 10).

Growing a diverse and representative clean energy workforce will require continued effort by employers, training and education providers, and policymakers.

TABLE 10. CLEAN ENERGY DEMOGRAPHICS, 2023[45]

	Overall Clean Energy, 2019	Overall Clean Energy, 2021	Overall Clean Energy, 2022	Overall Clean Energy, 2023	Renewable Electric Power Generation, 2023	Building Decarbonization and Energy Efficiency, 2023	New York State's Labor Force, 2023
Female	26%	25%	26%	26%	28%	26%	48%
Male	73%	75%	74%	74%	72%	74%	52%
White	75%	72%	72%	72%	71%	72%	60%
Hispanic/ Latino/a/x	12%	15%	15%	15%	16%	15%	19%
Black	9%	8%	9%	9%	9%	9%	14%
Asian	2%	7%	8%	8%	9%	8%	9%
Native American	4%	2%	1%	1%	1%	1%	1%
Pacific Islander	1%	1%	1%	1%	1%	1%	0%

CLEAN ENERGY EMPLOYMENT AND TRAINING IN DISADVANTAGED COMMUNITIES

New York State is advancing a clean energy transition centered on climate justice and equity.

As the clean energy economy continues to grow and develop, it is a priority to support job creation and access to economic opportunities in disadvantaged communities, which are defined through a set of criteria developed by New York State's Climate Justice Working Group as areas burdened by cumulative environmental pollution and other hazards that can lead to negative public health effects, and areas vulnerable to the impacts of climate change. In March 2023, the Climate Justice Working Group adopted a set of criteria that identifies a list of disadvantaged communities (DACs) statewide based on a combination of environmental pollution, socioeconomic, and health outcome indicators.[46]

The geography of clean energy jobs is a characteristic that can have profound effects on what types of potential workers are able to access the jobs and what types of communities benefit from clean energy economic activity. To gain clarity into these factors, this section of the report provides data on how clean energy employment opportunities are reaching DACs and how this has changed over the past year.

These metrics include:

- **Clean energy jobs** (place of employment) within DACs (Figure 44) – this metric shows the number of clean energy jobs located within DACs.
- **Year-over-year growth in clean energy jobs within DACs** (Figure 46) – this metric shows how clean energy employment within DACs changed from 2022 to 2023.

This analysis uses county-level clean energy employment data proportioned to the census-tract level, the geography at which DACs are defined.[47] Because census tracts are very small—sometimes encompassing as little area as a few city blocks—clean energy job totals within DACs are aggregated by the county the DAC falls within.

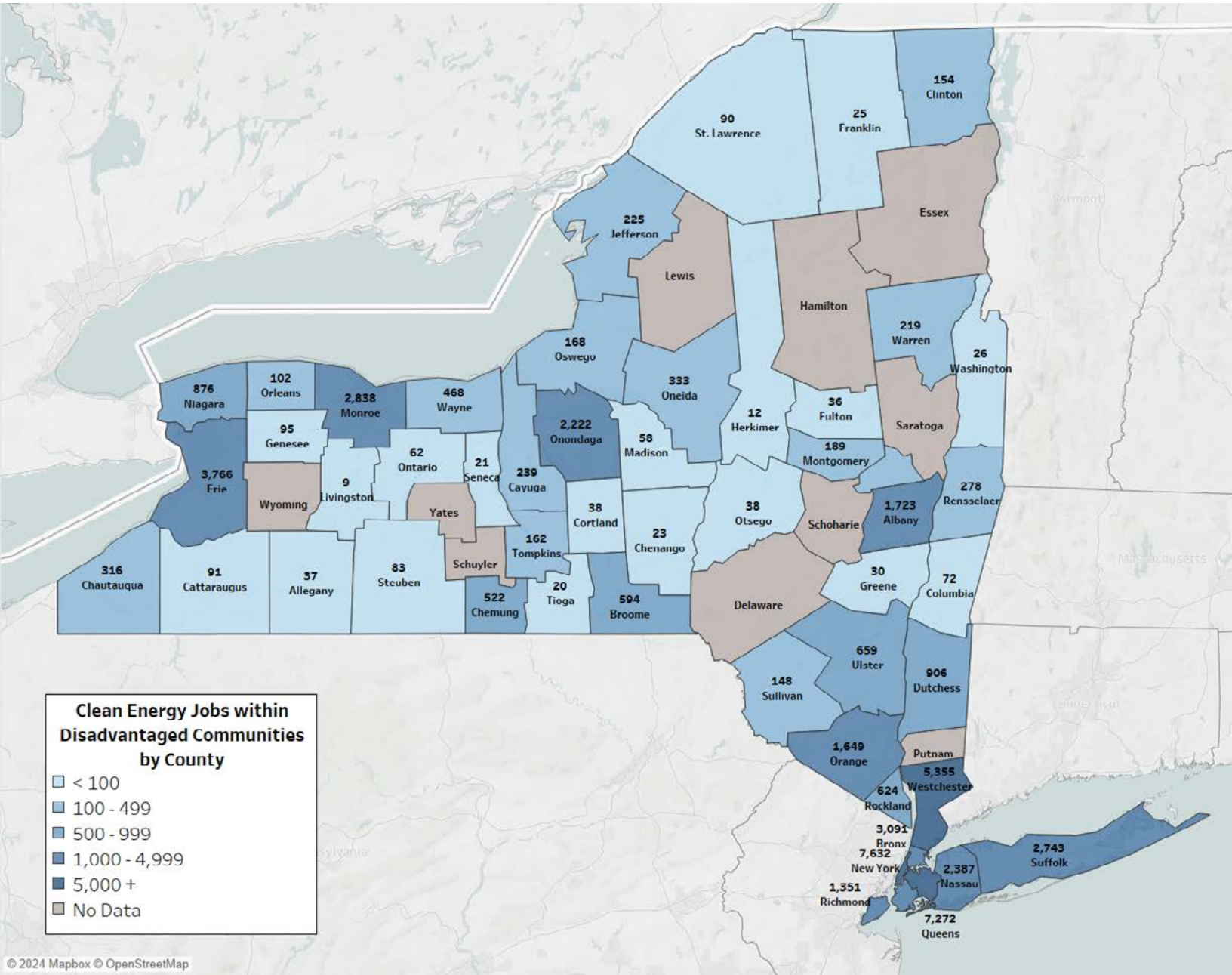
This aggregation attempts to minimize the margin of error that occurs from combining small geographic designations and county-level energy employment figures; however, the following results should still be treated as estimations.[48]

CLEAN ENERGY EMPLOYMENT IN DISADVANTAGED COMMUNITIES

Nearly 55,000 clean energy jobs can be found in DACs throughout the State, accounting for 31 percent of clean energy jobs.

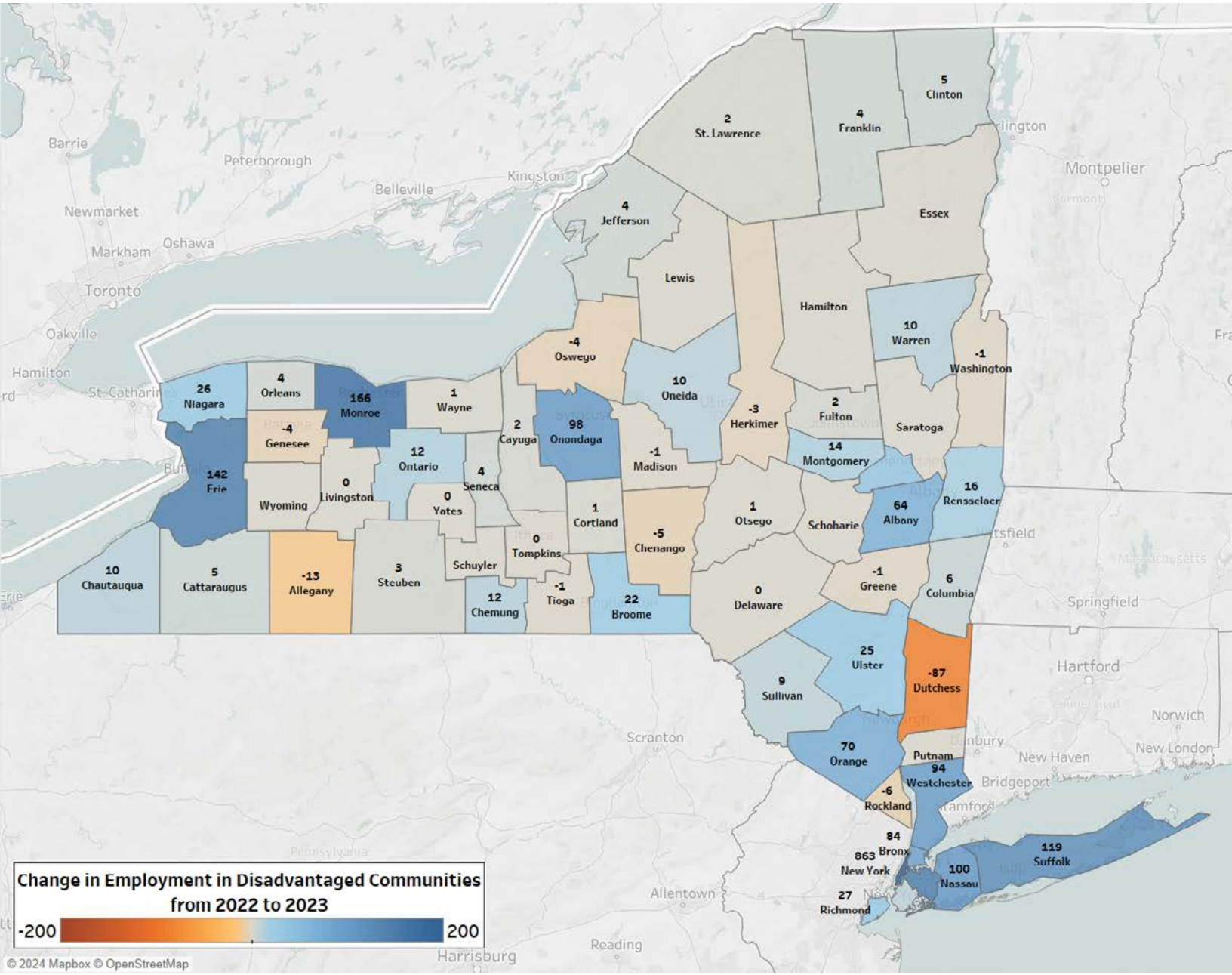
This is close to reaching parity with the 35 percent of the population that meets the criteria of living in a DAC community. Furthermore, these clean energy jobs in DACs can be found in counties all over the State; 33 counties have 100 or more clean energy jobs located within DACs in the county, including New York, Erie, Monroe, Onondaga, and Albany (Figure 44).

FIGURE 44. CLEAN ENERGY JOBS IN DISADVANTAGED COMMUNITIES



Clean energy employment within DACs increased in 40 out of 52 counties with DACs. The DACs within Ontario, Seneca, and Franklin counties saw the greatest increase in clean energy employment during this time, growing 20 percent, 18 percent, and 15 percent, respectively. Twelve out of 52 counties (23 percent) with DACs saw clean energy employment grow at a faster rate than the overall clean energy economy grew in the state (Figure 45).

FIGURE 45. GROWTH IN CLEAN ENERGY EMPLOYMENT IN DACS, 2022 TO 2023



CLEAN ENERGY TRAINING INVENTORY

Over 1,900 different training programs were identified and confirmed in a 2024 training inventory.

The research team has continued updating, expanding, and amending a database of training programs surrounding clean energy careers in New York. This includes in-person training, along with online courses by companies or universities based in the State. Programs related to installation and manufacturing roles were prioritized, and the database has been checked annually to remove any duplicates.

Focus was placed on occupations that are most prevalent in the clean energy industry, such as electrical and construction trades, or engineering. When a program hit upon multiple occupations, the primary focus was selected for analysis to prevent double-counting. The team also approached the research by concentrating on common worker pathways, such as Registered Apprenticeship programs, unions, and higher education institutions.

Programs that provide training and education for electrical occupations were the most common of those identified.

Many also offer training for construction and engineering trades, operations and maintenance, and heating, ventilation, air conditioning, and refrigeration (HVAC/R) occupations (Figure 46). The most common providers of training identified are private companies (35 percent), who often offer Registered Apprenticeship opportunities. The next-largest providers of training include unions (13 percent) as well as community colleges and four-year colleges, making up 11 percent each (Figure 47).

FIGURE 46. TRAINING PROGRAMS BY OCCUPATIONAL FOCUS

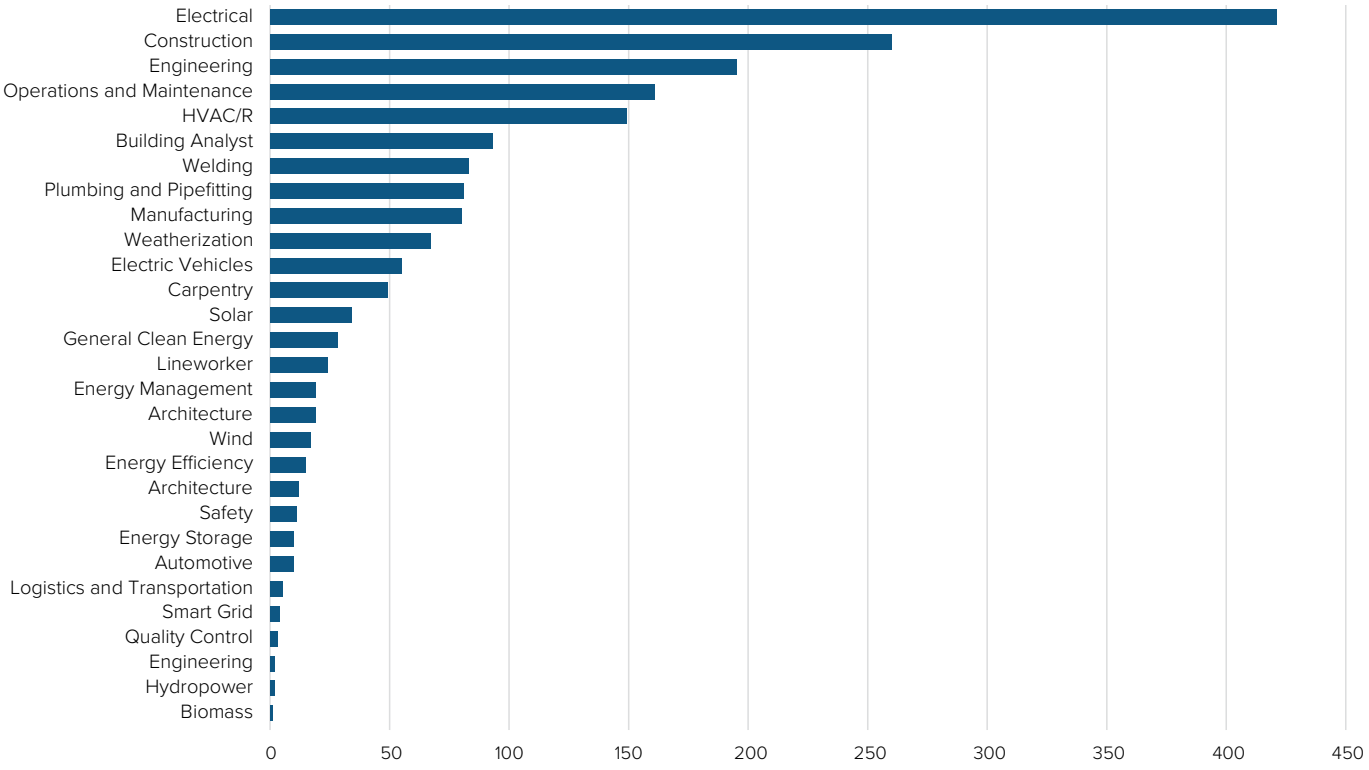
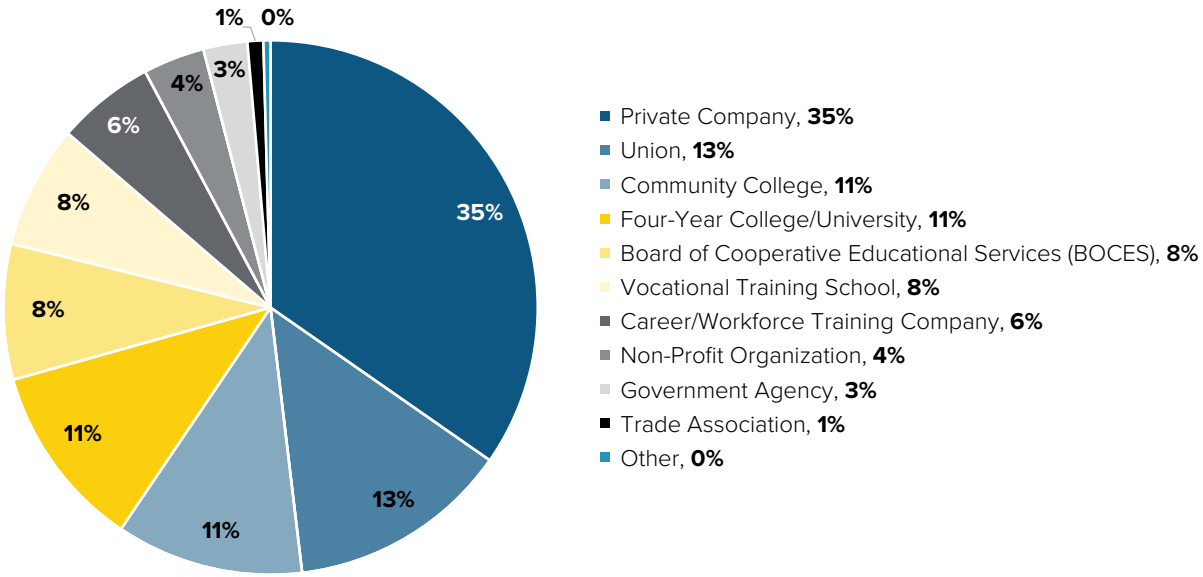


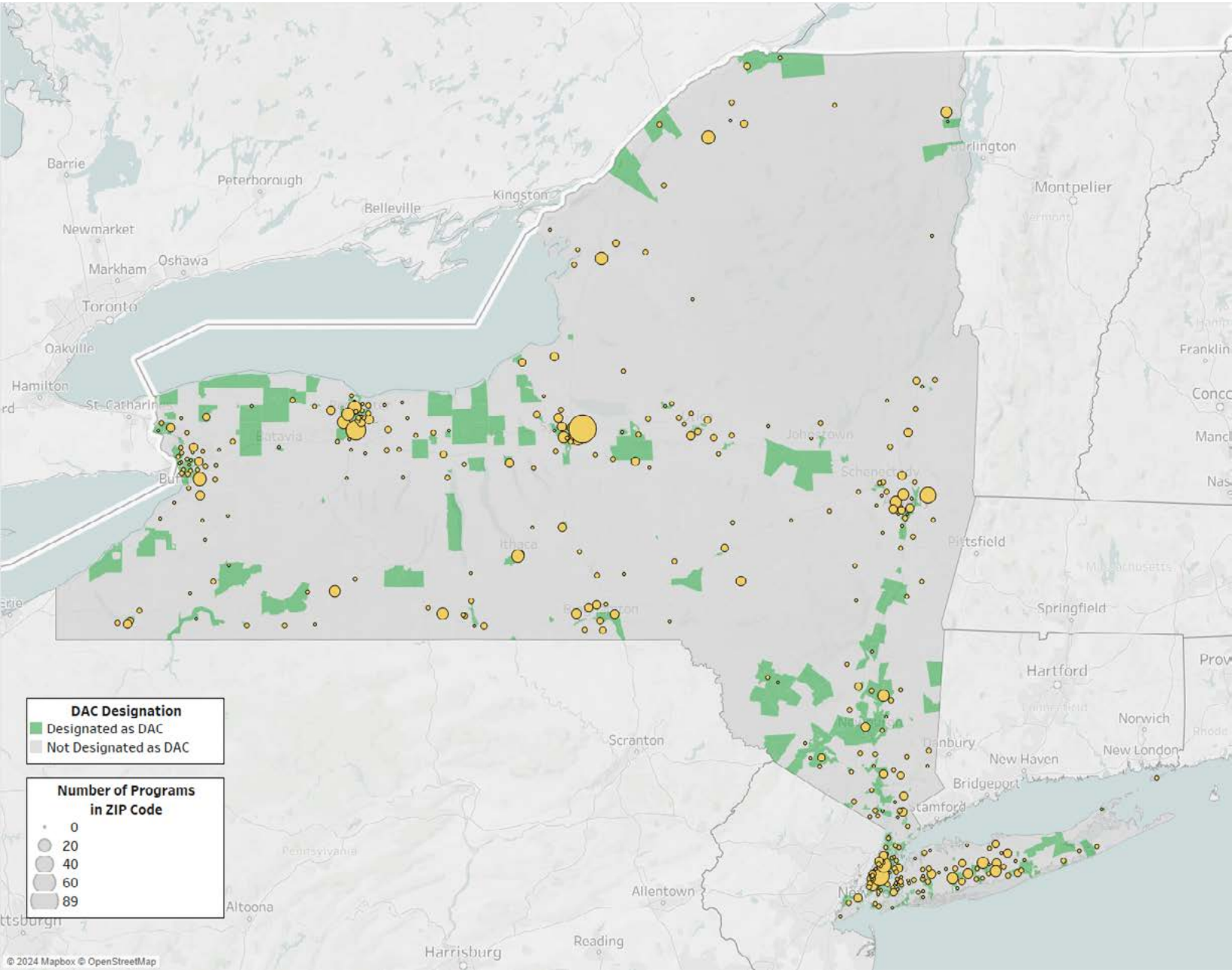
FIGURE 47. TRAINING PROGRAMS BY TRAINING PROVIDER TYPE



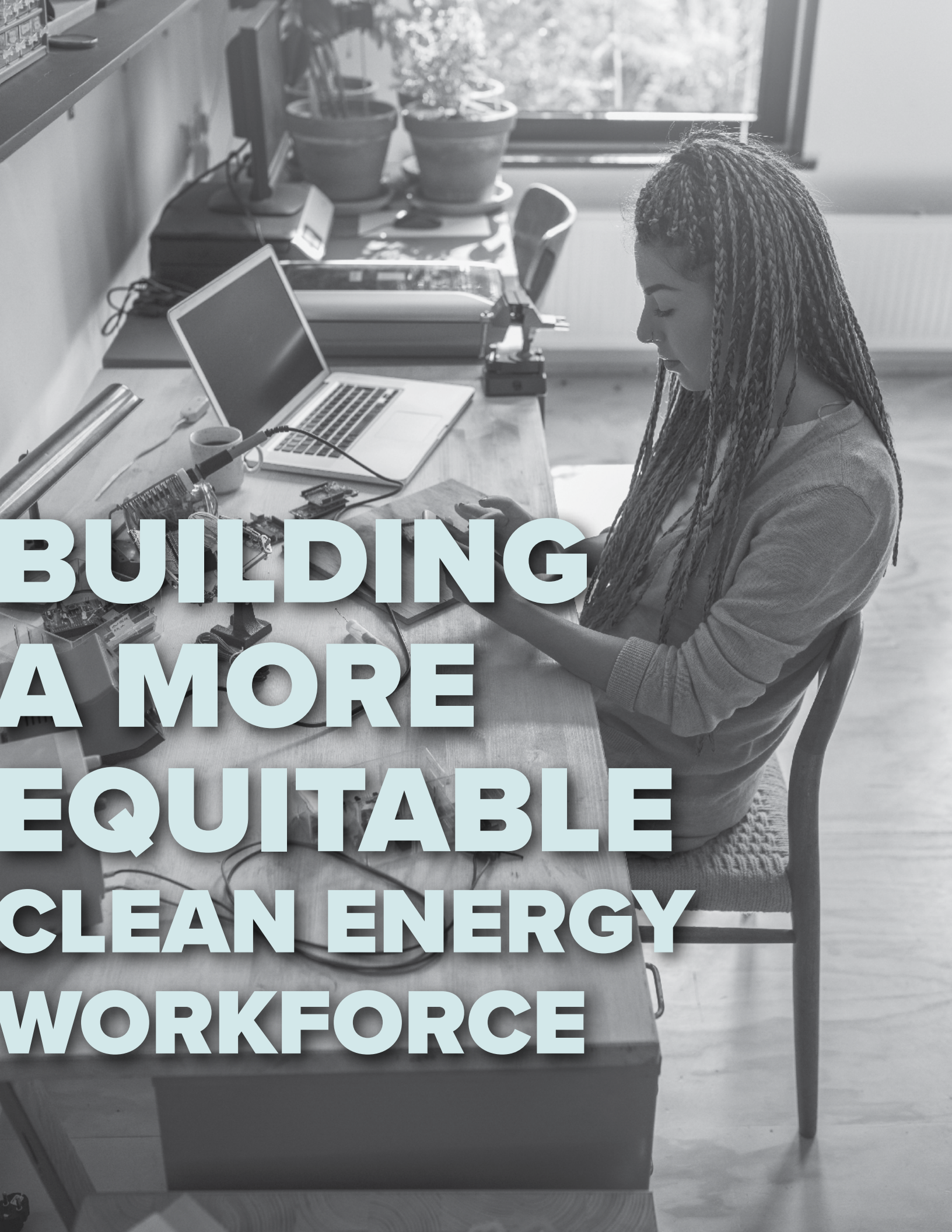
Training programs are most concentrated in and around cities such as New York City—particularly Queens and the Bronx—as well as Albany, Syracuse, Rochester, and Buffalo.

In city areas, the availability of training programming often coincides with urban disadvantaged communities, suggesting that access for urban disadvantaged communities may not face the same extent of transportation challenges when accessing workforce development opportunities as rural populations might (Figure 48).

FIGURE 48. LOCATION OF TRAINING PROGRAMS AND DISADVANTAGED COMMUNITIES




CONCRETE
CUBE RESULTS
CRANE ROSTER
CONCRETE
WASTAGE



BUILDING A MORE EQUITABLE CLEAN ENERGY WORKFORCE

Growing the clean energy economy in an equitable manner requires identifying current obstacles for clean energy employment and entrepreneurship among priority populations and disadvantaged communities and developing programs and policies to support opportunity in these communities.[53]

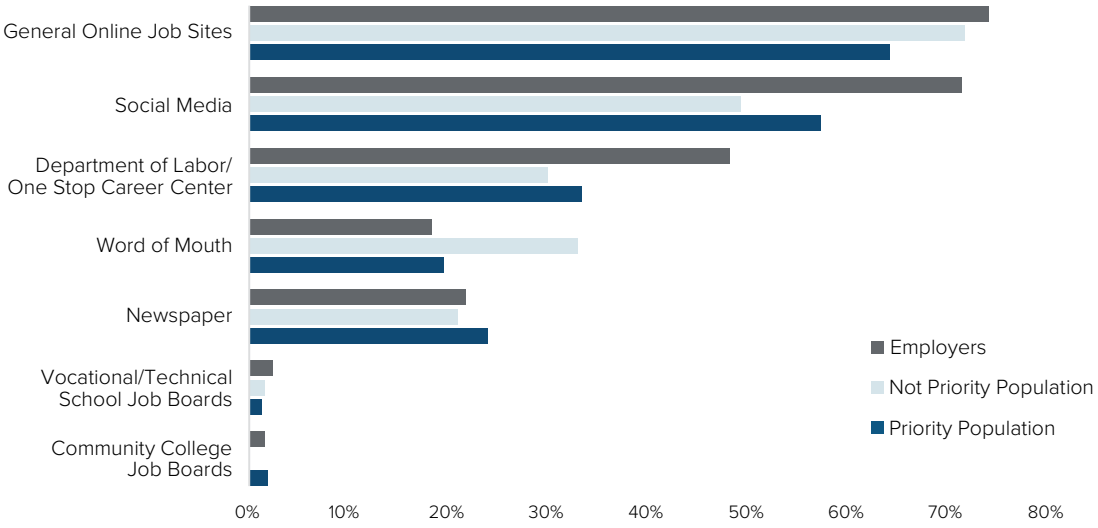
This section of the report seeks to assist in this effort by first understanding the current landscape of challenges and opportunities and then identifying opportunities to remediate these barriers.

The data in this section is primarily derived from surveys of employers and current workers. The employer survey focused exclusively on clean energy employers, while the worker survey included both clean energy and non-clean energy workers. The worker survey also asked qualifying questions to identify workers from priority populations for comparative analysis with workers not from priority populations. The results from these surveys are meant to be informative of workers' concerns, interests, and challenges at a high level. Ultimately, a survey is limited in the range of nuance, detail, and context that it can capture. The data provided in this section therefore ought to be considered preliminary, and indicative of areas for further inquiry. Focus groups, interviews, and ethnographic studies would all be suitable complimentary research methods that can offer much needed additional insight into the lived experiences of current and potential clean energy workers.

CONNECTING TALENT AND EMPLOYERS

Respondents of both employer and worker surveys were asked to identify their use of various measures when searching for new jobs or employees. For all respondents, general online job sites such as Indeed, Monster, and Career Builder are the most used, followed by social media. The results show that a significant number of workers not from priority populations (nearly 33 percent) use word of mouth to find new opportunities, compared to only 20 percent of workers from priority populations (Figure 49). If workers from priority population have less robust or less diverse social networks within or connected to clean energy employment, then this may present a barrier to entry into the clean energy field.

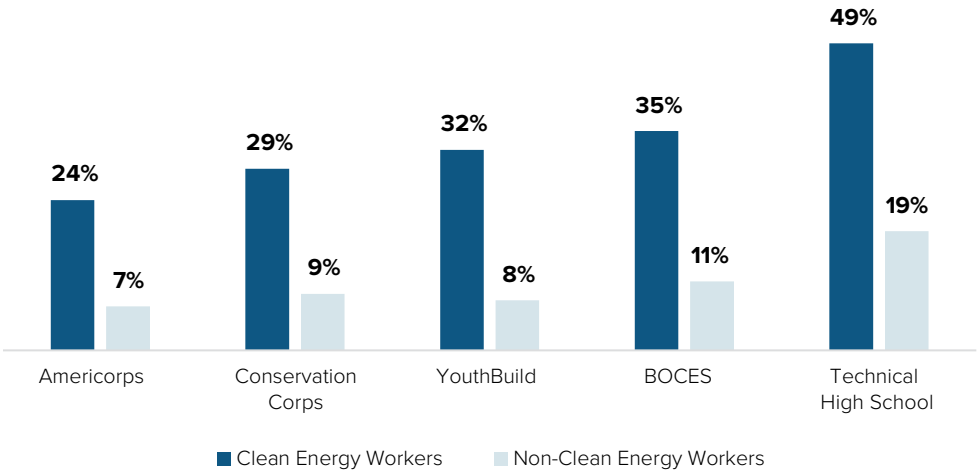
FIGURE 49. WHERE TALENT AND EMPLOYERS LOOK FOR ONE ANOTHER



Clean energy workers participate in training and education programming like AmeriCorps, Conservation Corps, and others identified in Figure 50 at rates much higher than non-clean energy workers.

Almost half of clean energy workers (49 percent) attended a technical high school, compared to only about one in five (19 percent) of non-clean energy workers. Other programming like that under the Board of Cooperative Education Services (BOCES), the Conservation Corps, YouthBuild, and AmeriCorps saw participation from clean energy workers at rates more than three times that of non-clean energy workers. These participation rates among suggest that these programs are important entry-ramps for clean energy workers (Figure 50).

FIGURE 50. RATE OF PARTICIPATION IN RELEVANT TRAINING AND EDUCATION OPPORTUNITIES



Survey participants were also asked to identify to what extent various factors to career advancement in clean energy had been a challenge. Respondents from priority populations identified these elements being considerable challenges at higher rates; the differences between workers from priority populations and other workers were significant for eight of the eleven issues surveyed on.[54]

The issues identified as considerable challenges by the highest percentage of priority workers include getting relevant work and/or industry experience (38 percent), having the free time needed to focus on career goals (37 percent), and getting academic degrees and/or certifications needed (36 percent) (Figure 51).

FIGURE 51. ISSUES IDENTIFIED AS "CONSIDERABLE" CHALLENGES

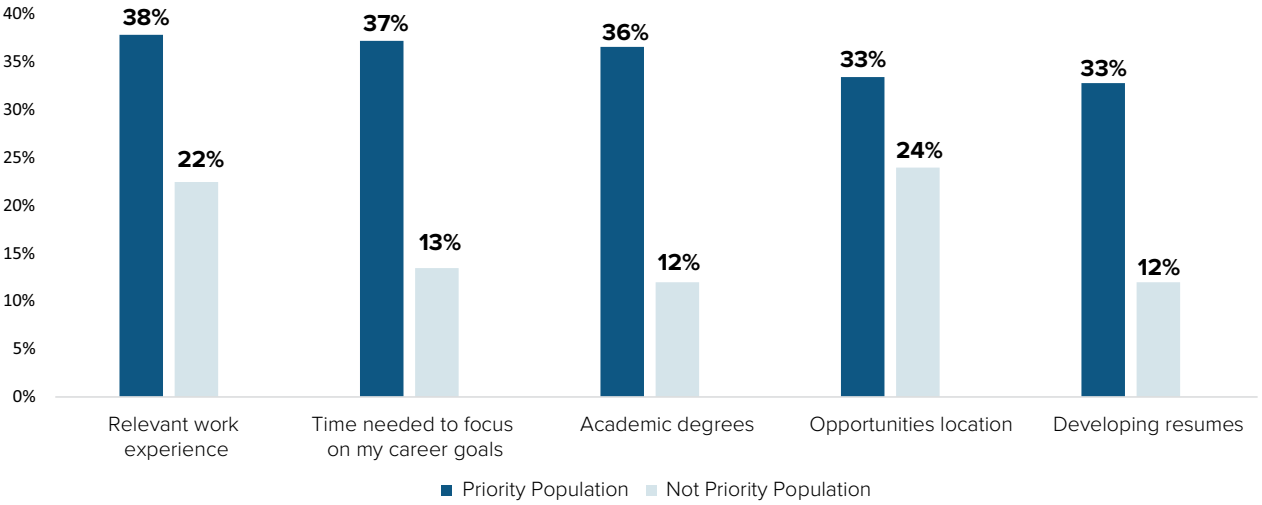
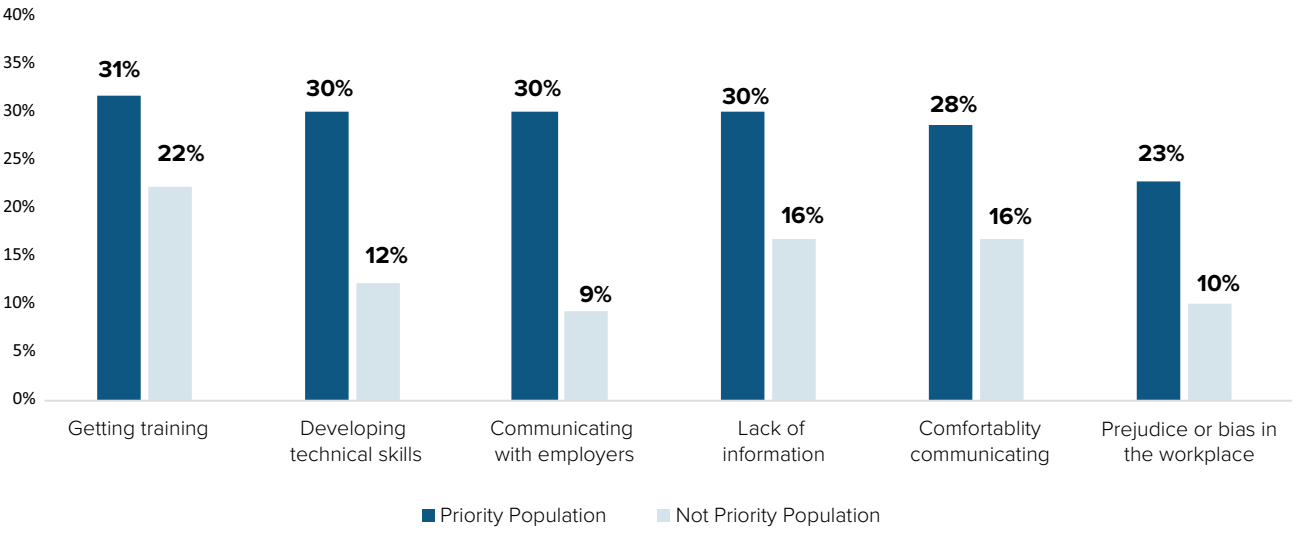


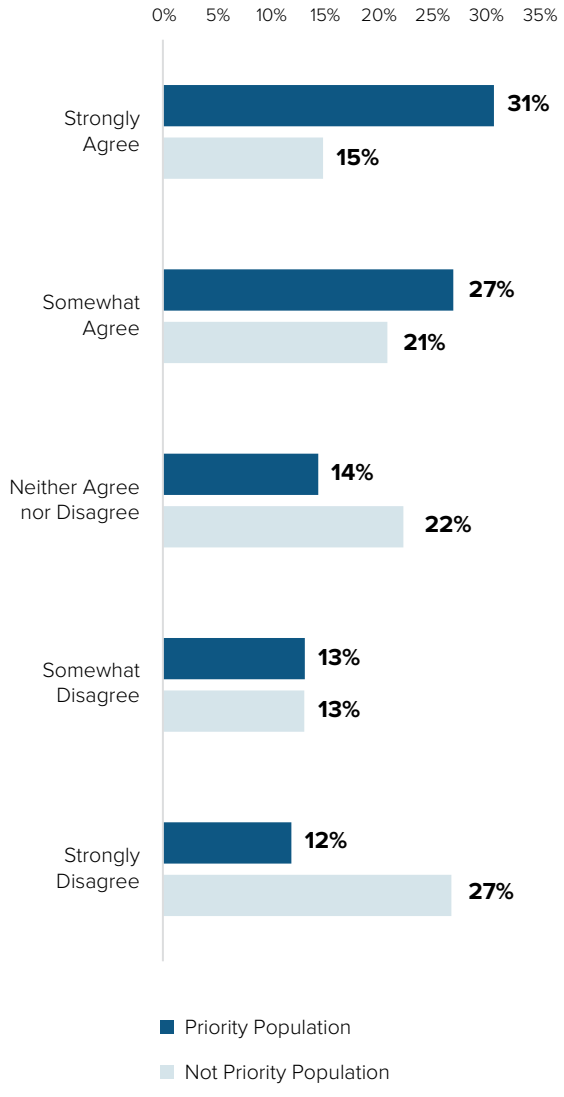
FIGURE 52. ISSUES IDENTIFIED AS "CONSIDERABLE" CHALLENGES (CONTINUED)



Proximity to clean energy opportunity is a very important consideration, and survey data suggests that workers from priority populations may have less access to relevant training opportunities.

Workers from priority populations strongly agree that training and education providers are too far away from their home at a rate more than double that of clean energy workers not from priority populations (Figure 53).

FIGURE 53. CLEAN ENERGY TRAINING AND EDUCATION PROVIDERS ARE TOO FAR AWAY FROM HOME

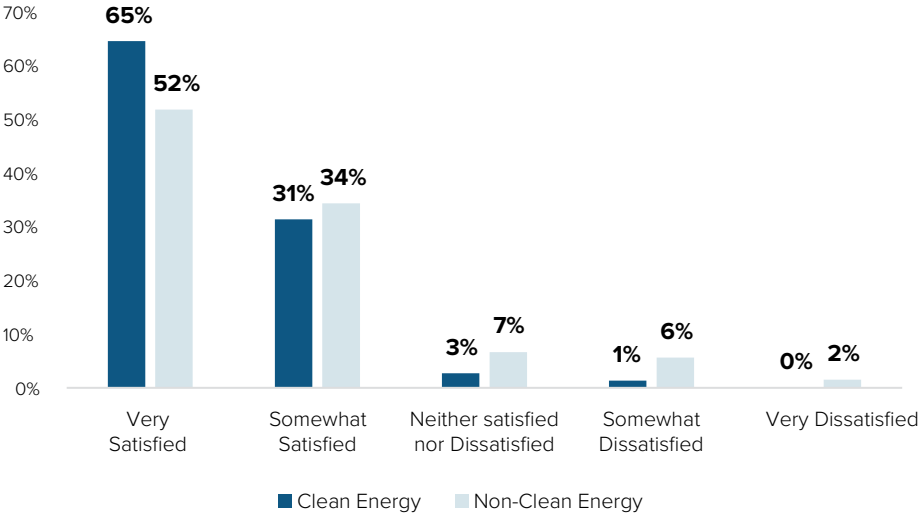


CLEAN ENERGY CAREER SATISFACTION AND ADVANCEMENT

Clean energy workers are satisfied with their careers at striking rates.

At least 95 percent of clean energy workers indicated satisfaction with their careers, with nearly two-thirds of the clean energy workforce (65 percent) being “very satisfied” with their job and another 31 percent indicating they are “somewhat satisfied.” Only 1 percent of clean energy respondents indicated any dissatisfaction, compared to 8 percent in the non-clean energy workforce (Figure 54).

FIGURE 54. CAREER SATISFACTION IN CLEAN ENERGY AND NON-CLEAN ENERGY WORKERS

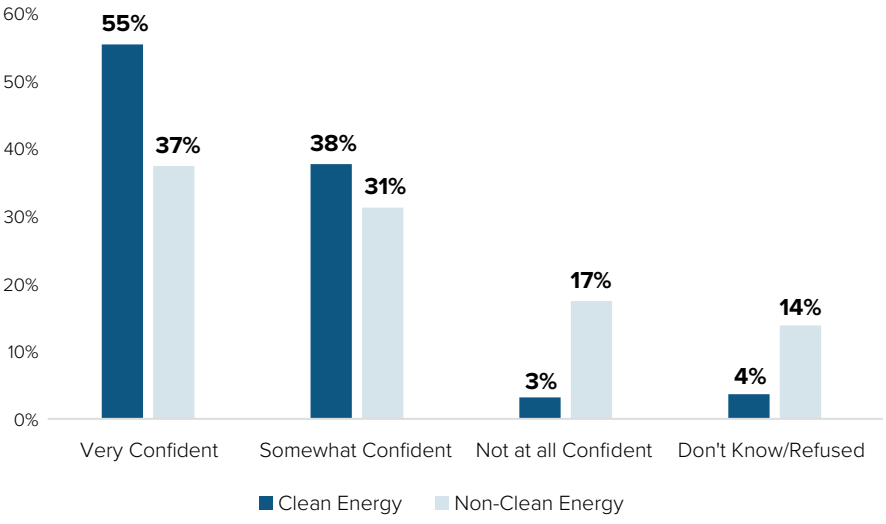


Clean energy workers also have more positive expectations for promotion (which is to move up in rank and responsibility within one's current company) and advancement (which is to gain more knowledge and understanding that can be used further one's career).

More than nine out of ten clean energy workers (93 percent) feel very or somewhat confident in a promotion or job advancement in the next 12 months.

This is almost 25 percentage points higher than that of non-clean energy workers (Figure 55). Conversely, less than 10 percent of clean energy workers were unsure about their prospects for promotion and advancement, compared to 31 percent of non-clean energy workers.

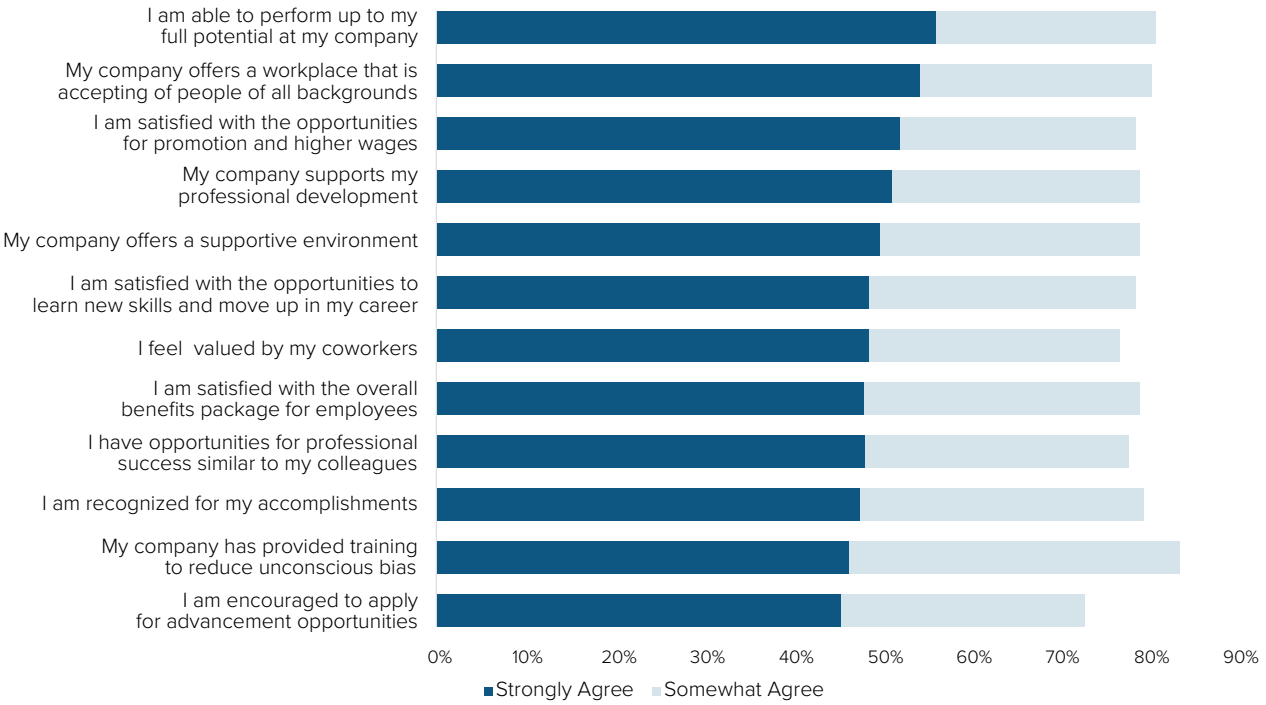
FIGURE 55. CONFIDENCE IN PROMOTION OR ADVANCEMENT IN NEW JOB IN NEXT 12 MONTHS



Clean energy workers generally indicate strong perceptions of optimism, support, and equitability in their workplace.

More than four-fifths of workers (84 percent) feel that their company has done a good job of providing training programs to reduce unconscious bias in the workplace. A similar amount (81 percent) feel that their company offers a workplace that is accepting of people of all backgrounds. Respondents also indicated their workplace as a supportive environment in which they feel valued and see future promotion (Figure 56).

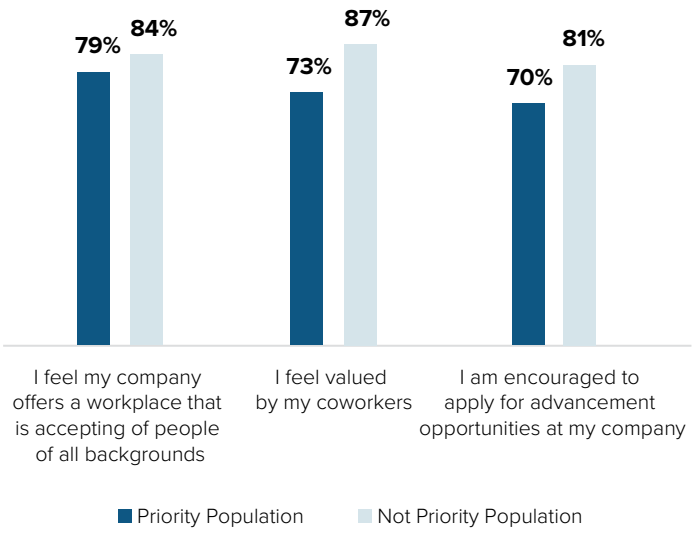
FIGURE 56. FIT, RECOGNITION, AND OPPORTUNITY WITHIN WORKERS' CURRENT CLEAN ENERGY COMPANY



Perceptions of optimism, support, and equitability in the workplace are generally similar between workers from priority populations and those that are not.

However, some positive perceptions are slightly greater for those workers not from priority populations. For instance, 84 percent of workers not in priority populations feel that their company offers a workplace that is accepting of people of all backgrounds, while 79 percent of workers in priority populations agree with this statement. As for being valued by coworkers, 87 percent of workers not from priority populations agree with the statement, compared to 73 percent within priority populations. Lastly, 81 percent of workers not from priority populations agree they feel encouraged to apply for advancement opportunities at their company, as opposed to 70 percent of workers within priority populations (Figure 57).

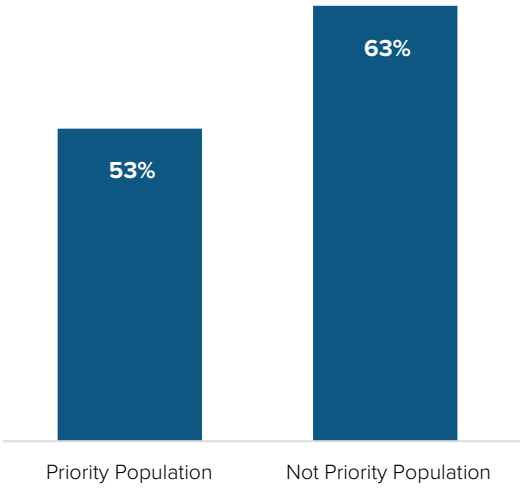
FIGURE 57. COMPARISON OF FIT, RECOGNITION, AND OPPORTUNITY WITHIN WORKERS' CURRENT CLEAN ENERGY COMPANY



Workers not from priority populations reported greater confidence in their ability to perform at their company than workers from priority populations.

When clean energy workers were asked if they are satisfied with their ability to perform at their full potential within their current company, almost 63 percent of workers not from priority population strongly agreed while 53 percent of workers from priority populations indicated the same (Figure 58).

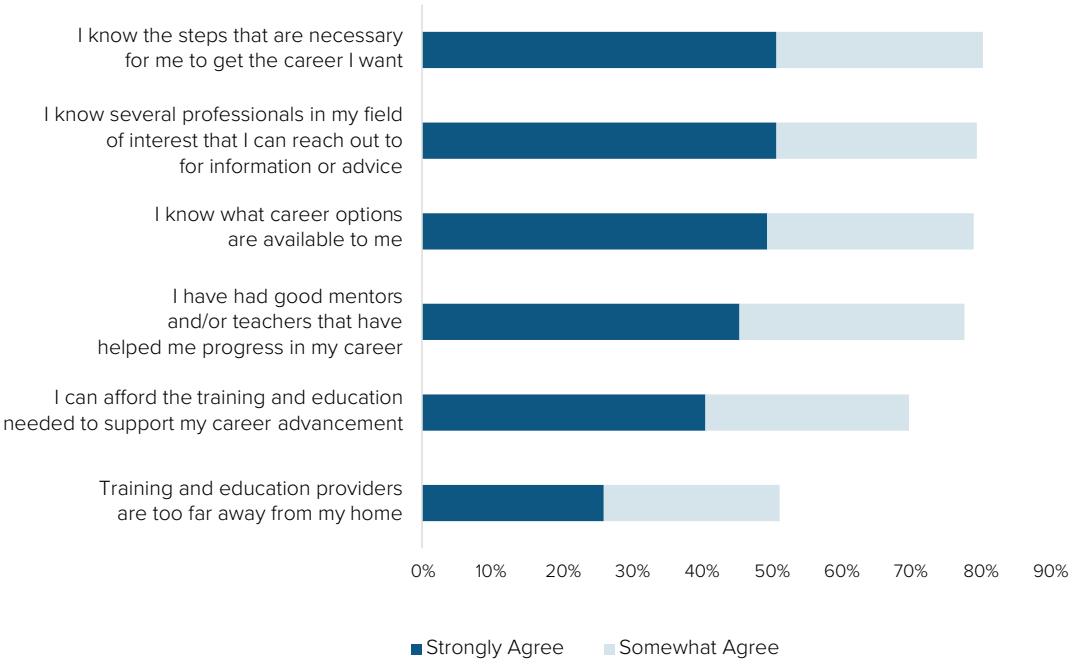
FIGURE 58. STRONG AGREEMENT THAT WORKERS ARE ABLE TO PERFORM TO FULL POTENTIAL AT THEIR COMPANY



Clean energy workers are generally aware of the resources available to help advance their career.

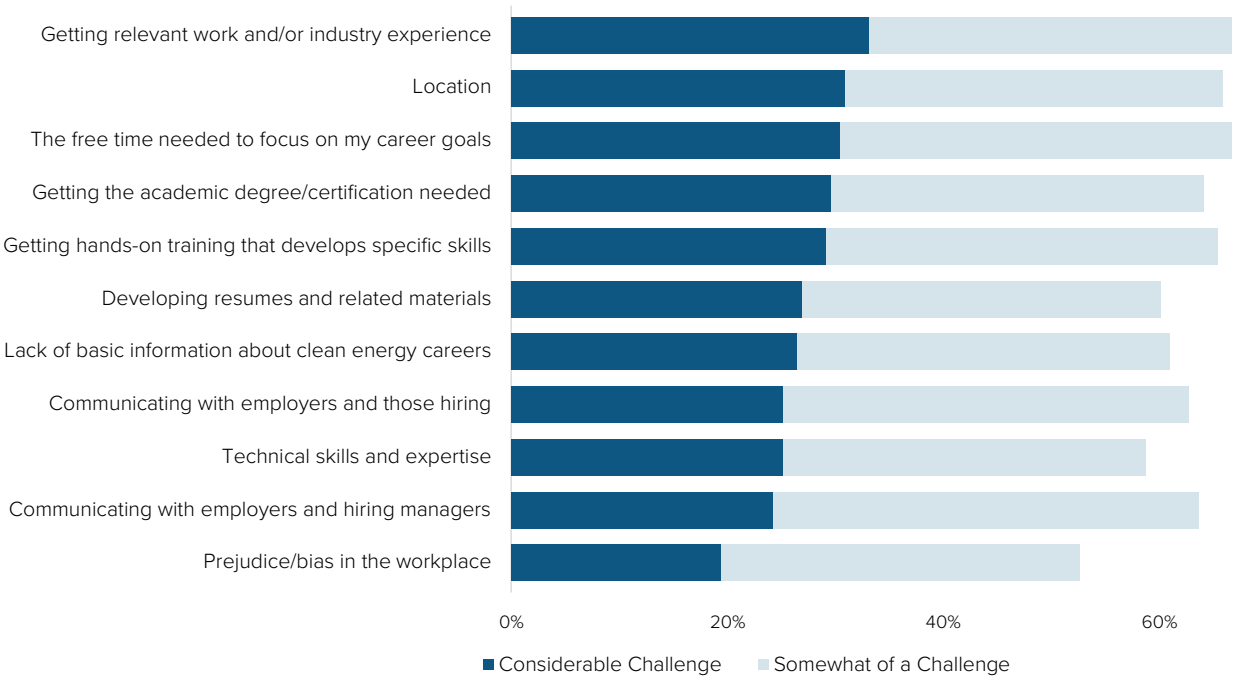
In fact, 81 percent indicate already knowing the steps necessary to attain the career they desire. Four-fifths of respondents (80 percent) reported knowing several professionals in their field that they can reach out to for information or advice, and a similar amount (78 percent) have had good mentors or teachers to help them progress their career (Figure 59). These response rates were similar between workers from priority populations and other clean energy workers.

FIGURE 59. AVAILABILITY OF RESOURCES TO CURRENT CLEAN ENERGY WORKERS



The greatest obstacles for workers in the clean energy field, regardless of whether they are from priority populations, are getting relevant experience, having the free time to focus on career goals, and finding opportunities near where they live or are willing to live (Figure 60).

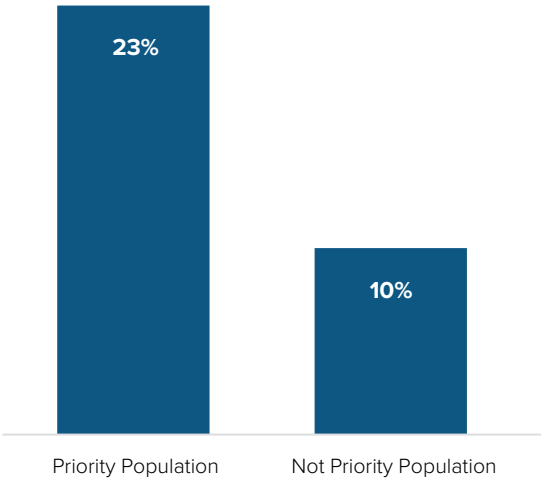
FIGURE 60. OBSTACLES IN ADVANCING [A RESPONDENTS'] CLEAN ENERGY CAREER



Workers from priority populations identified prejudice and bias in the workplace as a considerable challenge at a higher rate than workers not in priority populations.

Almost one-quarter of workers from priority populations saw prejudice as a considerable challenge, compared to only 10 percent of workers not in priority populations (Figure 61).

FIGURE 61. PREJUDICE/BIAS IN THE WORKPLACE IDENTIFIED AS A "CONSIDERABLE CHALLENGE"

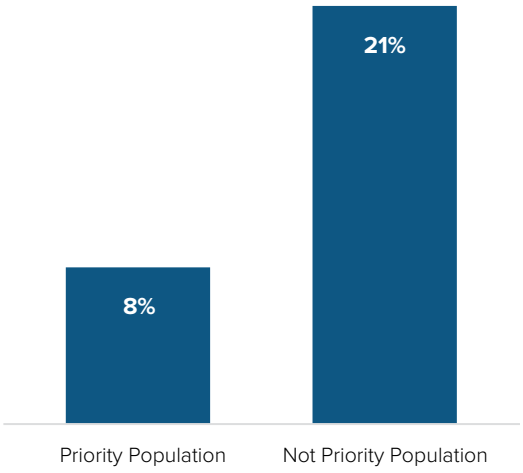


DIVERSITY, EQUITY, AND INCLUSION

When clean energy workers were asked about their awareness of company initiatives to recruit workers from diverse and under-represented backgrounds, a large variation was seen between workers from priority populations and those not from priority populations.

Only eight percent of workers from priority populations reported that they are aware of initiatives regarding diversity, equity, and inclusion (DEI) committees or policies within their company, compared to 21 percent of other respondents (Figure 62).

FIGURE 62. AWARENESS OF COMPANY DIVERSITY, EQUITY AND INCLUSION COMMITTEE OR POLICY

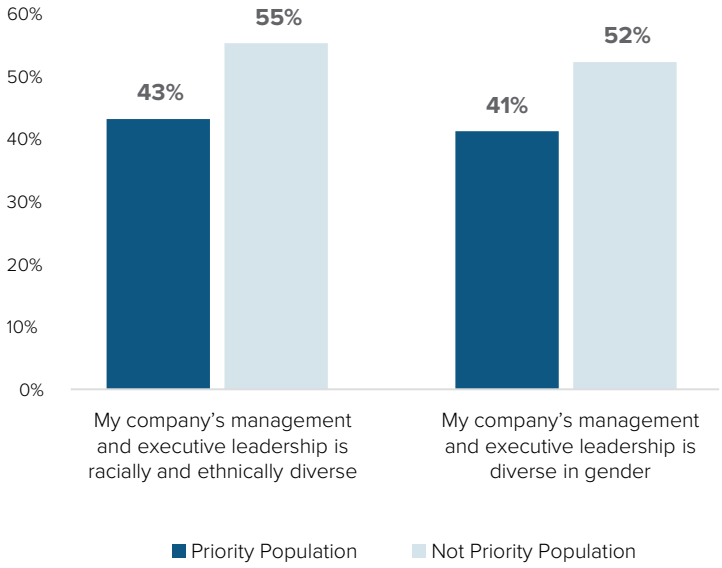


Workers were also asked to rate their level of agreement for various statements regarding representation within their company's leadership.

Less than half (43 percent) of clean energy workers from priority populations strongly agreed that their company's management and executive leadership is racially and ethnically diverse, compared to over half (55 percent) of those not within the priority populations definition.

This difference appears in the identification of company's leadership as diverse in gender as well, with workers from priority populations strongly agreeing at a rate of 41 percent compared to 52 percent of those not from priority populations (Figure 63).

FIGURE 63. STRONG AGREEMENT OF COMPANY DIVERSITY



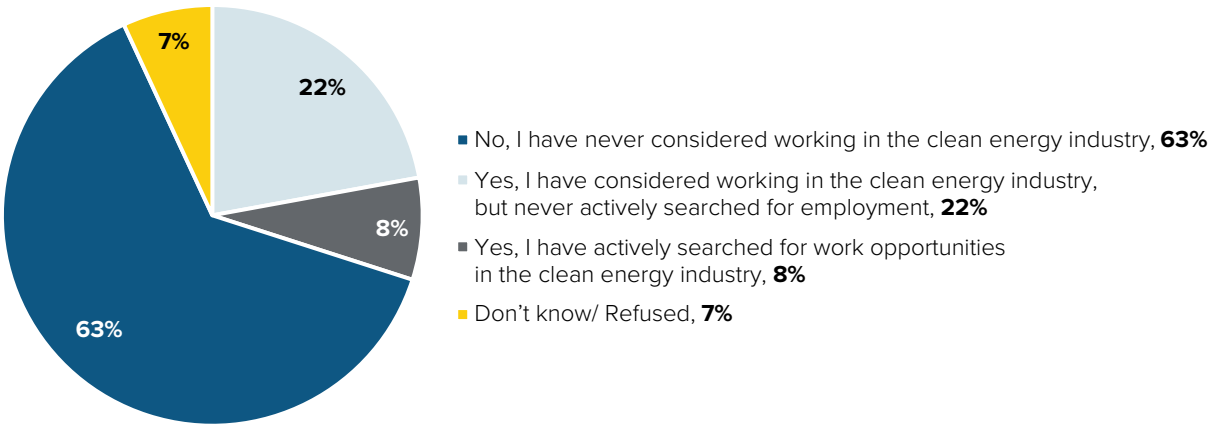
PROSPECTIVE CLEAN ENERGY WORKERS

This section highlights some perspectives of current workers and job seekers who are not involved in clean energy. By asking these prospective workers about their interests in, perceptions of, and barriers to the clean energy industry, more targeted strategies to recruit and attract new workers can be developed.

Interest in the clean energy industry is steadily increasing, with respondents who have considered employment in the industry up by six percentage points from last year's report.

This year, three in ten (30 percent) respondents have considered the clean energy industry, with 8 percent of them having actively looked for clean energy-specific work (Figure 64).

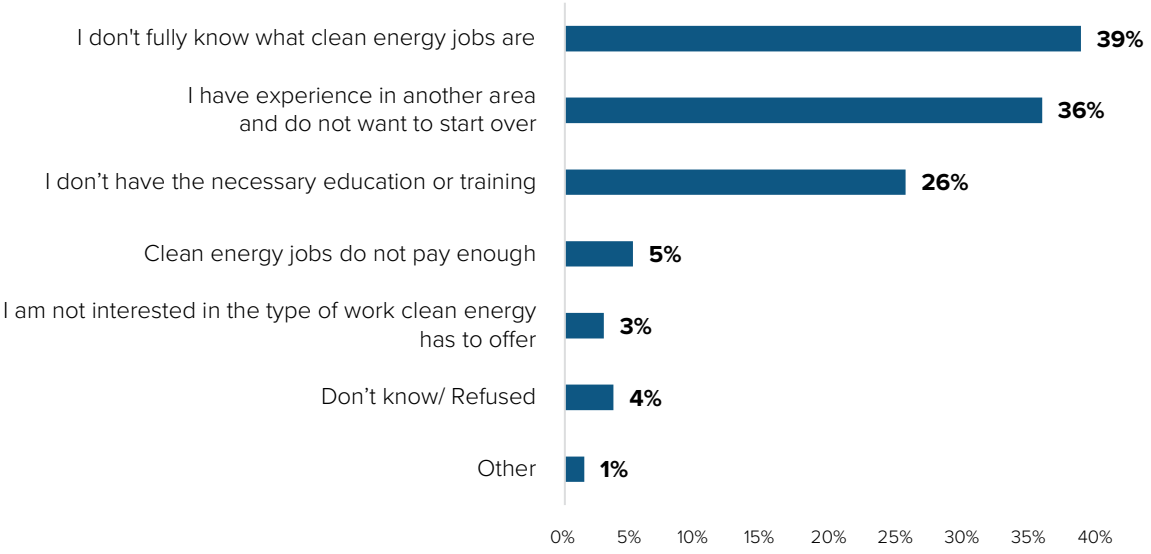
FIGURE 64. HAVE YOU EVER CONSIDERED AND/OR LOOKED FOR EMPLOYMENT IN THE CLEAN ENERGY INDUSTRY



Of workers not currently employed in the clean energy industry, nearly two-thirds (63 percent) have not considered working in the field, a 9 percentage point decrease from the prior year.

There are various reasons why workers may not have considered employment in the clean energy industry. The most cited reason (39 percent) is that workers do not fully know what clean energy jobs are. This reason, along with the quarter of participants who cited not having the necessary education or training, shows the opportunity to expand the clean energy workforce via career awareness and education. In addition, 36 percent of workers cited not wanting to start over in their career given their experience in another area (Figure 65). Notably, of the workers who have not considered or searched for employment in clean energy, a very small portion indicate it is because clean energy jobs are uninteresting or do not pay enough.

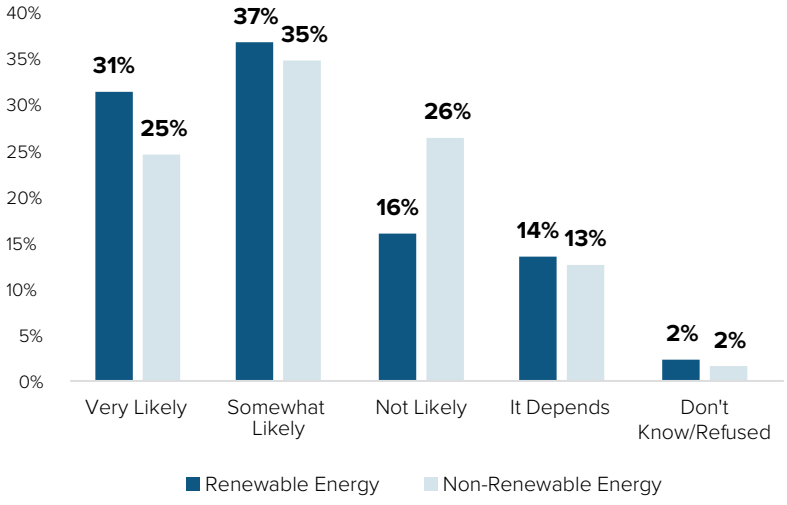
FIGURE 65. WHY HAVE YOU NOT CONSIDERED OR ACTIVELY SEARCHED FOR EMPLOYMENT IN THE CLEAN ENERGY INDUSTRY?



Prospective energy workers are more likely to consider new employment opportunities in renewable energy compared to non-renewable energy.

Sixty-eight percent of prospective energy workers were likely to apply for a job in renewable energy, with 31 percent indicating they would be very likely, compared to 60 percent (with 25 percent very likely) likely to apply for a job in non-renewable energy (Figure 66).

FIGURE 66. IF YOU WERE LOOKING FOR A NEW EMPLOYMENT OPPORTUNITY AND YOU SAW A POSITION IN THE _____ INDUSTRY, HOW LIKELY ARE YOU TO APPLY FOR IT?




CLEAN
ENERGY
INVESTMENTS

Investments are a crucial indicator of the clean energy economy.

The types of investments captured here include early research and development grants designed to help experimental ideas and early innovators become the next big manufacturer of green technology. Other investments tracked are later stage and signify a healthy commercial market that sees established clean energy technologies as profitable and worthy ventures. These investments lead to a variety of additional economic activity and create a range of jobs from research engineers to solar panel installers.

This section draws on investment and expenditure data from a variety of sources, including the Department of Energy's SunShot Initiative, the Advanced Research Projects Agency—Energy (ARPA-E), the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) program, the New York State Office of Science, NYSERDA expenditures, and Crunchbase, a proprietary dataset and platform that collects investments and funding information for public and private companies.

TOTAL INVESTMENTS

Clean energy investments in New York continue to grow rapidly, increasing from a $2.3 billion three-year rolling average from 2020 to 2022 to a $3.9 billion average between 2021 to 2023.

This is an increase of 71 percent across periods, and 690 percent since the 2011 to 2013 period.

The average number of deals from 2021 to 2023 also increased from 1,035 in the previous three-year period to 1,096, which is a growth rate of six percent (Figure 67). The total investment in 2023 alone was over $6.2 billion between 1,224 deals, which is over three times the dollar amount of any year besides 2022 (Figure 68).

Overall, clean energy firms saw a total of $21.19 billion in investments across 9,062 deals between 2011 to 2023.

FIGURE 67. CLEAN ENERGY INVESTMENTS (MILLIONS), 2011-2023 THREE-YEAR ROLLING AVERAGES

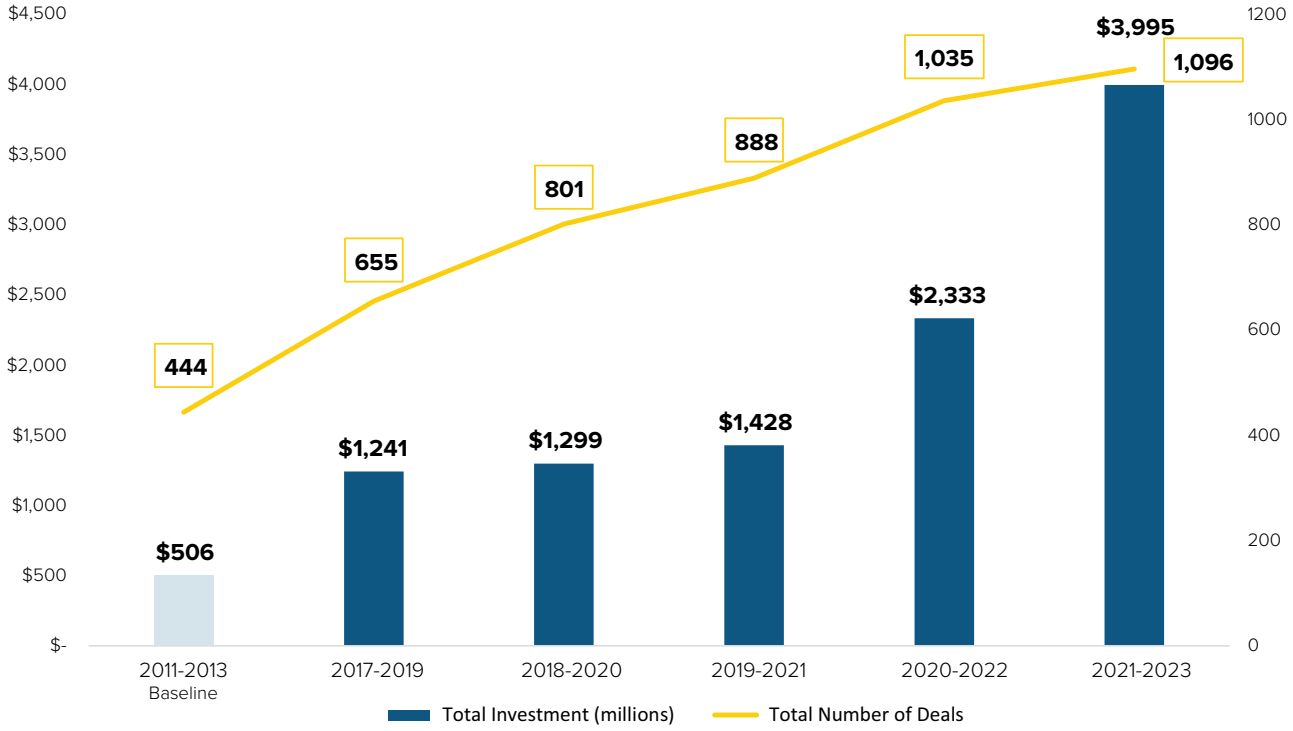
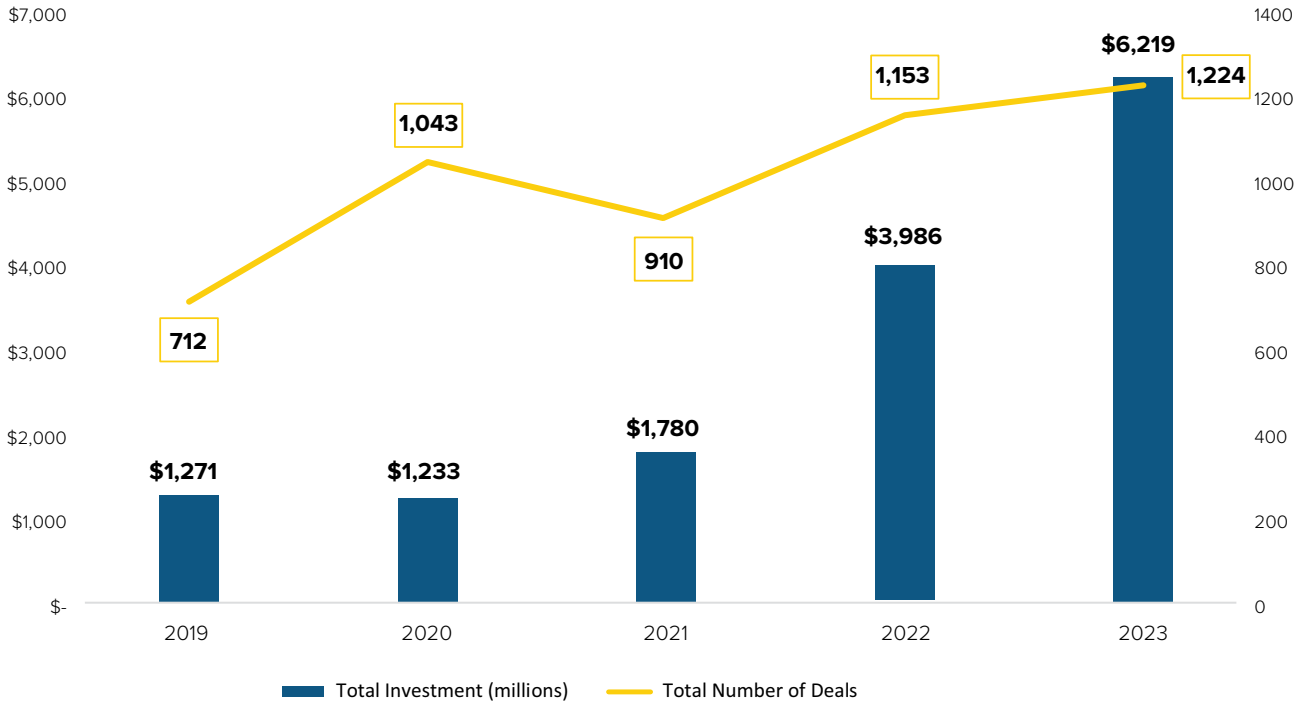


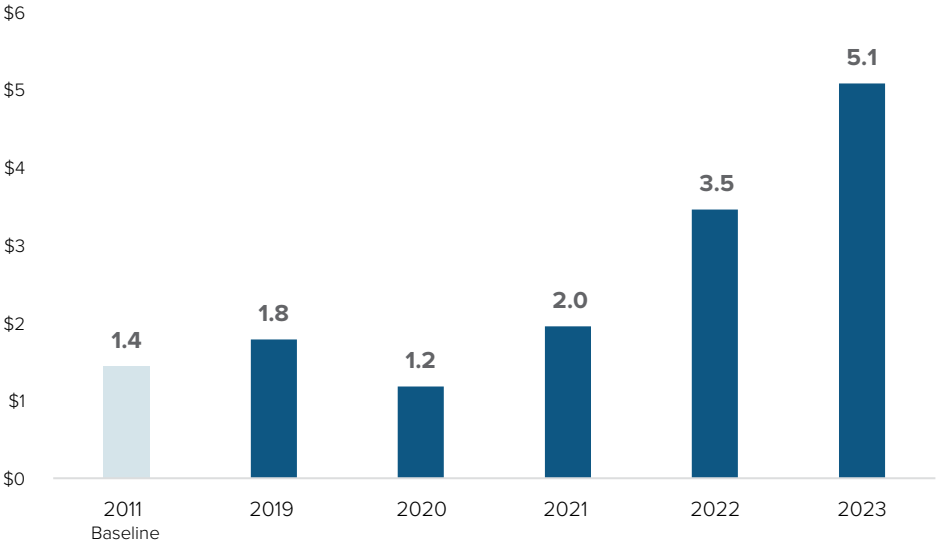
FIGURE 68. CLEAN ENERGY INVESTMENTS (MILLIONS), 2019-2023

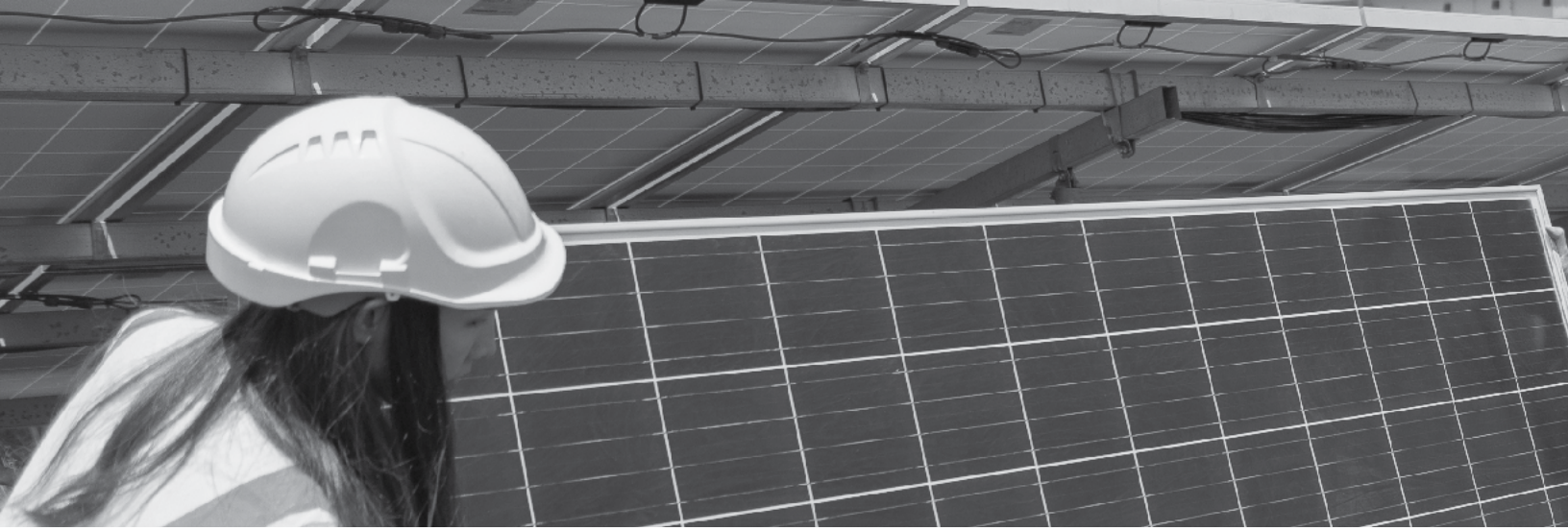


In addition, the value of individual deals continues to grow year after year.

When tracking began in 2011, the average deal size was $1.4 million, while in 2023 the average deal size is $5.1 million, a 264 percent increase (Figure 69).

FIGURE 69. AVERAGE CLEAN ENERGY INVESTMENT SIZE (MILLIONS), 2011-2023





Investment in renewable electric power generation experienced unprecedented growth in 2023, growing by over $2.6 billion from 2022, a 208 percent increase.

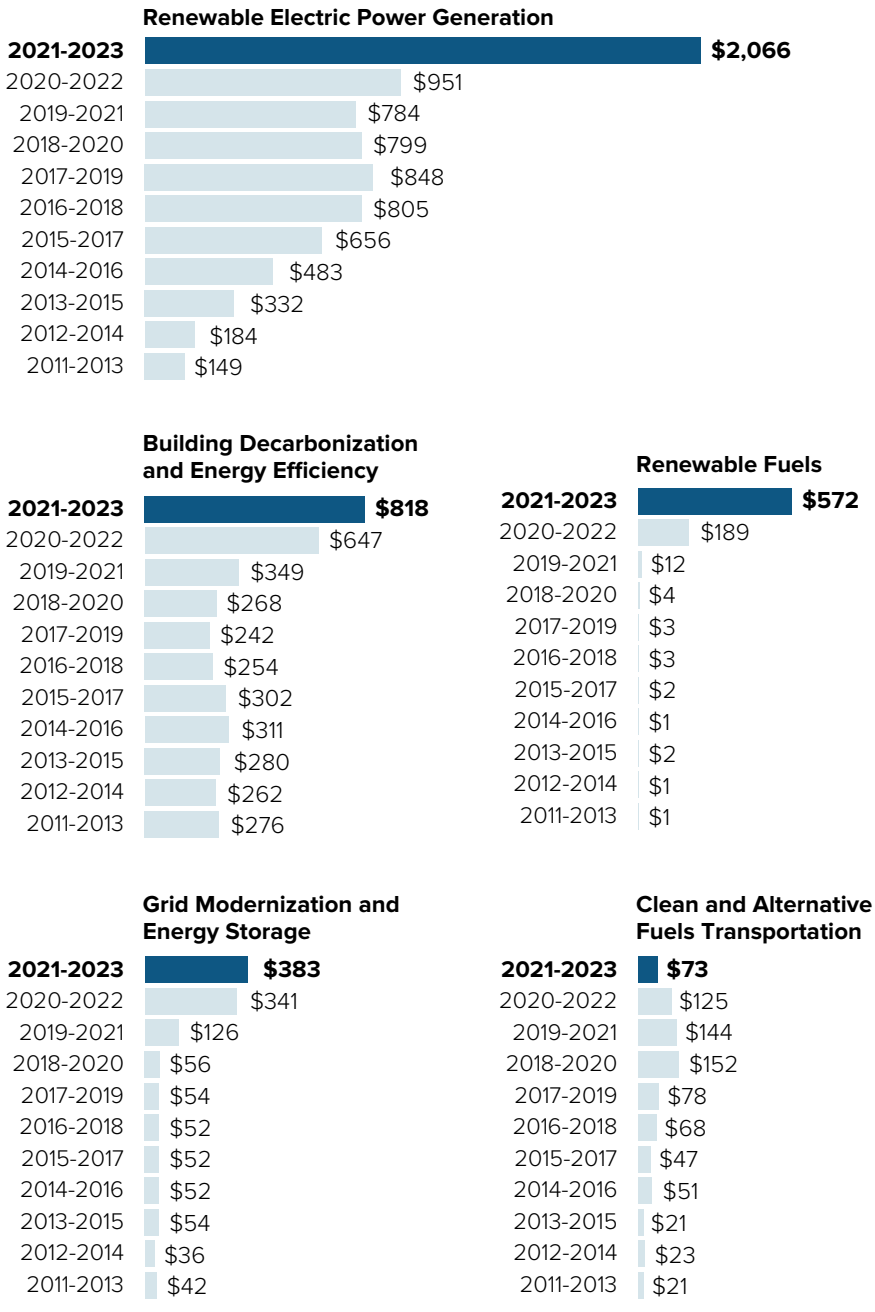
Renewable electric power generation is especially important to transition the State's electricity system from fossil fuels and provides means to boost the economy through in-state generation. This was led by a $1.2 billion investment from the company EnergyRe, supporting wind and solar generation.

The renewable fuels sector also saw extreme growth, increasing by $621 million, a 116 percent increase from 2022. The largest investment in this sector this year was a $500 million investment by Natrion to pioneer batteries with cleaner, renewable fuels.

Investments in two sectors—building decarbonization and energy efficiency, and grid modernization and energy storage—decreased between 2022 to 2023, though the three-year rolling averages in both sectors reached all-time highs.

The only rolling average to decrease from the 2020 to 2022 period to the 2021 to 2023 period was for investments in clean and alternative fuels transportation. However, clean and alternative fuels transportation investments did increase by $12 million, or 16 percent from 2022 to 2023 (Figure 70).

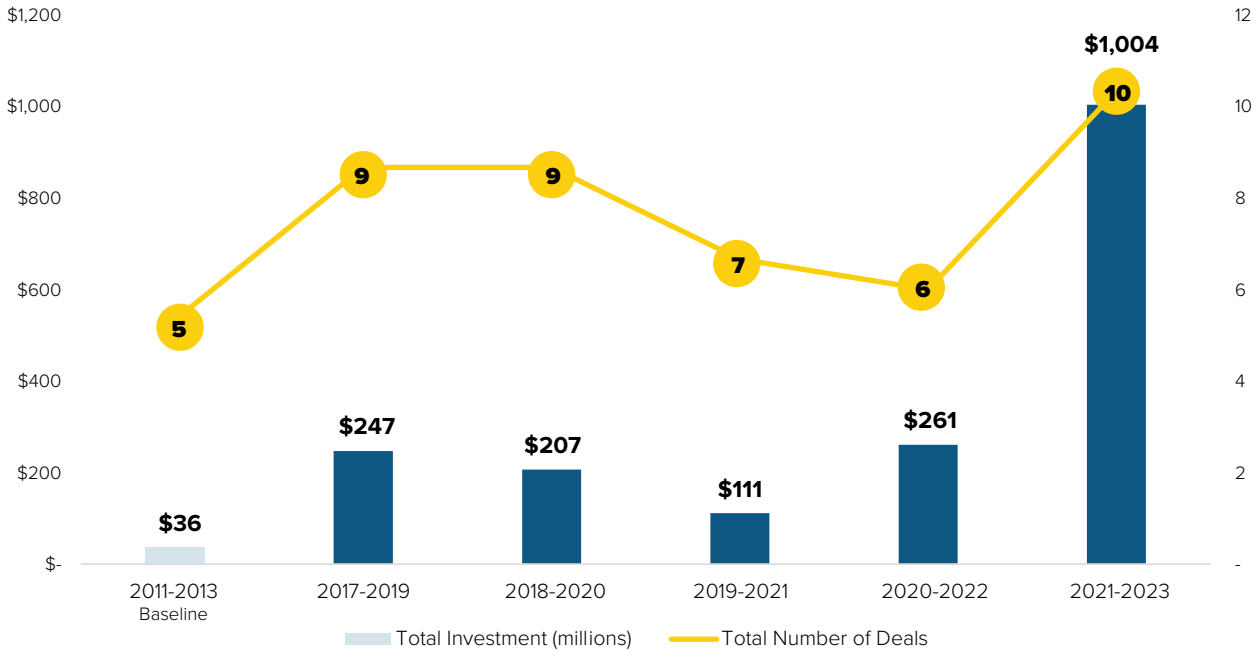
FIGURE 70. TOTAL CLEAN ENERGY INVESTMENTS BY TECHNOLOGY (MILLIONS), 2011-2023 THREE-YEAR ROLLING AVERAGES[55]



The majority of investments in New York's clean energy industry originate from the public sector, though the proportion of funding from the private sector has been increasing since 2020.

Private investment experienced a significant drop due to the pandemic, representing only 3 percent of dollars invested in 2020. However, this figure has increased each year since, with 36 percent of dollars invested in 2023 originating from the private sector. This is tied as the second highest proportion of funding from the private sector since tracking began in 2011. Two of the three largest private deals within the last three years occurred in 2023 (Figure 71).

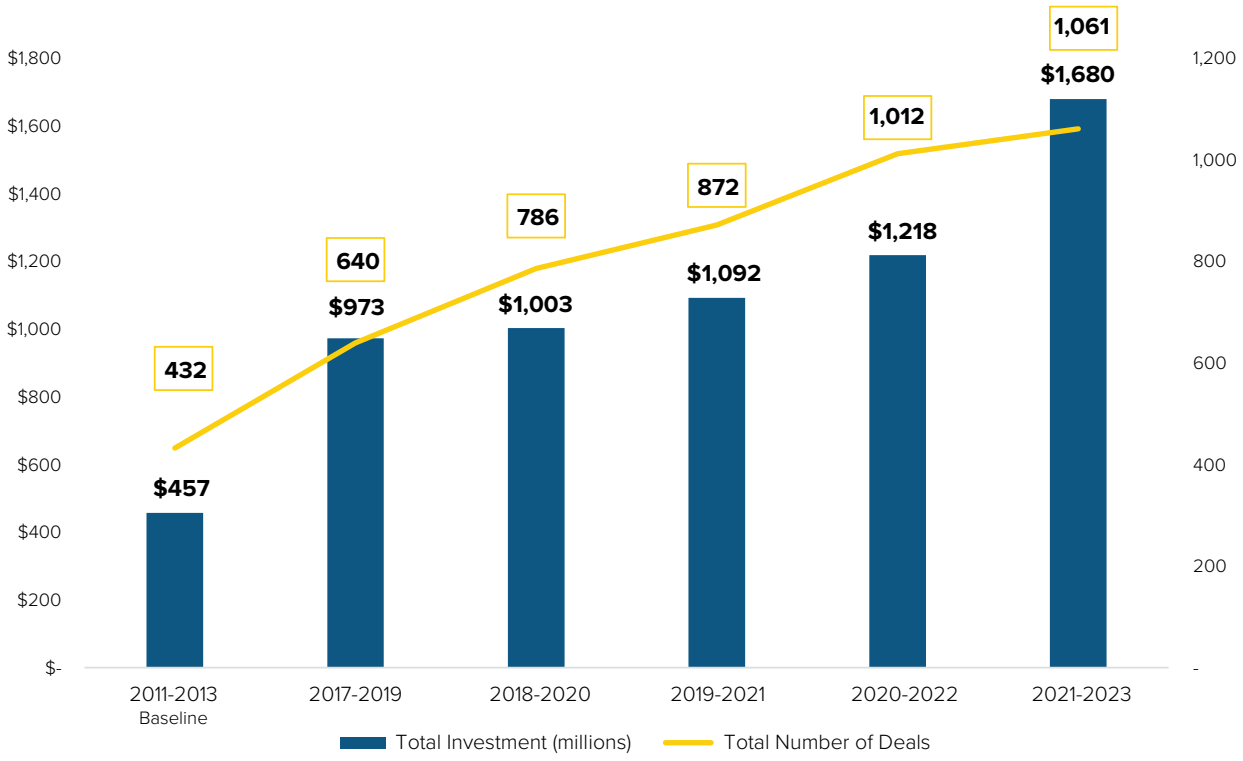
FIGURE 71. TOTAL PRIVATE CLEAN ENERGY FUNDING (MILLIONS), 2011-2023 THREE-YEAR ROLLING AVERAGES[56]



Public expenditure in clean energy has grown steadily since 2011, with an overall 145 percent increase in the average number of deals between 2011 to 2013 and 2021 to 2023 (Figure 72).

More recently, the average public expenditure climbed 38 percent to $1.7 billion in the period from 2021 to 2023 compared to 2020 to 2022. In 2023, the top five public investments in New York were all in renewable electric power generation technology.

FIGURE 72. TOTAL PUBLIC CLEAN ENERGY FUNDING (MILLIONS), 2011-2023 THREE-YEAR ROLLING AVERAGES[57]



INVESTMENTS BY INNOVATION PHASE

The following section provides a detailed breakdown of investment data by each of the three stages of innovation funding. It should be noted that not all investments and expenditures can be categorized into a distinct innovation phase due to lack of data availability regarding a specific abstract, project, or investment deal. As such, the sum of totals presented by innovation phase will not sum to the total values provided in Figure 67.

Below is a brief description of each phase of innovation:

Phase I: Research & Prototyping

This stage, which begins with basic research and ideation, is typically carried out in universities and public laboratories and includes everything up to bench-testing of prototypes. Funding for these activities almost always originates from public sources, though occasionally it includes angel or seed funding as well as private university funding. Other non-funding metrics useful for estimating this phase of activity include academic publications and patent activity.

Phase II: Demonstration & Acceleration

Innovation in this stage often involves startup firms' refinement of their technology and expansion of commercial readiness. Activity in this phase draws in part on private capital, typically in the form of seed funding, and often also on grant programs aiming for economic development. Additional metrics useful for estimating activity in this phase include numbers of physical incubator or accelerator spaces, venture capitalist investors and early-stage venture investment, demonstration facilities, and technology transfer licenses.

Phase III: Commercialization & Growth

In this final stage of innovation, companies bring fully developed products to wide commercial availability. Useful metrics for this phase include quantities of venture capital and project finance, as well as economic development grant funding and tax incentives.

FIGURE 73. THE STAGES OF INNOVATION

PHASE I: RESEARCH AND PROTOTYPING

> Ideation

> Theoretical research

> Prototype development

> Lab testing

PHASE II: DEMONSTRATION AND ACCELERATION

> Product testing

> System evaluation

> Market research

PHASE III: COMMERCIALIZATION AND GROWTH

> Expand manufacturing capacity

> Identify early customers

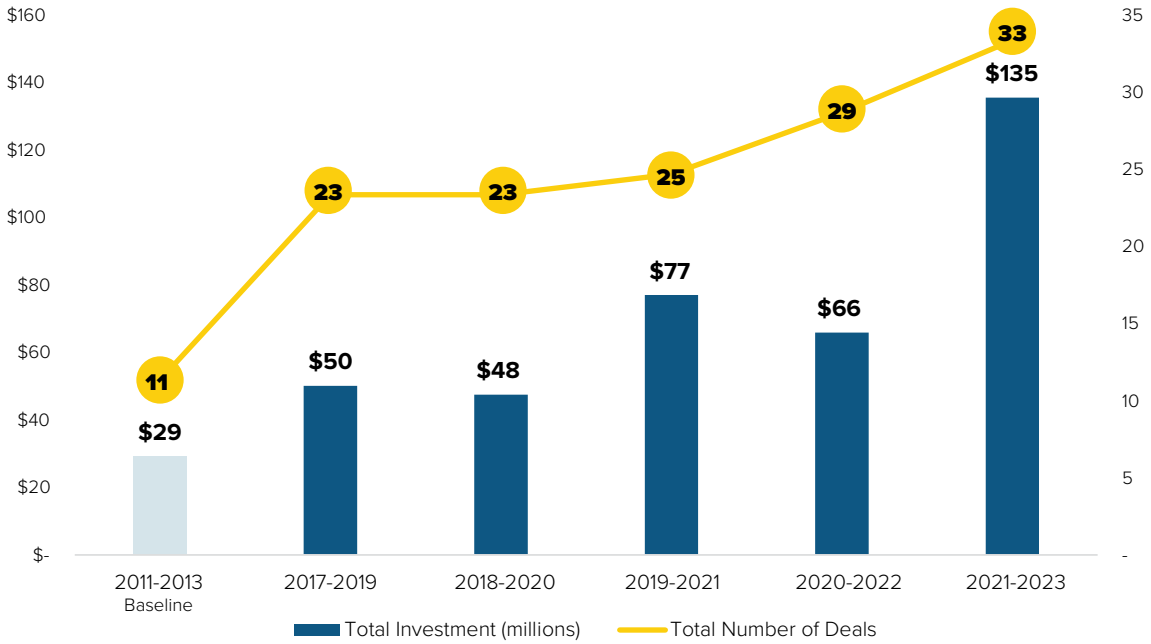
PHASE I: RESEARCH & PROTOTYPING

Phase I begins with basic research and ideation, and funding for these activities almost always originates from public sources. After a decrease in average Phase I investments between the 2020 to 2022 and 2019 to 2021 periods, investments more than doubled during the 2021 to 2023 period.

Investments between 2021 to 2023 averaged to $135 million, a 106 percent increase from 2020 to 2022.

Between these two periods, the average number of deals increased from 29 to 33 (Figure 74). The largest Phase I investment in 2023 was $139 million in renewable fuels by BlocPower, a company focused on energy-efficient home upgrades.

FIGURE 74. NEW YORK PHASE I INVESTMENTS (MILLION), 2011-2023 THREE-YEAR ROLLING AVERAGES



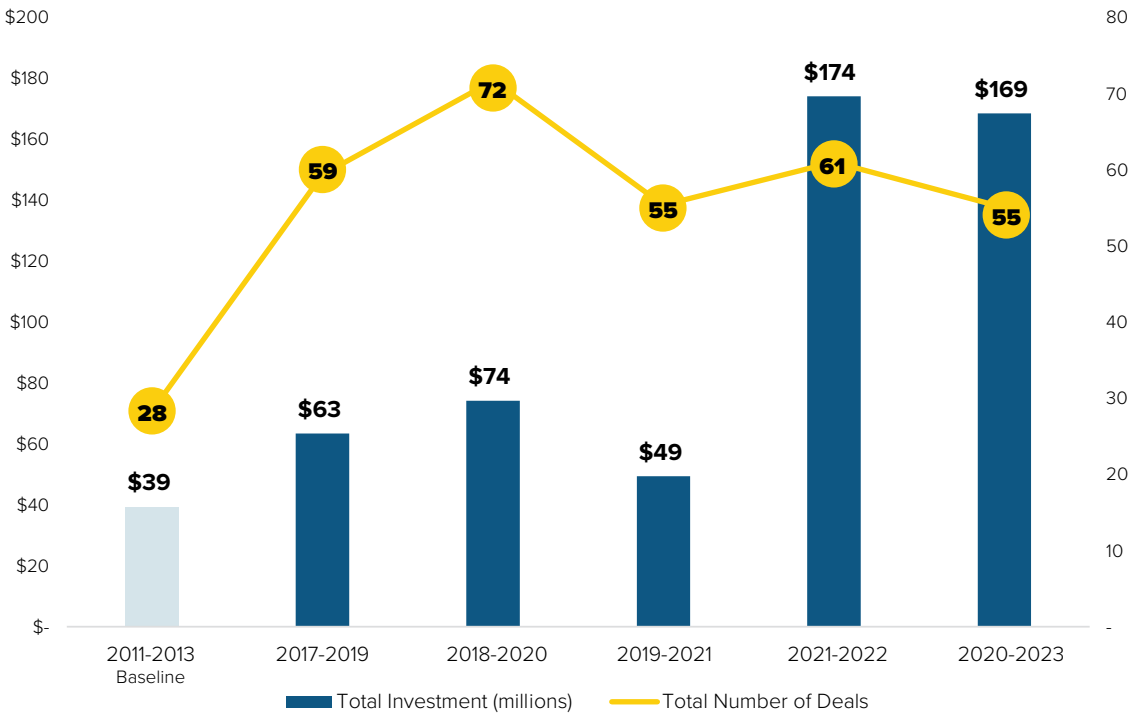
PHASE II: DEMONSTRATION & ACCELERATION

Innovation in this stage often involves startup firms' refinement of their technology and expansion of commercial readiness. The number of deals for phase II of innovation has been volatile since 2018.

The average annual innovation investment between 2021 to 2023 is $169 million, a slight decrease from the $174 million in 2020 to 2022, but a 127 percent increase from the total investment between 2018 to 2020.

While the total amount of investment dollars has been increasing in phase II, the number of deals has been decreasing since the 2018 to 2020 period. Potential reasoning for this shift could be a transition toward larger capital projects, or perhaps greater investor confidence to invest larger amounts (Figure 75).

FIGURE 75. NEW YORK PHASE II INVESTMENTS (MILLION), 2011-2023 THREE-YEAR ROLLING AVERAGES

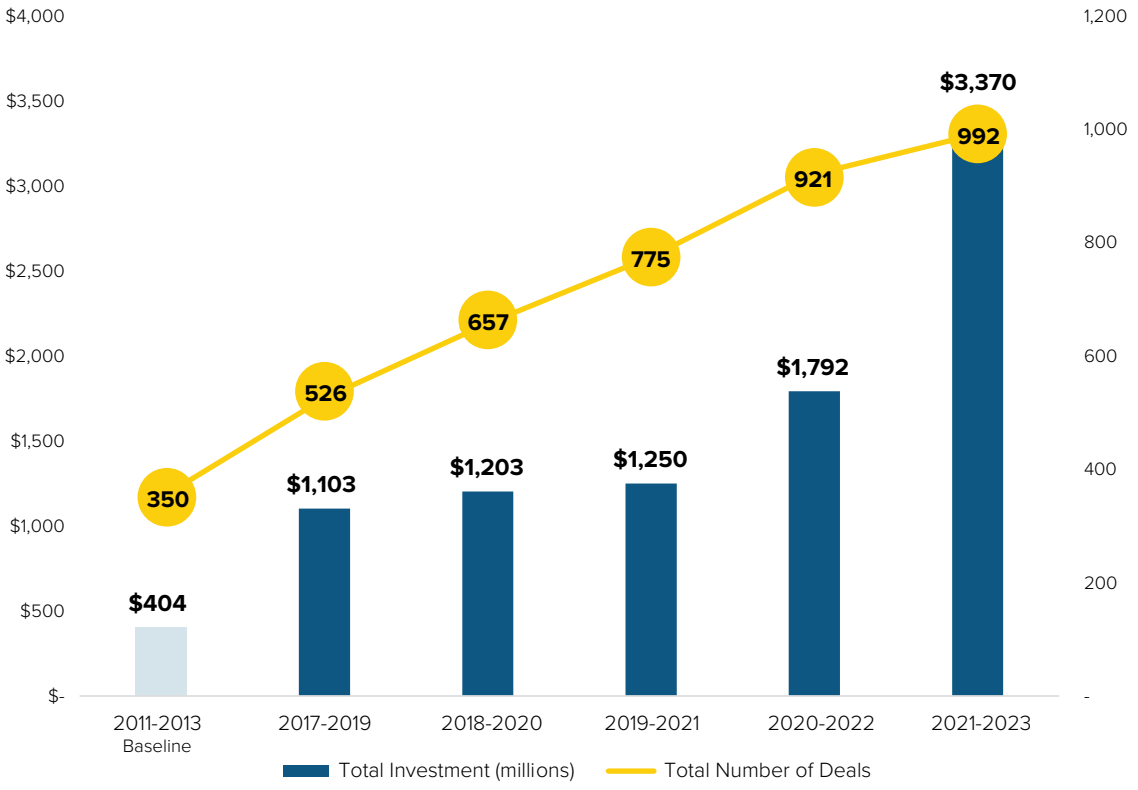


PHASE III: COMMERCIALIZATION & GROWTH

Phase III technology makes up the greatest share of investments, at 92 percent of total investment identified by innovation phase between 2021 to 2023.

In this final stage of innovation, companies bring fully developed products to wide commercial availability. Investments in Phase III innovation have steadily increased among all three-year rolling averages, with a fairly dramatic increase in investment between the most recent rolling average (2021 to 2023) and the previous period (2020 to 2022), by 88 percent from $1.8 billion to $3.4 billion. The average number of deals also increased from 921 to 992, an eight percent increase (Figure 76).

FIGURE 76. NEW YORK PHASE III INVESTMENTS (MILLION), 2011-2023 THREE-YEAR ROLLING AVERAGES



ECONOMIC IMPACT ANALYSIS

7,653

In 2023 there was a net increase of 7,653 jobs across New York's clean energy industries.

New clean energy jobs can spur "indirect" job growth in other related industries that indirectly support clean energy projects via supply chain impacts, or spur job growth in unrelated industries ("induced") as a result of higher demand for products and services from newly "directly" employed clean energy workers.

An economic impact analysis of these effects finds net increase of 13,911 jobs spurred by additional clean energy activity.

The industries with the largest employment growth during this time were maintenance and repair construction of residential structures, construction of new commercial structures, building material and garden equipment and supplies retail stores, electric power transmission and distribution, and labor and civic organizations.[58]

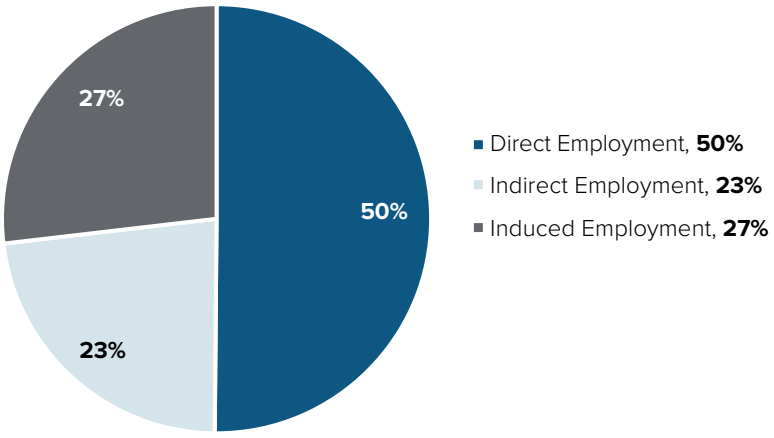
Results from the creation of 6,926 new direct jobs show that there was a total impact of 13,911 jobs gained due to clean energy economic activity in 2023, of which 3,224 were indirect jobs and 3,741 were induced jobs.[59] These jobs were responsible for almost $2.3 billion in gross state product (GSP) and $1.3 billion in labor income (Table 11).

TABLE 11. TOTAL ECONOMIC IMPACT OF THE NET CHANGE IN CLEAN ENERGY JOBS IN NEW YORK STATE, 2023

Impact Type	Employment	Value Added	Labor Income
Direct Effect	**6,926**	**$1,255,483,446**	**$732,997,209**
Indirect Effect	**3,244**	**$560,927,884**	**$311,317,536**
Induced Effect	**3,741**	**$518,552,746**	**$289,516,897**
Total Effect	**13,911**	**$2,334,964,076**	**$1,333,831,642**

Direct employment accounted for half of the net job gains, while indirect employment accounted for 23 percent and induced employment accounted for 27 percent (Figure 77).

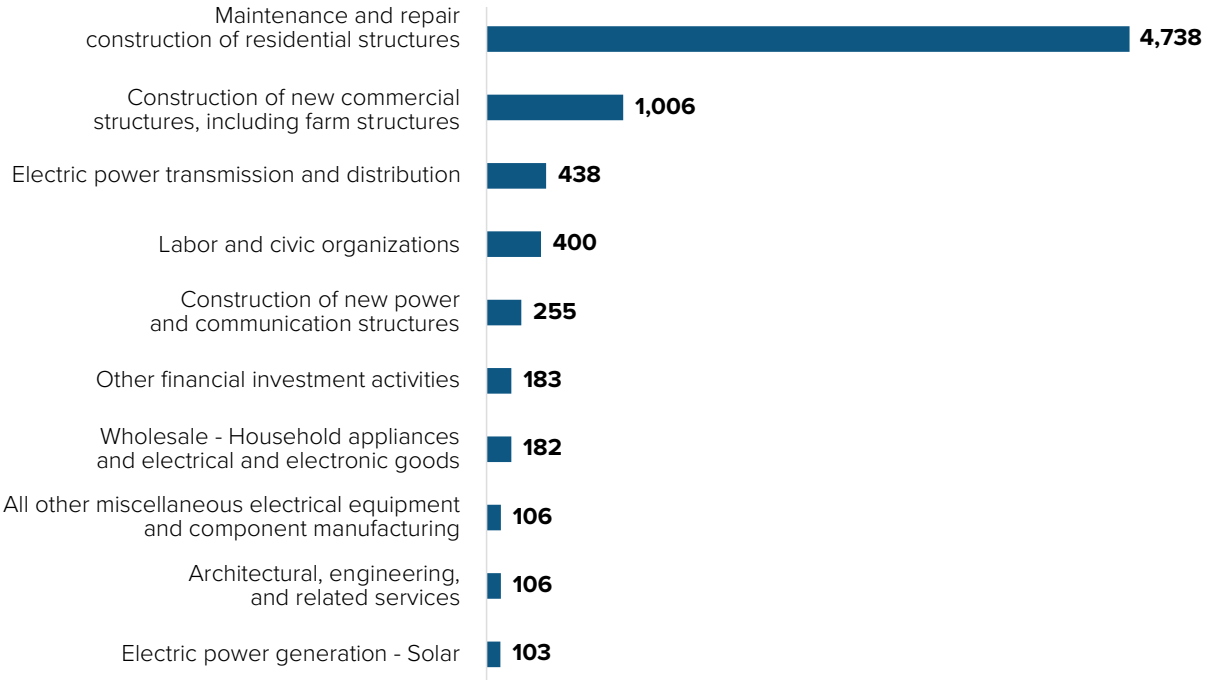
FIGURE 77. PORTION OF JOBS GAINED BY IMPACT TYPE



DIRECT INDUSTRIES

The clean energy industries with the largest direct job gains include maintenance and repair construction of residential structures, construction of new commercial structures, labor and civic organizations, electric power transmission and distribution, and construction of new power and communications structures (Figure 78).

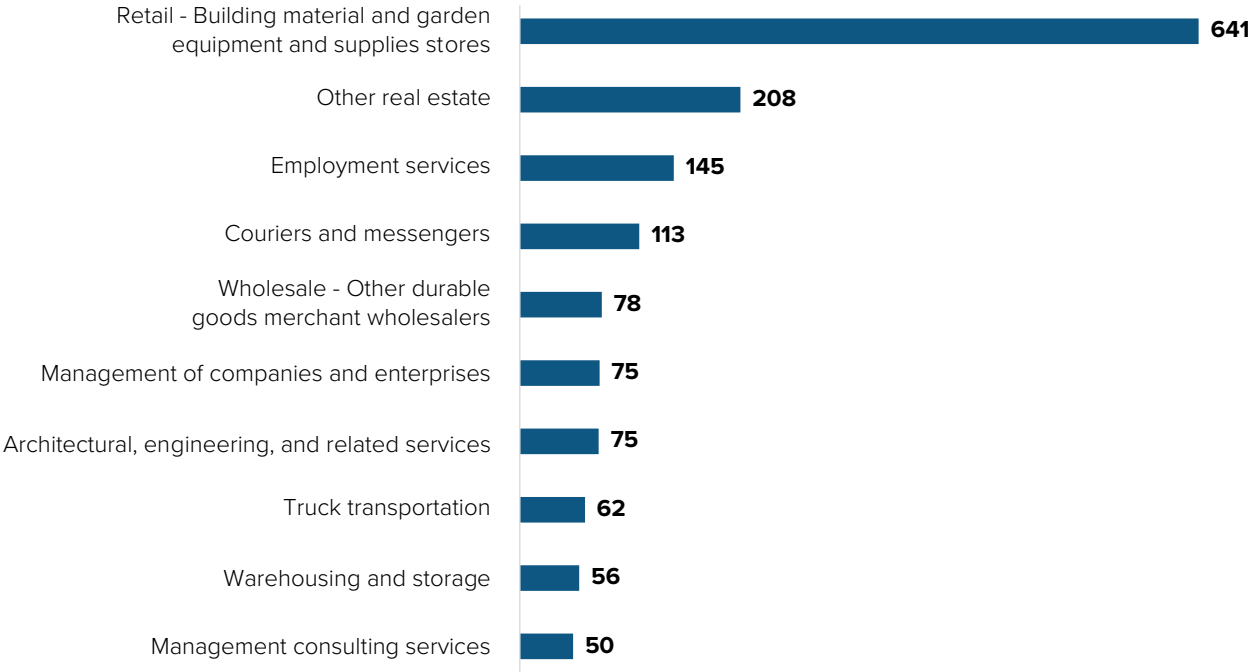
FIGURE 78. TOP 10 CLEAN ENERGY DIRECT INDUSTRIES IN NEW YORK STATE BY EMPLOYMENT GAINS, 2023



INDIRECT INDUSTRIES

Among the industries that make up the supply chain for New York's clean energy sector, those that saw the largest job growth from 2022 to 2023 were building material and garden equipment and supplies retail stores, real estate, employment services, couriers and messengers, and management of companies and enterprises (Figure 79).

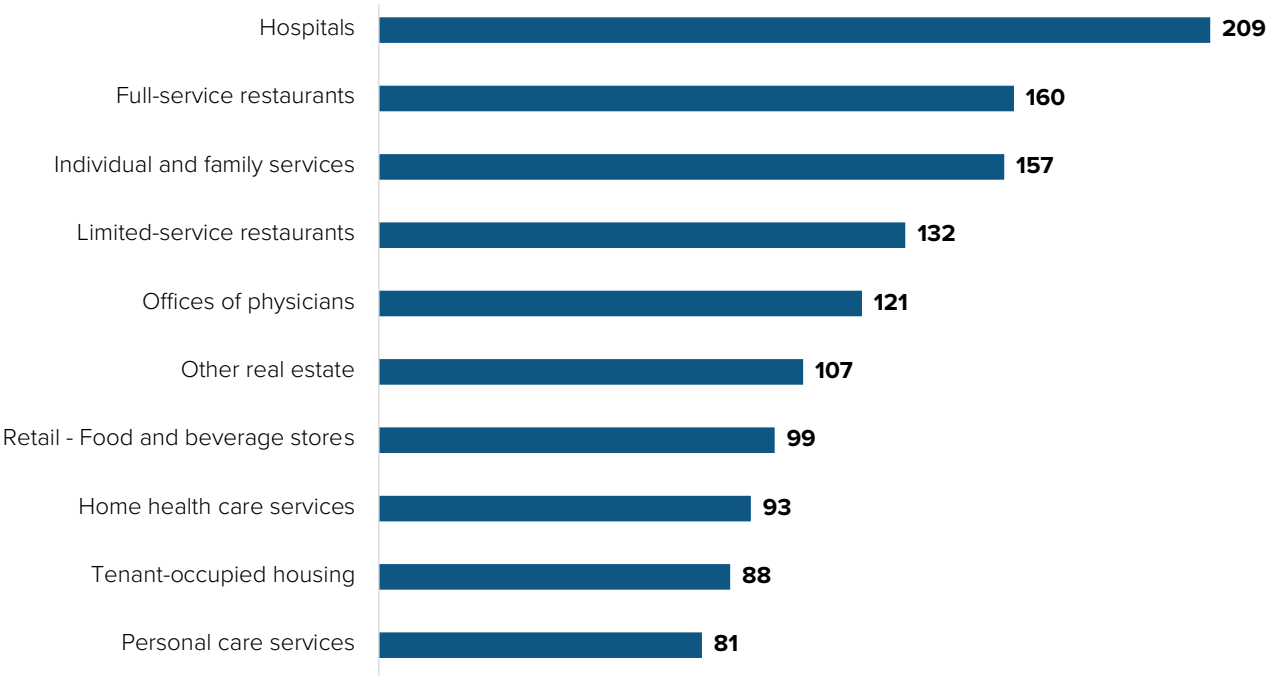
FIGURE 79. TOP 10 SUPPLY CHAIN (INDIRECT) INDUSTRIES IN NEW YORK STATE BY EMPLOYMENT GAINS, 2023



INDUCED INDUSTRIES

Whereas clean energy supply chain industries feel the effects of clean energy firms' increased investments and spending, other industries feel the ("induced") effects of more clean energy workers' spending of their wages in the State. These effects are felt in hospitals, restaurants, individual and family services, physicians' offices, real estate, and supermarkets (Figure 80). Recognizing the job increase induced by clean energy worker spending, along with direct and indirect job growth, provides a holistic view of the impacts New York clean energy jobs have in the State.

FIGURE 80. TOP 10 INDUCED INDUSTRIES IN NEW YORK STATE BY EMPLOYMENT GAINS, 2023



FISCAL IMPACTS

New York's clean energy economy makes meaningful annual contributions to federal, State, and local government revenues through taxes on production and imports. New York's clean energy jobs are responsible for roughly $322 million in State and local taxes on production and imports and almost $314 million in federal taxes (Table 12).

TABLE 12. IMPACT OF NEW YORK CLEAN ENERGY JOBS ON TAXES ON PRODUCTION AND IMPORTS, 2023

Taxes	Impact on Taxes
Local Taxes	**$191,403,710**
State Taxes	**$130,877,819**
Federal Taxes	**$313,486,012**

OUT-OF-SCOPE INDUSTRIES

IMPLAN identifies job changes in industries that are affected by the clean energy industry but are not part of the clean energy economy. Identifying job change in these "out-of-scope" industries provides a better idea of the overall size of New York's clean energy economy and helps to improve estimates of in-scope industries in future years. Table 13 provides a list of New York's Clean Energy supply-chain industries that were not included in the original dataset (by NAICS code).

TABLE 13. NEW YORK'S CLEAN ENERGY OUT-OF-SCOPE INDIRECT INDUSTRIES

Description	Indirect Jobs
Retail - Building material and garden equipment and supplies stores	**641**
Other real estate	**208**
Employment services	**145**
Couriers and messengers	**113**
Warehousing and storage	**75**
Truck transportation	**62**
Services to buildings	**56**
Investigation and security services	**46**
Legal services	**45**
Full-service restaurants	**43**
All other crop farming	**42**

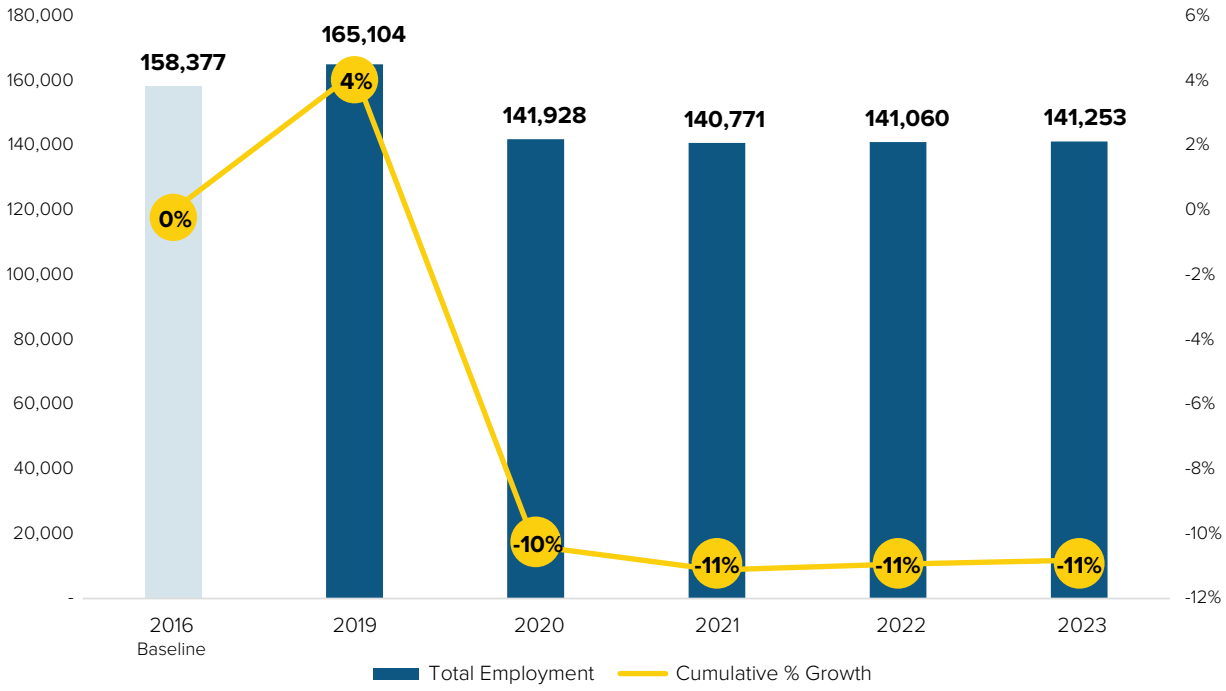
TRADITIONAL ENERGY EMPLOYMENT

This section details traditional energy employment for New York derived from the most recent United States Energy and Employment Report (USEER). For the purposes of this 2024 New York Clean Energy Industry Report, the term "traditional energy" refers to fossil-based energy and additional energy technologies not categorized into the five major clean energy technology areas identified in earlier sections of this report.

Some aspects of the broader energy system that are reported here within traditional energy will continue to play a role in New York's clean energy future (including sectors such as transmission, distribution, and storage, as well as nuclear power generation). However, for consistency and annual comparison purposes, they are not explicitly labeled as "clean energy" and are separated out from the clean energy section. There were also many workers that were unable to be explicitly labeled as "clean energy" due to splitting their time evenly between clean and non-clean energy technologies, working in uncategorized technologies, or not having enough information specified by employers; these workers—which likely do conduct significant clean energy work—were placed in the "other" detailed technologies.

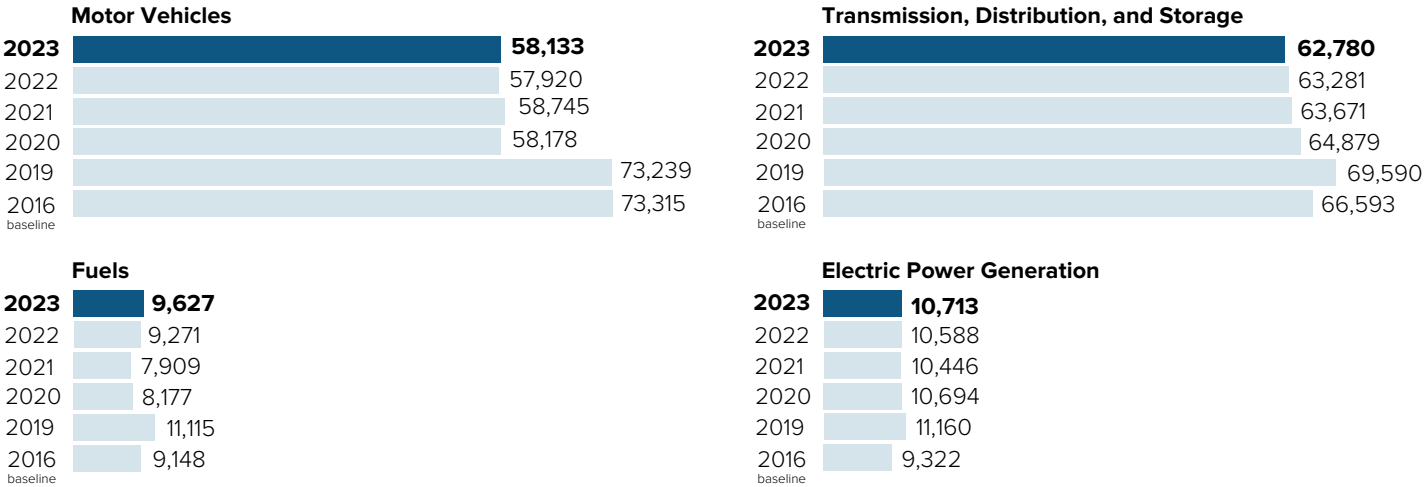
Traditional energy employment in New York grew by only about 0.1 percent from 2022 to 2023, compared to the 4.6 percent for clean energy employment (Figure 81).

FIGURE 81. NEW YORK TRADITIONAL ENERGY EMPLOYMENT, 2016-2023



The traditional technology sector to gain the most jobs from 2022 to 2023 was the fuels sector, with a four percent change, translating to 356 jobs. The electric power generation and motor vehicles sector saw minor changes of less than one percent, while transmission, distribution, and storage decreased by about one percent, or 500 jobs (Figure 82).

FIGURE 82. NEW YORK TRADITIONAL ENERGY EMPLOYMENT BY TECHNOLOGY, 2016-2023



APPENDIX A: CLEAN ENERGY TECHNOLOGY LIST

A clean energy job is defined as any worker that is directly involved with the research, development, production, manufacture, distribution, sales, implementation, installation, or repair of components, goods, or services related to the following sectors of the clean energy economy: renewable electric power generation; grid modernization and energy storage; building decarbonization and energy efficiency; renewable fuels; and clean and alternative fuels transportation. These jobs also include supporting services such as consulting, finance, tax, and legal services related to energy.

RENEWABLE ELECTRIC POWER GENERATION

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

GRID MODERNIZATION AND ENERGY STORAGE

Electric Power Transmission and Distribution

- Smart Grid

Energy 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

RENEWABLE FUELS

- Woody Biomass
- Other Ethanol and Non-Woody Biomass, including biodiesel

CLEAN AND ALTERNATIVE FUELS TRANSPORTATION

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

BUILDING DECARBONIZATION AND 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

APPENDIX B: RESEARCH METHODOLOGY

EMPLOYMENT DATA

Data for the 2024 New York Clean Energy Industry Report is taken from data collection for the US Energy and Employment Report (USEER). The full methodology can be found at www.energy.gov/policy/us-energy-employment-jobs-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 2024 USEER survey in New York resulted in more than 32,400 calls and more than 4,800 emails. Approximately 1,670 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 +/-2.39 percent at a 95 percent confidence level.

INTENSITY-ADJUSTED CLEAN ENERGY EMPLOYMENT

Intensity-adjusted clean energy employment was 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 percent of their time working on energy-related activities and what percent spends all of their time. Using the adjusted thresholds, employment by state is then split into three groups, those that spend all (100 percent) of their time on energy-related activities, those that spend a majority (50 to 99 percent) of their time, and those that spend less than a majority (0 to 49 percent) 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 percent group. Intensity-adjusted employment estimates are sum of these products.

DISADVANTAGED COMMUNITY ANALYSIS

BW Research developed a novel dataset of place of employment and place of residence estimates for clean energy workers. Using county-level value chain clean energy employment from the 2024 US Energy and Employment Report, the research team proportioned census-tract level data on place of employment and place of residence data by value chain from the U.S. Census Bureau's Longitudinal Employer-Household Dynamics (LEHD) Origin-Destination Employment Statistics (LODES)[61] Workplace Area Characteristics and Residence Area Characteristics, respectively. This census-tract level data allowed the research team to develop estimates for census-tract defined Disadvantaged Communities.[62] Existing census tract level data from the Technical Documentation Appendix: Communities Indicator Workbook[63] was used for population estimates. While the estimates generated through this exercise are imprecise estimates given the geographic granularity of census tracts, the data generated provide useful information into clean energy related economic activity, opportunity, and worker patterns.

NEW YORK EMPLOYER AND WAGE SURVEY

BW Research conducted employer interviews with clean energy organizations throughout New York State. The survey sample included a compilation of known clean energy firms in New York that BW Research has curated for the last decade and online panel through a third party of relevant businesses (firms in utilities, construction, manufacturing, wholesale trade, engineering, maintenance and repair, etc.). Known New York clean energy firms from BW Research's sample were recontacted as part of the research effort. Samples were de-duplicated before fielding the employer survey and contact information was checked upon completion of data collection to ensure that duplicate responses were removed. The survey instrument was programmed internally by BW Research and each respondent was assigned a unique ID to prevent duplication.

In order to be considered a clean energy business, respondents had to qualify for a number of screener questions, including;

"Is your organization involved, in whole or in part, with an activity related to clean energy, including building electrification and energy efficiency and clean and alternative transportation?

We define this as being directly involved in the research and development, manufacture, sales, installation, repair, and maintenance of goods and/or services related to energy technologies, including renewable energy and grid modernization, electric vehicles and other alternative transportation, and energy efficiency in buildings."

The employer survey was fielded between May 8 and May 26, 2024 and resulted in 258 total completes by firm. The average survey duration was 10.9 minutes.

NEW YORK WORKER SURVEY

BW Research conducted a survey of individuals in the state of New York that were of working age, including those that were currently employed and those that were currently unemployed but looking for work. Respondents were recruited from a panel of individuals active in the workforce that lived in the state of New York. The survey further split current workers into those currently employed in a clean energy field and those that were not. In order to be considered a clean energy worker, respondents had to qualify for a number of screener questions, including;

"Do/did you work in a clean energy or clean energy-related field, including building electrification and energy efficiency and clean and alternative transportation?

We define this as being directly involved in the research and development, manufacture, sales, installation, repair, and maintenance of goods and/or services related to energy technologies, including renewable energy and grid modernization, electric vehicles and other clean and alternative transportation, and energy efficiency in buildings."

The priority worker survey was fielded between May 8 and May 26, 2024 and resulted in 226 clean energy worker completes (out of 443 total completes). The average survey duration was 9.4 minutes.

NEW YORK EV CHARGING SURVEY

BW Research conducted employer interviews with firms involved with EV charging throughout New York State. The survey sample included a compilation of known EV charging firms in New York that BW Research has curated for the several years and online panel through a third party of relevant businesses (firms in utilities, construction, manufacturing, wholesale trade, engineering, maintenance and repair, etc.). Known New York EV charging firms from BW Research's sample were recontacted as part of the research effort. Samples were de-duplicated before fielding the employer survey and contact information was checked upon completion of data collection to ensure that duplicate responses were removed. The survey instrument was programmed internally by BW Research and each respondent was assigned a unique ID to prevent duplication.

In order to be considered an EV charging business, respondents had to qualify for a number of screener questions, including;

"Is your firm involved with the design, manufacture, installation, operation, sale, maintenance, or management of Electric Vehicle (EV) Charging Stations?"

The EV charging employer survey was fielded between May 8 and May 25, 2024 and resulted in 181 total completes by firm. The average survey duration was 9.9 minutes.

ECONOMIC IMPACT ANALYSIS

BW Research used IMPLAN, an input-output model that traces spending and infrastructural developments through the economy to determine the economic impact of the change in clean energy jobs in 2023 to New York. The cumulative effects of the initial job change are quantified, and the results are categorized into direct, indirect, and induced effects. Direct effects show the change in the economy associated with the initial job creation (or loss), or how the industry experiences the change. Indirect effects include all the backward linkages, or the supply chain responses as a result of the initial job change. Induced effects refer to household spending and are the result of workers who are responsible for the direct and indirect effects spending their wages.

Model Input

To develop the economic model in IMPLAN, BW Research identified the clean energy job net change in the State of New York disaggregated by NAICS code between 2022 and 2023, as calculated for the 2024 NYCEIR (i.e., in-scope jobs). These NAICS codes are then translated to IMPLAN industry code through an IMPLAN provided crosswalk. All job changes from 2022 to 2023, whether positive or negative, were added as input to IMPLAN by IMPLAN industry code. The study area was set as the State of New York and the event year was set to 2022.

Model Output

Results from the economic impact analysis included **employment** (full- and part-time jobs), **labor income**, **taxes**, and **value added**.[64] Value added is the total output minus the cost of inputs from outside the firm; it is a measure of the contribution to the Gross State Product made by the companies or industries. Labor income include all forms of employment income, such as employee compensation (wages and benefits) and proprietor income (i.e., payments received by self-employed individuals and unincorporated business owners).

Addressing Supply and Value Chain Double Counting

One important step in the analysis was to ensure the IMPLAN model, by quantifying direct and indirect jobs, would not double-count the in-scope jobs (i.e., jobs from the NYCEIR data). Since NYCEIR data includes value chain jobs and IMPLAN also calculates the supply chain employment in the indirect impacts, there could be some double counting. When using jobs as an input (as is done in this economic impact analysis) compared to sales or expenditures, there is the additional challenge of determining whether the jobs should be considered direct or indirect jobs, (i.e., part of the supply chain economic activity). For example, new construction jobs entered in IMPLAN have an impact through the entire value chain (e.g., purchasing Energy Star boilers). So, if the supply chain jobs are entered in IMPLAN as direct jobs and the model also accounts for them as an indirect impact of the new construction jobs, then there is double-counting, and the impacts will be inflated.

The challenge faced by using jobs as the economic model input was to determine the number of in-scope energy jobs that should be counted in IMPLAN as direct or indirect jobs, without eliminating activity that was not in initially included in the NYCEIR data. While this seems simple in theory, it is more difficult in practice. Thus, to address the double-counting challenge, the research team adopted the following methodology.

1. Step 1: Run detailed, individual models for each in-scope industry by IMPLAN code
The research team ran detailed models for each in-scope industry by IMPLAN code and analyzed the indirect jobs created (or lost) by each in-scope industry. By creating individual models for each IMPLAN code, the team gained a better understanding of the jobs created (or lost) in different indirect industries by each in-scope industry.

2. Step 2: Compare the number of direct + indirect jobs by industry estimated in IMPLAN with the initial in-scope jobs
This step included looking at the number of direct + indirect jobs by industry and comparing with the initial in-scope jobs by industry. By doing this, the team analyzed the supply chain jobs that are created (or lost) by each in-scope industry, which helped adjust the in-scope jobs based on the number of direct and indirect jobs created (or lost) in IMPLAN.

3. Step 3: Adjust the initial in-scope jobs based on the direct + indirect jobs calculated in the IMPLAN model
This step included adjusting the in-scope jobs based on the direct + indirect jobs that IMPLAN estimated. For example, if, based on the construction in-scope jobs, IMPLAN calculated that x number of indirect jobs were created in wholesale trade, we excluded that x number from the initial in-scope jobs in wholesale trade since they were already accounted for as indirect jobs of construction.

This important step addresses the fundamental challenge of this study which is determining the proportion of in-scope jobs that should be considered direct or indirect (supply-chain) jobs. By following this methodology, we avoided double-counting the in-scope jobs that would occur if all of them would be considered direct jobs.

4. Step 4: Re-run the IMPLAN model with the "adjusted" in-scope jobs by industry
After running several individual and collective models, the last step was to re-run the IMPLAN model one more time with the adjusted number of in-scope jobs by industry.

Final Output

- Direct = "adjusted" in-scope industry jobs by sector to account for the indirect jobs IMPLAN calculates.
- Indirect = indirect jobs produced by the model which include in- and out-of-scope industries
- Induced = all induced jobs calculated in IMPLAN

APPENDIX C:
EV CHARGING OCCUPATIONS

Sector	SOC Code	Top Occupation	Entry Level Education	Median Wages	75th Percentile Wages	Required or Preferred Certifications	Entry Occupation(s)	Advancement Occupation(s)
Maintenance or Repair of EV Chargers	17-3022	Civil Engineering Technologists and Technicians (employed by 53% of EV charging maintenance or repair employers)	Most occupations in this zone require training in vocational schools, related on-the-job experience, or an associate's degree.	$68,600	$82,300	Civil engineering technician qualification certification, Civil Technology Certificate, Cost engineer certificate, Environmental management certification	Traffic Technicians	General and Operations Managers
Manufacturing of EV chargers	11-3051	Industrial Production Managers (employed by 73% of EV charging manufacturing employers	Most of these occupations require a four-year bachelor's degree, but some do not.	$137,100	$175,700	Charging facility operating license, diploma, Industrial certificate, Lean production related certificates, Production Management Certificate	First-Line Supervisors of Production and Operating Workers	General and Operations Managers
Design of EV chargers	17-2071	Electrical Engineers (employed by 78% of EV charging design employers)	Most of these occupations require a four-year bachelor's degree, but some do not.	$110,900	$141,400	Bachelor's Degree, Electrician Certification, Professional Engineer (PE) certification	Electrical Drafters	Senior Engineer
Management, operation, or ownership of public EV Chargers	11-1021	General and Operations Managers (employed by 70% of EV charging management/ operations employers)	Most of these occupations require a four-year bachelor's degree, but some do not.	$137,000	$214,600	Bachelor's Degree, Business license, Master's Degree, Omni-media operator certificate, Resource Management Certificate	Food Service Managers	Owner
Installation of EV chargers	47-2111	Electricians (employed by 80% of EV charging installation employers)	Most occupations in this zone require training in vocational schools, related on-the-job experience, or an associate's degree.	$78,900	$115,800	State electrician license	Maintenance and Repair Workers, General	Master Electrician
Sale of EV chargers	41-4011	Sales Representatives (employed by 72% of EV charging sales employers)	Most of these occupations require a four-year bachelor's degree, but some do not.	$125,000	$172,700	Business Planner Qualification Certificate, Certified Inside Sales Person, college degree, diploma, Sales Management Professional Certificate	Insurance Sales Agents	Sales Managers

END NOTES

1 JobsEQ 2022 Q3.

2 Establishments are specific locations. A single company can have multiple establishments.

3 These categories correspond with the following delineations: 0 to 49 percent of labor hours, 50 to 99 percent of labor hours, and 100 percent of labor hours. For a full description of this methodology, please refer to Appendix A.

4 Figure 6 is an illustrative example of how intensity-adjustment may be used to count clean energy workers. For the methodology behind the intensity-adjusted clean energy employment quantified in Figure 7, please see the section Intensity-adjusted Clean Energy Employment located in Appendix B.

5 The "Other Support Services" value chain segment includes Administrative and Support and Waste Management and Remediation Services (NAICS 56) and industries classified under NAICS 81. The "Other" value chain segment includes Agriculture, Forestry, Fishing and Hunting (NAICS 11), Transportation and Warehousing (NAICS 48-49), Management of Companies and Enterprises (NAICS 55), and other establishments as identified by employers. Visit https://www.naics.com/search/ for more information on NAICS codes.

6 Data is from the US Energy and Employment Report which uses responses from clean energy employers. Value chain is determined by asking which category the organization is predominantly oriented towards. Therefore, one business location with multiple business lines (manufacturing and distribution, for example) would only count as the part of the value chain in which it is primarily focused on.

7 The building decarbonization and energy efficiency sector was previously labeled as the energy efficiency sector in past editions of the New York Clean Energy Industry Report and has been updated to more holistically describe the set of activities included. The value chain segments included within this category remain consistent with prior years.

8 Other building decarbonization and energy efficiency technologies include variable speed motors, other design services not specific to a sub-technology, software not specific to a sub-technology, energy auditing, rating, monitoring, metering, and leak detection, energy efficiency policy not specific to a sub-technology, LEED certification, consulting not specific to a sub-technology, and phase-change materials.

9 The wind energy employment estimate represents both land-based and offshore wind energy.

10 "EValuateNY," Atlas Public Policy, https://atlaspolicy.com/evaluateny/.

11 A smart grid is an electricity supply network that uses digital communications technology to detect and react to local changes in usage.

12 Other ethanol/ non-woody biomass includes fuel made from other materials such as straw, manure, vegetable oil, or animal fats.

13 "Governor Hochul Announces More Than 100 New Electric Vehicle Fast Chargers to be Built in New York City," Governor's Press Office, March 28, 2024, https://www.governor.ny.gov/news/governor-hochul-announces-more-100-new-electric-vehicle-fast-chargers-be-built-new-york-city.

14 "FOTW #1334, March 18, 2024: By 2030, the US Will Need 28 million EV Charging Ports to Support 33 million EVs," Office of Energy Efficiency & Renewable Energy, March 18, 2024, https://www.energy.gov/eere/vehicles/articles/fotw-1334-march-18-2024-2030-us-will-need-28-million-ev-charging-ports#:~:text=National%20Renewable%20Energy%20Laboratory%20estimates,and%20less%20common%20long%20trips.

15 New York State Climate Action Council. 2022. "New York State Climate Action Council Scoping Plan." https://climate.ny.gov/resources/scoping-plan/.

16 "Electric Vehicle (EV) Charging Station Make-Ready Requirements," Office of Energy Efficiency & Renewable Energy, https://afdc.energy.gov/laws/13379.

17 "In Advance of Climate Week 2021, Governor Hochul Announces New Actions to Make New York's Transportation Sector Greener, Reduce Climate-Altering Emissions," Governor's Press Office, September 28, 2021, https://www.governor.ny.gov/news/advance-climate-week-2021-governor-hochul-announces-new-actions-make-new-yorks-transportation.

18 The EV charging survey categorizes workers in a different manner than that of the United States Energy and Employment Report (USEER), where most data throughout the other sections of this report is derived from including Figure 19 of this deep dive on EV charging. This survey asks about any involvement with EV charging, while USEER classifies workers into their most dominant category. For example, all employees at a parts manufacturer that supplies parts to both electric vehicles and EV charging stations would be included as EV charging workers in these survey responses. However, in the USEER data these workers would likely show up as EV employees only, assuming that EVs comprised a larger share of the business than EV charging stations.

19 For more information about survey methodology, please see Appendix B.

20 Data is from the 2024 United States Energy and Employment Report. These value chain segments will not match the value chain segments derived from the supplemental NYS EV charging employer survey, as that survey instrument that was specific to EV charging manufacturers and uses a more granular and industry-specific set of value chain categories.

21 Manufacturing and Other Services value chain segments did not have enough data available to include in this analysis.

22 "FOTW #1334, March 18, 2024: By 2030, the US Will Need 28 million EV Charging Ports to Support 33 million EVs," U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy, March 18, 2024, https://www.energy.gov/eere/vehicles/articles/fotw-1334-march-18-2024-2030-us-will-need-28-million-ev-charging-ports#:~:text=National%20Renewable%20Energy%20Laboratory%20estimates,and%20less%20common%20long%20trips.

23 These business sectors are different than the value chain categories defined in USEER, and which form the basis for employment estimates. This is because BW Research conducted a supplemental survey specifically targeted to firms involved in EV charging and only asking questions related to EV Charging. This more targeted effort allowed for greater granularity into EV charging business sector characteristics.

24 There were many other training programs oriented towards electric vehicles but did not expressly include any charging components.

25 Some training programs are marketed to be accessible for multiple occupations.

26 "SAE International Electric Vehicle Supply Equipment (EVSE) Technician Certification," SAE International, https://www.sae.org/learn/professional-development/electric-vehicle-supply-equipment-technician-certification.

27 "Union Members – 2023," U.S. Bureau of Labor Statistics, January 23, 2024, https://www.bls.gov/news.release/pdf/union2.pdf.

28 This is the rate at which workers are dues-paying members of labor unions.

29 This is the rate at which workers are covered under labor union contracts. After a 2018 Supreme Court ruling, workers were no longer required to pay union fees to receive benefits and be "covered" under union contracts.

30 "Workers of the same occupational category" is inclusive of clean energy workers.

31 These occupations were selected because many appear on NYSERDA's Clean Energy Career Maps ("Clean Energy Career Maps," NYSERDA, https://www.nyserda.ny.gov/All-Programs/Clean-Energy-Workforce-Development-and-Training/Resources/Clean-Energy-Career-Maps.) and are expected to see some of the highest growth rates via the clean energy transition outlined in the 2021 Just Transition Working Group Jobs Study ("2021 Jobs Study," BW Research, March 2023, https://climate.ny.gov/-/media/Project/Climate/Files/JTWG-Jobs-Report-Update.pdf).

32 "May 2023 State Occupational and Employment Wage Estimates," U.S. Bureau of Labor Statistics, https://www.bls.gov/oes/current/oes_ny.htm.

33 The "poverty line" is a federal measure of economic insecurity, but this federal measure fails to account for state and region-level differences in cost of living due to rent, insurance, taxes, and other regionally specific factors. A "living wage" provides a more regionally specific metric of economic security. A living wage is a locally specific metric that designates the wage rate that a full-time worker requires to cover the costs of them and their family's basic needs

34 Living wage for a single adult with no children is $26.86 per hour. "Living Wage Calculation for New York," Massachusetts Institute of Technology, https://livingwage.mit.edu/states/36.

35 Minimum Wage in 2023 was $15.00 for New York City, Long Island, and Westchester and $14.20 for the remainder of New York State. "New York's Minimum Wage Overview," Department of Labor, https://dol.ny.gov/minimum-wage-0.

36 The information provided is access to employer-sponsored benefits, which is different from take-up rates of benefits, which is lower. Take-up rates of benefits are lower than access rates because employees may not need benefits (typically because they are eligible under another family member's benefits), or they are unaware or uninterested in the benefit.

37 "Table 2. Medical care benefits: Access, participation, and take-up rates," U.S. Bureau of Labor Statistics, September 21, 2023, https://www.bls.gov/news.release/ebs2.t02.htm.

38 "Public Work" generally includes projects involving construction, alteration or demolition work that is done on behalf of public agency or entity.

39 "Bureau of Public Work and Prevailing Wage Enforcement," Department of Labor, https://dol.ny.gov/bureau-public-work.

40 Wages represent all projects, including but not limited to clean energy.

41 Because prevailing wages are set at various local levels that are not consistent across occupations, median prevailing wages were utilized.

42 Bureau of Labor Statistics. Quarterly Census of Employment and Wages. Series ID ENU3600040010. August 2024.

43 Comparison data from 2023 Q4, Bureau of Labor Statistics Occupational Employment and Wage Statistics (OEWS) from JobsEQ.

44 Ibid.

45 The demographic estimation for additional sectors cannot be provided due to low sample sizes.

46 "Disadvantaged Communities Criteria," New York State, https://climate.ny.gov/Resources/Disadvantaged-Communities-Criteria.

47 County-level employment data is proportioned to the census-tract level data by value chain using the U.S. Census Bureau's Longitudinal Employer-Household Dynamics Origin-Destination Employment Origin-Destination Employment Statistics (LODES) Workplace Area Characteristics and Residence Area Characteristics. "Longitudinal Employer-Household Dynamics," U.S. Census Bureau, https://lehd.ces.census.gov/data/.

48 The U.S. Census Bureau does not currently have an agreed upon measure of accuracy for LODES data used in this analysis. However, a working paper that reviewed the data accuracy found the data to be reliable: Kevin L. McKinney et al., "Total Error and Variability Measures with Integrated Disclosure Limitation for Quarterly Workforce Indicators and LEHD Origin Destination Employment Statistics in OnTheMap," Center for Economic Studies, December, 2017, https://www2.census.gov/ces/wp/2017/CES-WP-17-71.pdf.

49 While this may suggest a slightly disproportionate share of clean energy jobs are located in disadvantaged communities relative to their share of the total population, this difference may not be statistically significant.

50 "Disadvantaged Communities Criteria," New York State, https://climate.ny.gov/Resources/Disadvantaged-Communities-Criteria.

51 Grey regions do not contain disadvantaged communities or do not have data available.

52 Grey regions do not contain disadvantaged communities or do not have data available.

53 Priority populations include veterans, individuals with disabilities, low-income individuals, incumbent or unemployed fossil fuel workers, previously incarcerated individuals, 16- to 24-year-olds that are enrolled in or have completed a comprehensive work preparedness training program, homeless individuals, or single parents. "Definitions," NYSERDA, https://www.nyserda.ny.gov/All-Programs/Clean-Energy-Workforce-Development-and-Training/Resources/Definitions.

54 These results are significant at the 95 percent confidence interval.

55 Not all investments are able to be classified under or assigned to a single technology sector because some investments are more general in nature (i.e., innovation competitions, research labs, etc.) and cannot be 100 percent dedicated or directed towards a specific technology area. As such, totals will not sum to Figure 67.

56 Totals will not sum to Figure 67 because not all investments could be categorized as public or private due to lack of information.

57 Totals will not sum to Figure 67 because not all investments could be categorized as public or private due to lack of information.

58 Based on the New York Clean Energy Industry Report custom IMPLAN codes.

59 This number is different than the initial net change since some of the NYCEIR jobs were distributed into direct and indirect jobs as part of the methodology to avoid double counting. The difference between the additional overall employment added in 2023 (7,653) and direct jobs (6,926) is indirect jobs that are counted in the initial NYCEIR employment as part of the value chain, accounting for 727 jobs. For additional detail, see Appendix B: Economic Impact Analysis.

60 This definition of Traditional Energy differs from its use in the U.S. Energy and Employment Reports. However, it characterizes the full spectrum of the energy sector in New York State, which includes clean and traditional energy alike.

61 "Longitudinal Employer-Household Dynamics - Data," U.S. Census Bureau, 2024, https://lehd.ces.census.gov/data/.

62 "Disadvantaged Communities Criteria," New York Climate Act Website, https://climate.ny.gov/Resources/Disadvantaged-Communities-Criteria.

63 "Technical Documentation Appendix: Communities Indicator Workbook, " New York Climate Act Website, https://climate.ny.gov/-/media/Project/Climate/Files/Disadvantaged-Communities-Criteria/Technical-Documentation-Appendix-Final-Disadvantaged-Communities-Indicator-Workbook.xlsx.

64 Employment refers to the annual average of monthly jobs (same definition used by QCEW, BLS, and BEA, nationally) and it includes both full- and part-time jobs.

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