NEW YORK STATE | NYSERDA

# NEW YORK CLEAN ENERGY INDUSTRY REPORT 2023

# LETTER FROM NYSERDA PRESIDENT AND CEO

Dear Partners and Friends,

I am eager to share with you the findings from NYSERDA's 2023 New York Clean Energy Industry Report. The report provides a vibrant, data-driven overview of New York State's clean energy landscape, highlighting trends and the progress we've made as we steadily work toward a dynamic clean energy economy and a zero-emissions electric grid.

Overall, the report paints a picture of growth, as New York added 5,800 jobs in the clean energy sector, reaching an all-time statewide employment record of 171,000 workers in 2022. I am heartened by these statistics as they illustrate how the clean energy economy can open doors of opportunity for many New Yorkers, now and in the future.

We are grateful for the steadfast leadership of Governor Kathy Hochul as New York continues to chart a path to a zero-emissions future that only a few U.S. states have attempted to pursue.

***New York is a leader in climate action at a time when we cannot afford anything less. This year has been punctuated with recurrent reminders that climate change is real, from a historic blizzard to once in a lifetime flooding. Our collective ability to respond will have lasting impacts for generations to come.***

The 2023 New York Clean Energy Industry Report, which provides data through the end of 2022, also demonstrates that the clean energy industry is a key component in securing a vibrant future. Despite rising operating costs, the clean energy industry grew its workforce by 3.5%, which was higher than New York's economy overall, with some clean energy subsectors seeing growth of up to 20%.

**Other key findings from this year's report:**

- Since NYSERDA's clean energy employment tracking began in 2015, the number of clean energy jobs has increased by 21%, adding nearly 30,000 jobs over eight years. The areas within the sector that saw the most growth in 2022 were clean and alternative transportation (2,223 jobs), building decarbonization and energy efficiency (2,000 jobs), and renewable power generation (1,200 jobs).
- Clean energy job growth took place across all technology sectors:
  > Building decarbonization and energy efficiency added over 2,000 jobs and accounted for 75% of all clean energy employment.
  > Clean and alternative transportation continued to experience exceptional growth, expanding by almost 20%, or 2,223 jobs in just twelve months.
  > Grid modernization and energy storage grew by 10%, or 241 jobs.
  > Renewable electric power generation also experienced 5% growth, with over 1,200 new jobs.
- Workers surveyed for this report also described high satisfaction regarding promotion and wage opportunities, as well as opportunities to learn new skills and move up in their careers, signaling growth prospects and career development possibilities in the clean energy industry.

Forging new paths is not without its challenges. However, this report helps to underscore what many of us at NYSERDA already know, as we see it in our daily work: investing in the clean energy economy is a boon to New York's labor market, and a vital step in growing our economy while saving our planet.

Best,

Doreen M. Harris

President and CEO, NYSERDA

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# EXECUTIVE SUMMARY

Section 01

## INTRODUCTION

***The 2023 New York Clean Energy Industry Report is the seventh edition of annual reports tracking clean energy employment across New York State.***

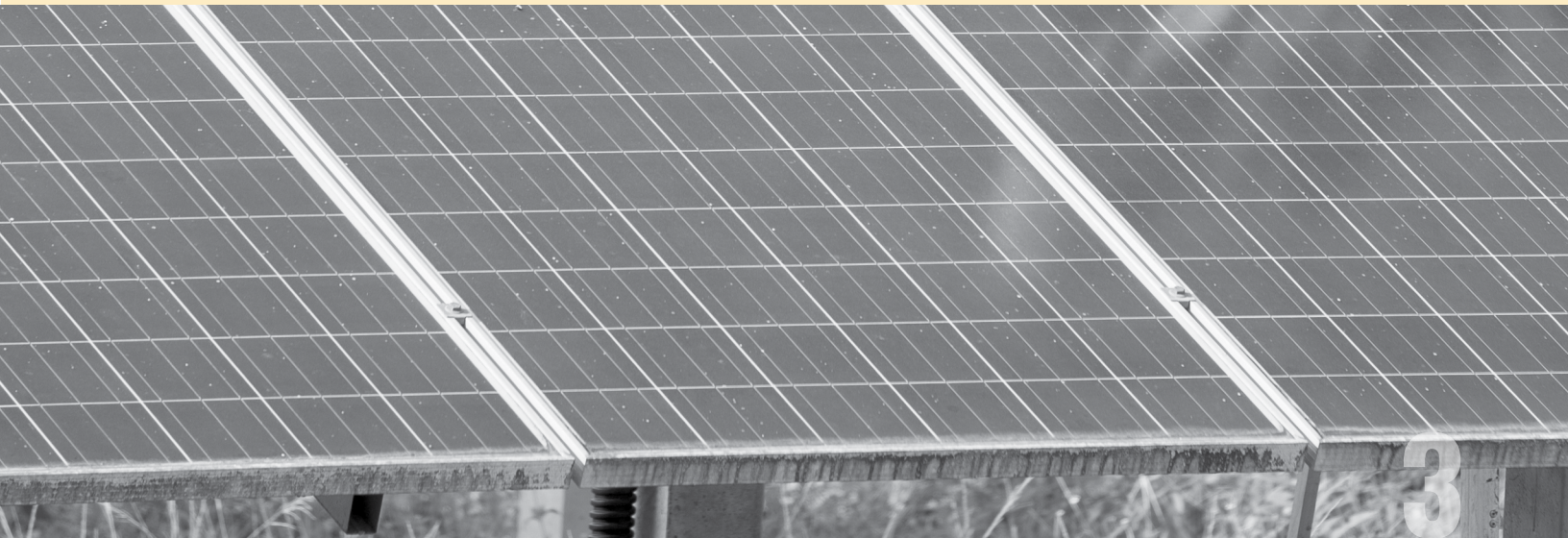
The report was commissioned by the New York State Energy Research and Development Authority (NYSERDA) in order to better understand the composition of the clean energy economy.

This year's report focuses on the continued growth of clean energy jobs throughout the State and includes analysis of clean energy employment in disadvantaged communities[1] as well as worker perceptions of jobs in the clean energy industry.

**5,800**
clean energy jobs added in 2022

**171,000**
clean energy workers across NYS

**3.5%**
clean energy job growth 2021-2022



# KEY FINDINGS

## *The clean energy economy in New York added 5,800 jobs in 2022, and there are now nearly 171,000 clean energy workers across the State.*

Between 2021 and 2022, clean energy jobs grew by 3.5%. This growth is faster than New York State's economy overall (3.0%) (Figure 2), as well as other key industries in the State, including Finance and Insurance (2.4%) and Educational Services (0.6%) (Figure 3). Since clean energy employment tracking began in 2015, the number of clean energy jobs has increased by 21%, adding nearly 30,000 jobs over eight years (Figure 1).

## *While all technology sectors grew between 2021 and 2022, clean and alternative transportation and building decarbonization and energy efficiency[2] added the greatest number of jobs.*

Clean and alternative transportation added more than 2,200 jobs, growing 20% in one year as consumers are increasingly interested in electric vehicles. Building decarbonization and energy efficiency—the largest technology sector—also added nearly 2,100 jobs, but its overall employment level remains just below its pre-pandemic peak in 2019 (Figure 4). However, after accounting for intensity of clean energy jobs (the time spent on clean energy activities), employment in the building decarbonization and energy efficiency sector has surpassed its 2019 levels (Figure 8). This suggests that even though the absolute number of workers in energy efficiency has yet to fully recover, the time spent on building decarbonization and energy efficiency activities has exceeded 2019 levels.

## *Hiring clean energy workers is increasingly difficult for clean energy employers.*

In 2022, 45% of clean energy employers reported it was very difficult to hire talent, and another 48% reported it was somewhat difficult. Only 7% of employers reported no hiring challenges (Figure 21).

Elevated hiring challenges is not a uniquely New York experience; the national 2023 U.S. Energy and Employment Report found that more than four in five clean energy employers had some difficulty hiring.[3]

## *The demographic composition of the clean energy workforce has become more diverse in 2022.*

However, it remains less diverse along gender, racial, and ethnic lines than the economywide workforce. Clean energy worker demographics in 2022 show an improvement from 2021 (Table 2), but greater diversity is needed to reach a representative workforce. Addressing hiring challenges and continuing to build an equitable and representative workforce will be crucial to growing the clean energy economy and meeting New York State's decarbonization goals.

## *Nearly a third (31%) of all clean energy jobs are located within disadvantaged communities across the State.*

An estimated 52,749 clean energy jobs are located within disadvantaged communities (DACs). Furthermore, many (44%) counties with DACs have a higher concentration of clean energy jobs within DACs than the overall statewide average.[4] This means that clean energy is actively supporting notable portions of economic activity within DACs. Where clean energy jobs are located may differ from where clean energy workers live, as nearly two-thirds of counties (63%) with DACs have a smaller share of residents who have clean energy jobs than the statewide average. This data represents an opportunity to continue to support residents of disadvantaged communities with clean energy employment opportunities.

## *While many of the disadvantaged communities have nearby clean energy training programs, there are many that are training deserts for clean energy-related training and education opportunities (Figure 29).*

In addition to addressing geographic disparities, strategic planning and analysis is required to ensure equitable access to training programs for high-demand clean energy jobs as well as to identify and remove barriers for students and job seekers from historically marginalized communities and priority populations.[5]

### *Clean energy workers tend to be very satisfied with their careers and are satisfied with those careers at much higher rates than their non-clean energy counterparts.*

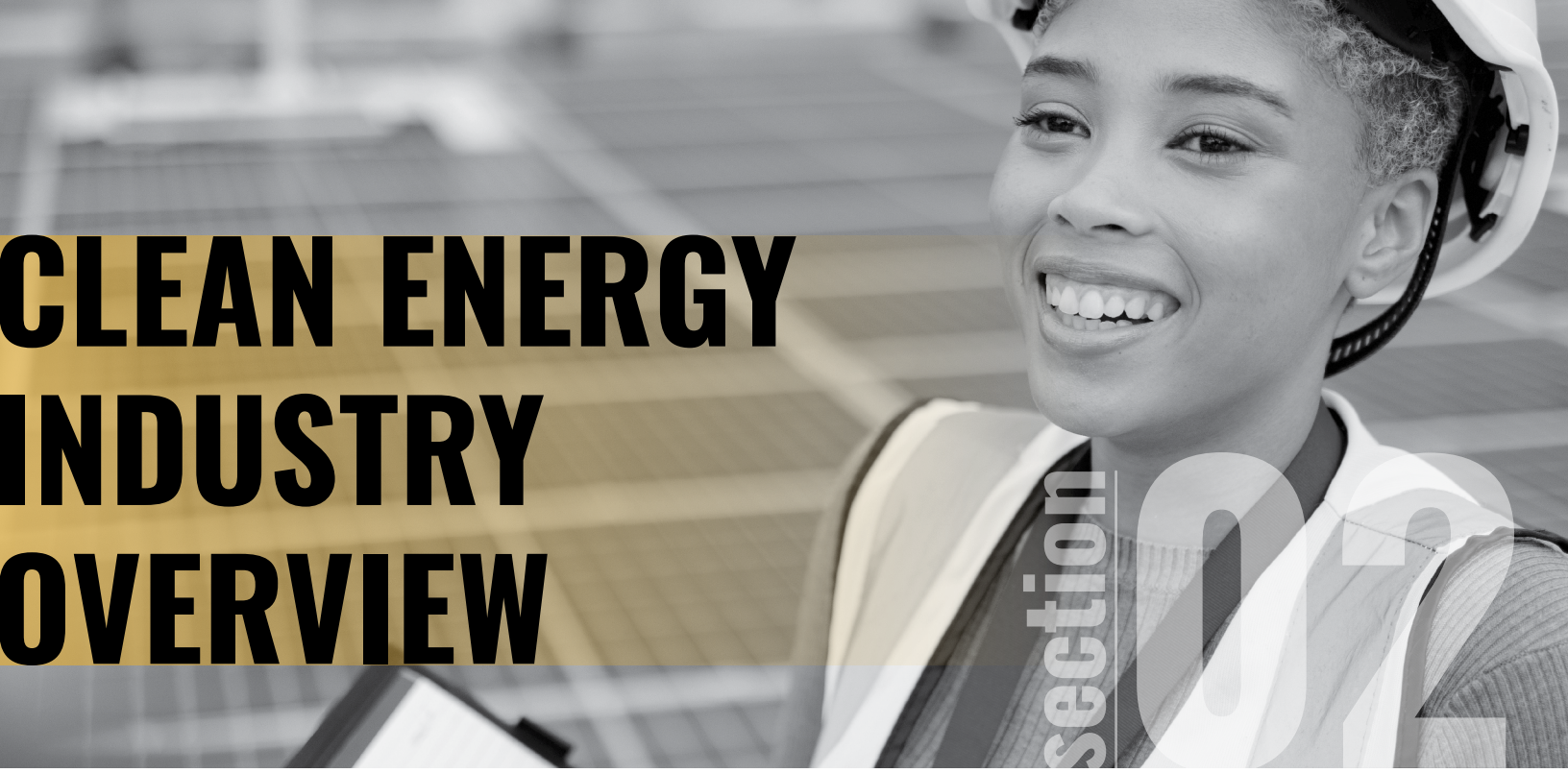
Eighty-eight percent of clean energy survey respondents were either very satisfied or somewhat satisfied with their career (Figure 32). Clean energy respondents were also more likely to report higher confidence that they would receive a promotion or advance in their careers within the next twelve months (Figure 33).

### *Nearly a quarter (24%) of current workers not involved in clean energy stated that they had considered, or actively searched for, jobs in clean energy (Figure 37).*

Of those that had not considered or actively searched for clean energy jobs, more than half (53%) reported that they had not done so because they did not fully understand what a clean energy job is. Another 28% reported it was because they lacked the necessary education or training. Fewer than 5% stated it was because of a lack of interest in clean energy (Figure 38). Survey responses from priority populations on interests and barriers to clean energy careers generally reflected those of the broader pool of non-clean energy workers. These findings further reinforce the importance of more ubiquitous and comprehensive clean energy career awareness efforts, particularly among students and prospective workers.

### *Clean energy investments saw an unprecedented boom during the most recent three-year period, increasing 63%—or roughly $905 million—between the 2019-2021 and 2020-2022 periods.*

Investment growth occurred throughout almost all technology sectors, though building decarbonization and energy efficiency saw the largest absolute increase in funding, increasing by $298 million between the 2019-2021 and 2020-2022 periods (Figure 41). Rolling average private funding increased by about $150 million during this time (Figure 42) and public funding grew by $126 million (Figure 43).



# CLEAN ENERGY INDUSTRY OVERVIEW

section 02

## TOTAL CLEAN ENERGY EMPLOYMENT

There are nearly 171,000 clean energy workers in New York State as of the last quarter of 2022. Between 2021 and 2022, clean energy employment saw an increase of 5,800 jobs, representing a 3.5% growth during this period.

***This rise marks the third largest year-over-year increase since the State began tracking clean energy employment in 2015.***

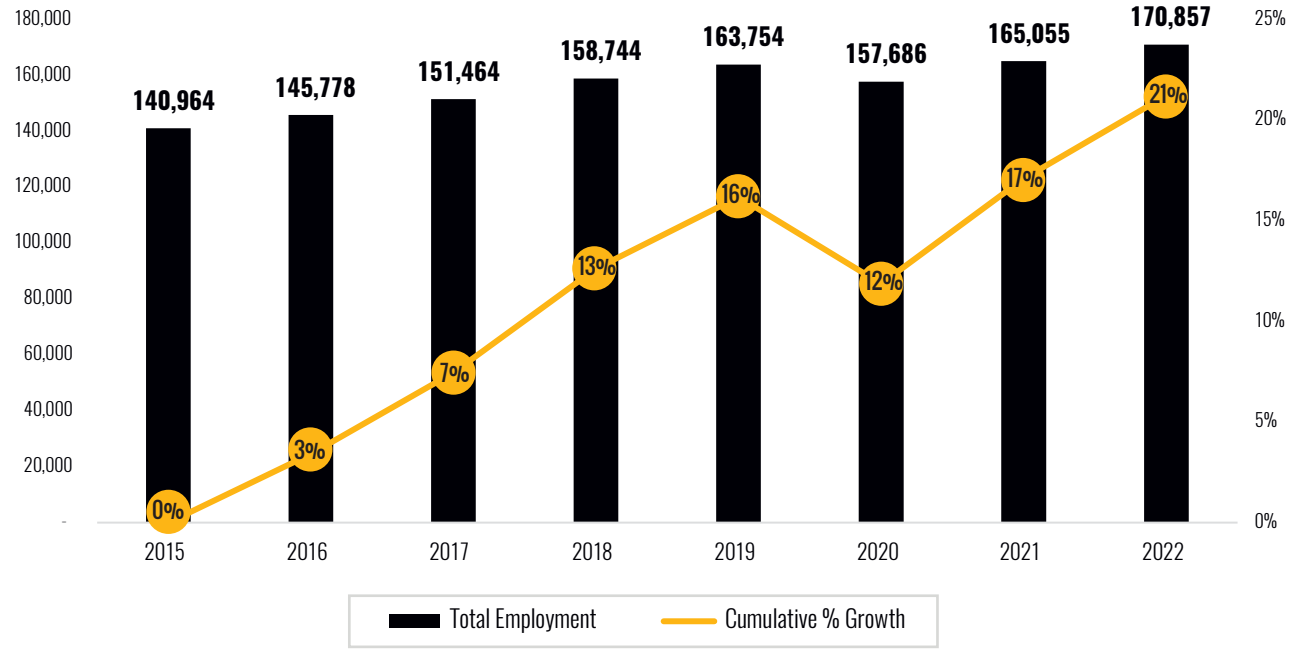
The strong growth rate exhibited in 2021 and 2022 demonstrates that New York State's clean energy economy is back on track to pre-pandemic growth rates (Figure 1).

**171,000**
workers employed by clean energy businesses across New York State

**3.5%**
increase over previous year

**5,800**
additional clean energy jobs

FIGURE 1. CLEAN ENERGY EMPLOYMENT IN NEW YORK, 2015-2022




***Growth in clean energy employment in New York outpaced the State's economywide growth between 2021 and 2022.***

It also outpaced the clean energy employment growth in Rhode Island (1.9%) and Maryland (1.3%)—two other states with substantial offshore wind development planned. New York's clean energy employment growth rate was just below the national average (3.9%) and nearby Massachusetts (4.1%) and Pennsylvania (4.3%) (Figure 2), though the total number of jobs added in New York exceed the number jobs added in both Massachusetts and Pennsylvania.

The clean energy sector in New York outpaced the growth of other parts of the New York economy, including the Educational Services (0.6%) and Finance and Insurance (2.4%) industries. Other parts of the State's economy, including Healthcare and Social Assistance (4.4%) and Accommodation and Food Services (8.3%) grew faster than the clean energy sector, though this growth was part of these industries' return to pre-pandemic employment (Figure 3). Employment in Accommodation and Food Services saw strong growth but has still not recovered to its pre-pandemic levels, and the fourth quarter of 2022 was the first quarter in which Healthcare and Social Assistance employment had returned to its previous peak in 2019.

FIGURE 2. CLEAN ENERGY EMPLOYMENT CHANGE **BY STATE**, 2021-2022

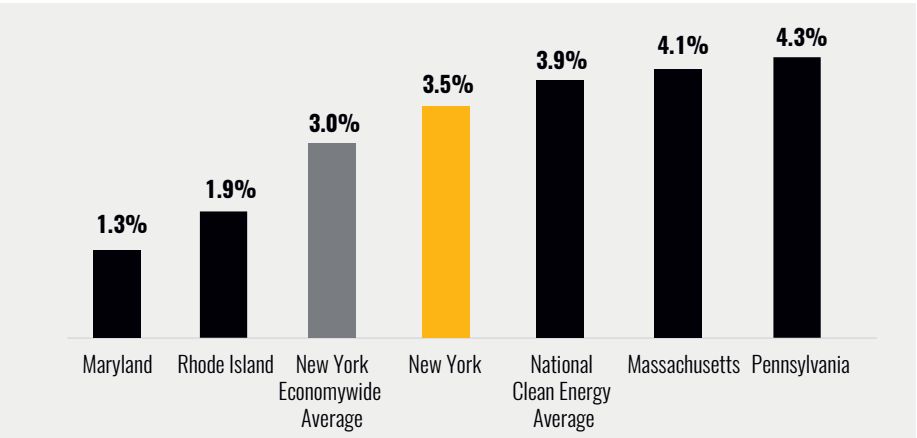
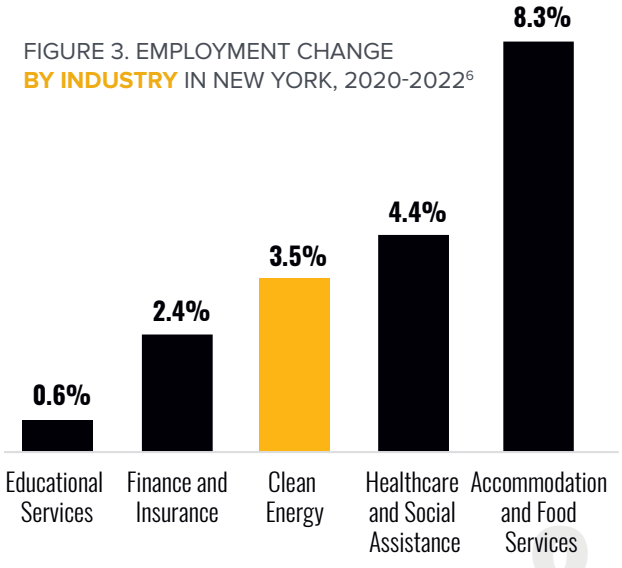



FIGURE 3. EMPLOYMENT CHANGE **BY INDUSTRY** IN NEW YORK, 2020-2022[6]



## *All clean energy sectors grew between 2021 and 2022.*

Some sectors saw double-digit growth while others saw fractional gains. While the COVID-19 pandemic had a temporary impact on clean energy employment in 2020—causing a dip in sectors like building decarbonization and energy efficiency, renewable electric power generation, and renewable fuels. Subsequent years have seen a full recovery across all sectors except for building decarbonization and energy efficiency—the largest sector.

**60%**
**growth for clean and alternative transportation 2016-2022**

**13,517**
**clean and alternative transportation jobs in 2022**

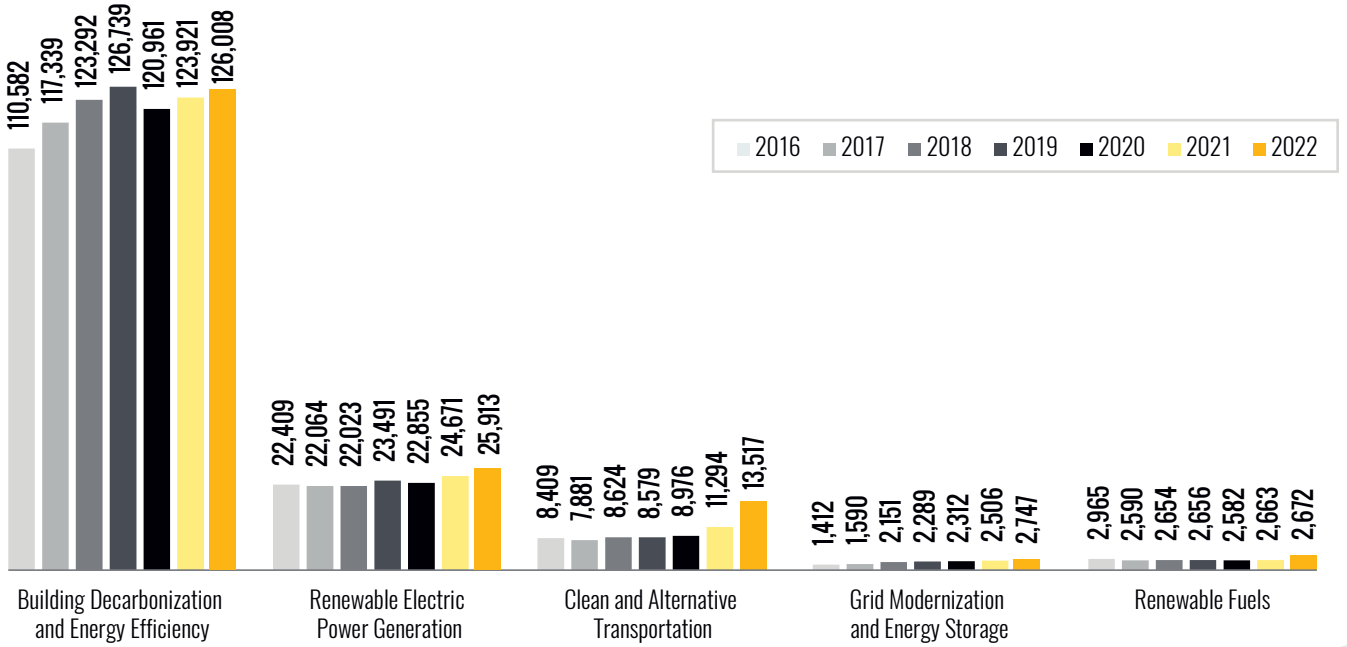
## *Clean and alternative transportation experienced significant growth, growing 60% between 2016 and 2022.*

Much of this growth has been recent. Between 2021 and 2022, clean and alternative transportation saw the most significant increase in employment of all sectors, growing from 11,294 jobs in 2021 to 13,517 jobs in 2022 with the greatest absolute increase in jobs and the greatest growth rate between 2021 and 2022.

## *Still, employment in building decarbonization and energy efficiency accounted for about 74% of all clean energy employment in New York in 2022 and for 36% of all job growth between 2021 and 2022.*

Renewable electric power generation and clean and alternative transportation sectors represent the next-largest shares of clean energy employment at 15% and 8%, respectively (Figure 4).

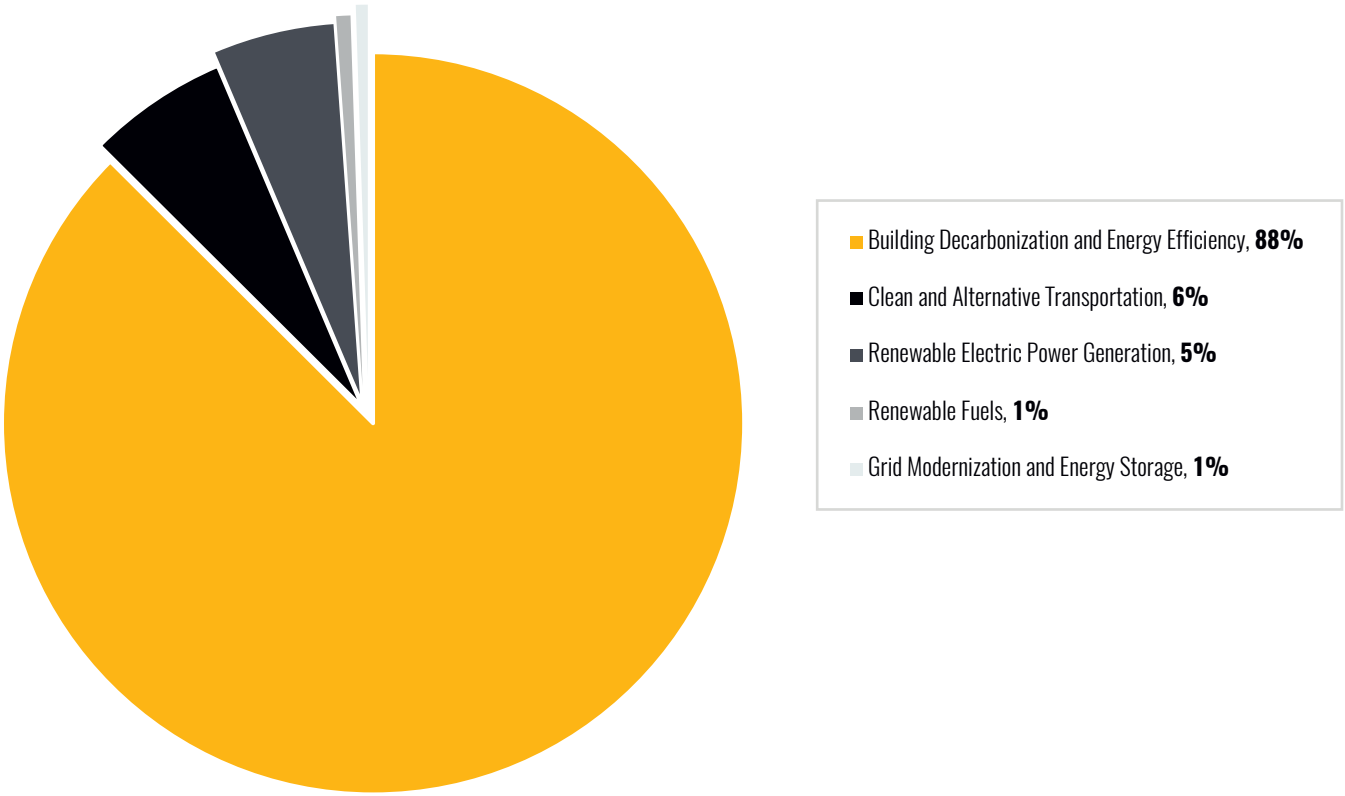
FIGURE 4. CLEAN ENERGY EMPLOYMENT BY TECHNOLOGY SECTOR, 2016-2022



***Building decarbonization and energy efficiency establishments continue to comprise a majority of clean energy establishments throughout the State.***

Clean and alternative transportation (6%) and renewable electric power generation (5%) make up the next-largest share of establishments in New York (Figure 5).

FIGURE 5. CLEAN ENERGY ESTABLISHMENTS BY TECHNOLOGY, 2022

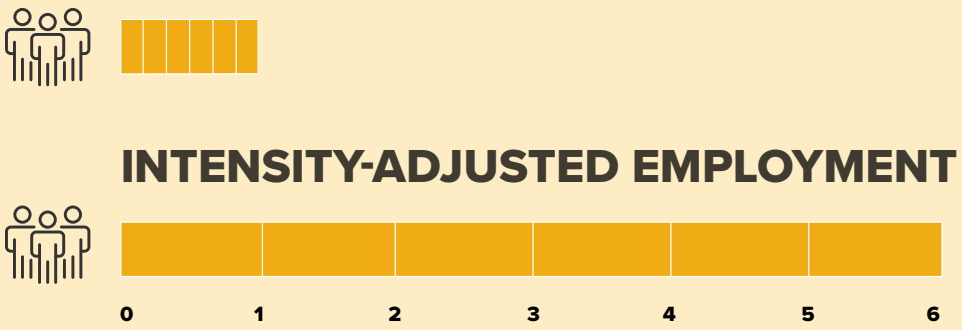


# CLEAN ENERGY EMPLOYMENT INTENSITY

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 the 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.[7]

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 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 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 in Figure 6 below.

FIGURE 6. EXAMPLE OF INTENSITY-ADJUSTED CLEAN ENERGY EMPLOYMENT[8]



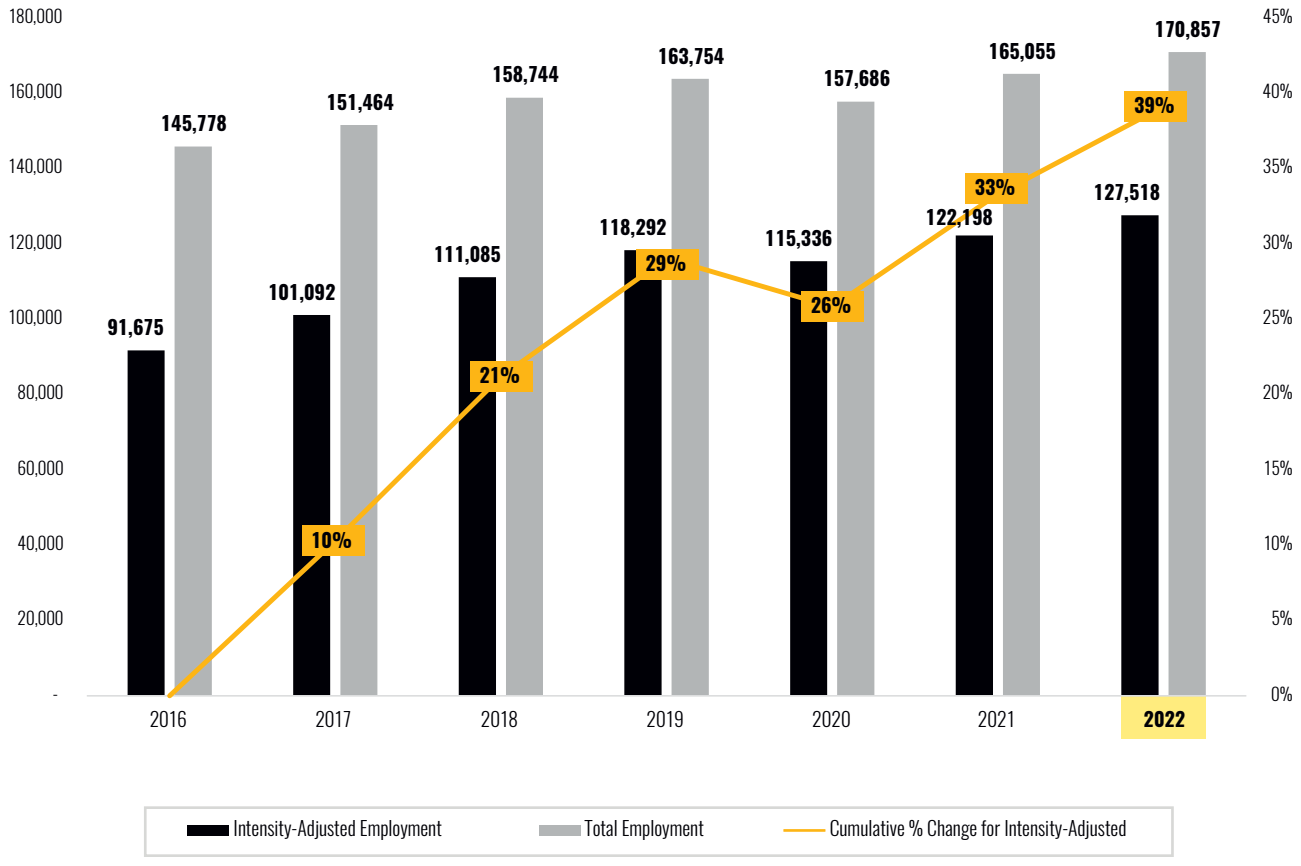

AN EXAMPLE CAN ILLUSTRATE THE IMPORTANCE OF TRACKING INTENSITY-ADJUSTED CLEAN ENERGY EMPLOYMENT.

If an HVAC firm had six installers in Year 1 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 clean energy employment in New York increased by 4% between 2021 and 2022.***

Overall, intensity-adjusted jobs were around 39% higher at the end of 2022 compared to the 2016 baseline (Figure 7).

FIGURE 7. INTENSITY-ADJUSTED CLEAN ENERGY EMPLOYMENT, 2016-2022

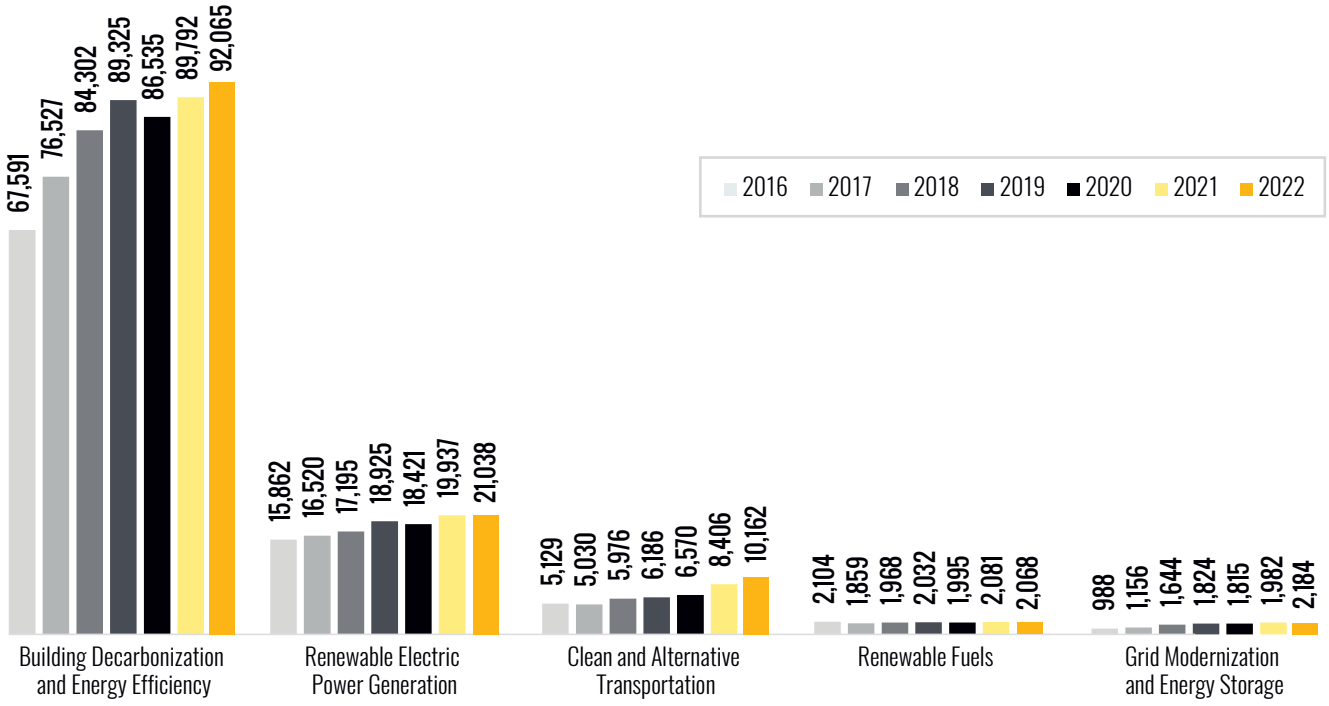


***By technology sector, clean and alternative transportation showed the greatest percentage increase in intensity-adjusted employment (21%) between 2021 and 2022.***

This is followed by grid modernization (10%), and renewable electric power generation (6%). The building decarbonization and energy efficiency sector grew by just 3% but saw the largest absolute increase, growing by 2,273 full time equivalents (FTEs).

Renewable fuels is the only sector that did not experience intensity-adjusted clean energy employment growth between 2021 and 2022, decreasing by less than 1% (Figure 8).

FIGURE 8. INTENSITY-ADJUSTED CLEAN ENERGY EMPLOYMENT **BY TECHNOLOGY,** 2016–2022



The proportion of workers that spend at least 50% of their labor hours on clean energy-related activities remained steady for every technology sector in 2022, staying the same or making small increases (Figure 9).

Similar trends were observed for the proportion of workers that spend 100% of their time on clean energy-related activities (Figure 10).

FIGURE 9. **50%** CLEAN ENERGY WORKERS BY TECHNOLOGY, 2016-2022

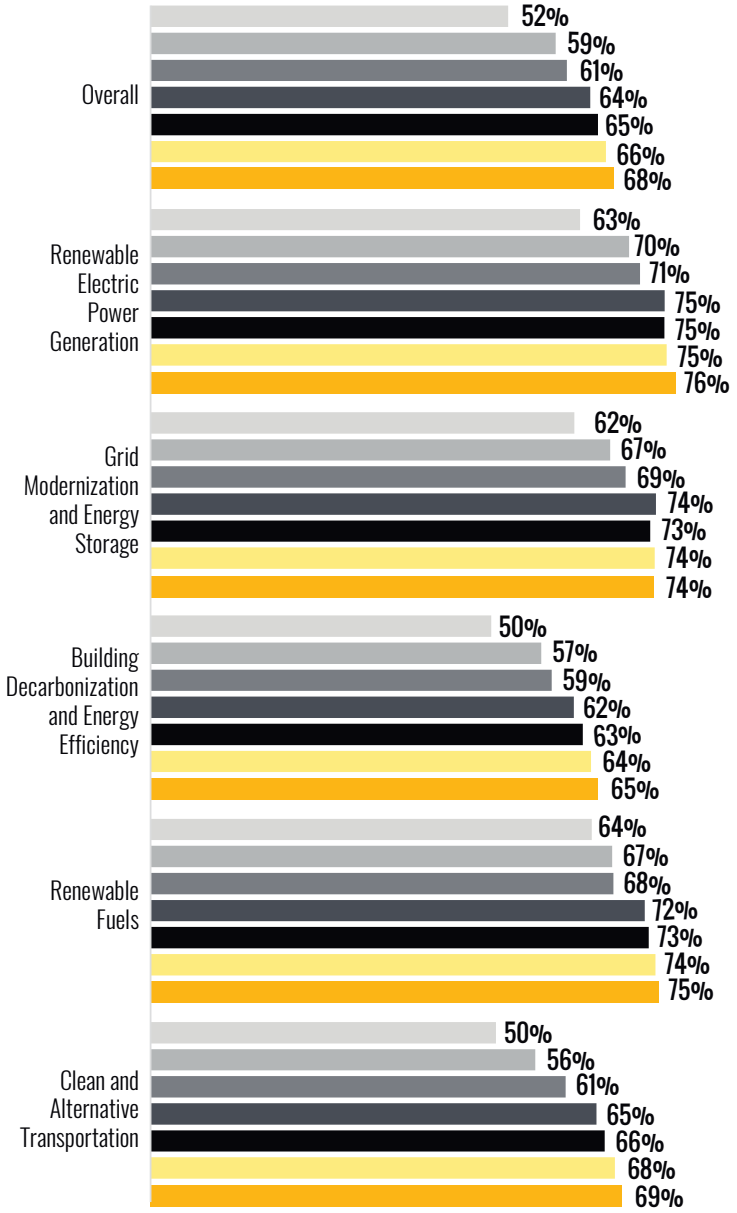
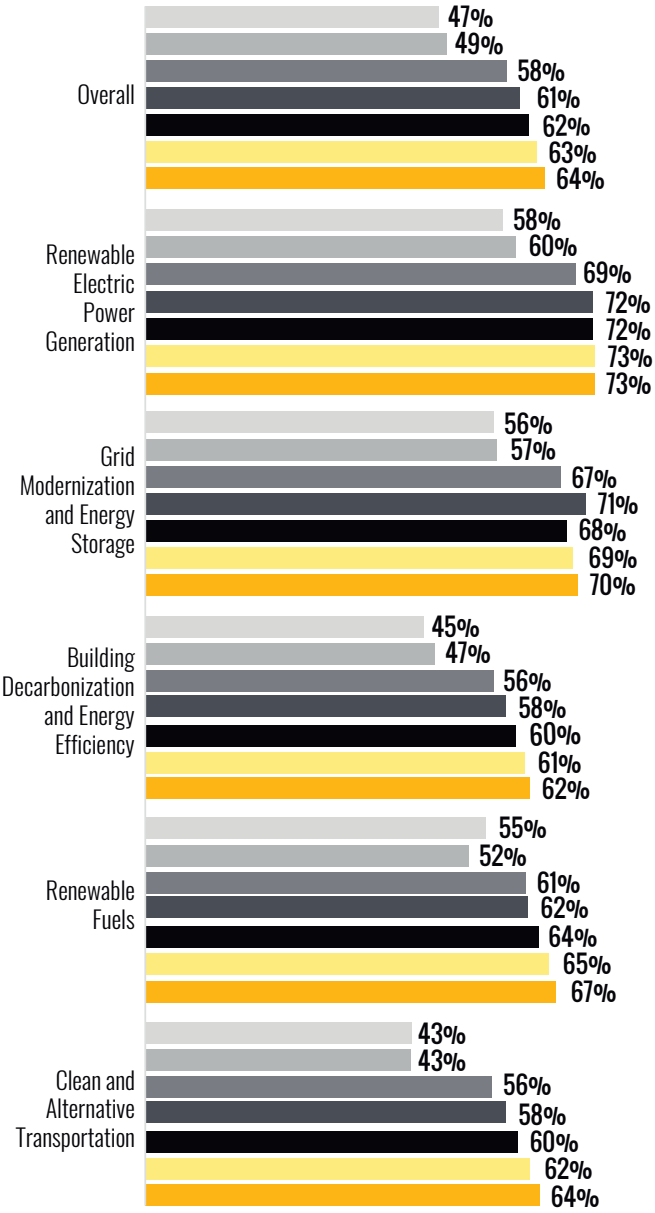



FIGURE 10. **100%** CLEAN ENERGY WORKERS BY TECHNOLOGY, 2016-2022




# CLEAN ENERGY VALUE CHAIN EMPLOYMENT

The following section provides an overview of clean energy employment in different value chain segments, specifically focusing on industries in New York that exhibit significant concentrations of clean energy activity. The main value chain segments encompassing clean energy employment align with federally defined industries, such as construction, manufacturing, wholesale trade, professional and business services, other support services, other industries, and utilities.

***Between 2016 and 2022, the value chain segments in New York's clean energy employment have largely demonstrated consistent growth and stability aside from the pandemic's impact in 2020.***

**From 2021 and 2022, the top three segments that experienced the highest percentage growth were Installation, Professional Services, and Manufacturing.**

Installation workers consistently comprise more than half of the clean energy establishments in New York since 2016 and have witnessed steady expansion in recent years. Employment in the Installation segment increased from 96,409 jobs in 2021 to 100,703 jobs in 2022, surpassing pre-pandemic levels. This segment accounted for 74% of the new jobs in the clean energy value chain.

**The second-largest segment, Professional Services, also saw growth, with employment rising from 21,866 jobs in 2021 to 22,536 in 2022, reflecting a 3% increase during the same period.**

Although a smaller segment of the value chain, manufacturing added 740 jobs between 2021 to 2022 at a growth rate of 3% (Figure 11). Installation continues to account for nearly half (46%) of all clean energy establishments throughout the State, while other support services account for a third (34%) of establishments (Figure 12).

FIGURE 11. CLEAN ENERGY EMPLOYMENT BY VALUE CHAIN SEGMENT, 2016-2022[9]

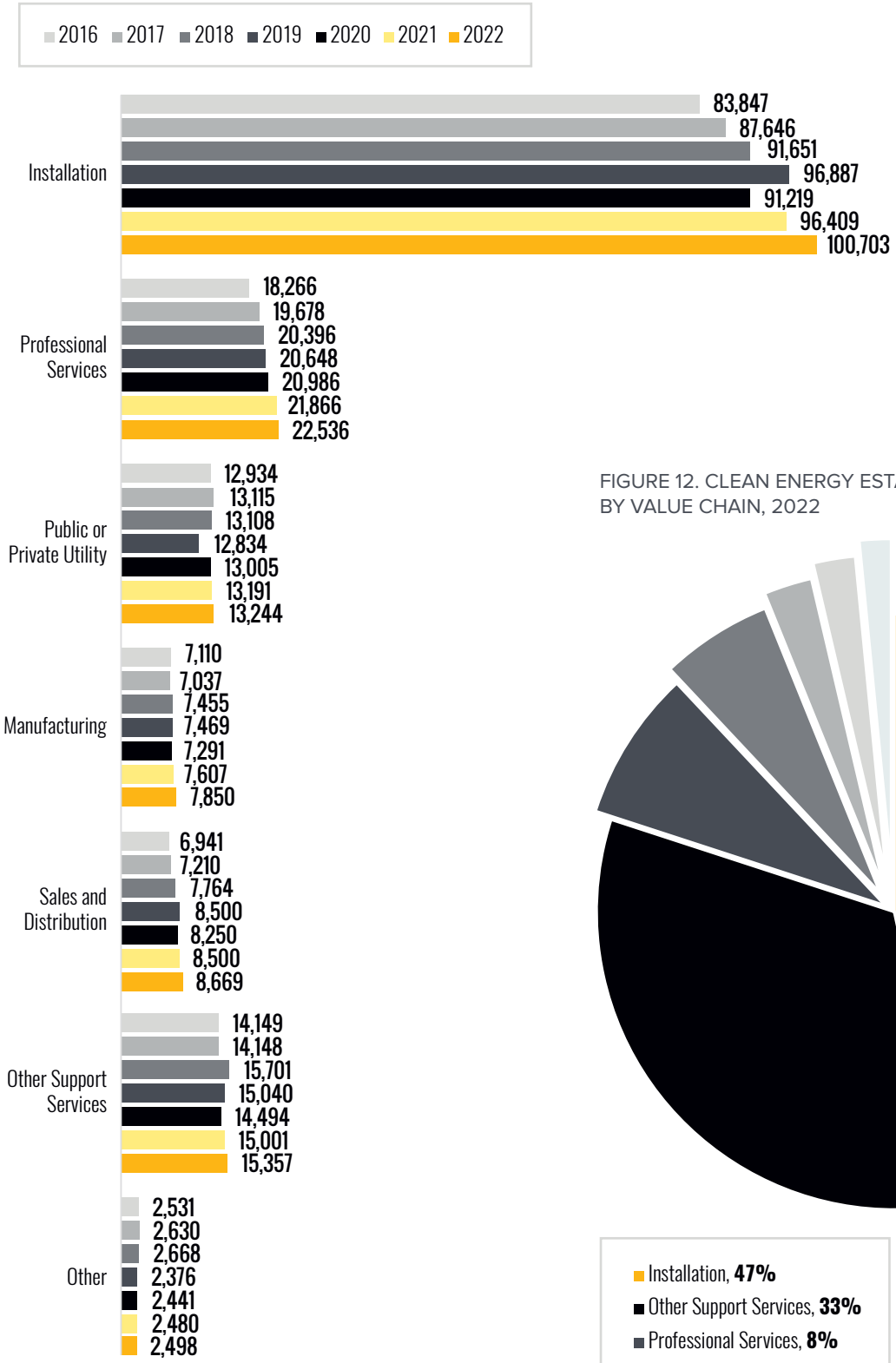
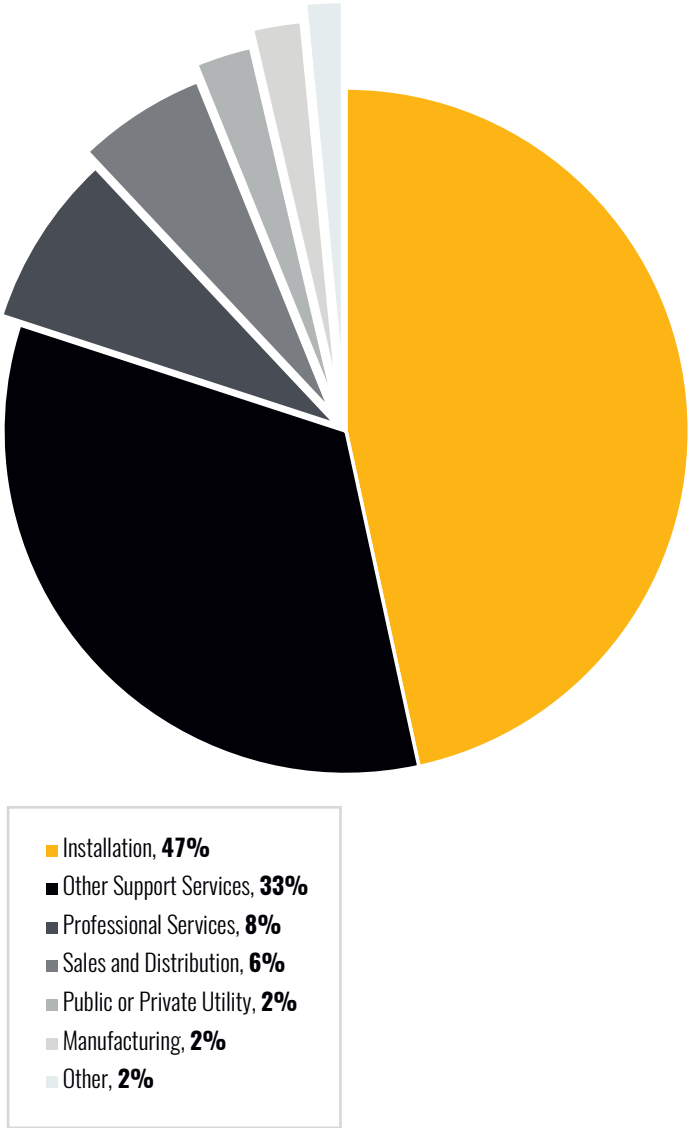



FIGURE 12. CLEAN ENERGY ESTABLISHMENTS BY VALUE CHAIN, 2022



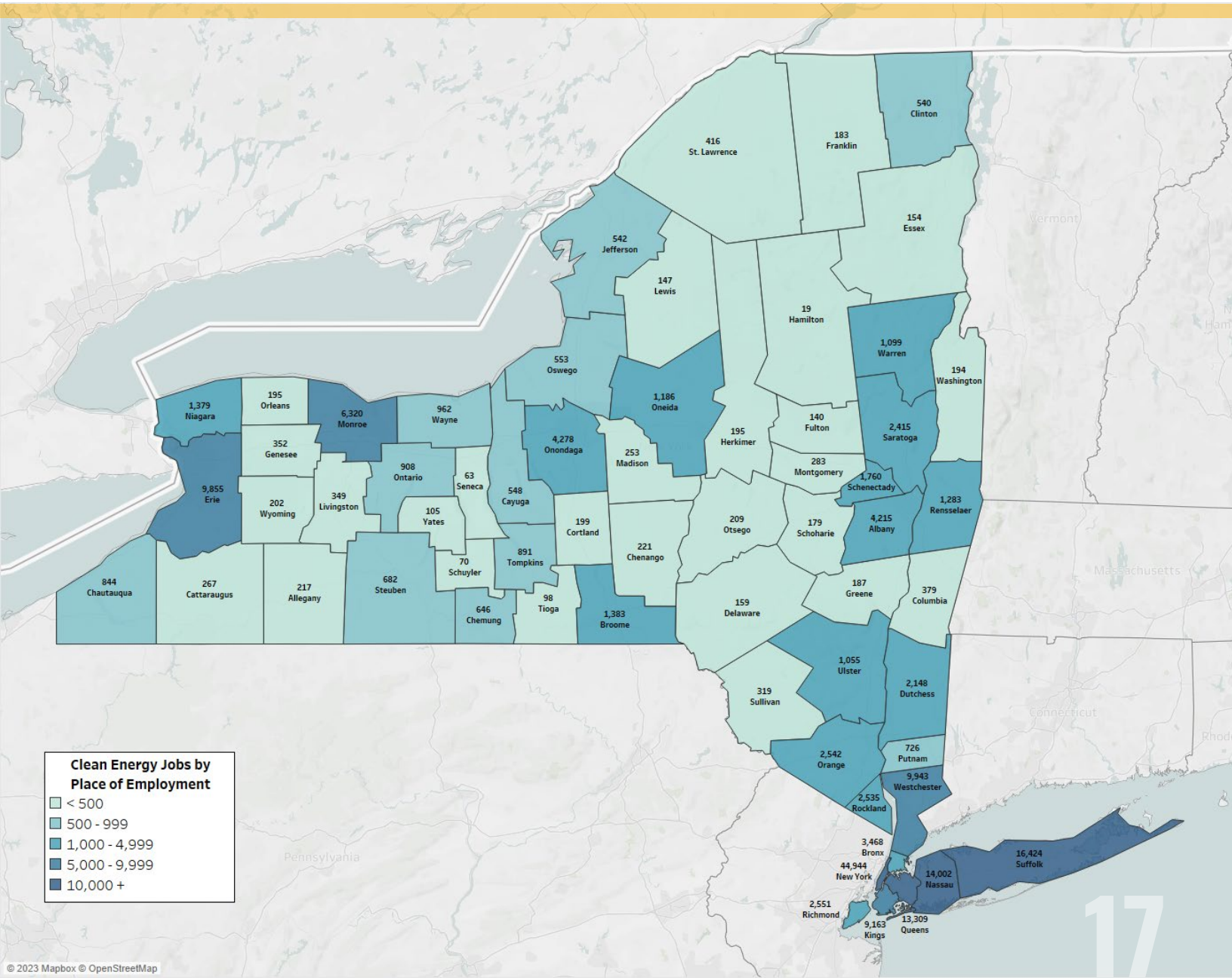
# GEOGRAPHY OF CLEAN ENERGY JOBS AND WORKERS

## *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.*

The difference between these two factors is often significant. **There are 170,857 clean energy jobs within New York in 2022, but only 159,706 New York residents work in clean energy**.

This suggests that the State sees a significant number of workers flow into New York for work, and then return home to another state at the end of the day. Figure 13 outlines the number of clean energy jobs by county, while Figure 14 shows the number of residents within each county who work within clean energy.

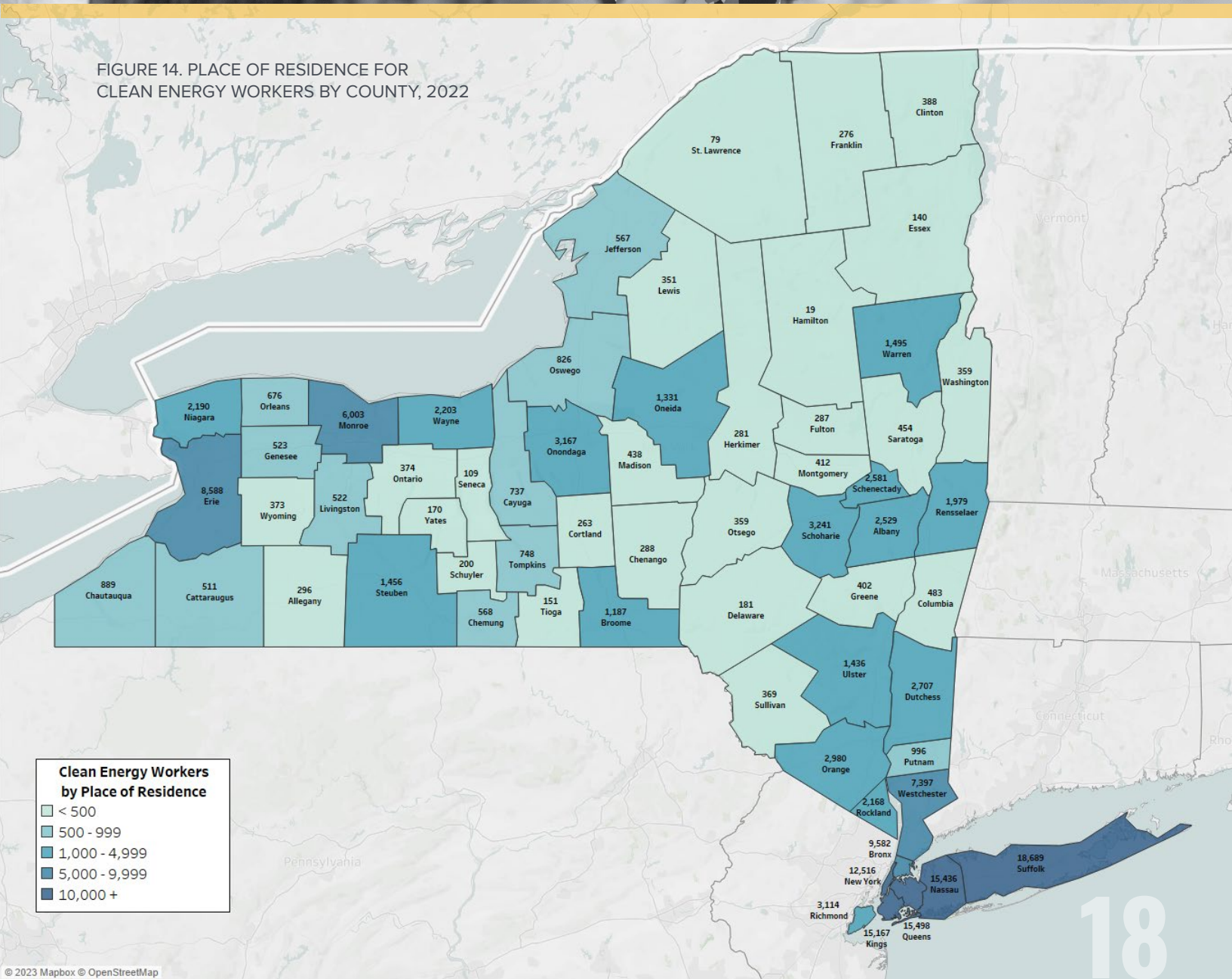
FIGURE 13. CLEAN ENERGY JOBS (PLACE OF EMPLOYMENT) BY COUNTY, 2022



**170,857**
clean energy jobs within New York in 2022

**159,706**
New York residents work in clean energy jobs in 2022

FIGURE 14. PLACE OF RESIDENCE FOR CLEAN ENERGY WORKERS BY COUNTY, 2022



# DETAILED CLEAN ENERGY SECTOR EMPLOYMENT

section 03

## 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.[10]

Its primary objective is to decarbonize and improve the efficiency of commercial, residential, 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, insulation technologies (advanced building materials), 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.

### *The building decarbonization and energy efficiency sector maintains the largest number of jobs in the clean energy industry.*

All sub-technologies within this sector experienced a steady increase in employment since the decline in 2020 caused by the impact of COVID-19. From 2021 to 2022, the building decarbonization and energy efficiency sector experienced an increase of 2,087 jobs across sub-technologies. These trends reflect a continued focus on energy efficiency and electrification in various sectors.

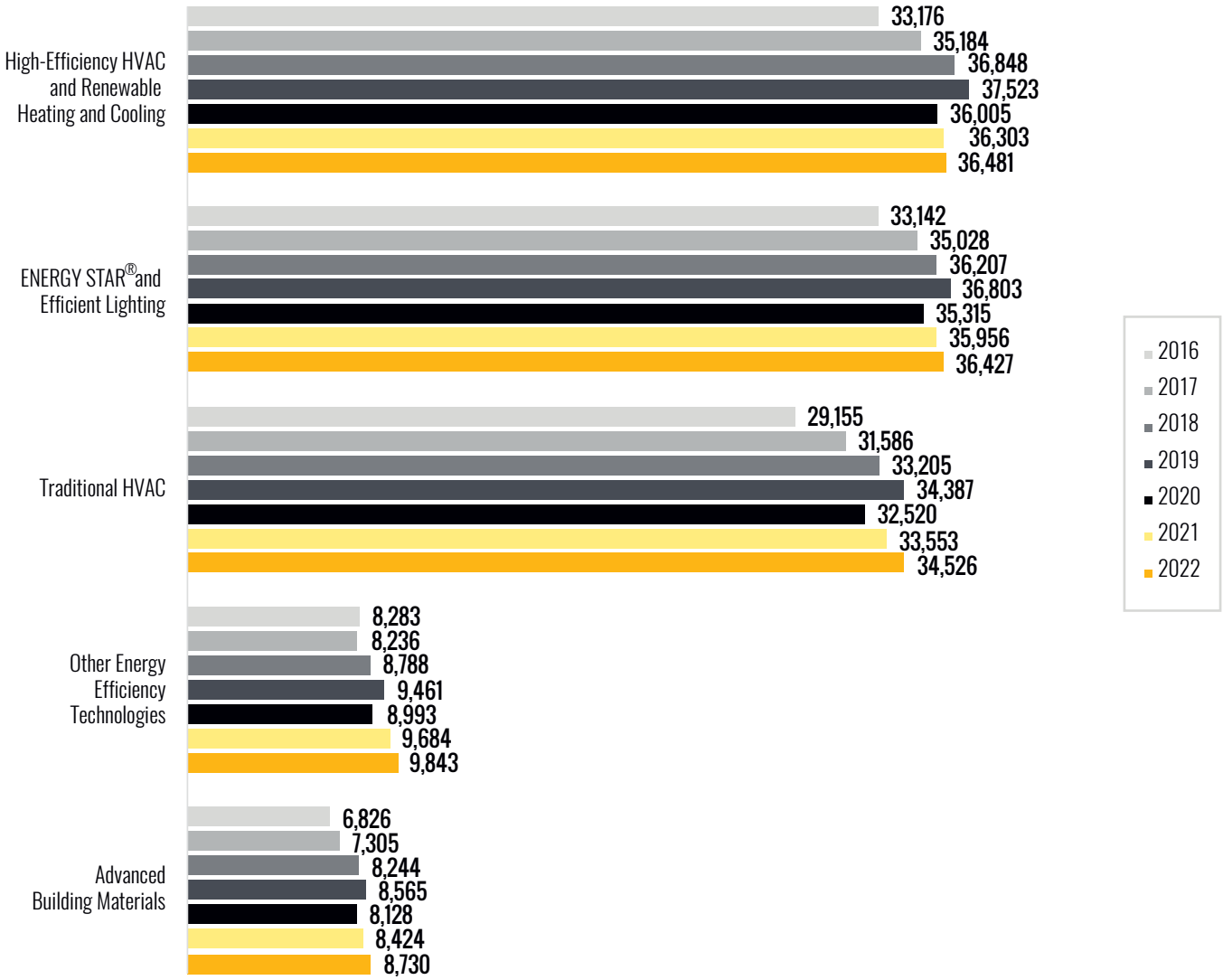
## *The two largest sub-technologies in the building decarbonization and energy efficiency sector—high efficiency HVAC and renewable heating and cooling—continue to recover from the pandemic and have not yet returned to their peak employment levels in 2019.*

High-efficiency HVAC and renewable heating and cooling experienced an increase of 525 jobs from 2021 to 2022, representing a growth rate of approximately 2%.

ENERGY STAR appliances and efficient lighting added 124 jobs, reflecting a more modest increase of less than 1% during the same period.

This is the first year since building decarbonization and energy efficiency employment tracking began in 2016 that employment in high-efficiency HVAC and renewable heating and cooling sub-technologies has exceeded employment in ENERGY STAR appliances and efficient lighting (Figure 15).

FIGURE 15. ENERGY EFFICIENCY EMPLOYMENT BY SUB-TECHNOLOGY, 2016-2022[11]



# 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.

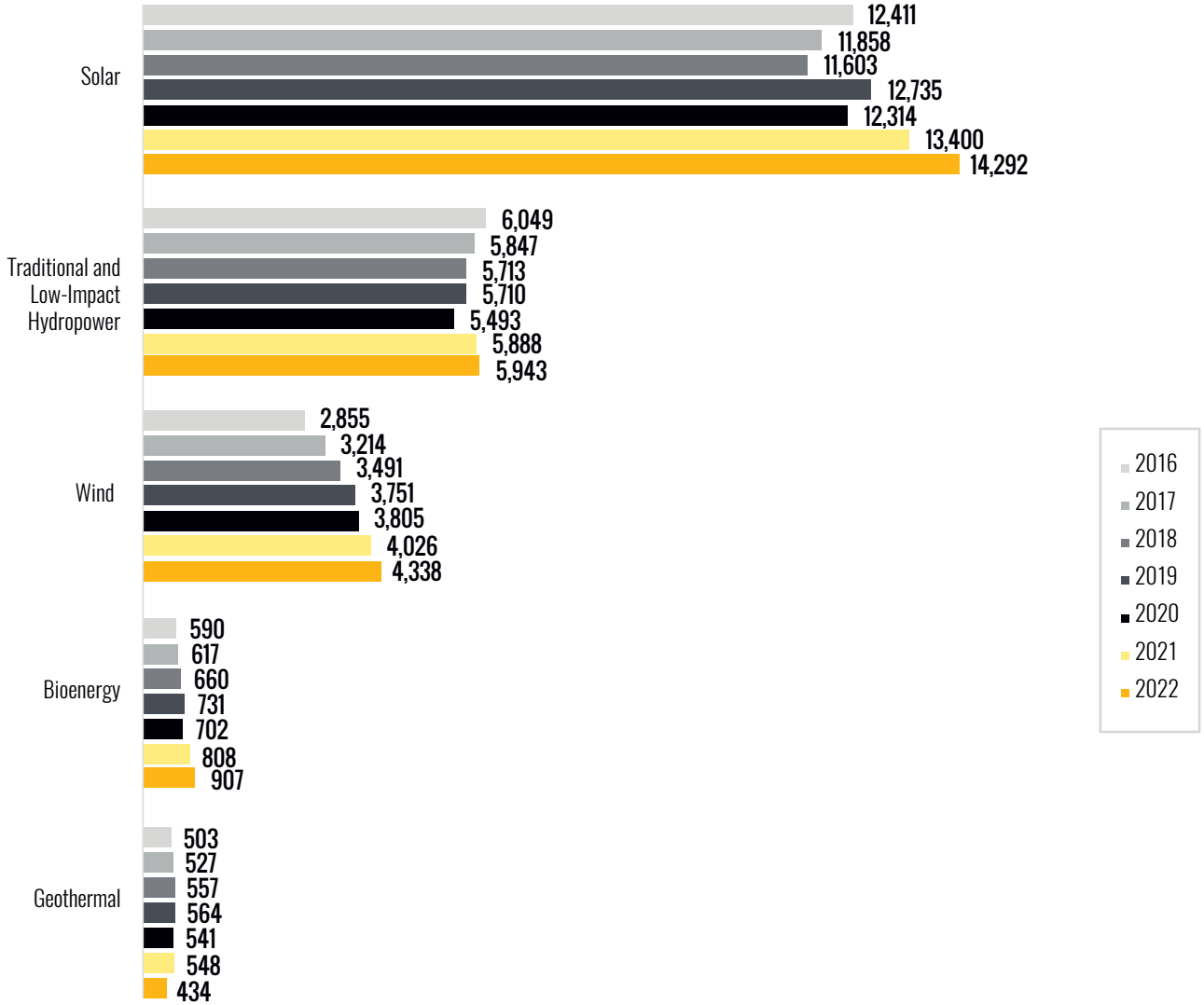
## *In 2022 the solar sub-technology accounted for over 55% of the employment within the renewable electric power generation sector.*

The number of jobs in the solar industry increased from 13,400 in 2021 to a new peak of 14,292 jobs in 2022, an addition of 892 jobs. This growth represented 66% of all new jobs in the sector between 2021 and 2022.

## *Growth in wind power accounted for 23% of new employment in the sector, adding 312 new jobs in 2022 as the industry ramps up.*

All but one sub-technology witnessed an increase in jobs from 2021 to 2022. The geothermal sub-technology, which has consistently held less than 3% of employment in the sector, experienced a reduction of 114 jobs in 2022 (Figure 16).

FIGURE 16. RENEWABLE ELECTRIC POWER GENERATION EMPLOYMENT BY SUB-TECHNOLOGY, 2016-2022[12]




# CLEAN AND ALTERNATIVE TRANSPORTATION

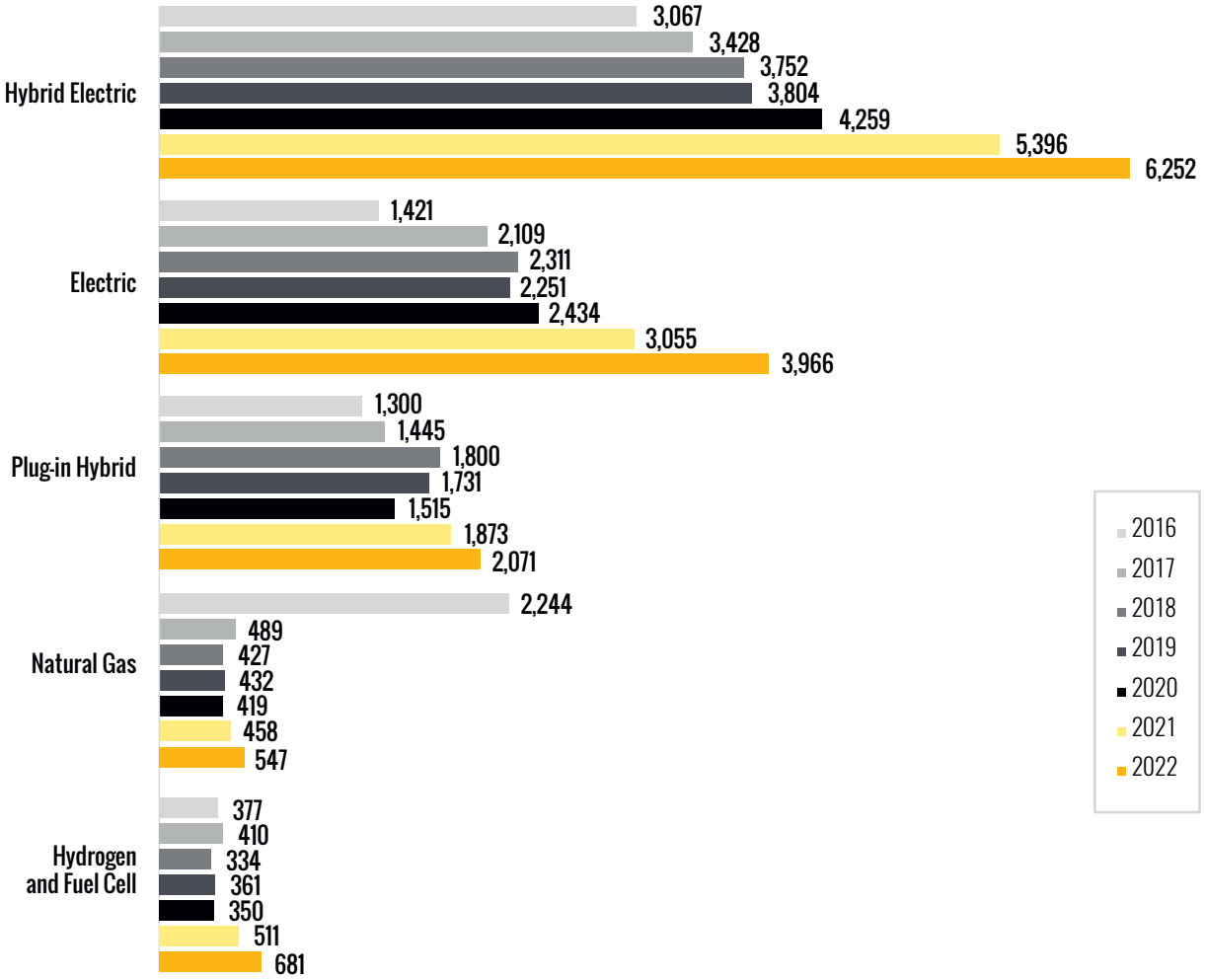
The clean and alternative transportation sector encompasses individuals involved in various aspects of clean and alternative vehicle technologies, including manufacturing, sales, repair and maintenance, as well as professional business support services such as legal, financial, engineering, and consulting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

## *Hybrid electric and electric sub-technologies exhibited the strongest growth rates between 2021 and 2022 as New York's transportation sector opts for cleaner and more sustainable transit options.*

The electric vehicle sub-technology saw the largest absolute increase in employment from 3,055 jobs in 2021 to 3,966 jobs in 2022, an addition of more than 900 jobs. It now accounts for 26% of total employment in the clean and alternative transportation sector, compared to 14% in 2016.

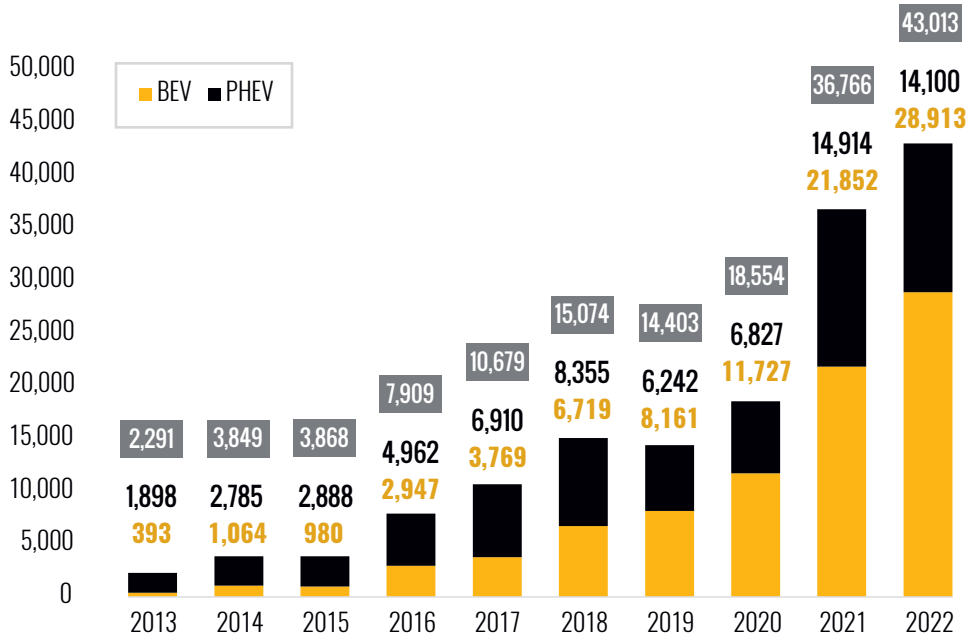
Since 2016, the hybrid electric sub-technology has consistently held the largest share of employment in the clean and alternative transportation sector. In 2022, this sub-technology accounted for 40% of clean and alternative transportation employment. The hybrid electric sub-technology continues to grow, adding 856 jobs between 2021 and 2022, representing a growth rate of 16% (Figure 17).

FIGURE 17. CLEAN AND ALTERNATIVE TRANSPORTATION EMPLOYMENT BY SUB-TECHNOLOGY, 2016-2022




## *Growth of consumer demand for electric vehicles suggests that employment to support these vehicles will continue to grow.*

FIGURE 18. ORIGINAL EV REGISTRATIONS IN NEW YORK STATE, 2013-2022[13]




The growth in consumer demand for both battery-electric vehicles (BEVs) and plug-in hybrid vehicles (PHEVs) can be observed through original EV registrations in New York State, and suggest that employment supporting these types of vehicles will continue to grow (Figure 18).


# GRID MODERNIZATION AND ENERGY STORAGE

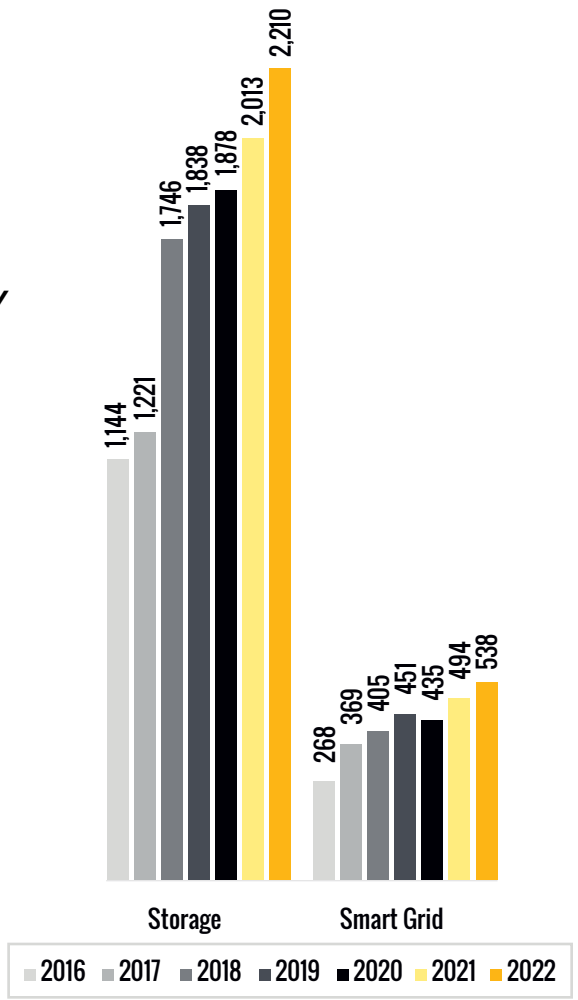
Grid modernization and energy storage workers refer to individuals involved in supporting the deployment (construction), manufacturing, wholesale trade, as well as legal, financial, and engineering services related to smart grid[14] and energy storage technologies.

## *Grid modernization and energy storage experienced significant growth in 2022, largely driven by a 10% increase in storage jobs.*

Energy storage—which includes pumped hydropower storage,[15] battery storage,[16] mechanical storage,[17] thermal storage,[18] biofuel storage (including ethanol and biodiesel), and nuclear fuel storage—has experienced a consistent upward trajectory in employment. Energy storage saw its second largest absolute increase in jobs between 2021 and 2022, adding 197 jobs (10% growth) during this period.

The smart grid sub-technology also saw a near-double digit growth rate (9%) between 2021 and 2022, adding 44 jobs and increasing the total employment from 494 jobs in 2021 to 538 jobs in 2022 (Figure 19). This growth in grid modernization and energy storage highlights the increasing importance of these technologies as the State's electrical grid modernizes and prepares to meet increased electrical load and demand.

FIGURE 19. GRID MODERNIZATION AND ENERGY STORAGE EMPLOYMENT BY SUB-TECHNOLOGY, 2016-2022



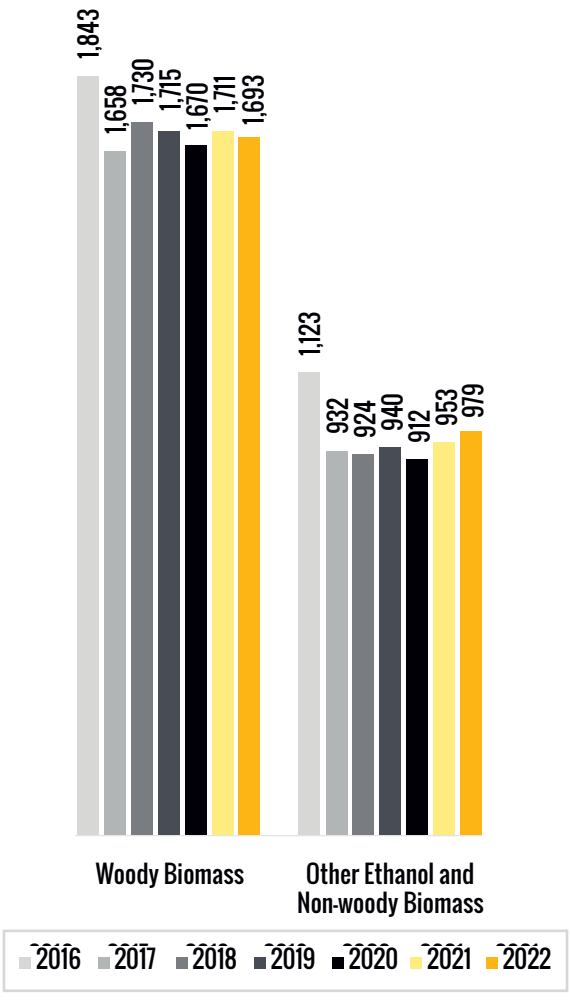
# RENEWABLE FUELS

***The renewable fuels industry in New York witnessed a slight growth in employment for both woody biomass and other ethanol and non-woody biomass sub-technologies in 2021 to 2022.***

Despite these increases, employment levels remained below their peak years.

The woody biomass sub-technology declined gradually (8%) between 2016 and 2022, including a 1% decrease between 2021 and 2022. Similarly, other ethanol and non-woody biomass sub-technologies experienced a greater decrease in employment (-13%) from 2016 to 2022 despite a small increase (3%) between 2021 and 2022 (Figure 20). These numbers suggest that while renewable fuels continue to play a role in the New York economy and clean energy transition, that role remains relatively small.

FIGURE 20. RENEWABLE FUELS EMPLOYMENT BY SUB-TECHNOLOGY, 2016-2021[19]



# CLEAN ENERGY UNIONIZATION

Section 04

***Roughly one-in-eight clean energy workers in New York are members of a union or are covered by a union, which is a higher rate than the national average in clean energy.***

These rates differ substantially by value chain segment. About one-in-five (21%) of public or private utility workers are covered under a union compared to only 3% of the sales and distribution segment (Table 1). Given the incentives available for union construction work under the Inflation Reduction Act, the share of this workforce may increase in future years.

TABLE 1. UNIONIZATION RATE IN CLEAN ENERGY BY VALUE CHAIN, 2022

| | Average Membership Rate[20] | Average Coverage Rate[21] |
|---|---|---|
| Installation | 16% | 17% |
| Professional Services | 4% | 5% |
| Public or Private Utility | **21%** | **21%** |
| Manufacturing | 10% | 12% |
| Sales and Distribution | 3% | 3% |
| Other Support Services | 5% | 5% |
| Other | 6% | 7% |
| Total | 12% | 13% |

# CLEAN ENERGY HIRING

Section 05

## *Hiring challenges continued to grow in severity in 2022.*

More than nine-in-ten employers stated it was at least somewhat difficult to hire clean energy workers, with 45% reporting that it was 'very difficult' to hire clean energy workers (Figure 21).

Hiring challenges were severe across all technology sectors, but renewable fuels employers reported the greatest levels of hiring difficulty.

Though hiring in clean and alternative transportation was challenging for most employers, one-in-five reported having little difficulty (Figure 22).

FIGURE 22. EMPLOYER-REPORTED HIRING DIFFICULTY BY TECHNOLOGY, 2022

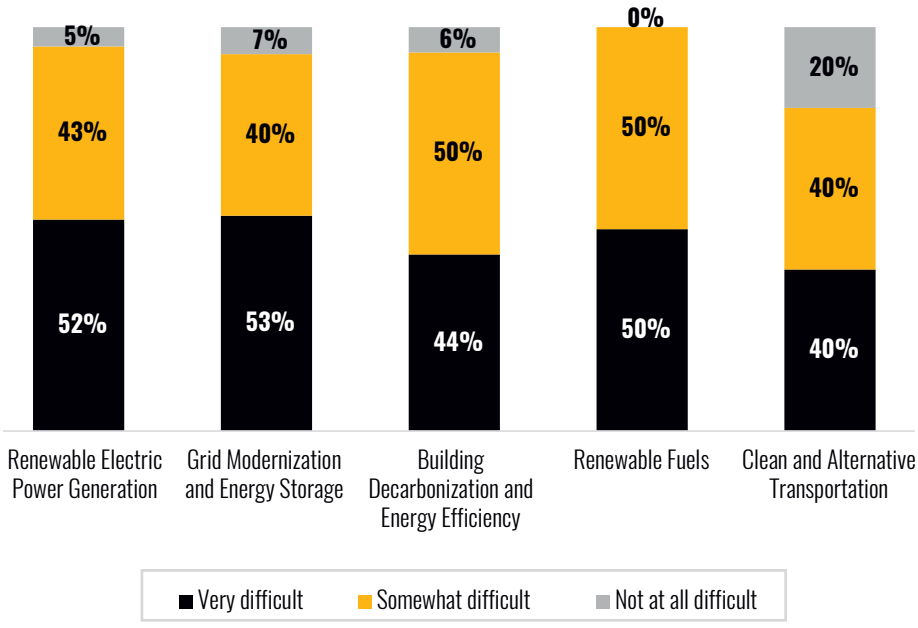
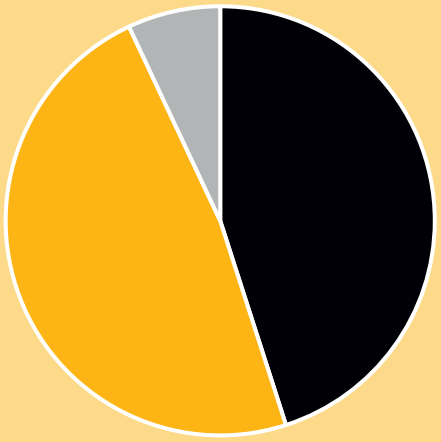



FIGURE 21. EMPLOYER-REPORTED HIRING DIFFICULTY, 2022



### *Elevated rates of hiring challenges are not unique to New York.*

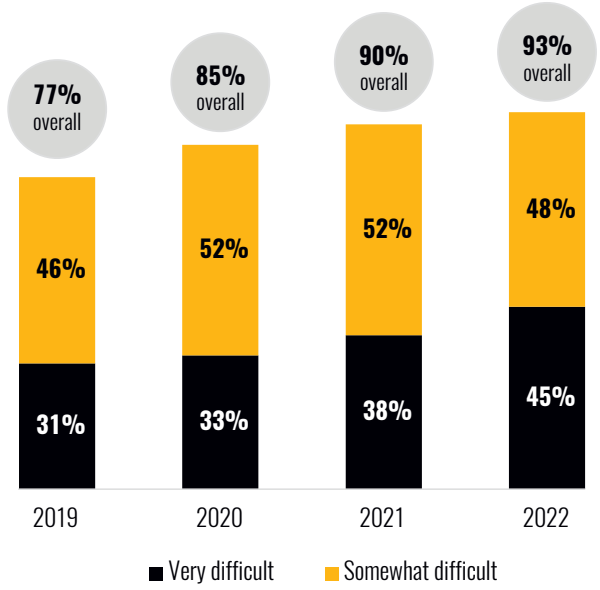
Nationwide, clean energy employers are having a difficult time hiring workers. The 2023 U.S. Energy and Employment Report finds that nationally, more than four-out-of-five clean energy employers have at least some challenges hiring.[22]

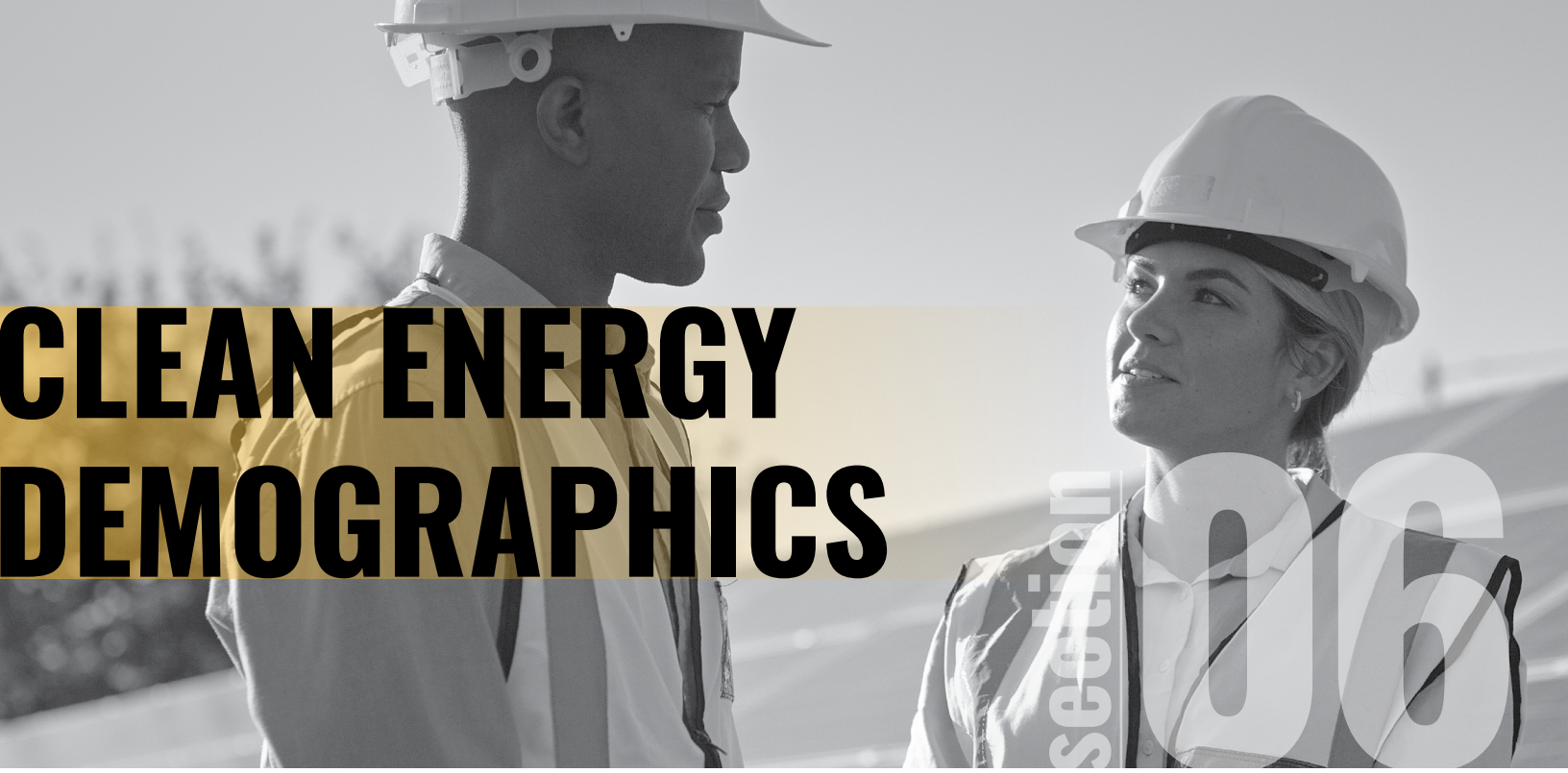
### *Overall hiring difficulty (both 'somewhat' and 'very difficult') increased significantly over the past four years.*

The share of employers reporting it is 'very difficult' to hire clean energy talent jumped from 31% in 2019 to 45% in 2022. Overall, clean energy employers are more frequently reporting more severe hiring challenges (Figure 23).

**This heightened and growing need for workers emphasizes the need for more investment in workforce training and pipeline development, ensuring that New York residents of all backgrounds have access to clean energy related job and skills training that connects them with local employers looking to hire talent.**

FIGURE 23. EMPLOYER-REPORTED HIRING DIFFICULTY, 2019-2022





# CLEAN ENERGY DEMOGRAPHICS

SECTION 06

## *The clean energy workforce in New York became more diverse between 2021 and 2022, but there is still progress to be made.*

The share of women in clean energy increased by 3% between 2021 and 2022. However, women account for just over a quarter of clean energy workers despite comprising nearly half of the State's workforce.

Similarly, Hispanic/Latin/a/x, Black, and Asian workers saw significant increases in representation in clean energy (4%, 11%, and 9% respectively), but are still slightly underrepresented in clean energy relative to the broader labor force (Table 2). It will be critical to continue to monitor, fund, and support New York's investments and programs that support diversification within the clean energy workforce.

TABLE 2. CLEAN ENERGY DEMOGRAPHICS, 2022[23]

| | NY Clean Energy Industry | | | | |
|---|---|---|---|---|---|
| | **Overall Clean Energy, 2021** | **Overall Clean Energy, 2022** | **Renewable Electric Power Generation** | **Building Decarbonization and Energy Efficiency** | **New York State's Labor Force** |
| Female | 25% | **26%** | 28% | 26% | 48% |
| Male | 75% | **74%** | 72% | 74% | 53% |
| White | 72% | **72%** | 71% | 72% | 70% |
| Hispanic/Latin/a/x | 15% | **15%** | 16% | 15% | 17% |
| Black | 8% | **9%** | 10% | 9% | 17% |
| Asian | 7% | **8%** | 9% | 8% | 9% |
| Native American | 2% | **1%** | 1% | 1% | 1% |
| Pacific Islander | 1% | **1%** | 1% | 1% | <1% |

CLEAN ENERGY HIGHLIGHT

# NONTRADITIONAL EMPLOYMENT FOR WOMEN (NEW)


***Nontraditional Employment for Women (NEW)* prepares, trains, and places women in careers in the skilled construction, utility, and maintenance trades, helping women achieve economic independence and a secure future for themselves and their families.**

At the same time, NEW provides a pipeline of qualified workers to the industries that build, move, power, green, and maintain New York, placing program graduates into apprenticeships, paid internships, and full-time jobs.

- **Curriculum:** Environmental literacy, sustainability, efficiency, construction
- **Activities:** Hands-on skills training, soft skills workshops, physical conditioning, mentoring and networking with subject matter experts, site tours, certifications, job/apprenticeship placement support
- **Partners:** Con Edison, National Grid and PSEG, Cushman & Wakefield, the Metropolitan Transit Authority (MTA), the City of New York's Department of Environmental Protection, and 30+ registered apprenticeship programs

# CLEAN ENERGY EMPLOYMENT AND TRAINING IN DISADVANTAGED COMMUNITIES

Section 07

***New York State is transitioning to an inclusive clean energy economy that reduces greenhouse gas emissions, addresses systemic inequities, and expands economic opportunity for all New Yorkers.***

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 (DACs), which are referred to in the 2019 Climate Leadership and Community Protection Act (Climate Act) as areas burdened by cumulative environmental pollution and other hazards that can lead to (1) negative public health effects as well as (2) areas vulnerable to the impacts of climate change.

In March 2023, the Climate Justice Working Group adopted criteria used to identify DACs statewide based on a variety of variables including a combination of environmental pollution, socioeconomic, and health outcome indicators.[24]

This section uses novel data and novel analyses to better understand the current clean energy employment landscape within these DACs.[25] From this initial high-level assessment, challenges and opportunities can be identified, and highly localized strategies potentially can be devised to support workforce development and economic development in these areas.

***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 a series of metrics that capture geographic aspects of where clean energy workers live and where clean energy jobs are.

***These metrics include:***

## Clean energy jobs within DACs

*(Figure 24)*

This metric shows the number of clean energy jobs located within DACs.

## Clean energy jobs relative to the population

*(Figure 25)*

This metric shows the concentration of clean energy jobs in a DAC relative to the overall population that lives there.

## Residents with clean energy jobs relative to the population

*(Figure 26)*

This metric shows the concentration of workers living in a DAC with clean energy jobs relative to the overall population that lives there.

This analysis uses county-level clean energy employment data proportioned to the census-tract level, the geography at which DACs are defined.[26] Because census tracts are very small—sometimes encompassing as little area as a few city blocks— clean energy job and resident 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.[27]

# CLEAN ENERGY EMPLOYMENT IN DISADVANTAGED COMMUNITIES

## *Clean energy jobs can be found in disadvantaged communities throughout the New York State.*

Figure 24 highlights that communities with hundreds of clean energy jobs can be found throughout the State.

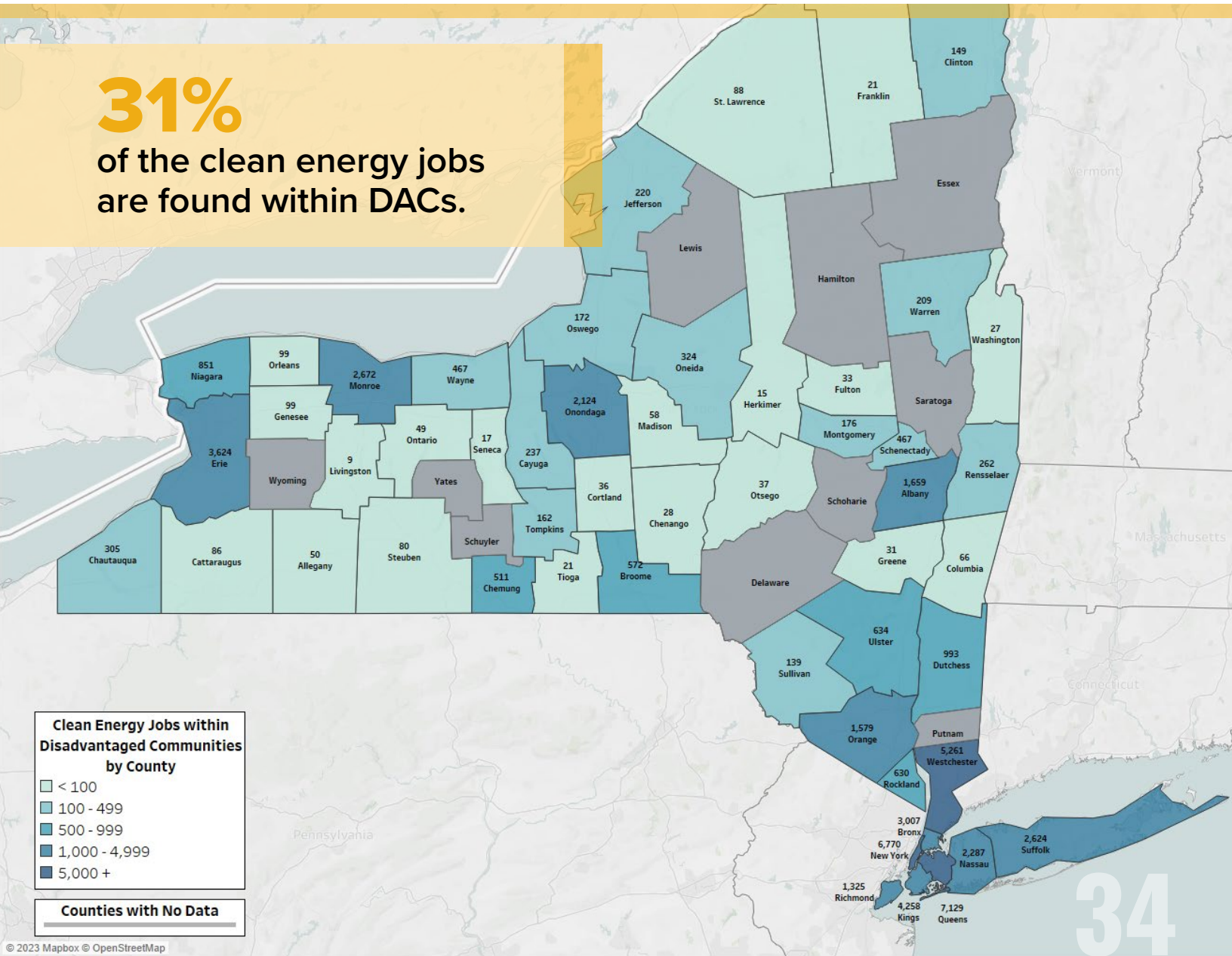
Of the 170,857 clean energy jobs in New York State in 2022, 52,749 (31%) of these jobs can be found within disadvantaged communities. While jobs within disadvantaged communities account for a significant share of clean energy jobs throughout the State, the number of residents living in disadvantaged communities account for 36% of the State's total population.[28, 29]

**13 of 52**

**counties with DACs have 1,000 or more clean energy jobs located within DACs.**

**including Erie, Monroe, Onondaga, Albany, Orange, and several counties around New York City and Long Island.**

FIGURE 24. CLEAN ENERGY JOBS IN DISADVANTAGED COMMUNITIES[30]



## *Concentrations of clean energy jobs in DACs vary around the State.*

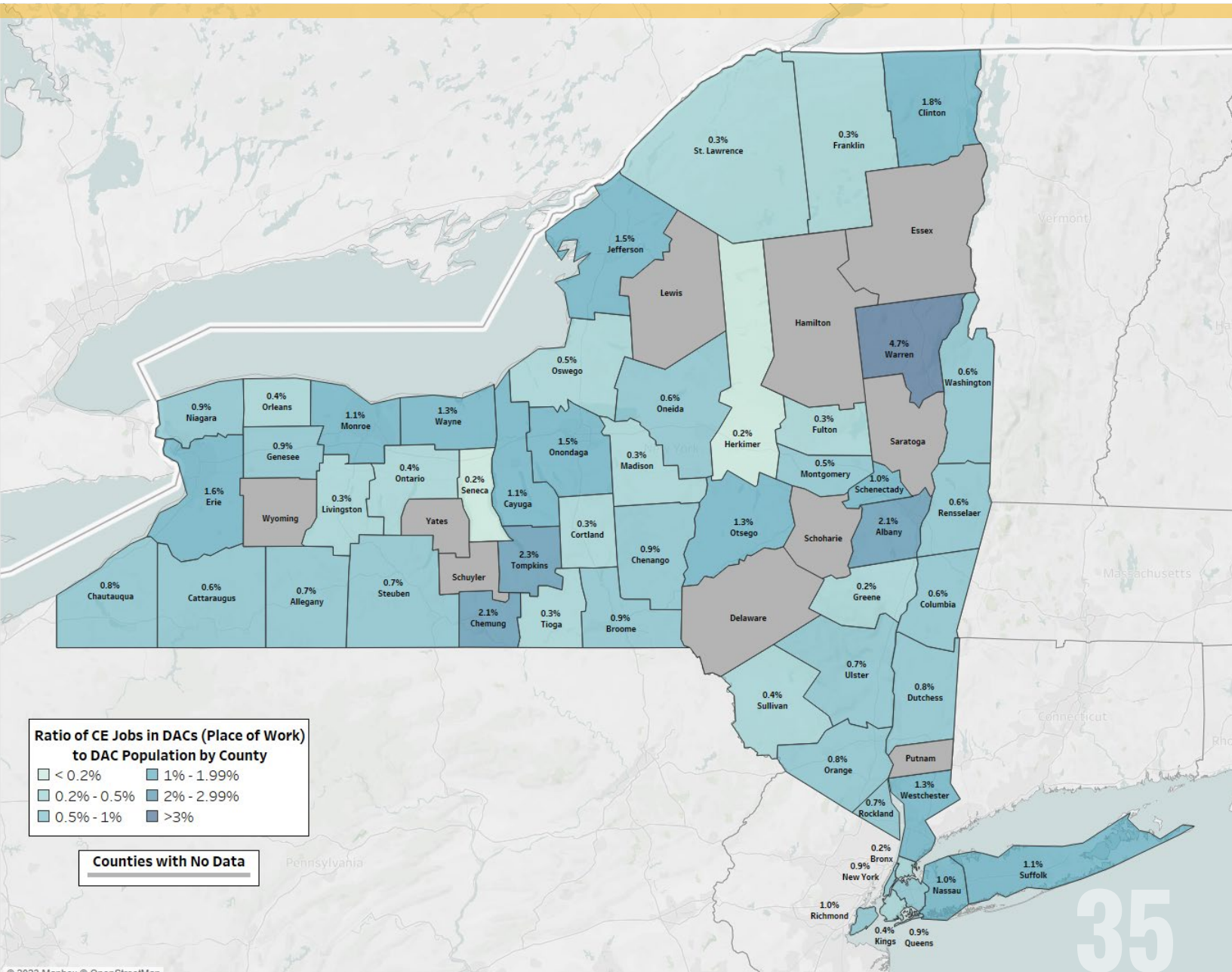
Disadvantaged communities in Warren, Tompkins, Chemung, and Albany counties have the highest concentration of clean energy jobs relative to the population living within DACs.[31] For example, in Warren County, clean energy jobs located within DACs are equivalent in number to almost 5% of the population within these communities (Figure 25), which is more than five times the statewide average concentration of clean energy jobs.

Furthermore, 23 of the 52 counties with DACs have a higher concentration of clean energy jobs in DACs than the statewide concentration of clean energy jobs. This data means that many DACs within counties around the State have a high proportion of clean energy employment opportunities.

**23 of 52**

**counties with DACs have a higher concentration of clean energy jobs in DACs than the statewide concentration of clean energy jobs.**

FIGURE 25. CLEAN ENERGY JOBS RELATIVE TO POPULATION[32, 33]



### *Most DACs have a lower share of clean energy workers living within them.*

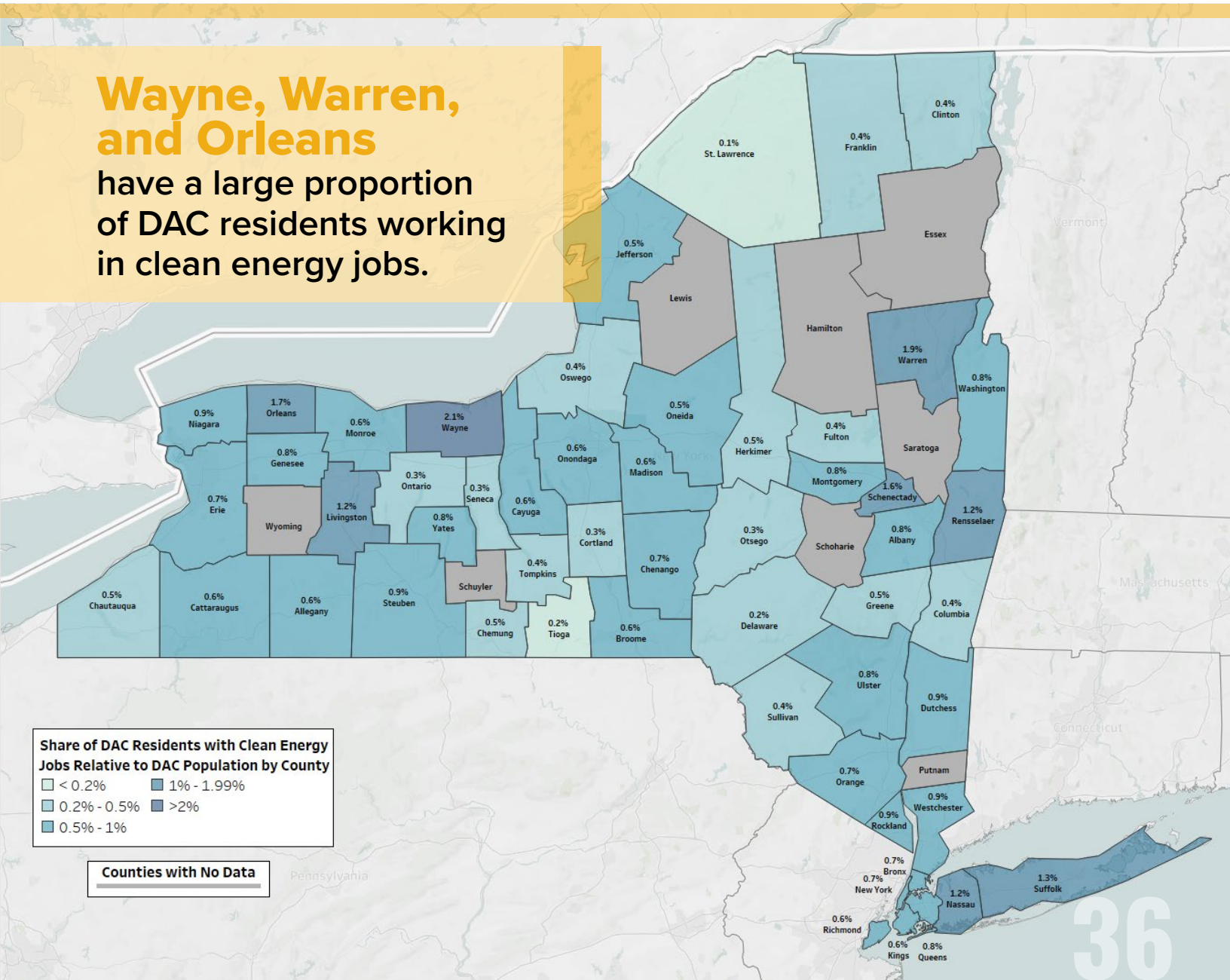
In fact, only 37% of counties with DACs have a greater concentration of residents with clean energy jobs than the overall average concentration for the State.[34]

This means that while there are some counties with a large proportion of DAC residents who work in clean energy—including Wayne, Warren, and Orleans counties (dark blue)—many counties have a lower share of DAC residents who have clean energy jobs (Figure 26).

**37%**

**of counties with DACs have a greater concentration of residents with clean energy jobs than overall average concentration for the State.**

FIGURE 26. RESIDENTS WITH CLEAN ENERGY JOBS RELATIVE TO POPULATION[35, 36]



# TRAINING INVENTORY

The research team has continued to update, expand, and revise a database of training programs around the State that are related to clean energy careers. While this list is not exhaustive, the research team focused on identifying trainings that offer entryways into some of the most common and in-demand clean energy occupations including Registered Apprenticeship programs, and trainings relevant to electrification of homes and transportation, residential and commercial energy efficiency retrofits, and offshore wind.

## *Over 1,700 different training programs were identified and confirmed through this exercise.*

Programs that involve training for electrical, construction, operation and maintenance, and heating, ventilation, air condition, and refrigeration (HVAC/R) occupations made up the largest share of identified training programs (Figure 27).

Private employers (often via apprenticeships), unions (also offering apprenticeships), and community colleges offer the greatest number of clean energy-relevant training programs, though non-profit organizations, vocational technical schools, and four-year colleges also offer relevant trainings (Figure 28).

FIGURE 28. TRAINING PROGRAMS BY TRAINING PROVIDER TYPE

| | | |
|---|---|---|
| Private Company | **644** | **37%** |
| Union | **251** | **14%** |
| Community College | **152** | **9%** |
| Board of Cooperative Educational Services (BOCES) | **150** | **9%** |
| Four-Year College/University | **131** | **8%** |
| Vocational Training School | **127** | **7%** |
| Career/Workforce Training Company | **100** | **6%** |
| Non-Profit Organization | **70** | **4%** |
| Government Agency | **50** | **3%** |
| Non-Profit Organization | **33** | **2%** |
| Trade Association | **18** | **1%** |
| Utility | **6** | **<1%** |
| Research Institute | **2** | **<1%** |

FIGURE 27. NUMBER OF TRAINING PROGRAMS BY OCCUPATIONAL FOCUS

| | |
|---|---|
| Electrical | **409** |
| Construction | **256** |
| Operations and Maintenance | **160** |
| HVAC/R | **148** |
| Engineering | **110** |
| Building Analyst | **93** |
| Plumbing and Pipefitting | **81** |
| Welding | **80** |
| Manufacturing | **77** |
| Weatherization | **67** |
| Carpentry | **49** |
| Solar | **34** |
| General Clean Energy | **28** |
| Lineworker | **24** |
| Architecture | **19** |
| Energy Management | **18** |
| Wind | **17** |
| Energy Efficiency | **15** |
| Electric Vehicles | **14** |
| Safety | **11** |
| Energy Storage | **10** |
| Logistics and Transportation | **5** |
| Smart Grid | **3** |
| Quality Control | **3** |
| Hydropower | **2** |
| Biomass | **1** |

***Many disadvantaged communities—particularly those near or within larger cities—have an abundance of nearby clean energy training opportunities.***

Disadvantaged communities around New York City, Buffalo, Albany, Syracuse, and Rochester all have a large number of nearby training programs.

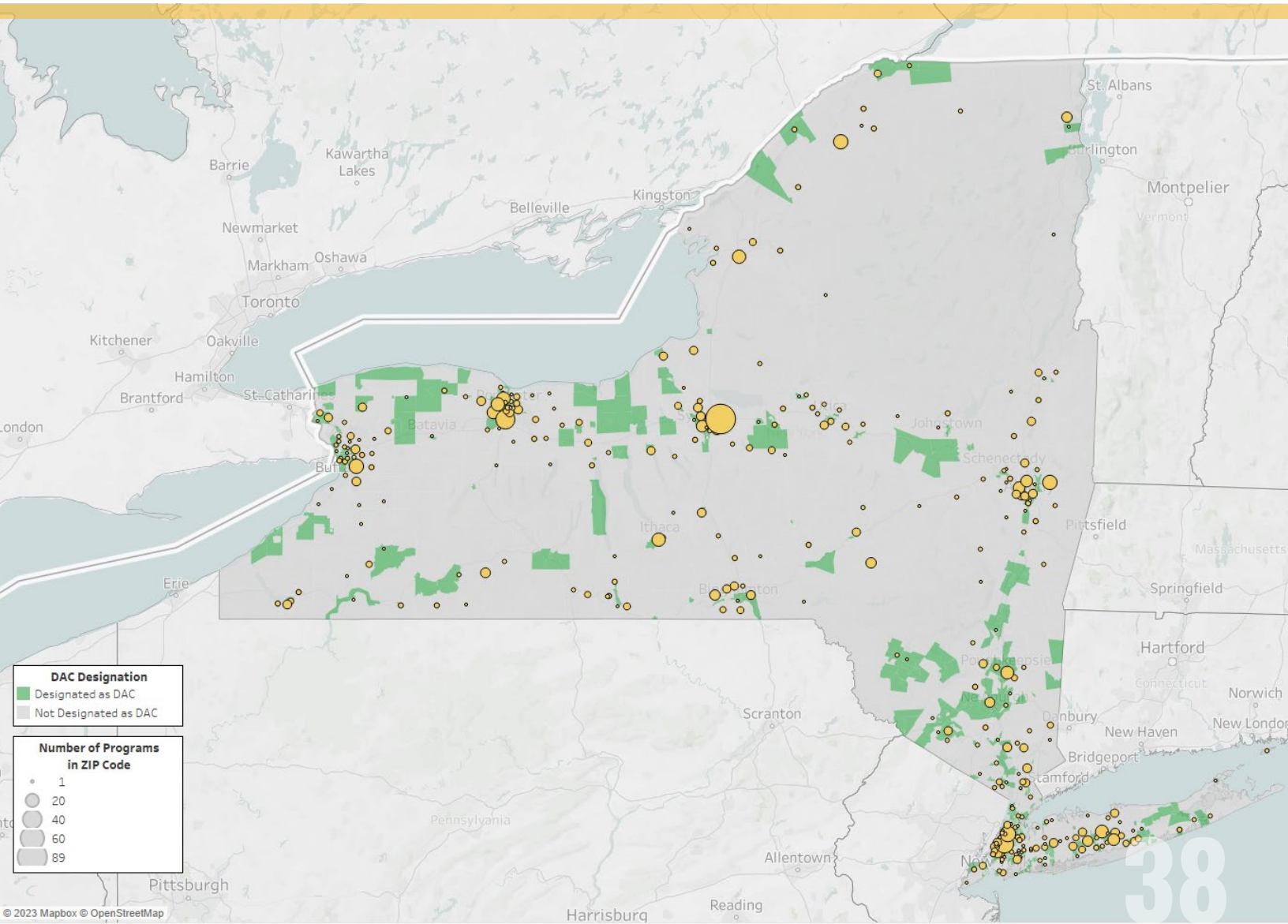
Other regions—particularly those that are more rural—have few or no clean energy training programs identified by the research team (Figure 29).

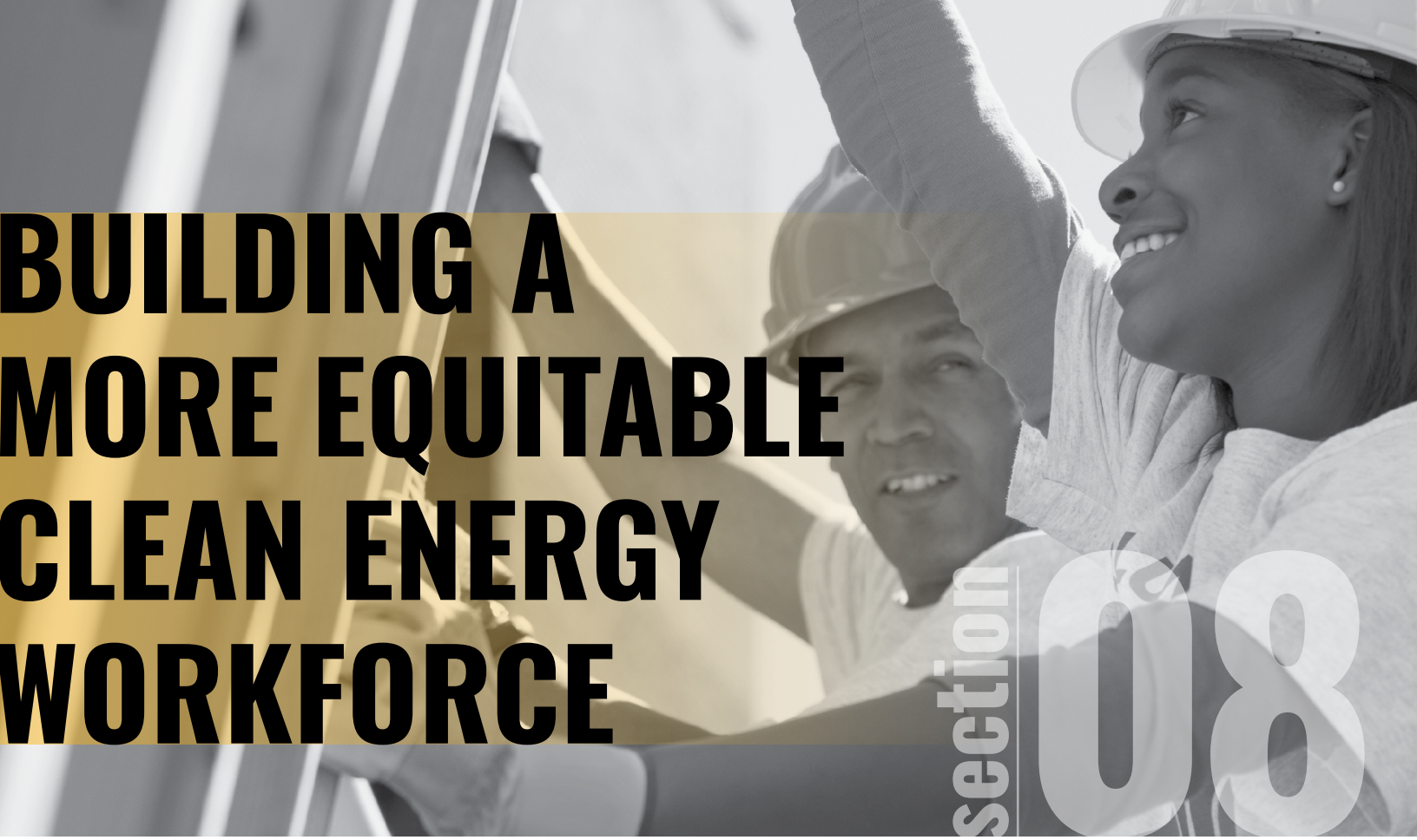
Further evaluation on the types of trainings and their capacities around the State would be needed to further identify gaps or shortages in the clean energy training ecosystem.

**more rural areas**

**have few to no clean energy training programs.**

FIGURE 29. LOCATION OF TRAINING PROGRAMS AND DISADVANTAGED COMMUNITIES





# BUILDING A MORE EQUITABLE CLEAN ENERGY WORKFORCE

section 08

***Growing the clean economy equitably requires identifying current obstacles for clean energy employment and entrepreneurship among workers from priority populations and residents of disadvantaged communities, and then developing policies to support opportunity in these communities.***

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 employer and current worker surveys.

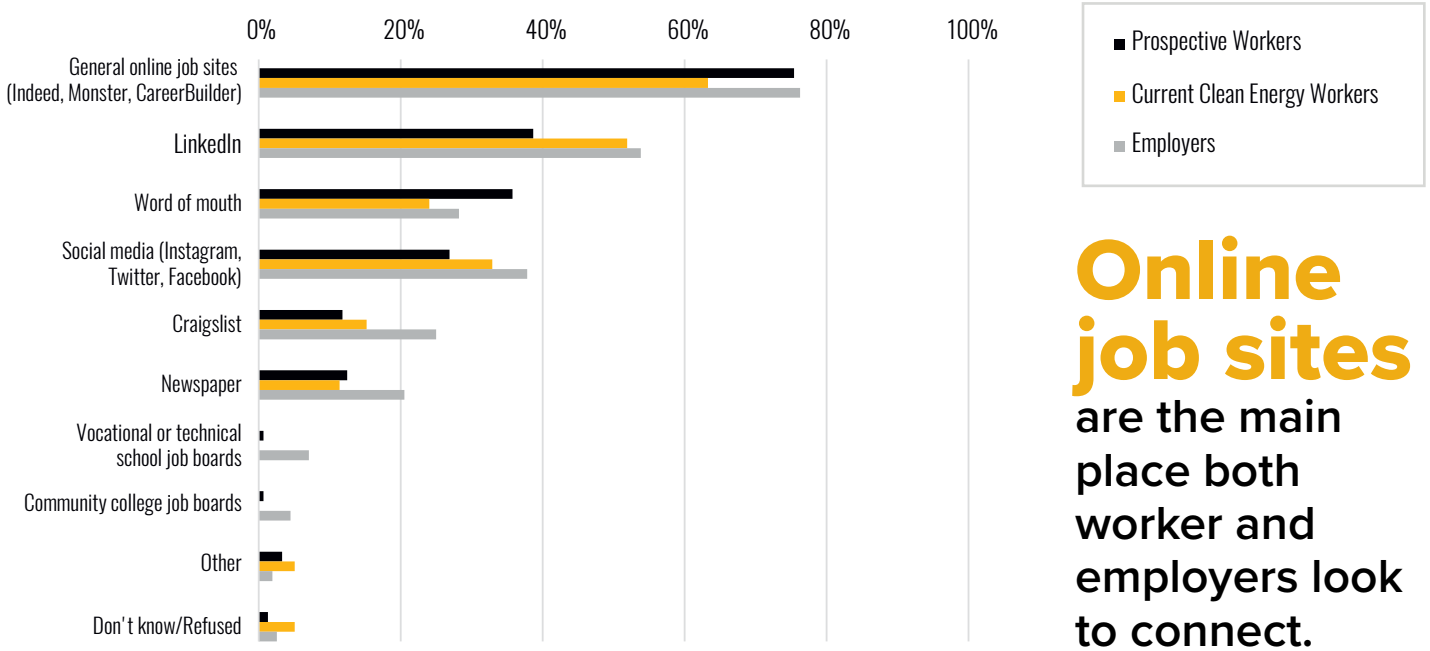
## CONNECTING TALENT AND EMPLOYERS

### *Current and prospective talent and employers tend to look for one another through similar sources.*

Online job sites are the most common, followed by LinkedIn and word of mouth (Figure 30). While the alignment of searching across platforms and mediums tends to suggest that both parties are looking for one another in the appropriate spaces, there may be equity considerations given that "word of mouth" searches rely on social networks and LinkedIn tends to favor roles for office workers and those with previous professional experience.

The survey results also showed that a smaller share of clean energy employers also reach out to local training providers (15%) and unions (13%) directly. Strengthening ties between training providers, unions, and employers may help alleviate equity and "matching" issues that arise through online resources or word of mouth.

FIGURE 30. WHERE TALENT AND EMPLOYERS LOOK FOR ONE ANOTHER




**Online job sites** are the main place both worker and employers look to connect.

## *Clean energy workers had high rates of participation in education and job training programs in the State that are geared toward youth and young adult populations.*

These participation rates were three-to-four times greater than non-clean energy workers. Nearly two-thirds (62%) of survey respondents had attended a technical high school program.

It is also noteworthy that many survey respondents participated in more than one program. This may suggest that pathways from one program to another—for example, from a technical high school to a YouthBuild program—are relatively strong and are the result of intentional career pathways planning and program development.

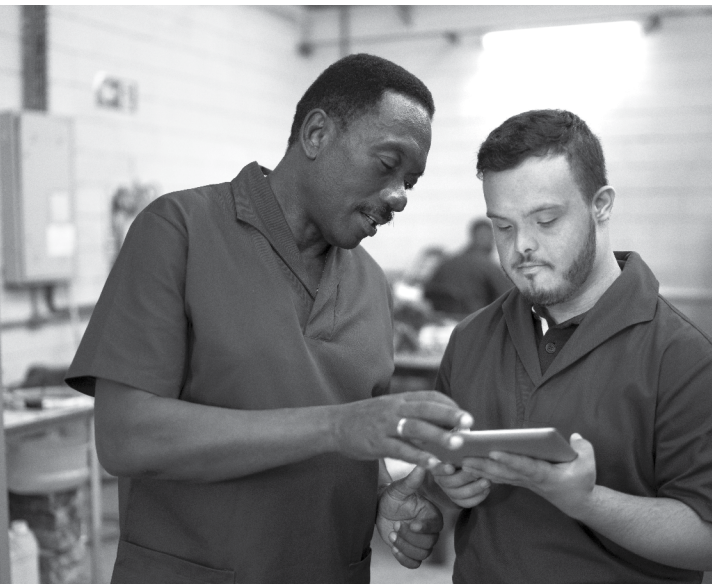
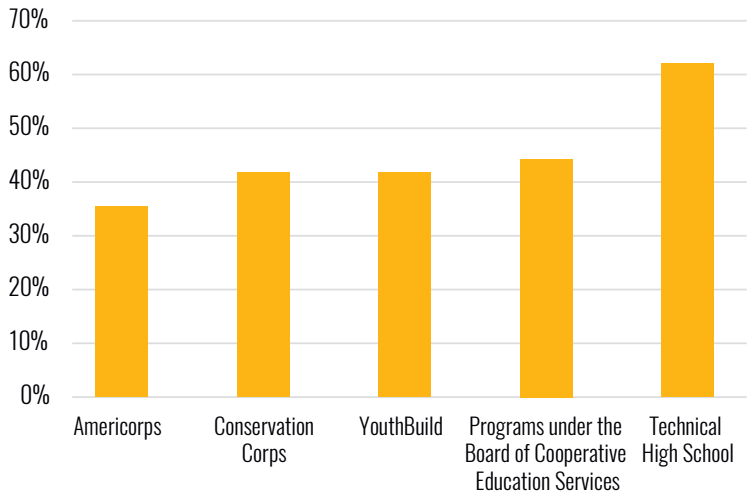


FIGURE 31. RATE OF PARTICIPATION IN RELEVANT TRAINING AND EDUCATION OPPORTUNITIES



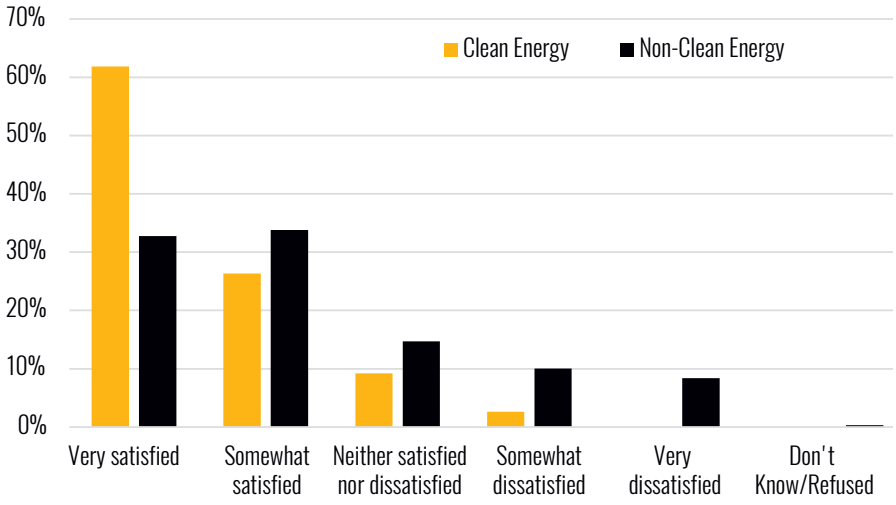
# CLEAN ENERGY CAREER SATISFACTION AND ADVANCEMENT

This section contains comparison of perceptions of current clean energy workers and non-clean energy workers based on a survey of current workers that primarily worked in New York. While clean energy industries and non-clean energy industries do not align perfectly, these comparisons are meant to be illustrative of differences in career opportunities and progression between clean energy and non-clean energy workers.[37]

## *Clean energy workers are overwhelmingly satisfied with their careers.*

Eighty-eight percent reported being at least somewhat satisfied, and most (62%) were very satisfied. These satisfaction rates did not differ significantly between race, ethnicity, gender, or management status. By comparison, only 33% of non-clean energy workers reported being satisfied in their careers (Figure 32).

FIGURE 32. CAREER SATISFACTION




**clean energy workers:**

**88%**
at least somewhat satisfied

**62%**
very satisfied

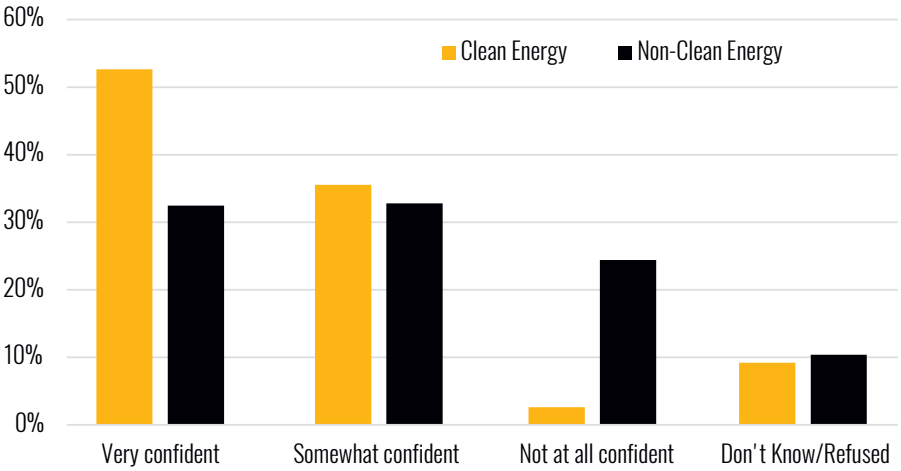
**non-clean energy workers:**

**33%**
satisfied

## *Higher career satisfaction may be related to the higher rates of anticipated career advancement for clean energy workers.*

Half (53%) of clean energy respondents reported they were 'very confident' they would receive a promotion or advancement in the next year, compared to 32% of non-clean energy workers (Figure 33).

FIGURE 33. CONFIDENCE IN PROMOTION OR ADVANCEMENT IN NEW JOB IN NEXT 12 MONTHS




**'very confident' about receiving a promotion or advancement in next year:**

**53%**
of clean energy respondents

**32%**
of non-clean energy respondents

***Nearly three-quarters of respondents (74%) agreed that they were satisfied with promotion and wage opportunities and 80% reported satisfaction with their opportunity to learn new skills and move up, signaling growth prospects and career development possibilities in the clean energy industry.***

Responses also highlight generally positive beliefs around workplace acceptance and diversity, as 75% of respondents either strongly agreed or somewhat agreed that their company offers a workplace that is accepting of people of all backgrounds.

Additionally, 66% of respondents either strongly agreed or somewhat agreed that they felt recognized for their achievements (Figure 34).

FIGURE 34. FIT, RECOGNITION, AND OPPORTUNITY WITHIN THEIR CURRENT CLEAN ENERGY COMPANY

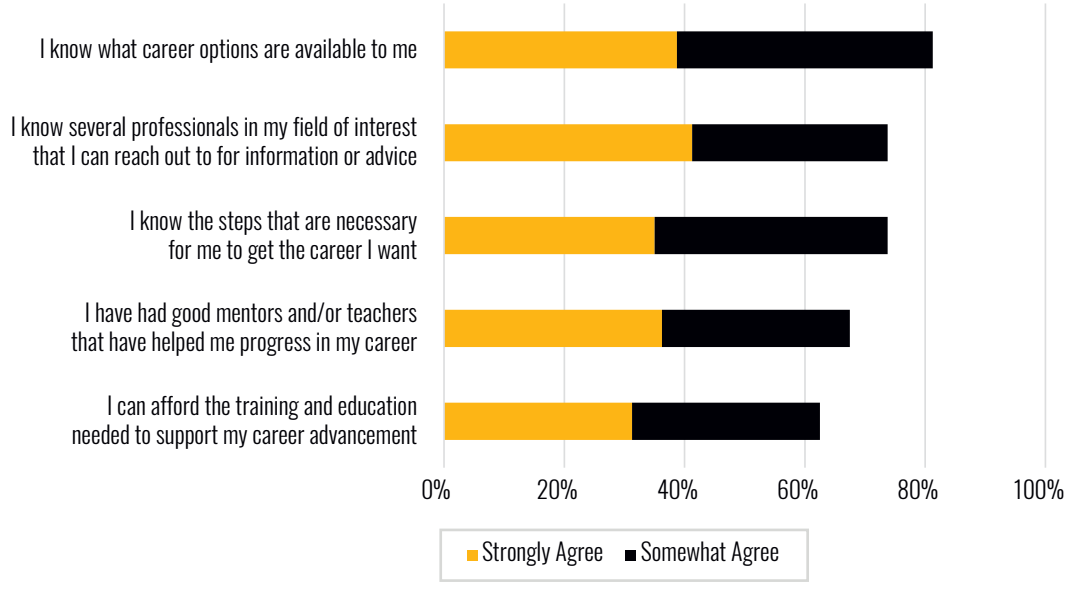
***Professional networks, mentors, and knowledge of career options are available aspects of career advancement for many clean energy workers***

A combined 74% of surveyed clean energy workers agree that they know several professionals in their field of interest whom they can reach out to for information or advice.

Additionally, 68% agree that they have had good mentors and/or teachers who have helped them progress in their careers, a finding that is consistent across race, ethnicity, and gender of respondents.

These findings highlight the importance of professional networks and guidance in supporting career development within the clean energy sector.

FIGURE 35. AVAILABLE RESOURCES TO CURRENT CLEAN ENERGY WORKERS

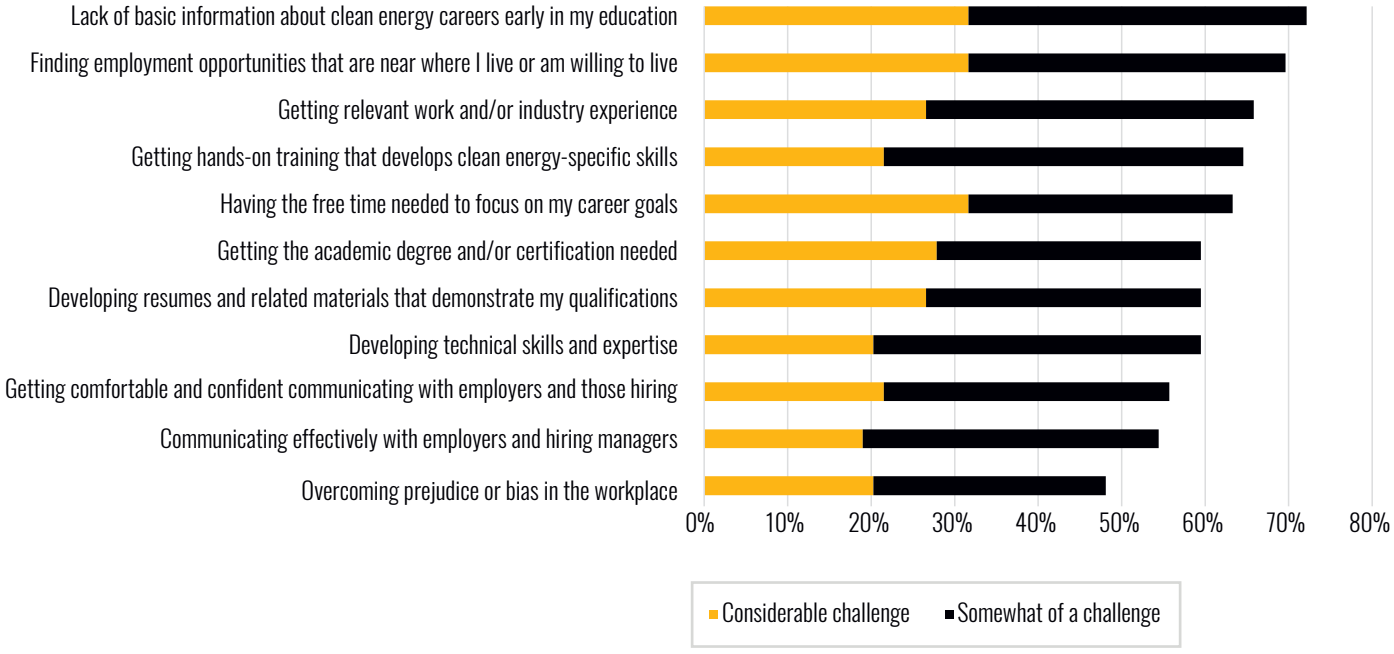


## CHALLENGES IN CAREER ADVANCEMENT

When asked about challenges in advancing their clean energy careers, clean energy workers most commonly reported 'a lack of basic information about clean energy careers early in their education,' 'finding employment opportunities near where [they] live,' and 'getting relevant work and/or industry experience' as the most significant challenges to their career advancement (Figure 36).

A lack of clean energy career knowledge is a barrier that prospective clean energy workers echoed, and the "Training Inventory" section discusses the geographic gaps between clean energy-related trainings, employers, and prospective workers, including within disadvantaged communities.

FIGURE 36. CHALLENGES OR OBSTACLES IN ADVANCING [A RESPONDENTS'] CLEAN ENERGY CAREER



# 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.

## *While most respondents said they have never considered working in clean energy, nearly a quarter reported considering or actively searching for employment in clean energy.*

Over one-third of both those who were considering and those who were actively searching for a clean energy job were younger respondents between the ages of 18 and 25.

Among those who had not considered clean energy careers, the most common reason why they had not considered the clean energy industry was because they did not fully know what clean energy jobs are (53%). Not having necessary education and training (28%) and not wanting to start over in a new career (24%) were the next most-common reasons. Few respondents felt the jobs were not interesting or did not pay enough (Figure 38).

Respondents from priority populations[38] were slightly more likely to report not having the necessary education or training and slightly less likely to say they are not fully aware of what clean energy jobs are.

These findings showcase that efforts to attract more clean energy talent should first focus on highlighting what clean energy jobs exist and then connecting job seekers to relevant training opportunities. while also leveraging any current experience they may have.

FIGURE 37. HAVE YOU EVER CONSIDERED AND/OR LOOKED FOR EMPLOYMENT IN THE CLEAN ENERGY INDUSTRY

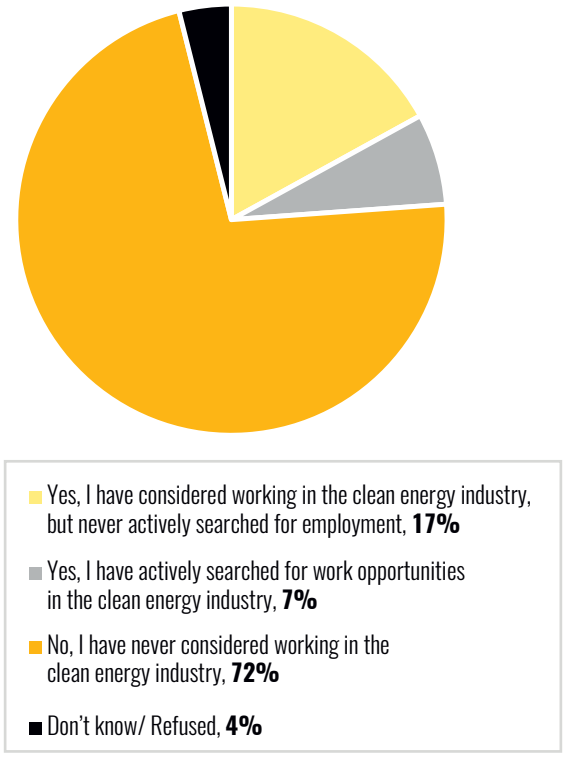
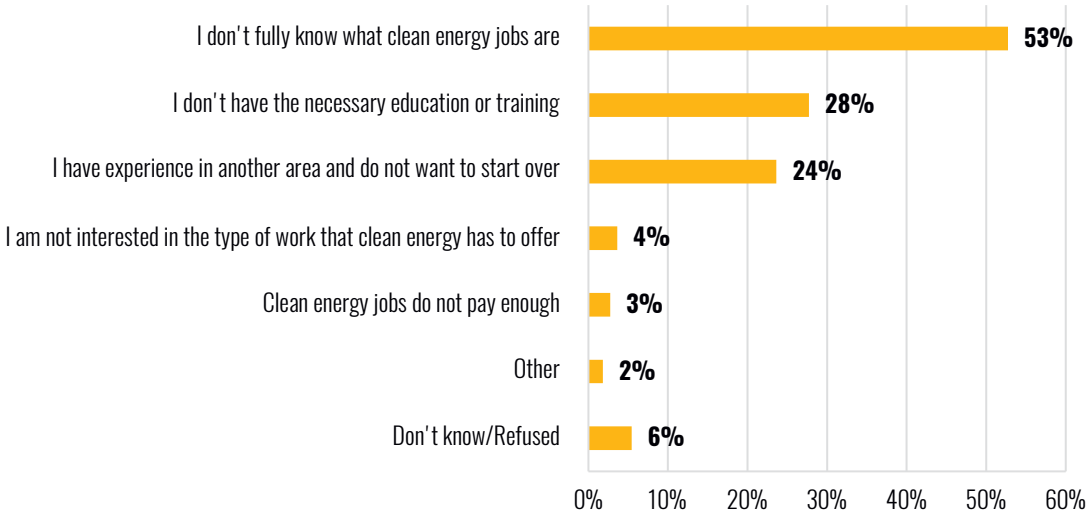



FIGURE 38. WHY HAVE YOU NOT CONSIDERED OR ACTIVELY SEARCHED FOR EMPLOYMENT IN THE CLEAN ENERGY INDUSTRY?



CLEAN ENERGY HIGHLIGHT

# EMPOWERED STATE

***NYSERDA powered a new documentary series created by Roadtrip Nation: "Empowered State," that showcases New York State's abundant clean energy innovation and green job opportunities, as it follows three young adults who travel throughout the Empire State to see the exciting, clean energy transition already underway, and the meaningful clean energy careers driving it.***

This documentary series highlights the impact of New York State's Climate Leadership and Community Protection Act (Climate Act) in demonstrating that a clean energy economy results in new economic development opportunities statewide and supports long-term jobs across all sectors.

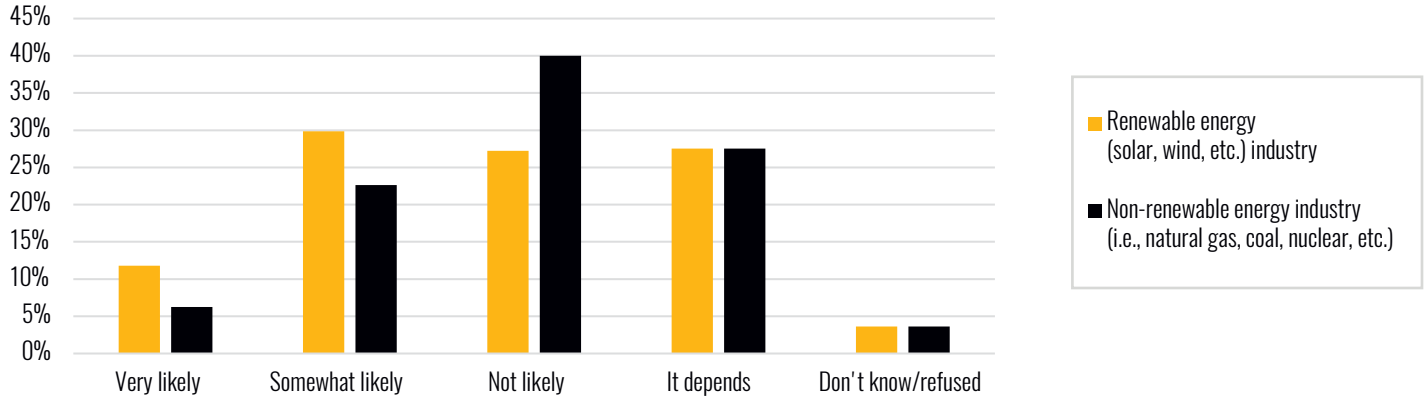
Additionally, a clean energy workforce community portal, "Energize Your Career, Transform the Future," is also available to help local career seekers and young adults explore their interests and find viable clean energy career paths in New York. The portal offers numerous interviews with clean energy professionals who give candid advice on what it was like for them as they pursued a green job and what path they took to secure it. It also provides an online self-discovery course for young adults, activity guides for students and teachers, and connects current job seekers to current job opportunities.

***Clean energy careers were significantly more appealing to prospective job seekers than non-renewable energy.***

Respondents were 44% more likely to say they were at least “somewhat likely” to apply for a position in renewable energy than non-renewable energy (Figure 39).

***This suggests that many job seekers have a preference toward renewable energy and away from non-renewable energy roles.***

FIGURE 39. 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

section 09

The following 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 data set and platform that collects investments and funding information for public and private companies.

## TOTAL INVESTMENTS

***Clean energy investments in New York saw unprecedented growth in 2022, increasing from $1.4 billion in 2021 to $2.3 billion in 2022.***

This increase builds on over a decade of strong clean energy investment growth. Between the first and last three-year rolling averages from 2011 through 2021, total investments increased by 361%, while the number of deals across these three-year rolling averages increased by 133%.

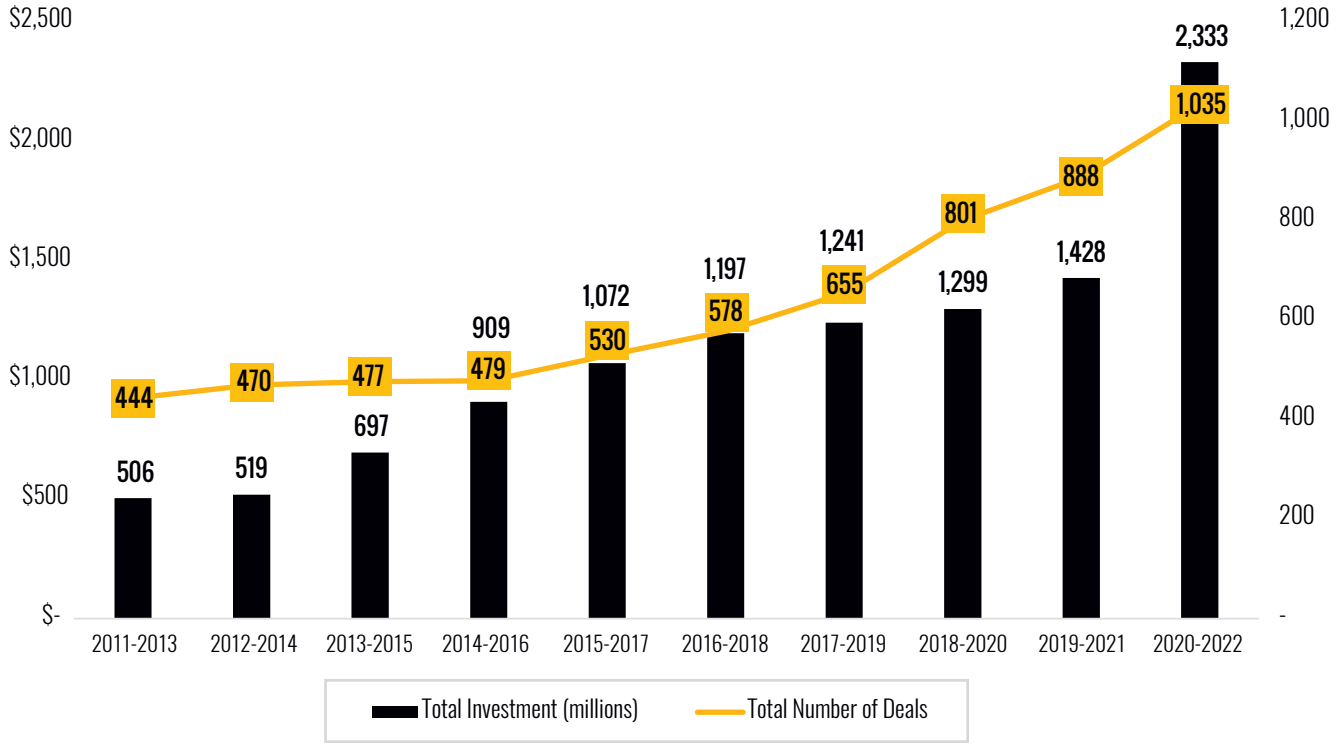
Overall, clean energy firms saw a total of $14.97 billion in investments across 7,838 deals between 2011 and 2022.

**$14.97 billion**
in investments 2011-2022

**7,838**
deals 2011-2022

**361%**
increase in total clean energy investments
between first to last 3-year rolling averages from 2011-2021

FIGURE 40. TOTAL CLEAN ENERGY INVESTMENTS (MILLIONS), 2011-2022 THREE-YEAR ROLLING AVERAGES[39]



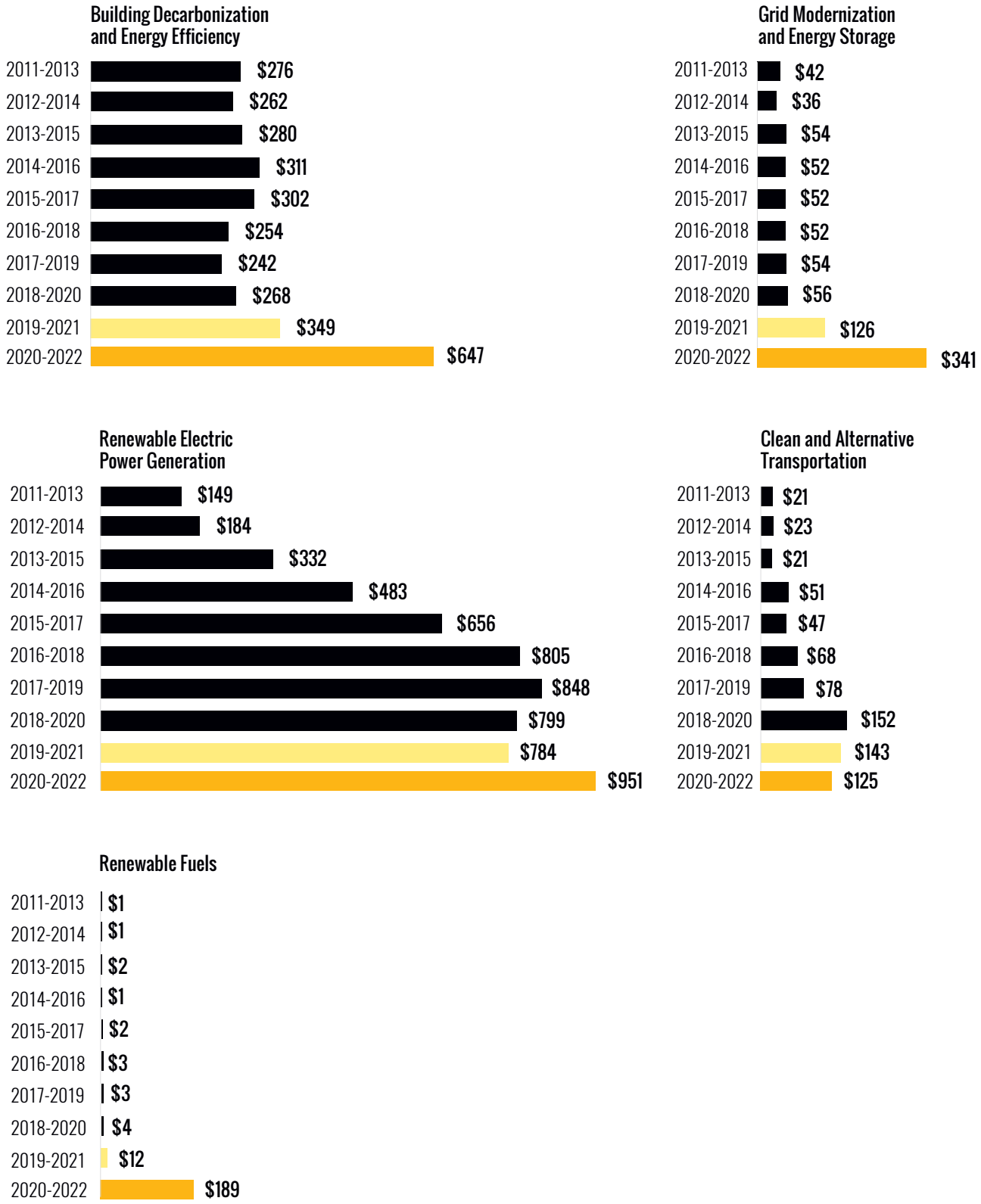

## *Each technology sector experienced extensive growth in investment dollars between 2011 and 2022.*

Renewable fuels investment increased by 12,756% between its first and last three-year rolling average, while investment in grid modernization and energy storage grew by 704%. The renewable electric power generation segment—which accounted for half of all investment dollars flowing to the clean energy economy from 2011 through 2022—saw investments grow by 540% between its first and last rolling average, and clean and alternative transportation investment increased by 496%. The building decarbonization and energy efficiency sector, which accounts for just less than a third of all clean energy investment dollars, experienced a 134% investment growth.

Renewable fuels, grid modernization and energy storage, building decarbonization and energy efficiency, and renewable electric power generation all saw substantial increases in investment dollars in recent years.

- Average investment in **renewable fuels** was 1,530% higher between 2020 and 2022 than between 2019 and 2021, driven by two separate investments in renewable natural gas and renewable ammonia fuel combining for more than half a billion dollars in investment.
- Average investment in **grid modernization and energy storage** was 171% percent higher between 2020 and 2022 than between 2019 and 2021.
- Average investment in **building decarbonization and energy efficiency** was 85% higher between 2020 and 2022 than between 2019 and 2021, while renewable electric power generation experienced a more modest 21% increase between its previous two rolling averages.
- Average investment in **clean and alternative transportation** decreased by 14% between the two most recent rolling averages. While average investment in clean and alternative transportation decreased over its last three rolling averages, it was still about 60% higher between 2020 and 2022 than between 2017 and 2020 (Figure 41).

FIGURE 41. TOTAL CLEAN ENERGY INVESTMENTS BY TECHNOLOGY (MILLIONS), 2011-2022 THREE-YEAR ROLLING AVERAGES[40]



## *The majority of investments in New York's clean energy industry from 2011 through 2022 (79%) originated from the public sector.*

- Public expenditures in the State's clean energy businesses grew continuously from 2011 through 2022—by a cumulative 159% across the three-year rolling averages (Figure 43).
- Though public investment increased steadily since 2011, private investments saw significant growth in 2022, increasing from $133.6 million in 2021 to $608.0 million in 2022 (Figure 42).
- From 2011 through 2022, private investments totaled $2.5 billion across 84 deals while public investments totaled $9.7 billion across 7,633 deals.

FIGURE 42. TOTAL **PRIVATE** CLEAN ENERGY FUNDING (MILLIONS), 2011-2022 THREE-YEAR ROLLING AVERAGES[41]

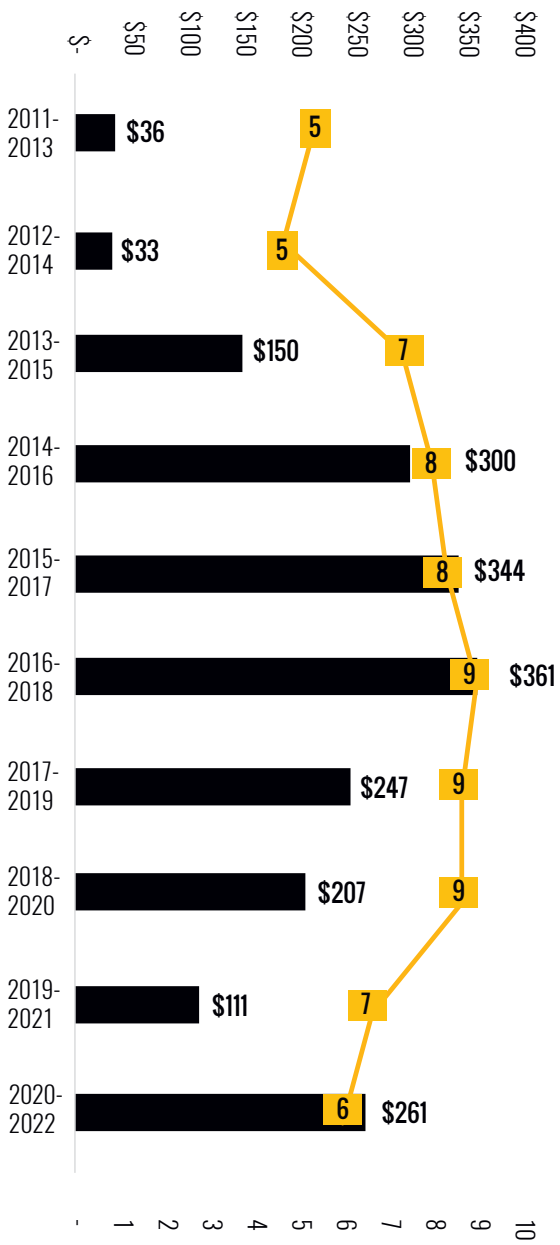
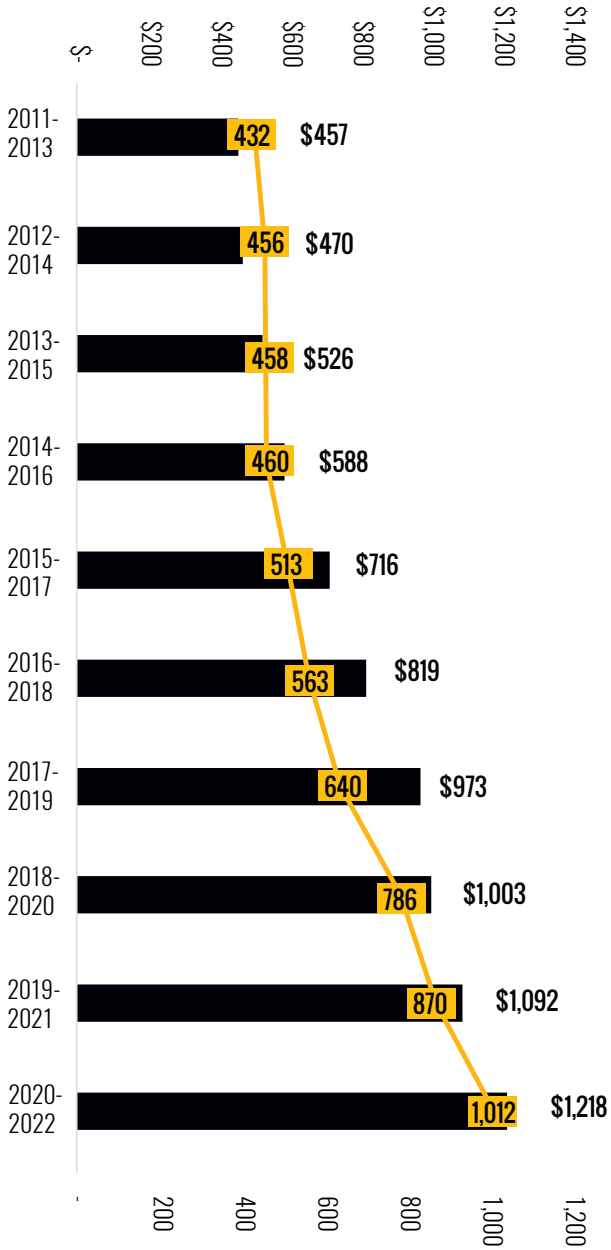
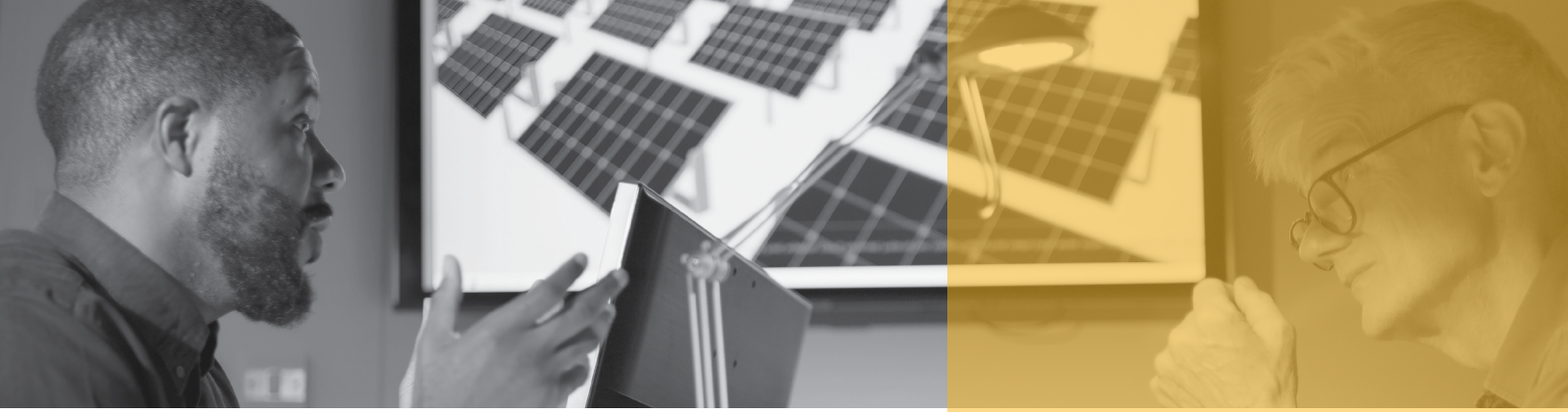



FIGURE 43. TOTAL **PUBLIC** CLEAN ENERGY FUNDING (MILLIONS), 2011-2022 THREE-YEAR ROLLING AVERAGES[42]




Total Investment (millions) — Total Number of Deals



# 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 40. Below is a brief description of each phase of innovation:

## Phase I: Research and 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 and 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 and 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 44. 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

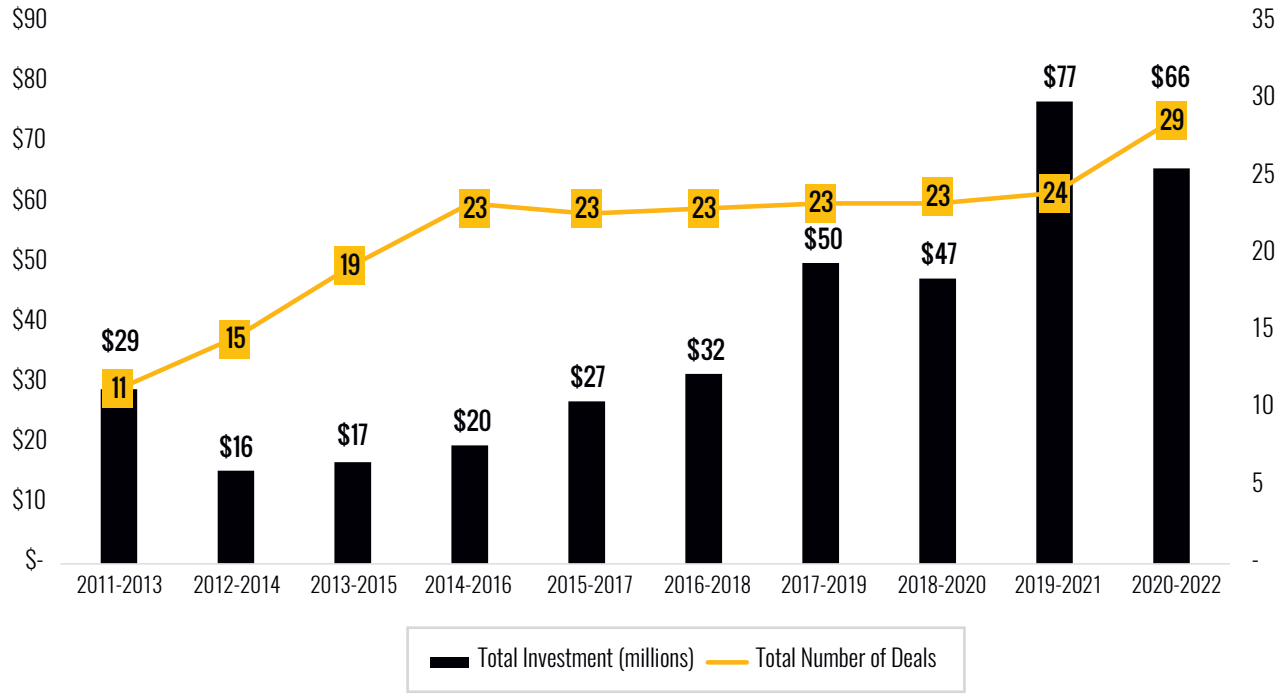
- > Expand manufacturing capacity
- > Identify early customers

# PHASE I: RESEARCH & PROTOTYPING

## *Total investments for Phase I reached $494 million across 260 deals from 2011 through 2022.*

Phase I investments accounted for 3% of all investments during this time and saw a cumulative growth of 127% over the first and last three-year rolling averages (Figure 45).

FIGURE 45. **PHASE I** INVESTMENTS (MILLIONS), 2011-2022 THREE-YEAR ROLLING AVERAGES

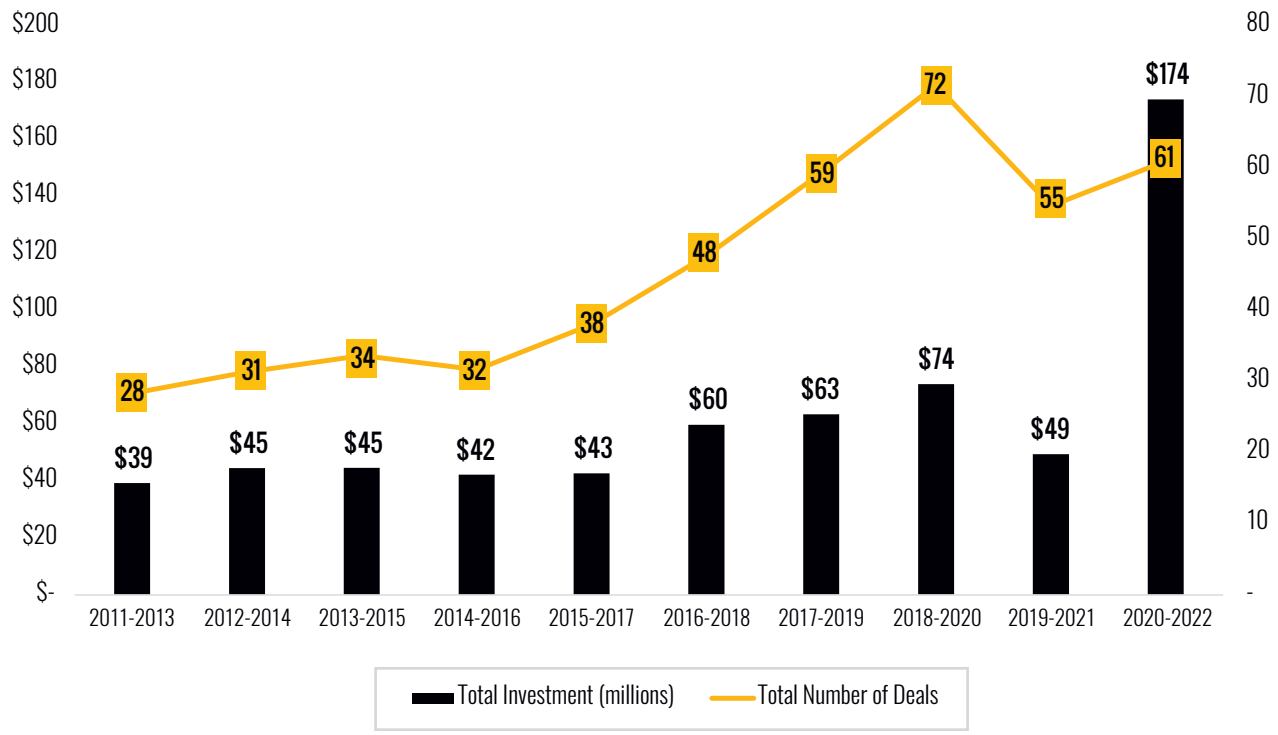


# PHASE II: DEMONSTRATION & ACCELERATION

## *Phase II investments accounted for 6% of all investments and totaled $957.3 million across 541 total deals (Figure 46).*

Between the 2011 to 2013 and 2020 to 2022 rolling averages, Phase II saw investment dollars grow by a cumulative 343%. Much of this cumulative growth is driven by strong Phase II investment in 2022; average Phase II investment was 252% higher between 2020 and 2022 than between 2019 and 2021.

FIGURE 46. **PHASE II** INVESTMENTS (MILLION), 2011-2022 THREE-YEAR ROLLING AVERAGES

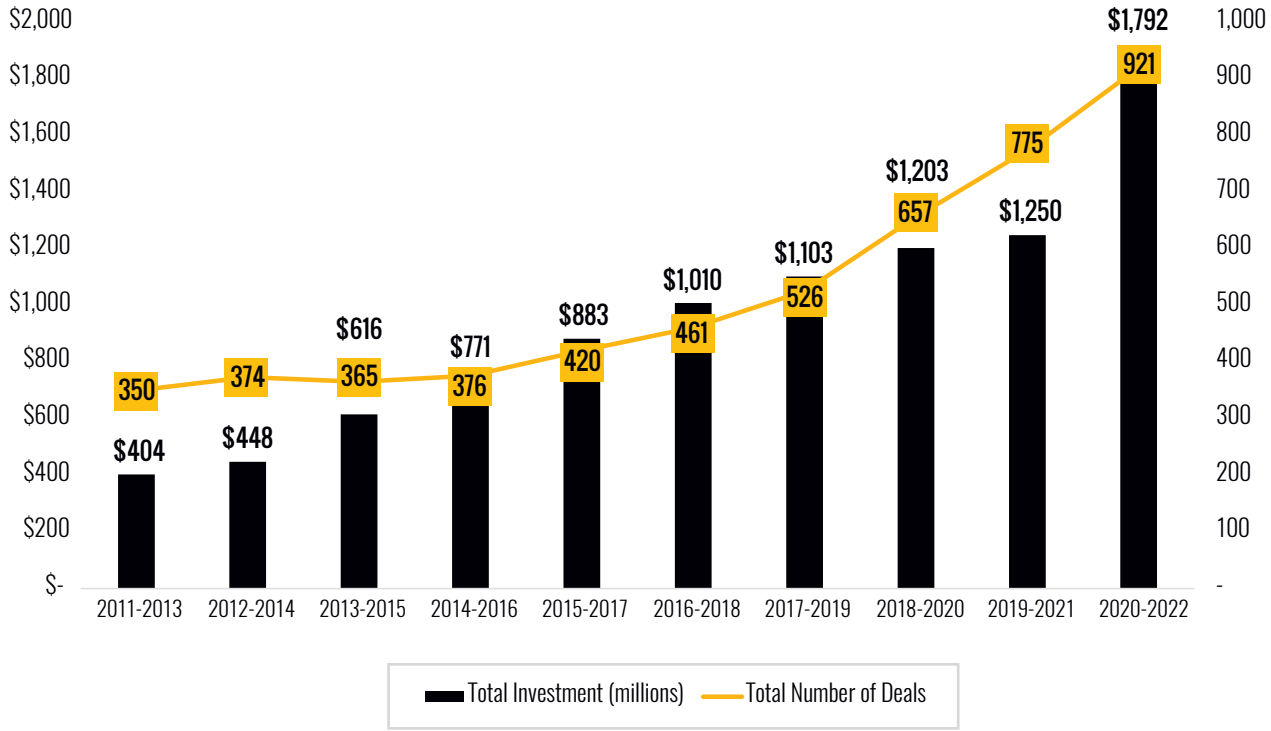


# PHASE III: COMMERCIALIZATION & GROWTH

## *Phase III accounted for the largest share of all total investment dollars by innovation phase, representing 82% of all expenditures.*

From 2011 through 2022, Phase III investments amounted to $12.2 billion across 6,518 deals. Phase III investments grew consistently between 2011 and 2022, resulting in a cumulative growth rate of 344% between the first and last three-year rolling averages. Phase III investment saw robust growth in 2022; average Phase III investment was 43% higher between 2020 and 2022 than between 2019 and 2021 (Figure 47).

FIGURE 47. **PHASE III** INVESTMENTS (MILLION), 2011-2022 THREE-YEAR ROLLING AVERAGES



# ECONOMIC IMPACT ANALYSIS

Section 10

## ECONOMIC IMPACTS OF CLEAN ENERGY JOBS ON THE STATE OF NEW YORK

### *Between 2021 and 2022 there was a net increase of 5,802 jobs in a variety of clean energy industries.*

Ultimately, an economic impact analysis finds that 10,062 net jobs were gained during this time due to increased clean energy activity. The industries with the largest job growth were maintenance and repair, construction of residential structures, construction of new commercial structures, labor and civic organizations, and construction of new power and communications structures.[43]

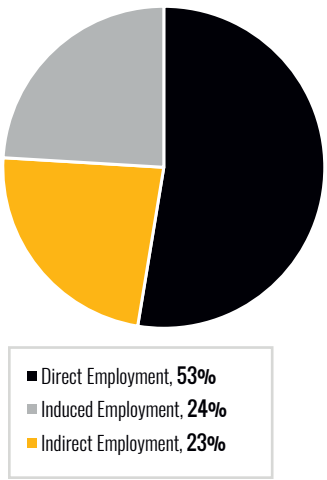
Results from the creation of 5,292[44] new direct jobs show that there was a total impact of 10,062 jobs gained due to clean energy economic activity in 2022, of which 2,350 were indirect jobs, and 2,420 were induced jobs. These jobs were responsible for nearly $1.5 billion in gross State product (GSP), and $907.4 million in labor income (Table 3).

TABLE 3. TOTAL ECONOMIC IMPACT OF THE NET CHANGE IN CLEAN ENERGY JOBS IN NEW YORK STATE, 2021-2022

| Impact Type | Employment | Value Added | Labor Income |
|---|---|---|---|
| Direct Effect | 5,292 | $812,225,309 | $515,287,825 |
| Indirect Effect | 2,350 | $345,022,115 | $203,982,959 |
| Induced Effect | 2,420 | $333,809,621 | $188,142,713 |
| **Total Effect** | **10,062** | **$1,491,057,046** | **$907,413,497** |

Indirect and induced impacts are equal; 24% of the jobs lost were induced and 23% were indirect jobs (Figure 48).

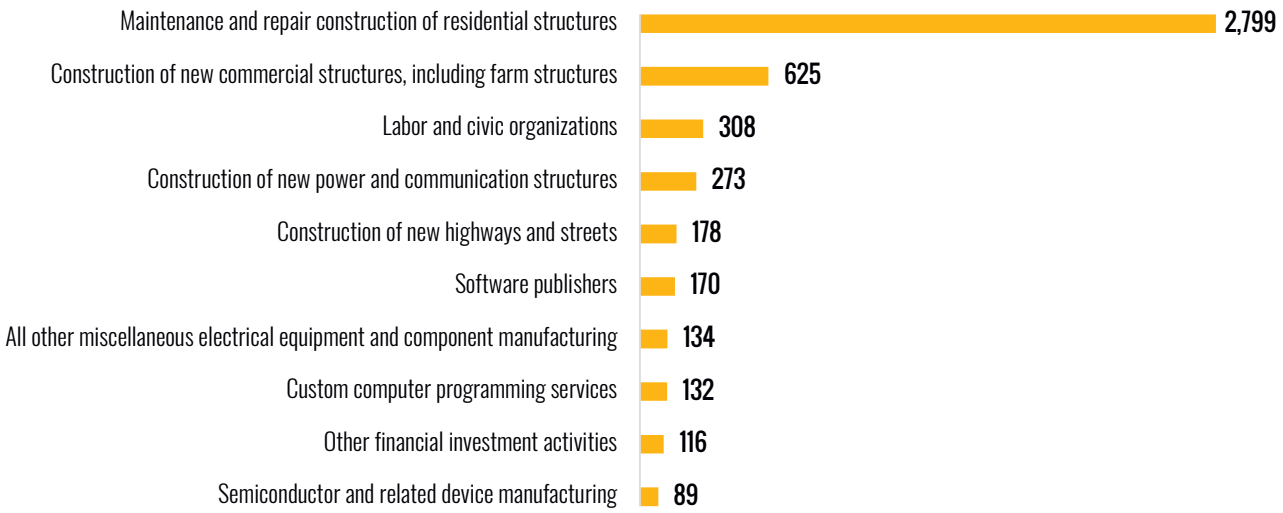
FIGURE 48. PORTION OF JOBS GAINED BY TYPE OF IMPACT



## 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, construction of new power and communications structures, and construction of new highways and streets (Figure 49).

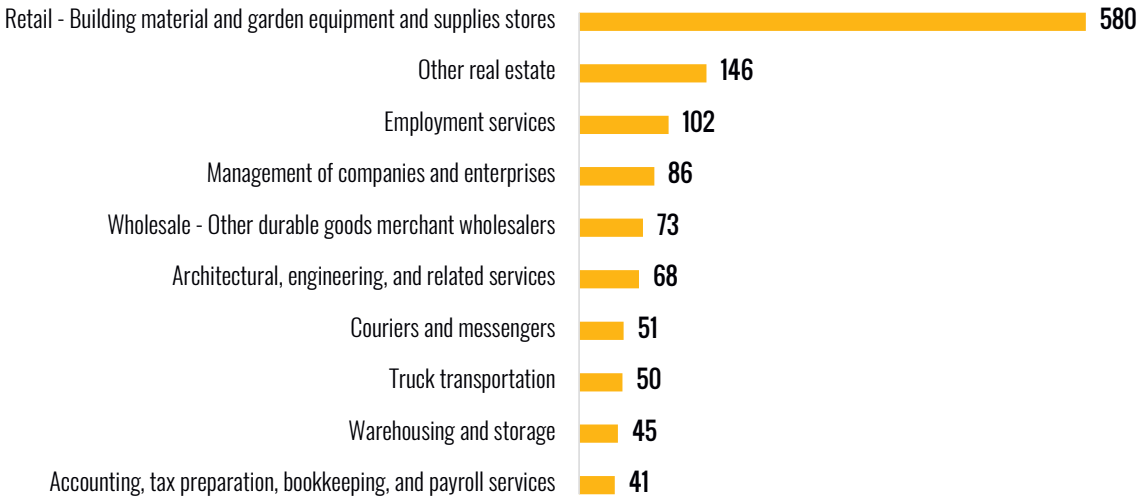
FIGURE 49. TOP 10 CLEAN ENERGY DIRECT INDUSTRIES IN NEW YORK STATE BY EMPLOYMENT GAINS, 2022




## 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 2021 to 2022 were building material and garden equipment and supplies retail stores, real estate, employment services, management of companies and enterprises, and durable goods merchant wholesalers (Figure 50).

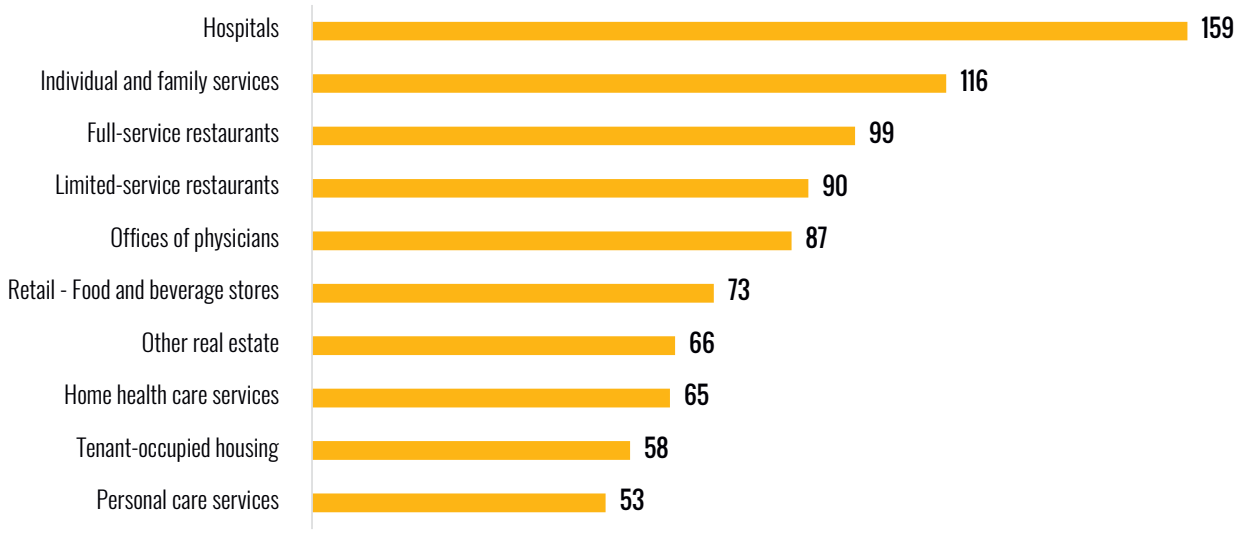
FIGURE 50. TOP 10 SUPPLY CHAIN (INDIRECT) INDUSTRIES IN NEW YORK STATE BY EMPLOYMENT GAINS, 2022[45]



## 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 their wages in the State. These effects are felt in hospitals, individual and family services, restaurants, physicians' offices, supermarkets, and real estate (Figure 51). 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 51. TOP 10 INDUCED INDUSTRIES IN NEW YORK STATE BY EMPLOYMENT GAINS, 2022[46]




## 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 over $157 million in State and local taxes on production and imports and more than $175 million in federal taxes (Table 4).

TABLE 4. IMPACT OF NEW YORK CLEAN ENERGY JOBS ON TAXES FOR PRODUCTION AND IMPORTS, 2022

| Taxes | Impact on Taxes |
|---|---|
| Local Taxes | $96,566,964 |
| State Taxes | $61,320,742 |
| Federal Taxes | $175,540,642 |

**$157 million**
**in State and local taxes**

**$175 million**
**in federal taxes**

## OUT-OF-SCOPE INDUSTRIES

The economic impact analysis identifies job changes in industries that are affected by the clean energy industry but are not part of that industry.

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 5 provides a list of New York's clean energy supply-chain industries that were not included in the original dataset (by NAICS code) and the jobs attributable to clean energy industry change in those industries.

TABLE 5. NEW YORK'S CLEAN ENERGY OUT-OF-SCOPE INDIRECT INDUSTRIES[47]

| Description | Indirect Jobs |
|---|---|
| Retail - Building material and garden equipment and supplies stores | 580 |
| Other real estate | 146 |
| Employment services | 102 |
| Couriers and messengers | 51 |
| Truck transportation | 50 |
| Warehousing and storage | 45 |
| Investigation and security services | 37 |
| Services to buildings | 36 |
| All other crop farming | 35 |
| Business support services | 26 |
| Full-service restaurants | 26 |

# TRADITIONAL ENERGY EMPLOYMENT

Section 11

This section details traditional energy employment for New York derived from the most recent U.S. Energy and Employment Report (USEER).

For the purposes of this 2023 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.[48]

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 and 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.

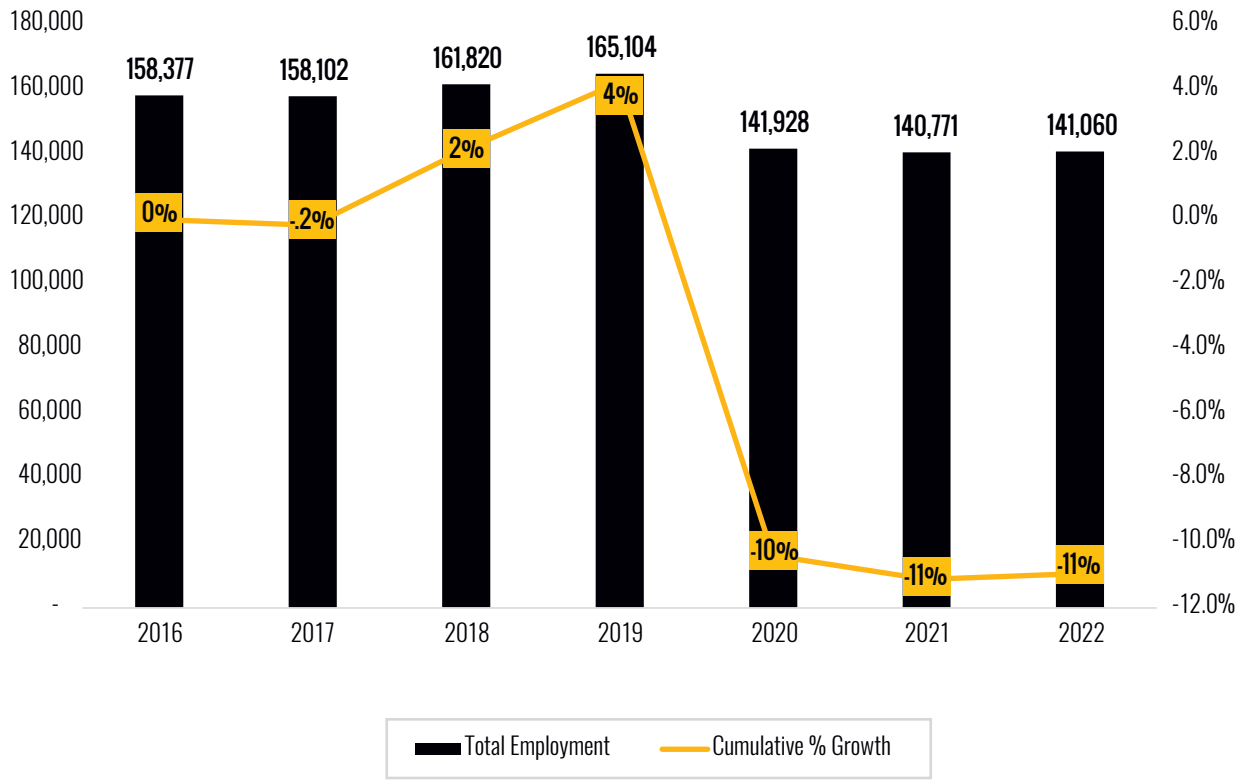
## what is traditional energy?

**fossil-based energy and additional energy technologies not categorized into the five major clean energy technology areas**

## *Traditional energy employment in New York saw minor increases in employment (less than 1%) between 2021 and 2022 and continues to be outpaced by clean energy employment growth.*

Traditional energy employment in New York has still not recovered to pre-pandemic levels of 2019. In fact, the sector is still 24,000 jobs short of 2019 levels (Figure 52). While it is still too early in the clean energy transition to definitively tell which subsectors will not return to their previous employment highs, it is likely that electric power generation and fuels will remain near their current levels in the near future as the State builds up its clean energy electricity generation capacity. Employment within motor vehicles may remain at lower levels from its 2019 levels as more New York residents switch to electric vehicles. Employment in traditional transmission, distribution, and storage is likely to shift to clean energy-related jobs as the grid decarbonizes and becomes smarter and more adaptive to shifting electricity demands.

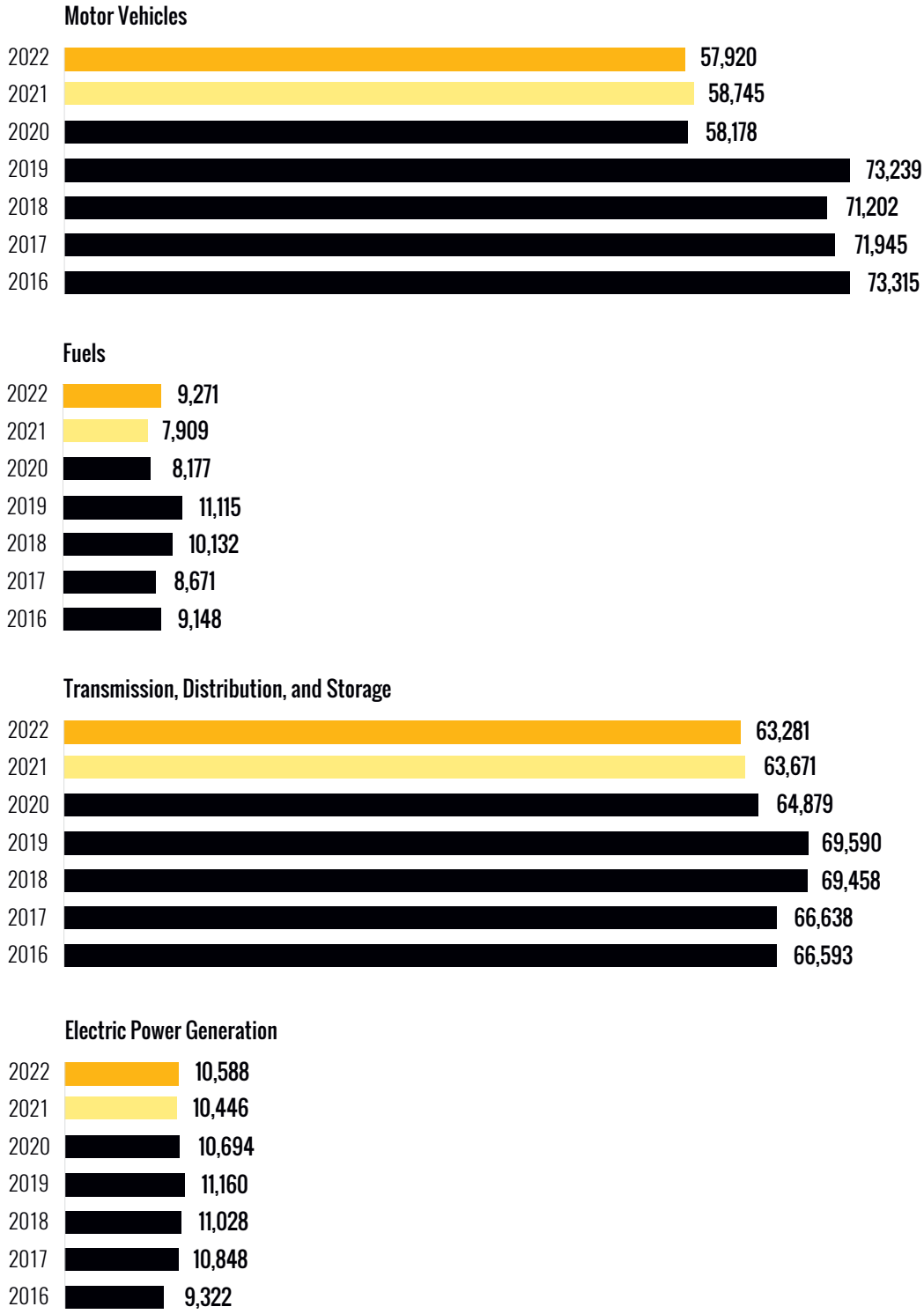
FIGURE 52. NEW YORK TRADITIONAL ENERGY EMPLOYMENT, 2016-2022



## *Employment trends differed across traditional energy technologies.*

Fuels saw a significant increase in jobs (17%), equating to nearly 1,400 jobs. Electric power generation saw more modest gains in employment (1%) between 2021-2022, adding 142 jobs. Transmission, distribution, and storage saw a modest decrease in employment, losing 390 jobs (-1%), while motor vehicles saw a more notable decline of 825 jobs (-1%) (Figure 53).

FIGURE 53. NEW YORK TRADITIONAL ENERGY EMPLOYMENT BY TECHNOLOGY, 2016-2022



# 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 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

## ALTERNATIVE TRANSPORTATION

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

## 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

## 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 2023 New York Clean Energy Industry Report (NYCEIR) is taken from data collection for the U.S. Energy and Employment Report (USEER) (https://www.energy.gov/policy/us-energy-employment-jobs-report-useer).

The link to the full methodology can be found here: https://www.energy.gov/sites/default/files/2023-06/ 2023%20USEER%20APPENDICES.pdf

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 2023 USEER survey in New York resulted in more than 27,800 calls and more than 5,200 emails. Approximately 1,790 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 +/-2.30% at a 95% 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% 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%) of their time on energy-related activities, those that spend a majority (50% to 99%) of their time, and those that spend less than a majority (0% to 49%) of their time. These employment groups are weighted 0.25 on the less than a majority group, 0.75 on the majority group, and 1 on the 100% group. Intensity-adjusted employment estimates are sum of these products.

# DISADVANTAGED COMMUNITY ANALYSIS

BW Research developed a novel data set of place-of-employment and place-of-residence estimates for clean energy workers. Using county-level value chain clean energy employment from the 2023 U.S. 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 Origin-Destination Employment Statistics (LODES)[49] Workplace Area Characteristics and Residence Area Characteristics, respectively. Existing census tract level data from the Technical Documentation Appendix: Communities Indicator Workbook[50] was used as the source for estimates regarding the general population sizes within DACs. This census-tract level data allowed the research team to develop estimates for census-tract defined disadvantaged communities.[51] The U.S. Census Bureau does not currently have an agreed upon measure of accuracy for LODES data used in this analysis.[52] However, a working paper that reviewed the data accuracy found the data to be reliable.[53] The research team is therefore not able to calculate a formal margin of error for these estimates, but aggregating findings to the county and state levels attempts to decrease the magnitude of variability in the underlying data. 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 CLEAN ENERGY EMPLOYER SURVEY

BW Research conducted employer interviews with clean energy organizations throughout New York State. The survey sample included a compilation of known energy efficiency firms that had completed surveys for the U.S. Energy and Employment Report (USEER)[54] in the last three 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 clean energy firms from the USEER survey 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.

The employer survey was fielded between May 23rd and June 15th, 2023 and resulted in 163 total completes by firm. The average survey duration was 8.5 minutes.

# NEW YORK CLEAN ENERGY WORKER SURVEY

BW Research conducted a survey of current clean energy workers in New York State. Current clean energy workers were recruited through a survey of current workers that primarily worked in New York. 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 energy efficiency 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."

The current worker survey was fielded between May 23rd and June 21st, 2023 and resulted in 81 clean energy worker completes (out of 399 total completes). The average survey duration was 7.9 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 2021 to the State of 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 North American Industry Classification System (NAICS) code between 2020 and 2021, as calculated for the 2022 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 2020 to 2021, 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 2020.

## Model Output

Results from the economic impact analysis included employment[55] (full- and part-time jobs), labor income, taxes, and value added. 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 we do in our 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 were 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

# ENDNOTES

1 Disadvantaged communities are referred to in the 2019 Climate Leadership and Community Protection Act, and identified through criteria adopted by the New York Climate Justice Working Group. The criteria and list of disadvantaged communities are available at: https://climate.ny.gov/Resources/Disadvantaged-Communities-Criteria

2 Building decarbonization and energy efficiency is the category formerly labeled as 'energy efficiency' in previous years of the Clean Energy Industry Report. The technology definition has not changed.

3 2023 United States Energy & Employment Report. https://www.energy.gov/sites/default/files/2023-06/2023%20USEER%20REPORT-v2.pdf

4 This concentration is the number of clean energy jobs located within DACs divided by the number of people living within DACs, aggregated to the county level. The statewide concentration is the total number of clean energy jobs in New York divided by the number of people living in the State.

5 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 as defined here: https://www.nyserda.ny.gov/All-Programs/Clean-Energy-Workforce-Development-and-Training/Resources/Definitions

6 JobsEQ 2022 Q4.

7 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.

8 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.

9 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.

10 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 subsectors included within this category remain consistent with prior years.

11 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.

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

13 Data from https://app.powerbi.com/view?r=eyJrIjoiODRhMWQzNmUtMjAyYy00YTlkL Tk2ZjUtYWQ0ZjI2NTE4MWF jIiwidCI6IjFiYjQ4ZGE0LTMxNDMtNDAzMS1iZGFlLWNjYzA0MDc1MDhmZSIsImMiOjF9

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

15 Hydroelectric energy storage used by electric power systems for load balancing. This method stores the gravitational potential energy of water pumped from a lower elevation reservoir to a higher elevation.

16 This includes battery storage for solar generation and lithium batteries, lead-based batteries, other solid-electrode batteries, vanadium redox flow batteries, and other flow batteries.

17 This includes flywheels and compressed air energy storage.

18 Temporary storage of energy for later use when heating or cooling is needed.

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

20 This is the rate at which workers are duty-paying members of labor unions.

21 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 despite receiving benefits and being "covered" under union contracts.

22 2023 United States Energy & Employment Report. https://www.energy.gov/sites/default/files/2023-06/2023%20USEER%20REPORT-v2.pdf

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

24 The final Disadvantaged Communities criteria and related documentation are available at https://climate.ny.gov/Resources/Disadvantaged-Communities-Criteria

25 The employment estimates include those found both in the public and private sectors.

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

27 The US 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. https://www2.census.gov/ces/wp/2017/CES-WP-17-71.pdf

28 Technical Documentation Appendix: Disadvantaged Communities Indicators Workbook. https://climate.ny.gov/Resources/Disadvantaged-Communities-Criteria

29 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.

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

31 This concentration is a calculation of the number of clean energy jobs located within DACs divided by the number of people living within DACs, aggregated to the county level. The statewide concentration is the total number of clean energy jobs in New York divided by the number of people living in the State.

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

33 Values are a proportion of clean energy jobs within disadvantaged communities relative to the population within those communities.

34 Concentration is a calculation of the number of clean energy workers living within DACs divided by the number of people living within DACs, aggregated to the county level. The statewide concentration is the total number of clean energy workers living in New York divided by the number of people living in the State.

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

36 Values are a proportion of residents within disadvantaged communities with clean energy jobs relative to the population within those communities.

37 It is worth noting that the trends highlighted in this section were maintained even when only clean energy-related industries were included in the "non-clean energy worker" pool of respondents, and traditionally non-clean energy-related industries, such as Retail, were excluded. This provides a more "apples-to-apples" comparison, but reduces the number of respondents.

38 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 https://www.nyserda.ny.gov/All-Programs/Clean-Energy-Workforce-Development-and-Training/Resources/Definitions

39 Two 2021 alternative transportation investments were removed from the Crunchbase data and subsequently excluded from the total clean energy investment calculation. At $2 billion and $1.5 billion, the two investments are outliers.

40 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 40.

41 Totals will not sum to Figure 40 because not all investments could be categorized as public or private due to lack of information.

42 Totals will not sum to Figure 40 because not all investments could be categorized as public or private due to lack of information.

43 Based on the NYCEIR jobs' IMPLAN codes.

44 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.

45 As a result of the 2021-2022 Clean Energy Net Job Change in New York.

46 As a result of the 2021-2022 Clean Energy Net Job Change in New York.

47 Table only includes industries that have declined by 25 or more indirect jobs.

48 This definition of Traditional Energy differs from its use in the US 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.

49 https://lehd.ces.census.gov/data/

50 https://climate.ny.gov/-/media/Project/Climate/Files/Disadvantaged-Communities-Criteria/Technical-Documentation-Appendix-Final-Disadvantaged-Communities-Indicator-Workbook.xlsx

51 https://climate.ny.gov/Resources/Disadvantaged-Communities-Criteria

52 https://www2.census.gov/about/training-workshops/2019/2019-10-23-led-questions.pdf

53 https://www2.census.gov/ces/wp/2017/CES-WP-17-71.pdf

54 U.S. Energy & Employment Jobs Report (USEER): https://www.energy.gov/policy/us-energy-employment-jobs-report-useer

55 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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