NEW YORK STATE | NYSERDA

NEW YORK CLEAN ENERGY INDUSTRY REPORT 2022

LETTER FROM NYSERDA PRESIDENT AND CEO

Dear Partners and Friends,

It is with great pleasure that I introduce the findings from NYSERDA's New York Clean Energy Industry Report, which details patterns and trends within New York's clean energy industry and highlights the significant progress we have made to **advance a clean and sustainable future for all New Yorkers**. This year's report shows the number of individuals with green jobs in New York State has reached a record level and despite COVID-19's impact to our economy over the last few years, the Empire State has not only recouped the clean energy jobs lost in 2020, but has now exceeded pre-COVID employment levels.

Of course, this progress has been made under the unwavering leadership of Governor Kathy Hochul as New York is executing one of the most ambitious clean energy and climate agendas in the country. And by doing so, we are leading the way with an orderly and equitable transition so that all New Yorkers can participate in our clean energy future, while creating family-sustaining jobs and providing meaningful economic opportunities for our communities all over our great state.

The 2022 Clean Energy Industry Report, which provides data through the end of 2021, demonstrates that the burgeoning clean energy sector experienced a faster recovery when compared to other industries in New York, a true reason for optimism about this industry's bright future.

Other key findings from this year's report:

- More than 165,000 New Yorkers had clean energy jobs at the end of 2021, up from 157,686 in 2020.
- New York's clean energy employment grew 5% from 2020 through 2021 – gaining over 7,000 jobs in 12 months.
- Employment met or exceeded pre-pandemic levels in almost all technology sectors. Renewable electric power generation, alternative transportation, renewable fuels, grid modernization, and energy storage all reached or surpassed their pre-pandemic employment levels by the end of 2021.
- The alternative transportation technology sector saw unprecedented growth between 2020 and 2021 and employment expanded by almost 26% or 2,318 jobs in just 12 months.
- Solar accounted for the largest share of job gains in the renewable electric power generation technology sector.
- The industries with the largest job growth were labor and civic organizations, software publishers, durable goods merchant wholesalers, and machinery, equipment, and supplies wholesalers.

As we look ahead, it's increasingly clear that our growing green economy is putting New York on a path to a future where our expanding clean energy workforce leads the way.

Best,

Doreen M. Harris

President and CEO, NYSERDA

CONTENTS

EXECUTIVE SUMMARY

CLEAN ENERGY JOBS

Clean energy employment in New York reached a new record level, more than fully recovering from pandemic-era losses. At the end of 2021, New York had more than 165,000 total clean energy workers. From 2020 through 2021, clean energy jobs increased by 5%—gaining over 7,000 jobs in 12 months. With this growth in total clean energy employment, New York has recouped the jobs lost in 2020 and exceeded pre-COVID employment levels by 1,300 jobs. Since 2015, clean energy employment in New York has grown by about 17%, or over 24,000 jobs.

The clean energy sector rebounded faster than nearly all other industries in New York. The clean energy sector experienced a faster recovery compared to other industries in New York including healthcare, education, and retail trade; employment in these industries grew between 2% and 3% between 2020 and 2021. The only industry in the State that saw greater employment growth than the clean energy industry was the accommodation and food service industry, though the greater rebound in this industry was to be expected given the significant job losses experienced during the height of the pandemic. The accommodation and food service industry shed over 32% of its jobs in the previous year; in comparison, clean energy employment only declined by 4% between 2019 and 2020.

Employment met or exceeded pre-pandemic levels in almost all technology sectors. Renewable electric power generation, alternative transportation, renewable fuels, and grid modernization and energy storage all reached or surpassed their pre-pandemic employment levels by the end of 2021. Only energy efficiency remains behind its 2019 employment, with almost 3,000 jobs still to be regained. Energy efficiency was hardest hit by COVID-related job losses in 2020; half of the nearly 5,800 jobs lost across all energy efficiency sub-technologies have been gained back between 2020 and 2021. But the three largest sub-technologies—ENERGY STAR® and efficient lighting, high efficiency HVAC and renewable heating and cooling, and traditional HVAC—have yet to fully recover from the job losses incurred between 2019 and 2020.

The alternative transportation technology sector saw unprecedented growth between 2020 and 2021. Alternative transportation employment expanded by almost 26% or 2,318 jobs in just 12 months. To put this into perspective, the alternative transportation sector has less than a tenth of the total employees and businesses in the energy efficiency technology sector yet grew by only 643 jobs fewer than the energy efficiency sector in 2021. All clean alternative transportation sub-technologies grew between 2020 and 2021, but about half of the overall growth in employment was driven by hybrid electric vehicle employment. These jobs largely consist of repair and maintenance workers, but can also include manufacturing, wholesale trade, and some professional services. The hybrid electric sub-technology grew by 1,137 jobs or almost 27% between 2020 and 2021. Electric vehicle employment is the second largest contributor to the job growth in the alternative transportation sector. The electric vehicle sub-technology gained 621 jobs and grew by over 25%. Of the remaining sub-technologies, plug-in hybrid gained 358 jobs, hydrogen and fuel cell gained 161 jobs, and natural gas gained only 39 jobs. This growth in alternative transportation employment coincides with a boom in electric vehicle registration in New York. Original electric vehicle registrations in the State nearly doubled between 2020 and 2021, jumping from about 21,000 in 2020 to 41,000 in 2021.[1]

Solar accounted for the largest share of job gains in the renewable electric power generation technology sector. The solar sub-technology saw the greatest amount of job losses within the renewable electric power generation technology sector in 2020 among clean energy employers and the greatest amount of job gains in 2021. While solar firms across New York lost 421 workers from 2019 through 2020, declining 3%, they grew by 9% or 1,086 workers from 2020 through 2021. This growth in solar jobs coincides with an increase in the New York's annual installed solar capacity, which grew from 549 megawatts in 2020 to over 650 megawatts in 2021.[2]

Each sub-technology within the grid modernization and energy storage technology sector expanded its employment between 2020 and 2021. The energy storage workforce has been growing since 2016. Between 2020 and 2021, the energy storage sub-technology expanded by 135 jobs or 7%; this was the largest employment increase since 2018. Between 2020 and 2021, smart grid employment grew by roughly 60 jobs for an increase of almost 14%. With this employment growth, the smart grid sub-technology recouped the jobs it lost in 2020 and surpassed its 2019 employment levels.

Clean energy installation firms accounted for most job gains by value chain segment. After experiencing the greatest loss in jobs across the value chain between 2019 and 2020, clean energy installation firms saw the greatest absolute and percentage increase in jobs from 2020 through 2021. These businesses saw their workforce expand by about 5,200 jobs—an increase of 6% in 12 months. However, clean energy installation firms still fall almost 500 jobs short of reaching their 2019 employment levels—the largest gap out of all clean energy value chain segments.

New York will be home to roughly 6,000 offshore wind jobs in 2030. Over the next decade, the State will see significant growth in its offshore wind labor market. As of 2021, there were roughly 400 offshore wind jobs in the state. By 2030, this industry is expected to grow to just over 6,000 offshore wind workers.

Most offshore wind jobs will be concentrated in the construction and manufacturing industries, with offshore wind manufacturing jobs accounting for nearly half (2,900 jobs or 48%) of all projected job growth, followed by construction jobs at roughly three in ten new offshore wind jobs over the next decade (1,800 jobs or 29%). Professional services will also see significant employment growth due to offshore wind developments (1,000 jobs or 16%), followed by wholesale trade (300 jobs or 5%) and utilities (100 jobs or 2%).

One-third of new jobs will be production occupations (32%), such as assemblers, fabricators, inspectors, welders, and metal workers. Following production occupations, construction and extraction jobs—including electricians, equipment operators, and laborers—will account for about one in six new jobs (16%), followed by installation, maintenance, and repair positions (15%), transportation and material moving positions (14%), management occupations (12%), and all other job types (11%). For more information on specific occupations and their projected job growth, please see Table 1.

HIRING

Most employers had difficulty hiring workers in 2021. About nine in 10 (90%) employers who were hiring in 2021 reported overall difficulty—finding hiring either somewhat or very difficult—between 2020 and 2021. Broken down by technology, energy efficiency employers experienced the most hiring difficulty; 93% reported overall difficulty. Alternative transportation employers experienced the least hiring difficulty of all technologies, but still 73% reported overall hiring difficulty in 2021.

CLEAN ENERGY INVESTMENTS

Investment in New York clean energy companies saw continual growth from 2011 through 2021. In total, between 2011 and 2021, clean energy firms in New York received $10.98 billion in investment dollars across 6,681 deals. Between the first and last three-year rolling averages of 2011 to 2013 and 2019 to 2021, clean energy investments in New York grew by 182% while the number of deals nearly doubled.

The majority of investments examined for this report are from public entities. Public investments accounted for 81% of investments or $8.24 billion and 6,509 deals from 2011 through 2021. Between the three-year rolling averages from 2011 and 2021, public expenditures into New York's clean energy economy saw continual growth, resulting in a cumulative growth rate of 139%.

Over the last decade, Phase III investments for technology commercialization and growth have comprised the majority of investment dollars for New York's clean energy economy. Between 2011 and 2021, Phase III investments[3] comprised 91% of total investments, or roughly $9.43 billion. Phase III investments saw continued growth from 2011 through 2021, rising by 210% over the first and last three-year rolling average. This is the only investment Phase that has seen continuous growth since 2011.

Renewable electric power generation accounts for the majority of investments and saw the greatest growth in investment dollars over the past decade. Investments in the renewable electric power generation sector accounted for 56% of all investments from 2011 through 2021. Renewable electric power generation also saw one of the greatest increases between its first and last three-year rolling averages, growing by 586%.

Energy efficiency, grid modernization and energy storage, and alternative transportation saw the greatest growth in investment dollars in recent years. Average investment in energy efficiency was 30% higher between 2019 and 2021 than between 2018 and 2020, while average investment in grid modernization and energy storage was 123% higher between 2019 and 2021 than between 2018 and 2020. Average investment in alternative transportation was nearly twice as high between 2017 and 2019 than between 2018 and 2020. While average investment in alternative transportation decreased between its 2018 to 2020 average and its 2019 to 2021 average, it was still about 84% higher between 2019 and 2021 than between 2017 and 2020.

ECONOMIC IMPACT ANALYSIS

The economic impact analysis finds that 13,010 net jobs were gained in New York between 2020 and 2021 due to increased clean energy activity. The industries with the largest job growth were labor and civic organizations, software publishers, durable goods merchant wholesalers, and machinery, equipment, and supplies wholesalers.

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 nearly $132 million in State and local taxes on production and imports and more than $203 million in federal taxes.

TRADITIONAL ENERGY JOBS

Clean energy employment outpaced traditional energy employment in New York, both in employment growth and in overall employment in 2021. New York's traditional energy industry employed 140,771 workers in 2021, a 1% decrease from 2020 employment and an over 11% decrease from 2016 employment. In comparison, New York's clean energy industry employed 165,055 workers at the end of 2021, a 5% increase from 2020 employment.

With the exception of the traditional motor vehicles sector, which grew by 1%, each traditional energy sector saw a slight decrease in employment between 2020 and 2021. The traditional energy sector with the largest relative decline in employment was traditional fuels, which decreased by 3% or 268 jobs. Traditional transmission, distribution, and storage saw the largest absolute employment decline, losing 1,208 jobs and decreasing by 2%. Employment in the traditional electric power generation sector decreased by 2% or 248 jobs between 2020 and 2021.

Traditional transmission, distribution, and storage (TDS) was the largest traditional energy sector, with traditional motor vehicle employment trailing only slightly behind. TDS employed 63,671 workers in 2021, comprising over 45% of all traditional energy employment while motor vehicles employed 58,745 workers, accounting for about 42% of all traditional energy employment. Traditional electric power generation and fuels were responsible for 7% and 6% of all traditional energy employment, or 10,446 and 7,909 jobs, respectively.

INTRODUCTION

CLEAN ENERGY JOBS

As in previous years, this report tracks key job trends in the clean energy sector by industry, geography, and the five major technology sectors described in Figure 1.

Within each major technology sector are clean energy sub-technologies, such as solar, wind, efficient lighting, microgrid, woody biomass, or electric vehicles. This sub-technology definition is specific to New York State and can be found in Appendix A.

In addition to technology employment, clean energy employment trends are discussed from an industry, or value chain, perspective. The data highlight trends over the last several years in key segments, such as installation, manufacturing, professional services, sales, and utilities as well as the recovery of clean energy jobs in each of these industries following the COVID-19 pandemic.

FIGURE 1. CLEAN ENERGY SECTORS

Energy Efficiency

Renewable Electric Power Generation

Alternative Transportation

Grid Modernization and Storage

Renewable Fuels

CLEAN ENERGY INDUSTRY OVERVIEW

TOTAL CLEAN ENERGY EMPLOYMENT

In the last quarter of 2021, clean energy businesses across New York employed more than 165,000 workers. This represents an increase of about 5%, or 7,369 jobs, compared to the end of 2020. Clean energy employment in the State was 17% higher compared to the baseline estimate for 2015.

With this growth, total clean energy employment in New York has recouped the jobs lost in 2020 and surpassed its pre-pandemic employment levels.

165,000

workers employed by clean energy businesses across New York in the last quarter of 2021

5%

increase over previous year

7,369

additional jobs

17%

increase from 2015

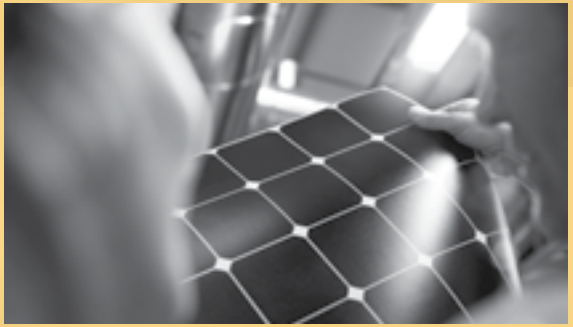
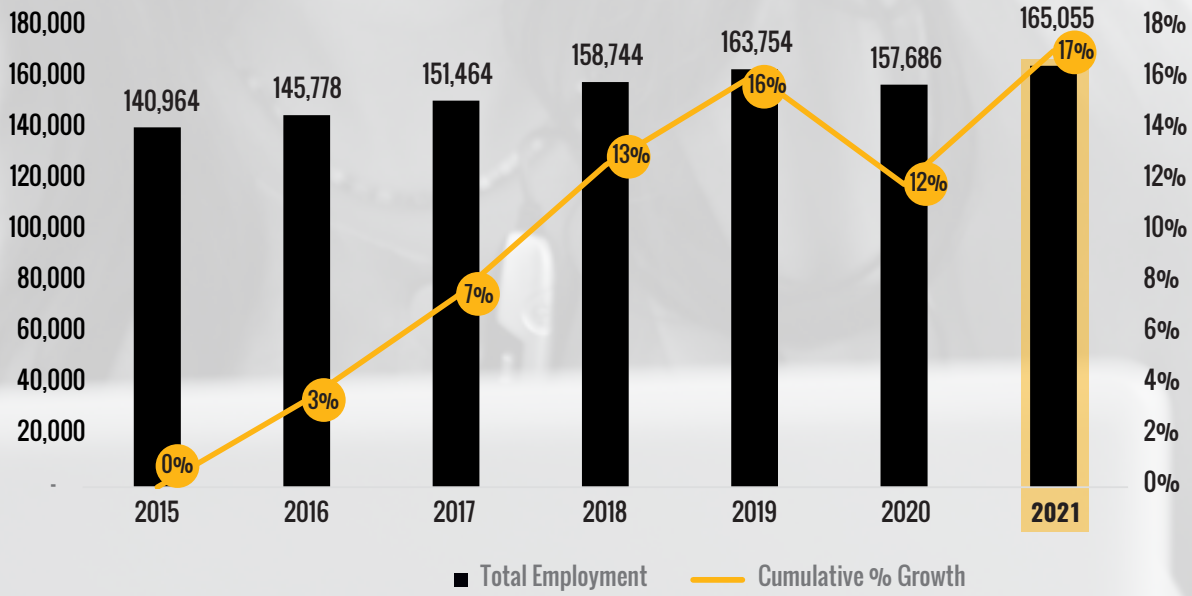


FIGURE 2. CLEAN ENERGY EMPLOYMENT IN NEW YORK, 2015-2021

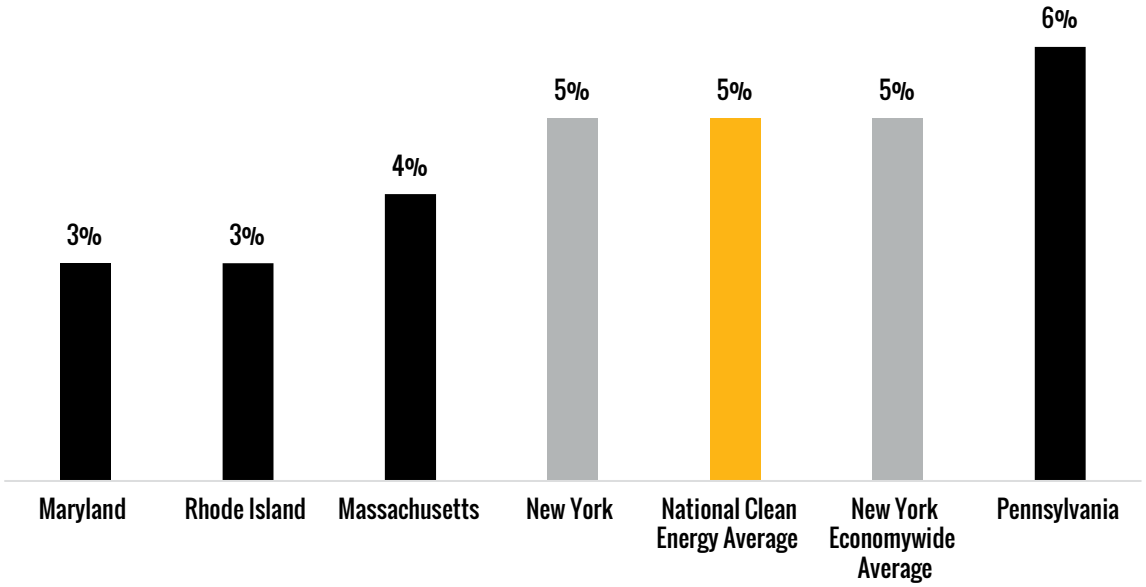


OVERVIEW

In clean energy employment change, New York's clean energy labor market falls in line with the national clean energy average and the statewide average. Clean energy employment expanded by 5% in New York between 2020 and 2021, compared to 5% in the overall statewide labor market and 5% for the U.S. clean energy economy.

Pennsylvania's clean energy employment growth surpassed New York by almost 2%. However, clean energy businesses in New York gained jobs at a higher rate compared to other neighboring clean energy economies like Massachusetts, Rhode Island, and Maryland; New York's clean energy employment growth was 1% higher than Massachusetts, 2% higher than Rhode Island, and 2% higher than Maryland.

FIGURE 3. CLEAN ENERGY EMPLOYMENT CHANGE BY REGION, 2020-2021

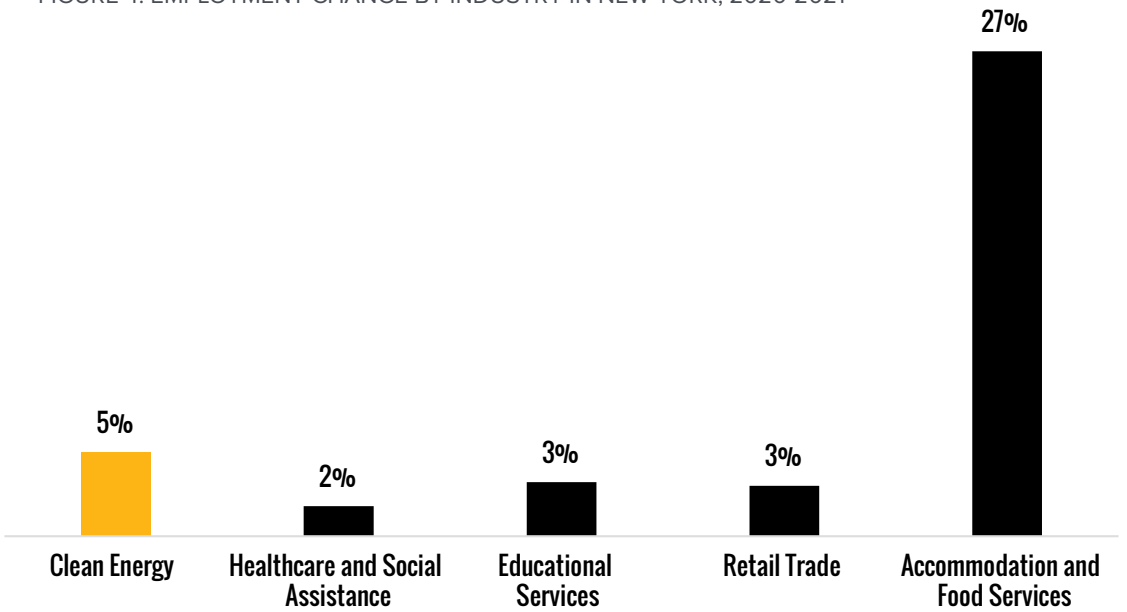


Within New York, the clean energy sector experienced a faster recovery compared to other industries like healthcare, education, and retail trade. The only industry to see greater employment growth was the accommodation and food service industry.

With an employment increase of 27% between the final quarters of 2020 and 2021, job gains in the accommodation and food services industry were about 22 percentage points higher than clean energy.

However, this employment growth comes after the accommodation and food service industry shed over 32% of its jobs in the previous year; in comparison, clean energy employment only declined by 4% between 2019 and 2020.

FIGURE 4. EMPLOYMENT CHANGE BY INDUSTRY IN NEW YORK, 2020-2021[4]



From 2016 through 2019, clean energy employment grew across nearly all five technology sectors, with the exception of renewable fuels. Energy efficiency saw the greatest absolute job growth, rising by almost 15%, for a total of 16,200 new jobs. Grid modernization and energy storage jobs grew by the highest relative rate, at 62% growth or almost 900 new jobs.

All clean energy sectors saw employment gains between 2020 and 2021.

Alternative transportation had the largest percentage increase and the second largest absolute increase in employment during this period, growing by 2,318 jobs or almost 26% between 2020 and 2021. To put this into perspective, the clean alternative transportation sector has less than a tenth of the total employees and establishments of the energy efficiency technology sector yet grew by only 643 jobs fewer than the energy efficiency sector in 2021.

The energy efficiency sector had the largest absolute employment growth during this period, gaining 2,960 jobs or a 2% increase.

Renewable electric power generation and grid modernization and energy storage also made notable employment gains between 2020 and 2021; renewable electric power generation grew by over 1,800 jobs or almost 8% and grid modernization and energy storage grew by almost 200 jobs or over 8%.

Energy efficiency remains the largest segment of clean energy establishments in New York, accounting for nearly nine in 10 (88%) clean energy firms. Following energy efficiency, alternative transportation firms comprise about 6% and renewable electric power generation firms comprise about 5% of total clean energy establishments across the State (Figure 6. Clean Energy Establishments by Technology, 2021).

The renewable electric power generation sector has larger firm sizes; while renewable electric power generation is only responsible for 5% of clean energy firms, it makes up 15% of clean energy employment.

alternative transportation

2,318 additional jobs

26% growth

energy efficiency

2,960 new jobs

2% growth

renewable electric power generation

1,800 new jobs

8% growth

grid modernization and energy storage

200 new jobs

8% growth

FIGURE 5. CLEAN ENERGY EMPLOYMENT BY TECHNOLOGY SECTOR, 2016-2021

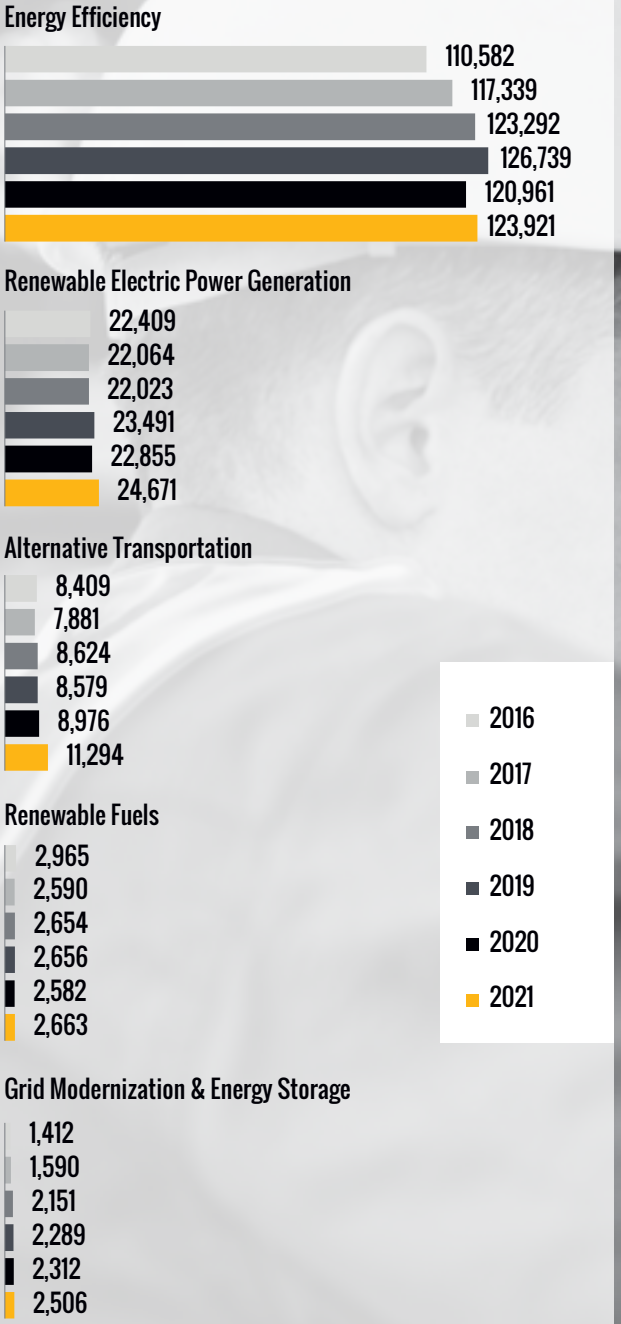
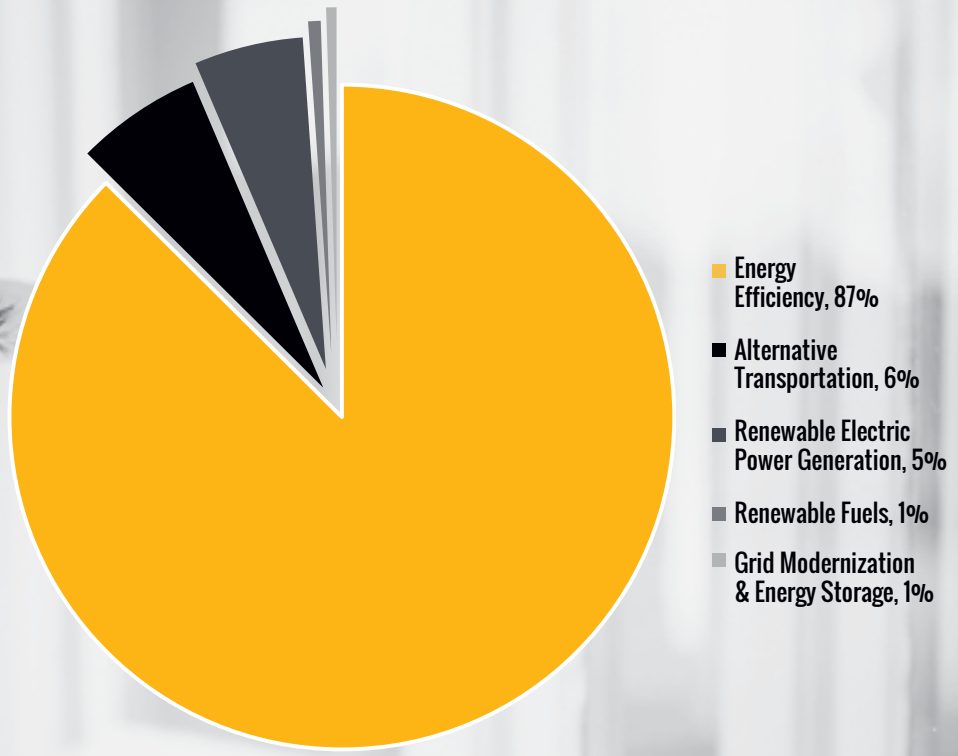


FIGURE 6. CLEAN ENERGY ESTABLISHMENTS BY TECHNOLOGY, 2021

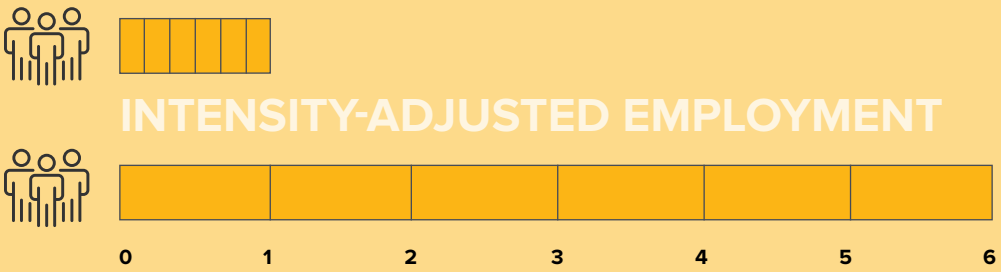


CLEAN ENERGY EMPLOYMENT INTENSITY

Intensity-adjusted clean energy job metrics are used to identify the concentration, or intensity, of clean energy activities. The clean energy employment featured in Figure 2 includes all workers that dedicate any amount of their labor hours or work week to clean energy goods and services. As such, an electrician who spends only a quarter of their work week installing or servicing solar panels would be counted as a clean energy worker in Figure 2. 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.[5]

An increase in total employment would indicate that there are more workers in the labor market overall 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 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 be spending 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 2 but would be captured as an increase in intensity-adjusted clean energy employment in Figure 8.

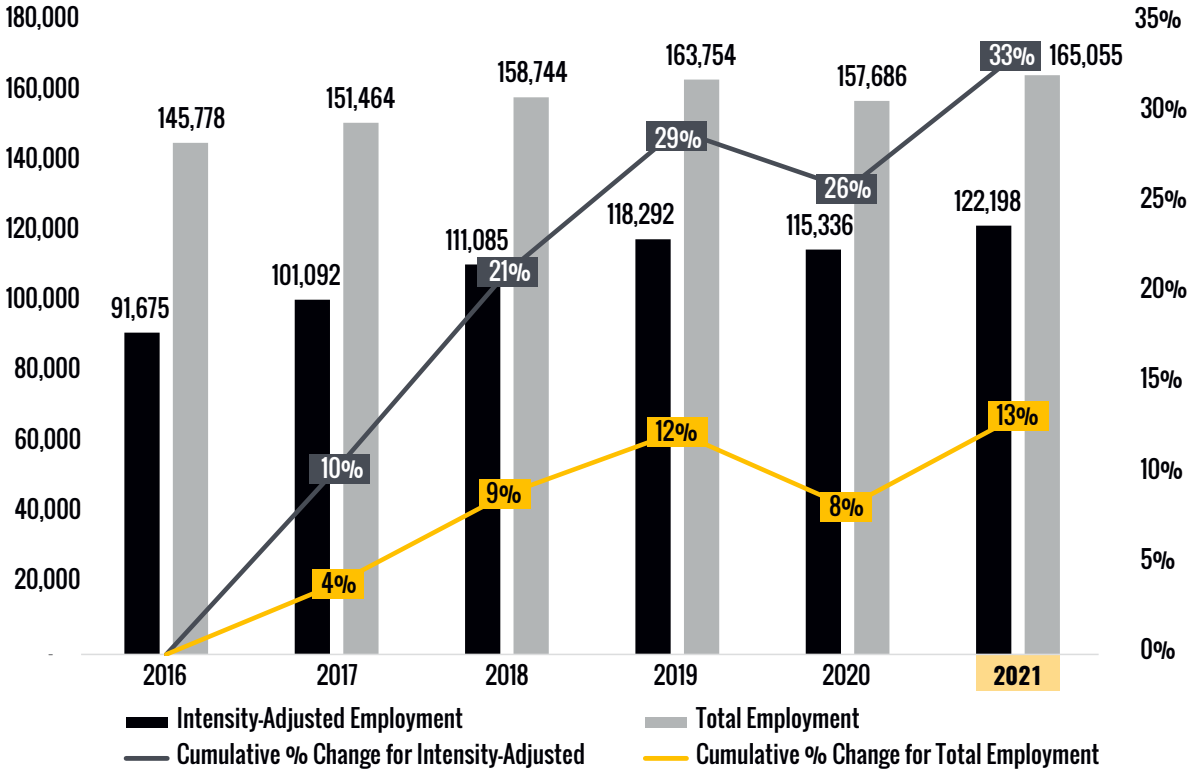
FIGURE 7. EXAMPLE OF INTENSITY-ADJUSTED CLEAN ENERGY EMPLOYMENT[6]



Intensity-adjusted clean energy employment in New York increased by 6% between 2020 and 2021, surpassing its pre-pandemic levels.

Overall, intensity-adjusted jobs were around 33% higher at the end of 2021 compared to the 2016 baseline.

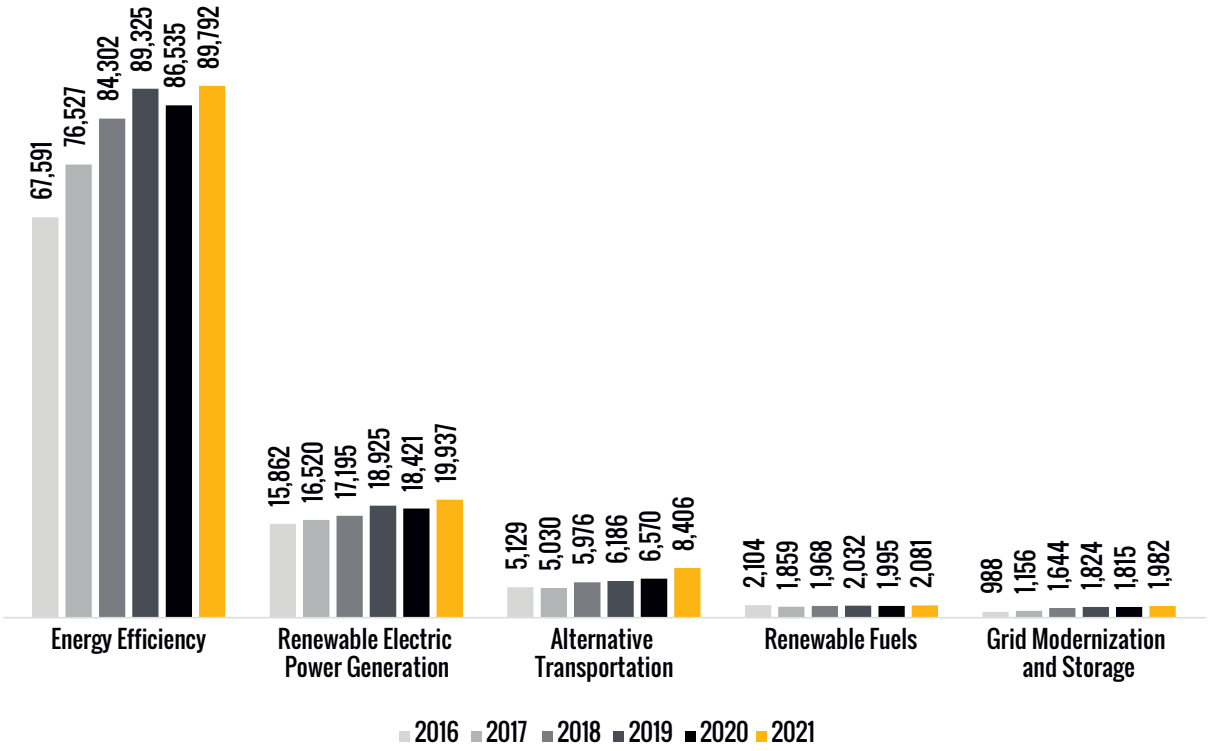
FIGURE 8. INTENSITY-ADJUSTED CLEAN ENERGY EMPLOYMENT, 2016-2021



By technology sector, alternative transportation showed the greatest percentage increase in intensity-adjusted employment (28%).

This is followed by grid modernization (9%), renewable electric power generation (8%), renewable fuels (4%), and energy efficiency (4%). While energy efficiency saw the smallest percentage increase in intensity-adjusted employment, it had the largest absolute increase, growing by 3,257 intensity-adjusted jobs. All five technology sectors surpassed their pre-pandemic intensity-adjusted employment levels in 2021.

FIGURE 9. INTENSITY-ADJUSTED CLEAN ENERGY EMPLOYMENT **BY TECHNOLOGY,** 2016-2021



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 2021, staying the same or making small increases. Similar trends were observed for the proportion of workers that spend 100% of their time on clean energy-related activities.

FIGURE 10. **50%** CLEAN ENERGY WORKERS BY TECHNOLOGY, 2016-2021

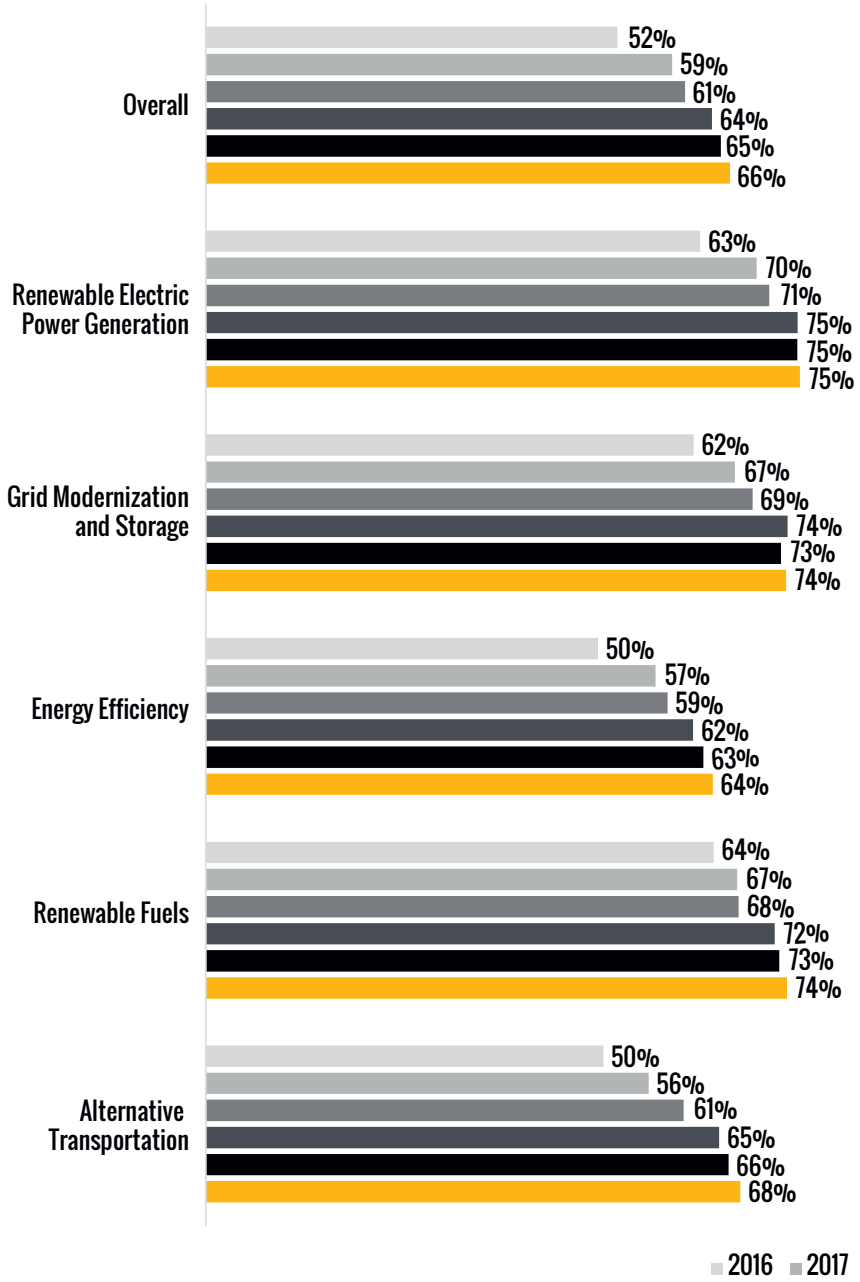
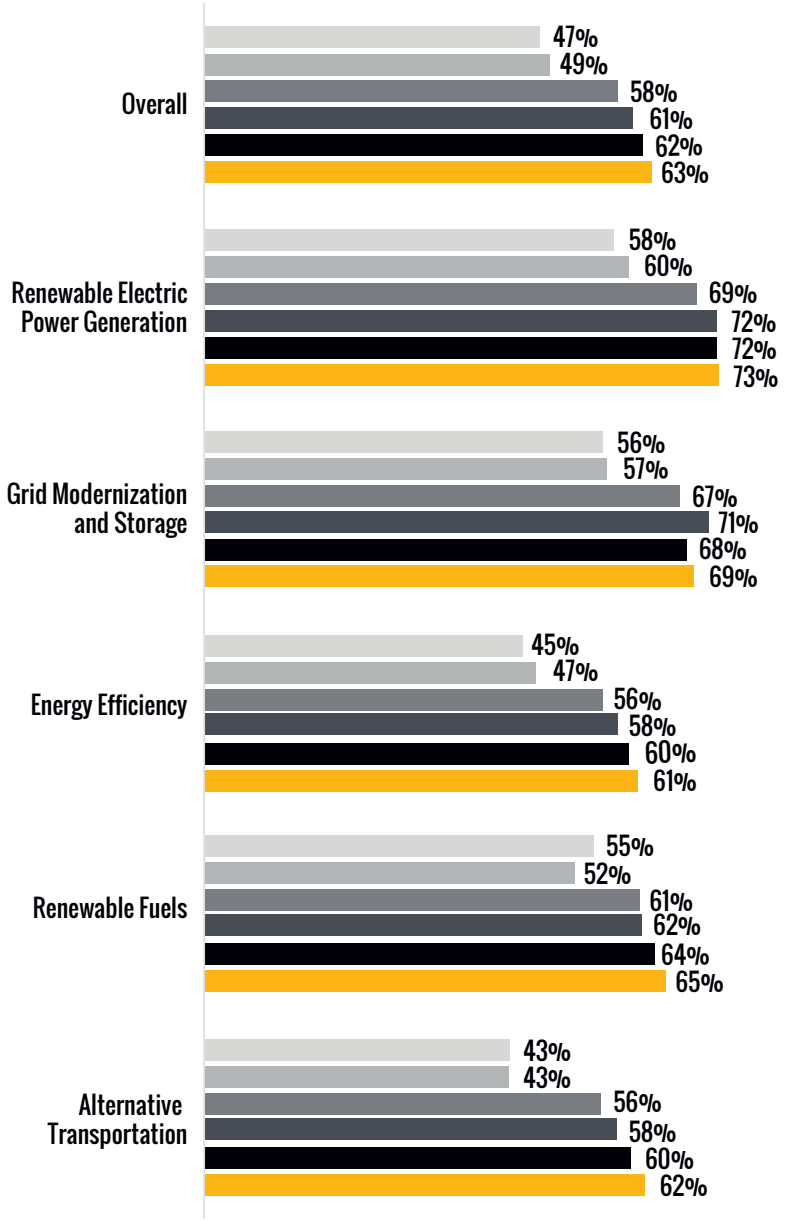


FIGURE 11. **100%** CLEAN ENERGY WORKERS BY TECHNOLOGY, 2016-2021



CLEAN ENERGY VALUE CHAIN EMPLOYMENT

The following section highlights clean energy employment by value chain segment with a focus on which industries in New York have high concentrations of clean energy activity. The major value chain segments containing clean energy employment are comparable to the federally defined industries; these include construction, manufacturing, wholesale trade, professional and business services, other support services, other[7], and utilities.

All the value chain segments represented in Figure 12 saw increases in their employment levels between 2020 and 2021 and either approached or surpassed their pre-pandemic employment levels.

After experiencing the greatest loss in jobs between 2019 and 2020, clean energy installation firms saw the greatest absolute and percentage increase in jobs from 2020 through 2021. These businesses saw their workforce expand by about 5,200 jobs—an increase of 6% in 12 months. However, clean energy installation firms still fall almost 500 jobs short of reaching their 2019 employment levels—the largest gap in all the industries below. Professional service firms gained almost 900 jobs (4%), followed by manufacturing, which increased by 4%, or 316 workers. Other support services gained over 500 jobs for an increase of almost 4%, and sales and distribution gained 250 workers for an increase of 3%. The remaining value chain segments saw more modest gains in their employment numbers between 2020 and 2021.

Installation firms comprise the largest segment of clean energy establishments in New York, accounting for almost half (47%) of total clean energy establishments.

Following installation, other support services comprise about a third (33%) of all clean energy establishments across the State. All other value chains make up a less substantial portion of clean energy establishments in New York; professional services make up 8%, sales and distribution make up almost 6%, and public and private utilities and manufacturing each make up about 2%.

FIGURE 12. CLEAN ENERGY EMPLOYMENT BY VALUE CHAIN SEGMENT, 2016-2021[8]

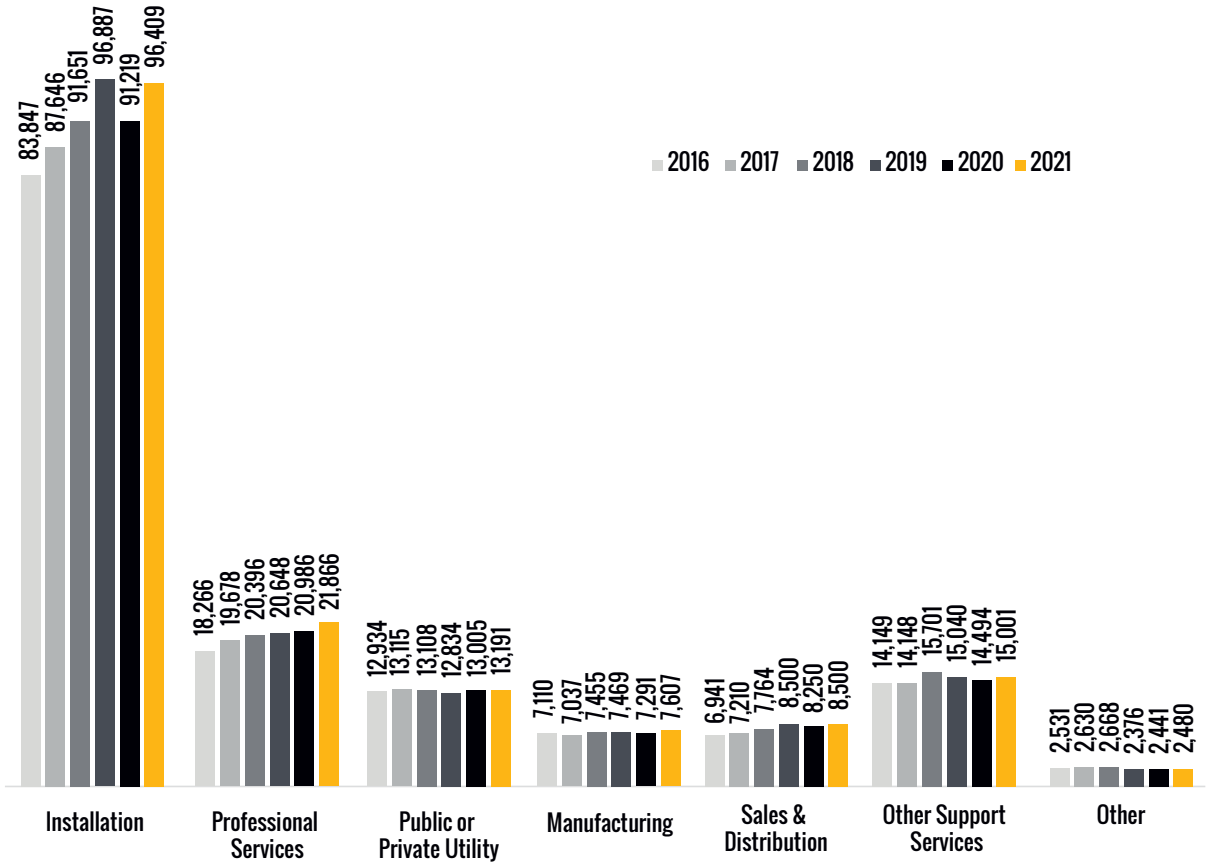
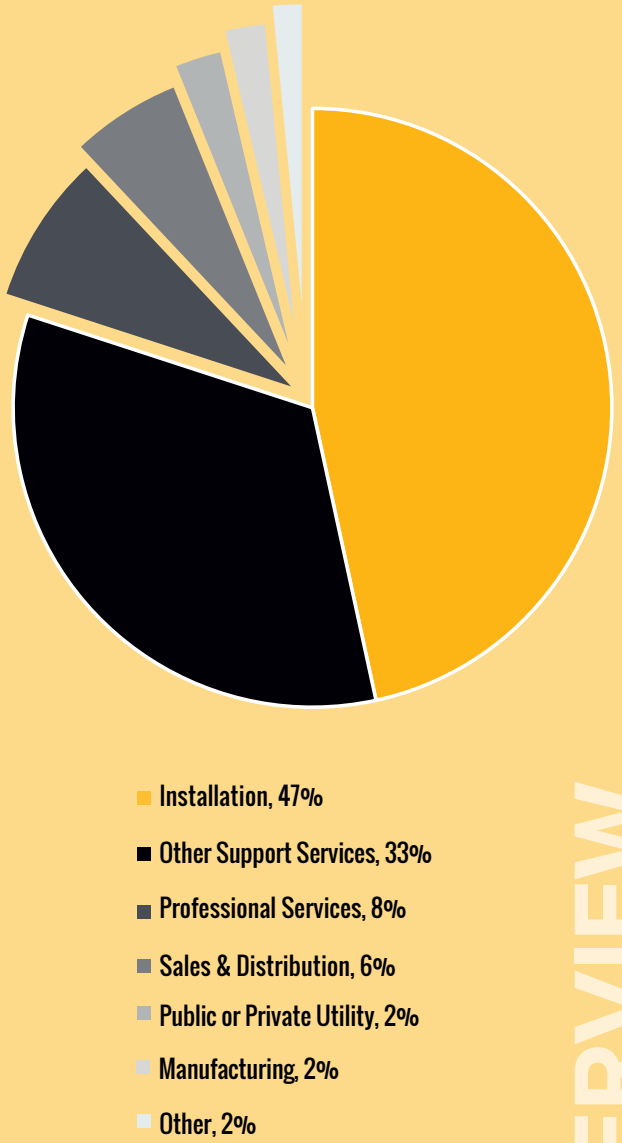


FIGURE 13. CLEAN ENERGY ESTABLISHMENTS BY VALUE CHAIN, 2021



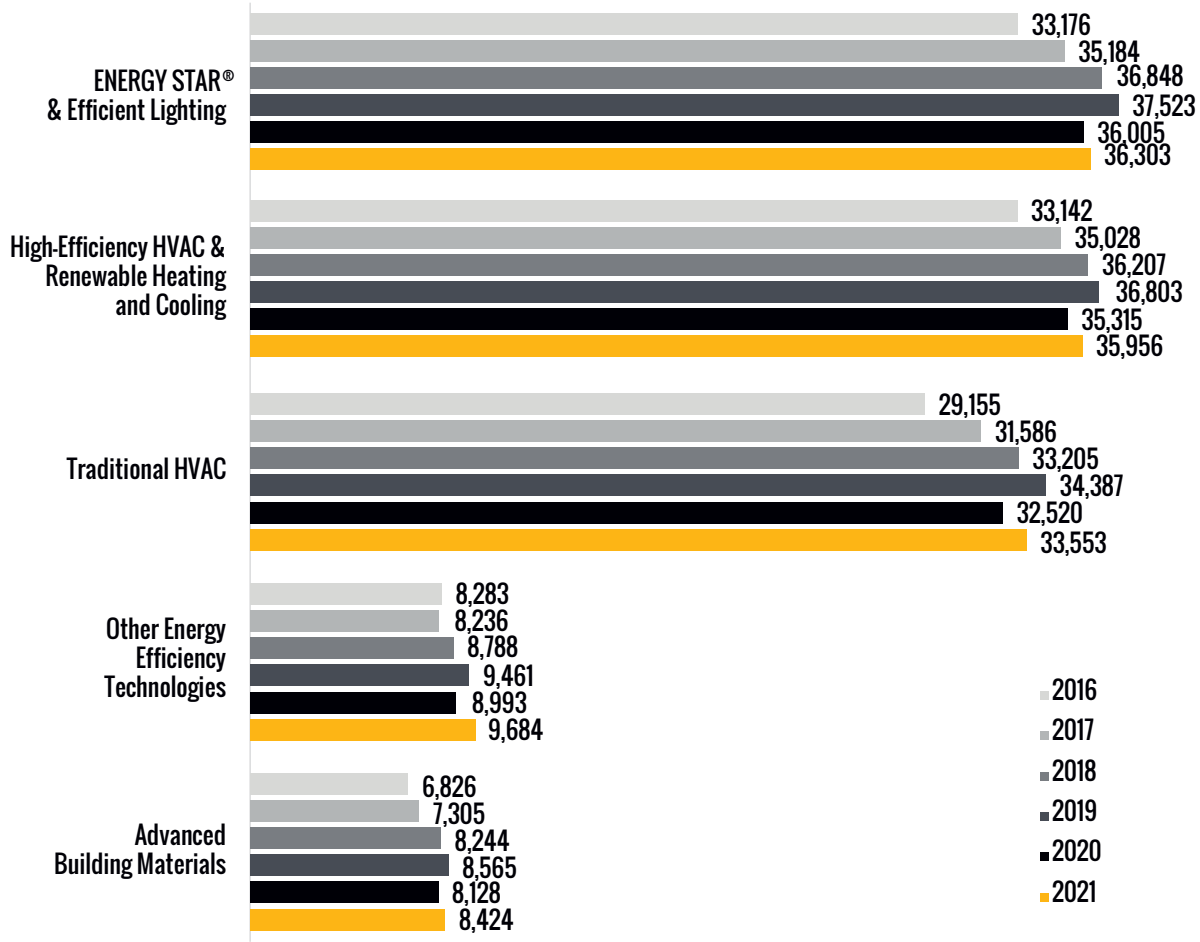
DETAILED CLEAN ENERGY SECTOR EMPLOYMENT

ENERGY EFFICIENCY

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

All five sub-technologies in energy efficiency saw an increase in employment levels between 2020 and 2021.

FIGURE 14. ENERGY EFFICIENCY EMPLOYMENT BY SUB-TECHNOLOGY, 2016-2021[9]



Traditional HVAC had the largest absolute increase in employment, gaining over 1,000 jobs and growing by 3%.

Other energy efficiency technologies saw the largest percentage change, growing by 8% or almost 700 jobs.

High-efficiency HVAC and renewable heating and cooling, and ENERGY STAR and efficient lighting had more modest employment growth.

High-efficiency HVAC and renewable heating and cooling grew by 641 jobs or 2%.

ENERGY STAR and efficient lighting grew by 298 jobs or 1%.

The three largest sub-technologies—ENERGY STAR and efficient lighting, high-efficiency HVAC and renewable heating and cooling, and traditional HVAC—have not fully recovered from the job losses incurred between 2019 and 2020. Between 2019 and 2020, each of these sub-technologies lost upwards of about 1,500 jobs each, while they each only gained between about 300 and 1,000 jobs between 2020 and 2021.

RENEWABLE ELECTRIC POWER GENERATION

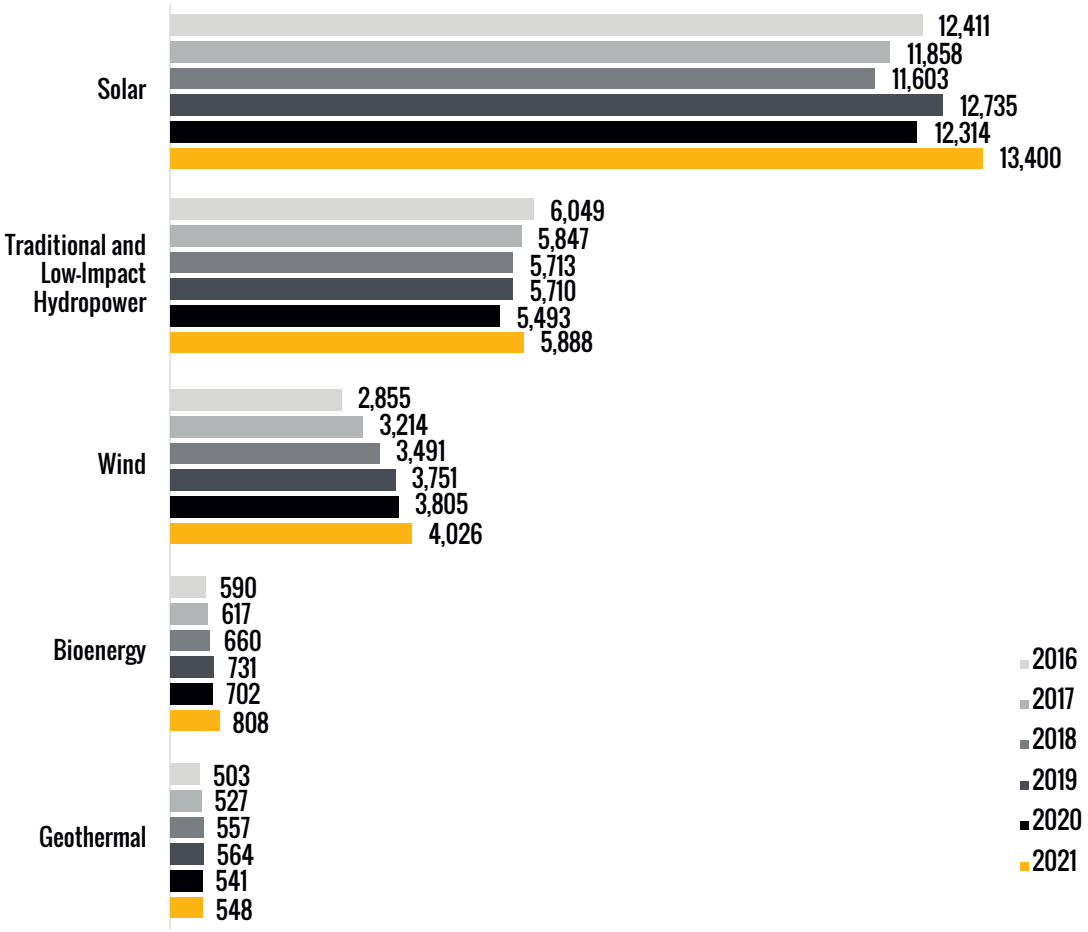
Clean energy generation jobs encompass all workers engaged in the research, development, production, manufacturing, sales, installation, maintenance, repair, or professional service support of carbon-free electricity generating technologies. Such clean energy generation technologies include solar, wind,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

All sub-technologies in renewable electric power generation saw job gains from 2020 through 2021. Except for geothermal, employment for all power generation sub-technologies fully recovered from the jobs losses they experienced in 2020 and surpassed their pre-pandemic employment levels.

All sub-technologies in renewable electric power generation saw job gains from 2020 through 2021.

The solar sector saw the greatest amount of job gains in 2021.

FIGURE 15. RENEWABLE ELECTRIC POWER GENERATION EMPLOYMENT BY SUB-TECHNOLOGY, 2016-2021[11]



The **solar sector**, which had seen the greatest amount of job losses in 2020, saw the greatest amount of job gains in 2021. While solar lost 421 workers from 2019 through 2020, declining 3%, it grew by 9% or 1,086 workers from 2020 through 2021, achieving its highest total employment to date.

Traditional and low-impact hydropower firms had the second greatest amount of job losses in 2020, declining by 4% or 217 jobs, and the second greatest amount of job gains in 2021, increasing by 7% or 396 jobs.

Bioenergy saw the largest relative employment increase, growing by 15% or 106 jobs.

Traditional and low-impact hydropower firms and wind firms also made strides in their employment numbers between 2020 and 2021; wind firms gained 221 jobs and grew by 6%.[10]

The **geothermal industry** held steady from 2020 to 2021.

PROJECTED OFFSHORE WIND JOB GROWTH

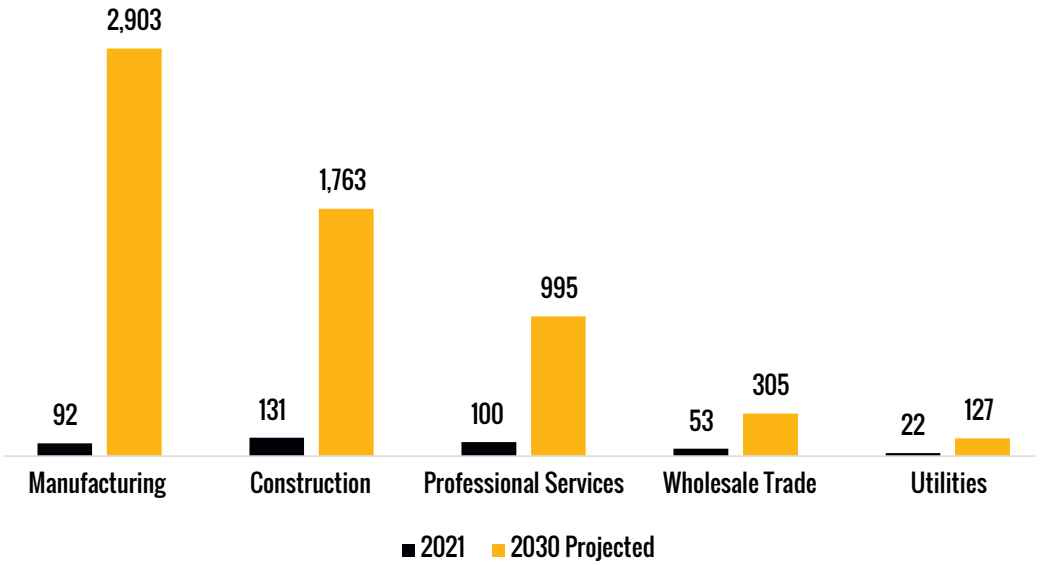
The 2030 OSW employment projections described here are based on the 4,230 MW of capacity additions that will be developed over the next decade from Sunrise Wind, Empire Wind 1, Beacon Wind, and Empire Wind 2.

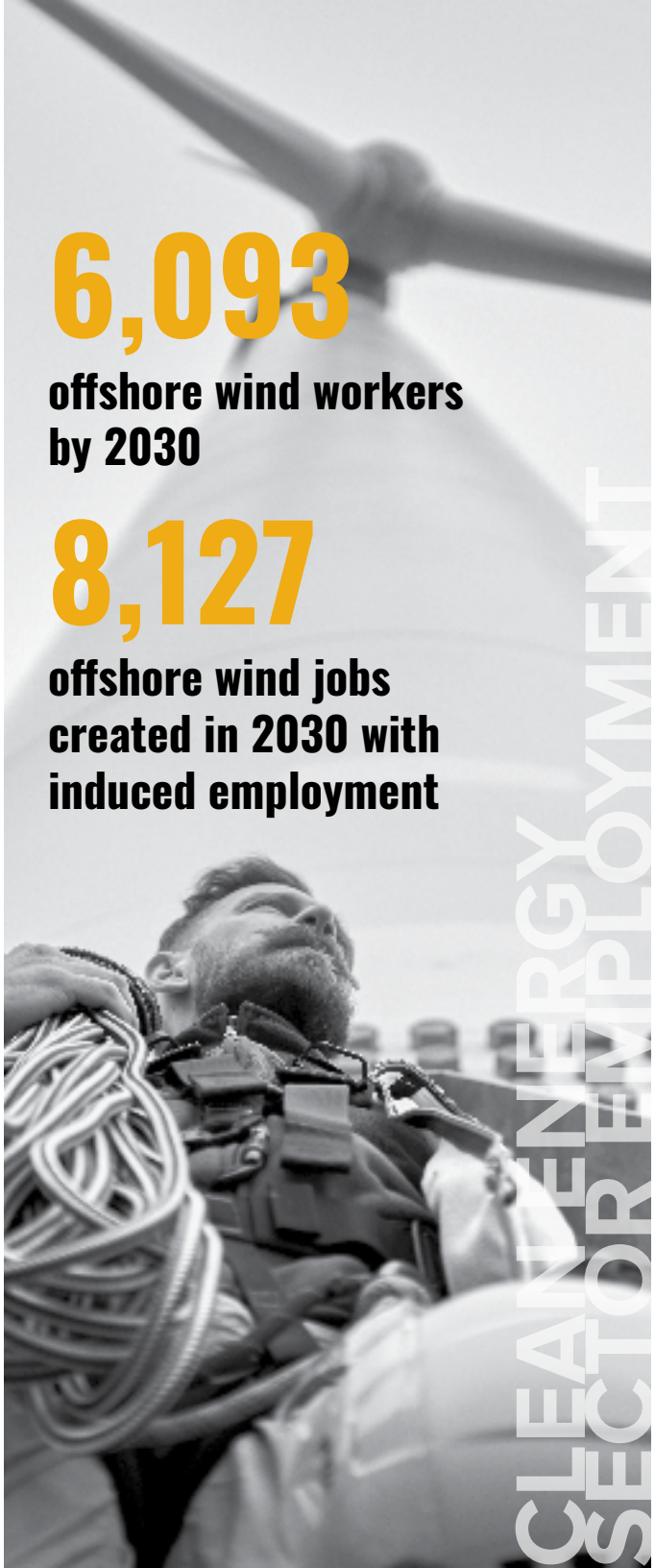
At the end of 2021, there were a total of 398 offshore wind workers in New York.

With planned offshore wind projects beginning development in 2022, and significant ramping up of manufacturing and construction over the next decade, the State will see an additional 5,695 offshore wind jobs by 2030, for a total of 6,093 offshore wind workers in New York in 2030. Including induced employment, New York's offshore wind industry will result in the creation of 8,127 jobs in 2030.

Manufacturing will account for just under half of all offshore wind jobs in New York, with 2,903 total jobs—48% of employment. Offshore wind construction workers will account for 1,763 jobs, or 29% of offshore wind employment. Professional services will also see significant growth, with 995 new jobs, or 16% of employment. Wholesale trade and utilities will see 305 and 127 new jobs, respectively.

FIGURE 16. OFFSHORE WIND EMPLOYMENT IN NEW YORK, 2021 & 2030 PROJECTED





6,093

offshore wind workers by 2030

8,127

offshore wind jobs created in 2030 with induced employment

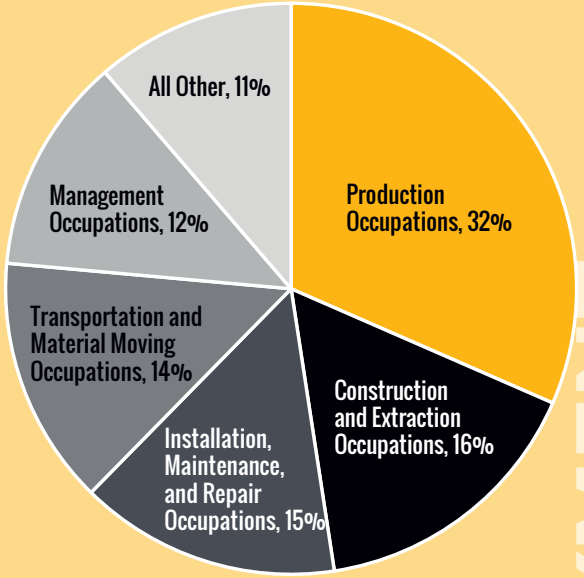
CLEAN ENERGY SECTOR EMPLOYMENT

BW Research ran the projected job growth by supply chain segments featured in Figure 16 through custom offshore wind staffing patterns to produce detailed occupational job growth.

Production occupations—such as assemblers and fabricators, metal workers, welders, or inspectors and testers—will account for roughly one in three new offshore wind jobs in 2030 (32%).

This is followed by construction and extraction occupations (16%), installation, maintenance, and repair occupations (15%), transportation and material moving occupations (14%), management occupations (12%), and all other positions (11%).[12]

FIGURE 17. OCCUPATIONAL DISTRIBUTION, 2030



Given the demand for offshore wind jobs, organizations including the Offshore Wind Training Institute (OWTI) are studying occupational pathways in an effort to understand the diverse needs of the OSW industry, and to establish market-based programs to support workshop training and development that bridges industry goals with new economic job pathways for New Yorker's.

TABLE 1. TOP 25 HIGHEST OFFSHORE WIND GROWTH OCCUPATIONS, 2030

Occupation	Projected OSW Jobs, 2030	Net Growth, 2021-2030	Total Jobs in New York, 2022[13]
Electricians	383	360	42,816
General and Operations Managers	253	226	202,562
Structural Metal Fabricators and Fitters	245	237	2,082
Assemblers and Fabricators, All Other	236	229	8,274
Maintenance and Repair Workers, General	222	212	124,426
Helpers--Installation, Maintenance, and Repair Workers	219	209	4,713
Inspectors, Testers, Sorters, Samplers, and Weighers	215	206	21,912
Plant and System Operators, All Other	214	202	237
Stockers and Order Fillers	199	191	124,945
Construction Laborers	193	178	66,278
Architectural and Engineering Managers	189	170	6,585
Administrative Services Managers	189	170	12,436
Excavating and Loading Machine and Dragline Operators, Surface Mining	165	152	1,317
Captains, Mates, and Pilots of Water Vessels	152	139	1,610
Welders, Cutters, Solderers, and Brazers	152	145	10,805
Shipping, Receiving, and Inventory Clerks	141	135	31,251
Plating Machine Setters, Operators, and Tenders, Metal and Plastic	122	118	1,115
Engine and Other Machine Assemblers	122	118	1,367
Industrial Machinery Mechanics	122	118	11,427
Sailors and Marine Oilers	118	109	1,396
Laborers and Freight, Stock, and Material Movers, Hand	107	97	116,546
Metal-Refining Furnace Operators and Tenders	105	102	430
Electrical, Electronic, and Electromechanical Assemblers, Except Coil Winders, Tapers, and Finishers	100	97	12,864
Molding, Coremaking, and Casting Machine Setters, Operators, and Tenders, Metal and Plastic	94	91	4,712
Riggers	88	82	627

ALTERNATIVE TRANSPORTATION

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

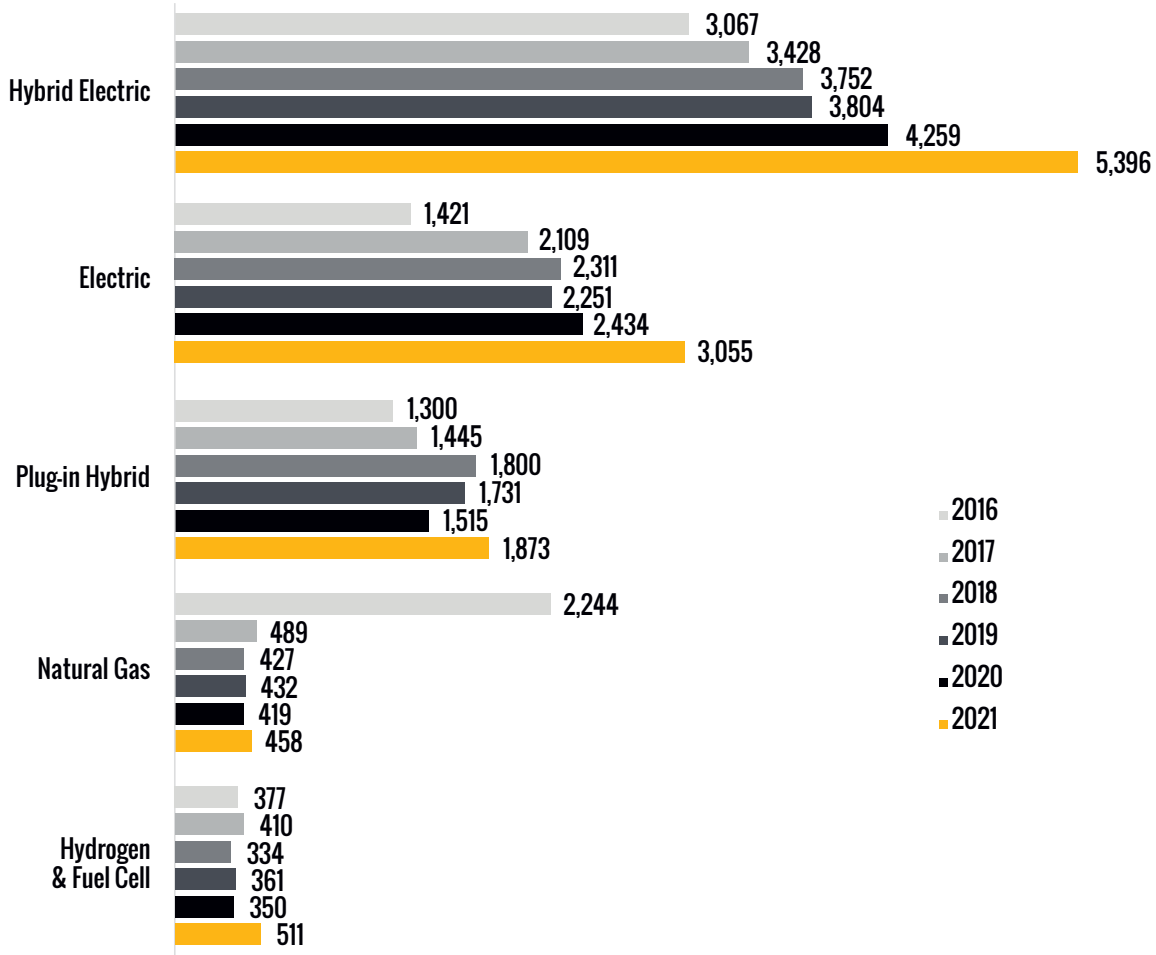
The alternative transportation sector remained strong throughout the pandemic, growing by almost 5% overall, or about 400 jobs.

This job growth was driven largely by the hybrid electric and electric vehicle sub-technologies, which grew by a respective 12% and 8% between 2019 and 2020.

The alternative transportation sector saw unprecedented growth between 2020 and 2021, expanding by almost 26% or 2,318 jobs in just 12 months.

All sub-technologies grew between 2020 and 2021, but about half of the overall growth in employment stems from the increase in hybrid electric vehicle employment. The hybrid electric sub-technology grew by 1,137 jobs or almost 27% between 2020 and 2021. Electric vehicle employment is the second largest contributor to the job growth in the alternative transportation sector. The electric vehicle sub-technology gained 621 jobs and grew by over 25%. Of the remaining sub-technologies, plug-in hybrid gained 358 jobs, hydrogen and fuel cell gained 161 jobs, and natural gas gained 39 jobs.

FIGURE 18. ALTERNATIVE TRANSPORTATION EMPLOYMENT BY SUB-TECHNOLOGY, 2016-2020



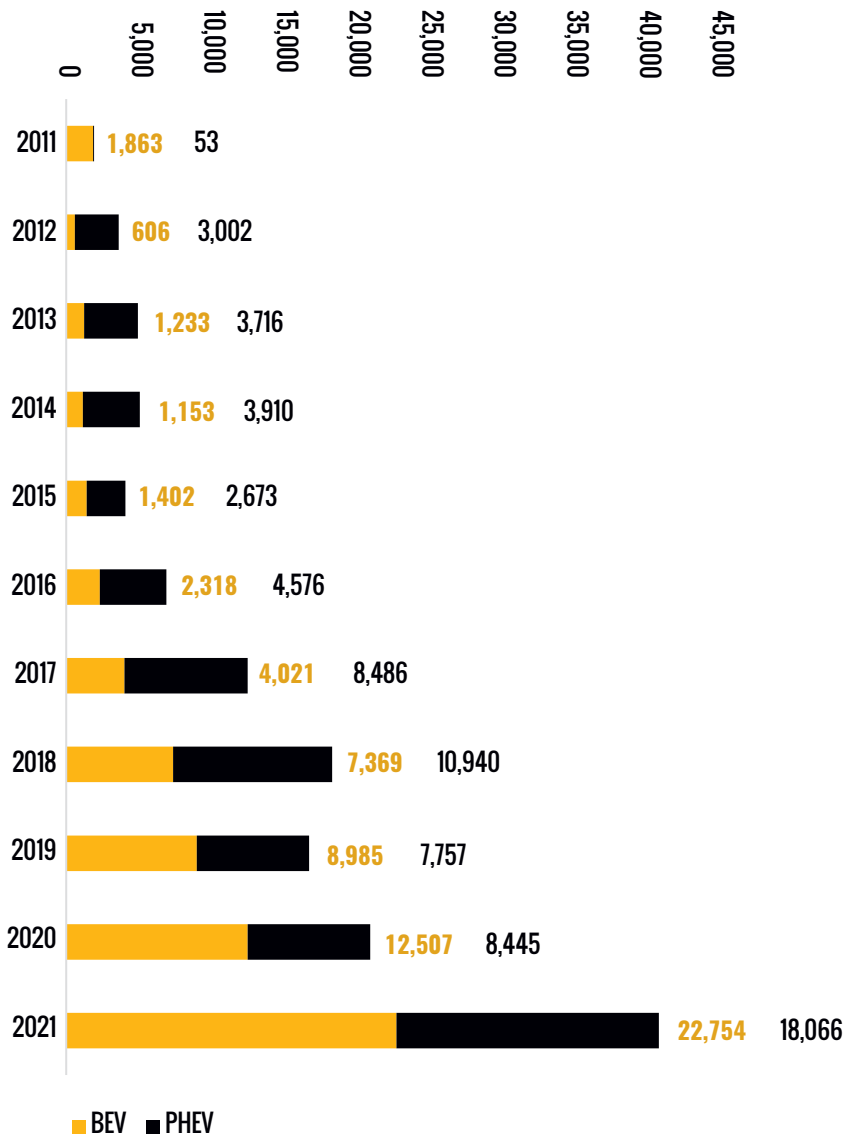
alternative transportation sector

26% growth

2,318 new jobs

CLEAN ENERGY SECTOR EMPLOYMENT

FIGURE 19. ORIGINAL EV REGISTRATIONS IN NEW YORK STATE, 2011-2021[15]



41,000

new electric vehicle registrations in 2021

23,000

BEVs

18,000

PHEVs

This unprecedented job growth coincides with a boom in electric vehicle registration in New York.

Original electric vehicle registrations in the State nearly doubled between 2020 and 2021, jumping from about 21,000 in 2020 to about 41,000 in 2021 (Figure 19).[14]

Of the nearly 41,000 new electric vehicle registrations in 2021, about 23,000 were battery electric vehicles (BEVs) and 18,000 were plug-in hybrid electric vehicles (PHEVs).

GRID MODERNIZATION AND ENERGY STORAGE

For the purposes of this report, grid modernization and energy storage workers include any individual that supports the deployment (construction), manufacturing, wholesale trade, or legal, financial, and engineering services of smart grid and energy storage technologies.

Energy storage—which includes pumped hydropower storage[16], battery storage[17], mechanical storage[18], thermal storage[19], biofuel storage (including ethanol and biodiesel), and nuclear fuel storage—accounted for about eight in ten grid modernization and energy storage jobs (80%) at the end of 2021. The energy storage workforce has been growing since 2016. Between 2020 and 2021, the energy storage sub-technology expanded by 135 jobs or 7%; this was the largest employment increase since 2018.

7%

energy storage job growth

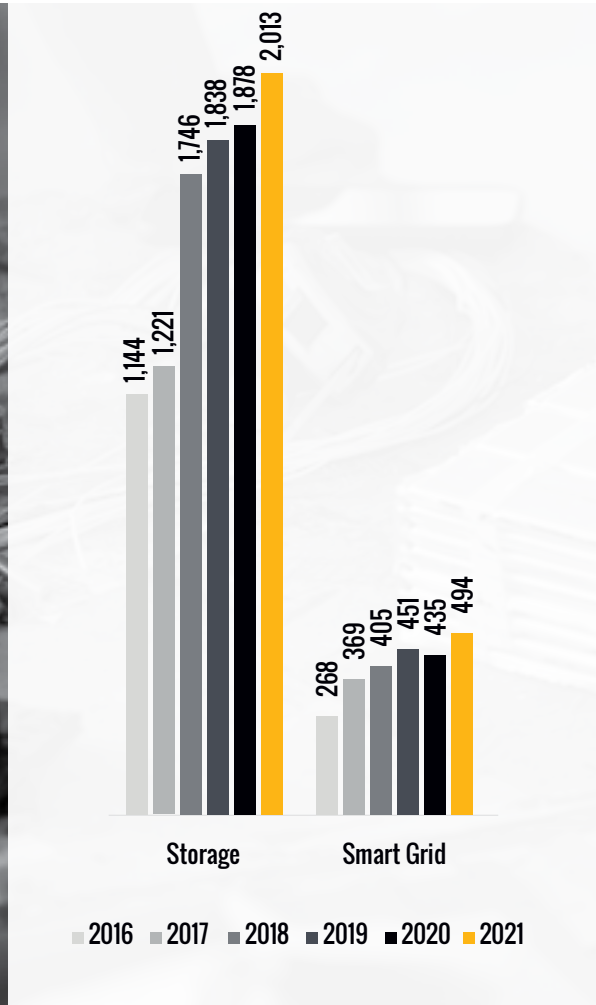
135

additional energy storage jobs

Between 2016 and 2019, smart grid employment grew by 69%—an additional 180 clean energy jobs over three years.

Between 2020 and 2021, smart grid[20] employment grew by roughly 60 jobs for an increase of almost 14%. With this employment growth, the smart grid sub-technology recouped the jobs it lost in 2020 and surpassed its 2019 employment levels.

FIGURE 20. GRID MODERNIZATION & ENERGY STORAGE EMPLOYMENT BY SUB-TECHNOLOGY, 2016-2021



14%

smart grid job growth

60

additional smart grid jobs

RENEWABLE FUELS

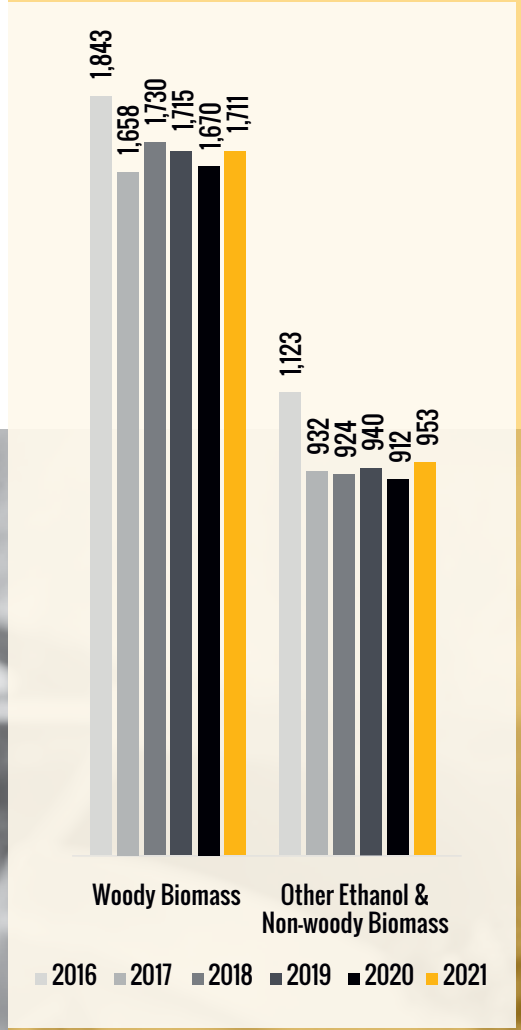
The renewable fuels sector includes all workers involved in the production, distribution and sales, or professional and business service support for renewable fuels and renewable fuel technologies that use woody and non-woody biomass.

Renewable fuels employment fell in 2016 and has stayed approximately steady since then.

This sector is the only component of New York clean energy economy that has lower employment levels today than in 2016. However, between 2020 and 2021, renewable fuels employment increased, returning to its 2019 employment level.

The woody biomass and other ethanol and non-woody biomass sub-technologies both gained 41 jobs between 2020 and 2021. This marks a 5% increase in other ethanol and non-woody biomass employment and a 3% increase in woody biomass employment in 12 months.

FIGURE 21. RENEWABLE FUELS EMPLOYMENT BY SUB-TECHNOLOGY, 2016-2021[21]



CLEAN ENERGY HIRING

About nine in ten (90%) employers who were hiring in 2021 reported overall difficulty—the sum of very and somewhat difficult—between 2020 and 2021.

Broken down by technology, energy efficiency employers experienced the most hiring difficulty; 93% reported overall difficulty.

Alternative transportation employers experienced the least hiring difficulty of all technologies, but still 73% reported overall hiring difficulty in 2021. It is important to note that responses to this question are based on the small sample of employers that reported seeking workers over the course of 2021.[22]

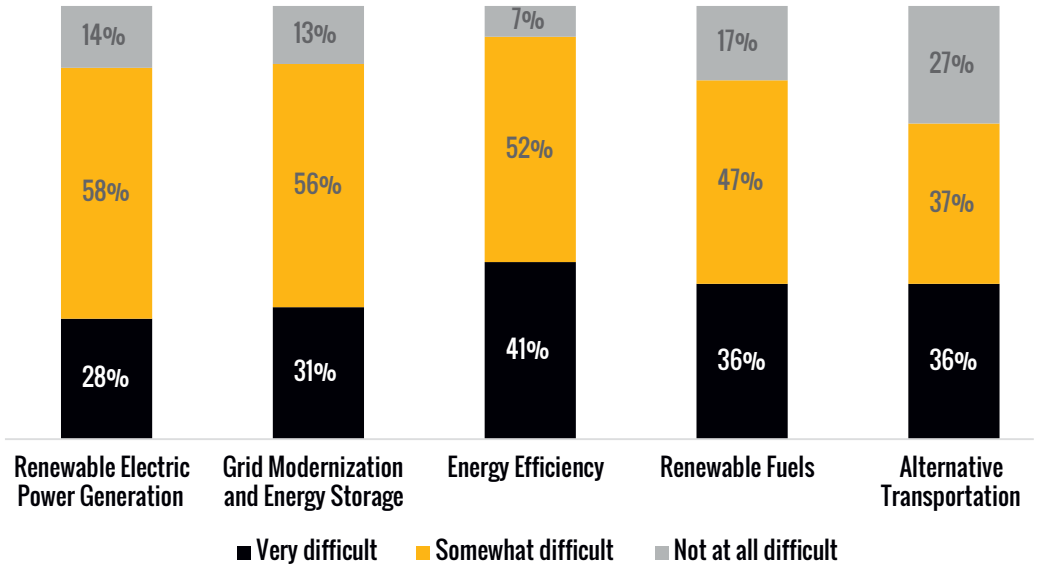
FIGURE 22. EMPLOYER-REPORTED HIRING DIFFICULTY, 2021

- Somewhat Difficult, 52%
- Very Difficult, 39%
- Not Difficult At All, 10%

Employer-reported hiring difficulty reached a three-year high in 2021.

The number of employers reporting overall hiring difficulty in 2021 was 5% higher than it was in 2020 and almost 13% higher than it was in 2019. Additionally, more employers in 2021 reported more severe hiring difficulty than in previous years; the number of employers reporting that hiring was "very difficult" in 2021 was over 5% higher than it was in 2020 and 7% higher than it was in 2019.

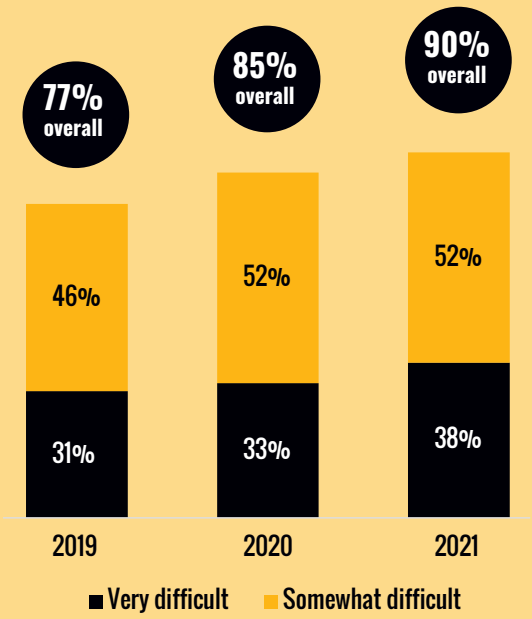
FIGURE 23. EMPLOYER-REPORTED HIRING DIFFICULTY BY TECHNOLOGY, 2021



13%

higher overall hiring difficulty in 2021 compared to 2019

FIGURE 24. EMPLOYER-REPORTED HIRING DIFFICULTY, 2019-2021



CLEAN ENERGY DEMOGRAPHICS

Clean energy demographics in Table 2 show there was a slightly higher proportion of women, Asian, and Black or African American workers in New York clean energy sector at the end of 2021 compared to the end of 2020, indicating progress on New York's commitment to building an inclusive clean energy economy.[23]

Despite the slight increase in the proportion of female workers and Black workers between 2020 and 2021, these demographics are especially underrepresented in the clean energy sector. The proportion of female workers in the clean energy industry is about 23 points below the statewide labor market average and the proportion of Black workers is about six points below the statewide labor market average.

At the end of 2021, there was a slightly higher proportion of women, Asian, and Black or African American workers in New York clean energy sector compared to the end of 2020.

Several organizations within the State have begun creating inclusive workforce development programs to address the lack of diversity within New York's clean energy workforce.

NYSERDA launched its On-The-Job Training for Energy Efficiency and Clean Technology program, which provides incentives for energy efficiency and clean technology businesses to "hire and provide on-the-job training for new workers."[24]

Businesses hiring from priority populations[25] and disadvantaged communities[26] are eligible for additional incentives, encouraging the development of a diverse clean energy workforce in the State.

TABLE 2. CLEAN ENERGY DEMOGRAPHICS, 2021[27]

	NY Clean Energy Industry					
	Overall Clean Energy, 2020	Overall Clean Energy, 2021	Energy Efficiency, 2021	Renewable Electric Power Generation, 2021	NY Overall[28]	U.S. Clean Energy
Female	25%	25%	25%	28.5%	49%	28%
Male	75%	75%	75%	72%	52%	73%
White	72%	72%	72%	71%	64%	73%
Hispanic/Latinx	15%	15%	15%	16%	18%	17%
Black	8%	8%	8%	9%	15%	8%
Asian	6%	7%	7%	9%	9%	8%
Native American	1%	2%	2%	1%	1%	1%
Pacific Islander	1%	1%	1%	1%	<1%	1%

CLEAN ENERGY INVESTMENTS

TOTAL INVESTMENTS

Clean energy investments in New York have been steadily on the rise since 2011. Between the first and last three-year rolling averages from 2011 through 2021, total investments increased by 182% while the number of deals across these three-year rolling averages increased by nearly 100%. Overall, clean energy firms saw a total of $10.98 billion in investments across 6,681 deals between 2011 and 2021.

182%

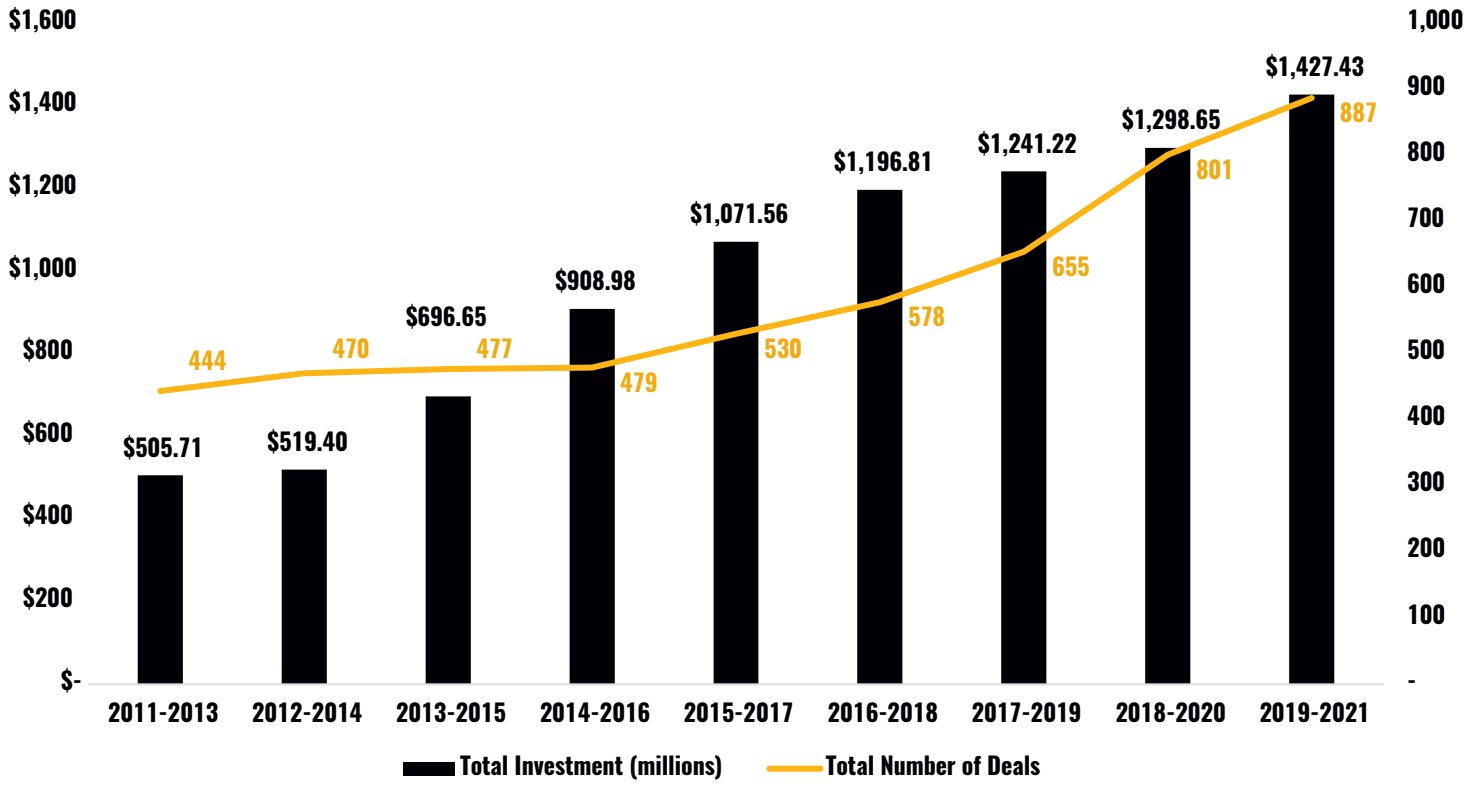
increase in total clean energy investments since 2011

$10.98 billion

in investments since 2011

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

FIGURE 25. TOTAL CLEAN ENERGY INVESTMENTS (MILLIONS), 2011-2021 THREE-YEAR ROLLING AVERAGES[29]



By technology sector, the renewable electric power generation segment accounted for the majority of all investments from 2011 through 2021, representing 56% of all investment dollars flowing to the clean energy economy during these years.

Renewable electric power generation also saw one of the greatest increases in investment dollars over the past decade, behind renewable fuels; renewable electric power generation firms saw investments grow by 586% between its first and last three-year rolling average and renewable fuels increased by 689% between its first and last three-year rolling average. Within recent years, however, average investment in renewable electric power generation decreased.

Energy efficiency, grid modernization and energy storage, and alternative transportation saw the greatest growth in investment dollars in recent years.

Average investment in **energy efficiency** was 30% higher between 2019 and 2021 than between 2018 and 2020, while average investment in grid modernization and energy storage was 123% higher between 2019 and 2021 than between 2018 and 2020.

Average investment in **alternative transportation** was nearly twice as high between 2017 and 2019 than between 2018 and 2020. While average investment in alternative transportation decreased between its 2018 to 2020 average and its 2019 to 2021 average, it was still about 84% higher between 2019 and 2021 than between 2017 and 2020.

Renewable fuels also saw modest gains in average investment in recent years.

CLEAN ENERGY INVESTMENTS

FIGURE 26. TOTAL CLEAN ENERGY INVESTMENTS BY TECHNOLOGY (MILLIONS), 2011-2021 THREE-YEAR ROLLING AVERAGES[30]

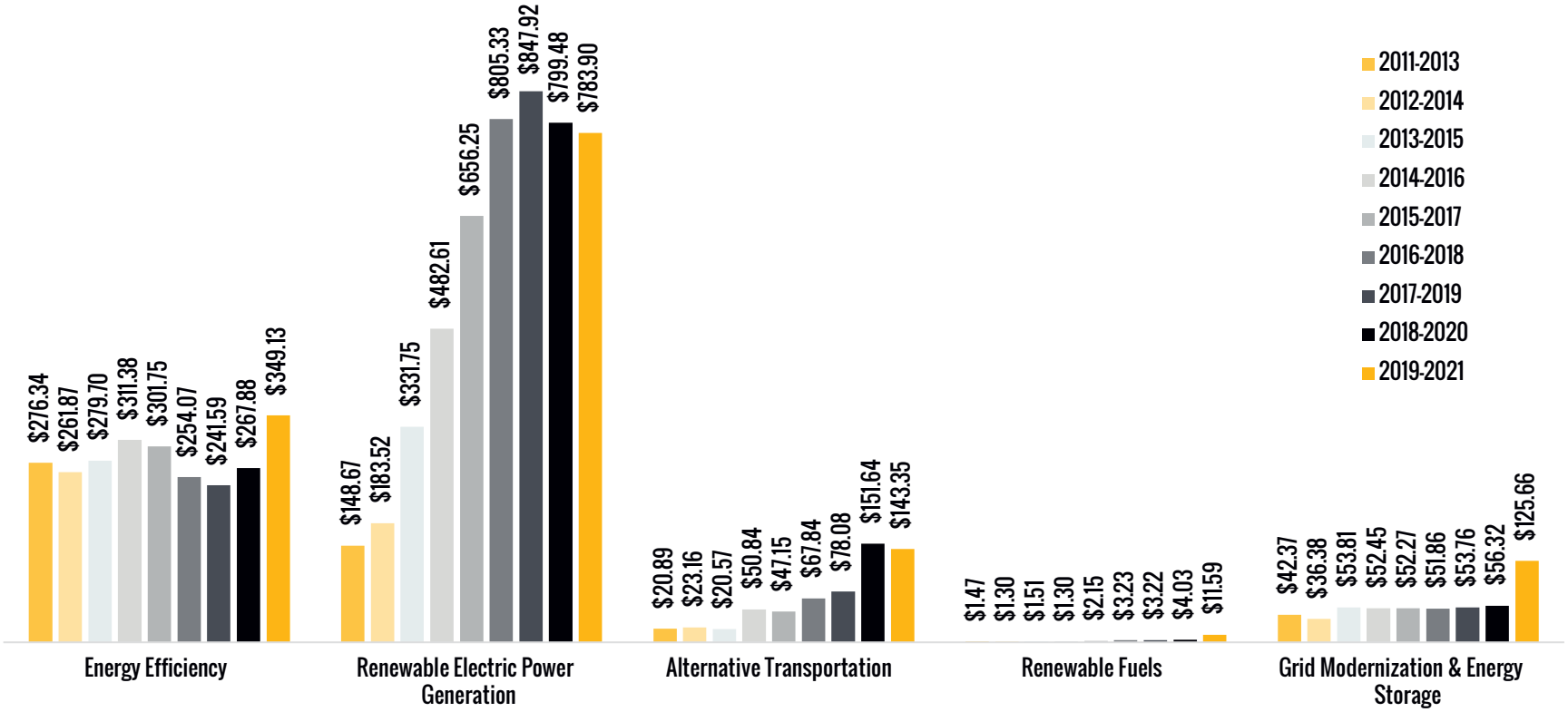


FIGURE 27. TOTAL **PRIVATE** CLEAN ENERGY FUNDING (MILLIONS), 2011-2021 THREE-YEAR ROLLING AVERAGES[31]

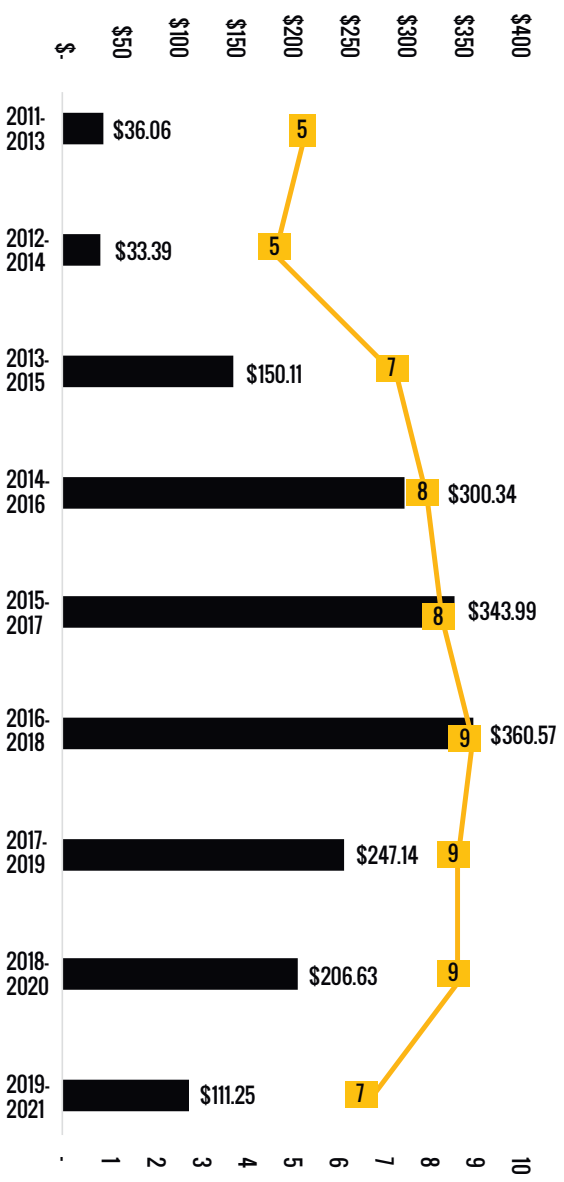
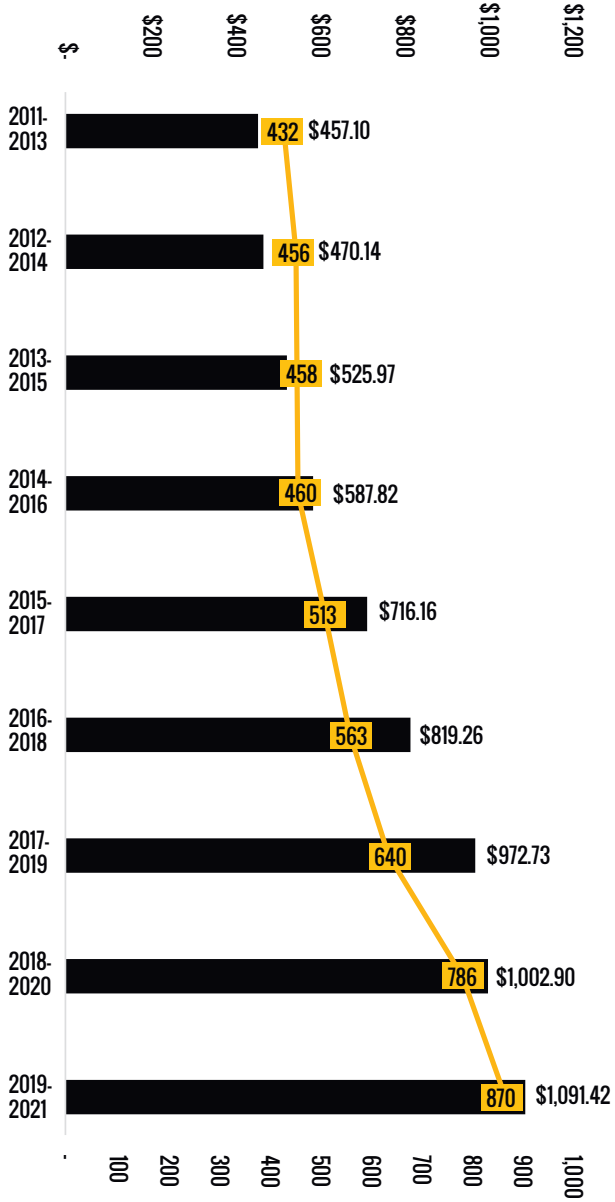


FIGURE 28. TOTAL **PUBLIC** CLEAN ENERGY FUNDING (MILLIONS), 2011-2021 THREE-YEAR ROLLING AVERAGES[32]



The majority of investments in New York's clean energy industry from 2011 through 2021 (81%) came from the public sector.

Public expenditures in the State's clean energy businesses grew continually from 2011 through 2021—by a cumulative 139% across the three-year rolling averages.

Though private investment has been decreasing across the past three rolling averages, private investments saw significant growth in 2021.

Private investment fell from $160.2 million in 2019 to $39.9 million in 2020 but has since increased to $133.6 million.

From 2011 through 2021, private investments totaled to $1.92 billion across 79 deals while public investments totaled to $8.23 billion across 5,509 deals.

INVESTMENTS BY INNOVATION PHASE

The following section provides a break-out of investment data by each of the three stages of innovation funding. It should be noted that not all investments and expenditures are able to 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 25. Below is a brief description of each phase of innovation:

Phase I: Research & Prototyping

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

Phase II: Demonstration & Acceleration

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

Phase III: Commercialization & Growth

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

FIGURE 29. 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

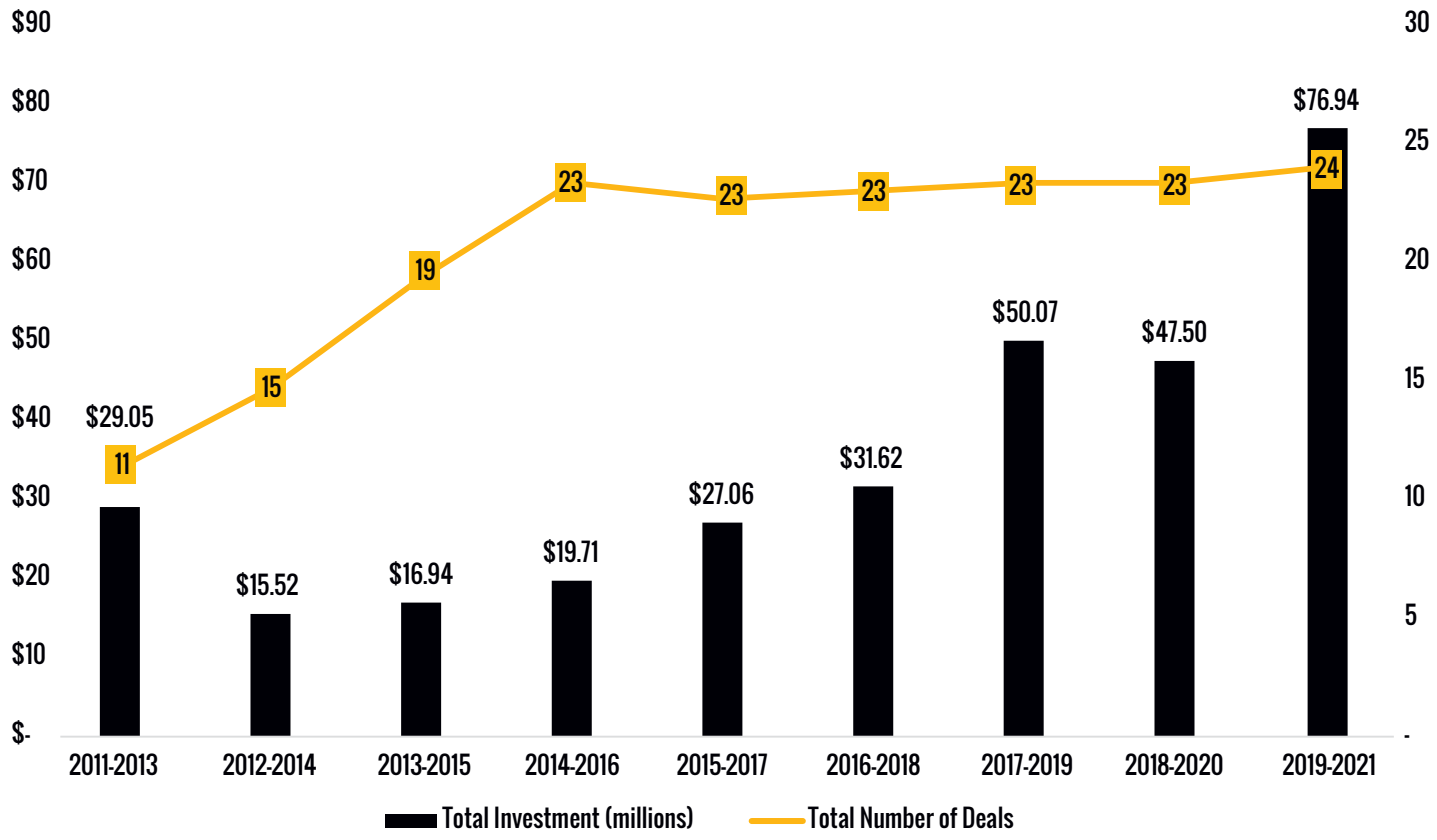
Phase III: Commercialization and Growth

- > Expand manufacturing capacity
- > Identify early customers

CLEAN ENERGY INVESTMENTS

PHASE I: RESEARCH & PROTOTYPING

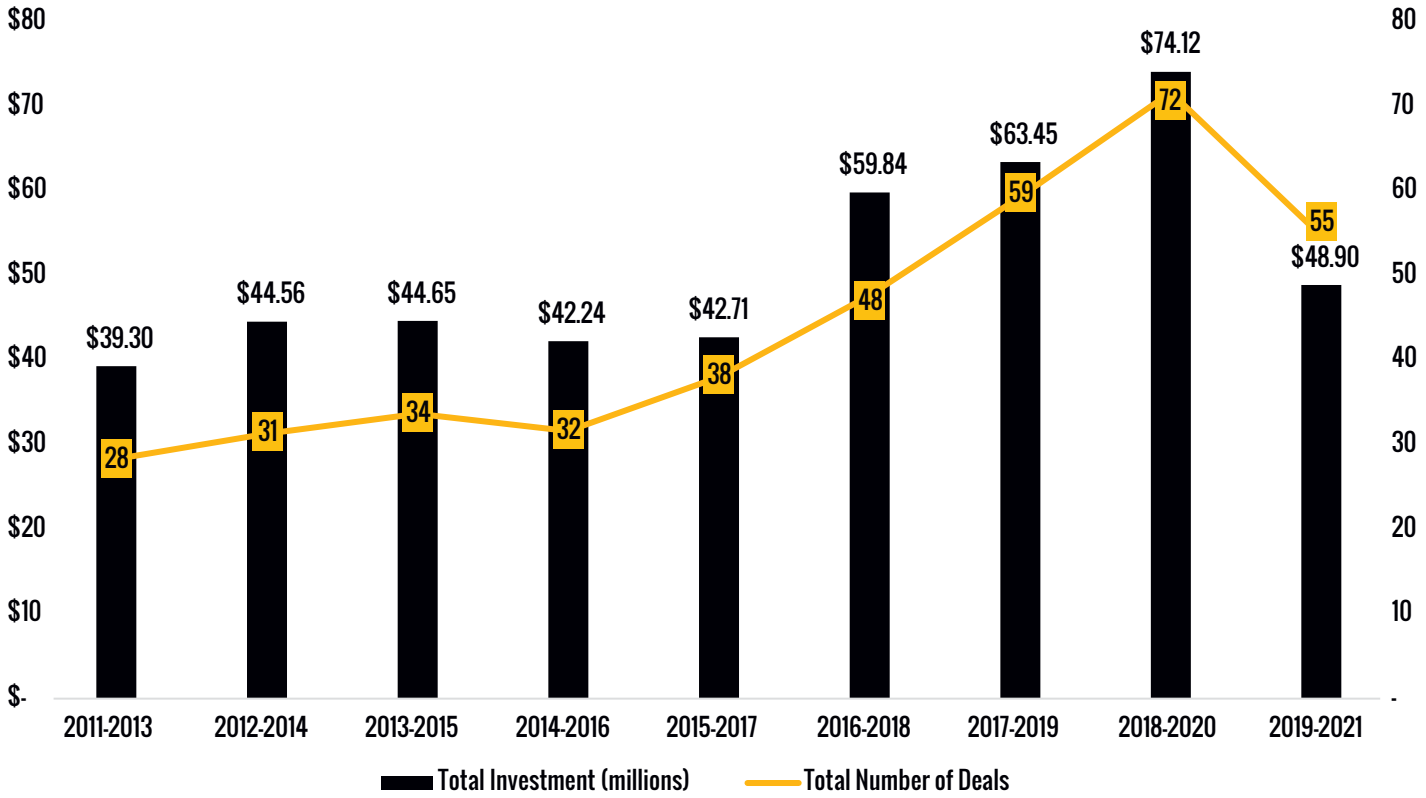
FIGURE 30. **PHASE I** INVESTMENTS (MILLION), 2011-2021 THREE-YEAR ROLLING AVERAGES



CLEAN ENERGY INVESTMENTS

PHASE II: DEMONSTRATION & ACCELERATION

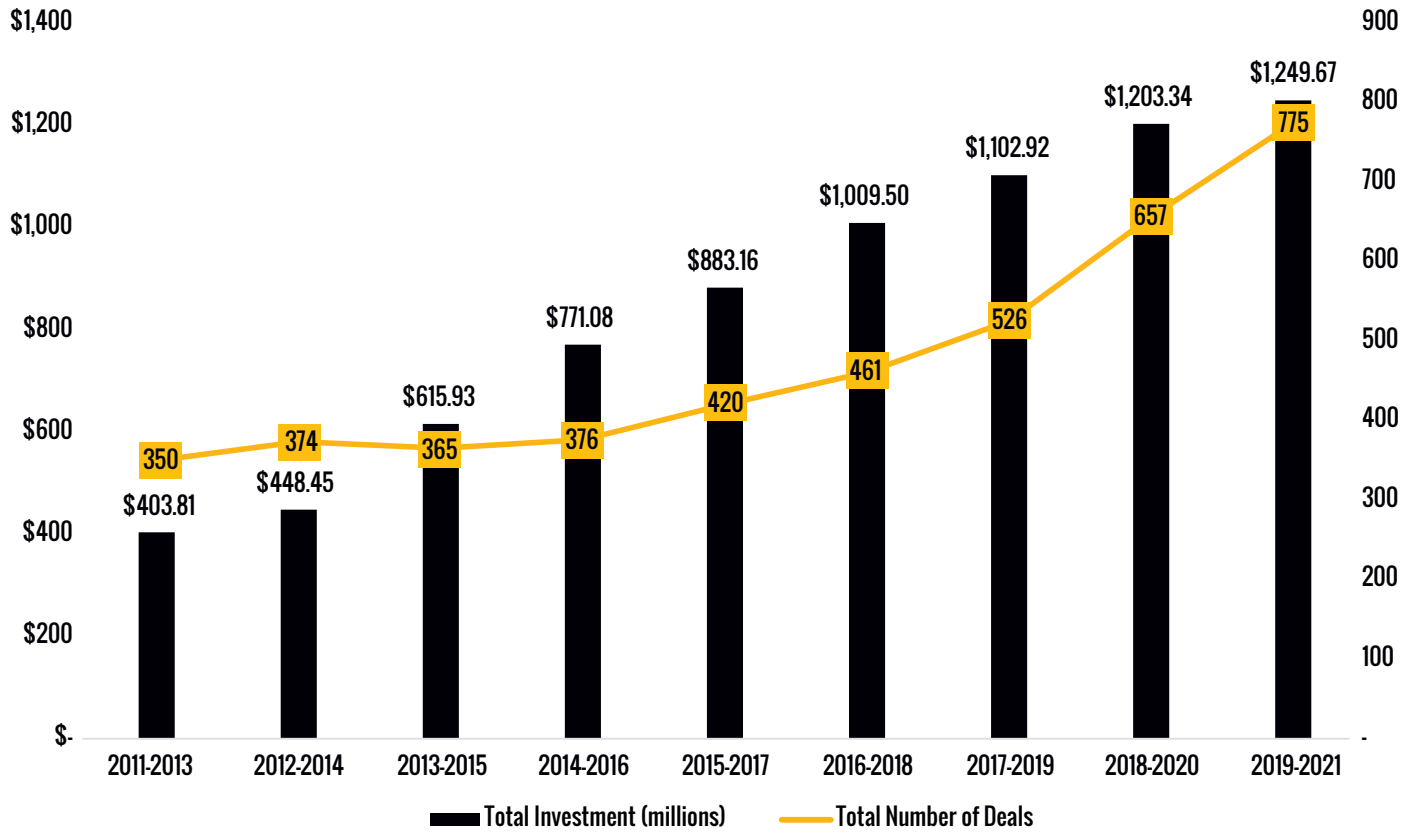
FIGURE 31. **PHASE II** INVESTMENTS (MILLION), 2011-2021 THREE-YEAR ROLLING AVERAGES



CLEAN ENERGY INVESTMENTS

PHASE III: COMMERCIALIZATION & GROWTH

FIGURE 32. **PHASE III** INVESTMENTS (MILLION), 2011-2021 THREE-YEAR ROLLING AVERAGES



Phase III accounted for the largest share of all total investment dollars by innovation phase, representing 91% of all expenditures.

From 2011 through 2021, Phase III investments amounted to $9.43 billion across 5,492 deals.

Phase III investments grew consistently between 2011 and 2021, resulting in a cumulative growth rate of 210% between the first and last three-year rolling averages.

Much of Phase III expenditures and investment dollars can be attributed to spending by NYSERDA.

ECONOMIC IMPACT ANALYSIS

13,010

net jobs gained due to increase in clean energy activity

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

Between 2020 and 2021 there was a net increase of 7,369 jobs in a variety of clean energy industries. Ultimately, the economic impact analysis finds that 13,010 net jobs were gained due to increased clean energy activity. The industries with the largest job growth were labor and civic organizations, software publishers, durable goods merchant wholesalers, and machinery, equipment, and supplies wholesalers.[33]

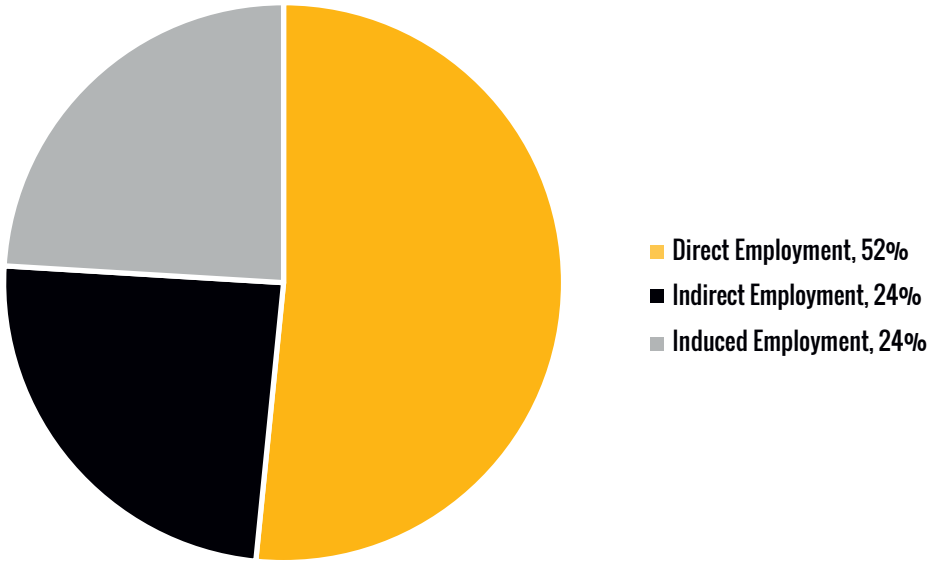
Results from the entry of the 6,711[34] direct jobs estimate into the IMPLAN economic impact model show that there was a total impact of 13,010 jobs gained due to clean energy economic activity in 2021, of which 3,171 were indirect jobs, and 3,128 were induced jobs. These jobs were responsible for $1.8 billion in GDP, and $1.1 billion in labor income (Table 3).

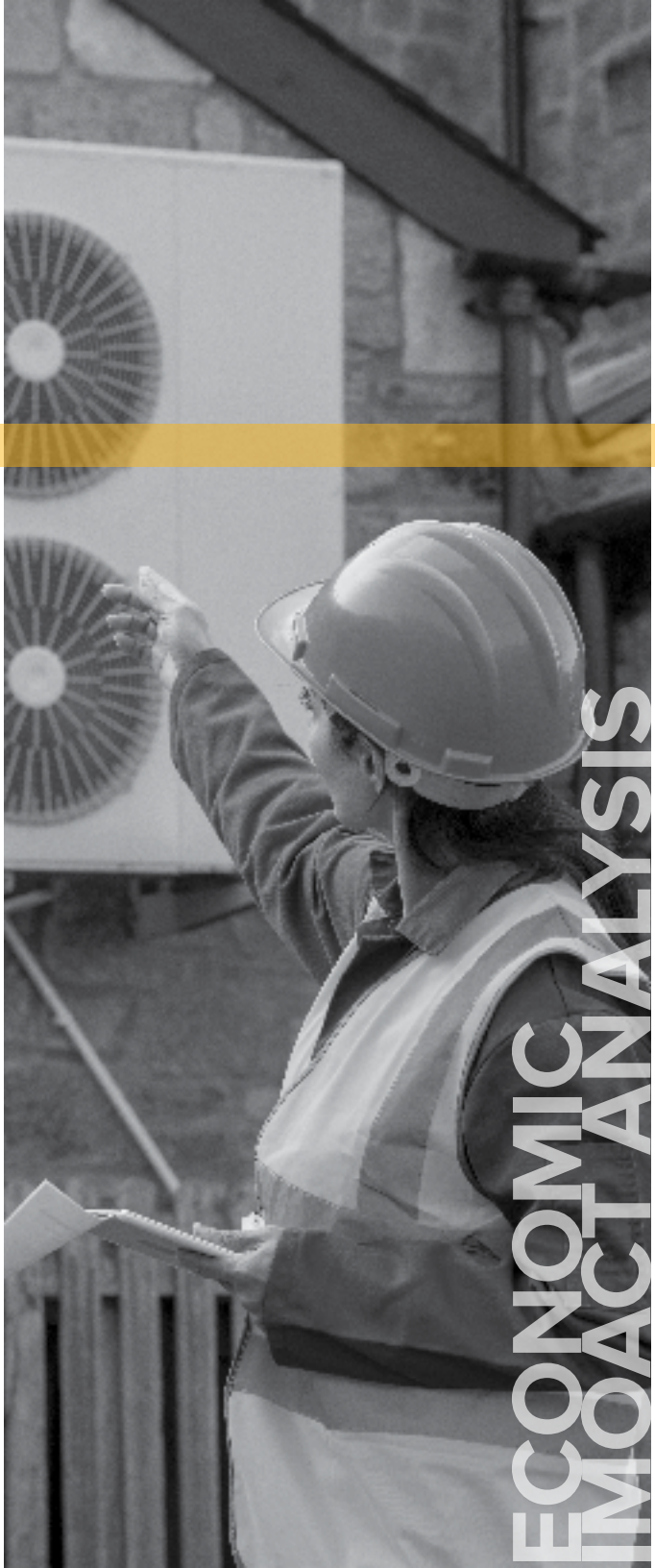
TABLE 3. TOTAL ECONOMIC IMPACT OF THE NET CHANGE IN CLEAN ENERGY JOBS IN NEW YORK STATE, 2020-2021

Impact Type	Employment	Value Added	Labor Income
Direct Effect	6,711	$995,960,626	$607,624,414
Indirect Effect	3,171	$437,411,404	$265,344,749
Induced Effect	3,128	$396,005,483	$229,003,487
Total Effect	**13,010**	**$1,829,377,513**	**$1,101,972,649**

Indirect and induced impacts are equal; 24% of the jobs lost were induced and 24% were indirect jobs (Figure 33).

FIGURE 33. PORTION OF JOBS GAINED BY TYPE OF IMPACT





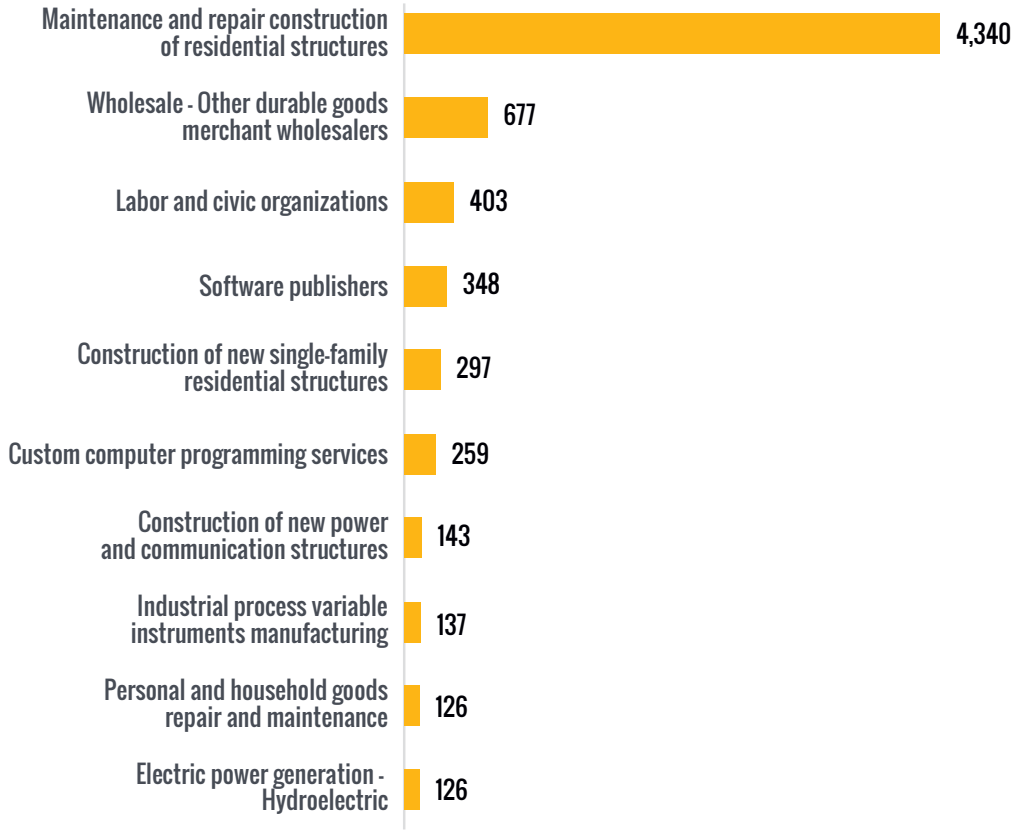
ECONOMIC IMPACT ANALYSIS

ECONOMIC IMPACT ANALYSIS

DIRECT INDUSTRIES

The clean energy industries with the largest direct job gains include maintenance and repair construction of residential structures, durable goods merchant wholesalers, labor and civic organizations, software publishers, and construction of new single-family construction (Figure 34).

FIGURE 34. TOP 10 CLEAN ENERGY DIRECT INDUSTRIES IN NEW YORK STATE BY EMPLOYMENT GAINS, 2021

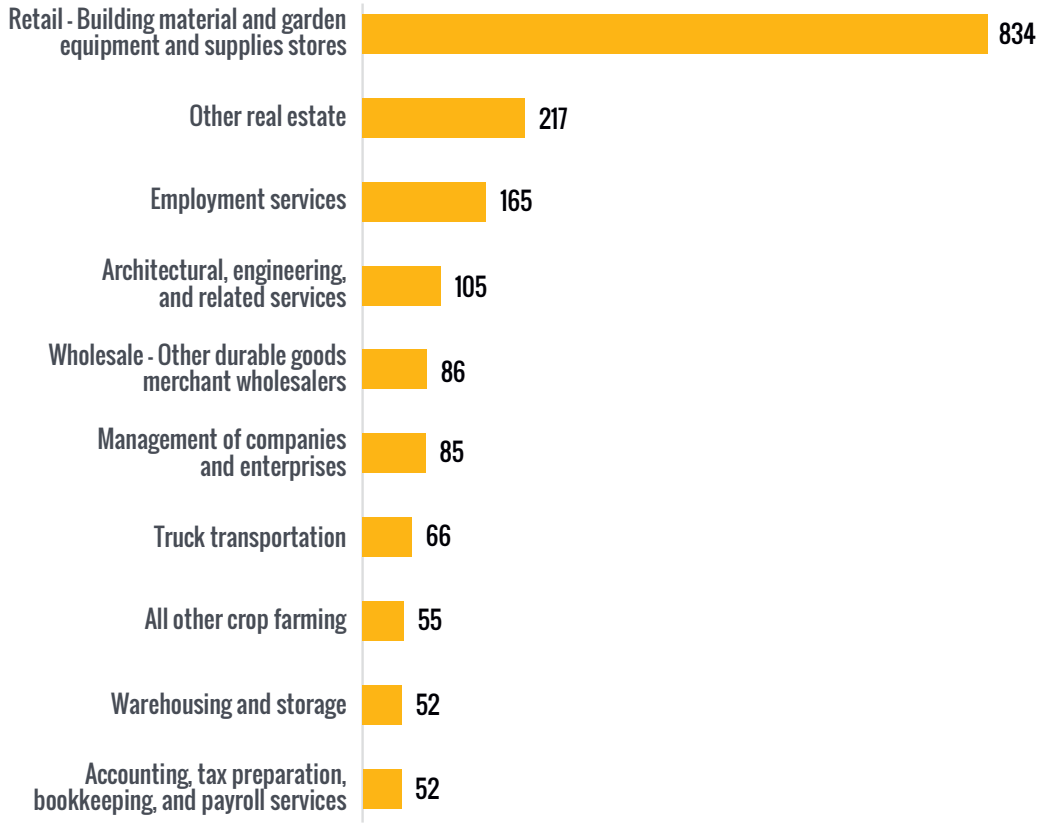


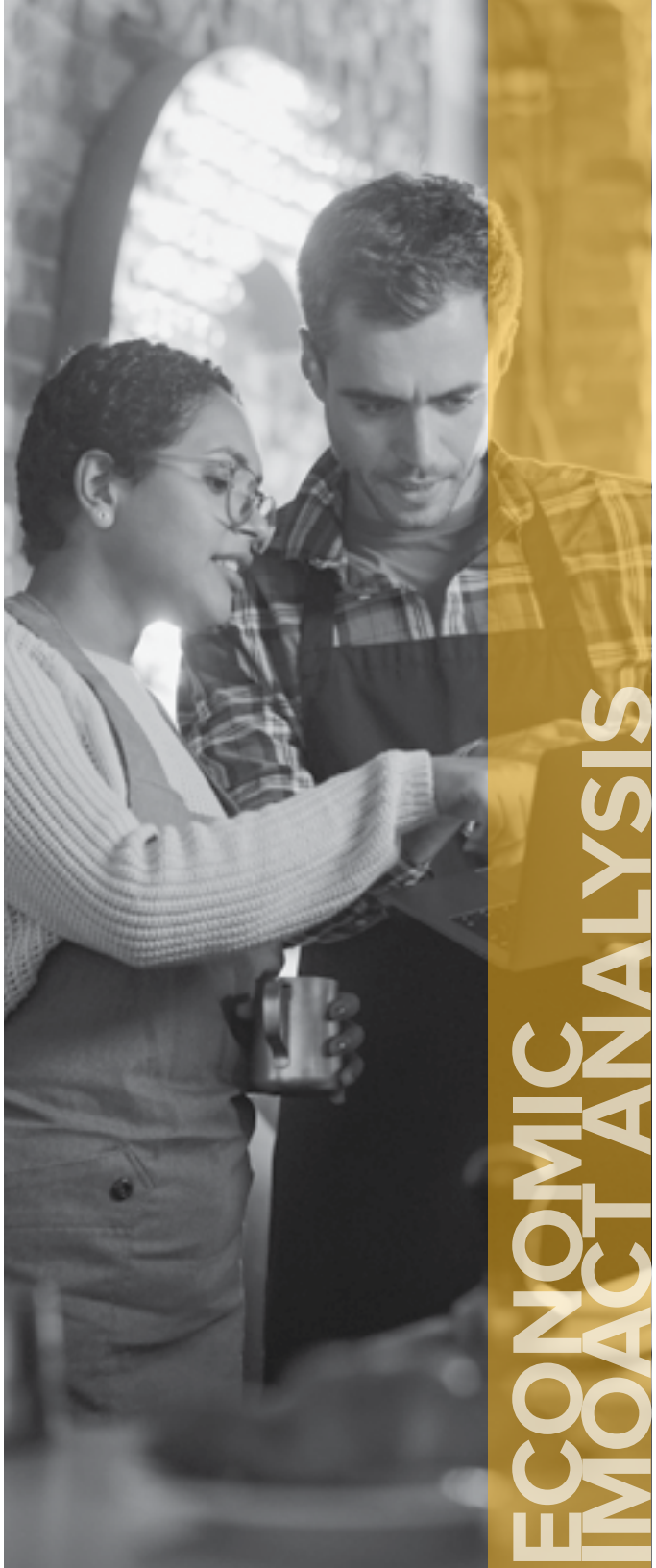
ECONOMIC IMPACT ANALYSIS

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 2020-2021 were building material and garden equipment and supplies retail stores, real estate, employment services, architectural, engineering, and related services, and durable goods merchant wholesalers (Figure 35).

FIGURE 35. TOP 10 SUPPLY CHAIN (INDIRECT) INDUSTRIES IN NEW YORK STATE BY EMPLOYMENT GAINS, 2021[35]



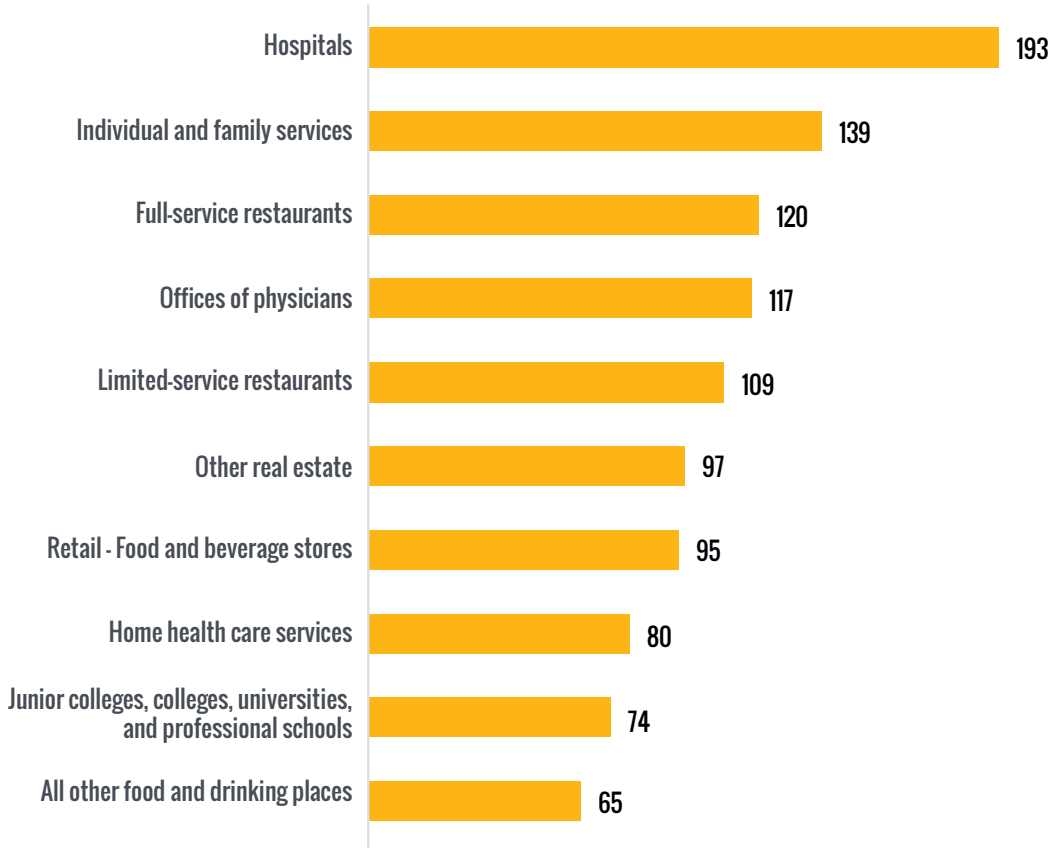


ECONOMIC IMPACT ANALYSIS

INDUCED INDUSTRIES

Whereas clean energy supply chain industries feel the effects of clean energy firms' increased investments and spending, other industries feel the ("induced") effects of more clean energy workers' spending of their wages in the State. These effects are felt in hospitals, individual and family services, restaurants, physicians' offices, real estate, supermarkets, and higher education institutions (Figure 36). 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 36. TOP 10 INDUCED INDUSTRIES IN NEW YORK STATE BY EMPLOYMENT GAINS, 2021[36]



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 nearly $132 million in State and local taxes on production and imports and more than $203 million in federal taxes (Table 4).

TABLE 4. IMPACT OF NEW YORK CLEAN ENERGY JOBS ON TAXES FOR PRODUCTION AND IMPORTS, 2021

Taxes	Impact on Taxes
Local Taxes	$66,111,765
State Taxes	$65,498,936
Federal Taxes	$203,204,612

$132 million

in State and local taxes

$203 million

in federal taxes

OUT-OF-SCOPE INDUSTRIES

One benefit of using an economic model like IMPLAN is that it identifies job change 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.

ECONOMIC IMPACT ANALYSIS

TABLE 5. NEW YORK'S CLEAN ENERGY OUT-OF-SCOPE INDIRECT INDUSTRIES[37]

Description	Indirect Jobs
Retail – Building material and garden equipment and supplies stores	834
Other real estate	217
Employment services	165
Truck transportation	66
All other crop farming	55
Warehousing and storage	52
Couriers and messengers	52
Investigation and security services	51
Services to buildings	40
Scenic and sightseeing transportation and support activities for transportation	34
Retail – Motor vehicle and parts dealers	34
Business support services	31
Full-service restaurants	30
Retail – General merchandise stores	28
Ready-mix concrete manufacturing	27
Retail – Nonstore retailers	27
Office administrative services	27
Wholesale – Motor vehicle and motor vehicle parts and supplies	26
Retail – Miscellaneous store retailers	26
Retail – Nonstore retailers	27
Office administrative services	27
Wholesale – Motor vehicle and motor vehicle parts and supplies	26
Retail – Miscellaneous store retailers	26

TRADITIONAL ENERGY EMPLOYMENT

This section details traditional energy employment for New York derived from the most recent United States Energy and Employment Report (USEER). For the purposes of this 2022 New York Clean Energy Industry Report (NYCEIR), the term "traditional energy" refers to fossil-based energy and additional energy technologies not categorized into the five major clean energy technology areas used in previous publications of the NYCEIR.[38]

Traditional energy

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

Some aspects of the broader energy system that identify within traditional energy will continue to play a role in New York's clean energy future (e.g., 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 in this year's report. 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.

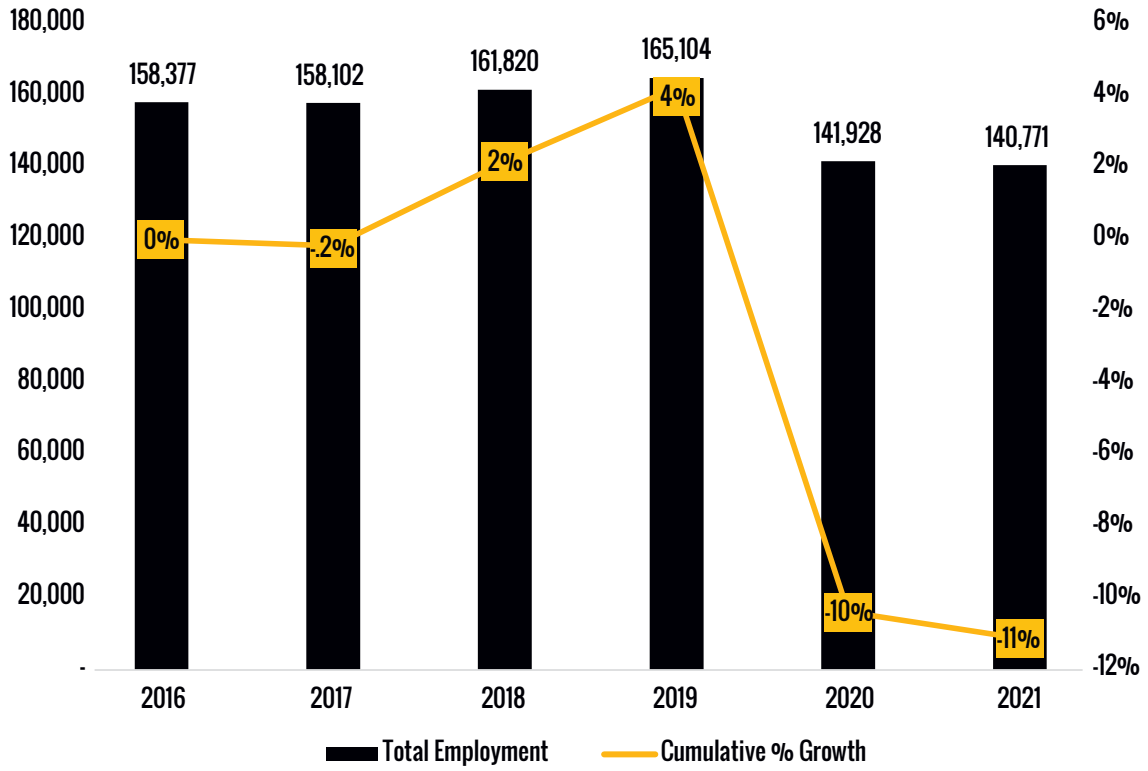
OVERALL EMPLOYMENT

Clean energy employment outpaced traditional energy employment in New York, both in employment growth between 2020 and 2021 and in overall employment in 2021.

New York's traditional energy industry employed 140,771 workers in 2021, a 1% decrease from 2020 employment and an over 11% decrease from 2016 employment.

In comparison, New York's clean energy industry employed 165,055 workers at the end of 2021, a 5% increase from 2020 employment.

FIGURE 37. NEW YORK TRADITIONAL ENERGY EMPLOYMENT, 2016-2021



140,771

TRADITIONAL ENERGY workers at end of 2021

1% decrease from 2020

11% decrease from 2016

165,055

CLEAN ENERGY WORKERS at end of 2021

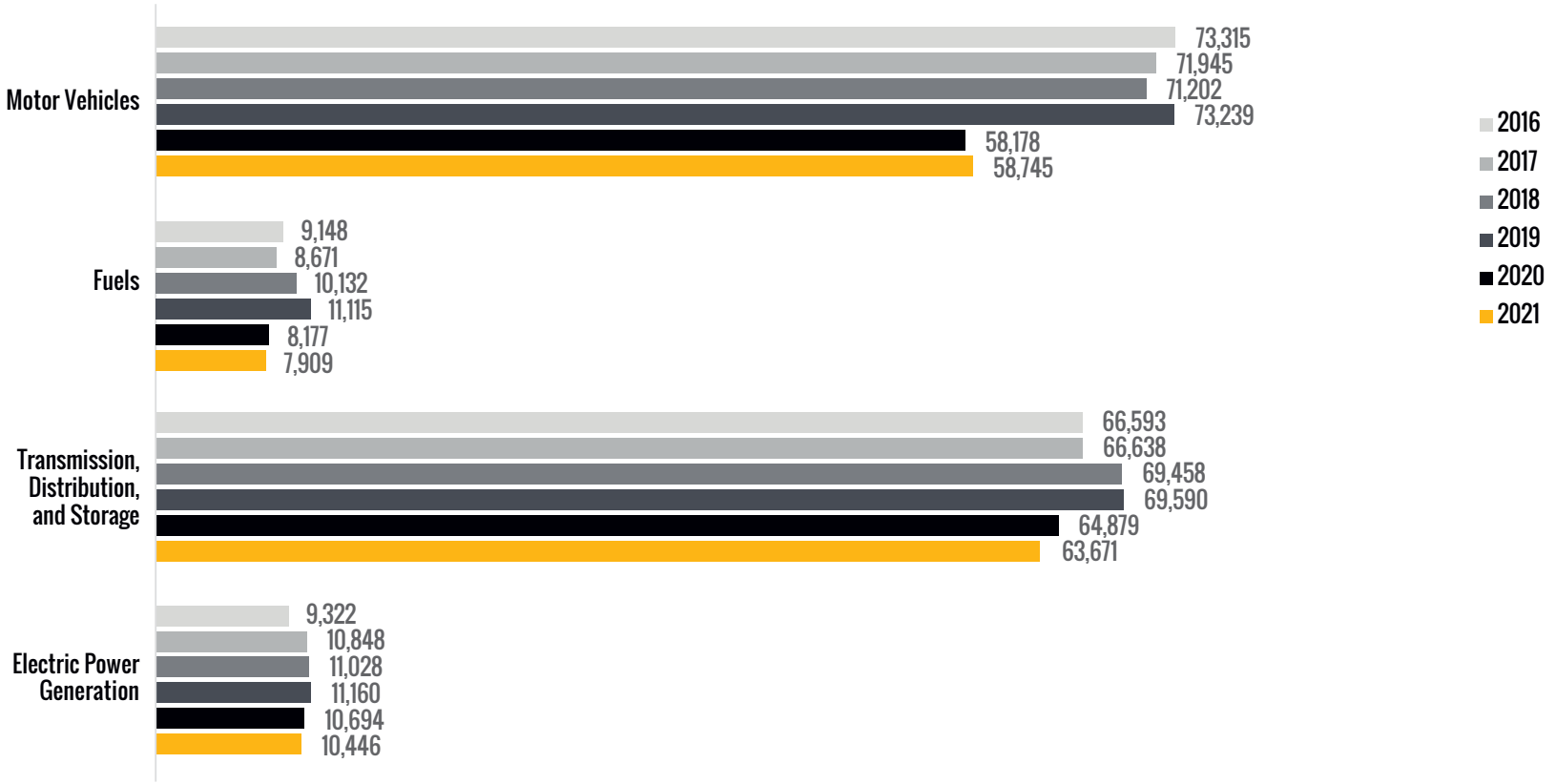
5% increase from 2020

TRADITIONAL ENERGY EMPLOYMENT

With the exception of the traditional motor vehicles sector, which grew by just 1% and gained fewer than 600 employees, each traditional energy sector saw a slight decrease in employment between 2020 and 2021. The traditional energy sector with the largest relative decline in employment was traditional fuels, which decreased by 3% or 268 jobs. Traditional transmission, distribution, and storage saw the largest absolute employment decline, losing 1,208 jobs and decreasing by 2%. Employment in the traditional electric power generation sector decreased by 2% or 248 jobs between 2020 and 2021.

Traditional transmission, distribution, and storage (TDS) was the largest traditional energy sector, with traditional motor vehicle employment trailing only slightly behind. TDS employed 63,671 workers in 2021, comprising over 45% of all traditional energy employment while motor vehicles employed 58,745 workers, accounting for about 42% of all traditional energy employment. Traditional electric power generation and fuels were responsible for 7 and 6% of all traditional energy employment, or 10,446 and 7,909 jobs, respectively.

FIGURE 38. NEW YORK TRADITIONAL ENERGY EMPLOYMENT BY TECHNOLOGY, 2016-2020



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; Energy Efficiency; Renewable Fuels; 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

GRID MODERNIZATION & ENERGY STORAGE

Electric Power Transmission and Distribution

- Smart Grid

Energy Storage

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

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

RENEWABLE FUELS

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

ALTERNATIVE TRANSPORTATION

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

APPENDIX B: RESEARCH METHODOLOGY

EMPLOYMENT DATA

Data for the 2022 New York Clean Energy Industry Report is taken from data collection for the US Energy and Employment Report (USEER).[39] The survey was administered by phone and web. The phone survey was conducted by ReconMR, and the web instrument was programmed internally. Each respondent was required to use a unique ID in order to prevent duplication.

The 2022 USEER survey in New York resulted in more than 23,100 calls, more than 4,800 emails, and nearly 1,700 letters to potential respondents. More than 1,900 businesses 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 +/-2.23% 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 percentage of a firm's employment spends at least 50% of their time working on energy-related activities and what percentage 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.

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 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**[40] (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 would be considered direct jobs.

4. **Step 4: Re-run the IMPLAN model with the "adjusted" in-scope jobs by industry**

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

Final Output

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

APPENDIX C: REGIONAL CLEAN ENERGY EMPLOYMENT

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

County Name	Clean Energy Jobs	Renewable Electric Power Generation Jobs	Energy Efficiency Jobs
Albany	3,927	711	2,898
Allegany	195	29	139
Bronx	3,093	460	2,101
Broome	1,254	187	957
Cattaraugus	241	36	176
Cayuga	496	73	303
Chautauqua	760	113	558
Chemung	580	86	428
Chenango	198	29	127
Clinton	482	71	312
Columbia	339	51	239
Cortland	183	27	134
Delaware	142	22	97

County Name	Clean Energy Jobs	Renewable Electric Power Generation Jobs	Energy Efficiency Jobs
Dutchess	1,927	286	1,503
Erie	9,090	1,351	5,414
Essex	137	21	107
Franklin	166	25	131
Fulton	125	18	93
Genesee	316	47	217
Greene	167	25	126
Hamilton	17	2	13
Herkimer	174	26	134
Jefferson	490	72	382
Kings	8,284	1,232	6,478
Lewis	131	19	76
Livingston	310	46	182

County Name	Clean Energy Jobs	Renewable Electric Power Generation Jobs	Energy Efficiency Jobs
Madison	226	33	167
Monroe	5,844	869	4,473
Montgomery	252	38	135
Nassau	12,920	1,921	9,449
New York	47,907	7,123	39,387
Niagara	1,236	184	843
Oneida	1,078	161	757
Onondaga	3,926	584	3,018
Ontario	812	121	633
Orange	2,308	343	1,476
Orleans	175	26	76
Oswego	489	72	274
Otsego	189	28	118
Putnam	647	96	506
Queens	11,788	1,753	9,660
Rensselaer	1,163	173	702
Richmond	2,260	336	1,854
Rockland	2,270	338	1,429

County Name	Clean Energy Jobs	Renewable Electric Power Generation Jobs	Energy Efficiency Jobs
St. Lawrence	370	55	289
Saratoga	2,171	323	1,691
Schenectady	1,608	240	940
Schoharie	157	24	83
Schuyler	63	10	49
Seneca	57	9	39
Steuben	652	97	453
Suffolk	14,799	2,201	10,696
Sullivan	284	42	212
Tioga	89	13	60
Tompkins	844	125	406
Ulster	948	141	665
Warren	998	148	374
Washington	171	26	115
Wayne	852	126	243
Westchester	9,025	1,342	6,732
Wyoming	182	27	98
Yates	93	14	51
N/A	2,977	443	2,437

END NOTES

1 New York State: Charge NY. Electric Vehicle Registration Map.

2 Solar Energy Industry Association. New York Solar. https://www.seia.org/state-solar-policy/new-york-solar

3 Phase III is the final stage of innovation funding, in which companies bring fully developed products to wide commercial availability. For more information, please see Investments by Innovation Phase.

4 Industry employment change is taken from JobsEQ 2020-2021 Q4.

5 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.

6 Figure 7 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 8, please see the section Intensity-adjusted Clean Energy Employment located in Appendix B.

7 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.

8 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.

9 Other 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.

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

11 Advanced natural gas includes efficient, low emission, leak free natural gas, including systems that use any of the following technologies: high efficiency compressor, advanced low NOx combustion technology, first application of closed loop steam cooling in an industrial gas turbine, advanced turbine blade and vane materials, high temperature TBC and abradable coatings, advanced row 4 turbine blades, 3-D aero technology, advanced brush seal.

12 "All Other" includes the following occupational groups: businesses and financial operations; office and administrative support; sales and related; legal; life, physical, and social science; arts, design, entertainment, sports, and media; and architecture and engineering.

13 JobsEQ. Data was extracted in September 2022. Total occupational employment across all industries in New York.

14 New York State: Charge NY. Electric Vehicle Registration Map.

15 New York State: Charge NY. Electric Vehicle Registration Map.

16 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.

17 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.

18 This includes flywheels and compressed air energy storage.

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

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

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

22 119 employers reported seeking workers over the course of 2021. Of those 119 employers, 81 reported overall hiring difficulty.

23 Race percentages in Table 1 do not sum to 100 percent because of overlap between White, Black, Asian, Native American, and Pacific Islander racial categories and the Hispanic/Latinx ethnic category.

24 NYSERDA. On-the-Job Training for Energy Efficiency and Clean Technology Program Summary. https://portal.nyserda.ny.gov/servlet/servlet.FileDownload?file=00P8z000001anXWEAY

25 "Priority populations" include individuals who are low income, disabled, veterans, homeless, previously incarcerated, and single parents, among others. Visit https://www.nyserda.ny.gov/All-Programs/Clean-Energy-Workforce-Development/Resources/Definitions for more information.

26 "Disadvantaged communities" are defined as "communities that bear burdens of negative public-health effects, environmental pollution, impacts of climate change, and possess certain socioeconomic criteria, or comprise high concentrations of low- and moderate-income households." Visit https://www.nyserda.ny.gov/All-Programs/Clean-Energy-Workforce-Development/Resources/Definitions for more information.

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

28 Demographic data for New York overall are compiled from JobsEQ using the average of four quarters ending in Q1 2020.

29 Two 2021 alternative transportation investments were removed from the Crunchbase data and subsequently excluded from the total clean energy investment calculation in Figure 21. At $2 billion and $1.5 billion, the two investments are outliers.

30 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 toward a specific technology area. As such, totals will not sum to Figure 25.

31 Totals will not sum to Figure 25 because not all investments could be categorized as public or private due to lack of information.

32 Totals will not sum to Figure 25 because not all investments could be categorized as public or private due to lack of information.

33 Based on the NYCEIR jobs' IMPLAN codes.

34 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.

35 As a result of the 2020-2021 Clean Energy Net Job Change in New York.

36 As a result of the 2020-2021 Clean Energy Net Job Change in New York.

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

38 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.

39 https://www.energy.gov/policy/us-energy-employment-jobs-report-useer

40 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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