New York Clean Energy Industry Report

2020

NEW YORK STATE OF OPPORTUNITY. | NYSERDA

Letter from NYSERDA Acting President and CEO

Dear Partners and Friends,

It is with great pleasure that I present the findings of NYSERDA's 2020 New York Clean Energy Industry Report. This report details important sector-specific job patterns and trends within the State and captures the optimism that clean energy employers have for **continued job growth in the future**.

Under Governor Andrew M. Cuomo's visionary leadership, New York State is committed to the most aggressive clean energy and climate agenda in the country. Last year, the Governor passed the Climate Leadership and Community Protection Act (Climate Act) to empower New Yorkers to work together to secure a clean, sustainable future and to set the bar for other states around the country to do the same.

Guided by the Climate Act, we are advancing an orderly and just transition to clean energy that creates jobs and continues to foster a green economy here in New York. This report, focusing on data from 2019, shows that we were, in fact, making steady progress towards these goals and in 2019, **nearly 164,000 New Yorkers had clean energy jobs – up from 2018**. However, the COVID-19 pandemic greatly impacted New York State including the clean energy sector – with job losses across the entire industry in early 2020. Despite this, the report also reveals the clean energy industry's resiliency, with approximately 5,000 clean energy jobs having returned since May 2020 when the State began to reopen for business. This, combined with cautious optimism across clean energy employers demonstrates the important role that our continued efforts play in helping New York build back greener and stronger.

Additional key findings from this year's report include:

- New York's clean energy employment **grew more than 3.2 percent from 2018 to 2019**. This past year's growth was three times faster than the rate of overall job growth in New York and close to three times the national clean energy job growth.
- Energy efficiency led clean energy employment in New York last year, accounting for almost **77 percent** of all clean energy employment.
- All regions in New York are benefiting from clean energy workforce opportunities with nearly **500 training programs** for HVAC, engineering, electrical, and construction workers available statewide and 25 percent of them accessible online with continual enrollment options during the COVID-19 pandemic.

In keeping with our commitment to help facilitate sustained job growth, NYSERDA monitors the industry for any signs of skilled clean energy worker shortages and uses information from this report – specifically current trends and hiring challenges faced by employers – to enhance our workforce training programs. The State is making significant investments in developing a clean energy workforce pipeline by providing training opportunities for new and existing workers along with upskilling existing workers. By developing this pipeline, the State can assist businesses by reducing hiring costs and recruiting and training new employees.

Even in a time of unprecedented uncertainty, the clean energy industry has demonstrated its ability to be a jobs creator and provides opportunities across the State for all New Yorkers. We value your partnership and applaud your commitment to the work that you do each and every day. **Together we will continue to build a greener economy for future generations of New Yorkers**.

Best,
Doreen M. Harris — Acting President and CEO, NYSERDA

Table of Contents


CLEAN ENERGY EMPLOYMENT GROWTH
16%
2015 through 2019
3.2%
between 2018 and 2019
3X FASTER than overall employment growth rate in New York
nearly 3X FASTER than national clean energy job growth rate

Executive Summary

New York State is at the vanguard of the movement to a carbon-neutral economy.

New York boasts a strong and diverse economic base — and the nation-leading Climate Leadership and Community Protection Act (Climate Act) — which charts a path to decarbonization and growing a talented workforce prepared to meet the challenges of the 21st century. These strengths have led to consistent employment growth in the clean energy sector, far exceeding the national clean energy average employment growth rate as well as outpacing job growth in the overall statewide economy.

This fourth installation of NYSERDA's annual New York Clean Energy Industry Report captures the State's clean energy economy through the end of 2019, prior to the pandemic-induced economic downturn, but also benchmarks COVID-19-induced job losses through August 2020. This study analyzes data on clean energy jobs, employer needs, existing assets, and workforce development to produce a report that can help New York State stakeholders and policymakers meet their climate goals, while maximizing the creation of in-state jobs and economic opportunities in the environment of COVID-19 recovery.

The report finds that clean energy employment grew more than 16 percent from 2015 to the end of 2019 and 3.2 percent between 2018 and 2019. This past year's growth rate is three times faster than the rate of overall employment growth in New York and nearly three times faster than the national clean energy job growth rate. At the end of 2019, before the pandemic, employers were cautiously optimistic going into 2020, reporting an expected 7.7 percent increase over the year for clean energy jobs.

COVID-19 and the associated economic effects have temporarily reversed this momentum. From the beginning of the pandemic through August, New York lost nearly 15,700 clean energy jobs, or about 9.6 percent of the total clean energy workforce.

Surveys taken in August 2020, found that energy efficiency employers and solar firms – assuming no significant re-emergence of the virus – expect to bring back the majority of their workforces. Supported by reopening initiatives under the New York Forward recovery plan, New York energy firms appear hopeful for a successful recovery.[1]

Additional highlights include:

Energy efficency 77% of industry employment

New York's energy efficiency sector employed the largest share of clean energy workers. At the end of 2019, the sector accounted for 77 percent of industry employment. The sector continued to add workers installing high-efficiency HVAC equipment and heat pumps, which accounts for over half of the sector's employment. This year, a deep dive into the emerging heat pump sub-sector – through supplemental surveys and interviews – exposed a desire for more job candidates with greater HVAC-specific trade skills, plus a greater understanding of relevant regulations.

Energy storage employment grew 6.5%

Energy storage employment doubled over two years and is primed for continued growth. This emerging sector, which includes grid modernization and energy storage, employed nearly 2,300 workers, up 6.5 percent over the previous year. Interviews with sector employers during the pandemic revealed widespread optimism for continued growth. The sector's hiring difficulties were found mostly in engineering and science positions, which are largely recruited through university relationships. The main factor viewed as delaying further sector acceleration is market hesitancy, tied in large part to regulatory uncertainties.

Clean and alternative transportation employment hardest hit by pandemic

Prior to COVID-19, New York boasted a steady clean and alternative transportation sector and stands to gain from further efforts to spur market interest. The sector was the only of the major sectors to not observe employment growth over 2019, with employment remaining relatively flat over the past five years. The technology was also hardest hit by COVID-19 job losses, down 13.7 percent at the height of the pandemic. This is consistent across all-transportation sectors as residents are buying fewer cars and requiring less maintenance due to reduced travel. Industry interviews revealed limited local demand for clean and alternative transportation products as the biggest inhibitor to growing a profitable business. New York's recently launched incentive and bus fleet initiatives should do well to raise demand, and could be complemented by initiatives in other market segments.

Share of clean energy workers spending all their time on clean energy activities rose from 47% in 2016 to 61% in 2019

Clean energy workers in New York continued to increase their clean energy workload. Intensity-adjusted employment – which weighs clean energy workers by the proportion of time they spend on clean energy activities and approximates full-time equivalent employment or FTE – continued to outpace total industry growth. In other words, not only were more New Yorkers entering the industry, each worker was doing more clean energy work. The share of clean energy workers spending all their time on clean energy activities rose from 47 percent in 2016 to 61 percent in 2019.

COVID impacts hit New York's economy hard, but companies are cautiously optimistic about a strong bounce back. Surveys with executives in the clean energy sector conducted in August 2020 revealed that energy efficiency employers and solar firms – assuming no significant re-emergence of the virus – expect to bring back nearly all of their workforces. If New York can successfully manage the impacts of COVID-19, clean energy employment can be a cornerstone for the State's economic recovery.

Clean Energy Industry Overview

The baseline data for the employment figures in this report were collected in the fourth quarter of 2019, prior to the COVID-19 pandemic. Unless otherwise stated, data represent this pre-COVID baseline. Throughout the report, we explore some initial impacts of the COVID-19 pandemic on New York's clean energy employment.

COVID-19

New York State's multi-faceted commitment to advancing clean energy had resulted in unprecedented employment growth through the end of 2019. Employment in clean energy, which includes renewable energy, energy efficiency, clean grid and energy storage, and clean and alternative fuel vehicles, was growing at a rate nearly three times faster than the overall economy in New York over 2019, hitting almost 164,000 jobs by the end of 2019.

COVID-19 and the associated economic effects from necessary closures and distancing measures led to an abrupt reversal of these growth trends. From the beginning of the pandemic through August, New York lost 15,674 clean energy jobs, or about 9.6 percent of the total clean energy workforce; the clean energy sector nationwide is down 14 percent as of August 2020. This reverses many years of growth and represents significant decline, but New York has started to rebound despite being one of the states hit hardest by the virus thus far.

Introduction

Now in its fourth edition, the annual New York Clean Energy Industry Report is a reliable and critical source of workforce insights on the State's clean energy industry. As with prior reports, this year's edition includes data from the U.S. Energy and Employment Report (USEER), which is a joint collaboration of state and local agencies and organizations and is led by the National Association of State Energy Officials (NASEO) and the Energy Futures Initiative (EFI). This year also includes significant supplemental data collection and analyses into key technologies and sectors. Data in this report are based on a comprehensive survey of employers in New York State and the Bureau of Labor Statistics Quarterly Census of Employment and Wages for Q4 of 2019.

This 2020 New York Clean Energy Industry Report compares data on clean energy jobs, geographic distribution, and employer needs. It reveals important patterns and trends to inform policy recommendations on how to meet New York's climate goals, help create jobs, and drive economic opportunity across the State.

To understand these impacts more clearly, the research for this report includes surveys and interviews with clean energy firms across New York. This data suggests some reasons to be optimistic, but also demonstrates the precarious economic situation and need for federal, state, and local governments to support clean energy businesses, most of which are micro- and small business enterprises.

Figure 1. New York Clean Energy Monthly Employment Estimates through COVID-19 (March – August 2020)[2]

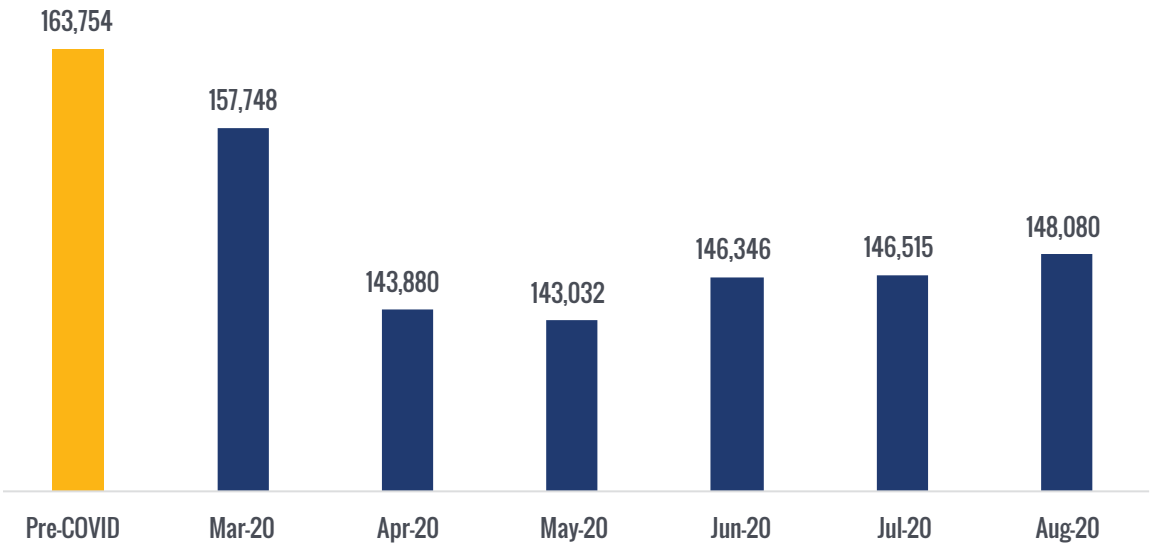
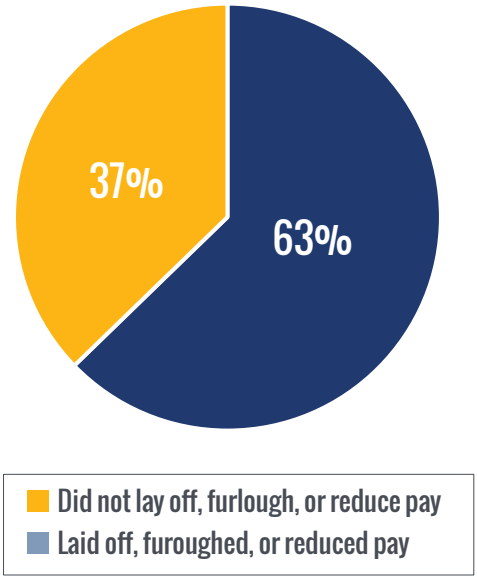


Figure 2. Share of New York solar and energy efficiency firms that reduced employment during COVID-19



The data collected from employers throughout July and the beginning of August demonstrates the resilience of clean energy employers, particularly in energy efficiency sectors. At the height of the pandemic and stay-at-home orders in New York, about 65 percent of clean energy businesses reported laying off or furloughing at least some of their employees on a temporary or permanent basis, or otherwise reducing hours or pay.

Nearly 35 percent of the high efficiency HVAC workforce (including heat pump installers) was on temporary or permanent furlough, compared to about 15 percent of workers in other energy efficiency fields such as ENERGY STAR® appliances and efficient lighting, as well as advanced building materials and insulation. Solar employers reported that they furloughed or laid off about half of their workforce in New York at the height of the State's response to the pandemic. Anecdotally, grid modernization and energy storage and clean and alternative transportation employers also reported significant workforce and workload reductions.

Employers reported that several policy interventions were important to their ability to weather the storm, including Economic Injury Disaster Loans and other federal, State, and local financial relief programs. Primary among these interventions was the Payroll Protection Program (PPP). Seventy-eight percent of efficient HVAC firms in New York State reported receiving PPP funds, followed by 72 percent of solar companies and 63 percent of other energy efficiency firms. A majority of other clean energy firms interviewed across other segments also reported receiving PPP funds.

Within New York, specific attention was focused on ensuring that businesses operating in the State, including those comprising the clean energy economy, were supported during the pandemic. Under New York Forward, businesses within the State had access to both financial and technical pandemic-related resources to support reopening. Resources specifically relevant for clean energy activities were developed to supplement the economy-wide guidance that applied to a variety of known clean energy activities. Furthermore, NYSERDA adjusted its own program offerings, prioritizing safety so that clean energy firms could continue or resume their operations and offering flexibility within many program and funding structures.

These effective programs and mitigations, together with the State's successful approach to containing the outbreak, has led to a rebound in overall economic activity and a rebound in New York's clean energy employment. In fact, more than two out of three clean energy firms that lost employees during the pandemic have brought workers back since the spring. Energy efficiency employers and solar firms, assuming no significant re-emergence of the virus that would require further stay-at-home orders, expect to bring back the majority of their workforces by the end of 2020. Grid modernization and energy storage firms were already seeing strong employment recovery by August 2020 and are optimistic about revenue returning to normal by the end of the year, while clean and alternative transportation employers expect a near-full workforce return but had slightly more concern over long-term revenue impacts.

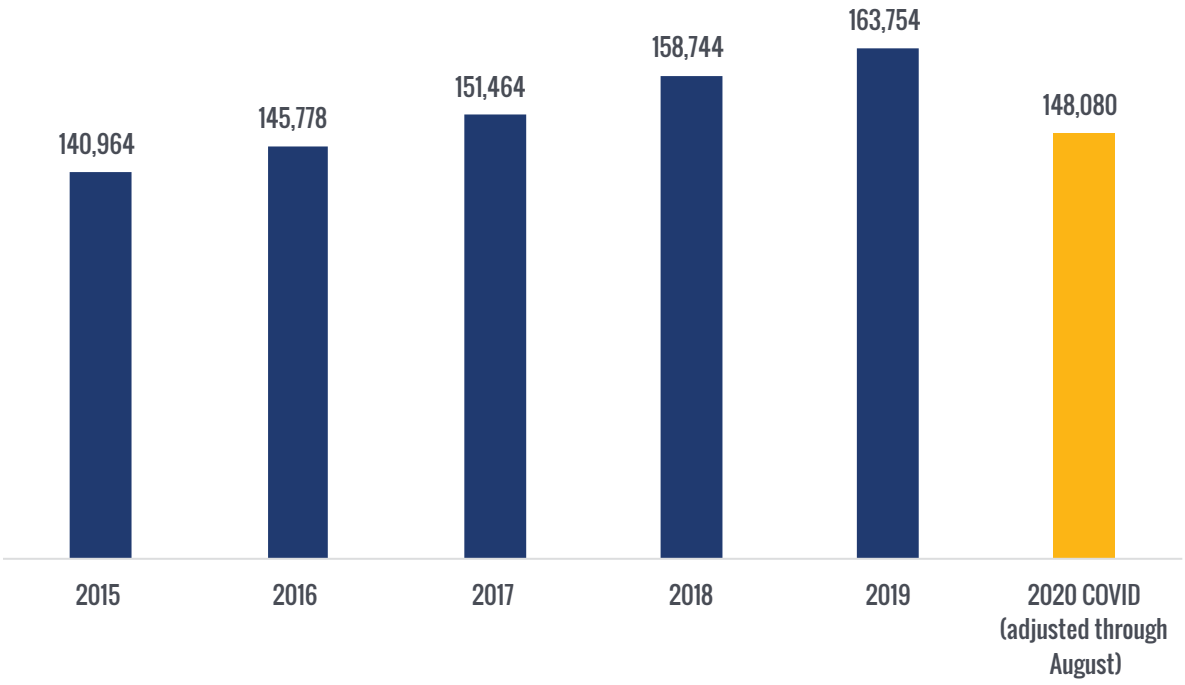
Clean energy employers are also cautiously optimistic about 2021. The majority of employers expect their headcount to remain steady in 2021 and more employers expect to grow than decline, acknowledging this is nowhere near the level of optimism reported by employers in prior years.

Although COVID-19 has introduced new challenges within the clean energy industry and across the economy overall, New York remains steadfast in its commitment to achieving a carbon-neutral economy by 2050. Under the ambitious climate and clean energy goals of the Climate Act, the State has and will continue to advance nation-leading initiatives for clean energy technologies. Key initiatives, like workforce development and training, provide critical support to empower clean energy workers with the skills needed to drive economic recovery allowing New York to build back better and greener.

Overall Employment

The clean energy industry employed 163,754 people in New York State in 2019; clean energy jobs represented 1.7 percent of all employment within the State. Between 2015 and 2019, clean energy employment increased by 16.2 percent and 3.2 percent from 2018 to 2019 (Figure 3), outpacing the total New York employment growth of 1.1 percent.[3] Prior to COVID-19, clean energy employers and stakeholders were optimistic going into 2020, reporting an expected 7.7 percent increase over the year for clean energy jobs.

Figure 3. Annual Clean Energy Employment in New York (2016-2020 COVID)

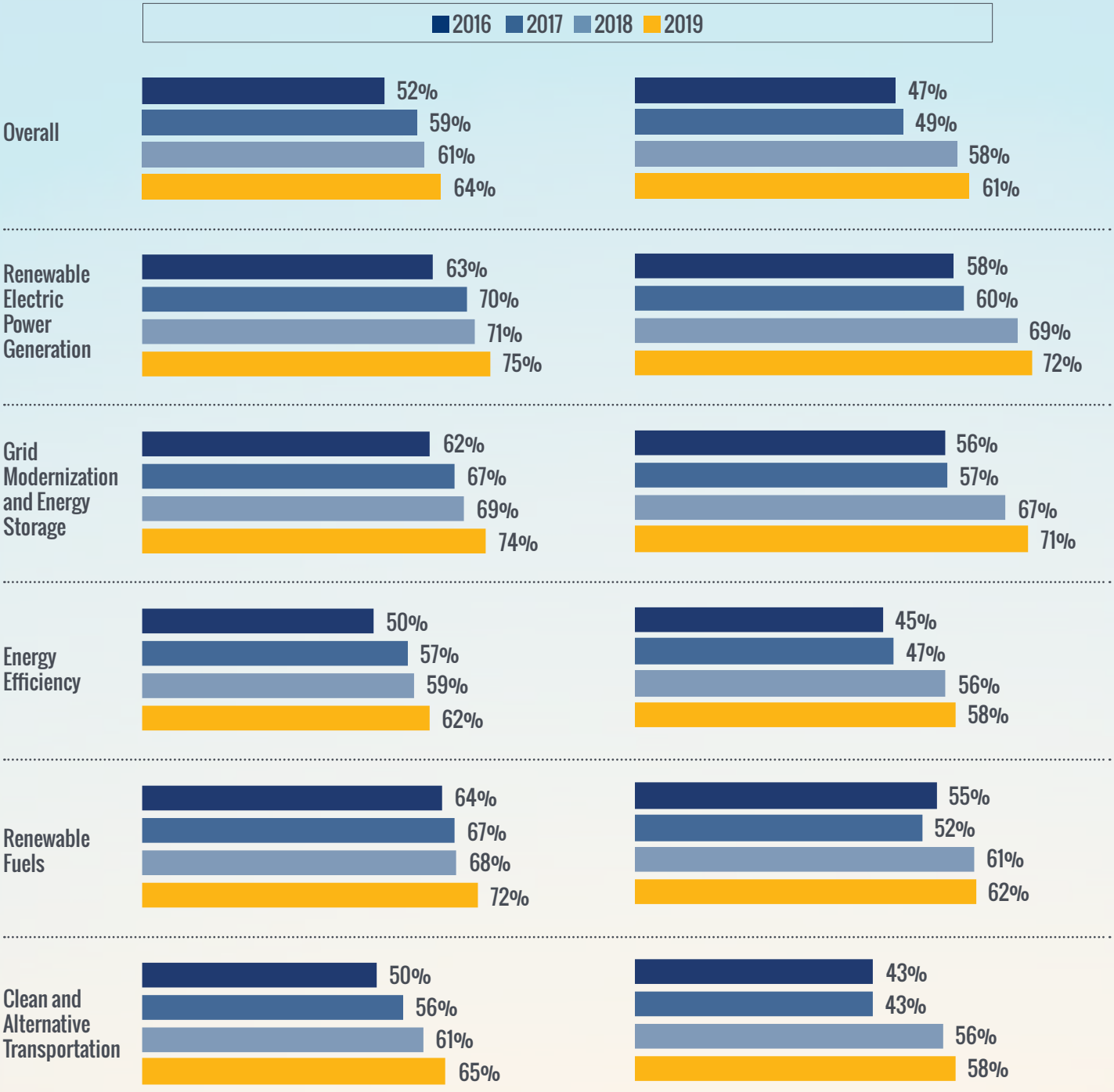


Clean Energy Employment Intensity

The number of majority-time workers — clean energy workers who spend 50 percent or more of their time on clean energy — increased by 38 percent between 2016 and 2019. The increased worker intensity was consistent across all technologies (Figure 4). This trend similarly exists for full-time workers; in 2016, 47.2 percent of clean energy workers worked on clean energy full-time. By 2019, that percentage had risen to 64.2 percent. Between 2018 and 2019, renewable electric power generation and grid modernization and energy storage both saw large increases in full-time clean energy workers, increasing by 10.9 percent and 12.9 percent respectively (Figure 5). Overall, 60.5 percent of all clean energy workers spent all their time on clean energy at the end of 2019.

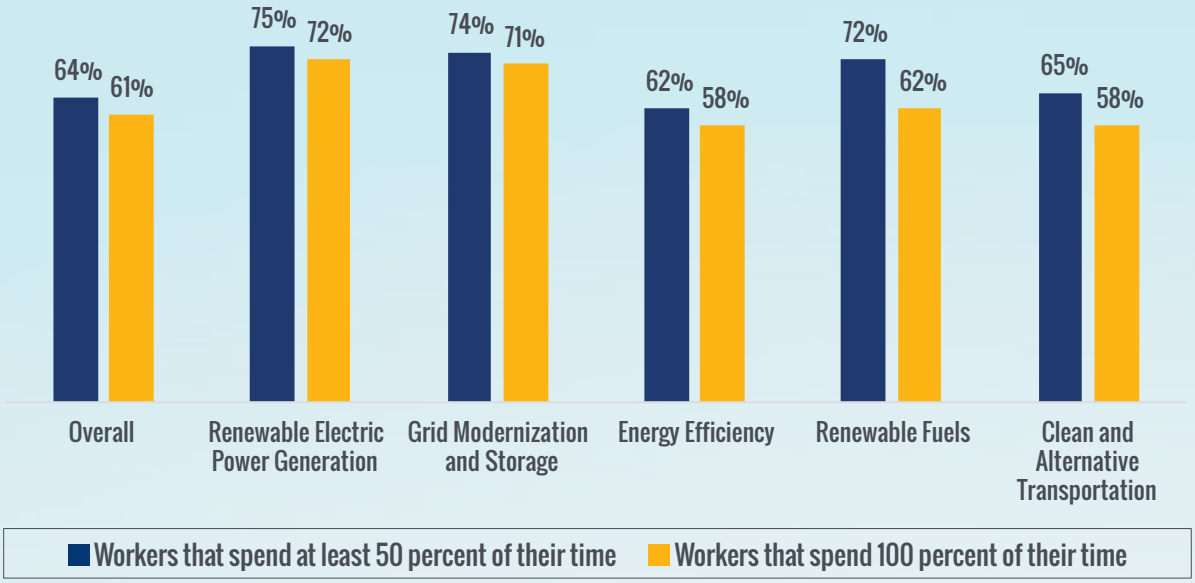
Figure 4. Clean Energy: **Majority-Time** Workers by Technology (2016-2019)

Figure 5. Clean Energy: **Full-Time** Workers by Technology (2016-2019)



There was relatively little difference in the percentage of workers who spent at least 50 percent of their time on clean energy and the percentage of workers who spent all of their time on clean energy. This suggests most workers who spent at least 50 percent of their time on clean energy actually spent all of their time on clean energy. This is seen with renewable electric power generation and grid modernization and energy storage, where nearly three out of every four workers in those sectors spent 100 percent of their time on clean energy-related work. While the difference between these two categories of workers was only four percentage points for overall clean energy employment, renewable fuels and clean and alternative transportation have differences of 10 percentage points and seven percentage points, respectively. (Figure 6)

Figure 6. Clean Energy Employment Thresholds by Technology (2019)



Intensity-Adjusted Employment

Intensity-adjusted employment provides another lens through which to analyze clean energy employment and how it changes over time. To create this metric, total clean energy workers are provided a weight based on whether they (a) spend some but not a majority of their time on clean energy activities; (b) spend a majority but not all of their time on clean energy activities; or (c) spend all of their time on clean energy activities. For example, a heating, ventilation, and air conditioning (HVAC) installer who spends all of their time installing heat pumps is weighted more heavily (1.0) than one who only occasionally does so (0.25). This weighting allows for more accurate comparisons to other states, which likely have different employment intensities, and allows for better tracking of activity.

This metric shows that intensity of clean energy jobs was drastically increasing. This means that, while the number of clean energy workers in the State was increasing, the amount of time that those workers spent on clean energy was increasing as well. Figure 7 shows that while un-adjusted clean energy jobs have increased by 12.3 percent since 2016, intensity-adjusted clean energy employment has increased by over twice as much (29.0 percent).

Intensity-adjusted employment increased by at least roughly 20 percent across all technologies, except for renewable fuels, which declined by 3.4 percent between 2016 and 2019. Intensity-adjusted grid modernization and energy storage employment increased by 84.5 percent between 2016 and 2019, while intensity-adjusted energy efficiency, renewable electric power generation, and clean and alternative transportation employment increased by 32.2 percent, 20.6 percent, and 19.3 percent respectively (Figure 8).

Figure 7. Intensity-Adjusted Employment Growth (2016-2019)

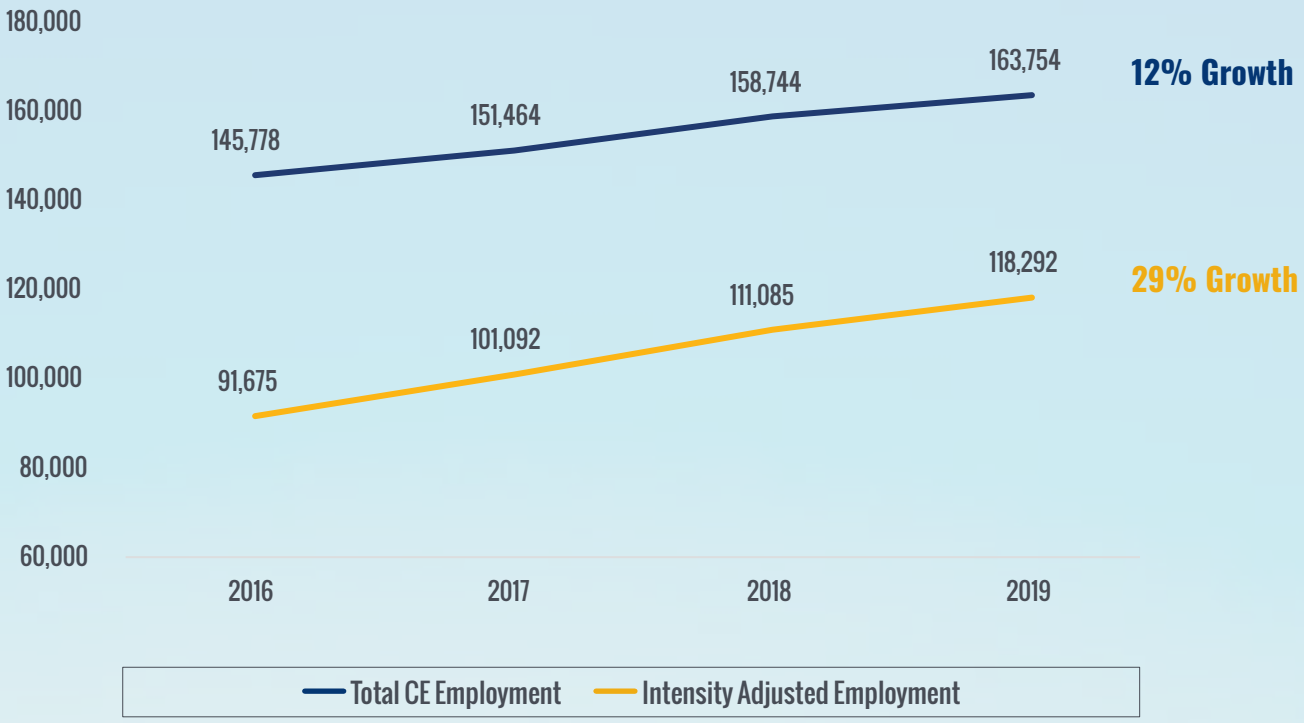
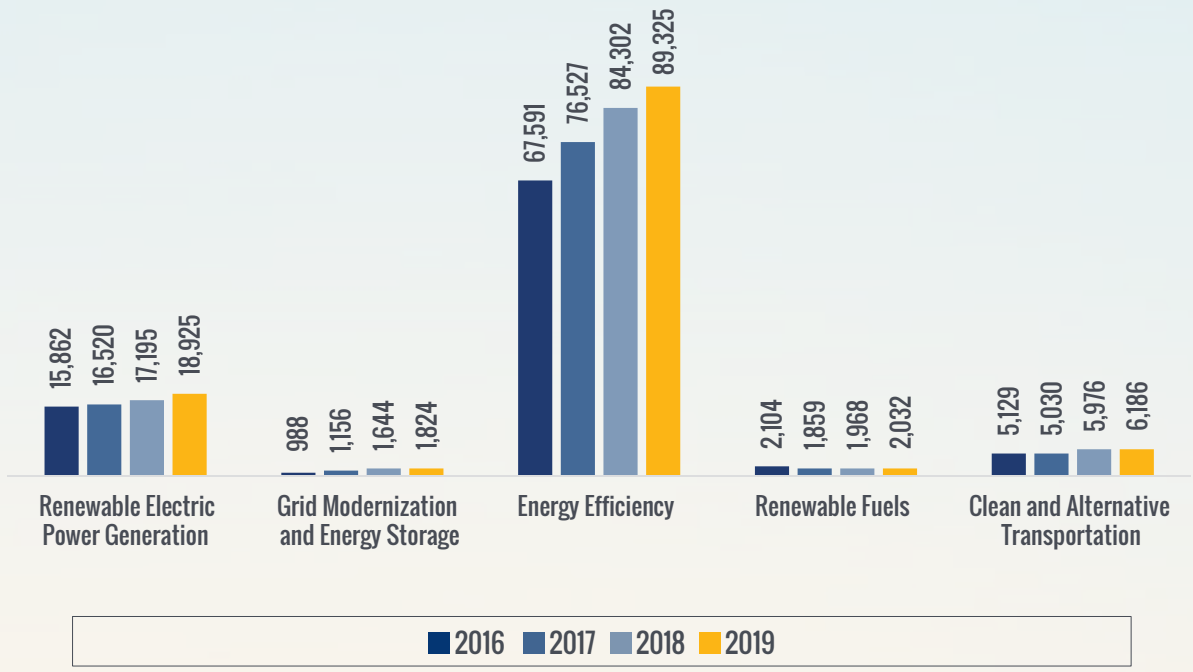


Figure 8. Intensity-Adjusted Employment by Technology (2016-2019)



Employment by Technology

Energy efficiency was the leading technology of clean energy employment in New York; this sector accounted for 77.4 percent of all clean energy employment. The sector grew by 2.8 percent over 2019, adding 3,447 new jobs. Renewable electric power generation and grid modernization and energy storage grew at the fastest pace in 2019, having increased by 6.7 percent (1,467 jobs) and 6.5 percent (139 jobs) respectively. The grid modernization and energy storage employment growth built on last year's trends, growing a total of 44 percent since 2017. Renewable fuels employment remained flat. Clean and alternative transportation decreased by 0.5 percent from 2018, or lost 45 jobs, yet the sector still employed 5.2 percent of all clean energy workers in the State.

Figure 9. Clean Energy Employment by Technology in New York (2015-2020 COVID)

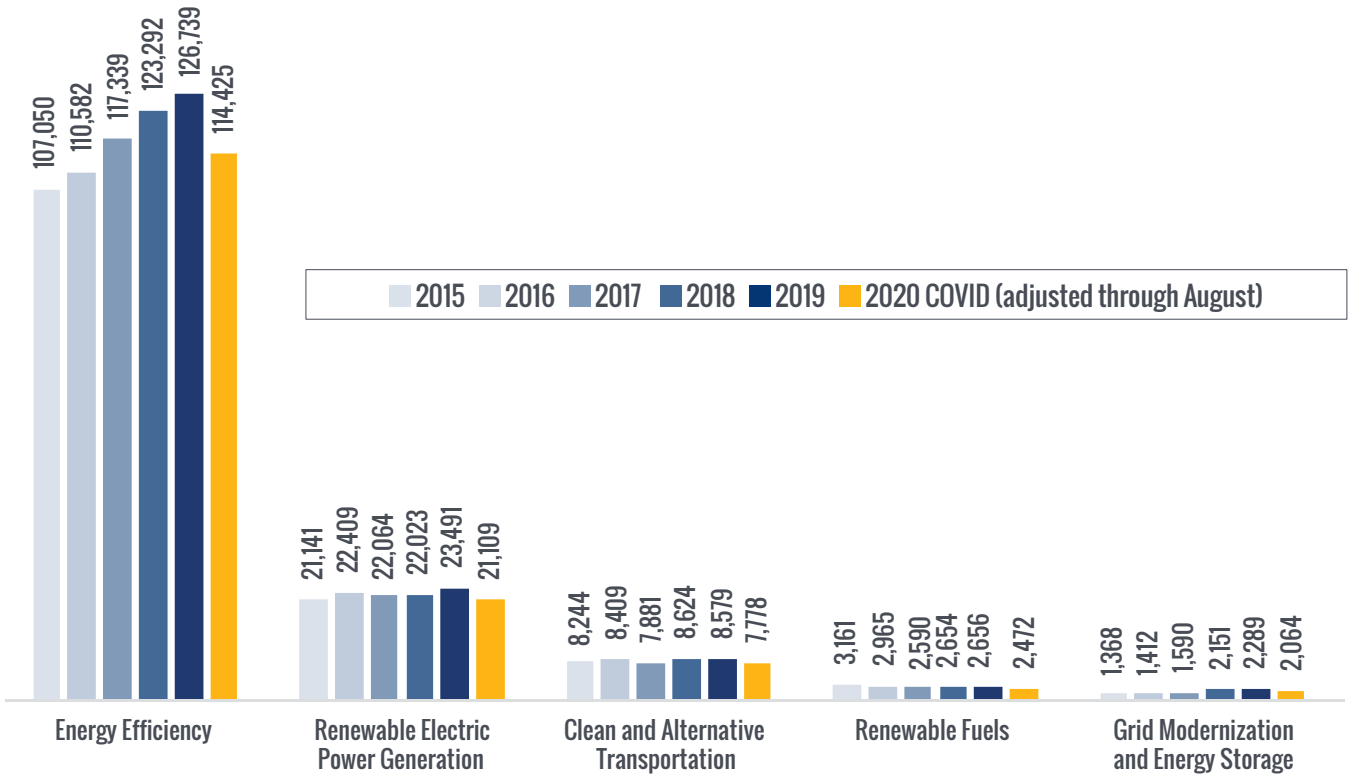


Table 1. Clean Energy Employment Growth by Technology in New York (2017-2019)

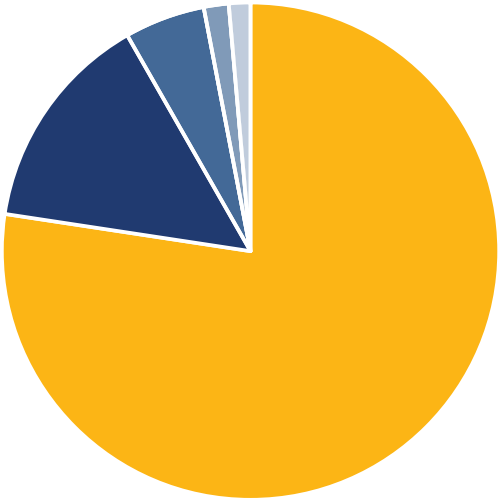
	Employment			Change, 2018–19		Change, 2019–August 2020	
Technology	**2017**	**2018**	**2019**				
Energy Efficiency	117,339	123,292	126,739	3,447	3%	-12,314	-10%
Renewable Electric Power Generation	22,064	22,023	23,491	1,467	7%	-2,382	-10%
Clean and Alternative Transportation	7,881	8,624	8,579	-45	-1%	-801	-9%
Renewable Fuels	2,590	2,654	2,656	2	0%	-184	-7%
Grid Modernization and Energy Storage	1,590	2,151	2,289	139	7%	-226	-10%

**Renewable Fuels changed by 0.1%*

Clean and alternative transportation and renewable electric power generation second and third most common clean energy establishments

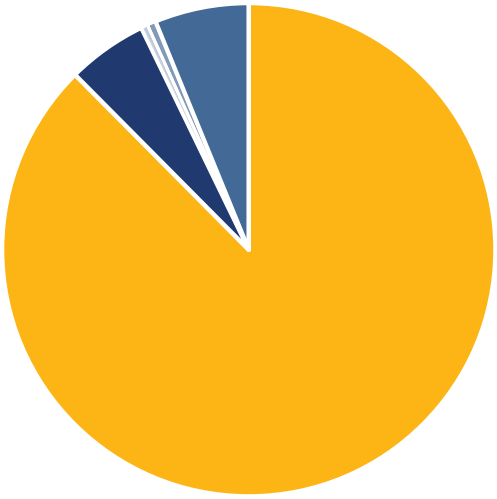
Most clean energy establishments in 2019 were energy efficiency firms; they accounted for almost 10,900 of the 12,442 clean energy firms across the State. Clean and alternative transportation and renewable electric power generation were the second and third most common clean energy establishments; respectively, they accounted for 6.2 percent and 5.3 percent of all New York clean energy firms (Figure 11).

Figure 10. New York Clean Energy **Employment** by Technology (2019)[4]



- Energy Efficiency, 77%
- Renewable Electric Power Generation, 14%
- Clean and Alternative Transportation, 5%
- Renewable Fuels, 2%
- Grid Modernization and Energy Storage, 1%

Figure 11. New York Clean Energy **Establishments** by Technology (2019)



- Energy Efficiency, 88%
- Renewable Electric Power Generation, 5%
- Clean and Alternative Transportation, 6%
- Renewable Fuels, 21%
- Grid Modernization and Energy Storage, 0%

** Grid Modernization and Energy Storage establishments accounted for 0.4 percent of clean energy establishments.*

Employment by Value Chain

The clean energy value chain consists of the underlying industries that support the local economy, such as manufacturing, construction (or installation), wholesale trade and logistics, and professional services. Tracking a growing industry's value chain provides insights into innovation activity, highlights regional strengths, and identifies potential areas for opportunities to improve linkages in regional clean energy activities. For example, a region with particularly strong research, manufacturing, and trade can support local demand for goods and services and presents an opportunity to export this expertise to outside of the region.

Installation was the largest segment of the value chain at 59.4 percent of clean energy employment (97,197 jobs). Installation had the highest employment growth rate among all sub-sectors (6.1 percent) between 2018 and 2019. Professional services – which includes consulting, engineering, finance, legal, and other professional support services – employed the second-largest share of workers across the value chain, 21,329 jobs, or 13.0 percent of clean energy employment. This subsector experienced the most growth since 2016, increasing 16.8 percent over the period. The sales and distribution sub-sector employed 8,067 workers in 2019; this was a 3.9 percent increase from 2018, or an additional 303 jobs. Manufacturing, other support services, and other all experienced employment losses between 2018 and 2019, decreasing 8.7 percent (652 jobs), 5.8 percent (909 jobs), and 11.6 percent (309 jobs), respectively. Public or private utilities added 100 jobs – a 0.8 percent employment growth. With the exception of utilities, manufacturing, and other, all components of the value chain increased by 4.5 percent or more between 2016 and 2019.

Figure 12. Clean Energy Employment by Value Chain (2019)[5]

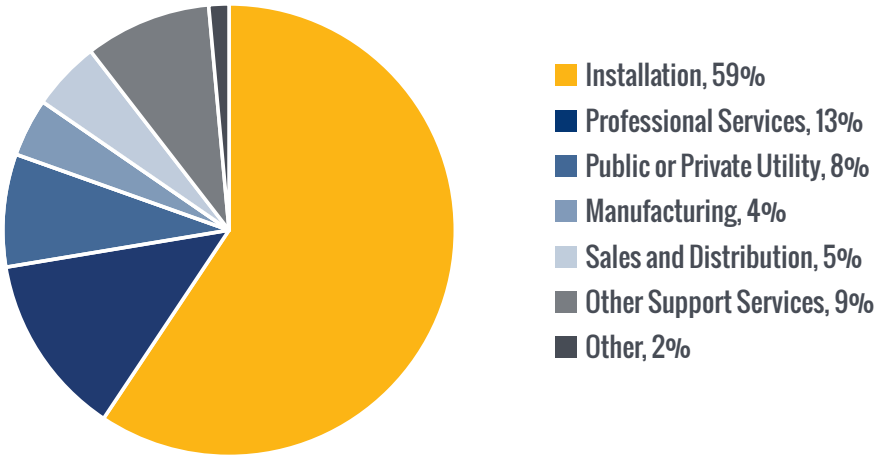


Figure 13. Clean Energy Employment by Value Chain (2016-2020 COVID)

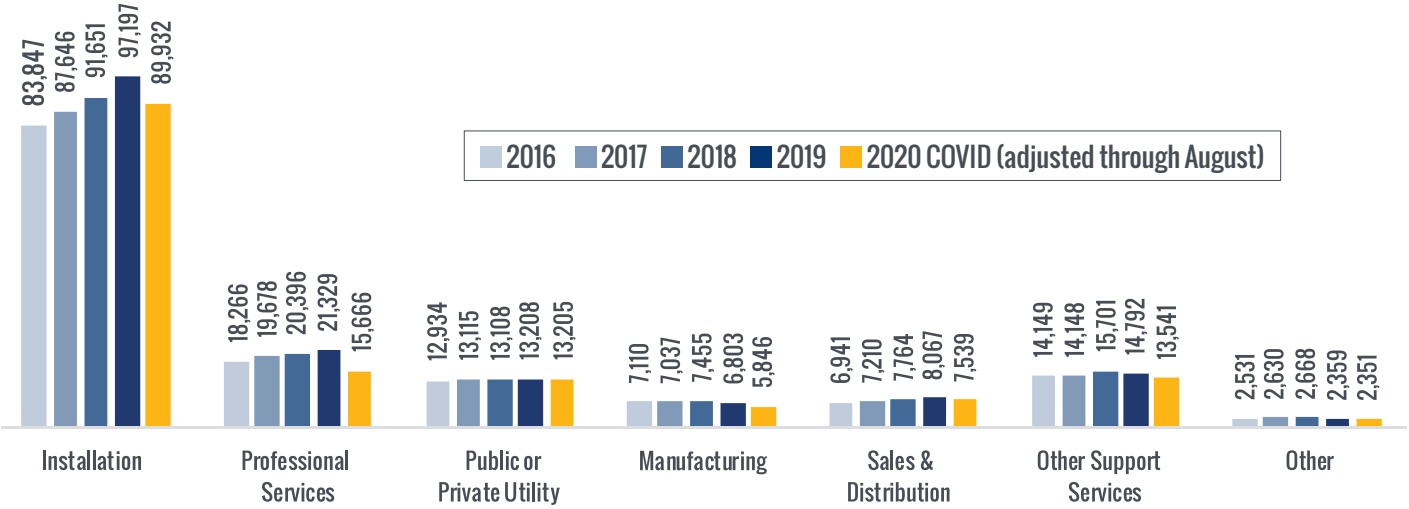


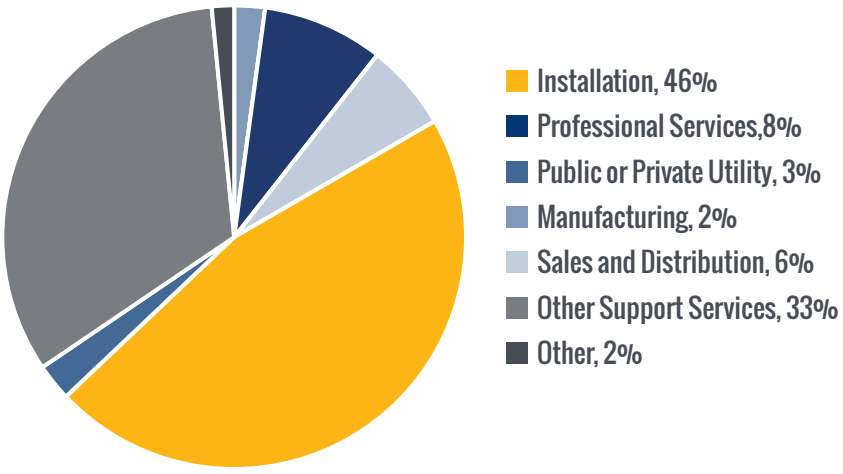
Table 2. COVID-19 Employment Impacts by Value Chain

	COVID job loss from 2019 to 2020	
	Number of Jobs	%
Installation	-7,265	-7%
Professional Services	-5,663	-27%
Public or Private Utility	-3	-0%
Manufacturing	-957	-14%
Sales and Distribution	-528	-7%
Other Support Services	-1251	-9%
Other	-8	-0%*

**COVID job loss in "Other" was -0.3%.*

There were 12,442 clean energy establishments in New York State at the end of 2019. Nearly half (46.3 percent) of clean energy establishments were installation firms, and a third (32.9 percent) were other support services. Consulting, engineering, finance, legal, or other professional services firms made up the third-largest sub-sector of the value chain by number of establishments (8.4 percent). All establishment shares remained relatively steady from the previous year.

Figure 14. Quantity of Number of Clean Energy Establishments by Value Chain 2019[6]



Wages and Benefits

Wages and benefit rates were high among most clean energy industries. A sampling of occupational profiles shows that in both the renewable energy generation and energy efficiency industries, mid-level wages were highest for construction managers and sales representatives (Table 3). All solar photovoltaic installers and wind turbine service technicians are found within the renewable energy generation sector, and both occupations pay particularly strong entry-level wages (a median of $17.11 and $20.25 per hour respectively).

Electricians in the energy efficiency and renewable energy sectors received higher wages at all experience levels than other electricians in the State. And, while the wage premiums tended to be lost among highest earners in each occupation, other key occupations enjoyed higher median wages in the energy efficiency industry, including HVAC mechanics (9.5 percent higher wages than other in-state HVAC mechanics) and construction laborers (7.5 percent higher). Construction laborers in the renewable energy generation sector also received higher median wages than their non-industry counterparts (8.9 percent).

Construction laborers and electricians within the grid modernization and energy storage sector were generally paid higher than their non-industry counterparts at every level of experience; managers and supervisors in the sector also tended to receive higher wages, particularly at the entry-level. Assemblers, electricians, and construction laborers and mangers within renewable fuels all generally received higher wages than workers outside the sector. On the whole, the clean and alternative transportation industry within New York tended to pay much higher wages than other in-state industries. For example, construction laborers and electricians in this industry earn 26.3 percent and 25.2 percent higher wages, respectively, compared to the State medians.

The sampled occupational profiles also indicate comparison between median prevailing and union wages for clean energy occupations. Prevailing wage is the pay rate set by law for work on public work projects, and applies to all laborers, workers, or mechanics employed under a public work contract; employers must pay the prevailing wage rate set for the locality where the work is performed.[7] Union wages are the wage rates set by contract for unionized employees through collective bargaining agreements. Where data was available, prevailing wages tended to be higher than union wages across occupations ($1.63 for construction laborers to $17.13 for electricians). The exception was for insulation workers working with mechanical systems, where prevailing wages were $2.83 less than union wages.

The same sampling of occupations shows that regional workers within the clean energy industry generally received greater benefits than those not in the industry (Table 5). At least 80 percent of clean energy workers in each key occupation received at least some health insurance, compared to 73 percent of workers in the greater economy. Healthcare benefits were highest among union members, at least 87 percent of workers within each occupation received healthcare coverage. A similar pattern existed for retirement benefits, which clean energy workers were more likely to receive than general workers but less likely to receive than union workers for each of the listed occupations.

Table 3. Sample of New York Clean Energy Median Hourly Wages (2019)

		Occupation							
		Construction Managers	Sales Reps, Wholesale & Manufacturing, Technical & Scientific Products	Construction Laborers	Electricians	Insulation Workers, Mechanical	Heating, Air Conditioning, & Refrigeration Mechanics and Installers	Assemblers & Fabricators, All Other, Including Team Assemblers	First-Line Supervisors of Mechanics, Installers, & Repairers
Energy Eficiency	Entry	$45.72	$20.87	$15.35	$20.61	$19.67	$20.15	$13.07	$22.93
	Mid	$56.55	$38.56	$24.07	$36.69	$31.80	$29.89	$16.03	$37.35
	High	$80.78	$71.12	$44.84	$63.76	$58.99	$44.70	$23.79	$55.71
Renewable Electric Power Generation	Entry	$49.44	$23.29	$15.20	$20.41	$19.48	$20.42	$12.53	$24.54
	Mid	$59.55	$41.10	$24.38	$37.16	$32.21	$30.56	$16.03	$37.42
	High	$83.03	$75.12	$44.09	$62.70	$58.02	$44.43	$23.79	$57.24
Grid Modernization & Energy Storage	Entry	$44.98	$22.05	$15.61	$20.96	$20.00	n/a	$12.63	$24.54
	Mid	$57.88	$39.32	$24.26	$36.97	$32.04	n/a	$15.52	$36.60
	High	$84.64	$72.50	$46.16	$65.64	$60.74	n/a	$23.07	$57.12
Renewable Fuels	Entry	$47.95	$22.98	$15.40	$20.69	n/a	n/a	$13.03	$25.72
	Mid	$59.75	$40.78	$23.45	$35.74	n/a	n/a	$16.25	$37.63
	High	$81.96	$75.72	$44.75	$63.64	n/a	n/a	$24.23	$56.15
Clean and Alternative Transportation	Entry	n/a	$22.05	$17.44	$23.41	$22.35	$18.24	$12.17	$23.57
	Mid	n/a	$39.48	$28.28	$43.11	$37.36	$26.05	$15.58	$35.86
	High	n/a	$71.36	$51.81	$73.68	$68.17	$38.73	$23.79	$54.51
Prevailing Wages[8]		n/a	n/a	$40.50	$56.00	$36.04	$38.18	$28.00	n/a
Union Wages[9]		n/a	n/a	$38.87	$38.87	$38.87	$31.10	$23.25	$31.10

Table 4. Sample of New York Clean Energy Median Hourly Wage Premiums (2019)

		Wage Premiums							
		Construction Managers	Sales Reps	Construction Laborers	Electricians	HVAC Installers	Mechannical Insulation Workers	Team Assemblers	First-Line Supervisors of Mechanics, Installers, & Repairers
Energy Eficiency	Entry	39%	-15%	16%	9%	25%	22%	13%	5%
	Mid	-2%	-19%	8%	7%	-6%	10%	6%	2%
	High	-23%	-28%	-1%	4%	-11%	-0%[10]	-2%	-4%
Renewable Electric Power Generation	Entry	50%	-6%	15%	8%	24%	24%	8%	12%
	Mid	3%	-13%	9%	8%	12%	-5%	6%	2%
	High	-21%	-24%	-3%	2%	-1%	-12%	-2%	-1%
Grid Modernization & Energy Storage	Entry	37%	-11%	18%	11%	n/a	27%	9%	12%
	Mid	0%[11]	-17%	8%	7%	n/a	-5%	2%	0%[12]
	High	-19%	-27%	2%	7%	n/a	-8%	-5%	-1%
Renewable Fuels	Entry	46%	-7%	16%	10%	n/a	n/a	13%	17%
	Mid	4%	-14%	5%	4%	n/a	n/a	7%	3%
	High	-22%	-24%	-2%	4%	n/a	n/a	0%[13]	-3%
Clean and Alternative Transportation	Entry	n/a	-11%	32%	24%	11%	42%	5%	7%
	Mid	n/a	-17%	26%	25%	-5%	11%	3%	2%
	High	n/a	-28%	14%	20%	-14%	3%	-2%	-6%

Table 5. Benefits Covered by Employers for Sample of Occupations[14]

	Clean Energy Benefits		Overall Benefits[15]		Union Benefits[16]	
Occupation	Health Insurance[17]	Retirement	Health Insurance	Retirement	Health Insurance	Retirement
Construction Managers	85%	75%	81%	72%	90%	85%
Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products	84%	74%	74%	69%	88%	84%
Construction Laborers	81%	70%	77%	67%	89%	84%
Electricians	81%	71%	78%	68%	89%	84%
Insulation Workers, Mechanical	85%	75%	78%	69%	90%	84%
Solar Photovoltaic Installers	81%	68%	77%	66%	89%	84%
Heating, Air Conditioning, and Refrigeration Mechanics and Installers	81%	69%	77%	67%	89%	84%
Wind Turbine Service Technicians	84%	79%	80%	74%	91%	86%
Assemblers and Fabricators, All Other, Including Team Assemblers	83%	75%	81%	74%	91%	87%
First-Line Supervisors of Mechanics, Installers, and Repairers	87%	79%	82%	74%	91%	87%

Demographics

New York's clean energy industry employs significantly fewer women and people of color than the broader labor force. This demographic trend is observed among clean energy workers across the United States (Table 6). Diversity in the State's renewable energy sector remained below even the clean energy industry averages; at the end of 2019, this sector employed a lower share of women and people of color across the board. While still well below the overall workforce, the State's energy efficiency sector employed a slightly higher share of women and people of color than the State's clean energy industry as a whole.

To address these issues of equity in employment, New York has implemented workforce training initiatives that place particular emphasis on drawing priority populations into the clean energy workforce (see "A Deeper Dive: Workforce Development in Priority Communities"). Such priority populations include minority workers, veterans, Native Americans, individuals facing substantial cultural barriers, low-income New Yorkers, homeless individuals, individuals with disabilities, previously incarcerated individuals, youth in work preparedness training programs, and single parents. In line with this work, the New York Power Authority (NYPA) has announced a ten-point action plan in partnership with the American Association of Blacks in Energy (AABE). The plan includes a $10 million investment into internal and external initiatives to increase Black representation in the broader energy, renewable energy, and electrification fields in order to build a more diverse, equitable, and inclusive workforce and grow the pipeline of utility and clean energy workers.[18]

Table 6. New York State and National Clean Energy Demographics[19]

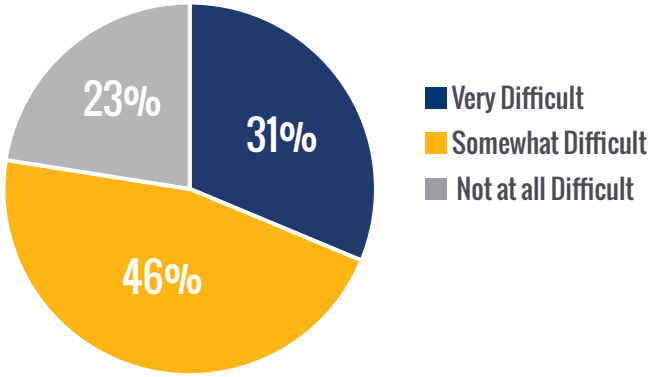
		NY Clean Energy Industry[20]			
Demographic	NY Overall[21]	Overall Clean Energy	Energy Efficiency	Renewable Energy Generation	US Clean Energy[22]
Female	52%	26%	28%	24%	25%
Male	48%	74%	72%	76%	75%
White	72%	72%	72%	74%	75%
Hispanic/Latinx	18%	15%	16%	14%	16%
Black	16%	8%	9%	7%	8%
Asian	10%	8%	9%	5%	6%
Native American	n/a	1%	2%	2%	2%
Pacific Islander	n/a	1%	1%	1%	1%

Hiring Difficulties

Overall Hiring Difficulties

In 2019, prior to widespread knowledge of COVID-19, over three-quarters (77 percent) of employers who had hired in the previous 12 months had some difficulty hiring, with 32 percent citing hiring as being very difficult. This represents a 3 percentage-point increase in respondents who felt hiring was somewhat difficult from 2018, and a 15 percentage-point increase from 2017. Most of the hiring difficulty could be attributed to incoming talent lacking experience, training, or technical skills. Other reasons cited for difficulty hiring were difficulties finding industry-specific knowledge, skills, and interest, insufficient qualifications (certifications or education), and competition (small applicant pool). The most difficult occupations to hire for in New York are management positions (directors, supervisors, vice presidents), technicians or mechanical support positions, and sales, and marketing, or customer service positions. Hiring difficulty among management positions, which rose 15 percentage-points since 2017, may suggest that there is a shortage of qualified management-level candidates or minimal financial inventive due to the

Figure 15. New York Clean Energy Industry Hiring Difficulty (2019)



A lack of experience, training, or technical skills was the primary reason for hiring difficulty across all technology sectors

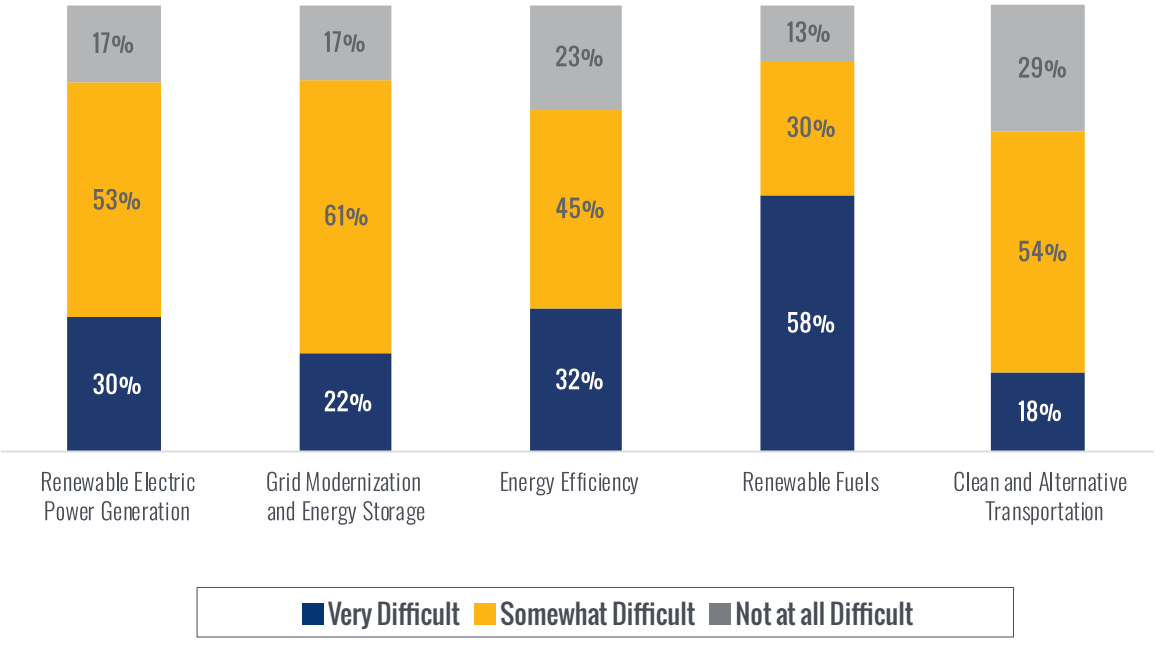
lack of, or even negative, wage premiums among experienced roles.

Hiring Difficulties by Technology

Renewable fuels employers reported the highest overall level of difficulty (58 percent "very difficult" and 30 percent "somewhat difficult"), followed by grid modernization and energy storage (22 percent "very difficult" and 61 percent "somewhat difficult") and renewable electric power generation (30 percent "very difficult" and 53 percent "somewhat difficult").

A lack of experience, training, or technical skills was the primary reason for hiring difficulty; across all technology sectors, this was indicated as one of the top three reasons for hiring difficulty. Half of clean and alternative transportation employers, however, cited competition (related to a small applicant pool) as a reason for hiring difficulty. Management positions were the most difficult-to-hire occupation for three of the five technologies, second most difficult for the grid modernization and energy storage and renewable fuels sectors. Engineers and scientists were the most difficult occupations to hire for grid modernization and energy storage firms.

Figure 16. New York Clean Energy Hiring Difficulty by Technology (2019)[23]



Clean Energy Workforce Development

Nearly 500

training programs available for the clean energy workforce in New York

Table 7. New York Clean Energy Training Programs by Field

Occupational Focus	Number of Programs
HVAC	103
Engineering	57
Construction	51
Electrical	51
Building Analyst	38
Solar	36
Weatherization	31
General Clean Energy	24
Energy Management	19
Architecture	18
Energy Efficiency	15
Manufacturing	14
Energy Storage	9
Wind	8
Quality Control	5
Safety	5
Smart Grid	3
Hydropower	2
Biomass	1
Electric Vehicles	1

As the New York clean energy industry continues to grow, so too will the demand for trained workers. In anticipation of future clean energy growth and in response to the hiring difficulties identified by clean energy employers in the past, last year Governor Cuomo committed $175 million through 2025 to address the statewide needs of rapidly expanding industries, like clean energy and advanced technologies. The Governor's Workforce Development Initiative includes efforts to improve curricula and fund on-the-job training and internships for energy efficiency and clean technology workers. NYSERDA has committed $108 million to support the creation of a clean energy workforce pipeline and provide new training opportunities for new and existing workers.

After a review of all publicly available listings, school programs, and existing NYSERDA inventories, the research constructed a comprehensive clean energy training inventory. This inventory – found in Appendix E – contains 492 training programs available for the clean energy workforce in New York. Though likely not capturing every program, the inventory provides a basic understanding of the occupational focus and geographic distribution of existing training programs.

About one fifth of the training programs are aimed at HVAC workers, followed by programs for engineering (11.6 percent), electrical (10.4 percent), and construction (10.4 percent) workers. Construction training programs include green building, BPI, and LEED training. Table 7 shows the number of programs offered for each clean energy field/occupation.

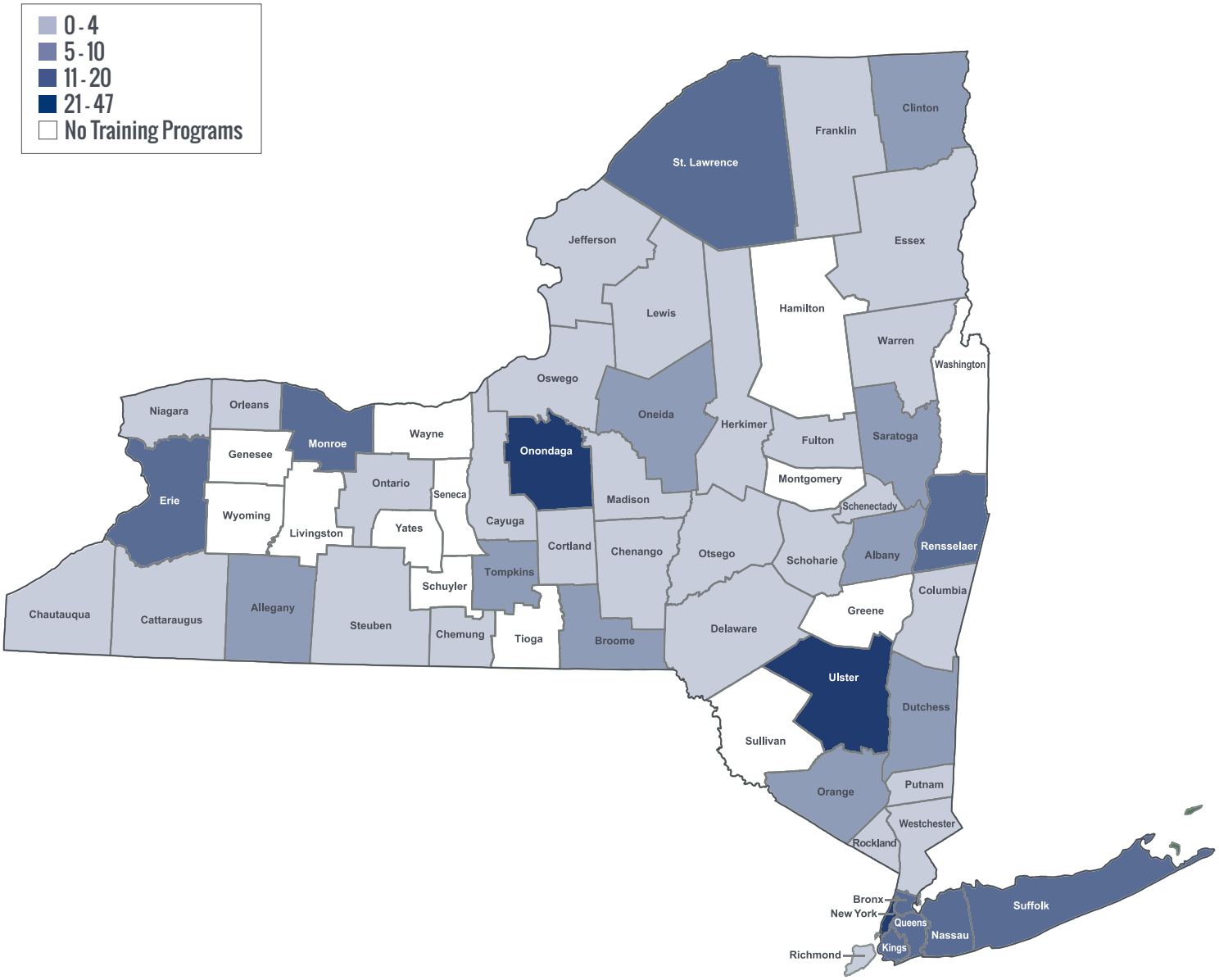
The training programs are offered by a variety of sources throughout New York State. Colleges provide the largest number of training opportunities, with 4-year colleges or universities offering 23 percent of known programs and community colleges offering 20 percent. Vocational/technical Schools, meanwhile, offer 17 percent of available training programs (Table 8).

Table 8. New York Clean Energy Training Programs by Program Type

Program Type	Number of Programs
4 Year College or University	114
Community/ Junior College	99
Career or Workforce Training Company	89
Vocational/Technical School	82
Non-Profit Organization	36
Private Consulting Firm	21
Union	14
Individual Course(s)	10
Cooperative Educational Service	9
Utility Company	6
Clean Energy Firm	5
Government Department	4
Research Institute	3

Onondaga, New York, and Ulster counties offer the greatest number of training programs overall (47, 42, and 32 programs, respectively). One hundred twenty-three training programs, are offered primarily online (25 percent of known programs). COVID-19 is expected to lead many more programs to adopt a virtual presence, increasing the geographic accessibility of quality workforce development opportunities.

Figure 17. New York Clean Energy Training Programs by County



A Deeper Dive:

Workforce Development in Priority Communities

NYSERDA has made a particular effort to increase clean energy workforce participation of various priority populations, including veterans, Native Americans, individuals with disabilities, and low- to moderate-income (LMI) individuals, particularly those in disadvantaged communities. The Authority offers funding premiums for eligible trainings in the Energy Efficiency and Clean Technology Training program (PON 3981), as well as prioritized participation in the On-the-Job Training Program (PON 3982). For the latter, NYSERDA also cost shares a new hire's wage at small companies for a 50 percent longer period if the worker is from a priority population. Policies that increase financial access to clean energy technology deployment (including the Energy Affordability Policy, Reforming the Energy Vision initiatives, and Solar for All Program) also work to provide industry exposure and work opportunities within LMI communities.

New York residents can attend one of the 64 SUNY colleges tuition-free under the Excelsior Scholarship, increasing accessibility to higher education for LMI communities. In 2018, Governor Cuomo announced a $15 million investment in SUNY clean energy workforce development and training programs. The City University of New York (CUNY), through their CleanTech Scholars program, offers paid internships to science, technology, engineering, and math (STEM) students seeking to support the school's sustainability projects.

New York residents can attend one of the 64 SUNY colleges tuition-free under the Excelsior Scholarship

The State is also home to many private and non-profit clean energy training providers with various initiatives to increase the attraction and retention of students from disadvantaged communities. The Social Enterprise and Training Center, for example, hosts an Energy Warriors Green Pathways Program in Schenectady that introduces students of underrepresented populations in the Capital Region to green career, work readiness, and life skills development through classroom instruction and hands-on energy efficiency skills training. NYSERDA has compiled a Directory of free online clean energy trainings on its website.[24]

Financial resources are the primary barrier to success

This year, interviews were held with various training programs to better understand how the State's training providers approach workforce development of disadvantaged communities and explore what impact COVID-19 has had on training outlooks.

Many training providers attempting to increase participation of disadvantaged communities found themselves limited by their immediate audience, either in locality or subject. Community colleges, for example, are typically asked to serve their county, while professional associations may have barriers to entry (i.e. college degrees) that can restrict access.[25] That being said, all training providers contacted as part of this study's outreach had strategies for increasing participation of particular populations.

Generally, financial resources are the primary barrier to success. Apprenticeship programs were favored where possible, as they allow students to earn an income while receiving their training. NYSERDA grants and public donations, meanwhile, assist greatly in a training provider's ability to cover costs and increase program affordability.

After financial considerations, providers often cited a lack of industry exposure and social ties as a hindrance to attracting individuals of disadvantaged communities. According to the interviews, targeted outreach that increases clean energy career exposure – particularly for elementary through high school students – has been found to be successful. Such outreach requires clear articulation of career pathways and opportunities for success. Finally, opportunities for training providers to partner on actual local clean energy projects provide the clearest avenues for industry exposure.

Once attracted to join, however, providers were quick to highlight issues with retention. One community college – with numerous green careers programs – found that third party certifications present a consistent struggle among their LMI students, with many choosing not to sign up for programs that ended in assessment and certification (like BPI certification). Barriers include the lack of basic skills (math, general electrical knowledge, etc.) and many have begun offering successful preparation courses that must be passed to gain access to the formal assessment programs. There are also opportunities to ensure instructors are properly prepared to work with students of varying background and identity.

Apprenticeship programs were favored where possible, as they allow students to earn an income while receiving their training

The economic downturn led to increased demand in training programs

COVID-19, unsurprisingly, has halted most in-person training and moved many programs online. However, the economic downturn also led to increased demand in training programs, as contractors had fewer on-going projects. Training providers reported that they had to quickly transition to offer virtual courses where possible, even implementing remote test proctoring for certifications like BPI. The switch to virtual – although not possible for all programs – removed the geographic restrictions of course offerings; one community college was able to market a summer course and receive students from around the State. This virtual shift can also help remove financial barriers for LMI students who no longer must spend time and money to travel, though many LMI individuals do not have reliable computers or internet access.

Another COVID-19 impact on the training of disadvantaged communities has been the inability to connect and outreach locally. Efforts have been made to improve the friendliness and clarity of online marketing, but it is difficult to replace the impacts of face-to-face consultation and an open local door for communities traditionally more hesitant to take initiative in seeking out new opportunities.

Ultimately, the education and training barriers for LMI communities to access employment in clean energy are similar to those across the country in all sectors. The challenges faced from the impact of poverty include housing, transportation, and food insecurity, limited exposure to higher wage careers, historic underinvestment and underachievement in low-income public schools, and lack of overall investment in low-income communities.

These challenges are not unique to New York nor the clean energy sector. Increasing the number of of ways people in low-income communities can get a foot in the door of the clean energy sector will require engagement with multiple stakeholder communities, as well as determination to address the underlying barriers to entry which includes persistent lack of resources. By leveraging the public workforce system, community college and university system, wrap-around services, community-based organizations, and other services in the community, needs can be met comprehensively, and progress can be accelerated.

Industry Profile: EMPOWER KINGSTON

EMPOWER KINGSTON, launched in 2020, is a Kingston-based apprenticeship program that aims to "give control over local energy back to local people." In a city whose median household income ($45,487) is 33 percent lower than the State median income ($67,844),[26] the nonprofit group Citizens for Local Power has partnered with local contractors to offer this program for any adult – regardless of building experience – to rotate between different types of hands-on building training (including solar panel installation, home sealing, and weatherization) over the course of four weeks. Participants are compensated at the rate of $15/hour for a flexible schedule (3 days a week) and have access to further educational certifications subsidized (up to $5,000) by SUNY Ulster.

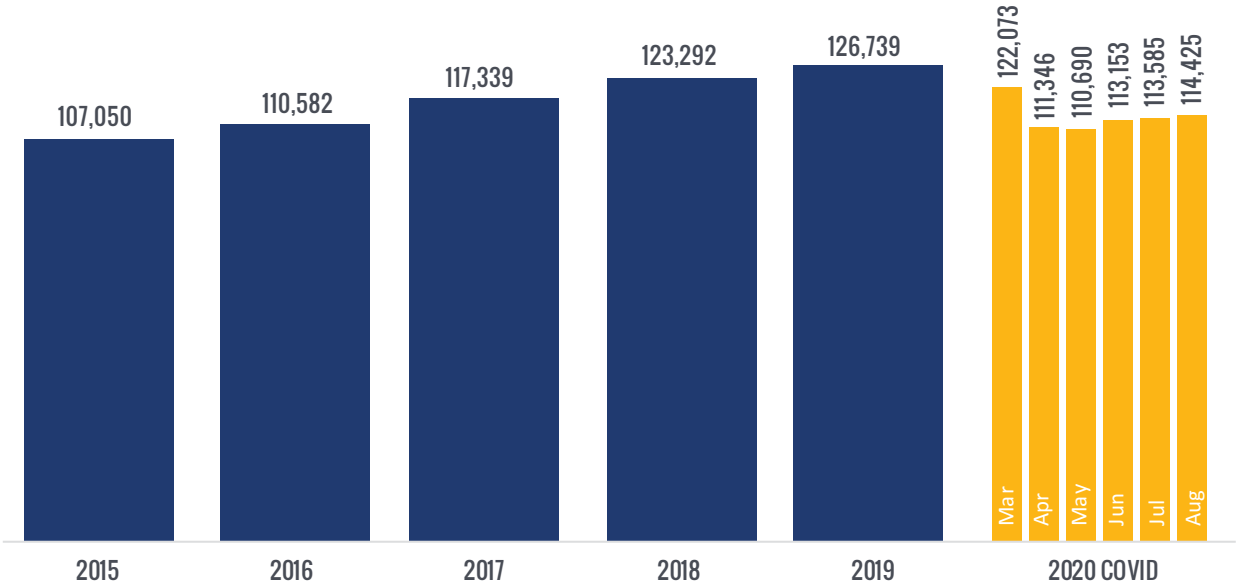
"The goal is to excite students about a job before they start trainings," says Barbara Reer, Assistant Dean for Workforce, Career Development, and Apprenticeship Initiatives at SUNY Ulster. She finds the program reduces a large array of typical barriers to entry for LMI students, including finances, time, geography, and industry awareness. "Students don't have to decide between class and pay," Reer said.

Clean Energy Technologies

Energy Efficiency

Energy efficiency accounted for the most jobs in the clean energy industry – 77.4 percent of industry employment. Energy efficiency employment increased by 2.8 percent in New York from 2018 to 2019, slightly higher than the 2.3 percent national increase.[27] Strong growth in traditional HVAC goods and services and advanced building materials and insulation helped fuel New York's energy efficiency growth over the last three years. There were significant job losses due to COVID-19 in the energy efficiency sector as shown in Figure 18 and described in the following section.

Figure 18. Energy Efficiency Employment Growth, 2015-2020 COVID



COVID Impacts: Energy Efficiency

Energy efficiency employers were optimistic prior to the pandemic, steadily adding jobs each year since 2015. The sector had grown to 126,739 jobs by the end of 2019, but COVID-19 and the ensuing economic decline eliminated nearly 33,000 of these jobs at the height of the job losses according to a survey of employers (60% of energy efficiency employers in the State reported layoffs as a result of the pandemic). By August, about 20,000 of these had returned to work, for a total of 12,314 lost.

About 75 percent of energy efficiency firms in New York reported receiving Payroll Protection Program (PPP), Economic Injury Disaster Loans (EIDL), or other emergency assistance, and about two thirds reported that they have already exhausted those funds as of September 2020. Twelve percent of energy efficiency firms in New York expected a new round of layoffs as a result of exhausting PPP and other emergency funds.

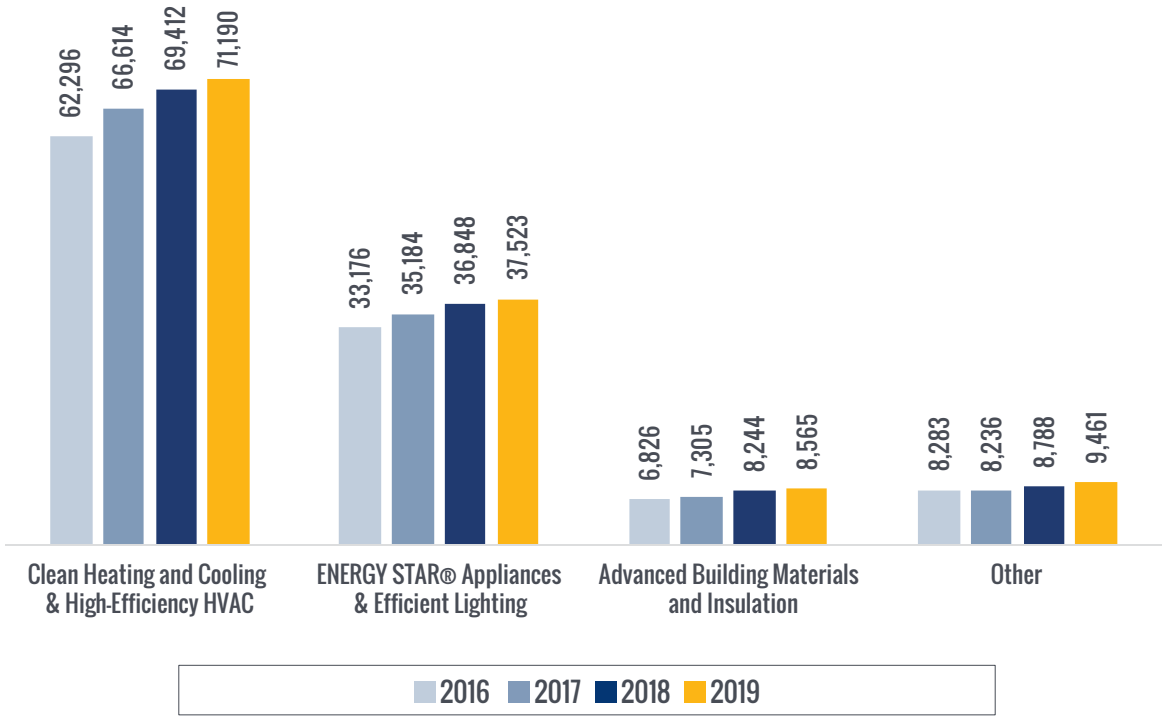
Based on the survey of 236 employers in August 2020, energy efficiency firms in New York are optimistic about the future, expecting to return to about 95 percent employment by the end of the year. This nets out to more than 6,000 job losses over 2020. Firms reported controlling the virus and a predictable policy environment as reasons for their optimism.

COVID-19 has made the work of energy efficiency firms considerably more difficult. Seventy seven percent of New York energy efficiency and heat pump installers noted that the virus has made installations more difficult (29 percent much more difficult). This is related to the reported difficulty acquiring new customers due to limitations surrounding on-premise sales prospecting. Two-thirds of employers noted that acquiring new customers was difficult while 33 percent reported that customer acquisition was much more difficult because of COVID-19.

There may be some longer-term obstacles impacting firms' ability to grow. Seventy-three percent of energy efficiency employers in New York reported "lower" revenue, with 35 percent reporting "much lower" revenue. Employers seek continued support of the industry and consumers to maintain and accelerate the employment rebound.

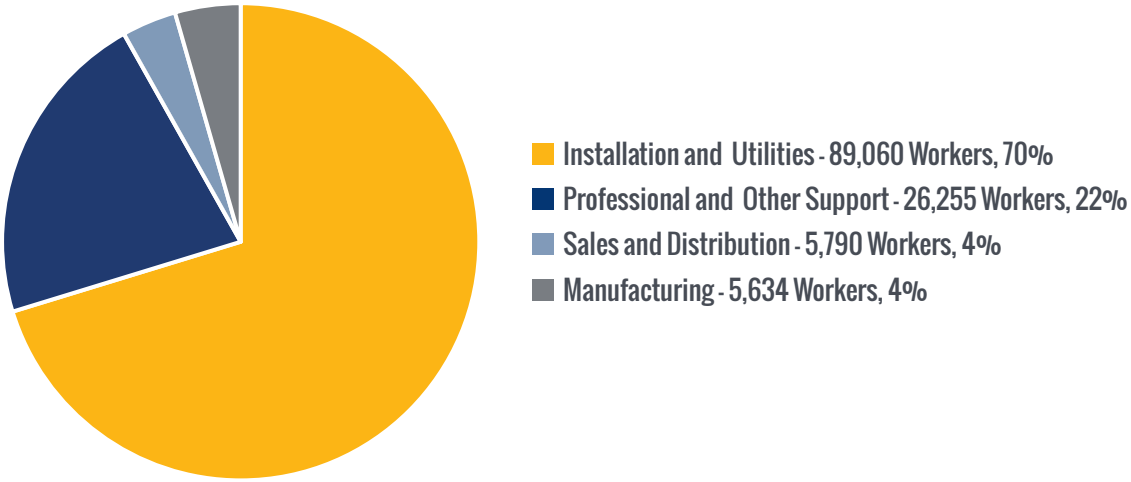
Between 2018 and 2019, clean heating and cooling and high efficiency HVAC employment increased by 2.6 percent, adding 1,778 jobs. ENERGY STAR® appliance and efficient lighting experienced a small increase of 1.8 percent (675 jobs), while advanced building materials and insulation saw a 3.9 percent increase (321 jobs). The largest employment gain came from the other energy efficiency technologies, with a total employment gain of 7.7 percent, or 673 jobs (Figure 19).[28]

Figure 19. Energy Efficiency Employment by Detailed Technology (2016-2019)[29]



Installation and utilities were the largest source of employment in the energy efficiency value chain, accounting for 70.3 percent of energy efficiency jobs in the State at the end of 2019. The share of energy efficiency employees working in professional and other support services grew by about two percentage points between 2018 and 2019, while the proportion of installation and utilities employees increased by about the same amount. The percentage of sales and distribution and manufacturing employees remained relatively unchanged.

Figure 20. Energy Efficiency Employment by Value Chain (2019)



A Deeper Dive:

Heat Pumps

This year, NYSERDA explored the business and workforce needs of the State's heat pump installer sector. An industry-wide survey was delivered through the month of August 2020, supplemented by qualitative interviews with industry executives.[30]

A heat pump is an all-in-one heating and cooling system that is an alternative to traditional air conditioners, chillers, boilers, furnaces, and electric resistance heating options. Heat pumps transfer thermal energy to and from a space to be conditioned and a sink/source (usually air, ground, or water). When cooling is needed, a heat pump works as a normal air conditioner by extracting heat from inside a home and transferring it to the outdoors. When heating is needed, the system transfers heat from the outdoors to the space to where it is needed indoors. The technology for air-source heat pumps – the most common type– has advanced in recent years to offer a low-carbon heating alternative in New York State; new cold climate models perform at high efficiency at 5°F and can extract useful heat from ambient air down to -15°F.[31]

In New York State alone, conventional heating and cooling systems are responsible for 37 percent of energy consumption and 32 percent of combustion-related greenhouse gas emissions.[32] Heat pumps make it possible for homes to stay comfortable year-round, save energy, and reduce their carbon footprints.

NEW YORK STATE OF OPPORTUNITY. | NYS Clean Heat

In January 2020, Governor Andrew M. Cuomo announced nearly $5 billion through 2025 for energy efficiency and building electrification initiatives to combat climate change. Through the NYS Clean Heat initiative, $454 million was allotted to heat pump incentives through 2025, to be coordinated with an additional $230 million in market development support. The initiative included dedicated funding and investments that provide the most vulnerable New Yorkers with access to energy efficiency technologies and strategies.

Heat pump incentives under the NYS Clean Heat Program are offered for air- and ground- source heat pumps and heat pump water heaters. For households that are at 60 percent or less of the State median income, NYSERDA's EmPower program will cover 100 percent of the costs for energy efficiency upgrades and heat pump water heaters, up to $8,000. In addition, NYSERDA is investing in demonstrations and pilots to support the development of electrification solutions for low- to moderate-income households. The State also offers loans for energy efficiency projects, including heat pumps, through its Green Jobs—Green New York program.

The heat pump installation sector includes 6,375 workers who spend some portion of their time working with heat pumps. This represents just under 9% of all HVAC contractors in New York, and about one in six of all high efficiency HVAC and clean heating and cooling installation workers statewide. It is important to note that this is not a full-time equivalency, nor does it represent workers who spend a majority of their time with the technology.

About 70% of these workers are reported to work with air-source heat pumps such as mini-splits, for about 4,400 workers. Employers report that there are no skill or certification requirement differences to install air-source heat pump systems that include heat or are rated for cold climates, as the only difference in the install is the physical piece of equipment. Because many of the air source heat pump employers work with the larger providers (Mitsubishi, Fujitsu, etc.), approximately 95% of firms report that they are able to sell and install cold climate heat pumps. One important note is that the majority of employers were not familiar with the term "cold climate heat pump" to refer to the systems that operate at lower temperatures.

In the August 2020 surveys, heat pump employers reported a lack of relevant work experience as the top reason for hiring difficulty across all key occupations except HVAC installers (where it was second). Interviews revealed that some difficulty may be location dependent, with less difficulty in cities than in rural communities. The most-cited deficiencies among HVAC installation candidates were technical skills (76 percent), relevant work experience (70 percent), and social skills (58 percent). The top technical deficiencies for HVAC installers were HVAC and plumbing skills, knowledge of code requirements, and inspecting/diagnosing systems (all selected by 37 percent of employers), while the most-cited social skill deficiency was critical thinking (50 percent). These were also the top skill deficiencies among construction/installation helpers.

Heat pump employers top reason for hiring difficulty:

lack of relevant work experience

Table 9. Top Reasons for Hiring Difficulty among Heat Pump Employers (for key occupations)[33]

	Technical skills	Relevant work experience	Interpersonal and social skills	Relevant installer certifications	Education level
Licensed HVAC installer	76%	70%	58%	52%	36%
HVAC supervisor	67%	77%	53%	43%	30%
Plumber	88%	88%	69%	31%	44%
Plumbing supervisor	83%	92%	67%	42%	50%
Electrician	88%	100%	50%	25%	38%
Owner/senior management	76%	76%	57%	57%	33%
Construction/ installation helper or apprentice	76%	85%	42%	27%	42%

Interviews revealed that technological difficulties are tied to a lack of technical exposure in trade programs to electronics (including circuit boards and control panels) as well as minimal practical experience (91 percent of employers reported a lack of general industry experience). “They know the general systems but don’t have the in-trade skills,” one employer said. Critical thinking, meanwhile, also seemed to be tied to limited industry experience, code knowledge, and diagnostics. Employers reported high levels of simple mistakes (often related to code compliance), a lack of systematic thinking, and a rush to replace technologies rather than diagnose issues. In general, employers called for support of high school trades as the main method of both expanding and improving the labor supply. To address the identified workforce skills gaps, over 100 training programs are currently offered to HVAC workers across the State; an additional 50 training programs are being offered specific to electricians.

Employers also cited business challenges correlated with geography. While some variability in demand for innovative technologies exist, the larger factor seems to be the relative cost of energy in each region. Generally speaking, higher electricity costs are reported to increase market demand for energy efficiency services (including cooling). However, for heating products such as air-source heat pumps, low delivered fuel and natural gas prices and high electricity costs are significant barriers to adoption. Incentives were appreciated and encouraged, with some calls for increased clarity on the combination of incentives for low-income residents.

Industry Profile: Dandelion Energy

Dandelion Energy, headquartered in New York City, installs ground-source heat pump systems for customers throughout New York. The entire process – from design to drilling to installation – is completed in-house and is now heavily vertically-integrated. Customers have an opportunity to confirm home qualification, meet with an energy consultant, and complete a site survey all virtually prior to an in-person installation. Depending on location and complexity, each of the three installation stages – installing underground piping, connecting the piping to the home, and replacing the furnace with a heat pump – can then take anywhere from two days to two weeks. While many projects were initially cancelled or postponed due to COVID, business has been steadily recovering since May according to project manager, Matthew Rigatti.

Renewable Electric Power Generation

After experiencing a decline from 2017 to 2018, renewable electric power generation in New York increased by 6.7 percent (1,468 jobs) between 2018 and 2019. New York's rebound outpaced the national rebound, which grew 3.0 percent in 2019 after a decline the previous year. This was even more profound within the solar industry, with New York employment growth outpacing national growth 9.8 percent to 3.1 percent. Bioenergy employment grew fastest (10.7 percent) among detailed technologies, followed by solar (9.7 percent) and wind (7.4 percent); geothermal (1.2 percent) and hydropower remained constant.[34]

Figure 21. Renewable Electric Power Generation Employment Growth (2015-2020 COVID)

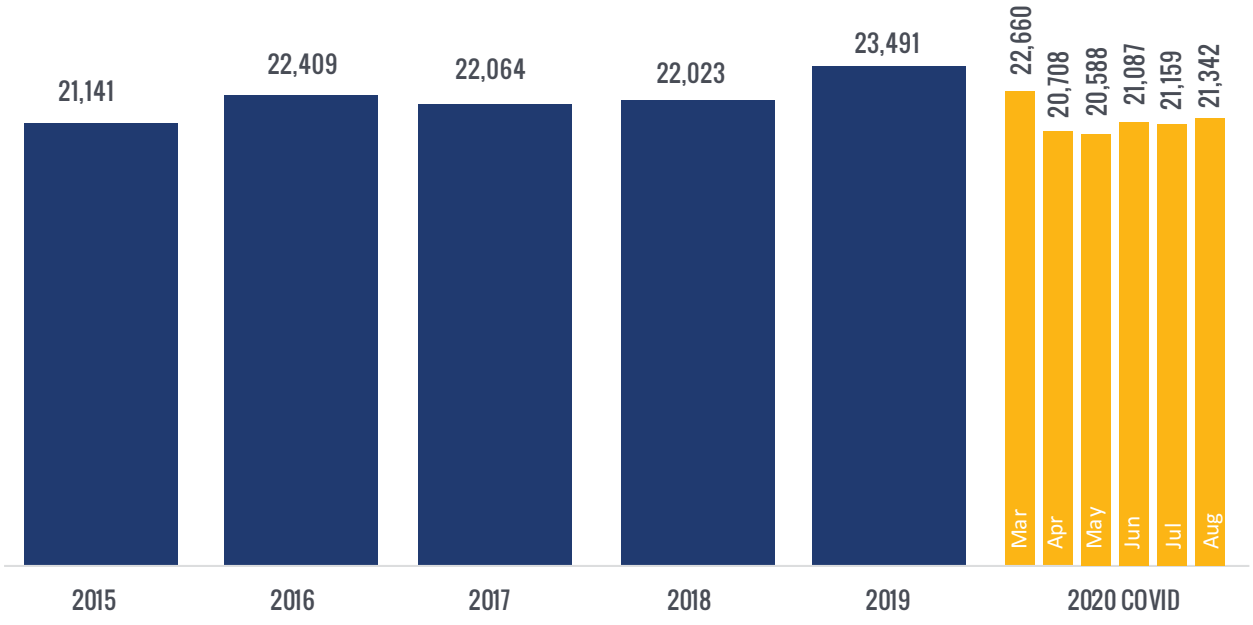


Figure 22. Renewable Electric Power Generation Employment by Detailed Technology (2016-2019)[35]

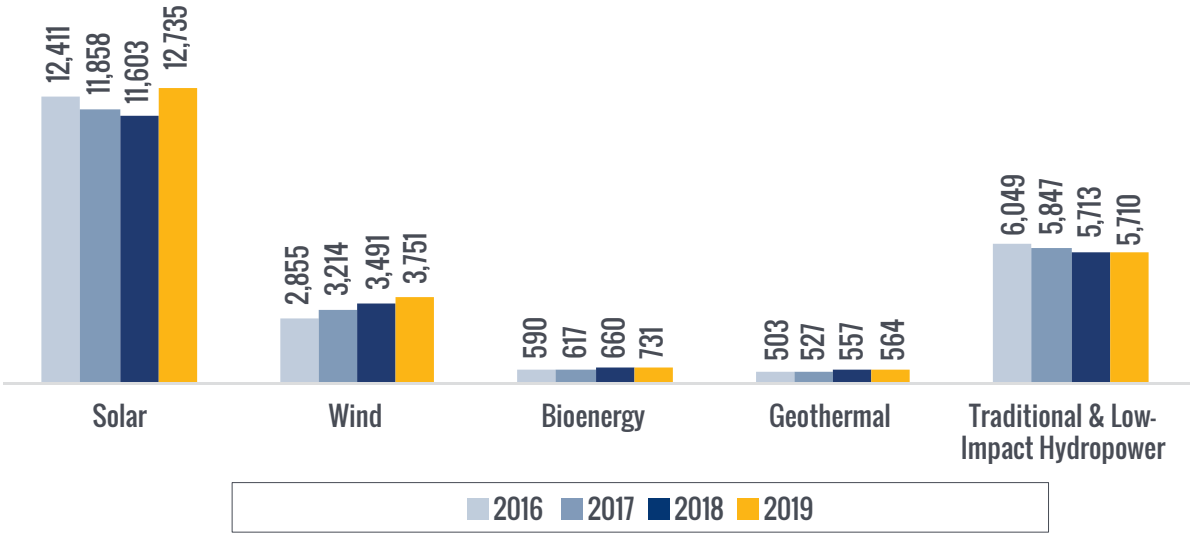
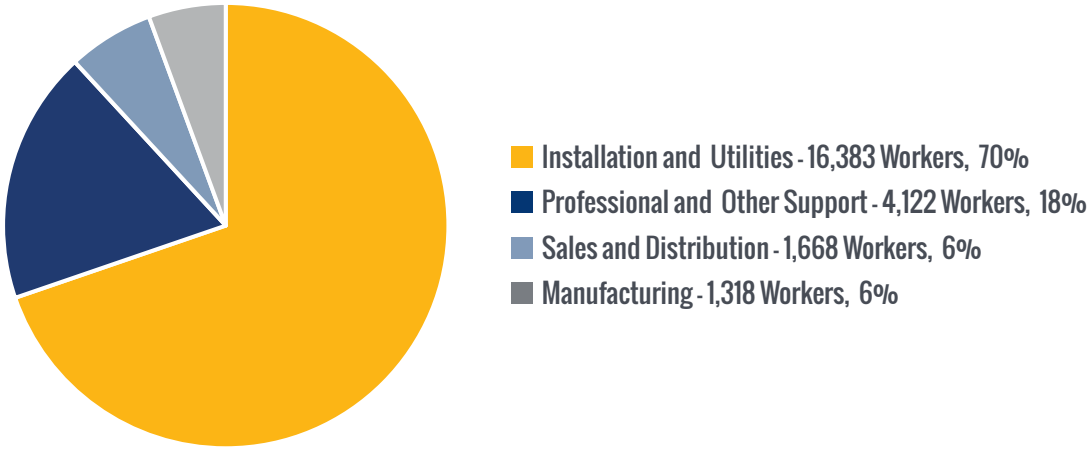


Table 10. Solar Employment by Primary Application, 2018 and 2019

	Percentage of Solar Employment by Primary Application	
	2018	2019
Residential	51%	48%
Non-residential	35%	40%
Utility-scale	14%	12%

Installation and utilities accounted for most of the employment in the renewable electric power generation value chain. The share of each value chain segment remained relatively stagnant from 2018 to 2019.

Figure 23. Renewable Electric Power Generation Employment by Value Chain (2019)



COVID Impacts: Solar

The solar industry in New York was growing rapidly leading up to COVID-19 and the long-term fundamentals for the industry remain strong, especially given the clear policy guidance and market stability from the State's commitment to installed capacity targets. In the short-term, solar companies have been deeply impacted by COVID-19 and its associated economic fallout but there has been a significant recovery to date.

Based on a survey of 171 solar employers in August 2020, more than six in ten solar companies reported reducing their staff during the second quarter of 2020, with a total of 52 percent of the workforce reportedly losing employment and another 12 percent having hours or pay reduced. By July, 78 percent of those laid off workers had been recalled and employers reported that 11.6 percent of solar workers were still on furlough. Companies did expect to bring back some more workers by the end of 2020, suggesting that employment will be 8 percent lower at the end of the year than it was prior to the pandemic.

Solar employers benefitted from federal relief, with 72 percent reporting that they received PPP funds and 11 percent reporting receiving an Economic Injury Disaster Loan (EIDL). Ninety percent reported that these funds had been or would be exhausted by the end of summer, and 20 percent noted that they would have to lay off additional workers if the funding were not extended.

COVID-19 has not only directly impacted employment, it has also made the work of solar companies much more difficult. Eighty-seven percent of solar employers in New York reported that municipal solar permits are more difficult to attain (46 percent reporting much more difficult) and 75 percent report that it is more difficult to have timely inspections completed (26 percent much more difficult). Financing is also a reported challenge, with 59 percent reporting it is more difficult (20 percent much more difficult).

Customer acquisition was also a challenge. Eighty-six percent of employers noted that it has become more difficult (44 percent much more difficult) and 45 percent expect it to get worse over the next six months (19 percent expect it to improve), largely citing general economic anxiety, challenges in door-to-door sales, and vacant commercial buildings.

Spotlight on Offshore Wind

New York currently boasts the nation's most aggressive offshore wind energy goal of 9,000 MW by 2025, which will generate enough power to supply 6 million homes with electricity. New York City and Long Island – the State's most strained energy systems – will benefit from the energy from offshore wind, and NYSERDA is working to develop supply chain capacity to ensure that the economic impacts flow all across the State. The Climate Act goal to build 9,000 MW of offshore wind by 2035 is also projected to create more than 10,000 new jobs for New Yorkers, an estimated 85 percent of whom will be skilled workers and assemblers with average salaries of around $100,000.[36]

In delivering on Governor Cuomo's bold offshore wind targets, New York has executed three long-term agreements with offshore wind projects, two by NYSERDA and one by Long Island Power Authority (LIPA). NYSERDA is solicited project bids for its second competitive solicitation. To support long-term offshore wind development, New York has also identified new wind energy areas offshore for consideration by the federal government for future leasing activity. In addition to the economic benefits, NYSERDA estimates that the first round of contracted projects alone will provide about $700 million of avoided health impact costs including avoided hospitalizations and premature deaths related to asthma, respiratory, and cardiovascular diseases.[37] The full magnitude of these benefits will be even greater as the State continues to advance towards its 2035 goal.

Since 2018, NYSERDA has been administering the National Offshore Wind R&D Consortium along with other State and organizational partners, with a $20.5 million Department of Energy award to address technological barriers and lower the costs and risks of offshore wind in the U.S.

To support these projects, New York is developing a regional offshore wind training infrastructure. Governor Cuomo announced in 2019 the establishment of a New York State Advisory Council on Offshore Wind Economic and Workforce Development and a new $20 million Offshore Wind Training Institute. Additionally, the developers of New York's Sunrise Wind project plan to invest $10 million in a National Offshore Wind Training Center in partnership with Suffolk Community College. SUNY Maritime College, with a grant from New York State,has also launched a Center of Excellence for Offshore Energy which is working to develop both classroom and online training programs.

Spotlight on Offshore Wind

January 2018

NYSERDA revealed the New York State Offshore Wind Master Plan which laid a path for the State to develop 2,400 MW of offshore wind energy by 2030.

January 2019

Governor Cuomo more than doubled down in State of the State address, raising the goal to 9,000 MW by 2035, which was later adopted into legislative mandate by the Climate Act.

July 2019

Announcement of two signed contracts through NYSERDA's first competitive offshore wind solicitation:

Empire Wind: 816 MW project, developed by Equinor Wind US LLC, located between 15-30 miles south of Long Island

Sunrise Wind: 880 MW project, developed by a joint venture of Ørsted and Eversource Energy, located 30 miles east of Long Island's Montauk Point

January 2020

Governor Cuomo officially launched a $20 million Offshore Wind Training Institute (OWTI) to be led by SUNY Farmingdale and Stony Brook University in his State of the State Address.

July 2020

NYSERDA issued its second competitive solicitation, seeking up to 2,500 MW of new offshore wind generation capacity and channeling $400 million of investments into port infrastructure assets.

2022-2025

Projected construction of Empire and Sunrise Wind, as well as future OSW project development.

Grid Modernization and Energy Storage

New York's grid modernization and energy storage sector consists of smart grid technologies, as well as all energy storage technologies (including lithium-ion battery storage). While not as large a growth as the previous year, grid modernization and energy storage employment still increased by 6.5 percent from 2018 to 2019, adding 138 jobs. This remained ahead of the national growth rate of 3.7 percent.[38] In total, grid modernization and energy storage are new and emerging sectors in New York, with employment growing by over 67 percent since 2015. The industry has been steadily recovering from COVID-19 job loss, with current levels estimated to be 10 percent below 2019 employment.

Energy storage employment, which increased by 5.3 percent in 2019 (93 jobs), made up roughly 80 percent of the sector. Grid modernization, however, did see 11.4 percent employment growth in 2019, adding 46 jobs.

Figure 24. Grid Modernization and Energy Storage Employment Growth (2015-2020 COVID)

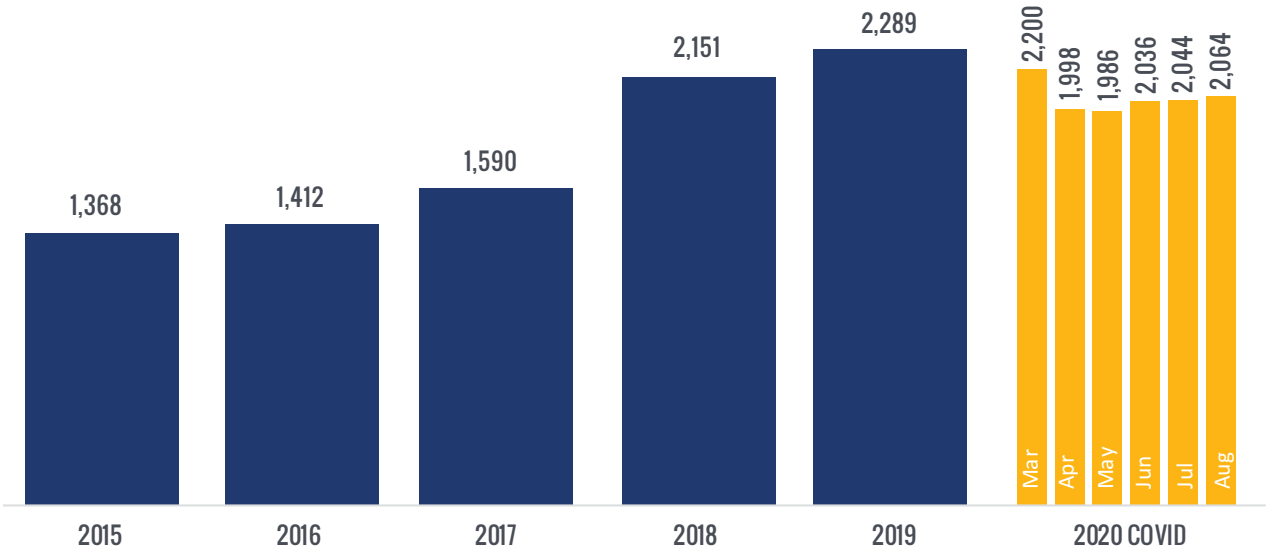
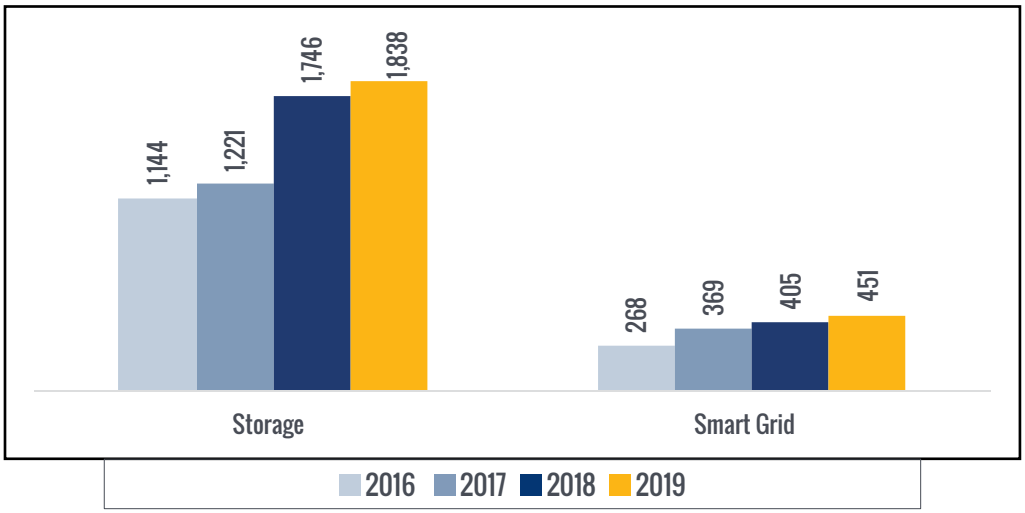


Figure 25. Grid Modernization and Energy Storage Employment by Detailed Technology (2016-2019)[39]



A Deeper Dive:

Grid Modernization and Energy Storage

NYSERDA has identified the Grid Modernization and Energy Storage sectors as key emerging technologies, establishing initiatives to support technical innovation and workforce development.

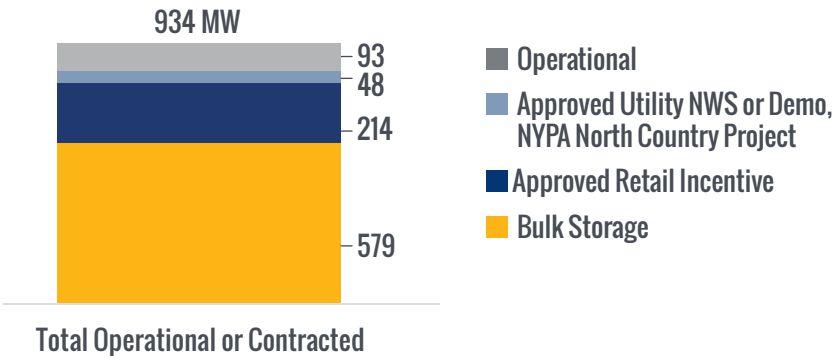
The Authority's Smart Grid Program – promoting a cleaner, more efficient, and more resilient electric grid – provides funding for research and development around three smart grid opportunities: Distributed Energy Resource Integration, High Performing Grid, and Future Grid.

The Public Service Commission has established goals to deploy 1,500 MW of energy storage by 2025 and 3,000 MW by 2030, now codified in the Climate Act. Energy storage is primarily seen as an opportunity to integrate clean energy into the grid in a way that stabilizes the supply during peak electric usage and improves resilience. The State estimates that the rapidly growing industry could employ 30,000 New Yorkers by 2030.[40] In April, the State published the first annual State of Storage report, finding that 706 MW in capacity had been deployed or awarded/contracted projects by the end of 2019, with another 9,779 MW of energy storage projects in various stages of prospecting or maturity presently in New York interconnection queues.

Separately for this Clean Energy Industry Report, interviews conducted with industry executives across the State to further understand the characteristics of grid modernization and energy storage firms. The research team identified 132 firms in New York operating directly with grid modernization and energy storage technologies, though, many remain primarily within other sectors. The interviews revealed that energy storage is accelerating within solar firms' operations, with anywhere from 50 percent to 100 percent of employees at least occasionally working on energy storage projects. Battery manufacturing and engineering firms typically focused more heavily on either grid energy storage or electric vehicle batteries but had capabilities to participate in both based on demand.

132 firms in New York operate directly with grid modernization and energy storage technologies

Figure 26. MW of Energy Storage Operating or Contracted, October 2020



Employers found minimal hiring difficulty to date and expressed satisfaction with New York State's university systems

Workforce Development

In February 2020, NYSERDA filed an Energy Storage Workforce Development report with the Department of Public Service that sought to inventory worker skills required, map required skills to existing training resources and labor supply, and develop strategies to fill workforce development gaps. NYSERDA's workforce development programs include providing grants for the design and implementation of energy storage curricula (including the purchase of relevant equipment) and assembling qualified training providers to fill unique or critical training gaps. Employers mostly expressed pursuing candidates for high-skilled occupations through trade school graduates, seeking applicants with engineering, project management, and math skills and electrical/technology-specific knowledge in addition to bachelor's or graduate degrees. On the whole, employers found minimal hiring difficulty to date and expressed satisfaction with the State's university systems; SUNY's Binghamton University, for example, has a strong battery storage program. Hiring for R&D firms has mostly been relationship-based with minimal online advertisement (organization websites and LinkedIn were most cited).

Industry employers cited regulatory uncertainty and market hesitancy – both due to industry immaturity – as the largest challenges to growing a profitable business. Many employers cited a lack of market rules or regulations specific to energy storage, particularly around utility and NYISO interconnection or market participation. Other related comments included a lack of certainty for energy storage incentives tied to solar, and delays in planning/zoning approval that can render a project ineligible to enjoy the benefits of some NYSERDA programs (e.g. the bulk incentive program). Market hesitancy, meanwhile, is less tied to regulation concerns. Multiple employers acknowledged that their firms were either still developing the right business model to be marketable within the new industry or relying heavily on customer education to overcome skepticism of new technologies.

Employers did not express major concern over COVID-19 impacts on mid- to long- term revenue. Some firms temporarily furloughed workers or reduced hours but had returned to normal employment by mid-summer. Most firms cited a slowdown from March through April, followed by a rapid recovery starting in May throughout the summer. Construction in progress mainly proceeded as normal (some sites had to reduce the number of workers at a time); however, some projects not yet in progress had to be significantly postponed due to supply chain disruptions – and winter construction is not always viable. Employers were confident in demand returning to normal – if not growing, as the economic proposition of community solar projects paired with energy storage improved – with only a slight mid-term revenue loss from the few months of minimal new project development.

Industry Profile: C4V

C4V, based in Binghamton, designs and manufactures lithium-ion batteries for electric grid energy storage technologies, as well as electric vehicle applications. In 2016, C4V was the winner of a $500,000 award in NYSERDA's annual 76West competition focused on growing entrepreneurs and attracting resources from the U.S. and around the world to build clean energy businesses and jobs in New York State's Southern Tier region. With more than 100 patents to their name, the firm is currently focused on bringing new technologies to market. In 2017, Governor Cuomo announced plans from Imperium-3 — a partnership headed by C4V, C&D Assembly (Groton), and Primet Precision Materials (Ithaca) — to build a $130 million lithium-ion battery production giga-factory in Endicott. The factory, currently projected to open in 2021, will be the second-largest in the Western Hemisphere behind only Tesla and is expected to create at least 230 new jobs.

Building upon unique, material-level improvements to existing battery technologies, the pilot line was tested and developed through a NYSERDA-funded research study. Particularly shrewd in the wake of the global pandemic, C4V prides themselves on a fully domestic supply chain that — incorporating over 20 firms, largely in NY — relies on composite and otherwise abundant raw materials to reduce costs and supply chain volatility. The firm cites an expert technical center in Binghamton, nation-leading energy storage investments and targets, proximity to financial capital and renewable markets, a sustainable supply chain and electrical grid, and a regional supply of skilled workers as leading factors in their New York location. "Governor Cuomo's target announcement and aggressive clean energy approach has psychologically supported both our team and our investors," says CEO and cofounder Shailesh Upreti.

Industry Profile: Key Capture Energy

Key Capture Energy (KCE) develops, constructs, owns and operates utility-scale energy storage projects across the country, including KCE NY 1, New York's largest operating energy storage project. KCE is currently constructing a 4.4 MW project for Orange & Rockland Utility and has more than 700 MW of projects under development in New York.

KCE currently employs 45 employees, with 23 of them based in the company's Albany headquarters. Since the company was founded in 2016, as part of the StartUP NY program, Key Capture Energy has hired five University of Albany alums and seven students from University of Albany as interns, two of which are now full-time employees. KCE continues to work collaboratively with University of Albany Center of Excellence Weather and Climate Analytics to better deploy and operate projects.

"We are pleased to have moved our headquarters to downtown Albany in 2018 in partnership with the University at Albany and the State's START-UP NY program, administered by Empire State Development," said Dan Fitzgerald, University of Albany alumni and COO of Key Capture Energy. "I am proud to be a SUNY-educated, New York resident and have the ability to hire talented graduates of the SUNY system to assist with meeting Governor Cuomo's nation-leading energy storage target, as well as the State's commitment to carbon-free electric system by 2040."

Renewable Fuels

Renewable fuels employment remained consistent from 2018 to 2019, adding only a few jobs; for reference, national renewable fuels employment growth was only 1.7 percent over the same period. In general, this sector has experienced a downward trend since 2015, a 16 percent employment decrease (a loss of around 500 jobs). The slight employment growth this year occurred within the other ethanol and non-woody biomass sector (1.7 percent), while the woody biomass sector experienced a slight loss (-0.8 percent).

New York recognizes that renewable fuels are a component of a carbon-neutral economy. As the Climate Action Council develops a scoping plan to achieve that outcome by 2050, on-going efforts will continue to undertake extensive research and policy development to better understand and support the role that renewable fuels will play in a clean energy future.

Figure 27. Renewable Fuels Employment (2015-2020 COVID)

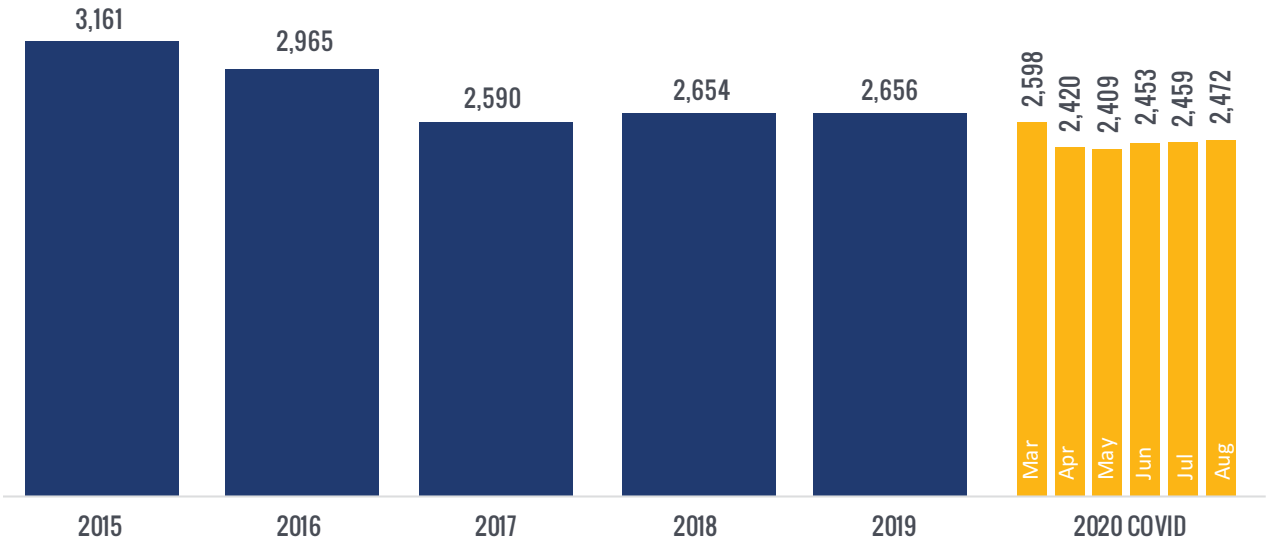
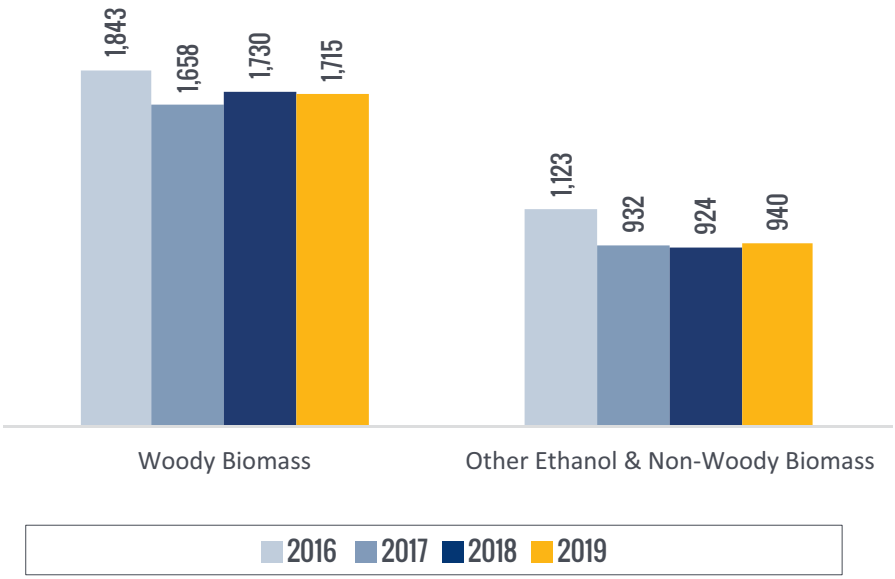


Figure 28. Renewable Fuels Employment by Detailed Technology (2016-2019)[41]



Clean and Alternative Transportation

After a notable increase last year, employment in clean and alternative transportation flattened out to a slight decrease of 0.5 percent (-45 jobs) between 2018 and 2019. Within the clean and alternative transportation sector, hydrogen and fuel cell, hybrid electric, and natural gas all saw employment increases (8.1 percent, 1.4 percent, and 1.1 percent growth respectively). Electric and plug-in hybrid sectors both took a small hit between 2018 and 2019, with employment shrinking 2.6 percent and 3.8 percent respectively. This is in the wake of a strong 2019 NYCEIR report, which saw hybrid and electric vehicles becoming increasingly popular in New York.[42] The sector has also notably been hardest hit by COVID-19 job loss, with employment still sitting 11.1 percent below 2019 levels.

The hybrid electric sector accounted for 44.4 percent of the industry's employment in 2019. Despite declines, the electric and plug-in hybrid sectors still made up 26.2 percent and 20.2 percent, respectively, of the State's clean and alternative transportation employment. Hydrogen and fuel cell and natural gas combined for 9.2 percent of industry jobs. National motor vehicle employment (not specific to clean and alternative transportation) increased by 0.8 percent in 2019 but has been relatively stagnant since 2016.[43]

Figure 29. Clean and Alternative Transportation Employment (2015-2020 COVID)

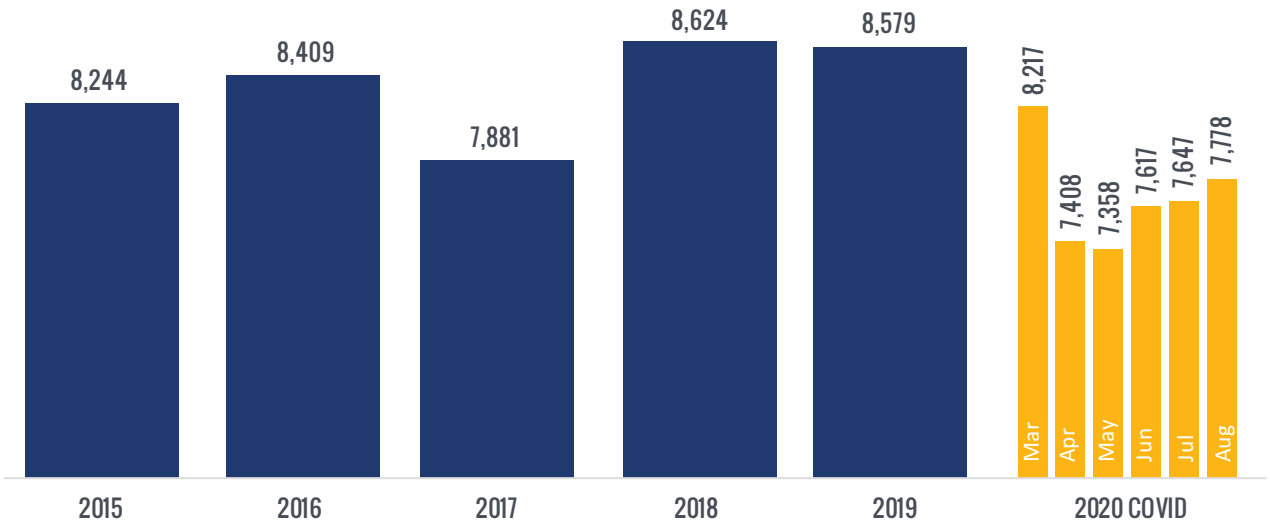
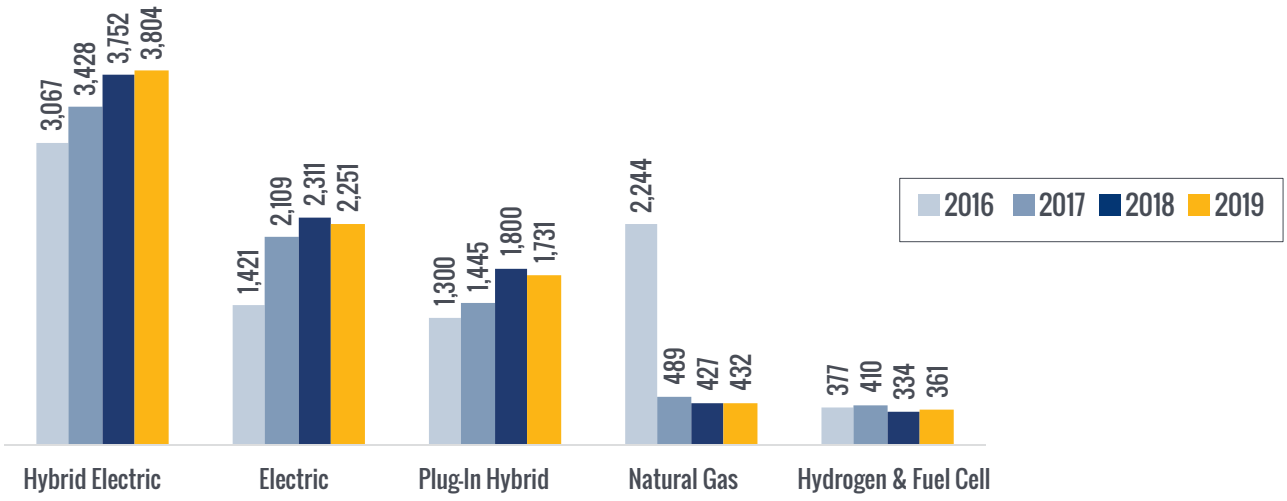


Figure 30. Clean and Alternative Transportation Employment by Detailed Technology (2016-2019)[44]



A Deeper Dive:

Clean and Alternative Transportation

NYSERDA recognizes that the clean and alternative transportation sector is key to New York's cleaner future, as transportation accounts for 36 percent of the State's greenhouse gas emissions.[45] Its Clean Transportation program focuses on developing new technologies, demonstrating underused technologies, and increasing deployment of existing technologies related to cleaner fuels, improved mobility, and congestion reduction.[46]

Through the Charge NY initiative– a collaboration with the New York Power Authority and the New York State Department of Environmental Conservation – NYSERDA offers the Drive Clean Rebate Program, which provides up to $2,000 for the purchase of a new all-electric/battery electric vehicle (BEV) or plug-in hybrid electric (PHEV) car, and the New York Truck Voucher Incentive Program for the conversion of diesel truck fleets to BEV, PHEV, hydrogen fuel cell electric, conventional hybrid electric, compressed natural gas, or propane medium- and heavy-duty vehicles (weight class 3 through 8). Charge NY also includes incentives and best practices for the installation of charging stations, as well as provides data and guides for policymakers.[47] New Yorkers can track electric vehicle growth on NYSERDA's "Electric Vehicle Registration Map" and other alternative fuels vehicle growth on NGV Global News.[48, 49]

In general, practical experience was viewed more favorably than certificates when applicable

To better understand the workforce needs, business challenges, and COVID impacts facing this key sector, in-depth interviews were conducted with industry executives across the State. Hiring difficulty was highly variable across firms, likely dictated by geography and occupation. New York's higher education programs for chemical engineers, for example, were reported to be better at providing qualified applicants than comparable electrical engineer programs. The relatively small R&D sector still relies heavily on professional contacts and university relationships to fill positions. In general, practical experience was viewed more favorably than certificates when applicable; one firm, for example, reported that a strong GitHub repository is significantly more valued than proof of programming course completion.

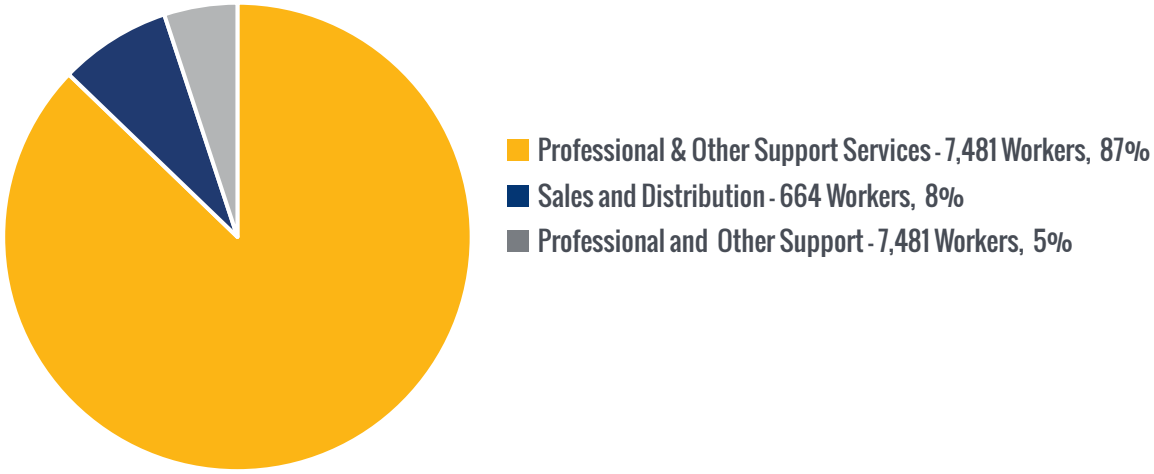
Firms highlight opportunities to expand market focus into the agriculture, manufacturing, and military sectors

In terms of business challenges, employers reported lagging market interest; multiple cited international demand as a much larger portion of sales than local customers. Without a more developed industry, many in-state clean project developers expressed hesitancy to focus efforts on EV charging infrastructure despite the large market potential. Firms also expressed support for expanded efforts to encourage large-scale EV adoption, including calls for mandated or highly incentivized bus and taxi fleet upgrades. Firms also highlighted opportunities to expand market focus into the agriculture, manufacturing, and military sectors.

COVID-19 had immediate impacts on industry supply chains, with heavy international shipping delays. In response, many firms were forced to reduce their workloads and/or focus on areas for internal improvement. However, employers are optimistic about the bounce back, as employment levels have started to return and international professional services have resumed virtually. While the industry's long-term contracts assisted in revenue stability on the micro level, there is some concern that widespread income loss and virtual work will result in reduced vehicle demand on the macro level.

This year, the CEIR inventoried New York clean and alternative transportation firms to estimate employment share by value chain across the sector. New York's clean and alternative transportation workers were mostly found in repair and maintenance and other professional services,[50] which accounts for 87.2 percent of the industry's in-state employment. This was followed by sales and distribution workers (7.7 percent of the industry) and manufacturing workers (5.1 percent).

Figure 31. Clean and Alternative Transportation Employment by Value Chain (2019)



Industry Profile: NOHMs

NOHMs Technologies, established in Rochester in 2011, develops custom electrolyte solutions that improve the safety and stability of lithium-ion batteries. Primarily for use in electric vehicles, the solutions can also improve safety and cost-savings for energy storage technologies, as tested through a NYSERDA-funded study into battery storage applications in city skyscrapers. The firm cites forward-thinking policy, as well as a large supply of skilled chemical engineers, as reason for their New York location. "The State has been very supportive of NOHMS in particular and advanced technologies in general," says Vice President of Business Development Paul Homburger.

Innovation in New York's Clean Energy Economy

This 2020 New York Clean Energy Industry Report focuses on innovation in the clean energy economy, including an analysis of both investment dollars and patents. These innovation metrics help to identify key drivers, challenges, and opportunities for New York's clean energy firms. The 2018 NY CEIR was the last to quantify the State's clean energy innovation funding; this report builds off those previously collected data, with some new sources and classification methods.

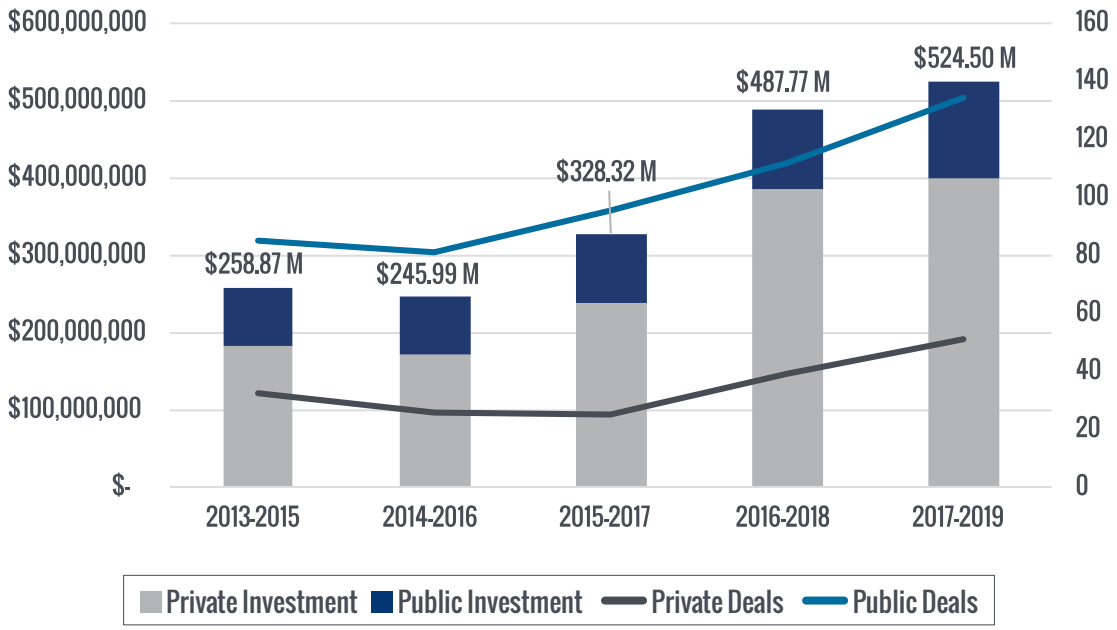
Overall Innovation Funding

Innovation investment data are drawn from a combination of public and proprietary datasets that together account for public grant spending, such as the Department of Energy's Advanced Research Projects Agency-Energy (ARPA-E) and Sunshot, the Small Business Administration's Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR), and all NYSERDA innovation grant funding. Private investments made by venture capitalists and entrepreneurs in clean energy technologies are also included. Innovation funding is tracked by both spending amount and number of investment deals. Since NYSERDA grant funding is counted by program, each program (counted as one "deal") may have multiple benefactors.

NYSERDA's early stage investment in venture development organizations such as incubators and proof-of-concept centers leverages significant additional public and private investment, resulting in outsized market impact.

Between 2013 and 2019, New York attracted a total of $2.8 billion in clean energy innovation funding via 1,063 investment deals. The three-year rolling averages of investment totals had risen steadily since 2014. Total number of deals, however, increased more than total investment money in the last three-year rolling average (21.6 percent and 5.2 percent, respectively), indicating that the average dollar amount per deal has decreased (Figure 32).

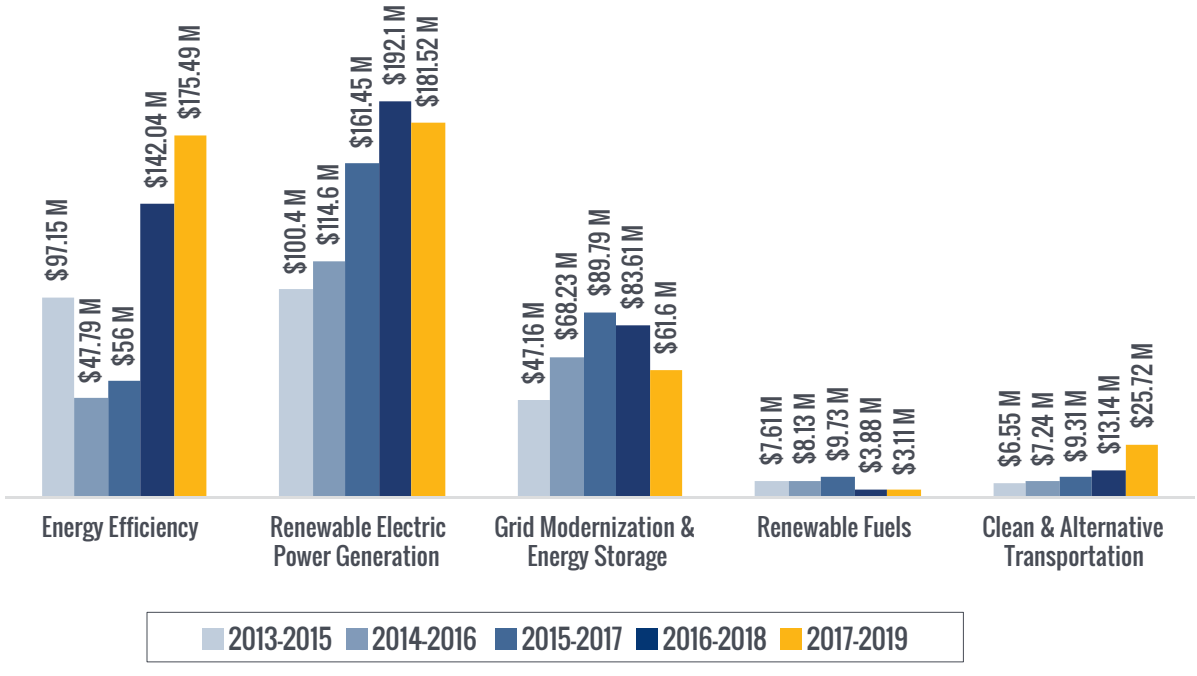
Figure 32. Clean Energy Innovation Funding, Three-Year Rolling Averages, 2013-2019



The renewable electric power generation sector received more than $180 million in investment funding annually over the last three years, 35 percent of all investments. This was followed closely by the energy efficiency sector, which received over $175 million annually, or 33 percent of innovation investment. Despite a slight decrease in the last three-year average of renewable electric power generation (down 6 percent), innovation funding for both sectors had generally risen over the last seven years.

Funding into clean and alternative transportation technologies, despite still only accounting for 5 percent of total investment, had risen dramatically over the previous seven years; the annual average had grown almost 300 percent since 2013-2015. The grid modernization and energy storage and renewable fuels sectors accounted for 15 percent and 1 percent, respectively, of annual investment from 2017 to 2019. Twelve percent of investments were not able to be assigned specifically to a technology sector.

Figure 33. Clean Energy Innovation Funding by Technology, Three-Year Rolling Averages, 2013-2019



Innovation Funding by Phase

Innovation phases cover research and prototyping, demonstration and acceleration, and commercialization and growth.[51] These are roughly based on NASA's Technology Readiness Levels (TRLs),[52] and are described here using data drawn from NYSERDA grant funding, federal datasets for SBIR/ STTR, ARPA-E, and SunShot, as well as proprietary venture-backed investments databases.

Phase I: Research and Prototyping

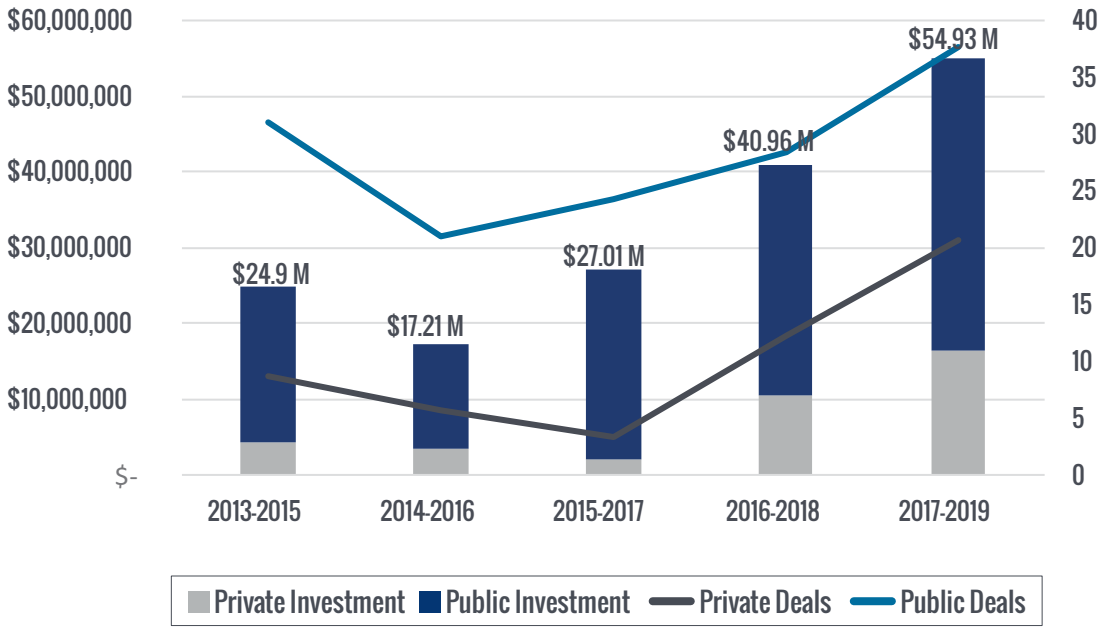
This stage, which begins with basic research and ideation, is typically carried out in universities and public laboratories and includes everything from initial proof of concept work up to bench-testing of prototypes.

Funding for these activities is almost always from public sources, though occasionally it includes angel or seed funding as well as private university funding. Non-funding metrics useful for estimating this phase of activity include academic publications and patent activity. This stage is equivalent to TRL 1 through 4.

Early-stage research funding increased from $17 to $55 million (more than 200 percent growth) over the three-year rolling averages since 2014. In total, clean energy companies and research centers engaged in Phase I activities attracted a total of $270 million in investment dollars through 305 deal rounds between 2013 and 2019; this accounted for roughly 6 percent of New York's total clean energy innovation investments over the seven years. Public funding is critical to early-stage innovation, accounting for 70 percent of total Phase I investment in the past three years.

Early-stage research funding: more than 200% growth over three-year rolling averages since 2014

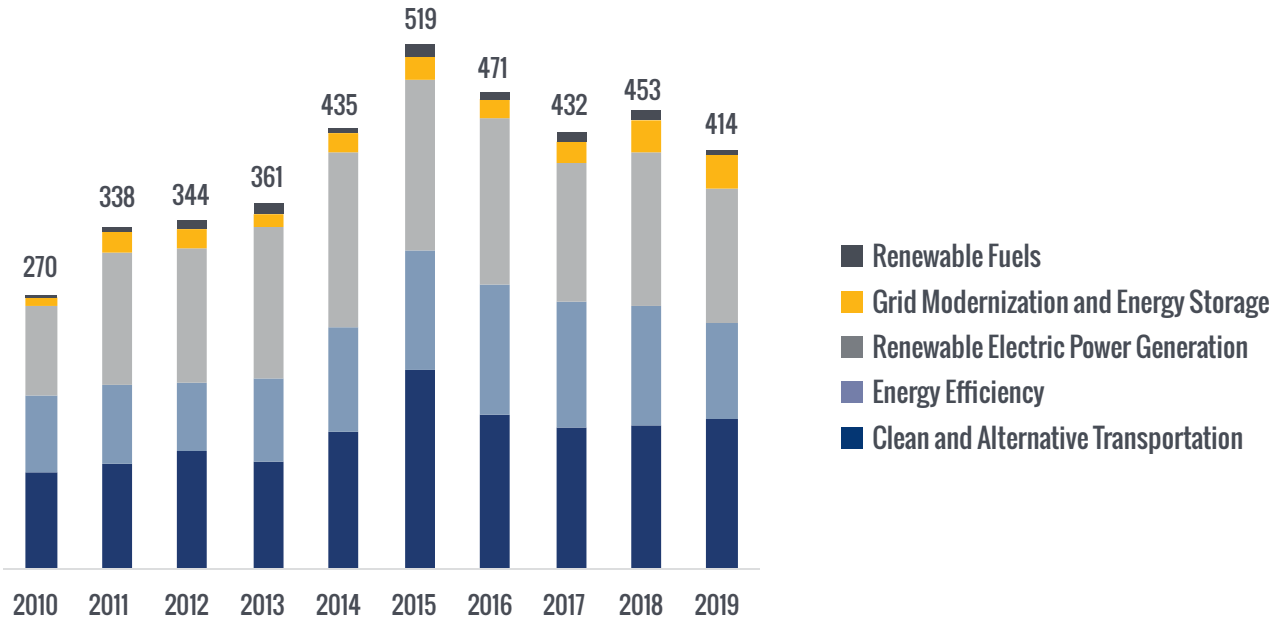
Figure 34. Overall Phase I Investments, Three-Year Rolling Averages, 2013-2019[53]



Patent counts are indicators of academic research and corporate research and development and may suggest level of activity in upstream research and development processes. This report uses patent data filings from the United States Patent and Trademark Office (USPTO).[54]

The total number of clean energy patents increased 53 percent between 2010 and 2019 but fell 20 percent since a peak in 2015 (Figure 35). Every technology increased in total patents over the decade. The renewable electric power generation and clean and alternative transportation sectors more than doubled annual output and secured the most patents since 2010, each capturing roughly one third of all clean energy patents in the decade. The nearly 1,000 patents for energy efficiency technologies account for a quarter of the decade's clean energy patents but saw the slowest annual growth over the period. The grid modernization and energy storage sector observed the largest relative increase in patents over the decade – up more than 300 percent – and accounted for 8 percent of clean patents in 2019.

Figure 35. Clean Energy Patents 2010-2019



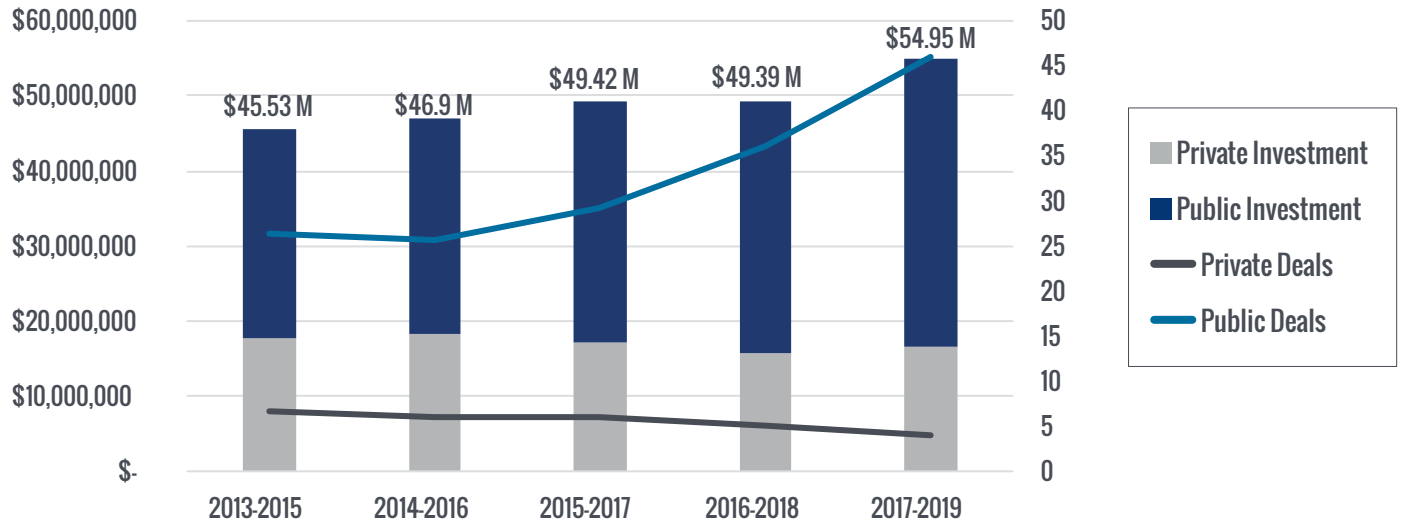
Phase II: Demonstration and Acceleration

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. This stage is equivalent to TRL 5 through 7.

In total, clean energy firms active in Phase II innovation attracted $436 million between 2013 and 2019 (10 percent of total innovation dollars over the timespan). Investment totals have risen gradually for Phase II innovation, but there has been a notable uptick in the number of public investments since 2014. Public deals and programs grew by 58 percent between the 2014-2016 and 2017-2019 rolling averages, accounting for 70 percent of total Phase II innovation dollars in the last three years.

Figure 36. Overall Phase II Investments, Three-Year Rolling Averages, 2013-2019



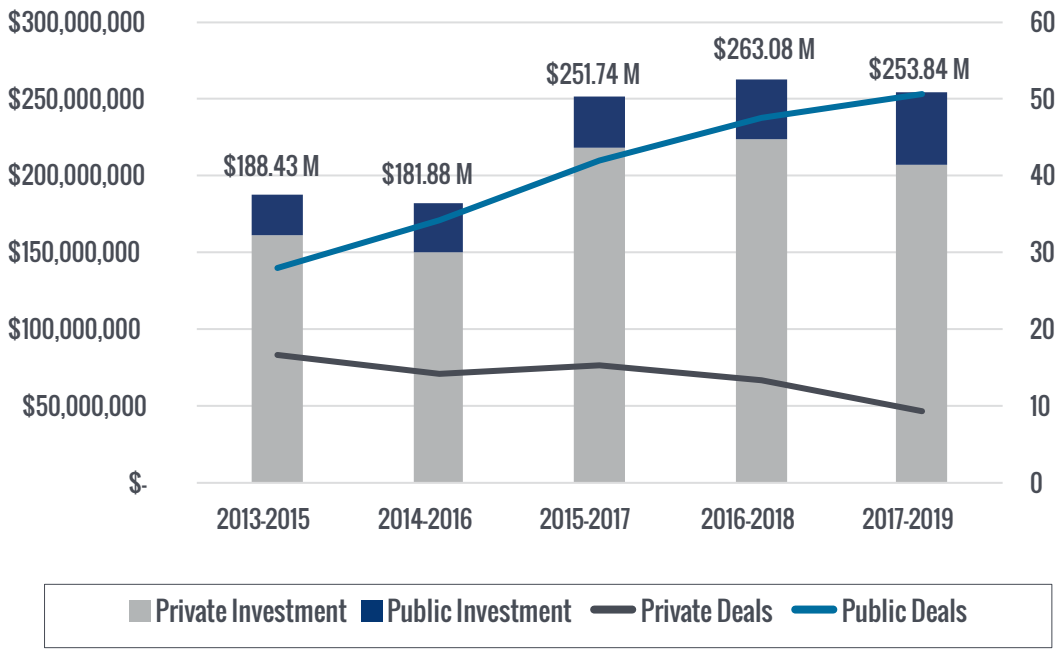
Phase III: Commercialization and Growth

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. This stage is equivalent to TRL 8 through 9.

Clean energy firms with primary technologies in the commercialization and growth stage of innovation attracted the largest proportion of innovation investments—over $3 billion, or roughly 72 percent of total innovation funding, over the last seven years. From 2013 to 2019, measured using three-year rolling averages, investments increased from $188 million to roughly $254 million (35 percent growth). Over the same period, the annual number of private investments fell 44 percent (to 4 annual deals 2017-2019) while the annual number of public investments rose 81 percent (to 46 annual deals).

Figure 37. Overall Phase III Investments, Three-Year Rolling Averages, 2013-2019



Appendix A: Methodology

Research Methodology

The research methodology employed for this report, including the survey instrument and sampling plan, has been reviewed rigorously and accepted by the Department of Energy and Bureau of Labor Statistics. The research methodology has been used by the U.S. Government in its annual Energy and Employment Report (2016 USEER & 2017 USEER) and has been used increasingly as a tool for measuring clean energy industry jobs and businesses across multiple states, including in California, Massachusetts, Florida, Illinois, Iowa, Missouri, Ohio, Pennsylvania, Rhode Island, Tennessee, and Vermont.

The lack of a commonly accepted definition for "clean energy" and the consequent lack of reliable data sources poses a significant challenge in assessing and reporting on the status of this growing industry. Clean Energy, while defined by NYSERDA, does not have a consistent definition across states and nations or a comprehensive set of North American Industry Classification System ("NAICS") codes. As a result, existing data frameworks, which rely on standard industry and occupational codes, do not provide meaningful insight into clean energy trends on their own. Primary data, collected directly from employers, serves as a necessary substitute to ensure the accurate development of clean energy-specific metrics, including employment and establishment totals.

COVID Employment Estimates Methodology

Employment change by industry monthly from February to August 2020 allows us to see differences in COVID-19 related employment impacts between industries. The Bureau of Labor Statistics provides this data in Table B-1 "Employees on nonfarm payrolls by industry sector and selected industry detail," from its Employment Situation news release. Since this data is based on surveys conducted in the second week of each month, it does not capture accurate total job losses for the whole month. For that information, we look to the Department of Labor's Unemployment Insurance Weekly Claims data. By totaling initial claims for all weeks in each month, we get a better picture of how many Americans are jobless. While this is not a perfect count, it allows for a more accurate, up-to-date estimate and illustrates the difference in impacts among states.

Industry employment change premiums are created by taking the percent change in employment of each industry over the national percent change in employment, then subtracting 1. State employment change premiums are made the same way. These state and industry premiums are combined evenly and applied to the national percent change in employment. BLS Local Area Unemployment Statistics (LAUS) also provides monthly employment data by high level industry and state in Table 5 "Employees on nonfarm payrolls by state and selected industry sector," which is then weighted and applied to the industry-state job loss rates. These final industry-state job loss rates are applied to the industry breakdown within each clean energy sector (renewable electric power generation, clean fuels, clean transmission, distribution, and energy storage, energy efficiency, and clean vehicles) for each state resulting in final clean energy employment loss estimates. Clean energy employment data broken out by sector, industry, and state is derived from the 2020 US Energy and Employment Report.

Workforce Analysis Classifications

As survey respondents were able to self-identify which industry they fell into and no formal definitions were provided, it would be improper to suggest that the following categories are pure equivalents. Rather, they should be thought of as generally similar categories that capture the main thrust of the technology categories used throughout the report.

- Alternative Fuel/Electric Vehicles ≈ Clean and Alternative Transportation
- Renewable Energy ≈ Renewable Electric Power Generation
- Energy Efficiency ≈ Energy Efficiency
- Construction or Building Trades ≈ (may contain some energy efficiency otherwise uncaptured)
- Other Clean Energy ≈ a catch-all that captures any other area unmentioned such as renewable fuels

Value Chain

In the interest of presenting reliable estimates for the value chain, some value chain categories were combined or in some cases omitted from this report due to a relatively small number of responses among certain value chain categories within specific technologies.

Data Sources

Jobs and Businesses Data

Jobs and business data are collected from federal data sources, State data sources and employer surveys; survey data references the 12 months between Q4 2018 and Q4 2019. The federal sources used include the Bureau of Labor Statistics' Quarterly Census of Employment and Wages, Current Employment Statistics, and Occupational Employment Statistics, all available publicly at http://bls.gov.

Survey Methodology

The 2020 New York Clean Energy Jobs data was prepared under a Memorandum of Understanding between the Energy Futures Initiative (EFI) and the National Association of State Energy Officials (NASEO) on New York energy employment.[55] These public data are refined and customized for New York based on NYSERDA's definition of the clean energy industry. Supplemental surveys for energy efficiency and solar employers were conducted on behalf of NYSERDA by BW Research Partnership, Inc.

2020 United States Energy and Employment Report (2020 USEER) Survey

Similar to previous reports, this year's Clean Energy Industry Report is based on the 2020 United States Energy and Employment Report (USEER), although growth rates used in this analysis are different from those used in the 2020 United States Energy and Employment Report (USEER). Technology definitions used in the 2020 NYCEIR are not consistent with those used in the USEER, so rates across reports are not comparable.

The 2020 USEER utilized data from the Bureau of Labor Statistics Quarterly Census of Employment and Wages (BLS QCEW 2019 Q2), as well as survey data. The survey was designed and implemented by BW Research Partnership, with management from Energy Futures Initiative (EFI) and the National Association of State Energy Officials (NASEO). For the past decade, national, state, and local energy-related data collection and analysis efforts have used this survey methodology.

The survey uses a stratified sampling plan based on industry code (North American Industry Classification System or NAICS), establishment size, and geography to determine the proportion of establishments that work with specific energy related technologies, as well as the proportion of workers in such establishments that work with the same. These data are then analyzed and applied to existing public data published by the BLS QCEW, effectively constraining the potential universe of energy establishments and employment.

Data is collected for all 50 states and the District of Columbia. BW Research provided additional analysis of data from the Bureau of Labor Statistics, the Energy Information Administration, the U.S. Census Bureau, Emsi, the BW Research Partnership Energy Employment Index, historical data from prior New York Clean Energy Industry Reports, and supplemental primary research conducted in Q3 of 2020. Of important to note, the USEER excludes any employment in retail trade NAICS codes—motor vehicle dealerships, appliance and hardware stores, and other retail establishments.

New York Efficient HVAC and Heat Pump Installer Employer Survey

A supplemental survey of Efficient HVAC and Heat Pump Installer employers was administered in order to assess the varying business impacts related to the COVID-19 pandemic. The survey also included questions related to specific occupations at these firms. The survey instrument was programmed internally by BW Research and each respondent was assigned a unique ID to prevent duplication. Respondents were incentivized with a gift card (provided by BW Research) to participate in the survey and to agree to take a follow up survey in the fall.

In total, 100 respondents participated in the supplemental survey effort. The surveys were administered between July 22nd, 2020 and August 17th, 2020 and the median survey duration was 11.6 minutes.

New York Energy Efficiency (other than Efficient HVAC and Heat Pump Installers) Employer Survey

A supplemental survey of Energy Efficiency employers was administered in order to assess the varying business impacts related to the COVID-19 pandemic. The survey instrument was programmed internally by BW Research and each respondent was assigned a unique ID to prevent duplication. Respondents were incentivized with a gift card (provided by BW Research) to participate in the survey and to agree to take a follow up survey in the fall.

In total, 43 respondents participated in the supplemental survey effort. The surveys were administered between July 22nd, 2020 and August 17th, 2020 and the median survey duration was 4.2 minutes.

New York Solar Employer Survey

A supplemental survey of Solar employers was administered in order to assess the varying business impacts related to the COVID-19 pandemic. The survey instrument was programmed internally by BW Research and each respondent was assigned a unique ID to prevent duplication. Respondents were incentive with a gift card (provided by BW Research) to participate in the survey and to agree to take a follow up survey in the fall.

In total, 163 respondents participated in the supplemental survey effort. The surveys were administered between July 22nd, 2020 and August 17th, 2020 and the median survey duration was 7.9 minutes.

Appendix B: Traditional Energy Overview

This appendix details traditional energy employment for New York derived from the most recent United States Energy and Employment Report (USEER). For the purposes of this 2020 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.[56]

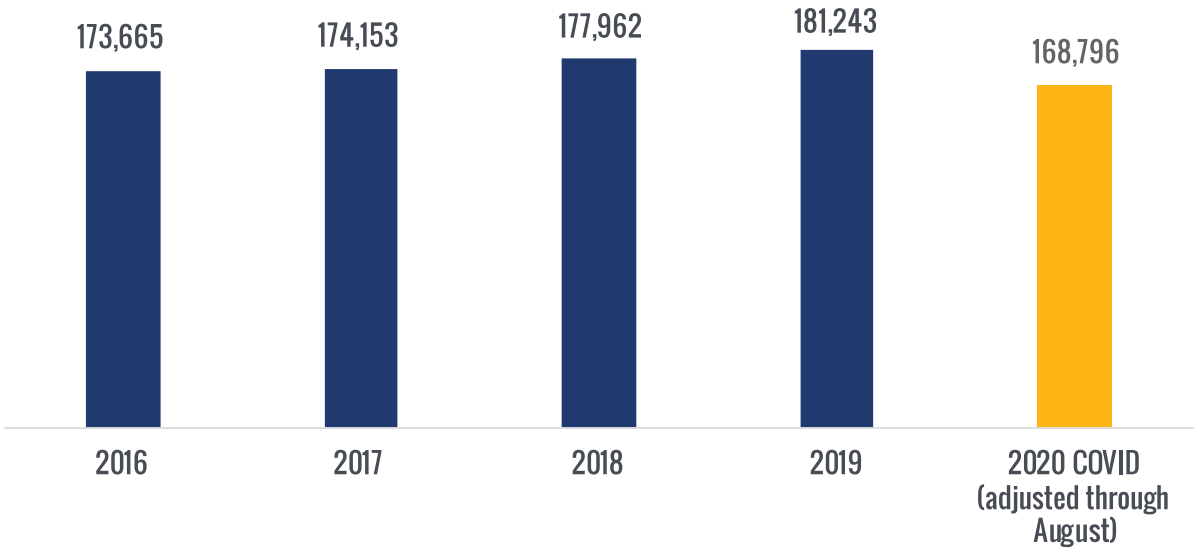
Some of the aspects of the broader energy system that identify within traditional energy will continue to play a role in New York's clean energy future (e.g., sectors such as transmission, distribution, and energy storage and nuclear power generation). However, for consistency and annual comparison purposes, 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 not explicitly labeled as "clean energy workers" due to splitting their time between clean and non-clean energy technologies, working in uncategorized technologies, or not having enough information specified to be able to place them with a primary technology; these workers – which likely do conduct significant clean energy work – were placed in the "other" detailed technologies below.

It is again important to note that this data was collected in the last quarter of 2019, before widespread knowledge of the COVID-19 pandemic, which has significantly altered the labor market and employment nationally and statewide. Therefore, the employment figures presented serve as a baseline of energy industry employment pre-pandemic, with COVID impacts indicated where available.

Overall Employment

New York's traditional energy industry employed 181,243 workers in 2019, a 1.8 percent rise over 2018. Traditional energy employment had grown steadily since 2016 (up 4.4 percent) but has been outpaced by clean energy employment (up 12.3 percent).

Figure 38. New York Traditional Energy Employment, 2016-2020 COVID



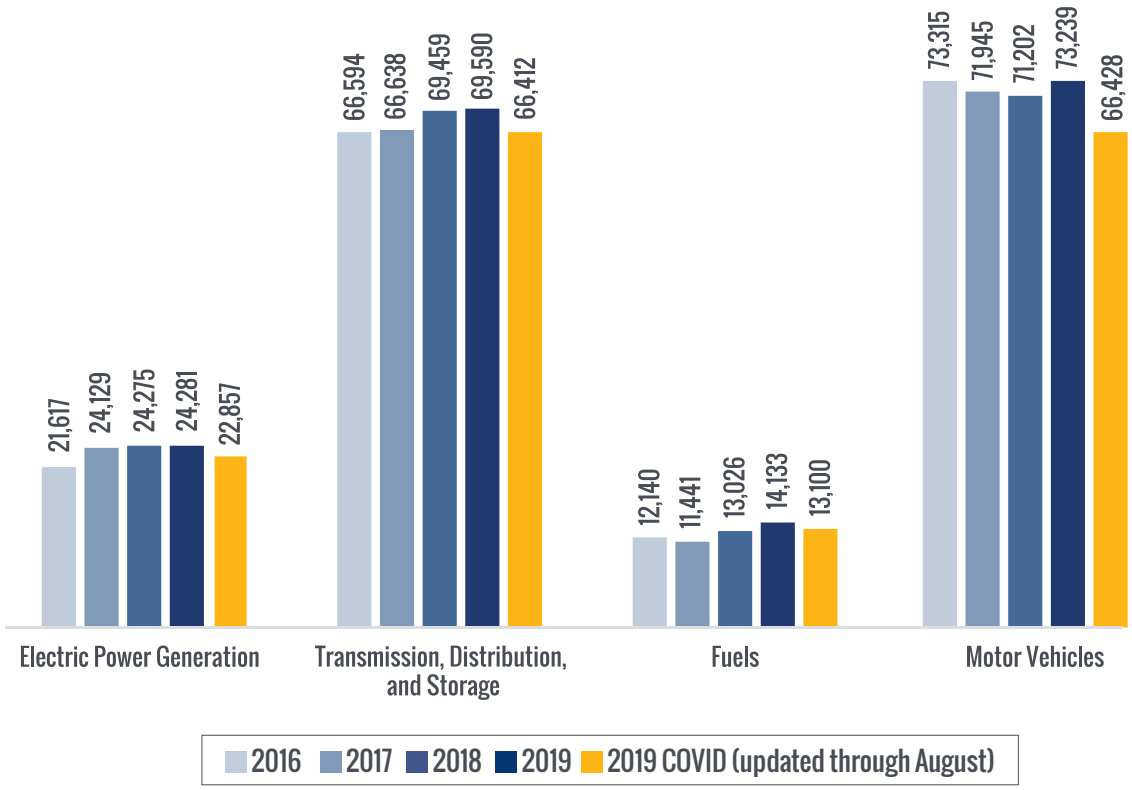
Traditional transmission, distribution, and energy storage was the largest traditional energy sector, employing 69,590 workers in 2019. This accounted for 38 percent of all traditional energy employment. Traditional transmission, distribution, and energy storage employment has steadily increased over the last five years, up 4.5 percent since 2016.

The traditional motor vehicles sector, meanwhile, employed 73,239 workers, 40 percent of the State's traditional energy workforce. The sector grew 2.9 percent over the year, adding 2,037 workers, to return to 2016 employment levels.

The traditional fuels sector observed the largest and most consistent growth, rising 8.5 percent since 2018 (1,107 workers) and 16.4 percent since 2016. The sector employed 14,133 workers in 2019, accounting for eight percent of the State's traditional energy workforce. Traditional electric power generation remained relatively steady at 24,281 workers. The sector accounted for 13 percent of the State's traditional energy employment and had increased 12.3 percent since 2016.

COVID-19 has been hardest on traditional motor vehicles employment, which remained an estimated 9.3 percent below 2019 levels by August 2020. Traditional electric power generation and fuels employment remained about 5.9 and 7.3 percent below 2019 levels, respectively. Traditional transmission, distribution and energy storage had recovered to only 4.6 percent fewer workers in August than in 2019.

Figure 39. New York Traditional Energy Employment by Technology, 2016-2020 COVID[57]

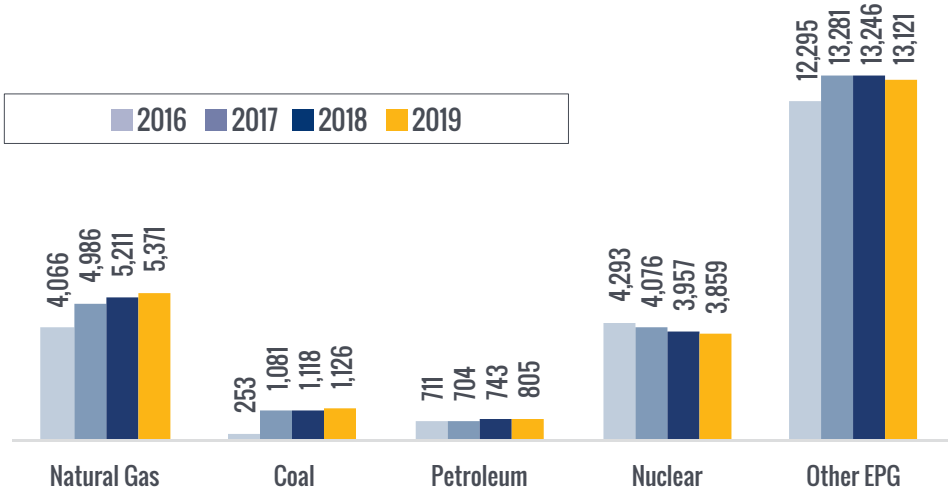


Employment by Technology

Electric Power Generation

The State's leading fossil fuel generation employer was natural gas, which grew 3 percent to a total of 5,371 workers. Coal and petroleum employed 1,126 and 805 workers, respectively. Petroleum's 60 new jobs account for 8 percent growth over the year. Nuclear employment has been on a slight decline over the past five years, falling another 2 percent over 2019 for a total employment loss of 10 percent since 2016. Other electric power generation workers – those not able to be classified into a specific technology – accounted for 7.2 percent of all traditional energy workers in 2019.

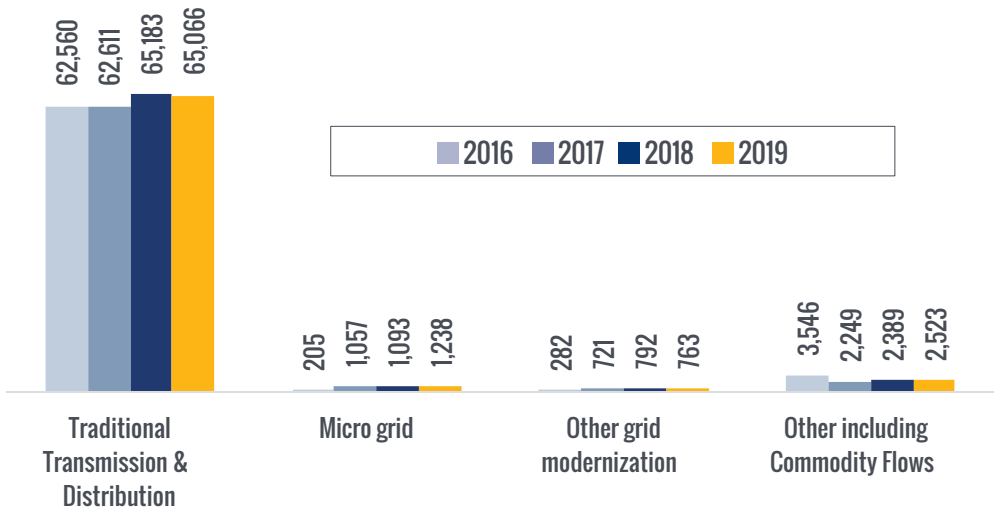
Figure 40. Electric Power Generation Employment, 2016-2019



Transmission, Distribution, and Energy Storage

New York's TDS sector, as in most states, was dominated by traditional transmission and distribution employment, which remained steady over 2019 at 65,066 workers. Micro grid employment, however, grew by 13 percent (adding 145 workers).

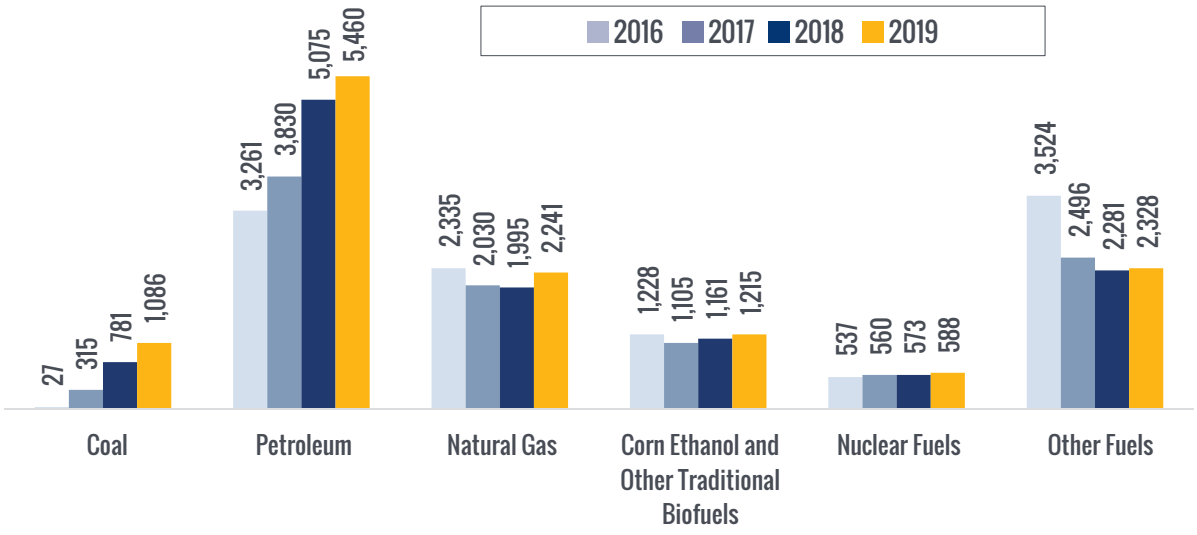
Figure 41. Transmission, Distribution, and Energy Storage Employment, 2016-2019[58]



Fuels

Petroleum, the leading traditional fuels employer, added 385 workers (8 percent growth) to a total of 5,460 workers in 2019. Coal employment, in contrast with national trends, has risen consistently over the past five years; the technology added another 305 workers over 2019, or 39 percent growth. Meanwhile, natural gas employment, after two consecutive years in decline, grew 12 percent to a total of 2,241 workers.

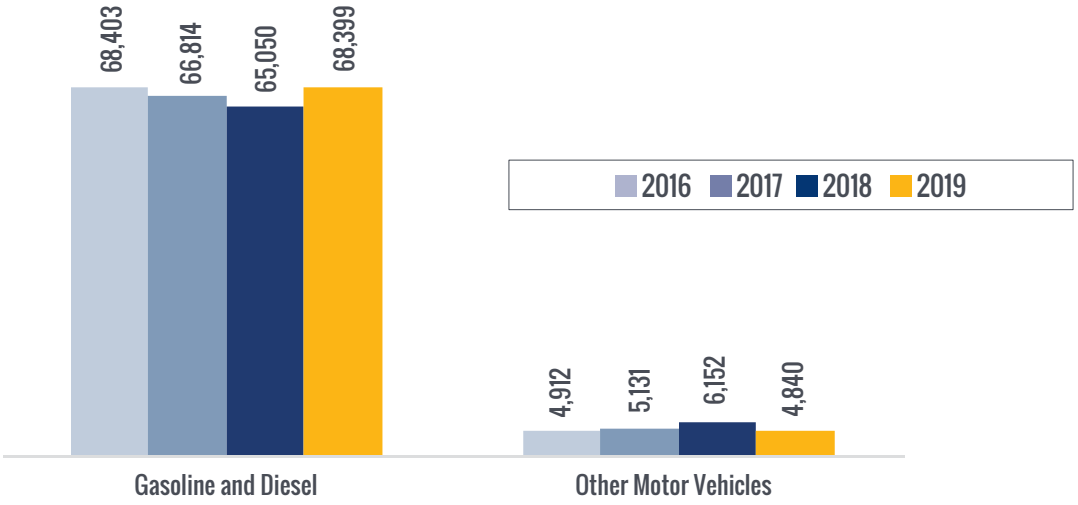
Figure 42. Fuels Employment, 2016-2019[59]



Motor Vehicles and Component Parts

Gasoline and diesel vehicles accounted for 84 percent of the State's total motor vehicles employment; the technology grew 5 percent over the year, adding another 3,350 workers. This growth was a reversal of several previous years of decline. There were 4,840 motor vehicles workers unable to be classified into a specific type of vehicle technology in 2019.

Figure 43. Motor Vehicle and Component Parts Employment, 2016-2019



Appendix C: Economic Impact of Clean Energy Job Growth in New York

Introduction

NYSERDA commissioned BW Research to estimate the economic impact of the net change in clean energy jobs in the state of New York from 2018 to 2019. The first step in this analysis pulled out a New York-specific subset of the United States Energy and Employment Report's (USEER) national dataset. The USEER uses NAICS codes to categorize the jobs that it disaggregates into major technology and sub-technology categories and related value chains. The energy jobs methodology used for USEER is identical to the one used for the 2018, 2019, and 2020 New York Clean Energy Industry Reports (NYCEIR).

To determine the size of the overall clean energy economy in the State of New York, BW Research conducted a further round of modeling in 2020. The research team started with the change in energy jobs calculated using the USEER methodology and entered those values into Emsi I/O, an economic modeling tool comparable to the IMPLAN model used in previous report years. Emsi calculated the impacts of the changes in various categories of New York clean energy jobs on employment, sales, earnings, and value added in New York's wider economy.

Methodology

BW Research used the Emsi I/O, 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 2018 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 Emsi, BW Research identified the clean energy job net change in the State of New York disaggregated by NAICS code between 2018 and 2019, as calculated for the 2020 NYCEIR (i.e. in-scope jobs). All job changes from 2018 to 2019, whether positive or negative, were added as input to Emsi by NAICS code. The study area was set as the State of New York and the event year was set to 2019.

Figure 44: Economic Impact Analysis Model

Model Output

Results from the economic impact analysis included employment[60] (full- and part-time jobs), earnings, value added, and sales. Sales is the gross revenue of the industry, otherwise referred to as total output. 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. Earnings 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 Emsi 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 Emsi 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 Emsi have an impact through the entire value chain (e.g., purchasing Energy Star boilers). So, if the supply chain jobs are entered in Emsi 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 Emsi 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.

The following methodology was developed for the 2018 and 2019 NYCEIR using IMPLAN modeling software. The 2020 NYCEIR has maintained the same core methodology but Emsi Input/Output data was used in place of IMPLAN.

1. **Step 1: Run detailed, individual models for each in-scope industry by NAICS code**

   The research team ran detailed models for each in-scope industry by NAICS code and analyzed the indirect jobs created by each in-scope industry. By creating individual models for each NAICS code, the team gained a better understanding of the jobs created in different indirect industries by each in-scope industry.

2. **Step 2: Compare the number of direct + indirect jobs by industry estimated in Emsi 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 by each in-scope industry, which helped adjust the in-scope jobs based on the number of direct and indirect jobs created in Emsi.

3. **Step 3: Adjust (decrease) the initial in-scope jobs based on the direct + indirect jobs calculated in the Emsi model**

   This step included reducing the in-scope jobs based on the direct + indirect jobs that Emsi estimated. For example, if, based on the construction in-scope jobs, Emsi 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 Emsi model with the "adjusted" in-scope jobs by industry**

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

Final Output

- **Direct** = "adjusted" in-scope industry jobs by industry to account for the indirect jobs Emsi calculates. ***Direct employment consists of the jobs that are created from the initial impact.*** For example, increase in demand and use of electric vehicles increases demand for mechanics who are certified to work on electric vehicles.
- **Indirect** = indirect jobs produced by the model which include in- and out-of-scope industries. ***Indirect jobs are jobs that are created along the supply chain as a result of the direct activity.*** For example, the new mechanic for electric vehicles now needs additional tools, which means increased demand for tool manufacturing.
- **Induced** = all induced jobs calculated in Emsi. ***Induced jobs are jobs that are created as a result of the additional income/wages earned from the direct impact.*** For example, the new electric vehicle mechanic now has more money and subsequently consumes more on healthcare, food at restaurants, and clothing from retailers. A new nurse, waiter, or retail worker hired as a consequence of this activity falls under induced jobs.

Economic Impacts of Clean Energy Jobs on the State of New York

Between 2018 and 2019 there was a positive net change of 5,010 jobs in a variety of clean energy industries. Ultimately, our economic impact analysis finds that **9,169 net jobs were created** due to increased clean energy activity. The industries with the largest job growth were plumbing and HVAC contractors, residential remodelers, electrical contractors and other wiring installation contractors, and commercial and institutional building construction.[61]

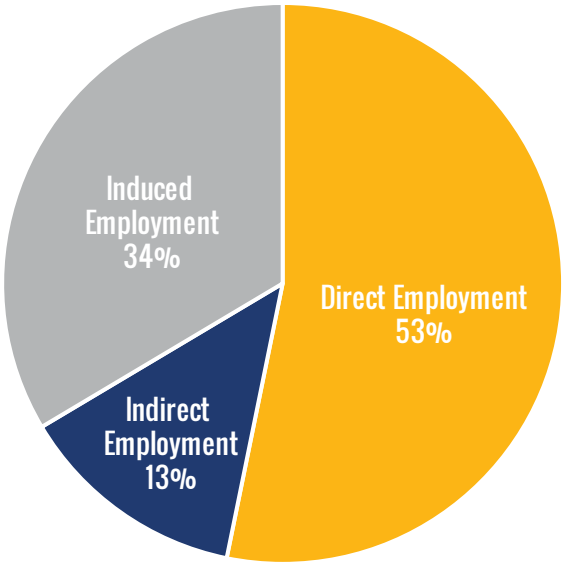
Results from the entry of the 4,878[62] direct jobs estimate into the Emsi economic impact model show that there was a total impact of 9,169 jobs created by clean energy economic activity in 2019, of which 4,878 were direct, 1,215 were indirect jobs, and 3,076 were induced jobs. These jobs were responsible for $1 billion in GDP, $655 million in earnings, and over $1.8 billion in sales (Table 11).

Table 11. Total Economic Impact of the Net Change in Clean Energy Jobs in New York State, 2018-2019

Impact Type	Employment	Value Added	Earnings	Sales
Direct Effect	4,878	$584,556,902	$366,606,389	$984,431,281
Indirect Effect	1,215	$142,940,859	$80,937,490	$252,121,967
Induced Effect	3,076	$311,837,902	$207,001,272	$563,494,234
Total Effect	**9,169**	**$1,039,335,662**	**$654,545,151**	**$1,800,047,482**

Induced impacts were larger than indirect impacts; 34 percent of the jobs created were induced and 13 percent were indirect jobs (Figure 45).

Figure 45. Portion of Jobs Created by Type of Impact



Direct Industries

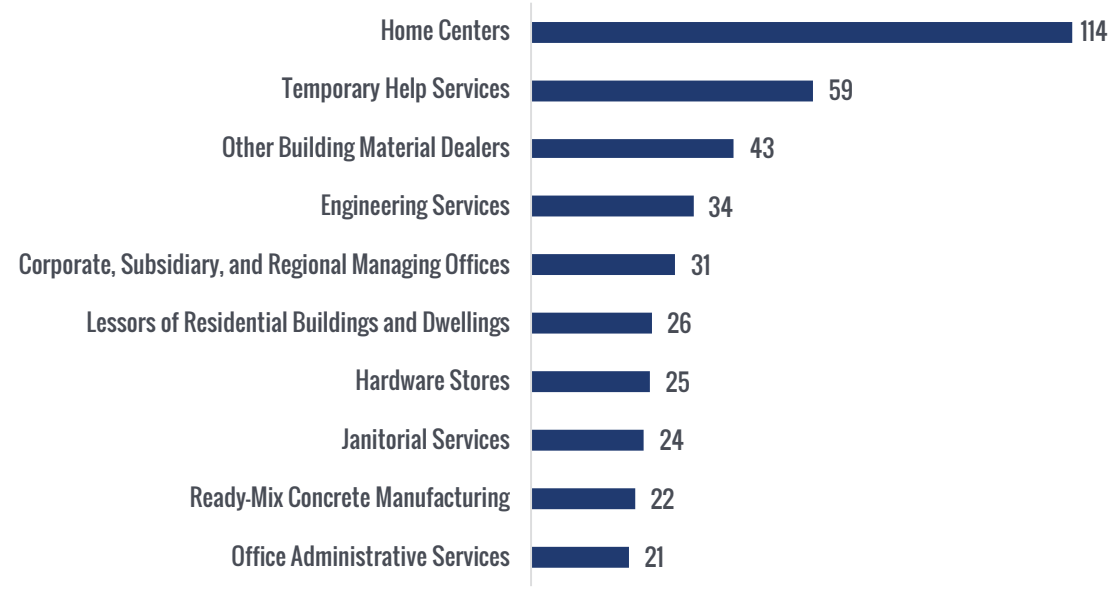
The clean energy industries with the largest direct job growth fall mostly in the energy efficiency sector and include plumbing and HVAC contractors, residential remodelers, electrical contractors and other wiring installation contractors, commercial and institutional building construction, software publishers, environmental organizations, and specialty trade contractors (Figure 46).

Figure 46. Top 10 Clean Energy Direct Industries in New York State by Employment, 2019

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 2018-2019 were home centers, temporary help services, building material dealers, engineering services, corporate managing offices, hardware stores, concrete manufacturers, office admin, and janitorial services (Figure 47).

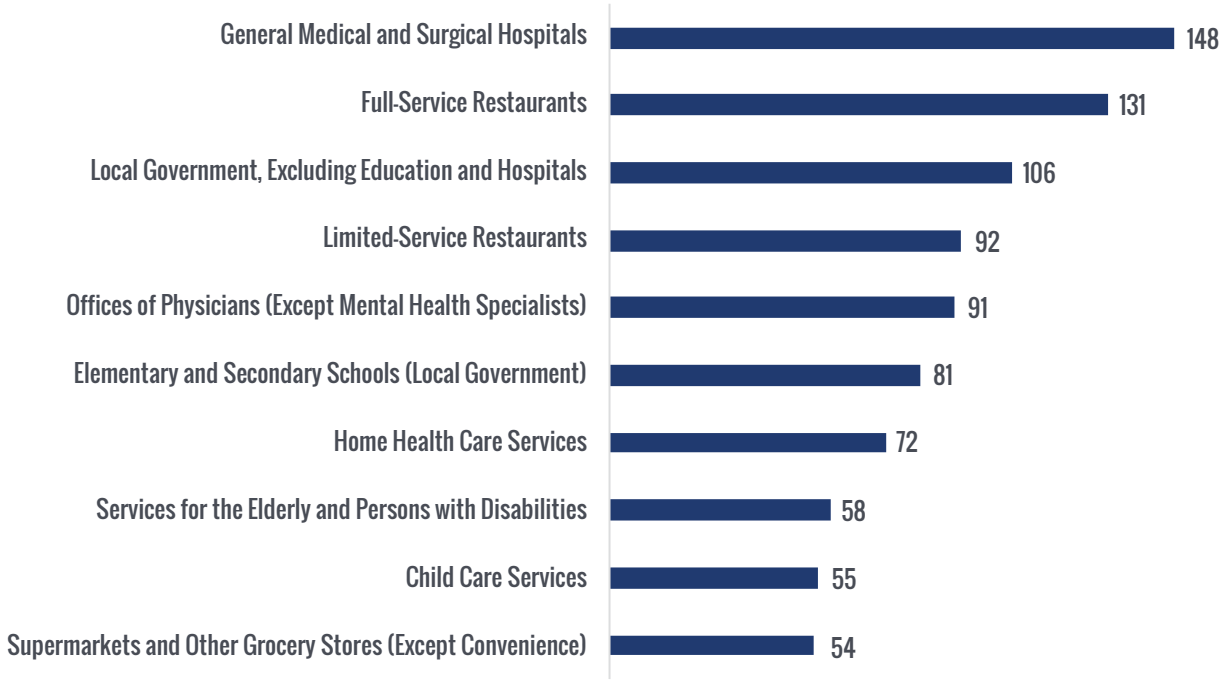
Figure 47. Top 10 Supply Chain (Indirect) Industries in New York State by Employment, 2019[63]



Induced Industries

Whereas clean energy supply chain industries feel the effects of clean energy firms' additional investments and spending, other industries feel the ("induced") effects of clean energy workers' spending of their wages in the State. These effects are felt in hospitals, restaurants, health care services, supermarkets, child day care services, and secondary education (Figure 48). Recognizing the job growth 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 48. Top 10 Induced Industries in New York State by Employment, 2019[64]



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 $78 million in State and local taxes on production and imports and nearly $18 million in federal taxes on production and imports (Table 12).

Table 12. Impact of New York Clean Energy Jobs on Taxes on Production and Imports, 2019

Taxes	Impact on Taxes
State and Local Taxes	$78,147,777
Federal Taxes	$17,622,966

Job Distribution

As mentioned previously, this study's economic analysis used multiple individual models to understand the relationship between direct and indirect jobs across multiple industries. This approach makes it possible to estimate the distribution of direct, indirect, and induced jobs created in New York by activity in the clean energy industry. For example, as Table 13 shows, the specialty trade contracting jobs created by clean energy industry activity are predominantly a direct result of that activity—that is, the money flowing to specialty trade contractors results with minimal exceptions in the hiring of trade contractors to install clean energy related products. By contrast, the money flowing from the clean energy industry to professional, scientific, and technical service firms results in the hiring of employees whose work relates indirectly or not at all to clean energy industry activity.

Table 13. Type of Job Created by In-Scope Industry[65]

Industry Description	Direct Employment	Indirect Employment	Induced Employment
Utilities	88%	4%	7%
Construction of Buildings	98%	0%	2%
Heavy and Civil Engineering Construction	98%	0%	2%
Specialty Trade Contractors	98%	0%	2%
Industrial Gas Manufacturing	97%	2%	2%
Mineral Wool Manufacturing	122%	-21%	-1%
Fabricated Metal Product Manufacturing	140%	-38%	-2%
Machinery Manufacturing	97%	3%	0%
Computer and Electronic Product Manufacturing	99%	1%	0%
Electrical Equipment, Appliance and Component Manufacturing	110%	-9%	-1%
Wholesale Trade	95%	3%	3%
Software Publishers	95%	3%	2%
Investment Advice	190%	1%	-92%
Professional, Scientific, and Technical Services	80%	11%	9%
Offices of Other Holding Companies	100%	0%	0%
Repair and Maintenance	104%	-3%	-1%
Religious, Grantmaking, Civic, Professional, and Similar Organizations	101%	1%	-2%

Out-of-Scope Industries

One benefit of using an economic model like Emsi is that it identifies job growth in industries that are affected by the clean energy industry but are not part of that industry. Identifying job growth in these "out-of-scope" industries provides us with 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. The table below 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 growth in those industries.

Table 14. New York's Clean Energy Out-of-Scope Indirect Industries[66]

Industry Description	Indirect Jobs
Home Centers	114
Temporary Help Services	59
Other Building Material Dealers	43
Corporate, Subsidiary, and Regional Managing Offices	31
Lessors of Residential Buildings and Dwellings	26
Hardware Stores	25
Janitorial Services	24
Ready-Mix Concrete Manufacturing	22
Office Administrative Services	21
Nursery, Garden Center, and Farm Supply Stores	20
Offices of Real Estate Agents and Brokers	19
All Other Professional, Scientific, and Technical Services	18
Couriers and Express Delivery Services	17
Full-Service Restaurants	16
Other Activities Related to Real Estate	16
Security Guards and Patrol Services	15
Wholesale Trade Agents and Brokers	13
General Warehousing and Storage	13
Landscaping Services	12
General Freight Trucking, Local	12
Professional Employer Organizations	12
Lessors of Nonresidential Buildings (except Miniwarehouses)	12
General Freight Trucking, Long-Distance, Truckload	10

Appendix D: Regional Clean Energy Employment

While New York County employed the most clean energy workers (47,960), Wayne County boasted the highest concentration of clean energy workers. In 2019, the clean energy industry accounted for 40 in every 1,000 workers in the county, a total of 1,190 workers, supported by State-leading adoption of community solar projects. Warren, Saratoga, Schenectady, and Lewis counties all found at least 20 in 1,000 workers in their total workforce were employed by the clean energy industry; with the clean energy industry employing 1,010 workers, 1,970 workers, 1,280 workers, and 137 workers, respectively.

Table 15. Clean Energy Employment by County (2019)

County Name	Clean Energy Jobs	County Name	Clean Energy Jobs	County Name	Clean Energy Jobs
Albany	3,838	Herkimer	173	Richmond	2,265
Allegany	194	Jefferson	490	Rockland	2,277
Bronx	3,096	Kings	8,267	St. Lawrence	373
Broome	1,255	Lewis	137	Saratoga	1,965
Cattaraugus	240	Livingston	310	Schenectady	1,277
Cayuga	488	Madison	226	Schoharie	158
Chautauqua	755	Monroe	5,835	Schuyler	62
Chemung	564	Montgomery	254	Seneca	57
Chenango	196	Nassau	12,399	Steuben	640
Clinton	482	New York	47,957	Suffolk	14,785
Columbia	338	Niagara	1,222	Sullivan	284
Cortland	183	Oneida	1,074	Tioga	90
Delaware	142	Onondaga	3,927	Tompkins	829
Dutchess	1,934	Ontario	811	Ulster	944
Erie	8,909	Orange	2,224	Warren	1,011
Essex	137	Orleans	171	Washington	171
Franklin	166	Oswego	500	Wayne	1,186
Fulton	125	Otsego	190	Westchester	8,827
Genesee	313	Putnam	644	Wyoming	178
Greene	167	Queens	11,786	Yates	91
Hamilton	16	Rensselaer	1,152	N/A	2,996

Figure 49. Clean Energy Employment Jobs per 1,000 Total Jobs, by County

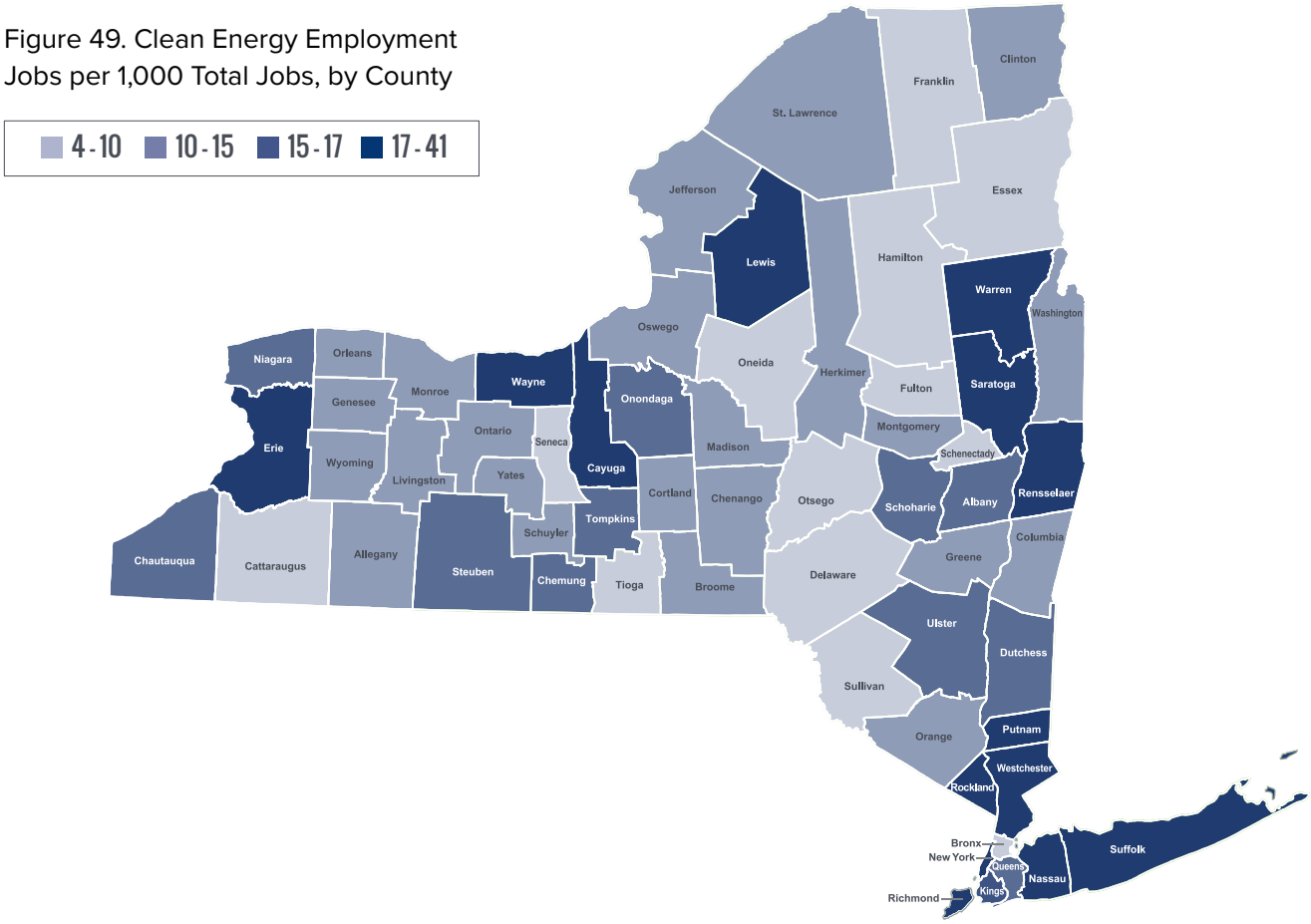


Figure 50. Clean Energy Employment Jobs per 1,000 Total Jobs, by REDC

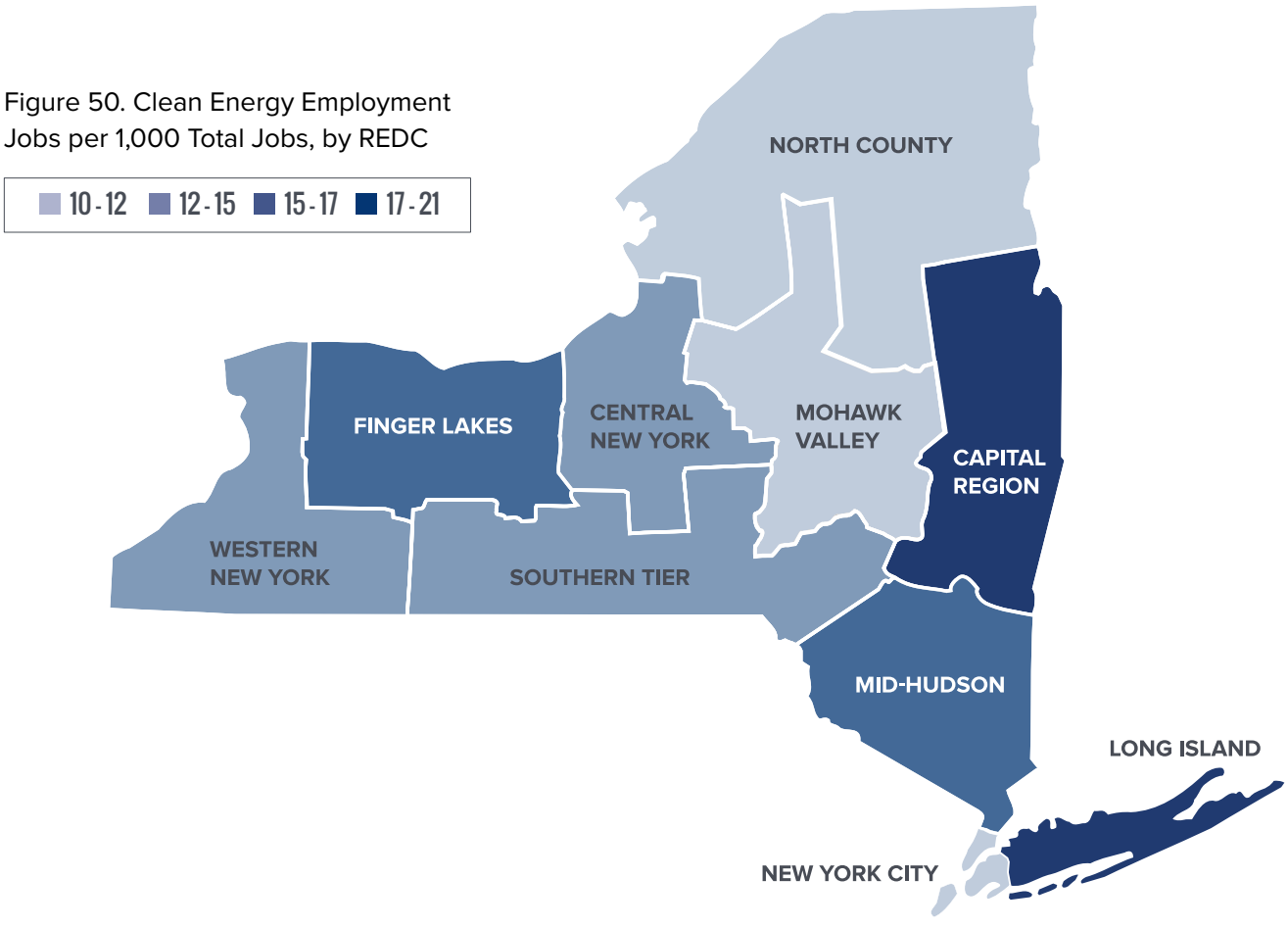


Table 16. Clean Energy Employment Jobs per 1,000 Total Jobs, by REDC (2019)

REDC	Clean Energy Jobs per 1,000
Capital Region	18
Central New York	14
Finger Lakes	16
Long Island	20
Mid-Hudson	17
Mohawk Valley	11
New York City	12
North Country	13
Southern Tier	13
Western New York	15

Appendix E: Training Inventory

Program	Provider	City
ElectroniAcs Associate of Applied Science: Renewable Energy Systems Concentration	Bramson ORT College	Forest Hills
Electronics Associate of Applied Science: HVAC Control Systems Concentration	Bramson ORT College	Forest Hills
Bachelor of Architecture	Cooper Union for the Advancement of Science and Art	New York
Parsons' BFA Architectural Design Degree Program	The New School	New York
Architectural Studies (B.A.)	Ithaca College	Ithaca
Architectural Technology (AAS)	SUNY College of Technology at Alfred	Alfred
Architectural Technology (BS)	SUNY College of Technology at Alfred	Alfred
Bachelor of Architecture	University at Buffalo	Buffalo
Bachelor of Architecture	Pratt Institute	Brooklyn
Master of Architecture Degree	Rochester Institute of Technology	Rochester
Bachelor of Architecture	New York Institute of Technology (NYIT)	Old Westbury
Bachelor of Architecture	City College of New York (CCNY)	New York
Master of Architecture Program	Columbia University	New York
Bachelor of Architecture Degree	Cooper Union	New York
BFA Architectural Design Degree Program	Parsons School of Design	New York
Bachelor of Architecture	The City College of New York	New York
Five-year BArch curriculum	Syracuse University	Syracuse
Bachelor of Architecture (Professional)	Rensselaer Polytechnic Institute	Troy
Undergraduate Architecture Program	Cornell University	Ithaca
Home Inspection Licensing	Molloy College	Rockville Centre
Building Operator Certification Level 1 (BOC-1)	The City University of New York	New York
Construction Technology (AAS)	SUNY College of Technology at Delhi	Delhi
Certificate in Building Construction	Long Island University - Brooklyn Campus	Brooklyn
Construction Management	Pratt Institute-Main	Brooklyn
Associate of Applied Science in Building and Construction	Pratt Institute-Main	Brooklyn
Associate in Applied Science in Construction Management, Bachelor of Technology in Construction Technology	CUNY New York City College of Technology	Brooklyn
Construction Management	Polytechnic Institute of New York University	Brooklyn
Residential Construction A.O.S.	Morrisville State College	Morrisville
Construction Management Engineering Technology	Farmingdale State College	Farmingdale
Construction Management, M.S.	New York University	New York
Construction Project Management Certificate	Pace University - New York	New York

Program	Provider	City
Program	**Provider**	**City**
Certificate in Real Estate Construction Project Management	CUNY Bernard M. Baruch College	New York
Construction Management	Utica College	Utica
Construction Management	SUNY College of Environmental Science and Forestry	Syracuse
Construction Technology: Management - A.A.S.	SUNY College of Technology at Canton	Canton
Electrical Construction and Maintenance Electrician - AOS Degree	Alfred State College — Tech College	Alfred
Electrical Engineering Technology - BTECH	New York City College of Technology	Brooklyn
Electrical Construction & Maintenance - Certificate	State University of New York (SUNY) at Canton	Canton
Energy Management, M.S.	New York Institute of Technology	Old Westbury
Energy Management, M.S.	New York Institute of Technology	Old Westbury
Environmental and Sustainable Engineering	SUNY at Albany	Albany
Mechanical Engineering Technology AAS Degree	SUNY College of Technology at Alfred	Alfred
Mechanical Engineering Technology BS Degree	SUNY College of Technology at Alfred	Alfred
Environmental Engineering (BS)	University at Buffalo	Buffalo
Mechanical Engineering Technology	Rochester Institute of Technology	Rochester
Mechanical Engineering	University of Rochester	Rochester
BA in Engineering Science	University of Rochester	Rochester
Chemical Engineering	Cooper Union for the Advancement of Science and Art	New York
Civil Engineering	Cooper Union for the Advancement of Science and Art	New York
Electrical Engineering	Cooper Union for the Advancement of Science and Art	New York
Mechanical Engineering	Cooper Union for the Advancement of Science and Art	New York
General Engineering	Cooper Union for the Advancement of Science and Art	New York
Mechanical Engineer	SUNY Polytechnic Institute	Utica
Bachelor of Science in Building Sciences	Rensselaer Polytechnic Institute	Troy
BS Engineering Science	College of Staten Island CUNY	Staten Island
AS Engineering Science	College of Staten Island CUNY	Staten Island
Civil and Environmental Engineering Technology (B. Tech)	SUNY College of Technology at Canton	Canton
Civil Engineering Technology (A.A.S.)	SUNY College of Technology at Canton	Canton
Construction Technology: Management (A.A.S.)	SUNY College of Technology at Canton	Canton
Electrical Engineering Technology (A.A.S.)	SUNY College of Technology at Canton	Canton
Electrical Engineering Technology (B. Tech)	SUNY College of Technology at Canton	Canton
Engineering Science (A.S.)	SUNY College of Technology at Canton	Canton
Industrial Technology Management (B. Tech)	SUNY College of Technology at Canton	Canton

Program	Provider	City
Mechanical Engineering Technology (A.A.S.)	SUNY College of Technology at Canton	Canton
Program	**Provider**	**City**
Mechanical Engineering Technology (B. Tech)	SUNY College of Technology at Canton	Canton
Mechatronics Technology (B.S.)	SUNY College of Technology at Canton	Canton
Sustainable Energy Technology (B. Tech)	SUNY College of Technology at Canton	Canton
The Civil Engineering Undergraduate Program	Stony Brook University	Stony Brook
The Engineering Science Program	Stony Brook University	Stony Brook
The Accelerated (Five-year) Bachelor of Engineering/Master of Science Program	Stony Brook University	Stony Brook
Mechanical Engineering	State University of New York at New Paltz	New Paltz
Electrical Engineering	State University of New York at New Paltz	New Paltz
Engineering Science A.S.	SUNY Morrisville	Morrisville
Heating, Ventilation, and Air Conditioning	Alfred State College-School of Applied Technology Campus	Wellsville
Heating, Ventilating and Air Conditioning (AAS)	SUNY, Delhi	Delhi
Associate of Applied Science in Environmental Control Technology	New York City College of Technology	Brooklyn
Environmental Control Technology - AAS	City College of New York	New York
HVAC/R Certified Technician	Wagner College	Staten Island
Machine Tool Technology	SUNY College of Technology at Alfred	Alfred
Manufacturing and Mechanical Systems Integration	Rochester Institute of Technology	Rochester
Bachelor of Architecture	SUNY College of Technology at Alfred	Alfred
Mechanical Engineering	Syracuse University	Syracuse
Master of Engineering in Systems Engineering	Cornell University	Ithica
Online Clean Energy Program/Training: Construction	University of Cincinnati	Online
Online Clean Energy Program/Training: Construction	Louisiana State University (LSU)	Online
Automotive Management Technology (BS) Program	SUNY Farmingdale	Farmingdale
Online Clean Energy Program/Training: Electrical	Carrier University	Syracuse
RPI Light Research Center	RPI	Troy
Energy Innovation and Emerging Technologies Certificate Courses	Stanford University	Online
Energy Management Bachelors' Degree Program	Everglades University	Online
Energy Innovation and Emerging Technologies Certificate Courses	Stanford University	Online
Materials for Packaging and Energy Storage	Binghamton University	Vestal
Sustainable Energy Technology	SUNY Canton	Canton
Renewable Energy Engineering	Alfred University	Alfred
Sustainable Energy Systems	SUNY Cortland	Cortland
Environmental Sustainability	Oneonta - SUNY	Oneonta
Energy Studies (Minors)	Union College	Schenectady

Program	Provider	City
Environmental and Energy Technologies Internship	Cobleskill - SUNY	Cobleskill
Sustainability Studies	Stony Brook - SUNY	Stony Brook
Program	**Provider**	**City**
Energy Innovation and Emerging Technologies Certificate Courses	Stanford University	Online
Heating, Ventilation, Air Conditioning & Refrigeration	Binghamton University - SUNY	Binghamton
ARC 473LEC Environmental Controls: Thermal Environmental Systems & ARC 573LEC Environmental Systems 2	University at Buffalo - SUNY	Buffalo
Facility Management Technology (BS) Program	SUNY Farmingdale	Farmingdale
Online Clean Energy Program/Training: HVAC	Carrier University	Syracuse
Sustainable Energy Technology - B. Tech	Canton - SUNY	Canton
Online Clean Energy Program/Training: HVAC	University of Cincinnati	Online
Electrical Engineering Technology	Buffalo State - SUNY	Buffalo
NABCEP Solar PV Training	New York City College of Technology	Brooklyn
Sustainable Energy Technology	SUNY Canton	Canton
Residential & Small Commercia Energy Storage	New York City College of Technology	Brooklyn
NABCEP Solar PV Training/Associate Program	SUNY Farmingdale	Farmingdale
Energy Innovation and Emerging Technologies Certificate Courses	Stanford University	Online
Renewable Energy and Sustainability Center	SUNY Farmingdale	Farmingdale
Energy and its Impacts	Syracuse University	Syracuse
Energy Systems Minor (within College of Engineering and Computer Science)	Syracuse University	Syracuse
HVAC and Refrigeration Engineering Technology	SUNY College of Technology at Canton	Canton
Online Clean Energy Program/Training: Biomass	European Energy Centre (EEC)	Online
Multifamily Building Operator Prep course	Association for Affordable Energy Incorporated	New York
Residential Energy Auditor Level One Prep course	Association for Affordable Energy Incorporated	New York
Residential Energy Auditor Level Two Prep course	Association for Affordable Energy Incorporated	New York
Multifamily Building Analyst	Association for Affordable Energy Incorporated	New York
Residential Energy Auditor Level One	Association for Affordable Energy Incorporated	New York
Multifamily Retrofit Project Manager	Association for Affordable Energy Incorporated	New York
Retro-Commissioning for Energy Efficiency	Association for Affordable Energy Incorporated	New York
Energy Efficient Building Operations Specialist	Association for Affordable Energy Incorporated	New York

Program	Provider	City
Healthy Home Evaluator (HHE)	Association for Affordable Energy Incorporated	New York
Data Center Certified Associate(DCCA)	Schneider Universities	Online
Training Package: Building Analyst	BD+C University	Online
Program	**Provider**	**City**
Training Package: Building Analyst	ESCO Institute (ESCO Group)	Online
Building Analyst Training	Green Training USA	Online
Construction Training Program	Nubian (New) Directions/Youth Build	Poughkeepsie
Concepts and Techniques of Green Construction	Urban League of Rochester	Rochester
Energy Efficiency and Renewable Energy Training	Envirolution One	New York
Online Program/Training: Construction	STRIVE	New York
Construction Training Program and Continuing Education	Social Enterprise and Training (SEAT) Center/Youth Build and other programs	Schenectady
Construction Training Program and Continuing Education	Ulster Youthbuild, LLC	Ulster
Continuing Education, Credentials available	Green Building Institute (GBRI)	New York
Online Clean Energy Program: Construction	Heatspring	Online
Construction Training Program	American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)	Online
Construction Training Program	BD+C University	Online
Online Program/Training: Construction	Ecotech Training	Online
Online Program/Training: Construction	Hanleywood University	Online
Building Science Training	Everblue Training Institute	Online
Construction Training Program and Continuing Education	Green Training USA	Online
Online/Campus Specific LEED Training	Leading Green	Online
Online Clean Energy Program: Electrical	Heatspring	Online
NERC Continuing Education	360 Training	Online
Online Program/Training: Electrical	ITC Learning	Online
Electrical Training Videos	Mastery Training Services	Online
Environmental Education Programming	Solar One	Queens
Energy Efficiency Training Programs	Association for Energy Affordability	New York
Energy Corps AmeriCorps Program	Americorp. Corp	New York
Energy Efficiency Inspection Training	Everblue Training Institute	Online
Energy Efficiency Training and Certification Programs	American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)	Online
Energy Efficiency Training Package	ESCO Institute (ESCO Group)	Online
Online Clean Energy Program/Training: Energy Efficiency	European Energy Centre (EEC)	Online
Certified Passive House Tradesperson (CPHT)	Association for Affordable Energy Incorporated	New York

Program	Provider	City
Operation and Monitoring of Energy Management Systems	Association for Affordable Energy Incorporated	New York
Professional Energy Manager (PEM)	Schneider Universities	Online
NERC Continuing Education	360 Training	Online
Online Learning/Continuing Education courses: Energy Management	Hanleywood University	Online
Program	**Provider**	**City**
Battery Storage: Understanding the Battery Revolution	Class Central	Online
Technical and Academic Advancement Support Programs	Northland Workforce Training Center	Buffalo
General Clean Energy Continuing Education and Professional Development	The Osbourne Association	New York
YouthBuild	Youth Action Youth Build	New York
Online Clean Energy Program/Training	European Energy Centre (EEC)	Online
Energy Efficiency Training	Renac Renewables Academy	Online
Heating Professional	Association for Affordable Energy Incorporated	New York
Build Automation and Energy Management Systems	Stacks and Joules	New York
HVAC and Facilities Management Training	Tauris Tech	New York
HVAC Associates Program	North American Board-Certified Energy Practitioners (NABCEP)	Clifton Park
Online Clean Energy Program: HVAC	Heatspring	Online
NERC Continuing Education	360 Training	Online
HVAC Training and Certification Programs	American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)	Online
HVAC Training Package	ESCO Institute (ESCO Group)	Online
Online Learning/Continuing Education courses: HVAC	Hanleywood University	Online
HVACR Industry training and reference materials	Refrigeration Service Engineers Society (RESI)	Online
Online Maintenance and Safety Training	TPC Training	Online
HVAC credited and non-credited trainings/ Continuing Education	Green Training USA	Online
HVAC Training Videos	Mastery Training Services	Online
HVACR Technician Career Prep	ProTrain	Online
Online Clean Energy Program/Training: Hydropower	European Energy Centre (EEC)	Online
Multifamily Quality Control Inspector Certification	Association for Affordable Energy Incorporated	New York
Quality Control Inspector	Association for Affordable Energy Incorporated	New York
Online Safety Program/Training	Ecotech Training	Online

Program	Provider	City
Online Safety Training Course	ITC Learning	Online
Safety training videos	Mastery Training Services	Online
Win-Win Program	Envirolution One	New York
Online Solar Program/Training	Ecotech Training	Online
Environmental Education Programming	Solar One	Queens
Solar Associates Program	North American Board Certified Energy Practitioners (NABCEP)	Clifton Park
Program	**Provider**	**City**
Comprehensive Solar Plus Storage	Heatspring	Online
Online Clean Energy Program/Training: Solar	European Energy Centre (EEC)	Online
Online Learning/Continuing Education courses: Solar	Hanleywood University	Online
Solar Water Heating Technician Career Prep	ProTrain	Online
Envelope Professional	Association for Affordable Energy Incorporated	New York
Green City Force	Americorp. Corp	New York
Professional and Volunteer Opportunities	Commisssion on Economic Opportunity/ Youth Build	Troy
Small Wind Associates Program	North American Board Certified Energy Practitioners (NABCEP)	Clifton Park
Online Clean Energy Program/Training: Wind	European Energy Centre (EEC)	Online
Wind Energy Technician Career Prep	ProTrain	Online
Energy Efficiency Training Program	National Association of Energy Service Companies (NAESCO)	Online
Understanding NY's Wholesale Energy Markets for Energy Storage: Online Webinar Course, Energy Storage Technology: Understanding the Essentials	New York Battery and Energy Storage (NY-BEST)	Albany
Online Clean Energy Program/Training	Clean Energy Solutions Center	Online
HVAC Learning	American Cooling and Heating	Online
BPI Certification/Recertification Field Test	Hudson Valley Community College	Troy
BPI Certification/Recertification Written Test	Hudson Valley Community College	Troy
Construction Trades	CV-Tec Plattsburgh Main Campus	Plattsburgh
Associate in Applied Science in Construction Technology	Dutchess Community College	Poughkeepsie
Associate in Applied Science in Construction Management Engineering Technology	Erie Community College	Buffalo
Construction Technology: Sustainable Building AAS	Fulton-Montgomery Community College	Johnstown
Associate in Applied Science in Construction Technology	Monroe Community College	Rochester
Certificate in Construction Management	Nassau Community College	Garden City
Associate of Applied Science in Construction Technology: Building Technology	Hudson Valley Community College	Troy
Construction and Environmental Technology	Tompkins Cortland Community College	Dryden

Program	Provider	City
Industrial/Commercial Electrician Certificate	Clinton Community College SUNY	Plattsburgh
Electrical Technology (ELT)	Dutchess Community	Poughkeepsie
Electrical Technology	Fulton-Montgomery Community College	Johnstown
Electrical Technology (A.A.S.)	Onondaga Community College	Syracuse
Electrical Construction and Maintenance (AOS)	Hudson Valley Community College	Troy
Engineering Science	CUNY Bronx Community College	Bronx
Engineering Science - A.S.	SUNY Broome Community College	Binghamton
Engineering Science (Transfer) (ENR)	Dutchess Community College	Poughkeepsie
Program	**Provider**	**City**
ENGINEERING SCIENCE	Erie Community College	Buffalo
Engineering Science (A.S.)	Herkimer County Community College	Herkimer
Engineering Science (A.S.)	Jamestown Community College	Jamestown
Engineering Science (A.S.)	Jefferson Community College	Watertown
Engineering Science (A.S.)	CUNY Kingsborough Community College	Brooklyn
Engineering Science & Physics	Monroe Community College	Rochester
Engineering Science (A.S.)	CUNY Borough of Manhattan Community College	New York
Engineering Science (A.S.)	Mohawk Valley Community College	Utica
Engineering Science (A.S.)	Onondaga Community College	Syracuse
Engineering Science	Finger Lakes Community College	Canandaigua
Engineering Science (A.S.)	Orange County Community College	Middletown
Associate in Science degree (AS)	CUNY Queensborough Community College	Bayside
Engineering Science (A.S.)	Hudson Valley Community College	Troy
Engineering Science (A.S.)	Corning Community College	Corning
Engineering Science	Suffolk County Community College	Selden
Engineering Science	Tompkins Cortland Community College	Dryden
Engineering Science	Ulster County Community College	Stone Ridge
Engineering Science	Adirondack Community College	Queensbury
Engineering Science (A.S.)	SUNY Westchester Community College	Valhalla
HVACR Technician Career Prep	Bronx Community College - CUNY	Bronx
Air Conditioning and Refrigeration Technology (ACR)	Dutchess Community College	Poughkeepsie
Heating, Ventilation, Air Conditioning and Refrigeration	Erie Community College	Buffalo
Certificate in Heating Ventilation Air Conditioning and Refrigeration	SUNY@Erie Community College-North Campus	Buffalo
Air Conditioning Technology: Heating and Ventilation	Monroe Community College	Rochester
Heating & Air Conditioning Certificate	Mohawk Valley Community College	Utica
HVAC Technical Services Program	Hudson Valley Community College	Troy
Heating, Ventilation, Air Conditioning and Refrigeration (HVAC/R) / Certificate Program	Suffolk County Community College	Selden

Program	Provider	City
Heating, Ventilation, Air Conditioning and Refrigeration (HVAC/R) / A.A.S. Degree	Suffolk County Community College	Selden
Mechanical Technology - Design (A.A.S.)	Jamestown Community College	Jamestown
Precision Machining AAS	Monroe Community College	Rochester
Semiconductor Manufacturing Technology AAS	Mohawk Valley Community College	Utica
Advanced Manufacturing Technology (AOS)	Hudson Valley Community College	Troy
NABCEP PV-Associate Exam	Hudson Valley Community College	Troy
PV-Installation Basics	Hudson Valley Community College	Troy
PV-Associate (Solar Power) Blended	Hudson Valley Community College	Troy
Program	**Provider**	**City**
PV-Associate (Solar Power) Online	Hudson Valley Community College	Troy
PV-Advanced Solar Power Systems with Installer Workshop	Hudson Valley Community College	Troy
Solar Thermal Technology Certificate	Monroe Community College	Rochester
BPI BUILDING ANALYST PROFESSIONAL	SUNY Ulster - Green Careers Academy	Stone Ridge
Building Analyst Written exam	SUNY Ulster - Green Careers Academy	Stone Ridge
Building Analyst Field Test Prep	SUNY Ulster - Green Careers Academy	Stone Ridge
Building Analyst Field exam	SUNY Ulster - Green Careers Academy	Stone Ridge
HEP Energy Auditor	SUNY Ulster - Green Careers Academy	Stone Ridge
HEP Energy Auditor Field Exam	SUNY Ulster - Green Careers Academy	Stone Ridge
HEP Energy Auditor Written Exam	SUNY Ulster - Green Careers Academy	Stone Ridge
BPI Building Science Principles	SUNY Ulster - Green Careers Academy	Stone Ridge
Construction Technology/Preservation Carpentry Certificate Program	Columbia Greene Community College	Hudson
Industrial Mechanics and Maintenance Technology	Cayuga Community College	Auburn
Energy Efficiency and Clean Technology	SUNY Ulster - Green Careers Academy	Stone Ridge
Sustainable Business Leadership certificate	Shoreline Community College	Online
Renewable Energy Technologies Certificate	Clinton Community College SUNY	Plattsburgh
Sustainable Design and Renewable Energy	Nassau Community College	Garden City
Clean Energy Management	Hudson Valley Community College - SUNY	Troy
Energy Systems	Westchester Community College - SUNY	Valhalla
Facilities Maintenance and Industrial Technology A.A.S	Fulton-Montgomery Community College	Johnstown
HVAC and Refrigeration Technology Certification	Fulton-Montgomery Community College	Johnstown
Building Heating Professional Field exam	SUNY Ulster - Green Careers Academy	Stone Ridge
Heating Professional Field Test Prep	SUNY Ulster - Green Careers Academy	Stone Ridge
Building Heating Professional Written exam	SUNY Ulster - Green Careers Academy	Stone Ridge
BPI Heating Professional	SUNY Ulster - Green Careers Academy	Stone Ridge
BPI Infiltration & Duct Leakage (IDL)	SUNY Ulster - Green Careers Academy	Stone Ridge
BPI Infiltration & Duct Leakage (IDL) Review Class	SUNY Ulster - Green Careers Academy	Stone Ridge
BPI Infiltration & Duct Leakage (IDL) Certification Field Exam	SUNY Ulster - Green Careers Academy	Stone Ridge

Program	Provider	City
Building A/C Heat Pump Written exam	SUNY Ulster - Green Careers Academy	Stone Ridge
BPI A/C Heat Pump Professional	SUNY Ulster - Green Careers Academy	Stone Ridge
A/C Heat Pump Field Test Prep	SUNY Ulster - Green Careers Academy	Stone Ridge
Building A/C Heat Pump Field exam	SUNY Ulster - Green Careers Academy	Stone Ridge
Mathematics for Manufacturing & Technical Careers	SUNY Ulster - Clean Energy Training	Stone Ridge
Electrical Theory I Basics	SUNY Ulster - Clean Energy Training	Stone Ridge
HEP Quality Control Inspector	SUNY Ulster - Green Careers Academy	Stone Ridge
HEP Quality Control Inspector Written Exam	SUNY Ulster - Green Careers Academy	Stone Ridge
Photovoltaic Systems Certification	HVCC	Troy
Program	**Provider**	**City**
NY-Sun Professional Development Photovoltaic Training	Erie Community College	Buffalo
Building Envelope Written exam	SUNY Ulster - Green Careers Academy	Stone Ridge
Building Envelope Field exam	SUNY Ulster - Green Careers Academy	Stone Ridge
BPI Envelope Professional	SUNY Ulster - Green Careers Academy	Stone Ridge
Envelope Professional Field Test Prep	SUNY Ulster - Green Careers Academy	Stone Ridge
Wind Turbine Service Technician Certificate	Clinton Community College SUNY	Plattsburgh
Wind Energy Course	Bristol Community College	Online
Community Hiring Hall Program	PUSH Buffalo	Buffalo
Assessment and Implementation Programs	Energy and Resources Solutions	New York
Online Construction Program/Training	NC Clean Energy Technology Center	Online
Assessment and Implementation Programs	Energy and Resources Solutions	New York
Energy Efficiency Training	DuPont Sustainable Solutions	Online
Electrical courses	Enerdynamics	Online
AIA Training	Steven Winter Associates (SWA)	New York
AIA Training	Steven Winter Associates (SWA)	New York
Energy Efficiency Online Program/Training	NC Clean Energy Technology Center	Online
Energy Modeling Training	Karpman Consulting	Online
Fundamentals of Battery Storage - NY	Electric Utility Consultants Inc (EUCI)	Online
Clean Energy Online Program/Training	NC Clean Energy Technology Center	Online
Assessment and Implementation Programs	Energy and Resources Solutions	New York
Consultant Engineer	Danfoss	Online
HVAC Online Program/Training	NC Clean Energy Technology Center	Online
Energy Efficiency Training	DuPont Sustainable Solutions	Online
HVAC courses	Enerdynamics	Online
Hydropower courses	Enerdynamics	Online
Online Solar Program/Training	NC Clean Energy Technology Center	Online
Solar courses	Enerdynamics	Online
Wind courses	Enerdynamics	Online
Online Wind Program/Training	NC Clean Energy Technology Center	Online

Program	Provider	City
Heating, Ventilation, Air Conditioning & Refrigeration, HVAC Training & Certification Program for Adult Students	Capital Region BOCES	Albany
Construction Technologies: HVAC	Cattaraugus - Allegany BOCES	Belmont
Construction Technologies: HVAC	Cattaraugus - Allegany BOCES	Ellicottville
Construction Technologies: HVAC	Cattaraugus - Allegany BOCES	Olean
HVAC	Erie 2-Chautauqua-Cattaraugus BOCES	Angola
Heating, Refrigeration & Air Conditioning, Refrigeration & Air Conditioning (Advanced)	Erie 1 BOCES	West Seneca
Heating, Ventilation and Air Conditioning	Franklin-Essex-Hamilton BOCES	Malone
Plumbing/HVAC	Jefferson Lewis Hamilton Herkimer Oneida BOCES	Watertown
Program	**Provider**	**City**
NCCER Certification: HVAC Level 1 & 2	Eastern Suffolk BOCES	Patchogue (as well as various locations throughout Long Island)
Advanced Building Construction (ABC)	US Department of Energy (DOE)	Online
Federal Energy Management Program (FEMP)	US Department of Energy (DOE)	Online
Energy Storage Grand Challenge	US Department of Energy (DOE)	Online
Research and Design Projects	US Department of Energy (DOE)	Online
Multi-Family Building Operator Training & Certification	Green Jobs Training Center	New York
Multi-Family Building Analyst Training & Certification	Green Jobs Training Center	New York
Building Analyst Training and Certification Exams	Green Jobs Training Center	New York
Premier Certified Energy Manager Training	Certified Energy Manager Training Program	New York
RRP Lead Safety Training & Certification	Green Jobs Training Center	New York
OSHA Training & Certification	Green Jobs Training Center	New York
Heating Professional Training & Certification	Green Jobs Training Center	New York
Air Conditioning and Heat Pump Professional Training	Green Jobs Training Center	New York
Air Seal and Insulation Training & Certification	Green Jobs Training Center	New York
Enevlope Professional Training & Certification	Green Jobs Training Center	New York
HVAC Continuing Education	Trane	Online
Online Weatherization Training	PHII	Online
Building Analyst Certification and Training Programs	Association of Energy Engineers (AEE Center)	Online
Building Analyst Webinar	Slipstream	Online
Green Building, Energy Code, O&M Course	Urban Green Council	New York
Certified Green Building Course	Building Performance Institute (BPI)	Matla

Program	Provider	City
Electric Power Industry, Education and Research	Smart Electric Power Alliance (SEPA) Knowledge	Online
Energy Efficiency Certification and Training Programs	Association of Energy Engineers (AEE Center)	Online
Energy Efficiency and Clean Technology	National Apartment Association (NAA)	Online
Online Energy Management Program/Training	Energy Star	Online
Energy Management Certification and Training Programs	Association of Energy Engineers (AEE Center)	Online
Resources to promote inclusiveness in the design, delivery, technology, and management of solutions addressing energy and natural resource integration.	Peak Load Management Alliance (PLMA)	Online
Individual Energy Management Courses	AESP	Online
Online Energy Storage Program/Training	International Solar Energy Society	Online
Sustainable South Bronx	The HOPE Program	New York
Program	**Provider**	**City**
IGSHPA Accredited Installer Course	New York Geothermal Energy Organization	Buffalo
Certified HVAC Course	Building Performance Institute (BPI)	Matla
HVAC courses	Home Performance Coalition	Online
Certification and Training Programs: HVAC	Association of Energy Engineers (AEE Center)	Online
Open Online HVAC Courses	edX	Online
Conference/Workshop	International Ground Source Heat Pump Association	Online
Conference/Workshop	International Ground Source Heat Pump Association (Oklahoma State Marketplace)	Online
HVAC Webinar	Slipstream	Online
Workforce Development, Adoption of Clean Energy & Efficiency	Interstate Renewable Energy Council (IREC)	Latham
Training and Certification Programs, Safety Solutions	International Code Council (ICC)	Rochester
Open Online Smart Grid Courses	edX	Online
Microgrid Design and Implementation	American Solar Energy Society	Online
NABCEP PV Associate Program	Midwest Renewable Energy Association	Online
SEI Global Solar Connection Imitative	Solar Energy International (SEI)	Online
NABCEP Certifications	Solar Energy International (SEI)	Online
Advanced PV Installer training	American Solar Energy Society	Online
Online Solar Program/Training	International Solar Energy Society	Online
NABCEP PV Installation Professional Certification Practice Exam	American Solar Energy Society	Online
Energy Storage Systems and Solar Safety	National Fire Protection Association	Online
Online Weatherization Training	PHII	Online
Weatherization Webinar	Slipstream	Online

Program	Provider	City
HVACR Training	Penn Foster	Online
Online Lighting Education	Illuminating Engineering Society (IES) eLearning	New York
Online HVAC Education	Interplay Learning	Online
Online Solar Education	Interplay Learning	Online
Energy Generation, Storage and Systems	Golisano Institute for Sustainability - RIT	Rochester
Sustainable Energy Management	SUNY College of Environmental Science and Forestry	Syracuse
Solar Power as Renewable Energy (SPARE)	SUNY College of Environmental Science and Forestry	Syracuse
CATS Home Inspection	CATS Home Inspection School Buffalo	Buffalo
BPI Building Analyst Professional	New York School of Home Inspection and Construction Inc.	Rochester
Home Inspection Course	New York Real Estate Institute	New York
Home Inspector Training	American Building Inspection and Training Co. Inc.	Syracuse
Program	**Provider**	**City**
BPI Building Analyst Professional	New York State Weatherization Directors Association	Syracuse
HEP Energy Auditor	New York State Weatherization Directors Association	Syracuse
The Licensed Home Inspector	NY Home Inspector School	Putnam Valley
Construction Trades	Onondaga Cortland Madison BOCES	Liverpool
OSHA 10 Hour Construction Safety Certification	New York State Weatherization Directors Association	Syracuse
Construction Technology	Center for Instruction Technology & Innovation (CiTi)	Mexico
Construction & Building Skills	Apex Technical School	Long Island City
Electrical Program	Electrical Training Center	Copiague
Residential Electricity	Broome-Tioga — BOCES	Binghamton
Carpentry and Construction Trades	Delaware / Chenango / Madison / Otsego BOCES — Chenango Campus	Norwich
Construction Electricity Program	Dutchess BOCES	Poughkeepsie
Electrical Systems	Potter Career & Technical Center — BOCES	West Seneca
Basic Electrical Skills	Champlain Valley BOCES — Mineville	Mineville
Electrical Wiring Technology	Jefferson County BOCES — Charles H. Bohlen Technical Center	Watertown
Electrical Wiring Technology	Lewis County BOCES — Howard G. Sackett Technical Center	Glenfield
Electric - National Center for Construction Education and Research (NCCR) Certification	Adult Career and Continuing Education Services — BOCES	Fairport
Electrical Maintenance Technician	Irvin E. Henry Education Campus — OCM BOCES	Syracuse
NCCER Electrical Level 1	Orange-Ulster BOCES	Goshen

Program	Provider	City
Electricity I, II & Schematics/2514	Orleans / Niagara BOCES	Medina
Electrical (Residential and Commercial)	Rockland BOCES	West Nyack
Construction Electricity Program	Putnam Northern Westchester BOCES	Yorktown Heights
Combustion Appliance Zone Testing 101	New York State Weatherization Directors Association	Syracuse
Heating, Ventilation, Air Conditioning and Refrigeration (HVAC/R)	Capital Region Career Technical School	Albany
HVAC Technician	Career & Technical Institute/Dutchess BOCES	Poughkeepsie
Electricity for HVAC	Dutchess County BOCES	Poughkeepsie
Motors and Controls for HVAC	Dutchess County BOCES	Poughkeepsie
Isaac Bootcamp	Isaac Heating and Air Conditioning Inc.	Rochester
Air Conditioning, Refrigeration, Appliance/Controls	Apex Technical School Inc.	New York
Refrigeration and Air Conditioning Certificate	The Refrigeration Institute	New York
HVAC-R Technician	Onondaga Cortland Madison BOCES	Liverpool
BPI Heating Professional	New York State Weatherization Directors Association	Syracuse
Program	**Provider**	**City**
Clean and Tune for Heating Systems	New York State Weatherization Directors Association	Syracuse
HVAC Duct Blaster 101	New York State Weatherization Directors Association	Syracuse
Heating and Venting Fundamentals	New York State Weatherization Directors Association	Syracuse
90% Furnace Install	New York State Weatherization Directors Association	Syracuse
HVAC Troubleshooting	New York State Weatherization Directors Association	Syracuse
BPI Infiltration & Duct Leakage Professional	New York State Weatherization Directors Association	Syracuse
NCCER HVAC Level 1	Orange-Ulster BOCES	Goshen
NCCER HVAC Level 2	Orange-Ulster BOCES	Goshen
HVAC and Refrigeration Engineering Technology	Center for Instruction Technology & Innovation (CiTi)	Mexico
Air Conditioning, Refrigeration, and Heating Technology	Lincoln Technical Institute	Whitestone
HVAC Engineering Technology Program	SUNY Canton-Camino Schl of Engineering Technology	Canton
Heating, Ventilation, Air Conditioning (HVAC) & Refrigeration	Myers Education Center	Saratoga Springs
The HVAC Program	Branford Hall Career Institute	Bohemia
Machine Tool Technology	Clinton Essex Warren Washington BOCES	Plattsburgh
Manufacturing Technician	Onondaga Cortland Madison BOCES	Cortland

Program	Provider	City
Machining with CNC Fundamentals	Monroe 2 Orleans BOCES-Center for Workforce Development	Rochester
Welding Technology	Center for Instruction Technology & Innovation (CiTi)	Mexico
Combination Welding Technology	Apex Technical School	Long Island City
Combination Welding	Modern Welding School	Schenectady
HEP Quality Control Inspector	New York State Weatherization Directors Association	Syracuse
Online Solar Installer Training Courses	SOLAIRGEN School of Solar Energy	Online
Weatherization Assistance Program (WAP)	Association of Energy Affordability	Bronx
Advanced Air Sealing	New York State Weatherization Directors Association	Syracuse
Air Sealing Techniques	New York State Weatherization Directors Association	Syracuse
Insulation Machine Maintenance	New York State Weatherization Directors Association	Syracuse
EPA RRP Lead Renovator Certification	New York State Weatherization Directors Association	Syracuse
Program	**Provider**	**City**
RRP Refresher	New York State Weatherization Directors Association	Syracuse
BPI Manufactured Homes Professional	New York State Weatherization Directors Association	Syracuse
NYS Manufactured Housing Mechanics Certification	New York State Weatherization Directors Association	Syracuse
Applied Case Studies	New York State Weatherization Directors Association	Syracuse
BPI Envelope Professional	New York State Weatherization Directors Association	Syracuse
Weatherization Health and Safety	New York State Weatherization Directors Association	Syracuse
Stove/Oven Maintenance	New York State Weatherization Directors Association	Syracuse
Infrared for Weatherization Professionals	New York State Weatherization Directors Association	Syracuse
Basic Electricity for Weatherization Professionals	New York State Weatherization Directors Association	Syracuse
HEP Crew Chief Leader	New York State Weatherization Directors Association	Syracuse
Implementing ASHRAE 62.2	New York State Weatherization Directors Association	Syracuse
NREL Multifamily Quality Control Inspector	New York State Weatherization Directors Association	Syracuse

Program	Provider	City
Small Homes Auditing	New York State Weatherization Directors Association	Syracuse
One Day Lead Safe Weatherization	New York State Weatherization Directors Association	Syracuse
Boot Camp for Weatherization Installers	New York State Weatherization Directors Association	Syracuse
Electrical and Advanced Electrical Training	Apex Technical School	New York
Electrical/HVAC	Madison-Oneida — BOCES	Verona
Electrical - Inside Wireman	The Tri-City Training Program	Latham
Electrical - Inside Wireman	JATC of Binghamton	Binghamton
Electrical - Inside Wireman	JATC of Local 106 and Jamestown	Jamestown
Electrical - Inside Wireman	JATC of Local 139 in Elmira	Elmira
Electrical - Inside Wireman	JATC of Local Union #41	Orchard Park
Electrical - Inside Wireman	JATC of Watertown	Watertown
Electrical - Inside Wireman	JATC of Rochester	Rochester
Electrical - Inside Wireman	JATC of Niagara County	Niagara Falls
Electrical - Inside Wireman	JATC of Central New York	Clay
Electrical - Inside Wireman	JATC of Geneva and Local 840	Geneva
Program	**Provider**	**City**
Electrical - Inside Wireman	JATC of the Hudson Valley	Harriman
Electrical - Inside Wireman	JATC of Nassau and Suffolk Counties	Hauppauge
Electrical - Inside Wireman	JATC of Ithaca	Ithaca
Electrical - Inside Wireman	JATC of Westchester and Fairfield	White Plains
Construction and Building Skills	San Diego Gas & Electric (SDG&E) Energy Innovation Center	Online
Electrical Safety	San Diego Gas & Electric (SDG&E) Energy Innovation Center	Online
University and Training Programs	Pacific Gas & Electric	Online
University and Training Programs	Pacific Gas & Electric	Online
HVAC Systems and Technology Education	San Diego Gas & Electric (SDG&E) Energy Innovation Center	Online
University and Training Programs	Pacific Gas & Electric	Online
Online Construction Program/Training	Zack Academy	Online
Online Energy Efficiency Program/Training	Zack Academy	Online
HVACR Training Program	Electrical Training Center	Copiague
Online Solar Program/Training	Zack Academy	Online

Endnotes

1 https://forward.ny.gov/

2 See Appendix A for detailed Methodology.

3 Bureau of Labor Statistics Q2 Third Month 2018-2019, All Ownership.

4 Values are rounded, so percentages may not sum to 100 percent.

5 "Other support services" includes primarily NAICS 81 (Repair and Maintenance), as well as some administrative support and waste management firms (NAICS 56). "Other" includes anything not otherwise classified, e.g. non-profits (NAICS 81), management of companies and enterprises (NAICS 55), and other unclassifiable industries by NAICS code.

6 "Other support services" includes primarily NAICS 81 (Repair and Maintenance), as well as some administrative support and waste management firms (NAICS 56). "Other" includes anything not otherwise classified, e.g. non-profits (NAICS 81), management of companies and enterprises (NAICS 55), and other unclassifiable industries by NAICS code.

7 https://labor.ny.gov/workerprotection/publicwork/PWContents.shtm#:~:text=Prevailing%20wage%20is%20the%20pay,under%20a%20public%20work%20contract.

8 Hourly wages for New York State (2019), New York State Department of Labor. https://apps.labor.ny.gov/wpp/publicViewPWChanges.do

9 "Median hourly wages for union workers in New York" (2019), Bureau of Labor Statistics https://www.bls.gov/mwe/home.htm

10 EE wage premiums for mechanical insulation workers was -0.2%.

11 Grid modernization and energy storage wage premiums for construction managers was 0.3%.

12 Grid modernization and energy storage wage premiums for first-line supervisors of mechanics, installers, and repairers was 0.2%.

13 Renewable fuels wage premiums for team assemblers was 0.2%.

14 Prevailing wage benefits are not included in the table as all public work contractors and subcontractors are required to pay the prevailing rate of supplements (fringe benefits) to all workers under a public work contract. It is not specified what fringe benefits (health insurance, etc.) are required.

15 National Compensation Survey: Employee Benefits in the United States, March 2020, Bureau of Labor Statistics, https://www.bls.gov/ncs/ebs/benefits/

16 Ibid.

17 This includes employees that receive both full and partial coverage of healthcare insurance costs.

18 https://www.nypa.gov/news/press-releases/2020/20200728-aabe

19 Race/ethnicity demographic shares may add to more than 100 percent because an individual was able to identify as Hispanic or Latino in addition to their racial identification, consistent with US Census Bureau methodology.

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

21 New York Civilian Labor Force: Employed, "States: Employment Status of the civilian noninstitutional population by sex, race, Hispanic or Latino ethnicity, and intermediate age, 2019 annual averages," US Bureau of Labor Statistics. bls.gov/lau/table14afull19.htm

22 2020 US Energy and Employment Report. https://www.usenergyjobs.org/

23 Due to rounding, percentages may not sum to 100 percent.

24 https://www.nyserda.ny.gov/All-Programs/Programs/Clean-Energy-Workforce-Development/Directory-of-Free-Online-Resources

25 Certified Energy Manager (CEM) certification, for example, requires STEM degrees which are traditionally underpopulated by minority and female students.

26 Data USA, August 2020.

27 Please see Appendix A for more information on how rates in this analysis may compare to those used in the 2020 United States Energy and Employment Report (USEER).

28 Other energy efficiency technologies includes employment in variable speed pumps; energy auditing, rating, monitoring, metering, and leak detection; LEED certification; and phase-change materials; as well as other design, software, policy, and consulting services not specific to detailed technologies.

29 COVID-adjusted values are not available at the sub technology level of granularity.

30 The survey was completed by 140 heat pump employers, and five in-depth interviews were conducted.

31 NEEP (July 2017). Northeastern Regional Assessment of Strategic Electrification. https://neep.org/reports/strategic-electrification-assessment

32 Renewable Heating and Cooling Policy Framework: Options to Advance Industry Growth and Markets in New York. (NYSERDA, February 2017)

33 Employers were allowed to select all categories that apply. Some occupations have lower sample sizes, as not all firms employ all occupations.

34 New York's geothermal jobs include firms conducting consulting, policy, engineering, and other services for plants outside the state of New York.

35 COVID-adjusted values are not available at the sub technology level of granularity.

36 nyserda.ny.gov/offshorewind

37 nyserda.ny.gov/All%20Programs/Programs/Offshore%20Wind/Focus%20Areas/Offshore%20Wind%20Solicitations/2018%20Solicitation

38 Rates used in this analysis are different from those used in the 2020 United States Energy and Employment Report (USEER). Technology definitions used in the 2020 NYCEIR are not consistent with those used in the USEER, so rates across reports are not comparable.

39 COVID-adjusted values are not available at the sub technology level of granularity.

40 New York State Energy Storage Roadmap and Department of Public Service / New York State Energy Research and Development Authority Staff Recommendations, June 2018.

41 COVID-adjusted values are not available at the sub technology level of granularity.

42 NYSERDA Electric Vehicle Registration Map.

43 “Current Natural Gas Vehicle Statistics.” NGV Global.

44 COVID-adjusted values are not available at the sub technology level of granularity.

45 New York State Greenhouse Gas Inventory: 1990-2016, July 2019.

46 https://www.nyserda.ny.gov/All-Programs/Programs/Clean-Transportation-Program

47 https://www.nyserda.ny.gov/All-Programs/Programs/ChargeNY

48 https://www.nyserda.ny.gov/All-Programs/Programs/ChargeNY/Support-Electric/Map-of-EV-Registrations

49 http://www.ngvglobal.com/

50 Professional services include mainly vehicle repair and maintenance firms, as well as engineering, financial, and project development firms.

51 Fifty-one deals since 2013 were unable to be classified by phase, roughly 5 percent of recorded innovation investments.

52 https://www.nasa.gov/directorates/heo/scan/engineering/technology/txt_accordion1.html

53 NYSERDA grant funding has been recalculated since the 2018 CEIR. Many investments previously classified as Phase I were reclassified into Phases II and III.

54 Totals may vary slightly from previous reports due to a change in source.

55 https://www.usenergyjobs.org/

56 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.

57 “Fossil” includes all fossil fuel energy employment and traditional transmission, distribution, and storage

58 Traditional energy categories include primary micro grid, or other grid modernization employment.

59 Traditional energy categories include primary ethanol and other biofuels.

60 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.

61 Based on the NYCEIR jobs’ NAICS codes.

62 This number is different than the initial net change of 5,010 because 132 NYCEIR jobs were distributed into indirect jobs as part of the methodology to avoid double counting.

63 As a result of the 2018 Clean Energy Net Job Change in New York.

64 As a result of the 2018-2019 Clean Energy Net Job Change in New York.

65 Negative percentages for indirect and induced employment are due to direct/total job declines in certain industries. A negative percent for indirect or induced jobs in an industry that experienced net negative job growth means positive jobs.

66 Table only includes industries that have grown by 10 indirect jobs or more.

State of New York
Andrew M. Cuomo, Governor

New York State Energy Research and Development Authority
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