Clean Energy Education and Training Resources and Opportunities in New York's Southern Tier Region

Allison Moe and Sarah Turner

National Renewable Energy Laboratory

NREL is a national laboratory of the U.S. Department of Energy
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List of Acronyms

BLS	U.S. Bureau of Labor Statistics
BOCES	Board of Cooperative Educational Services
CTE	Career and technical education
DOE	U.S. Department of Energy
EWD	Education and workforce development
GBEOP	Greater Binghamton Education Outreach Program
GED	General Educational Development
HVAC	Heating, ventilating, and air conditioning
IBEW	International Brotherhood of Electrical Workers
NABTU	North America's Building Trades Union
NEST	The Network for a Sustainable Tomorrow
NREL	National Renewable Energy Laboratory
NYSERDA	New York State Energy Research and Development Authority
PV	Photovoltaic
SUNY	State University of New York
USEER	United States Energy and Employment Report

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1 Introduction and Methodology

New York's Southern Tier region is experiencing high growth and investment in the clean energy sector and is anticipating more jobs to come in energy efficiency, renewable energy, and manufacturing in the coming years (Southern Tier Regional Economic Development Council 2015). This region is defined differently by different entities. For the purposes of this report, we are including the following counties: Broome, Chemung, Chenango, Cortland, Delaware, Otsego, Schoharie, Schuyler, Steuben, Tioga, Tompkins.

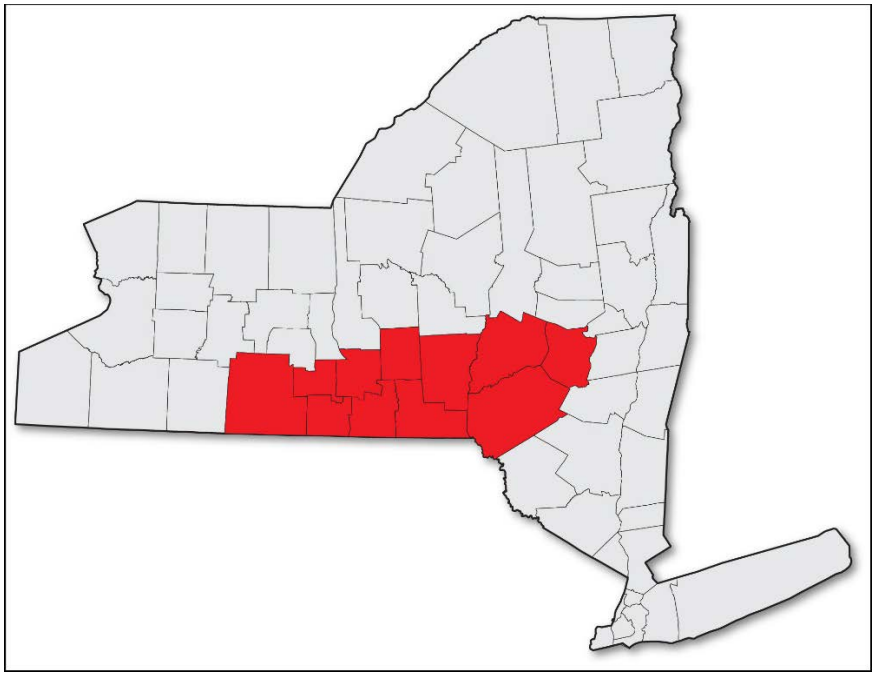

Figure 1. Map of New York's Southern Tier region

Source: NREL Geographic Information Systems

The Network for a Sustainable Tomorrow (NEST) is a "community-based network of programs working towards social, environmental, and economic justice and equity" in New York's Southern Tier region (NEST 2022). Within this environment of growth in the clean energy sector, NEST is working to develop a regional backbone system for education and training programs as well as curricula to support the workforce needed for these growing industries to succeed.

Through its participation in the U.S. Department of Energy's (DOE) Better Buildings Workforce Accelerator, NEST requested technical assistance from the National Renewable Energy Laboratory (NREL) in conducting a landscape and needs assessment of the region's existing clean energy education and workforce development (EWD) assets. For the purposes of this paper, clean energy refers to renewable energy technology (deployment, generation, transmission, distribution, and storage), buildings energy efficiency, and advanced manufacturing. This report provides a baseline of clean energy employment data and an inventory and gap analysis of the education and workforce development assets currently available and serving the Southern Tier region. This report also highlights case studies of

innovative and successful regional EWD coalitions in other parts of the state and county, provided in Appendix C.

1.1 Project Methodology

This project used two main research approaches to guide its analysis. The first was a review of employment data specific to clean energy jobs in New York and the counties within the Southern Tier region. This is provided in Section 2.

The second approach was the development of an inventory of existing education and training programs and resources offered within the Southern Tier region. This inventory was completed through internet searches of known key stakeholders, both nationally and regionally. This inventory is not meant to be 100% inclusive, but to provide a guide to programs that exist. NREL staff then analyzed the types of EWD programs available, looking at both geographic dispersion within the region and comparing it to current and projected employment data. This analysis identified any gaps in workforce development education or any misalignments from expected workforce composition based on state data, which are summarized in Section 3. A full list of all EWD program inventoried is provided in Appendix A, and a more detailed methodological explanation is included in Appendix B.

1.2 Project Limitations

Due to the relatively small nature of the Better Buildings Workforce Accelerator Technical Assistance program, there are limitations to the scope of this project. The first is that this paper is focused on clean energy training related to buildings, and therefore excludes energy efficiency programs related to other fields and technologies such as electric vehicles or agriculture. It also excludes any analysis of state and local policies that can impact clean energy education and workforce development, as well as any information on funding resources. Finally, the inventory of online resources includes education and training organizations that are physically located within the Southern Tier region and does not address programs that may serve the area (virtually or not) but are located outside the region.

2 Clean Energy Employment Landscape

2.1 State-Wide Employment Data

According to the New York State Energy Research and Development Authority (NYSERDA), the clean energy sector[1] employed more than 157,000 workers across the state in 2020. As shown in Figure 2, three-quarters of these jobs were in energy efficiency, and about another 15% were in renewable electricity generation. More than half of those positions were installation jobs while another 13% of those positions were in professional services, 9% in utilities, 5% in

[1] The NYSERDA report uses a broader definition of clean energy than is used in this NREL analysis. The NYSERDA report's definition includes energy efficiency, renewable electric power generation, alternative transportation, renewable fuels, and grid modernization and energy storage.

manufacturing, and the rest in sales and other support services, as shown in Figure 3 (NYSERDA 2021).

Due to the impacts of the COVID-19 pandemic, the state's clean energy employment remains almost 4% below than the state's peak in 2019. Employment reductions in this sector, however, were smaller than in other sectors, and smaller than the reductions seen in neighboring states (NYSERDA 2021). In addition, the most recent U.S. Energy and Employment Report (USEER) found a 1.9% increase in energy employment overall in the state from 2020–2021, with a 2.5% increase in energy efficiency jobs and a 6% increase in renewable energy jobs (DOE 2022).

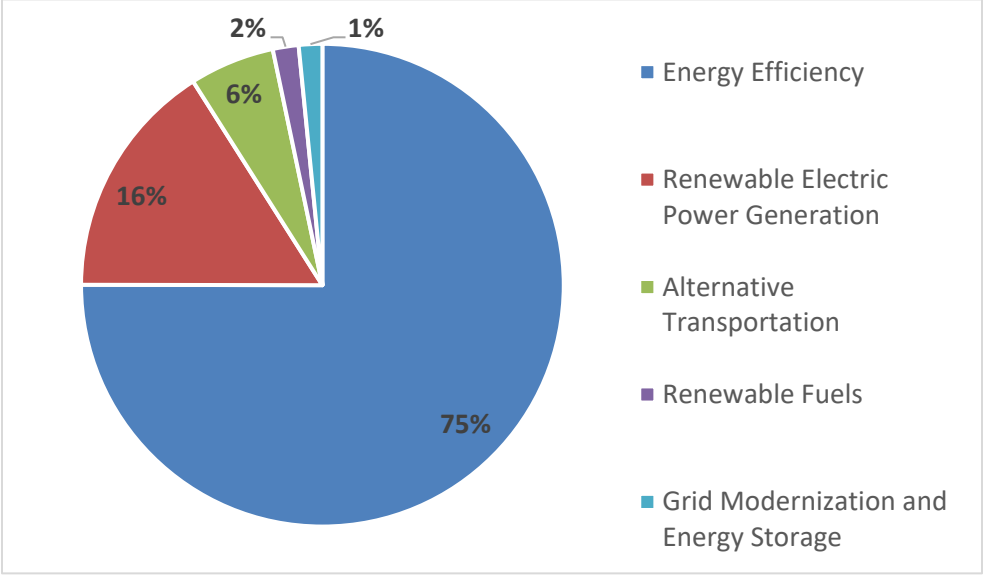

Figure 2. New York State clean energy employment by technology, 2020

Source: NYSERDA (2021)

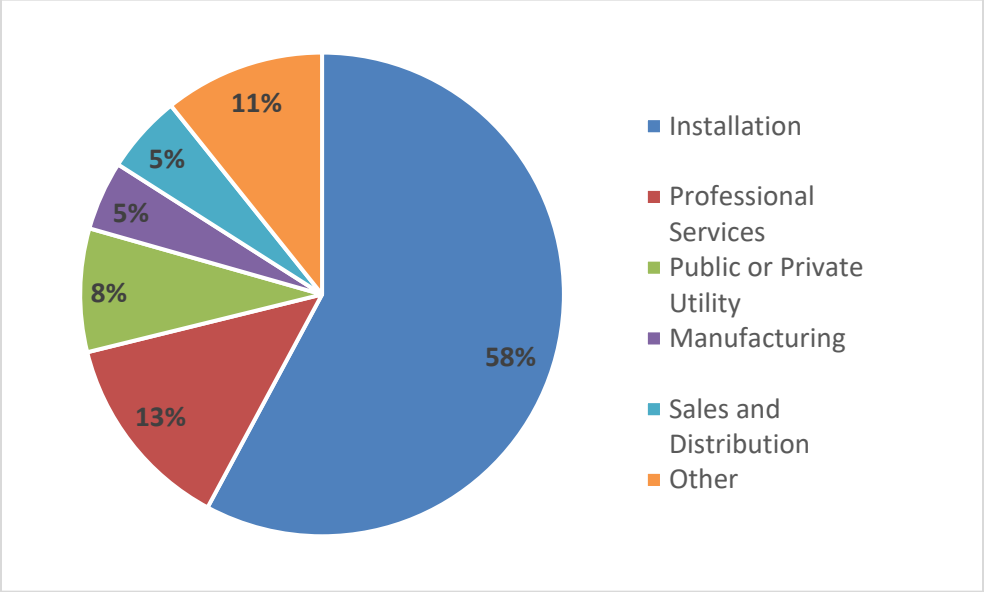

Figure 3. New York State clean energy employment by value chain segment, 2020

Source: NYSERDA (2021)

Because energy efficiency represents the largest clean energy employment sector in both the state and region, this report will provide a bit more detail on the different types of employment within this sector. Using the most recent data available for the state from USEER, 56% of all energy efficiency jobs in New York are in heating, ventilating, and air conditioning (HVAC) services, including both traditional and high efficiency heating and cooling as well as renewable heating and cooling, followed by ENERGY STAR® appliances and efficient lighting (29%). In a divergence from national energy efficiency and clean energy trends which are dominated by construction jobs, the highest number of energy efficiency jobs in New York are in professional services (47%), followed by construction (40%) (USEER 2022). We do not have the same breakdown of jobs data at the county/region level.

Clean energy jobs are expected to grow in New York State in the coming years. NREL published a report in 2022 providing state-level employment growth potential estimates for 2025 and 2030 for the following sectors: solar photovoltaics (PV), land-based wind energy, battery energy storage, and utility-funded energy efficiency deployments. This report estimated that jobs in these sectors would increase significantly from 2020 to 2030 in New York, as is illustrated in Table 1: Modeled job growth ranges from 23% for wind in a low-deployment scenario to 310% for energy efficiency, and as much as 463% for battery energy storage in a high deployment scenario (Truitt et al. 2022). Although these categories do not directly align with those used by the USEER or NYSERDA reports, or from this study, they do indicate the scale and magnitude of job growth potential in these sectors. It should also be noted that the data modeling published in this report was completed before either the Bipartisan Infrastructure Law[2] or the Inflation Reduction Act[3] were passed, and therefore those elements are not directly accounted for in the modeling.

Table 1. Clean Energy Job Growth Potential for New York State 2020–2030

Industry Sector	Estimated Job Growth 2020–2030 (low deployment scenario)	Estimated Job Growth 2020–2030 (high deployment scenario)
Solar PV	73%	158%
Wind energy (land-based)	23%	88%
Battery storage (grid-connected)	196%	463%
Energy efficiency (utility cost-effective measures in buildings)	310%	N/A
TOTAL	**108%**	**195%**

Source: Truitt et al. (2022)

Finally, we provide some qualitative information on the clean energy jobs market in the state of New York. According to the USEER (2022), 52.7% of energy employers reported that it was "somewhat difficult" or "very difficult" to hire workers. This is a lower rate than reported in the

[2] Infrastructure Investment and Jobs Act, Public Law 117-58 (also known as the "Bipartisan Infrastructure Law"). https://www.congress.gov/117/bills/hr3684/BILLS-117hr3684enr.pdf

[3] Inflation Reduction Act of 2022, Public Law 117-169. https://www.congress.gov/bill/117th-congress/house-bill/5376/text

previous year, which largely reflects economy-wide changes due to the COVID-19 pandemic, but indicates that skilled workers are still needed (DOE 2022). NYSERDA also surveyed clean energy employers and workers, and the top employment obstacle cited by almost half of workers was challenges in getting hands-on training to develop specific skills, although this varied by gender and race/ethnicity (NYSERDA 2021).

2.2 Southern Tier Region Employment Data

NYSERDA also provides a snapshot of employment at a more local level, identifying 4,157 clean energy workers in New York's Southern Tier region in 2020. Of these workers, 2,843 (68%) were in energy efficiency services and 600 (14%) were in renewable electric power generation (NYSERDA 2021). In 2020, clean energy jobs made up approximately 1.5% of the total workforce in the region, which was slightly lower than the statewide average of 1.8%. This is shown broken down by county in Table 2. It should be noted that the employment categories in the NYSERDA report do not align completely with the categories investigated in this research; however, it is offered as a point of reference.

Table 2. Clean Energy Employment in the Southern Tier Region of New York, 2020

County	Energy Efficiency Jobs	Renewable Electric Power Generation Jobs	All Clean Energy Jobs	Clean Energy Jobs as Share of All Jobs*
Broome	934	173	1,198	1.6%
Chemung	418	80	554	1.7%
Chenango	124	27	189	1.2%
Cortland	131	25	175	1.1%
Delaware	95	20	136	1.0%
Otsego	115	26	181	0.9%
Schoharie	81	22	150	1.9%
Schuyler	48	9	60	1.3%
Steuben	442	90	623	1.9%
Tioga	59	12	85	0.7%
Tompkins	396	116	806	1.8%
REGION TOTAL	**2,843**	**600**	**4,157**	**1.5%**
NY STATE TOTAL	**86,535**	**18,421**	**157,686**	**1.8%**

Source: NYSERDA (2021)
* "All jobs" total based on 2020 data from the U.S. Bureau of Labor Statistics

If we assume, conservatively, that the Southern Tier region will continue to capture the same share of the state's clean energy jobs in 2030 as it did in 2020, then based on the NREL jobs estimates referenced in Table 1, the region can expect to see the number of clean energy jobs more than double, led by approximately 300% growth in the energy efficiency sector.

2.3 Worker Demographics and Other Characteristics (National Data)

Finally, we present information on worker characteristics, namely demographics and educational attainment. Demographic information is available from NYSERDA and is illustrated in Figures 4 and 5. Figure 4 shows that the racial and ethnic demographics of New York's clean energy workforce, and that of individual sub-industries, mirrors that of the state's overall workforce fairly closely.

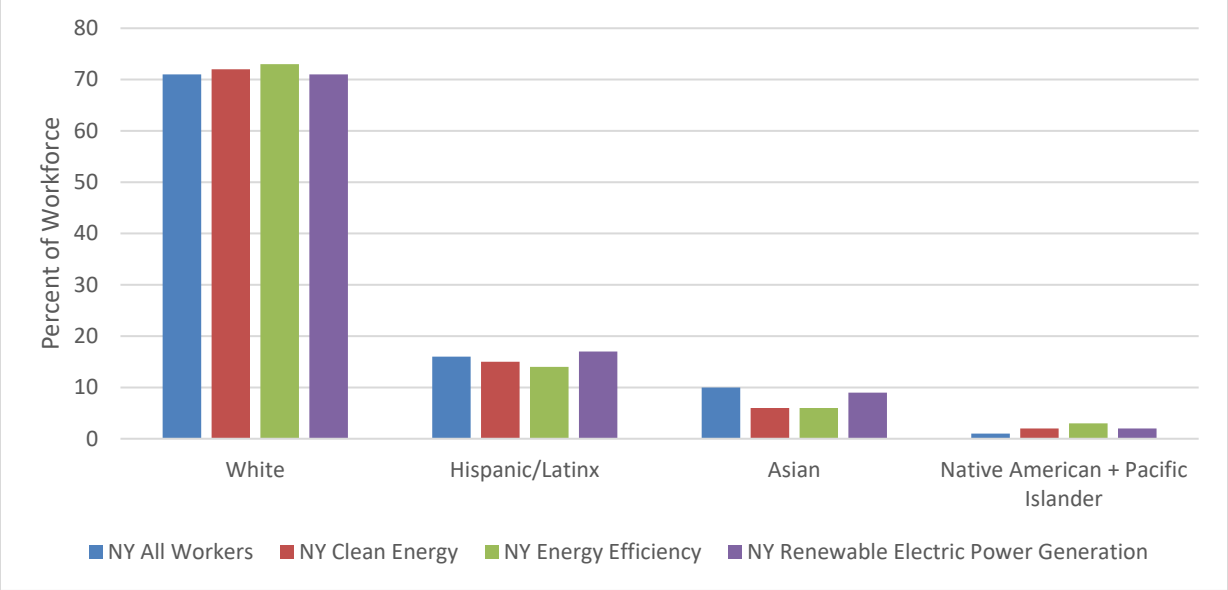

Figure 4. Racial and ethnic demographics in New York's clean energy industry, 2020

Source: NYSERDA (2021)

In terms of gender diversity, women are underrepresented in New York's clean energy industry, representing only 25% of the state's clean energy workforce compared to 49% of the state's overall workforce. Although this rate is consistent with nationwide trends in clean energy, it indicates an opportunity for added attention to enhance diversity, equity, and inclusion in New York's clean energy workforce.

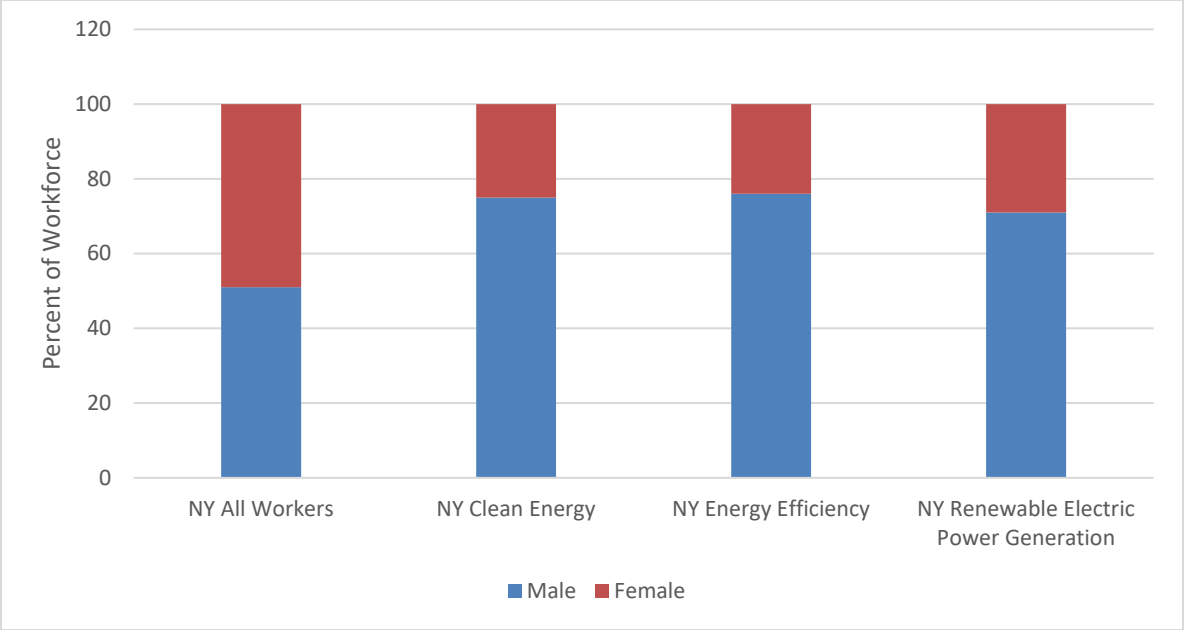

Figure 5. Gender in New York's clean energy industry, 2020

Source: NYSERDA (2021)

Finally, when analyzing the education and workforce development resources and potential in an area, it is also important to factor in the educational requirements and attainment levels necessary for clean energy careers. At the time of this publication, the most recent relevant data is from 2016 and is national in scale (not specific to New York or the Southern Tier region). However, it provides a useful point of reference.

Overall, clean energy jobs may require less formal education than other professions, although some positions may require greater scientific knowledge and/or technical skills. This trend was especially pronounced for clean energy production workers and energy efficiency workers, as shown in Figure 6. This lower barrier to entry is especially important given that clean energy workers also have slightly higher median wages compared to the national average, as shown in Figure 7 (Muro et al. 2019).

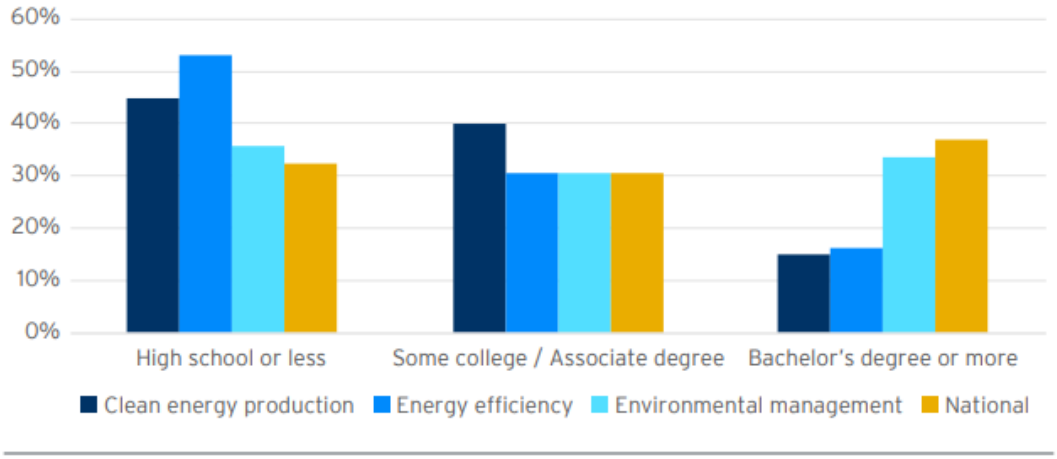

Figure 6. Educational attainment by workers in clean energy economy sectors, 2016

Source: Muro et al. (2019)

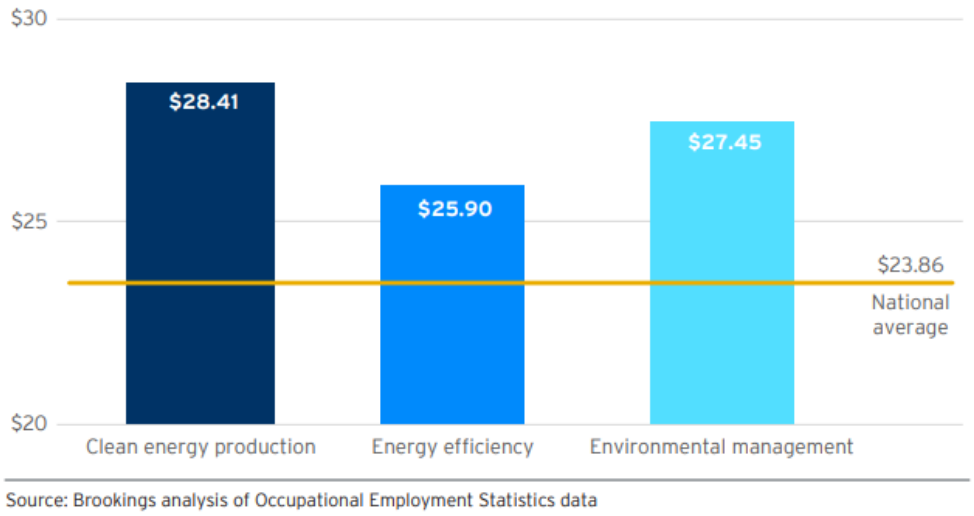

Figure 7. Mean hourly wages by clean energy economy sectors, 2016

Source: Muro et al. (2019)

The information detailed in this section provides the backdrop and point of reference for the gap analysis that follows in Section 3.

3 Resource Inventory and Gap Analysis

NREL's inventory of existing EWD resources identified over 40 programs in the Southern Tier region of New York that provide direct training and education to individuals on topics related to

clean energy industries discussed in the previous section. Based on input from NEST, we have organized these programs into the following five categories:

- **Energy efficiency**, which includes efficient and sustainable new construction and building retrofits, building automation and controls, and specific high efficiency HVAC systems and heat pump programs
- **Renewable energy**, which includes deployment, generation, transmission, distribution, and storage for solar, wind, and other renewable technologies
- **Advanced manufacturing**, which includes both the manufacturing of energy efficiency and renewable technologies as well as processes and technologies that make manufacturing processes more efficient, sustainable, and safe
- **General construction**, which includes technical training on traditional building-related fields such as carpentry, electrical power, plumbing, and pipefitting in addition to more advanced engineering concepts like designing, building, and maintaining machines, engines, and other structural components
- **Other**, which includes programs and classes that provide professional development, employment preparation, and wrap-around services in addition to other building-specific training, such as building code knowledge checks and water-efficient systems.

As mentioned in the methodology, NREL assembled this inventory through a literature review of EWD programs in the region. Because of the vast scope of educational content, large quantity of programs, and unpredictability as to the future continuation of programs, the inventory is reflective of, but does not encompass the entirety of EWD programs in the Southern Tier region of New York.

Figure 8 shows that most of these programs (55%) address building energy efficiency and general construction and building trades, followed by programs in advanced manufacturing (20%), and renewable energy production and transmission (15%).

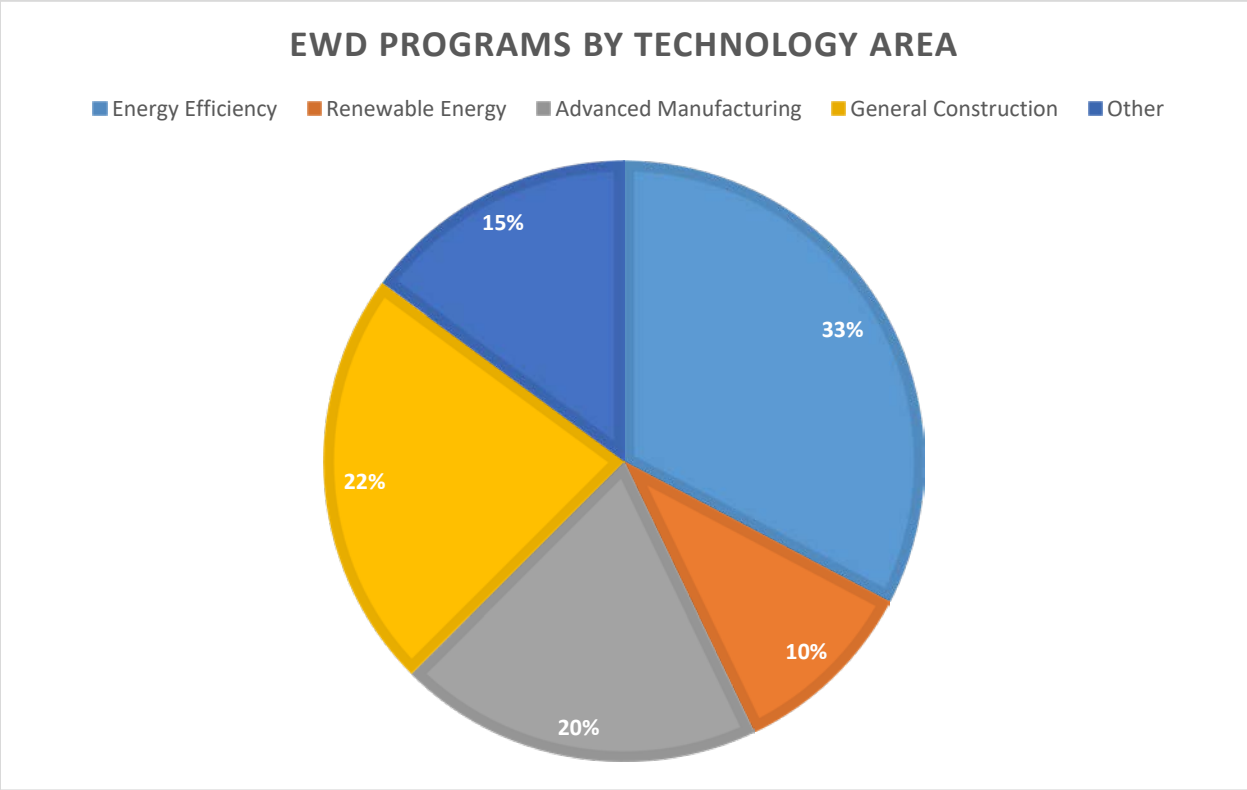

Figure 8. EWD programs in the Southern Tier region by technology area

The educational focuses of these programs generally reflect the region's current clean energy job specializations, which are dominated by energy efficiency jobs. The energy efficiency and renewable energy jobs described in the previous section also include manufacturing positions, in further alignment with the existing training programs that the current job market demands.

In addition to the technology focus of workforce development, this report examines the type of program and audience for the training and education, using the following categories:

- K-12 (mostly high school programs with some middle school)
- Community/technical colleges
- Colleges and universities
- Nonprofits
- Union and industry groups
- Other (workforce centers, economic development organizations, business incubators).

Figure 9 shows that for each of the technology areas identified in the previous figure, there are programs addressing almost all previously listed audiences. Overall, this graphic shows a fair balance of training programs relative to the education levels and requirements of workers in the five different technology sectors. About one-third of the programs overall are geared towards high school students, through programs such as career and technical education (CTE) and Project

Lead the Way,[4] both of which focus on helping students develop hands-on and skills-focused learning. In addition, the region's many universities offer relevant courses of study and perform critical clean energy research and development. The region has many trade unions that incorporate traditional construction and electrical and mechanical training, as well as specific trainings related to clean energy, such as renewables, building automation, and heat pumps. A full list of all programs identified for this analysis can be found in Appendix A.

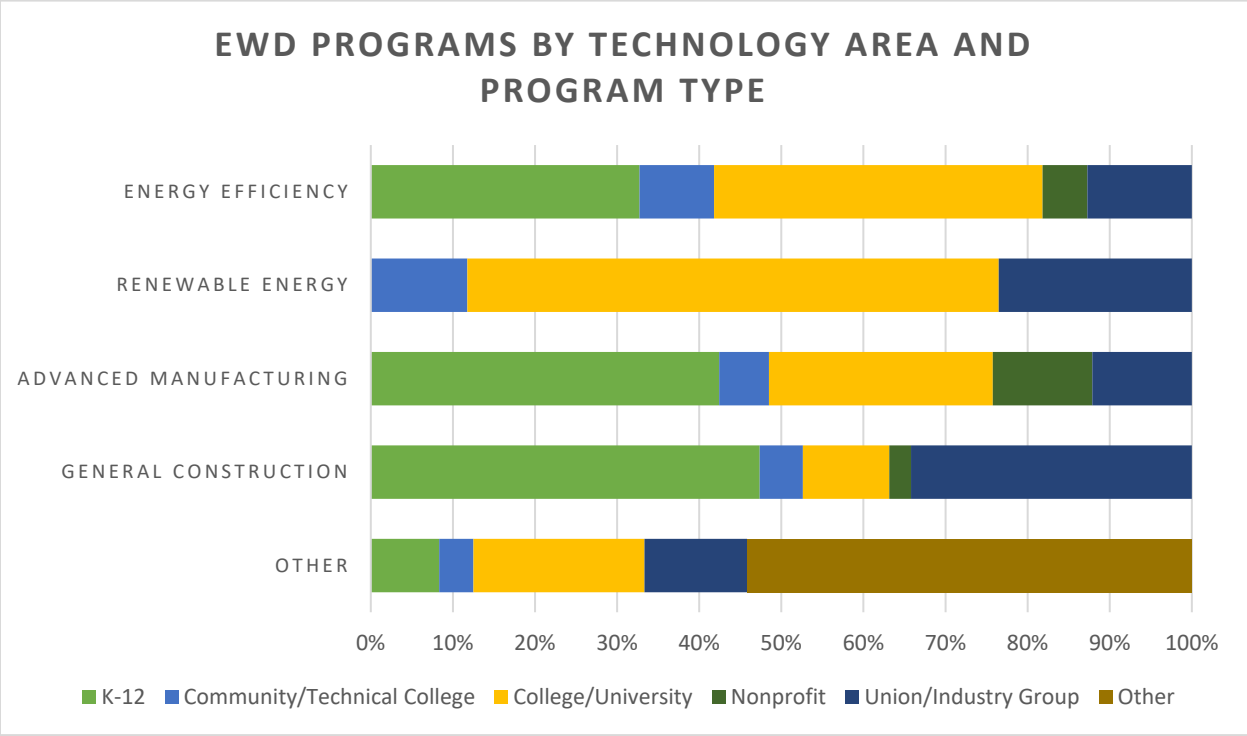

Figure 9. EWD programs in the Southern Tier region by technology area and program type

Based on the Southern Tier region's current clean energy workforce, and educational requirements described in the previous section, this analysis suggests three major gaps in available EWD offerings for the region:

1. Low level of high school programs specifically addressing renewable energy
2. Relatively low number/share of community college programs overall
3. Low level of nonprofit-based training programs.

Gaps are discussed in detail below.

[4] Project Lead the Way is a nationally available program offering resources to support hands-on STEM-related learning for PreK-12 students. https://www.pltw.org/.

3.1 Gap 1: High School Programs Specifically Addressing Renewable Energy

The first gap NREL identified was the overall lack of high school level courses or trainings focused specifically on renewable energy. It should be noted that there are several high schools in the Southern Tier region that offer engineering programs through Project Lead the Way that do discuss and address energy and renewable energy as topics. However, energy is not the main topic or one of the main topics, and therefore those schools were excluded from this analysis. These schools do present an opportunity for expanding energy and renewable energy topics in the future.

Renewable energy and energy education at the high school level can present some implementation challenges. The most critical form of trade-related education in high schools is through CTE programs. These programs guide much of the career-focused and hands-on learning that take place in high schools across the country (Advance CTE 2022). Because many CTE programs rely on the national CTE career cluster framework, their programs reflect the topics that are a part of it. Energy is not an approved national CTE career cluster framework, which in itself can be a barrier to broader inclusion of energy in high school classrooms. To work around this challenge, some states have modified their CTE career clusters. To date, eight states[5] have adopted their own energy cluster outside of the national framework and several more have adapted energy education into existing CTE career clusters such as Architecture, Construction, or Science and Technology, Engineering, and Mathematics. Given the projected growth in renewable energy and battery storage jobs in New York, this gap is significant to note and may result in future workforce challenges for New York's clean energy sector.

3.2 Gap 2: Community College Programs

The second most critical barrier is the relatively low number of community college programs offering clean energy related education. Because the clean energy industry needs skilled professionals but doesn't necessarily require four-year, post-secondary degrees (see Figure 6), community colleges often play a large role in these industries, especially in sectors like advanced manufacturing. However, NREL's inventory returned relatively few community college and technical school programs in the Southern Tier region.

Often these programs are driven by partnerships with local employers, where schools work directly with firms to craft programs to meet their workforce needs. This is the case, for example, with the Advanced Manufacturing Alliance in North Carolina (Tooling U-SME n.d.), the Tennessee College of Applied Technology Advanced Manufacturing Technology program (Tooling U-SME 2021), or the Energy Workforce Development Consortium in Michigan (DTE Energy 2022). In the Southern Tier region, the State University of New York (SUNY) Delhi is one university that has successfully established an anchor partnership in clean energy. They are working with the International Brotherhood of Electrical Workers to offer an associate degree in Electrical Construction and Instrumentation, which includes specific courses on HVAC and energy. SUNY Delhi remains a rare educational leader in this fast-emerging field. Some other regional universities, like Binghamton and Cornell, offer professional development opportunities

[5] California, Florida, Georgia, Michigan, Minnesota, North Dakota, Oklahoma, Virginia

through laboratory experience. While these are valuable educational opportunities, they are often associated with graduate and/or post-graduate academic degree programs. These remain financially out of reach for most of the workforce and do not teach the skills that many in the clean energy field will need.

3.3 Gap 3: Nonprofit-Based Training Programs

The third most critical barrier identified in NREL's inventory assessment was the low number of nonprofit-based training programs. This is generally not surprising for more rural areas, which have lower populations and therefore tend to have lower numbers of services providers overall; however, it does highlight an opportunity for further investigation. For example, when conducting the inventory, we found no Americorps or corps programs in the region training their members in clean energy. Corps programs can be valuable community partners to help equitably expand energy education, because these programs, by design, focus on training through hands-on projects that support community needs (The Corps Network 2022).

Many Corps programs direct their training services specifically to individuals from diverse and underserved communities. Examples of successful clean energy corps programs in other parts of New York include the state include Powercorps in Buffalo NY, which currently has an environmental stewardship corps program and is working to develop a green building and energy efficiency corps program with the local branch of North America's Building Trades Unions (NABTU) and NABTU's apprenticeship-readiness program (Wright 2022 and NABTU 2022). Another example is the Youth Build program run by the E3 Smart Build Training Center in Long Island (United Way of Long Island 2022). This program offers job training, employment readiness, and General Educational Development (GED) services to low-income youth, including building trades, weatherization, renewable energy, and manufacturing. These types of corps programs are built upon partnerships with industry and focus on equity and community benefits. They provide valuable education to aspiring professionals and are an essential component in developing a skilled pipeline of workers. At present, the vast majority of these nonprofits operate in the urban pockets of New York, disadvantaging those living in the Southern Tier region as they require long-distance commuting to participate.

3.4 Additional Opportunities

In addition to the three gaps described above, another interesting finding from NREL's inventory analysis was that there were no training programs in the region credentialed by the Interstate Renewable Energy Council for either solar PV or home energy professional/weatherization certifications. Both of these clean energy training and education areas are often (although not always) provided by nonprofits. As mentioned before, the relatively small population size of the region is likely the reason for this, and it will be important to coordinate with these types of existing training providers outside of the region moving forward.

3.5 Geographic Distribution

Finally, we mapped these programs to understand their geographic distribution throughout the region. As illustrated in Figure 10, most of the programs are clustered around Broome and Tompkins counties, homes to Binghamton and Cornell Universities respectively, which have their own programs and partnerships with local schools. These are also the counties with higher population and clean energy job counts overall—and the highest proportion of clean energy jobs

within the regional workforce. This gap is especially important given the high level of potential future job growth in energy efficiency described in the previous section. Unlike manufacturing and renewable energy jobs, energy efficiency employment tends to be more locally distributed because the work can be done on all buildings (versus manufacturing facilities which can be regional employment hubs, or large-scale, centralized renewable energy projects). This presents an opportunity to reach out to existing and related construction, HVAC, and electrical contractors and provide additional clean energy technology training.

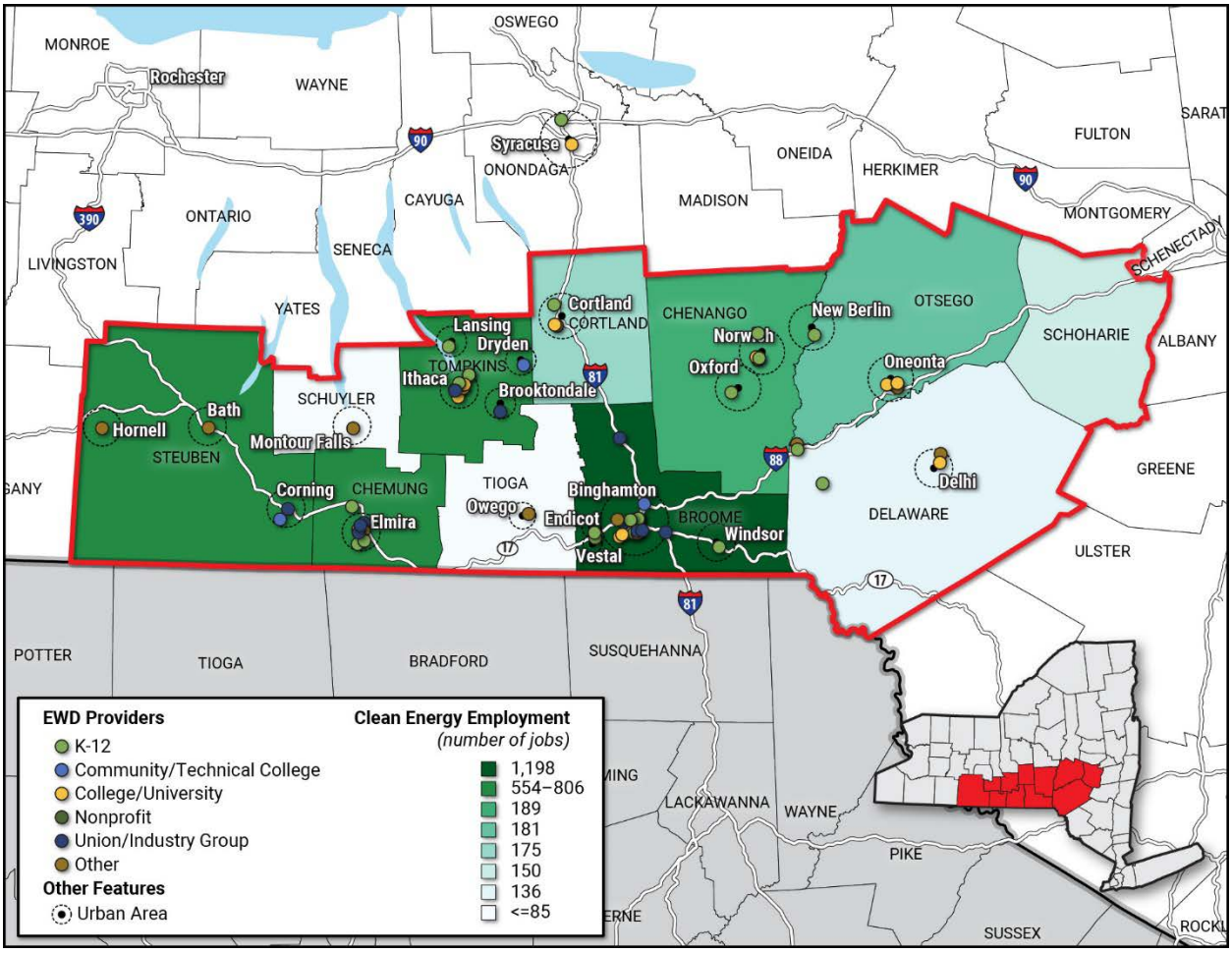

Figure 10. Map of EWD programs in the Southern Tier region

Source: NREL Geographic Information Systems

4 Conclusions and Next Steps

Although clean energy employers in New York and across the county are no longer facing the extreme level of difficulty finding workers as they were in 2020 or 2021, an underlying challenge is that clean energy employers are typically recruiting from the same pool of potential workers as other traditional "blue collar" industries such as construction trades and manufacturing, each vying for a "larger slice of the same pie." As demonstrated in the previous section, the Southern Tier region has a variety of existing education and workforce development programs that focus on recruiting and upskilling existing workers to deploy clean energy

technologies, which are vital to the success of the industry, especially in the short-term. Looking forward, however, these sectors and their supporting organizations, like NEST, will need to focus efforts on growing the size of the overall pie to ensure that new entrants into the workforce can meet the demands of an industry projected to grow significantly, and whose existing workforce is aging.

Overall, this research found that the Southern Tier region already supports almost 3,000 clean energy jobs, representing 1.4% of the total workforce. Despite the identified gaps, the region has a solid infrastructure including training, education, and workforce development providers that support this workforce, particularly with regards to high school career exposure programs and robust programming at the university level.

The resource inventory analysis identified three major gaps in terms of existing training programs: (1) a low number of high school programs addressing renewable energy; (2) few community college programs focused on any clean energy sectors; and (3) a lack of nonprofit-led training programs. As discussed in the previous section, these trends are not necessarily unexpected given that the region is predominately rural with sparse population and few cities. These challenges also highlight potential opportunities for developing and expanding energy education pathways to better meet projected job growth. This is especially relevant at this moment in time, when clean energy job growth may be accelerated due to the implementation of the Bipartisan Infrastructure Law and Inflation Reduction Act.[6]

This research did not uncover strong evidence of collaboration between key anchor industries or institutions and regional education and labor infrastructure. The previous section mentioned other programs in the state and the country whose success was based on strong partnerships with employers, who can help shape training and education programs to be as industry relevant as possible and provide clear pathways and pipelines to employment. The examples of program partnerships referenced above can be accessed through links in the References section of this report. Appendix C has case studies demonstrating how industry and education have coalesced to create successful education pathways to address growing regional workforce pipeline challenges.

While these insights are valuable, it is important to note that this research was limited in its scope and available information and may not fully reflect the region's EDW programs. Therefore, NEST may consider continuing to build on this research, using this analysis as a starting point for future conversations and investigations. In addition, this technical assistance is not intended to be prescriptive for NEST and the Southern Tier region in terms of which steps would be best for the region to take—that requires significant stakeholder and community engagement and consensus building, which is beyond the scope of this project. The EWD resource inventory, gap analysis, and case studies provided in this report will give NEST the information it needs to develop strategies and prioritize efforts as well as investment to support the clean energy industries in the Southern Tier region moving forward.

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[6] See https://www.whitehouse.gov/bipartisan-infrastructure-law/; https://www.whitehouse.gov/briefing-room/statements-releases/2022/08/19/fact-sheet-the-inflation-reduction-act-supports-workers-and-families/

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Appendix A. List of EWD Programs in the Southern Tier Region

The list below outlines the programs, organizations, and schools identified through our inventory of education and workforce development resources in the Southern Tier region. This list aligns with the analysis and graphics provided in Section 3.

Organization/Program Name	County
K-12 Programs	
Binghamton High School - Project Lead the Way	Broome
Broadway Academy - Project Lead the Way	Chemung
Broome-Tioga Board of Cooperative Educational Services (BOCES) - Career and Technical Education Services	Broome
Broome-Tioga BOCES - New Visions Engineering Academy	Broome
Delaware-Chenango-Madison-Otsego BOCES - Career and Technical Education Services	Chenango
Elmira High School - Project Lead the Way	Chemung
Greater Binghamton Education Outreach Program (GBEOP) - Broome Leadership Institute	Broome
GBEOP - PEAK program	Broome/Tioga
GBEOP - SPARK program	Broome
Greater Southern Tier BOCES - Career and Technical Education Services	Chemung
Homer High School - Project Lead the Way	Cortland
Ithaca High School - Project Lead the Way	Tompkins
Lansing High School - Project Lead the Way	Tompkins
Norwich High School - Project Lead the Way	Chenango
Onondaga-Cortland-Madison BOCES - Career and Technical Education Services	Cortland
Oxford Academy High School - Project Lead the Way	Chenango
Seton Catholic Central - Project Lead the Way	Broome
Sidney High School - Project Lead the Way	Delaware
Tompkins-Seneca-Tioga BOCES - CTE	Tompkins
Unadilla Valley High School - UV ECHO/Project Lead the Way	Chenango
Union-Endicott High School - Project Lead the Way	Broome
Vestal Senior High School - Project Lead the Way	Broome
Windsor High School - Project Lead the Way	Broome
Community & Technical Colleges	
SUNY Broome Community College	Broome
SUNY Corning Community College	Steuben
Tompkins Cortland Community College	Tompkins

Organization/Program Name	County
Colleges & Universities	
Binghamton University	Broome
Binghamton University - Small Scale Systems Integration and Packaging Center	Broome
Cornell University	Tompkins
Cornell's Energy Systems Institute	Tompkins
Elmira College	Chemung
Hartwick College	Otsego
Ithaca College - School of Humanities and Science	Tompkins
SUNY Cortland - Physics Department	Cortland
SUNY Delhi	Delaware
SUNY Morrisville	Chenango
SUNY Oneonta	Ostego
Syracuse University - Industrial Assessment Center	Onondaga
Nonprofits	
Alliance for Manufacturing and Technology	Broome
Union/Industry Groups	
International Brotherhood of Electrical Workers (IBEW) Local 139	Chemung
IBEW Local 241	Tompkins
IBEW Local 325	Broome
International Union of Bricklayers and Allied Craftworkers - Local 3	Broome
International Union of Painters and Allied Trades - Local 178	Tompkins
Laborers' International Union of North America - Local 785	Tompkins
New York Solar Energy Industries Association	Queens
North Atlantic States Regional Council of Carpenters - Local 277 Binghamton Office	Broome
North Atlantic States Regional Council of Carpenters - Local 277 Horseheads Office	Chemung
Sheet Metal Air Rail Transportation Local 112 - Elmira/Jamestown	Chemung
Southern Tier Home Builders & Remodelers Association	Broome
Tompkins/Cortland Builders & Remodelers Association	Tompkins
Tompkins-Seneca-Tioga BOCES - Adult Education	Tompkins
United Association Local 112 Plumbers & Pipefitters	Broome
United Steelworkers - Local 1000	Steuben
United Union of Roofers, Waterproofers, and Allied Workers - Local 203	Broome

Other*	
American Job Center - Bath Career Center	Steuben
American Job Center - Broome-Tioga Workforce	Broome
American Job Center - Chenango County	Chenango
American Job Center - Cortland Works Career Center	Cortland
American Job Center - Chemung-Schuyler-Steuben Career Center	Schuyler
American Job Center - Delhi	Delaware
American Job Center - Elmira Career Center	Chemung
American Job Center - Hornell Career Center	Steuben
American Job Center - Otsego County	Otsego
American Job Center - Sydney Civic Center	Delaware
American Job Center - Tioga Career Center	Tioga
American Job Center - Tompkins Career Center	Tompkins
Binghamton University - Koffman Southern Tier Incubator	Broome

* "Other" includes American Job Centers as well as economic and business services including workforce centers and clean energy business incubators

Appendix B. Inventory Tools and Methodology

This section provides an explanation of the approach used to conduct the education and workforce development resources inventory for the Southern Tier region.

Program Search Tools

The inventory started using some standard organizations/agencies, tools, and other resources to identify training programs for the region. These are summarized below with a description and a link for each program. In addition to these resources, NREL also conducted web-based research, and coordinated with NEST.

Type of Program/ Organization	Where to Start Your Search	Notes/Explanation
K-12 Programs		
High School	Advance CTE	You can search for the state contact (amy.cox@nysed.gov) for CTE programs. You will need to reach out to this contact and ask about specific locations of secondary and post-secondary construction, green construction, energy, or manufacturing programs.
	SME PRIME	Advanced manufacturing high school programs.
	USGBC High School Resources	Contact education@usgbc.org to ask about existing schools in a given location.
Community & Technical Colleges		
Community, Technical, and Vocational Colleges and Schools	FAME USA	Advanced manufacturing community college programs.
	College Navigator	US Department of Education search tool. Search by location and program/major (Architecture and Related Services, Construction Trades, Engineering, Mechanical and Repair Technologies).
	College Map	US Department of Education interactive mapping tool. Search by location, major/degree.
	Advance CTE	You can search for the state contact (amy.cox@nysed.gov) for CTE programs. You will need to reach out to this contact and ask about specific locations of secondary and post-secondary construction, green construction, energy, or manufacturing programs.
Colleges & Universities		
College/ University	College Navigator	Search by location and program/major (Architecture and Related Services, Construction Trades, Engineering, Mechanical and Repair Technologies).
	Industrial Assessment Centers	Programs at colleges and universities that provide energy audit training for university students.
Nonprofits & Community Based Organizations		
Nonprofits	Web search	Search by location and keywords such as “clean energy training programs” or “green building training programs.”

Type of Program/ Organization	Where to Start Your Search	Notes/Explanation
Corps Programs	The Corps Network	List of corps programs by state would need to keyword search "green building" or "energy."
	Americorps	Search tool for state and national Americorps programs. Filter by location (state) and "Housing" and "Environment" service areas.
	Service Year Alliance	Search tool for service year programs. Filter by location (state) and environment.
Solar Training	Certified PV Training Providers	Search by state, then "Accredited Training Provider – PV Installation Professional" and "Technical Sales."
Energy Efficiency Training	Home Energy Professionals Training Providers	Search by state, then all categories of "Accredited Training Provider – Crew Leader, Energy Auditor, Quality Control Inspector, Multifamily Quality Control Inspector, Retrofit Installer Technician."
Industry & Trade Organizations		
Industry Associations	Home Builders Institute (HBI)	Apprenticeship and Pre-apprenticeship programs.
	National Association of Home Builders (NAHB)	Find local chapter and search website or contact to ask if they offer any green building/energy efficiency trainings.
	National Association of the Remodeling Industry (NARI)	Find local chapter and search website or contact to ask if they offer any green building/energy efficiency trainings.
	Building Performance Association (BPA)	Find local affiliates and search website or contact to ask if they offer any green building/energy efficiency trainings.
	Solar Energy Industry Association (SEIA)	Find local chapter and search website or contact to ask if they offer any solar trainings.
Construction Trades/Unions	North America's Building Trades Union (NABTU)	Find local union halls and search website or contact to ask if they offer any green building or energy efficiency trainings.
	International Association of Sheet Metal, Air, Rail and Transportation Workers (SMART)	Find local union halls and search website or contact to ask if they offer any energy efficiency or heat pump training.
	United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry	Find local union halls and search website or contact to ask if they offer any energy efficiency or heat pump training.
	Insulators Union	Find local union halls and search website or contact to ask about apprenticeships.
	International Brotherhood of Electrical Workers (IBEW)	Find local union halls and search website or contact to ask if they offer any trainings on any EE/clean energy topic areas.

Type of Program/ Organization	Where to Start Your Search	Notes/Explanation
	International Union of Painters and Allied Trades (IUPAT)	Find local union halls and search website or contact to ask if they offer any trainings on any EE topic areas.
Other*		
Workforce Innovation and Opportunity Act (WIOA)-funded workforce services	American Job Centers	Search by location.
	WIOA-eligible training providers	Search by state, then you can look into types of training.
Economic/ Business Services	Web search	Search terms: chambers of commerce, small business development centers, minority business development centers.
Clean Energy Business Incubators	Web search	Search by state, and then by region if possible, using key terms to guide your research like clean energy, energy efficiency, and renewable energy.

Inventory Template and Methodology

For reference, we have included a simplified version of the worksheet NREL used to research and inventory the EWD resources available in and serving the Southern Tier region of New York State. Instructions and explanation are described below.

Based on the results from the searches described above, we listed the organization and/or program name, and filled in as much information as possible. In the Location and “Program Description” sections, we completed all columns. For all other sections, we placed an "X" in the column or columns that best described the EWD resource provided. Some organizations had multiple program offerings. In this case, we chose to enter each program as a separate entry, with the organization name first. For example: "XYZ Community College - Green Building Construction Program" and "XYZ Community College - Solar PV Installation Program." Alternately, you can combine all programs under one organization, explaining the program details in the “Program Description” section. For the “Technology Focus Area,” some programs addressed multiple areas, and we captured those distinctions respectively. For “Program/Audience Type,” we tracked the inventory by listing one main entry for each program or organization.

There were other program elements that we captured for our research but did not use for this specific analysis (and therefore did not include in this publication). The first was degrees and certifications, which included high school diploma/GED, AA/AS, BA/BS, MA/MS, industry-recognized certification or credential, and certificate of completion, as well as other forms of accreditation. The second element was the type of training offered, and the categories we included were online, in-person, work-based learning, apprenticeship, professional development, mentorship, wrap-around services, and others.

Organization and/or Program Name	Location			Program Description	Technology Focus Area					Program/Audience Type					
	Address	County	Website		Energy Efficiency*	Renewable Energy	Advanced Manufacturing	General Construction/Trades	Other**	K-12/CTE	Community/ Technical College	College/ University	Non-profit	Union/Industry Group	Other***

* “Energy Efficiency” includes building energy efficiency, green building, HVAC, and building automation

** “Other” Technology Focus Area referred to business support and wrap-around services

*** “Other” Program/Audience Type includes economic and business services, including workforce centers and clean energy business incubators

Appendix C. Case Studies of Regional EWD Coalitions

This report looked at the full range of stakeholders engaged in education and workforce development activities around clean energy. Below are some case studies on coalitions that have successfully brought together key stakeholders along this EWD continuum to support regional goals around workforce development and employment. Although not all include groups in every category, all of the following examples demonstrate broad and diverse collaboration.

RePower LA

RePower LA is a coalition formed in 2011 that works with the Los Angeles Department of Water and Power (LADWP) to develop and support policies and programs that help reduce energy burden for residents and create quality job opportunities. The coalition includes utilities, unions (IBEW), nonprofits, environmental and community organizations, interfaith groups, and school/education and workforce groups. The group's close coordination with LADWP and the local IBEW was foundational to its workforce successes.

Water Energy Education Alliance (WEEA)
https://www.mwdoc.com/water-energy-education-alliance-weea/

WEEA brings together more than 55 professional organizations working together to build and support career pathways to water and energy jobs for high school students in southern California. Although the direct audience for their efforts is high school students, the coalition includes not only primary education providers, but colleges and technical trade schools, water and energy agencies/utilities, and professional organizations.

Virginia Energy Workforce Consortium (VEWC)
https://virginia.getintoenergy.com/who-we-are/

VEWC brings together education, industry, labor, and public partners to support the energy sector workforce in Virginia, including renewable energy. VEWC hosts a Careers in Energy Week each year, and works on STEM and related state policy efforts, including supporting the state's adoption a formal 17th Energy Career Cluster for CTE programs across the state.

Ready Connecticut
https://readyct.org/overview/

ReadyCT is an effort that brings together stakeholders to ensure high quality academics and career-connected learning for high school students throughout the state of Connecticut. Members include educators and education administrators, local government staff and elected officials, workforce organizations, unions, and private companies. Although not clean-energy specific, they recently launched their Manufacturing Skills-CT project website, which is focused on connecting students directly to employers. Their coalition and interactive website offer a variety of tools and resources.

Partners for Education & Business, Inc. (PEB)
https://www.macny.org/peb/

PEB is a nonprofit associated with the Manufacturers Association of Central New York (MACNY) and tries to bridge the gap between high school education and industry employment. They work with education and industry partners to refine curricula and develop opportunities ranging from guest speakers to site tours to work-based learning opportunities.

New York City Employment & Training Coalition (NYCETC)
https://nycetc.org/about-us/
NYCETC is a workforce development association with approximately 200 members involved in all aspects of education, training, and community services. This ranges from secondary and post-secondary educators to adult learning providers, nonprofit workforce development and wrap-around service providers, and more. They are not focused on clean energy but have an explicit equity focus.

Center for Energy Workforce Development (CEWD) – State Consortia
https://cewd.org/state-consortia/
According to their website, CEWD is "a non-profit consortium of energy companies, contractors, associations, unions, educators, and business partners working together to ensure a skilled, diverse workforce pipeline to meet future industry needs." Their website includes a map, list, and information on formal CEWD Energy Workforce Consortia for each state. The types of organizations included and their scopes or scale of work vary, but it is another place to learn more about these types of activities across the country.