



 University at Buffalo
The Center for Industrial
Effectiveness (TCIE)

 ALFRED STATE COLLEGE
STATE UNIVERSITY OF NEW YORK

Report prepared for UB TCIE and
Alfred State College of Technology
by the UB Regional Institute.

Clean Energy Workforce Assessment for Western New York

June 2019

Acknowledgements

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This research study assesses the educational needs of the clean energy sector for the five county region of Western New York (WNY): Erie, Niagara, Cattaraugus, Chautauqua, and Allegany. The assessment is meant to inform curricular development for the University at Buffalo and Alfred State, and other SUNY and local academic institutions, as they seek to prepare students for current and future jobs in the expanding field of clean energy.

The project team would like to thank the local experts from industry and academic institutions of the WNY Clean Energy Advisory Group for graciously giving their time and providing critical insight for this project. The team would also like to thank Invest Buffalo Niagara for sharing data that revealed key findings of this study.

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THE WNY CLEAN ENERGY ADVISORY GROUP

To support this project, a Clean Energy Advisory Group was assembled to guide and inform this assessment. More than twenty representatives from clean energy employers across the five county region, including firms of various sizes (small, medium and large enterprises) and sectors (including public and private) participated in the Advisory Group. The group was consulted through three focus group meetings and interviews with selected representatives.

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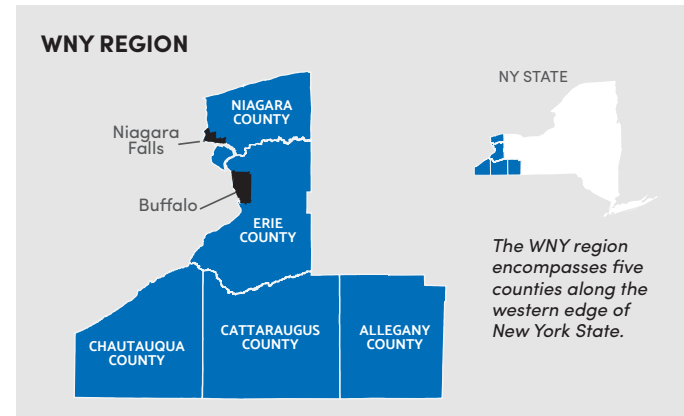
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The five-county Western New York (WNY) Region is the geographic scope for the analyses presented in this report, unless otherwise noted. Situated along New York State's border with Ontario, Canada, the region includes the Buffalo-Niagara Falls MSA (metropolitan statistical area) encompassing Erie and Niagara counties. It is the largest metro area in New York State outside of New York City.



AN IMPORTANT NOTE ON THE DATA PRESENTED IN THIS REPORT

Standard industry employment data from the U.S. Bureau of Labor Statistics does not track “clean energy” jobs. Therefore, it is impossible to quantify the number of active “clean energy” jobs in WNY at any given time. However, these data can be used to find out more about the industries that can promote clean energy goals and the occupations needed to support those industries in WNY. As such, the numbers presented in this report illustrate the economic ecosystem needed to support and advance the region’s clean energy sector, and not the actual number of jobs and firms actively involved in clean energy work.

Five subsectors of clean energy are used throughout this report to better understand the nuanced workforce needs of the industry. A wide variety of occupational and industry codes used in official government data are used to quantify the job types, industry demands, and academic programs that tie into WNY’s clean energy subsectors. These codes were assembled from a number of sources, including NYSERDA, the NYS Department of Labor, the US Bureau of Labor Statistics, and the National Center of Education Statistics. For details, please see the Data Sources and Notes.

CLEAN ENERGY INDUSTRY SUBSECTORS

- Manufacturing*
- Construction & Installation*
- Professional Services & Consulting*
- Energy Distribution*
- Public Policy & Advocacy*

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Clean Energy in Western New York

Dating back to the opening of the Niagara Falls Hydraulic Power and Manufacturing Company in the 19th Century, up to the recent creation of North America's largest solar manufacturing plant on the shores of the Buffalo River, clean energy has always been a part of Western New York's (WNY's) economic identity.

Clean energy industries are growing across the nation, and economic development officials in the region and state identify the clean energy sector as an area for targeted growth and investment. New York State has bold targets for reducing greenhouse gas emissions through energy efficiency and the adoption of renewable energy. How academic institutions in WNY keep pace with the workforce needs of clean energy will be key to meeting these goals and driving industry growth.

Moving further into the 21st Century, it is critical to understand what jobs, skills, and areas of expertise will be required for businesses involved in clean energy technologies and services. Academic institutions can use this information to adapt their programs to prepare the workforce for clean energy jobs and meet the emerging needs of industry.

Clean energy is part of WNY's heritage. Sharpening WNY's local academic institutions to meet the growing demands of the clean energy industry is key to the region's future.

Why conduct a clean energy workforce assessment?

The clean energy industry is constantly evolving. To support this sector in WNY, while advancing renewable energy and improving energy efficiency, it is critical to understand the industry's shifting workforce needs. Assessing these ever-changing industry demands requires a broad overview of WNY's clean energy industry, and the key occupations and skill sets needed to drive industry growth.

This report investigates employment trends, educational needs, and hiring demands of the clean energy industry. These topics can provide insight to local colleges, universities, and other partners in clean energy workforce development. This can reveal opportunities for academic programs to fulfill the workforce needs of local clean energy employers and help grow the industry.

How can data be used to understand the workforce needs of WNY's clean energy sector?

To gain a glimpse into the scale, capacity, and dynamics of clean energy in WNY, official government statistics are relied on for accurate, detailed trends and projections about the local economy. These numbers are classified into long established industry and occupational codes based on traditional types of jobs and businesses.

"Clean energy," however, cuts across industry sectors and occupational groups, since many similar types of jobs and businesses potentially could, but often do not, participate in the distribution of renewable energy, or the promotion of energy efficiency. For instance, the data would not distinguish a vehicle parts manufacturer that produced parts solely for combustion engine vehicles from an electric vehicle plant.

Data still shed light on the current capacity and workforce needs of clean energy in WNY. Assessing the data can also reveal opportunities, because even if a particular job or firm found in the data is currently uninvolved in clean energy, if it is coded as a similar type of job or business, it likely has capacity to actively support WNY's clean energy industry.

Why is it important to look at data for both industries and occupations?

It is important to note that businesses in the clean energy industry employ many positions that are often not on the front lines of clean energy work, but still require expertise in clean energy, such as sales workers at a solar panel manufacturer. Conversely, workers in clean energy occupations are often employed in industries not directly involved in clean energy, but may still be involved in clean energy work, such as electricians employed by colleges or hospitals. As such, data presented for clean energy industries do not match figures for clean energy occupations.

Looking at industry data reveals what businesses may currently be active in the clean energy economy, and can show the extent of the support and supply chains for clean energy products and services in WNY. Industry trends can show the hiring needs of clean energy employers. But data for occupations is needed to bring the workforce needs of the industry into clearer focus, since training and academic programs are generally structured around jobs.

With this in mind, this report presents numbers for both clean energy industries, as well as clean energy occupations, since each perspective can reveal unique key insights into the workforce needs of the clean energy sector.

What can be learned from local clean energy industry experts?

Since data can only tell so much, input from local industry experts is absolutely critical. Local employers and educators actively involved in clean energy can provide details on their experiences recruiting and training for the most in-demand jobs. There is often a lag in published economic data, but industry experts provide up-to-the-minute insights into the needs and challenges of local clean energy employers.

This study relied upon a series of meetings and conversations with many local clean energy experts from WNY's clean energy employers and academic institutions. The insights gained from industry experts are crucial to this assessment. This feedback often supports findings from the analysis of labor market data, but greatly deepens an understanding of the true workforce challenges faced by the clean energy industry.

Together with the labor market analysis of WNY's clean energy sector, insights from local experts can reveal significant opportunities and key challenges for colleges and universities as they look to adapt academic programs to meet the needs of the local clean energy industry.

The Policy Landscape Guiding Clean Energy in Western New York

Public policy influences every sector of clean energy. From energy distribution and professional services, to clean energy manufacturing and construction, all employers are affected by the evolving landscape of clean energy policy at the local, state and federal levels.

The primary policy consideration for clean energy in WNY lies in New York State's (NYS) Reforming the Energy Vision (REV) initiative. This is a strategy to build clean, resilient and affordable energy systems that will affect every aspect of the clean energy sector in NYS.

Goals of the REV include:

- Reducing greenhouse gases by 40% from 1990 levels of 238.32 millionmetric tons of CO2 emissions (MMTCO2e) by 2030, and 80% reduction by 2050;
- 50% electricity generated from renewable energy sources (solar, wind, hydropower, and biomass) by 2030;
- 23% reduction in energy consumption in buildings from 2012 levels (equated to 600 trillion British thermal units (TBtu)) by 2030.

Meeting the goals of the NYS REV will require a massive deployment of clean energy related workers with knowledge of changing policy initiatives. These workers will design and construct efficient buildings, retrofit existing buildings for energy efficiency, and to develop and deploy new clean energy technologies, such as battery storage facilities.

New York's clean energy goals put heavy demands on employers that generate and distribute renewable energy.

REV is reshaping the way utility companies do business. The development of distributed renewable energy sources across the state has forced utility companies to adjust how energy is deployed. With the closure of coal and gas burning power generation facilities, and the development of large scale wind and solar farms, energy distribution firms will need to be nimble to create efficiencies and maintain stability and security of the energy system.

State policies and regulations increase the training needs of construction and installation jobs for clean energy.

The NYS REV will have a large impact on those involved in improving the energy efficiency of buildings. Businesses and workers in energy efficiency will need to understand evolving building codes, installation of new materials and technologies, like geothermal systems, and how to properly implement designs to create more efficient new buildings. It will be crucial for front line installers to have a base knowledge of the proper application of clean energy technology in order to meet REV efficiency goals.

New clean energy technologies and policies add to the skills needed for many professional services jobs.

As the clean energy industry requires consulting, design services, sales, and other supporting services for clean energy, it is important that continuing education opportunities around clean energy policy are available to workers in these professions. The changing policy landscape forces professional service firms to continually adapt.

Professional services shape the way private business and governments make decisions when it comes to clean energy. It is vital for clean energy workers in professional services to fully understand the impacts of policy initiatives like REV.

Advancing clean energy in the public sector adds to the workforce demands of private employers.

REV is shaping local policy initiatives. Local governments across NYS are creating laws and policies to regulate the development of renewable technologies like solar and wind in their communities.

Some municipalities are also developing initiatives to encourage the adoption of clean energy technologies. One example is Property Assessed Clean Energy (PACE) financing which allows commercial properties to leverage the assessed value of their property to implement clean energy projects for their buildings. Policies like these are already playing a role in how and where clean energy is developed in NYS.

Sources: New York State Department of Public Service, 2016; New York State Energy Research and Development Authority (NYSERDA), 2016; U.S. Department of Energy, 2017. See Data Sources and Notes for more details.

NYSERDA provides numerous resources to support the REV and clean energy employers.

Through the New York State Energy Research and Development Authority (NYSERDA), NYS provides resources to support the State's energy goals. Most notable is the NYS Clean Energy Fund (CEF). The CEF supports NYS goals to make 500,000 homes and 20,000 businesses more energy efficient, and bring solar to 150,000 homes and businesses by 2020.

NYSERDA committed \$70M over the next 10 years to clean energy workforce development. This funding supports education for building operations staff, on-the-job training, and internships to prepare clean energy workers in hands-on skills. Many organizations are eligible from colleges and universities, to unions and manufacturers.

NYSERDA provides incentives to eligible employers to hire and provide on-the-job training in heating, ventilation, and air conditioning (HVAC), smart grids, and other emerging clean energy technical as like energy storage. NYSERDA also provides funding for internships at clean energy companies through its NYS Clean Energy Internships program. NYSERDA's Building Operations and Maintenance Workforce Development program also provides funding for employers and building owners to develop novel, on-site training projects to suit their needs and facilities.

Federal policies and automation are changing the landscape of clean energy manufacturing.

Policy implications for some subsectors of the clean energy economy, such as manufacturing, are most prevalent at the federal level. Current federal policy is trying to revive the manufacturing sector across the US. Tariffs are a part of these efforts, and have encouraged some solar panel manufacturers to relocate plants to the US. Although federal support may create more job opportunities in clean energy manufacturing, a national trend toward automation in the private sector may result in a net loss of traditional manufacturing jobs in exchange for new types of high-tech positions.

There are federal resources to support the advancement of clean energy.

Federal policy currently plays a limited role in the growth of the clean energy sector, however the federal government is supporting research and development (R&D) through grant funding that will impact the future of this sector.

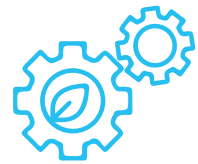
Some opportunities to support clean energy workforce development at the federal level include the Department of Energy's Title XVII Innovative Clean Energy Projects Loan Program that offers loans guarantees to accelerate the deployment of innovative clean energy technology, like nuclear energy, renewable energy, and energy efficiency. The Environmental Protection Agency works with industry and others to encourage efficient, clean technologies such as combined heat and power and green power from renewable resources, across a variety of sectors such as agriculture and waste management.

Clean Energy Industry Overview

The clean energy industry includes businesses or organizations potentially working to produce, distribute, install, or promote policies related to energy derived from renewable, carbon-free sources, as well as efforts to reduce energy demand through efficiency measures in buildings, transportation and infrastructure.

The industry is made up of five subsectors supporting clean energy: Manufacturing, Construction and Installation, Energy Distribution, Professional Services and Consulting, and Public Policy and Advocacy. These subsectors are used throughout this report as a way to understand the common types of businesses, jobs, and skills needed to support the clean energy workforce.

CLEAN ENERGY SUBSECTORS



Manufacturing

The production of goods used in the generation and distribution of clean energy, or materials and components that explicitly enhance energy efficiency.



Construction & Installation

The assembly, set up, or repair of components used to generate clean energy or to explicitly increase energy efficiency.



Professional Services & Consulting

The provision of services that support clean energy or energy efficiency, including environmental services, design, legal and financial services, and more.



Energy Distribution

The supply, generation, and distribution of energy from renewable sources, including solar, wind, geothermal, hydropower, biomass, and waste-to-energy.



Public Policy & Advocacy

The development and administration of policies, or advocacy for, the adoption of renewable energy, or energy efficiency in buildings and infrastructure by government entities or non-profit organizations.

Over **130,000** Clean Energy Jobs in WNY

8%

job growth in clean energy occupations from 2012 to 2017

Six times the pace of job growth across the regional economy overall

1 out of 5 jobs in the region are in industries with ties to clean energy

+11,770 more older workers (55+) than younger workers (25-34) in the WNY clean energy industry

Workers in clean energy industries earn

\$11,000 more per year than WNY's average wage

Sources: U.S. Bureau of Labor Statistics, Quarterly Census of Employment and Wages, 2017 US BLS, Occupational Employment Statistics, 2012 and 2017; US Census, Quarterly Workforce Indicators, 2016-2017 See Data Sources and Notes.

Firms, Wages and Jobs by Clean Energy Subsector, 2017

CLEAN ENERGY SUBSECTOR	# OF FIRMS	AVG. ANNUAL WAGES	# OF JOBS
Manufacturing	926	\$66,809	27,646
Construction & Installation	3,009	\$53,784	21,504
Professional Services & Consulting	4,303	\$60,216	44,771
Energy Distribution	218	\$94,173	4,621
Public Policy & Advocacy	1,114	\$46,980	34,207
Clean Energy Total	9,458	\$57,566	130,201

Source: U.S. Bureau of Labor Statistics, Quarterly Census of Employment and Wages, 2017. * Some industries are included in multiple subsectors so clean energy sector totals are less than the sum of all subsectors.

Clean Energy Industry Overview

Clean Energy Industries in WNY

Clean energy industries are a big part of WNY's economy, accounting for more than a quarter of the region's firms and total wages—nearly \$7.5 billion in 2017. These figures show the significance of the current pool of workers who could be served by clean energy training, not the number of firms and jobs actively involved in clean energy work.

Job numbers in each clean energy subsector illustrate the relative potential for clean energy training across the industry. The energy distribution sector is the smallest subsector in terms of employment, but as these employers are the primary producers of clean energy, their workforce needs remain critical. There are many more jobs involved in construction and installation, and manufacturing, which are also key to innovation and growth.

The greatest number of jobs is in professional services, which includes legal, financial, and other support businesses that can be essential to clean energy, and may require specialized training to take on supporting roles. Overall, the professional

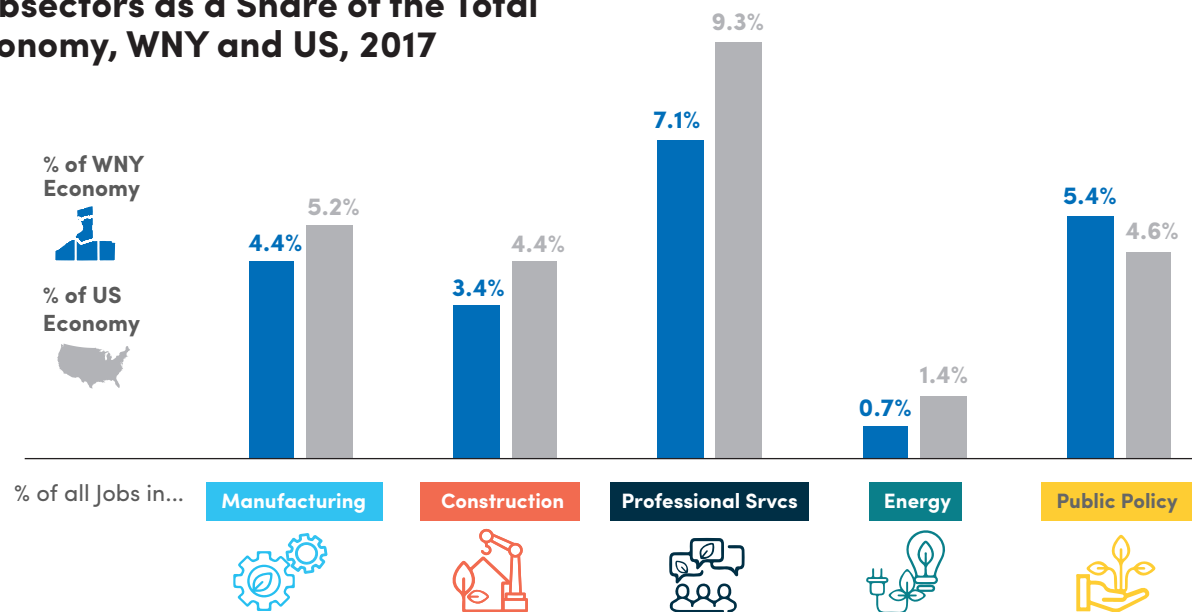
services subsector grew from 2012 to 2017 (+6.4%), driven by an increase of 500 jobs in the architecture, and engineering firms. Jobs in other high-paying industries, such as legal, and financial services also grew in WNY. Firms involved in construction and installation, such as building finishing contractors, and nonresidential construction firms, also added hundreds of jobs since 2012.

Government agencies and departments make up the largest industry in the public policy and advocacy subsector with over 23,600 jobs in 2017. Public employment was relatively stable in WNY between 2012 and 2017. Jobs involved in the administration of environmental programs grew by double digits from 2012 to 2017, suggesting an opportunity to integrate clean energy policies as the sector expands.

21% of all jobs in WNY are in Clean Energy

24% of all jobs in the US are in Clean Energy

Percent Employment in Clean Energy Subsectors as a Share of the Total Economy, WNY and US, 2017



Source: U.S. Bureau of Labor Statistics, Quarterly Census of Employment and Wages, 2017.

Clean Energy Subsectors



Clean energy subsectors these industries apply to

Top Clean Energy Industries in WNY by Employment, 2017

General Government Support	23,636
Building Equipment Contractors	7,675
Legal Svcs	5,278
Building Material & Supplies Dealers	4,948
Architectural, Engineering, & Related Svcs	4,128
Scientific Research & Development Svcs	4,073
Commercial Equipment & Supplies Wholesalers	3,650
Accounting, Bookkeeping, & Payroll Svcs	3,480
Machine Shops & Hardware Manufacturing	3,294
Building Finishing Contractors	3,213

Source: U.S. Bureau of Labor Statistics, Quarterly Census of Employment and Wages, 2017.

Job Growth in Top Growing Clean Energy Industries in WNY, 2012 to 2017

Administration of Environmental Programs	789
Building Equipment Contractors	733
Architectural, Engineering, & Related Svcs	500
Building Finishing Contractors	374
Other Specialty Trade Contractors	349
Civic & Social Organizations	235
Nonresidential Building Construction	213
Commercial Equipment & Supplies Wholesalers	161
Administration of Economic Programs	160
Electric Power Generation & Distribution	142

Source: U.S. Bureau of Labor Statistics, Quarterly Census of Employment and Wages, 2012 and 2017.

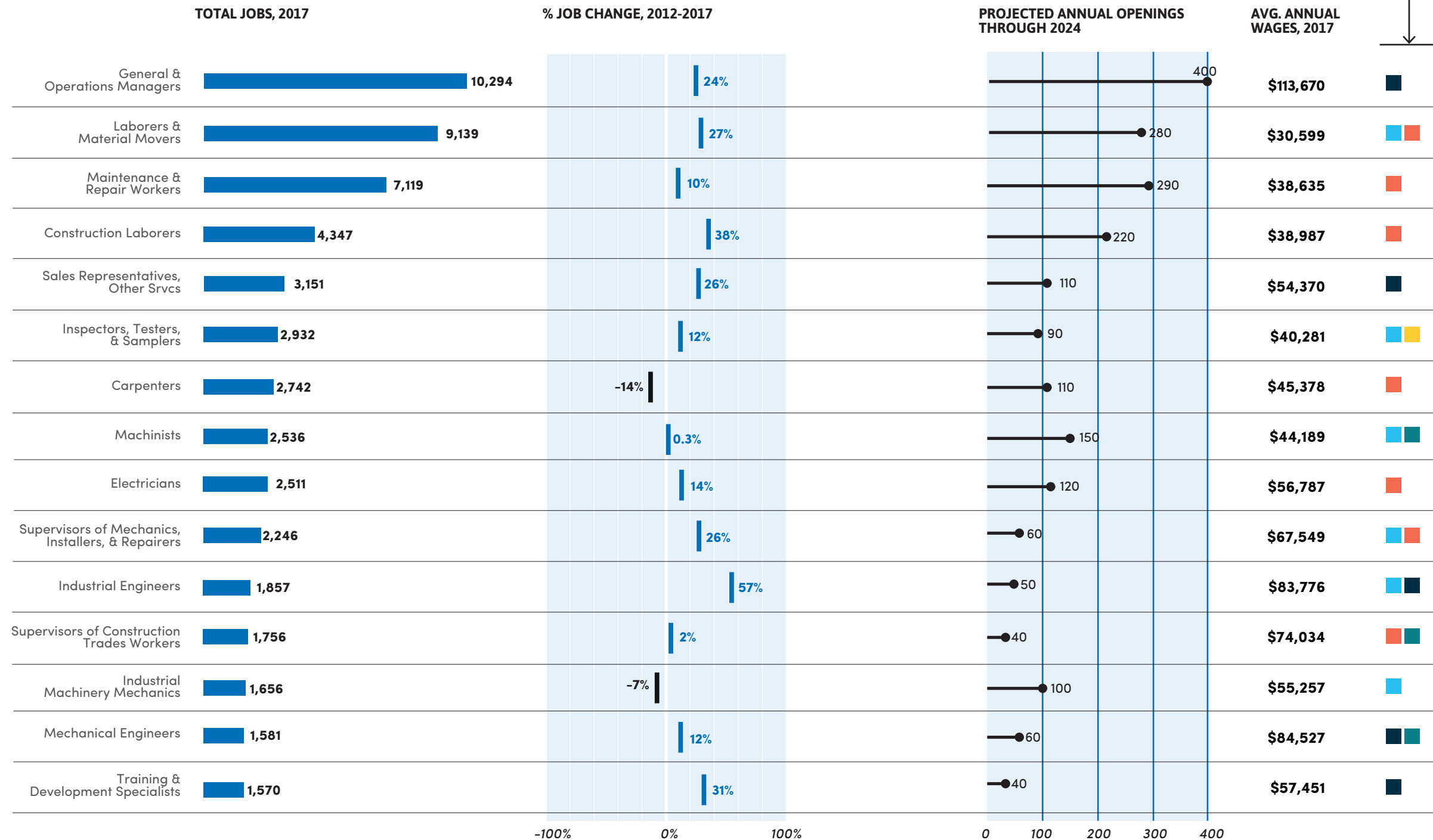
Clean Energy Industry Overview

Clean Energy Occupations in WNY

Clean Energy Subsectors



Clean energy subsectors these occupations can be applied to



Across all the occupations potentially involved in WNY's clean energy sector, managers, construction trades workers, sales representatives, and engineers have the highest employment levels.

Thousands of jobs supporting clean energy are in the skilled trades, such as carpenters, repairers, and electricians. Many engineers are needed across most subsectors of clean energy, including electrical engineers, although they do not fall into this list in terms of current overall employment.

Most of the top occupations supporting clean energy grew faster than all jobs in the WNY economy overall in recent years (+1.2% from 2012 to 2017). As a whole, occupations connected to clean energy are projected to grow somewhat faster than the regional economy overall. Across 82 occupational codes related to clean energy, over 3,100 openings are expected each year through 2024, according to the NYS Department of Labor's most recent projections.

Well over half (1,860) of the annual projected job openings in clean energy occupations typically require no more than a high school diploma or equivalent, including many of the skilled trades. More than a third of these projected job openings (1,130) require a bachelor's degree, like engineers, managers, and sales representatives.

These trends suggest demand for clean energy jobs and supporting training and academic programs, is likely to grow in the near future. But it is important to note that, most of these occupations, like engineers and electricians, are often employed by businesses currently uninvolved in clean energy work. Clean energy employers will need to compete with other sectors to recruit the skilled workers they need.

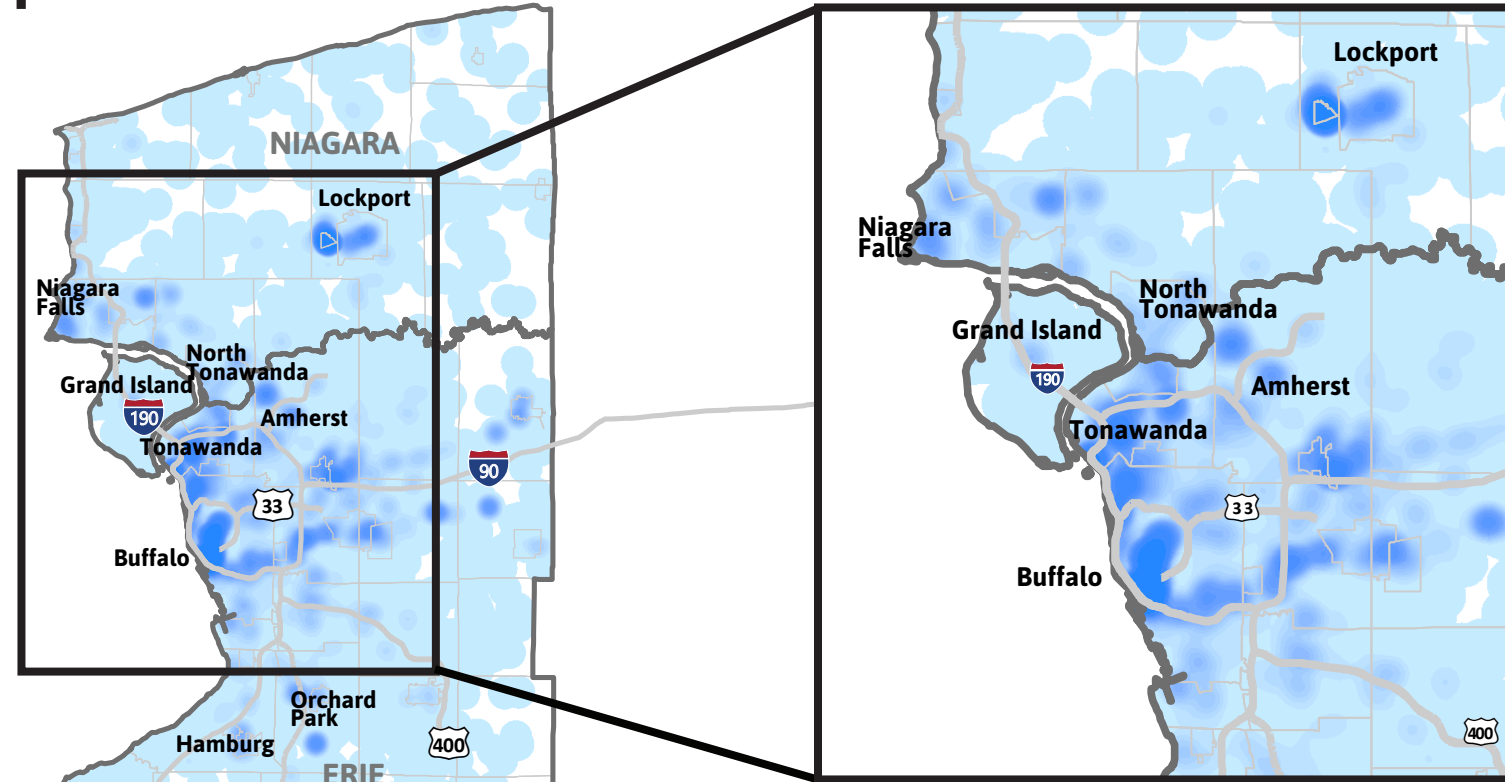
Source: US Bureau of Labor Statistics, Occupational Employment Statistics, 2012 and 2017; NYS Department of Labor, "Long-Term Occupational Projections, Western New York" 2014-2024. Projected openings include both growth and replacement.

Clean Energy Industry Overview

Clean Energy Employers in WNY

The clean energy industry in WNY is extensive, spanning a wide range of businesses across the region. The industry is made up of nearly 9,500 firms involved in one or more of the five subsectors of the clean energy industry. Understanding where clean energy businesses are concentrated can help academic institutions focus outreach efforts for industry partnerships and workforce engagement.

Similar clean energy employers are often located in similar types of places. Manufacturing firms are often found near recognized industrial areas, like Buffalo and the Tonawandas. Professional service firms, are typically in business districts and downtowns. Construction and installation businesses tend to be located along suburban commercial corridors and in urban and rural town centers. Energy distribution firms are in places like Niagara Falls, Lockport, and Jamestown. As any local government can be involved in clean energy policy, the public policy subsector is found in every municipality in WNY.



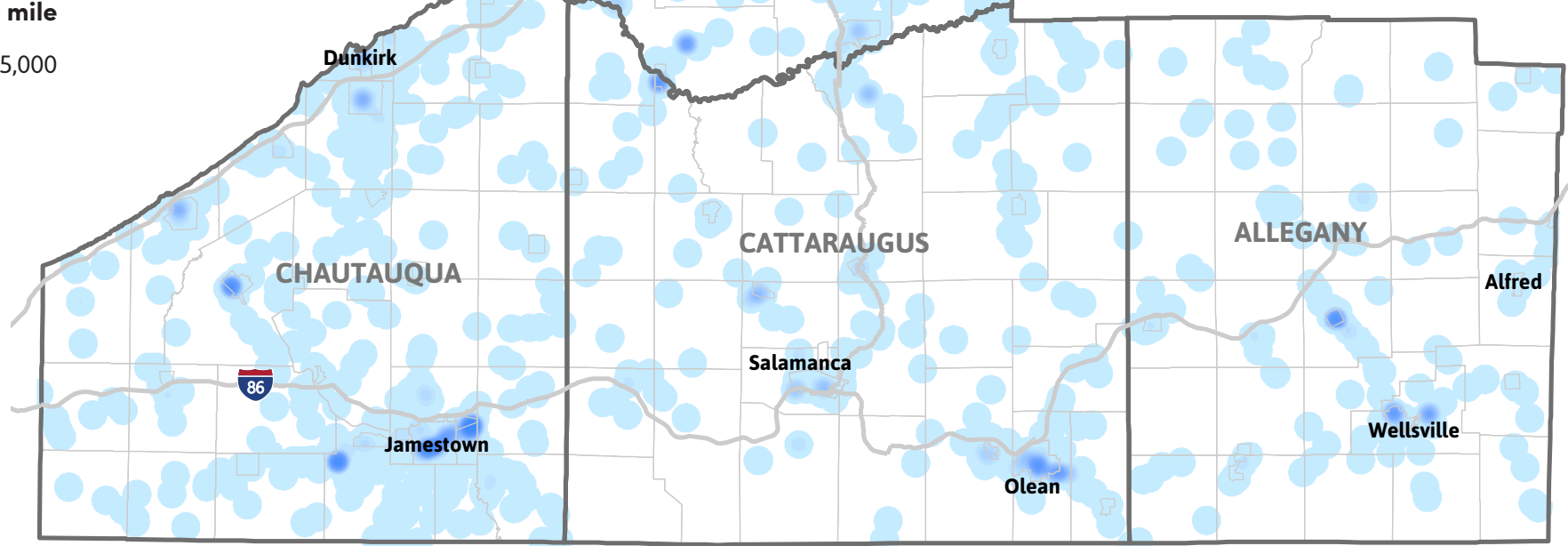
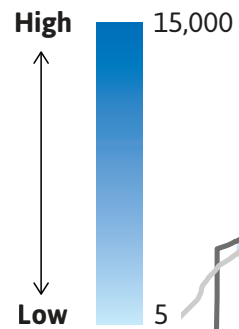
A wide array of WNY businesses posted a number of open positions related to clean energy over the last couple years. These range from manufacturers and utilities, to engineering firms and technical consultants. Most of these companies take more time than the regional average (29 days) to fill these positions.

Many key clean energy positions are often not even posted, like electricians and other skilled workers, which are often recruited through unions or social connections of current workers. Employers with recent job postings in energy distribution are primarily from traditional utility companies, like National Grid, who are primarily responsible for responding to the adoption of renewable energy products. Overall, manufacturers have more job postings, and likely greater hiring needs, than businesses in other subsectors of clean energy.

Companies looking to hire clean energy workers offer academic institutions potential opportunities to partner with industry in training programs and curricula development.

Employment Density of Clean Energy Industries, 2018

Jobs per sq. mile



Source: UBRI analysis of InfoGroup, Inc., Reference USA Business Database, 2018.

WNY Companies with Recent Clean Energy Related Job Postings

COMPANY	LOCATION	UNIQUE POSTINGS (Sept. 2016 - Dec. 2018)
Cannon Design, Inc.	Grand Island	132
Computer Task Group, Inc.	Buffalo	109
Panasonic Corporation	Buffalo	103
Mahle Industries, Inc.	Buffalo	81
GHD	Buffalo, Niagara Falls	62
Middough Inc.	Amherst	56
Greenman-Pedersen, Inc.	Buffalo, Dunkirk	43
Arcadis U.S., Inc.	Buffalo	41
Aecom	Buffalo	38

Source: UBRI analysis of WNY job postings using Emsi, September, 2016-December, 2018.

Clean Energy Industry Overview

In-Demand Occupations

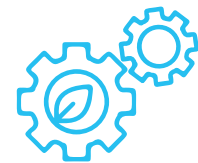
Job postings in clean energy show that a wide range of academic programs can play a role in training clean energy workers.

Engineering occupations are among the top in-demand jobs for many subsectors of clean energy. This includes civil, mechanical, electrical, and industrial engineers, all of which were indicated by local experts as top in-demand occupations for WNY.

WNY also has a need for construction managers, solar photovoltaic installers, and electricians, particularly Master Electricians. Other in-demand jobs important for clean energy include skilled trades workers, architects, and operations engineers. Postings for installers and technicians typically take more time to fill, implying that companies have difficulty hiring emerging occupations.

Business specialists, engineers, and managers were among the top posted jobs in clean energy professional services. This supports local industry feedback that experienced engineers with business skills and interdisciplinary knowledge are often needed for consulting work. Many open positions in policy and advocacy are in the financial, administrative, and specialty services involved in clean energy policies.

Local academic institutions have many opportunities to design programs that equip workers with the wide variety of technical and professional skills needed to advance clean energy goals.



Manufacturing

Industrial engineers, the most common job posting in clean energy manufacturing, were relatively more common in WNY than across the US, as were postings for production supervisors, managers, and clerks. Local experts also indicated that engineering technicians are a top in-demand job in manufacturing.

Industrial Engineers

Production Worker Supervisors

Supervisors of Installers/Repairers

Sales Representatives

Electrical Engineering Technicians

Industrial Engineering Technicians



Construction & Installation

The high number of postings for managers and supervisors shows that, unlike many construction hires, companies often must post openings to fill management jobs. These roles typically require college degrees and are critical to advancing clean energy.

Construction Managers

HVAC Mechanics and Installers

Electricians

First-Line Construction Supervisors

First-Line Supervisors of Installers/Repairers

Solar Photovoltaic Installers



Professional Services & Consulting

Engineers top the list of most commonly posted jobs in clean energy professional services across the US. This includes civil, mechanical, electrical, and industrial engineers, which are relatively more common in job postings in WNY than across the US.

Civil Engineers

Mechanical Engineers

Electrical Engineers

Architects

Architecture/ Engineering Managers

Business Operations Specialists

Industrial Engineers



Energy Distribution

Most in-demand jobs in energy distribution typically require a college degree. Based on feedback from local experts, WNY has a heightened need for many of these positions, including mechanical and environmental engineers, solar installers, and sales representatives.

Sales Representatives

Mechanical Engineers

Wind Turbine Service Technicians

Solar Photovoltaic Installers

First-Line Construction Supervisors

Environmental Engineers



Public Policy & Advocacy

A wide range of job types are posted in public policy positions. Local experts indicated that many of these occupations are critical to support clean energy policy work in WNY, including financial analysts and environmental engineers.

Managers/ Chief Executives

Environmental Engineers

Public Relations Specialists

Construction and Building Inspectors

Urban/Regional Planners

Compliance Officers

Financial Analysts

Source: UBRI analysis of job postings from US and WNY, using Emsi, September, 2016–December, 2018.

Clean Energy Industry Overview

In-Demand Areas of Expertise

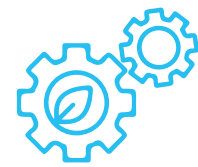
An analysis of recent job postings across the US reveals in-demand areas of expertise for today's clean energy jobs. These skill sets were vetted by local industry and academic experts, and compared to WNY job postings, to produce the set of skills shown here.

In-demand areas of expertise reflect the wide array of job types involved across clean energy subsectors. This includes skills related to professional supporting roles, like sales and management, as well as many technical areas of expertise, such as experience in solar, wind, and electrical equipment.

The prevalence of technical skill sets in job postings backs local expert feedback that hands-on skills are critical for architects, engineers, and product designers, as well as those working to implement renewable energy technologies and energy efficiency measures. This highlights the need for crossover training in academic and training programs that support clean energy.

Computer programming was not as common in recent job postings as others skills shown here, but local experts indicated that there is a growing demand for digital literacy and programming across the spectrum of clean energy jobs.

Overall, future clean energy workers will need to be more educated than current workers in the industry overall. These in-demand areas of expertise show how interdisciplinary academic programs are needed to support the range of jobs involved in clean energy.



Manufacturing

Continuous improvement processes, such as Six Sigma Methods, are the most common skill set in clean energy manufacturing job postings. Local experts pointed to electronic and control systems, automation, and solar photovoltaics as being in-demand by WNY manufacturers.

Continuous Improvement Process/ Lean Mfg/ Six Sigma Methods

Electronic Systems

Corrective and Preventive Actions

Control Systems

Automation

Photovoltaic/Solar Cells

Computer Programming



Construction & Installation

Most of the top in-demand skills for clean energy construction and installation lie in the skilled trades. Experience with photovoltaic cells, operations management, and computer control systems are relatively more common in WNY job postings than across the US.

HVAC

Construction Management

Operations Management

Electrical Wiring/ Electrical Equipment

Pumps

Computer Control Systems

Occupational Health and Safety (OSHA)



Professional Services & Consulting

Overall, the most common skill set needed in this subsector is in design software, like AutoCAD, which is key for architects and engineers. Sustainable design, building codes, and HVAC reinforce the cross-cutting nature of clean energy professional jobs.

Computer-Aided Design Software

Business Development

Mechanical Engineering

Engineering Design Processes

Sustainable Design

Electrical Engineering

Building Codes

Computer Programming



Energy Distribution

The variety of in-demand skill sets for clean energy distribution reflect a range of professional jobs, like sales, and engineers, and technical workers. Expertise with wind turbines and electrical equipment were relatively more common in WNY postings than across the US.

Customer Relationship Management

Solar Systems

Loans/Equities

Turbines/Wind Turbines

Alternative Fuels

Consultative Approaches

Electrical Equipment/ Wirings/ Components

Computer Programming



Public Policy & Advocacy

The top in-demand skills for clean energy policy include energy conservation, strategic planning, and environmental science. Areas of expertise in economics and environmental laws were relatively more prevalent in recent related WNY job postings than the US.

Energy Conservation

Strategic Planning

Public Administration

Building Codes

Community Development

Economics

Environmental Laws

Financing/Financial Analysis

Computer Programming

Source: UBRI analysis of job postings from US and WNY, using Emsi, September, 2016-December, 2018.

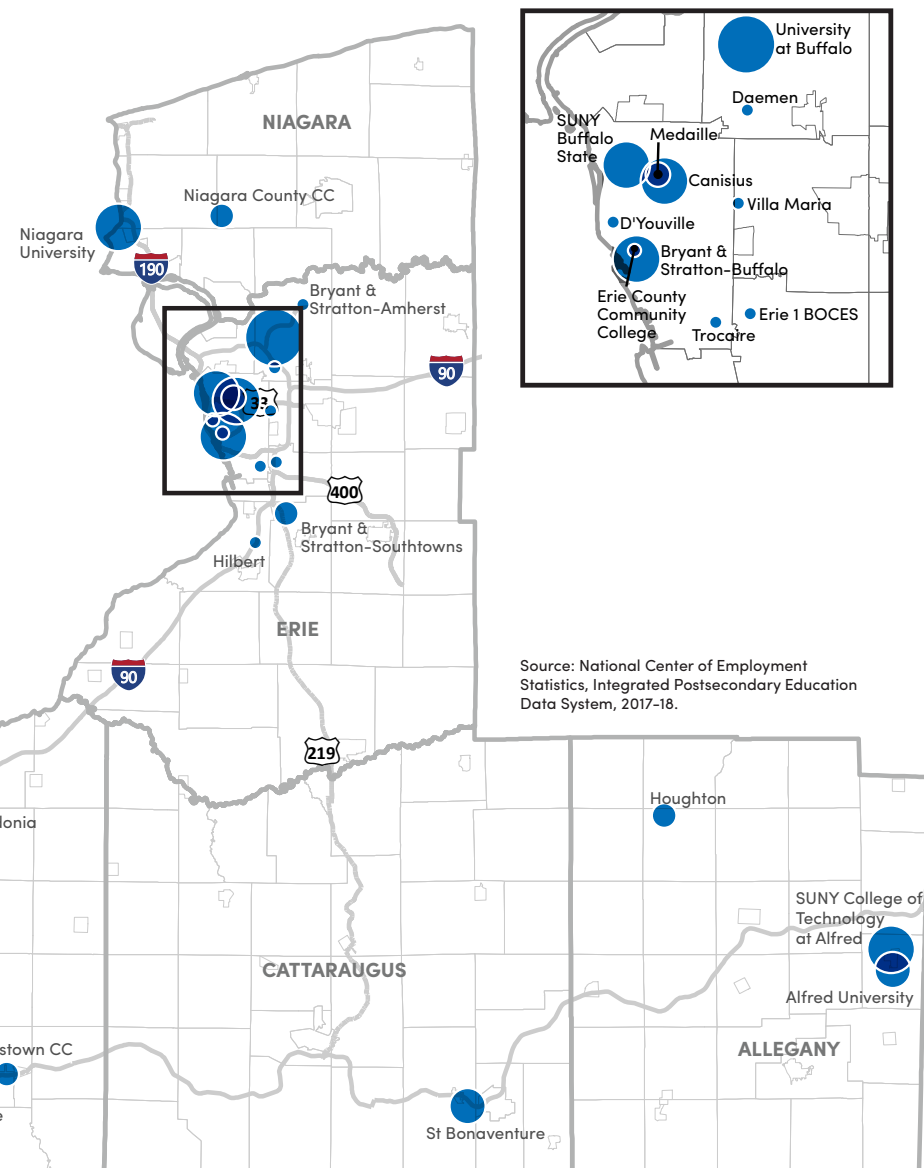
WNY Academic Institutions Involved in Clean Energy

Over twenty academic institutions across WNY play a role in educating the region's clean energy workforce. Academic programs supporting clean energy jobs include ones closely tied to clean energy, like engineering, and technical trades, and those that educate for support services, like business, finance, and sales.

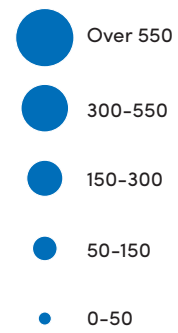
WNY colleges and universities awarded over 7,800 degrees and certificates with potential to support clean energy work in 2018.

An abundance of WNY graduates have an opportunity to advance the clean energy industry through engineering, business, architecture, public policy, and other roles.

WNY Academic Institutions with Clean Energy Potential Degrees/Certifications, 2018



of Degrees/Certificates awarded with Clean Energy Potential



Clean Energy Subsectors



Clean energy subsectors these programs can be applied to

Degrees with Potential Applications to Clean Energy by Educational Program Category, WNY, 2018

Business, management, marketing, & related	3,114	Manufacturing, Construction, Professional Svcs, Energy, Public Policy
Engineering	1,386	Manufacturing, Construction, Professional Svcs, Energy, Public Policy
Computer and information sciences	746	Manufacturing, Construction, Professional Svcs, Energy, Public Policy
Engineering technologies & related	422	Manufacturing, Construction, Professional Svcs, Energy, Public Policy
Architecture & related Svcs	202	Manufacturing, Construction, Professional Svcs, Energy, Public Policy
Physical sciences	146	Manufacturing, Construction, Professional Svcs, Energy, Public Policy
Communication & journalism	119	Manufacturing, Construction, Professional Svcs, Energy, Public Policy
Construction trades	111	Manufacturing, Construction, Professional Svcs, Energy, Public Policy
Biological & biomedical sciences	69	Manufacturing, Construction, Professional Svcs, Energy, Public Policy
Precision production	59	Manufacturing, Construction, Professional Svcs, Energy, Public Policy
Mathematics & statistics	56	Manufacturing, Construction, Professional Svcs, Energy, Public Policy

Source: National Center of Employment Statistics, Integrated Postsecondary Education Data System, 2017-18.

A Sampling of Clean Energy Degree Programs in WNY

Alfred State	Building Trades: Building Construction, Associates of Occupational Studies (AOS) Architectural Technology, Associates of Applied Science (AAS)
Buffalo State College	Industrial Technology, BS and MS Engineering Technology, BS
Erie 1 BOCES	Heating, Air Conditioning, Ventilation and Refrigeration Maintenance Technology Certificate
University at Buffalo	Industrial Engineering, BS and BS/MBA Electrical Engineering, BS and BS/MBA
Niagara County Community College	Engineering Studies, AS
Northland Workforce Training Center	Energy Utility Technology Certificate (SUNY Erie) Electrical Construction and Maintenance Electrician, AOS (Alfred State)
SUNY Erie	Mechatronics Certificate CNC Precision Machining Certificate

Clean Energy Workforce Challenges, Opportunities and Key Considerations

A series of meetings and interviews with local industry and academic experts from the WNY Clean Energy Advisory Group revealed key takeaways for academic institutions supporting the clean energy workforce. These crucial insights are interconnected and often supplement findings from the analysis of labor market data. Along with the quantitative overview of WNY's clean energy workforce, the insights from local experts uncovered significant opportunities, challenges, and key considerations for local colleges and universities as they look to adapt academic programs to meet the evolving needs of the clean energy sector.

Challenges pg. 26

Region-wide workforce challenges hinder WNY's clean energy industry

Preparing for approaching retirement cliffs in clean energy subsectors

Attracting businesses and getting them to grow and stay in the region

Working without having one clear definition of "Clean Energy"

Keeping pace with industry needs in a rapidly evolving industry

The evolving clean energy policy landscape can present challenges to both industry and academia

Opportunities pg. 34

Advancing clean energy can fuel economic growth in WNY

Leveraging WNY academic institutions to meet the region's clean energy workforce needs

Meeting future clean energy workforce needs starts with engaging youth

Diversifying the clean energy workforce can help meet industry demands

Launching crossover training for clean energy knowledge and expertise

Promoting career opportunities in the skilled trades is essential

Training engineers to fill critical roles across every clean energy subsector

Key Considerations pg. 42

Innovative, non-traditional educational models can prepare the clean energy workforce

Communicating and collaborating can build innovative, effective programs

Learning from successful clean energy programs like "the Alfred State College model"

Encouraging new career pathways can fuel workforce pipelines

Promoting innovation and clean energy goals benefits industry, academia, and the workforce

Clean Energy Workforce Challenges

Conversations with industry and academic partners reveal some overarching challenges for WNY’s clean energy workforce. These findings cut across multiple industry subsectors and are often substantiated by analyses of related labor market data and job postings. Many of these barriers are interrelated and tie into key opportunities to grow the sector and develop supporting training programs. These factors can deepen an understanding of the true workforce challenges faced by the clean energy industry.



Region-wide workforce challenges hinder WNY’s clean energy industry

Transportation issues can limit job opportunities for many in the region.

In WNY, clean energy jobs typically require a personal vehicle. Clean energy workers often need to travel to different sites on a daily basis to do their job, like installing solar panels or wind turbines. This limits job opportunities for those who do not own an automobile, or a valid driver’s license, which can create hiring challenges for businesses. Trainers and employers can offer transportation services to help workers get to job sites. Public policy professionals can advocate for policies and initiatives to help address this issue and other general workforce challenges.

Workforce barriers lead to hiring challenges for clean energy companies.

Despite signs of recent growth, workforce barriers can hold clean energy companies back. Hiring difficulties in key roles can be triggered by a lack of qualified workers with clean energy experience. This can hinder employers’ capacity to build partnerships, fund on-the-job training, and engage in clean energy work. The culture of clean energy industries may deter underrepresented groups from getting involved in clean energy, especially in subsectors like construction, manufacturing, and energy distribution, where people of color and women make up smaller shares of the workforce.

Retaining college graduates to support WNY’s clean energy sector can be difficult due to a lack of relevant jobs in the region.

Other challenges may include high an insufficient number of specialized local contractors to fuel future growth. For instance, expansion of certain renewable energy technologies in WNY may be hampered by a relative shortage of supporting businesses and professionals, such as solar technicians and engineers that are often concentrated in other parts of the US where the industry is more established. Experts pointed to a lack of consulting services to support the sector, such as facility management optimization for energy efficiency, and policy knowledge.



FROM THE
WNY CLEAN
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“Our biggest challenge was finding someone with a valid NYS driver’s license... I did not expect that...”

“Every time we post... [a job] we get a lot of applicants, just not qualified ones.”

“We’re dealing with some of the same challenges that a lot of companies [face], not just in our industry but across the board.”

“About 20% of the applicants couldn’t get to our job sites.”

Preparing for approaching retirement cliffs in clean energy subsectors

The clean energy workforce skews slightly older than WNY overall.

Over half (54%) of workers in clean energy industries are age 45 or older. Across the clean energy industry, older workers (55+) outnumber younger workers (25-34) by a margin of 11,770. This equals more than half the gap between all older and younger workers across all sectors of the WNY economy (23,200). This reveals a need for employers, academic institutions, and trainers to prepare workers to advance clean energy work in job openings caused by retirements in related industries.

The gap between older and younger workers is highest in the public policy, manufacturing, and energy distribution subsectors.

Among all subsectors of clean energy, manufacturing has the oldest group of workers. About 60% of workers in these industries are age 45 or older. In WNY's clean energy public policy and advocacy subsector, older workers (55+) outnumber younger workers by a margin of nearly 4,400, which represents about 14% of all jobs in the subsector. In the professional services subsector, the number of workers age 55 and over outnumbers younger workers by about 1,580, suggesting a retirement cliff for clean energy support services, such as architecture, engineering, scientific research, and financial services. Workers in clean energy distribution also tend to be older than the typical WNY worker, as 56% are age 45 and older. Effort to address retirement gaps should be focused on these subsectors.

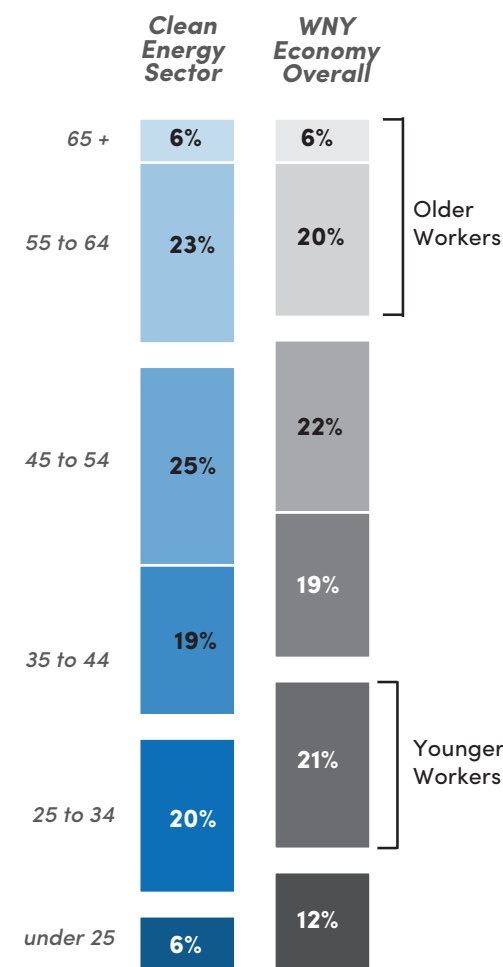
Younger workers will need to be prepared to advance clean energy work in job openings caused by retirements in related industries.

Workers in construction and installation are generally younger than other clean energy subsectors. Local industry experts noted that the physical demands of clean energy construction jobs may deter older, more experienced workers from filling these positions. This points to an opportunity for younger workers in construction to start clean energy career pathways. Local academic programs could reach out to current workers in skilled trades to enroll in related academic programs and fill job roles opened up by retirements in professional jobs. Training programs targeting working professionals could be developed to bring younger workers into clean energy roles.

There is a need to bring younger workers into clean energy career pathways.

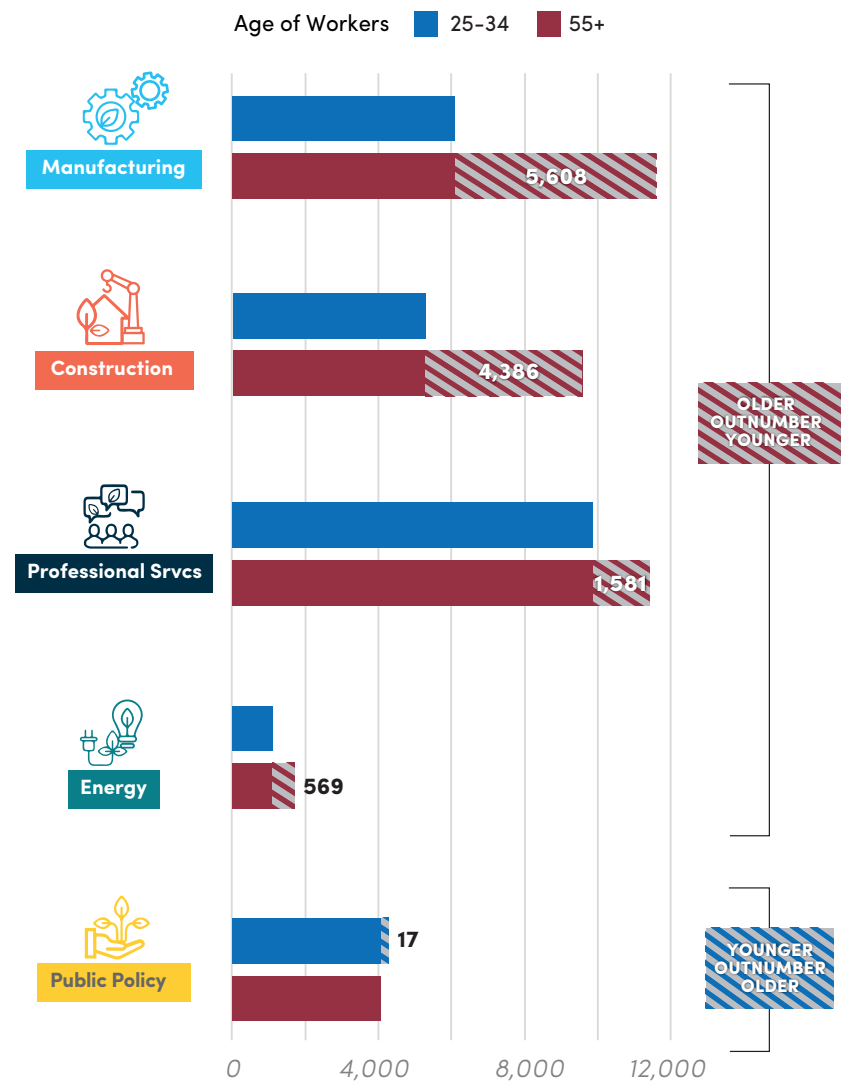
WNY has a significant labor pool of younger workers in other industries that could move into potentially higher-paying jobs in clean energy. Over 242,000 young adult workers (25-34) in WNY work in industries that pay lower wages than the average clean energy job. Well over half (62%) of these young workers are in three industries--Health Care (26%), Accommodations and Food Services (20%), and Education (16%). Academic institutions and trainers can market and cater programs to bring some of these young workers into the clean energy workforce.

Age Distribution of WNY Clean Energy Workforce Compared to the Regional Economy Overall, 2017



Source: US Census, Quarterly Workforce Indicators, 2016-2017.

Number of Jobs by Clean Energy Subsector and Age of Worker, WNY, 2017



Source: US Census, Quarterly Workforce Indicators, 2016-2017.

“Current individuals are... about to retire and [there’s] a non-existent pipeline because students are just not aware [of] or interested in pursuing those careers.”

“We need to find ways to replace those individuals that are retiring because we’re getting hit with that right now.”



FROM THE WNY CLEAN ENERGY ADVISORY GROUP

Attracting businesses and getting them to grow and stay in the region

A shortage of local clean energy businesses and job opportunities can make it difficult to retain recent graduates and younger, skilled workers in the region.

While there are positive signs for the clean energy industry in WNY, these are overshadowed by higher rates of job growth in other parts of the country. Young adult population is key to the region's economic growth and also for clean energy industry. While the region's young adult population is growing for the first time in decades, more can be done to retain talented young workers and recent graduates locally, and leveraging them to advance clean energy goals.

High costs of doing business, including labor, health care, and taxes, may limit industry growth in the region.

A perceived high cost of doing business in New York State can slow growth of businesses and deter new firms from relocating to the region. Labor and health care costs, tax policies, and a low number of highly skilled workers can hinder companies looking to start or grow in the region. Economic development initiatives, investments in communities and infrastructure, strategic incentives, and marketing to change unfavorable perceptions of the region's business and labor climate are some strategies that could help attract and keep clean energy businesses in WNY.

Various workforce challenges can place hiring constraints on local businesses.

Many factors of the regional labor market may create hiring issues for local clean energy employers. These include a shrinking, and aging labor market, and a lack of soft skills in entry-level job applicants. Finding skilled professionals in the local labor market can also be a challenge, as many engineers educated in WNY leave to find jobs outside of the region that often pay higher wages. Local industry experts indicated that many open positions in manufacturing are typically being filled by those outside of the region, rather than Western New Yorkers. These issues may lead to existing local businesses downsizing or moving out of the region.



Working without having one clear definition of "Clean Energy"

It can be a challenge to identify clean energy opportunities and track industry growth.

Much like other terms, like "green," and "sustainability," "clean energy" can mean something unique to everyone. In different contexts, "clean energy" incorporates different processes and technologies, which makes it hard to define. Unlike more traditional, established sectors, like manufacturing, clean energy is not codified in government economic data. As clean energy jobs cannot be separated out in official data, it can be difficult to track industry trends and uncover opportunities to form partnerships and programs to promote clean energy work in existing businesses. Industry and professional associations can help build these networks and promote clean energy goals.

Workers in clean energy occupations may be employed by businesses without clear ties to clean energy.

Clean energy occupations are often employed in industries not directly tied to clean energy, but may still have potential to become involved in clean energy work, such as electricians employed by colleges or hospitals. Public policy workers, advocates, employers, and workers themselves, can advance renewable energy and promote energy efficiency in their daily work, even if employers are not directly involved in clean energy.

Clean energy businesses employ workers that are not in clean energy occupations. These employees may also need clean energy expertise.

Clean energy firms employ many positions that are often not thought of as being on the front lines of clean energy work, but still require expertise in clean energy, such as sales workers at a solar panel manufacturer. While academic and training programs are generally structured around specific occupations, many supporting roles in related businesses will require additional education or on-the-job training in clean energy. This is essential to run clean energy businesses and the industry as a whole.

The workforce challenges for the "clean energy" sector are very similar to those of the traditional energy, construction, manufacturing sectors.

A narrow focus on "clean energy" may obscure the broader issues needed to drive the sector and prepare the workforce. Ultimately, the workforce needs of "clean energy" are very similar to the needs of the traditional energy sector. Rather than focusing on industry and academic programs labeled as "clean energy," higher education institutions can concentrate efforts on integrating "clean energy" into existing programs.

FROM THE WNY CLEAN ENERGY ADVISORY GROUP

“the majority [of graduates] like to stay in the region where they come from. We don't have very many big companies... coming in to [hire] our graduates.”

“Industry can be engaged in talent attraction too.”

“Companies have gone out of business because they've had workforce issues and we still have those.”

FROM THE WNY CLEAN ENERGY ADVISORY GROUP

“Clean energy sector needs are really the same as energy needs.”

“We are still hiring the traditional workers that we have hired in the past.”

“Sustainability... is kind of a buzzword... let's be more efficient.”

Keeping pace with industry needs in a rapidly evolving industry

It can be difficult for academic and training programs to keep pace with emerging technologies and rapidly evolving industry needs in a global marketplace.

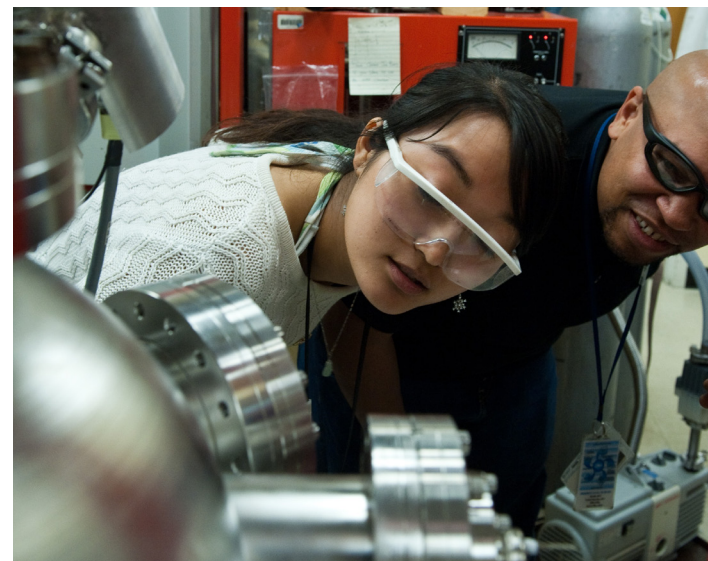
New, specific job types are needed to carry out novel clean energy tasks, like solar photovoltaic installers. However, many of the traditional trades are still needed, so these workers should be well-versed in clean energy. Technical skills and digital literacy are important aspects of many clean energy roles. With technology reducing costs and improving efficiency, experienced and new workers must keep up with the latest trends to help ensure that renewable energy efforts maintain maximum effectiveness as technologies are upgraded.

The future workforce will need the skills and knowledge to optimize clean energy sources.

Energy demands are constantly growing, and the energy system is becoming more distributed as clean energy facilities plug into the grid. Understanding the ebbs and flows of clean energy, such as the optimal timing to tap into renewable sources, will be a key challenge of the workforce. The intermittent nature of renewables, like wind and solar, needs to be understood within the grander scheme of energy production, to ensure reliable and secure energy connectivity. These needs may change as battery storage technologies improve the capacity to capture and use these energy technologies, no matter the weather.

Automation continues to transform the nature of jobs and skills needed.

A global trend toward automation may result in a net loss of traditional manufacturing jobs in exchange for new types of high-tech positions. However, automation will increase demand for new skill sets and positions. Skills such as computer programming, operations management, quality control, and troubleshooting will be needed in higher demand as manufacturers and other firms shift to incorporate artificial intelligence, digital manufacturing, and smart building technologies in their products and services.



The evolving clean energy policy landscape can present challenges to both industry and academia

Rapidly shifting clean energy policies can be a challenge for workers at various levels of government.

The speed at which public policy changes presents challenges for clean energy policy workers. A significant amount of staffing resources can be needed to keep up with one major policy alone, let alone all interconnected policies at the state and federal levels. Additionally, government agencies need to be active in promoting and educating key stakeholders on clean energy policy so they can plan for policy changes and participate in new clean energy initiatives. However, taking on new clean energy work can be a challenge when resources are already strapped.

There is often a disconnect between the clean energy industry and government.

This has resulted in the industry misunderstanding the constantly changing and often complicated clean energy policy landscape. This disconnect between the market and policy can inhibit creative and proactive efforts to promote clean energy. Due to the nature of clean energy's existence in a regulatory environment, there is a need for the industry to operate in public policy and advocacy circles. Government involvement is a necessary operation for WNY clean energy companies, so continual collaboration between employers and government is critical.

Government agencies have limited resources to educate key stakeholders on clean energy policies and promote participation in clean energy initiatives.

Public policy positions in clean energy often require an understanding of science, engineering, and technology, as well as policy to effectively carry out necessary work. For instance, scientific knowledge can help guide businesses and residents through the application process for renewable energy and energy efficiency incentive programs. But filling these important public positions with workers well-qualified in clean energy can be a challenge. These roles, like senior energy development specialists, or energy engineers, are often dictated by civil service guidelines and have stringent educational requirements. The public sector has trouble finding qualified workers for these positions due to competition with the private sector, which are typically able to lure these professionals with higher wages.

Regulations can constrain academic institutions' efforts to adapt and create innovative clean energy programs.

Academic programs must be flexible to adapt with quickly evolving workforce needs, but regulations for clean energy programs, like in engineering, are inherently rigid. But these regulations need to be flexible to limit bureaucratic obstacles for academic institutions as they look to adapt their programs. This can help colleges and universities cut costs and advance clean energy policy goals of NYS while keeping up with industry trends through innovative academic and training models.



FROM THE
WNY CLEAN
ENERGY
ADVISORY
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“New emerging technologies... building automation, smart technology, digital manufacturing, artificial intelligence... you need people to maintain all that.”

“I think battery storage is going to become very important to us down the road.”

“Programs involve understanding the new technology, shifting away from some of the legacy things, to the challenges and processes of... new emerging technologies.”



FROM THE
WNY CLEAN
ENERGY
ADVISORY
GROUP

“When there’s no certainty about what’s going to be funded, and it’s always shifting, it’s hard to plan.”

“You need someone who’s keeping an eye on what programs are coming out...”

“Biggest... struggle... is understanding the implications for taxes, because a lot of incentives are in the form of tax credits.”

Clean Energy Workforce Opportunities

Significant opportunities to prepare the workforce and advance clean energy goals in WNY were revealed through conversations with industry and academic partners. These often stem from related workforce challenges that cut across multiple industry subsectors. These opportunities signal pathways for academic institutions and trainers to prepare the clean energy workforce to fuel industry growth and achieve the broader clean energy goals.



Advancing clean energy can fuel economic growth in WNY

Clean energy is already an important part of WNY and the regional economy.

Clean energy is a big part of the region's legacy and modern economy. About one out of every five jobs in WNY are in industries that support clean energy. The region has many specific industries that make up a larger share of total employment in WNY than across the US. These include industries related to clean energy manufacturing, such as chemical manufacturing and electrical equipment manufacturing; professional services such as scientific research and development; as well as public advocacy industries like government services. These industries represent specializations for WNY that can be seen as opportunities for the regional economy to advance clean energy goals through support services and product supply chains.

NYS and local governments have ambitious goals for clean energy.

NYS' Reforming the Energy Vision (REV) initiative sets goals to reduce greenhouse gas emissions by 80% from 1990 levels by 2050. Local governments across WNY are also promoting clean energy through programs like Climate Smart Communities and Property Assessed Clean Energy (PACE) financing. All these initiatives will increase demand for clean energy products and services and can be seen as opportunities for regional economic growth. Colleges, universities, and trainers can help keep up with these growing workforce demands in order to capture the potential economic growth generated by these initiatives.

Clean energy aligns with regional strengths and target sectors for economic development.

The WNY Regional Economic Development Council lists advanced manufacturing, energy, and professional services as target industries for regional economic growth. Many initiatives and projects launched in the past several years are focused on the growth of these sectors to revitalize the regional economy. Efforts to bolster the region's clean energy industry can dovetail with these regional economic development plans and initiatives.

Recent growth of clean energy occupations can help expand the WNY economy.

Recent occupational trends suggest demand for clean energy jobs is likely to grow in the near future. However, the regional outlook for clean energy occupations is brighter than clean energy industries. One reason for this is that many common occupations, like engineers and electricians, are employed in industries unrelated to clean energy. This shows how clean energy employers will need to compete with other sectors to recruit the skilled workers they need. Conversely, workers in clean energy occupations may be able to carry out clean energy work even if they are employed by businesses that are currently uninvolved in clean energy.



FROM THE
WNY CLEAN
ENERGY
ADVISORY
GROUP

“We’ve seen how [clean energy] manufacturing can play a role in job growth... There is more to be done in that area.”

“I see a lot of growth for the industry in WNY... and there’s a lot of opportunity.”

Leveraging WNY academic institutions to meet the region's clean energy workforce needs

Local academic institutions produce many graduates in supporting fields, but programs must adapt to meet clean energy needs.

In terms of the overall number of graduates in programs that can be applied to clean energy work, WNY academic institutions are well-positioned to meet the demands for related jobs in the region. Across the industry as a whole, there were 7 graduates for each projected clean energy job opening in 2018.

While these numbers suggest that WNY colleges and universities are producing enough total graduates for the region's clean energy industry, degree programs have to adapt to better prepare future clean energy workers. Local experts suggested some ways to do this, including: hands-on training in electrical wiring and computer programming for students in engineering programs; recruiting skilled trades workers into related degree programs to meet the needs for professionals with technical skills; promoting training for students in business, sales, and accounting programs on clean energy policy implications.

Growing regional job prospects can keep home-grown talent in WNY and advance clean energy goals.

Like all academic institutions, local colleges and universities are educating students to be competitive in a global job market. Many higher paying clean energy jobs are located outside of WNY. Growing local job prospects can attract students into degree programs geared for clean energy and retain talent for clean energy firms. Industry and academia can collaborate on initiatives to attract and retain talent that meets the needs of industry.

Working with industry to expand innovative, interdisciplinary programs can prepare students for clean energy jobs.

Thorough knowledge of the general science, technical nature, and current policies related to new clean energy products are often important for professionals in clean energy support services and sales. Employers invest a significant amount of time and resources in on-the-job training for these positions. Clean energy jobs demand programs that cut across traditional academic disciplines. For instance, local experts suggest that equipping engineering, architecture, and management students with hands-on experience in technical skills, like wiring electrical components, can better prepare them for clean energy roles.



FROM THE
WNY CLEAN
ENERGY
ADVISORY
GROUP

“The University at Buffalo has... an excellent engineering program, so we're blessed to have them right down the street from us.”

“... companies here need the workforce, and there's great universities here that can help train that workforce.”

“Alfred State is a very highly regarded program...”

Meeting future clean energy workforce needs starts with engaging youth

Educating K-12 students about clean energy work and its importance is key.

Educating public school students about the importance of clean energy, and the wide range of career opportunities can grow interest among youth. Making these jobs, particularly those in the skilled trades, more desirable to youth will create stronger connections and career pipelines to fill future clean energy jobs. Proactive outreach by industry leaders, academic institutions, and trainers to local youth about clean energy can help fuel the future workforce pipeline.

Making clean energy jobs more desirable to youth can fuel future career pipelines.

Promoting the wide range of career opportunities in construction and manufacturing to youth can fuel the future clean energy workforce pipeline. These occupations are often needed in the greatest numbers to implement clean energy projects. Public perception of the nature of these jobs and the prospects for this work may not reflect modern realities. These jobs are higher-paying and have a positive impact on people and the environment. Outreach efforts, like the “Dream It Do It” program, have made progress in shaping a positive image of advanced manufacturing jobs among children and parents. Multimedia approaches, such as videos and social media outreach, can also encourage people to get into trades.

Primary and secondary schools can help prepare students for clean energy jobs.

Most clean energy jobs require a high school diploma or equivalent, and a high school education is also needed to be admitted into most related academic and training programs. Raising local graduation rates can help trainers find qualified students for their programs. Some have difficulty finding recruits that meet basic language and math requirements to qualify for programs. Along with the fundamentals, local schools can play a role in teaching students the underlying science of clean energy technologies, the need for energy efficiency, and personal skills to communicate technical details to non-technical audiences.

Education and outreach to grow interest in clean energy careers should start early.

Proactive outreach to local youth by industry leaders, colleges, and trainers about clean energy can help fuel the future workforce pipeline. Outreach programs to teach school children about the opportunity for jobs in skilled trades and the importance of clean energy work can help build a pipeline for this sector. Messaging can be important. Communicating about the positive outlook, in terms of prospects, pay, and public benefit, of jobs in manufacturing, energy, and the skilled trades before detailing program specifics can be helpful. To be interested in clean energy careers, potential students need to understand the opportunities.



FROM THE
WNY CLEAN
ENERGY
ADVISORY
GROUP

“We go into schools... community centers... churches with a team of outreach specialists and do presentations about manufacturing and energy jobs.”

“... literacy and numeracy is a huge challenge.”

“If you don't have those basic foundational skills — math..., reading and writing, it will be hard to... work in... industry.”

Diversifying the clean energy workforce can help meet industry demands

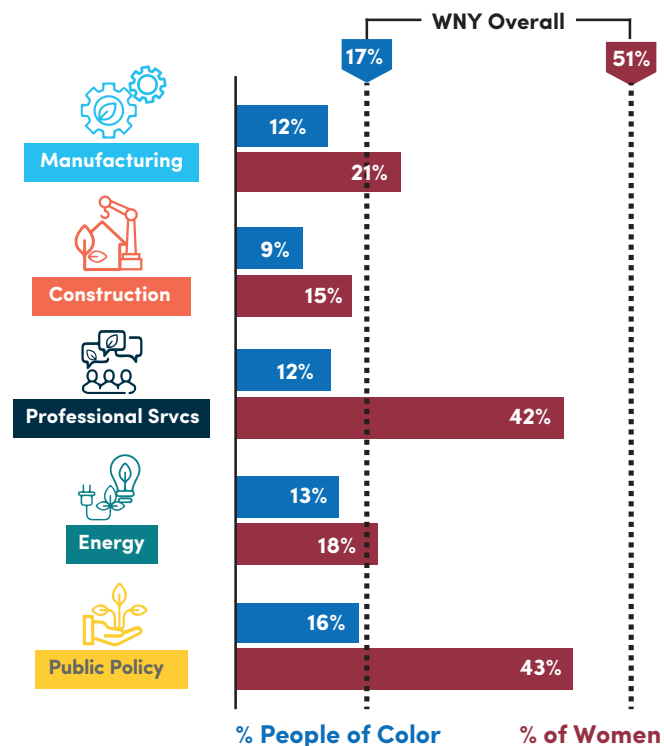
Bringing more women and people of color into the clean energy workforce can help meet industry needs and advance goals.

Women and people of color are underrepresented in WNY's clean energy sector. While females make up over half of all WNY workers, less than a third of all clean energy workers are women. People of color make up 17% of all WNY workers, compared to under 13% of clean energy workers. It is critical to bring these groups into clean energy jobs, particularly in manufacturing, construction, and energy distribution. This is particularly important considering the region has a stagnant working age population and an increasingly diverse workforce.

Proactive outreach to diverse communities can attract more people to clean energy jobs.

Northland Workforce Training Center has been successful in these efforts by using outreach specialists, and reaching children at schools, community centers, and churches. Similar outreach to vocational and public schools could present an opportunity to get students interested in clean energy work. Mentorships, internships, and proactive outreach can help promote clean energy career opportunities among underrepresented groups. There is also an opportunity for community education to advance clean energy and engage underrepresented groups. One effective local example is a recent partnership between TM Montante Development and PUSH Buffalo.

Women and People of Color as Share of All Workers in Clean Energy Subsectors, 2017



Source: US Census, Quarterly Workforce Indicators, 2016-2017.

Launching crossover training for clean energy knowledge and expertise

Practical, specialized training for clean energy can better prepare students and help all involved "speak the same language."

Crossover skills and knowledge areas are important across many clean energy occupations and industries. The wide variety of in-demand areas of expertise in recent clean energy job postings also shows how interdisciplinary academic programs with crossover training in technical and professional skills are needed to support the range of occupations involved in clean energy. Typically, clean energy workers learn these crossover skills on the job, but local colleges and universities could also play a role by adapting degree programs, or offering workshops.

Clean energy professionals, like sales workers, can benefit from technical training.

Looking at thousands of recent job postings across the US demonstrates the wide range of expertise needed for clean energy jobs. Many of these positions are related to positions in sales and consulting, such as lead generation, and customer relations. But many others are technical, requiring knowledge of solar, wind, and electrical equipment. This reinforces feedback from local experts that a knowledge of renewable energy technologies, and the science behind it, is necessary for sales positions, and conversely that skills in sales and communication also may be needed for technicians and installers.

Learning clean energy science, policy, and business practices can help prepare skilled workers, like HVAC techs, and electricians.

The construction and installation subsector relies on apprenticeships and on-the-job training to fill training demands. Higher education does have opportunities to fill critical roles and provide crossover skills training in related academic programs, such as engineering and architecture. In-person modes of teaching that are already widely used for clean energy jobs, such as internship, mentorship, and apprenticeship programs, may be able to partner with colleges and universities to meet the need for crossover skills and mid-career training for clean energy jobs. Local academic programs could reach out to current skilled trades to enroll in related academic programs and fill the need for other clean energy careers, like construction managers.



FROM THE WNY CLEAN ENERGY ADVISORY GROUP



When I came to master's [program], we had 3 girls... in a class of 30... that's something that needs to be addressed early on... to get more interest..."

"In order to retain your workforce you have to offer organizational cultures that... [are] attractive and respectful of everyone."



FROM THE WNY CLEAN ENERGY ADVISORY GROUP



I'm an electrical engineer, but I've learned more... cross-training in other fields of engineering."

"Even a sales position needs to have some technical background."



Promoting career opportunities in the skilled trades is essential

High schools can help bring more young people into skilled trades careers.

High schools can develop innovative programs to promote careers in skilled trades. One example is the P-TECH (Pathways in Technology Early College High School) Program, a collaborative model implemented across the US. P-TECH partners public high schools with two-year colleges, and local industry. Buffalo's McKinley High School has a P-TECH program called BEGREEN (Buffalo Employment Green and Renewable Energy Education Network) that prepares students for green construction jobs. Industry partners, like Montante Solar, help ensure the program produces students with the skills employers seek.

Expanding recruitment methods could help bring more people into the skilled trades.

Much of the work involved in clean energy is done by skilled trades workers, but finding enough quality workers can be a major challenge for industry. With increasing demand and looming retirements, more young people are needed in the skilled trades. However, open skilled trades positions are often not advertised or posted on-line. Rather, skilled trades workers tend to be hired through personal relationships and word-of-mouth recruitment.

This hiring process may limit awareness of job opportunities among potential future workers, especially underrepresented population groups. Programs, like Building and Construction Exchange and Blue Sky Design, are making headway in recruiting workers into these jobs. Proactive outreach, on-line job postings, marketing, and mentorships can help grow and diversify the workforce pipeline for careers in the skilled trades.

Current skilled trades workers can earn college degrees to enhance their clean energy career opportunities.

The expertise and contributions of skilled trades workers can be vital for many other clean energy professions, even in consulting and policy. Workers with hands-on experience in clean energy, such as HVAC technicians and electricians, can be seen as a valuable labor pool for professional jobs in clean energy.

Industry experts indicated an opportunity for experienced skilled trade workers to move up the career ladder into critical roles, like Master Electricians, construction managers, and operations engineers. Skilled trades workers, already equipped with the hands-on skills of the industry, could be ideal candidates for these positions if they earn the necessary college degree. Affording continuing education opportunities to these individuals can help fuel clean energy workforce pipelines. Academic programs must be able to adjust to the needs of current skilled trades workers.



Training engineers to fill critical roles across every clean energy subsector

Integrated, interdisciplinary engineering programs can give graduates the flexibility to adapt to shifting labor demands.

A number of engineering specializations are critical across various subsectors of clean energy. This includes electrical, industrial, and mechanical engineers that are often part of the design of clean energy products and the operations of manufacturing facilities. Engineers with expertise that cuts across these disciplines can be critical to clean energy businesses. Technicians for these engineering fields are also in demand and can often be adequately prepared with less education than a four-year degree.

Engineers can learn technical, hands-on skills to develop practical and effective clean energy technologies.

Clean energy projects often start with the engineers who design systems to improve energy efficiency and generate renewable energy. Practical, hands-on experience with the technologies they design, such as wiring and soldering electronic parts, can be critical for these roles. This can streamline product installation and maintenance for skilled workers working with novel products. Engineering technician programs, internships in utilities and construction, and on-the-job training can help equip engineers these important hands-on skills.

Engineers and scientists drive policy decisions, and can help educate on evolving clean energy policies and technologies.

Scientists and engineers are driving industry and policy decisions in clean energy. This work can be hindered by frequently changing policy frameworks at different levels of government, and a lack of real-world understanding connecting these policies to the on-the-ground jobs. This leads to issues for engineers as well. Engineers should know policy fundamentals, like the National Electrical Code (NEC) code book, in order for alternative energies, like solar, to proliferate successfully in this region.

WNY has a wide variety of engineering programs to address clean energy needs.

There is a need for more well-rounded engineers across the clean energy industry. Comprehensive engineering education can be provided at institutions like the University at Buffalo and Alfred State College to ensure that a practical skill set is acquired by graduates. UB is now preparing an integrated interdisciplinary engineering program to ensure that students are not limited to one aspect of the field, but have a fluency in a range of related disciplines, and the flexibility to change with labor demands.



FROM THE
WNY CLEAN
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“Skilled trades... pay family sustaining wages and people can have great careers doing technical jobs.”

“The bulk of the work is tied to the construction side of things.”

“Shaping that image, telling that story in a meaningful way that resonates with young people... The opportunities... to make a difference in people's lives.”



FROM THE
WNY CLEAN
ENERGY
ADVISORY
GROUP

“Electrical engineers are playing a much more important role as clean energy advances continue to take hold.”

“We do have a sales person that does have an engineering background and I think that has been beneficial.”

Key Considerations

Several overarching key considerations for colleges and universities to prepare the clean energy workforce became evident through discussions with local experts. These interconnected factors are mutually beneficial, and cut across multiple industry subsectors. Key considerations will be important for academic institutions and trainers to keep in mind as they prepare the clean energy workforce to fuel industry growth and achieve broader clean energy goals.



Innovative, non-traditional educational models can prepare the clean energy workforce

Exploring non-traditional, newer forms of education can bolster clean energy training for students, and working professionals.

Remote learning options, like massive open online courses (MOOCs) and digital certificates, can open up educational opportunities to more types of students, including professionals working in the field. These models are often less expensive and more convenient for non-traditional students and working professionals, compared to traditional college programs. Exploring these alternative programs can prepare more workers to take on clean energy roles.

Expanding training facilities beyond traditional classrooms can equip students with in-demand skills.

Employers sharing facilities and equipment with trainers and academic institutions can equip students with industry relevant skills. Northland Workforce Training Center in Buffalo is working with industry to develop a “living learning lab” with novel equipment to introduce and train students in emerging technologies, like microgrids. Colleges could also reserve clean energy facilities, like solar panels and wind turbines on campus, as test beds or learning labs for their students.

Offering training for industry recognized credentials in clean energy, like NABCEP.

Along with interdisciplinary, hands-on training for skilled trades, community colleges and technical schools could look into industry specific certifications, particularly for emerging jobs like wind and solar technicians. These certifications typically also require on-the-job training and work experience, such as the North American Board of Certified Energy Practitioners (NABCEP). Alfred State hosts NABCEP training, offering exams several times a year focusing on a wide range of topics. Companies like Tesla operate programs online, and offer installer certifications specific to the technologies they develop. Workers for this company are taught sales and technical skills through a web-based system. Training programs at BOCES and Northland Workforce Training Center, and colleges like Alfred State, could partner with firms to offer such industry manufacturer certifications so workers develop skills needed for key technologies before they are hired.



FROM THE
WNY CLEAN
ENERGY
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“We understand... we’re in a unique field and there’s not a lot of trained people, but we’re able to train them on the job. That’s how our current team was made.”

“Living learning labs need to be replicated... Small projects across WNY could help.”

“We do include [credentials] when it makes sense, and it does give our students an advantage. Nothing really focused on clean energy. We’re exploring digital badging.”

Communicating and collaborating can build innovative, effective programs

Working across disciplines to develop programs can give students crossover skills needed across many clean energy jobs.

Workers in clean energy often must take on roles beyond their educational background. For instance, an engineer designing renewable energy products may also work on tasks related to sales, marketing, and consulting. Examples like this from local experts show the need for degree programs to be interdisciplinary, like mixing business skills into engineering programs. Clean energy workers learn these crossover skills through work experience, but this training could be provided by local colleges and universities within degree programs, or through workshops. For example, accounting staff often needs to understand financial and tax implications of pursuing clean energy incentives, which could be learned through a unique workshop bringing together academic and industry experts.

Public policy workers can promote training and funding opportunities to employers.

Contractors are active year-round in on-the-job training, often working with hiring halls and consultants. But firms may not be taking full advantage of funding opportunities for clean energy on-the-job training, such as NYSERDA programs. Employers can use these funds to launch new training programs, and enable their workers to earn credentials for clean energy. But first they need to know about these opportunities and how to put them to use, which demands collaboration and communication between policy experts and clean energy businesses. It was suggested that a state-level clean energy policy administrator could enable clean energy businesses to participate in clean energy incentives.

Open, ongoing channels of communication help academic institutions and trainers can help advance clean energy goals.

To advance clean energy goals and prepare the workforce, everyone involved needs to work together. Local experts said collaboration between businesses and academic institutions is critical. This approach has proven helpful in adapting programs to meet industry needs. Local academic institutions do partner with clean energy employers to develop curricula and training programs. Similarly, local experts indicated that policy players, especially at the state level, need to be involved in these discussions to promote and educate around clean energy programs, regulations, and incentives. The WNY Clean Energy Advisory Group can serve as a model, or a starting point, for an on-going discussion on regional clean energy workforce issues.



FROM THE
WNY CLEAN
ENERGY
ADVISORY
GROUP

“... it’s a matter of looking at how do we adjust the curriculum, the equipment, to modify the training... to align with where the industry is now.”

“The solution to anything isn’t really made in a vacuum... it’s all about cooperation.”

Learning from successful clean energy programs like “the Alfred State College model”

The technical programs at Alfred State College are best practices that could be implemented across WNY to help meet clean energy workforce needs.

In 2018, Alfred produced 175 bachelor’s degrees related to clean energy, and many more at the associate’s level (267). The college is considered a leader in the region, and across the nation, in technical training in fields related to manufacturing, engineering, construction, business, and architecture with clear connections to clean energy. Industry experts pointed to a few academic programs with a strong potential to serve the region’s clean energy workforce training needs. These include programs in mechatronics, engineering design, and building trades. Some of these are offered at Northland WTC in Buffalo.

Continuous engagement with industry partners helps keep pace with evolving industry needs.

A key part of the successful student outcomes at Alfred State lies in their ability to adapt programs with industry needs. There is a minimum annual touch point for most programs to bring industry in to review curricula, processes, and student outcomes. Alfred State works with these industry partners to keep up with new technologies and skill sets so they are better prepared for modern jobs with industry relevant skills. They also use this information to forecast industry needs and adapt their facilities to suit. For instance, a combustion engine lab was transformed into an energy lab with more modern equipment to train students in skills more applicable to a wider array of jobs.

Applied learning and hands-on training is needed to equip students with important technical skills.

Exposing students to labs, software, equipment, and practical experiences, whenever possible, and one-on-one time with instructors prepares students for jobs in the field. This approach is time intensive for both students and faculty. As such, this model is more applicable to technical institutions like Alfred State or many community colleges, as opposed to research-focused universities.



FROM THE
WNY CLEAN
ENERGY
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“Applied learning is across everything we do...”

“Companies... offer co-ops and internships and get students connected earlier. The growing trend is more job placements before graduation.”

“Affording the students the exposure to the labs, to the software, to the equipment, to practical experiences whenever possible as much as possible...”

Encouraging new career pathways can fuel workforce pipelines

Academic institutions could reach out to current workers with relevant expertise to move into in-demand clean energy roles.

There is a need for crossover skills in a variety of occupations, including engineers, building and construction managers, and sales representatives. Representatives from local industry indicated that incorporating “in the field” training in degree programs to develop hands-on technical skills would help prepare professionals like architects and engineers for clean energy work.

Academic institutions can partner with industry to develop related programs to improve student outcomes and meet industry needs. These could be geared to working professionals, or “boot camps” to expose students to clean energy issues and interact with people working in the field. Efforts such as these could facilitate private sector participation in clean energy programs and drive industry development.



Academic and training programs could be developed for current skilled workers to fit their schedules and training needs.

Public policy professionals can help address the broader workforce challenges impacting the clean energy industry. Incentives or tuition assistance could be offered by employers, academic institutions, or training providers to help current workers go back to school or pursue training. Experienced clean energy workers can help sponsor and promote training workshops around different policies and technologies. Clean energy policy oversight in NYS can help employers and trainers keep up-to-date with important policies, incentives, and other opportunities.

Academic programs and trainers can use internships, mentorships, and career placement services to improve outcomes.

Internship and mentorship opportunities could also be used to prepare workers as they move into jobs in clean energy. Several organizations, such as Women in Renewable Energy, already offer mentorship programs that academic institutions could look to for guidance. Supporting trainees before and after they are recruited by employers can also be critical. Northland WTC students are given coaches that assist with mentoring and job placement. Wrap-around services like these can fuel the workforce pipeline by bringing more diverse groups into clean energy jobs.

Promoting innovation and clean energy goals benefits industry, academia, and the workforce

Focusing on clean energy goals can help grow the industry and academic programs.

There are boundless opportunities to promote energy efficiency and renewable energy in WNY. This will not only help meet clean energy goals, but advance the industry and related academic programs that fuel the workforce pipeline. Upstate New York has some of the oldest building stock in the US, much of it was developed before the 1970s when energy considerations for buildings were first advanced. Working to make buildings more energy efficient can create jobs, grow businesses and benefit the regional economy. Meanwhile, WNY also has great potential for micro-hydro, wind, geothermal, and solar energy, as noted by local industry experts. Promoting renewable energies locally can also benefit the economy while advancing clean energy goals.

Senior leadership positions in government, business, and academic institutions, must be proactive with clean energy and be able to promote this work effectively. Meeting the needs of the clean energy workforce will require executives, managers, and local governments assuming leadership roles to advance clean energy policy goals. Collaboration between leaders in governments, community groups, faculty, and industry will be key in developing academic and training programs around clean energy policy.

Fostering clean energy innovation locally can expand and prepare the workforce.

Innovation and entrepreneurship spurs the creation of new clean energy businesses and jobs while advancing clean energy goals. WNY has recent start-ups in clean energy technologies and services, some of which were developed out of university-led research. Buffalo’s 43North competition has fueled some of these companies with start-up funding, like CleanFiber which uses recycled products to produce insulation for buildings. Promoting local entrepreneurship through programs like these, funding competitions, incubators and mentorship programs, can feed the innovation to commercialization pipeline, grow the industry, promote clean energy academic programs, and advance clean energy goals.

Existing firms can advance clean energy goals through efficiency and innovation.

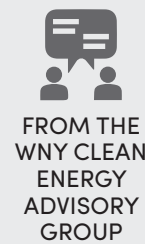
It is generally more useful and efficient to integrate “clean energy” into existing products and companies than to supplant what already exists. “Intrapreneurship,” or innovation within existing companies, is a great opportunity for existing firms to innovate, adopt renewables, and take on energy efficiency work. Many local firms are working on interesting new technologies to improve efficiencies that could evolve into new products, or spin-off companies. As large established firms are among the region’s top consumers of energy, particularly manufacturers, promoting efficiency in these businesses is also key to clean energy. WNY academic institutions can work with employers through applied coursework to promote the cost savings of renewables and motivate employers to take on clean energy work.



“When talking about... a solar job... anyone... that has a general sense of the trades and how you manage them, that’s beneficial.”

“Companies [are] looking for people with... those tangible skills that can go to work and start very quickly and be productive.”

“There are associations for pretty much every field. But there’s not a lot of awareness... Those are great resources...”



“[Our engineering staff] has been able to come up with many different types of inventions.... There’s more room for that type of growth here in WNY.”

“Inventors... don’t just know about one science. You’ve got to bring things together”

Data Sources and Notes

Data Sources Overview

All economic figures presented in this report, including industry maps, trends in jobs, firms, and wages, and occupational job projections, are compiled using a series of industry and occupational codes found through research to have a potential application to clean energy, that is, the distribution and advancement of renewable energy, or the promotion of energy efficiency in buildings and infrastructure. As such, the figures presented in this report illustrate the economic ecosystem needed to support and advance clean energy, and not the actual number of jobs and firms actively involved in clean energy work.

The codes were found through consultation with the Clean Energy Advisory Group and a number of different sources, including: New York State Energy Research and Development Authority (NYSERDA), "New York Clean Energy Industry Report," 2018; the U.S. Bureau of Labor Statistics, "Green Goods and Services Survey," 2010; National Center for O*NET Development, "All Green Economy Sectors," O*NET OnLine, accessed December, 2018. The selected codes and used for this report are presented below.

North American Industry Classification System (NAICS) codes used to define clean energy subsectors

Depending on data availability, industry codes at the 4-, or 6-digit level were used to compile data for this report (6-digit codes are most specific, while 4-digit codes are more general).

Construction and Installation: 4-digit NAICS codes: 2111: 2361, 2362, 2381, 2382, 2383, 8113. | 6-digit NAICS codes: 221114, 221115, 221116, 236118, 236117, 236116, 236115, 236210, 236220, 238140, 238160, 238170, 238150, 238290, 238220, 238910, 238330, 238350, 238310, 238320, 238390, 238210, 238990, 811219, 811310

Energy Distribution: 4-digit NAICS codes: 1133, 2111, 2211, 2212, 2213, 2371, 3211, 3212, 3251, 5622. | 6-digit NAICS codes: 221111, 221122, 221210, 221113, 221114, 221115, 221116, 221117, 221118, 325193, 221330, 237130, 237110, 237120, 321219, 486210, 221121, 211130, 113310, 321114, 562213, 562212

Clean Energy Manufacturing: 4-digit NAICS codes: 3212, 3219, 3222, 3251, 3261, 3271, 3272, 3273, 3279, 3312, 3313, 3314, 3315, 3321, 3323, 3324, 3325, 3326, 3327, 3328, 3329, 3331, 3332, 3333, 3334, 3335, 3336, 3339, 3341, 3344, 3345, 3351, 3352, 3353, 3359, 3361, 3362, 3363, 3364, 3365, 3369. | 6-digit NAICS codes: 326199, 327993, 332312, 332321, 332322, 332410, 332420, 332991, 333414, 333413, 333415, 333611, 333618, 333912, 333914, 334413, 334517, 334516, 335110, 335121, 335129, 335210, 335311, 335312, 335911, 335931, 335999, 336111, 336112, 336120, 321918, 321992, 321911, 321991, 321219, 322299, 324122, 325193, 325180, 325199, 325120, 325211, 325220, 326140, 327211, 326150, 327999, 331222, 331221, 331511, 331513, 331210, 331512, 331420, 331410, 331491, 331524, 331523, 331492, 332112, 332114, 332111, 332117, 332510, 332911, 332721, 332618, 332813, 332996, 332311, 332323, 332313, 332912, 332992, 332919, 333242, 333132, 333511, 333517, 333249, 333120, 333243, 333613, 333994, 333996, 333241, 333318, 333995, 333993, 333612, 333991, 333999, 334111, 334417, 334419, 334418, 334416, 334519, 334514, 335122, 335912, 335313, 335314, 335932, 335929, 335921, 335991, 336370, 336340, 336390, 336320, 336999, 336310, 336350, 336211, 336510, 336991, 336213, 327120, 327390, 327331, 327332, 327992, 331529, 331313, 336411.

Professional Services and Consulting: 4-digit NAICS

codes: 2372, 4231, 4233, 4234, 4236, 4237, 4238, 4239, 4247, 4441, 5239, 5411, 5412, 5413, 5414, 5415, 5416, 5417, 5418, 8112, 8113, 8114. | 6-digit NAICS codes: 423110, 423120, 423140, 423330, 423610, 423620, 423690, 423720, 423710, 424720, 454310, 523920, 523930, 541110, 541214, 541213, 541219, 541310, 541320, 541330, 541340, 541350, 541370, 541380, 541511, 541512, 541613, 541612, 541618, 541614, 541620, 541611, 541713, 541714, 811211, 811212, 811213, 811219, 811310, 811412, 423840, 423930, 423390, 423740, 423830, 423440, 423990, 541360, 541410, 541420, 541490, 237210, 423320, 444110, 444190, 541199, 541810, 541820, 541890.

Public Policy and Advocacy: 4-digit NAICS codes: 8132, 8133, 8134, 8139, 9211, 9231, 9241, 9251, 9261. | 6-digit NAICS codes: 813319, 813312, 813211, 813910, 813920, 813940, 813410, 813219, 921110, 921120, 921130, 921190, 921140, 921150, 928120, 924120, 925110, 925120, 923110, 926110, 926120, 926150, 924110, 926130, 926140.

Standard Occupational Classification (SOC) codes used to define clean energy occupations by subsector

Construction and Installation: 11-9021, 47-1011, 47-2031, 47-2051, 47-2061, 47-2073, 47-2111, 47-2121, 47-2131, 47-2151, 47-2152, 47-2181, 47-2211, 47-2221, 47-2231, 47-3012, 47-3013, 47-3019, 47-4011, 47-4098, 49-1011, 49-9021, 49-9043, 49-9051, 49-9071, 49-9098, 49-9099, 51-2021, 51-2028, 51-2041, 51-4121, 53-7021, 53-7041, 53-7062.

Energy Distribution: 11-3051, 11-9013, 11-9199, 15-1111, 17-2011, 17-2021, 17-2031, 17-2041, 17-2051, 17-2081, 17-2141, 17-2161, 17-2199, 17-3022, 17-3023, 17-3024, 17-3026, 17-3027, 17-3029, 19-1021, 19-2031, 19-2032, 19-4011, 19-4031, 19-4051, 41-4011, 45-2011, 47-1011, 47-2011, 47-2152, 47-2211, 47-2231, 49-2094, 49-9081, 49-9099, 51-2031, 51-4041, 51-8011, 51-8012, 51-8013, 51-8099, 51-9011, 51-9012, 53-7071, 53-7081

Clean Energy Manufacturing: 11-3051, 11-3071, 11-9199, 13-1081, 17-2112, 17-2199, 17-3023, 17-3024, 17-3026, 17-3029, 27-1021, 41-4011, 43-5061, 47-2211, 47-2221, 49-1011, 49-2094, 49-9041, 49-9043, 49-9044, 51-1011, 51-2028, 51-2031, 51-2041, 51-2098, 51-4041, 51-4121, 51-8021, 51-9012, 51-9023, 51-9061, 53-7062.

Professional Services and Consulting: 11-1021, 11-2011, 11-2021, 11-3071, 11-9041, 11-9121, 11-9141, 11-9199, 13-1028, 13-1081, 13-1151, 13-1199, 13-2051, 15-1199, 17-1011, 17-1012, 17-2011, 17-2021, 17-2041, 17-2051, 17-2071, 17-2072, 17-2112, 17-2141, 17-2161, 17-2199, 17-3011, 17-3024, 17-3025, 17-3027, 17-3029, 19-2021, 19-2031, 19-2032, 19-2041, 19-3011, 19-3051, 19-3099, 19-4099, 27-1021, 27-3031, 41-3099, 41-4011, 41-9031, 49-2094

Public Policy and Advocacy: 11-1011, 11-9199, 13-1041, 13-1075, 13-1199, 13-2051, 17-2081, 17-2161, 19-3051, 19-3094, 19-3099, 27-3031, 45-2011, 47-4011, 51-9061.

A note on the relationship of clean energy industries and occupations based on industry staffing patterns.

It is important to note that businesses in clean energy industries employ many positions that are not thought of as clean energy occupations, and on the other hand, workers in clean energy occupations are often employed in industries unrelated to clean energy. As such, data presented for clean energy industries do not match figures for clean energy occupations, but it can be telling to look into how these industries and occupations overlap.

Statewide staffing patterns from the NYS Department of Labor, which show the mix of occupations that make up all jobs within a given occupation, and vice versa, can be used to estimate the portion of jobs in clean energy industry sectors that are also within a clean energy industry, and conversely, the share of jobs in potential clean energy occupations employed in an industry related to clean energy. While the staffing patterns of businesses in WNY are likely somewhat different than those across the state, the statewide staffing patterns still can show the relative extent to which each clean energy subsector is comprised of clean energy occupations. The results of this analysis are shown below.

WNY has over 130,000 jobs in industries related to clean energy, more than a quarter (27%) of which are also in an occupation with ties to clean energy. Meanwhile, there are over 89,000 jobs in occupations potentially involved in clean energy, and more than a third of these jobs (34%) also fall in industries related to clean energy. These dynamics vary widely by clean energy subsector. For example, only 5% of jobs in industries involved in public policy are in occupations with potential links to clean energy, whereas 61% of jobs in construction and installation related industries are help in occupations that are also connected to clean energy. (These numbers are based on an analysis of data from the US Bureau of Labor Statistics (BLS), Quarterly Census of Employment and Wages (QCEW), 2017; US BLS, Occupational Employment Statistics (OES), 2017; and the NYS Department of Labor Statewide Staffing Patterns by Industry & Occupation, 2018. Statewide staffing patterns exclude occupations

that make up less than 1% of industry employment, and vice versa.)

Classification of Instructional Program (CIP) codes used to define clean energy related academic degree programs

A crosswalk between Standard Occupational Classification (SOC) codes and Classification of Instructional Program (CIP) codes from the National Center for Educational Statistics and the Bureau of Labor Statistics was used to find the degree programs that relate to clean energy occupations. CIPs that relate to SOCs indicate that programs classified in the CIP category prepare individuals directly for jobs classified in the SOC category.

Below is a list of the instructional program codes related to clean energy by educational program category: AGRICULTURE, AGRICULTURE OPERATIONS, AND RELATED SCIENCE - 01.0102, 01.0601; NATURAL RESOURCES AND CONSERVATION - 03.0103, 03.0104; ARCHITECTURE AND RELATED SERVICES - 04.0201, 04.0301, 04.0401, 04.1001; COMMUNICATION, JOURNALISM, AND RELATED PROGRAMS - 09.0702, 09.0900, 09.0902; COMPUTER AND INFORMATION SCIENCES AND SUPPORT SERVICES - 11.0101, 11.0103, 11.0104, 11.0301, 11.0401, 11.0701; ENGINEERING - 14.0101, 14.0201, 14.0501, 14.0601, 14.0701, 14.0801, 14.0803, 14.0805, 14.0901, 14.1001, 14.1201, 14.1301, 14.1401, 14.1801, 14.1901, 14.2301, 14.3501, 14.9999; ENGINEERING TECHNOLOGIES AND ENGINEERING-RELATED FIELDS - 15.0101, 15.0201, 15.0303, 15.0399, 15.0403, 15.0499, 15.0507, 15.0612, 15.0613, 15.0702, 15.0805, 15.1001, 15.1201, 15.1202, 15.1301, 15.1302, 15.1601; BIOLOGICAL AND BIOMEDICAL SCIENCES - 26.0202, 26.0203, 26.1103; MATHEMATICS AND STATISTICS - 27.0305, 30.3001, PHYSICAL SCIENCES - 40.0501, 40.0599, 40.1001; SCIENCE TECHNOLOGIES/TECHNICIANS - 41.0204, 41.0301; PSYCHOLOGY - 42.2799, 42.2804; PUBLIC ADMINISTRATION AND SOCIAL SERVICE PROFESSIONS - 44.0401, 44.0501; SOCIAL SCIENCES - 45.0101, 45.0102, 45.0601, 45.0602, 45.0604, 45.0699, 45.0701, 45.0702, 45.0901, 45.1001, 45.1201; CONSTRUCTION TRADES - 46.0101, 46.0301, 46.0399, 46.0401, 46.0412, 46.0415; MECHANIC AND REPAIR TECHNOLOGIES/TECHNICIANS - 47.0201; PRECISION PRODUCTION - 48.0503, 48.0508; VISUAL AND PERFORMING ARTS - 50.0404; BUSINESS,

MANAGEMENT, MARKETING, AND RELATED SUPPORT SERVICES - 52.0101, 52.0201, 52.0203, 52.0206, 52.0305, 52.0601, 52.0701, 52.0703, 52.0801, 52.0808, 52.1001, 52.1301, 52.1401, 52.1499, 52.2001.

The policy landscape guiding clean energy in Western New York

New York State Department of Public Service, "Reforming the Energy Vision (REV)," 2016. Accessed March, 2019 at www.ny.gov/sites/ny.gov/files/atoms/files/WhitePaperREVMarch2016.pdf; New York State Energy Research and Development Authority, "Clean Energy Fund Fact Sheet," 2016. Accessed March, 2019 at www.nyserda.ny.gov/About/Funding/Clean-Energy-Fund; U.S. Department of Energy, Loan Guarantee Program Office, "Energy Policy Act of 2005, Final Rule (10 CFR Part 609)," Final Rule, January 17, 2017. Accessed March, 2019 at www.energy.gov/lpo/title-xvii/title-xvii-governing-documents

Clean Energy Industry Overview

Big Picture Stats

"130,000 jobs..." "1 out of 5 jobs..." and "\$11,000 more per year..." U.S. Bureau of Labor Statistics, Quarterly Census of Employment and Wages, 2017.

"8% job growth..." US Bureau of Labor Statistics, Occupational Employment Statistics, 2012 and 2017.

"11,770 more older workers..." US Census, Quarterly Workforce Indicators, 2016-2017. Numbers reflect averages from quarter 4 2017 to quarter 3 of 2017.

Clean Energy Industries in WNY

All figures are from the U.S. Bureau of Labor Statistics, Quarterly Census of Employment and Wages, 2012 and 2017. Figures are based county-level data using 4-digit NAICS codes tied to clean energy (see Data Sources Overview). Some industries are included in multiple subsectors so clean energy industry totals are less than the sum of all subsectors. Data for some industry codes can be suppressed in some counties due to a low number of firms and jobs. These data suppressions are excluded from the numbers shown.

Clean Energy Occupations in WNY

US Bureau of Labor Statistics (BLS), Occupational Employment Statistics, 2012 and 2017. Occupational employment for WNY was estimated using data for the Buffalo-Niagara Falls Metropolitan Statistical Area, and the US BLS' Southwest NY non-metropolitan area. Occupational employment from the Southwest non-metropolitan area was allocated to WNY based on the share of that area's total employment that fell within WNY counties (Allegany, Cattaraugus, and Chautauqua). Job projections and educational requirements of projected openings are from the NYS Department of Labor, "Long-Term Occupational Projections, Western New York" 2014-2024. .

Clean Energy Employers in WNY

Clean Energy Job Density Map: InfoGroup, Inc., Reference USA Business Database, 2018. The ReferenceUSA database classifies businesses under a primary NAICS code. WNY businesses classified with a primary NAICS code that fell in the list of clean energy industry codes at the six-digit level (see Data Sources Overview) were selected and mapped by x,y coordinates. ArcGIS software was used to calculate the employment density of these points across a one-mile search radius based on the estimate of employees at each clean energy business location. InfoGroup, Inc. uses robust outreach to estimate the employees at each business site, but these are not official numbers.

"The industry is made up of nearly 9,500 firms..." U.S. Bureau of Labor Statistics, Quarterly Census of Employment and Wages, 2017.

"Most of these companies take more time than the regional average (29 days) to fill..." UBRI analysis of WNY job postings using Emsi, September, 2016-December, 2018.

In-Demand Occupations and Areas of Expertise

U.S. Bureau of Labor Statistics, Quarterly Census of Employment and Wages, 2012 and 2017.

UBRI analysis of job postings from US and WNY, using Emsi, September, 2016–December, 2018. Clean energy job postings were selected by using related clean energy occupational codes, industry codes, and clean energy keywords (see Data Sources Overview). The keywords used to search for clean energy related job postings in Emsi software are: “energy efficiency,” “building efficiency,” “renewable energy,” “clean energy,” “alternative energy,” “energy storage,” “battery technology,” “battery storage,” “solar energy,” “solar power,” “solar panel,” “wind energy,” “wind power,” “wind turbine,” “geothermal,” “biofuel,” “biomass,” “biodiesel,” “energy audit,” “waste to energy,” “microgrid,” “electric vehicle,” “hybrid vehicle,” “LEED,” “nuclear energy,” “hydroelectric,” “hydropower,” “waste-to-energy,” “energy conservation,” “energy management,” “energy coordinator,” “sustainable building,” “sustainable design,” “smart grid,” “smart building,” “energy sustainability,” “sustainable energy,” “environmental sustainability,” “environmental services,” “energy services,” “environmental design,” “energy policy,” “energy program,” “energy solutions,” “energy and sustainability,” “greenhouse gas reduction,” “climate change mitigation,” “energy and environmental”

WNY Academic Institutions Involved in Clean Energy

National Center for Educational Statistics, Integrated Postsecondary Education Data System, 2017–2018. Figures are based institutional programs that support occupations related to clean energy (see Data Sources Overview).

Clean Energy Workforce Challenges

Preparing for Approaching Retirement Cliffs...

All figures are from US Census, Quarterly Workforce Indicators, 2016–2017. Numbers reflect averages from quarter 4 2017 to quarter 3 of 2017.

Clean Energy Workforce Opportunities

WNY academic institutions are well-positioned...

“Across the industry as a whole, there were 7 graduates for each projected clean energy job opening in 2018.” UBRI analysis of the NYS Department of Labor, “Long-Term Occupational Projections, Western New York” 2014–2024, and degrees awarded from the National Center of Employment Statistics, Integrated Postsecondary Education Data System, 2017–18.

Diversifying the clean energy workforce...

All figures are from the US Bureau of Labor Statistics, Occupational Employment Statistics, 2017.

Key Considerations

Learning from successful clean energy programs like “the Alfred State model”

“In 2018, Alfred produced 175 bachelor’s degrees related to clean energy, and many more at the associate’s level (267).” National Center of Employment Statistics, Integrated Postsecondary Education Data System, 2017–18.

Promoting innovation and clean energy goals benefits industry, academia, and the workforce

“Buffalo’s 43North competition has also fueled the grow of some of these companies with start-up funding, like CleanFiber which uses recycled products to produce insulation for buildings.” Dan Miner, “A look at Buffalo’s growing collection of clean-energy startups,” Buffalo Business First, Nov 25, 2018. Accessed May, 2019 at www.bizjournals.com/buffalo/news/2018/11/25/a-look-at-buffalos-growing-collection-of-clean.html

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