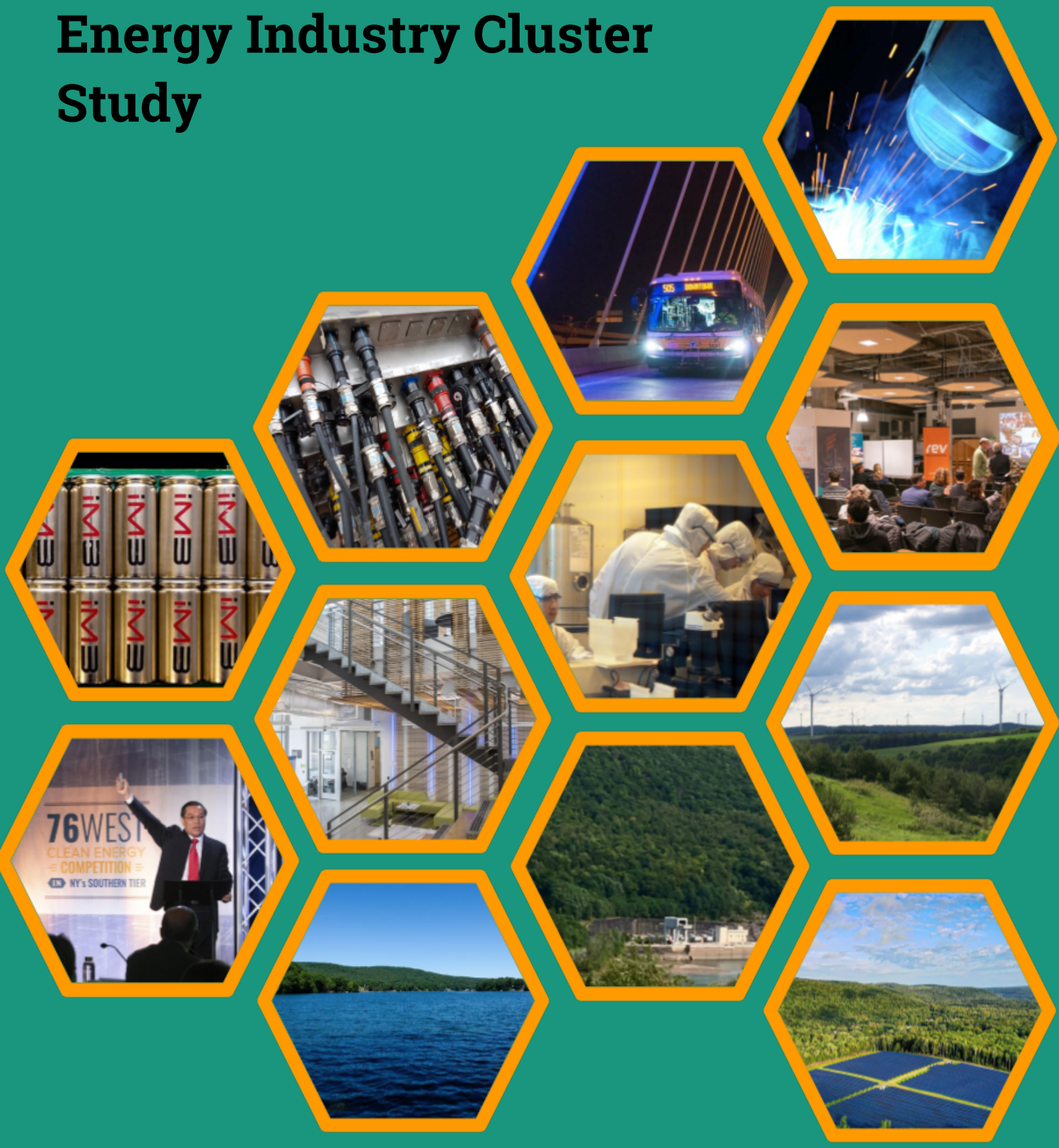
The Southern Tier Clean Energy Industry Cluster Study



INTRODUCTION

Clean Energy is becoming the new global norm. Energy and resource efficiency improvements will directly benefit almost all conceivable industries in the near future. Timely and targeted investments in the already developing Southern Tier Clean Energy Industry Cluster will transform the entire regional economy through knowledge spillover into innovation-forward industries. By increasing business growth opportunities in this trade-able sector, both in terms of generating commercialized products, materials, etc. as well as attracting new firms and stabilizing populations, the Southern Tier can reach new heights.

It is imperative that we take a strong, coordinated, regional systems approach to economic development based on existing strengths. The region contains appealing urban and rural areas, and each has unique assets and challenges.

Collaboration and Public Private Partnerships (PPPs) that span from planning and development through implementation are necessary to ensure regional economic success.

This report was prepared in 2020 for Southern Tier 8 Regional Board with support from the Appalachian Regional Commission. Collaboration was at the core of this study's activities.

The Tier Energy Network (TEN) would like to thank all of the partners and collaborators who made this project possible. Major funding partners included the Southern Tier 8 Regional Board of the Appalachian Regional Commission (ARC) and Customized Energy Solutions, Inc (CES). Many public and private collaborators across the eleven county study area supported and participated during the process.

ACKNOWLEDGMENTS

The Tier Energy Network would also like to thank the following individuals and organizations for providing input during the course of the study:

Bill Acker: Executive Director, New York Battery & Energy Storage Technology Consortium

Nasir Ali: Co-Founder, Entrepreneur, Mentor & Investor, Upstate Venture Connect

Roger Bason: Chief Executive Officer, Atlantic Ocean Aquaculture

Joe Batchelder: Facilities Management Director, SUNY Cobleskill

Dr. William Bernier: Chief Executive Officer, ChromoNano Tech

SaLisa Berrien: Chief Executive Officer, COI Energy Solutions

Dustin Broderick: Senior Program Manager, Franklin Energy

Franz Bronnimann: Founder and Chief Executive Officer, Aestus Energy Storage

Michael Brookman: Chief Executive Officer, Brash Power

Norma Bryon: President, Ashlawn Energy

Dan Buchanan: President, Southern Tier Technologies

Gay Canough: President, ETM Solar Works

Terry Carroll: Clean Energy Communities Coordinator, Cornell Cooperative Extension

John Ciovacco: President, Aztech Geothermal

Brian Creegan: US General Manager, Hub Controller

Sara Culotta: Market Lead, Higher Education, Energy & Sustainability; Business-to-Society Programs, Siemens

Emily Dean: Director of Market Development, NYSERDA

Jennifer de Souza: Senior Director of Energy Solutions, Procurement & Leasing, Raymond

Herbert Dwyer: Chief Executive Officer, Empire Equity Inc.

Peg Ellsworth: Executive Director, Mark Project Inc.

Janyce Fadden: Director of Strategic Engagement, UNA College of Business

Romy Fain: Chief Executive Officer, Heat Inverse

Stephen Fernands: President, Customized Energy Solutions

Adele Ferranti: Program Manager, Workforce Development & Training, NYSERDA

Mary Jo Ferrare: Regional Director, Mohawk Valley, Workforce Development Institute

Ryan Fisher: General Manager, Amphenol Aerospace

Adam Flint: Director of Clean Energy Programs, Network for a Sustainable Tomorrow

Lynn Freid: Regional Director, Rochester -Genesee Valley, Workforce Development Institute

Jerone Gagliano: Chief Executive Officer, Bright Buildings LLC

Barry Gell: Deputy Operations Manager, SUNY Cobleskill

Matt Gill: Founder and Developer, Enhance VR

David Goodness: Regional Director, Central NY, Workforce Development Institute

Ross Gould: Director of Energy and Climate Programs, Workforce Development Institute

David Gower: Chief Executive Officer, Youbicwitus

Aldo Grech: Founder, VoltWall

Brenda Grober: Director of Industry Development, Strategic Business Development Division, New York State Empire State Development.

Dr. Arun Gupta: Chief Executive Officer, at Skyven Technologies

Chad Hall: Co-Founder/Senior Vice President of Sales & Marketing, IOXUS

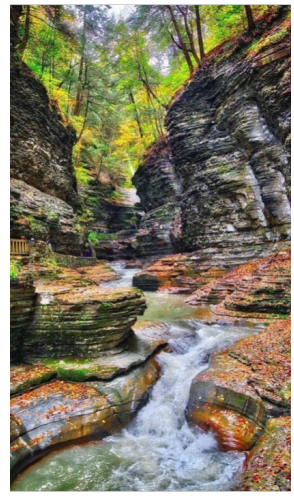
Charles Hamilton: Chief Executive Officer, Conamix

Christian Harris: Regional Labor Market Analyst, NYS Department of Labor

Christopher Houghtaling, Co-Founder, VisioneersPartners

John Hroncich: Regional Sales Manager, Power and Propulsion Solutions, BAE Systems

Lisa Ianello: Director, Corporate Foundation and Government Relations, Hartwick College



Patrick Jackson: Global Director, Energy Management, Corning Inc.

Nancy Kirby Kurjakovic: Executive Director, Incubator Works

Eric Knolles: Superintendent, Waverly Central Schools

Alex Kosyakov: Chief Executive Officer, Natrion

Aiden Livingston: Chief Executive Officer, ThermalAI

John Lochner: Vice President, Innovation. NYSERDA

Robert Lofthouse: Engineering Science & Physics Dept Chair, Professor, SUNY Broome

Ashleigh Madison: Office Manager, Incubator Works

Charles Murray: Chief Executive Officer, Switched Source

Paul Mutolo: Chief Executive Officer, Standard Hydrogen Corporation

Liz Nilsen: Author, Strategic Doing

Michael Oshetski: Chief Executive Officer and Co-founder, Micatu Inc.

Steven Palmatier: President, Walking Ridge Development

Anthony Paniccia: President and CEO, Delta Engineering

Michael Pentaris: President and CEO, Custom Electronics

Theresa Pipher: Senior Research Analyst, Dawnbreaker

Joe Rizzo: Manager of Economic Development, NYSEG/RG&E

Joe Rusin: Central Region Community Outreach & Development Manager, NYSEG/RG&E

Paul Stratton: Senior Vice President Marketing and Sales, iM3NY

Per Stromhaug: Assistant Vice President for Innovation and Economic Development, Binghamton University

Larry Thomas: Chairman/President/CEO, Primet Precision Materials Inc.

David Turner: Regional Manager, Energy & Sustainability, Siemens Smart Infrastructure

Shailesh Upreti: Founder and Chairman, C4V / iM3NY

Lou Vogel: President, Taitem Engineering

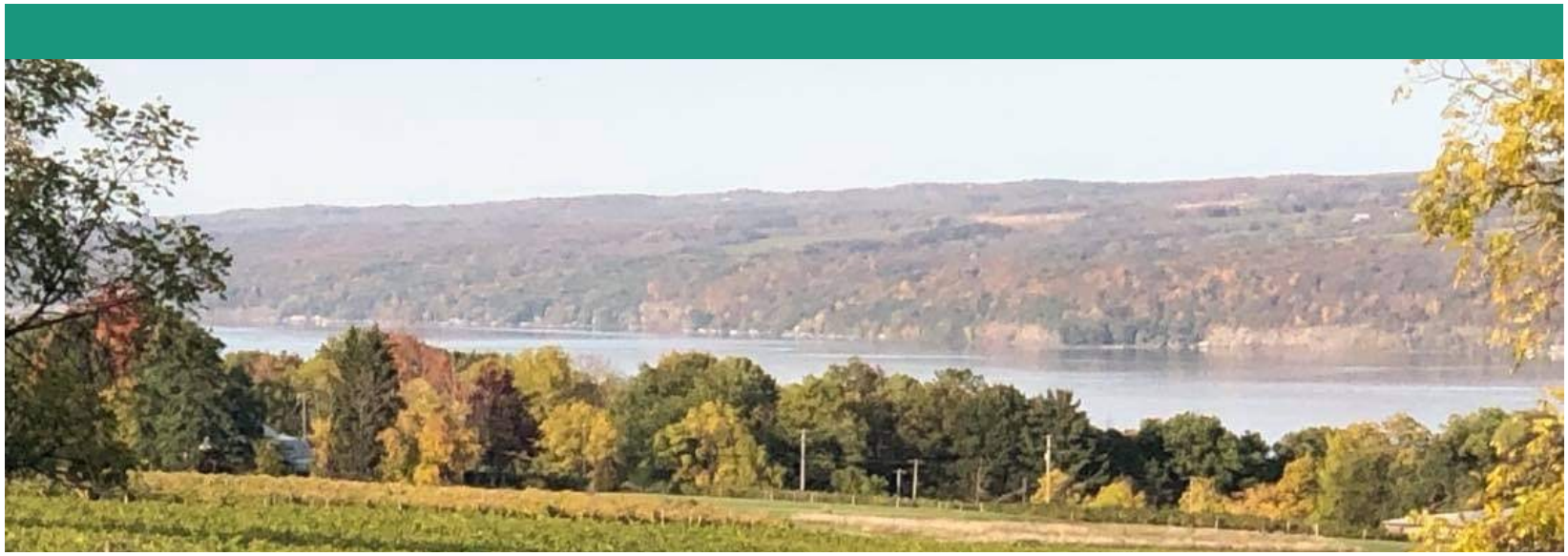
Christopher Wen: TEN Intern from Binghamton University

Parr Wiegel: Chief Executive Officer and Chief Technology Officer, EKO Stinger

Tom Xu: Chief Executive Officer, AGreatE

Dr Qing-Chang Zhang: Chief Executive Officer, Syndem

Special thanks for photographic support to: Binghamton University, Cornell University, D.O.B. Photography, and E.S.N. Photography.



INDEX

Executive Summary 7

Recommendations.....9

Study Methodology.....15

Best Practices and Literature Review.....17

Study Area Map.....20

Study Area Description.....21

Private Sector Overview.....26

StartUp Sector Breakout..... 29

iM3NY: A Success Story.....31

Regional Clean Energy Workforce: Status & Projected Growth.....34

Technology Penetration.....41

Public Sector.....46

Regional Entrepreneurial Ecosystem.....50

Research & Development.....54

Rural Entrepreneurial Access.....56

Start Up Funding Access.....57

Barriers to Business Growth..... 62

Projected Impact of CLCPA on the Southern Tier.....65

Appendix.....79

EXECUTIVE SUMMARY

Many forces are coming together to create an opportunity for the Southern Tier in one of the most significant transformations taking place in the world today. The need for efficiency and the growing demand for environmental responsibility are pushing both technology and the marketplace. New York State has established the Climate Leadership and Community Protection Act (CLCPA), a legislative commitment to 70% renewable energy by 2030. The CLCPA includes some of the most progressive renewable energy goals in the U.S.

A clean energy industry cluster is emerging in the Southern Tier of New York State, rising from the region's long-established Aerospace, Defense and Manufacturing industries' relationships with world-renowned research centers at regional universities. An "industry cluster" is a geographic concentration of related businesses which can help drive innovation and productivity, build a sustainable competitive advantage and promote increased growth. Companies throughout the 11 county study area are working in the clean energy industry, and tier residents are filling roles across the spectrum - from developing new battery materials in research labs, to designing new equipment, to installing heat pump systems.

The electrification of heating systems, vehicles, and industrial equipment, along with the necessary development of renewable energy generation to meet increasing power needs, is a major strategy for achieving aggressive clean energy goals in New York and around the globe. Regardless of opinions on climate-based policy change, no one can argue the ever increasing need for efficiency in an extremely competitive global marketplace.

The clean tech revolution, sometimes referred to as the "4th Wave," is taking the globe by storm. Studies from across the globe are showing that clean energy is the top emerging clean tech sector. The worldwide rush to control the renewable energy industry is well underway, and the Southern Tier is poised to play a major role. Market analysts projected exponential increases in the frequency of tech innovation, and that time is now for clean energy technologies.

There are many challenges to supporting such a fast-moving field. Innovation often outpaces policy and regulatory measures as advanced manufacturing technology dramatically shortens development timelines, making it possible to prototype in days, not weeks. This speed requires both flexibility and careful monitoring by policy-makers, and often also necessitates access to non-traditional funding formats.

Advancements in clean tech are catalysts for advancement across multiple industry areas, as a restrictive economic climate makes efficiencies necessary not just for profitability but also for sustainability. Industries of the future, such as space exploration and commercialization, advanced transportation, biotechnology and A.I. rely on clean energy technology. The relationship grows ever more interdependent, as clean energy increasingly utilizes computer

thinking as part of new energy efficiency technology, and biotechnology crosses into energy with not only biofuels but biogeneration exploration. These trends and inter-relationships have created a burgeoning market for clean tech in an otherwise shrinking market environment.

Taking a proactive and strategic approach will allow the Southern Tier to optimize this opportunity by leveraging existing public and private resources to create a virtuous cycle of sustainable economic development based on clean energy technology.

The primary purpose of this study is to understand the clean energy industry cluster that exists in the Southern Tier and assess the impact of the CLCPA on the region. This study will help county planning professionals to:

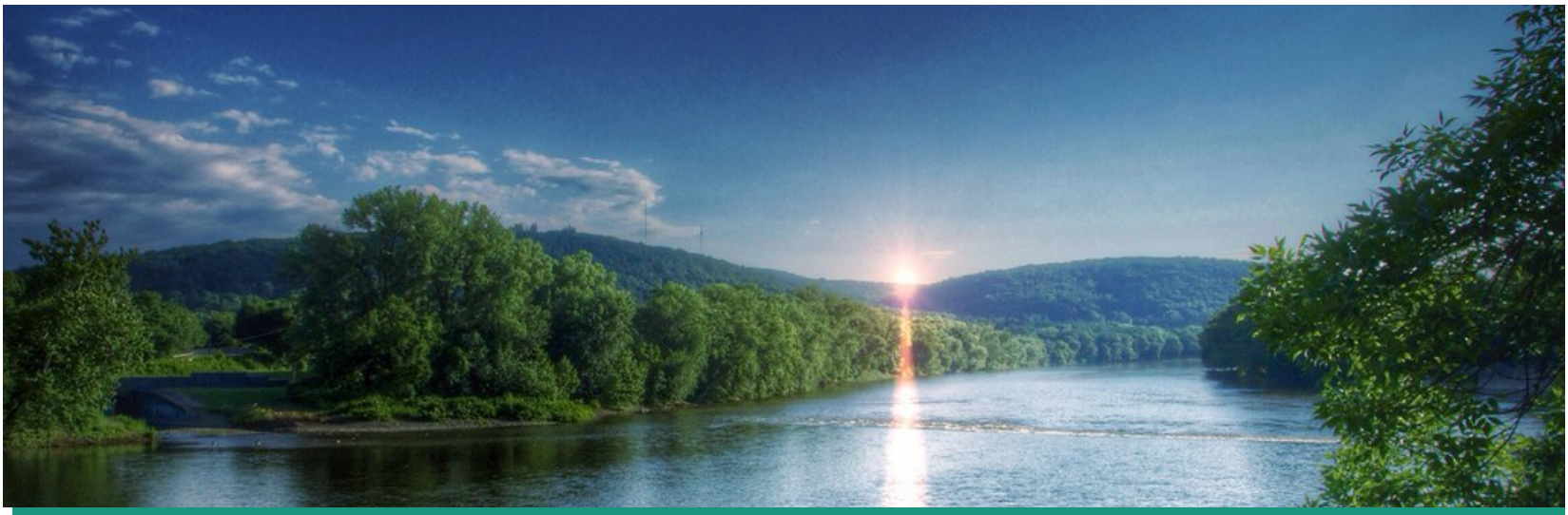
- Develop cost effective plans for implementing New York State's Climate Leadership and Community Protection Act.
- Understand the needs and potentials of the emerging clean energy industry cluster.

To complete this assignment TEN:

- Identified and mapped all the clean energy companies, startups, supporting organizations and renewable generation projects in the 11-county region.
- Interviewed companies and organizations to understand employment needs and barriers to business growth.
- Interviewed state-level department and agency representatives to understand their perspectives and needs for regional partners.
- Worked with project partners to identify recommended actions and strategies.
- Evaluated the existing entrepreneurial ecosystem with a focus on rural communities.
- Assessed the projected impact of the CLCPA on the region.
- Reviewed best practices and studies regarding industry cluster development, ecosystems for entrepreneurs, advanced manufacturing, and workforce development.
- Developed recommendations that regional leaders can consider over the next five years.

The transition to a "net zero" environment represents a profound change to our economy. The Southern Tier clean energy industry cluster has the potential to create 5,000 to 10,000 jobs over the next ten years, while strengthening the related regional industry clusters and enhancing the profile of the Southern Tier in world-wide markets.

Energy policy is unfolding on a daily basis. President Biden recently proposed a $2.3 trillion American Jobs Plan, which is focused on infrastructure investments including advanced transit improvements, universal broadband access, energy efficiency building upgrades and retrofits in commercial and residential spaces, and improved manufacturing and social service infrastructure. The Southern Tier has a strong presence in advanced transportation and a growing presence in battery energy storage. Coordinated regional planning will allow the Southern Tier to benefit from both State and Federal energy policy actions.



RECOMMENDATIONS

The following list presents key actions that regional stakeholders should consider over the next five years to improve regional competitiveness by growing the clean energy industry cluster, strengthening the innovation triangle nodes, increasing opportunities for rural entrepreneurs and supporting the transition needed to reach New York State's clean energy goals.

Many of these strategies require the collaboration of government, nonprofit and private sector stakeholders. All will be achieved optimally with stakeholders representing each sector participating.

Primary public sector agency participants should include: Regional Economic Development Councils (REDCs) representing the Southern Tier, Mohawk Valley and Central regions; County Economic Development Departments; Economic Development Nonprofits, such as Chambers of Commerce; County Planners; Southern Tier 8 and Southern Tier Central Regional Boards; and Municipal leaders. Relevant local governments should be constantly informed of all actions to facilitate related local processes. High-level community engagement and transparency is also recommended; in some instances this action may save months of time caused by potential negative public opinions.

Regional Planning Professionals should facilitate the regional sharing of issues, opportunities and best practices to the greatest extent possible. Collaboration is imperative to success.

The Tier Energy Network is a willing and able partner in these initiatives. The Tier Energy Network board and members are committed to facilitating the further development of the Clean Energy Industry Cluster.

Strategies to grow the Southern Tier Clean Energy Industry

STRATEGY 1 PREPARE TO COMPETE IN THE GLOBAL MARKET

ACTION ITEMS:

1. **Market the Southern Tier Clean Energy Industry.** Develop regionally coordinated print and video marketing materials for the region's clean energy industry cluster promoting the region's capacity and assets. County planning and economic development professionals should actively participate in this activity, ideally guided by the Chambers & IDAs, with the support of County Planning Directors.
2. **Provide Public Education on Clean Energy.** With the help of CCE's and the Clean Energy Community program, provide Public Education regarding the value of the CLCPA's goals. A call for public education on clean energy technologies has been requested across the region.
3. **Facilitate Development of Key Sites.** As Economic Development Organizations, Industrial Development Agencies and NYSERDA identify and assess key sites for development inquiries, comprehensive site assessments should be made publicly available online and updated regularly. This action should be integrally tied to and supported by Empire State Development (ESD).
4. **Assess Current and Potential Supply Chain Opportunities.** Industrial Development Agencies should collaborate with Manufacturing Education Partnerships (MEPs) and state level advanced manufacturing agencies to identify supply chain opportunities. MEPs can identify retooling opportunities required to maximize regional advanced manufacturing potential.
5. **Promote the clean energy research, testing and advanced manufacturing capabilities of the region.** Stakeholders throughout the region should collaborate to compile data and develop a summary of regional activities in clean energy research and development.
6. **Develop Coordinated International Marketing/Outreach Processes.** New York State is considering very significant development projects and joint ventures with clean energy companies around the world. Competition among regions for these lucrative partnerships is expected. Coordinated efforts will allow the Southern Tier to be competitive for these opportunities. Regional Planning Directors, Higher Education leaders and Industrial Development Agencies should collaborate on this action with support from REDCs and Empire State Development.

7. **Assess the potential for a Soft Landing Program in the Southern Tier for the clean energy industry cluster.** A soft-landing program provides work space, mentoring, and some startup expenses for companies entering US markets through the Southern Tier.

8. **Urge NYSERDA to continue the 76 West Business Plan Competition for Clean Energy Companies**. This program serves as a strong marketing program for the Southern Tier around the world.

STRATEGY 2 ACCELERATE WORKFORCE DEVELOPMENT

ACTION ITEMS:

1. **Provide leadership resources for Regional STEM Initiative**. A dedicated director or coordinator is needed to implement and manage the program. The Southern Tier 8 Regional Board would be the ideal host agency.

2. **Develop Regional Clean Energy Industry Career Pathways.** Collaborate across sectors with partners such as AM&T, workforce development offices, educational institutions and business leaders to co-design a career pathway plan responding to specific existing regional business needs. Define entry-level positions and promote use of available funding for Internship and Work-to-Learn Programs that support the underemployed workforce (veterans, those in recovery, black & brown residents, women and disadvantaged youths) as available through agencies including NYSERDA, the Department of Energy and local workforce offices. Knowledge of these programs is not widespread. Provide equitable access to stackable credentialing opportunities in STEM fields. Coordinate with county workforce development offices, school districts and BOCES to create pipeline of ready-to-work applicants. Examples include the New York State Clean Energy Internship Program, Program Opportunity Number (PON) 4000, administered by NYSERDA, which can fund up to 90% of an intern's salary.

3. **Promote existing Heat Pump Awareness Programs.** Develop a Heat Pump Strategy for the Southern Tier in concert with established support programs (NEST, HeatSmart Finger Lakes, HeatSmart Tompkins), NYSERDA and the industry. The strategy will develop case studies, estimate projected demand, identify barriers in deployment and recommend training and awareness programs. Coordinate with Electrical Contractors and Trade Unions to promote Heat Pump Installation Training. Consider financially supporting training comparable to union opportunities by offering shared training opportunities for small contractors using existing workforce development funding opportunities.

4. **Support the Development of Additional Mechatronics Programs**. These programs are critical to training two-year technical graduates for the clean energy industry. The program is coupled with remedial training for candidates with STEM skill gaps such as math. Mechatronics programs DCMO BOCES and SUNY Delhi provide examples.

STRATEGY 3 PROMOTE CLEAN ENERGY DEVELOPMENT PROJECTS

ACTION ITEMS:

1. **Support and Promote Energy Storage Demonstration Projects.** New technologies being developed in the regional innovation triangle should be supported with an energy storage demonstration project. A collaborative effort to develop the project would improve workforce talent and storage capacity, and allow the Southern Tier to be a model for regions around the world.
2. **Assemble Case Studies on Clean Energy Technology Options.** These studies will allow counties and developers to consider: solar, wind, storage, hydro, micro-grid, on-site generation, air and ground source heat pumps, EV charging stations, EV and hybrid vehicles, load demand, power factor control, insulation, etc. Some of the products being developed in the Southern Tier can help reduce energy costs.
3. **Use Steuben County's Industrial Development Agency's process for large scale Energy Projects as a Best Practices example.** The county has 20 years of experience with this strategy and is the leading county in the region in large scale project development.
4. **Promote the use of Tompkins County Business Advisor Program as a model for programs across the region.** This program supports analysis of energy needs for commercial and industrial business owners.
5. **Form a Southern Tier Clean Energy Industry Association.**

   A coordinated, industry led effort is required to drive regional business growth. This Association would: Provide technical support to county and municipal officials; Represent the regional cluster at the state level; Inform regional stakeholders on Federal clean energy policy reforms; Monitor and support the industry's workforce needs; Support development of the ecosystem for entrepreneurs; Define research and development needs for the Southern Tier; Support related grant applications for regional stakeholders; Provide training in programs such as economic gardening.

   TEN has been serving in this role on a voluntary basis. Dedicated resources will accelerate business development and climate protection.

Strategies to advance all three Clean Energy Innovation Triangle nodes to Top 50 Smaller Cities Supporting Clean Energy Entrepreneurs status.

STRATEGY 1 INCREASE REGIONAL START-UP FUNDING OPPORTUNITIES

ACTION ITEMS

1. **Promote the Development of Regional Entrepreneur-led Seed Funds.** A fund committee will be established to work with Upstate Venture Connect to develop bylaws, prospectus and marketing. Upstate Venture Connect has helped several regions establish entrepreneur led funds. Ideal initial fund size target is $2,000,000. Individual investors can invest in up to three seats at $40,000 each. The TEN Executive Committee will help fund committee development. Funding will be from private investors. These funds will help to instill greater local participation in entrepreneurial development.
2. **Support the development of Clean Energy Innovation Competitions.** The 76West Clean Energy Competition was building the region's ability to support local innovators and attract new entrepreneurs, but its future is in question due to Covid-19 budget cuts; a replacement program should be implemented as soon as possible.

STRATEGY 2 IMPROVE REGIONAL BROADBAND ACCESS

ACTION ITEMS:

1. **Expand Technical and Planning Assistance to all counties.** The Southern Tier 8 Regional Board has created a 5-county working group, the Regional Broadband Collaborative, to assess current limitations, build community capacity, and align resources to position communities for expansion of broadband infrastructure in Broome, Chenango, Cortland, Delaware, & Tompkins Counties. Expanded efforts are needed to include all 11 study-area counties. Rural areas face additional challenges due to smaller municipal staff capacity as well as challenges due to extremely varied terrain. Counties and Municipalities should consider developing expansion efforts with the public non-profit Southern Tier Network to bring additional fiber infrastructure and connect the most rural communities that have faced continued private sector dis-investment.
2. **Act as Lead Agency/Partner for Implementation Funding Requests.** Collaboration between all stakeholders is imperative. Federal, state and private foundation grant funding should be sought by all eligible stakeholders: municipal governments; regional planners; nonprofits; and higher level education institutions are all potential eligible

applicants for currently available funding. USDA assistance should be utilized in rural counties. The Regional Planning Board should act as lead agency/municipal to allow equitable distribution of available funding resources. Coordinate outreach efforts of regional business leaders to ensure all potential corporate partners are contacted.

Strategies to Support Entrepreneurs in Rural Communities

STRATEGY 1 INCREASE ENTREPRENEURIAL SUPPORT PROJECTS AND PROGRAMS IN RURAL COMMUNITIES

ACTION ITEMS:

1. **Support and coordinate satellite incubator projects in rural communities.** Best practices resources should be proactively provided to stakeholders. The Regional Board should support additional/satellite incubator and accelerator programs in Delhi, Cortland, Norwich, Owego and Ithaca.
2. **Assist the Waverly School District to develop a STEM Training Center and Business Incubator.** The Waverly School District is developing the Chemung Center for Innovation Studies to provide STEM training. A proposed phase 2 project would also develop a satellite incubator in a closed school building. Partners involved to-date include Waverly Schools, the Tier Energy Network, Team Tioga and the Southern Tier 8 Regional Board.
3. **Expand the manufacturing upskilling educational program at local high schools, such as the Fab Lab at Oxford High School.**
5. **Expand the regional industry cluster mapping to include startup companies for all industries, mentors and supporting organizations and services.** This data will serve as an information hub for the rural communities. Data can be displayed by industry cluster and in total. The Southern Tier 8 Regional Board should lead this action with all regional planning professionals collaborating to create and share the data.
6. **Conduct transmission constraint studies for key development sites in all counties.** The utilities have developed new plans and to address constraints. County planning professionals can support development in their communities by proactively informing utilities of development sites requiring grid infrastructure improvement.

STUDY METHODOLOGY

This study was conducted by the Tier Energy Network, a collaborative group of energy industry and community leaders, supported by consultants, over the course of 2020. The TEN project team brings 75+ years of energy industry experience to the table. The group utilized their network of industry leaders as well as knowledge gained through professional experience to guide this study. Continued participation throughout the study period by group members in policy guidance and leadership boards at industry related agencies and associations allowed the study to reflect up-to-the moment changes in policy and infrastructure development.

The study included all aspects of the Clean Energy Industry in the Southern Tier, with entities listed in the complete cluster participant database including:

- Advanced Manufacturers and Contract Manufacturers which make or use clean/energy efficiency processes
- Energy Efficiency Service Providers/Technology Developers and retailers
- Professional/Technical Service Providers (Architectural Engineers, Construction/Installation services)
- Utilities, Energy Suppliers & Projects
- Research & Development Partners (including specialized lab sites)
- Energy-related Infrastructure
- Available Funding Resources, Public and Private
- Government Agency & Nonprofit Resources

Business data was collected through phone interviews and surveys, as well as internet research. Surveys were sent via email to business and public sector leaders throughout the Southern Tier. Interviews and discussions were conducted by TEN study committee members throughout 2020. Interviewees included representatives of regional Clean Energy startups, key leaderships at established companies, and public sector actors active in the clean energy, planning and economic development arenas. In-depth discussion summaries, notes, and survey tool samples can be found in the report appendix.

Public sector information was gathered using internet research focused on organization websites, as well as peer-to-peer contact, including emails, calls, meetings, and presentation and workshop attendance. The Tier Energy Network also hosted virtual meetings throughout the year featuring speakers representing both the public and private sectors, and utilized notes from those meetings to inform the study. TEN executive committee members attended virtual events, meetings and discussions hosted by nonprofit agencies, workforce development groups, state-level industry coalitions and economic development agencies throughout the year to gather information about visions, opportunities and challenges across the region.

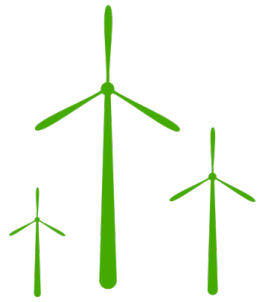
Demographic data was utilized from the US Census Bureau American Community Survey, 2018 5 year estimates, with additional statistical data sourced from agencies including the US Bureau of Economic Analysis, the Bureau of Labor Statistics' Office of Employment Statistics, the New York State Department of Labor, and the Bureau of Labor Statistics. Additional datasets were utilized through New York State's Open Data Portal at data.ny.gov.

Utility and grid data was collected from New York Independent System Operator (NYISO), as well as New York State Energy Research and Development Authority (NYSERDA) and New York State Department of Public Services (DPS). The interconnection queues, which log the lineup of generation sites waiting to connect to the power grid, as well as Article 10 filings, Federal Energy Regulatory Commission (FERC) filings, and planning and zoning board minutes, were accessed to provide information regarding grid-connected renewable energy generation projects, existent and planned, within the region. The NYISO interconnection queue data was accessed through the NYISO website. The New York State Electric & Gas (NYSEG) and Niagara-Mohawk Power Corporation (NiMO) interconnection queue information was accessed through the New York State Public Service Commission website. Information regarding project details was also collected from renewable generation contractors' project websites and regional news sources.

Local and Regional plans were reviewed to discover communities' existing plans, hopes and visions regarding clean energy and renewable generation technology adoption, as well as economic and workforce development. Recent studies and plans from the Appalachian Regional Commission regarding business incubation in rural communities also informed this report; as did multiple reports and studies conducted NYSERDA.

A best practices and literature review was conducted on industry cluster development policies and methods, entrepreneurial ecosystem development and support, and economic development for rural communities, with a focus on high-tech/emerging technologies and innovation.

Challenges resulting from Covid-19 were addressed through use of shared virtual work spaces, virtual communication and meeting tools. A summary of those challenges and solutions found, considering both this study and the regional clean energy industry, can be found in the appendix.



BEST PRACTICES & LITERATURE REVIEW

Throughout 2020 the Tier Energy Network project team conducted a review of available academic and scientific journals, business journal, gray and white papers and popular literature regarding industry clusters , cluster support and evaluation mechanisms , as well as entrepreneurial development methods for small cities and rural communities.

The rationale for supporting concentrations of industry, aka industry clusters, was written about as early as 1890, when Alfred Marshall published his Principles of Economics. The term “industry cluster” was popularized by Harvard Business School Professor Michael E. Porter in his book, the Competitive Advantage of Nations in the 1990s.

Industry clusters have naturally occurred since commercialization began, and were studied as early as the turn of the century. As the world economy grows ever more competitive industry cluster study and strategic use has become that much more important.

Michael Porter, the Harvard professor who popularized the term “industry cluster” in the late 1990s, offers three big reasons to utilize cluster strategies:

- Increasing Productivity of area companies
- Driving Innovation
- Stimulate new Business Development

Essentially, businesses that cluster enjoy greater opportunities than their scale would typically offer. Small to medium-sized enterprises (SMEs) can share resources without requiring pooling, including public infrastructure, workforce talent training, local support service providers, manufacturers, and suppliers..

The proximity of complementary high tech industries encourages shared technology knowledge, often referred to as transferability or spillover. Networking in clusters is likely to create new ideas, as each innovation can build on the last, and competitiveness within the cluster community can further push innovation forward.

Successful clusters are a result of the combination of spontaneous results of markets and strategic supporting policies. Hallmarks of successful cluster development initiatives include:

A focus on high-tech & advanced manufacturing which leads to knowledge spillover into complementary industries (Park, et al, 2017; Lehmann & Menter, 2017; Ortuzar & Slaper, 2015; Hospers, 2008); University-Industry Collaborations (Lehmann & Menter 2017); and Inclusion of Complementary Industries within cluster plans/policy (Lehmann & Menter 2017).

Supported growth of existing entities should be balanced with a slightly lower percentage of investments on attracting outside area businesses (Yi, et al; Feld; Wang, 2011).

Successful case examples exist across the country. Places which should be considered include: the Alabama Shoals Cluster; the Dallas Fort Worth High-Tech Cluster; the Boulder, CO

Entrepreneurial Hub; and Innovation District Initiatives in Oklahoma City, Philadelphia, and Pittsburgh.

Numerous examples of failed clusters and failed cluster development strategies can be found throughout the world. Unsuccessful clusters have some notable shared characteristics; they tend to be top-down approaches, and they tend to be overly tied to a single technology.

An overly specific focus, such as Germany's failed effort to create a solar industry town, is also less likely to succeed.

Politically-driven, not actual existing industry-driven actions, dreaming outside existing resources, or prioritizing development policy based on short-term public response has not typically resulted in long-term success. Sometimes mocked as a “field of dreams” aka “Build it they will come” style of development, this top-down effort, is not industry supported, not leveraged by private investors, and has consistently proven to be a bad investment. In countries with stricter government control of activities, such as China, this has occasionally been successful, but it is far from the norm. Forced industry selection, not reflective of existing resources and assets, does not result in a functional, sustainable economy.

Another characteristic shared by many failed cluster development ventures is inflexibility or low transferability across other regionally specific industries. This can be considered an overly focused methodology. An example of a better level of focus is Detroit, which is dependent upon the auto market, but not any single type of vehicle technology. An example of too tight a focus is Germany’s Dresden area, which was retooled to focus entirely on solar industry manufacturing. When China moved to control that market by flooding it with cheaper products, Dresden’s new (and primary) economic base was crushed. A hyper-focused cluster is not resilient to market changes, and investments do not spillover into adjacent clusters. Knowledge spillover into related industries increases tendencies for industry growth and decreases costs of production, in addition to cost lowering efficiency from shared resources (Wang; Hospers).

Ideal clusters are developed through supported but organic development, which is co-designed by a diverse mix of related (even competitive) businesses partnering with policy makers and economic development professionals. This collaborative method avoids common pitfalls of top heavy and narrowly focused strategies that can result in the so called “field of dreams with no players” situation referenced by the OECD Innovation Policy Platform report in 2015, or areas lacking flexibility and therefore resilience in the case of market decline if the cluster is too narrowly envisioned (Lehmann & Menter).

Standard measures and metrics for evaluation of successful industry cluster support programs include: Local level GDP changes over time, number of regional patents, and population retention and migration. Well defined industry clusters can improve a region's competitiveness in national and global markets.

THE CLEAN ENERGY INDUSTRY

The Clean Energy Industry is an evolving concept. According to New York State Energy Research and Development Agency (NYSERDA) there are five primary technology arenas within Clean Energy:

- Energy Efficiency
- Renewable Electric Power Generation
- Alternative Transportation
- Renewable Fuels
- Grid Modernization and Storage

Another way in which the components of the cluster might be broken down considers each enterprise's role: Generation, Transportation, Service, or Energy Efficiency.

This study looks at the clean energy industry holistically. In the Southern Tier, that includes companies as small as mom-and-pop technical/trade services businesses to huge global powerhouses. The Southern Tier clean energy industry cluster crosses through the 11 county study area and requires regional-level coordination.

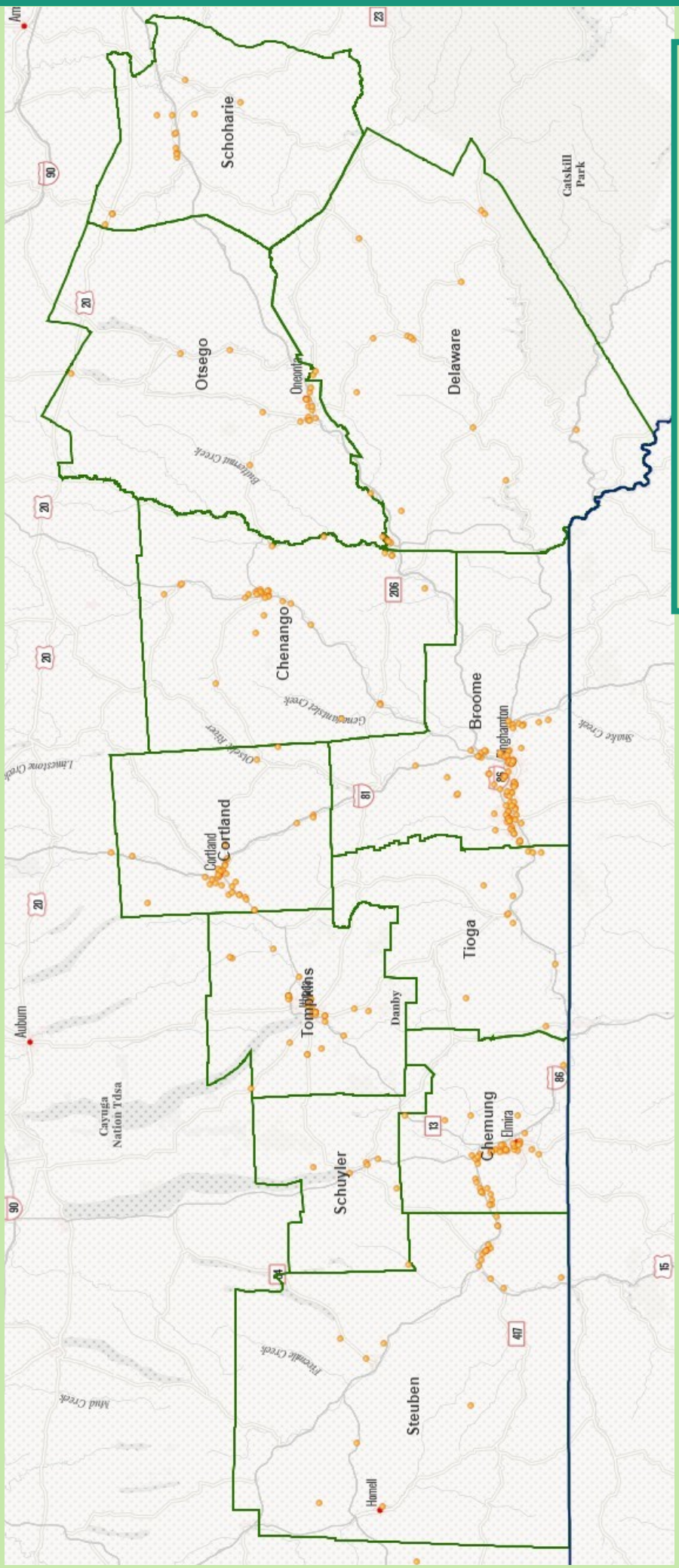
Two different priority perspectives are examined in additional detail in this report. The first view is focused on the industry participants creating and/or manufacturing clean energy technology products for sale locally and around the world. The second considers the cluster's potential to reach the state's lofty environmental goals from the perspective of our region's leaders as they seek strategies to meet those targets in the most effective manner possible.

Due to the interrelated nature of actors within clusters, strategies to improve the cluster ecosystem from either priority perspective will result in benefits to all. For example, great demonstration projects increase the reputation of the industry cluster and help instill an interest in clean energy jobs in youths, which strengthens the pipeline for the jobs we will require. Greater use of interns for clean energy projects in industry and in our municipalities provides greater opportunity to retain graduates.

Clean Energy Industry cluster development in New York's Southern Tier can be expected to offer spillover benefits to the Biotech, Aerospace, Defense, Robotics and Artificial Intelligence, Agricultural and Food Processing industries.

An investment in the clean energy cluster can be an investment in multiple other industries within the region, through coordinated regional planning. Strategically filling the shared needs of complementary high tech clusters represents the most financially responsible choice, with the lowest risk for both public and private funds.

STUDY AREA



Broome
Chemung
Chenango
Cortland
Delaware
Otsego
Schoharie
Schuyler
Steuben
Tioga
Tompkins

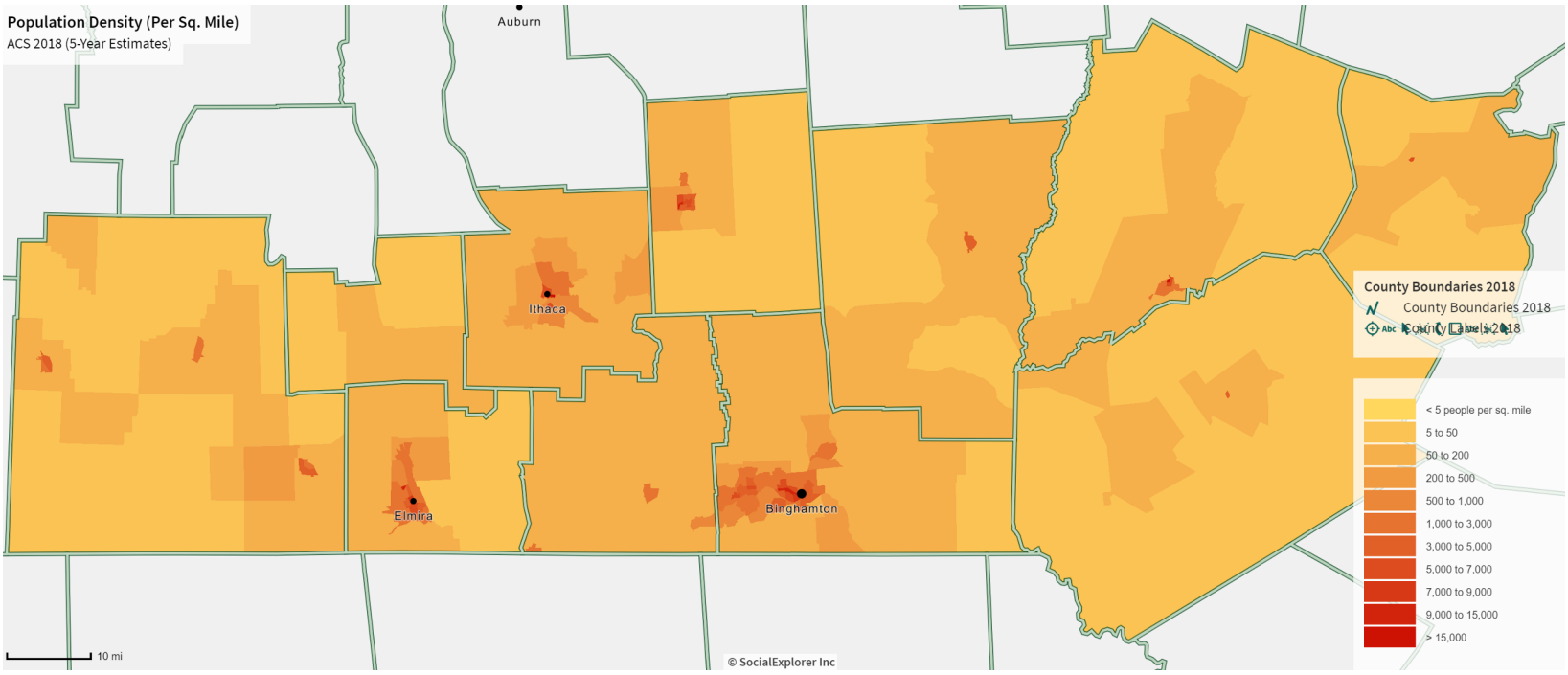
*Clean Energy Industry Private Sector Entities highlighted-

STUDY AREA DESCRIPTION

The Southern Tier of New York State, as referred to in this study, is a geographic area covering eleven counties - Broome, Chemung, Chenango, Cortland, Delaware, Otsego, Schoharie, Schuyler, Steuben, Tioga and Tompkins. These counties are grouped along the border with Pennsylvania, extending north to the southern tips of the Finger Lakes.

Encompassing approximately 8,300 square miles, the region is primarily green rolling foothills along the Susquehanna River Valley just touching the Western Catskill Mountain range. The area is dotted with a multitude of lakes, and crossed by multiple smaller rivers and streams. Open agricultural land separated by new growth temperate woodland areas and floodplains makes up the bulk of the landscape. Much historically agricultural land remains fallow, or has succumbed to overgrowth. Large expanses of state game lands fill areas between communities and agricultural areas. The easternmost counties, Delaware and Schoharie, particularly, have less agricultural land available, with steep inclines, mountain cloves and rocky outcroppings. Much of this space is dedicated to outdoor recreation uses through regulatory measures, as it includes portions of the Catskills Park as well as large reservoirs built for the New York City Water Supply System.

Approximately 780,649 people call the Southern Tier home. Most of the population is centrally located in the Greater Binghamton Metropolitan Statistical Area (MSA) area in Broome County, with additional pockets of density in the Greater Ithaca MSA and the Greater Elmira MSA. Those key communities form the nodes of the regional clean tech innovation triangle. The majority of the counties in the study area are rural, with populations below 50,000 and population densities as low as 31.5 people per square mile, as seen in Delaware County.



The map above illustrates more clearly the population variations within counties, with darker shading representing higher density.

This mix of countryside dotted with historic small towns and right-sized urban areas with unique neighborhoods and accessible downtown areas has been growing more appealing as technology allows professionals to select locations based more on lifestyle than employer location. Over 90% of the population has a high school diploma or equivalent - a higher percentage than NYS (86.5%) and the overall U.S. (87.7%). Approximately ⅔ of the population over 25 years old has some college experience with the last third moving on to a Bachelor's degree or higher. This represents a large pool of educated workforce talent.

Binghamton is just over 2 hours driving from the Greater New York City Metro area and just over 3 hours to Manhattan; the trip from Elmira/Corning adds just over an hour to the trip, giving the region easy access to greater resources. According to the 2020 Global Startup Ecosystem Report (GSER) by Startup Genome, New York City ranks No. 2, behind only behind Silicon Valley, as having the best tech ecosystem in the world. With a tech sector valued at $147 billion, New York City ranks as the No. 2 startup ecosystem globally.

A variety of transportation assets offer connections in every direction. The Southern Tier has N/S and E/W interstate access via I-81 and I-86, with Greater Binghamton, in the region's core, located at the interchange. NY I-88 begins in Binghamton, offering a direct route to the State Capital in Albany, and NY-17 offers easy access to the downstate metro area. The western section of the Southern Tier offers access to the Buffalo-Rochester Region via I-390.

Active commercial rail corridors facilitate commercial shipping throughout the region, but no passenger rail transit systems are currently in operation.

Recent airport updates have been made to facilitate both travelers and large commercial cargo at Elmira-Corning Regional, Ithaca Tompkins International and Greater Binghamton Airports. All three airports have also adopted clean energy practices, utilizing geothermal; technology to heat tarmacs and runways, and solar energy to power facility systems. Recent remodeling efforts have included passive energy efficiency measures as well

Within the primary Research and Development Nodes at Binghamton, Elmira, and Ithaca, multiple available commercial/industrial sites are connected by public transit systems. Typical of the northeast's post-industrial blight spaces, the area's communities are still burdened by the environmental injustices of the past, and include multiple brownfields and vacant industrial buildings. These sites offer high return on investment opportunities to developers ready to coordinate their reuse, as these spaces offer multi-level incentives for cleanup and reuse.

Goodyear Lake in Summer, above, and winter, below

NATURAL ENVIRONMENT

Rich in resources and natural beauty, the Southern Tier features a natural environment which contributes to a high quality of life as well as development opportunities.

Water resources abound. The northwest portion of the study area features portions of the deep, glacially-formed Finger Lakes in Steuben, Schuyler and Tompkins counties. The Susquehanna River represents both an opportunity and a challenge to the region. From its origin in Cooperstown in Otsego County to the Pennsylvania border past Tioga County the river offers scenic beauty, enhanced by the historic towns and villages along its route. The Southern Tier holds the highest single drop of any waterfall in the East, and is home to and unbelievable number of publicly accessible waterfalls. This bounty presents unique generation opportunities. Small scale hydro generation at the Colliersville Hydroelectric Project at Goodyear Lake creates renewable energy from the impounded waters of the Susquehanna; while the New York Power Authority's Blenheim-Gilboa Project utilizes pumped-storage technology to generate up to 1,160,000 kw of electricity. Cornell University utilizes a

small scale run-of-river hydropower facility just below Beebe Lake in Fall Creek and the City of Binghamton has a feasibility study underway to assess the potential of a microhydro plant at the Rock Bottom Dam, in the Susquehanna River just before its confluence with the Chenango River. Woodland and agricultural resources offer opportunities to explore biofuel technologies including waste-to-power and biomass.

While the region boasts environmental capital resources beneficial to a variety of clean energy generation opportunities, those resources also have the potential to slow or even halt clean energy project development, as communities, developers and property owners struggle to find middle ground in debates about the value and ownership of the rural views. Though a regulatory process exists which encourages public comment on developments, little guidance exists regarding solution methods to allow development while answering the concerns of residents. This issue is most apparent in public comments regarding wind and solar projects, with wind projects seeing the most objections from communities in Broome and Tompkins, and solar projects facing challenges in Tioga County. As an example of how public opinion varies across the study area, Steuben County has been supporting large scale renewable energy projects, including both wind and solar, for over 20 years.

QUALITY OF LIFE

The Southern Tier region has a great quality of life, with walkable downtowns, access to green space, and excellent public schools. Unique community centers, such as Corning's Gaffer District, Binghamton's Beautiful Washington Street and Ithaca's Downtown Commons offer hip urban amenities, while right-sized historic villages like Owego, (recently voted America's Coolest Small Town), offer a small-town, know-your-neighbor feel.

Communities of all sizes host festivals galore -Maple, Apple, Mark Twain, Blues, Bluegrass, Hot Air Balloon, Mural, Glass, Ice Carving and ethnic festivals representing a wide world of American immigrants. Some of these events have gained world renown - the city of Binghamton plays host to the internationally recognized LUMA projection festival.

The region holds multiple nationally-recognized attractions including the Baseball Hall of Fame and the National Corvette Museum in Cooperstown, the world-famous Corning Museum of Glass, Watkins Glen International Raceway, and the National Soaring Museum. Chenango County hosts the largest car museum in the nation - the Northeast Classic Car Museum in Norwich, and the world's oldest petrified forest is found in the Town of Gilboa in Schoharie County.

Entertainment opportunities include indoor and outdoor music and theatre venues, the Tioga Downs Casino/Raceway, and all-ages

fun at the Ithaca Science Center. Maker-spaces allow public access to creative STEM experiences and most regional communities have public libraries.

Parks and public recreation areas feature waterfalls, lakes & rivers offering a variety of water-sports and world-class fishing experiences. The area's rolling hills and valleys lend themselves to hiking and biking, with trails including the Finger Lakes Trail and the Appalachian Trail crossing through the region. Many other shorter trails are located in the area, most densely in the Western Catskill Mountains and surrounding the Finger Lakes. Outdoor fun isn't limited to the warmer months either -winter brings skiing, snowboarding and tubing at Greek Peak, Labrador, Song Mountain and Plattekill, as well as cross country skiing, snowshoeing, horseback riding and ice-skating throughout the region.

Destination shopping is found in Ithaca, Binghamton and Elmira for those still looking for the mall experience. For those seeking a local lifestyle, the Southern Tier features multiple farmers markets; an active local food scene with eclectic eateries including Ithaca's world famed Moosewood. The region also features multiple craft beverage trails, with wineries, cideries, breweries and distilleries offering tours and tastings. Local craftspeople and artists offer open studio weekends, and sell their work throughout the area in boutiques and galleries.

CULTURE OF INNOVATION

The region has a heritage of innovation - as the birthplace of technologies including computing, space exploration, advanced manufacturing and materials, flight simulation, robotics and AI, aerospace and transit, and highly sophisticated custom manufacturing. Public school districts in the region are early adopters of clean energy technologies, largely driven by long-term savings. P-12 School districts as well as college campuses have adopted geothermal heating and cooling systems, thermal ice storage systems, co-generation, and solar power technologies.

Recent investments of over $95 million in clean energy technology innovation by New York State, such as the 76West competition, high tech labs and business incubators in the Southern Tier offer concrete evidence of state support for the clean tech industry cluster.

Over the past five years, 60 new startups were launched with licensed inventions from Cornell's Center for Technology Licensing (CTL). During the same time frame, Cornell was awarded 564 U.S. patents, 1,114 international patents, granted 428 commercial licenses and options, and received $88.8 million from the licensees. Though these numbers do not represent only clean energy technologies, most if not all which aren't directly CE innovations rely on clean energy technology, or shared advanced materials technology, from within the regional innovation triangle.

PRIVATE SECTOR OVERVIEW

The Clean Energy Industry is part of the emerging Energy and Smart Energy industry cluster in the Southern Tier. It is tightly tied to other industries in the area, most clearly to Advanced Manufacturing sectors such as Advanced Transportation, Appliance & Component Manufacturing, and Advanced Materials.

Businesses representing all four recognized sectors of the clean energy industry - Generation, Service, Energy Efficiency and Transportation, are found within the Southern Tier Study Area.

The Southern Tier also includes globally-recognized research centers and clean tech incubators, leading to businesses, both startups and small-to-medium enterprises, working in all five of NYSERDA's designated clean energy technologies.

- Energy Efficiency
- Renewable Electric Power Generation
- Grid Modernization and Energy Storage
- Renewable Fuels
- Clean & Alternative Transportation

A solid history of technological innovation, especially in fields related to Aerospace and Defense, provided the current Clean Energy Industry the original knowledge density which it has been built upon, albeit under the proverbial radar, for the recent past decades. Both industries have a solid history of quietly moving the most high tech innovations, which are often unnoticed because they move first to the government-level marketplace before being tooled into products for the home marketplace.

In today's world, this has created a density of high-level research into transformative technologies. The region features not only a Clean Energy cluster, but other overlapping, complementary high tech clusters, the most future-forward of which rely on clean energy technology. Transformative technology industries with strong regional presence and clean energy knowledge/tech overlap include:

- Aerospace
- AquaCulture/Agriculture
- BioTech
- A.I./Computer Thinking
- Robotics
- Space Exploration
- Information & Communication

The area's previous industrial spaces have begun conversions to Advanced Manufacturing facilities; the area features a density of Contract Manufacturers, most using advanced digital technologies allowing them to handle prototyping as quickly (and now even more timely with international trade slowdowns and new tariffs) as any facility in China.

The Advanced Materials research and development happening regionally is informing the advancement of all mentioned sectors, affecting the Clean Energy Industry most directly in terms of Energy Storage. The Southern Tier enjoys a Research and Development rate that is 5 times the national average on a per capita basis. Describing and connecting our intellectual assets is critical to telling the story of the Southern Tier. We not only want to attract companies, we want to attract the intellectual talent that can innovate for decades to come.

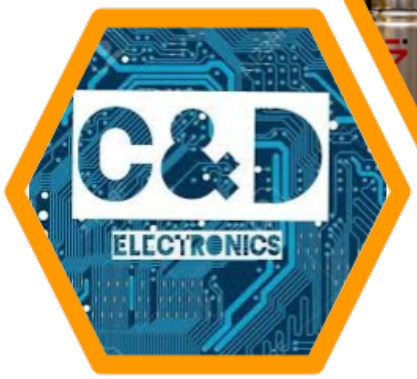
Though many of the region's anchor manufacturers have begun utilizing clean energy in their processes, the focus of study remains on those who are part of the Clean Energy Industry, not simply acting as end-users of clean tech. Those users, however, do offer insight into adoption of clean energy tech as a key to competitiveness in multiple marketplaces, including advanced manufacturing and higher education. The growing trend of perceived quality attached to clean tech choices by consumers has combined with the clear encouragement by the state to drive Electric Vehicle Charge Station installs throughout the region.

LOOKING DEEPER

Established enterprises and universities anchor the cluster's high tech innovation triangle, while some major employers are located in rural areas outside of those triangle nodes.

Many of our core companies have established clean energy technology products today. BAE Endicott is a leader in hybrid bus development with over 12,000 buses deployed around the world. Raymond Corporation is leading the charge to develop the most energy efficient forklift technology and is developing energy efficient manufacturing processes along the way. A great example of a developing Public-Private Partnership relationship, their President and CEO, Michael Field, is Chairman of the New York Battery and Energy Storage Technology (NYBEST) consortium. Raymond also offers an example of the other industries which overlap clean tech, as their work also delves into robotics and AI.

Lockheed-Martin, an anchor employer in the Owego, NY area, is a high-level Aerospace & Defense firm, but they utilize clean energy tech throughout their facility, and work on products which utilize the latest energy storage and advanced material innovations. Corning Inc.



manufactures catalytic converters for diesel engines and is the inventor and a major manufacturer and innovator of fiber optics. Corning , Inc is also a leading glass and ceramic research organization and is the manufacturer of Gorilla Glass found in Samsung and Apple phones. Their work on roll to roll manufacturing and ceramics technology may soon have implications for solar PV cells and hydrogen fuel cells.

IOXUS in Oneonta is building ultra-capacitors for transportation, renewable generation, industry and back-up power applications. Capacitors can be combined with battery storage to improve life expectancy under variable load operation. This company was just purchased by XS Power Batteries in Tennessee. The IOXUS facility is expected to expand and grow employment. Also in Oneonta, Custom Electronics produces capacitors and bus bars for the power and transportation industries.

Unison Industries/GE Aerospace manufactures power generation and controls in Norwich. Collins Aerospace in Binghamton is working on hybrid -electric and electric propulsion. Eaton Corporation in Horseheads manufactures equipment for the power industry. Trane in Hammondsport produces thermal battery cooling systems with ice bank energy storage.

Other companies are supply chain providers to the clean energy industry. Amphenol IPC in Endwell manufactures bus bars, cable assemblies and connectors for the power and transportation industry. Amphenol AIO in Sidney manufactures connectors. C&D Electronics in Groton is a battery electronics partner with iM3NY. Many other companies exist that can benefit by growth in the clean energy industry.

Some local corporations may not have local clean energy manufacturing but have corporate relations that may be beneficial. Siemens plays a very significant role in clean energy technology and deployment. Siemens also offers energy performance contracts for energy project retrofits. Siemens is a major supporter of STEM education around the world. The corporate parent of Borg Warner in Ithaca has developed an alliance with Romeo, a battery technology company.

The biggest opportunity in the Southern Tier is the development of lithium-ion batteries. The Fourth Wave Report sponsored by the Agency, Team Tioga and Three Rivers provides an in-depth assessment of the market and the companies involved locally.

STARTUP SECTOR

In addition to established business, there were 35 active start-up companies in the Southern Tier involved in various clean energy technologies in 2020. Imperium3, now iM3NY, is anticipating the start of manufacturing in 2022 at the Huron Campus. iM3NY is developing a recyclable, lower cost and cleaner lithium-ion battery. The development of a Gigafactory in the Southern Tier is a major milestone that presents significant regional opportunities for employment and supply chain participation.

Some other notable startups include:

- Micatu in Horseheads: Optical wave guide based stray voltage monitoring.
- Brash Power in Binghamton: Residential electricity generation, domestic hot water and heating with demand response capability.
- Thermal AI in Ithaca: AI (artificial intelligence) optimization of combustion while reducing fuel consumption, equipment wear and tear and decreasing emissions.

Most start up companies are developing products and services for world markets. Some of these products and services can also help our region to attain CLCPA targets. Southern Tier Technologies makes efficient control equipment for power factor and demand management. This equipment can reduce energy costs, reduce demand and free up transmission capacity.

C4V, part of the iM3NY Gigafactory project, is continuing research into battery related improvements in charging rates, battery packs and management. Developments outside of batteries are also possible as the company strives to create a cleaner and greener world.

The growth of startup development in the Southern Tier is due to many factors. Significant resources and mentoring organizations have been added in the Southern Tier including incubators, research labs and commercialization assistance offices. Networking opportunities have gone virtual due to Covid-19, but are expected to return in traditional formats in the future. The 76 West Clean Energy Technology Competition has sparked world-wide interest in the Southern Tier as a place to start a clean energy technology company. Though covid-19 related budget cuts are putting a hold on the program for now, there is support for the program's return when funding becomes available.

Focusing on locally produced products and services will accelerate regional economic achievement while building a stronger ecosystem for entrepreneurs.

Southern Tier Clean Energy Technology Start Ups

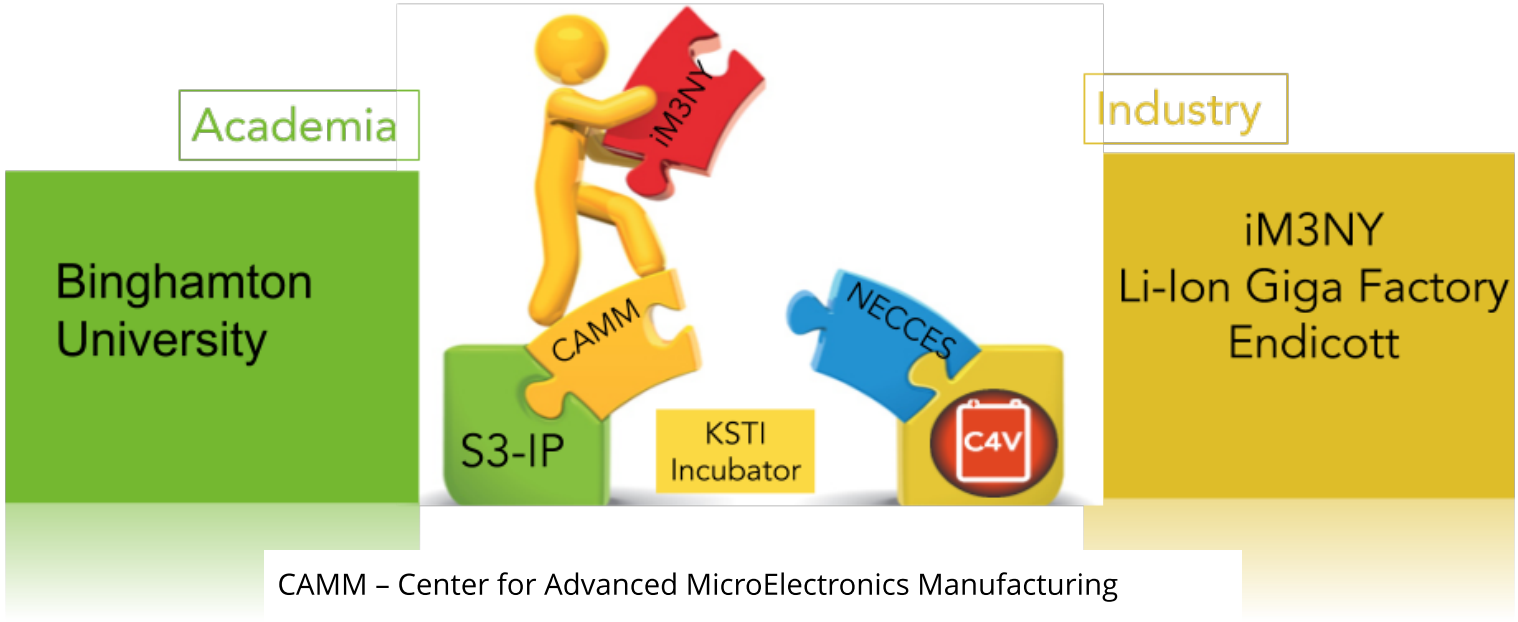
Aestus
AGreatE
Ashlawn Energy
Aletair
Brash Power
C4V
ChromoNano Tech
Clir
COI Energy Solutions
Dimensional Energy
Enhance VR
EthosGen
Hub Controller
Imperium3
M.E.D. Energy Inc.
Natrion
Southern Tier Technologies
Switched Source
Syndem
Echostinger
Micatu
Skyven
Youbicwitus LLC
IOXUS
Bright Buildings LLC
Conamix Inc
Ecolectro Inc.
Primet Precision Materials
Standard Hydrogen Corp.
Empower Equity Inc.
Xallent LLC
Heat Inverse
Thermal AI
VoltWall

IM3NY: AN EMERGING SUCCESS STORY

iM3NY, the most significant emerging regional startup, is growing in a way that will strengthen our industry cluster in clean energy technology and provide significant regional benefit. iM3NY is a consortium of businesses spearheaded by three Southern Tier companies: C4V, C&D Assembly, and Primet Precision Materials. C4V, a 76 West award recipient, holds the patents for the new battery technology. The partnership is establishing a manufacturing facility at the Huron Campus in Endicott, NY to produce the cleanest lithium-ion batteries in the world. Endicott will also be the headquarters for the North America business division.

This example illustrates what New York State and the residents of the region are hoping to create through a strong focus on clean energy development. An exciting recent announcement for the group was the selection of Professor Stanley Wittingham, from Binghamton University, as a Nobel Prize winner for his work in battery energy storage.

Some of the 60 partners and supply chain companies will also seek to establish a local presence and are expected to add jobs to the area. iM3 choose New York for four primary reasons: Infrastructure, Funding Access, State Policies, and Supply Chain Access, as illustrated in the model below.



CAMM – Center for Advanced MicroElectronics Manufacturing

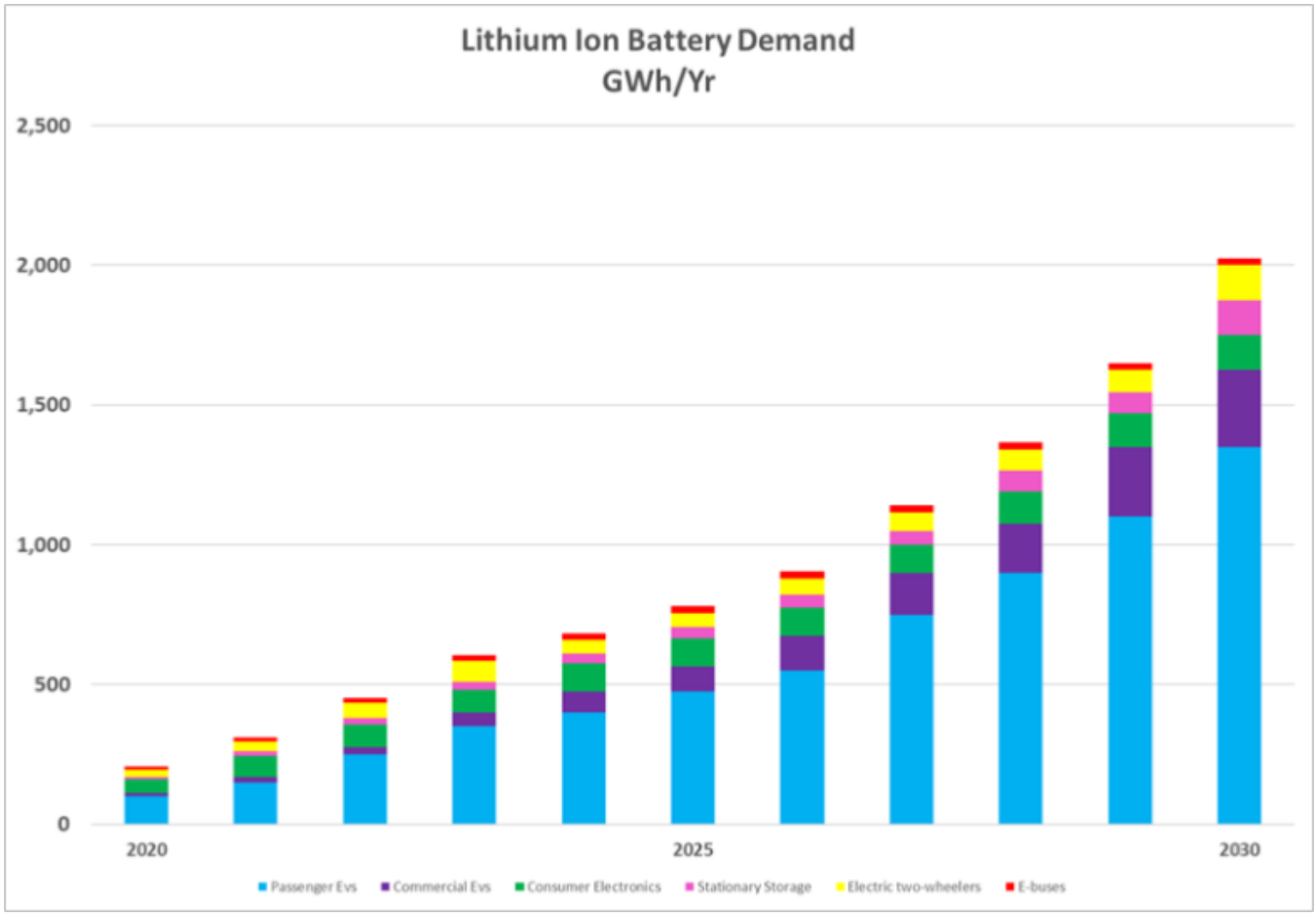
NECCES – North Eastern Center for Chemical Energy Storage

S3-IP – Links to Binghamton University Center of Excellence

KSTI – Koffman Southern Tier Incubator

This success would not have been possible without the partnerships and supporting relationships that led to the creation of this opportunity. Those relationships are shown in the model above.

The graphic below illustrates the significant market growth projected for lithium-ion batteries.

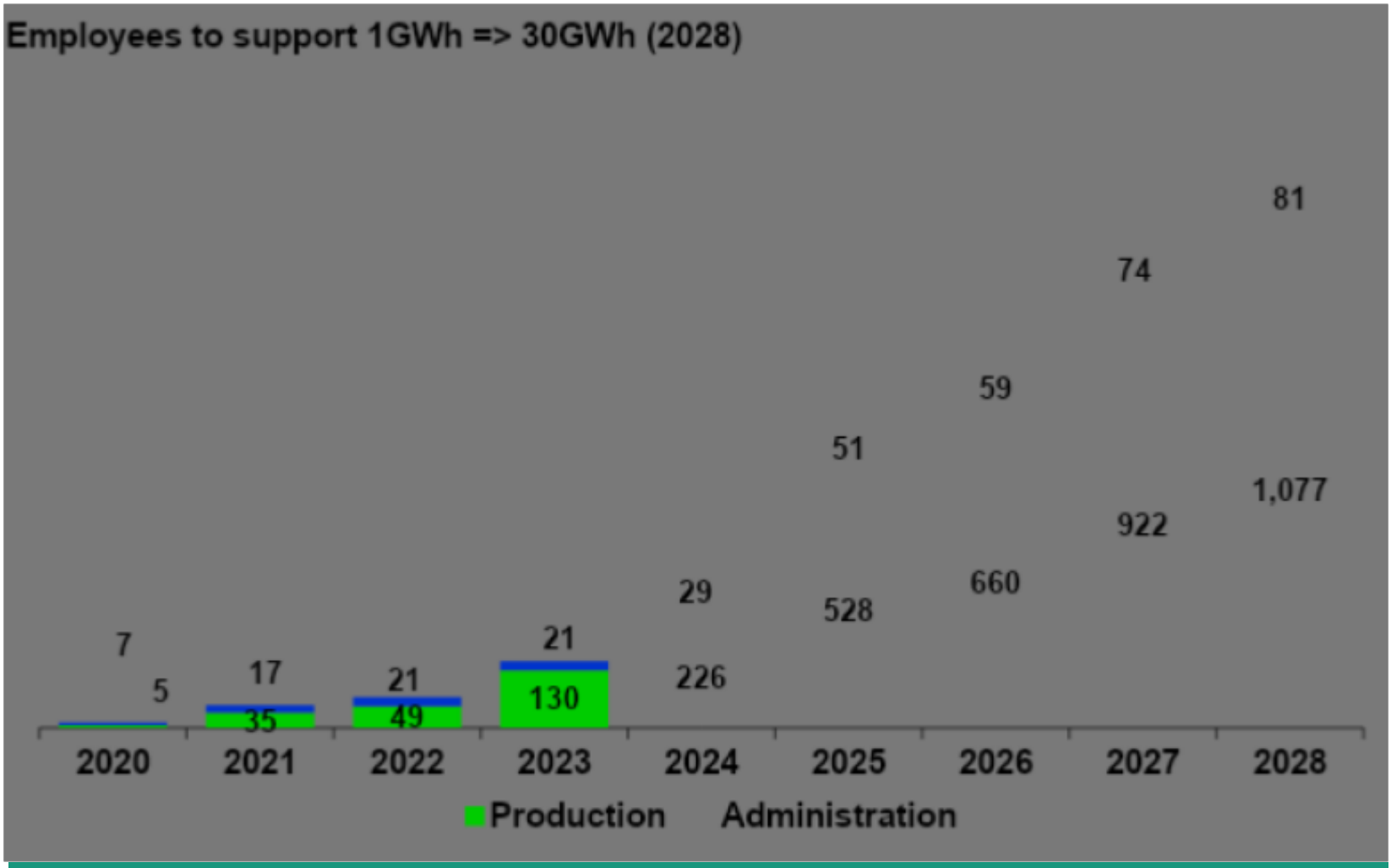


The Southern Tier is embarking at the beginning of a major market trend.

The chart below provides an estimate of the jobs that will be required to develop a giga-factory in Endicott NY. This estimate does not include suppliers and other corporate partners that may elect to create a local presence in our region. Significant jobs impact is expected to result from this endeavor.

In addition to the jobs created directly by the iM3 facility, 94 % of all supplies will come from the United States including opportunities for local suppliers. The entrepreneurial talent creating this company are also excited to help lead a stronger ecosystem in the Southern Tier.

Over 150 positions to be filled by 2023 to support 1st production line (1GWh)



Regional Clean Energy Workforce: Status & Projected Growth

The clean energy industry in the Southern Tier has the potential to create 5,000 to 10,000 jobs from the end of 2019 to 2030. Job growth is expected in all five major sectors of the industry:

- **Energy Efficiency:** Lighting, appliances, insulation, advanced building materials, heat pumps, cogeneration, waste-to-heat and other efficiency technologies
- **Renewable Electric Power Generation**: Solar, wind, hydro, geothermal, and other renewable generation technologies
- **Clean and Alternative Transportation**: Electric, hybrid and fuel cell/hydrogen vehicles, natural gas and other alternative fuel bases, and transportation- specific battery tech
- **Renewable Fuels**: Biofuels,including wood pellets and ethanol, hydrogen and others
- **Grid modernization and Energy Storage**: Smart grid, microgrid, demand response response management, and energy storage (includes battery technology)

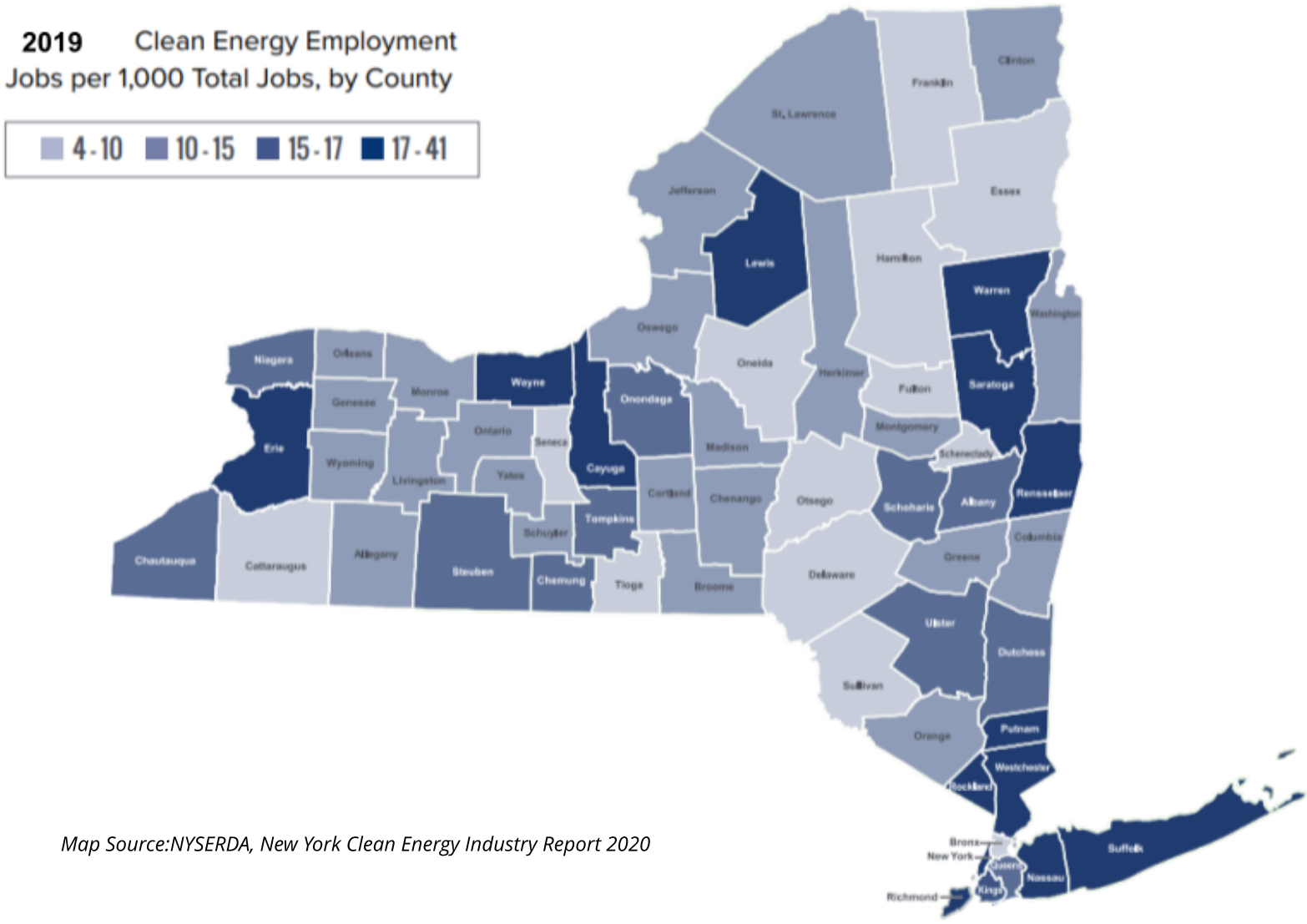
NYSERDA's recently released New York Clean Energy Industry Report showed 163,754 clean energy jobs in the state in 2019, representing a 3% per year growth rate. Energy efficiency jobs made up the greatest share of clean energy jobs across the state,with 77% of positions falling into the category; HVAC contractors representing the largest segment.

Job results vary across the state**,** with counties of Delaware, Otsego, and Tioga seeing the lowest rates of Clean Energy jobs per 1,000 for the the Southern Tier. Chemung, Steuben and Tompkins had the highest rates in the region, falling into the second highest state-wide tier of job density, with 15-17 jobs per thousand in the clean energy industry.

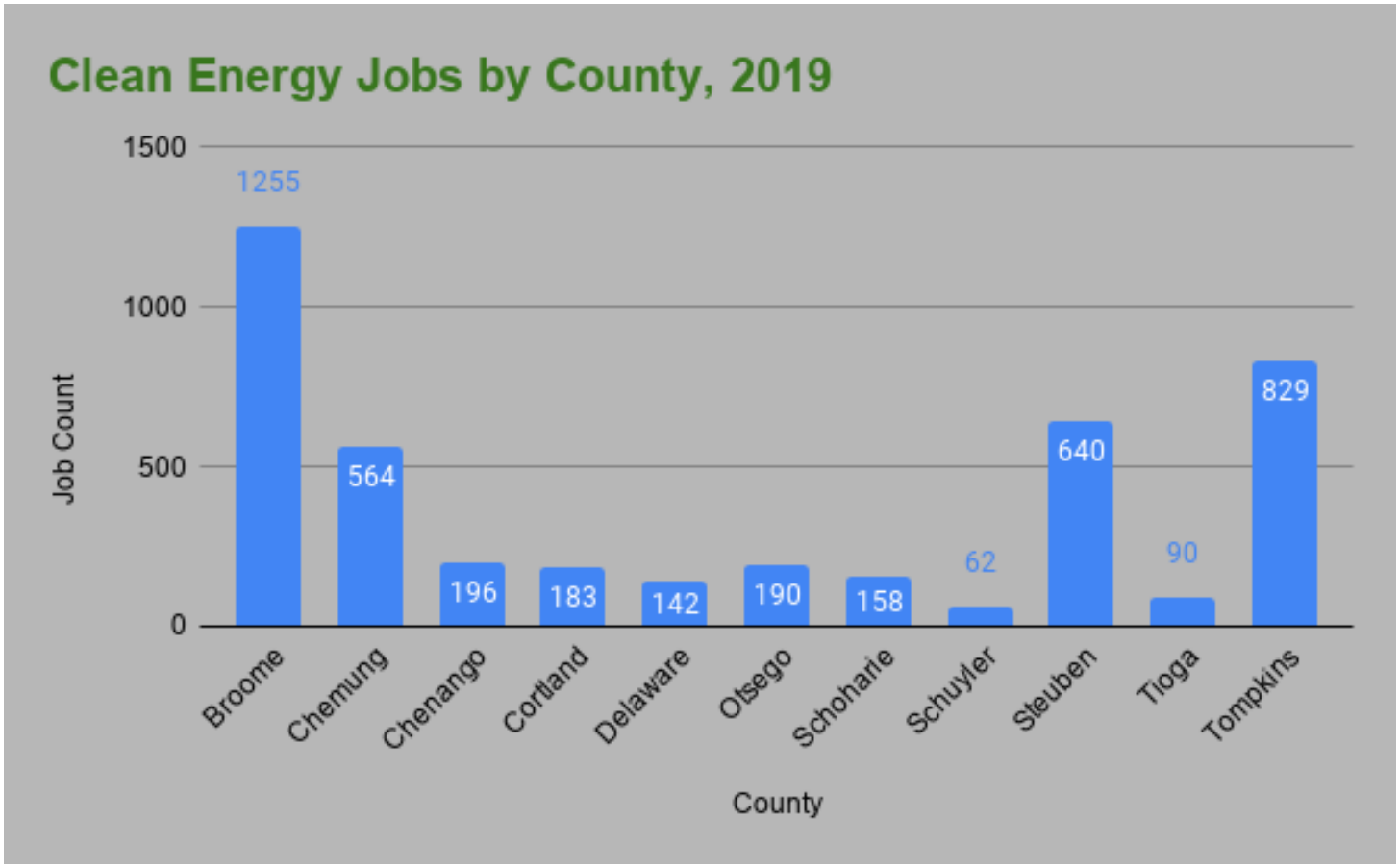
The growth rate for clean energy jobs in the Southern Tier during the 2015-2019 period was approximately 2 %, with the region ending 2019 with 2,750 clean energy jobs, according to the NYSERDA report.

The impact of COVID has been significant for the clean energy industry, and according to NYSERDA, as of August 2020, the total number of jobs has declined by 9.6%. These jobs are recovering and should catch up by the end of 2021 based on recovery rates noted by both NYSERDA and E4 The Future, a group which provides monthly estimates of energy efficiency jobs across the country.

The map and table on the following page illustrate breakdown of jobs in clean energy fields by county for 2019.



Map Source:NYSERDA, New York Clean Energy Industry Report 2020



Source data: NYSERDA, New York Clean Energy Industry Report 2020

The following table illustrates the most recent data available regarding a sampling of clean energy industry jobs within the region's Metropolitan Statistical Areas of Binghamton, Elmira, and Ithaca. The location quotient (LQ) is the ratio of the area's concentration of occupational employment to the national average concentration. A LQ greater than one indicates the area has a higher share of employment in that occupation than average, and a location quotient less than one indicates the occupation is less prevalent in the area than average. N/A means that the area did not have enough workers in the specific field to fall within the top 100 occupational fields.

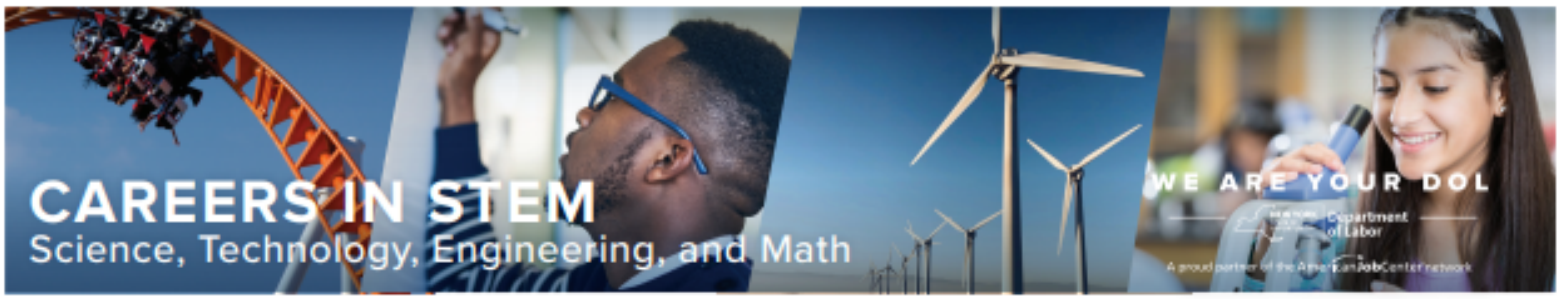
Variations are visible across the region, evidencing the unique positions of each hub area in the innovation triangle. These same variations are reflected in inconsistent workforce resources across the region mentioned by some interview participants. While expenditures intended to even-out the hubs might not always be economically feasible, increasing shared knowledge of human resources available in neighboring counties is an efficient alternative to a focus on drawing new population into the region.

The info-graphic on the following page is from the Department of Labor, and breaks down regional pay rates for STEM career fields.

Sample Southern Tier Clean Energy Industry Job Densities and Wages

	Binghamton MSA		Ithaca MSA		Elmira MSA	
Job Title	Location Quotient	Median Hourly Wage	Location Quotient	Median Hourly Wage	Location Quotient	Median Hourly Wage
Electrical Engineers	2.46	$40.42	0.56	$35.01	0.81	$41.62
Industrial Engineers	1.31	$38.03	0.86	$42.57	1.61	$37.79
Mechanical Engineers	0.86	$38.07	N/A	N/A	0.94	$39.47
Electrical and Electronic Engineering Technologists	3.35	$24.68	0.97	$26.52	N/A	N/A
Industrial Engineering Technologists and Technicians	1.79	$24.46	1.36	$29.58	N/A	N/A
Calibration Technologists and Technicians and Engineering Technologists and Technicians,Except Drafters, All Other	2.79	$23.74	N/A	N/A	N/A	N/A
Construction and Extraction Occupations	0.92	$24.31	0.65	$23.32	0.84	$22.05
Construction Laborers (includes insulation workers)	1.26	$21.66	0.51	$15.47	1.2	$18.52
Electricians	0.94	$30.56	0.74	$27.55	0.85	$27.87
Heating, Air Conditioning, and Refrigeration Mechanics and Installers	1.11	$23.45	0.41	$29.95	1.51	$24.16
Electrical Power-Line Installers and Repairers	2.28	$35.75	N/A	N/A	N/A	N/A
Production Occupations	0.93	$15.36	0.57	$20.71	1.54	$19.86

Source: Bureau of Labor Statistics May 2019 Occupational Employment Statistics data



The median wage of Southern Tier Region STEM occupations is $61,970 a year, which is 59 percent higher than the median annual wage of $39,080 for all workers in the region.

STEM CAREERS PAY

Southern Teir

Occupation	Median Annual Wage*
Automotive Service Technicians and Mechanics	$34,750
Computer Network Support Specialists	$62,680
Computer Systems Analysts	$80,060
Computer User Support Specialists	$53,940
Computer, Automated Teller, and Office Machine Repairers	$38,510
Dental Hygienists	$61,080
Electrical and Electronic Engineering Technicians	$51,990
Emergency Medical Technicians and Paramedics	$34,320
First-Line Supervisors of Mechanics, Installers, and Repairers	$64,240
Health Specialties Teachers, Postsecondary	$121,150
Heating, Air Conditioning, and Refrigeration Mechanics and Installers	$45,290
Industrial Machinery Mechanics	$52,110
Licensed Practical and Licensed Vocational Nurses	$41,100
Machinists	$46,350
Medical and Health Services Managers	$91,430
Medical Scientists, Except Epidemiologists	$79,240
Nurse Practitioners	$99,460
Nursing Instructors and Teachers, Postsecondary	$64,700
Occupational Therapists	$75,090
Physician Assistants	$103,710
Physicians and Surgeons, All Other	$176,660
Registered Nurses	$66,010
Software Developers, Applications	$91,700
Veterinary Technologists and Technicians	$43,430
Welders, Cutters, Solderers, and Brazers	$39,300

*Half the workers were paid wages above and half were paid wages below this value.

DO YOU WANT TO MAKE THE WORLD A BETTER PLACE TO LIVE?

If you are concerned about changes in the environment, creating better medicines and building new gadgets to make everyday life easier, consider a Science, Technology, Engineering and Math (STEM) education. A STEM education can give you the tools to help solve some of today's most perplexing problems.

DO YOU WONDER WHAT PUTS THE THRILL IN A ROLLER COASTER?

It takes both design and engineering skills to develop a thrill ride. If you are curious about how things work and are a creative and original thinker, a STEM career could be for you.

DO YOU IMAGINE SOLVING CRIMES USING THE LATEST TECHNOLOGY?

You could be a Forensic Science Technician in your local area or travel the world tracking the latest infectious disease. Professionals in STEM careers protect and serve people around the world.

GET STARTED

- Take classes in Science, Technology, Engineering and Math to learn about exciting STEM career opportunities
- Talk to people who have the STEM jobs you like and learn how they got started
- Join math and science clubs and participate in activities that build STEM knowledge and interest
- Explore careers, job skills, wages and more at **www.careerzone.ny.gov** (for grades 6-12) and **www.jobzone.ny.gov** (for adults)
- There are over 240 STEM occupations with new ones created every year. The table to the left lists just a few. You can find more STEM occupations at **www.onetonline.org/find/stem**
- For more information about STEM occupations in your region contact your local Labor Market Analyst at **www.labor.ny.gov/stats/lslma.shtm**

The Southern Tier has potential to see significant growth in clean energy jobs from now throughout 2030. Regional clean energy industry jobs are expected to grow healthily from 2019 levels by the end of 2021 if current recovery rates remain consistent. The continued development of the current clean energy start ups in the region is expected to drive the growth rate significantly higher.

The previous growth rate of 2% has the potential to increase to at least 3% for energy service jobs as state and federal agencies implement incentive programs and utilities, projects.

Construction occupations across all trade professions (electrical, plumbing/heating, general labor, excavation, carpentry) are required for installation and project implementation, and can expect to see significant growth. NYSERDA estimates that 200,000 heat pump installations per year will be needed to reach New York State requirements by 2030.

Other energy efficiency technologies expected to drive jobs include lighting, insulation, advanced building materials, and non-heat pump technologies, such as combined heat and power (CHP). The projected 3% growth rate equates to 838 new energy efficiency jobs in the Southern Tier by 2030. To meet the state's goal of 70% renewable power generation by 2030, the region is expected to need a minimum of 1,000 new renewable generation jobs by 2030.

Transmission systems upgrades are expected to result in significant jobs in construction fields. The utilities released their plans as the study reached completion; as such, job estimates for those projects are not included. At least 3,000 megawatts of energy storage will also be required to support that goal. The state predicts that 30,000 workers will be employed state-wide in the energy storage sector.

The details of a $2 trillion federal program for green infrastructure, which includes 1,500,000 green housing projects, and the installation of electric vehicle (EV) charging stations, are currently in discussion. All of the major automakers are now pushing hard into the EV development world, with at least 21 fully electric vehicles hitting the consumer market in 2021.

STUDY AREA CLEAN ENERGY INDUSTRY JOB PROJECTIONS

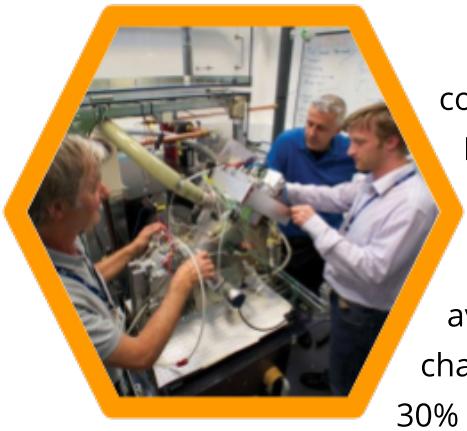
Clean Energy Sector	New Jobs Projected
Energy Efficiency	800
Renewable Electricity Generation	1000
Clean and Alternative Transportation	2000
Renewable Fuels	200
Grid Modernization and Energy Storage	400
Supply Chain	200
Uncategorized CE Startup companies	2000
Total Clean Energy Jobs	6600

The chart above represents conservative projections of regional Clean Energy job gains by 2030

Clean energy technology manufacturing companies such as Corning Inc, BAE, Raymond, IOXUS and Custom Electronics make clean energy products including hybrid buses, high-speed train components, electric forklifts, fuel filtration systems, solar cell components, capacitors and more which are distributed globally. The global market for these clean energy technologies have multi-decade growth forecasts. While companies are leery of making job forecasts while the pandemic lingers on, a conservative estimate of growth for regional Clean Energy Manufacturing jobs would be +1,000 positions by 2030.

Regionally, clean energy startups can be expected to make a major impact on area jobs. For example, the iM3NY mega factory in Endicott projects a need for over 1,000 employees by 2027. The company's growth will also require many corporate partners that may develop local offices, The Southern Tier has 35 clean energy startup companies to-date. Through continued strengthening of the ecosystem and cluster development support, the forecast for jobs driven by area startups could reach 3,000 new jobs by 2030.

New York State is committed to attracting demonstration projects and joint ventures with leading global clean energy companies. Many of these developments also provide supply chain opportunities. Job estimates for these developments are not included though



companies in the region are expected to vie for these opportunities. Estimates include clean transportation, renewable fuels and supply chain development.

A significant barrier to achieving these job results is skilled workforce availability. Communities are struggling to match workforce skills with changing job needs. The region's aging job force is expected to experience 30% turnover over the next 5 to 7 years. All of the counties have recognized this need and have strategies to address workforce development.

STEM-career workforce development programs have been initiated sporadically within the region; the most notable being a BAE program which hires promising 2-year technical graduates and pays for continued education up to and including a Master's degree. BAE is working with the Owego School system to develop a program that promotes hiring of High School graduates. Increasing the number of programs of this type will maximize job growth in the region's clean energy industry.

Technical degree programs are offered at regional higher education institutions, and some BOCES locations offer beginning technical training. Workforce development agents, such as Oneonta Job Corps offer some pre-apprentice programs for STEM careers.

Trade unions offering apprenticeship programs which lead to technical certifications have offices present across the region, with the International Brotherhood of Electrical Workers local chapters currently seeking participants and actively promoting clean energy training on their websites and social media.

Two-year technical degrees are actively being sought by clean energy companies. Reports from school administrators suggest that all graduates from SUNY Broome's 2-year technical programs are being hired.

Demand for four-year industrial, mechanical and electrical engineering degrees also will increase in the region, but at lower numbers than technical certification and two-year degrees.

Though these resources exist, no clear regional clean energy (or STEM) career pathway exists. Technical career choices are rarely promoted to youths entering the workforce, and the general public remain uninformed regarding the wages available in the skilled trades (regionally most reach double-to-triple minimum hourly wage rates). Creating a pathway program co-designed by public and industry stakeholders would offer the most equitable and regionally beneficial results and would create a direct pipeline of employees needed by area employers.

A coordinated, regional focus on the demand for a robust STEM-skills trained workforce will prepare the region's residents to advance through economic opportunities driven by the state's recent clean energy policy goals.

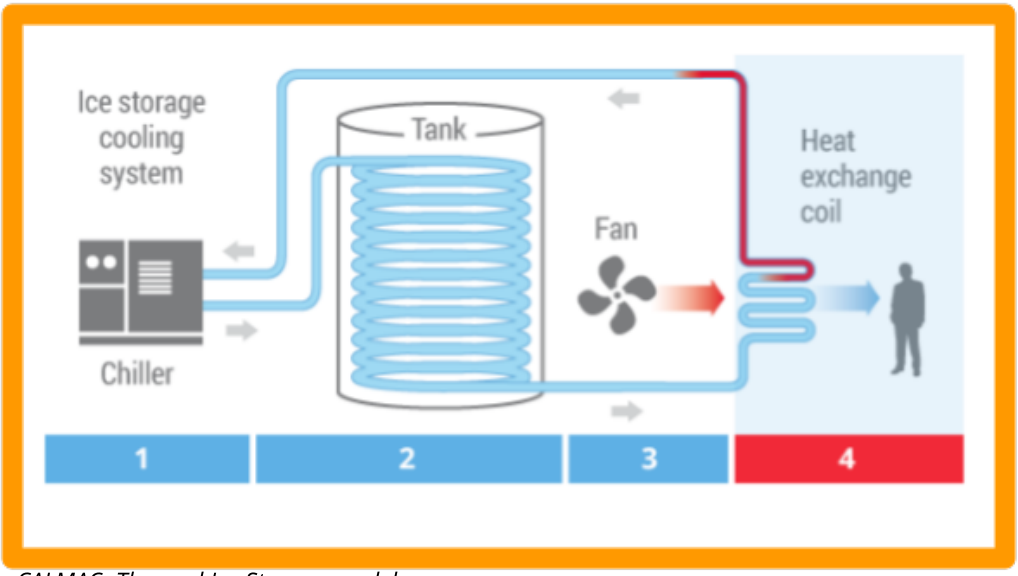
TECHNOLOGY PENETRATION

Clean energy technologies are being adopted throughout the Southern Tier by businesses, residents and institutions. Renewable generation projects are present in each county in the study area, though the type of generation varies, due to both terrain and public sentiments. Infrastructure to support changing technology, such as electric vehicle charging sites, are being installed throughout the region.

Renewable Energy Generation technology adoption varies across the region, with counties to the west favoring large scale wind projects, and the bulk of residential and community solar in the center of the region. A handful of sites in the region generate hydro-power, and each currently operational facility represents a variation of hydro generation technology: Pumped-storage at Blenheim-Gilboa, Run-of-River (aka diversion) at Cornell's Microhydro power plant, and Impoundment at the Colliersville hydro-power facility at Goodyear Lake.

Consumer and institutional adoption of energy efficiency technologies, including air and ground sourced heat pumps and LED lighting, are on the rise. Ground source heat pumps are only viable for sites with large space for footprint available, making them more suitable to rural locations or modern builds with larger lot sizes. Housing stock in urban/suburban areas subdivided before the 1960s, or built with older setback standards, cannot accommodate the system footprint or the equipment needed to install residential geothermal. Air source heat pumps are more likely viable for conversions in the bulk of regional housing stock with existing forced hot air systems. Eighty-three area HVAC companies were found during this study which offer air source heat pump installation/conversion, but lack of advertising in the arena makes it likely that more may offer the service than have been discovered to-date. Big box home improvement retailers throughout the region, such as Home Depot and Lowes, are promoting air source heat pumps with in-store displays and brand representatives on hand on weekends offering promotional information. Training and education of the HVAC industry and the general public would increase adoption speed of heat pump technology.

Larger buildings, such as schools, are good candidates



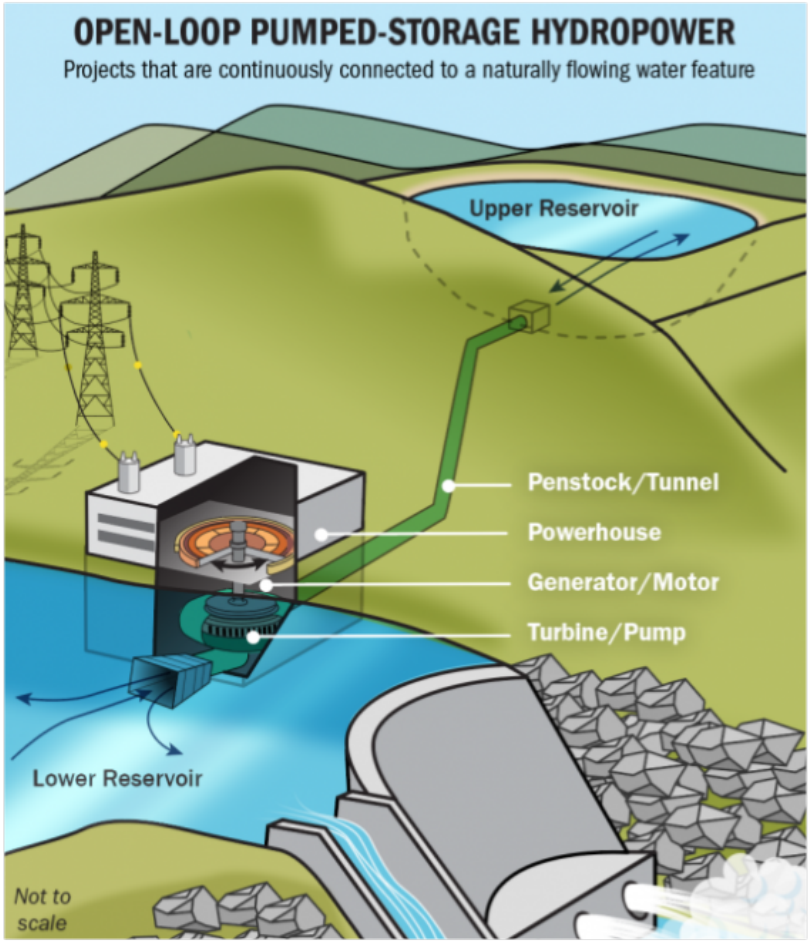
CALMAC- Thermal Ice Storage model

for geothermal heating and cooling; multiple educational institutions in the region, including Owego-Apalachin Central Schools, Binghamton City School District's MacArthur Elementary, and Ithaca College are testing the technology.

Cogeneration is being utilized at multiple sites including Bates Troy, a commercial laundry facility in Binghamton, SUNY Cobleskill, Kennedy Valve, in Elmira, and at multiple higher education facilities, including Ithaca College.

Thermal Ice-Storage systems are in use in facilities located in Elmira, Hammondsport, and Oneonta. Thermal Ice Storage utilizes off peak energy to freeze a solution which is stored and then used for cooling during peak energy hours.

Biomass is utilized at Lockheed Martin's Owego facility; and biogass technology is used at farms, landfills and wastewater treatment plants throughout the region.



Model of Pumped-storage hydropower process used at Blenheim-Gilboa

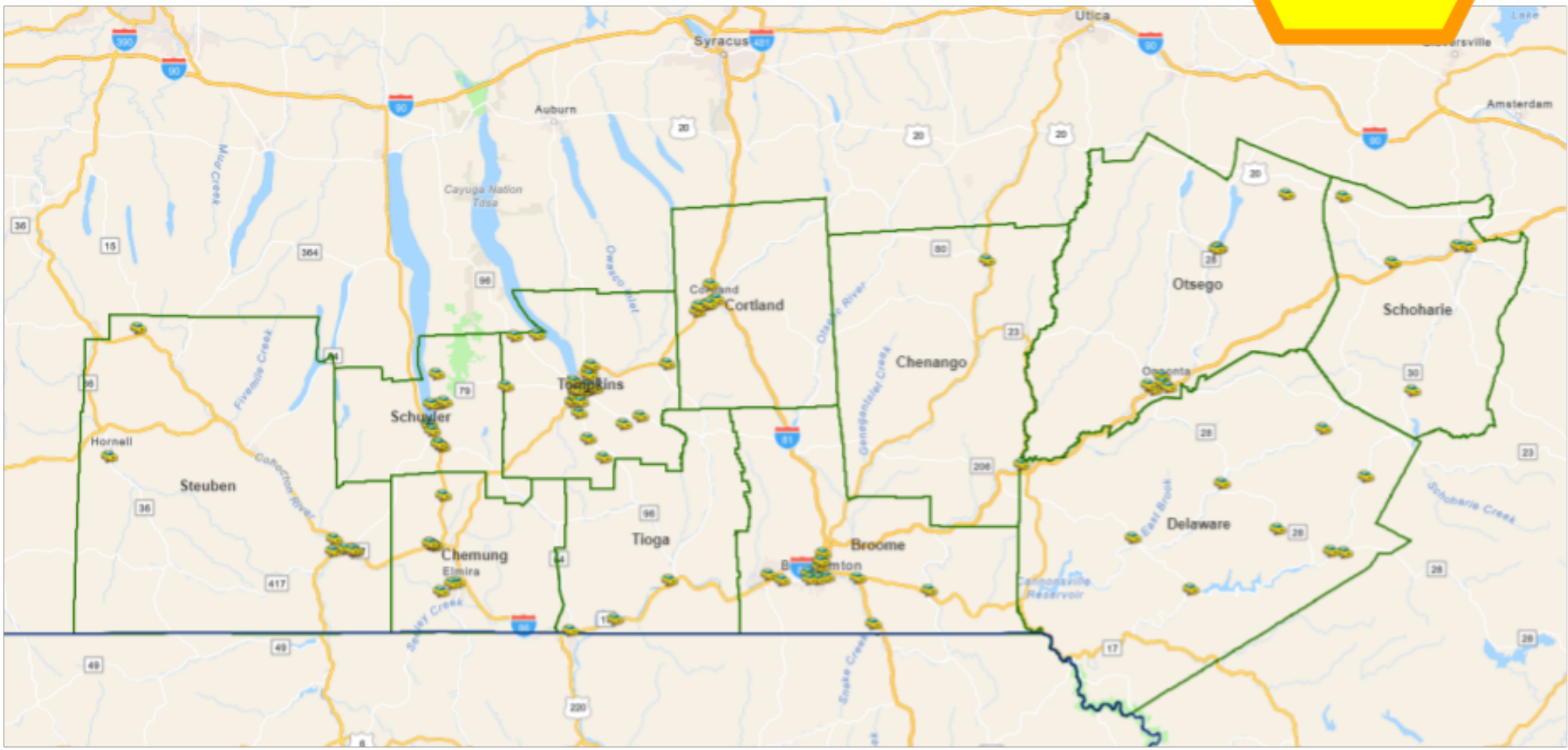
Car dealerships throughout the region are currently selling electric vehicles. To-date approximately 104 electric vehicle charging stations are present in the study area.

By taking a more active role we improve our own performance in greenhouse gas reduction while supporting a stronger local economy. Strategies will vary by county due to energy pricing, wind and sun potential, local infrastructure constraints and public sentiment/knowledge, but all counties in the region have the potential to benefit from clean energy industry growth.

Maps on the following pages illustrate adoption of clean energy generation technologies throughout the Southern Tier.

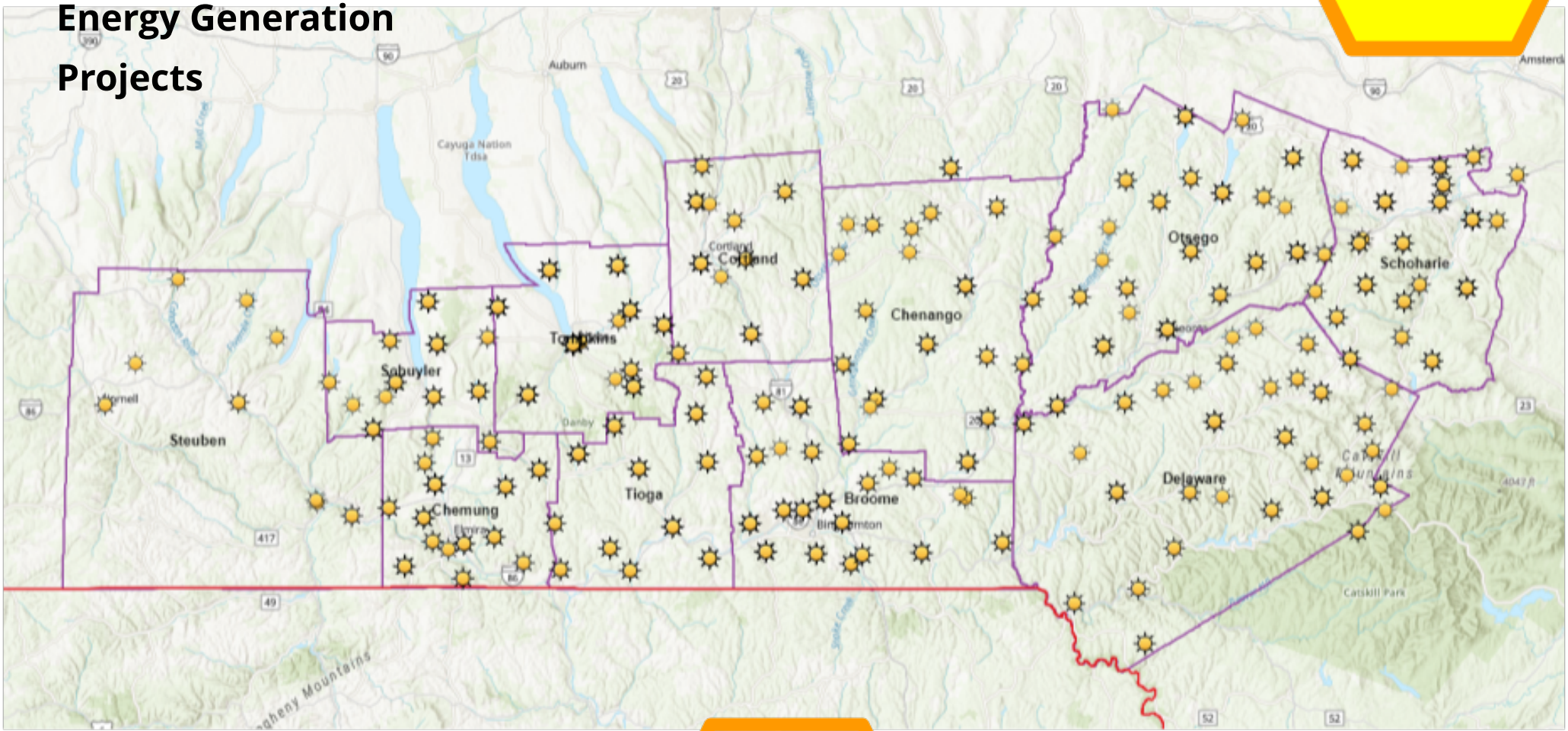
Electric Vehicle Charge Station Locations

104
EV Charging Stations



Southern Tier Communities with Grid-connected Solar Energy Generation Projects

3968
Solar
Projects



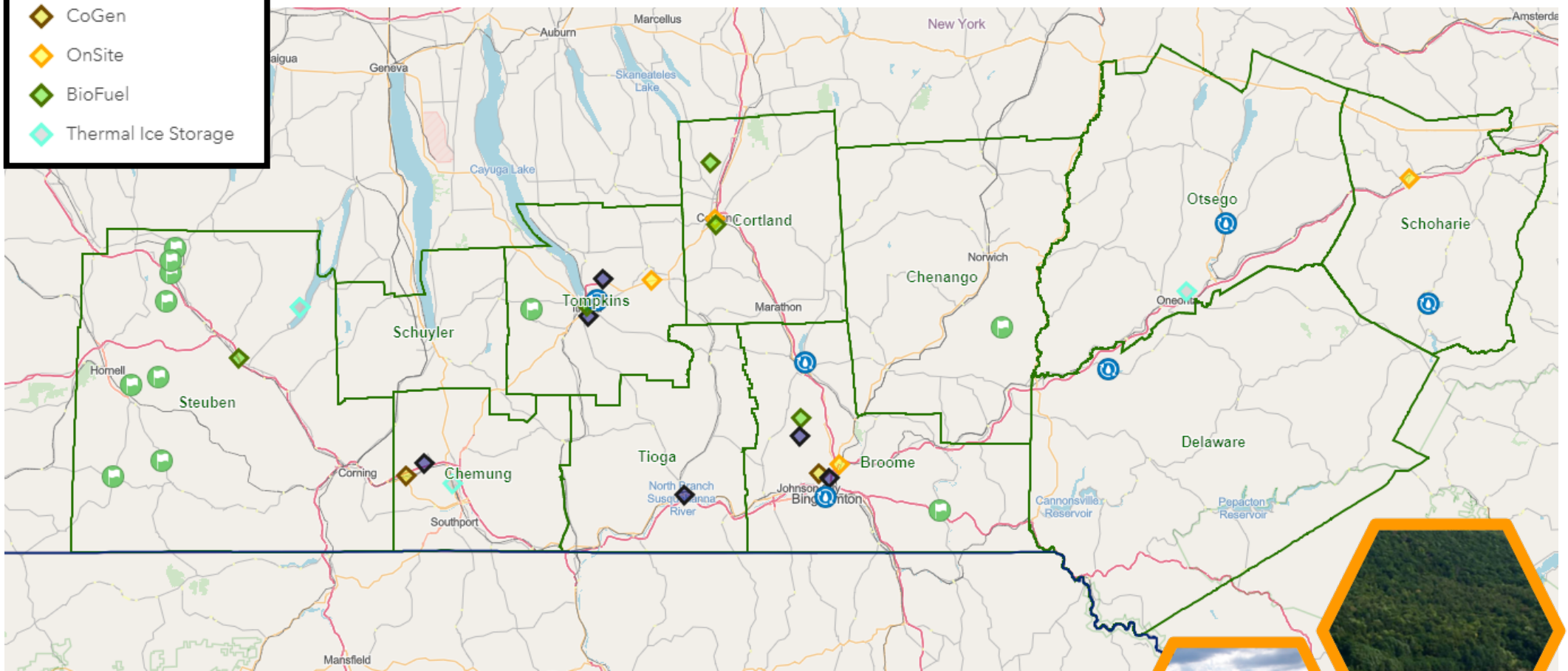
Southern Tier Non-Solar Renewable Energy Generation Projects

Southern Tier Wind Power Project Sites

Southern Tier Hydro Power Sites

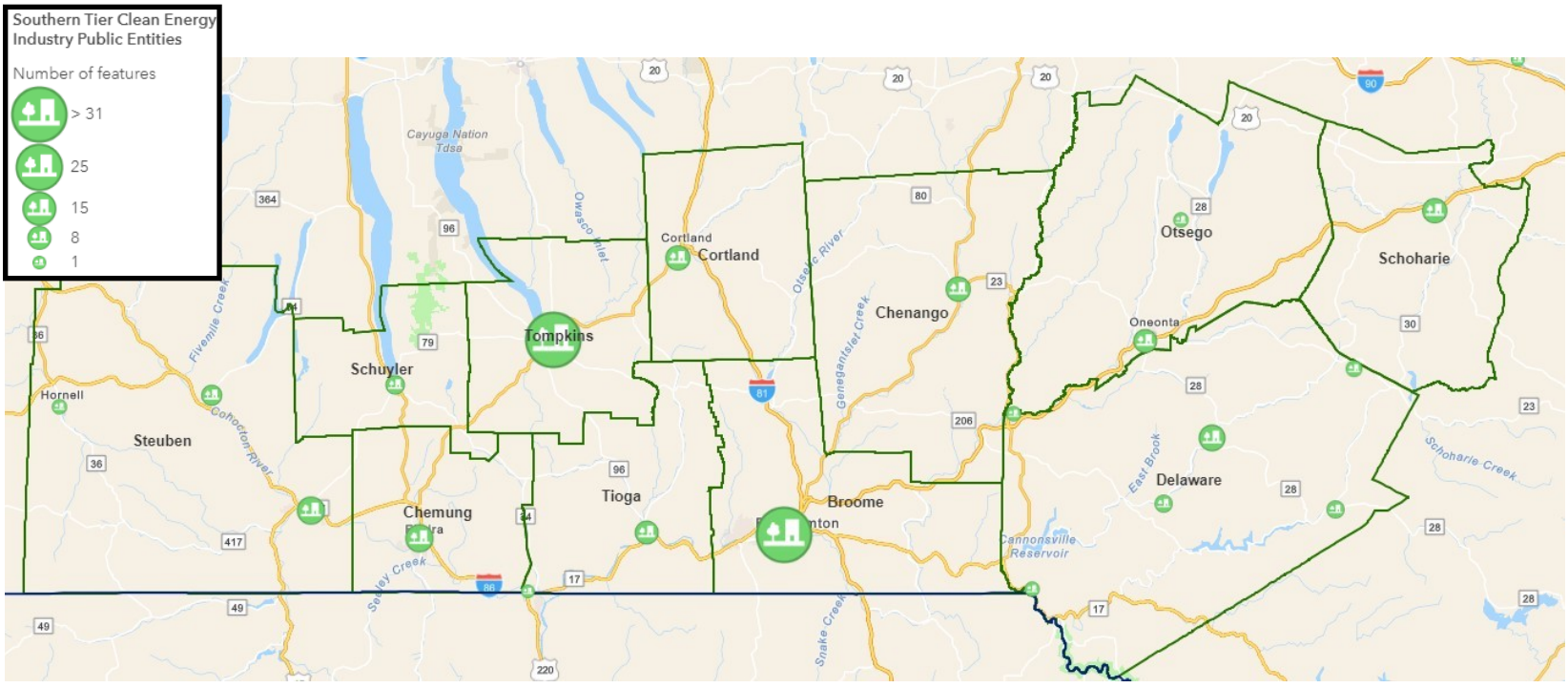
Other Renewable Generation Sites

- Geothermal
- CoGen
- OnSite
- BioFuel
- Thermal Ice Storage



PUBLIC SECTOR

The Southern Tier has a robust nonprofit sector prepared to support the Clean Energy Industry Cluster, but support is not evenly distributed across the region's counties. New York State is providing multiple levels of investment to support the industry, from funding, to innovation competitions, to programs providing professional services, as well as lab and office space, business development support and R&D support.



The above map illustrates the distribution of public entities supporting clean energy industry activities in the region. Source: Tier Energy Network Clean Energy Industry Cluster Study data.

Supporting the clean energy industry cluster are a vast array of government and nonprofit agents. The Public Sector of the Clean Energy Industry ecosystem includes:

- Regional Economic Development Councils
- Small Business Administration offices
- Industrial Development Agencies/Local Development Corps
- Chambers of Commerce
- Municipal/County Economic Development Departments
- Economic & Community Development Non Profits
- Planning, Policy & Infrastructure Development Agencies
- Workforce Development & Technology Training Agencies

A number of development sites with potential to connect to dark fiber exist throughout the area, largely in the recently designated “Opportunity-Zones” which are present in each of the area’s counties. Those located within the Innovation Triangle Node MSAs provide the greatest development potential, as they are within areas which have received investments or have

strong arguments for public infrastructure investments, including improved access to broadband, transit resources, and available workforce.

However, development sites located outside urbanized areas represent the best opportunities for large facility developments with on-site generation capabilities, which would provide a high regional value at a low cost, as public investment to workforce and public transit using already available funding could be utilized to provide necessary workforce. Both types of sites offer great opportunity for savvy investors willing to work through the Public Private Partnership (PPP) contracts, grants and incentives processes.

State support starts with an aggressive plan for greenhouse gas reduction through the Climate Leadership and Community Protection Act (CLCPA). New York has tasked multiple departments and agencies to provide support for technology development, training, workforce development and other activities required to achieve the plan goals. The CEO of Southern Tier Technologies, Dan Buchanan, shared that his company would not have progressed without the help of NYSERDA. Several public sector investments and programs have been developed to support the private sectors, including incubators, mentors, research labs, technical services, and workforce development programs. Some resources are barely utilized within the region, while some, such as incubators at Binghamton and Ithaca, are often at maximum capacity.

Two internationally recognized universities, Cornell and Binghamton, are seated in the region. Both feature active alumni networks and world class research facilities. Innovation research and development drivers, including clean energy specific incubators and accelerators, are housed at both universities, and both are able to partner with clean tech innovators for federal STIR and SBIR grants, often a first step to bringing emerging technology to market.

The growth of start-up companies in clean energy has been increased through state investments including the 76West Clean Energy Competition and the development of the network of incubators, laboratories and mentors in the region, created through the local stewardship of the Regional Economic Development Councils. Over 35 clean tech startups have formed in the region over the past five years.

A great example of a successful support resource, the Koffman Incubator in Binghamton is home to a specialized clean energy acceleration program, Southern Tier Clean Energy Incubator (SCI), which leverages research and development resources at Binghamton University and the business development resources available through the Koffman. They currently house the bulk of regional startups entering the battery technology arena.

Regional sustainable campus initiatives are being implemented at Binghamton University, Cornell University, SUNY Cortland, SUNY Delhi, SUNY Oneonta, Ithaca College and Tompkins Cortland County Community College; Other area institutions are in earlier stages of sustainability planning. All of the campuses are using their onsite clean energy projects to provide additional learning experiences for students.

BOCES provides transitional training opportunities in all Southern Tier counties. Local STEM programs are being developed piece-meal throughout the region; for example, Broome-Tioga BOCES has a new program - Vision's Engineering Academy, in which Lockheed Martin provides mentors to students interested in becoming engineers. Job Corps, a national job-training program, offers students in the Oneonta area pre-apprentice training programs in auto and construction trades. Non-traditional STEM education activities are taking place sporadically throughout the region led by museums, public libraries, and maker-spaces.

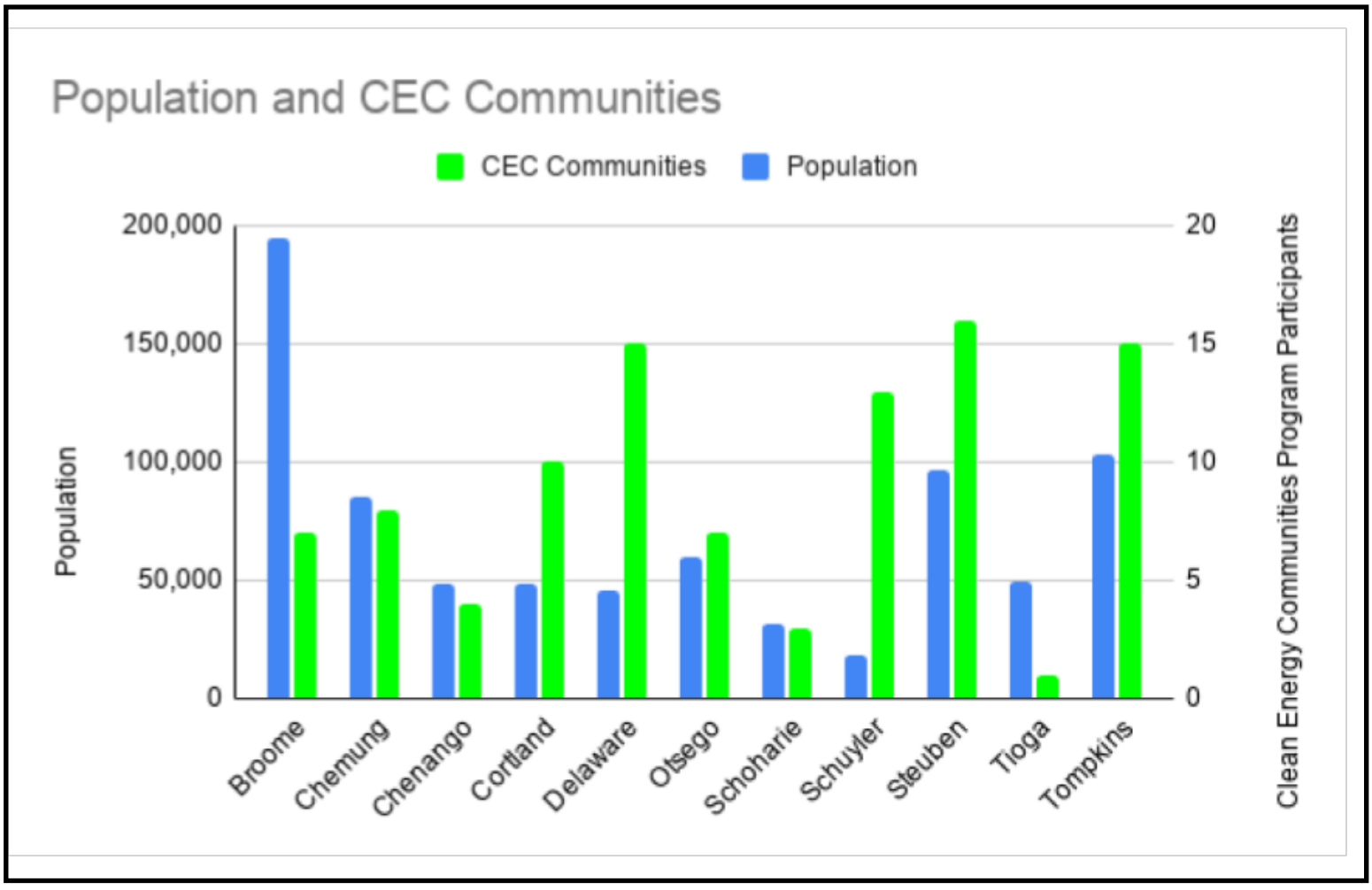
Area nonprofits such as the Alliance for Manufacturing & Technology (AM&T), exist to assist small to medium enterprises (SMEs) which are often challenged by the administrative requirements attached to accessing available resources.

Downtown Revitalization Initiative and Upstate Revitalization Initiative place-making projects, including special "Innovation Districts" have been planned for communities throughout the region, but implementation has slowed due to the pandemic. These project plans include amenities intended to bring Southern Tier communities into Top 50 status.

While the bulk of the region has major highway access, some areas are faced with physical barriers to connection both within and outside the region. Ithaca, key to the regional Innovation Triangle, lacks major highway access, with only older state routes crossing through the MSA. The community's previous resistance to highway development makes commuter train transit a potential alternative. High speed commuter transit options are typical amenities of highly rated, economically successful communities.

NYSERDA's Clean Energy Communities program provides free technical assistance to municipalities considering clean energy initiatives. The program has been funded for 2021 and will likely continue for the next 2-4 years. Communities that complete high impact clean energy actions within the program can qualify as Clean Energy Communities with the possibility of receiving up to $250,000 for large communities, and up to $100,000 for small and medium communities. To-date, there are 37 designated Clean Energy Communities in the region.

As of December 2020, only three of the 11 counties, (Tioga, Schoharie, Chemung) have not joined the program at the county level. No direct correlation between populations size and community adoption rate was found. The breakdown of adoption by communities within each county is illustrated in the following table.



NYSERDA is also supporting communities implementing multi-year community-based outreach and education campaigns. Building on the success of campaigns like Solarize, NYSERDA is tapping into the power of communities to increase consumer awareness of Clean Heating & Cooling (CH&C) technologies and their benefits. CH&C campaigns help homes and businesses in the same area install these technologies through locally organized community outreach. Community members can negotiate rates collectively, select an installer competitively, and decrease up-front costs by enrolling in a local campaign.

With this focus, NYSERDA has also developed a Clean Heating and Cooling Communities Program. This program is aimed at getting groups of homes and businesses in New York State to install clean heating and cooling (CH&C) technologies, such as ground and air source heat pumps, solar heating and cooling, and biomass. These technologies help lower energy bills and reduce emissions of harmful greenhouse gases while making homes and businesses more comfortable. The Network for a Sustainable Tomorrow (NEST), HeatSmart Tompkins and HeatSmart Finger Lakes are current regional program administrators.

PROJECT INCENTIVES & SUPPORT

Both state and local incentives are available to fund projects in the Southern Tier. Not all programs included are specific to the Clean Energy Industry; however many could be utilized by industry stakeholders to support, grow and enhance the developing industry cluster.

Types of incentives include: Corporate income tax credits, property tax exemptions and PILOT agreements, sales/use tax exemptions, investment grants, energy efficiency retrofit grants, employee training funds, commercialization capital, R&D capital, subsidized sites, industrial revenue bonds, access to low-interest loans, infrastructure assistance (grid capacity/access), utility incentives (extensions, rate reductions), and mortgage recording tax exemptions.

Other existing support mechanisms which are not directly capital/incentives include:

- Environmental Testing/Review Assistance
- Recruiting Support
- Planning Technical Assistance
- Energy Efficiency Assessments
- Preferred Contractor Supplier listings (includes both service providers & contract manufacturers)

Successful grant/incentive requests include multiple types of funding sources, including a percentage of private investment. Public-Private Partnerships (PPPs), in which local/regional nonprofits play a formal role in the projects, are highly preferred.

New York State is also very supportive of groups who have faced unequal economic disadvantages in the past, including minorities, women, and veterans. Businesses owned by individuals in these categories can register for a preferred vendor status through the Minority and Women Business Enterprise Certificate (MWBE) program or other similar initiatives.

REGIONAL ENTREPRENEURIAL ECOSYSTEM

The Southern Tier has a long and storied history of innovative technology entrepreneurship and company building that started at the turn of the 20th century with Corning Glass Works, General-Electric, and the International Business Machines (IBM) Corporation, followed by the Raymond Corporation, and Link Aviation Devices, among others. These large firms employed thousands of individuals, often for their entire working careers, and provided a very stable economic base for the area. The region has been a historically significant entrepreneurial area and cradle to some of the most innovative companies the world has known. Today the increased public support of entrepreneurial activities combined with the region's research and development capacity offers potential for more innovative new businesses to develop.

In 2016 the Ithaca node of the innovation triangle was ranked as a top small-to-medium city for entrepreneurs by Livability.com and Entrepreneur Magazine. Raising the qualifying indicators of the other two nodes would greatly expand the profile of the region. Though Livability.com has not updated that list, Ithaca made their general livability Top 100 Places to Live for 2019 at#39. Notably, it was one of only 10 with populations under 50k. Other media entities have created best places rankings since, but none focused on small-to-mid sized cities.

However, all of the rankings used similar quantifiable indicators combined with surveys given to sample populations of young adults. Smaller cities which made the cut focused on lifestyle amenities, such as parks, bike and rail trails, vibrant arts scenes, boutique shopping, robust local food & beverage culture, inclusivity, diversity and connections to larger cities for investments. The other primary qualifiers included: access to broadband, low cost of living, percentage of population with some college education, university (college town) connection. Indicators of a healthy entrepreneurial economy were measured by: growth of new businesses over the previous 5 years, jobs increases over the past 5 years, number of business loans originated, SBA funding to city businesses, number of venture capital deals over the previous 10 years, projected household income growth and unemployment rates.

From a financial perspective, a complete entrepreneurial ecosystem supports and encourages all stages of innovation, from initial curiosity and idea/pre-seed into seed, through the transition from exploration (post/seed - pre-A) and into Series A. This requires participation by a number of supportive partners: Incubators, Accelerators, Seed Funds, Angel Investors, and Venture Capital Funding. But, when viewed through a wider lens, which is more reflective of the measures and criteria used to achieve top 50 city status, a complete entrepreneurial ecosystem also includes higher than average quality of life and amenities. As seen in the case of Ithaca, and other small (populations under 50,000) cities which are highly ranked, a strong university connection is also a key factor.

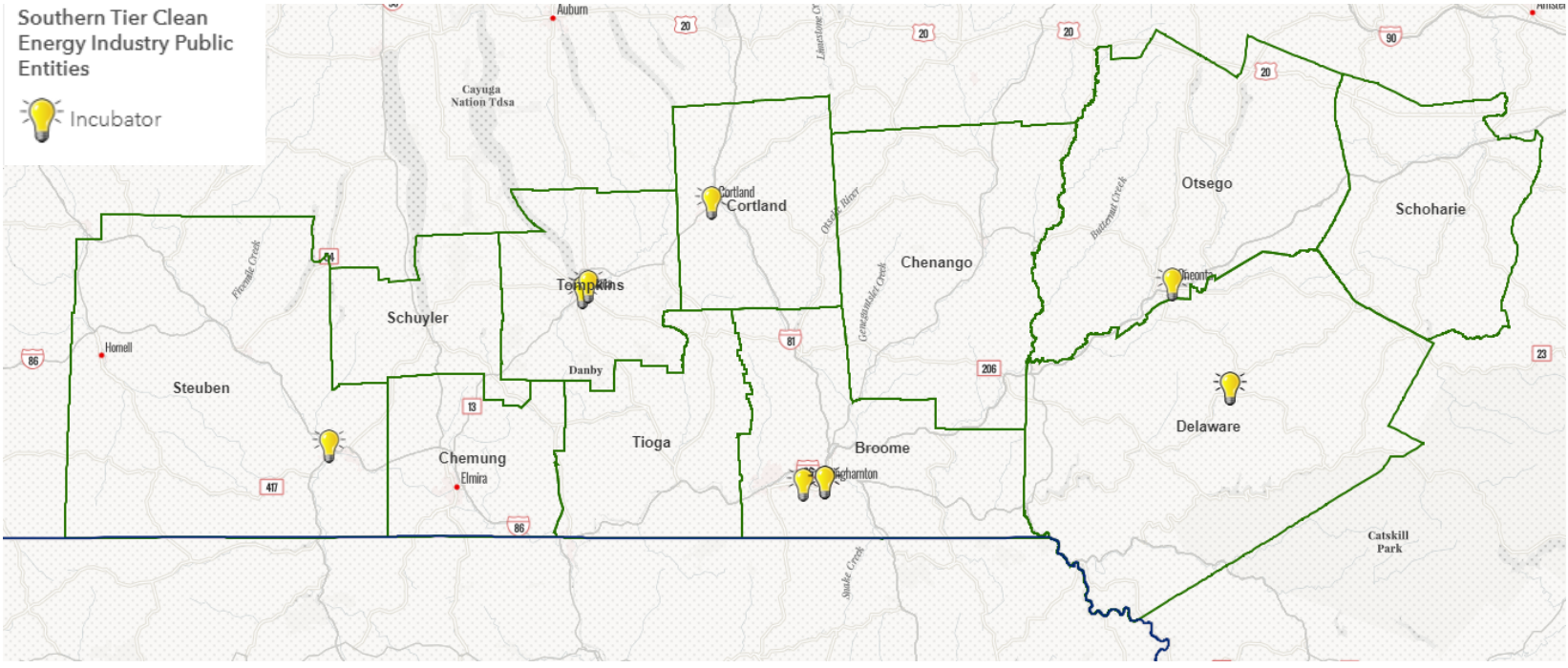
Throughout the 1990’s and into the 2000's Silicon Valley, Boston and New York City were establishing their reputations as entrepreneurial “Hubs of Innovation” with their own focus including Technology, Healthcare and Software, respectively. This “Brain Drain” of high end, entrepreneurial talent did not go unnoticed. In 2008, The Southern Tier Opportunity Coalition (STOC) was formed as an informal group of local business people and academia who met with budding entrepreneurs, on an as needed basis, with investment decisions left up to the individual members to negotiate directly with entrepreneurs. The money was not “pooled” and investment decisions were made individually as opposed to Fund models using group driven decisions. This is very similar to UpState Ventures, which does not provide funds as an organization, but facilitates access by startups to an interested group of investors.

2010 marked the beginning of New York State’s targeted investments in growing cleantech industries, with the creation of the New York Battery and Energy Storage Technology (NY-BEST) Consortium. In 2016, the Koffman Southern Tier Incubator broke ground, and the 76 West Clean

Energy Competition kicked-off. Previously, there had been a haphazard entrepreneurial support system, with limited access to funding information, training or networking for aspiring entrepreneurs in the Southern Tier region. Potential regional businesses were lost as innovators relocated to other areas with more developed support infrastructures and funding availability.

Today, a greater number of support options are available in the region, though access is somewhat limited to communities in and around the three nodes of the regional innovation triangle of Binghamton, Ithaca and Elmira. Some of the supports currently available for regional cleantech entrepreneurs include Incubators and Accelerators, Innovation Competitions, Training and Mentoring, Research Labs, and Funding. Some resources are underutilized, due to either lack of access or lack of knowledge of program availability.

INCUBATORS & ACCELERATORS



These sites have the added benefit of business office space and guidance/mentoring. All also feature access to state of the art virtual meeting capabilities and communication technology facilitating virtual attendance at events, workshops and meetings. Some of the Incubators and accelerators in the region offer dry lab testing facilities as well. Incubators in Ithaca and Binghamton have strong, direct university ties, which facilitates research through commercialization activities. Members at Binghamton's SCI have a direct pipeline to clean energy industry technology specific interns through the XCEED Program. SCI is currently home to 12 of the recent 76 Clean Energy Competition Winners.

Research Node Incubators & Accelerators:
Southern Tier Clean Energy Incubator(SCI), at the Koffman Incubator, Binghamton

Binghamton University Start-Up Suite, Binghamton

Rev: Ithaca Startup Works, Ithaca

McGovern Center at Cornell University, Ithaca

Praxis Center for Venture Development Ithaca

IncubatorWorks/Ceramics Corridor Innovation Center, Corning

Additional, small incubators have begun development throughout the region, including: the Delaware County eCenter; the Cortland Business Innovation Center; and the CADE Food & Farm Business Incubator.

TRAINING OPPORTUNITIES

Training opportunities for would-be entrepreneurs are offered by various organizations throughout the region, such as Chemung County Chamber of Commerce's Elevate Elmira Entrepreneurs; A free ten-week entrepreneur education, mentoring and networking program that includes a two-year Chamber membership, sponsored by ESPRI and the Chamber. The region's incubators offer workshops to members, and occasionally to the surrounding community. Though such opportunities exist, they are offered sporadically, as individual communities find funding. No regularly scheduled, regional entrepreneurial training opportunities were found.

College-level entrepreneurship programs are available at community colleges and area universities, but the high associated costs decreases their accessibility to the overall population, and the lengthy commitment makes degree-oriented entrepreneurial training impossible for most adults already in the workforce. Students at the region's higher education institutions are well supported on campuses, with most featuring entrepreneurial guidance and assistance centers.

INNOVATION COMPETITIONS

Pitch-style competitions can be used to draw new businesses from outside the area, as well as to discover and support budding businesses from within the area. Local competitions can be used to draw out innovators who might not yet be participating in the commercialization process.

An example of a successful program is the 76 West Clean Energy Competition, introduced in 2016. The competition was created to encourage promising early stage Clean Energy companies from the region and around the world with large cash prizes to the top 5 participants. The 2020 competition featured 183 startup applicants, and included startups from five different countries. A great example of attracting startups, over half of the semi-finalists were from out of state. To-date, competition winners have raised over $29 million and catalyzed multi-million dollar investments. Past winners include: Micatu, Optimus Technologies, Skyven Technologies, Switched Source, Hub Controls, C4V, SunTegra, ProsumerGrid, SolarKal, Global Thermostat, and Southern Tier Technologies.

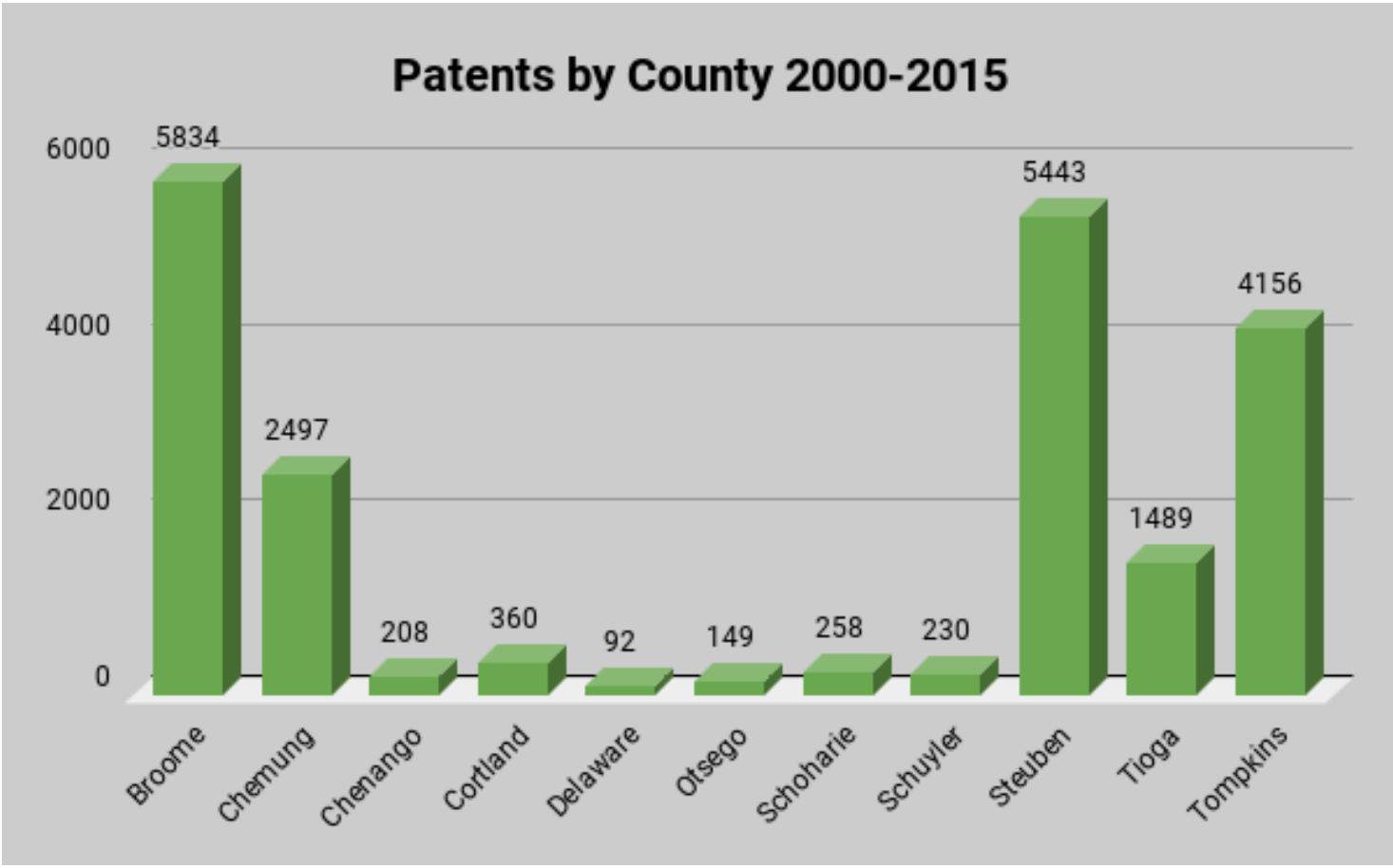
There are also national level competitions, primarily funded through the Department of Energy (DOE) or the National Science Foundation (NSF), such as American Made Solar Prize. A shortcoming of national innovation competitions, from a regional perspective, is the frequent requirement for winners to move their work to out of the area to national labs.

RESEARCH & DEVELOPMENT

The Southern Tier enjoys a Research and Development rate that is 5 times the national average on a per capita basis. Describing and connecting our intellectual assets is critical to telling the story of the Southern Tier.

The regional research or innovation triangle was identified by the Southern Tier Economic development Council. The three nodes are Greater Ithaca, Greater Binghamton and Elmira/Corning. These areas have been supported with incubators, mentors, networking events, and business plan competitions.

Not surprisingly, the three nodes of the research triangle fall into the top 25 patent creating counties in NYS: Broome, 12th; Tompkins, 17th; Chemung, 22nd; and another county in the region, Steuben coming in at 13th. Though Tompkins falls behind Broome in the number of recent patents, Broome and Tompkins Counties have the largest number of support mechanisms. The Elmira research node has the least entrepreneurial supports. Corning provides a solid anchor enterprise, and nonprofit-focused economic development groups and incubators exist, but there is little knowledge between organizations about the resources available. Interviewees mentioned a disconnect between area higher education and economic



Source data: United States Patent & Trademark Office.

development. While many were positive about resource availability, some public and private stakeholders had little awareness of incentives or potential collaborative partners.

Ithaca received the bulk of National Science Foundation research and development funding for the region over the last five years (Jan. 2015-Dec. 2020), winning over 500 awards.. Greater Binghamton has won 90 during the same period; 18+ of those were for directly clean energy tech-related projects.

Corning Inc. conducts significant research in material science. Recent developments in willow glass and ceramics are leading to advancements in solar cell development and ceramic based energy storage. Corning is also recognized for innovation in adopting their design of diesel particulate filters to the the gasoline engine. Cellular ceramic products are being engineered to trap fine particulates and significantly help reduce the emission impact of a vehicle.

A major achievement in the Southern Tier R&D sector was the award of a Nobel Prize to Professor Stanley Wittingham for his work on lithium-ion batteries. We have detailed how this research is leading to a major manufacturing opportunity. The mapping data includes many research programs taking place in the Southern Tier in the Public sector. Further study to identify and promote all of the clean energy research taking place in the Southern Tier is needed.

RURAL ENTREPRENEURIAL ACCESS

The rural communities outside of innovation triangle nodes have a different set of assets and challenges. The Appalachian Regional Commission (ARC) has developed case studies on ecosystem development for rural communities and has established a set of best practices. ARC cautions that the needs of each county or region can be unique and a cookie cutter approach may not work. Alternatives are available for more rural communities that want to establish an ecosystem program or connect to existing programs. Entrepreneurial service providers are willing to collaborate with the rural communities to evaluate the options.

While AM&T, the region's Manufacturing Extension Partnership (MEP) program provider, is working to facilitate program and funding access for small businesses in all 11 counties, their only office location is in the Binghamton node. Similar small business supports, such as AIM (Otsego & Schoharie), and TDO (Cortland) provide additional support. No regional organization currently coordinates efforts, and areas outside of the cities mentioned do not have equivalent support.

Though each node of the innovation triangle has public transit systems, little to no regional public transit options exist. This restricts employment options in rural areas between nodes, and silos the knowledge culture of each node.

A strategy to address rural access to services is being developed which can be though of as a "hub & spoke" model. This concept identifies communities that can serve in the rural areas as secondary Hubs, aka "spokes" where information and support services can be accessed. Suitable communities in the Southern Tier include Norwich, Delhi, Oneonta, Cortland, Owego and Cobleskill. There has been limited success with this strategy with Norwich and Oneonta partnering with SUNY Morissville and SUNY Oneonta to make initial efforts. Many entrepreneurial programs are offered virtually, but lack of high-speed internet access limits many residents from access to virtual opportunities. Incubator Works is using a national platform, Co-Starters, that provides community based entrepreneurial support.

VENTURE FUNDING

Venture funding can be used for a wide variety of startup needs. Finding such unrestricted funding can be challenging. Some opportunities exist regionally, but no funds specific to clean tech or which cover the entire study area are currently available. Some individual investors welcome startup pitches, and make their contact information available through organizations such as Empire State Development (ESD) and organizations such as the UpState Capital Association.

New York State's progressive clean energy policies are opening the door to healthier returns on investment and attracting more fund groups to consider clean tech. Upstate NY is home to several geographically focused private investment funds. The Southern Tier region includes the offices of two privately funded investment firms, Cayuga Ventures and Chloe Capital.

Some funds cover startups located anywhere in the country, while some focus on companies located within specific areas. Funding eligibility can also be focused on specific technologies. Private venture funding tends to be very responsive to market mood; clean tech saw an initial period of high interest, followed by disappointment at slow returns, especially on the generation hardware end. However, changing market demands, combined with supply chain challenges caused initially by tariffs and now exacerbated by Covid-19, has changed the value of clean tech, shortened the expected time and value of return on investments, creating a resurgence of interest in clean tech venture and “angel” investing.

New York State supports early stage and add on financing entities such as **Launch NY** and **NY Ventures**. Both play an important role in the area entrepreneurial ecosystem by providing much needed Equity Capital to worthy early stage companies. Funds through Binghamton and Cornell University campuses are attempting to fill much needed gaps in local funding.

BingTech Ventures supports startup activity in the Southern Tier by investing in Koffman ST Incubator member companies. They are clean tech-oriented, preferring businesses offering benefits to the community at large.

Big Red Ventures is an early-stage fund, formed in 2001 and operated by a team of MBA students at Cornell University’s Johnson Graduate School of Management. The group invests up to $25,000 in U.S.-based innovators. The fund is “evergreen” - meaning all proceeds are reinvested back into the fund.

Empire State Development’s **New York Ventures** offers a Direct Investment Fund, and Funds-of-Funds programs including: the Innovate New York Fund; the Innovation Technology Commercialization Fund (an investment capital fund for pre-seed stage companies); and a Minority- and Women-Owned Business Investment Fund.

Cayuga Ventures, headquartered in Ithaca, invests in early stage founders in any industry with companies located in upstate NY and NYC. Cayuga Ventures currently has investments in 13 companies and is raising another round of funding at present.

Chloe Capital, also located in Ithaca, invests in women-led, seed stage, tech and tech enabled companies from anywhere in the US. They currently have a portfolio of 10 companies with approximately $60,000,000 in value.

Upstate Venture Connect is an organization supporting startups through networking events, including the annual "Unleashed" event which awards leaders and innovators from across the upstate area, led by well-known entrepreneur Martin Babinek.

Upstate Capital Association is a non-profit, membership-based 501c6 organization supporting the entrepreneurial ecosystem throughout upstate. They provide opportunities for entrepreneurs and capital investors to connect. Members may support any phase: early stage, venture, growth and private equity investors. The association also records and publishes all their deals, although individual investment details are made public. The reporting is strictly voluntary and the group does not claim to have access to all deal flow in the region.

Clean tech is a growing area in venture funding, and multiple opportunities are available to Start-ups in the area, though their offices are not located in the Southern Tier. One such fund is **Portfolia**, a national women-led fund, investing in US companies from seed to Stage C through four funds. The group chooses 10 businesses per fund annually, and though female focused they invest in both female and male-led teams, with a preference for gender-balanced executive teams.

DEBT CAPITAL PROVIDERS

Few early stage companies can qualify for debt capital unless a founder offers personal guarantees. Traditional financial institutions are not a good fit for early stage companies due to their relatively inexpensive debt capital based on risk tolerance. A number of publicly funded entities exist that may consider debt capital solutions for entrepreneurs including:

- Southern Tier Regional Economic Development Corporation , managed by REDEC
- Southern Tier East Economic Development Fund, managed by The Agency/Broome County IDA
- Small loan programs, managed by municipal Economic Development Departments and individual County Industrial Development Agencies (IDAs)

Identifying viable debt capital for early stage company funding will require varied initiatives including: Alternative debt options such as Venture Debt, which includes a combination of debt and equity, typically with a higher interest rate; and Lender Education and loan product development for early stage companies risk profiles.

SEED FUNDS

Some regions of New York have Seed Funds with specific geographic focus providing much needed seed-stage capital to startup companies. The seven primary geographically focused seed funds in upstate are shown in the table below.

NAME	FOCUS AREA	SOUTHERN TIER FUNDING POTENTIAL
Eastern NY	Capital District /	All- will cover any NYS; will most consider
Rochester Angel	Rochester	None
Buffalo Angels	Buffalo	None
Seed Capital	Central / Upstate	*status unknown
Mohawk Valley	Mohawk Valley	*early development; not enough capital to
Hudson Valley	Hudson Valley	None/maybe Delaware, Otsego
Southern Tier NY	Southwest NY	will consider funding in Chemung

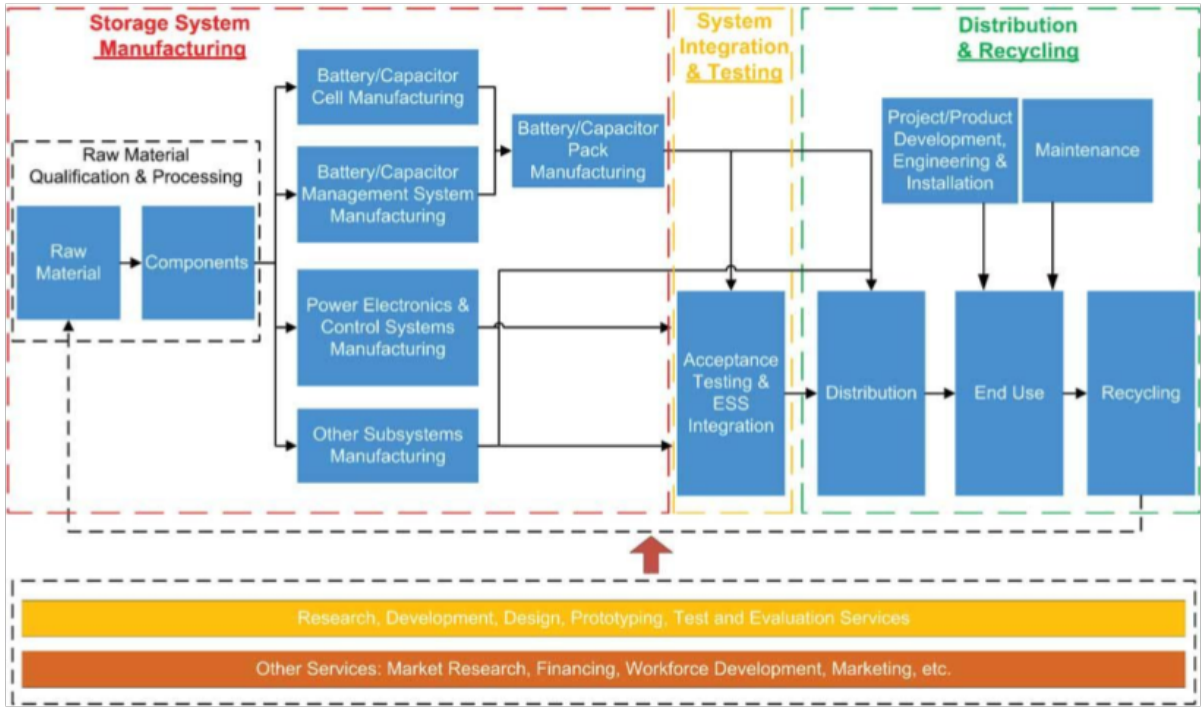
The majority of the funds do not publish statistics on capital raised, deployed or the claimed economic impact, however, through discussions with various fund participants throughout the state, the following positive effects are identified:

- Retention of fundable startups
- Increased support mechanisms for entrepreneurs
- Creates a network of accredited investors, entrepreneurs & business leaders
- Draws in input from outside the immediate region
- Positive impact on University entrepreneurship programs
- Bridge to other private sector support infrastructure in the region
- Positive identity/publicity for the startup community and region
- Support Collaborative opportunities, such as PPPs

Having a regionally focused Seed Fund has far reaching and significant benefits to the areas they focus on. The Southern Tier region does not currently have a focused Seed Fund, however, there does appear to be an interest and desire to do so in the very near future.

OTHER SUPPORT

New York Battery and Energy Storage Technology consortium, NYBEST, is a government-supported, industry-driven organization which supports power storage tech innovation and manufacturing throughout the state. They maintain a supply chain database for energy storage and offer a Bridge Program which gives accepted startups [minimum eligibility <25 emp & <5 years in business] a wide range of support and guidance, including funding assistance. Members can utilize the Battery Prototyping Center (BPC) at Rochester Institute of Technology as well as access to the services of Battery and Energy Storage Technology Test & Commercialization Center (BEST T&CC).



Start-Up NY helps new and expanding businesses through tax-based incentives and innovative academic partnerships. START-UP NY offers new and expanding businesses the opportunity to operate tax-free for 10 years on or near eligible university or college campuses in New York State. Partnering with these schools gives businesses direct access to advanced research laboratories, development resources and experts in key industries.

The **Southern Tier Startup Alliance** (STSA) partners with incubators to leverages existing regional entrepreneurial resources to create support services where none currently exist. Their goal is to cultivate to a growing regional ecosystem of entrepreneurs and support organizations by helping connect potential entrepreneurs to resources and guidance.

Additional support mechanisms were still in development during the study period. For example, Binghamton University is developing a Soft Landing program, meant to assist high tech business entrants into the US market. Leaders at SUNY Morrisville in Norwich are working to create a rural entrepreneur support system, and the Waverly School District is planning a STEM training and business incubator for Tioga residents.

START-UP FUNDING TIMELINE TABLE

Start-Up Funding Timeline			
Stage	Need Range Est	Activities	Source Types
Idea/Pre-Seed	$50-750k	Pre-Product Research	Incubators, Accelerators, Family & Friends, Grants
Seed	$750-1.5mil	Product Development	Accelerators, Seed Funds, some Angel Investors, Grants
Post-Seed Transition	$1.5-2.5mil	Initial Mfg /Acquisition	Seed Funds, Angel Investors, some Venture Funds
Series A+	$2.5-10mil	Scaling Up	Venture Funds

TRANSITIONING FROM STARTUP ONWARD

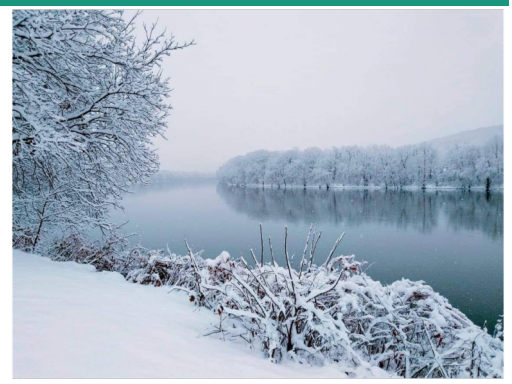
Multiple funding and incentive opportunities for startups ready to scale up exist within the region, but knowledge of program availability causes many businesses to relocate out of the area, lured away by aggressive marketing campaigns. Unfortunately, those campaigns are especially successful due to a lack of knowledge/negative attitude by many stakeholders within the region.

Within targeted economic areas such as Opportunity Zones, and/or within StartUp NY locales, businesses have the opportunity to pay next to no taxes (including capital gains, employee, sales) while paying only a tiny percentage of land value for sites through support from Industrial Development Agencies and Local Development Corporations. The Southern Tier 8 Regional Board is working with all municipal IDA and County Planning Department s to develop a Regional Opportunity Zone Portfolio to showcase investment opportunities across 19 designated Zones across the Region.

Those opportunities can also be combined with workforce training initiatives that can pay for large percentages of payroll while new employees are being trained.

Property tax issues are easily overcome through tax credits for energy efficiency upgrades, and the cost of living in area counties is some of the lowest in the nation. Programs such as the Trade Adjustment Assistance Center (TAAC) and Foreign Trade Zones help both new and established companies compete with foreign markets, but are often underutilized in the region.

SHARED REGIONAL CHALLENGES & BARRIERS TO BUSINESS GROWTH



Physical Infrastructure Weaknesses

- Inadequate Broadband Access
- Lack of commuter public transit between the region's innovation triangle cities
- Inadequate infrastructure to support industrial activities at sites outside largest cities

Policy Challenges

- Slow and varied permitting processes across region slow developments

Information-related Barriers

- Lack of knowledge about available Clean Energy technologies and adoption incentives
- Negative Perceptions of the Region

Funding and Capacity Issues

- Southern Tier startups are not connecting with investors
- Lack of a regionally-specific clean energy technology seed fund
- Administrative capacity gaps diminish access to available programs

While each county and community in the region has unique and varied resources, some challenges were cited across the board by area stakeholders. The lack of broadband or high speed internet access is a problem in even the most populated counties. Recent census data showed that only 77.85% of homes in the study area have broadband services, while the national is 80.4%. Pre-covid, regional libraries were swamped with patrons using facilities for internet access. Multiple study participants sited lack of broadband access as a barrier and challenge, with anecdotal evidence of potential professional employee candidates who turned down positions for that reason. Lack of internet access limits even virtual access to resources in rural communities, where topography and distance add challenges and costs to providing service equitably throughout the region. This issue is widespread across all 11 counties in the study area, and it limits already economically challenged community members, restricting them from participation in the workforce educational opportunities in the region.

If remote work continues for a large segment of the population post-covid, as is predicted, the "last-mile" of service access becomes imperative to economic sustainability as well as population stability. Business and industry rely so heavily on access to online resources, that any space without high speed internet will be the least likely to be selected as a site for either a startup or the regional site of a larger company. This directly affects advanced manufacturing and product development, as those areas increasingly rely on computational machining techniques requiring high-speed data and design transfer.

Existing regional efforts to improve internet access include the development of the dark fiber network owned by the nonprofit Southern Tier Network (STN), which is present in six of the eleven counties in the study area: Chemung, Schuyler, Steuben, Broome, Tioga and Tompkins counties. STN provides access to large-scale enterprises, government and educational entities which require their own secure networks, and follows an open access model to allow service providers to lease bandwidth to support last-mile service infrastructure. STN is not available to small businesses or residential locations. While STN enables service providers, such as Spectrum, to improve access to small businesses and residents, those carriers are not moving quickly to improve access throughout the region. This means several rural areas still lack last-mile service and the STN footprint does not yet cover all communities across the study area.

The Southern Tier 8 Regional Board has created a 5-county working group, the Regional Broadband Collaborative, to assess current limitations, build community capacity, and align resources to position communities for expansion of broadband infrastructure in Broome, Chenango, Cortland, Delaware, and Tompkins Counties. Educational programs were also recently given by regional planning professionals for municipal leaders in the region regarding broadband technology and project funding availability. The Regional Board also recently championed the Broadband Deployment Accuracy and Technological Availability (DATA) Act, which requires the FCC to change broadband data processes to improve the accuracy of FCC maps to ensure underserved communities are eligible for federal investments. These activities represent a positive start, and show interest and support from municipal stakeholders. Additional actions are likely to be needed to achieve implementation of improvement projects throughout the region.

The distances between rural areas and the innovation triangle nodes are poorly connected, with no commuter transit options. During winter months travel is hindered by weather between nodes, especially Ithaca, which relies on state routes. Large corporations located in disconnected rural communities are having trouble attracting professional employees due to lack of amenities in those rural communities, including modern grocery shopping. Within the more urban areas of Binghamton, Ithaca and Elmira, regional malls, multiple grocery and specialty food stores, as well as boutique shopping opportunities are available.

Transmission infrastructure constraints are an issue for rural sites in the Southern Tier. The issue was mentioned by economic development professionals as a reason development sites remain empty. Schoharie County, for example, has limited capacity along route 7, which has discouraged potential industrial developers.

Renewable energy generation developers expressed dissatisfaction with the permitting process for smaller municipalities. The process varies by community, and there is no clear path to follow through each municipality's requirements. At the time of this report, the majority of the region's communities required developers to go through a special use request process, with timelines varying by the frequency of planning board meetings, which can occur very infrequently. Thus

the permitting and planning approval process can take significant time. Some of the delay is caused by a lack of resources to move the project forward. Empire State Development representatives also cited a concern with local permitting processes.

Lack of knowledge regarding clean energy technologies and related incentives and programs was noted among both private and public entities. Public comments recorded in meeting minutes of local municipal boards in the region during the period from 2015-2020 showed widespread lack of knowledge among public meeting participants regarding wind and solar projects. Public entities have reported challenges related to public knowledge of clean energy technologies have slowed development projects in the region. In both instances, community members had negative perceptions about the projects being planned connected to misinformation regarding environmental safety, policy protections, project and land ownership, and landscape stewardship/property rights.

The region suffers from negative perception both within and without. This reflects two separate issues: not enough outside marketing of regional assets, and a lack of knowledge about available assets and amenities within the area. Regional business incentives and quality of life assets are significant, but are not well known, even within the region. Professional advertising campaigns have been created by Chambers of Commerce throughout the region, but distribution may not have been effective. Examples of recent positive but underutilized efforts include *Broome is Good* and *Ithaca is Gorges*. Interviewees from private enterprises mention both the poor reputation of the area and lack of resources as position refusal reasons given by potential employees. This shows a dramatic disconnect between available incentives, business and community development programs and their end-users.

Availability of funding was sited as a challenge by study participants. Regional start ups report challenges connecting to investors. While there are a few privately held investment funds with large enough coverage areas to offer some opportunities to businesses in the Southern Tier, none currently exist which are specific to the region. A fund which limited eligibility to the region would be a draw to the area, and would encourage startups to stay in the region.

A large number of regional clean energy industry businesses fall into the category of small-to-medium enterprises (SMEs) which lack the staff capacity and specialized expertise needed to participate in the available supportive programs which would allow them to scale-up. A chicken-and-egg situation, the public sector has created multiple support mechanisms to allow businesses to grow, but truly small businesses do not have the administrative staff to manage the research, application, compliance and reporting required for program participation. While some nonprofits, such as the Alliance for Manufacturing and Technology (AM&T) have begun filling the role, not enough such groups exist to manage regional needs, and there is no overarching regional coordination.

The Climate Leadership and Community Protection Act and the Southern Tier

The 2015 State Energy Plan (SEP) stated that 50% of all electricity used in New York State by 2030 be generated from renewable energy resources. In December of 2015, the New York State Department of Public Service (NYS DPS) was directed to develop a Clean Energy Standard (CES) that converts the SEP goal to mandated requirements. Included in the directive, the NYS DPS was to determine ways to keep, with the exception of the Indian Point Nuclear Plant, the remaining nuclear facilities in operation to support the reduction of greenhouse gas emissions. The power authorities LIPA and NYPA would also develop comparable programs to support the New York State goals. To accomplish these goals the CES had a three tier plan, adopted on August 1, 2016 and in effect on August 15, 2016. The tiered plan was based on the Renewable Energy Credits (RECs). RECs are the renewable energy generated and help to provide a financial incentive to encourage the development of renewable resources. The RECs created are equal to the amount of electricity created by the renewable facility in megawatt hour increments.

All Load Serving Entities (LSEs) and electricity suppliers are required to invest in renewable generation by purchasing RECs from the NYSERDA administered market or through 3rd party sources. Self-generated electricity is not included in the CES as well as micro grids and co-generation plants.

The Tiers briefly are as follows:

Tier 1 - The generation facility must have begun operation after January 1, 2015.

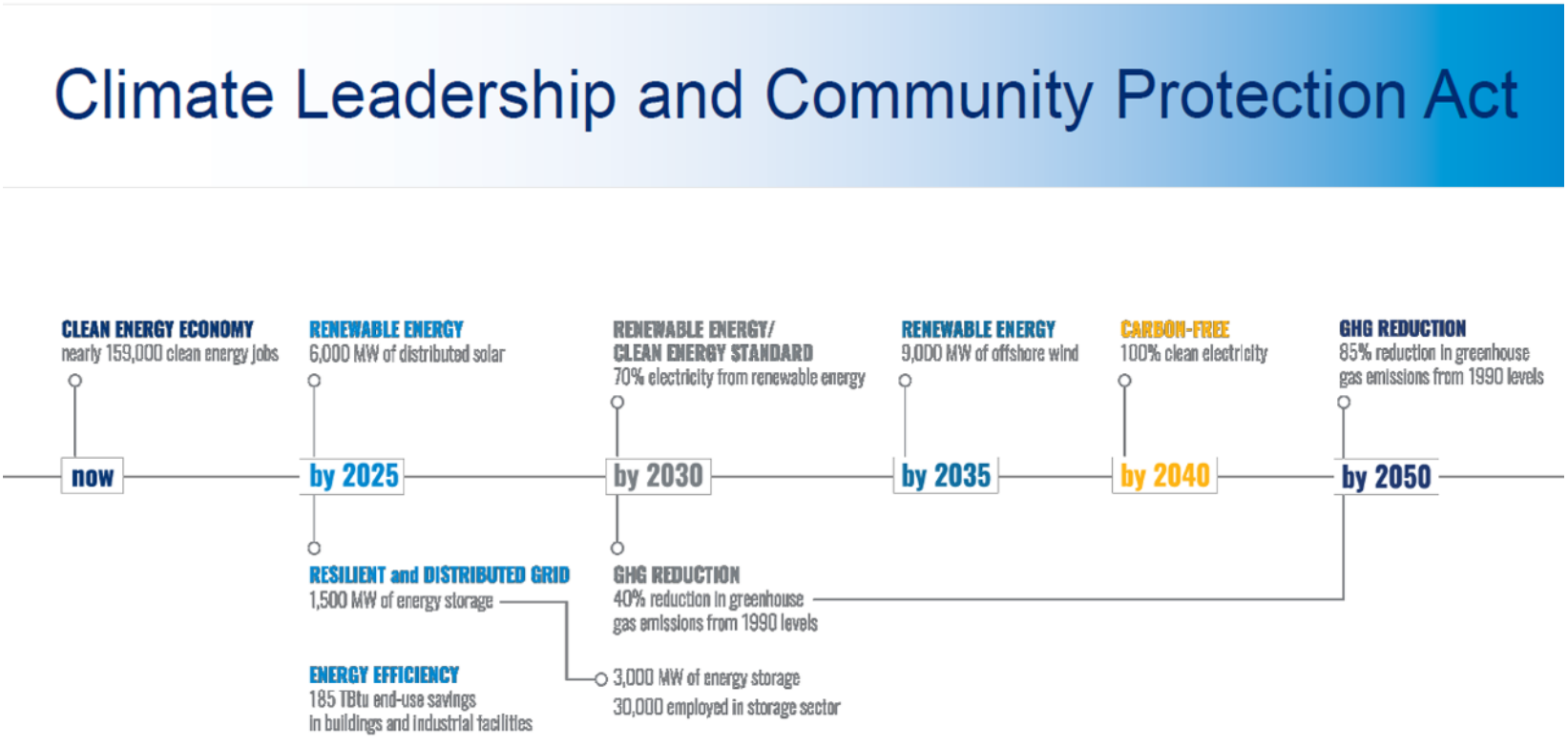
Tier 2 - Run of River (ROR) hydroelectric facilities of 5 MW or less, wind facilities, and biomass direct combustion facilities in operation prior to January 1, 2003 can seek funds if they need financial assistance in order to stay in business.

Tier 3 - Beginning April 1, 2017, through a contracted relationship with NYSERDA, all LSE's must purchase a percentage of Zero Emissions Credits (ZECs) based on the portion of load served by the nuclear generating stations.

A ZEC is an environmental attribute which is purchased on behalf of the Load Serving Entities (LSEs) and electricity suppliers from the statewide nuclear generation proportioned by the respective use. The cost per unit of the ZEC is evaluated every two years and relates to the nuclear units ability to recover their operating costs through the wholesale market.

Shortly after the CES directive, Governor Cuomo issued a comprehensive energy strategy "to make better and more informed energy choices, enable the development of new energy products and services, protect the environment and create new jobs and economic opportunities throughout NYS". The strategy, entitled Reforming the Energy Vision (REV), was deemed the most aggressive energy program to redesign the existing energy market to the future needs of society.

On July 18, 2019, the Governor signed into law the Climate Leadership and Community Protection Act (CLCPA) which mandated a new target of at least 70% of New York's electricity come from renewable energy resources by 2030 and that the State's power system is 100% zero emission by 2040. At the time the CLCPA was signed 26.4 % of the state's electricity came from renewables according to the New York State Independent System Operator. AThe full extent of the CLCPA is illustrated in the diagram below. The targets on the diagram will be reassessed each year by the State and adjusted as necessary to the 5 year milestones.
The results of the CLCPA Statewide energy supply goals are presented in the table below. For the energy demand and renewable energy supply, NYSERDA first forecasted the energy demand requirements expected in 2030. The projected demand included the assumed heat pump additions, demand from the electric vehicles, countered by the demand reduction from expected improvements in energy efficiency. Then the NY-SUN and energy storage targets for 2025 which were developed in previously established goals. The renewable energy resource and energy storage targets for 2030 are listed. These included the total renewable requirement at the 70% level from the forecasted demand with the breakdown of the currently accounted renewables and the renewables yet to be deployed. In addition, the CLCPA targets 3,000 MWs of Energy Storage Systems by 2030 to support the reliability requirements resulting from the intermittency of the various renewable resources.



The CLCPA will provide opportunities for new business development as well as encourage the efficient use of energy for residential, commercial and industrial facilities in the coming years. The opportunities are in the form of new technology research, product development and commercialization of systems locally and around the world. The 11 county Southern Tier region is well suited in its education and industrial systems to address the needs that CLCPA will require to reach its goals. The counties within the region are diverse and if plans are structured properly they will be able to accommodate the changes expected from the State's goals pursuing a zero carbon society. The region may have additional advantages as the population base of the downstate region migrates to the less populated upstate regions of New York.

Statewide Electric Load & Supply - 2025 & 2030

Projected Load influenced by decarbonizing electric generation and initiatives pursuing the electrification of the heating, transportation system and improved energy efficiency use.

2030 forecasted energy demand requirements estimated at 151,678 gigawatt hours (includes line losses and behind the meter resources).

This also includes:

- 10,334 gigawatt hours of new demand from heat pumps (21% of primary bldg heating stocks)
- 9,048 gigawatt hours of demand from electric vehicles (17% of the on-road vehicle stock)
- 40,865 gigawatt hours of demand reduction from energy efficiency improvements

2025 forecasted renewable energy supply requirements:

- 1,500 MW Energy Storage 2018 - Energy Storage Order (case 18-E-0130 12/13/2018)
- 7,266 gigawatt hours if NY-SUN 6 GW target (~13.8% capacity factor)

2030 forecasted renewable energy requirements:

- 105,175 gigawatt hours (151,678 times 70% by 30 Goal)
- 63,317 gigawatt hours currently accounted for as follows:
  - 39,013 gigawatt hours 2018 renewable generation
  - 8,952 gigawatt hours of contracted & constructed renewable energy systems (RES)
  - 7,985 gigawatt hours of contracted offshore wind projects
- 42,858 gigawatt hours of renewables to be deployed
  - 17,868 gigawatt hours of offshore wind (5.8 gigawatts at ~35% capacity factor)
  - 24,990 gigawatt hours comes from other RESs
- 3,000 MW by 2030 of Energy Storage

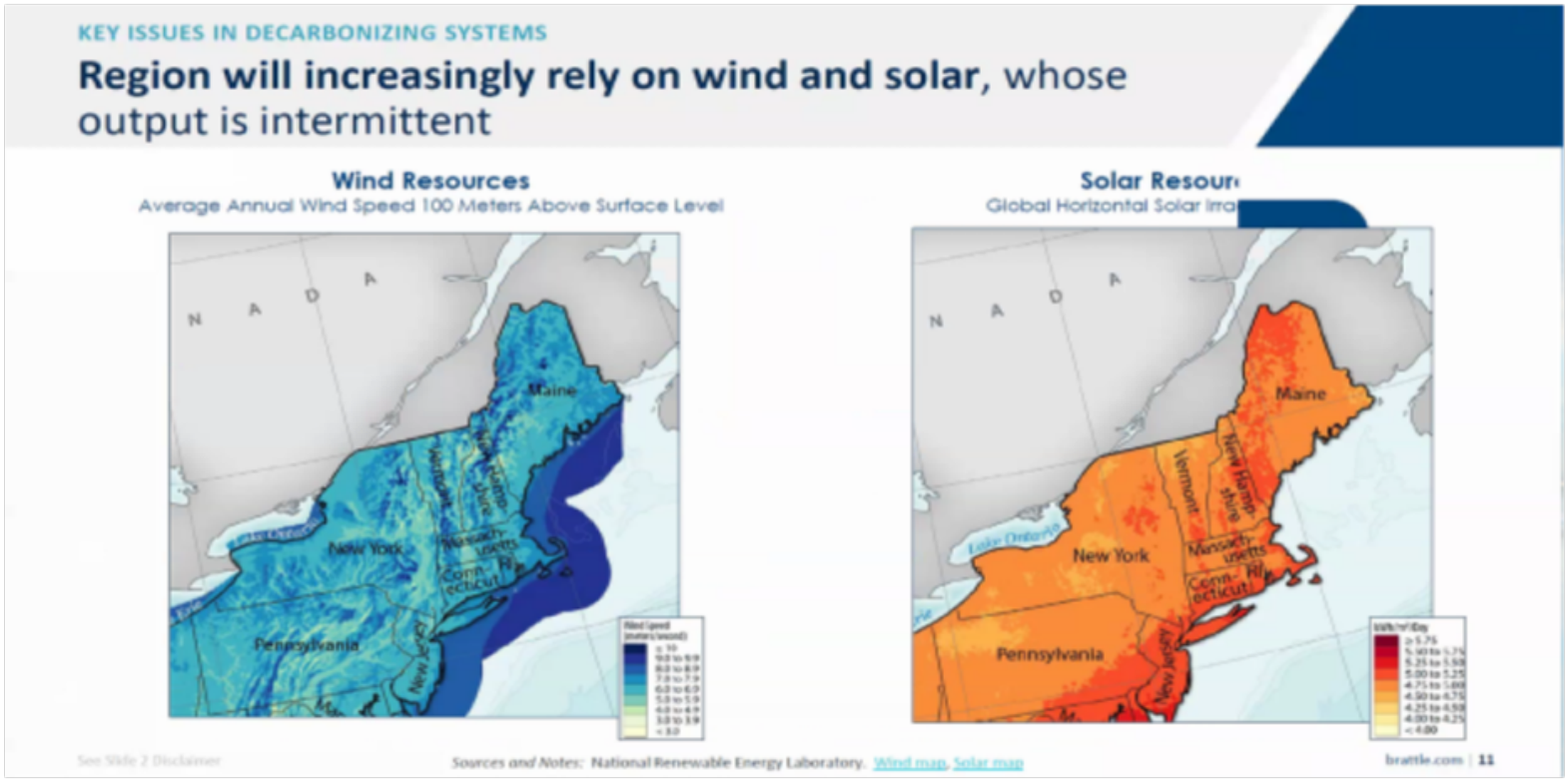
Through attrition, society's use of natural gas and other fossil fuels will be curbed. Appliances and equipment that use these fuels for heating, cooling, hot water, cooking, etc. will be replaced largely by electric based appliances and products. Our gasoline powered car, small engine equipment and related transportation systems will no longer be the norm and replaced with battery and hydrogen operated engines. This will truly be an energy revolution for New York State to minimize the impact that humanity has on the State and the global environment and operate in an efficient energy based society.

There are a number of studies underway by different organizations to analyze the timeline for the implementation of CLCPA and its impact on the sustainability and reliability of the electric system. Since the implementation of the CLCPA will rest largely on the supply from intermittent renewable resources, there are concerns on the overall development of the renewable resources to meet the goals and the reliability of the electric system in the times when the sun doesn't shine, the wind doesn't blow and other events (storms, floods, droughts, etc.) impact the generation and delivery of electricity to the consumers. There are other studies underway to determine the market design that will incent and sustain the development of the renewable resources. There are many issues still unresolved and need to be addressed as the implementation timeline moves forward. The following is a list of many of the potential hurdles that are being debated at the Local, State and Federal level.

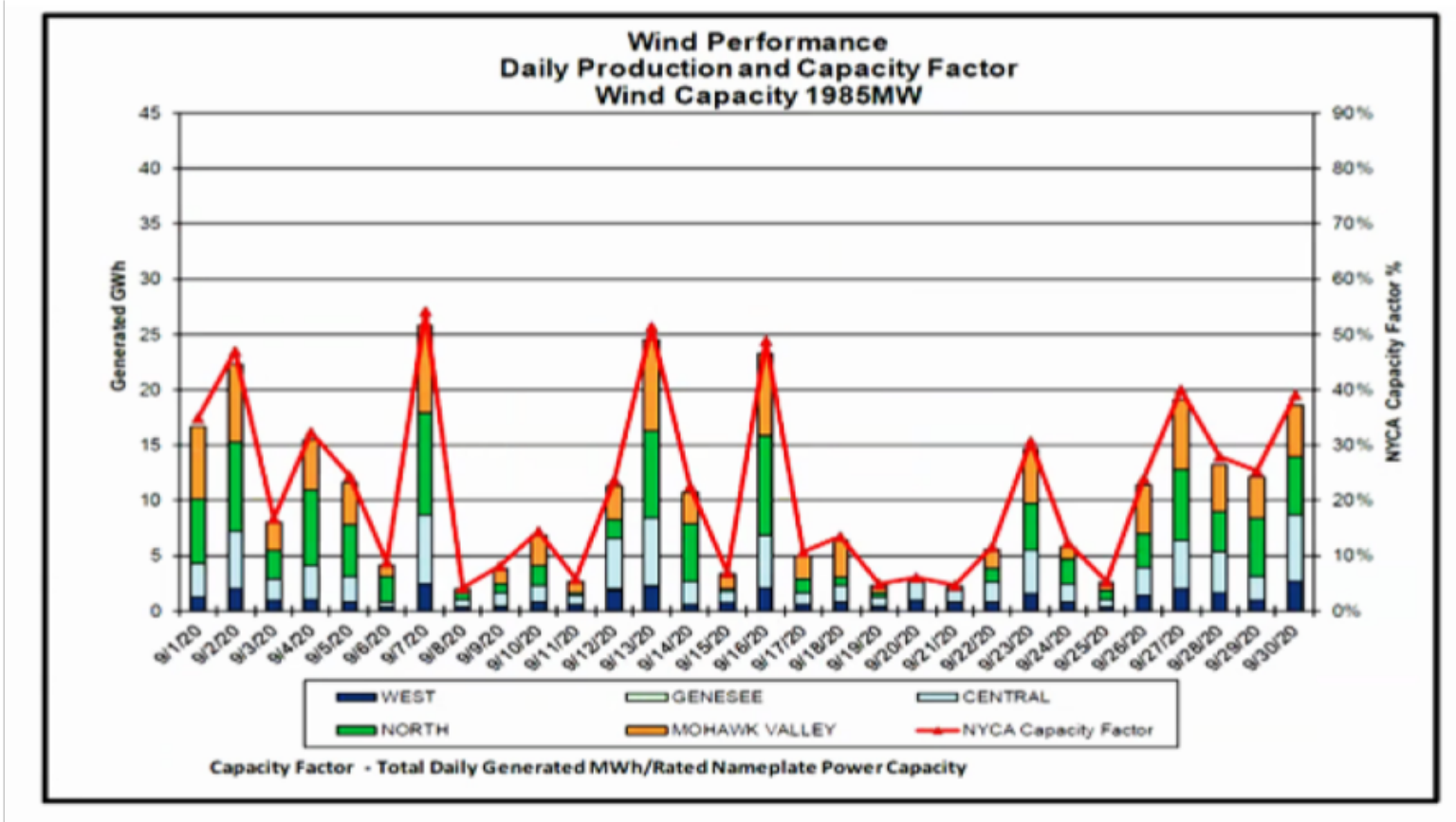
CLCPA Deployment Challenges

- Permitting and Land Use Concerns
- Distribution and Grid Transmission Access
- Attrition rate of existing carbon emitting systems to electrification
- Reliability and Intermittency of renewable resources on Grid Operation
- Missing money for investment in Renewable Systems
- Carbon Pricing
- Electric Market redesign for Ancillary Services
- Demand Growth and NYS overall economy
- Electric Vehicle penetration and charging station development
- Changing Climate and Weather patterns
- Project financing
- Fuel supply diversity
- Energy Storage system technologies and development

The following illustration from the National Renewable Energy Laboratory provides the typical intensities of Solar and Wind in the Northeast Region of the United States. For both of these renewables the Southern Tier Region does not show a high energy intensity for these resources. This does not suggest that there won't be development in the Southern Tier Region, but rather the developers will need additional benefits to locate in the Southern Tier Region to warrant the investment over other regions of higher solar and wind intensity.

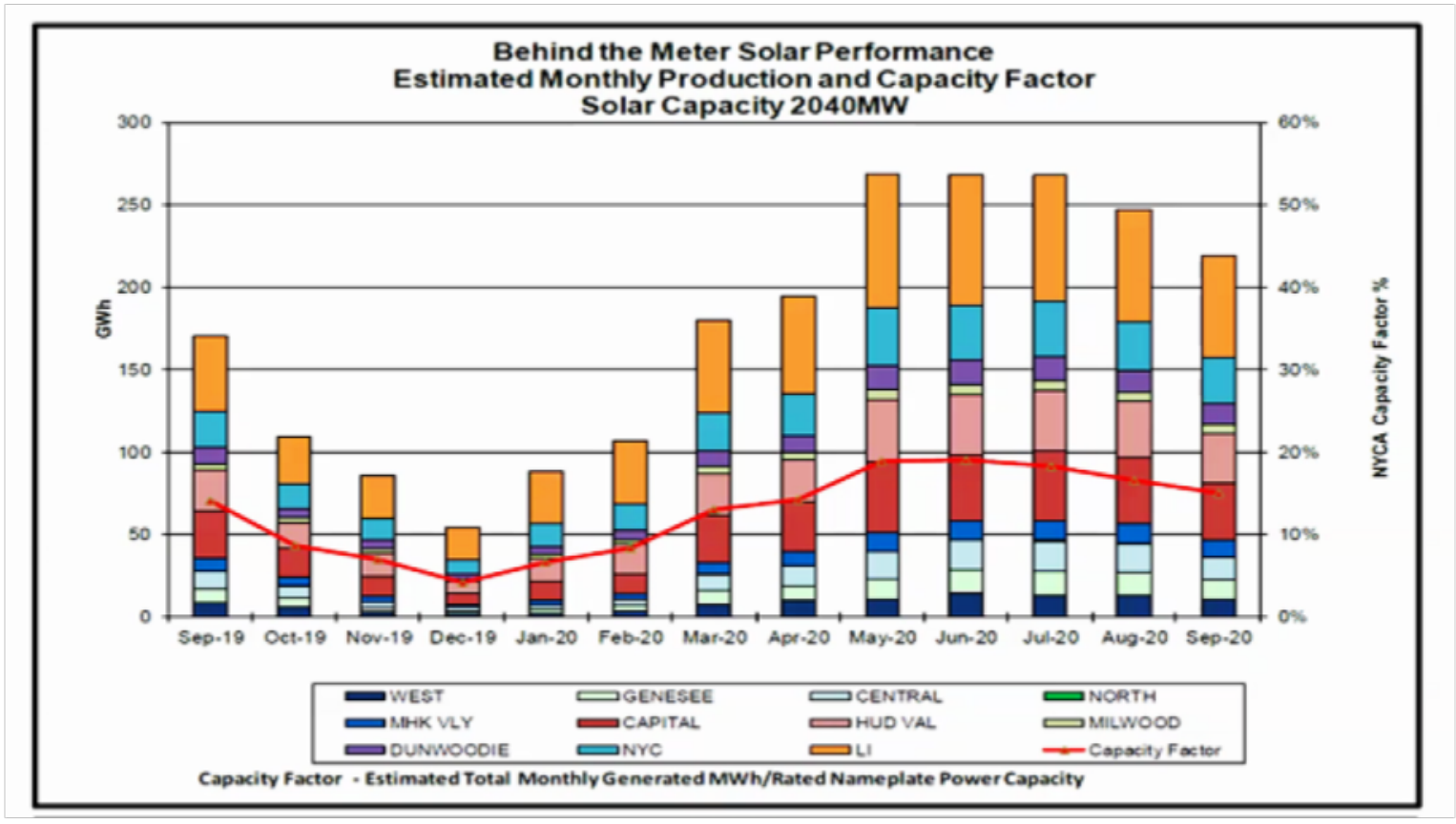


The following illustrations were presented at the NYISO October 15, 2020 Operating Committee Meeting and shows the performance of the wind resources for September 2020 and the Solar resources for the year ending September 2020. The Central label on both illustrations most closely relates to the 11 county area of the Southern Tier of NY.



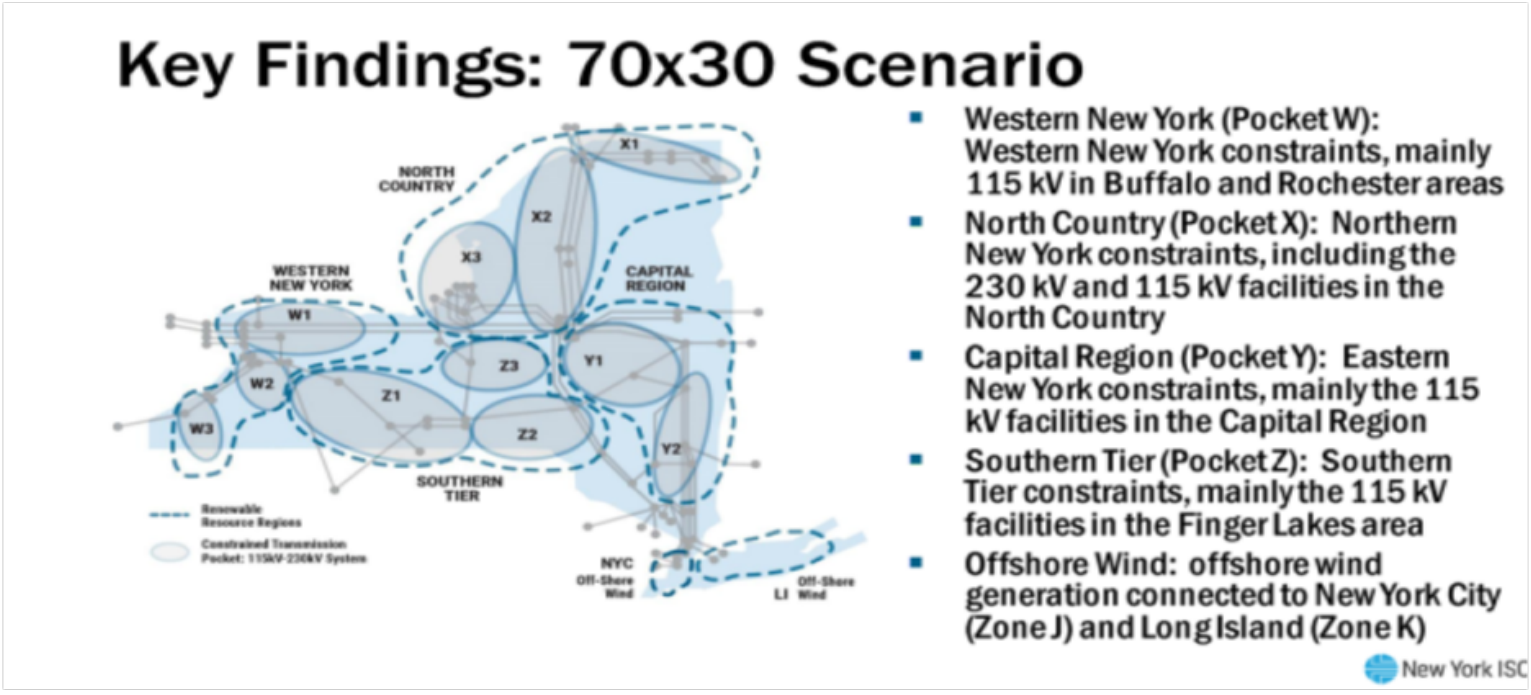
The daily wind resource performance for September 2020 is quite volatile for the month and not atypical for other periods of the year, thus showing some of the concerns over the intermittency of the renewal resource and the need for support systems such as energy storage.

Most of the solar resource installations to date are a result of the NY-SUN Program and are typically behind the meter, i.e., on homes and businesses offsetting the energy requirements of the host facility. The second illustration shows the year-to-date of solar production and performance. The pattern is more reflective of the seasonal intensity of the sun. An additional issue that impacts this resource is that the peak energy demand requirements for the system occur in the winter at 6 PM and into the early evening, when the energy from the sun is typically not available.



Another critical issue in reaching the CLCPA goals requires the ability to move the energy generated from the renewal resources to the energy demand centers, primarily in the Downstate regions of the State, i.e., the Hudson Valley, New York City and Long Island. Typically, the renewable resources, wind, solar and hydro, would be located in the Upstate regions of New York where the investment economics would be lower and the energy would be moved to the Downstate region of NY where the value of the energy is higher. For this to occur, there must be adequate transmission and distribution systems in place to support the transmission of the energy from the source to the demand. The below illustration shows that the current transmission system constraints to move the energy from the various regions of

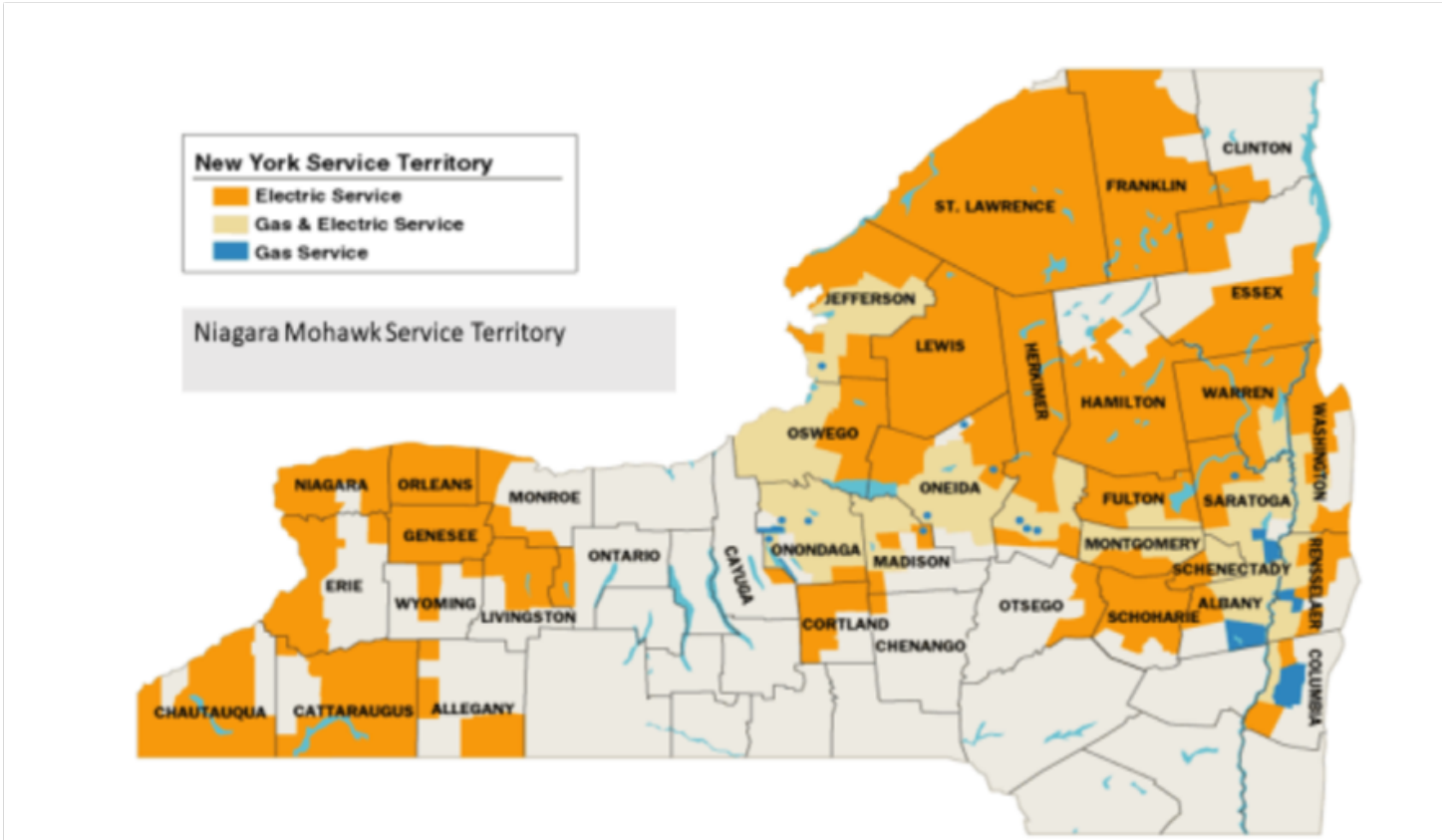
the State. The area labeled the Southern Tier covers much of this study's 11 county region. The entire state has limitations to move the energy from the renewable energy development regions to the downstate demand centers. Over the course of the next decade upgrades of the transmission system will be needed to support the transfer of the renewal energy to the energy demand centers in New York. The NYS DPS and NYISO are actively involved, as well as the Utilities, identifying the needs both from a system reliability standpoint and points of congestion.

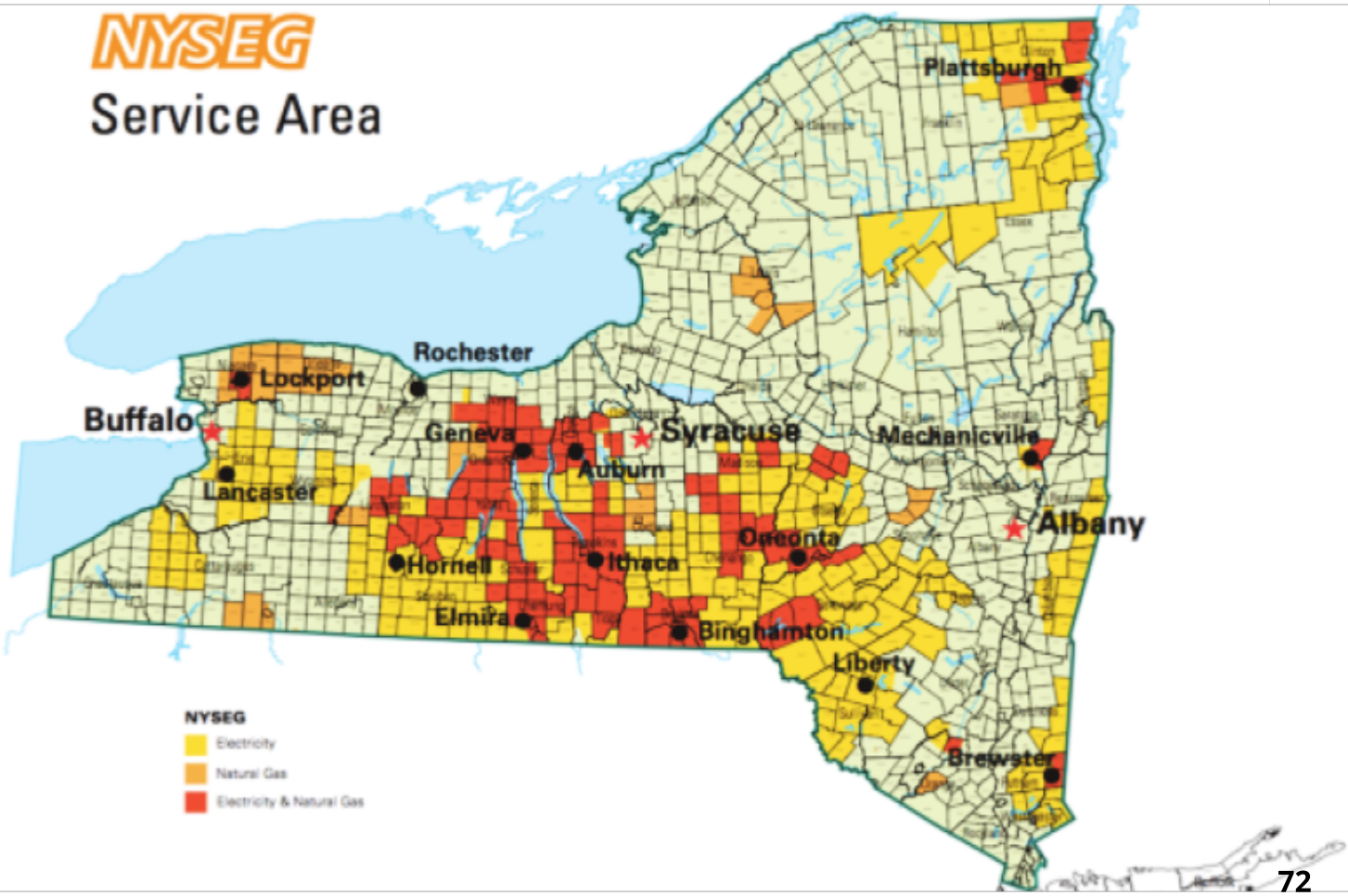


The New York Independent System Operator (NYISO) and the Utilities (New York State Electric & Gas Corp (NYSEG) and Niagara Mohawk (NiMo)) have databases that report the various interconnection requests for requested changes to their systems. These databases are very volatile with projects being proposed throughout the year and projects are being withdrawn from the database for various financial and siting issues. The Interconnection Queues for the NYISO and the Utilities differ by the size of the project. Smaller MW additions are left to the Utilities to evaluate while the larger additions to the electric system are the responsibility of the NYISO to evaluate. Both the Utilities and the NYISO have procedures to evaluate the impact of the addition to the system. Proposed projects also have to get approval from the NYS DPS and DEC before they can move forward in the project development.

The NYISO interconnection information includes both the proposed projects in the Interconnection Queue and the projects that are in-service since the start of the NYISO in 1998 and can be sorted by fuel type (Wind, Solar, Hydro, and Energy Storage) for each county. The Utility interconnection projects did not have direct reference to the county, but did list the city and village for the proposed project. Based on the city or village, the county for the project was

identified and sorted by renewable resources. The following maps illustrate the service territory for NYSEG and NiMo. There are overlapping projects for Cortland, Delaware, Otsego, Schoharie and Tompkins Counties where the county is served by both NYSEG and NiMo.





The information provided in the following table is from the NYISO Interconnection Queue website for September 30, 2020. The following table summarizes the projects currently in service or proposed in the Interconnection Queues for the 11 county region.

County/Division	Queue Ref	Wind kW	Solar kW*	ES kW	Hydro kW
Broome	NYISO	124,200	0	120,000	0
	NYSEG	38	43,984	38	0
	Total Capacity	**124,276**	**43,984**	**120,038**	**0**
Chemung	NYISO	0	0	0	0
	NYSEG	22	24,170	2,006	1,998
	Total Capacity	**22**	**24,170**	**2,006**	**1,998**
Chenango	NYISO	100,800	20,000	5000	
	NYSEG	0	124,400	16,319	0
	Total Capacity	**100,800**	**144,765**	**21,319**	**0**
Cortland	NYISO	0	160,000	0	0
	NYSEG/NiMo	190	165,284	36,000	0
	Total Capacity	**190**	**325,284**	**36,000**	**0**
Delaware	NYISO	0	0	0	0
	NYSEG/NiMo	12	17,600	1,762	0
	Total Capacity	**12**	**17,600**	**1,762**	**0**
Otsego	NYISO	0	0	0	0
	NYSEG/NiMo	96	7,100	16,812	1,500
	Total Capacity	**96**	**7,100**	**16,812**	**1,500**
Schoharie	NYISO	0	149,000	0	120,000
	NYSEG/NiMo	10,024	28,478	5	0
	Total Capacity	**10,024**	**177,478**	**5**	**120,000**
Schuyler	NYISO	0	50,000	0	0
	NYSEG	7	35,712	4,997	0
	Total Capacity	**7**	**85,712**	**4,997**	**0**

Steuben	NYISO	777,300	547,000	0	0
	NYSEG	24	127,826	0	0
	Total Capacity	**777,324**	**674,826**	**0**	**0**
Tioga	NYISO	0	39,600	290,000	0
	NYSEG	45	115,787	7	0
	Total Capacity	**45**	**53,600**	**290,007**	**0**
Tompkins	NYISO	0	586,900	0	0
	NYSEG/NiMo	50	75,714	1,378	8,392
	Total Capacity	**50**	**662,614**	**1,378**	**8,392**
NYISO Total		1,002,300	1,552,500	415,000	120,000
Utility Total		10,420	775,170	67,532	11,890
Total		1,012,720	2,327,670	482,532	131,890
Resulting kWhrs		2,893,486	16,867,174		

Projects listed in the NYISO Interconnection Queue have anywhere from a few months to 3+ year commercialization horizon. The NYISO capacity includes the renewables added to the system since 1998 the start of the NYISO's operation. The Wind projects, as well as Hydro tend to be larger in scope and appear on the NYISO Interconnection Queue whereas there is little development of these resources at the Utility level. The grid size solar installations (over 20 MW) are just starting to come into the NYISO Interconnection Queue. The NY-SUN program accounts for the largest penetration of the Solar renewable which is primarily related to projects and the residential, commercial and industrial levels and generally located behind the meter. The data in the above is limited to projects in operation or to being developed in the relative short term. The table above is presented to illustrate penetration to date of the renewable resources into the various counties. This penetration is likely due to the beneficial siting of the resource, the interest and support for the development by the community and/or the incentive provided through local, State and Federal funding. As the CLCPA gets traction from the various incentives and business opportunities, the magnitude of the renewables penetration is expected to increase. The NYS PSC and NYSERDA monitoring of the progress may result in specific actions to incent development appropriately to meet the CLCPA program goals.

The earlier illustration for the Statewide Electric Load & Services – 2025 & 2030 notes that there are 24,990 gigawatt hours of renewables yet to be deployed. This represents approximately 24% of the 2030 goal yet to be developed. For the 11 county region, wind renewable development at this time is ~0.01% of the 2030 goal statewide wind resource penetration goal and Solar development is at ~0.23% of the 2025 statewide solar penetration goal. Energy Storage, which complements the intermittent renewable resource supply for the 11 county region, is at approximately 32% of the 2025 target.

From the table, it appears Chenango, Cortland, Schoharie, Steuben, Tioga and Tompkins have the greatest activities to move to the CLCPA goals, although most of the projects are at the NYISO level providing large grid connected facilities. Much of the CLCPA is dependent on the State's activities to promote offshore wind development. The offshore wind resource development is approximately 17% of the 2030 goal.

Parallel and in support of the CLCPA, the NYS PSC requires each NYS Utility to develop their Distributed System Implementation Plans (DSIPs). The DSIP for New York focuses on six core areas:

- Forecasting: Improving How Utilities Predict System Needs
- Planning for increased Penetration of Distributed Energy Resources
- Planning for Non-Wire Alternatives: Reforming How Utilities Address System Needs
- Advanced Metering Infrastructure: Utilities' Plans to Enhance Information Gathering
- Electric Vehicle Infrastructure: Utilities Plans to Enable EV Development
- Distributed System Platform InvestmentNYSEG and NiMo's DSIP provides a comprehensive multi-year plan that presents investments, innovation activities, and changes in utility planning and operations that are designed to deliver value to customers, enhance grid performance, and contribute to a cleaner environment. The intent is for the integration and deployment of energy storage, electric vehicles, distributed generation, and energy efficiency to be included in the planning, grid operations, and market services system design.

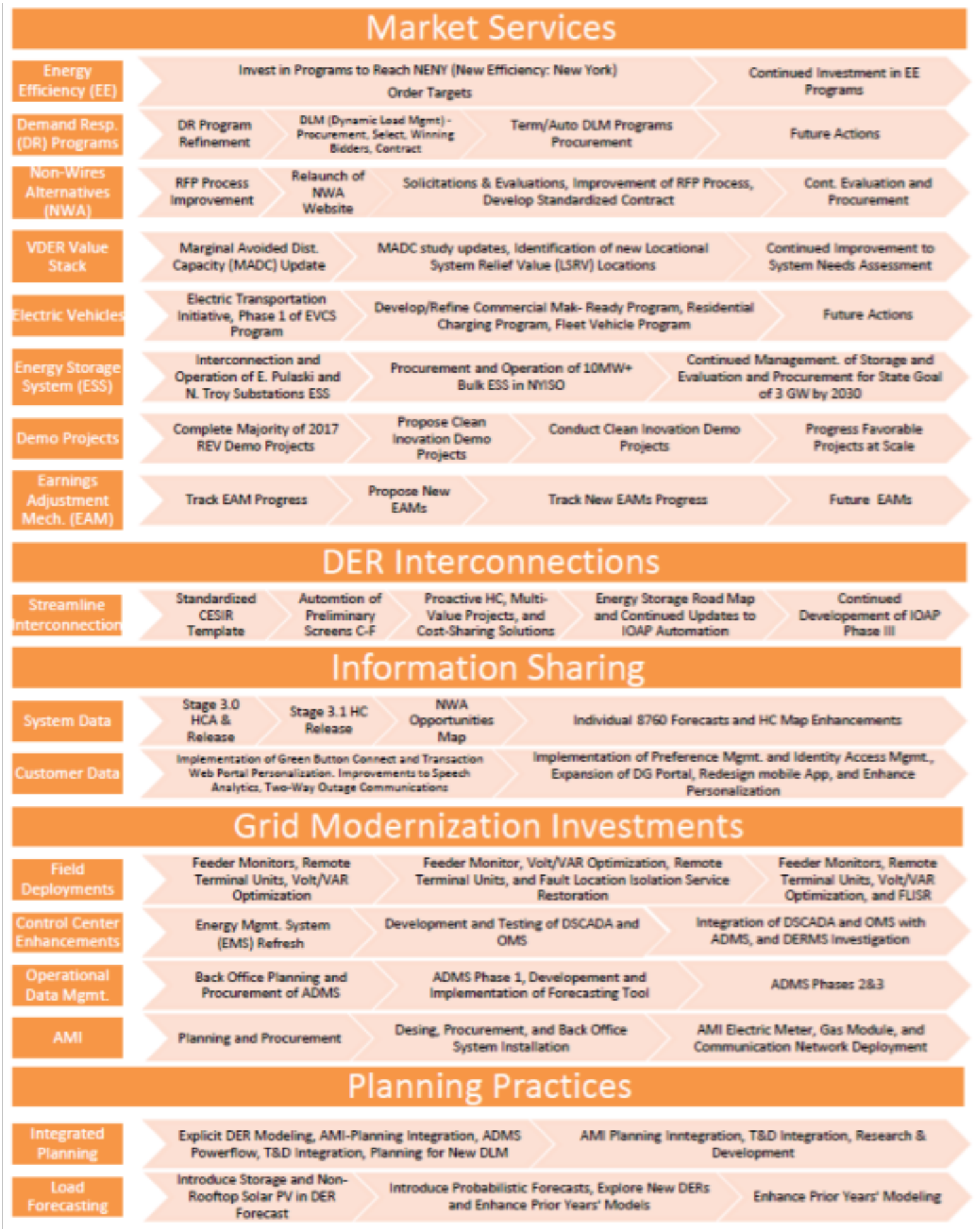
NYSEG's 2020 DSIP updated report dated June 30, 2020 includes the following priorities for the next 5 years:

Priorities for the next five years

1. Implement Advanced Metering to measure electric flows at the grid edge and enable pricing and programs that help customers make informed energy decisions.
2. Make significant progress implementing our long-term Grid Automation program, including investments in grid devices[1] that measure, monitor and control electric power flows along the network, capabilities that are necessary to accommodate large numbers of connected distributed energy resources (DER) and beneficial electrification loads while also enhancing the resiliency of the grid.
3. Enhance the accuracy and integrity of data and network models that correctly represent our distribution system assets and all connected DER and electrification loads - information that is required to plan and operate the grid.
4. Improve our integrated planning methodologies and the data and insights we share with developers.
5. Enable the deployment of clean DER and electric vehicle charging stations to make progress toward New York's clean energy goals.
6. Implement an Advanced Distribution Management System (ADMS) and design and build other control systems that will be needed to optimize our grid and DER.

Similarly, National Grid/ Niagara Power Corporation provided their updated DSIP report dated June 30, 2020 included the following Key Progress and Plans. The following table provides the program plan through 2025.

Along with the Utilities and the project developers, the counties throughout the State must aggressively participate in supporting the NYS in reaching its goals to create carbon free electricity by 2040. The NYS PSC has a proceeding currently underway Case 20-E-0249 – In the Matter of Renewable Energy Facility Host Community Benefit Programs, where from the Accelerated Renewable Energy Growth and Community Act would "provide benefits to utility customers in the Host Communities in which future Major Renewable Energy Facilities are located". This program should further incent community involvement.


Market Services
Energy Efficiency (EE)
Invest in Programs to Reach NENY (New Efficiency: New York) Order Targets
Continued Investment in EE Programs
Demand Resp. (DR) Programs
DR Program Refinement
DLM (Dynamic Load Mgmt) - Procurement, Select, Winning Bidders, Contract
Term/Auto DLM Programs Procurement
Future Actions
Non-Wires Alternatives (NWA)
RFP Process Improvement
Relaunch of NWA Website
Solicitations & Evaluations, Improvement of RFP Process, Develop Standardized Contract
Cont. Evaluation and Procurement
VDER Value Stack
Marginal Avoided Dist. Capacity (MADC) Update
MADC study updates, Identification of new Locational System Relief Value (LSRV) Locations
Continued Improvement to System Needs Assessment
Electric Vehicles
Electric Transportation Initiative, Phase 1 of EVCS Program
Develop/Refine Commercial Mak- Ready Program, Residential Charging Program, Fleet Vehicle Program
Future Actions
Energy Storage System (ESS)
Interconnection and Operation of E. Pulaski and N. Troy Substations ESS
Procurement and Operation of 10MW+ Bulk ESS in NYISO
Continued Management. of Storage and Evaluation and Procurement for State Goal of 3 GW by 2030
Demo Projects
Complete Majority of 2017 REV Demo Projects
Propose Clean Inovation Demo Projects
Conduct Clean Inovation Demo Projects
Progress Favorable Projects at Scale
Earnings Adjustment Mech. (EAM)
Track EAM Progress
Propose New EAMs
Track New EAMs Progress
Future EAMs
DER Interconnections
Streamline Interconnection
Standardized CESIR Template
Automtion of Preliminary Screens C-F
Proactive HC, Multi-Value Projects, and Cost-Sharing Solutions
Energy Storage Road Map and Continued Updates to IOAP Automation
Continued Developement of IOAP Phase III
Information Sharing
System Data
Stage 3.0 HCA & Release
Stage 3.1 HC Release
NWA Opportunities Map
Individual 8760 Forecasts and HC Map Enhancements
Customer Data
Implementation of Green Button Connect and Transaction Web Portal Personalization. Improvements to Speech Analytics, Two-Way Outage Communications
Implementation of Preference Mgmt. and Identity Access Mgmt., Expansion of DG Portal, Redesign mobile App, and Enhance Personalization
Grid Modernization Investments
Field Deployments
Feeder Monitors, Remote Terminal Units, Volt/VAR Optimization
Feeder Monitor, Volt/VAR Optimization, Remote Terminal Units, and Fault Location Isolation Service Restoration
Feeder Monitors, Remote Terminal Units, Volt/VAR Optimization, and FLISR
Control Center Enhancements
Energy Mgmt. System (EMS) Refresh
Development and Testing of DSCADA and OMS
Integration of DSCADA and OMS with ADMS, and DERMS Investigation
Operational Data Mgmt.
Back Office Planning and Procurement of ADMS
ADMS Phase 1, Developement and Implementation of Forecasting Tool
ADMS Phases 2&3
AMI
Planning and Procurement
Desing, Procurement, and Back Office System Installation
AMI Electric Meter, Gas Module, and Communication Network Deployment
Planning Practices
Integrated Planning
Explicit DER Modeling, AMI-Planning Integration, ADMS Powerflow, T&D Integration, Planning for New DLM
AMI Planning Inntegration, T&D Integration, Research & Development
Load Forecasting
Introduce Storage and Non-Rooftop Solar PV in DER Forecast
Introduce Probabilistic Forecasts, Explore New DERs and Enhance Prior Years' Models
Enhance Prior Years' Modeling

Private Sector Participation Opportunities

- Train staff in Clean Tech Applications
- Utilize Interns from area colleges and Universities
- Implement Apprenticeship Programs
- Utilize and Promote Energy Efficient Green Building Techniques
- Update Facilities to be Energy Efficient
- Use On-Site Renewable Generation

Public Sector Participation Opportunities

- Implement Municipal Building Energy Efficiency Upgrades
- Participate in NYSERDA's Clean Energy Communities Program
- Review local Building Codes and Planning Documents to include clean energy technology
- Utilize Interns from area Colleges and Universities
- Add green spaces and trees to downtown areas to decrease heating and cooling needs
- Support Public Transit Options within and between communities
- Engage communities in public forums regarding clean energy benefits and opportunities

Appendix

TEN Action Items

Covid-19

Study Outreach

Research Literature

Works Cited

Regional Plans & Studies

TEN ACTION ITEMS TO-DATE

These action items have been developed based on specific interaction with project partners. Additional action items are expected in 2021 as the impact of the coronavirus begins to subside.

1. TEN to collaborate with Schoharie County and Niagara Mohawk Power to review alternatives to address transmission constraints at rural industrial sites in Schoharie County. TEN will hold the first meeting in the first quarter.

2. TEN to develop a list of energy consultants for clean energy building retrofits. List will be developed in the first quarter.

3. TEN to participate in the Talent Task Force for workforce development for Broome and Tioga Counties.

4. TEN to support AM&T PACT project to address workforce development for clean energy manufacturing.

5. TEN to collaborate with the Waverly School District and Dawnbreakers to develop a white paper on the creation of a STEM Education Center. First meeting has been held. Develop a white paper in the first quarter.

6. TEN to collaborate with Siemens, the Southern Tier 8 Regional Board, SUNY Broome, BOCES and Greater Binghamton Chamber on the restart of a regional STEM Hub initiative. A key step is to identify some dedicated resources to lead the effort. Identify resources by July 1, 2021.

7. TEN to collaborate with iM3NY, the Broome County Chamber, the Southern Tier 8 Regional Board to support development and implementation of a PR strategy for iM3NY. This effort has started and will continue until early operation.

8. TEN to collaborate with Upstate Venture Connect and regional partners to initiate development of a seed fund for the Southern Tier. First organizational meeting to take place by July 1, 2021.

9. Ten to collaborate with the Southern Tier 8 Regional Board, the Southern Tier Central Regional Board and other project partners to create print and video summary of the clean energy industry cluster in the Southern Tier.

TEN activities to support study recommendations in 2021

1. Mentor entrepreneurs and organizations supporting the ecosystem including the previous winners of the 76 West Clean Energy Competition, our Universities and colleges and service organizations.

2. Maintain database on the clean energy technology industry cluster

3. Publish quarterly newsletter and bi-monthly membership meetings that feature organizations and companies that are involved in the clean energy technology industry cluster.

4. Provide periodic updates on the Climate Leadership and Communities Protection Act and its impact on the Southern Tier

5. Maintain contacts with municipalities, organizations and key businesses involved in development of the industry cluster in clean energy technology

6. Promote and participate in collaborations to support projects and key programs such as workforce development, STEM Hub, entrepreneurial development, economic gardening, supply chain development, corporate attraction, local and regional marketing of the industry cluster in clean energy technology.

7. Begin development of a technology road map that will identify investment opportunities and support cost effective achievement of clean energy goals by county and region. Seek support of NYSERDA and other partners.

8. Work with Upstate Venture Connect and other organizations to form a “for profit” early-stage investment fund for the Southern Tier. Develop an information hub for entrepreneurs.

Working through Challenges: Covid-19

I. How has Covid affected conducting the study?
II. How has Covid-19 affected CEI & the regional workforce?

Conducting a Study during Covid-19

This study was initiated in January and by mid-March the community was impacted by COVID – 19. The primary goal of counties and the region was to respond, recover and thrive from a world-wide crisis. Today, the crisis is peaking again but the hope for a vaccine is getting closer. Members of TEN have been involved in community efforts to respond and have participated in collaborations with businesses, hospitals, industry, schools, municipalities and service providers. We have heard first hand how organizations and businesses are changing their practices for the interim and the long-term.

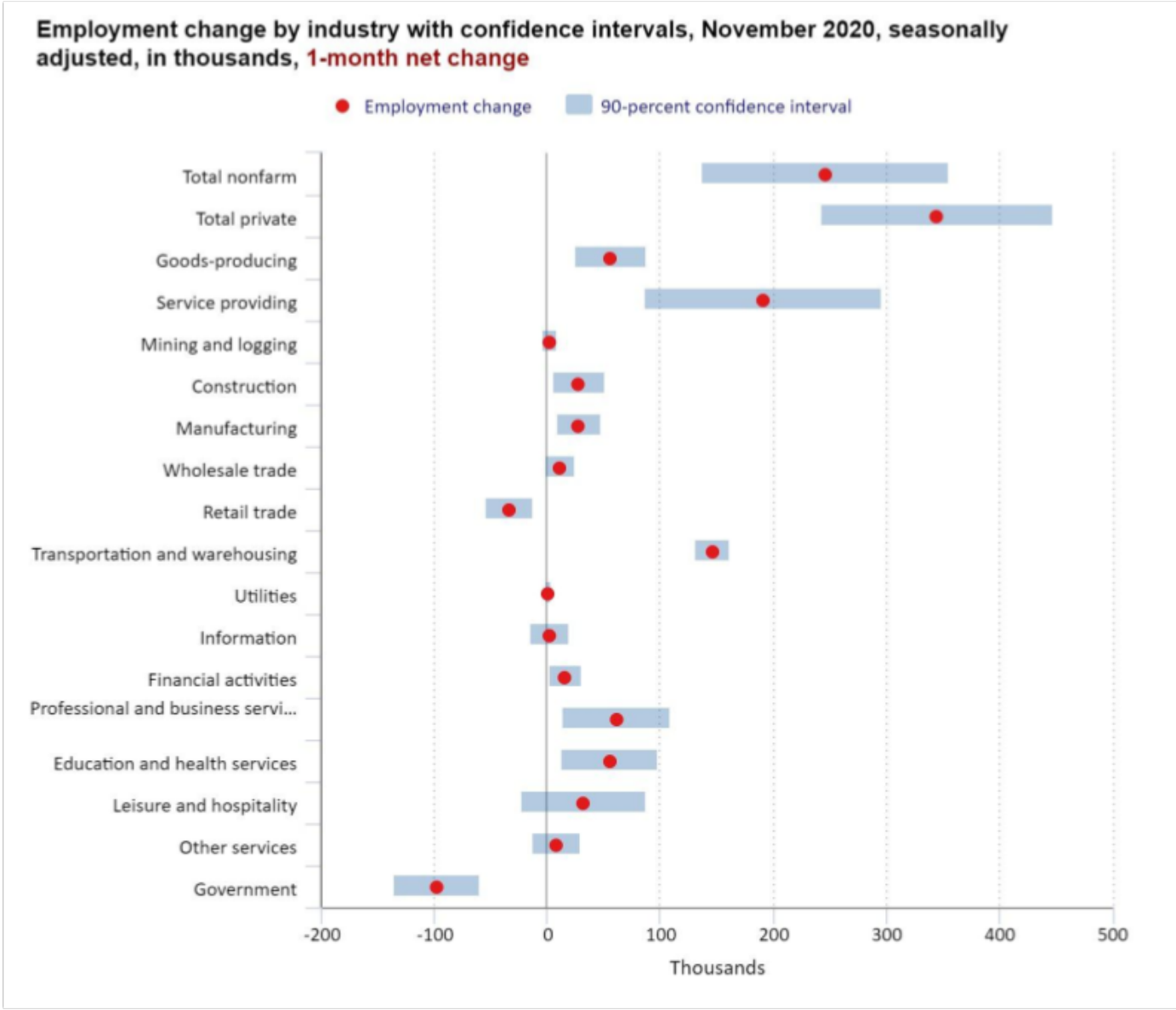
COVID – 19 has impacted this study in the following ways:

- The number one focus for the counties has been to address community safety and recovery. With staff busy with new challenges daily, often while dealing with staff shortages, it was difficult to obtain information from surveys and phone calls.
- COVID – 19 restriction prevented face to face collaboration. TEN will be following up with face-to-face collaboration during 2021 when it is safe to visit county organizations and businesses. TEN will also periodically update the database and assessment of the impact of the Climate Leadership and Protection Act. Additional action plans will be developed.
- On a positive note, meetings through platforms like zoom have accelerated and will remain a permanent option after the crisis. This development could prove to be a benefit to rural areas if broadband access is improved.
- Budgets at all levels of government, educational institutions and businesses will be strained for a prolonged period of time as they struggle to accommodate covid-related changes. Some development projects have been stopped or deferred.
- Service providers to low-to-moderate income populations are facing significant budget cuts. The needs of our communities are rising due to COVID – 19 while services are being reduced.

- The region will rely more heavily on volunteers and community collaboration to make progress in a period of scarce resources. Recommendations in this report may take longer to implement as communities struggle to recover.

Covid-19 and the Workforce

Changes in some sectors which previously provided a high percentage of employment to the region (hospitality industry, retail) are negative, while other sectors (transportation & warehousing, manufacturing, professional & business services, education, and health) have seen increases in jobs on a national level, as evidenced in the table of Department of Labor statistics below.
*Arts, Ent, Etc & Retail are hardest hit by Covid -19; people transitioning from these industries are good candidates for STEM skills up-training.
Companies are restructuring their process for the workforce. Jobs not required for hands-on operations and manufacturing can remain remote. Large corporations with many locations can



conduct their hiring at those locations where hiring is ideal in terms of availability, cost and skill. This trend can work both ways. We can attract workers with job flexibility that want to escape high population areas. On the other hand, existing companies can recruit from other regions. It is too early to determine the net impact of these changes. It is imperative that support systems for workforce development are effective for this new level of competition. Some companies are reluctant to give workforce forecasts as they adjust to the new realities.

Across the country slowed shipping and supply-line challenges are causing companies to consider on-shoring of manufacturing and supply chains. This offers the Southern Tier's strong advanced manufacturing, custom manufacturing and advanced materials industries opportunities for growth.

1911 hand-sanitizer production. Many regional brewers and distillers were able to alter lines to help cover shortages.

Covid-19 and the Southern Tier Population Influx

Numbers and News show migration into Upstate NY. Some areas of our region (especially Delaware County) are experiencing an influx of population. Most of these increases are not captured in the latest census and it is too early to determine if this change will be sustained.

On a related note, two articles by Business Insider featured Southern Tier cities. The first article issued June 30 was titled "The best Northeast cities to live in after coronavirus". Elmira, Binghamton and Ithaca were noted with Ithaca rated #2. The second article issued September 22 was titled "Best US cities to live in after the coronavirus". Ithaca was rated #19 in the country. The quality of life provided in the rural Southern Tier is appreciating in value after our collective experience with the coronavirus.

Study Outreach

Summary of Outreach for the Study

1. Developed customized surveys, three examples of which follow this summary.

2. Contacted 42 Private entities working in clean energy in the region as well as 38 public entities playing a role in the regional cluster.

3. Attempted to contact all 35 clean energy-related startup companies in the Southern Tier. Completed interviews with leaders of 28 of the companies. Developed a one-year and five year jobs forecast from the interview. Will continue to reach out to the remaining 7 companies. Verified the companies were still active through incubator databases. Startup company list is in the appendix. Will repeat this review on a yearly basis.

4. Interviewed the following clean energy companies: Raymond, Custom Electronics, Corning Inc., Amphenol in Sidney, BAE (several discussions), Siemens, NYSEG, Franklin Energy (Presentation at TEN), ETM Solar, Revolution Solar, Delta Engineering (twice), Customized Energy Solutions, Taitem Engineering. Many other companies were provided surveys.

5. Interviewed the following supporting organizations: Koffman Incubator, Hartwick College, SUNY Cobleskill, Incubator Works, Mark Project, NEST, Upstate Venture Connect (three times), Cornell Cooperative Extension in Ithaca (reviewed all Extension offices in the Southern Tier), AM&T, SUNY Broome (ongoing discussions), Strategic Doing.

6. Interviewed the following State Departments and Agencies: WDI (4 participants), Empire State Development (Brenda Grober made presentation to TEN), PSC deferred to NYSERDA VP of Innovation, NYBEST, NYISO (4 participants), Department of Labor, NYSERDA Training (2 participants).

7. Provided project updates at 5 CEDS meetings. Interviewed five County Planners, Visited Waverly Schools for proposed STEM Center and ARC Grant, Village of Endicott (several including proposed clean energy strategy), submitted survey to all planners and economic developers.

8. Provided work drafts to Executive Director of STC and met to discuss project. Sent information package to three IDAs including description of TEN, description of projects, survey questions and list of contacts that TEN would make. Sent survey to the three IDAs. Provided December project update.

9. Participated in several forums during the year:

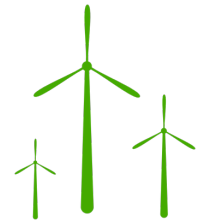
- TEN Workforce Committee
- Held six TEN Membership Meetings where companies and service providers make presentations. The scope of the grant has been distributed to the e-mail list of about 200. Provide updates on the grant.
- Participated in 76 West business plan competition as judge and advisor.
- Member of Broome County COVID Recovery Plan for Workforce
- Member of Broome/Tioga Talent Taskforce
- Participated in Regional Stem initiative
- Gave presentation on funding options for entrepreneurs at the Koffman Incubator
- Mentored several entrepreneurs
- Participated with community collaboration Endicott Proud on a monthly basis and serve on the Executive Committee. Provided three updates on the ARC grant.
- Participated in several discussions on the developments of a "soft landing" program for the Southern Tier.
- Sponsored AM&T grant to support workforce development for clean energy manufacturers
- Member of Greater Binghamton Legislative Committee and Government Affair Committee. Barriers to growth are discussed at length.
- Helped to develop PR strategy for iM3NY.
- Member of Greater Binghamton Chamber committee on clean energy education.

MEETINGS with NYS DEPARTMENTS & AGENCIES

TEN met with NYSERDA, New York BEST, Workforce Development Institute, NYISO, Empire State Development and NYSEG. NYSEG was added because of the key role they will play in implementing clean energy initiatives throughout the region. The NY PSC deferred to NYSERDA. In addition, a TEN Executive Board member follows PSC and ISO proceedings and his company is a member of New York Best. NYSEG is a member of TEN and their contractor made a presentation to the TEN membership committee on utility clean energy offerings. Brenda Grober, Director of Industrial Development, Clean Technology also made a presentation to the membership committee on her work. She provided thoughts on how regions can improve their role in economic development.

During this study, TEN also Interviewed Liz Nielson, author at Strategic Doing, and Jaynce Fadden, Director of Strategic Engagement, UNA College of Business. Strategic Doing is a community collaboration organization developed at Purdue University. Liz and Jayce participated in the ecosystem project for the Shoals Shift and provided their project report along

with an NBIA publication title “Best Practices in Rural Business Incubation: Successful Programs in Small Communities.”



Some key points include:

1. The services, incentives, grants and programs offered by NYSERDA, the utilities and others are evolving quickly. It is important to assess these offerings and determine opportunities for Counties and the region. NYSERDA is seeking support to promote their programs in the region. Penetration of NYSERDA programs is greatest downstate and along the Hudson River.

2. The utilities developed significant capital plans to upgrade the Transmission System. The utilities also have developed new incentives for local projects to upgrade the transmission system or extend service. These plans and incentives need to be reviewed to see if there are opportunities to remove system constraints for key economic development sites. Other options for addressing constraints include energy storage, distributed generation, power factor control and load limiting technology.

3. WDI and others are concerned about improving the opportunity for New York State companies to compete for clean energy development projects. They also see a shortage of good project management skills. They are also concerned that local opposition to clean energy projects can slow progress. Greater levels of clean energy education are required in our communities.

4. New York State is reviewing siting of clean energy projects from a social equity perspective. Are rural communities underrepresented and should there be some incentives?

5. New York State is very serious about the State being well positioned in the emerging clean energy industry. The Vice President of Innovation at NYSERDA is exploring ways to improve collaboration between the business and university experts within the State and attracting major demonstration projects and alliances with leading clean energy companies in the world.

6. The ISO believes the goals for 2030 can be met with current technology. Goals beyond 2030 will require advancements in technology.

7. NY BEST agrees that workforce development and a strong, regional eco-systems are key factors in growing the clean energy industry in New York State. We need many more storage development projects in a variety of use cases. The Southern Tier may be a good location to improve battery pack design.

8. Brenda Grober, Director of Industry Development, Strategic Business Development Division, New York State Empire State Development, offered several recommendations for counties and regions to improve economic development relating to clean energy technology.

   a. Develop a strategic communications plan on the clean energy industry in your region and your capabilities to support.

b. Develop more “ready built” sites. Make sure permitting processes are prompt and effective. Take a personal interest in the companies that are considering your region for location.

c. Be more active in trade shows and trade mission trips. Be knowledgeable about the clean energy industry more broadly and make inquiries on companies that could relocate to your area or be a source of development projects.

d. Be aware of supply chain opportunities. A major wind manufacturer may not locate to the Southern Tier but may locate along the Hudson River. Be aware of the various sites that promote supply chain opportunities.

e. Improve the reputation of your region for business development.

The TEN recommendations address these issues and opportunities.

A variety of business growth challenges were cited by the 50+ company and community leaders surveyed during the study. We also reviewed county and regional plans that are noted in our list of references and participated in several committees where these topics are discussed. Those committees included:

- Broome/Tioga Talent Task Force
- COVID - 19 Broome County Workforce Committee
- Greater Binghamton Chamber Legislative Committee
- Greater Binghamton Chamber Government Affairs Committee
- Endicott Proud community collaboration
- TEN workforce development committee
- TEN membership meetings

The top barriers discussed:

Workforce: This topic remains a top barrier to business growth. Most counties have programs for workforce development but the jobs pipeline to the trades and to STEM continues to be weak. COVID - 19, has further weakened the pipeline as students opt for a year off in their schooling, according to Dr. Kevin Drumm, President of SUNY Broome. Carol Miller, Executive Director of AM&T says the lack of labor is curtailing business of many of the region's manufacturers today. The growing clean energy technology industry represents significant growth opportunities, and the Southern Tier must keep pace with labor needs. Improved labor supply will also accelerate penetration of clean energy projects.

Two separate issues were mentioned during the study regarding the regional workforce: lack of local talent and difficulty attracting out-of-area talent. Some reported difficulties recruiting workers to the Southern Tier, stating that potential candidates had mentioned limited air travel and lack of shopping as negatives about our region.

One business leader mentioned a lack of local engineering talent. Conversely, employment data showed well above average numbers of workers with those desirable skills in other areas within the region, suggesting a lack of connectivity and regional knowledge.

Infrastructure Gaps: Transmission constraints are an issue for specific sites and regions in the Southern Tier. Schoharie county has limited capacity along route 7, including SUNY Cobleskill. The utility companies have committed to significant upgrades of the grid. These plans need to be reviewed for application to key sites in each of the counties. Multiple parties mentioned lack of high speed internet.

Ecosystem Development: Ithaca has an excellent reputation as a startup community. The remainder of the Southern Tier has made great strides with incubators, support programs and business plan competitions, but more supports are needed. Per Stromhaug, Vice President of Entrepreneurship and Innovation Partnerships sees a need for entrepreneur led seed funds and great involvement by community leaders and industry. The ecosystem for rural communities needs to be strengthened.

Resource Limitations: County and regional transformation requires resources to develop new programs. In some of our schools, municipalities and small manufacturers there is not time to take on new projects. AM&T's Carol Miller believes some of our smaller manufacturers will fade away if they do not take steps to re-tool and update their businesses. Siemens is willing to be a strong partner on development of the STEM Hub but we need additional resources to lead the effort.

Information is not shared across counties within the region. Resource and program information is not well shared within all counties; further analysis of those networks is needed to define bottlenecks, gaps and potential remedies

Steve Palmatier in Chenango County has been working on an ecosystem for Norwich in concert with SUNY Morrisville. They have developed a plan that would involve support by the Startup Alliance and the Koffman Incubator. They are seeking grant funding to further the program.

Per Stromhaug, Assistant Vice President for Innovation and Economic Development at BU noted that the Koffman incubator is making some of their programs virtual and other incubators in the region have been taking advantage of these offerings. They would like to provide more hands-on support to more rural communities, but staffing is limited. He mentioned that Incubator Works has been using Co-Starters, a national provider of ecosystem support to communities to supplement their offerings; the Koffman is reviewing this option.

Lisa Ianello, Director of Corporate Foundation and Government Relations at Hartwick College, has a great deal of involvement in the CADE incubator in Oneonta. Hartwick also provides testing services to brewers and beverage makers in the region.

Regarding resource limitations the following are ideas that have been discussed.

1. NYSERDA offers 75% to 90% reimbursement to qualifying interns that work on clean energy projects and programs.

2. The use of interns and volunteers from our colleges and universities can be increased through focus and innovation. The use of interns has the added benefit of introducing our jobs and careers to the student population.

3. Make use of existing programs. Across the nation programs and best practices have been developed on many topics critical to our transformation of the Southern Tier. Within New York State NYSERDA, WDI, Department of Labor and the Utilities have developed programs and funding opportunities. Many of these opportunities are listed in the appendices.

4. Local and regional collaboration can benefit from proven methodologies such as Strategic

Doing. This methodology is designed for busy people operating in a network with scarce resources. Training and guidance can be provided locally and regionally.

5. More organizations like TEN can be formed to focus on specific issues and opportunities in economic development and community well-being. One of TEN's goals is to attract more members of industry into the economic development process. We operate on a "give first" principle to support entrepreneurs and organizations that improve the ecosystem for development.

6. Make use of major corporations that support community development. Microsoft, Google, IBM, Goldman Sachs, J.P. Morgan, Siemens and many others offer support for community development. The City of Syracuse recently partnered with Microsoft for the development of a smart city. We are working with Siemens on the development of best practices for STEM development. Siemens couples smart energy solutions in the community with a focus on educational programs that bolster workforce development.

7. Siemens is active in the region and seeks institutional partners, including K-12, higher education, government and industry to couple clean energy solutions with education and workforce development initiatives. Siemens supports best practices for creating virtuous cycles of economic development through collaboration and support across an engaged STEM-to-Workforce ecosystem. It is an example of a company that will bring financing, project development, education and research opportunities into the region, in partnership with public and private organizations who share its vision of smart connected communities.

Each region must develop a strategy based on its strengths and needs. The Southern Tier is a primarily rural region with great assets and a high quality of life. To compete with large urban areas and provide an environment that attracts and retains the talent we require, we should be moving toward a "smart region" concept where greater levels of in-depth collaboration are taking place through technology. Some major corporations can help accelerate this transformation.

SURVEY EXAMPLE A

Survey for Planners and Economic Developers: November 2020

Introduction: Tier Energy Network (TEN) is working on a grant through the Appalachian Regional Commission to study the developing Southern Tier Clean Energy Technology Industry Cluster and develop strategies for enhancement. The project is nearly complete and this is a final opportunity to provide comments and suggestions. We appreciate your participation during this most difficult year. Responses by December 5 can be considered for the final report. We have captured the responses provided during our discussions.

1. How is clean energy technology being considered in the projects and programs you are developing for the county?

2. Does the county have any special programs or projects that you would like mentioned in the report?

3. Does the county have any significant issues and opportunities relating to energy?

4. New York State's Climate Leadership and Community Protection Act is calling for carbon free electricity by 2040. What impact will this program have on your county?

5. One area of focus in the grant is entrepreneurial support in rural areas. Do you have any recommendations or opportunities for collaboration on this topic for the county or region?

6. What barriers to growth do you see in the county and region? Examples include workforce development, day care, public transportation, permitting, infrastructure gaps, lack of resources etc.

7. We have received many comments on the need for education and analysis on energy to business, economic developers and the general public. How can this need best be met?

8. How long will it take the Southern Tier to recover from COVID-19?

9. Do you have any other comments regarding the study.?

Jeff Smith

607-754-0673

SURVEY EXAMPLE B

Survey for SUNY Cobleskill: November 2020

Introduction: Tier Energy Network (TEN) is working on a grant through the Appalachian Regional Commission to study the developing Southern Tier Clean Energy Technology Industry Cluster and develop strategies for enhancement. The scope of the project is attached. The project requires TEN to interview businesses and organizations involved in the industry. I would like to schedule a brief call or zoom meeting to describe the project and address the following questions.

1. How is clean energy technology being considered in the projects and programs you are developing for the campus?

2. How many equivalent positions are involved in clean energy technology?

3. How many equivalent positions do you expect to be working in clean energy technology in five years?

4. New York State's Climate Leadership and Community Protection Act is calling for carbon free electricity by 2040. What impact will this program have on your course offerings and community initiatives?

5. One area of focus in the grant is to focus on entrepreneurial support in the rural areas. You have programs in this regard. Do you have any recommendations or opportunities for collaboration on this topic for the county or region?

6. What barriers to growth do you see in the county and region? Examples include workforce development, day care, public transportation, permitting, infrastructure gaps etc.

7. How long will it take the Southern Tier to recover from COVID-19?

8. Do you have any other comments regarding the study.?

Jeff Smith

607-754-0673

Jsmith1532@aol.com

SURVEY EXAMPLE C

Survey for iOXUS: November 2020

Introduction: Tier Energy Network (TEN) is working on a grant through the Appalachian Regional Commission to study the developing Southern Tier Clean Energy Technology Industry Cluster and develop strategies for enhancement. The scope of the project is attached. The project requires TEN to interview businesses and organizations involved in the industry. I would like to schedule a brief call or zoom meeting to describe the project and address the following questions.

1. How is your business impacted by COVID – 19?

2. How many equivalent positions are involved in clean energy technology products and services in the Southern Tier?

3. How many equivalent positions do you expect to be working in clean energy technology in five years in the Southern Tier?

4. New York State's Climate Leadership and Community Protection Act is calling for carbon free electricity by 2040. What impact will this program have on your business and the services that you provide?

5. What barriers to growth in your business do you experience? Examples include workforce development, day care, public transportation, permitting, infrastructure gaps etc.

6. How long will it take the Southern Tier to recover from COVID-19?

7. Do you have any other comments regarding the study.?

Jeff Smith

607-754-0673

Jsmith1532@aol.com

REFERENCES

LITERATURE CITATIONS

Ortuzar, G. & Slaper, T. (2015). Industry Clusters & Economic Development. Indiana Business Review, Spring, 7-9.

Lehmann, E. & Menter, M. (2017). Public cluster policy and performance. The Journal of Technology Transfer, 2017-09-15, Vol.43 (3), p.558-592, doi: 10.1007/s10961-017-9626-4

Desrochers, P., Hospers, G., & Sautet, F. (2008). The next Silicon Valley? On the relationship between geographical clustering and public policy. International Entrepreneurship and Management Journal, 2008-03-05, Vol.5 (3), p.285-299, doi: 10.1007/s11365-008-0080-5

Park, S.; Rebecchi, E; Garibaldo, F. (2017). The Fourth Industrial Revolution and implications for innovative cluster policies. AI & Society, 2018-08, Vol.33 (3), p.433-445, doi: 10.1007/s00146-017-0777-5

Carayannis, E. & Campbell, D. (2005). Key Insights and Lessons Learned for Policy and Practice. In Carayannis, E. & Campbell, D. (Eds), Knowledge creation, diffusion, and use in innovation networks and knowledge clusters: A comparative systems approach across the United States, Europe, & Asia (pp. 331-341). Westport, CT: Praeger Publishers.

Ye, D.; Wu, Y.J.; Goh, M. (2020). Hub firm transformation and industry cluster upgrading: innovation network perspective. Management Decision, 2020-03-26, Vol.58 (7), p.1425-1448, doi: 10.1108/MD-12-2017-1266.

Porter, M. (2000). Location, Competition, and Economic Development: Local Clusters in a Global Economy. Economic Development Quarterly, 2000; 14; 15, doi: 10.1177/089124240001400105.

Porter, M. (1998). Cluster and the New Economics of Competition. Harvard Business Review

Wang, Z., Liu, C. & Mao, K. Industry cluster: spatial density and optimal scale. Ann Reg Sci 49, 719–731 (2012). https://doi-org.proxy.binghamton.edu/10.1007/s00168-011-0452-6

Katz, B. & Wagner, J. (XXXX). The Rise of Innovation Districts: A New Geography of Innovation in America. (report #?). Retrieved from the Brookings Institute website:

CLCPA REFERENCES

NYS (2016) **Reforming the Energy Vision: Building a clean resilient and affordable energy system for all New Yorkers**, SUNY Office for Capital Facilities – Clean Energy Summary

New York State Public Service Commission, **Clean Energy Standard Description**, https://www.nyserda.ny.gov/All-Programs/Programs/Clean-Energy-Standard

Joint Utilities of New York, **Distributed System Platform (DSP) Enablement Quarterly Newsletter**, October 2020.

NYS DPS/NYSERDA, **White Paper on Clean Energy Standard Procurements to Implement New York's Climate Leadership and Community Protection Act**, Case 15-E-0302, June 18, 2020

The Brattle Group, **New York's Evolution to a Zero Emission Power System**, May 18 2020 prepared for NYISO Stakeholders,, accessed at www.nyiso.com

NYSERDA Technical Conference, White Paper: **Clean Energy Standard Procurements to Implement New York's Climate Leadership and Community Protection Act,** July 14, 2020

PA Consulting, **NYISO ICAP and Reliability Considerations. Potential Challenges and Enhancements to the NYISO' Capacity Market and Reliability Metrics for Economically, Efficiently, and Effectively meeting CLCPA mandates,** February 26, 2020. accessed at www.nyiso.com

Analysis Group, **NYISO Climate Change Phase II Study**, June 4, 2020, www.nyiso.com.

NYSERDA, **Statewide Solar Projects**,, accessed at www.nyserda.ny.gov

NYISO Interconnection Queue, System and NYSEG Databases, August 31, 2020 , https://www.nyiso.com/interconnections

NYISO Operating Committee Meeting, October 15, 2020, Wind and Solar Performance

NYSEG-RGE 2020 DSIP Report, June 30, 2020, NYSPSC Case Matter 16-M-0411

National Grid/Niagara Mohawk Power Corporation DSIP Report, June 30, 2020, NYSPSC Case Matter 16-M-0411

REGIONAL PLANS & STUDIES

Fourth Wave Initiative: Phase 1 Assessment Report, November 2019 , Sponsored by The Agency, Three Rivers Development and Team Tioga

I86 Innovation Corridor: 2019 Report to Community and Update Plan: 2020-2022

I86 Innovation Corridor: Integrated Workforce Development Strategy Executive Summary, April 2018

Tioga County Workforce Development Strategy, 2020-2025

Clean Energy Workforce Assessment for Western New York, June 2019

Developing the Next Generation Energy Technology Ecosystem to Accelerate Domestic Manufacturing and Commercialization in NY, Eastman Business Park

Talent Task Force: Strategic Action Plan Executive Summary 2017-2020, Commissioned by The Agency, Prepared by Susan Payne, Strategic Planning Consultant

ST8 Comprehensive Economic Development Strategy: 5 Year Plan 2018-2022

Southern Tier Central Comprehensive Economic Development Strategy 2020-2025

Southern Tier Soaring: Upstate Revitalization Initiative Plan, Southern Tier Regional Economic Development Council, (ST-REDC), 2015.

State of the Region: 2019 STREDC Progress Report

Sparking Transformation: Upstate Revitalization Investment Prospectus, Mohawk Valley REDC 2015

State of the Region: Mohawk Valley 2019 Progress Report

CNY Rising: From the Ground Up: Upstate Revitalization Initiative Plan, Central NY REDC, 2015

State of the Region: Central New York 2019-2020

Significant Industries: A Report to the Workforce Development System, Southern Tier, 2019

BOOKS

The Coming Jobs War, Jim Clifton, Chairman of Gallup

Startup Communities: Building an Entrepreneurial Ecosystem in Your Community, Brad Feld

The Rain Forest: The Secret to Building the Next Silicon Valley, Victor Hwang and Greg Horowitt

The Rise of Innovation Districts; A New Geography of Innovation in America by Bruce Katz and Julie Wagner

Innovation Districts: A Toolkit for Urban Leaders, The Brookings Institute

Small Towns Big Ideas, UNC School of Government

Smart Growth in Small Town and Rural Communities, US EPA

Best Practices in Rural Business Incubation: Successful Programs in Small Communities, NBIA Research Series. Bridget Lair and Dinah Adkins

The Shoals Shift Project: An Ecosystem Transformation Success Story, 9/4/2019, University of North Alabama, Ed Morrison, Dr. J Douglas Barrett, Jaynce Fadden

Advanced Manufacturing: The New American Innovation Policies, by William Bonvillian and Peter Singer

Strategic Doing: Ten Skills for Agile Leadership, Edward Morrison, Scott Hutcheson, Elizabeth Nilsen, Janyce Fadden and Nancy Franklin

Jump-Starting America: How Breakthrough Science Can Revive Economic Growth and the American Dream, Jonathan Gruber and Simon Johnson

The Startup Community Way: Evolving an Entrepreneurial Ecosystem, Brad Feld and Ian Hathaway

More Good Jobs: An Entrepreneurial Action Plan to Create Change in Your Community, Martin Babinec

ORGANIZATIONS BEYOND THE SOUTHERN TIER

How to Build a Better Block: Community Led Development Projects

Praxis Strategy Group: Develops Strategies for Businesses and Communities

Institute for Strategy and Competitiveness: Features Michael Porters work on Industry Clusters

IBM Smarter Cities (note 1)

Economic Gardening, Kaufman Foundation

Economic Gardening, Edward Lowe Foundation

Purdue University Center for Regional Development: Strategic Doing

Co-Starters: Making Local Entrepreneurship Your Communities Pathway to a Better Economy

Goldman Sachs: 10k Small Businesses

Upstate Venture Connect: Supporting Entrepreneurship in Upstate NY

Upstate Capital Association of NY: Venture Capital

CleanTech Group: Tracks Clean Energy Startups Around the World

Chloe Capital, VC Firm Investing in Women

Enovation Partners

Startup Genome: Global Entrepreneurial Network

Cleantech Open National: National Accelerator for Clean Energy

Fuze Hub: Helping NY Manufacturers

SME Prime: Preparing the Next Generation of Manufacturing and Engineering Talent

Note 1: Several large corporations have programs to support business and community development. Syracuse recently joined with Microsoft to develop the smart "Smart City" concept. Siemens is working with the Southern Tier 8 Regional Board, SUNY Broome and the Agency (Broome County Industrial Development Agency) to further the development of a STEM Hub program. Corporations providing similar programs include J. P. Morgan, Google, Goldman Sachs and others.