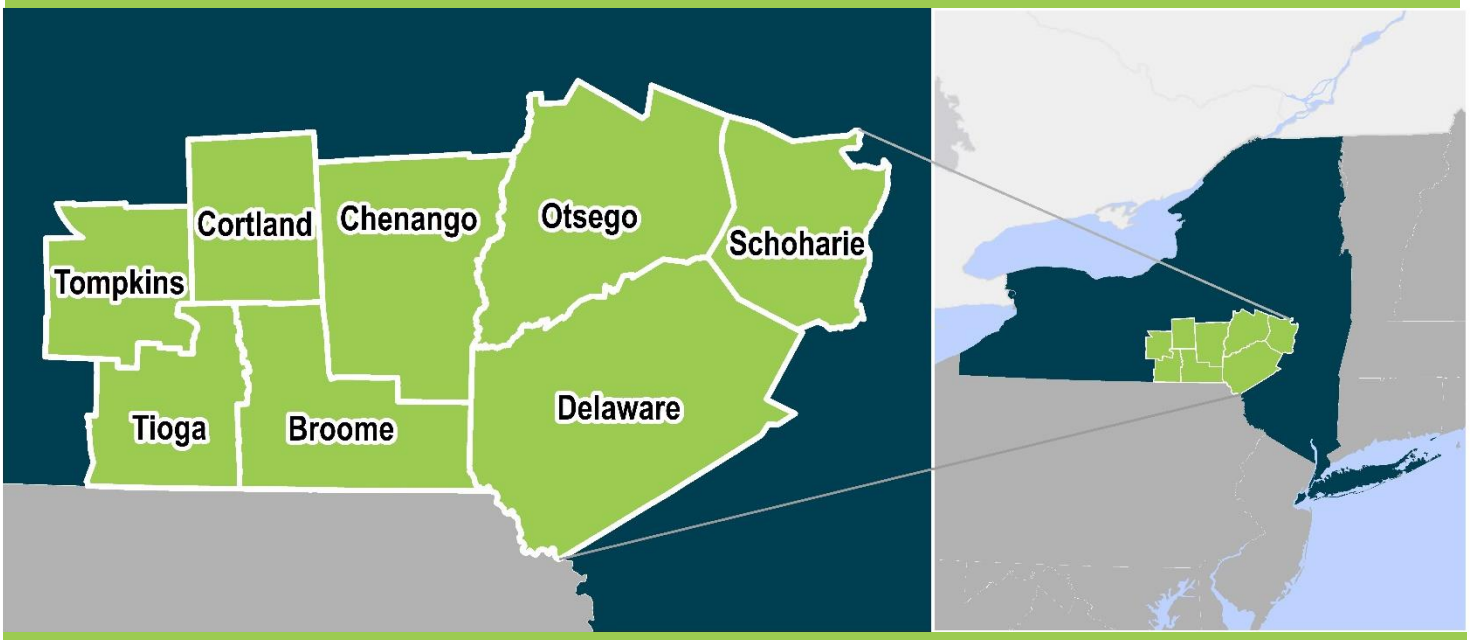
SOUTHERN TIER 8 REGIONAL BOARD



REGIONAL ENERGY INFRASTRUCTURE ASSESSMENT AND STRATEGY

JULY 2020

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SOUTHERN TIER 8
Regional Board

INTRODUCTION

While energy needs rise across the region for residential and industrial use, the infrastructure that several of our communities and businesses utilize is at capacity. Much of the current infrastructure is reliant upon natural gas fuel, and while recent exploitation of shale gas has proven energy reliability in neighboring markets, state policy will not allow the capture or use of this fossil fuel resource in the Southern Tier. With the hope of neutralizing the State's carbon footprint, several recent investments include solar and ground source applications for mainly residential use. Only very recently have developers pursued investments in local wind-sourced energy technologies as most of the region's topography is not ideal for wind generation. In addition, large-scaled renewable energy generating facilities will require and transmission lines for delivering the energy that have yet to be constructed.

Municipal Leaders and Community Planners are currently faced with the challenge of developing solar collection facilities that will make generational changes to the rural landscape and present uncertainties regarding the long-term maintenance, useful life and eventual disposal or reconstruction of this infrastructure.

Over the last 50 years, the Regional Board has offered a platform for collaboration to assess challenges with water, wastewater and broadband infrastructure and bring forward potential community solutions. During the recent 5-year regional planning process, the economic impediment of limited energy supply was raised by local economic developers and private sector business owners. In acknowledgment of this community challenge, the Regional Board Staff and County Planning Directors worked together to secure funding from the Appalachian Regional Commission and retain LaBella Associates to develop this document to define the current energy environment, offer several best practices and investigate several site-specific projects as examples of technologies that can be implemented across the region.

The intent of this community resource is to:

1. Define terminology (and the many acronyms)
2. Offer a common platform baseline across the eight rural counties that comprise the Southern Tier region
3. Present local best practices
4. Showcase several examples that with further investment, can provide energy solutions.

While energy providers transition from fossil fuel dependency to carbon-reducing alternatives, the region's manufacturing base is also expanding clean-energy technologies. We hope to align the needs of the Southern Tier with the entrepreneurs developing new technologies to meet the communities' current and future energy demands.

- Jen Gregory
  Executive Director
  Southern Tier 8 Regional Board

- Shane Butler
  Energy Steering Committee Chair

ORGANIZATIONAL STAFF

LaBella Associates:

- Barbara Johnston, AICP, LEED AP ND, Project Manager
- Edward Flynn, Director of Planning
- Michael Barbasch, PE, CEM, CBCP, Energy & Commissioning Lead
- Aaron Schauger, EIT, EMIT, Energy Engineer

Southern Tier 8 Regional Board Contributions:

- Jaclyn Courter, Regional Development Analyst
- Lolene Cornish, Event Coordinator
- Jen Gregory, Executive Director

STEERING COMMITTEE

2019-2020 Energy Steering Committee, Chair: Shane Butler		
Name	**Title**	**Representation**
Frank Evangelisti	Director - County Planning	Broome County
Shane Butler	Director of Planning	Chenango County
Dan Dineen	Director of Planning	Cortland County
Shelly Johnson-Bennett	Director - County Planning	Delaware County
Karen Sullivan	Planning and Solid Waste Director	Otsego County
Shane Nickle	Lead Supervisor - Office of Community Development	Schoharie County
Elaine Jardine	County Planning Director	Tioga County
Katie Borgella	Commissioner of Planning and Sustainability	Tompkins County

THE PLANNING PROCESS

In 2017, while the Southern Tier 8 Regional Board was drafting the organization's 5-year plan (Comprehensive Economic Development Strategy), business leaders raised concerns with the continued delay of William's natural gas "Constitution" pipeline as energy needs are not being met in communities across Chenango, Delaware & Otsego Counties, creating a significant obstacle for economic growth.

The organization took on the role of researching the use of natural gas and other fuels for both industrial and residential use in the area and discovered that the available information came up short. The raw data for energy usage and fuel type percentages was not available. Recognizing the need for a multi-county assessment of energy infrastructure needs, Southern Tier 8 secured $150,000 from the Appalachian Regional Commission to draft a baseline document, identify the unique challenges and offer strategies for alternative energy solutions. Southern Tier 8 released an RFP inviting firms to complete the study in January of 2019. Interviews were conducted with the three finalists, and ultimately LaBella Associates of Rochester was selected to complete the work. LaBella was chosen based on its high community rating from the Steering Committee and impressive relationships with NYS, NYSEG and PSC.

This one-year planning process – the start of which was delayed due to the Federal government shutdown in late 2018 and early 2019 - was designed to provide regional private and public leaders with a baseline of available energy infrastructure and usage data. It was also designed to help them plan for allocating resources to support, identify and encourage sustainable energy development initiatives and opportunities that will improve the economic progress of the 8-county region. The Steering Committee invested numerous hours in gathering information, engaging stakeholders and prioritizing community projects that are ready for development.

SOUTHERN TIER 8 REGIONAL BOARD AND COUNTY PARTICIPATION

Periodically during the planning process, LaBella staff met with Southern Tier 8 Regional Board staff and economic development and planning staff from each County to identify priorities, obtain information, review draft reports and identify candidates for site-specific investigations. In addition, LaBella staff facilitated periodic check-in calls throughout the planning process with Southern Tier 8 Regional Board staff held to review progress, address issues of concern and facilitate input from stakeholders. These phone meetings included County representatives as needed to communicate progress of the site-specific investigations and preparation of the technical report.

The following table summarizes the meeting dates, topics discussed and actions taken by Southern Tier 8 Regional Board and the Energy Steering Committee which oversaw the project.

Date	Place	Group	Topics Discussed/ Actions
April 16, 2019	Binghamton – Southern Tier 8 Regional Board offices	Southern Tier 8 Regional Board staff	Kick-off and scoping
August 15, 2019	Binghamton Doubletree Inn	Southern Tier Regional Comprehensive Economic Development Strategy (CEDDS) Committee meeting	Exercise to identify Strengths, Weaknesses, Opportunities and Threats (SWOT); Present initial findings from inventory and stakeholder interviews/ Identified data sources and priorities for inventory; SWOT summary
December 6, 2019	Online via WebEx	Southern Tier 8 Regional Board Energy Committee	Review findings from Business Survey; Review draft goals; Discuss feedback from Educational Symposium; Review draft report; Present candidates for site site-specific investigation and criteria for selection / Revised goal statements; confirmed selection criteria for site-specific investigations; identified candidates to contact
December 13, 2019	Binghamton Doubletree Inn	Southern Tier 8 Regional Board Energy Steering Committee	Evaluate and select candidates for site-specific investigation / Selected sites for Tioga and Chenango Counties
January 9, 2020	Online via Zoom	Southern Tier 8 Regional Board Energy Steering Committee	Evaluate and select candidates for site-specific investigation / identified additional candidates for follow-up
January 14, 2020	Online (Zoom)	Southern Tier 8 Regional Board Energy Steering Committee	Evaluate and select candidates for site-specific investigation
February 6, 2020	Binghamton – Southern Tier 8 Regional Board offices	Southern Tier 8 Regional Board Energy Steering Committee	Evaluate and select candidates for site-specific investigation; prep for public open houses

STAKEHOLDER INTERVIEWS

During summer and fall of 2019, LaBella staff met with County planners and economic development representatives in each County to discuss priorities, obtain information, and identify issues with energy

infrastructure that were affecting economic development. County representatives followed up with business contacts during the fall and winter of 2019 to identify candidates for the site-specific investigations. The following table lists in-person meetings with County Planners, Economic Developers and other stakeholders.

Date	County	Participants
9/11/19	Broome	• Stacy Duncan, The Agency/ IDA • Frank Evangelisti, Broome County Planning Dept.
9/11/19	Broome	• Bob Murphy, City of Binghamton
9/11/19	Broome	• Joseph Moody, Town of Union
6/25/19	Chenango	• Shane Butler, Planner • Steve Craig, Chenango Commerce • Rena Doing, Planner
6/21/19	Cortland	• Dan Dineen, County Planner
7/12/19	Delaware	• Shelly Johnson-Bennett, Planner • Glenn Nealis, Economic Development • Evan Bowker
6/25/19	Otsego	• Karen Sullivan, Planner • Jody Zakrevsky, Otsego Now
7/12/19	Schoharie	• Ron Filmer, IDA • Shane Nickle, Planner
6/22/19	Tioga	• Elaine Jardine, Planning Director • LeeAnn Tinney, Economic Development Director
6/21/19	Tompkins	• Katie Borgella, Commissioner of Planning • Heather McDaniel, President, TCAD

The following table lists interviews with other stakeholders.

Joseph Rizzo, NYSEG		
Tier Energy Network (TEN) Executive Committee	9/12/19	in person (Binghamton)
Mark Schneider, Delaware Electric Coop	9/26/19	phone interview
David Bovee, NYSEG	12/17/19	in person (Rochester)
Adam Flint, Southern Tier Solar Works	9/25/19	phone interview
Andrea Aguirre, Senior Planner, Energy Specialist, Tompkins County	11/27/19	phone interview
Evan Hallas, Taitem Engineering	12/3/19	phone interview
Bob Murphy, City of Binghamton	9/11/19	in person
Joseph Moody, Town of Union	9/11/19	in person
Irene Weiser	9/25/19	Phone interview
Mark Schneider, Delaware Electricity Coop.	9/26/19	Phone interview
Lindsay Wickham	9/25/19	Phone interview

BUSINESS SURVEYS

LaBella Associates, with the assistance of County economic development and planning staff, distributed surveys to businesses in the region. The survey requested information about how energy impacts their business, the types of energy that they have had problems with, and whether they would be interested in alternative energy options. County Planners and Economic Developers sent businesses the link to the SurveyMonkey survey or sent them the survey directly. Tioga County called business directly and asked them the questions over the phone. The survey launched in August 2019 and was open through October 2019. A summary of the survey results is in Part 1.

EDUCATIONAL SYMPOSIUM

On October 24, 2019, the Southern Tier Regional Board and LaBella Associates presented an educational symposium at the Tioga Downs Casino & Resort in Nichols, Tioga County to educate stakeholders and the public about energy infrastructure issues and opportunities. The program included information and facilitated discussion about:

- the regulatory framework that drives investment in new and traditional energy infrastructure,
- technological innovations in alternative energy, and
- funding sources to implement beneficial projects.

"ENERGY SOLUTIONS FOR ECONOMIC SUCCESS" PROGRAM

Session Title and Description	Presenters
Utility and Regulator Roundtable • Existing infrastructure –maintenance process and future plans • Planned extensions/ improvements • Roles of utilities and regulators, including key initiatives such as REV and FERC's reliability requirements	• Keith Hayes, Senior Vice President, Clean Energy Solutions, New York Power Authority (NYPA) • Michael DeAngelo, Program Manager, Non-Wires Alternatives, Asset Management and Planning, NYSEG • Mark Schneider, CEO & General Manager, Delaware County Electric Cooperative (DCEC)
Technical Case Studies • Biomass • Energy Efficiency • Solar + Storage • Geothermal	• Michael Barbasch, Energy Engineer, LaBella Associates • Stuart Bailey, Electrical Engineer, LaBella Associates
The Path Forward • Funding • Incentives • Opportunities for partnerships	• Donna Howell, Regional Director, NYS Empire State Development • Karim Beers and Terry Carroll, Cornell Cooperative Extension/ Clean Energy Communities • Joseph Rizzo, Manager, Economic Development, NYSEG

Approximately 108 people attended, including exhibitors and panelists. Based on responses to participant surveys, most attendees found the information to be useful and improved their understanding of the region's energy issues and alternative technical and regulatory approaches to addressing the issues. Several participants were disappointed that the sessions did not present clear solutions or that the information was too basic.

The following table summarizes participant responses to the event, provided through the comment sheets submitted by participants after the event.

"Energy Solutions for Economic Success" – Participant Feedback

1. What did you think about the sessions and the presenters?
• Great variety of presentations! • Provided good coverage of the relevant issues in the presentations. Occasionally there was presentation of incorrect or outdated information • Great!!! Lots of good info • Disappointed in the micro-grid presentation because this was represented as a clean energy, when in fact most every micro-grid in NY State runs on gas not renewables. • Some info missing. Capacity factor: solar 15%. Capacity factor wind: 30-35%. NY Prize microgrids are 99% gas projects. Some info incorrect. Check with Dr. Howarth or Dr. Ingrafea at Cornell. Interruptibles provide capacity flexibility for demand fluctuation. This benefits utility and customers. • I thought this was a very informative event. I learned a lot about available resources

• Wonderful, great job. • Good
2. What do you think are the most significant energy infrastructure issues within the Southern Tier 8 region?
• Interruptible power with manufacturers and big employers • Lack of delivery options outside of NYSEG • Electric grid is greatly outdated. As we transition from fossil fuels will need a robust electric grid. Need substation upgrades. Additional 3-phase lines for DER projects. In urban areas there should be more ___ of distribution lines for resiliency. • Natural gas vs renewables • Stop promoting new and expanded gas infrastructure projects. This is the issue. We must demand non-pipe alternatives (No CNG.) Very disappointed that 2 speakers suggested that gas was the cleanest energy choice at this time. Shame! • Availability of funding adequate enough to encourage companies to make green changes. Energy capacity; quick enough response time when working on putting a project together (NYSEG); overall challenges with dealing with NYSEG. • Region's capacity to bring clean energy online. • Aging energy infrastructure
3. What topics would you like more information about?
• How can we get the Delaware Co-op into other areas? • Specific information on improving commercial and industrial energy efficiency. Reduce substantially the heating and cooling load. • Alternative DER, Case studies, Open C-PACE • How to get info needed in a realistic timeframe • More and better technical assistance to municipalities. CCE and their CSC program doesn't cut it. They only check off their own boxes and leave the community to figure the rest out. • Energy co-op structure

PROCESS FOR SELECTING PROJECTS FOR SITE-SPECIFIC INVESTIGATION

LaBella staff worked with each County's planning and economic development representatives to identify potential candidates for the site-specific investigations. LaBella Associates conducted the initial phase of outreach through in-person meetings and phone interviews with County planners, economic development representatives, and other stakeholders. Additional candidates were identified from responses to the Business Survey and direct outreach to businesses and institutions by LaBella staff and County economic developers. This outreach resulted in a list of potential sites where energy infrastructure concerns were affecting economic development.

During the fall of 2019, LaBella staff and County economic development representatives reached out via phone or e-mail to more than 35 businesses and institutions to find out whether they were interested in participating in a site-specific investigation.

Several prospective partners were not interested in participating, either because they were currently conducting or recently completed a similar investigation, or they were not able to devote the time required to compile

needed information and accompany the consultant in a site visit. Some businesses in Tompkins County had already received similar assistance through the County's Business Energy Advisors program.

Businesses and institutions that expressed interest in participating in the study were entered into a "short list" of suitable candidates. Several sites that may have been suitable candidates were not available to participate. Some potential candidates did not respond to phone calls or e-mails and others responded that they did not have sufficient resources to participate in a study at this time. Some expressed interest initially but were unable to proceed.

At meetings held in November and December 2019, the Energy Committee evaluated each of the candidates on the "short list" based on the following criteria:

- Project readiness and availability to coordinate with investigators
- Energy issues representative of those in the region
- Potential for replicability throughout the region
- Consistency with goals of energy strategy
- Potential regional economic benefit
- Geographic representation (one project per county)

By December 2019, the Southern Tier 8 Regional Board's Energy Committee, with input from legislators in their respective counties, formally selected the following eight projects for demonstration – one in each County:

Broome County	UHS Binghamton
Chenango County	UHS Chenango Memorial Hospital
Cortland County	JM Murray
Delaware County	Delaware River Basin Stone
Otsego County	Oneonta Business Park
Schoharie County	American Recycling
Tioga County	Crown Cork & Seal
Tompkins County	Human Services Building

Good candidates that were not selected for participation included A.O. Fox Hospital (Otsego County), Broome Community College (Broome County) and Lockheed Martin (Tioga County.) In March 2020, the selected site in Broome County, UHS Binghamton Hospital, needed to withdraw its participation because of time demands in responding to the COVID-19 crisis.

During January and February 2020, LaBella's energy specialists contacted a representative at each site and began collecting the information needed for the report. The analyses and individual site reports were completed by April 2020.

"VIRTUAL" OPEN HOUSE

LaBella Associates and the Southern Tier 8 Regional Board hosted a Public Informational Meeting to present the study's findings on March 31, 2020. The meeting was held on-line due to the limitations on in-person meetings required by the COVID-19 pandemic.

Print advertisements for the Virtual Open House were placed in the following media outlets across the region:

- Owego PennySaver
- PressConnects (online)
- Five PennySavers/ Shoppers

All regional media received a press release about the event and information was available on the Southern Tier Regional Board's website.

The virtual event was recorded and available for review at Southern Tier 8 Regional Board's website.

Following the Virtual Open House, LaBella staff revised the report to incorporate comments received.

ORGANIZATION OF DOCUMENT

The Regional Energy Infrastructure Assessment & Strategy includes:

Part 1: **Vision, Goals, Strategies and Recommendations**. Key findings from Parts 2-4; a focused analysis of the key issues that affect the ability of the region's energy infrastructure to meet the region's economic development objectives; and the Vision, Goals, Strategies and Recommended Projects and Programs.

Part 2: **Economic Development Assessment**: Findings from the Business Survey and stakeholder interviews and a review of how important energy is to regionally competitive industries.

Part 3: **Regional Energy Profile:** an overview of regional energy usage, assessment of energy infrastructure and a description of the regulatory framework.

Part 4: **Existing Plans, Studies and Programs:** Summary of energy-related recommendations in existing State, Regional and County plans and studies as well exemplary programs and practices within the region.

Appendices:

A. **Glossary**
B. **Site-Specific Investigations:** Technical reports from energy studies of seven sites throughout the region, including an assessment of energy needs, evaluation of alternative solutions and recommended measures.

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STRENGTHS, WEAKNESSES, OPPORTUNITIES & THREATS (SWOT)

The Southern Tier 8 Regional Board's Energy Committee identified the following Strengths, Weaknesses, Opportunities and Threats at its meeting on August 15, 2019.

Table 1: Strengths, Weaknesses, Opportunities, Threats (SWOT)

STRENGTHS	OPPORTUNITIES

- Volume
  o Large Capacity
  ▪ Especially in Broome County
  ▪ Development
- Variety of Power Types
  o Especially in Cortland County
- Solar Power
  o Especially in Tioga County
- Electric Loop
  o Especially in Delaware and Otsego
  o Endicott
- Biomass
  o Otsego County
- Low cost of land
- Clean Energy
  o Binghamton, 76 West
- Energy Storage
- Political Support
	- New tech start up
	  o 76 West
	- Availability of resources
	  o Wood
	  o Biomass
	- Higher Ed
	  o Innovation
	- Ithaca/Binghamton
	  o Tech development
	- Land
	- Cost of living
	- Renewable
	  o Pros and cons
	- Funding
	  o Broad
	- Industrial/Institutional demand for renewable

WEAKNESSES	**THREATS**

- Lack of redundancy
- Lost electricity
- Aged infrastructure
- Large gaps, esp. with natural gas
- Interruptible natural gas power
- Communication
- Lack of will/commitment
- No development of alternatives
- Homeowners
- Communities not ready for renewables (zoning / local laws)
- Utilities not up to date with new State regulation/policies
- Distribution lines cannot support renewables market
	- Pennsylvania Energy Policy
	- Rate hike
	- State Regulation
	  o No direction
	  o Not firm

PART 1
VISION, GOALS, ISSUES ANALYSIS AND STRATEGIES

The Southern Tier 8 Regional Board, a regional planning and economic development agency, initiated the Regional Energy Infrastructure Assessment & Strategy to address concerns among businesses about constraints to economic development relating to their need for energy to support their operations.

This Part presents the overall Vision, Goals and Strategies for regional energy infrastructure. It also includes a focused analysis of the key issues that affect the ability of the region's energy infrastructure to meet the region's economic development objectives and specific recommended actions for the Regional Board and its partners.

VISION STATEMENT

THE SOUTHERN TIER 8 REGION WILL BE A LEADER IN SUPPORTING ADVANCED, RELIABLE, AND RESILIENT ENERGY INFRASTRUCTURE THAT PROMOTES LONG-TERM REGIONAL ECONOMIC GROWTH.

GOALS AND STRATEGIES

GOAL 1: Recognize the Southern Tier 8 Region's energy infrastructure in a manner that maximizes the social and economic benefits while minimizing the social, economic and environmental costs to the region, its people, and businesses.

- In partnership with both public and private entities, develop and maintain programs aimed at advancing energy conservation, renewable energy and energy demand management with a focus on creating or retaining employment and stimulating private investment.
- Encourage the development, continuation and replication of energy-related projects utilizing locally available energy resources with the priority of reducing dependency on fossil fuel and encouraging an environmentally sound approach to addressing energy demands.

GOAL 2: Encourage installation of energy improvements, with a focus on alternative and renewable energy, energy efficiency and demand management, to improve the reliability, resiliency and environmental benefits of the region's energy infrastructure in a manner that supports regional economic development.

- Encourage counties to develop a means for project promotion and review by assigning an Energy Review Assessment Agency or Department that would assist developers through the process of considering alternative energy sources and seeking funding.
- Assist municipalities with the implementation of priority projects including seeking technical assistance and funding.
- Promote alternative and renewable energy opportunities by organizing or promoting events that encourage implementation of the most up-to-date technologies and policies.
- Support energy improvement districts in downtowns and business parks.

GOAL 3: Encourage improvements to energy infrastructure that enhance the region's economic competitiveness.

- Prioritize energy infrastructure improvements that help retain and expand existing businesses, attract new businesses, and foster job growth.
- Stimulate investment and jobs in renewable and alternative energy and other emerging energy-related technologies.

GOAL 4: Strengthen partnerships to support a reliable and resilient regional energy infrastructure.

- Continue to support and participate in industry-led Tier Energy Network (TEN), NYSERDA's business competition 76 West and other regional programs.
- Support continuing education of municipal officials, businesses and residents about regional energy challenges and opportunities.

GOAL 5: Obtain funding for regional energy infrastructure improvements with strategic economic development benefits.

- Support initiatives among the Southern Tier 8 region's municipalities, and partners to obtain funding for energy improvements that support economic growth.
- Raise awareness and encourage solutions with the Public Service Commission and other New York State government entities and Utilities about the energy needs in the Southern Tier and how addressing those needs would positively impact economic development.
- Recognize that New York State is committed to an aggressive clean energy program and that all infrastructure improvements seeking funding must adhere to the State's policies.

KEY FINDINGS FROM REGIONAL ENERGY PROFILE

The Regional Energy Profile (Part 2) describes the region's energy use and infrastructure as well as the regulatory framework. The key findings are as follows:

ENERGY USAGE

- Total electricity consumption of electricity in the 8-County region is approximately 4.7 GWh (based on 2013 data)
- Natural gas consumption by customers in the portion of the region served by a natural gas utility totals approximately 24,672,514 Mcf.
- Approximately 40% of households use natural gas and 22% rely on fuel oil for heating.

NATURAL GAS INFRASTRUCTURE

- Natural gas service is available to a portion of the region. Businesses that are outside natural gas service areas have requested service because of its relatively low cost.
- Recently proposed natural gas pipelines would have alleviated supply and distribution constraints in Tompkins County (Freeville-Lansing) and allow additional connections for customers in Chenango, Delaware and Otsego County (Constitution.) However, required regulatory approvals were not granted for these projects.
- The demand for expansion of natural gas infrastructure to power economic development remains high in some areas and at the same time there is also pressure to reduce use of natural gas due to greenhouse gas emissions. There remains substantial conflict over this topic in the region.

ELECTRICITY GENERATION

- Approximately 92,575 MWhs of electricity is currently generated within the region from solar facilities. Proposed solar and wind facilities proposed to be constructed within the region capacity of nearly 340 MW would generate are proposed and there is a steeply growing trend of developers proposing large-scale solar in the region.
- The integration of battery storage will allow for more solar generating capacity on site, because the electricity generated can be temporarily stored then released into the grid during periods of higher demand.
- Four renewable energy facilities are proposed in the region subject to "Article 10" siting process for facilities with 25 MW or more generating capacity. Siting authority for these projects is handled by the NYS Public Service Commission's Siting Board rather than municipalities.
- Former "peaking plants" have been retired recently, including the Binghamton Cogeneration facility, Lansing coal plant, and the Westover facility in Broome County. The sites of these former plants present opportunities for redevelopment because of the connection to electric infrastructure.

ELECTRICITY TRANSMISSION AND DISTRIBUTION

- Large transmission lines traverse the region to transmit electricity from large generating plants in Niagara and Oswego County to areas of high demand downstate
- Upgrades to distribution and transmission infrastructure, as well as energy management systems, are underway and proposed to accommodate the increase in distributed energy generation.

REGULATORY CONTEXT

New York State laws, regulations, programs, agencies and authorities affect the region's energy infrastructure in significant ways. The Public Service Commission regulates utilities, including requiring them to invest in infrastructure and accommodate additional distributed energy resources. The New York Energy Research & Development Authority supports research and administers incentives. The New York Power Authority operates generating and transmission infrastructure and assists municipalities and utilities with energy infrastructure improvements.

Two State laws will continue to influence investment in energy infrastructure: the Climate Leadership and Community Protection Act (CLCPA), enacted in July 2019, and the Accelerated Renewable Energy Growth and Community Benefit Act (AREGCBA), passed as part of the 2020-2021 budget in April 2020.

The CLCPA sets the following target reductions from a 1990 baseline:

- 70% renewable power generation by 2030
- 100% zero emissions by 2040
- 6,000 MW solar energy by 2025
- 185 trillion BTU reduction through energy efficiency
- 3000 MW energy storage by 2030

The law calls for an appointed Climate Action Council will prepare a scoping plan with recommendations for how to achieve net zero emissions. The NYS Department of Environmental Conservation will develop rules to curtail GHG emissions. NYSERDA and DEC will determine the social cost of carbon for use by state agencies, in terms of dollars per ton of carbon. Finally, the Public Service Commission will require utilities, by 2040, to meet demand with zero-emissions generation although it will be able to waive these requirements to ensure "safe and adequate electric service."

The AREGCBA establishes an Office of Renewable Energy Siting within the Department of State, which will streamline siting decisions for energy generation projects with 25MW capacity or larger to ensure action within one year. Projects 20-25 MW in size and projects currently going through the Article 10 process can opt in. Host communities will receive intervenor funds process as well as utility bill discounts or other benefits or incentives.

The law also aims to accelerate planning and build-out of bulk and local transmission and distribution infrastructure to accommodate increase in renewable and distributed generation to accommodate increase in renewable and distributed generation. The Department of Public Service, in consultation with NYSERDA, NYPA, NYISO and utilities, will identify cost-effective upgrades. PSC will establish a capital program for each utility in need of upgrades in their service territory. A bulk transmission investment program will leverage NYPA's ability to construction new transmission. A streamlined siting process of no more than nine months for transmission infrastructure built within existing rights-of-way.

ISSUES ANALYSIS AND POTENTIAL APPROACHES

Businesses and stakeholders identified the following energy infrastructure issues as most significant for economic and community development:

- Reduce economic impacts of unavailable or interruptible natural gas service
- Leverage benefits and minimize negative impacts from large scale renewable electricity generation
- Improve the reliability of electric service
- Redevelop sites of former "peaking" plants
- Minimize expansion of new fossil fuel infrastructure in order to reduce greenhouse gas emissions to mitigate the negative impacts of climate change.

REDUCE ECONOMIC IMPACTS OF UNAVAILABLE OR INTERRUPTIBLE NATURAL GAS SERVICE

Because natural gas is much less expensive than alternative heating and processing fuels, virtually all large industries and institutions in the region prefer to use natural gas where it is available. In many areas of the region, a reliable supply of natural gas is a significant benefit to businesses' bottom line.

Unavailable or interruptible natural gas service affects economic development in certain areas of the region in the following ways:

1. The business is located outside a natural gas service area
2. Natural gas service is interruptible during periods of high demand.
3. A moratorium on new natural gas services affects businesses in the Lansing area of Tompkins County

1. Location outside natural gas service area

Many businesses and institutions in the Southern Tier 8 region are located in areas outside of natural gas service areas and rely on other fuels for space heating and processing. These businesses pay significantly higher prices (50% to 100% more) for fuel than those with access to natural gas. The cost difference has been especially large in recent years due to the low cost of natural gas in the region.[1]

2. Interruptible natural gas service

Several regionally significant businesses and institutions obtain natural gas service through NYSEG that is subject to interruption if supplies are needed to serve residential customers.

[1] A calculator to compare annual home heating costs using different fuels: https://www.efficiencymaine.com/at-home/heating-cost-comparison/

Interruptible natural gas arrangements allow NYSEG to discontinue service to high-demand customers during periods of peak demand, in order to maintain reliable service to all other customers. This arrangement allows the utility connect more customers to natural gas service, provided that they switch fuels during these periods.

The customers subject to interruptible power pay lower rates for natural gas as established in the rates and service conditions regulated by the NYS Public Service Commission. Interruptible customers purchase a minimum of 40,000 therms per month. (The cost of 40,000 therms under a continuous service tariff would be $7,518 per month. The cost under the interruptible service tariff is determined by NYSEG monthly.)

Several times each winter, when demand for natural gas for residential heating is exceptionally high, NYSEG will notify its interruptible supply customers that natural gas service will not be available for a period of time. To prepare for the interruption, these customers switch their heating and processing fuels to an alternative supply. These businesses and institutions must maintain a secondary supply of fuel for those days that natural gas is not available. The cost of switching from natural gas to the alternative fuel is substantial.

Several large businesses and institutions in in Chenango, Delaware, Otsego and Tompkins Counties receive natural gas service from NYSEG subject to interruptible service agreements. These include:

- SUNY Oneonta, A.O Fox Memorial Hospital and Lutz Feed in Oneonta
- Chobani, a yogurt manufacturer with 135 employees in Norwich, Chenango County

Many of these businesses are significant employers in the region.

The natural gas delivery system in these areas is not sufficient to provide the maximum amount required during periods of peak demand, such as cold winter days when residential usage is high.

3. Natural gas moratorium

NYSEG has issued a moratorium on new natural gas hookups for customers in the Lansing area of Tompkins County. The natural gas distribution system in this area lacks capacity to serve additional users because of low gas pressure in the northern part of the service area occurs during periods of high usage.

WHAT ARE THE ALTERNATIVES?

There are no simple solutions for businesses dealing with unavailable or interruptible natural gas service. Proposed new or expanded pipeline projects have not been able to obtain needed regulatory approvals. Compressed natural gas projects at business parks have not received needed public funding. Cost-effective alternatives to natural gas for industrial processes are not currently available.

Reducing demand among residential and small business customers to preserve capacity for industrial uses may have potential over the long term. Utilities statewide continue to develop programs and technologies to manage demand and reduce peak usage.

Potential alternatives proposed by local partners, utilities and others include:

- Construct new pipelines
- Construct Compressed Natural Gas (CNG) or Liquid Natural Gas (LNG) stations
- Reduce demand among residential and small business customers through conservation and installation of alternative heating technologies such as air- or ground-source heat pumps
- Reduce peak demand through load management

The feasibility of these alternatives depends on approvals from State and/or Federal regulatory agencies, the Public Service Commission, funding and/or direct investment by the businesses and institutions affected by interruptible natural gas supply, as well as the economic cost and benefit to individual businesses and development sites.

Construct new pipelines

Many businesses and institutions in Broome, Delaware, Otsego, and Schoharie Counties hoped that the proposed Constitution pipeline would have provided a supply of natural gas and reduced fuel costs. However, the project was cancelled in early 2020. It is unlikely that another major new pipeline could be built to serve customers in the region. Although smaller scale pipeline extensions have the potential to serve businesses, the expansion of distribution networks will require sufficient supply from existing transmission pipelines or other sources.

For example, Amphenol Aerospace, the largest private employer in Delaware County with 1,000 employees, estimated that it would save approximately $1 million annually by switching from propane to natural gas. The company rebuilt portions of its facility after flood damage in 2011 with the expectation that natural gas service would be available after construction of the proposed Constitution Pipeline.

The Constitution pipeline would have provided natural gas to Amphenol, Raymond (a forklift manufacturer with approximately 1500 employees in Greene, Chenango County) and potentially to many other businesses in Broome, Delaware, Chenango, and Schoharie Counties that do not currently have access to natural gas service. Business representatives and economic development officials supported the pipeline because lower cost energy would attract new and support existing businesses.

However, the project was cancelled after years of regulatory challenges.[2] Businesses such as Amphenol and others will continue to rely on propane, heating oil, or compressed natural gas for heating and processing.

Increase the capacity of existing pipelines

Businesses and institutions in Chenango, Otsego and Schoharie County that receive “interruptible” natural gas supply from NYSEG would benefit from proposed upgrades to the DeRuyter pipeline and additional capacity supplied through the Dominion pipeline. NYSEG proposed enlarging and upgrading this pipeline as part of its Five-Year Capital Improvement Program. However, in order to commit funds to these upgrades, NYSEG would

[2] https://constitutionpipeline.com/

need approval from the NYS Public Service Commission. In addition, Dominion would need approval from NYS DEC to increase capacity. The regulatory approvals for capacity increases and rate increases to support investment in pipeline upgrades are unlikely.

Construct CNG or LNG Station

Several businesses in the region use compressed natural gas (CNG) at stations installed at their facilities that receive delivery of natural gas supplied by trailers transported over public roads.

In 2018, NYSEG and Otsego NOW proposed to construct a $17 million CNG station to serve several businesses in Oneonta that would otherwise be affected by interruptible natural gas service. Although the project was recommended by the Regional Economic Development Council (REDC), it did not receive $3.5 million in funding requested from the NYS Empire State Development and the project did not advance.

Construction of an LNG station would require funding and permits from NYS. No plans for such a project have been publicly announced.

Reduce demand through conservation and increasing use of other fuels such as air- or ground-source heat pumps

Businesses and institutions that use natural gas for space heating may be able to reduce demand through conservation and adoption of ground-source or air-source heat pumps. However, these approaches are not currently cost-effective, as found in *the site-specific project investigation conducted for this study at Oneonta Business Park and Railyard development site in Oneonta.*

Tompkins County has seen significant growth over the past several years by developers and businesses utilizing air-source heat pumps and ground-source heat pumps for their space and water heating and cooling.

Reduce natural gas use by other customers sufficiently to reduce hours of interruptibility

If natural gas customers reduce the peak demand for natural gas on the coldest winter days, sufficient capacity may be available for industrial users to avoid the need to interrupt supply. Measures that would reduce demand include:

- Energy conservation measures to reduce heat losses from buildings
- Encourage conversion from natural gas to geothermal (ground source heat pumps), air source heat pumps or electric heat

Although energy efficiency and switching to other fuels would reduce natural gas usage, it is not clear whether these measures would eliminate the need for interruptible service along the DeRuyter pipeline or the moratorium in Tompkins County. Predicting future demand is difficult because it depends on weather conditions such as temperature and wind.

Communities affected by interruptible natural gas or a natural gas moratorium have instituted initiatives to reduce demand among those users with the ability to more economically switch to other fuel sources to free up capacity for industrial users. For example, Tompkins County promotes use of ground source and air source heat pumps through NYSERDA's Heat Smart NY program.

Conservation and switching to electricity-based heating can reduce demand for natural in the residential and commercial sectors, which could reduce the number of days that businesses subject to interruptible power would need to switch to an alternate fuel. However, the impact of these conservation measures will not be effective for some time and are unlikely to be a factor for businesses seeking a site for new or expanded businesses.

POTENTIAL APPROACHES

The following actions or initiatives will be needed to address the impacts of unavailable or interruptible natural gas service on economic development in the region. These approaches will require efforts from utilities, regulators, individual businesses and local governments and regional entities.

1. In cooperation with businesses, local governments and economic development officials, natural gas utilities, regulators, and State agencies will advance initiatives that reduce the economic impact of unavailable or interruptible natural gas service on businesses in the region *(for example – NYSEG RFP for Lansing area)*.
2. Municipalities, industries, utilities and community partners will implement projects that reduce periods of peak demand, including increased efficiency in the residential, commercial and institutional sectors. *(for example, HeatSmart, efficiency initiatives)*
3. Community initiatives will accelerate conversion from natural gas and other heating fuels to geothermal, solar thermal, biomass and other renewable and alternative fuels.

The Southern Tier 8 Regional Board will advance these solutions through annual events to promote new technologies, providing technical assistance and facilitate grant funding for priority projects.

LARGE-SCALE RENEWABLE DEVELOPMENT

Large-scale solar facilities (as documented in the Regional Energy Profile) have been developed throughout the region over the past several years. These facilities include community solar projects, which are supported by subscribers, off-site generation developed by institutions such as Cornell University, and projects built by developers to sell electricity to utilities. Several proposed large solar and wind projects would add substantial additional capacity.

The development of these large solar facilities has increased the amount of energy that is generated from renewable sources. The increase in renewable generation capacity helps to meet New York State's target, set by the 2019 Climate Leadership and Community Protection Act, that 70% of the state's electricity will be produced by renewable sources.

The main issues associated with increasing large-scale renewable electricity generating facilities are:

- Need to upgrade electric infrastructure to accommodate increasing amounts of renewable electricity generation
- Need to balance the benefit of generating electricity with potential impacts on communities and resources

Need to upgrade electric grid

As more electricity is generated from distributed sources, rather than from a few large power plants, utilities must upgrade their distribution infrastructure, including substations, to increase capacity and to ensure stability and reliability of the electric grid. To ensure that the new generating facility will not affect the stability of the distribution system, utilities need to approve all new interconnections.

Before allowing new interconnections, utilities often require extensive (and expensive) upgrades to the infrastructure. As a result, the interconnection process is long and cumbersome, increasing uncertainty and adding cost to proposed projects.

Balance the benefits of generating electricity with potential impacts on communities and resources

Although the generation of electricity from renewable sources reduces greenhouse gas emissions and helps to meet New York State's renewable energy goals, many community members are concerned about the potential negative impact of these projects. Concerns include the decommissioning of solar facilities, including the disposal of hazardous materials contained in solar panels, visual impacts, and the loss of agricultural land or natural resources. In some communities, there is strong public opposition to the development of solar facilities in specific locations.

The electric utilities, NYISO, NY Department of Public Services, NYSERDA, NYPA, FERC and other entities have roles in advancing the development of additional renewable electric generation capacity in the region. Currently, New York State's Article 10 process governs the review process for facilities with generating capacity of 25 MW or more; municipalities are responsible for the review and approval of renewable energy facilities with less than 25 MW generating capacity. However, the Act to Accelerate Renewable Energy, proposed by Governor Cuomo in March 2020 as a budget amendment, would replace the Article 10 process with one administered by a new Office of Renewable Energy Permitting. The new process would apply to projects with generating capacity of 10 MW or more. Local concerns will be a consideration in the new siting process, but municipalities would not have the authority to approve or deny these projects. In addition, the negotiation of agreements for Payments in Lieu of Taxes (PILOTs) can be an obstacle to solar facility development in some locations. Some communities expect PILOTs of $20,000/ MW, where $3,000 - $5,000 per MW is more typical. The proposed siting process for projects 10 MW or larger would standardize PILOT agreements and require counties and municipalities to consult with NYSERDA.

Several municipalities lack clear policies and regulations regarding the siting of renewable electric generating facilities, such as a local solar law and/or siting standards in local zoning regulations. Local planning boards,

Town boards, County Industrial Development Agencies and residents need additional information and support to facilitate review of these projects. If municipalities are aware of suitable sites for solar electric generation, developers are interested in working with them.

POTENTIAL APPROACHES

The following actions and initiatives will advance the development of renewable electricity generation capacity in the region.

1. Municipalities will clarify local siting policies and priorities through comprehensive planning and review criteria through local laws.
2. Businesses, landowners, municipalities and residents will have access to information about renewable energy siting and review.
3. Individual businesses, institutions and residents will install additional renewable capacity for on-site use.
4. Utilities and regulators will coordinate to implement improvements to the distribution system that are needed to accommodate additional renewable capacity.

The role of the Southern Tier 8 Regional Board will be to promote the development of additional renewable energy, assist municipalities and businesses with obtaining funding, and share success stories.

IMPROVE THE RELIABILITY OF ELECTRIC SERVICE

Businesses depend on reliable electric service at an affordable price. Businesses in many areas throughout the region would benefit from the extension of 3-phase electric service, but cannot justify the cost of extending this service. Power outages affect business operations and profitability.

Public utilities, electric cooperatives and municipal electric services continually invest in maintenance and improvements to minimize power disruptions and to recover after storm events. However, strategic improvements in infrastructure take a long time to plan and design. Communication with the utility needs to occur well in advance of the business's need for infrastructure improvements. Coordination and cooperation among utilities, suppliers and regulators is also needed to maintain sufficient and reliable electric service.

POTENTIAL APPROACHES

1. In partnership with businesses, economic development coordinators, identify specific infrastructure improvements that would benefit regional economic development and provide sufficient lead time to utilities to plan for these improvements.
2. Encourage on-going communication and cooperation among electric utilities, municipal electric companies, electric cooperatives and regulators to meet the needs of businesses. Encourage utilities and regulators to prioritize electric infrastructure improvements that meet the needs of regionally significant businesses.

The role of the Southern Tier 8 Regional Board would be to assist businesses and municipalities with funding applications to undertake infrastructure improvements with strategic value to the region's economic development.

REDEVELOP SITES OF RETIRED PEAKING PLANTS

As the electric grid becomes more decentralized to accommodate renewable energy, and as grid management systems replace the need for centralized plants to deliver energy during periods of peak demands, several former generating plants in the Southern Tier 8 region have been recently retired. These facilities include:

- Westover plant – Broome County
- Cayuga plant – Tompkins County
- Binghamton Cogen – Broome County

These facilities have advantages for economic development due to the robust infrastructure that connects the facilities to the electric grid. Reuse of these facilities represent potentially significant economic development opportunities.

POTENTIAL APPROACHES

1. Facilitate communication among municipalities, facility owners and utilities to identify infrastructure and site improvements needed to prepare the sites for reuse
2. Assist municipalities and project sponsors to obtain funding for beneficial reuse of former electric generation facilities

The role of the Southern Tier 8 Regional Board would be to assist with funding applications and technical assistance.

STIMULATE INVESTMENT AND JOB CREATION IN ENERGY-RELATED TECHNOLOGIES

Many energy-related businesses in the Southern Tier 8 region have become established to advance innovating energy-related technologies and related opportunities. Binghamton University and Cornell University are hubs of research and host business incubators to nurture energy-related businesses. The 76 West competition attracts international attention to the Southern Tier among innovative energy-related businesses.

POTENTIAL APPROACHES

1. Support networking organizations that advance energy-related businesses and technologies (e.g., Tier Energy Network)
2. Work with municipalities and County economic development staff to identify suitable sites for development of energy-related businesses

The role of the Southern Tier 8 Regional Board would be to facilitate the exchange of information and support businesses with technical assistance and funding.

PART 2
ECONOMIC DEVELOPMENT ASSESSMENT

As part of the energy infrastructure assessment an analysis of how energy issues impact economic development was performed. The assessment included a business survey and meetings with stakeholders which helped identify specific energy-related issues and opportunities for each County and the Southern Tier 8 region overall. In addition, a brief review of how important energy is to key regional competitive industries was evaluated.

BUSINESS SURVEY

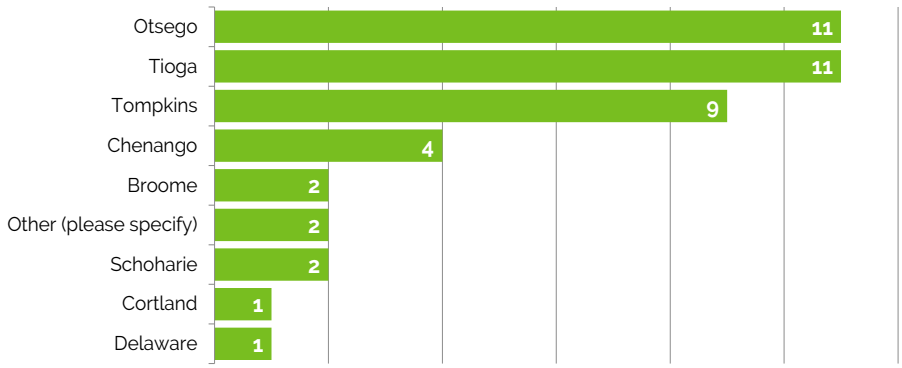
A business survey was developed which included 10 questions requesting businesses to answer questions on how energy impacts their business, the types of energy that they have had problems with, and whether they would be interested in alternative energy options. County Planners and Economic Developers sent businesses the link to the SurveyMonkey survey or sent them the survey directly. Tioga County called business directly and asked them the questions over the phone.

Forty seven responses were received from businesses in a variety of industries. At least one survey was received from each County within the Southern Tier 8 region.

Key results of the survey are:

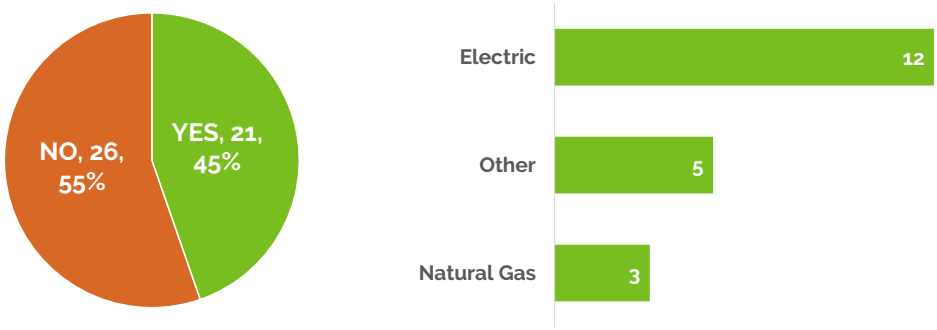
- *The majority of survey respondents were from Otsego, Tioga and Tompkins County*. (Figure 1).

Figure 1. Location of Business Survey Respondents



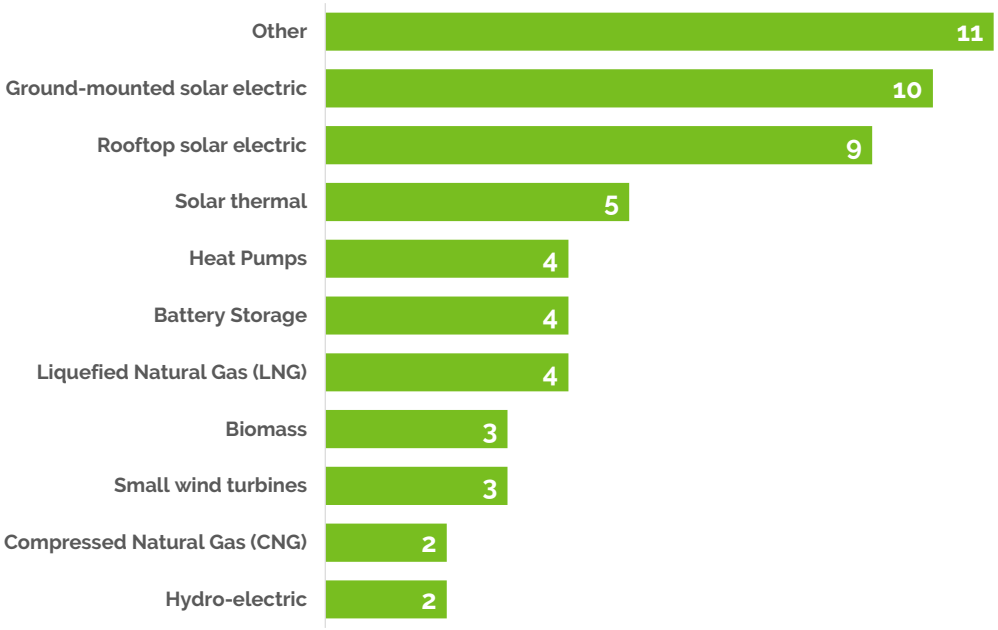
- *Nearly one-half (45%) of respondents, or 21 businesses, experienced significant energy issues related to their business and the majority of those issues related to electric energy supply*. (See Figure 2).

Figure 2. Responses to "has your business experienced significant issues related to energy" and "what type of energy do you have challenges with?" Other represents those that had issues with all sources of energy.



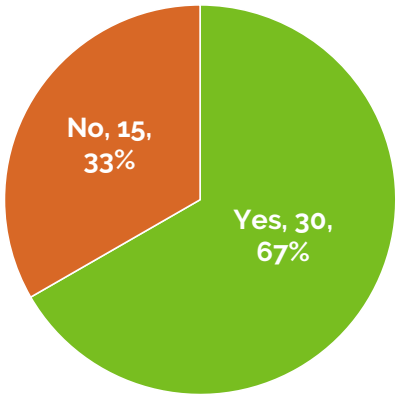
- *Solar-based alternative energy options would be the most popular on-site alternative energy option considered by businesses.* (See Figure 3).

Figure 3. Responses to "have you considered any of the following alternative energy options on-site?" Other represents fuel storage, backup and micro-grids.



- ***A majority of all those surveyed want to learn more about micro-grid systems.*** (See Figure 4.)

Figure 4. Response to "Do you want to learn more about micro-grid systems?"



ECONOMIC DEVELOPMENT STAKEHOLDER ENGAGEMENT

County Planners and Economic Developers were interviewed to provide their knowledge and perceptions of energy issues within the region. Interviews included questions about:

- Perceptions of energy issues among residents, businesses and elected officials in the County;
- Energy issues impacting business development within the County;
- Impacts of energy issues on various businesses; and
- Impediments for alternative energy options.

Some of the common, shared responses for certain issues included:

- Lack of natural gas infrastructure is impacting economic development expansion opportunities;
- Natural gas interruptibility and the quality and reliability of electricity continues to be a major issue among many companies in the region;
- The cost of electricity is high in the region compared to other regions in New York State which hinders the region's competitiveness;
- The acceptance of renewable energy options varies greatly among municipalities and one of the major issues is decommissioning of solar sites;
- Concern that the opportunity to provide electric as an alternative to gas is limited because of the limited infrastructure and capacity;
- There may be an opportunity for renewable energy jobs (it is the fastest growing employment in the nation) but workforce training is needed;
- Municipal utilities have been very helpful for economic development in terms of their cost structure and time for implementation of energy solutions for companies;
- The level of understanding of energy issues is very mixed among Counties and also among residents and elected officials while most businesses understand the energy issues.

- While compressed natural gas delivered through a "virtual pipeline" of shipments by truck from one point to another has been sought to address the lack of gas infrastructure, it too is controversial; and
- Better communications between utilities and economic developers regarding needs of businesses and potential energy solutions is needed.

IMPORTANCE OF ENERGY FOR REGIONAL ECONOMIC DEVELOPMENT

In 2013 New York State prepared an Industry Cluster Analysis for each economic development region. Cluster analysis identifies which regional industries have a competitive advantage because of their location in the region when compared to national and state trends for that industry. In short, industry cluster analysis helps economic development professionals focus their efforts on industries that have the potential to grow and have positive economic impacts in terms of jobs and wages.

Some industries, however, are more dependent, or impacted, by energy issues than others including manufacturing and processing. Table 11 provides a list of industry clusters developed by the New York State Department of Labor in 2013 for the Southern Tier region sorted by the Location Quotient for each industry (a location quotient measures the concentration of employment in a region compared to the nation – anything over 1.0 indicates a strong location quotient).

Table 2. Industry Clusters in the Southern Tier Region

Industry Cluster	Report-ing Units	Jobs	Total Wages ($ mns)	Average Wage	Regional Exports ($ bns)	Location Quotient	Rank
Food Processing	47	4,600	$326.0	$70,300	$1.15	3.05	1
Industrial Machinery & Services	93	3,600	$255.1	$71,400	$1.67	2.11	2
Back Office & Outsourcing	181	12,500	$832.5	$66,600	$2.63	1.98	3
Materials Processing	107	2,300	$97.3	$41,400	$0.50	1.37	4
Front Office & Producer Services	29	3,700	$245.3	$65,400	$1.68	1.35	5
Financial Services	175	4,700	$201.1	$43,100	$2.69	1.17	6
Biomedical	2,355	9,400	$203.9	$21,700	$0.89	0.91	7
Information Technology Services	90	3,400	$197.5	$58,500	$1.21	0.86	8
Distribution	679	7,300	$433.9	$59,700	$1.54	0.79	9
Forest Products	246	4,300	$203.2	$47,000	$0.52	0.79	9
Transportation Equipment	28	500	$20.9	$38,900	$0.07	0.76	11
Communications, Software & Media Services	904	8,400	$676.6	$80,700	$1.44	0.70	12
Electronics & Imaging	794	5,900	$263.6	$44,600	$1.43	0.62	13
Fashion, Apparel & Textiles	108	4,800	$135.5	$28,400	$0.13	0.57	14
Miscellaneous Manufacturing	156	2,200	$156.2	$71,000	$0.26	0.52	15
Travel & Tourism	23	300	$12.2	$36,400	$0.06	0.47	16
Southern Tier	**6,015**	**78,000**	**$4,261.0**	**$54,600**	**$17.88**		

Source: NYS Department of Labor

The takeaway from the data is important to the relationship between energy and economic development in the region – three of the top four regional industry clusters are high energy users. Consequently, energy issues has the potential to impact more than 10,000 jobs (13% of jobs in the region), $678 million in wages, and jobs with wages as high as $70,000 in the Southern Tier.

PART 3
REGIONAL ENERGY PROFILE

The Regional Energy Profile presents data, maps and information to describe the energy use, infrastructure and regulations within the Southern Tier 8 Region. This part includes the following components:

Current Energy Use

This section presents estimated total energy usage by County, fuel type and sector. The energy use statistics presented in this section show the regional differences and trends over time.

Energy Infrastructure

This section describes existing and proposed energy generation, electric transmission and natural gas infrastructure within the region. The description of **Existing and Proposed Energy Generation** facilities describes where energy used by customers in the Southern Tier 8 region is generated, identifies the large energy generators and distributed energy facilities within the region, and presents an overview of the large wind and solar photovoltaic installations planned within the region.

An overview of **Electricity Transmission Infrastructure** section describes the existing electricity transmission mains in the region and how electricity is transmitted from generators to customers. It also identifies planned improvements within the region.

The **Natural Gas Infrastructure** overview describes the existing natural gas pipelines and other infrastructure located within the region as well as projects proposed by utilities.

This section also identifies energy infrastructure in the region relating to **other fuels** such as propane, compressed natural gas and fuel oil. (NOTE: This study does not address transportation fuels and infrastructure.)

Energy Suppliers and Regulatory Context

This section describes the existing utilities that provide electricity and gas to customers in the Southern Tier 8 region as well as the regulatory and management entities involved in energy infrastructure.

REGIONAL ENERGY USAGE

The available data on total energy usage by County and sector offer insights into total energy consumption by type of fuel, by county and by residential, commercial and industrial sectors. The data presents a "snapshot" for the annual usage as documented in published sources as well trends over time.

This section summarizes:

- Total electricity usage by County and sector and trends over time;
- Total natural gas usage by County and sector;
- Total residential fuel consumption; and
- Household heating fuels.

ABOUT THE DATA

This section utilizes data from various sources and time periods in order to understand generally the types and sources of energy used by households and businesses throughout the Southern Tier 8 region. No one source provides definitive data about the entire region or about individual municipalities. This report relies on data published by reliable sources such as the New York Energy Research & Development Authority (NYSERDA) and the U.S. Census Bureau. The level of detail of the data analysis is intended to be sufficient to draw broad conclusions about energy use and trends, not to serve as a definitive energy baseline for individual counties or for the region as a whole.

OVERVIEW OF REGION

The Southern Tier 8 region comprises eight counties: Broome, Chenango, Cortland, Delaware, Otsego, Tioga and Tompkins. The total population of the region, based on 2018 Census estimates, is 579,990. One-third of the region's population is in Broome County and 18% is in Tompkins County.

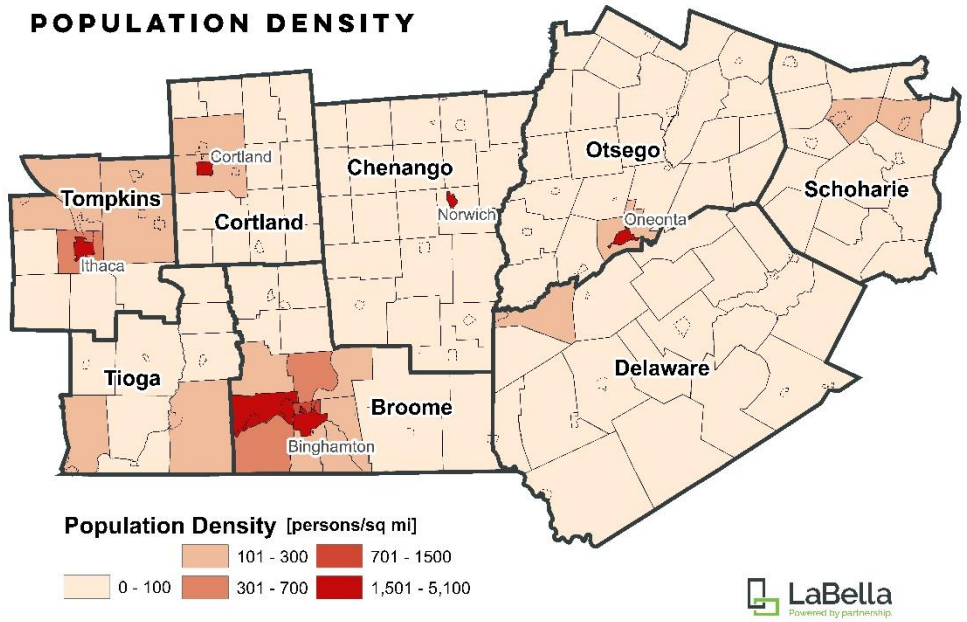
Table 3. Total Population and Households by County

COUNTY	POPULATION	HOUSEHOLDS	% OF REGIONAL POPULATION
BROOME	194,402	78,594	33.5%
CHENANGO	48,348	20,616	8.3%
CORTLAND	48,123	17,685	8.3%
DELAWARE	45,502	19,030	7.8%
OTSEGO	60,244	23,556	10.4%
SCHOHARIE	31,364	12,559	5.4%
TIOGA	49,045	20,045	8.5%
TOMPKINS	102,962	39,326	17.8%
REGION	579,990	231,411	100.0%

SOURCE: Data Source: U.S. Census Bureau, American Community Survey, 2014-2018

As illustrated in the following map, the region's population is concentrated in and around a few densely populated cities: Binghamton, Endicott, and Johnson City in Broome County, Ithaca in Tompkins County, Cortland in Cortland County, and Oneonta in Otsego County, and Norwich in Chenango County. Most of the region is rural and sparsely populated.

Map 1: Population Density

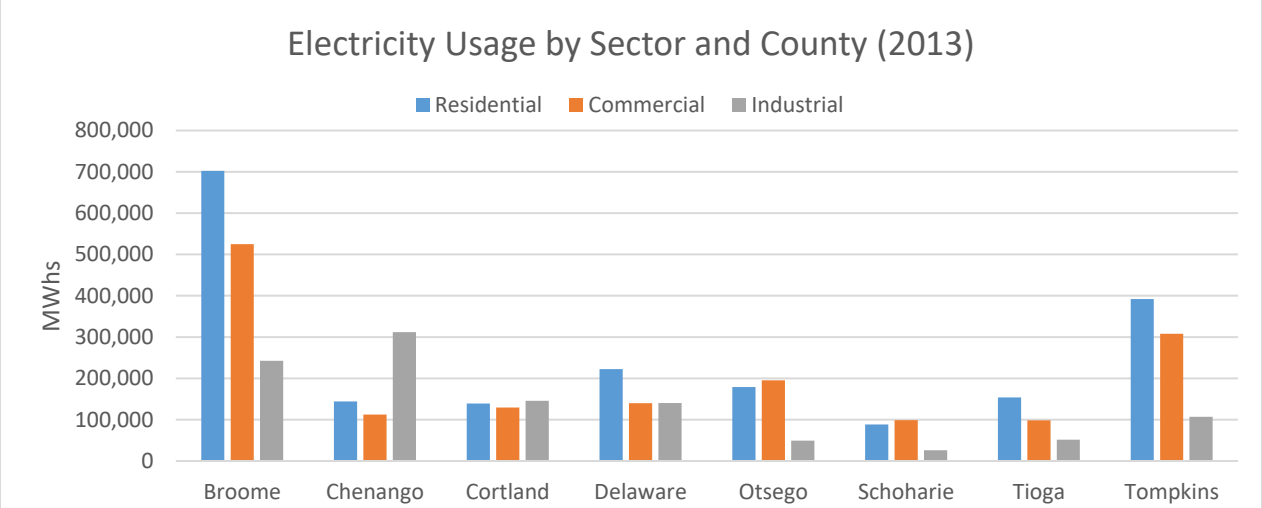


ELECTRICITY UTSAGE BY COUNTY AND SECTOR

The total amount of electricity used annually in the Southern Tier 8 region is approximately 4.7 Gigawatt hours. Approximately 43% of the electricity usage is by residences, 34% in commercial uses, and 23% by industries.

Table 4: Estimated Annual Electricity Usage by Sector and County (2013)

County	Population[3]	Residential	Commercial	Industrial	Total	% of Regional Total	
		Electricity (MWh)	Electricity (MWh)	Electricity (MWh)	Electricity (MWh)	Population	Electricity Usage
Broome	194,402	702,325	524,802	242,504	1,469,631	33.5%	31.3%
Chenango	48,348	144,179	112,450	311,824	568,453	8.3%	12.1%
Cortland	48,123	138,939	129,525	145,598	414,062	8.3%	8.8%
Delaware	45,502	222,448	139,829	140,212	502,489	7.8%	10.7%
Otsego	60,244	178,999	195,240	49,181	423,420	10.4%	9.0%
Schoharie	31,364	88,412	98,897	25,805	213,114	5.4%	4.5%
Tioga	49,045	153,714	98,326	51,692	303,732	8.5%	6.5%
Tompkins	102,962	391,916	307,907	107,065	806,888	17.8%	17.2%
Regional Total	579,990	2,020,932	1,606,976	1,073,881	**4,701,789**	100.0%	100.0%
		43.0%	34.2%	22.8%	100.0%		



In Chenango, Cortland and Delaware Counties, the industrial sector consumes more than 25% of the electricity used countywide. In Tompkins, Tioga and Broome Counties, the residential sector uses the highest proportion of electricity.

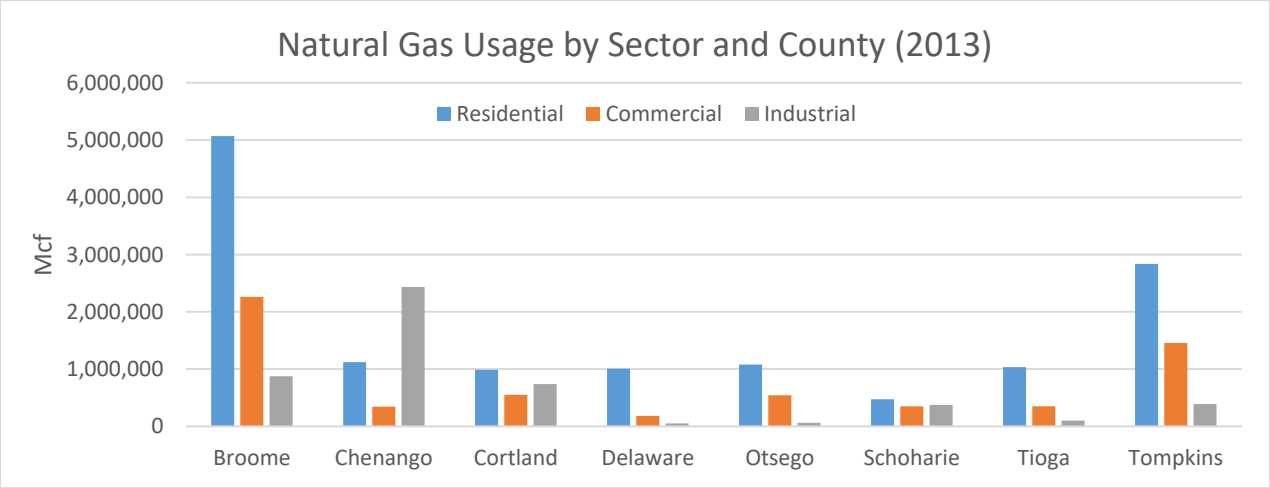
[3] Population from U.S. Census Bureau, American Community Survey, 2014-2018

NATURAL GAS USAGE BY SECTOR AND COUNTY (2013)

The total amount of natural gas used annually in the Southern Tier 8 region is approximately 24.7 million cubic feet.[4] Regionwide, 55% of natural gas usage is in residences, 25% in commercial uses, and 20% by industries.

Table 5: Natural Gas Usage by Sector and County (2013)

County	Population	Residential Natural Gas (Mcf)	Commercial Natural Gas (Mcf)	Industrial Natural Gas (Mcf)	Total Natural Gas (Mcf)	% of Regional Total Population	% of Regional Total Natural Gas
Broome	194,402	5,070,251	2,261,735	876,329	8,208,315	33.3%	33.3%
Chenango	48,348	1,120,179	345,162	2,434,948	3,900,289	15.8%	15.8%
Cortland	48,123	988,005	552,036	736,768	2,276,809	9.2%	9.2%
Delaware	45,502	1,004,958	182,981	50,396	1,238,335	5.0%	5.0%
Otsego	60,244	1,079,086	542,120	62,068	1,683,274	6.8%	6.8%
Schoharie	31,364	472,727	350,766	375,957	1,199,450	4.9%	4.9%
Tioga	49,045	1,034,030	349,530	102,198	1,485,758	6.0%	6.0%
Tompkins	102,962	2,835,759	1,454,917	389,608	4,680,284	19.0%	19.0%
Regional Total	579,990	13,604,995	6,039,247	5,028,272	**24,672,514**	100.0%	100.0%
		55.1%	24.5%	20.4%			



SOURCE: Source: Natural gas usage from Patterns and Trends, New York Energy Profiles: 2002-2016, NYSERDA, 2019, Appendix C, Table C-4; Population from U.S. Census Bureau, American Community Survey, 2014-2018

[4] Source: Patterns and Trends, New York Energy Profiles: 2002-2016, NYSERDA, 2019, Appendix C, Table C-4: 2013 Estimated Electricity and Natural Gas Usage by Sector by County https://www.nyserda.ny.gov/About/Publications/EA-Reports-and-Studies/Patterns-and-Trends. Note that data for individual counties are estimated by NYSERDA based on aggregated data.

In Chenango, Cortland and Schoharie County, industrial uses consume a large portion of the total natural gas used in these Counties. Although the study did not collect usage data from individual sites, major energy users in Cortland County likely include manufacturers such as Marrietta Corporation/ KIK products and Cortland Asphalt/ Suit-Kote in the City of Cortland, as well as SUNY Cortland and medical facilities. In Chenango County, major industries include Kerry Bio-Science, Chobani, and Raymond Corporation. Large users in Schoharie County likely include Kintz Plastics and SUNY Cobleskill.

In Broome, Delaware, Otsego, Tioga and Tompkins Counties, residential and commercial uses are the predominant consumers of natural gas. These counties have large numbers of households with natural gas service.

RESIDENTIAL ENERGY CONSUMPTION BY TYPE OF FUEL

The major fuels used by households are electricity, natural gas, propane, distillate (fuel oil), kerosene, and wood. A small number of households use coal as heating fuel.[5]

Published data reveal the following characteristics of residential energy use among the eight counties in 2002 and 2016:

- Residential use of natural gas and propane was higher in 2016 than in 2002 among all counties in the Southern Tier 8 Region, as well as across New York State;[6] In Tompkins and Broome Counties, the amount of natural gas used in residences was significantly higher in 2016 than in 2002.
- Residential consumption of electricity was higher in 2016 than in 2002 among all but two counties in the Southern Tier 8 Region, Otsego and Schoharie, where residential electricity usage was slightly lower in 2016 than in 2002;
- Distillate (fuel oil) and kerosene consumption was lower in 2016 than in 2002 among all counties in the Southern Tier 8 Region.
- Between 2002 and 2016, the number of households that use wood fuel decreased throughout the region.

RESIDENTIAL ELECTRICITY USAGE

Data published by NYSERDA for 2013-2016 reveal trends and differences among Counties in residential energy consumption.

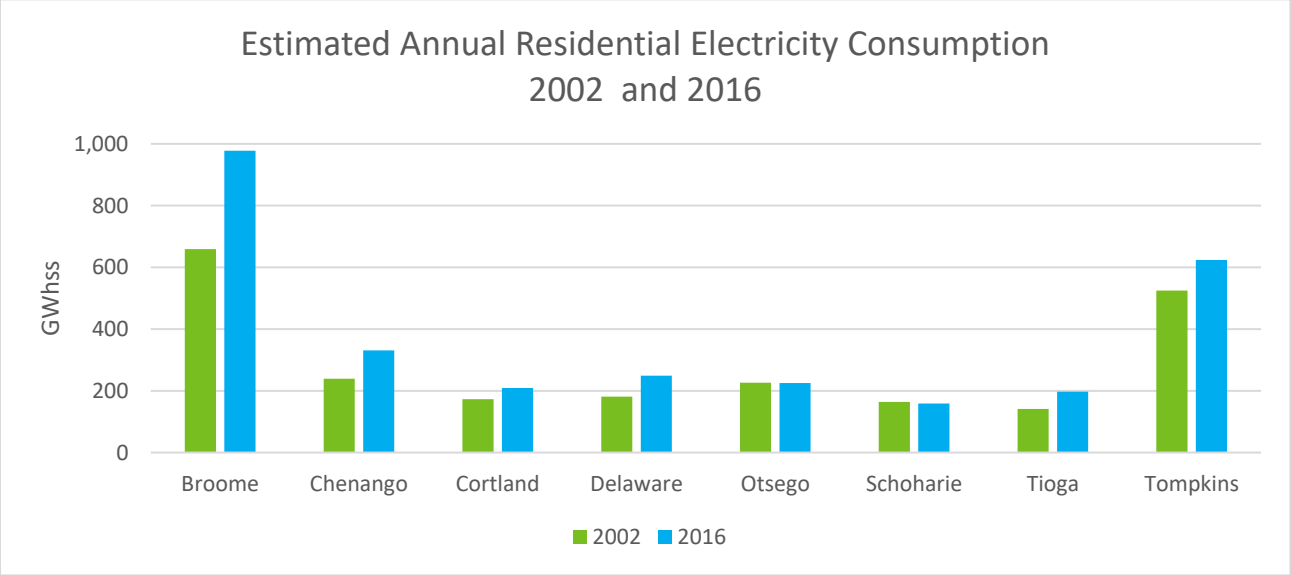
The amount of electricity used by residences throughout the region in 2016 was approximately 2,972 gigawatt hours. The average electricity usage per household in the region increased 29% between 2002 and 2016, from 10.1 MWhs per household in 2002 to 13.0 MWhs per household in 2016.

[5] Coal usage is not among the six fuels tracked by NYSERDA in its "Patterns and Trends" series.
[6] Source: Patterns and Trends, New York Energy Profiles: 2002-2016, NYSERDA, 2019

The Counties with the highest electricity usage per household are Chenango (16.7 MWhs/ HH), Tompkins (16.3 MWhs/ HH), Delaware (13.2 MWhs/ HH), and Schoharie (12.9 MWhs/ HH). Between 2002 and 2016, per household electricity usage increased in Broome, Chenango, Cortland, Delaware, Tioga and Tompkins Counties but decreased in Otsego and Schoharie Counties. (See Table 3.)

Table 6: Estimated Annual Residential Electricity Usage (2002 and 2016)

	2002			2016	
		Total Electricity Usage	Per Household Usage	Total Electricity Usage	Per Household Usage
County	Households	GWhs	MWhs	GWhs	MWhs
Broome	80,749	659	8.2	978	12.4
Chenango	19,926	239	12.0	331	16.7
Cortland	18,210	173	9.5	209	11.8
Delaware	19,270	181	9.4	249	13.2
Otsego	23,291	226	9.7	225	9.6
Schoharie	11,991	164	13.7	159	12.9
Tioga	19,725	141	7.1	197	10.0
Tompkins	36,420	525	14.4	624	16.3
Regional Total	229,582	2,308	10.1	2,972	13.0



The increase in residential electricity consumption per household between 2002 and 2016 is consistent with national trends toward smaller households and increasing use of electric devices, including the conversion to electric heat pumps for space and water heating and electric vehicles. Although the

widespread installation of energy-efficient lighting[7] may have reduced electricity usage in recent years, increases in cooling demand, electric heating and vehicles is likely to increase demand for electricity in the future.

Table 7: Estimated Annual Residential Energy Consumption – Fuels Other Than Electricity (2002 and 2016)

County	Natural Gas		Propane		Distillate		Kerosene		Wood	
	Bcf		Mbbl		Mbbl		Mbbl		Mcords	
	2002	2016	2002	2016	2002	2016	2002	2016	2002	2016
Broome	5.8	7.7	109	137	177	132	9	5	61	14
Chenango	0.3	0.5	51	74	143	97	7	4	63	14
Cortland	1.0	1.3	32	35	55	34	3	1	30	7
Delaware	0.3	0.3	47	62	176	122	9	5	75	20
Otsego	0.4	0.6	83	84	198	122	10	5	70	16
Schoharie	0.0	0.1	30	41	128	74	6	3	43	10
Tioga	0.7	1.0	49	66	139	93	7	4	41	10
Tompkins	2.0	2.8	90	104	74	55	4	2	40	11
Regional Total	**10.5**	**2.8**	**491**	**603**	**1,090**	**729**	**55**	**29**	**423**	**102**

SOURCE: Patterns and Trends, New York Energy Profiles: 2002-2016, NYSERDA, 2019

Table 8: Total Number of Heating and Cooling Degree Days - 2002 and 2016

	2002	2016
Total # Heating Degree Days	5791	5642
Total # Cooling Degree Days	877	799

SOURCE: Patterns and Trends, New York Energy Profiles: 2002-2016, NYSERDA, 2019

Total residential consumption of all types of energy was higher in 2016 than in 2002 in all counties except for Otsego and Schoharie.[8] Figure 1 shows the total residential energy usage in 2016 by County, after converting the energy units for each fuel to the common unit of billion BTUs, based on the following conversion factors. However, this may have resulted from single year usage anomalies.

[7] https://energyathaas.wordpress.com/2017/05/08/evidence-of-a-decline-in-electricity-use-by-u-s-households/

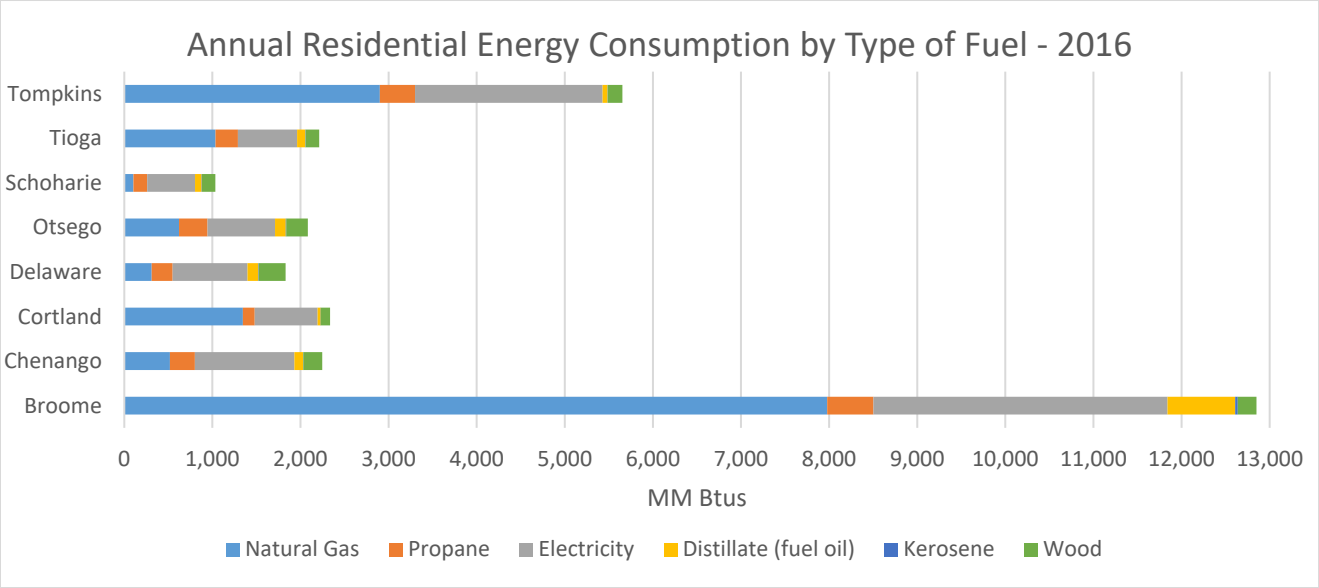
[8] The 2013 data appear to underestimate residential electricity usage in Schoharie, Chenango, Cortland and Tompkins Counties due to different methodologies and aggregation approaches used by NYSERDA in its published report.

Table 9: Conversion Factors (Physical Units to MMM BTUs) for Fuel Types

Fuel Type	Physical Unit		Common Unit	
Natural Gas	1,000,000,000	cubic feet (Bcf)	1,036	billion Btus
Propane	1000	Barrels (Mbbl)	3.836	billion Btus
Electricity	1,000,000	Watt-hours (gWhs)	3.412	billion Btus
Distillate	1000	Barrels (Mbbl)	5.825	billion Btus
Kerosene	1000	Barrels (Mbbl)	5.67	billion Btus
Wood	1000	Cords (seasoned firewood)	15.3	billion Btus

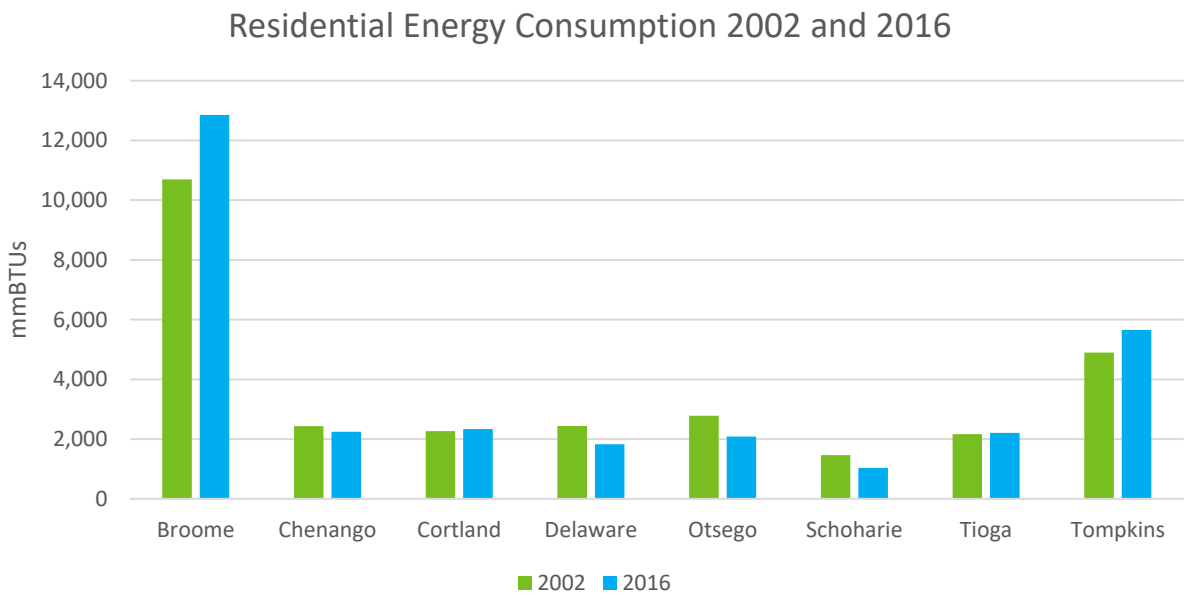
SOURCE: Patterns and Trends, New York Energy Profiles: 2002-2016, NYSERDA, 2019

Figure 5. Annual Residential Energy Consumption by Type of Fuel, 2016



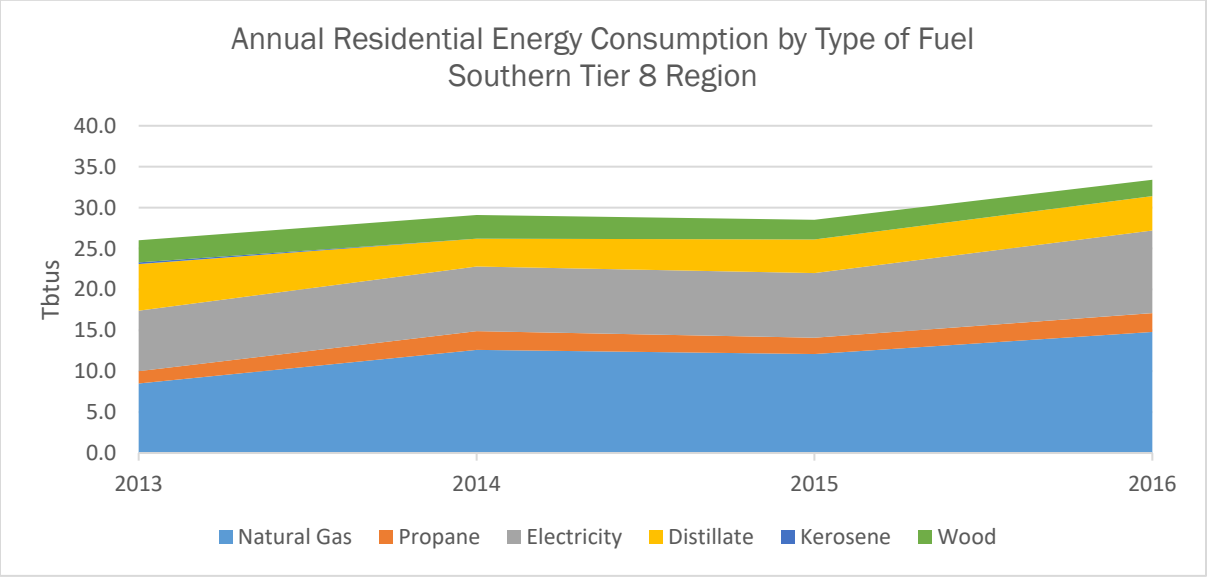
SOURCE: Patterns and Trends, New York Energy Profiles: 2002-2016, NYSERDA, 2019

Figure 6: Residential Energy Consumption 2002 and 2016



SOURCE: Patterns and Trends, New York Energy Profiles: 2002-2016, NYSERDA, 2019

Figure 7: Annual Residential Energy Consumption by Type of Fuel, Southern Tier 8 Region, 2013-2016



SOURCE: Patterns and Trends, New York Energy Profiles: 2002-2016, NYSERDA, 2019, 2018, 2017 and 2016

Comparing the charts highlights the overall increase in energy usage. Between 2013 and 2016 the amount of energy use per household in the Southern Tier 8 region increased by 28%, from 113.2 Tbtu to 144.8 TBtus. Some of the year-to-year differences result from the number of heating and cooling degree days. For example, the summer in 2016 was much hotter than in 2014, resulting in significantly higher electricity usage.

Table 10: Annual Residential Energy Use

Annual Residential Energy Use Southern Tier 8 Region	2013 (Tbtu)	2014 (Tbtu)	2015 (Tbtu)	2016 (Tbtu)
Natural Gas	8.5	12.6	12.1	14.8
Propane	1.5	2.3	2.0	2.3
Electricity	7.4	7.9	7.9	10.1
Distillate or Kerosene	5.9	3.4	4.1	4.2
Wood	2.7	2.9	2.4	2.0
Solar	0.2	0.1	0.1	0.1
Total	26.2	29.2	28.6	33.5
Total Per Household	113.2	126.2	123.6	144.8
Total # Heating Degree Days	6,231	6,517	6,203	5,642
Total # Cooling Degree Days	644	471	670	799

SOURCE: Patterns and Trends, New York Energy Profiles: 2002-2016, NYSERDA, 2019, 2018, 2017 and 2016

RESIDENTIAL HEATING FUELS

Based on U.S. Census data the number of households that use electricity for house heating increased from 11.9% in 2010 to 13.7% in 2017. During the same period, the number of households that used fuel oil or kerosene for house heating declined from 27.3% in 2010 to 22.2% in 2017. The proportion of households relying on natural gas for house heating stayed the same at 41%.

In those areas where natural gas service is available, a majority of households use it to heat their homes. Reflecting the availability of natural gas service, a majority of households purchase natural gas from a utility for heating in Broome County (62.1% of households), Cortland County (50.9% of households), and Tompkins County (50.9% of households.)

The use of fuel oil or kerosene as a residential heating fuel is most common in Chenango (34.0% of households), Delaware (41.6%), Otsego (38.1%), and Schoharie (43.3% of households) counties. In Tioga County, nearly one-third of households use natural gas purchased from a utility (30.0% of county total occupied units) and another one-third use fuel oil or kerosene (30.9% of total occupied units) for heating.

Table 11: Households by Type of Residential Heating Fuel, 2018

County	Total Households	Utility Gas	Bottled, tank or LP gas	Electricity	Fuel oil, kerosene	Wood	Solar energy	Other or no fuel used
Broome	78,594	48,793	5,156	11,055	9,035	2,709	6	1,840
Chenango	20,616	3,008	3,044	3,665	6,926	2,812	15	1,146
Cortland	17,685	9,147	1,631	2,074	2,577	1,388	21	847
Delaware	19,030	2,153	2,581	2,392	7,838	3,366	22	678
Otsego	23,556	4,372	3,577	2,581	8,850	3,490	23	663
Schoharie	12,559	770	2,093	1,839	5,229	2,085	8	535
Tioga	20,045	5,940	2,562	2,420	6,066	1,800	85	1,172
Tompkins	39,326	19,384	4,291	7,989	3,623	2,426	96	1,517
Southern Tier 8 Region	231,411	93,567	24,935	34,015	50,144	20,076	276	8,398
% of total		40.4%	10.8%	14.7%	21.7%	8.7%	0.1%	3.6%

Source: U.S. Census Bureau American Community Survey, 2014-2018 Five-Year Estimates, Table B25040

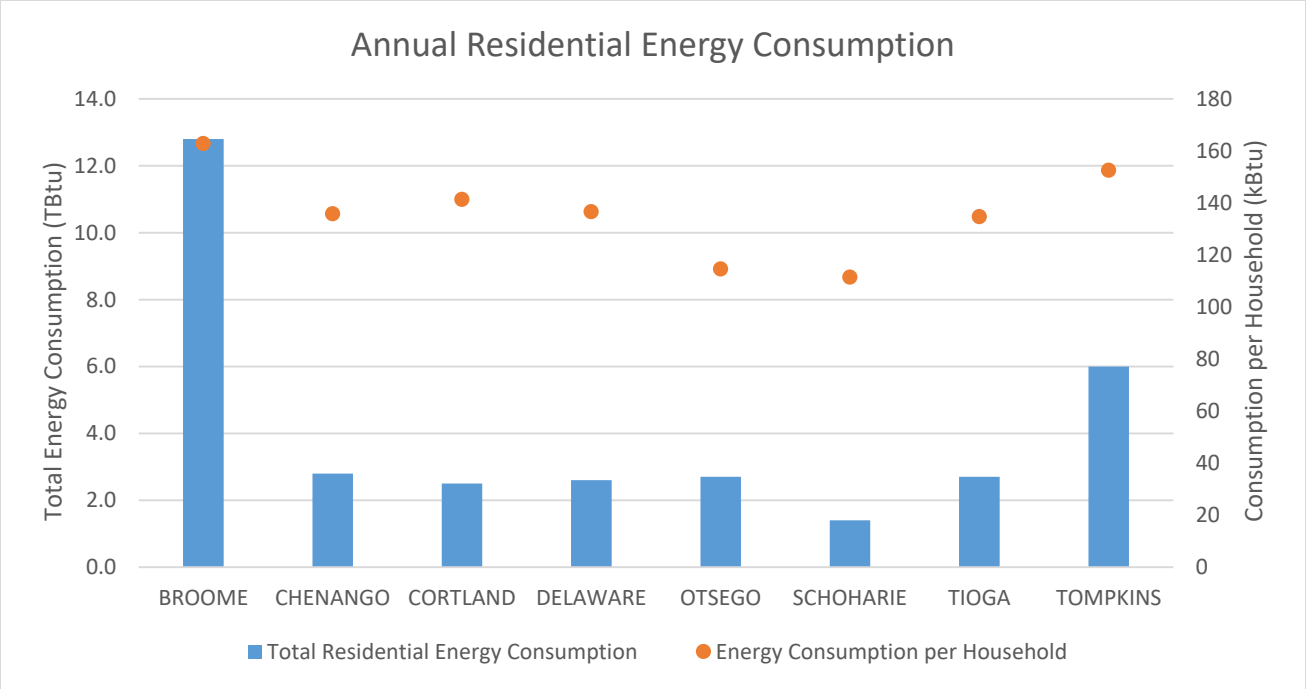
Table 12: Percent of Total Households by Type of Residential Heating Fuel, 2018

County	Total Households	Utility Gas	Bottled, tank or LP gas	Electricity	Fuel oil, kerosene	Wood	Solar energy	Other or no fuel used
Broome	78,594	62.1%	6.6%	14.1%	11.5%	3.4%	0.0%	2.3%
Chenango	20,616	14.6%	14.8%	17.8%	33.6%	13.6%	0.1%	5.6%
Cortland	17,685	51.7%	9.2%	11.7%	14.6%	7.8%	0.1%	4.8%
Delaware	19,030	11.3%	13.6%	12.6%	41.2%	17.7%	0.1%	3.6%
Otsego	23,556	18.6%	15.2%	11.0%	37.6%	14.8%	0.1%	2.8%
Schoharie	12,559	6.1%	16.7%	14.6%	41.6%	16.6%	0.1%	4.3%
Tioga	20,045	29.6%	12.8%	12.1%	30.3%	9.0%	0.4%	5.8%
Tompkins	39,326	49.3%	10.9%	20.3%	9.2%	6.2%	0.2%	3.9%
Southern Tier 8 Region	**231,411**	**40.4%**	**10.8%**	**14.7%**	**21.7%**	**8.7%**	**0.1%**	**3.6%**

Source: U.S. Census Bureau American Community Survey, 2014-2018 Five-Year Estimates, Table B25040

SUMMARY OF RESIDENTIAL ENERGY CONSUMPTION

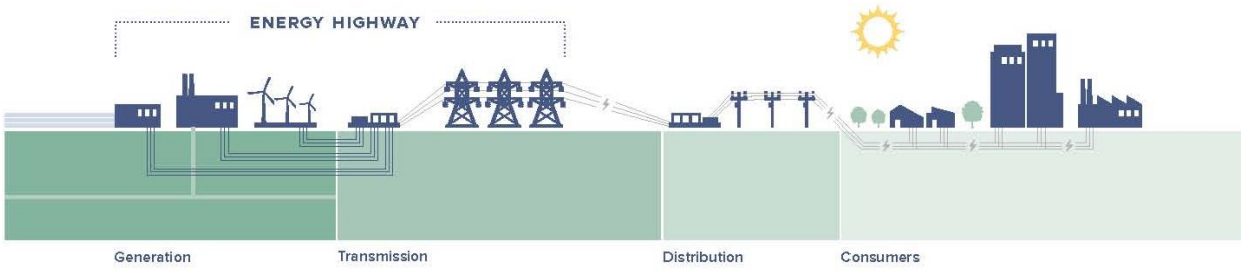
Total energy consumption as well as energy consumption per household has increased between 2013 and 2016. Energy consumption per capita is highest in Broome and Tompkins Counties; these counties also have the highest proportion of households that use natural gas for house heating.



SOURCE: Patterns and Trends, New York Energy Profiles: 2002-2016, NYSERDA, 2019, 2018, 2017 and 2016

ELECTRICITY INFRASTRUCTURE

Existing electricity infrastructure in the region include electricity generation facilities, electric transmission mains, distribution and substations.



ELECTRICITY GENERATION

A majority of the approximately 4,700,000 MWhs of electricity used within the Southern Tier 8 region is generated at large power plants located outside the region and transmitted to customers via a network of transmission and distribution infrastructure. Energy generation facilities located within the region include a large pumped storage plant operated by the New York Power Authority, a small hydro-electric plant, landfill gas facility, and several plants maintained by institutions to power their own facilities. An increasing amount of electricity is generated by solar photovoltaic facilities. Proposed large wind and solar facilities are expected to increase the amount of electricity generated within the region.

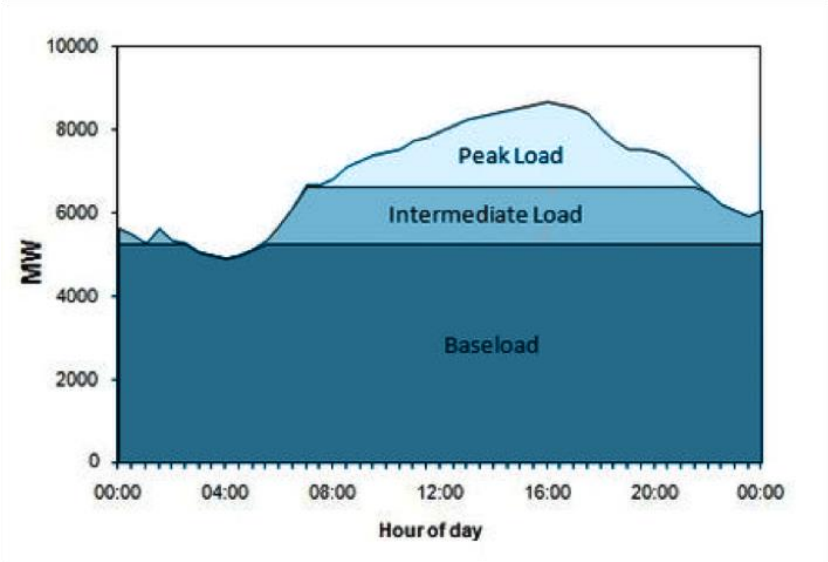
This section describes:

- Sources of base load electricity purchased by utilities in the region
- An explanation of how electricity generation addresses both “base” and “peak” loads
- Existing and recently retired peaking plants
- Existing and proposed solar and wind facilities and generators
- Distributed energy facilities including powered by biogas, hydro-power, and lake source cooling
- Cogeneration facilities
- Backup generators

EXPLANATION OF "BASE LOAD" AND "PEAK LOAD"

Electricity generation facilities must produce enough electricity to supply electricity to users at exactly the time it is needed. Sufficient capacity is needed to meet both "base" and "peak" loads or demand.[9]

Figure 8: Daily Load Curve and Generation Type



Source: Institute for Energy Research Baseload-Grid-Graphic

"Base load" or "base demand" is the amount of electricity that flows continuously through the grid to meet a consistent demand. "Peak demand" refers to periods when electricity is consumed over a sustained period at higher-than-average levels. A typical peak demand period is during hot summer afternoons when air conditioning use spikes and during evenings when residential and commercial usage is highest. Levels of base and peak loads also vary by season, with higher usage occurring during the summer.

"Base load" generators are typically large plants that run almost continuously to produce power to meet the minimum level of demand on an electric grid over a period of time. These include the large hydro-electric and nuclear plants that provide most of the region's electricity.

When demand for electricity exceeds the base load, peaking plants or demand management or stored energy are activated to supply the needed electricity. Generating facilities designed to meet peak loads can be turned off and on quickly and/or adjust power output as needed. These generators are referred to as "dispatchable generation" and serve to meet intermediate demand or "peak loads." Peaking plants typically are less efficient than base load generators, as they trade off system efficiency to improve

[9] The terms "load" and "demand" both refer to the amount of electricity required by users.

response times. Many peaking plants operate on fossil fuels such as coal and natural gas, although all of the coal plants in New York State have now been retired.[10]

New technologies to manage peak demand include battery storage and demand management. With advances in technology, battery storage may function in the future as cost-effective "peaking plants." Currently, battery storage associated with renewable energy facilities are designed to provide approximately four hours of storage to increase the amount of electricity that can be generated from renewable facilities. Storage capacity will need to be larger for batteries to function as dispatchable generation that responds rapidly to changes in peak demand.

Systems that reduce peak demand and avoid the need for dispatchable generation are currently in development. For example, real-time pricing can incentivize customers to reduce load during times of peak demand and schedule high-demand activities during off-peak times. This type of "peak shaving" helps to reduce the need for generating facilities, especially those that operate with fossil fuels, which only operate during peak times. Electric utilities purchase electricity from various sources to meet both base and peak loads. The cost is lower during off-peak times.

BASELINE ELECTRICITY GENERATING PLANTS

Electric utilities purchase most of the base load power used by customers in the Southern Tier 8 region from four large generating facilities located in New York State, but outside the Southern Tier 8 region.[11]

- two hydro-electric plants operated by the New York Power Authority (NYPA) (Robert Moses Niagara hydroelectric plants near Niagara Falls and the St. Lawrence-FDR plant in Massena) and
- two privately owned nuclear plants (Nine Mile Point plant in Oswego and the Ginna Nuclear Power Plant in Ontario, Wayne County.)

Electricity generation is measured by "capacity" and "production." Capacity refers to the amount of electricity that the facility is capable of generating at any one time and is measured in kilowatts (or megawatts or gigawatts). Production refers to the amount of energy generated over a period of time and is measured in kilowatt hours. Because renewable sources of energy such as wind and solar produce power intermittently, they rarely produce at the maximum capacity. For example, a wind energy facility with 3 MW capacity would produce the same amount of electricity over the course of a year as a hydro power facility with 1 MW capacity. In contrast, hydropower represents 11% of New York's generating capacity and 21% of its production because it produces constantly and varies only as water flows change.

[10] The last coal burning plant in NYS, located in Somerset, Niagara County closed in 2020
[11] Nine Point Nuclear Station generated 15,434.7 Gwhs and the Ginna Nuclear Power Plant generated 4,706.6 Gwhs in 2018 and approximately 4,655.2 GW annually in 201, NYS ISO Gold Book

Table 13: 2018 Net Energy Production from Large Upstate Generators[12]

Owner/ Operator	Facility	Location	Net Energy Production– 2018 (GWh)
New York Power Authority	St. Lawrence-FDR	Massena	7,661.2
New York Power Authority	Moses Niagara	Niagara Falls	16,142.8
Nine Mile Point Nuclear Station	Nine Mile Point 1	Scriba, Oswego County	5,314.8
Nine Mile Point Nuclear Station	Nine Mile Point 2	Scriba, Oswego County	10,119.9

SOURCE: New York ISO 2019 Load & Capacity Data (Gold Book)

Goodyear Lake HydroElectric Plant[13]

The Colliersville Hydroelectric Project on Goodyear Lake in Milford, Otsego County is a conventional "run-of-river" hydroelectric power generation facility with a capacity of 1.4 MW. In 2018, the net energy generated was 6,200 MWhs. The electricity is sold to NYSEG, which operates a substation adjacent to the facility. This facility provides a portion of the "base demand" for electricity in the region.

The dam and hydroelectric facility were rehabilitated during the late 1970s and started operations in 1980.The Federal Energy Regulatory Commission issued a new operating license to this facility's operator, Goodyear Lake Hydro, in July 2019.[14]

[12] NYISO 2019 Load & Capacity Data (Gold Book,) https://www.nyiso.com/documents/20142/2226333/2019-Gold-Book-Final-Public.pdf/

[13]"The project consists of a 200-foot-long, 35-foot-high reinforced-concrete Ambursen-type dam; a 364-acre reservoir with a gross storage capacity of 7,800 acre-feet at normal pool elevation; a 550-foot-long reinforced concrete power canal; a 103-foot-long by 33-foot-wide reinforced concrete powerhouse containing two turbine-generator units; a tailrace; and three 4.16-kV underground generator leads to an adjacent substation owned by the New York State Electric and Gas Corporation." https://www.power-eng.com/2019/07/19/ferc-issues-new-operating-license-for-colliersville-small-hydroelectric-project/#gref

[14] https://www.hydroworld.com/articles/2019/07/ferc-issues-new-operating-license-for-colliersville-small-hydroelectric-project.html

Broome County Landfill Gas-to-Energy

Two generating facilities at the Broome County Landfill, located at 286 Knapp Road in Binghamton and operated by NYSEG, convert the methane emitted from decaying waste into electricity.[15] In 2018 the facility generated 6,300 MW and the facility operated by Consolidated Edison Energy, Inc. generated 18,600 MW of electricity.[16] The facility was opened in 1969 and is owned by Broome County. Up to 600 MWhs are annually provided to Broome County for use in County operations.[17]

The gas to energy facility converts landfill gas to electricity. Currently four engines are on site to produce electricity. Excess gas that is not used to produce electricity must be flared-off to prevent the release of green house gases.

PEAKING PLANTS

Certain electricity generating facilities specialize in producing electricity to meet demand at peak times. One such facility, operated by the New York Power Authority (NYPA) is located in Schoharie County.

Blenheim-Gilboa Pumped Storage

The Blenheim-Gilboa Pumped Storage hydro-power plant is a hydroelectric pumped storage power generation facility that functions as a peaking plant. During periods of low demand (and low electricity cost) the plant pumps water from the lower reservoir to the upper reservoir. When electricity is needed, the water is released downward through turbines to generate up to 1.16 MW of electricity.

The facility opened in 1973 and is operated by the New York Power Authority. The facility is located at 397 Power Plant Access Road in the Towns of North Blenheim and Gilboa (Schoharie County.) The plant functions as a peaking plant to provide electricity to the grid during times of peak demand. The facility functions like a giant rechargeable battery, providing power to the grid when needed and recharging when demand and power prices are low.

[15] The NYS DEC 2015 Annual Report noted that the facility recovered 801.065,345 cubic feet of methane for energy generation and generated 33,028 MWhs of electricity, and generated 55,124 gallons of condensate (https://www.dec.ny.gov/chemical/23679.html)
[16] NYSISO 2019 Gold Book
[17] http://www.gobroomecounty.com/files/Landfill.pdf

RETIRED GENERATING FACILITIES

During the past several years, coal-fired power plants and gas-powered "peaker" plants have been retired. Three such facilities are located in the Southern Tier 8 region:

- Cayuga coal-fired plant in Lansing, Tompkins County
- Binghamton Cogen, Binghamton
- Westover Power Plant, Johnson City
- Jennison Power Plant, Bainbridge

Each of these facilities operated to provide electricity to utilities as needed to meet peak demand. As energy storage and energy management technologies advance, the electric grid has less need for peaker plants.

The Cayuga plant in Lansing, Tompkins County, operated for more than 50 years as a conventional steam coal power generation facility. By September 2019, the two coal-powered generators operated by Cayuga Operating Company, LLC, were retired. The two turbines had generating capacity of 155.3 MW and 167.2 MW. In 2018 the plant produced 99,000 MWh of electricity.[18]

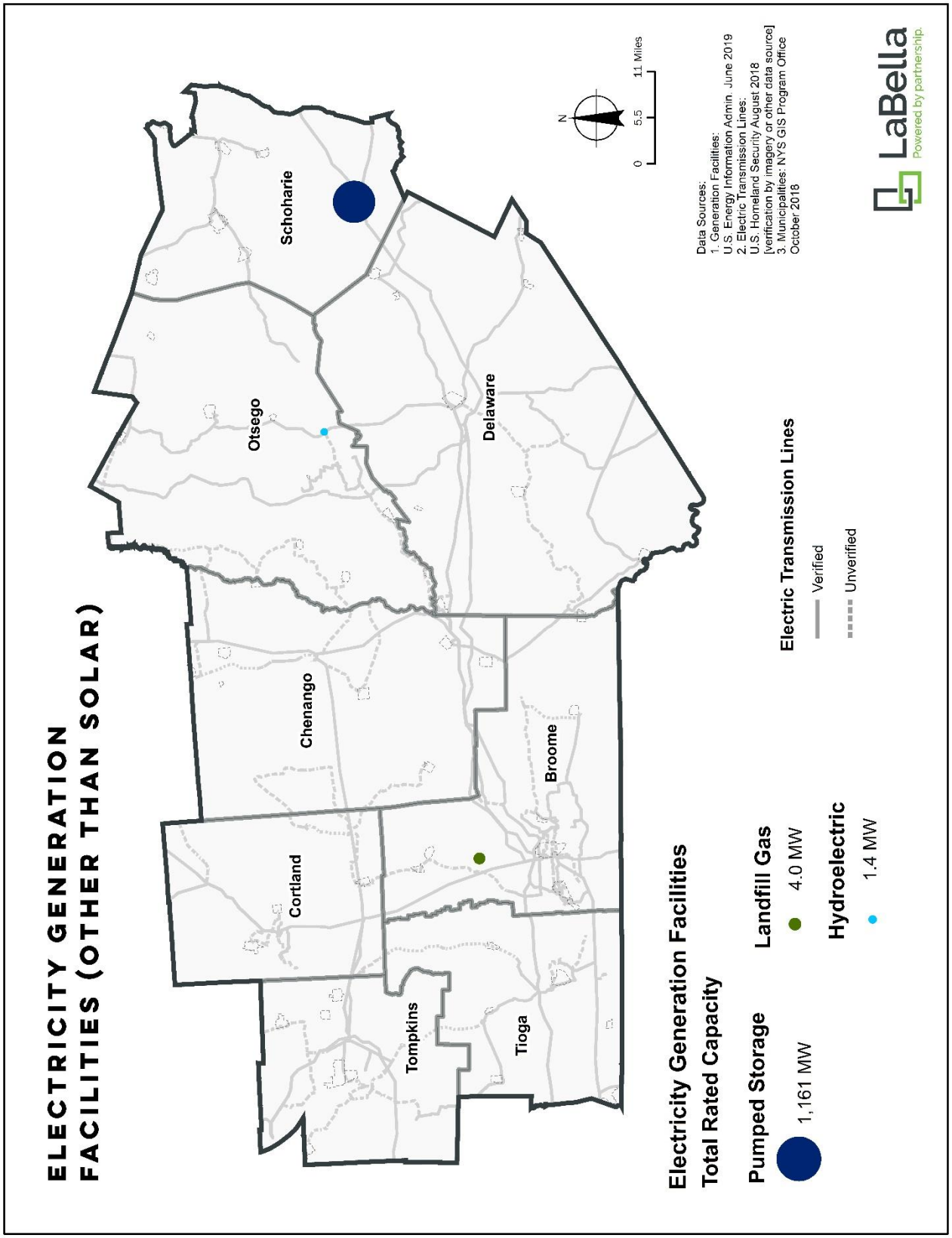
The former Binghamton Cogen was a natural gas fired combustion turbine power generation facility located at 22 Charles Street in Binghamton, NY (Broome County). The 42 MW capacity facility opened in 1992. Between 2014 and 2018, Wellhead Services Inc. operated the facility as a peaking plant which generated electricity when needed during periods of peak demand. After the City of Binghamton purchased the facility in 2017,[19] the turbines were removed and the facility is no longer operational.

The AES Westover generating facility in Johnson City, formerly known as the Goudey Station, operated as a coal-burning power plant between 1917 and 2012 and had a generating capacity of 119 MW. AES purchased the facility from NYSEG in 1999. In 2010, a 20MW storage project using lithium-ion batteries was proposed at the site. The electric interconnection for this project was canceled in 2013, and the installed battery storage system was moved to another AES facility in Ohio.[20]

The Jennison Station power plant in Bainbridge, Chenango County began operation in 1945 with generating capacity of 60 MW. It was primarily fueled with coal but also burned wood waste and tires. In 1999, NYSEG sold the facility to AES Corporation, which closed the facility in 2000. In 2006, AES proposed to construct a 500 MW plant that would use coal and biomass. However, this project was not funded, and the facility remains idle.

[18] NYSISO 2019 Gold Book
[19] http://www.wicz.com/story/37161377/city-of-binghamton-acquires-charles-street-power-plant
[20] https://www.transmissionhub.com/articles/2013/08/nyiso-cancels-interconnection-for-20-mw-battery-project.html

Map 2: Electricity Generation Facilities (other than solar)

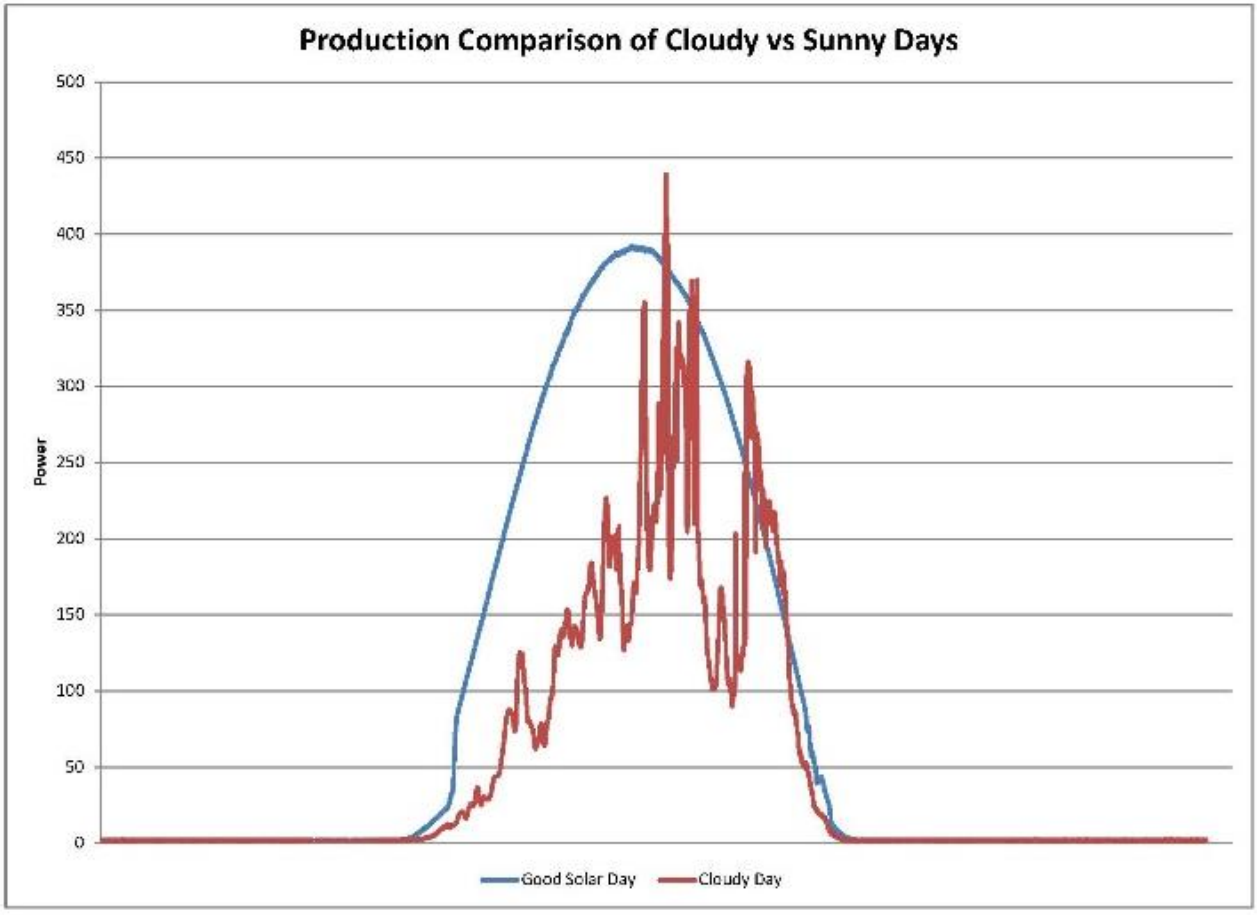


DISTRIBUTED GENERATION - OVERVIEW

Distributed generation refers to a variety of technologies that generate electricity at or near where it will be used. In New York State, the term includes large solar and wind facilities that sell electricity directly to utilities or other buyers, as well as facilities that generate electricity predominantly for on-site use.

Siting electricity generating facilities close to the end user helps lower the base demand and reduces electricity losses along transmission and distribution lines.[21] An extensive set of regulations and procedures apply to distributed generation to ensure that the amount of electricity generated and flowing through the grid is balanced with customer demand, and that the substations, electric lines and other components of the electric grid are able handle the flow.

As the electric grid was designed to transmit electricity in one direction only – typically from large power plants to substations – the introduction of distributed energy has required extensive upgrades to accommodate flow in two directions. Many distribution lines need to be "reconductored" to increase capacity. Upgrades to substations are needed to ensure reliability and stability.



[21] https://www.epa.gov/energy/distributed-generation-electricity-and-its-environmental-impacts

Figure 9: Solar Production Capacity - Cloudy vs Sunny Days

The intermittent nature of solar and wind generation creates challenges for the stability of the electric grid. . For example, passing clouds cause the amount of electricity produced by solar panels to fall suddenly, then increase once the cloud has passed. In addition, total generation on rainy days may be 10% of nameplate capacity. When solar or wind output is high, large generators need to shut down to prevent over-generation, excessive voltage and power system instability. As battery storage technology evolves, the problem with intermittent output will be alleviated as solar plants will be able to store electricity on-site and ensure a consistent flow into the electric grid. As the proportion of electricity generated from wind and solar increases, additional improvements are needed to ensure stability.

Several distributed generation facilities within the Southern Tier 8 region generate electricity primarily for use on-site and sell the excess to the utility under "net metering" arrangements. Many of these distributed energy facilities generate electricity from renewable sources such as solar, wind, hydropower and biogas.

The following sections summarize the electricity generated within the Southern Tier 8 region based on the following categories:

- Utility-Scale wind and solar
- Renewable generation for predominantly on-site use
- Combined heat and power generators
- Back-up generators

EXISTING SOLAR

Existing solar energy facilities within the region have a rated capacity of 80.04 MW and are expected to generate approximately 92,575 MWhs per year[22] (approximately 2% of the 4.7 GWhs total regional electricity usage.) These existing facilities[23] range from large solar farms to rooftop residential systems.

Several solar facilities in the region sell electricity directly to utilities or other energy buyers, rather than for onsite consumption.[24] These include community solar facilities supported by consumers on a subscription basis as well as those that sell electricity directly to utilities. (Table 8 and Maps 1 and 2 list facilities with more than t1 MW generating capacity.)

Several governments, colleges and businesses have developed large solar facilities to generate electricity for their own use. For example, Broome County developed a solar farm in the Town of Conklin that is expected to save the County $140,000/year in electricity costs. Some facilities are located off-site and the electricity generated is credited to the owner to off-set electricity usage from the electric grid. Other

[22] The projected production from solar facilities is based on an assumed "capacity factor" of 13.4%. [MW capacity x 8760 hours/ year x Capacity Factor = Projected Annual Production]
[23] As of January 2020. NYSERDA, Statewide Solar Projects Map. Based on interconnection data from NYS DPS, NYISO. Projects beginning in 2000 through January 2020
https://www.nyserda.ny.gov/All-Programs/Programs/NY-Sun/Solar-Data-Maps/Statewide-Projects
[24] https://emp.lbl.gov/sites/default/files/lbnl_utility_scale_solar_2019_edition_final.pdf

solar facilities are constructed on-site and sell excess electricity generated to the utility through a "net metering" arrangement. Some of the larger facilities are listed in Table 8. In addition, many residences, businesses and industries have installed rooftop or ground-mounted systems to generate electricity primarily for on-site use.

In Tompkins County, many residences have installed solar through efforts such as Solar Tompkins. Many public and commercial buildings have installed solar photovoltaic systems in the past few years as well. The Tompkins County Library was a leader in this work with its 147 kW PV installation in 2000, one of the largest in the county [22] at the time.

The Cornell Snyder Road Solar Farm adjacent to the Ithaca Tompkins Regional Airport was completed in 2014. The 10-acre site has a rated capacity of 2 MW, which would produce ~1% of Cornell's electricity needs and reduce carbon pollution by more than 600 tons per year [22]. Other solar systems at Cornell include a 15 kW system on the roof of Day Hall and a 2.2 kW system at the Cornell Store. These two systems started operating in late 2007 and mid-2008 respectively [23,24].

In 2015, the Tompkins Cortland Community College (TC3) completed a 2.6 MW solar farm on approximately 10 acres of land. The solar farm was expected to meet 90% of TC3's annual electricity needs[25] and reduce TC3's GHG emissions by more than 890 metric tons per year[26].

Table 14: NYSERDA-Supported Solar Projects by County (through February 2020)

Total Existing Solar Power Generation	# of Projects	Nameplate Capacity (MW DC)	Expected MWh Annual Production
Broome	347	9.971	11,704
Chenango	123	2.547	2,990
Cortland	232	6.981	7,857
Delaware	152	5.318	6,242
Otsego	269	6.654	7,811
Schoharie	367	6.619	7,769
Tioga	227	34.230	40,181
Tompkins	1443	34.901	39,925
Total:	**3,160**	**107.221**	**124,479**

SOURCE: *https://data.ny.gov/Energy-Environment/Solar-Electric-Programs-Reported-by-NYSERDA-Beginn/3x8r-34rs , accessed 3/29/20*

Table 15: SOURCE: NY-SUN, Total Existing Solar Power Generation by County (through December 2019)

Total Existing Solar Power Generation	# of Projects	Nameplate Capacity (MW DC)
Broome	363	17.4
Chenango	114	3.3
Cortland	246	7.1
Delaware	156	5.1

Otsego	303	7.0
Schoharie	441	7.2
Tioga	264	33.6
Tompkins	1456	39.2
Total:	**3,343**	**119.9**

SOURCE: Statewide Solar Projects Map, Based on interconnection data from NYS DPS, NYISO. Projects beginning in 2000 through December 2019. https://www.nyserda.ny.gov/All-Programs/Programs/NY-Sun/Solar-Data-Maps/Statewide-Projects

PROPOSED SOLAR AND WIND

Solar and wind facilities proposed to be constructed within the Southern Tier 8 region would add an additional 786 MW of generating capacity with the potential to generate approximately 911,000 MWhs per year. Proposed facilities include large (25 MW) facilities subject to Article 10/Section 94-c, solar facilities of 1-24 MW, and smaller facilities designed to supply electricity predominantly for on-site use. Once these projects are completed, solar and wind facilities in the region would generate 21.2% of the regional electricity demand.[25]

Table 16: Total Proposed Solar Power Generation by County (through February 2020)

Proposed Solar Power Generation	# of Projects	Nameplate Capacity (MW DC)	Expected MWh Annual Production
Broome	15	15.548	18,251
Chenango	13	36.899	43,314
Cortland	11	38.893	45,655
Delaware	10	3.47	4,071
Otsego	5	0.047	55
Schoharie	10	0.088	103
Tioga	9	32.310	37,927
Tompkins	16	30.167	35,412
Total:	**110**	**13.031**	**220,643**

SOURCE: NYSERDA-Supported Solar Projects Map. Projects beginning in 2000 through February 2020. https://www.nyserda.ny.gov/All-Programs/Programs/NY-Sun/Solar-Data-Maps/NYSERDA-Supported-Solar-Projects

[25] 86,628 MWhs from existing solar, plus 911,000 MWHs from proposed solar and wind, divided by 4,701,789 total regional electricity usage

Proposed Article 10 Wind and Solar Projects

Electricity generation facilities with generating capacity of 25 MW or more are subject to approval through the Power New York Act of 2011. To implement this legislation, Article 10 of the NYS Public Service Law establishes a project review process that is administered by the NY Department of Public Service. A Siting Board has the authority to review and approve Article 10 projects. The review process supersedes municipal land use laws as well as the State Environmental Quality Review (SEQR) process. With the passage of the Accelerated Renewable Energy Growth and Community Benefit Act in April 2020, this review process has been essentially replaced by a new siting process with uniform permit conditions as outlined in the Section 94-c of the Executive Law. As of July 2020, no large utility scaled renewable projects have been formally submitted for Section 94-c's new NYS Office of Renewable Energy Siting.

Four projects proposed through the Article 10 process would add an additional 364 MW of generating capacity – 224 MW from wind and 140 MW from solar. These include:

- East Point Energy Center in Sharon, Schoharie County – 50 MW capacity
- Homer Solar Energy Center in Homer, Cortland County – 90 MW capacity
- High Bridge Wind in Guilford, Chenango County – 100.8 MW
- Bluestone Wind in Windsor and Sanford, Broome County – 124 MW

East Point Energy Center in Schoharie County, under development by NextEra Energy Resources, is expected to occupy approximately 350 acres. A distribution substation and switchyard will connect to National Grid's 69kV transmission line, which is adjacent to the existing Sharon substation. [26]

The Homer Solar Energy Center, under development by EDF Renewables, will connect to National Grid's 115 kV transmission line that runs through the project area. The project will be sited on approximately 600 acres of leased private land.[27]

The High Bridge Wind project would include up to 25 turbines and connect to an existing NYSEG transmission line that traverses the area.[28] The developer is High Bridge Wind LLC, a subsidiary of Calpine Corporation.

The Bluestone Wind would include up to 27 turbines and would interconnect with a NYSEG transmission line that traverses the area. The developer is a subsidiary of Calpine Corporation.

The electricity generated from the Article 10/Section 94-c projects goes into the grid for use where it is needed. Substations manage the flow of electricity to assure sufficient supply and maintain the stability of the electric grid. Some of the electricity generated by these large facilities will be used in the region; what is not needed within the region will be transmitted to areas in NYS with higher demand (i.e., downstate).

[26] https://www.eastpointenergycenter.com/
[27] https://www.edf-re.com/project/homer-solar-energy-center/
[28] http://www.calpine.com/highbridgewind

Table 17: Proposed Article 10 Wind and Solar Projects

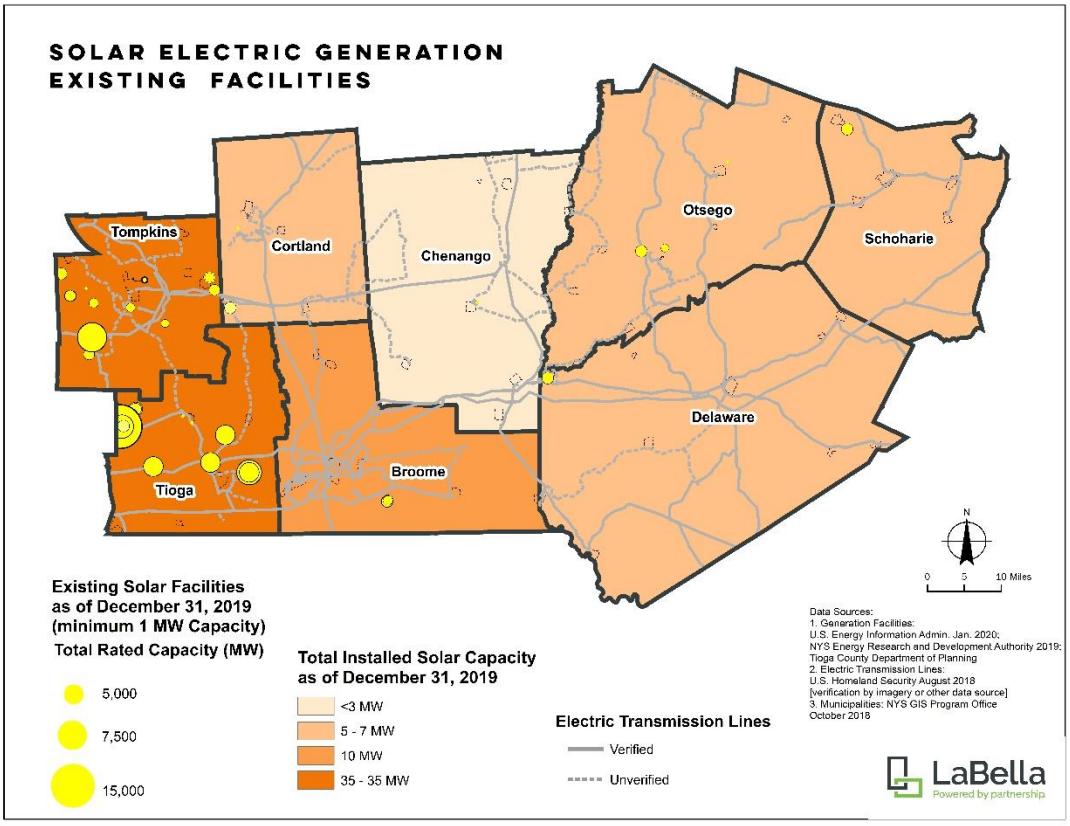
Project	Case #	Location	Capacity (MW)
Bluestone Wind	16-F-0559	Broome County	124
High Bridge Wind	18-F-0262	Chenango County	100
East Point Energy Center	17-F-0599	Schoharie County	50
Homer Solar Energy Center	19-F-0488	Cortland County	90

SOURCE: NYS Department of Public Service, PSC Siting Board, http://www3.dps.ny.gov/W/PSCWeb.nsf/All/763B187DD5A792DE8525847400667D6B?OpenDocument

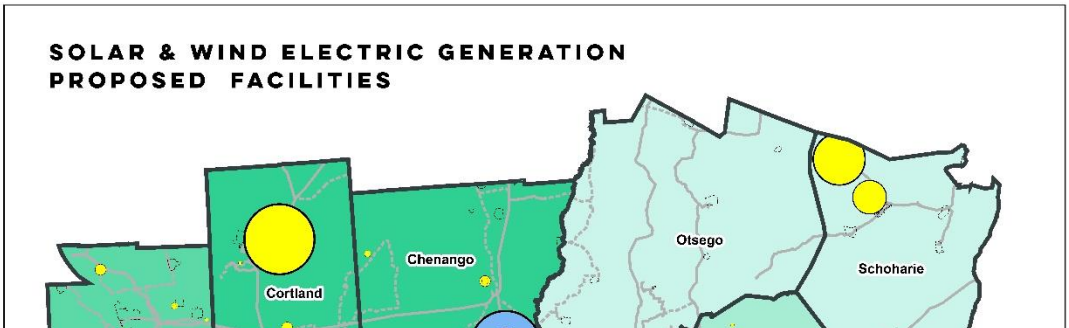
The status of each project may be followed through the Siting Board's website: http://www3.dps.ny.gov/W/PSCWeb.nsf/All/763B187DD5A792DE8525847400667D6B?OpenDocument

Map 4 depicts the locations of the proposed large solar and wind facilities, including those proposed through the Article 10 process.

Map 3: Existing Solar Electric Generation Facilities



Map 4: Proposed Wind & Solar Generating Facilities



DISTRIBUTED GENERATION - BIOMASS DIGESTERS

Agricultural Anaerobic Digesters

One dairy farm in the Southern Tier 8 region generate electricity using manure as a fuel source. The anaerobic digester facility at New Hope View Farm in Homer, Cortland County was constructed in 2006 and has a capacity of 70 kW. The facility was designed to sell conditioned biogas to Ingersol Rand, which operated a microturbine and sold the electricity to NYSEG.

A facility at AA Dairy Farm in Candor was installed in 1998 to generate biogas from 11,000 gallons of manure each day. A 130 kW generator produced power for the farm. Coarse fiber recovered from digester effluent was bagged and sold as compost. The facility was no longer operating by 2014.

Grants and other subsidies are needed for these facilities to be economically viable. Although New York State offered financial support for several biodigesters in the past, the incentives are not as generous now as they were a few years ago. With construction costs ranging from $400,000 to $5 million, a major challenge is ensuring a large enough supply of manure and other organic waste to justify the high cost.

Ithaca Wastewater Treatment Plant

The Ithaca Wastewater Treatment Plant produces biogas that is purified then burned to generate electricity and hot water. The plant has a rated capacity of 260kW for generation of electricity and 100 Mbtu's for heating water.

COMBINED HEAT AND POWER

Combined Heat and Power (CHP), also known as "Cogeneration," is an efficient technology that generates electricity and captures the waste heat to create steam or hot water for use in space heating, cooling, hot water or industrial processes. Most combined heat and power facilities generate electricity with turbines powered by natural gas or fuel oil.

Those facilities located in the Southern Tier 8 region that are listed in the NYISO 2019 Gold Book or report data to NYSERDA's Distributed Energy Resources Integrated Data System website are described below. Nearly all of them use natural gas as the primary fuel in their cogeneration facilities.

Cornell University's Central Heat is a natural gas fired power generation facility located on Route 366 in Ithaca, NY (Tompkins County.) It has a capacity of 42 MW and opened in 1988. The natural gas turbine at the Central Energy Plant generated 239,400 Mwhs of electricity in 2018 and provides the majority of campus electrical needs.

Figure 10. Cornell University CHP

The Cornell University Combined Heat and Power (CHP) facility is a co-generation facility that generates both heat and electricity. It is integrated with the Central Heat facility. The steam turbine at Cornell's cogeneration facility generated 26,800 Mwhs in 2018.

Cornell University's Central Energy Plant (CEP), now fueled by natural gas with a nameplate capacity of 30 MW, was originally constructed in 1922 [13]. This facility and the hydroelectric plant went through multiple renovations over the years. At the time of Tompkins County's 2008 GHG emissions inventory, CEP) was powered mostly by coal. Emissions from the CEP were 153,537 MTC02e and are added to the overall Tompkins County GHG emissions inventory under the "Commercial" category.

Cornell's Combined Heat and Power Plant (CCHPP), the newest and most significant addition to CEP, was commissioned in December 2009. CCHPP has an operating efficiency of ~75% [13], compared to 33% on average for conventional electricity generation [14]. The central energy and hydroelectric plants combine to meet ~86% of the university's annual electricity needs, which total ~215,000 MWh annually, leaving ~35,000 MWh to be purchased from the grid through the university substation each year [13]. Since CCHPP was not commissioned until end of 2009, its GHG emissions are not counted in the 2008 inventory.

SUNY Cobleskill operates a cogeneration facility that is rated to produce 1063.18 kW of electricity and 1063.18 mBtus of heat. The Bouck Pool Building at SUNY Cobleskill has the capacity to produce 130 kW of electricity and 840,000 Btu/hr of heat.[29]

SUNY Cortland's CHP facility is rated to produce 539.5 kW of electricity.

Bates Troy Healthcare Linen Service, an industrial laundry in Binghamton, operates a CHP facility with a rated capacity of 400 kW. The facility generates electricity and uses the waste heat to heat water used in cleaning.

[29] https://der.nyserda.ny.gov/facilities/932/

South Hill Business Campus in Ithaca, Tompkins County, has a cogeneration facility with generating capacity of 500kW and recovers heat for use in space heating and an absorption chiller.[30]

The **City of Cortland Wastewater Treatment Facility** uses digester gas to generate electricity. The facility was installed in 2018 and has the capacity to generate 500 kW of electricity. [31]

Cortland Memorial Hospital uses natural gas to generate electricity. The facility was installed in 2006 and has a capacity of 1,650 kW.[32]

The **Dryden High School** co-generation facility, installed in 2000, has a capacity of 180 kW. A second facility operated by the Dryden Central School District was installed in 2013 and has capacity to generate 60 kW.

Many other facilities throughout the region generate electricity for on-site use only and recover heat for use at the facility. These facilities reduce the demand on the electric grid for energy but do not sell excess electricity back to the grid.

HYDRO-POWER FOR ON-SITE USE

Cornell University generates electricity for on-site use at its hydroelectric plant and central energy plant (CEP). The hydroelectric plant, with a total rated capacity of 1,870 kW, was built on campus in 1904 when Beebe Lake was created [13]. Cornell Hydro is a conventional hydroelectric power generation facility located in Fall Creek at Beebe Lake near Thurston Avenue in Ithaca, NY (Tompkins County) and was opened in 1981. This hydroelectric plant is "run of river", which means that no water is stored. It is operated by Cornell Hydro to generate electricity for use at the Cornell University campus. It has a rated capacity of 1.6 megawatts and the average annual production is 5,000 kWh.[33]

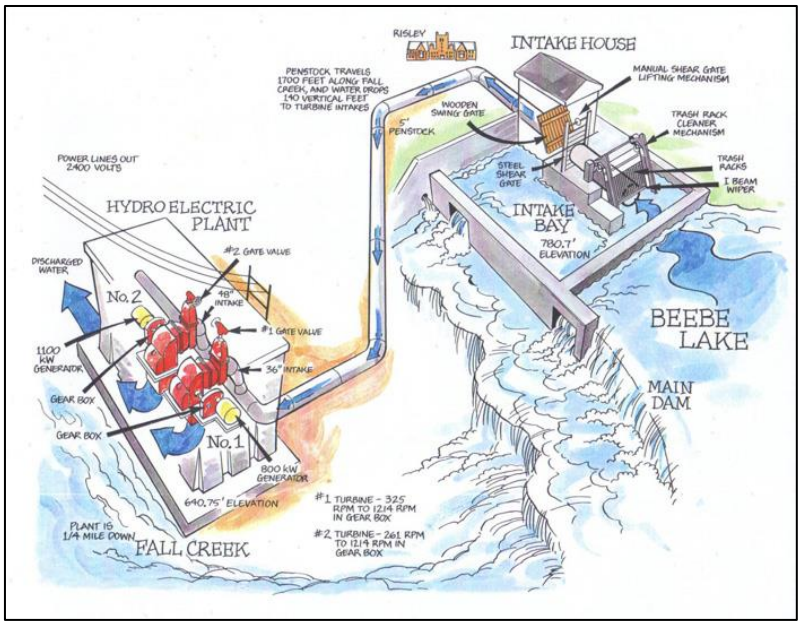


Figure 11. Hydropower Illustration

SOURCE: Cornell University: https://energyandsustainability.fs.cornell.edu/util/electricity/production/hydroplant.cfm

[30] https://der.nyserda.ny.gov/facilities/627/
[31] https://doe.icfwebservices.com/chpdb/state/NY
[32] https://doe.icfwebservices.com/chpdb/state/NY
[3333] https://energyandsustainability.fs.cornell.edu/util/electricity/production/hydroplant.cfm

Cayuga Power Plant, formerly known as AES Cayuga, was commissioned in 1955 and closed in 2019. The plant was fueled by coal and had a capacity of 306 MW [15]. Though the Cayuga Power Plant is an important constituent of the county's electricity fuel mix, GHG emissions from the Cayuga Power Plant are not double-counted in the inventory because the plant supplies electricity to end-users through the public power transmission and delivery system, and those emissions are already counted in the inventory at end use. In 2014, two competing proposals regarding the future of the Cayuga Power Plant were submitted to the New York State Public Service Commission (PSC) [16]. NYSEG supports upgrading the electrical transmission system to bring external electricity to the region, which would result in the ultimate retirement of the power plant. Cayuga Power Plant, on the other hand, proposes retrofitting the plant to a gas-fired facility to improve the power grid's reliability [17]. The final decision will be made by PSC.

BACK-UP GENERATORS

Many facilities maintain a back-up generator for use when electric power is interrupted. Generators with an output rating of 400 horsepower (300 kW) or greater must register with the NYS DEC and may require a permit to operate.

Among the largest generators in the region is Bassett Healthcare in Cooperstown, Otsego County. The petroleum liquid power generation facility is located at the Bassett Medical Center at 1 Atwell Road in Cooperstown, NY (Otsego County). The facility has a capacity of 5.6 MWs and generates electricity during off-peak hours and as needed during power interruptions.[34]

POTENTIAL MICROGRIDS

Community facilities and institutions with electricity generation capacity have the potential to function as "microgrids" that can provide back-up power to critical community facilities if power from the grid is interrupted. To be economically viable, a microgrid must provide continuous service to a critical facility.

For example, a proposed microgrid in the City of Binghamton would generate electricity from a 1.95 hydropower plant at Rock Bottom dam (1,950 kW capacity), a combined cooling, heating and power unit at the YMCA (200 kW capacity), a two 50-kW combined heat and power units at the YMCA, and rooftop solar at the UMCA and City Hall totaling 280 kW capacity. The facility would provide power to City Hall, Police and Fire Departments, the YMCA, Binghamton Housing Authority, Superior Ambulance and Keystone Associates.

The Binghamton microgrid was awarded funding from NYSERDA for a Stage 1 Feasibility study and a Stage 2 engineering design. Stage 3 funding has not been announced (as of January 2020) but would fund build-out of project selected through a competitive application process.

The other locations in the Southern Tier 8 Region that were awarded funding under Stage 1 of the NY Prize Program, including:

[34] http://www.russelectric.com/bassett-healthcare/

- Tompkins County Community Microgrid, including facilities in the Village of Lansing and around the Ithaca Tompkins Regional Airport (#67)
- City of Ithaca, including the Ithaca Wastewater Treatment Plant (#68)
- Village of Sherburne, including the Village Municipal Building, Sherburne Electric, Wastewater Treatment Plant, Senior Housing and several businesses (#69)
- Village of Endicott, including Huron Campus waste treatment plant, Village of Endicott facilities

These projects did not proceed to Stage 2: Engineering Design.

Significant obstacles to creating successful microgrids include[35]:

- Financial feasibility, including funding for development and determining the monetary value of the project benefits
- Utility franchise regulations that limit microgrids that serve facilities with multiple owners
- Technical issues in interconnecting microgrids with the utility-owned distribution system

If these obstacles can be overcome, universities, hospitals and other institutions with combined heat and power facilities may be good candidates to host microgrids. Generating capacity at the following educational facilities located in the region may be able to support microgrids to the benefit of the surrounding community:

- SUNY Cobleskill
- SUNY Oneonta
- Binghamton University
- Hartwick College
- Broome Community College
- SUNY Cortland
- Cornell University
- Ithaca College
- SUNY Delhi
- SUNY Morrisville (Norwich campus)
- Davis College

[35] NYSERDA, 17-23 Evaluation of New York Prize Stage 1 Feasibility Assessments, https://www.nyserda.ny.gov/All-Programs/Programs/NY-Prize/Feasibility-Studies

FOR MORE INFORMATION

Several data sources report existing and planned renewable energy projects.

NYSERDA's Large Scale Renewables program supports for projects larger than 5 MW. https://catalog.data.gov/dataset/large-scale-renewable-projects-reported-by-nyserda-beginning-2004

The NY-SUN website lists all solar projects that are supported by NYSERDA. Data is categorized by project sector (Residential, Small Commercial, and Commercial/ Industrial.) This dataset does not include projects larger than 5 MW AC. https://www.nyserda.ny.gov/All-Programs/Programs/NY-Sun/Solar-Data-Maps/NYSERDA-Supported-Solar-Projects Interactive maps that display data by county and sector are available at the NY-Sun website: https://www.nyserda.ny.gov/All-Programs/Programs/NY-Sun/Solar-Data-Maps/NYSERDA-Supported-Solar-Projects

The NY-SUN "Statewide Solar Projects" map provides summary data by County of all solar projects installed between 2000 and June 30, 2019 (as of November 2019.) This map draws data from interconnection data provided by the NYS Department of Public Service and the NYISO. https://www.nyserda.ny.gov/All-Programs/Programs/NY-Sun/Solar-Data-Maps/Statewide-Projects

Renewable energy generating projects larger than 25 MW (20-24 MW can opt in) are reviewed by the NYS Office of Renewable Energy Siting under the new Section 94-c. Article 10 permitting process with Public Service Commission's Siting Board will remain an option for 25+ MW energy generation projects. Information about these Article 10 projects is posted on the Siting Board's website at each stage of the siting process, beginning with the "Petition for a Certificate of Environmental Compatibility and Public Need" through the Order Granting the Certificate, including any required conditions. Each project is assigned a Case # and all documents related to the case are posted on the Siting Board's website. http://www3.dps.ny.gov/W/PSCWeb.nsf/All/763B187DD5A792DE8525847400667D6B?OpenDocument

The U.S. Energy Information Agency (EIA) collects data from existing electric generating plants and publishes the Annual Electric Generator Report (Form EIA-860.) Data include the location, nameplate capacity, year placed in operation, and whether the facility has net metering agreement. https://www.eia.gov/survey/#electricity

The NYISO 2019 Load & Capacity Data Report ("Gold Book") Table III-2: Existing Generating Facilities identifies the owner, location and generating capacity of existing solar and other facilities as of March 2019. Table IV-1 Proposed Generator Additions & CRIS Requests lists solar and other projects that have proposed interconnecting to the grid as of March 2019.

NYSERDA publishes data about distributed energy projects including generating capacity. Although NYSERDA collects data about the performance of facilities, only aggregate data about the amount of electricity generated from distributed energy facilities is provided. Performance data for individual facilities is not available. https://der.nyserda.ny.gov/data/

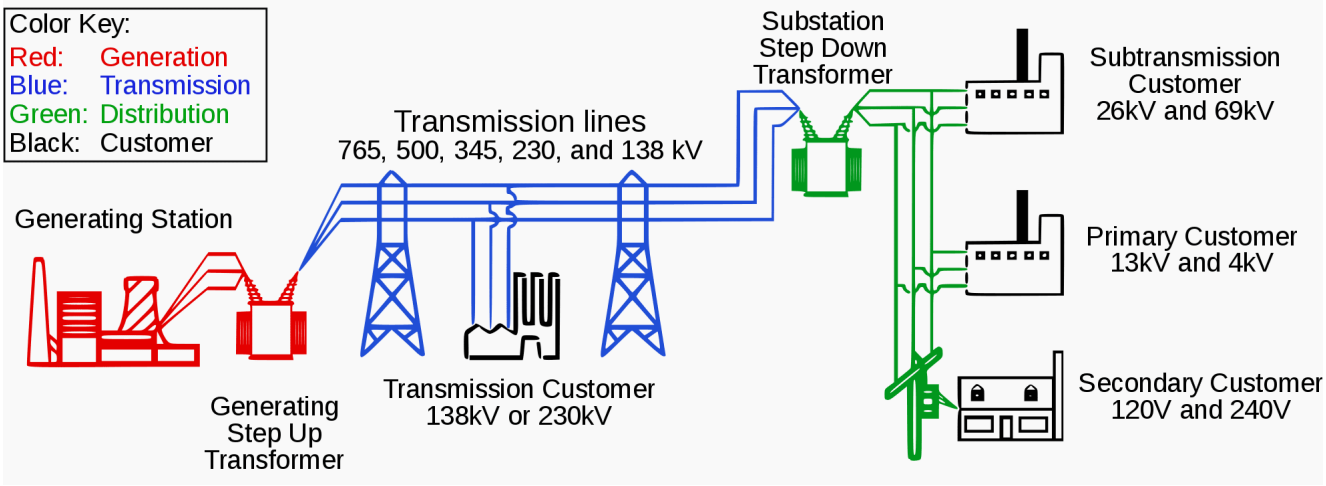
The NYISO maintains a listing of projects that have requested interconnection into the electric grid. The interconnection request specifies the point of interconnection and the substation that would receive the electricity. Projects approved for interconnection are listed in the NYISO's Interconnection Queue. (See https://www.nyiso.com/interconnections)

ELECTRICITY TRANSMISSION & DISTRIBUTION

The infrastructure that carries electricity from generating facilities to end users includes "transmission" and "distribution" facilities. Transmission refers to the high voltage power lines that carry electricity in bulk over long distances. The transmission system includes transmission lines, substations that convert the electricity from high voltage to the lower voltage that can be distributed to customers, transformers, switching stations, breakers, circuits and remote terminal units. "Distribution" refers to the lower voltage electric lines that deliver electricity to the end user.

The bulk transmission sources feed the lower voltage sub transmission system, which in turn feeds the distribution system. Lines with 115kV or higher voltage are subject to regulation by the Federal Energy Regulatory Commission (FERC) lines as part of the bulk electricity system.

Figure 12. Electricity process diagram



SOURCE: Electrical Engineering Portal, https://electrical-engineering-portal.com/electric-power-systems

TRANSMISSION LINES

The electricity grid consists of a network of transmission, subtransmission and distribution lines which are connected at key hubs by substations. The high capacity lines that pass through the Southern Tier 8 region carry electricity from large generating plants in Niagara Falls, Oswego and Massena to substations within the region as well as to New York City and other high demand areas. Transmission lines within the Southern Tier 8 region include 360 miles of 345-volt transmission lines, 31 miles of 230-volt transmission lines, and 637 miles of 115-volt lines.

As depicted in Map 5, the high capacity 345 kV transmission lines transmit electricity from large generators to three major substations within the Southern Tier 8 region:

- Oakdale in Johnston City, Broome County;
- Gilboa in Schoharie County; and
- Fraser in Delaware County.

The **Oakdale** substation in Johnson City, Broome County is a key hub that transforms electricity from both 345 kW lines and 115 kW lines connecting from the north and the west. NYSEG owns and operates this substation.

The **Fraser** substation in Delaware County is a critical hub in the transmission of electricity from the north and west to downstate customers, in addition to transferring electricity to local distribution lines.

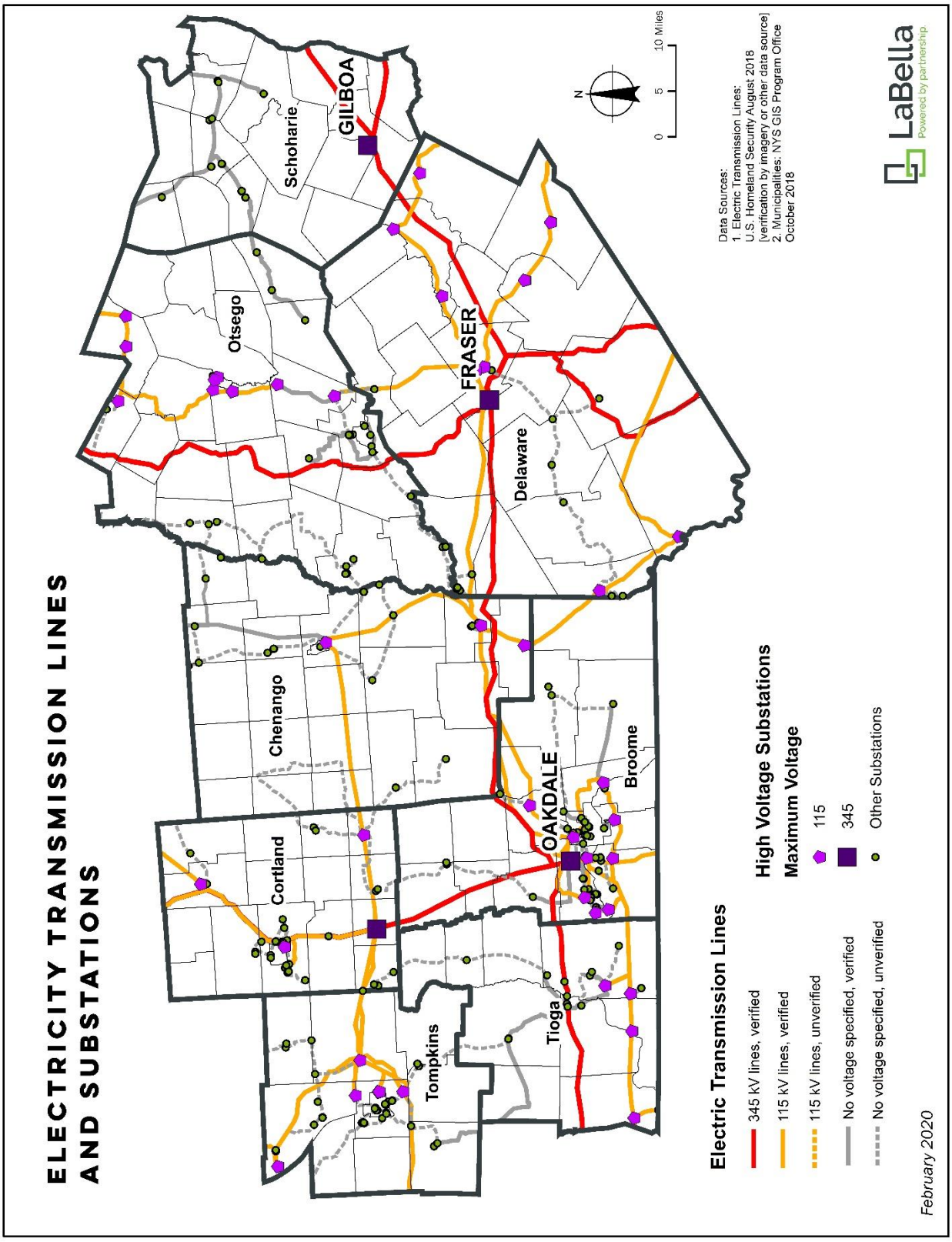
The **Gilboa** substation in Schoharie County is owned and operated by the New York Power Authority (NYPA),and is located near NYPA's pumped storage hydropower facility.

The **Cortland** substation in Cortlandville is operated by National Grid.

These large substations convert a portion of the electricity from 345-volt or 230-volt to 115-volt to be transmitted to smaller substations, which convert it to 48 kV or 32 kV to be distributed to customers.

Map 5 depicts the locations of four major substations located in the Southern Tier 8 region and the 345 kV transmission lines that connect them. These facilities not only transform electricity transported from large generating stations in Oswego and Niagara County for use by local customers, but also play a role in transporting electricity through the region for use downstate.

Map 5: Electricity Transmission Infrastructure



ABOUT THE DATA

Maps of electric transmission lines and substations available through public sources. These data illustrate the overall system components. They may not include every substation or distribution line. The locations of specific facilities may not be accurate to the parcel level.

NYSEG and National Grid both publish maps of distribution lines on-line to assist developers of distributed energy projects. The maps depict the capacity of distribution lines to accommodate distributed energy generation and the locations of lines with Phase 1 and Phase 2 power only, which are not suitable for hosting distributed energy connections. The NYS Public Service Commission requires the major utilities in NYS to publish these maps in order to facilitate the installation of distributed energy generation facilities.

The following **transmission line segments**, named for the substations they connect, play a key role in carrying electricity from large generators in Niagara and Oswego County to the Southern Tier 8 region as well as in transporting electricity to downstate customers:

- **Watercure to Oakdale :** Both a 345 kV transmission line and a 220 kV transmission line connect the Watercure substation in Elmira, Chemung County and the Oakdale substation, in Johnson City, Broome County. The portion within the Southern Tier 8 region is 31 miles. It is owned by NYSEG.
- **Lafayette to Oakdale:** A 345k transmission line connects the Lafayette substation in Onondaga County and the Oakdale substation. This segment passes through portions of Broome and Cortland counties. Avangrid, the parent company of NYSEG, owns and manages this transmission line.
- **Oakdale to Fraser:** A total of 21 miles of 345 kV transmission line connects the Oakdale substation and the Fraser substation near Delhi, Delaware County. NYSEG recently upgraded this line and transferred ownership to New York Transco in 2016.
- **Fraser to Coopers Corners:** A total of 21 miles of 345 kV transmission line connects the Fraser substation near Delhi, Delaware County and the Coopers Corners substation near Monticello in Sullivan County. NYSEG recently upgraded[36] this line and transferred ownership to New York Transco in 2016.
- **Gilboa – Leeds:** The 36-mile Gilboa-Leeds transmission line is owned by New York Power Authority, which also operates the pumped storage hydro plant near the Gilboa substation.

[36] Reconductoring and 240 MVAR series capacitor bank Source: https://nytransco.com/

Planned Projects

NYSEG plans to construct a 120 MW Battery Storage project at the Oakdale 115kV substation.[37] This project would have the capacity to store 120 MW of electricity. The battery storage project was proposed in 2018 and is projected to be operational by 2021.[38]

National Grid plans to "reconductor" 0.3 miles of 115 kV transmission line between the Cortland and Clarks Corners #1-716 substations and to install a 115kV Capacitor bank at the Cortland substation. These improvements are proposed to improve reliability.

Recently Cancelled Projects

After requesting proposals to improve the transmission of electricity from large generators to high demand areas in the New York City area, the NY Public Service Commission selected a small number of projects for implementation and rejected several proposals that would have impacted the Southern Tier 8 region. The following project proposals were not selected for implementation as the NY Public Service Commission determined that they would not meet the criteria under its Public Policy Transmission Planning Process (PPTPP) for efficiency and cost-effectiveness.

- A proposal to construct a new 57 mile, 345-kV transmission line between the Oakdale and Fraser substation;[39] and
- A proposed transmission line between Edic and Fraser, proposed by North America Transmission Corporation

NYSEG had planned to construct a 68.5-mile, 345-KV power line through Cortland County between NYSEG's Oakdale substation in Broome County and National Grid's LaFayette substation in Onondaga County. In April 2019, NYSEG notified affected landowners that the project is no longer being pursued. Based on NYISO load forecasts, it is no longer required to meet reliability criteria.[40]

[37] Indicated in NYISO's Interconnection Queue, www.nyiso.com › documents › NYISO-Interconnection-Queue.xlsx

[38] *www.nyiso.com › documents › NYISO-Interconnection-Queue.xlsx*

[39] NYS PSC Order file:///J:/Southern%20Tier%208%20Regional%20Board/2191283%20-%20Energy%20Infrastructure%20Assess.%20&%20Strategy/Infrastructure%20Assessment/Electricity%20Transmission/PSC%20Order%20denying%20Fraser-Oakdale%20Transmission%20Improvements.pdf

[40] https://cortlandstandard.net/2019/05/03/nyseg-pulls-plug-on-project/

SUB-TRANSMISSION AND DISTRIBUTION SYSTEM

The sub-transmission system consists of lines and sub operate at voltages of 69kV or less.

The primary distribution system voltages in the Cortland area served by National Grid are 13.2 kV and 48 kV. Most of the area is fed from a 34.5 kV sub-transmission system supplied out of the Cortland and Labrador substations.[41]

ELECTRICITY SUPPLIERS AND REGULATORY FRAMEWORK

Energy generators, natural gas and electricity utilities, energy suppliers, and regulators all play a role in determining the fuel mix, reliability and cost of the electricity used in the Southern Tier 8 region.

ELECTRIC UTILITIES

Two investor-owned utilities, six municipal electric utilities and two electric cooperatives are authorized by the New York Public Service Commission to deliver electricity to customers within the Southern Tier 8 region.

New York Gas & Electric (NYSEG) serves electricity customers in most of Broome, Chenango, Delaware, Otsego, Tioga, Tompkins Counties, and portions of Cortland and Schoharie Counties. NYSEG is a subsidiary of Avangrid, Inc., an international energy services and delivery company with headquarters in Spain. NYSEG maintains a network of transmission lines and substations as well as distribution lines that deliver electricity directly to consumers.

National Grid serves most of Schoharie County and Cortland Counties and portions of Chenango and Otsego Counties. National Grid is a multinational company headquartered in London that acquired Niagara Mohawk Power Corporation in 2002. National Grid maintains a network of transmission lines, substations and distribution lines within its service areas.

MUNICIPAL ELECTRIC UTILITIES

Six municipal electric utilities serve customers in the Southern Tier 8 region.

Greene Municipal Electric in Chenango County serves customers in the Village of Greene and a portion of the Town of Greene:

- Utility Established: 1900
- System Operating Voltage: 4,160 kW

[41] National Grid 2018 NY Capital Investment Plan. https://www9.nationalgridus.com/oasis/non_html/pdf/Niagara%20Mohawk_National%20Grid%20Five-Year%20Transmission%20and%20Distribution%20Capital%20Investment%20Plan,%20FY19_FY23.pdf

- # of Customers: 1,250

Richmondville Municipal Electric in Schoharie County serves customers in the Village of Richmondville and a portion of Town of Richmondville.

- Utility Established: 1918
- System Operating Voltage: 8,230 kW Y/4,800 kW Delta (1 customer)
- # of Customers: 1,100

Endicott Municipal Electric in Broome County: Village of Endicott serves customers in the portion of Town of Union

- Utility Established: 1906
- System Operating Voltage: 4,160 - 12,470 kW
- # of Customers: 3,25

Groton Municipal Electric in Tompkins County serves customers in the Village of Groton:

- Utility Established: 1933
- System Operating Voltage: 4,160/2,470 kW
- # of Customers: 1,153

Marathon Municipal Electric in Cortland County serves customers in the Village of Marathon.

- Utility Established: 1896
- System operating Voltage: 4,160 kW
- # Customers: 915

Sherburne Municipal Electric in Chenango County serves 1,981 customers in the Village of Sherburne and portions of the Towns of Sherburne, Columbus and North Norwich.

ELECTRIC DISTRIBUTION COOPERATIVES

A distribution cooperative is a non-profit, member-owned electric company that purchases electric power at wholesale and distributes it to its members. New York State regulations prohibit cooperatives from providing service to locations that are already served by an investor-owned utility.

Two electric distribution cooperatives serve customers in the Southern Tier 8 region: Otsego Electric Cooperative and Delaware County Electric Cooperative.

OTSEGO ELECTRIC COOPERATIVE

The Otsego Electric Cooperative serves customers in portions of Otsego County (Towns of Butternuts, Burlington, Cherry Valley, Edmeston, Exeter, Hartwick, Laurens, Middlefield, Milford, Morris, New Lisbon, Oneonta, Otego, Otsego, Pittsfield, Plainfield, Richfield, Springfield, Westford, Unadilla) and Chenango County (Towns of Columbus, New Berlin.)

The Otsego Electric Cooperative maintains 774 miles of line, 7 substations, a 46kV point of delivery station, 13,659 poles, and 4,768 active meters.[42]

DELAWARE COUNTY ELECTRIC COOPERATIVE

The Delaware County Electric Cooperative serves customers in portions of **Delaware County (**Towns of Andes, Bovina, Colchester, Davenport, Dehli, Franklin, Hamden, Harpersfield, Kortright, Masonville, Meredith, Middletown, Sidney, Stamford, Tompkins, Walton), **Otsego County** (Town of Maryland), **Schoharie County** (Towns of Gilboa, Jefferson, Summit) and **Chenango County** Town of Bainbridge.

Maps of service areas and infrastructure are available at DCEC's website.[43]

FEDERAL ENERGY REGULATORY COMMISSION (FERC)

The **Federal Energy Regulatory Commission** regulates all power producers and utilities that engage in interstate commerce. FERC also has jurisdiction over interstate electricity sales, wholesale electric rates and hydroelectric licensing. FERC also reviews and authorizes non-federal hydropower projects.[44]

Utilities are required to comply with FERC requirements regarding electric system reliability. FERC's Order No. 773, issued in December 2012, changed the definition of "Bulk Transmission System" to include all lines larger than 100kV. As a result, utilities were required to develop plans to upgrade infrastructure.

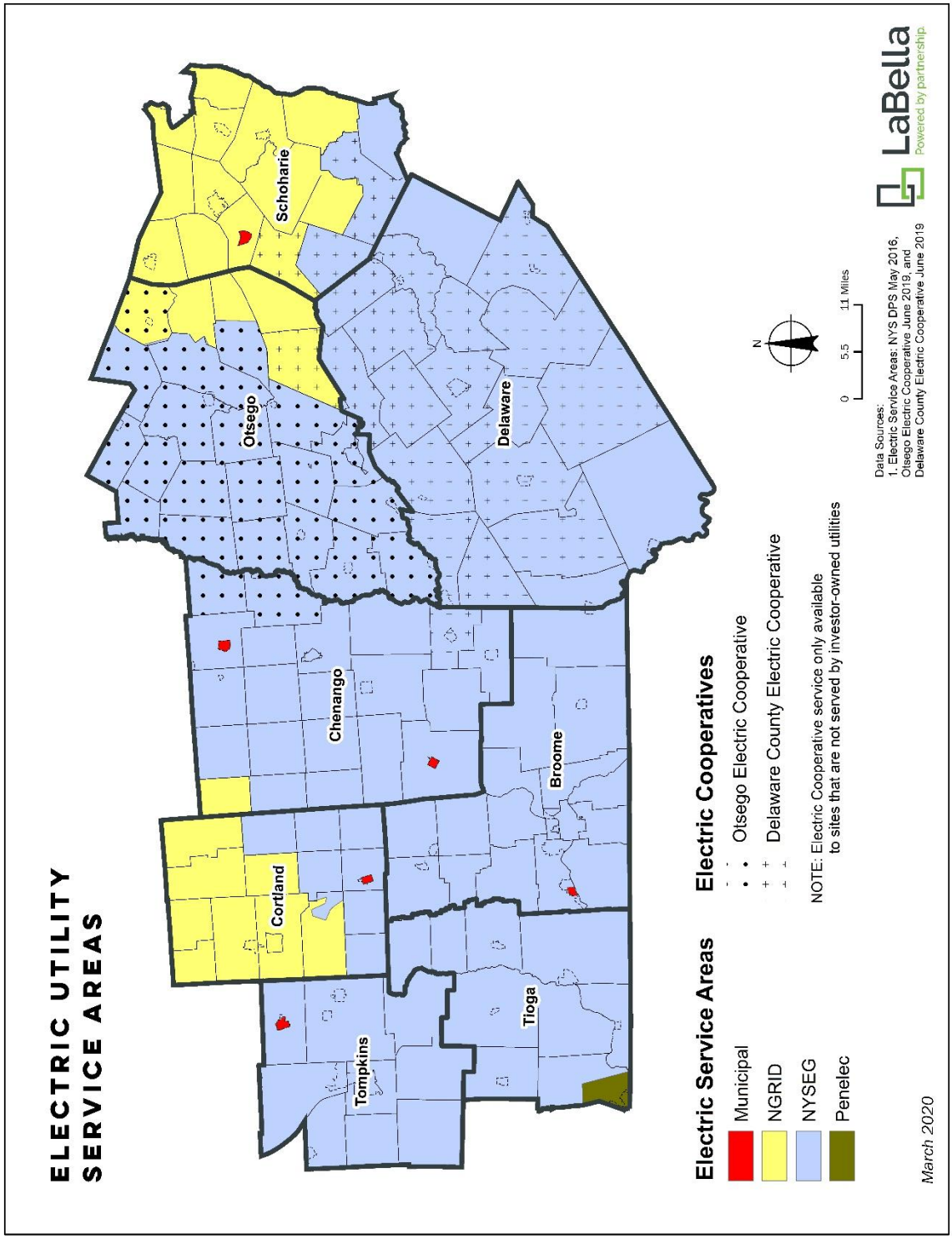
NEW YORK PUBLIC SERVICE COMMISSION (PSC)

The **New York Public Service Commission** (PSC), a government agency, regulates the electric and gas industries in New York State to ensure access to safe, reliable utility service at just and reasonable rates.[45] Its responsibilities include determining the rates utilities may charge customers for electricity and natural gas. A utility that seeks to raise rates must file documentation of its expenses to demonstrate the need for the rate increase. Interested parties ("interveners") may participate in the decision-making as parties to the "rate case."

The PSC is staffed by the NY Department of Public Service.

[42] www.otsegoec.coop
[43] http://www.dce.coop/content/service-area
[44] http://en.wikipedia.org/wiki/Federal_Energy_Regulatory_Commission
[45] NY PSC website:
http://www3.dps.ny.gov/W/PSCWeb.nsf/All/78F051A24B026591852576A5006D5163?OpenDocument

Map 6: Electric Utility Service Areas

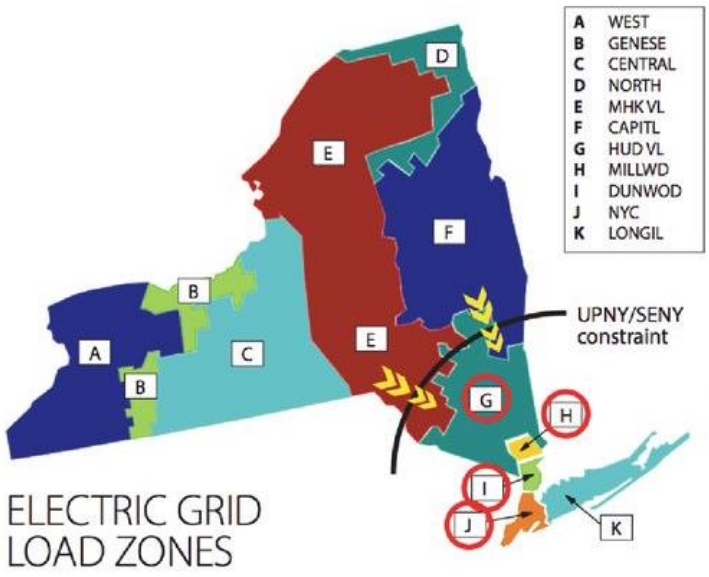


NEW YORK INDEPENDENT SYSTEM OPERATOR (NYISO)

The **New York Independent System Operator (NYISO)** was created in 1998 in accordance with guidance from the Federal Energy Regulatory Commission (FERC) to "…operate the transmission systems of public utilities in a manner that is independent of any business interest in sales or purchases of electric power by those utilities." It is one of five ISO's within the United States.[46] NYISO evolved from the New York Power Pool, an organization of seven investor-owned utilities (including Niagara Mohawk and Rochester Gas & Electric) plus the New York Power Authority which was established in 1966 to provide statewide oversight for New York's utilities[47] . A catalyst to its creation was the 1965 blackout in New York City.

The New York Independent System Operator (NYISO) manages the network of high-voltage transmission lines within New York State. The NYISO helps ensure a reliable supply and pricing.[48] The load zones location of large electric generating facilities affects the price of electricity generated by the facility.

Figure 13: NYISO Load Zones Map and Upstate/ Southeast NY capacity constraint



Electricity markets are organized according to "load zones." Most of Broome, Tioga, Cortland and Tompkins Counties are within Load Zone C-Central; Delaware, Otsego, Schoharie Counties are within Load Zone E- Mohawk Valley.

As the demand for electricity in the NYC region (Southeast NY) exceeds the amount generated in the region, electricity must be transmitted from Upstate load zones to meet this demand.

New York Power Authority (NYPA)

[46] http://en.wikipedia.org/wiki/ISO_RTO
[47] New York Independent Systems operators website, http://www.nyiso.com/public/flash/timelinenyiso/NYISO/index.html
[48] ISO has operational control over facilities designated in the NY ISO- Transmission Owners Agreement filed and approved in FERC Docket No. ER97-1523-000. ISO also manages transmission services on all NYSEG and National Grid transmission facilities, pursuant to the NYISO Open Access Transmission Tariff.

The Power Authority of New York (**New York Power Authority, or NYPA**) operates 16 power plants, including the Blenheim-Gilboa stored hydropower plant in Delaware County. These facilities produce up to one-quarter of the electricity used in New York State.

NYPA also manages more than 1400 circuit-miles of high voltage transmission lines – more than one-third of the major transmission lines in New York State that carry power from generation sources to substation distribution centers.

NYPA is a public authority created by State law. It is not subject to the jurisdiction of the New York State Public Service Commission but plays a key role in advancing New York State's energy policies.

A portion of the electricity produced by NYPA is allocated to municipal electric utilities and Rural Electric Co-ops. These entities benefit from low-cost hydropower, but the amount of low-cost power available is capped in accordance with NYPA's agreements with each entity. NYPA also supplies low-cost power to participants in ReCharge NY and administers numerous programs to promote energy efficiency, renewable energy development, and economic development throughout New York State.

NATURAL GAS INFRASTRUCTURE

EXISTING NATURAL GAS INFRASTRUCTURE

Existing natural gas infrastructure includes wells, transmission mains, gathering systems, compressor stations, storage facilities and distribution mains. Most of the approximately 24.7 million cubic feet of natural gas used by customers in the Southern Tier 8 region is supplied from wells located outside the region and transported to the region via transmission pipelines.

NATURAL GAS WELLS

Active natural gas wells within the Southern Tier 8 region are located primarily in Chenango County. Based on data reported by the NYS Department of Environmental Conservation, gas wells in Chenango County produced 638,000 Mcf in 2018.[49] This amount represents approximately 2.5% of the natural gas used by customers within the region.

GATHERING SYSTEM

Gathering pipelines transport gas from the well source to storage, transmission or processing facilities. Gathering lines generally operate at relatively low pressure and flow and are smaller in diameter than transmission lines.[50]

For example, a gathering pipeline carries natural gas from wells in northern Pennsylvania to the Hancock compressor station in Broome County.

TRANSMISSION PIPELINES

Transmission pipelines carry large volumes of gas long distances at relatively high pressures from upstream suppliers and supply the distribution pipeline system. As shown in Map 5, portions of the following transmission pipelines are located within the Southern Tier 8 region:

> The **Millennium Pipeline**, owned by TransCanada Corp., runs from Corning to Rockland County and passes through Tioga, Broome and Delaware Counties. An interconnect point (Stagecoach) in Newark Valley, Tioga County connects the Millenium Pipeline to the Tennessee Pipeline. Meter stations along the line allow natural gas utilities to transfer natural gas to their distribution lines. [51]

[49] NYS Department of Environmental Conservation, 2018 Oil & Gas Production Data, https://www.dec.ny.gov/energy/36159.html
[50] U.S. Department of Transportation, Pipeline & Hazardous Materials Safety Administration, "Fact Sheet: Gathering Pipelines," https://primis.phmsa.dot.gov/comm/FactSheets/FSGatheringPipelines.htm?nocache=2438
[51] SOURCE: Millennium Pipeline website, accessed 8/10/10 http://www.millenniumpipeline.com/pipeline-map/

The **Columbia Gas Transmission** pipeline, also owned by TransCanada Corporation, passes through Tioga, Broome and Delaware Counties.

Texas Eastern Transmission, owned by Spectra Energy Partners, is a 9,000-mile natural gas pipeline that brings natural gas from the Gulf of Mexico to the New York City area. A portion of this pipeline passes through Tompkins, Cortland, Chenango, Otsego, Delaware and Schoharie Counties.

The **Tennessee Gas Pipeline**, owned by Kinder Morgan, is an 11,750-mile pipeline system that transports natural gas from Louisiana, the Gulf of Mexico and south Texas to the northeast, including New York City and Boston.[52] Portions of the pipeline pass through the Town of Richfield in Otsego County and the towns of Carlisle, Esperance and Wright in Schoharie County.

A small segment of the **Iroquois Pipeline** passes through the northeast corner of Schoharie County. A compressor station in the Town of Wright (Main Line Valve 14) connects to the Tennessee Gas pipeline.

The **Dominion Transmission** pipeline passes through Tompkins and Cortland Counties. Connections to NYSEG's distribution system in Tompkins County are at Newfield, Comfort, Cornell (Genung Road), Ithaca, East Ithaca, Dryden, and Groton/ Freeville. Connections in Cortland County are at Virgil, Cortland/ South Cortland.

The **DeRuyter Pipeline,** owned by NYSEG, passes through Chenango and Otsego Counties. It connects to the Dominion pipeline just north of the northwest corner of Chenango County.

The **Williams** pipeline in Broome County connects to the larger Williams Transco pipeline in Pennsylvania, which transports natural gas through a 10,000 mile system extending from South Texas to New York City.

COMPRESSOR STATIONS AND STORAGE FACILITIES

Natural gas is transferred from transmission pipelines to the distribution system at gate stations where gas flow is metered and the gas is odorized and pressure reduced. Pipelines then transport gas from the gate stations to district regulator stations where the pressure is further reduced. Distribution lines transmit natural gas to customers in the region.

Map 7 identifies two of the compressor stations in the region.

- The Hancock Compressor Station, located in Delaware County along the Millennium Pipeline, was put into service in 2014. The compressor station initially operated with a 15,700 hp natural gas turbine. As part of the Eastern System Upgrade project, the Millenium Pipeline Co. added an additional 22,400 hp of compression in 2018.[53]

[52] SOURCE: Kinder Morgan website, accessed 8/10/19 https://www.kindermorgan.com/pages/business/gas_pipelines/east/TGP/default.aspx

[53] The Hancock project includes a 1,230 hp emergency engine, a 1.2 mmBTU/hour gas heater, and a 1,500 gallon lube oil tank.[53] The project required approval by the Federal Energy Regulatory Commission as well as

- The Dunbar Compressor Station in Windsor, Broome County, operated by DMP New York, Williams Field Services Company LLC was constructed in 2017 and expanded in 2019. The station was constructed as part of the Laser Northeast Gathering Pipeline project which transports natural gas from wells in Susquehanna County, Pennsylvania to the Millenium Pipeline.

An underground storage facility for natural gas in Tioga County, operated by Stagecoach, was developed from a depleted natural gas field. It has a working capacity of 24,787,815 Mcf and maximum daily delivery of 500,000 Mcf.[54]

DISTRIBUTION PIPELINES AND SERVICE LINES

Distribution pipelines operate at lower pressures and volumes than transmission pipeline and transport gas directly to customers across the service territory. Service lines are the individual connections of the distribution pipeline system that supply each individual gas utility customer. All utility-operated transmission, distribution and service lines carry odorized gas from upstream suppliers to the end user or customer.

PROPOSED NATURAL GAS PROJECTS

CONSTITUTION PIPELINE

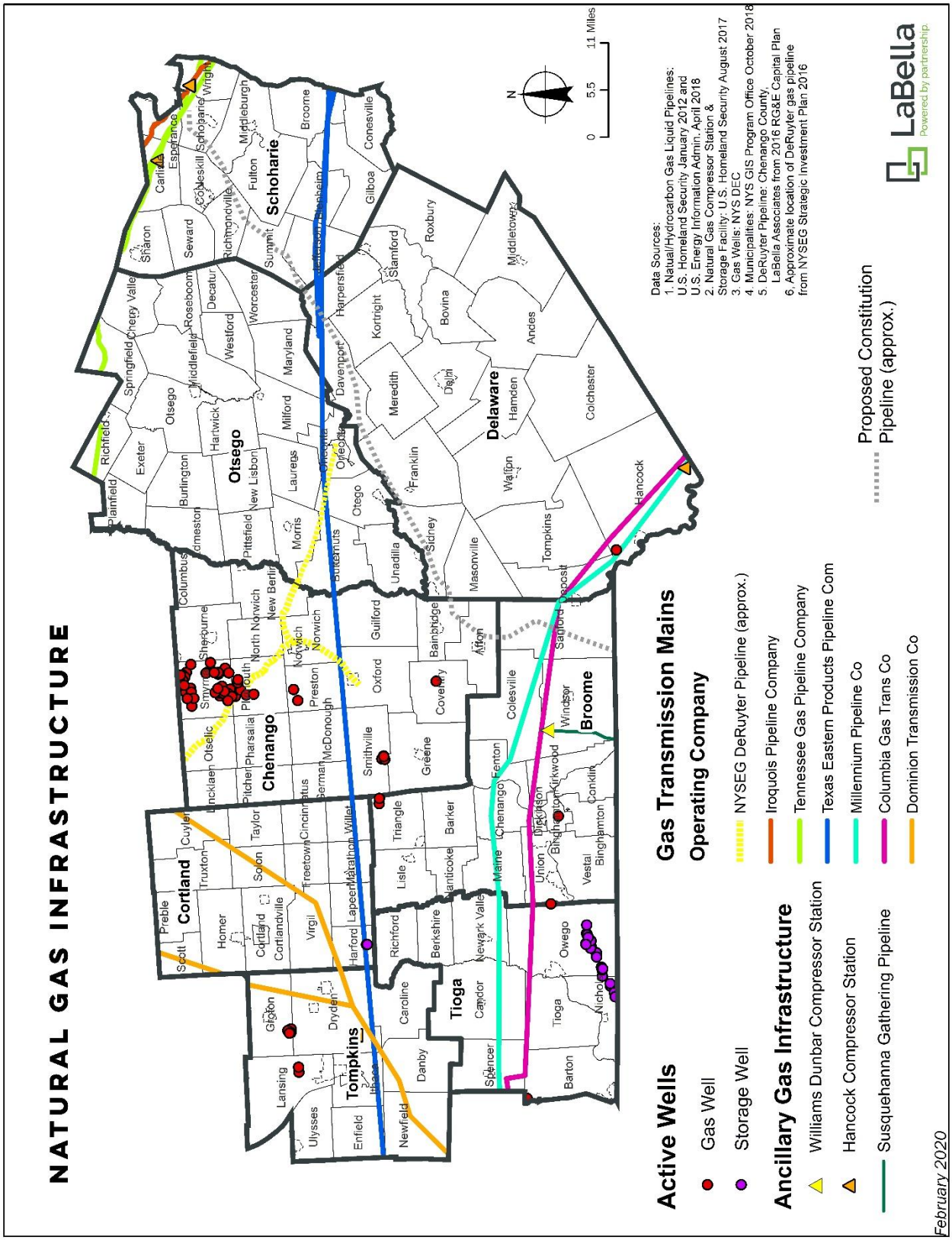
Initially proposed with filings to FERC in 2012, the proposed 124-mile, 30" diameter Constitution Pipeline was designed to transport 650,000 dekatherms of natural gas per day from production sites in Susquehanna County, PA to the Iroquois Gas Transmission and Tennessee Gas Pipeline system in Schoharie County. It was to pass through Broome, Chenango, and Delaware Counties and terminate at the Wright Compressor station in Schoharie County. The pipeline was designed to allow utilities to connect in order to serve customers in portions of Broome, Chenango, Delaware and Schoharie Counties that do not currently have natural gas service.

New York State Department of Environmental Conservation denied permits for the pipeline and the United States Supreme Court upheld the denial. The project sponsors petitioned the Federal Energy Regulatory Commission (FERC) to overrule the State. In August 2019, FERC issued a determination that NYS did not properly administer the Section 401 permit. In September 2019, NYS petitioned FERC for a rehearing to reconsider the approval, which FERC denied in December 2019. New York State is likely to challenge FERC's approval in Federal court.

compliance with air emission limits for turbines[53] under Title V of the Federal Clear Act and NSPS leak detection and repair requirements.[53]. FERC approved the project in 2017. NYS DEC approved the required Air State Facility permit for the compressor station components in 2017.

[54] US Energy Information Agency New York Profile

Map 7: Natural Gas Infrastructure



WRIGHT INTERCONNECT PROJECT

The proposed Wright Interconnect Project, which is dependent upon construction of the Constitution Pipeline, proposes to connect the Iroquois Pipeline to the proposed Constitution pipeline and expand the existing compression and metering facility operated by Iroquois Pipeline Company in Wright, Schoharie County. Substantial upgrades to the Wright Compressor station would be required to enable 22,000 HP of transfer compression. The project would have a capacity of up to 650,000 Dth per day using a 22,000 horsepower compression turbine, cooling and associated facilities.[55]

The Wright Interconnect Project will not proceed without construction of the Constitution Pipeline.

LEATHERSTOCKING GAS COMPANY DISTRIBUTION SYSTEM EXPANSION

Leatherstocking Gas Company, which is jointly owned by Corning Natural Gas and Mirabito Holdings, planned to expand natural gas distribution network with a supply from the Constitution Pipeline, including delivery of natural gas to Amphenol Corp in Sidney, Delaware County, as well as other delivery points in Delaware and Otsego Counties. This project is unable to proceed without completion of the Constitution Pipeline.[56]

DERUYTER PIPELINE UPGRADES

NYSEG's Five Year Capital Investment Plan includes $54,733,000 for the DuRuyter Transmisison Replacement. The proposed project included replacement of 50 miles of 8-inch and 10-inch (298 psig coated steel) mains with 12-inch mains. The project was planned to be implemented in several phases between 2021 and 2023. Funding for the project was requested in NYSEG's Rate Case, which is currently under review by the NYS Public Service Commission. In addition, approval through the NYS Article VII process would be required before construction can begin.[57] The project was designed to ensure sufficient supply of natural gas to customers in Chenango and Otsego Counties.

BORGER SUBSTATION REPLACEMENT

Dominion Energy proposed to install new compressor units, replace a boiler and install a heat recovery system at the Borger compression station in Dryden, Tompkins County. The project, as part of a larger "New Market Project," was approved by the Federal Energy Regulatory Commission (FERC) in April 2016, but has not yet been authorized by the Town. The DEC is currently considering renewal of the facility's Title V permit which addresses air emissions.[58] The Borger Compressor Station upgrades were intended

[55] SOURCE: Iroquois, https://www.iroquois.com/operations/projects/wright-interconnect-project-wip/
[56] https://www.naturalgasintel.com/articles/97760-constitution-pipeline-leatherstocking-eye-expanding-north-pasouth-ny-gas-service
[57] NYSEG and RG&E Capital Investment Plan 2019-2023, April 2019, p. 212 file:///C:/Users/BJohnston/Downloads/%7B12DB6C9F-C2D4-4585-88EE-82C06E59BD61%7D.pdf
[58] NYS DEC Environmental Notice Bulletin, 11/27/2019, https://www.dec.ny.gov/enb/20191127_reg7.html#750240000700004

to enable transport of additional supplies of natural gas through the Dominion Pipeline, which traverses Tompkins and Cortland Counties.

FENTON NATURAL GAS COMPRESSOR STATION

NG Energy proposed to construct a natural gas compressor/ transfer station along the Millennium Pipeline in the Town of Fenton, Broome County. The project was abandoned following disapproval by the Town and public opposition.

COMPRESSOR STATIONS AND OTHER NON-PIPELINE SOLUTIONS, LANSING, TOMPKINS COUNTY

As an alternative to the proposed Lansing/ Freeville Reinforcement Gas Pipeline Project, which would have passed through the Town of Dryden, Tompkins County, NYSEG proposed installing four electric powered compressor stations within the gas distribution system to boost pressures during peak demand times. The project was intended to address safety, pressure and reliability issues experienced by 19,000 existing natural gas customers in Tompkins County. Although the NY PSC approved NYSEG's petition to construct a natural gas compression station in the Town of Lansing in 2017, NYSEG withdrew this proposal.

In December 2019, NYSEG issued a Request for Proposals to address the service reliability concerns as an alternative to a new pipeline. The project is intended to resolve the low gas pressures during times of high load and to potentially remove the moratorium on new gas customers that has been in effect since 2015. Selected projects to reduce natural gas load on the system would begin construction no later than November 2021.

NATURAL GAS UTILITIES AND REGULATORS

Energy generators, utilities, energy suppliers, and regulators all play a role in determining the availability, reliability and cost of the natural gas used in the Southern Tier 8 region.

FEDERAL ENERGY REGULATORY COMMISSION (FERC)

Power producers and utilities that engage in interstate commerce are regulated by the **Federal Energy Regulatory Commission.** FERC has jurisdiction over natural gas pricing and oil pipeline rates. FERC also reviews and authorizes liquefied natural gas (LNG) terminals and interstate natural gas pipelines.[59]

NYS PUBLIC SERVICE COMMISSION

The **New York Public Service Commission** (PSC) develops and enforces safety standards for natural gas and liquid natural gas pipeline and storage facilities.[60] Its responsibilities include determining the rates utilities may charge customers for gas and steam. A utility that seeks to raise rates must file documentation of its expenses to demonstrate the need for the rate increase. Interested parties ("interveners") may participate in the decision-making as parties to the "rate case."

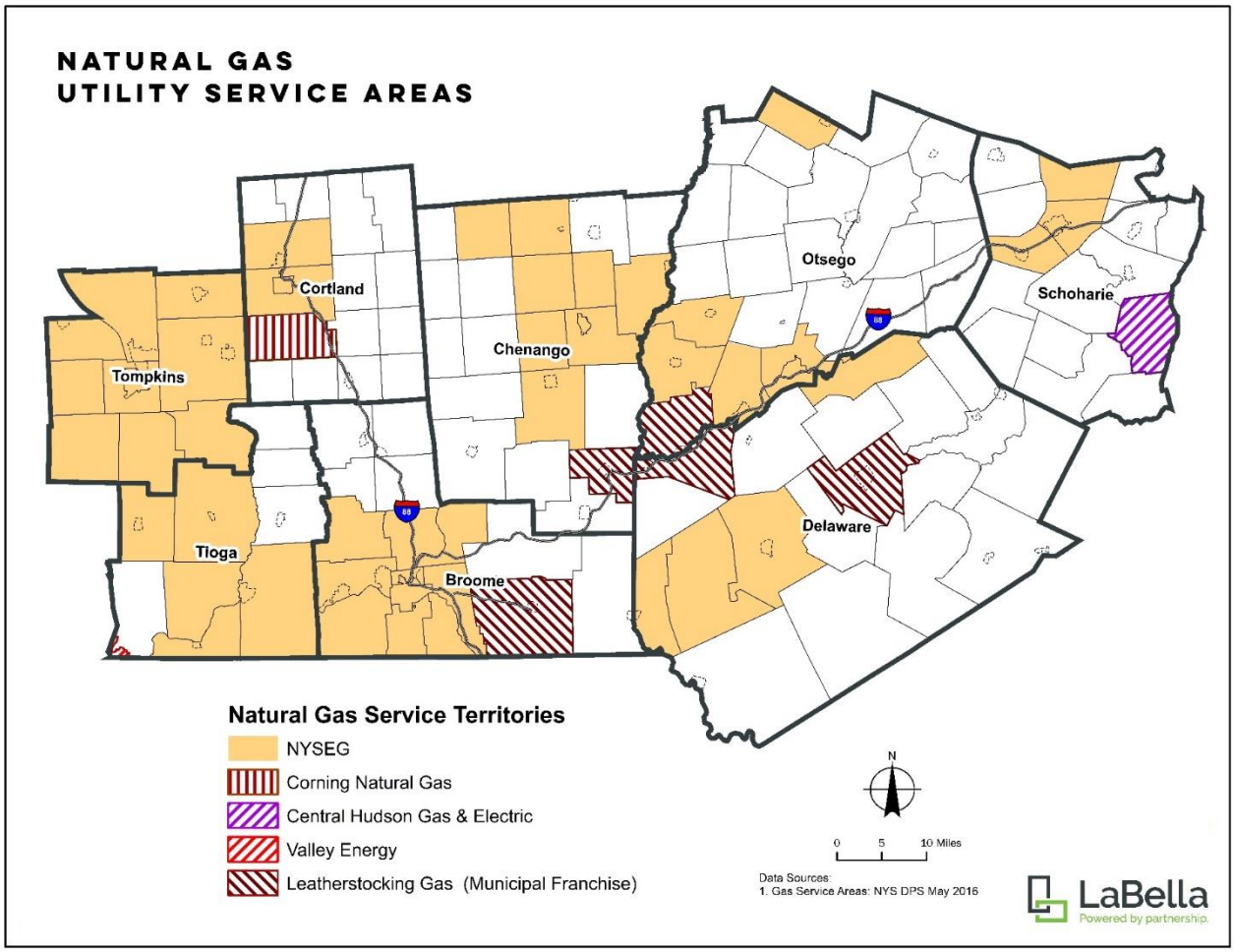
NATURAL GAS UTILITIES

Several utilities have been authorized by the New York Public Service Commission to deliver natural gas to customers within designated service areas.

- New York Gas & Electric (NYSEG) is authorized to deliver natural gas to customers throughout Tompkins County and portions of Broome, Delaware, Cortland, Chenango, Otsego and Schoharie Counties.
- Corning Natural Gas serves a portion of southern Cortland County
- Leatherstocking Gas Company, LLC serves municipal franchises in Broome, Chenango, Otsego and Delaware Counties
- Central Hudson Gas and Electric serves a portion of Schoharie County
- Valley Energy serves the southwesternmost corner of Tioga County

[59] http://en.wikipedia.org/wiki/Federal_Energy_Regulatory_Commission
[60] NY PSC website:
http://www3.dps.ny.gov/W/PSCWeb.nsf/All/78F051A24B026591852576A5006D5163?OpenDocument

Map 8: Natural Gas Service Areas



NYSEG

The natural gas franchises granted to NYSEG by the NYS Public Service Commission allows NYSEG to serve customers within the identified franchise areas. However, NYSEG must receive approval from the PSC to "exercise" the franchise. Expansion of service to additional customers within the approved franchise area requires that NYSEG demonstrate that costs are reasonable and the project will not cause a significant impact on the environment. Many areas within franchise areas are not currently receiving natural gas service.

The NYS Public Service Commission is currently in the process of updating NYSEG's natural gas tariff in a "Rate Case" that was filed in May 2019.

Leatherstocking Gas Company

Leatherstocking Gas Company (LGC) was formed as a joint venture between Corning Natural Gas Corporation and Mirabito Regulated industries. The NYS Public Service Commission has granted LGC the following municipal franchises:

- Village and Town of Windsor (Broome County)
- Village and Town of Bainbridge (Chenango County)
- Village and Town of Sidney (Delaware County)
- Village and Town of Delhi (Delaware County)
- Town of Unadilla (Otsego County)

U.S. DOT PIPELINE AND HAZARDOUS MATERIALS SAFETY ADMINISTRATION

Gathering pipelines are regulated under 49 CFR Part 192, Transportation of Natural/Other Gas by Pipeline.

ESCOs

Utilities and Energy Service Companies (ESCOs), purchase electricity through the wholesale market and sell it to electricity consumers through bilateral contracts, "Day Ahead Market," or NYISO's "Real-Time Market." Customers have the option of purchasing electricity through a utility or through an independent ESCO.

An energy service company company (ESCO) is a commercial or non-profit business that provides a range of energy conservation solutions. Energy purchased through an ESCO is typically delivered to customers via a public utility.

OTHER HEATING AND PROCESSING FUELS

Other fuels and processes used for heating and industrial processes in the Southern Tier 8 region include:

1) Propane and liquid natural gas (LNG)
2) Heating oil, kerosene and other petroleum-based products
3) Biodiesel
4) compressed natural gas;
5) biomass fuels such as wood chips and wood pellets; and
6) ground—source, air-source and water-source heat pumps.

This section describes the use of these fuels and processes as well as the infrastructure within the Southern Tier 8 region used to transport, store and distribute the fuels.

PROPANE AND LIQUID NATURAL GAS (LNG)

Propane is delivered from bulk storage facilities to customers via rail and truck. Propane infrastructure within the region includes the Teppco pipeline, which has the capacity to transport 60,000 barrels per day of natural gas liquids. A storage facility and terminal in Harford Mills, Cortland County, connected to the TEPPCO pipeline, has 680,000 barrel capacity of underground propane storage and includes rail and truck loading capability.[61]

Most of the Liquid Natural Gas (LNG) in the United States is created and stored by utilities for use during peak demand periods. LNG is also used as an alternative fuel in vehicles. Terminals & Storage LLC operates a LPG storage and terminal facility in Oneonta, Otsego County.

HEATING OIL, KEROSENE AND OTHER PETROLEUM PRODUCTS

Heating oil, also known as fuel oil, is a distilled petroleum product which is refined from crude oil. “Number 2 fuel oil” is the most commonly used heating fuel. (Number 6 fuel oil has a higher sulfur content; “Number 4 fuel oil” is a mixture of Number 2 and Number 6 fuel oil.)

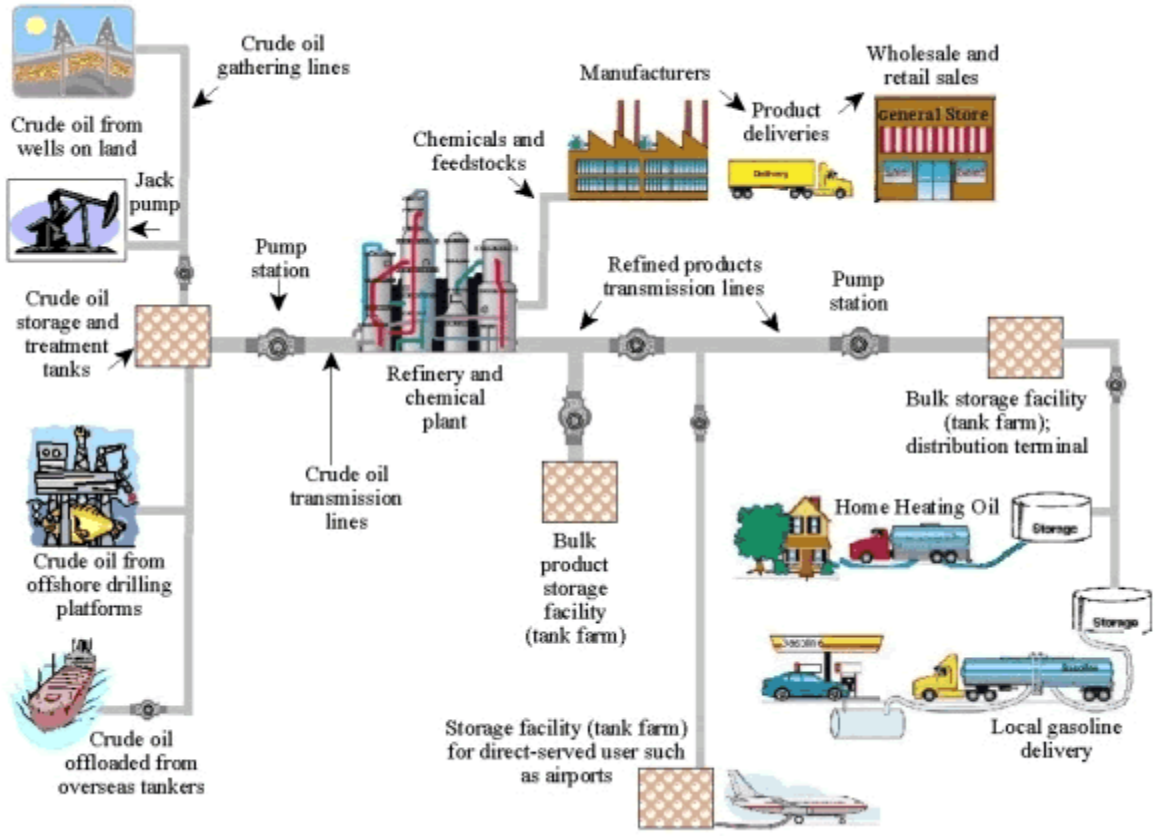
Number 2 heating oil is virtually the same product at the diesel fuel used in vehicles. Heating oil is dyed red to distinguish it from diesel fuel, which is dyed green.

[61] U.S. Department of Energy, “Natural Gas Liquids Primer – With a Focus on the Appalachian Region, December 2017, https://www.energy.gov/sites/prod/files/2017/12/f46/NGL%20Primer.pdf

In 2012, New York State began requiring a transition to "ultra-low-sulfur" (ULHO), which has a sulfur content of 15 parts per million (ppm) or less, the same requirement for the diesel fuel used in vehicles.[62]

Kerosene (No. 1 fuel oil) is another type of distillate produced from crude oil, which condenses at a lower temperature.

Heating oil and kerosene are liquid fuels that are transported from refineries to bulk storage facilities via rail or pipeline. Distributors deliver these fuels to customers' tanks in special trucks. Several companies that store and/or distribute heating fuels also store and distribute vehicular fuels such as gasoline and diesel.



SOURCE: https://primis.phmsa.dot.gov/comm/PetroleumPipelineSystems.htm?nocache=147

[62] https://www.eia.gov/energyexplained/heating-oil/

BIODIESEL

Biodiesel is manufactured from vegetable oil, animal fats, recycled restaurant grease and other materials. Biodiesel can be added to Number 2 fuel oil as a heating fuel, typically in a blend with 5-20% biodiesel. Some heating fuel distributors carry products that include up to 20% biofuel.

COMPRESSED NATURAL GAS (CNG)

Compressed natural gas is made by compressing natural gas to less than 1% of the volume it occupies at standard atmospheric pressure.[63] Compressed natural gas is transported by truck in special trailers from producing areas to customers throughout the Southern Tier 8 region that do not have access to natural gas from a utility.

BIOMASS

Biomass fuels used for heating and industrial processes include wood pellets and wood chips. These fuels are delivered to customers in bulk or purchased in packets. Manufacturing and delivery infrastructure within the Southern Tier 8 region include a wood pellet manufacturer and a bulk wood pellet storage facility.

New England Wood Pellet, owned by Lignetics, a national manufacturing company, manufactures wood pellets for use in wood pellet boilers at a facility in Deposit, Delaware County. The pellets are manufactured from sawmill residue sourced from mills in the region.[64]

Ehrhhart Energy in Trumansburg, Tompkins County established a bulk wood pellet storage depot with assistance from Cornell Cooperative Extension of Tompkins County through the Southern Tier Bulk Wood Pellet Infrastructure Boost Program. The program, which ended in 2018, was intended to promote the use of pellet stoves and pellet boilers to replace fossil fuels (especially heating oil and LPG.)

Demonstration projects were completed in Triangle, Broome County and Hanford Mills Museum, in East Meredith, Otsego County.

A demonstration project facilitated by Cornell Cooperative Extension of Delaware County to produce fuel pellets from grasses did not turn out to be economically feasible. [65]

[63] https://en.wikipedia.org/wiki/Compressed_natural_gas
[64] https://lignetics.com/pages/wood-fuel-pellets
[65] http://ccetompkins.org/energy/renewable-energy/biomass/biomass-energy-case-studies/enviro-energy-llc

GROUND SOURCE, AIR SOURCE, AND L SOURCE HEATING AND COOLING

GROUND SOURCE HEAT PUMPS

Geothermal systems, also known as ground source heat pumps, utilize the energy absorbing capacity of the earth to heat indoor air during the cold winter months and remove heat from indoor air during the warm summer months. [66]

The main types of geothermal systems are:

- Closed Loop - fluid (typically a chemical compound) continuously re-circulates in closed piping from underground to a building or complex and back underground for the purpose of heat exchange.
- Open Loop - groundwater or surface water is pumped directly from the earth, used once for the purpose of heat exchange, and then discharged to the surface or underground.
- Standing Column - groundwater is pumped up through a central pipe, used once for heat exchange, and then discharged into the upper casing of the same well.

AIR SOURCE HEAT PUMPS

Air source heat pumps transfer heat from outdoors to indoors using a refrigeration system.

> A heat pump's refrigeration system consists of a compressor and two coils made of copper tubing (one indoors and one outside), which are surrounded by aluminum fins to aid heat transfer. In heating mode, liquid refrigerant in the outside coils extracts heat from the air and evaporates into a gas. The indoor coils release heat from the refrigerant as it condenses back into a liquid. A reversing valve, near the compressor, can change the direction of the refrigerant flow for cooling as well as for defrosting the outdoor coils in winter.[67]

LAKE SOURCE COOLING

Cornell University operates a plant that draws cold water from Cayuga Lake and uses it to cool campus buildings before returning it to the lake. A closed loop of chilled water circulates through campus buildings and collect heat removed by air conditioning. The water intake is about two miles from shore and 10 feet above the lake bottom, where the temperature is about 39 degrees F year-round.[68]

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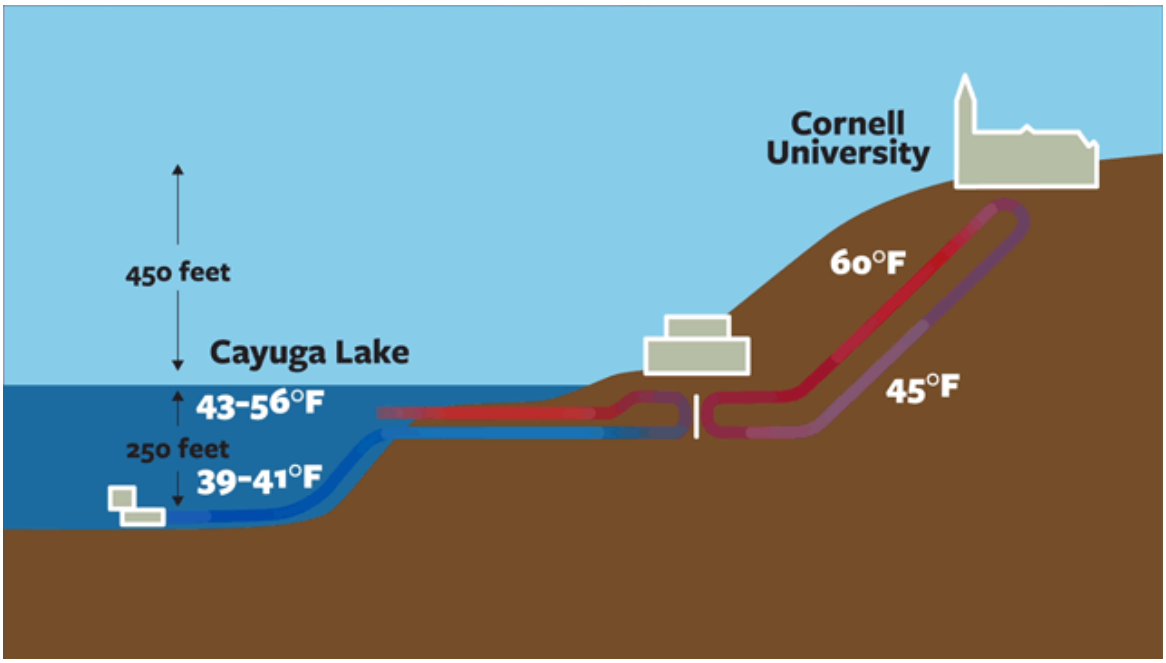
[66] *NYS DEC Geothermal Energy website:* https://www.dec.ny.gov/energy/43303.html
[67] SOURCE: U.S. Department of Energy, https://www.energy.gov/energysaver/heat-pump-systems/air-source-heat-pumps
[68] https://fcs.cornell.edu/departments/energy-sustainability/utilities/cooling-home/cooling-distribution/lake-source-cooling-home/how-lake-source-cooling-works

Cornell University operates a chilled water cooling system that significantly reduces the amount of electricity used to cool buildings at Cornell University and Ithaca High School.

Figure 14: Cornell Chilling Plant Diagram



PART 4
EXISTING PLANS, PROGRAMS & REGULATIONS

This section presents summaries of relevant State, Regional, and County plans, studies and programs. It includes an overview of the NYS Reforming the Energy Vision (REV) initiative, which is driving rapid development of renewable and other distributed energy projects through reforms to utility rate structures and incentives, as well as of the NYS Energy Plan, NYS Energy Blueprint and other key State initiatives. It summarizes the policies and recommendations of the Southern Tier 8 CEDS strategy and other regional and county plans. It presents examples of exemplary energy-related projects within the region.

NY CLIMATE LEADERSHIP AND COMMUNITIES PROTECTION ACT

Two State laws will continue to influence investment in energy infrastructure: the Climate Leadership and Community Protection Act (CLCPA), enacted in July 2019, and

The CLCPA sets the following target reductions from a 1990 baseline:

- 70% renewable power generation by 2030
- 100% zero emissions from electricity generation by 2040
- 6,000 MW solar energy by 2025
- 185 trillion BTU reduction through energy efficiency
- 3000 MW energy storage by 2030

The law calls for an appointed Climate Action Council will prepare a scoping plan with recommendations for how to achieve net zero emissions. The NYS Department of Environmental Conservation will develop rules to curtail GHG emissions. NYSERDA and DEC will determine the social cost of carbon for use by state agencies, in terms of dollars per ton of carbon. Finally, the Public Service Commission will require utilities, by 2040, to meet demand with zero-emissions generation although it will be able to waive these requirements to ensure “safe and adequate electric service.”

ACCELERATED RENEWABLE ENERGY GROWTH AND COMMUNITY BENEFIT ACT

The Accelerated Renewable Energy Growth and Community Benefit Act, passed as part of the 2020-2021 budget in April 2020, requires establishing an Office of Renewable Energy Siting within the Department of State, which will streamline siting decisions for energy generation projects with 25MW capacity or larger to ensure action within one year. Projects 20-25 MW in size and projects currently going through the Article 10 process can opt in. Host communities will receive intervenor funds process as well as utility bill discounts or other benefits or incentives.

The law also aims to accelerate planning and build-out of bulk and local transmission and distribution infrastructure to accommodate increase in renewable and distributed generation to accommodate increase in renewable and distributed generation. The Department of Public Service, in consultation with NYSERDA, NYPA, NYISO and utilities, will identify cost-effective upgrades. PSC will establish a capital program for each utility in need of upgrades in their service territory. A bulk transmission investment program will leverage NYPA's ability to construction new transmission. A streamlined siting process of no more than nine months for transmission infrastructure built within existing rights-of-way.

NYS REFORMING THE ENERGY VISION (REV) INITIATIVE

Enacted in 2018, New York State's "Reforming the Energy Vision" (REV) initiative has stimulated rapid growth in renewable energy and other infrastructure investments throughout New York State. Because of its significant impact, a description of REV is presented below. The next section summarizes the other key NYS programs and legislation that affect energy infrastructure in the Southern Tier 8 region.

New York State's "Reforming the Energy Vision" (REV) instituted reforms to utility ratemaking practices and revenue models[69] in order to spur investment in distributed energy resources (DER) and energy efficiency. The reforms are intended to create financial incentives for utilities to support energy efficiency and distributed energy by encouraging customers to reduce peak demand and the need for new, expensive centralized infrastructure. Modified rate structures enable utilities to profit from managing distributed energy. It also instituted incentives to develop more renewable and distributed energy resources and increase energy efficiency.

The electricity grid's biggest challenge is ensuring sufficient power to meet demand at peak times. The largest peaks occur for only a few hours every year.[70] The REV program seeks to better manage the existing grid to reduce peaks in demand instead of building new plants. The regulations enable utilities to generate income from the management of electricity and from projects that help to reduce peak demand.

Track 1 of PSC's proposal envisioned utilities acting as a "distributed system platform" (DSP) provider that coordinates and facilitates the deployment of various distributed energy resources on the grid.[71] "Under the customer-oriented regulatory reform envisioned here, a wide range of distributed energy resources will be coordinated to manage load, optimize system operations, and enable clean distributed power generation." Utilities will be responsible for managing and coordinating demand loads and distributed power generation.

The PSC issued an order in 2015 (Track 1 of the REV docket) requiring utilities to file Distribution Service Implementation Plans (DSIPs.) The DISPs were required to forecast growth in demand, identify beneficial

[69] https://www.utilitydive.com/news/ny-regulators-propose-groundbreaking-new-utility-models-under-landmark-rev/403111/

[70] Davide Savenije, Utility Dive, "All about the REV: How and why New York wants to develop distributed energy markets," March 3, 2015. https://www.utilitydive.com/news/all-about-the-rev-how-and-why-new-york-wants-to-develop-distributed-energy/370536/

[71] Gavin Bade, "REV in 2016: The year that could transform utility business models in New York," Utility Dive, January 20, 2016, https://www.utilitydive.com/news/rev-in-2016-the-year-that-could-transform-utility-business-models-in-new-y/412410/

locations for distributed energy resources and address operational requirements relating to interconnection and grid optimization. Supplemental DISP would include details about grid operations and pricing.

"Track 2 focuses on reforming utility ratemaking practices and revenue streams to accommodate the DSP provider model."[72] Revised rates would be based on performance ("Earnings Adjustment Mechanisms") rather than cost of service, allowing utilities to earn revenue from peak demand reduction, efficiency and customer engagement. Rates would also be tied more closely to peak usage, which is more directly related to the cost of maintaining the electric grid.

In 2017, PSC issued an order specifying compensation structure for distributed energy (Value of Distributed Energy Resources (VDER.) The four-tier "Value Stack" is a step away from retail net-metering for large solar arrays. [73] The order was intended to streamline the process of interconnecting distributed energy to the electric grid.

Several NYSERDA initiatives help to advance the REV initiative. NYSERDA established the REV Connect digital portal to connect businesses and electric utilities.

Demonstration projects to further the REV initiative include energy storage, clean energy, and micro-grids.

Utilities have responded to the REV orders in their capital investment plans with Non-Wire solutions to energy grid capacity issues. Non-Wire solutions include load and demand management and other approaches that do not involve physical improvements to electric distribution lines and substations. NYSEG's 5-year capital investment plan includes: Advanced Metering Infrastructure to allow for time-of-day metering and improved management capabilities.

OTHER NEW YORK STATE LEGISLATION, REGULATIONS AND PROGRAMS

2015 NEW YORK STATE ENERGY PLAN

The 2015 New York State Energy Plan is a "comprehensive roadmap to build a clean, resilient, and affordable energy system for all New Yorkers." It includes regulatory reform to integrate more renewable energy into the power grid, stimulate market investment, and implement innovative energy solutions in State-owned facilities and operations. The Plan includes technical information about end-use energy and potential for renewable energy.

[72] Gavin Bade, "REV in 2016: The year that could transform utility business models in New York," Utility Dive, January 20, 2016, https://www.utilitydive.com/news/rev-in-2016-the-year-that-could-transform-utility-business-models-in-new-y/412410/

[73] Robert Walton, "New York REV orders promise growth for diverse set of distributed resources," Utilty Dive, Martch 15, 2017

2017 BIENNIAL REPORT TO THE 2015 STATE ENERGY PLAN

The 2017 Biennial Report to the 2015 State Energy Plan highlighted major initiatives including Reforming the Energy Vision (REV), Clean Energy Standard (CES), zero-emission vehicles, and the Clean Energy Communities program.

Renewable Energy

The Clean Energy Standard requires 50 percent of the electricity consumption in the state to be generated by renewable resources by 2030. In support of the CES, NYSERDA and NYPA announced in June of 2017 a solicitation for up to 2.5 million megawatt hours of renewable electricity.

Buildings and Energy Efficiency

The 2017 Biennial Report to the 2015 State Energy Plan noted that energy efficiency reduces energy spending, system costs, and emissions in a cost-effective manner. Initiative included updated building codes NYPA's energy efficiency financing activities, and funding through the Clean Energy Fund. The BuildSmart NY program is progressing toward its 2020 goal of reducing energy consumption by 20 percent in state-owned and -managed facilities.

Clean Energy Financing

Clean energy financing initiatives include New York Green Bank financing to help scale clean energy markets toward self-sufficiency.

Sustainable and Resilient Communities

Sustainable and Resilient Communities initiatives include the REV Campus Challenge and Clean Energy Communities programs. Through the REV Campus Challenge, SUNY Broome Community College installed a geothermal system to heat and cool its campus. Several municipalities in the Southern Tier 8 region have advanced energy efficiency and renewable energy projects to become certified as Clean Energy Communities.

Energy Infrastructure Modernization

Energy infrastructure modernization includes: community solar projects and other "behind-the-meter" solutions; and the valuation of all types of distributed resources, allowing customers to be paid for providing grid solutions. Alternatives to traditional power distribution facilities are another way REV is using new technologies to modernize and expand the capabilities of New York's energy infrastructure. DPS continues to work with utilities to upgrade the state's energy infrastructure and reduce the amount of leak-prone pipe, which contributes to methane emissions.

Innovation and R&D

REV is driving utilities to test new technologies and business models. For example, utilities are developing systems to manage demand in order to reduce the need to maintain peaking plants and reduce the need for significant investment in physical infrastructure.

POWER NEW YORK ACT OF 2011

This Act institutes a streamlined permitting process for new and repowered power plants with 25 MW generating capacity or more. Article 10 of the NYS Public Service Law establishes a siting process that replaces municipal approvals and the State Environmental Quality Review (SEQR) process.

NEW YORK CLEAN ENERGY STANDARD (CES)

New York's Clean Energy Standard, adopted in 2016 by order of the Public Service Commission, requires 50 percent of the electricity consumption in the state to be generated by renewable resources by 2030. NYSERDA and NYPA offer provides financial incentives to develop renewable energy resources.

Renewable Energy Credit Projects

The Clean Energy Standard authorized annual procurement of renewable energy projects. In 2017 and 2018, NYS awarded $2.9 billion in contracts to 46 wind and solar projects. [74]

New York State's Clean Energy Standard (CES) requires every "load serving entity" (including electric utilities, cooperatives, and municipal electric systems) to procure renewable energy credits (RECs) for their retail customers or make an alternative compliance payment.[75] Purchases of RECs are tracked in the New York Generation Attribute Tracking System (GATS) to demonstrate compliance with and progress toward the CES goal. In 2020, the cost of a REC is $22.09/ MW of renewable capacity. Renewable energy developers apply to NYSERDA for a Statement of Qualification that allows the energy to be sold as a REC. [76]

Renewable energy generators that participate in procurement of Renewable Energy Certificates through the Renewable Energy Certificates solicitation as required under New York State's Clean Energy Standard are listed in the New York Generation Attribute Tracking System (NYGATS.) Approved applications are granted "Operational Eligibility" and listed in the NYGATS registry. (See https://www.nyserda.ny.gov/All-Programs/Programs/Clean-Energy-Standard/Renewable-Generators-and-Developers/RES-Tier-One-Eligibility/Certification

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I. [74] Robert Walton, "New York targets 1.5 TWh of new renewables with latest solicitation," Utility Dive, April 24, 2019 https://www.utilitydive.com/news/new-york-targets-15-twh-of-new-renewables-with-latest-solicitation/553298/

[75] https://www.nyserda.ny.gov/All-Programs/Programs/Clean-Energy-Standard
[76] https://nygats.ny.gov/ng/Report/getdto_view_Report_PublicOperationalEA

NEW YORK ENERGY HIGHWAY BLUEPRINT (2012)

The Energy Highway Blueprint presents policies and recommendations to improve the reliability and efficiency of energy generation, transmission and distribution systems. Its primary goals/ initiatives are 1) construct new transmission projects to increase the capacity of the grid to transmit power from upstate to downstate when demand is high; 2) address uncertainties in the bulk power system resulting from potential plant closures; 3) increase generation of renewable energy.

The Energy Blueprint identified the following projects proposed in Southern Tier 8 region:

- EDP Renewables North America, LLC: build a new 345kV line from North Country, From Zone D, North to Zone E, Mohawk Valley
- Energize Ithaca, LLC, Renewable generation - Biofuel, 12 MW, Tompkins County
- New York Transmission Company (Transco)/ NYSEG: Marcy South Series Compensation and Fraser-Coopers Corners Reconductoring: Transmission–AC Upgrade Existing line from Sullivan County to Delaware County New York Transmission Company (Transco) / NYSEG: Oakdale–Fraser 345 kV line upgrade, Transmission–AC Upgrade existing line from Broome County to Delaware County
- New York Transmission Company (Transco) / NYSEG: Hillside–North Waverly 115 kV line Reconductoring Existing Transmission–AC, from Chemung County to Tioga County
- New York Transmission Company (Transco) / NYSEG: Delhi–Colliers 115 kV line Reconductoring Existing Transmission–AC from Delaware County to Otsego County
- Ridgeline Energy LLC Generation: 18.45 MW, new Wind generation, Otsego County.

Key Relevant Recommendations and Policies

Support Clean Energy

- Encourage the development of renewable generation through $250 million NYSERDA 10-year contracts with renewable energy developers.
- Facilitate further development of upstate renewable energy projects
- Build up to $35 million worth of strategic transmission upgrades to remove a potential impediment to additional renewable energy development in Northern New York.
- Advance policies to encourage distributed renewable energy development; continue and build on the NY-Sun initiative.

Drive Technology Innovation

- Leverage the Smart Grid Program with an investment of $110 million; provide additional support for Smart Grid technologies through an investment of $80 million for new technologies in power grid system operations, security, and energy storage
- Support energy efficiency and other demand-side measures.

Drive Technology Innovation

- Advance *Smart Grid in New York* (Smart Grid and energy storage to reduce peak demand and improve reliability)
- Ensure electric utility capital expenditure plans include cost-effective Smart Grid technologies.
- Evaluate policies to encourage technological and commercial innovation.

Expand and Strengthen the Energy Highway

- Build $1 billion worth of electric transmission projects totaling over 1,000 mw of capacity, providing an alternative to locally constructed generation of equal capacity, and allowing energy produced at upstate power plants to reach downstate consumers.

Accelerate Construction and Repair

- Advance up to $800 million of investments in electric generation, transmission, and distribution to enhance reliability, safety, and storm resilience
- Advance up to $500 million of investments in natural gas distribution to reduce costs to customers and enhance reliability, safety, and emission reductions.

BUILD NOW NY AND SHOVEL READY SITES

New York State currently has a program known as Build Now NY with the focus of developing and promoting Shovel Ready Sites in New York State. According to the website, “having a Shovel Ready Certified site means that the local developer has worked proactively with NYS to address all major permitting issues prior to a business expressing interest in the location . . . a site where construction can begin rapidly once a prospective business decides to develop a facility there. The program reduces the time a business needs to set up their development in New York State, thereby reducing their cost of investment. Currently only Lounsberry East in Tioga County qualifies for the program within the Southern Tier 8 region

ENERGIZE NY OPEN C-PACE PROGRAM

Energize NY Open C-PACE (Property Assessed Clean Energy) is operated by Energy Improvement Corporation (EIC) and provides a low cost, long-term alternative to traditional loans to fund clean energy projects in commercially owned buildings.[77] Open C-PACE is not a bank loan and differs from traditional financing options because:

- financing is available for up to 100% of the project cost, or can be combined with other financing
- competitive private financing from EIC-approved capital providers
- customizable loan terms up to the expected life of the improvement
- repayment is secured through a benefit assessment lien that is subordinate to municipal taxes
- financing automatically transfers to a new owner if the property is sold
- projects must comply with NY State Article 5-L (NY's PACE law) and NYSERDA's Commercial PACE Guidance Document

To enable Open C-PACE, municipalities pass a local law and sign an EIC municipal agreement. EIC bills the property owner and directs them to remit the funds to the capital provider, removing any collection obligation from the municipality. As the program administrator, EIC will review and approve each financing, ensuring it conforms with the enabling legislation and NYSERDA C-PACE guidelines.

NYSERDA CLEAN HEATING & COOLING PROGRAMS [78]

- Air Source Heat Pumps (ASHP) Program [PON 3635 $10.95M] – NYSERDA will provide up to $10.95 million in incentives to participating installers for the installation of program qualified ASHP systems in residential sites to include single-family and multifamily buildings through 2020. Incentives of $500 per installed program qualified ASHP system are available only to participating installers on a first-come, first-served basis, up to $500,000 per participating installer. – 198 Participating Installers
- Ground Source Heat Pumps (GSHP) Rebate Program [PON 3620 $15M] – Offers $15 million to support the installation of ground source heat pump systems at residential, commercial, institutional, and industrial buildings. Funding is available only to eligible designers and installers of renewable heating and cooling systems that have been approved by NYSERDA through June 2019. – 68 Participating installers
- Clean Heating & Cooling Communities Campaigns [PON 3922 / $2 Million available in second round, $8 Million total investment] – Support for communities to increase customer awareness of CH&C technologies, reduce installed costs, and jump-start the market by implementing multi-year campaigns consisting of community-based outreach and education focused on CH&C. – Retained consultant to provide technical assistance to communities

[77] https://energizeny.org/commercial/eny-open-pace
[78] http://otsegocc.com/wp-content/uploads/2019/03/16_Clean_Heating_and_Cooling_Energy_Studies_and_Net_Zero_Scott_Smith_Flextech_NYSERDA.pdf

- Geothermal Clean Energy Challenge [$3.5 Million Available] – NYSERDA and NYPA will identify the best candidates for large, multi-building geothermal ground-source heat pump installations by providing free technical assistance and financial support. Open only to qualified colleges and universities, K-12 schools, State and local governments, and hospitals in New York State

NEW YORK CLEAN ENERGY COMMUNITIES PROGRAM

Local governments in New York State can use the Clean Energy Communities program to implement clean energy actions, save energy costs, create jobs, and improve the environment. In addition to providing tools, resources, and technical assistance, the program recognizes and rewards leadership for the completion of clean energy projects.

How it Works

Communities that complete four out of the 10 High Impact Actions and meet all other eligibility requirements are:

Designated by New York State as a Clean Energy Community

Eligible to apply for grants to fund additional clean energy projects

At no cost to the local government, Clean Energy Communities Coordinators are available to help local leaders to:

- Develop and prioritize clean energy goals
- Access guidance resources such as templates for legislation, procurement, and contracts
- Take advantage of available funding and technical assistance opportunities

There are 126 communities participating in the Mohawk Valley and the Southern Tier. All 8-counties of the Southern Tier 8 region have at least one community participating. There are 61 designated communities, meaning these communities have been designated a CEC or have completed at least 1 high-impact action under the CEC participating communities' program.

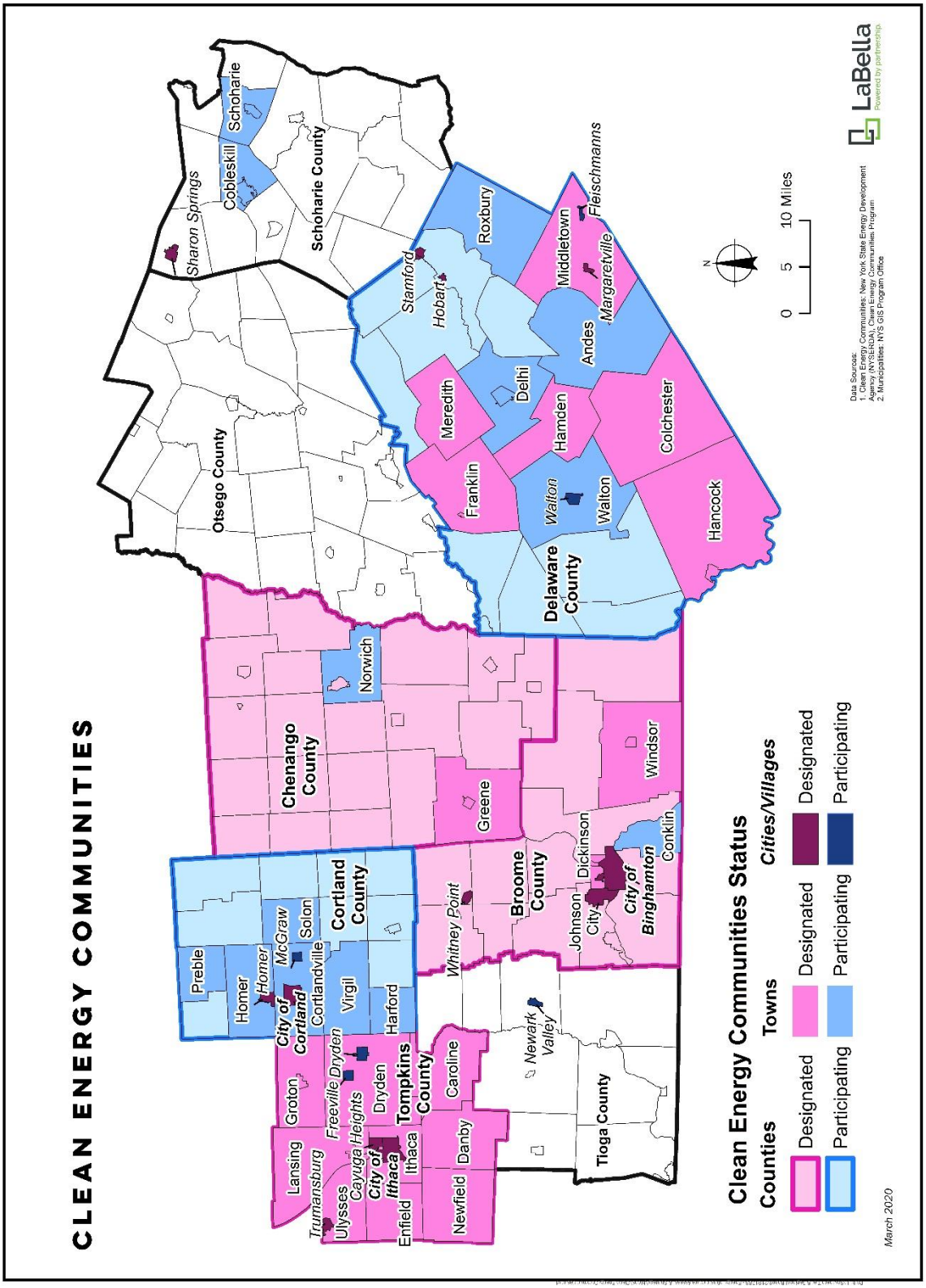
Table 18: Clean Energy Communities

County/Town/Village	County	Population (2010)	CEC Designation	Number of High Impact Actions Completed (X)	Benchmarking	Clean Energy Upgrades	Clean Fleets	Climate Smart Communities Certification	Energize NY Finance	Energy Code Enforcement Training	LED Lights	Solarize	Unified Solar Permit
Broome County	Broome	200,600	Designated CEC	4	X				X	X			X
City of Binghamton	Broome	47,376	Designated CEC	4			X			X	X		X
Town of Conklin	Broome	5,441	Participating	1						X			
Town of Dickinson	Broome	5,278	Designated CEC	5		X	X			X	X		X
Town of Windsor	Broome	6,274	Designated CEC	4	X				X	X			X
Village of Johnson City	Broome	15,174	Designated CEC	4	X			X	X			X	
Village of Whitney Point	Broome	23,893	Designated CEC	4	X			X	X		X		
County of Chenango	Chenango	50,477	Designated CEC	4	X					X		X	X
Town of Greene	Chenango	5,604	Designated CEC	4	X		X			X			X
Town of Norwich	Chenango	3,998	Participating	1	X								
Cortland County	Cortland	49,336	Participating	2	X								X
City of Cortland	Cortland	19,204	Designated CEC	5		X	X			X	X		X
Town of Cortlandville	Cortland	8,509	Participating	1						X			
Town of Harford	Cortland	943	Participating	1						X			
Village of McGraw	Cortland	1,053	Participating	1						X			
Town of Preble	Cortland	1,392	Designated CEC	1						X			
Town of Solon	Cortland	1,079	Participating	1						X			
Town of Homer	Cortland	6,405	Participating	1						X			
Village of Homer	Cortland	3,291	Designated CEC	4	X					X		X	X
Town of Virgil	Cortland	2,401	Participating	1						X			
County of Delaware	Delaware	47,980	Participating	2	X							X	

County/Town/Village	County	Population (2010)	CEC Designation	Number of High Impact Actions Completed (X)	Benchmarking	Clean Energy Upgrades	Clean Fleets	Climate Smart Communities Certification	Energize NY Finance	Energy Code Enforcement Training	LED Lights	Solarize	Unified Solar Permit
Town of Andes	Delaware	1,301	Participating	2	X								X
Town of Colchester	Delaware	2,077	Designated CEC	4	X		X			X			X
Town of Delhi	Delaware	5,117	Participating	2	X								X
Town of Hamden	Delaware	1,323	Designated CEC	5		X	X			X	X		X
Town of Hancock	Delaware	3,224	Designated CEC	4	X	X				X			X
Town of Franklin	Delaware	2,411	Designated CEC	4	X	X				X			X
Town of Meredith	Delaware	1,529	Designated CEC	4	X	X				X			X
Town of Middletown	Delaware	3,750	Designated CEC	4	X	X				X			X
Town of Roxbury	Delaware	2,502	Participating	1						X			
Town of Walton	Delaware	5,576	Participating	1						X			
Village of Homer	Delaware	441	Designated CEC	4	X		X			X			X
Village of Margaretville	Delaware	596	Designated CEC	4	X		X					X	X
Village of Stamford	Delaware	1,119	Designated CEC	4	X					X		X	X
Village of Fleischmans	Delaware	351	Participating	3	X					X			X
Village of Walton	Delaware	3,088	Participating	3	X					X			X
Otsego County	Otsego	62,259	Designated CEC	4	X		X			X			X
City of Oneonta	Otsego	13,901	Designated CEC	4	X		X			X			X
Town of Hartwick	Otsego	2,110	Participating	2	X							X	
Town of Oneonta	Otsego	5,229	Participating	2			X			X			
Village of Cherry Valley	Otsego	520	Designated CEC	4	X	X	X				X		
Village of Cooperstown	Otsego	1,852	Participating	1			X						
Town of Roseboom	Otsego	711	Designated CEC	4	X	X				X			X

County/Town/Village	County	Population (2010)	CEC Designation	Number of High Impact Actions Completed (X)	Benchmarking	Clean Energy Upgrades	Clean Fleets	Climate Smart Communities Certification	Energize NY Finance	Energy Code Enforcement Training	LED Lights	Solarize	Unified Solar Permit
Town of Cobleskill	Schoharie	6,625	Participating	1						X			
Town of Schoharie	Schoharie	3,205	Participating	2	X					X			
Village of Sharon Springs	Schoharie	558	Designated CEC	4	X	X				X			X
Village of Newark Valley	Tioga	997	Participating	1						X			
County of Tompkins	Tompkins	101,564	Designated CEC	4			X	X	X			X	
City of Ithaca	Tompkins	30,014	Designated CEC	5	X		X	X	X			X	
Town of Caroline	Tompkins	3,282	Designated CEC	6	X		X	X	X			X	X
Town Danby	Tompkins	3,329	Designated CEC	4	X					X		X	X
Town of Dryden	Tompkins	14,435	Designated CEC	5	X			X		X		X	X
Town of Enfield	Tompkins	3,512	Designated CEC	4	X					X		X	X
Town of Groton	Tompkins	5,950	Designated CEC	4	X	X				X		X	X
Town of Ithaca	Tompkins	19,930	Designated CEC	4	CX	X				X		X	X
Town of Lansing	Tompkins	11,033	Designated CEC	4	X	X				X		X	X
Town of Newfield	Tompkins	5,179	Designated CEC	4	X			X		X		X	X
Town of Ulysses	Tompkins	4,900	Designated CEC	6	X		X	X	X			X	X
Village of Cayuga	Tompkins	3,729	Designated CEC	4	X	X				X			X
Village of Dryden	Tompkins	14,435	Designated CEC	5	X			X		X		X	X
Village of Freeville	Tompkins	520	Participating	1						X			
Village of Trumansburg	Tompkins	1,797	Designated CEC	4	X	X				X			X

Map 9: Clean Energy Communities



NYSERDA ENERGY EFFICIENCY PROJECTS (2019)

Fourteen businesses in Tompkins County participated in NYSERDA's Commercial and Industrial (C&I) programs that offer businesses in New York State solutions to improve energy efficiency and save money through design, new construction, renovation, and process improvements to commercial and industrial buildings. This includes the Commercial New Construction Program that helps building owners make informed decisions about designing and renovating sustainable buildings, the FlexTech Program that offers energy-saving opportunities through consultation and cost-shared studies, and the Industrial and Process Efficiency Program that helps organizations increase manufacturing output and data processing.

REGIONAL PARTNERS

MUNICIPAL ELECTRIC & GAS ALLIANCE

Several local governments and school districts are members of the Municipal Electric and Gas Alliance (MEGA), an aggregator of electricity, natural gas and renewable power. By purchasing energy in bulk, MEGA is able to obtain lower energy costs for its members. In addition to energy procurement, MEGA products and services include community choice aggregation, renewable energy credits, curtailment services, feasibility analyses and delivery of compressed natural gas.[79]

TIER ENERGY NETWORK (TEN)

The Binghamton Regional Sustainability Coalition (BRSC) was developed as a 501 (c)(3) to improve the quality of life and achieve a sustainable community. The BRSC has a family of programs including the Tier Energy Network which is a regional network of industry, government and higher education organization with expertise and interest in energy conservation, energy efficiency and sustainability.

TIER Network Goals

- Support the development of a Southern Tier energy strategy consistent with NYS Reforming the Energy Vision (REV) and Clean Energy Standard goals and objectives.
- Promote smart energy technology and services in the Southern Tier.
- Improve the energy cost profile and sustainability of the Southern Tier.
- Promote workforce development and jobs in the Southern Tier.
- Make smart energy technology a core strength of the Southern Tier as measured by jobs created; research and development; venture capital per capita; greenhouse gas abatement; health; smart energy business growth and industry reputation.

[79] http://www.megaenergy.org/about/

SOUTHERN TIER CLEAN ENERGY INCUBATOR

Funded by NYSERDA, the Southern Tier Clean Energy Incubator program leverages research and development opportunities at Binghamton University and the Koffman incubator to provide mentoring, networking, training and technical support to clean energy companies.[80]

76WEST COMPETITION

Funded through NYSERDA, the 76West completion awards funding to new businesses that increase the supply of renewable energy, improve energy efficiency, or improve energy systems. The program awards one $1 million prize, one $500,000 prize, and four $250,000 awards to winning proposals. Within the Southern Tier 8 region, businesses within Broome, Chenango, Delaware, Tioga and Tompkins County are eligible.

SYRACUSE CENTER FOR EXCELLENCE

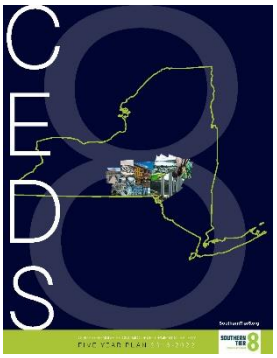
The Syracuse Center for Excellence supports research and entrepreneurship relating to energy and environmental sectors to the Central NY region, which includes Cortland County. The Thermal and Environmental Controls (TEC) initiative offers technical support, grants and networking for businesses in this industry cluster.

[80] Southern Tier Incubator website, accessed 8/13/19, https://southerntierincubator.com/sci/

REGIONAL ECONOMIC DEVELOPMENT STRATEGIES

SOUTHERN TIER REGIONAL BOARD COMPREHENSIVE ECONOMIC DEVELOPMENT STRATEGY, 2018-2022 (2018)

The Southern Tier 8 Regional Board developed a five-year economic development plan to guide and measure economic and community development progress in the Southern Tier 8 region. Plan recommendations will also be used to guide public investments as the Southern Tier 8 region has been designated as a federal Economic Development District.



Key Relevant Recommendations and Strategies

- Address infrastructure deficiencies across the eight counties including energy infrastructure
- Develop a strategy to respond and address businesses with infrastructure needs including increased communication, funding and partnerships.
- Update infrastructure needs and challenges across the region
- Develop a long-range energy infrastructure strategy including utilizing smart energy programs.

REGIONAL ECONOMIC DEVELOPMENT COUNCIL PLANS

Three Regional Economic Development Council (REDC) regions established by New York State guide economic development policy and investment in the 8-County Southern Tier 8 region:

Southern Tier REDC:	Broome, Chenango, Delaware, Tioga, and Tompkins Counties
Central New York REDC:	Cortland County
Mohawk Valley REDC:	Otsego and Schoharie Counties

Each REDC prepared a Strategic Plan in 2011 and the Southern Tier and Central New York REDC's also prepared an Upstate Revitalization Initiative Strategy. A summary of relevant recommendations for all the regions related to energy include:

REDC Goals and Strategies – Energy Infrastructure

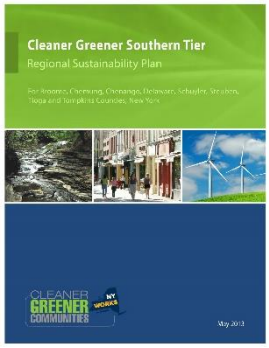
- Provide incentives for residential and commercial renewable energy and energy efficiency programs
- Initiate an Energy Workforce Development program
- Strengthen Clean Energy workforce and institutions
- Build upon the New York Energy Regional Innovation Cluster
- Support energy storage and harvesting
- Invest in renewable energy sources for agri-business

REGIONAL SUSTAINABILITY PLANS (2013)

NYSERDA coordinated the development of Regional "Cleaner Greener" plans for each of the Regional Economic Development Council (REDC) regions in New York. The overall goal of these plans was to reduce greenhouse gas emissions while simultaneously revitalizing the regional economies.

CLEANER GREENER SOUTHERN TIER (INCLUDES BROOME, CHENANGO, DELAWARE, TIOGA AND TOMPKINS COUNTIES)

The Cleaner Greener Southern Tier plan includes goals relating to energy and greenhouse gas emissions as well as an inventory of greenhouse gas emissions from buildings, transportation, waste and agriculture.



Key Recommendations

- Reduce building energy use and develop, produce, and deploy local renewable energy sources and advanced technologies across the Southern Tier.
- Significant opportunities to lower greenhouse gas emissions by replacing a portion of fossil fuels in the region with a variety of renewable energy resources (wind, solar, biomass)

CENTRAL NY REGIONAL SUSTAINABILITY PLAN (INCLUDES CORTLAND COUNTY)

Central New York's Regional Sustainability Plan focused on energy management, economic development and infrastructure, as well as land use, materials management, environment, and climate adaptation.

The key energy-related Goal is:

> Improve the region's energy management by increasing the efficiency of residential and commercial buildings, curtailing energy demand, increasing the use of local clean energy sources in place fossil fuels, and accelerating the development of advanced energy technologies.

of

Key Recommended Short-Term Initiatives

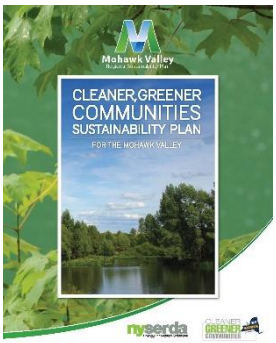
- Reduce energy consumption and improve energy efficiency in residential and commercial buildings.
- Promote the development of renewable energy resources.
- Increase access to private and public financing options for investments in energy efficiency and distributed generation.
- Prepare a Regional Energy Roadmap.

Key Recommended Long-Term Initiatives

- Facilitate the use of combined heat and power.
- Develop district energy systems.
- Develop neighborhood-scale "net zero" projects.
- Upgrade or replace power generation, transmission, distribution and storage systems to encourage the development of renewable energy resources and smart grid technologies including vehicle-to-grid.
- Foster local innovation including the development of clean energy businesses.
- Encourage the deployment of advanced energy technologies such as hydrogen fuel cells.

MOHAWK VALLEY SUSTAINABILITY PLAN (INCLUDES SCHOHARIE AND OTSEGO COUNTIES)

The Mohawk Valley Sustainability Plan focused on smart growth practices such as sustainable development and transportation. The greenhouse gas inventory was prepared for the region as a whole and did not include breakdown of energy use by county.



Key Recommendations

- Reduce consumption of electricity and heat generated by fossil fuels
- Increase energy efficiency
- Increase renewable local energy generation and use for electricity and heat to become more energy independent
- Evaluate life-cycle impacts of energy generation and use

COUNTY AND MUNICIPAL INITIATIVES IN BROOME COUNTY

Several counties and municipalities have prepared economic development strategies or plans that provide recommendations to attract and retain business investment. A summary and key relevant recommendations related to energy infrastructure are summarized in the following sections.

BROOME COUNTY CLIMATE SMART COMMUNITY DESIGNATION

Broome County demonstrated its commitment to sustainability by passing the Climate Smart Communities pledge in June 2019. As a result of completing required and priority actions, Broome County was designated a Bronze level Climate Smart Community and is eligible for grant funding through the NYS Department of Environmental Conservation.

BROOME COUNTY 2020 COMPREHENSIVE PLAN (2013)

Broome County's Comprehensive Plan noted that the cost of energy can be a deterrent for businesses coming to Broome County.

Key Recommendations

- Incentive programs which aim to help companies increase their energy efficiency and reduce utility costs include NYSERDA's
  - Industrial and Process Efficiency Program;
  - Existing Facilities Program; and
  - New Construction Program.

CITY OF BINGHAMTON ENERGY CLIMATE ACTION PLAN (2011)

The City of Binghamton intends to handle a changing environment and climate by conserving resources and responsibly handling energy use, waste management, and development of renewable energy technology.

Key Recommendation

- Promote the use of renewable energy rather than fossil fuels
- Reduce energy use, focusing on existing buildings and new construction

CITY OF BINGHAMTON GREENHOUSE GAS INVENTORY REPORT (2006)

The City of Binghamton's GHG Inventory Report found a strong correlation between greenhouse gas emissions and energy consumption levels in the City of Binghamton, with residential and commercial buildings accounting for about half of each.

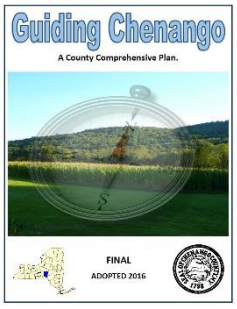
Key Recommendation

- Reduce the City's energy consumption in its facilities, which will also lower greenhouse gas emissions

COUNTY AND MUNICIPAL INITIATIVES IN CHENANGO COUNTY

CHENANGO COUNTY COMPREHENSIVE PLAN (2016)

The Chenango County Comprehensive Plan notes that Chenango County is located on an area containing natural gas bearing rock. However, a 2008 de-facto moratorium prevented future "high volume hydraulic fracturing" in several types of shale which are located within Chenango County. Under current regulations, hydraulic fracturing is still legal in other types of shale, which are located in the County and not effected by the above-references moratorium. Future hydraulic fracturing operations could have both positive and negative impacts on the County.

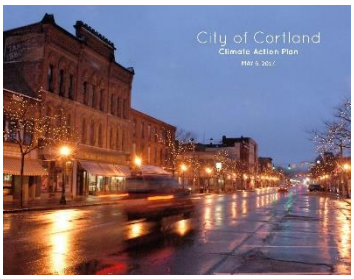


In addition to natural gas, the County also has identified renewable energy (biomass, wind, solar) as options, however notes that it will not meet all of the energy needs of the County.

COUNTY AND MUNICIPAL INITIATIVES IN CORTLAND COUNTY

CITY OF CORTLAND CLIMATE ACTION PLAN (2014)

Energy efficiency is a critical component of the Climate Action Plan. Recommendations focused on reducing fuel use in the transportation and building sectors.



Key Recommendations

- Increase use of alternative fuel options/ low-carbon transportation (hybrid vehicles, propane fueled buses)
- Increase energy efficiency and use of renewable energy (i.e., solar) and reduce greenhouse gas emissions associated with buildings

COUNTY AND MUNICIPAL INITIATIVES IN OTSEGO COUNTY

OTSEGO COUNTY COMMUNITY ENERGY PLAN (2019)

Otsego County, with funding from New York State Consolidated Funding Application and Otsego County, is preparing a Community Energy Plan to identify the economic challenges of an aging energy infrastructure,

provide solutions and actions to address the challenges, and consider renewable alternatives that are economically feasible and technically adaptable to their identified need. $50,000

Otsego County is recognized as a Clean Energy Community and received f$250,000 in funding from NYSERDA for a geo-thermal installation to their Tiny Homes Project and LED upgrades to county office buildings.

OTSEGO COUNTY PARTNERSHIP FOR A GREENER TOMORROW (2019)

Otsego County will facilitate a collaborative working group to complete greenhouse gas inventories with a subset of its municipalities. $27,159

Otsego County's Building Services is under contract with TRANE to complete an energy investment grade audit with options for energy conservation measures on ten County owned buildings. Report will include costs, savings and possible incentive payments. Project currently underway.

OTSEGO COUNTY STRATEGIC PLAN

One of the goals of Otsego County's Strategic Plan is:

"We will protect the environment and enhance public health by preserving air and water quality, minimizing energy use, and having a broad range of open space and recreational amenities to support the needs of our residents and employees".

COUNTY AND MUNICIPAL INITIATIVES IN SCHOHARIE COUNTY

SCHOHARIE COUNTY DEPARTMENT OF PUBLIC WORKS

The Schoharie County Department of Public Works, in cooperation with NYSERDA, evaluated County buildings and converted all exterior lighting to LED. This lighting is changed over to T4 as required.

SCHOHARIE COUNTY PUBLIC SAFETY FACILITY COMMUNITY SOLAR PROJECT

Schoharie County is working with several companies to investigate a community solar project on County property adjacent to the new Public Safety Facility in Howes Cave. It is anticipated that the project will power most County buildings and still provide the required allotment of power to residential users.

SCHOHARIE COUNTY ENERGY COMMITTEE

In 2020, a new County Energy Committee was formed to comprehensively work with all Towns and Villages on energy needs and commercial solar projects. The East Point Energy Center is a proposed 50-megawatt solar project to be located in the Town of Sharon. The 352-acre project has a complete Article 10 application and the project is expected to position Schoharie County as a leader in renewable energy and help New York meet its renewable energy goals.

COUNTY AND MUNICIPAL INITIATIVES IN TIOGA COUNTY

TIOGA COUNTY DEPARTMENT OF PUBLIC WORKS

The Tioga County Department of Public Works completed an energy audit on all Tioga County Buildings. The Department of Public Works (DPW) then implemented the recommended energy conservation measures.

Tioga County Department of Public Works looked extensively into developing solar energy, both as power purchasing agreements and subscriptions. It has chosen to enter into a contract with Renovus Solar, a developer based in Ithaca. The contract is now being finalized (February 2020.)

COUNTY AND MUNICIPAL INITIATIVES IN TOMPKINS COUNTY

Tompkins County has been very active in planning for energy and related economic development over the past 10 years. Relevant findings of these studies are summarized in this section.

TOMPKINS COUNTY ENERGY STRATEGY (2019)

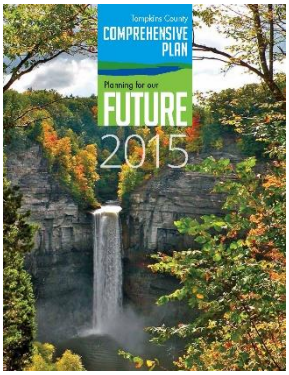
A significant update to the 2010 Strategy, the County Legislature adopted this Strategy that calls on Tompkins County government to lead by example and determine a financially sound path to net-zero emissions for its facilities and fleet in the shortest time possible. It also calls on the County to lead the community by supporting and facilitating community work to reduce fossil fuel dependency and reduce greenhouse gas emissions.

CITY OF ITHACA GREEN NEW DEAL ACTION PLAN (2019)

The Ithaca Green New Deal was adopted by the City of Ithaca to address climate change, economic inequality, and racial injustice. It has two goals: achieve carbon-neutrality community-wide by 2030 and ensure benefits are shared among all local communities to reduce historical social and economic inequities. The City has pledged to develop a road map to achieve these goals that will be informed by completing a greenhouse gas emissions inventory and fleet inventory for its government operations, as well as greenhouse gas inventory for the entire City. This information will be used to inform a Green New Deal Action Plan. Development of the Plan was awarded $100,000 in 2019.

TOMPKINS COUNTY COMPREHENSIVE PLAN (2019)

In 2019, Tompkins County updated its 2015 Comprehensive Plan and reinforced its commitment to its three overarching principles of sustainability, regional cooperation and fiscal responsibility. One of the sections of the report, Energy and Greenhouse Gas Emissions, continues its focus on the principle that "Tompkins County should be a place where the energy system meets community needs without contributing additional greenhouse gases to the atmosphere."



Key Relevant Recommendations and Policies

- Reduce greenhouse gas emissions by 80% of 2008 levels by 2050.
- Improve energy efficiency of energy systems.
- Increase the use of renewable energy and related technologies.

TOMPKINS COUNTY ECONOMIC DEVELOPMENT STRATEGY 2.0 (2019)

Tompkins County Area Development updated its 2015 Economic Development Strategy and reinforced its commitment to sustainable growth strategies for economic development, including strategically investing in community infrastructure – water, sewer, transportation, energy and broadband - to attract private investment that leverages existing infrastructure and promotes infill in identified development focus areas.

CORNELL UNIVERSITY ENERGY RECOVERY AND BUILDING CONTROLS PROJECT (2019)

Cornell University will work to recover and reuse waste heat in four research/lab facilities on campus, upgrade building controls system, and continue associated recommissioning for multiple campus facilities. In addition to reducing energy consumption and carbon emissions significantly, the new systems provide additional resiliency to buildings harboring sensitive research. This work was awarded $1,200,000 from NYSERDA in 2019.

ITHACA COLLEGE CARBON CHALLENGE PROJECT (2019)

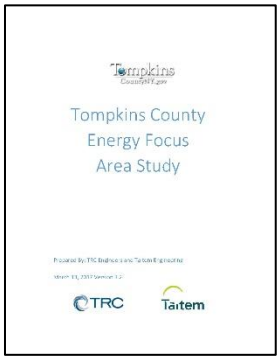
During the summer of 2019, Ithaca College's Senior Leadership Team formally launched a Strategic Planning Review Process that incorporates many potential sustainability elements, including an expedited carbon neutrality date. To that end, Ithaca College will install a new, on-site thermal plant utilizing ground source heat pumps to reduce carbon emissions and to facilitate future transitions from natural gas to heat pump systems. This work received $500,000 in funding in 2019.

OPTIONS FOR ACHIEVING A CARBON NEUTRAL CAMPUS BY 2035 (2016)

Produced by the Cornell University Senior Leaders Climate Action Working Group, this report analyzes viable energy alternatives for the Ithaca campus to achieve carbon neutrality by 2035. Strategies identified include investing immediately in reducing energy demand through conservation, evaluate Earth Source Heat and ground source heat pumps as heating solutions, and striving for 100 percent of the campus electric supply to come from renewable sources.

TOMPKINS COUNTY ENERGY FOCUS AREA STUDY (2017)

Tompkins County and the Tompkins County IDA engaged Taitem Engineering to evaluate existing energy infrastructure in four existing or emerging development areas in the County. The focus of the evaluation was electrical and natural gas infrastructure primarily in the Ithaca area including Downtown Ithaca, South Hill, East Hill, and along Warren Road near the Ithaca-Tompkins County Airport.



Key Findings

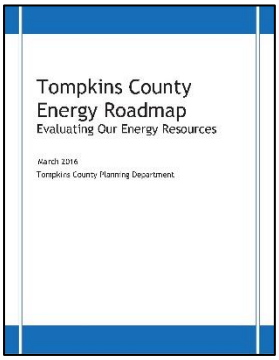
- Electric infrastructure is sufficient to support increases in electricity usage
- Natural gas infrastructure limits growth potential in the Airport area
- Converting residences near Warren Road to electric thermal energy could potentially free up gas for industrial development in the Warren Road/ Airport area.

TOMPKINS COUNTY ENERGY ROADMAP (2016)

The 2016 Energy Roadmap outlined how Tompkins County could reach an 80% greenhouse gas emission reduction goal by 2050. It evaluated whether achieving that goal is possible primarily using local renewables and demand reduction and identifies local actions that can be taken in the short and long term to achieve that goal. The Roadmap presents three scenarios that utilize local potentials to reduce greenhouse gas emissions, meet the County's projected energy needs in 2050, and achieve the goal of 80% emissions reduction. The Roadmap identified strategies to reduce energy use & greenhouse gas emissions.

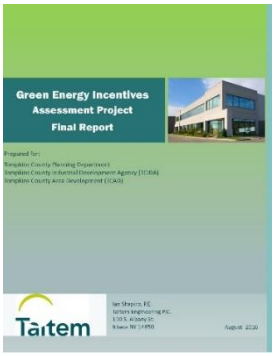
Key Strategies

- Develop local renewable energy resources (combination of solar, wind, and micro-hydro energy)
- Develop deployment and thermal energy sources (biomass, ground and air source heat pumps)
- Transition to electric vehicles to reduce emissions



TOMPKINS COUNTY GREEN ENERGY INCENTIVES ASSESSMENT PROJECT (2016)

The Tompkins County Planning Department and Tompkins County Area Development supported a project to evaluate potential incentives for developers to build more energy efficient buildings in the County. Based on interviews with developers, an analysis of existing state and local incentives and an evaluation of potential savings to improve developers' returns on their capital investments, the consultants developed a potential incentives including the following strategies.

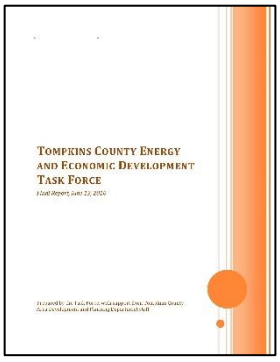


Key Relevant Recommendations and Policies

- Accelerate the 7 and 10 year IDA abatement schedules to provide higher abatements in the initial years to incent energy efficiency.
- To receive the abatements developments would need to achieve the following minimum program requirement:
  - Achieve a minimum 10 percent reduction in energy use than the current energy code
  - Participate in NYSERDA's new construction program to document the 10 percent reduction or in another methodology.
- To received enhanced abatements developments would need to achieve the following:
  - A minimum 40% reduction
  - Participate in NYSERDA Multi-family construction program or achieve LEED 4.0 certification.

TOMPKINS COUNTY ENERGY AND ECONOMIC DEVELOPMENT TASK FORCE FINAL REPORT (2016)

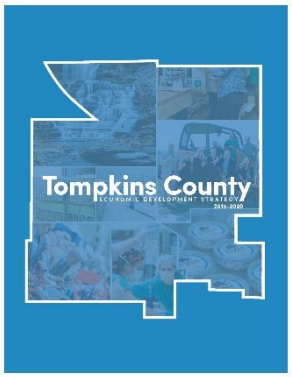
Spurred by a proposed natural gas distribution pipeline along West Dryden Road, Tompkins County convened a Task Force to address public concerns and recommend actions to advance the County's goals to reduce greenhouse gas emissions and support economic development.



Key Recommendations

- Work with the Public Service Commission and NYSEG to reduce dependence on natural gas, while supporting the ongoing Energy Smart Community collaboration with NYSEG to support increased dependence on distributed energy resources.
- Provide secure and reliable energy to support local industrial processes.
- Reduce fossil fuel energy use in commercial and industrial buildings.
- Develop the energy infrastructure needed to support and energy system that primarily relies on renewable energy resources.
- Reduce fossil fuel use in transportation.
- Develop housing in ways that limit energy use both in buildings and transportation.
- Educate decision makers, contractors, developers, and the public at large on critical facets of energy and economic development

TOMPKINS COUNTY ECONOMIC DEVELOPMENT STRATEGY (2015)



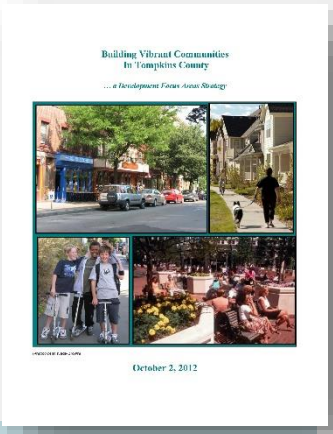
The Tompkins County Area Development (TCAD) organization prepared an Economic Development Strategy in 2015 for future development in the County. It provides sustainable growth strategies for economic development. Although the plan is reaching the end of its horizon, many of the strategies and policies will continue to be relevant for energy infrastructure and were recently revisited by the Tompkins County Energy and Economic Development Task Force.

Key Relevant Recommendations and Policies

- Strategically invest in community infrastructure and district development to attract private investment in Target development to Development Focus Areas
- Achieve progress toward the County's housing and economic development goals in a manner compatible with the County's goal of reducing greenhouse gas emissions at least 80% by 2050:
    - Proactively plan for changes in energy demand and provision of stable energy infrastructure.
    - Improve the energy performance of buildings and foster innovations to the energy production, transmission and distribution systems.
    - Developing energy-specific planning and economic development tools to support efforts energy transition away from fossil fuels.
    - Encourage and support business opportunities related to the energy transition and guided by the County's Energy Road Map.

BUILDING VIBRANT COMMUNITIES IN TOMPKINS COUNTY (2012)

To further the goals identified in the 2004 Tompkins County Comprehensive Plan to locate housing near jobs and businesses, work was done to identify 16 Development Focus Areas where new development should be encouraged. This strategy also identifies types of preferred development and actions to discourage sprawl while encouraging compact, mixed use centers. The plan is relevant and important to energy infrastructure because it identifies *where* development priorities are in the County. Knowing where development should happen provides a framework to energy providers on where they should focus energy investments.



Key Relevant Recommendations and Policies

- A denser development pattern enables:
  - Development of alternative energy systems including combined heat and power systems;
  - Reduced distances for energy infrastructure investments;
  - Reinvestment in existing energy infrastructure instead of extending new infrastructure;
  - Economies of scale for energy providers; and
  - Improves resiliency by creating opportunities for shared energy infrastructure.
- Four types of development areas were established with decreasing densities and types of uses encouraged but all were compact mixed use centers where there was existing infrastructure and development:
  - Urban Center: Ithaca
  - Established Nodes: Dryden, Groton, Newfield, Trumansburg and Varna
  - Emerging Nodes: NYSEG office center in the Town of Dryden, and South Lansing
  - Rural Centers: Brooktondale, Danby, Enfield, Etna, Freeville, Jacksonville, McLean and Slaterville Springs.

In addition to the initiatives summarized below, Tompkins County has advanced the following energy-related projects between 2016 and 2018.

2018

1. **Climate Smart Communities Silver (DEC)**: Originally the 12th "certified" community in 2017, the County achieved more points and became the 4th silver certified community in the State (highest level possible at that time). The program recognizes demonstrated accomplishments in the reduction of greenhouse gas emissions and changing climate adaptation.
2. **Business Energy Advisors Program**: TCDPS launched the program in August 2018 with funding from a NYSERDA Clean Energy Community grant, TCAD and the County to hire a staff Energy Specialist and consultants to work with business owners/facility managers to set energy goals and understand energy options. Program provides advice on incentives and financing, presents options to save energy and operational costs, and serves as an objective resource for projects.
3. **Wind study:** TCDPS completed Small to Medium Scale Wind Feasibility Report, which concluded that with current electricity prices wind turbine installation at three sample sites does not make economic sense.

2017

1. **Clean Energy Community:** NYSERDA announced Tompkins County as the first county in the Southern Tier to be designated a Clean Energy Community, which led to a $250,000 NYSERDA grant award accepted in early 2018.
2. **Municipal Tools to Promote Deployment of Renewable Energy Systems:** TCDPS worked with municipalities to develop and share tools to encourage widespread deployment of renewable energy systems.

2016

1. **Hydro power:** Legislature authorized a 20-year hydroelectric utility remote net metering agreement, between Tompkins County and Gravity Renewables, Inc., which is expected to produce electricity to meet roughly two-thirds of county government electricity needs through clean, local, and renewable generation (in 2017 it covered ~80% of County government electricity due to wet weather).
2. **GHG emissions inventory:** Planning Department completed detailed GHG emissions and energy use inventories for both the community and County government using 2014 data, which went beyond traditional GHG accounting methods to show results of the latest climate science on methane emissions.
3. **Community Microgrid for Critical Facilities, NY Prize:**
4. **Non-pipe Alternative Development:** County, Public Service Commission, NYSEG, and other partners began meeting to find alternatives to a natural gas pipeline expansion.
5. **HeatSmart Tompkins:** TCPD advised and assisted the Solar Tompkins Board of Directors in launching HeatSmart II and served as fiscal agent for this second round of a county-wide energy efficiency and heat pumps program.
6. **Ithaca 2030 District**: Launched with Tompkins County joining as a founding member in this effort to reduce energy demand, transportation emissions, and water use in downtown commercial buildings, including County government facilities.
7. **Residential Energy Score Project**: A consortium of five municipalities in partnership with Tompkins County and Cornell Cooperative Extension completed the final report evaluating building envelope rating methods and considering how best to create value for energy efficiency in the local housing market. Funded by a NYSERDA Cleaner Greener Communities grant, all five municipalities endorsed the report and program.

APPENDIX A
GLOSSARY OF TERMS

SOURCES:

- New York Energy Development Authority (NYSERDA), Patterns & Trends, https://www.nyserda.ny.gov/About/Publications/EA-Reports-and-Studies/Patterns-and-Trends
- United States Energy Information Agency, https://www.eia.gov/tools/glossary
- Southern Tier 8 Regional Board

Anaerobic Digesters: A range of anaerobic digestion technologies are converting livestock manure, municipal wastewater solids, food waste, high strength industrial wastewater and residuals, fats, oils and grease (FOG), and various other organic waste streams into biogas, 24 hours a day, 7 days a week. Separated digested solids can be composted, utilized for dairy bedding, directly applied to cropland or converted into other products. Nutrients in the liquid stream are used in agriculture as fertilizer.

Barrel (bbl) – Liquid unit of volume measure equal to 42 U.S. gallons, commonly used in expressing quantities of petroleum or petroleum products.

Biofuels – Liquids derived from non-fossil biomass energy sources through chemical, thermal, and biological processes and used to produce thermal energy or electricity. Examples are fuel wood, waste wood, garbage, and crop waste. Different mixes of biofuels are used by each consuming sector. The residential sector burns wood for space heating. The transportation sector uses ethanol as an additive to motor gasoline and biodiesel blended with diesel fuel. Some electric generation uses wood or municipal waste as co-firing or primary fuels.

Biomass Digesters: A biogas digester (also known as a biogas plant) is a large tank where inside Biogas is produced through the decomposition/breakdown of organic matter through a process called anaerobic digestion. It's called a digester because organic material is eaten and digested by bacteria to produce biogas.

British thermal unit (Btu) – The quantity of heat necessary to raise the temperature of one pound of water one-degree Fahrenheit. Because different energy types use different standards of measurement, this unit provides a common denominator for quantifying all types of energy on an equivalent energy content basis. One Btu is equal to 252 calories of heat energy.

Btu Method: A method of allocating costs between different operations or between different products based upon the heat content of products produced in the various operations or of the various produced products.

Btu per Cubic Foot: A measure of the heat available or released when one cubic foot of gas is burned.

Capacity, Peaking: The capacity of facilities or equipment normally used to supply incremental gas under extreme demand conditions; generally available for a limited number of days at maximum rate.

Core Customers: Residential and small commercial customers who must rely on the traditional distributor bundled service of sales and transportation.

Cogeneration: Cogeneration or combined heat and power (CHP) is the use of a heat engine or power station to generate electricity and useful heat at the same time.

Commercial sector – The part of the energy-using sector of the economy that engages primarily in providing goods and services other than manufacturing. The commercial sector includes both private and public entities, and is made up of apartment and office buildings, governmental units, schools, institutions, churches, hotels, restaurants, and retail stores are included.

Conversion Unit: A unit consisting of a burner together with associated thermostat and safety controls, which can be used to convert heating equipment from one fuel to another.

Cord of wood – A cord of wood measures 4-feet by 4-feet by 8-feet, or 128 cubic feet.

Degree-days, cooling – A measure of temperature as it affects energy demand for space cooling. It is similar to heating degree-days, although the relationship is not as precise. If the average of a day's high and low temperature extremes is below 65°F, then the cooling degree-days for that day are zero; otherwise, they are equal to the difference between the average and 65°F.

Degree-days, heating – A measure of temperature as it affects energy demand for space heating. It is based on the fact that most buildings require no heat to maintain an inside temperature of at least 70°F when the daily mean is 65°F or higher. If the average of a day's high and low temperature extremes is more than 65°F, the heating degree-days for that day are taken to be zero; otherwise, they are equal to the difference between the average and 65°F. Note that a higher number of heating degree-days implies cooler temperatures.

Distillate fuel – A general classification for one of the petroleum fractions produced in conventional distillation operations. It includes diesel fuels and fuel oils. Products known as No. 1, No. 2, and No. 4 diesel fuel are used in on-highway diesel engines, such as those in trucks and automobiles, as well as off-highway engines, such as those in railroad locomotives and agricultural machinery. Products known as No. 1, No. 2, and No. 4 fuel oils are used primarily for space heating and electric power generation.

Distribution: refers to the lower voltage electric lines that deliver electricity to the end user. **Generation:** The process of producing electric energy by transforming other forms of energy; also, the amount of electric energy produced, expressed in kilowatthours.

End-use – Any ultimate consumption of any type of energy source including fossil fuels (petroleum, coal, natural gas) or electricity, whether generated by fossil fuel or other energy sources. End-users are often classified by economic sector, such as residential, commercial, industrial, and transportation.

Gallon (gal) – A unit of volume, the U.S. gallon contains 3.785 liters and is 0.083 times the imperial gallon. Also equal to 4 quarts (231 cubic inches), commonly used to measure petroleum products such as gasoline and heating oil. One U.S. gallon of water weighs 8.3 pounds.

GHG: Green House Gas

Generation company: An entity that owns or operates generating plants. The generation company may own the generation plants or interact with the short-term market on behalf of plant owners.

Generator capacity: The maximum output, commonly expressed in megawatts (MW), that generating equipment can supply to system load, adjusted for ambient conditions.

Generator nameplate capacity (installed): The maximum rated output of a generator, prime mover, or other electric power production equipment under specific conditions designated by the manufacturer. Installed generator nameplate capacity is commonly expressed in megawatts (MW) and is usually indicated on a nameplate physically attached to the generator.

Geothermal energy – Thermal energy generated and stored in the Earth. Water or steam extracted from geothermal reservoirs can be used for geothermal heat pumps, water heating, or electricity generation.

Gigawatt: a unit of electric power equal to one billion (109) watts.

Gigawatt-hour (GWh) – One million kilowatt-hours, or one billion watt-hours. Unit of measure for amount of electricity generated or used.

Hydro – A prefix used to identify a type of generating station, power, or energy output in which the prime energy source is water.

Industrial Sector – That section of the energy-using economy involved in or associated with either mining, construction, or manufacturing.

Kerosene – A petroleum middle distillate with burning properties suitable for use as an illuminant when burned in wick lamps. Kerosene also is used in space heaters, cooking stoves, and water heaters and to reduce viscosity of distillate fuels during winter.

Kilowatt (kW) – One thousand watts. A unit of power usually used for electricity.

Kilowatt-hour (kWh) – The amount of electrical energy involved with a one-kilowatt demand over a period of one hour. One kilowatt-hour is equivalent to 3,412 Btu.

Liquefied petroleum gas (LPG) – Propane, propylene, butane and propane-butane mixtures produced at a refinery or natural gas-processing plant, including plants that fractionate raw natural gas-processing plant liquids. These are derived by refining and processing natural gas, crude oil, or unfinished oil.

Mcf – One thousand cubic feet. Measure of volume commonly used for natural gas.

Megawatt (MW) – One thousand kilowatts or one million watts.

Megawatt hour (MWh) – One thousand kilowatt-hours, or one million watt-hours.

Metric Ton – A unit of weight equal to approximately 2,204 pounds.

New York Public Service Commission (PSC): Government agency, regulates the electric and gas industries in New York State to ensure access to safe, reliable utility service at just and reasonable rates. Its responsibilities include determining the rates utilities may charge customers for electricity and natural gas

MMBtu: One Million British Thermal Unit

DeRuyter Line: NYSEG System natural gas pipeline between Deruyter and Oneonta.

mCf: The quantity of natural gas occupying a volume of one thousand cubic feet at a temperature of sixty degrees Fahrenheit and at a pressure of fourteen and seventy-three hundredths pounds per square inch absolute.

Efficiency: Relating to heat, a percentage indicating the available Btu input to combustion equipment that is converted to useful purposes.

Electric Energy: Available heat in electricity; one kilowatt hour equals 3,412.97 Btu.

Electric Heating Pump and Air-Conditioning Efficiency: Energy Efficiency Ratio (EER) : a ratio calculated by dividing the cooling capacity in Btu per hour by the power input in watts at any given set of rating conditions. Heating Seasonal Performance Factor (HSPF) - the total heating output of a heat pump during its normal annual usage period for heating divided by the total electric power input in watt-hours during the same period. Seasonal Energy Efficiency Ratio (SEER) - the total cooling capacity of a central unitary air conditioner or unitary heat pump in Btu's during its normal annual usage period for cooling divided by the total electric energy input in watt-hours during the same period.

Fracking: the process of injecting liquid at high pressure into subterranean rocks, boreholes, etc., so as to force open existing fissures and extract oil or gas.

Natural gas – An odorless, colorless, tasteless, non-toxic clean-burning fossil fuel, widely used to generate electricity and used directly by end-use customers to provide space heat, water heating, and cooking.

Net Energy Consumption – The energy consumed at the end-use location (e.g., building or vehicle), including electricity as well as the fuels burned to provide space heat, water heat, etc. “Net” energy accounts for electricity based on the heat content of energy at the plug (3,412 Btu per kWh), and excludes the heat losses incurred during generation, transmission, and distribution of electricity. Adding the heat losses associated with electricity use to “net” energy results in “primary” energy.

Petroleum – A general term applied to oil and oil products in all forms, such as crude oil, lease condensate, unfinished oil, and refined non-hydrocarbon compounds blended into finished petroleum products such as gasoline, diesel fuel, jet fuel, and heating oil.

Primary Energy Consumption – The total consumption of fuels, including the fuels used to generate electricity. “Primary” energy accounts for electricity based on the equivalent heat content of fuel at the generator. Subtracting the heat losses associated with electricity generation, transmission, and distribution from “primary” energy results in “net” energy.

Propane – A colorless, highly volatile hydrocarbon that is readily recovered as a liquefied gas at natural gas-processing plants and refineries. It is used primarily for residential and commercial heating and cooling, and as a fuel for transportation and industrial uses, including petrochemical feedstocks. Propane is the first product refined from crude petroleum. Propane is often used at customer locations where natural gas is not available, as it can be easily transported by truck and stored at the customer site.

Residential sector – The part of the economy having to do with the places people stay or live. The residential sector is made up of homes, apartments, condominiums, etc. including private households. Specifically included are the following end-uses: space heating and cooling, water heating, cooking, lighting, clothes drying, and refrigeration.

Residual fuel – The heavier oils that remain after the distillate fuel oils and lighter hydrocarbons are boiled off in refinery operations. Included are products known as No. 5 and 6 fuel oil, heavy diesel oil, Navy Special Fuel Oil, Bunker C oil and acid sludge and pitch used as refinery fuels. Residual fuel oil is used for production of electric power, space heating, vessel bunkering, and various industrial purposes.

Solar electric – A technology that directly converts light energy radiated by the sun as electromagnetic waves (electromagnetic radiation) into electricity by means of solar electric (also known as photovoltaic or PV) panels or concentrating (focusing) collectors.

Solar thermal – A technology that collects heat energy from the sun to heat water. Solar thermal energy is used for space heating; domestic hot water heating; and heating swimming pools, hot tubs, or spas.

Substation: A set of equipment reducing the high voltage of electrical power transmission to that suitable for supply to consumers.

Therm – 100,000 Btu.

Transmission line: A set of conductors, insulators, supporting structures, and associated equipment used to move large quantities of power at high voltage, usually over long distances between a generating or receiving point and major substations or delivery points.

Transmission line (electric): A system of structures, wires, insulators and associated hardware that carry electric energy from one point to another in an electric power system. Lines are operated at relatively high voltages varying from 69 kV up to 765 kV, and are capable of transmitting large quantities of electricity over long distances.

Watt (W) – The unit of measure for electric power or rate of doing work. The rate of energy transfer equivalent to one ampere flowing under a pressure of one volt at unity power factor. It is analogous to horsepower or foot-pounds per minute of mechanical power. One horsepower is equivalent to approximately 746 watts.

Watt-hour (Wh) – An electrical energy unit of measure equal to one watt of power supplied to, or taken from, an electrical circuit operating continuously for one hour.

Fueling Costs Based on Residential Numbers

Fuel	Unit	$/Unit	BTU's/Unit	Efficiency	$/100MBTU
Cord Wood	Full Cord	$200.00	24,000,000	82%	$1,016
Natural Gas	Mcf	$11.26	1,031,000	85%	$1,285
Wood Pellets	Ton	$265.00	16,500,000	75%	$2,141
Fuel Oil	Gallon	$3.02	138,690	85%	$2,562
Propane	Gallon	$2.67	91,333	85%	$3,439

Assumptions for Residential Heating Numbers (per Heat Smart Otsego)

-Fuel Switching Cost $2.1 Million over 5 Years of $420,000/year

-Upcharge for Fuel Oil is $4.1Million total or $283,254/year

-Total Gas Used is 630,631 total or 126,126/year

-Equivalent NG is 87,658 dth or 17,532/year

-IF average envelope improvement job costs $6544 and saves 200 therms/year (20%), then; 877 envelope upgrades would be needed to offset the gas equivalent of fuel oil consumed. Net cost for 877 upgrades is $5,736, 317 and would bring in $2,055, 572 in state incentives. *

*These numbers based on NYSERDA Heat alternative incentive program

APPENDIX B: DISTRIBUTED INTERCONNECTION GUIDE MAPS: NYSEG AND NATIONAL GRID

The maps included in this report were accessed in October 2019.

Currently available maps are available to the public through the following links:

National Grid: **https://ngrid.portal.esri.com/SystemDataPortal/NY/index.html**

NYSEG:

https://www.arcgis.com/apps/webappviewer/index.html?id=84de299296d649808f5a149e16f2d87c

Distributed Interconnection Guide Maps

National Grid New York - System Information Portal

National Grid has created a collection of maps to help customers, contractors and developers identify potential project sites. Each map provides the location and specific information for selected electric distribution lines and associated substations within the National Grid NY electric service area. National Grid's electric system is dynamic. System configurations can change for a variety of reasons both planned and unplanned. National Grid will update the contents on a periodic basis so be aware that the same location may show different information over time.

Please note that the portal and maps are not a guarantee that generators can interconnect at any particular time and place. A number of factors drive the ability and cost of interconnecting distributed generation to the electric system and actual interconnection requirements and costs will be determined following detailed studies. These studies will consider your specific project location, operating characteristics and timing. Additionally, environmental and other required permits are independent of our interconnection process and may limit the suitability of a particular site.

Detailed information on this process can be found at: (nCAP) Customer Application Portal.

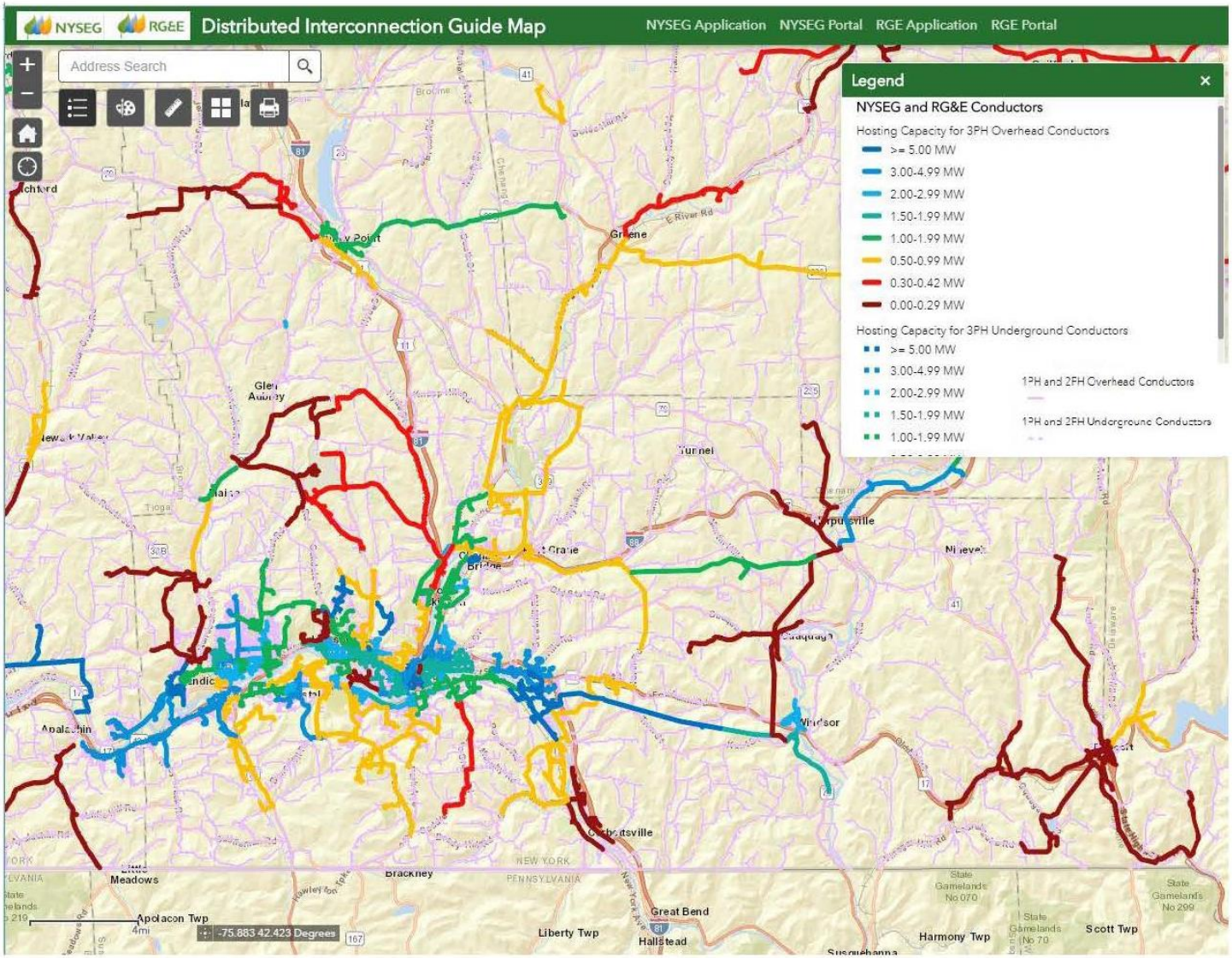
Hosting Capacity Disclaimer:

Thank you for visiting NYSEG & RGE's hosting capacity portal. The interactive hosting capacity maps in this portal were developed to provide insight into the location-specific ease of solar PV integration. The analysis reflects the available sub-feeder level hosting capacity for solar PV interconnections larger than 300kW. A full list of assumptions and considerations for the analysis can be found using the link included below:

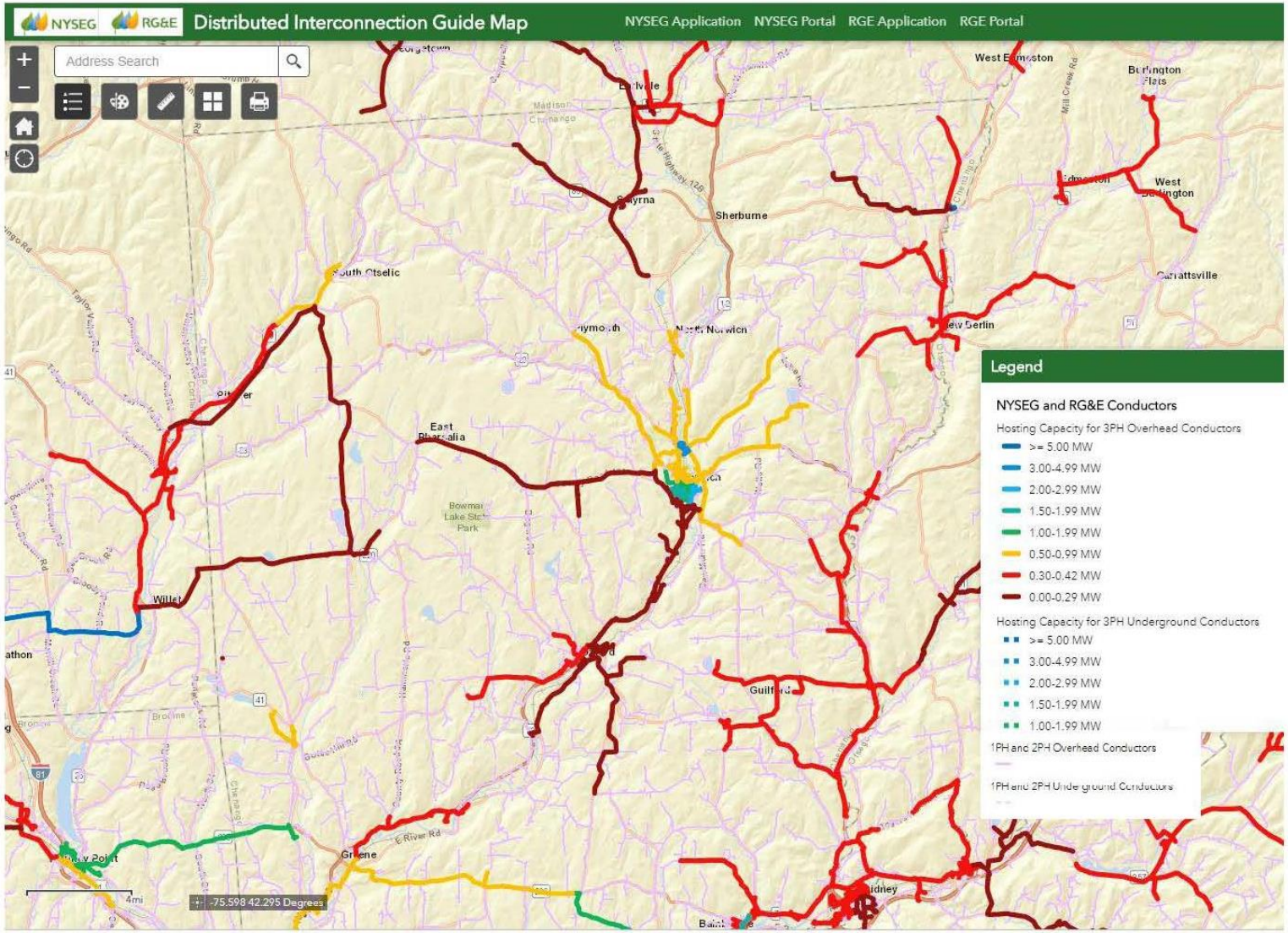
Hosting Capacity Analysis Methodology and Assumptions

***Hosting capacity data as of 10/1/2019. Interconnection queue data is updated on a monthly basis.**

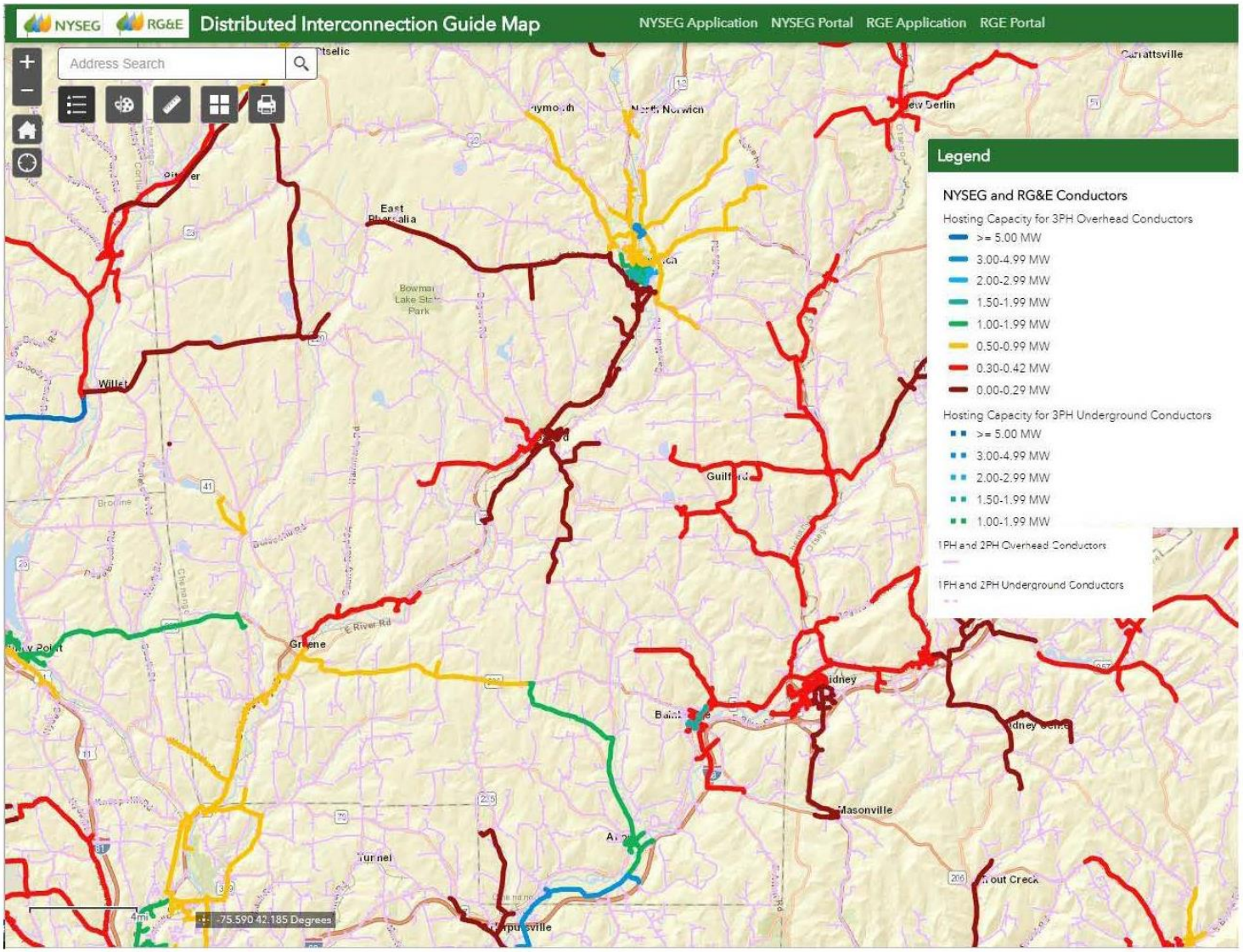
Broome County - NYSEG



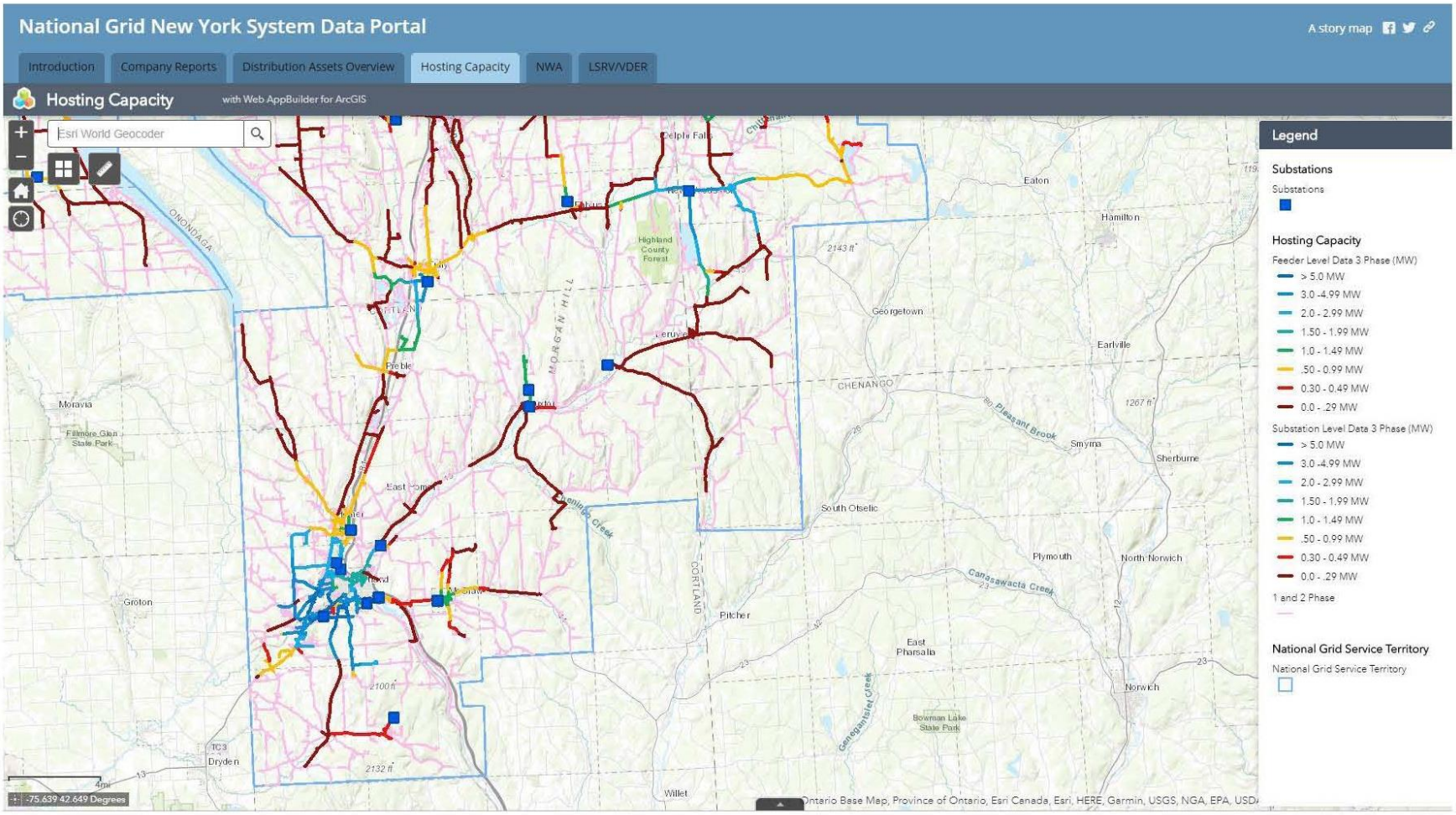
Chenango (north) - NYSEG



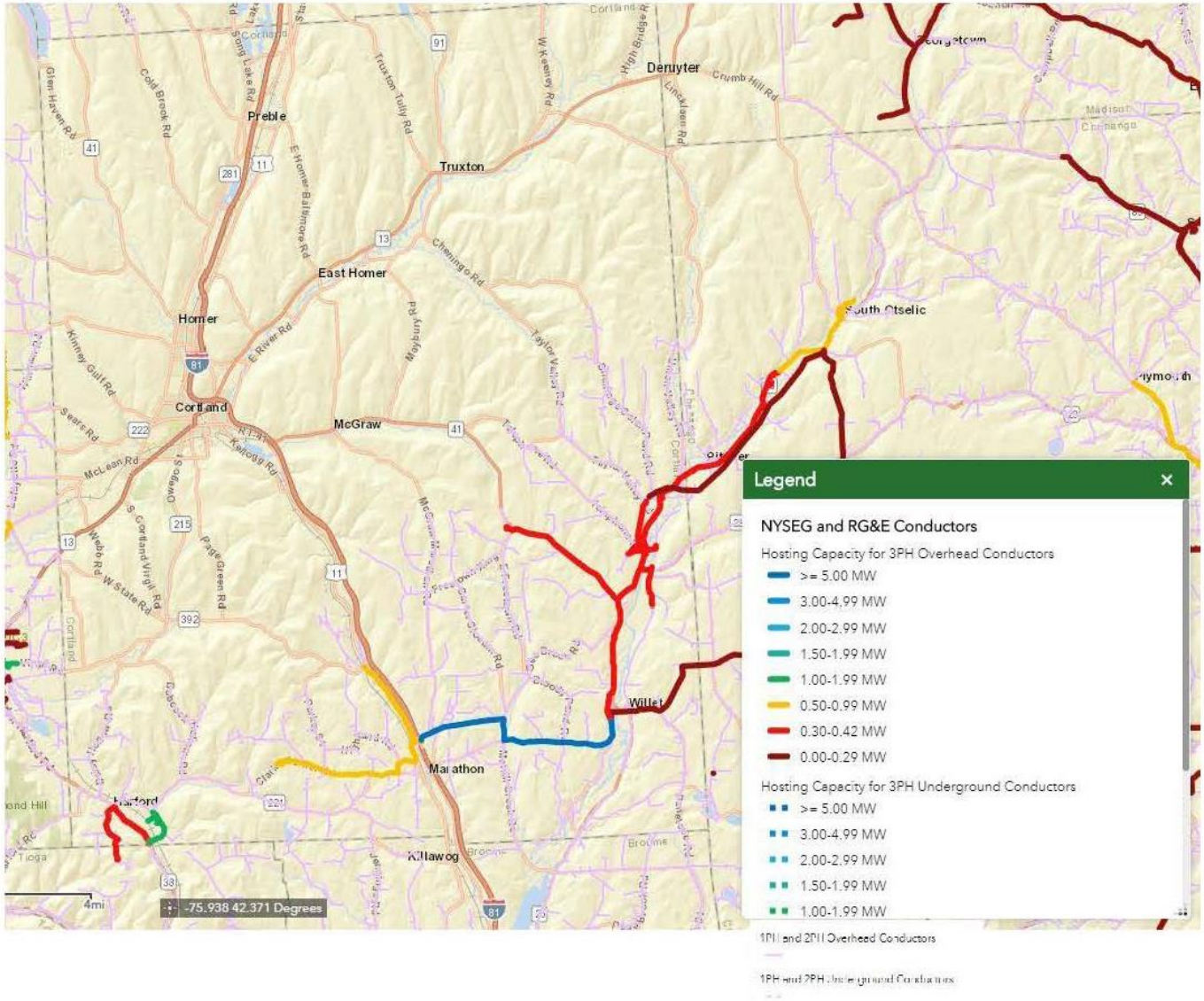
Chenango (south) – NYSEG



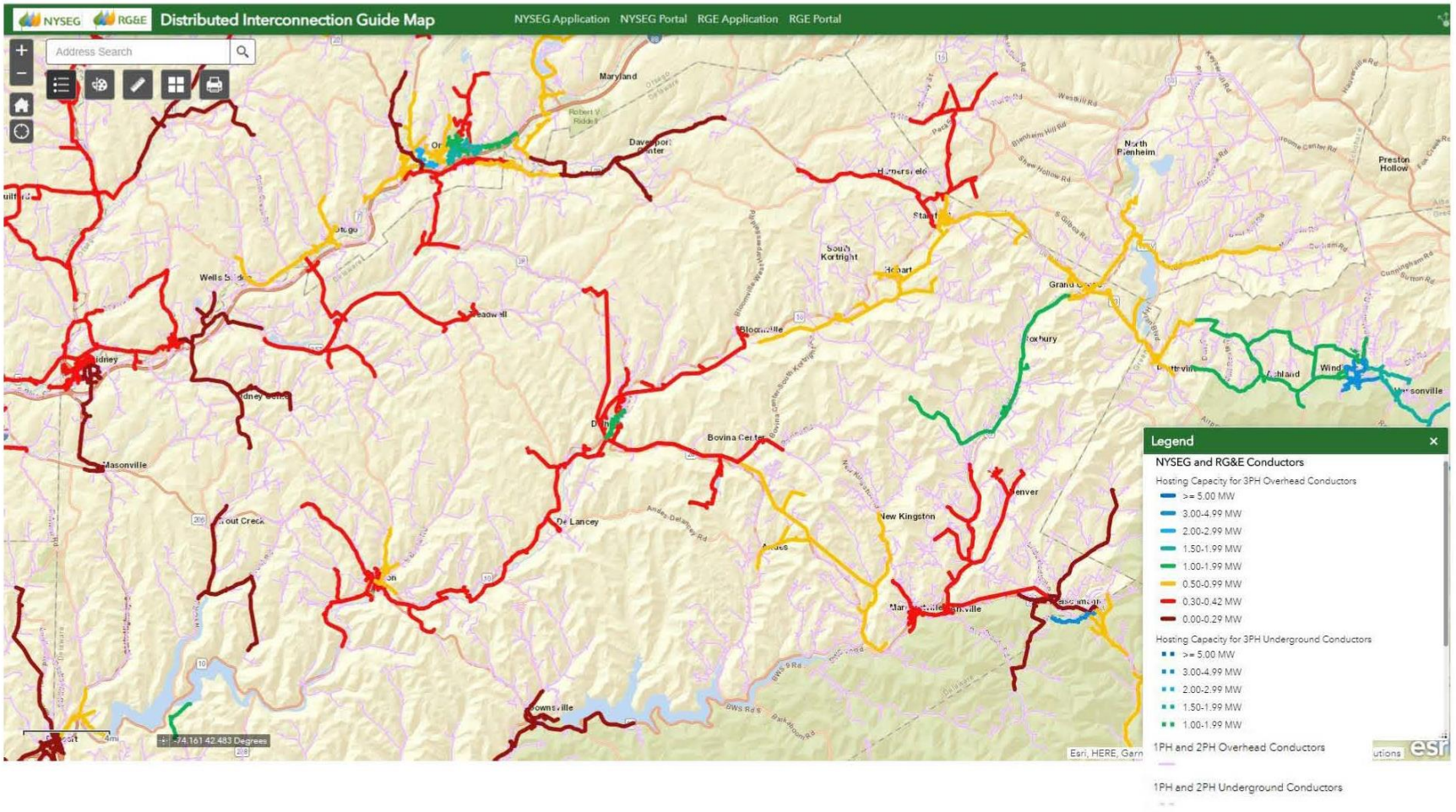
Cortland (north) – National Grid



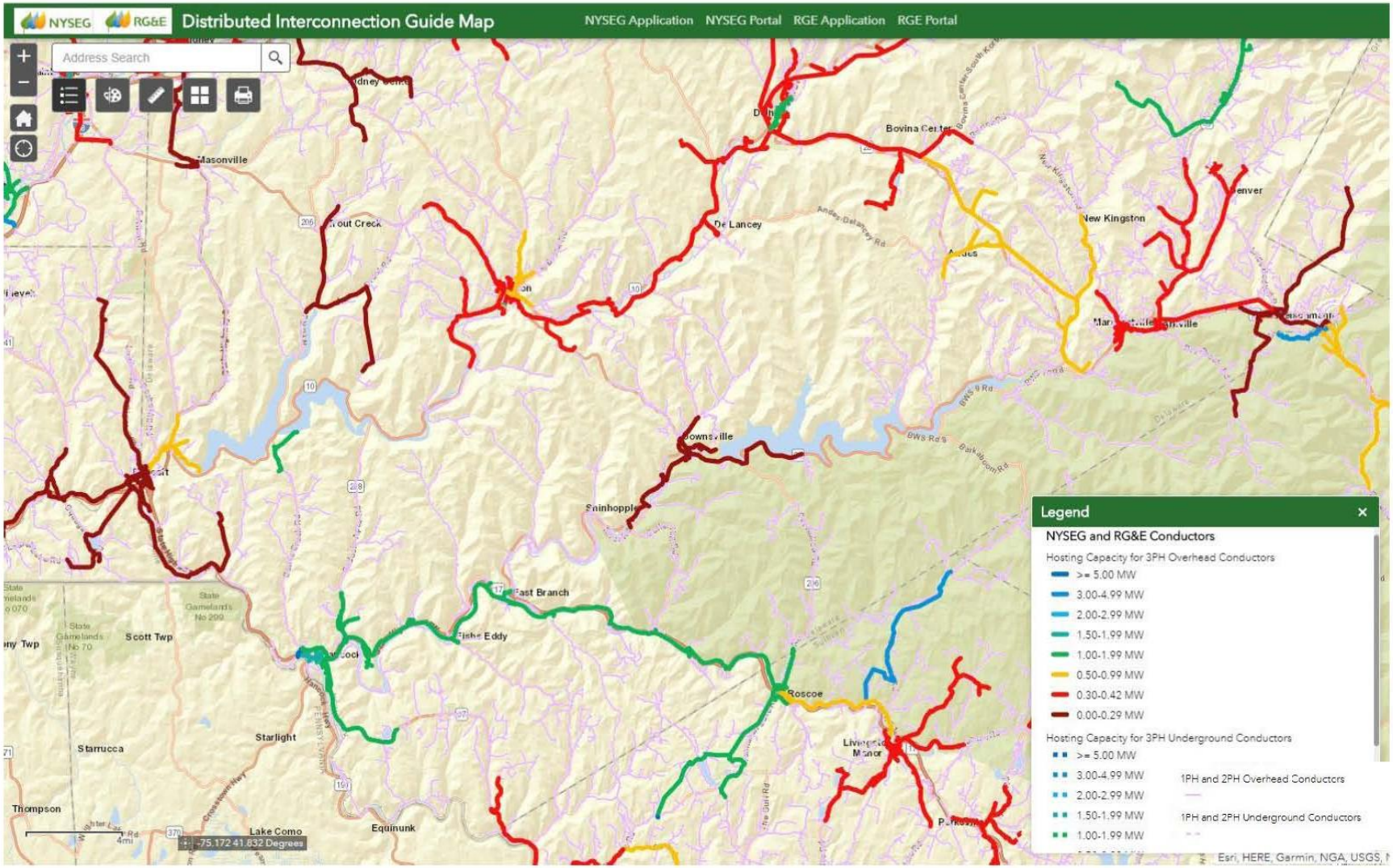
Cortland (south) – NYSEG



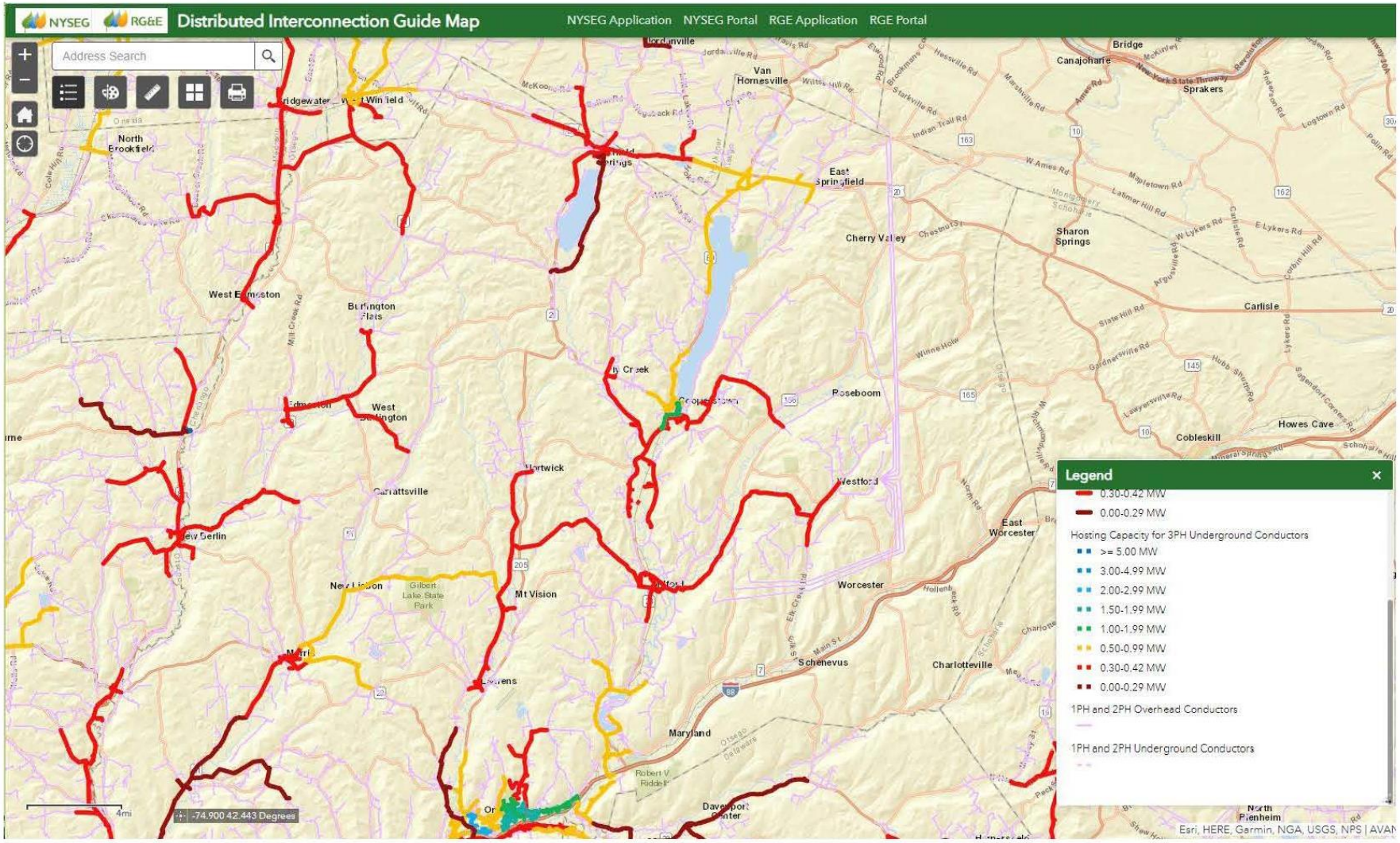
Delaware (north) – NYSEG



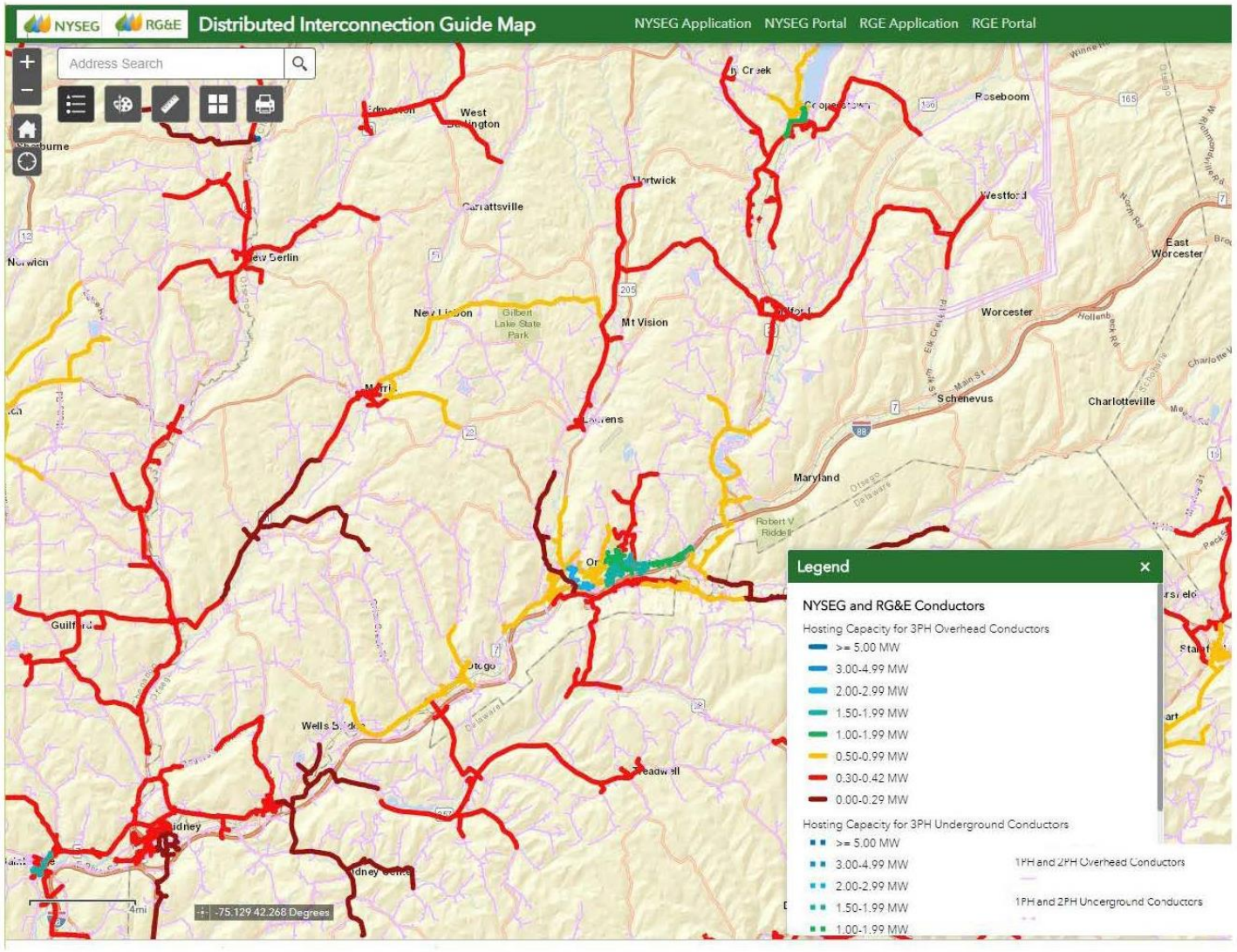
Delaware (south) – NYSEG



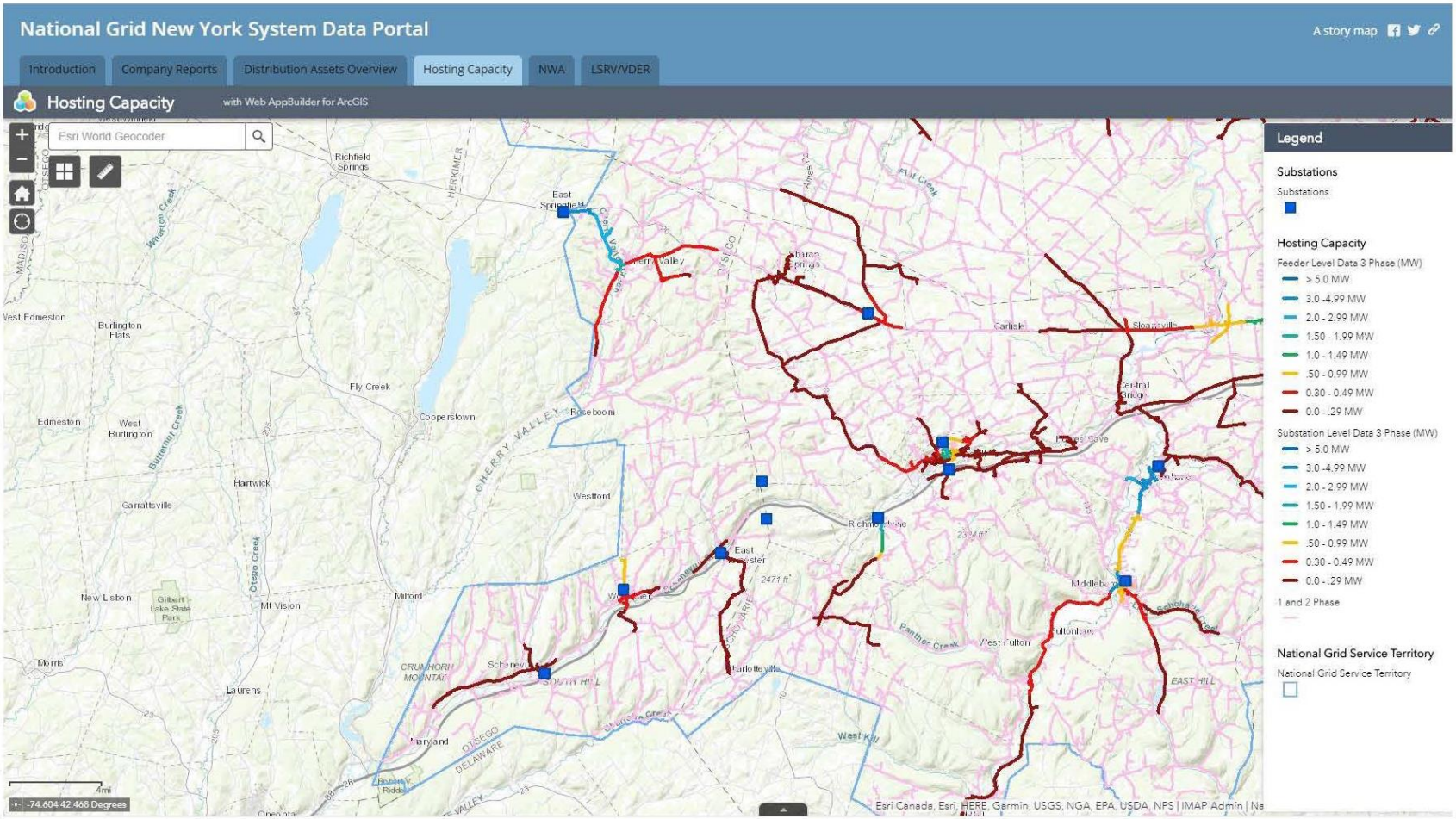
Otsego (north) – NYSEG



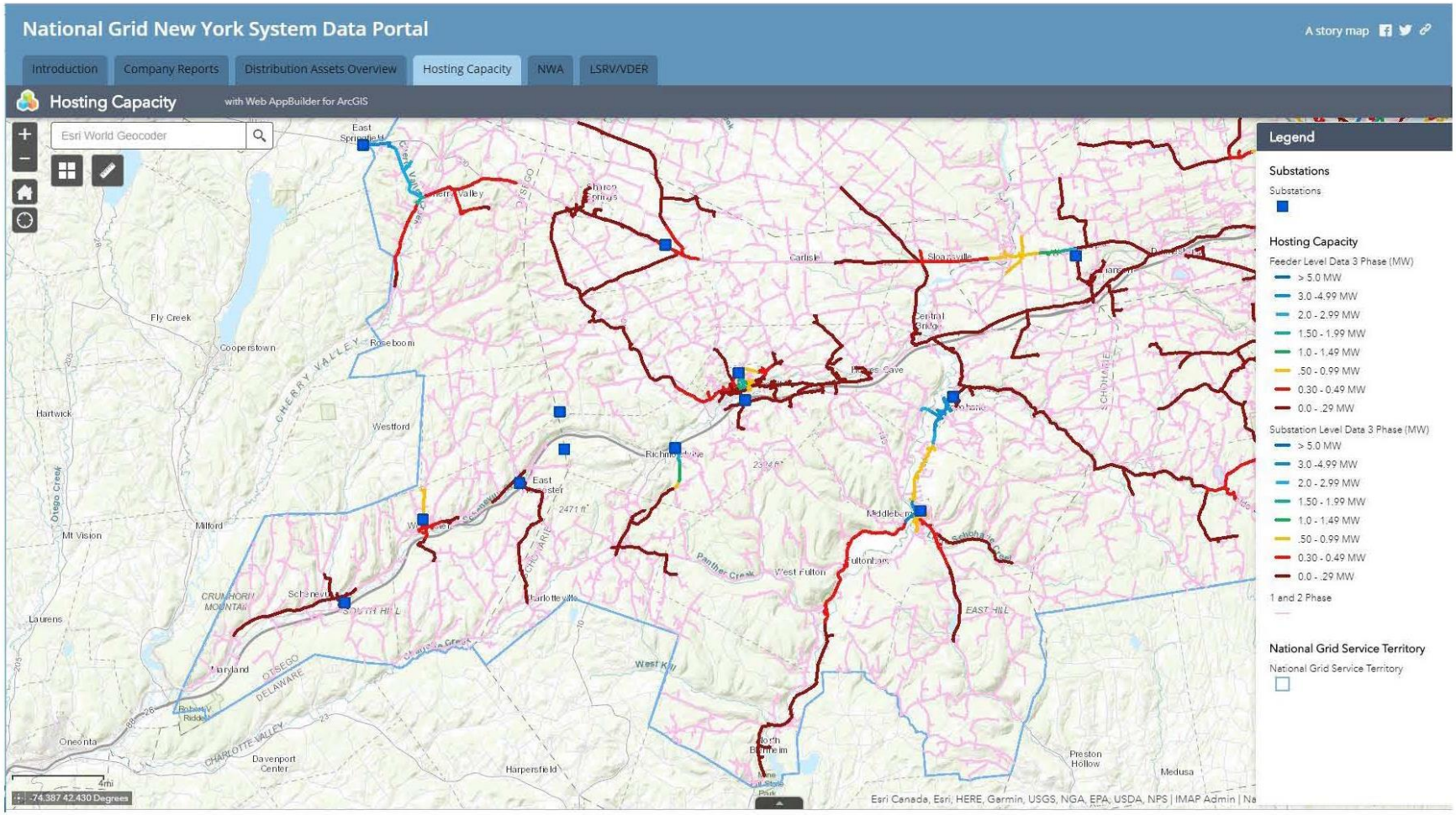
Otsego (south) – NYSEG



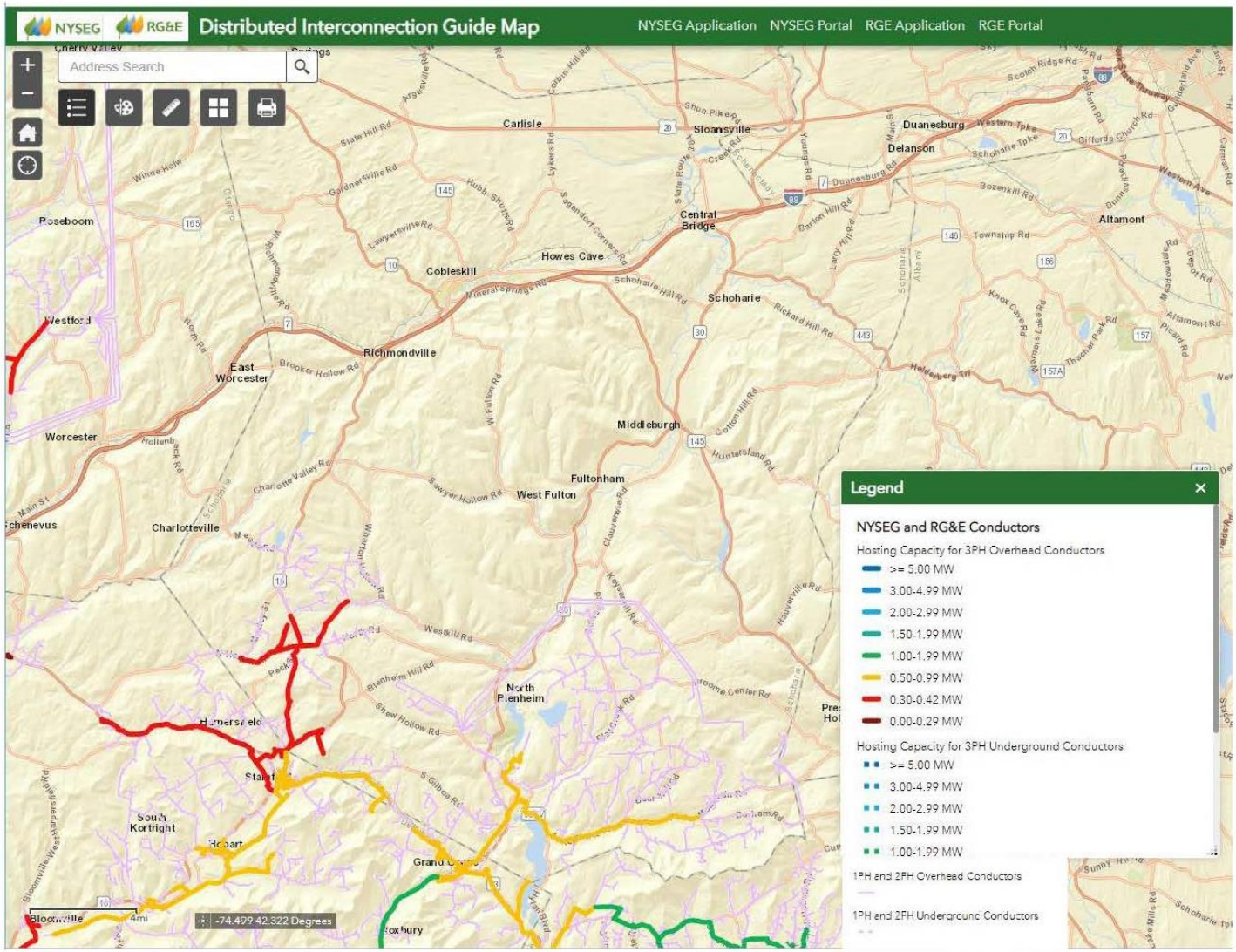
Otsego (southeast) – National Grid



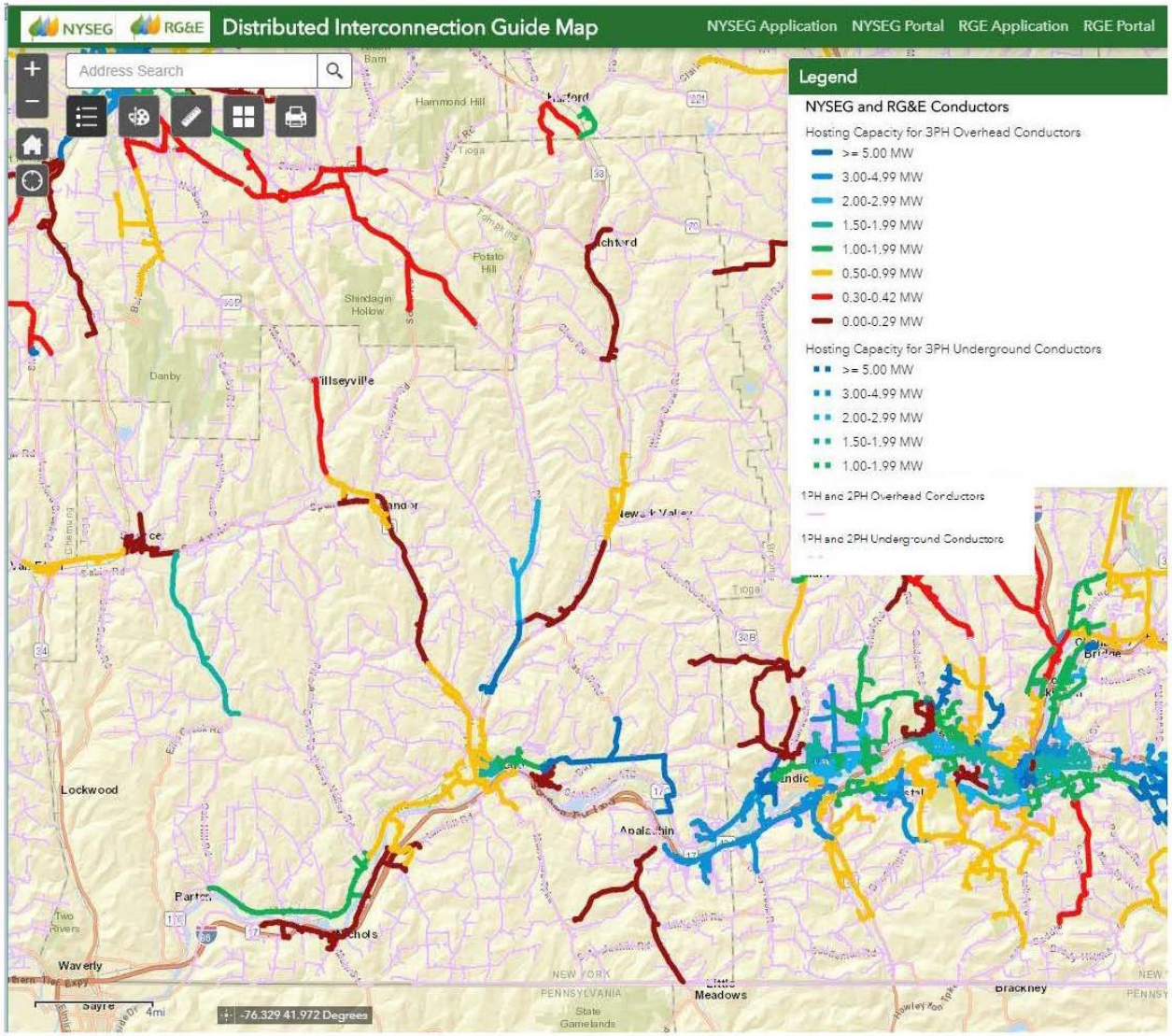
Schoharie – National Grid



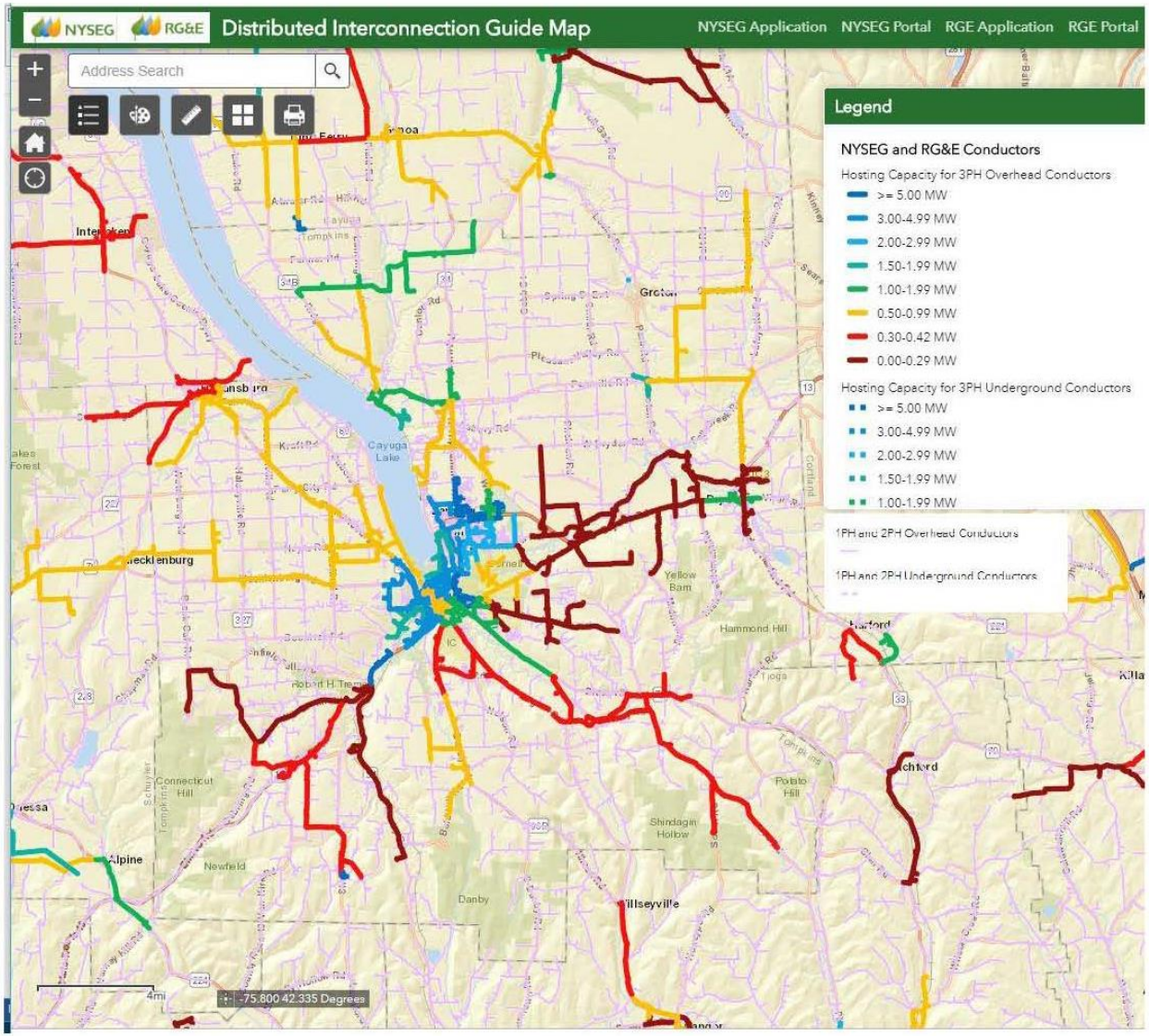
Schoharie (southern portion) – NYSEG



Tioga County – NYSEG



Tompkins County – NYSEG



APPENDIX C:

SITE-SPECIFIC INVESTIGATION REPORTS

SOUTHERN TIER 8 REGIONAL BOARD

REGIONAL ENERGY INFRASTRUCTURE ASSESSMENT AND STRATEGY

APPENDIX C

Site-Specific Investigation Reports

MARCH 2020

LaBella
Powered by partnership.

SOUTHERN TIER 8
Regional Board

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INTRODUCTION

To complement the assessment of energy infrastructure in the Southern Tier 8 region, LaBella Associates evaluated potential energy efficiency and renewable energy options at seven specific sites. The objective of the site-specific investigations was to demonstrate possible methods of alleviating stressors placed on businesses by interruptible energy supply or other energy concerns. Each site-specific investigation evaluated potential energy conservation measures and the feasibility of a variety of distributed energy resources that could help alleviate the energy issues at each site while meeting the financial and other objectives of the owners.

The findings from these investigations provide examples for how sites with a variety of energy issues can implement measures such as energy efficiency, renewable energy and other distributed energy sources to reduce costs and greenhouse gas emissions. Each investigation report includes an analysis of the potential for distributed energy resources (DER) to meet the site's energy demand and calculations of the potential cost savings from energy efficiency and other investments. The recommended measures were evaluated based on high-level analyses and may require further investigation prior to implementation.

SITE-SELECTION METHODOLOGY

LaBella staff worked with each County's planning and economic development representatives to identify potential candidates for the site-specific investigations. LaBella Associates conducted the initial phase of outreach through in-person meetings and phone interviews with County planners, economic development representatives, and other stakeholders. Additional candidates were identified from responses to the Business Survey and direct outreach to businesses and institutions by LaBella staff and County economic developers. This outreach resulted in a list of potential sites where energy infrastructure concerns were affecting economic development.

During the fall of 2019, LaBella staff and County economic development representatives reached out via phone or e-mail to more than 35 businesses and institutions to find out whether they were interested in participating in a site-specific investigation.

Several prospective partners were not interested in participating, either because they were currently conducting or recently completed a similar investigation, or they were not able to devote the time required to compile needed information and accompany the consultant in a site visit. Some businesses in Tompkins County had already received similar assistance through the County's Business Energy Advisors program.

Businesses and institutions that expressed interest in participating in the study were entered into a "short list" of suitable candidates. Several sites that may have been suitable candidates were not available to participate. Some potential candidates did not respond to phone calls or e-mails and others responded that they did not have sufficient resources to participate in a study at this time. Some expressed interest initially but were unable to proceed.

At meetings held in November and December 2019, the Energy Committee evaluated each of the candidates on the "short list" based on the following criteria:

- Project readiness and availability to coordinate with investigators
- Energy issues representative of those in the region
- Potential for replicability throughout the region
- Consistency with goals of energy strategy
- Potential regional economic benefit
- Geographic representation (one project per county)

By December 2019, the Southern Tier 8 Regional Board's Energy Committee, with input from legislators in their respective counties, formally selected the following eight projects for demonstration – one in each County:

Broome County	UHS Binghamton
Chenango County	UHS Chenango Memorial Hospital
Cortland County	JM Murray
Delaware County	Delaware River Basin Stone
Otsego County	Oneonta Business Park
Schoharie County	American Recycling
Tioga County	Crown Cork & Seal
Tompkins County	Human Services Building

Good candidates that were not selected for participation included A.O. Fox Hospital (Otsego County), Broome Community College (Broome County) and Lockheed Martin (Tioga County.) In March 2020, the selected site in Broome County, UHS Binghamton Hospital, needed to withdraw its participation because of time demands in responding to the COVID-19 crisis.

During January and February 2020, LaBella's energy specialists contacted a representative at each site and began collecting the information needed for the report. The analyses and individual site reports were completed by April 2020.

DEFINITIONS & ACRONYMS

Definitions

Net Zero Carbon	Buildings operating where the sum of carbon caused minus carbon avoided is less than or equal to zero.
Net Zero Energy	Buildings operating where the sum of energy consumed minus the sum of energy generated is less than or equal to zero.
Source Energy	Energy measured at the source of generation
Site Energy	Energy measured at the site of consumption
Carbon Offset	Credit that can be purchased from third party organization that invests those dollars in renewable energy generation projects- thus displacing an equivalent amount of carbon emissions.
Energy Utilization Index	Measure of energy consumption density per square foot. (kBtu/SF)

Commonly-Used Acronyms & Abbreviations

BTU	British Thermal Unit
CBECS	Commercial Building Energy Consumption Survey
CO_2	Carbon Dioxide
CO_{2E}	Equivalent Carbon Dioxide
Cogen	Cogeneration- used interchangeably with CHP
CHP	Combined Heat and Power
DER	Distributed Energy Resource
DER CAM	Distributed Energy Resource - Customer Adaptation Model
DHW	Domestic Hot Water
DOE	(United States) Department of Energy
EAC	Energy Attribute Certificates
ECM	Energy Conservation Measure
EIA	(Unties States) Energy Information Agency
EPA	(United States) Environmental Protection Agency
EPC	Energy Performance Contract
EUI	Energy Utilization Index
HVAC	Heating, Ventilation, and Air Conditioning
IRR	Internal Rate of Return
kBtu	kilo-British Thermal Unit (1,000 BTU)
kW	kilo-Watt (1,000 W)
kWh	kiloWatt hours
LEED	Leadership in Energy and Environmental Design
MBH	One thousand British Thermal Units
MMBtu	One million British Thermal Units
NPV	Net Present Value
NYSEG	New York State Electric & Gas
NYSERDA	New York State Energy Research & Development Authority
PV	Photovoltaic
RTU	Rooftop Unit
SF	Square Foot
VFD	Variable Frequency Drive

PROJECT SUMMARIES

The following summaries describe each of the facilities and the key findings from the site-specific investigation project. For each of the sites, the analyses in this report are high-level in nature. Further investigation into these measures is needed to confirm their feasibility before implementation.

Chenango County - UHS Chenango Memorial Hospital

UHS Chenango Memorial Hospital is a healthcare facility located in Norwich, NY. The hospital is a 24/7 inpatient facility with three separate wings that were constructed at different times, between 1928 and 1970.

A walkthrough of the hospital was conducted to evaluate potential opportunities for energy conservation as well as distributed energy resources. Based on the analyses and estimated load profile using the DER CAM modeling software, the following measures are recommended:

Recommended Measures:

-Install VFD on 5 hp chilled water pump

- Install VSD on 10 hp condenser water pump

- Replace (2) 150 hp 1958 HW boilers

- Replace 250 hp 1970 HW boiler

- Replace AHU-6 makeup air unit

- Replace constant volume RTU serving 1992 addition ICU

- Replace RTU serving 1991 addition radiology

- Retro-Commissioning of entire facility

- Install 250 kW micro-turbine CHP generation plant

The following measures are recommended for further evaluation due to their complexity:

Measures Recommended for Further Evaluation:

- Replace 240 ton chiller with variable speed chiller

- Utilize free cooling in cooling tower with bypass in rooftop MER

- Upgrade to electric DDC controls from pneumatic

Cortland County – JM Murray

J.M. Murray is a manufacturing facility located in Cortland, NY. This facility offers people with disabilities the opportunity to gain meaningful employment in a manufacturing setting. J.M. Murray produces a number of various items, including dental floss cases, toothbrush handles, garbage bag rolls, and many others. The facility also provides packaging and filling of medical creams.

A walkthrough was conducted with facility personnel to observe the facility and make recommendations on how to conserve energy as well as identify opportunities for distributed generation. The following measures were recommended to increase energy efficiency and reduce energy costs:

-Installation of a variable frequency drive on the cooling tower fan

- Replacing existing unit heaters with higher efficiency overhead radiant heaters

- Replacing existing office space RTUs with higher efficiency RTUs

- Install 358 kW ground-mount or rooftop PV system

The measures listed above were evaluated based on high-level analyses and may require further investigation prior to implementation.

Delaware County – Delaware River Basin Stone

Delaware River Basin Stone is a 55,000 square foot facility located in Deposit, NY that manufactures a variety of bluestone products from rock extracted from quarries. The facility is in operation 24/7 and a high percentage of its energy consumption is directly from process loads. The facility noted that it experiences approximately $50,000 worth of production losses a year due to unexpected power outages or brown outs.

Delaware River Basin Stone has recently moved into their new building in Deposit NY after renovating it in 2016. A walkthrough was conducted to identify energy conservation opportunities, building operational improvements, and potential for the installation of Distributed Energy Resources (DERs).

The following recommendations were made to improve building operations:

- Install automated chemical injection to limit labor requirements for water treatment system

- Close large garage doors during winter months when possible to limit heat loss and improve indoor comfort levels

The DER analysis identified a 200 kW CHP system as the most economically attractive option that will help reduce energy costs as well as prevent losses of product from unexpected outages. This option will increase the facility's carbon footprint by an estimated 200 metric tons.

An alternate option of a 520 kW PV system and 240 kW/ 2000 kWh of flow battery storage was identified if the facility wants to reduce their carbon footprint. This option will reduce the facility's carbon footprint by an estimated 68 tons.

Otsego County – Oneonta Business Park

Two business parks are located in Oneonta: Oneonta Business Park and Railyards, which is currently in the process of being developed as a "shovel-ready" site. Natural gas service is currently provided to the Oneonta Business Park, however, NYSEG's natural gas customers in the business park are subject to interruptible service agreements. Several businesses in the area on

the same gas line have experiences significant outages in the past 5 years- which has limited potential growth for the business/ industrial parks.

LaBella performed a preliminary feasibility analysis on the two sites and determined that (2) grid-connected microgrids powered by PV, battery storage, and diesel CHP are likely the best fits for both microgrids. Preliminary electric and thermal loads were estimated based on square footages and building usage types. Based on the peak demands and estimated critical loads, proposed technologies were recommended, along with a budget of just under $6.5 million for both sites.

Further analysis is recommended in order to develop a detailed analysis that is able to evaluate the building needs on a more granular level and input them into a modeling software that is able to simulate multiple scenarios and determine the optimal combination and sizing of distributed energy resources in the microgrids.

Schoharie County – American Recycling

American Recycling Management LLC is a recycling center that is currently in the process of building a new 20,000 square foot trucking terminal in Schoharie County. This facility will consist of an office area as well as a truck storage area to store them overnight. The facility has future plans to store organic waste on-site, but it is not included in the current construction of their facility.

A number of distributed energy resources were evaluated based on their economic impact and carbon footprint. Since 99% of the facility's carbon footprint comes from diesel gas for the trucks according to LEED Zero standards, the cost to achieve a net zero carbon facility is significant.

Two different options are recommended for the facility, depending on American Recycling's desire to achieve net zero carbon emissions:

To achieve net zero carbon, it is recommended that American Recycling installs a 72 kW PV system, a 50 ton geothermal heating and cooling loop, and purchases carbon offset credits to offset the remainder of the facility's carbon emissions. This option reduces the total net costs by $5,357, but has a payback period of 68 years due to the high upfront cost.

To present the greatest return on investment, it is recommended that the facility installs 75 kW of ground-mount or rooftop solar to provide supplemental electricity to the facility. The estimated annual net savings for this is $13,435, resulting in an 11.7 year payback- which is significantly shorter than the net zero option.

Tioga County – Crown Cork & Seal

Crown Cork & Seal is a manufacturing facility located in Nichols, NY. This facility manufactures a variety of aluminum cans that are used as beverage containers. The Nichols facility is a recently constructed facility and has a highly-automated process that takes rolls of aluminum, molds them into the desired shape, paints, and then heat-treats them before exporting.

A walkthrough was conducted with facility personnel to observe the facility and make recommendations on how to conserve energy as well as identify opportunities for distributed

generation. The following measures were recommended to increase energy efficiency and reduce energy costs:

-Establish nighttime temperature setbacks in office areas

-Reduce negative pressure in building to reduce infiltration

-Install 5MW CHP system to increase facility resiliency and reduce energy costs

The measures listed above were evaluated based on high-level analyses and may need further investigation prior to implementation.

Tompkins County – Tompkins County Human Services Building

The Tompkins County Human Services Building is a four-story 71,200 square foot building constructed in 1998, and a one-story, 1,700 square foot addition built in 2014. The office building serves the Tompkins County Department of Social Services, Youth Services, and Probation and Community Justice.

A walkthrough was conducted with facility personnel to observe the building and to make recommendations for how to conserve energy as well as identify opportunities for distributed generation. The following measures are recommended to increase energy efficiency and reduce energy costs.

- Replace T8 lights with LED lamps.
- Replace non-condensing boilers with condensing boiler.
- Install a variable speed drive (VSD) for the cooling tower pumps.
- Install 735 kW PV system & 800 kW / 6500 kWh battery storage

The feasibility of a ground-source geothermal system was examined. The total cooling load of the building is about 190 tons. Using conservative assumptions it is estimated that a 70 to 80 well field would be needed, requiring roughly 0.5 to 0.75 acres. The building's existing parking area might accommodate about half of the required area.

The recommended PV + energy storage system is based on the maximum economic return on investment that both increased the facility's resiliency and achieved net zero carbon. Carbon offset credits are necessary to offset the remainder of carbon emissions that could not be offset by on-site generation.

SITE-SPECIFIC INVESTIGATION REPORT

CHENANGO COUNTY: UHS CHENANGO MEMORIAL HOSPITAL

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NOTE:

The energy analyses in this report are high-level in nature. All recommendations made in this report require further verification before being implemented.

FACILITY DESCRIPTION

UHS Chenango Memorial Hospital is a 200,000 SF healthcare facility operating 24 hours a day, 7 days a week located in the City of Norwich, NY. The four-story brick structure is comprised of three separate wings, which were constructed in 1929, 1958 and 1970, with a smaller single-story addition in 1991. The Hospital has more than 700 employees working three shifts.

UHS Chenango Memorial Hospital includes inpatient and outpatient surgical care units, a women's health center and a maternity and obstetrics unit. There is an intensive care unit, general surgery, cardiology, diagnostic heart care center, orthopedics, diagnostic imaging and laboratory departments as well as a 24-hour physician-staffed emergency care department. Included within the hospital is a senior living center with a wing for short-term rehabilitation.

The building is heated by three steam boilers and cooled with either chilled water supplied by a combination cooling tower-chiller system or separate DX cooling. Although some areas, clinics and laboratories, are occupied from 8am to 5 pm, all of the HVAC systems operate continually with no setback. This is due both to the fact that areas are interspersed throughout the Hospital with most units serving differing occupancies.

The 1929 Building is three stories plus a basement. The boiler mechanical room is in the basement. Fast track / Emergency Room and Radiology are located on the first floor of this building. The nursing home PT, offices, dining hall, and beauty salon are on the second floor. The third floor houses some training rooms, the pharmacy and sterile compounding.

The 1958 Building section is also three stories plus a basement. The basement of this section houses the Dietary and laboratory, lab offices, MER, restrooms, laundry sorted (incoming) and soiled laundry. The Hospital originally cleaned all of its own laundry but has since contracted with an outside company for laundering services. This reduced the steam load for the building since steam was used for cleaning, drying and pressing the laundry. On the first floor is the Nuclear medicine laboratory, CT scanner, and Women's Health. In the near future Women's Health is moving to an alternate location downtown. This space and the recently vacated area from the old Cardiology unit will be renovated for the new ER. Nursing Home individual rooms, 25 total, are on the second floor. The Maternity ward is on the third floor which is comprised of Maternity rooms, 10 total, a nurses' station, nursery, training room and birthing room with tub.

The largest wing is the 1970 wing, which is connected to the 1929 wing and extends south. In the basement is the shipping and receiving, maintenance office and two electrical rooms for the entire complex. There is also a separate mechanical equipment room. Primary Care is located on the first floor with no separate patient rooms. The second floor houses individual rooms, 27 total, for the Nursing Home. The third floor houses individual patient rooms, 27 total, for the Med/Surgical unit. On the fourth floor is the operating room, recovery room, ambulatory surgery and sterile processing. There is a partial penthouse mechanical room on this portion of the building.

In 1991 a single story addition was built in the southwest portion where the three wings merge. This addition houses the ICU, Radiology and Pharmacy/Sterile Compounding Room.

A new roof has just recently been installed on all of the building complex.

EXISTING INFRASTRUCTURE

There are three existing water-tube boilers located in the basement mechanical room in the 1929 building section which produce approx. 70 psi steam. There are two (2) 150 HP boilers which were installed in 1958 and one (1) 250 HP boiler installed in 1970. All of the boilers are dual fuel, natural gas and No. 6 fuel oil, although the 250 HP boiler is not operable on No. 6 fuel oil. A 10,000 gallon No. 6 fuel oil tank is located directly outside the mechanical room. This tank is heated with steam from the boilers to avoid gelling of the No. 6 fuel oil. The Hospital is currently undertaking a project changing over from No. 6 fuel oil to cleaner No. 2 fuel oil as a backup fuel source due to availability and cost. Once this is complete the steam for heating the tank will no longer be required due to the viscosity of No. 2 fuel oil.

One of the boilers is always in operation with the other two kept hot on standby for redundancy during the winter months and one on standby during the other months. The boiler plant is extremely well maintained and efficient for a plant of this type with minimum boiler efficiency of 83%. The facility personnel has noted that only one 150HP boiler can handle the load during the winter months and believes two (2) 150 HP boilers with one (1) 80 HP boiler for would better match the capacity requirements for summer and winter. The boiler stacks all combine within the mechanical room and exit to a brick stack separate from the building located on the West side which rises above the rooftop. There a three separate feedwater loops each with their own feedwater pump. A new boiler house was erected on the site during a previous renovation project which currently sits empty. The facility personnel would prefer firetube boilers for replacement.

The 1929 building wing is oriented North-South on the site fronting on Broad Street. It is heated with steam radiators throughout. A constant volume rooftop makeup unit (AHU-6) comprised of a filter section, supply fan and Dx cooling coil provides outside air to all of the floors. A glycol heating coil is located on each floor to heat the outside air. Two pumps, one fully redundant, circulate the glycol from the steam to glycol heat exchanger in the 1970 building to the glycol heating coils.

The 1958 building section extends west from the center of the 1929 wing. One of the 480V main service feeds enters the building in this wing. An indoor air handling unit comprised of a filter section, glycol preheat coil, Dx coil, 2 Plenum supply fans and 1 exhaust fan is located in the basement mechanical equipment room of this wing which serves the Lab and Nuclear Medicine on the basement and first floor. There is an instantaneous indirect fired steam domestic hot water heater for the wing. Two steam to hot water heat exchangers, one water and one glycol serve the equipment in this wing with associated pumps for circulation. All second and third floor rooms are served by individual wall mounted 4-pipe fan coil units.

The main portion of the hospital is housed in the 1970 wing of the building with a basement, four floors and a partial mechanical room penthouse. The largest mechanical equipment room is located in the basement. Steam from the boiler room in the 1929 wing enters this room and is reduced to medium pressure (45-60 psi) to be used for the kitchen equipment: steam kettle, steamer and dishwasher and medical sterilizers. Medium pressure steam is further reduced to low pressure (5-10 psi) for building heating. All of the condensate is collected and returned to the

boiler plant. Originally there was a steam absorption chiller for the building located in this room which has since been replaced with a 240 ton water cooled chiller. Chilled water and condenser water is circulated for the plant via base mounted constant volume centrifugal pumps which are original to the building. Heating hot water is all circulated with base mounted constant volume centrifugal pumps that are original to the building.

A custom built-up air handling unit, AHU-1, located in the MER, is comprised of a filter section, glycol heating coil, chilled water coil, and supply fan provides makeup air to the basement, first, second and third floors of the building. Four-pipe wall mounted fan coil units are located within all of the spaces for conditioning. The new cardiology area/cardiac rehab is served by a new horizontal makeup air handling unit hung in the basement MER. All of the original fan coil units in the cardiology area were recently replaced with above the ceiling horizontal fan coil units, 13 total.

The cooling tower on the roof is drained in the winter. There is a VFD for the fans. An existing bypass in the penthouse MER allows for the potential for free cooling in cooling weather.

Within the penthouse MER are two air handling units which serve the 4th floor. One for the operating room, AHU-5, and one for the remainder of the floor, AHU-4. AHU-4 is comprised of a filter, steam heating coil, Dx cooling coil, supply and return fan. AHU-5 is equipped with a steam humidifier, 300 lb/hr, which humidifies the air both in summer and winter as required. It is also equipped with a steam heating coil, Dx cooling coil, backup chilled water coil and variable speed supply and return fans. Two associated air cooled condensing units are located on the rooftop adjacent to the penthouse for each of the AHUs. There are also a number of exhaust fans which serve different areas: Kitchen range, Dental Center, ER/Radiology, 2nd and third floor restrooms.

There are three separate rooftop units which served the 1991 addition area. These units are all comprised of a filter section, Dx cooling coil and supply fan with separate hot water duct mounted reheat coils located indoors.

The Hospital currently receives a discount from NYSEG for both electric and natural gas supply due to the fact that they have backup for both electric and gas and have agreed to switch to their alternate source when requested during high demand times. Electric can switch to their diesel generator and natural gas can switch to fuel oil.

There are occasional outages associated with an aging switchgear, but no significant energy supply issues. The facility is fed by 2 separate full-size electrical feeds from the street, one from the East and one from the West, which allows for switchover in the event of an outage on one. All life-safety and high-priority systems are currently connected to a 1 mega-watt diesel generator.

All existing light fixtures are currently being changed over to LED as time and funds allow. All of the newly renovated areas have been equipped with LED fixtures and occupancy sensors. The parking lot exterior light fixtures have also been changed out to LED with daylight sensors.

UTILITY DATA & CARBON EMISSIONS

The following figures outline the electric and natural gas usages for the years 2018 and 2019. Corresponding carbon emissions, as outlines by LEED net zero guidelines are listed as well.

UTILTY DATA & EMISSIONS SUMMARY

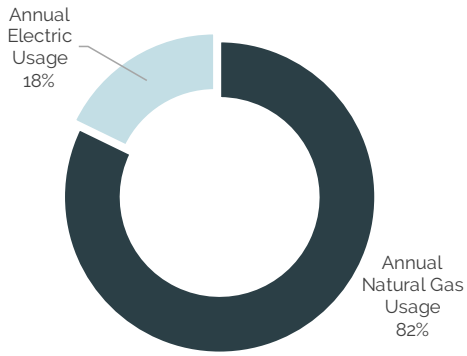
ELECTRICITY	Annual Totals				CO_2 Emissions
Annual Electric Usage	319,541	kWh	=	1,090,273 MBtu	43 Metric Tons
Peak Electric Demand	0	kW			
Total Monthly Electric Demand	0	kW			

FOSSIL FUELS	Annual Totals				CO_2 Emissions
Annual Natural Gas Usage	5,035	MMBtu	=	5,035,000 MBtu	267 Metric Tons
Annual Propane Usage	0	gal	=	0 MBtu	0 Metric Tons
Annual #2 Fuel Oil Usage	0	gal	=	0 MBtu	0 Metric Tons
Annual Gasoline Usage	0	gal	=	0 MBtu	0 Metric Tons
ANNUAL TOTALS				**6,125,273 MBtu**	**309.9 Metric Tons**

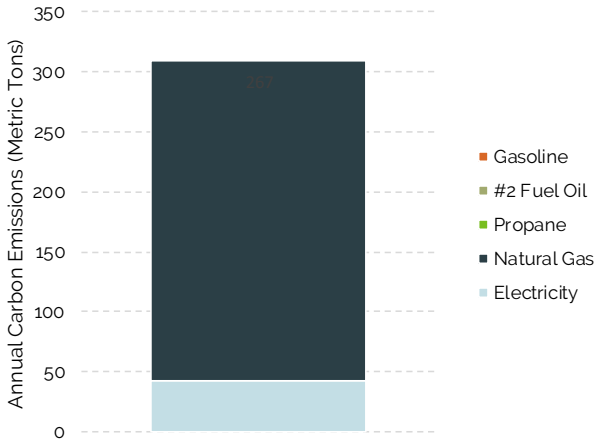
Total Annual Electric Costs	$	276,716
Total Annual Natural Gas Costs	$	129,524
Total Annual Propane Costs	$	0
Total Annual #2 Fuel Oil Costs	$	0
Total Annual Gasoline Costs	$	0
TOTAL UTILITY COSTS	**$**	**406,240**

Blended Electric Rate ($/kWh)	$	0.077
Electric Demand Rate ($/kW)	$	-
Incremental Electric Usage Rate ($/kWh)	$	0.077
Natural Gas Rate ($/MMBtu)	$	2.366
Propane Rate ($/gal)	$	0.000
#2 Fuel Oil Rate ($/gal)	$	0.000
Gasoline Rate ($/gal)	$	0.000

ENERGY CONSUMPTION



CARBON EMISSIONS



ELECTRIC UTILITY SUMMARY

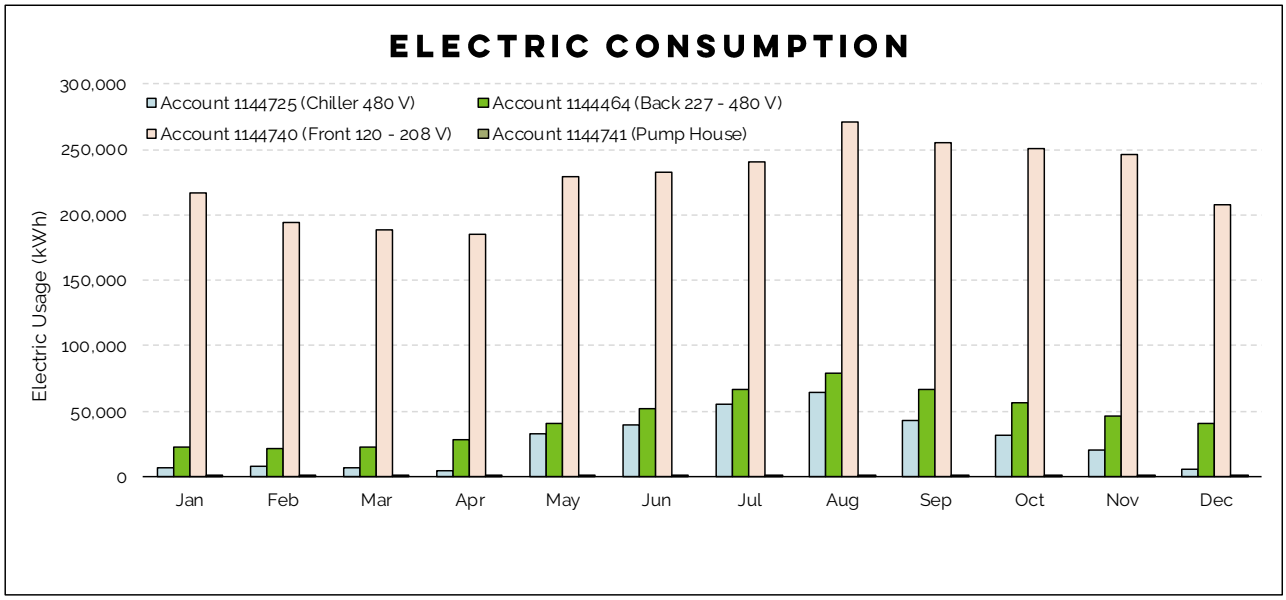
Annual Electric Usage (kWh):	3,579,647	Electric Demand Rate ($/kW):	$ -
Peak Electric Demand (kW):	0.0	Blended Electric Rate ($/kWh):	$ 0.077
Annual Electric Demand (kW):	0.0	Incremental Electric Rate ($/kWh):	$ 0.077
		Total Annual Electric Costs:	$ 276,716

ELECTRIC UTILITY DATA

Month-Year	Days	Usage (kWh)	Peak Demand (kW)	Demand Cost	Demand Rate ($/kW)	Commodity Cost	Delivery Cost	Total Cost	Blended Rate
Account 1144725 (Chiller 480 V)									
Oct-15	32	6,708	-	-	-	$319	$275	$594	$0.089
Nov-15	32	8,236	-	-	-	$394	$276	$671	$0.081
Dec-15	32	7,365	-	-	-	$355	$282	$637	$0.087
Jan-16	29	5,000	-	-	-	$237	$963	$1,200	$0.240
Feb-16	30	32,424	-	-	-	$1,547	$1,411	$2,957	$0.091
Mar-16	31	39,095	-	-	-	$1,865	$1,429	$3,294	$0.084
Apr-16	30	55,318	-	-	-	$2,639	$1,865	$4,504	$0.081
May-16	30	64,772	-	-	-	$3,090	$2,076	$5,166	$0.080
Jun-16	31	42,915	-	-	-	$1,998	$1,419	$3,417	$0.080
Jul-16	29	31,725	-	-	-	$1,513	$1,298	$2,811	$0.089
Aug-16	30	20,534	-	-	-	$979	$936	$1,915	$0.093
Sep-16	29	5,449	-	-	-	$260	$261	$521	$0.096
		319,541				**$15,196**	**$12,491**	**$27,686**	**$0.087**
Account 1144464 (Back 227 - 480 V)									
Oct-15	32	22,358	-	-	-	$1,059	$914	$1,973	$0.088
Nov-15	32	21,350	-	-	-	$1,017	$751	$1,768	$0.083
Dec-15	32	22,863	-	-	-	$1,096	$929	$2,025	$0.089
Jan-16	29	28,425	-	-	-	$1,366	$1,256	$2,623	$0.092
Feb-16	30	40,690	-	-	-	$1,971	$1,564	$3,535	$0.087
Mar-16	31	51,510	-	-	-	$2,494	$2,024	$4,518	$0.088
Apr-16	30	66,575	-	-	-	$3,224	$2,373	$5,597	$0.084
May-16	30	78,838	-	-	-	$3,821	$2,514	$6,334	$0.080
Jun-16	31	66,660	-	-	-	$3,096	$2,218	$5,313	$0.080
Jul-16	29	56,466	-	-	-	$2,269	$2,309	$4,579	$0.081
Aug-16	30	46,273	-	-	-	$2,132	$1,821	$3,953	$0.085
Sep-16	29	40,400	-	-	-	$1,854	$1,233	$3,087	$0.076
		542,407				**$25,401**	**$19,905**	**$45,306**	**$0.084**
Account 1144740 (Front 120 - 208 V)									
Oct-15	32	216,383	-	-	-	$10,302	$4,585	$14,887	$0.069
Nov-15	32	193,856	-	-	-	$9,276	$4,434	$13,710	$0.071
Dec-15	32	188,721	-	-	-	$9,093	$4,489	$13,582	$0.072
Jan-16	29	185,608	-	-	-	$8,978	$5,169	$14,147	$0.076
Feb-16	30	228,801	-	-	-	$10,914	$6,322	$17,236	$0.075
Mar-16	31	232,162	-	-	-	$11,299	$7,006	$18,306	$0.079
Apr-16	30	240,173	-	-	-	$11,456	$6,982	$18,439	$0.077
May-16	30	271,094	-	-	-	$12,931	$7,187	$20,118	$0.074
Jun-16	31	255,224	-	-	-	$11,881	$6,418	$18,298	$0.072
Jul-16	29	250,832	-	-	-	$11,965	$10,259	$22,224	$0.089
Aug-16	30	246,439	-	-	-	$11,755	$5,723	$17,478	$0.071
Sep-16	29	208,191	-	-	-	$9,931	$5,126	$15,057	$0.072
		2,717,484				**$129,780**	**$73,700**	**$203,480**	**$0.075**

(Electric Utility Data Continued)

Account 1144741 (Pump House)									
Oct-15	32	22	-	-	-	$1	$20	$21	$0.941
Nov-15	32	20	-	-	-	$1	$19	$20	$1.011
Dec-15	32	17	-	-	-	$1	$19	$20	$1.192
Jan-16	29	18	-	-	-	$1	$19	$20	$1.118
Feb-16	30	20	-	-	-	$1	$19	$20	$1.017
Mar-16	31	20	-	-	-	$1	$19	$20	$1.020
Apr-16	30	17	-	-	-	$1	$20	$20	$1.198
May-16	30	17	-	-	-	$1	$19	$20	$1.179
Jun-16	31	15	-	-	-	$1	$19	$20	$1.338
Jul-16	29	17	-	-	-	$1	$19	$20	$1.212
Aug-16	30	18	-	-	-	$1	$19	$20	$1.130
Sep-16	29	15	-	-	-	$1	$19	$20	$1.338
		216				**$11**	**$232**	**$243**	**$1.127**

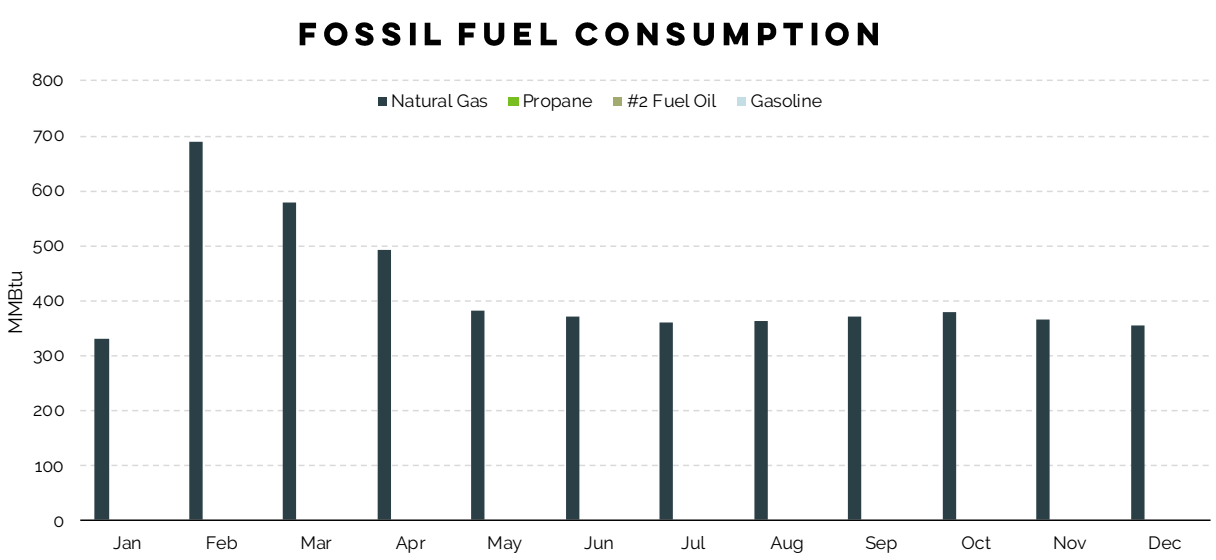


FOSSIL FUELS UTILITY SUMMARY

Natural Gas Usage (MMBtu):	54,740	Natural Gas Rate ($/MMBtu):	$ 2.366
Propane Usage (gal):	0.0	Propane Rate ($/gal):	$ 0.000
#2 Fuel Oil Usage (gal):	0.0	#2 Fuel Oil Rate ($/gal):	$ 0.000
Gasoline Usage (gal):	0.0	Gasoline Rate ($/gal):	$ 0.000

FOSSIL FUELS UTILITY DATA

Month-Year	Days	Natural Gas Usage (MMBtu)	Propane Usage (gal)	#2 Fuel Oil Usage (gal)	Gasoline Usage (gal)	Natural Gas Costs	Propane Costs	#2 Fuel Oil Costs	Gasoline Costs
Account 85943000 (Dietary)									
Oct-15	32	331	0	0	0	$173	$0	$0	$0
Nov-15	32	690	0	0	0	$290	$0	$0	$0
Dec-15	32	579	0	0	0	$251	$0	$0	$0
Jan-16	29	491	0	0	0	$223	$0	$0	$0
Feb-16	30	381	0	0	0	$207	$0	$0	$0
Mar-16	31	371	0	0	0	$155	$0	$0	$0
Apr-16	30	361	0	0	0	$163	$0	$0	$0
May-16	30	362	0	0	0	$154	$0	$0	$0
Jun-16	31	370	0	0	0	$154	$0	$0	$0
Jul-16	29	378	0	0	0	$167	$0	$0	$0
Aug-16	30	366	0	0	0	$153	$0	$0	$0
Sep-16	29	354	0	0	0	$171	$0	$0	$0
		5,035	**0**	**0**	**0**	**$2,260**	**$0**	**$0**	**$0**
Account 85940000 (Boiler Gas)									
Oct-15	32	2,632	0	0	0	$9,188	$0	$0	$0
Nov-15	32	2,599	0	0	0	$8,962	$0	$0	$0
Dec-15	32	2,252	0	0	0	$7,770	$0	$0	$0
Jan-16	29	2,610	0	0	0	$8,884	$0	$0	$0
Feb-16	30	1,980	0	0	0	$6,721	$0	$0	$0
Mar-16	31	1,868	0	0	0	$6,278	$0	$0	$0
Apr-16	30	1,573	0	0	0	$5,249	$0	$0	$0
May-16	30	1,404	0	0	0	$4,763	$0	$0	$0
Jun-16	31	1,475	0	0	0	$4,968	$0	$0	$0
Jul-16	29	1,687	0	0	0	$5,499	$0	$0	$0
Aug-16	30	2,047	0	0	0	$6,135	$0	$0	$0
Sep-16	29	2,600	0	0	0	$7,729	$0	$0	$0
		24,727	**0**	**0**	**0**	**$82,146**	**$0**	**$0**	**$0**
Account 10010010592 (Boilers 2 & 3 Gas)									
Oct-15	32	2,657	0	0	0	$4,864	$0	$0	$0
Nov-15	32	2,624	0	0	0	$4,820	$0	$0	$0
Dec-15	32	2,274	0	0	0	$4,099	$0	$0	$0
Jan-16	29	2,636	0	0	0	$4,734	$0	$0	$0
Feb-16	30	1,999	0	0	0	$3,603	$0	$0	$0
Mar-16	31	1,886	0	0	0	$3,363	$0	$0	$0
Apr-16	30	1,588	0	0	0	$2,852	$0	$0	$0
May-16	30	1,418	0	0	0	$2,548	$0	$0	$0
Jun-16	31	1,498	0	0	0	$2,667	$0	$0	$0
Jul-16	29	1,704	0	0	0	$3,179	$0	$0	$0
Aug-16	30	2,067	0	0	0	$3,714	$0	$0	$0
Sep-16	29	2,626	0	0	0	$4,675	$0	$0	$0
		24,978	**0**	**0**	**0**	**$45,119**	**$0**	**$0**	**$0**


FOSSIL FUEL CONSUMPTION
Natural Gas
Propane
#2 Fuel Oil
Gasoline
MMBtu
800
700
600
500
400
300
200
100
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

ENERGY CONSERVATION

Eleven energy conservation measures were identified as suitable for this facility. The table below outlines a summary of the estimated energy savings as well as the estimated cost of installation. Approximate energy savings and payback periods were listed with each measure as well as approximate installation costs based on experience with similar measures from other facilities.

ECM SUMMARY TABLE

ECM	Measure Decription	Measure Estimated % Savings	Estimated Cost of Installation	Estimated Payback Period	Recommendation
1	Replace 240 ton chiller with variable speed chiller	20%	$250,000	15-20 yrs	FE
2	Install VSD on 25 hp chilled water pump	30%	$7,500	10-15 yrs	R
3	Install VSD on 10 hp condenser water pump	30%	$5,000	10-15 yrs	R
4	Utilize free cooling in cooling tower with bypass in rooftop MER	10%	$60,000	15-20 yrs	FE
5	Replace (2) 150 hp 1958 HW boilers	25%	$1,200,000	15-25 yrs	R
6	Replace 250 hp 1970 HW boiler	25%	$1,000,000	15-25 yrs	R
7	Replace AHU-6 makeup air unit	20%	$3.50/CFM	20-30 yrs	R*
8	Replace constant volume RTU serving 1992 addition ICU	20%	$3.50/CFM	20-30 yrs	R*
9	Replace RTU serving 1991 addition radiology	20%	$3.50/CFM	20-30 yrs	R*
10	Upgrade to electric DDC controls from pneumatic	5% total facility	$500,000	15-25 yrs	FE
11	Retro-Commissioning	5% total facility	$50,000	0-5 yrs	R

Notes:

FE = Further Evaluation Needed, based on combination with other DERs.

R = Recommended

R* = Recommended replacement due to age of unit

NR = Not Recommended

Demand Savings estimated based on ratio of calculated electric usage savings.

Percent savings indicate estimated % savings of the unit's energy consumption, unless noted as a % of the total facility's energy consumption
For ECM 7, the equipment size was not able to be gathered. Due to the age of the unit, it is still recommended to be replaced. A rule of thumb cost was used to estimate the total unit cost. Percent energy savings were still calculated for the unit based on knowledge of the facility anf unit's age.

The cost to implement free cooling is assume to entail the re-routing of piping and controls updates. It is expected that free cooling is used under the temperatures of 45 def F, which accounts for 3890 hours per year.

ECM 1: Replacing the 240 ton chiller with a new, variable speed chiller will increase the chiller's part load performance and provide significant savings in cooling energy consumed. The estimated savings for this measure is between 15-20 years. Due to the potential complexity of installing a new chiller, further evaluation of this measure is recommended in order to better estimate the energy savings and cost of implementation.

ECM 2: Installing a variable speed drive on the 25 hp chilled water pump will provide significant savings to the pump's energy consumption. The payback for variable speed drives on chilled water pumps is typically between 10-15 years.

ECM 3: Installing a variable speed drive on the 10 hp condenser water pump will provide significant savings to the pump's energy consumption. The payback for variable speed drives on condenser water pumps is also typically between 10-15 years.

ECM 4: It was noted that there is an existing bypass valve in the rooftop MER that can be used to provide free cooling at the cooling tower. Establishing free cooling instead of running the chillers at inefficient part loads typically presents savings around 10% with a payback period of 15-20

years. The installation cost was estimated to be $60,000 assuming piping configurations and controls changes are needed to accomplish this task. Any additional equipment needed may increase the capital cost of this measure.

ECM 5: Replacing (2) boilers from the 1958 wing with newer, more efficient boilers will present an energy savings of approximately 20%. It is recommended that these boilers are replaced as they approach the end of their useful life. The payback from the replacement of these boilers is longer, but still recommended to avoid frequent maintenance and emergency replacement in case of failure.

ECM 6: Replacing the 250 hp boiler from the 1970 wing with a newer, more efficient boiler will present an energy savings of approximately 20%. It is recommended that this boiler is replaced as it approaches the end of its useful life. The payback from the replacement of this boiler is longer, but still recommended to avoid frequent maintenance and emergency replacement in case of failure.

ECM 7, 8, 9: Replacing the air handling units that are approaching the end of their useful life typically presents an energy savings of 10-15% based on the increased efficiency of newer units. The replacement of these units is recommended despite the longer payback period in order to limit excessive maintenance and to prevent emergency replacement.

ECM 10: Upgrading to DDC (direct digital) controls from pneumatic controls will allow for the most recent energy management strategies to be incorporated into the building's operation. Healthcare facilities that switch from pneumatic to DDC typically see an average energy savings of 5-15% with an estimated implementation cost of $2.50/ square foot. Since the replacement of all controls in the facility is a major upgrade to the facility and pricing may vary based on the type of system, further evaluation is recommended in order to determine exact costs of the system. Upgrading to a more modern controls system is recommended, however, in order to better control the building and reduce overall energy consumption.

ECM 11: Retro-commissioning is the act of commissioning an existing building to identify opportunities for energy conservation and areas where the building systems are not operating at their design conditions. Buildings typically benefit from retro-commissioning and see an average energy savings of 5% through small "fine-tuning" of the building systems such as re-balancing, calibration of sensors, and testing of air dampers to ensure they are opening and closing properly. The typical payback period for retro-commissioning is 0-5 years based on the relatively low cost to perform the measure and the anticipated savings of the measure.

DER ANALYSIS

The DER CAM modeling tool was used to model the energy load profiles of the facility and run an optimization of potential distributed energy resources based on economic impact to the facility. This modeling software has thousands of input variables that allows the user to input hourly load profiles throughout the course of a year, custom utility rates, custom costs and specifications of energy technologies, as well as desired outcomes in terms of the facility's energy outlook.

Several optimizations were run to determine the most cost effective technology that fits the profile of the facility. The three scenarios below indicate the energy impacts of installing a PV system, PV system with battery storage, and a CHP system and their associated economic impacts on the facility.

DER ANALYSIS SUMMARY TABLE

	BASE CASE	OPTION 1	OPTION 2	OPTION 3
Suggested DER Technologies	-	725 kW	1.8 MW PV 850kW/ 7000kWh	250 kW MT CHP
DER CAM Optimization Inputs		*PV Only*	Battery Storage	*PV Disabled*
ANNUAL ENERGY CONSUMPTION & CARBON EMISSIONS				
Electric Purchase from Grid (kWh)	3,579,647	2,419,476	957,469	1,423,096
Peak Electric Demand from Grid (kW)	-	-	-	-
Monthly Electric Demand (kW)	-	-	-	-
On-Site Electric Generation	-	1,190,100	3,044,988	2,162,915
Natural Gas Usage (MMBtu)	54,740	54,740	54,740	83,016
Carbon Emissions (MT)	3,391	3,235	3,039	4,606
Electric Savings (kWh)	-	1,160,171	2,622,178	2,156,551
Natural Gas Savings (MMBtu)	-	0	0	-28,275
Carbon Emisisons Savigns (MT)	-	155	351	-1,215
ECONOMIC ANALYSIS				
Electric Costs	$276,716	$187,032	$74,015	$110,009
Natural Gas Costs	$129,524	$129,524	$129,524	$196,428
Total Energy Costs	$406,240	$316,556	$203,539	$306,437
Total Energy Cost Savings	-	$89,684	$202,701	$99,803
Estimated Maintenance Cost Savings	-	-$13,050	-$25,200	-$23,792
Estimated DER Cost	-	$1,450,000	$4,449,000	$544,000
Estimated Incentives	-	$253,750	$2,030,000	$0
Net DER Cost	-	$1,196,250	$2,419,000	$544,000
Payback Period (Years)	-	15.6	13.6	7.2
Net Present Value	-	$509,886	$1,525,877	$1,135,660
Internal Rate of Return	-	4.9%	6.1%	13.7%

$0.011/kWh maintenance CHP
$2,176/kW total installed CHP
$18/kW maintenance solar PV
NYS PV incentive $0.35/W
$1.72/W installed solar PV > 1 MW
Assume $750/ton absorption chiller
Battery Storage Sizing & Costs taken from 2019 cost data & available sizing
NYS Battery Incentive $200/kWh

The economic variables that were used to evaluate the options are as follows:

Net present value (NPV) is a method to determine the current value of all future cash flows during the project's lifespan, including initial capital investment. The higher the NPV, the greater the net return on investment is.

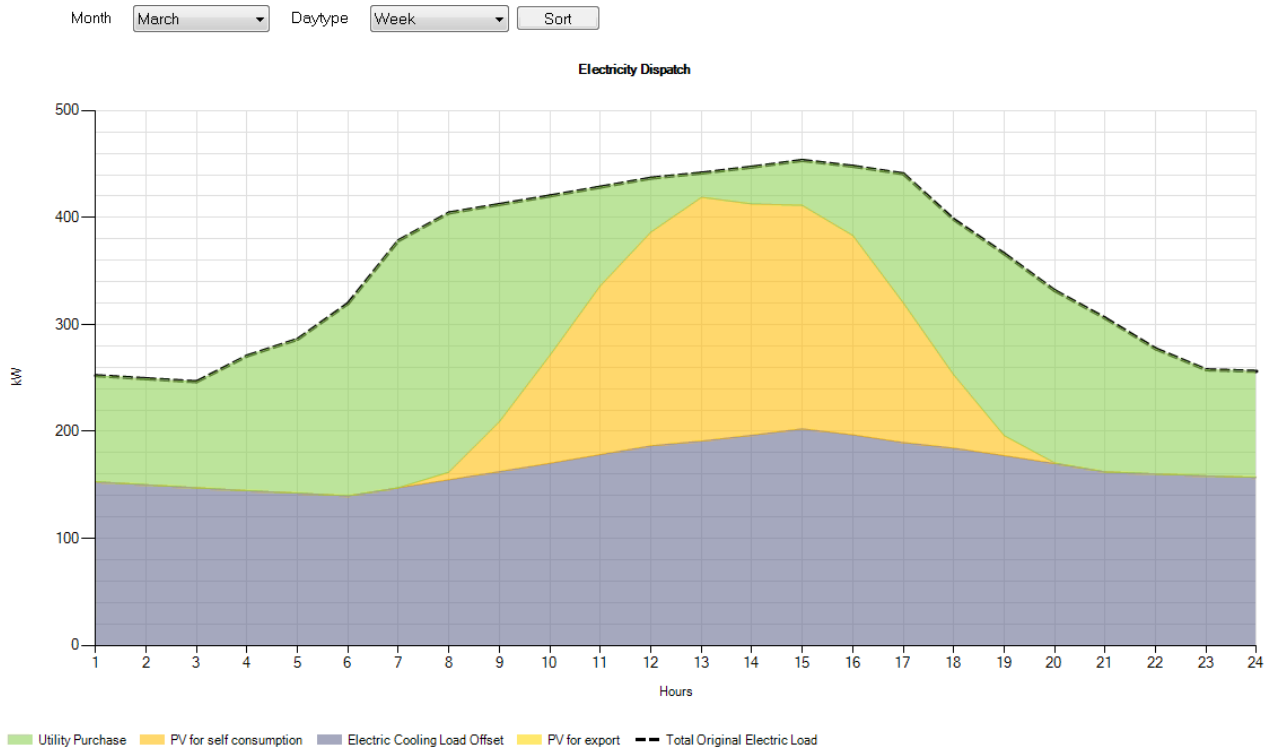
Internal Rate of Return (IRR) is the equivalent percentage increase or decrease in value of an investment over a set period. It is calculated by taking the difference between the expected value and original value, divided by the original value multiplied by 100.

Payback Period is the number of years it takes for the savings to equal the initial investment of the capital investment.

Option 1 entails the installation of a 725 PV-only system. The location of the PV system is dependent on there being available space on site or on additional property that can be used for net-metering. There are currently incentives for solar installations, as reflected in the table above.

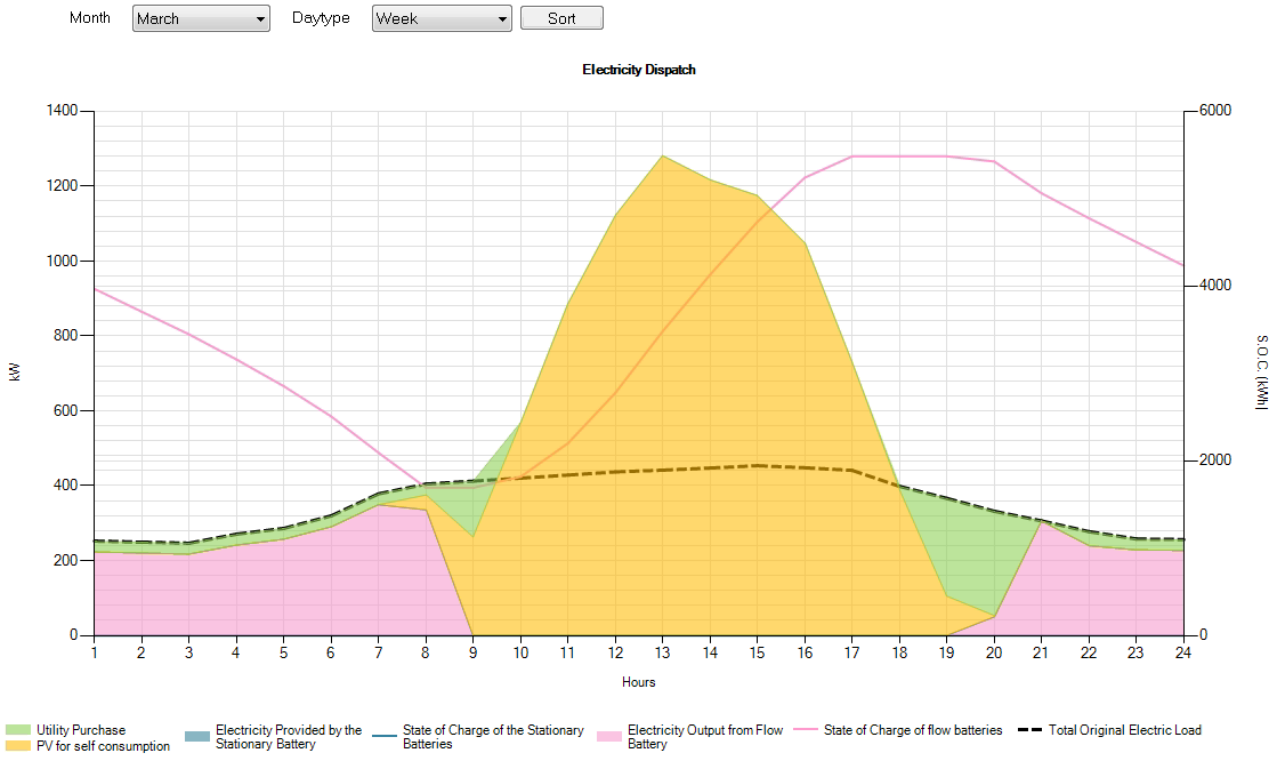
The load profile shown below was generated using the DER CAM software and illustrates the solar generation and electricity purchased from the grid over the course of a 24-hour period. The DER CAM software was used to simulate the optimum sizing of a PV-only system with the assumed load profiles for a hospital in the northeastern United States.

The green region indicated electricity purchased from the grid, yellow indicates electricity generated from PV, and blue indicates the electric cooling load offset.



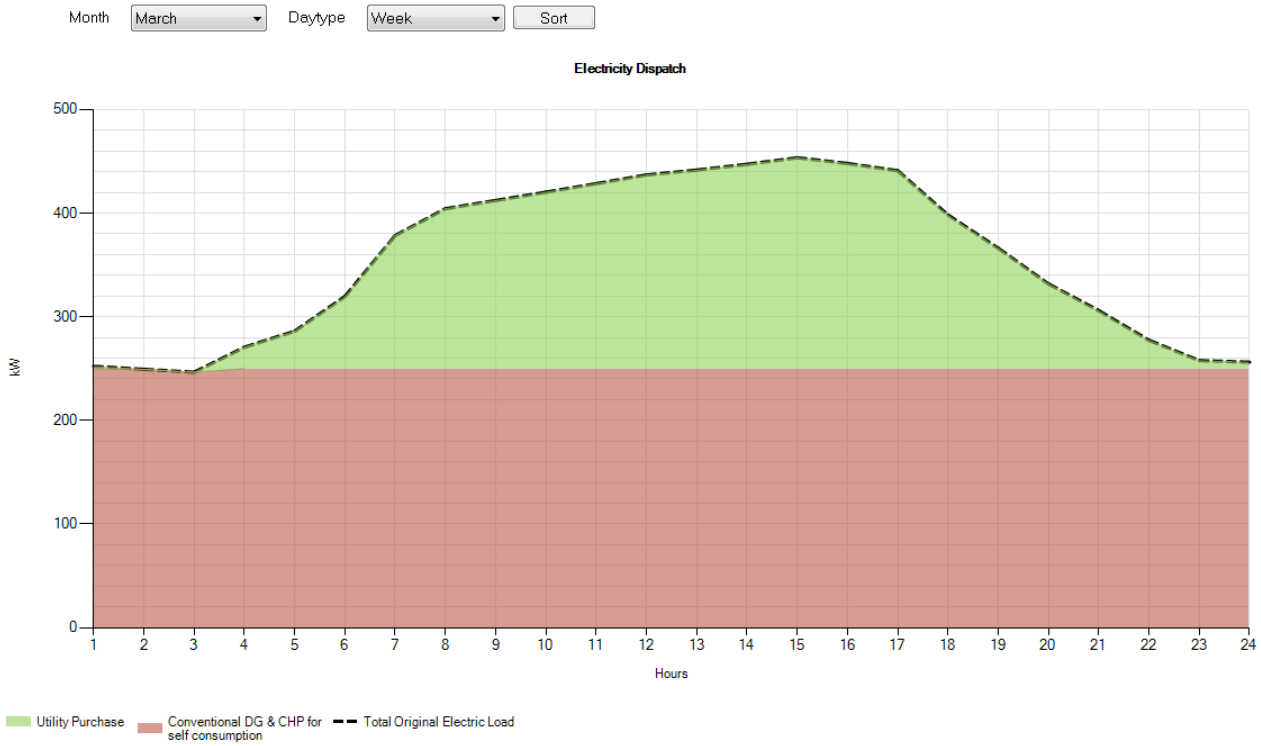
Option 2 entails the installation of a 1.8 MW PV system and 850 kW/ 7000 kWh of flow battery storage. The location of the PV system is dependent on there being available space on site or on additional property that can be used for net-metering. There are currently incentives for solar installations, as reflected in the table above.

The graph below indicates the DER CAM simulated load profile energy distribution – where the battery charges through PV generation and discharges at night to reduce the amount of electricity needed from the grid.



Option 3 entails the installation of a 250 kW combined heat and power system (CHP) that generates a majority of the facility's electric load. CHP generators are essentially electric generators that run off of natural gas and use the waste heat from generation to help meet the building's heating loads. Since hospitals need waste heat year-round for steam generation and other heating loads, CHP is a good candidate for this application. In addition, CHP has a small footprint relative to PV.

The graph below shows the daily load profile of the facility from the DER CAM outputs. The green shaded area indicated electricity purchased from the grid and the red shaded are indicates electricity generated from the CHP plant.



RECOMMENDATIONS

Based on the energy conservation analyses and DER analyses, the following actions are recommended in order to maximize economic return on investment:

Recommended Measures:

-Install VFD on 5 hp chilled water pump

- Install VSD on 10 hp condenser water pump

- Replace (2) 150 hp 1958 HW boilers

- Replace 250 hp 1970 HW boiler

- Replace AHU-6 makeup air unit

- Replace constant volume RTU serving 1992 addition ICU

- Replace RTU serving 1991 addition radiology

- Retro-Commissioning of entire facility

- Install 250 kW micro-turbine CHP generation plant

Implementing these measures will increase the facility's energy efficiency as well as increase resiliency to help protect from power interruptions.

The analyses in this report are high-level in nature and are intended to identify the most economically attractive options. Further investigation into these measures to confirm their feasibility may be necessary before installation.

The following measure are recommended for further evaluation in order to confirm their feasibility and economic impact on the facility:

Measures Recommended for Further Evaluation:

- Replace 240 ton chiller with variable speed chiller

- Utilize free cooling in cooling tower with bypass in rooftop MER

- Upgrade to electric DDC controls from pneumatic

SITE-SPECIFIC INVESTIGATION REPORT

CORTLAND COUNTY: J.M. MURRAY

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NOTE:

The energy analyses in this report are high-level in nature. All recommendations made in this report require further verification before being implemented.

FACILITY DESCRIPTION

J.M. Murray is a manufacturing facility in Cortland, NY that consists of a mix of office spaces and high-bay manufacturing spaces. This facility employs approximately 100 people, and it offers people with disabilities the opportunity to obtain meaningful employment in a community-based work environment while also teaching them valuable skills, improving their self-esteem, and enriching their lives.

The standard operating hours for the facility are between the hours of 8AM to 5PM, Monday through Friday. The total square footage of the facility is 23,000 ft^2; of which 11,000 ft^2 consists of office space.

In the high-bay manufacturing space there are six electric injection molding machines. These machines are used to produce various products such as dental floss cases, toothbrush handles, and plastic cutlery. The Bristling Room is a partitioned area in the manufacturing space. Finishing and packaging are completed in this space. In another similar partitioned area referred to as the Cream Room, employees utilize several machines to fill tubes of toothpaste and other various medical creams. Another small space is used for the bottling and packaging of CBD oil for another local company.

There is ample rooftop space, as well as 19 acres that are currently mostly early succession growth.

J.M. Murray has noted occasional electric outages. They purchase their electric and natural gas supply from an ESCO and it is delivered by NYSEG.

EXISTING INFRASTRUCTURE

The manufacturing high bay space is heated through the use of (31) gas-fired Modine unit heaters. Each heater is controlled with a local thermostat. Overhead destratification fans are located throughout the high bay manufacturing spaces, and are operated 24 hours per day through the use of a VFD.

The office spaces are heated and cooled through the use of two 20 ton split variable air volume air handling units. These units are split DX cooling with gas fired heat. They operate with plenum return, and zone level single duct boxes with no reheat. The single duct boxes are Trane Vari-Trac. The zones are each supplied with a thermostat, with an average being taken across all zones to determine if they system will operate in heating or cooling mode.

The cafeteria and kitchen area is heated and cooled through the use of a packaged 20 ton rooftop unit. This unit is constant volume.

The HVAC for the Bristling Room is handled through the use of a 20 ton cooling only packaged rooftop unit.

A process chiller supports the cooling of the hydraulics for the injection molding machines.

Another process chiller supports the cooling of a machine in the Cream Room.

A cooling tower is used to support the jacketed cooling system for the injection molding machines. There is a VFD for the supply pump, but not for the cooling tower fan.

Two 40 HP air compressors utilizing VFDs provide compressed air throughout the facility.

The high bay space unit heaters are each programmed to provide nightly and weekend heating setback to 60 degrees.

LED lighting has been installed throughout the entire facility.

UTILITY DATA & CARBON EMISSIONS

J.M. Murray currently purchases electricity from Direct Energy that is supplied by NYSEG. Natural gas is supplied by NYSEG as well. They have experienced an estimated one to two power outages a year, likely due to weather conditions.

The following figures outline the electric and natural gas usages for 2019. Corresponding carbon emissions, as outlines by LEED net zero guidelines are listed as well.

UTILTY DATA & EMISSIONS SUMMARY

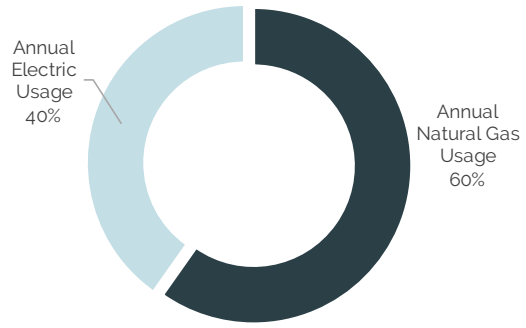
ELECTRICITY	Annual Totals				CO_2 Emissions
Annual Electric Usage	829,590	kWh	=	2,830,561 MBtu	111 Metric Tons
Peak Electric Demand	324.6	kW			
Total Monthly Electric Demand	3388.7	kW			

FOSSIL FUELS	Annual Totals				CO_2 Emissions
Annual Natural Gas Usage	4,207	MMBtu	=	4,207,000 MBtu	223 Metric Tons
Annual Propane Usage	0	gal	=	0 MBtu	0 Metric Tons
Annual #2 Fuel Oil Usage	0	gal	=	0 MBtu	0 Metric Tons
Annual Gasoline Usage	0	gal	=	0 MBtu	0 Metric Tons
ANNUAL TOTALS				**7,037,561 MBtu**	**334.1 Metric Tons**

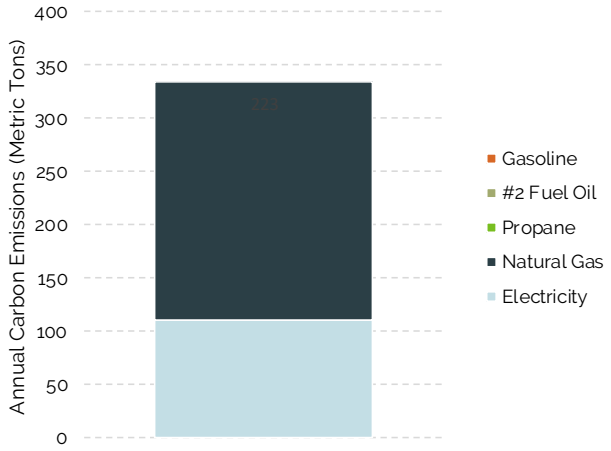
Total Annual Electric Costs	$	87,459
Total Annual Natural Gas Costs	$	24,239
Total Annual Propane Costs	$	0
Total Annual #2 Fuel Oil Costs	$	0
Total Annual Gasoline Costs	$	0
TOTAL UTILITY COSTS	**$**	**111,698**

Blended Electric Rate ($/kWh)	$	11.664
Electric Demand Rate ($/kW)	$	0.105
Incremental Electric Usage Rate ($/kWh)	$	0.058
Natural Gas Rate ($/MMBtu)	$	5.762
Propane Rate ($/gal)	$	0.000
#2 Fuel Oil Rate ($/gal)	$	0.000
Gasoline Rate ($/gal)	$	0.000

ENERGY CONSUMPTION



CARBON EMISSIONS

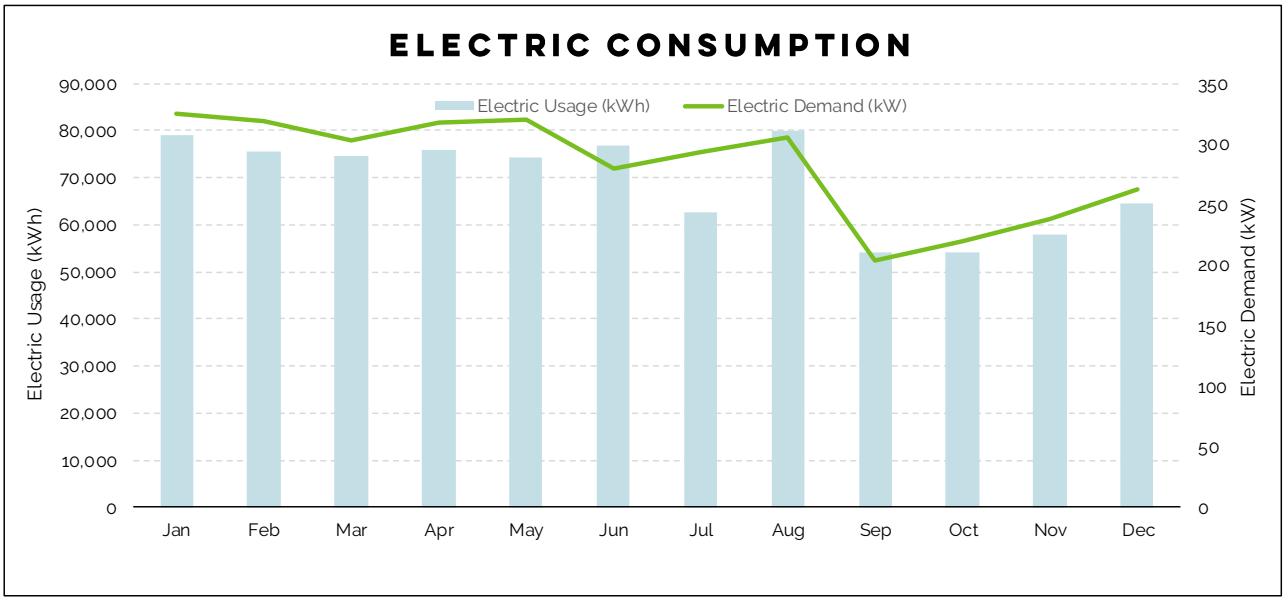


ELECTRIC UTILITY SUMMARY

Annual Electric Usage (kWh):	829,590	Electric Demand Rate ($/kW):	$	11.664
Peak Electric Demand (kW):	324.6	Blended Electric Rate ($/kWh):	$	0.105
Annual Electric Demand (kW):	3,388.7	Incremental Electric Rate ($/kWh):	$	0.058
		Total Annual Electric Costs:	$	87,459

ELECTRIC UTILITY DATA

Month-Year	Days	Usage (kWh)	Peak Demand (kW)	Demand Cost	Demand Rate ($/kW)	Commodity Cost	Delivery Cost	Total Cost	Blended Rate
Fiscal Year 2019									
Jan-19	31	78,999	324.6	$3,786	$11.66	$3,924	$4,122	$8,046	$0.102
Feb-19	28	75,524	319.4	$3,725	$11.66	$3,751	$3,799	$7,550	$0.100
Mar-19	31	74,488	303.6	$3,541	$11.66	$3,700	$3,751	$7,451	$0.100
Apr-19	30	75,916	318.3	$3,713	$11.66	$3,771	$4,029	$7,800	$0.103
May-19	31	74,184	320.8	$3,742	$11.66	$3,685	$4,278	$7,963	$0.107
Jun-19	30	76,910	279.9	$3,265	$11.66	$3,820	$3,903	$7,723	$0.100
Jul-19	31	62,756	292.9	$3,416	$11.66	$3,117	$4,169	$7,286	$0.116
Aug-19	31	80,024	305.3	$3,561	$11.66	$3,975	$4,515	$8,490	$0.106
Sep-19	30	54,103	204.2	$2,382	$11.66	$2,687	$3,030	$5,717	$0.106
Oct-19	31	54,197	219.7	$2,563	$11.66	$2,692	$3,174	$5,866	$0.108
Nov-19	30	57,947	237.6	$2,771	$11.66	$2,878	$3,487	$6,366	$0.110
Dec-19	31	64,542	262.4	$3,061	$11.66	$3,206	$3,996	$7,201	$0.112
		829,590	**3,388.7**	**$39,525**	**$11.66**	**$41,206**	**$46,254**	**$87,459**	**$0.105**



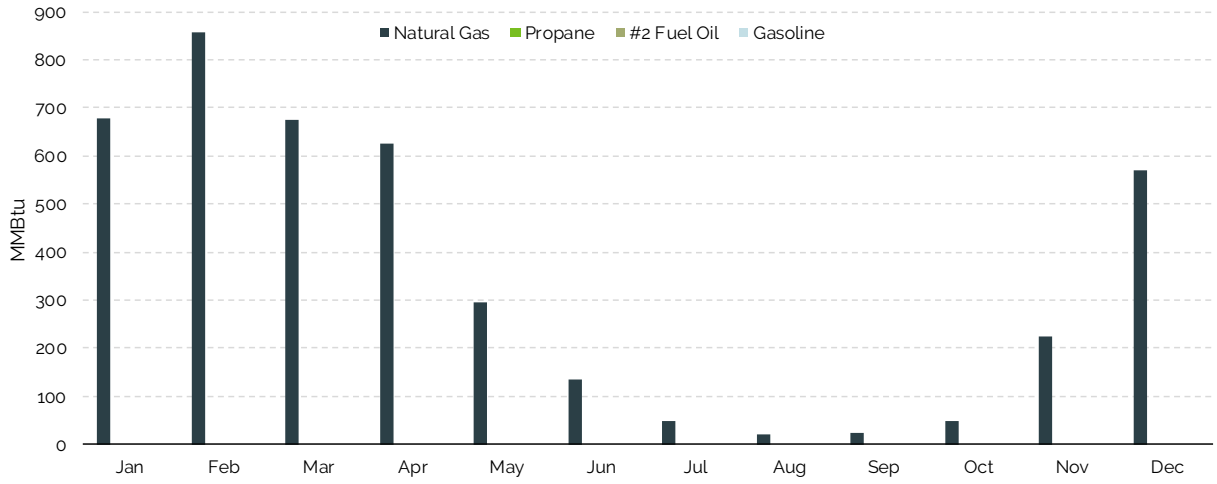
FOSSIL FUELS UTILITY SUMMARY

Natural Gas Usage (MMBtu):	4,207	Natural Gas Rate ($/MMBtu):	$ 5.762
Propane Usage (gal):	0.0	Propane Rate ($/gal):	$ 0.000
#2 Fuel Oil Usage (gal):	0.0	#2 Fuel Oil Rate ($/gal):	$ 0.000
Gasoline Usage (gal):	0.0	Gasoline Rate ($/gal):	$ 0.000

FOSSIL FUELS UTILITY DATA

Month-Year	Days	Natural Gas Usage (MMBtu)	Propane Usage (gal)	#2 Fuel Oil Usage (gal)	Gasoline Usage (gal)	Natural Gas Costs	Propane Costs	#2 Fuel Oil Costs	Gasoline Costs
Fiscal Year 2019									
Jan-19	31	680	0	0	0	$4,806	$0	$0	$0
Feb-19	28	857	0	0	0	$4,778	$0	$0	$0
Mar-19	31	676	0	0	0	$3,376	$0	$0	$0
Apr-19	30	627	0	0	0	$2,989	$0	$0	$0
May-19	31	296	0	0	0	$1,585	$0	$0	$0
Jun-19	30	135	0	0	0	$814	$0	$0	$0
Jul-19	31	48	0	0	0	$488	$0	$0	$0
Aug-19	31	21	0	0	0	$406	$0	$0	$0
Sep-19	30	25	0	0	0	$414	$0	$0	$0
Oct-19	31	48	0	0	0	$481	$0	$0	$0
Nov-19	30	225	0	0	0	$1,307	$0	$0	$0
Dec-19	31	569	0	0	0	$2,795	$0	$0	$0
		4,207	**0**	**0**	**0**	**$24,239**	**$0**	**$0**	**$0**

FOSSIL FUEL CONSUMPTION



EMISSIONS SUMMARY SHEET

Annual Electric Consumption

Annual Usage	Units	CO_2 (lbs)	CH_4 (lbs)	N_2O (lbs)
829,590	kWh	244,480	17.4	2.5

Annual Natural Gas Consumption

Annual Usage	Units	CO_2 (lbs)	CH_4 (lbs)	N_2O (lbs)
4,207	MMBTU	492,219	9,255.4	925.5

Annual Propane Consumption

Annual Usage	Units	CO_2 (lbs)	CH_4 (lbs)	N_2O (lbs)
0	gal propane	0	0.0	0.0

Annual #2 Fuel Oil Consumption

Annual Usage	Units	CO_2 (lbs)	CH_4 (lbs)	N_2O (lbs)
0	gal #2 oil	0	0.0	0.0

Annual Gasoline Consumption

Annual Usage	Units	CO_2 (lbs)	CH_4 (lbs)	N_2O (lbs)
0	gal gasoline	0	0.0	0.0

Not including transportation usage.

Emissions from Transportation

		CO_2 (lbs)	CH_4 (lbs)
150	Full Time Equivalent Employees	795,600	33,990
15	Average Commute Distance (miles)		
5	Days per Week	N_2O (lbs)	
2	Trips per day	6,798	
52	Weeks per Year		
Bus	Mode of Transportation		

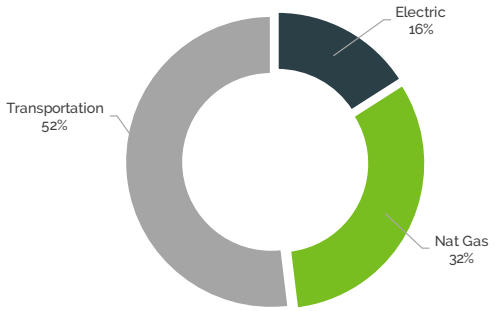
Site Emissions Factors

		CO_2	CH_4	N_2O	
Electricity					
1 kWh	=	0.2947	2.1E-05	3E-06	lbs
Natural Gas					
1 MMBTU	=	117	2.2	0.22	lbs
1 MBTU	=	0.117	0.0022	0.00022	lbs
1 kBTU	=	0.117	0.0022	0.00022	lbs
1 therms	=	11.7	0.22	0.022	lbs
1 decatherms	=	1.17	0.022	0.0022	lbs
1 CF Natural Gas	=	0.117	0.0022	0.00022	lbs
1 MCF Natural Gas	=	0.000117	2.2E-06	2.2E-07	lbs
Other Fuels					
1 gal #2 oil	=	22.7	0.92	0.18	lbs
1 MMBTU #2 oil	=	163.1	6.6	1.3	lbs
1 MMBTU propane	=	12.6	0.6	0.12	lbs
1 gal propane	=	138.3	6.6	1.3	lbs
1 gal gasoline	=	19.3	0.8	0.2	lbs

Transportation Emissions Factors

Mode	CO2 lbs/mile
Walk, Bike, Telecommute	0
Motorcycle	0.26
Heavy Rail	0.33
2-3 Carpool	0.39
Light Rail	0.44
Alternative Fuel Vehicle	0.44
Bus	0.68
Car (solo)	0.93

CARBON EMISSIONS SOURCES



SUM of Total Emissions

	CO_2	CH_4	N_2O
lbs	1,532,299	43,263	7,726
kg	694,920	19,620	3,504
Tons (US)	766	22	4
Metric Tons	695	10	2

Emissions Equivalencies

102 Houses Energy Use

183 Cars Removed from the Road

306 Acres of Trees Planted

ENERGY CONSERVATION

Three energy conservation measures were identified as suitable for this facility. The table below outlines a summary of the estimated energy savings as well as the estimated cost of installation. Descriptions of the ECM are included below as well and calculations are included in Appendix A.

ECM SUMMARY TABLE

ECM	Measure Decription	Electric Savings (kWh)	Electric Cost Savings	Natural Gas Savings (therms)	Natural Gas Cost Savings	Total Cost Savings	Cost of Installation	Payback Period	Recommendation
1	Cooling Tower Fan VFD	1,140	$ 120	-	-	$ 120	$1,200	10	R
2	Overhead Radiant Heaters	-	-	523	$ 3,013	$ 3,013	$17,000	6	R
3	New Office RTUs	59,328	$6,229	-	-	$6,229	$30,000	5	R

Notes:
FE = Further Evaluation Needed, based on combination with other DERs.
R = Recommended
NR = Not Recommended
Demand Savings estimated based on ratio of calculated electric usage savings.

ECM 1: Addition of a VFD to the Process Cooling Tower Fan

The injection molding machines utilize a jacketed cooling system. The machines are cooled by a liquid-cooled process chiller. The cooling tower for the system is located on the roof of the facility.

Cooling towers typically have three methods of cooling the condenser water: running water through the tower, operating the spray pump which sprays the condenser coil with water droplets to provide cooling via evaporation, and a fan that blows outside air over the condenser water coil. The addition of a variable frequency drive to the fan motor would allow the fan to operate at lower speeds when full speed is not necessary, optimizing the efficiency of the fan.

ECM 2: Replacing the Unit Heaters in Receiving Area with Overhead Radiant

Gas-fired unit heaters are currently being utilized in a high-bay area with a total of (5) overhead loading dock doors. These doors are opened many times throughout the day, causing a large increase in the heat required due to infiltration of cold air.

A more efficient alternative to the existing unit heaters is using a radiant heating system. Overhead gas fired radiant tubes with aluminum heat shields are commonly used in this application. The efficiency comes from the radiant heaters heating the concrete slab, and the heat is more concentrated near the floor of the space, where employees are. The unit heater relies on providing heat by heating the air, and the temperature gradient throughout the space is such that the hottest air is near the ceiling of the space, providing less heat to the employees near the floor level.

ECM 3: Replacing the Office RTUs with RTUs of Higher Efficiency

The office space is currently heated and cooled with split RTUs. Modern day RTUs consist of inverter driven scroll compressors. These compressors are truly modulating, and can offer cooling optimization. The new RTUs will be outfitted with a true VAV fan, with a static pressure sensor located in the ductwork to modulate the fan through a VFD when the spaces do not require full cooling.

DER ANALYSIS

The DER CAM modeling tool was used to model the energy load profiles of the facility and run an optimization of potential distributed energy resources based on economic impact to the facility. This modeling software has thousands of input variables that allow the user to input hourly load profiles throughout the course of a year, custom utility rates, custom costs and specifications of energy technologies, as well as desired outcomes in terms of the facility's energy outlook.

Several optimizations were ran to determine the most cost effective technology that fits the profile of the facility. The four scenarios below indicate the energy impacts of installing a ground mount PV system, a ground mount PV system with battery storage, a ground mount PV system with geothermal wells, as well as a CHP system and their associated economic impacts on the facility.

DER ANALYSIS SUMMARY TABLE

	BASE CASE	OPTION 1	OPTION 2	OPTION 3	OPTION 4
Suggested DER Technologies	-	358 kW PV	558 kW PV 200kW/ 1000kWh Battery Storage	350 kW CHP	360 kW PV 310 ton Geothermal System
ANNUAL ENERGY CONSUMPTION & CARBON EMISSIONS					
Electric Purchase from Grid (kWh)	829,590	374,774	144,499	0	549,350
Peak Electric Demand from Grid (kW)	324	243	72	0	243
Monthly Electric Demand (kW)	3,389	2,258	432	0	2,204
On-Site Electric Generation	-	587,107	914,328	829,590	589,904
Natural Gas Usage (MMBtu)	4,207	4,207	4,207	10,181	370
Carbon Emissions (MT) w/o transportation	335	274	243	541	93
Electric Savings (kWh)	-	454,816	685,091	829,590	280,240
Natural Gas Savings (MMBtu)	-	0	0	-5,974	3,837
Carbon Emisisons Savigns (MT) (before carbon offset)	-	61	92	-207	242
ECONOMIC ANALYSIS					
Electric Costs	$87,459	$39,351	$15,172	$0	$57,682
Natural Gas Costs	$24,239	$24,241	$24,241	$58,664	$2,132
Total Energy Costs	$111,698	$63,592	$39,413	$58,664	$59,814
Total Energy Cost Savings	-	$48,106	$72,285	$53,034	$51,884
Estimated Maintenance Cost Savings	-	-$6,444	-$14,544	-$9,125	-$15,883
Net Savings		$41,662	$57,741	$43,908	$36,001
Estimated DER Cost	-	$644,400	$1,533,900	$761,600	$2,498,005
Estimated Incentives	-	$125,300	$395,300	$0	$498,000
Net DER Cost	-	$644,400	$1,138,600	$761,600	$2,000,005
Payback Period (Years)	-	15.5	19.7	17.3	55.6
Net Present Value	-	$283,021	$151,560	$217,437	($1,170,305)
Internal Rate of Return	-	4.9%	3.0%	4.0%	-3.6%

$0.011/kWh maintenance CHP
$2,176/kW total installed CHP
$18/kW maintenance solar PV
NYS PV incentive $0.35/W
$1.72/W installed solar PV > 1 MW
Assume 10 outages per year, $5,000 each in production losses
Carbon offset credit rate: $1.80/MT
Carbon emissions savings do not take into consideration transportation costs or carbon offset credits.
Assume 90% of existing natural gas usage is due to space heating.

The economic variables that were used to evaluate the options are as follows:

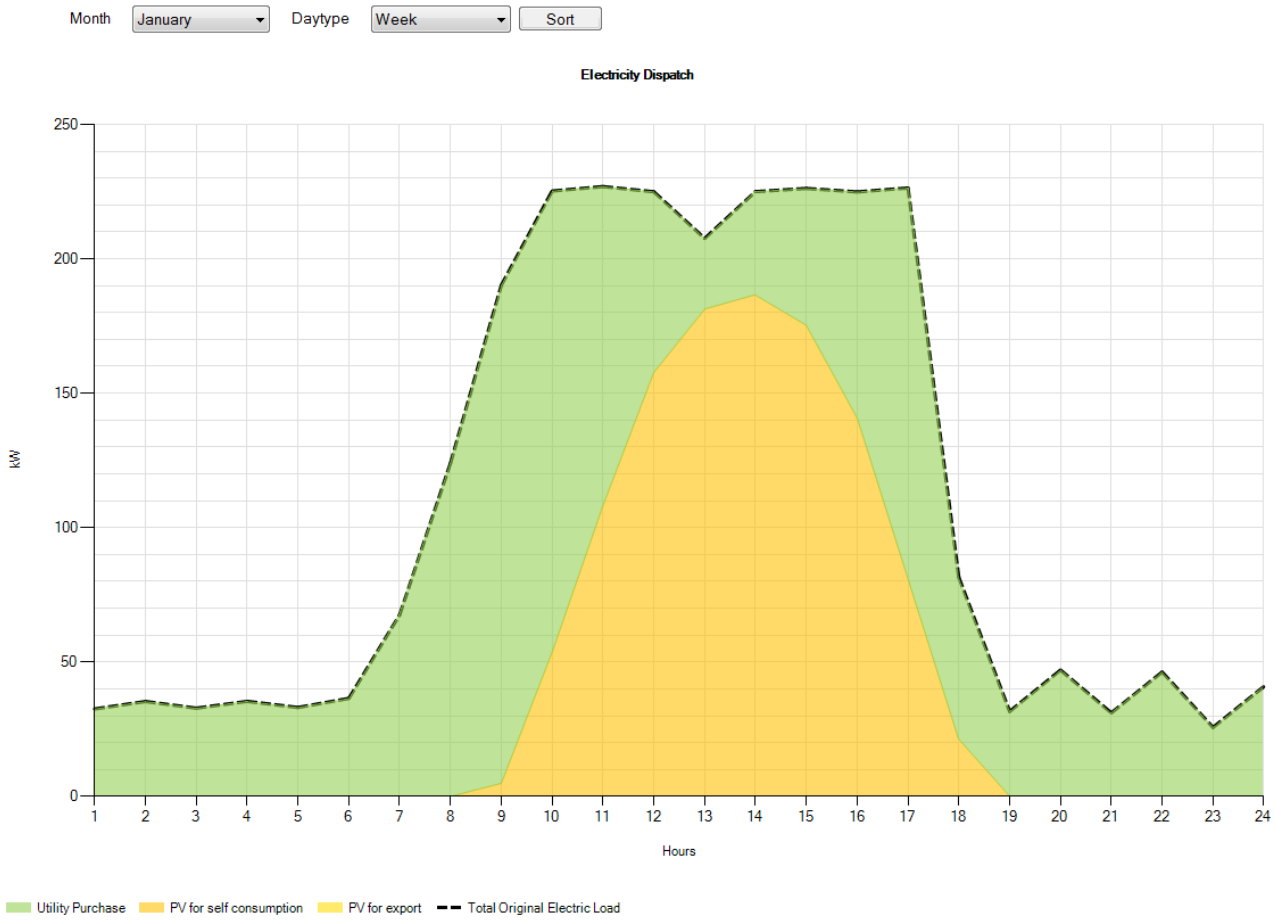
Net present value (NPV) is a method to determine the current value of all future cash flows during the project's lifespan, including initial capital investment. The higher the NPV, the greater the net return on investment is.

Internal Rate of Return (IRR) is the equivalent percentage increase or decrease in value of an investment over a set period. It is calculated by taking the difference between the expected value and original value, divided by the original value multiplied by 100.

Payback Period is the number of years it takes for the savings to equal the initial investment of the capital investment.

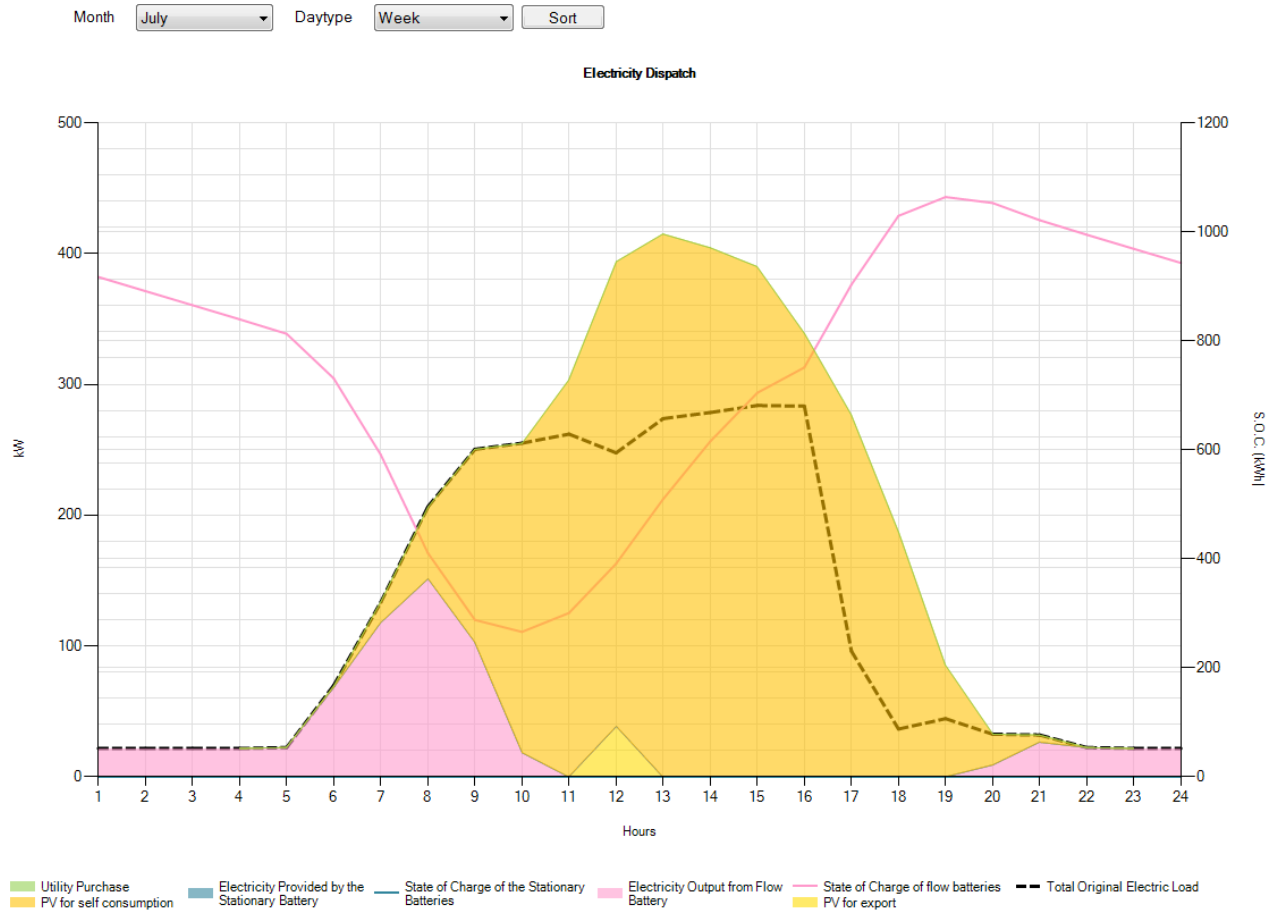
Option 1 entails the installation of a 358 kW PV system to provide supplemental electricity to the facility. The recommended installation of the solar panels are either ground-mount or on the rooftop- as long as the structural analysis deems the rooftop suitable for a rooftop PV system.

Solar arrays in New York State currently qualify for incentive dollars- lowering the estimated payback period to 15.5 years. The figure below shows the proposed load profile over the course of a 24 hour period. Note that due to the majority of the electric load being process loads, the load profile was assumed to be relatively flat. This option would help reduce energy costs and increase the facility's resiliency, but it would not completely eliminate issues associated with unexpected power outages throughout the year.



Option 2 entails the installation of a 558 kW PV system as well as 200 kW/1000 kWh flow batteries for energy storage. This option would require the solar panels to be placed on the ground and have the battery storage located nearby on the same meter. As in option 1, JM Murray would have the option to locate the panels on a separate property and use net-metering to offset the energy usage at the main site.

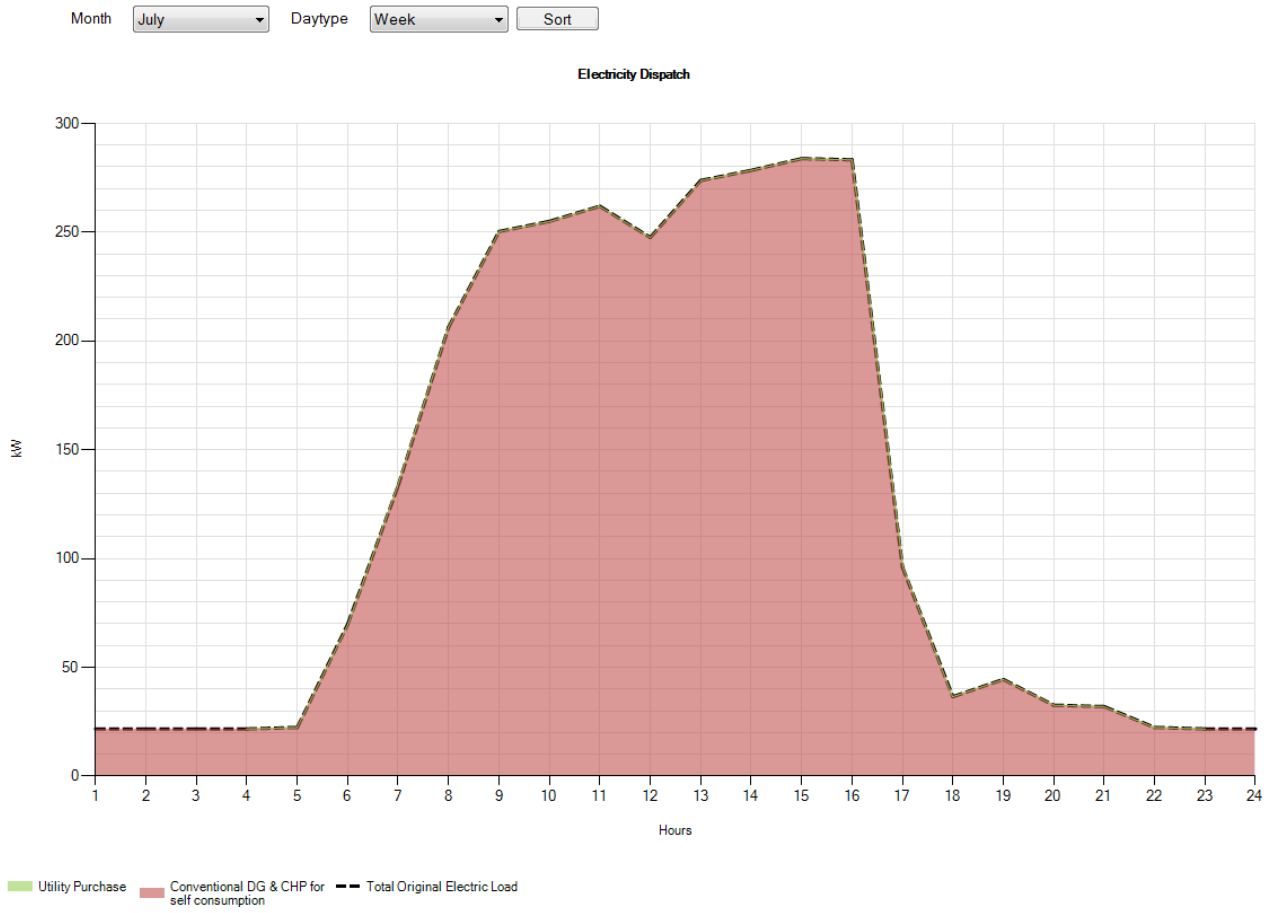
Both the solar panels and energy storage qualify for NYS incentives. In addition, if located on-site, the battery storage would increase the facility's resiliency and eliminate losses in production due to power outages. The load profile below illustrates production by PV, charging and discharging of the battery storage, and electricity purchased from the grid.



Option 3 entails the installation of a 350 kW combined heat and power (CHP) system as well as replacement water-to-water heat pumps to replace the gas-fired heaters in the shop area. A CHP system is an on-site natural gas-powered generator that uses the waste heat from generation to heat a hot water loop that can in turn be used to heat the building.

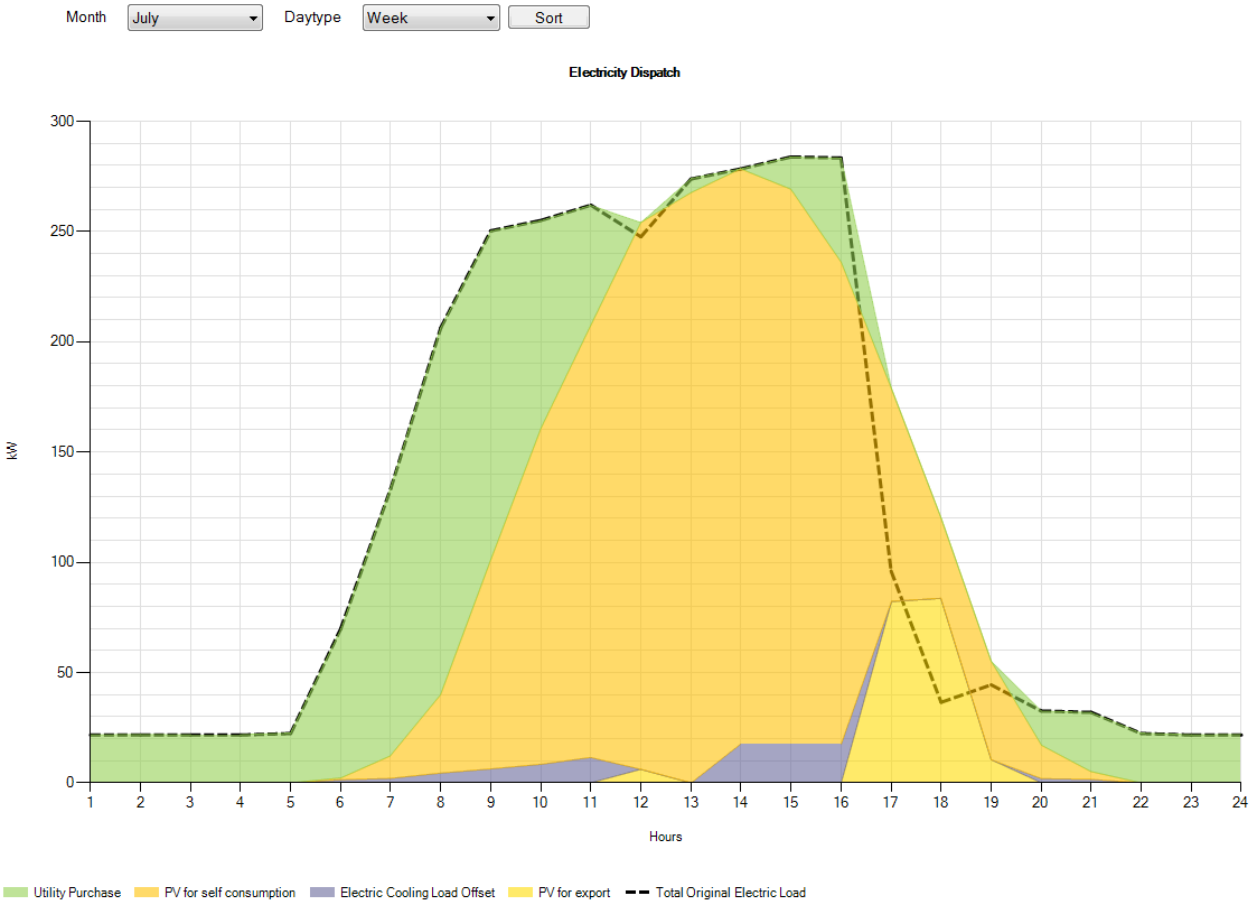
The benefits to a CHP system includes reduces energy costs as well as increased facility resiliency. Since the CHP system is powered from natural gas, the carbon footprint of the facility would increase by approximately 207 metric tons per year.

The graph below indicates the estimated daily load profile for a CHP system. The CHP system is expected to produce 100% of the facility's electricity.



Option 4 entails the installation of 360 kW of PV and a 310 ton geothermal heating system. The geothermal heating loop would consist of numerous bore-holes as well as heat pumps to provide heat to the building. The water is pumped through the vertical bore-holes deep in the ground and uses the heat from the earth as a natural heat exchanger to heat the water. Once the water is pumped through the wells, it is re-circulated to the building loop and can be used to heat the building using heat pumps. This type of system typically replaces hot water boilers, but can also be used if gas-fired heating equipment is replaced with water-to-water heat pumps. This would eliminate most of the natural gas heating in the facility, which will save an estimated 242 metric tons of carbon emissions per year.

The electric load profile is shown below and mirrors the load profile for option 1, which has the same size PV system, but does not include the geothermal heating system.



RECOMMENDATIONS

Based on the energy conservation analyses and DER analyses, the following actions are recommended in order to maximize economic return on investment:

-Install a VFD for the process cooling tower fan

-Replace the unit heaters in the receiving area with overhead radiant heaters

-Replace the office RTUs with newer, more efficient RTUs.

-Install 358 kW ground-mount or rooftop PV system

Several other measures were noted, however they may not provide a feasible payback, or they are simply operational changes. These measures are listed below:

A maintenance schedule could be created on a bi-weekly basis to complete compressed air piping walk-downs, to check for leaking fittings and connections. A bi-monthly pressure test of the compressed air piping would also be beneficial to check for leaks. A leaking compressed air system can cause the air compressors to operate longer or more frequently than required.

An updated DDC building management system would also be beneficial, however would likely be costly and typically provides a payback greater than 20 years The benefit to a building management system would not only improve energy efficiency, but would also benefit from an operational perspective.

The (5) overhead doors in the receiving area could be replaced with fast-opening doors. These new doors would cut down on cold air infiltration, as well as likely provide a better seal than the existing doors. Due to the limited number of openings per day (estimated 10 times per day), this measure is recommended, but will not present a positive return on investment. According to the International Energy Conservation Code (IECC), high-speed garage doors typically do not begin to present positive cash flow unless the doors open a minimum of 55 times per day.

Implementing these measures will increase the facility's energy efficiency as well as increase resiliency to help protect from interruptions in production from power outages.

The analyses in this report are high-level in nature and are intended to identify the most economically attractive options. Further investigation into these measures to confirm their feasibility may be necessary before installation.

APPENDIX A: ECM CALCULATIONS

ECM 1 CALCULATIONS

Description: VFD on cooling tower fan for the process cooling loop.

Totals:

Electric Savings (kWh)	Electric Cost Savings	Total Cost Savings	Cost of Installation	Payback Period
1,140	$ 120	$ 120	1,200	10.0

Assumptions:

1) Estimated approximate vintage of cooling tower as 2010.

Blended Electric Rate ($/kWh): $ 0.105

Community College

Climate	Measure Unit Savings (kWh/hp)				
	CW Pump	CHW Pump	HW Pump	Return Fan	Su
Albany	606	683	497	429	
Binghamton	716	682	496	510	
Buffalo	663	631	460	471	
Massena	553	835	383	390	
NYC	419	399	290	293	
Poughkeepsie	464	441	321	325	
Syracuse	539	513	373	380	

ADD VFD TO PROCESS COOLING TOWER

Existing											Proposed		
Unit	Building	Model No	Fan HP[2]	Vintage	Current Age (Years)	ASHRAE Expected Useful Lifespan	Estimated Original Efficiency[1]	Estimated Current Efficiency	Estimated Full Load Hours Per Year[3]	Annual Electric Consumption (kWh)	Estimated Unit Savings (kWh/hp)[1]	Proposed Annual Electric Consumption (kWh)	Estimate Installatio Cost
Cooling Tower	J.M. Murray	N/A	3	2010	10	20	86.0%	76.0%	2,080	6,123	380	4,983	$ 1,2

1) Used data from the NYS Public Service Commission Manual that most closely represents the cooling needs of J.M. Murray

2) Received HP data from Advantage Process Chilled Water Systems Specifications

3) Estimated by using the need for constant cooling at 8 hour shifts for a full year

ECM 2 CALCULATIONS

Description: Install overhead radiant heaters to efficiently heat the area in the receiving space that contains five overhead doors.

Totals:

Natural Gas Savings (therms)	Natural Gas Cost Savings	Total Cost Savings	Cost of Installation	Payback Period
523	$ 3,013	$ 3,013	17,000	5.6

Natural Gas Rate ($/therm): $ 5.762

Assumptions:

1) Assumed approximate area of receiving dock.
2) Radiant heater is approximately 23% more efficient by heating slab in areas with a high ceiling level.

Equations Used:

Annual Gas Energy Savings

$$\Delta therms = units \times \left(\frac{kBTUh_{in}}{unit}\right) \times \left(\frac{\eta_{ee}}{\eta_{baseline}} - 1\right) \times \left(\frac{EFLH_{heating}}{100}\right)$$

Receiving Area (FT^2)	Heat Load (BTU/HR)	$EFLH_{Heating}$	Efficiency of Unit Heater	Efficiency of Overhead Radiant Heaters	Annual gas savings (therms)	Annual Savings	Total Project Cost
2400	144000	1023	0.72	0.95	523	$ 3,012.8	$17,000

ECM 3 CALCULATIONS

Description: Replace existing RTUs that serve the office space with newer RTUs with higher efficiency.

Totals:

Electric Savings (kWh)	Electric Cost Savings	Total Cost Savings	Cost of Installation	Payback Period
59,328	$ 6,229	$ 6,229	30,000	4.82

Blended Electric Rate ($/kWh): $ 0.105

Assumptions:

1) Approximate age of existing AHU is mid 1990s.
2) Proposed RTU EER = 13
3) Assumed reduction in maintenance = $240/year

Existing												Proposed			Estimate Reductio in Mainter nce Cos
Unit/Location	Building		Capacity (tons)	Vintage	ASHRAE Expected Useful Lifespan	Original Heating Efficiency	Assumed Original EER	Estimated Decrease in Overall Efficiency	$EFLH_{htg}$	$EFLH_{clg}$	Annual Electric Consumption (kWh)	Proposed Cooling EER	Annual Electric Consumption (kWh)	Estimated Installation Cost	
RTU-01	JM Murray		20.0	1990s	15	100%	10	25%	2047	2047	240,226	13	180,898	$30,000	$ 24

SITE-SPECIFIC INVESTIGATION REPORT

DELAWARE COUNTY: DELAWARE RIVER BASIN STONE

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Facility Description....43
Existing Infrastructure....43
Utility Data & Carbon Emissions....44
Energy Conservation....47
DER Analysis....48
Recommendations....53

NOTE:

The energy analyses in this report are high-level in nature. All recommendations made in this report require further verification before being implemented.

FACILITY DESCRIPTION

Delaware River Basin Stone is a 55,000 square foot facility located in Deposit, NY that manufactures a variety of bluestone products from rock extracted from quarries. Rock is unloaded, cut into smaller pieces, extracted with a forklift, cut down again, loaded onto a processing line, torched, ripped and cut to the correct width, and cut to the specified length.

A variety of different stone products such as steps, window sills, coping, countertops, and custom products are manufactured in this facility. There are 32 employees that work at the facility across 3 shifts. The facility is in operation 24/7, 364 days a year.

The facility currently experiences an average of 24 hours of down time a year due to power outages. These outages result in a sum of approximately $50,000 in losses per year. For this reason, Delaware River Basin Stone is interested in increasing the facility's resiliency as well as reducing energy costs.

EXISTING INFRASTRUCTURE

The 55,000 square foot facility has several interconnected buildings that consist of a small office space and a large shop area used for machining the rock. The office space has central forced air for heating and cooling. The shop area is heated by gas-fired radiant tube heaters that are controlled by an analog thermostat. Due to the frequent loading and unloading of rock, the large garage doors in the shop area are typically open all of the time and the gas heaters run constantly,

In the shop area, there are several exhaust fans plus a large makeup air unit that ventilate the space 24/7. The excess process water is intentionally flooding the floor to prevent indoor air quality concerns from the dust created from the saws. Due to these concerns from the dust, the exhaust and makeup air units are running 24/7 at constant speed.

The temperature setpoint for the shop area is 40 degrees F, just high enough to prevent the process water from freezing. The office area and break room setpoints are between 68 and 72 degrees F, year round.

UTILITY DATA & CARBON EMISSIONS

Delaware River Basin Stone currently purchases electricity from Constellation Energy that is supplied by NYSEG. Natural gas is supplied by NYSEG as well.

Delaware River Basin Stone has had issues with brief electric interruptions that result in a loss of product equating to an estimated $50,000 per year. In most cases, the duration of these outages ranges from seconds to minutes, but is enough to disrupt production.

The following figures outline the electric and natural gas usages for the years 2018 and 2019. Corresponding carbon emissions, as outlines by LEED net zero guidelines are listed as well.

UTILTY DATA & EMISSIONS SUMMARY

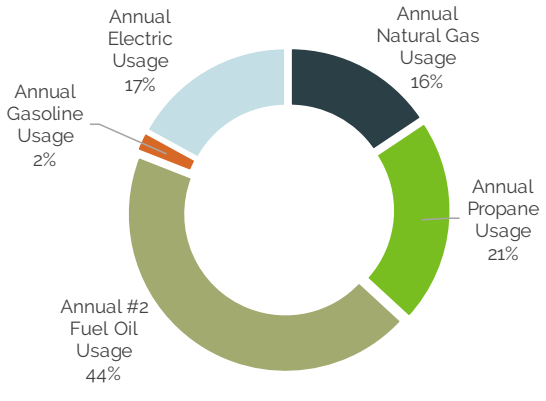
ELECTRICITY	Annual Totals				CO_2 Emissions	
Annual Electric Usage	614,987	kWh	=	2,098,334 MBtu	82	Metric Tons
Peak Electric Demand	166	kW				
Total Monthly Electric Demand	1388	kW				

FOSSIL FUELS	Annual Totals				CO_2 Emissions	
Annual Natural Gas Usage	1,925	MMBtu	=	1,924,842 MBtu	102	Metric Tons
Annual Propane Usage	28,619	gal	=	2,613,810 MBtu	1,795	Metric Tons
Annual #2 Fuel Oil Usage	38,934	gal	=	5,435,145 MBtu	400	Metric Tons
Annual Gasoline Usage	1,998	gal	=	247,751 MBtu	17	Metric Tons
ANNUAL TOTALS				**12,319,881 MBtu**	**2397.3**	**Metric Tons**

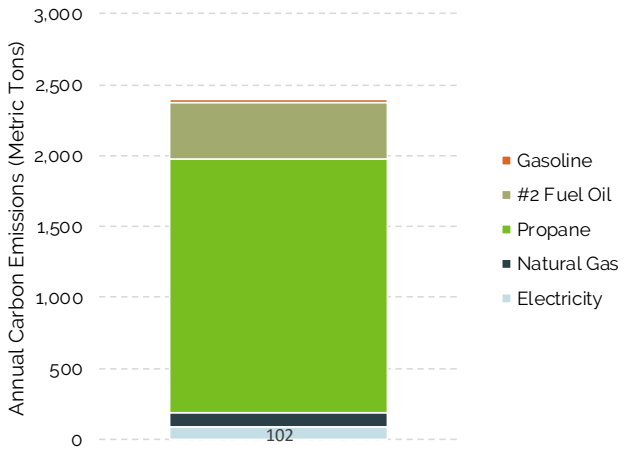
Total Annual Electric Costs	$	53,675
Total Annual Natural Gas Costs	$	10,686
Total Annual Propane Costs	$	29,973
Total Annual #2 Fuel Oil Costs	$	96,039
Total Annual Gasoline Costs	$	4,260
TOTAL UTILITY COSTS	**$**	**194,633**

Blended Electric Rate ($/kWh)	$	9.587
Electric Demand Rate ($/kW)	$	0.087
Incremental Electric Usage Rate ($/kWh)	$	0.066
Natural Gas Rate ($/MMBtu)	$	5.552
Propane Rate ($/gal)	$	1.047
#2 Fuel Oil Rate ($/gal)	$	2.467
Gasoline Rate ($/gal)	$	2.132

ENERGY CONSUMPTION



CARBON EMISSIONS

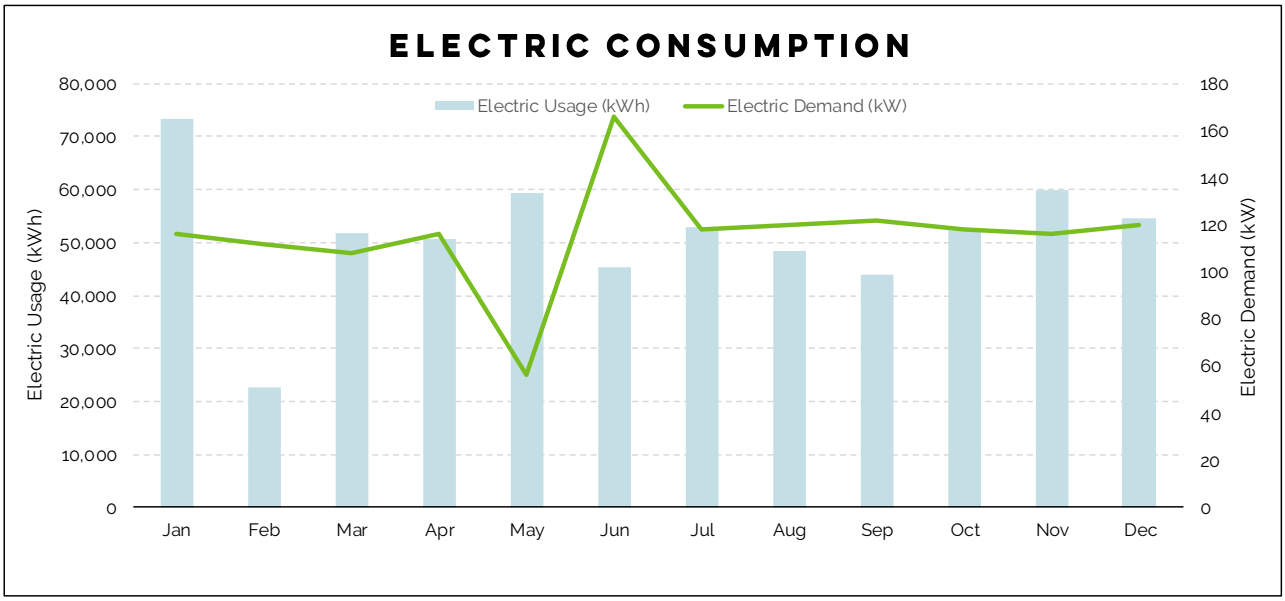


ELECTRIC UTILITY SUMMARY

Annual Electric Usage (kWh):	614,987	Electric Demand Rate ($/kW):	$	9.587
Peak Electric Demand (kW):	166.0	Blended Electric Rate ($/kWh):	$	0.087
Annual Electric Demand (kW):	1,388.0	Incremental Electric Rate ($/kWh):	$	0.066
		Total Annual Electric Costs:	$	53,675

ELECTRIC UTILITY DATA

Month-Year	Days	Usage (kWh)	Peak Demand (kW)	Demand Cost	Demand Rate ($/kW)	Commodity Cost	Delivery Cost	Total Cost	Blended Rate
Fiscal Year 2019									
Oct-18	32	52,400	118.0	$1,127	$9.55	$2,840	$1,585	$4,425	$0.084
Nov-18	32	60,000	116.0	$1,108	$9.55	$3,251	$1,557	$4,809	$0.080
Dec-18	32	54,663	120.0	$1,146	$9.55	$2,962	$1,552	$4,515	$0.083
Jan-19	29	73,212	116.0	$1,108	$9.55	$3,967	$1,719	$5,686	$0.078
Feb-19	30	22,600	112.0	$1,070	$9.55	$1,225	$1,186	$2,411	$0.107
Mar-19	31	51,712	108.0	$1,032	$9.55	$2,802	$1,650	$4,452	$0.086
Apr-19	30	50,641	116.0	$1,108	$9.55	$2,744	$1,629	$4,373	$0.086
May-19	35	59,256	56.0	$532	$9.50	$3,211	$1,672	$4,884	$0.082
Jun-19	31	45,211	166.0	$1,565	$9.43	$2,450	$2,293	$4,743	$0.105
Jul-19	29	52,893	118.0	$1,160	$9.83	$2,866	$2,096	$4,962	$0.094
Aug-19	30	48,431	120	$1,151	$9.59	$2,625	$1,602	$4,227	$0.057
Sep-19	29	43,968	122.0	$1,199	$9.83	$2,383	$1,806	$4,188	$0.095
		614,987	**1,388.0**	**$13,307**	**$9.59**	**$33,327**	**$20,349**	**$53,675**	**$0.087**



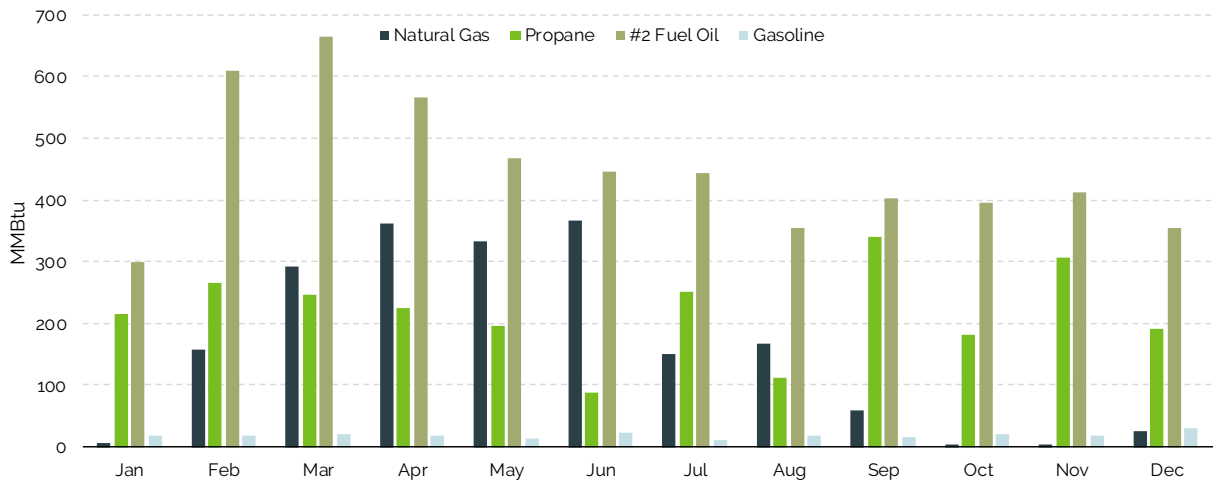
FOSSIL FUELS UTILITY SUMMARY

Natural Gas Usage (MMBtu):	1,925	Natural Gas Rate ($/MMBtu):	$ 5.552
Propane Usage (gal):	28,619.4	Propane Rate ($/gal):	$ 1.047
#2 Fuel Oil Usage (gal):	38,933.7	#2 Fuel Oil Rate ($/gal):	$ 2.467
Gasoline Usage (gal):	1,998.0	Gasoline Rate ($/gal):	$ 2.132

FOSSIL FUELS UTILITY DATA

Month-Year	Days	Natural Gas Usage (MMBtu)	Propane Usage (gal)	#2 Fuel Oil Usage (gal)	Gasoline Usage (gal)	Natural Gas Costs	Propane Costs	#2 Fuel Oil Costs	Gasoline Costs
Fiscal Year 2019									
Oct-18	32	6	2,351	2,153	153	$44	$2,462	$4,701	$326
Nov-18	32	157	2,902	4,380	166	$441	$3,040	$9,714	$355
Dec-18	32	293	2,701	4,776	183	$1,015	$2,829	$13,833	$390
Jan-19	29	363	2,470	4,067	168	$2,680	$2,586	$16,877	$357
Feb-19	30	333	2,137	3,355	115	$1,607	$2,238	$7,551	$245
Mar-19	31	367	971	3,205	200	$1,712	$1,017	$7,118	$427
Apr-19	30	149	2,742	3,191	102	$1,140	$2,872	$6,805	$217
May-19	30	167	1,211	2,547	169	$1,124	$1,268	$5,430	$361
Jun-19	31	59	3,708	2,899	129	$533	$3,883	$6,181	$275
Jul-19	29	3	1,977	2,850	186	$113	$2,071	$6,076	$396
Aug-19	30	3	3,351	2,967	156	$32	$3,509	$6,327	$333
Sep-19	29	26	2,099	2,545	271	$245	$2,199	$5,426	$578
		1,925	**28,619**	**38,934**	**1,998**	**$10,686**	**$29,973**	**$96,039**	**$4,260**

FOSSIL FUEL CONSUMPTION



ENERGY CONSERVATION

Delaware River Basin Stone has recently renovated their facility in 2016. As a part of this renovation, the facility upgraded to LED lighting, installed a variable speed pumping system intended to filter excess process water for re-use, and installed new makeup air units to provide the shop area with fresh air. The facility has already taken measures to effectively reduce the building's energy consumption- which accounts for only 33% of the total energy consumption of the facility. The remainder of the energy consumption is used for trucking and process equipment that is fueled by gasoline, diesel, and propane.

Due to the facility's low energy usage and utilization of building energy, the following operational improvements are recommended.

Automated Chemical Injection

The facility currently uses a series of chemicals that are used to separate the mud from the water so it can be re-used as process water to cool the large saw blades. The chemical injection process is currently done manually. An automated process that monitors the sediment levels in the water and automatically inserts the chemicals into the water will help reduce labor costs and improve operational efficiency.

Close Garage Doors during Winter Months

Closing the large garage doors during winter months when they are not needed to be open will help increase the indoor air temperature of the shop area and improve occupant comfort by minimizing heat loss through the doors. It was noted that the indoor setpoint of the area is 40 degrees F to ensure no process water freezes. Having the garage doors closed during periods of time when they are not in use will also reduce the heating demand of the gas-fired heaters in the shop area.

Depending on the frequency of the door openings, it may be beneficial to evaluate high-speed garage door openers that have been proven to save energy when opening in excess of 55 times per day by the International Energy Conservation Code (IECC). This is recommended for further evaluation to determine the feasibility of frequent opening and closing with the day to day operations of the facility.

DER ANALYSIS

The DER CAM modeling tool was used to model the energy load profiles of the facility and run an optimization of potential distributed energy resources based on economic impact to the facility. This modeling software has thousands of input variables that allow the user to input hourly load profiles throughout the course of a year, custom utility rates, custom costs and specifications of energy technologies, as well as desired outcomes in terms of the facility's energy outlook.

Several optimizations were ran to determine the most cost effective technology that fits the profile of the facility. The four scenarios below indicate the energy impacts of installing a ground mount PV system, a ground-mount PV system with battery storage, a ground mount PV system with geothermal wells, as well as a CHP system and their associated economic impacts on the facility.

DER ANALYSIS SUMMARY TABLE

	BASE CASE	OPTION 1	OPTION 2	OPTION 4	OPTION 3
Suggested DER Technologies	-	107 kW PV	520 kW PV 240kW/2000kWh	(2) 100 kW MT CHP	700 MBH Geothermal 107 kW PV
DER CAM Optimization Inputs		*No restraints*	Battery Storage		
ANNUAL ENERGY CONSUMPTION & CARBON EMISSIONS					
Electric Purchase from Grid (kWh)	614,987	450,339	108,177	0	450,339
Peak Electric Demand from Grid (kW)	166	101	79	0	101
Monthly Electric Demand (kW)	1,388	846	375	0	846
On-Site Electric Generation	-	175,048	506,810	614,987	175,048
Natural Gas Usage (MMBtu)	1,925	1,925	1,925	7,230	0
Carbon Emissions (MT)	185	163	117	385	60
Electric Savings (kWh)	-	164,648	506,810	614,987	164,648
Natural Gas Savings (MMBtu)	-	0	0	-5,305	1,925
Carbon Emisisons Savigns (MT)	-	22	68	-200	124
ECONOMIC ANALYSIS					
Electric Costs	$53,675	$39,179	$9,411	$0	$39,179
Natural Gas Costs	$10,686	$10,688	$10,688	$40,143	$0
Total Energy Costs	$64,361	$49,867	$20,099	$40,143	$39,179
Total Energy Cost Savings	-	$14,494	$44,262	$24,218	$25,182
Estimated Maintenance Cost Savings	-	-$1,926	-$13,860	-$6,765	-$1,926
Estimated Reduction in Production Losses from Outages	$0	$0	$50,000	$50,000	$0
Estimated DER Cost	-	$224,700	$1,792,500	$485,200	$634,675
Estimated Incentives	-	$37,450	$582,000	$0	$37,450
Net DER Cost	-	$187,250	$1,210,500	$485,200	$597,225
Payback Period (Years)	-	14.9	15.1	7.2	25.7
Net Present Value	-	$92,379	$578,647	$1,005,412	($74,887)
Internal Rate of Return	-	5.3%	5.2%	13.6%	1.0%

$0.011/kWh maintenance CHP
$2,176/kW total installed CHP
$18/kW maintenance solar PV
NYS PV incentive $0.35/W
$1.72/W installed solar PV > 1 MW
Assume 10 outages per year, $5,000 each in production losses
Geothermal system assume $6000/ton + additional $10,000 per heat pump.

The economic variables that were used to evaluate the options are as follows:

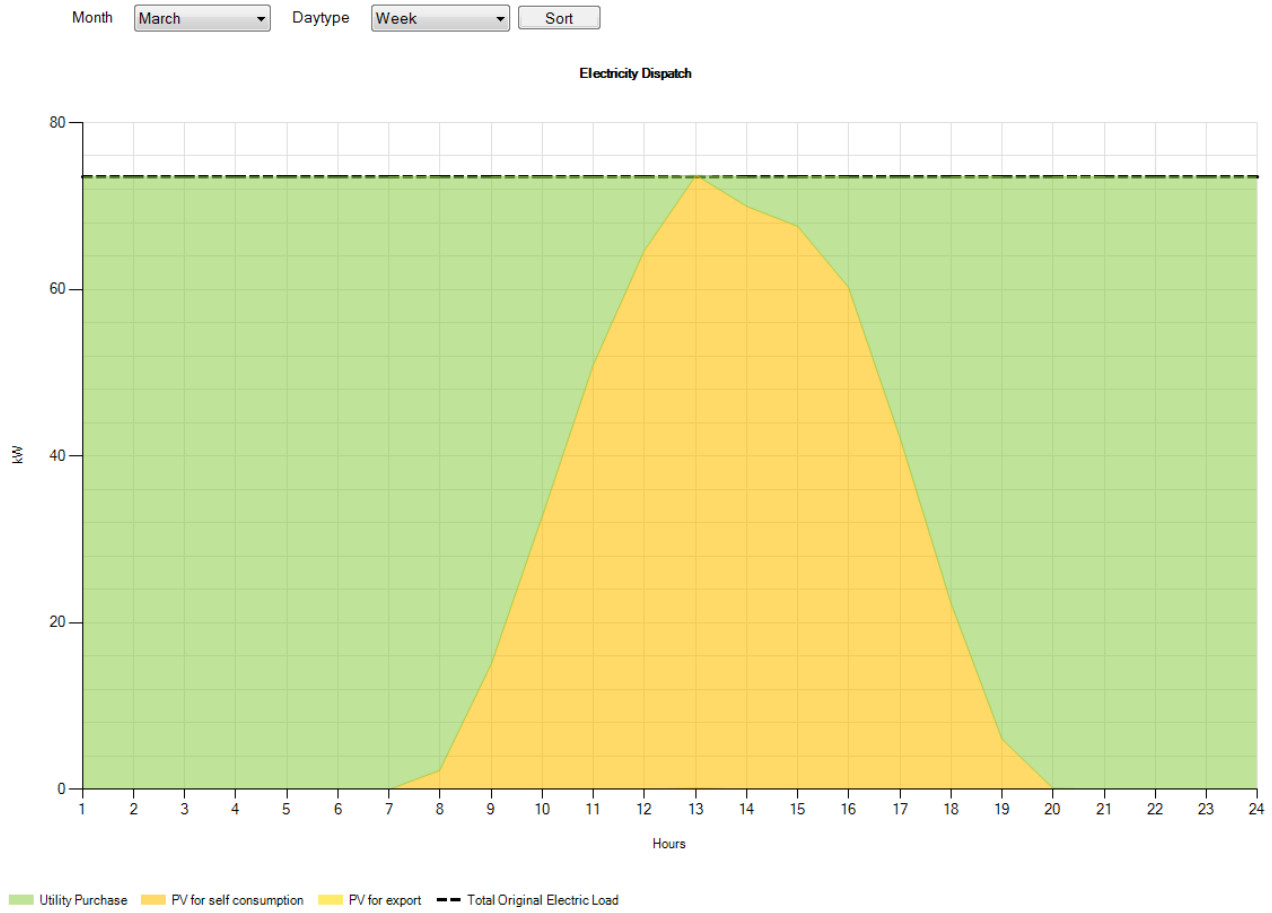
Net present value (NPV) is a method to determine the current value of all future cash flows during the project's lifespan, including initial capital investment. The higher the NPV, the greater the net return on investment is.

Internal Rate of Return (IRR) is the equivalent percentage increase or decrease in value of an investment over a set period. It is calculated by taking the difference between the expected value and original value, divided by the original value multiplied by 100.

Payback Period is the number of years it takes for the savings to equal the initial investment of the capital investment.

Option 1 entails the installation of a 107 kW PV system to provide supplemental electricity to the facility. The recommended installation of the solar panels are either ground-mount or on the rooftop- as long as the structural analysis deems the rooftop suitable for a rooftop PV system.

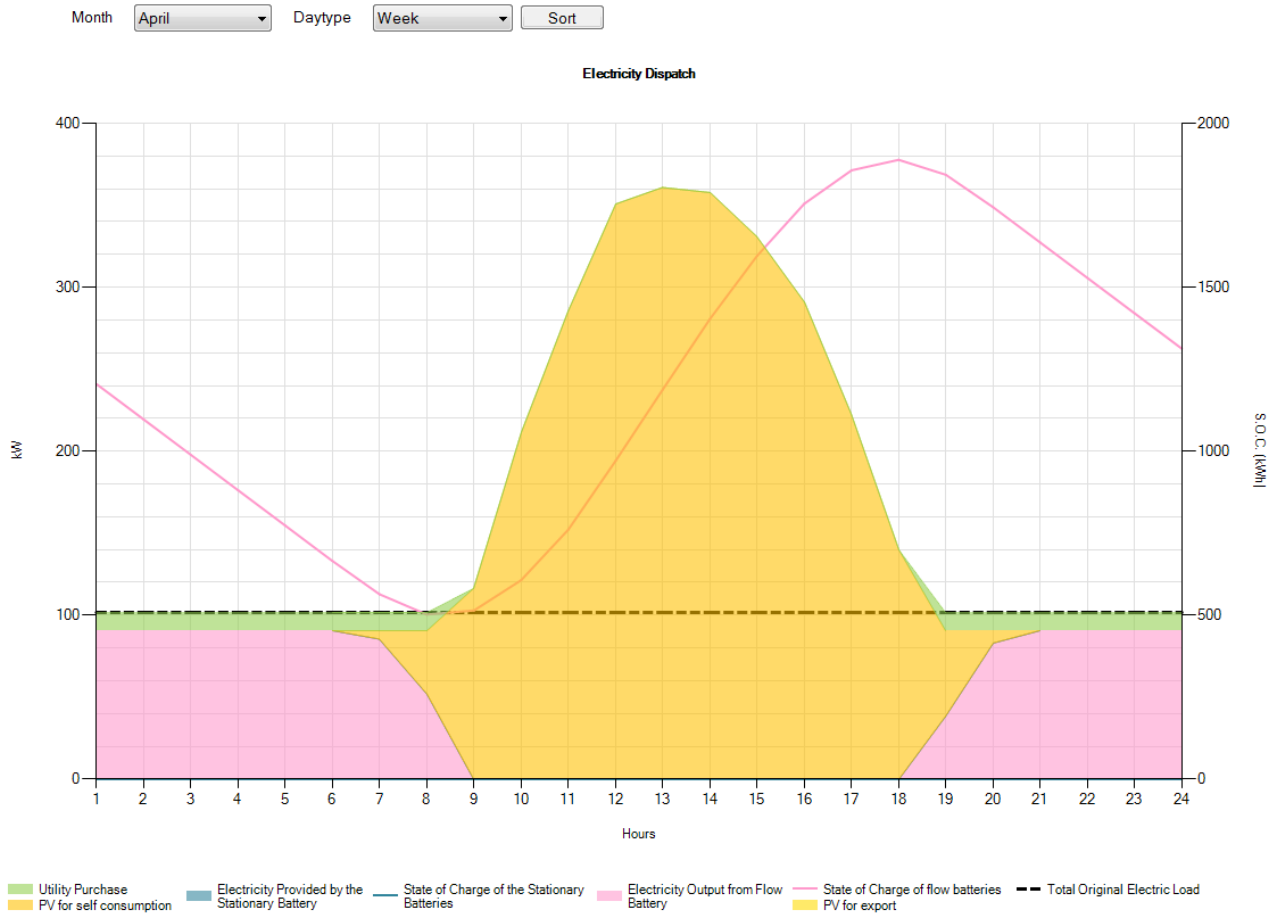
Solar arrays in New York State currently qualify for incentive dollars- lowering the estimated payback period to 14.9 years. The figure below shows the proposed load profile over the course of a 24 hour period. Note that due to the majority of the electric load being process loads, the load profile was assumed to be relatively flat. This option would help reduce energy costs and increase the facility's resiliency, but it would not completely eliminate issues associated with unexpected power outages throughout the year.



Option 2 entails the installation of a 520 kW PV system as well as 240 kW/2000 kWh flow batteries for energy storage. This option would require the solar panels to be placed on the ground and have the battery storage located nearby on the same meter. As in option 1, Delaware River Basin Stone would have the option to locate the panels on a separate property and use net-metering to offset the energy usage at the main site.

Both the solar panels and energy storage qualify for NYS incentives. In addition, if located on-site, the battery storage would increase the facility's resiliency and eliminate losses in production due to power outages. The load profile below illustrates production by PV, charging and

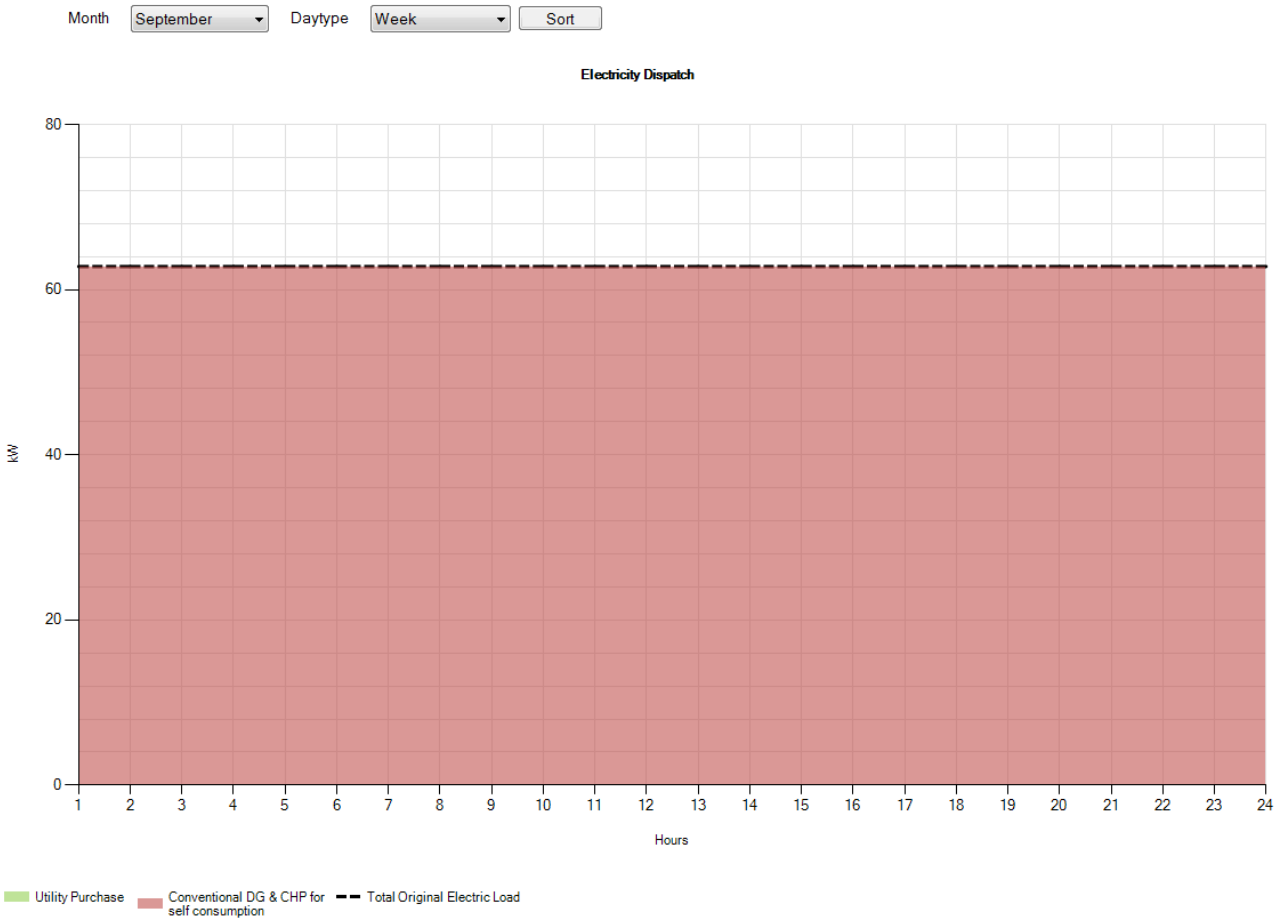
discharging of the battery storage, and electricity purchased from the grid. Since this system is not meet 100% of the load at all times, it may be necessary to shed non-essential loads in the case of an outage in order to prevent the loss of product. This can be programmed into the controls of the system.



Option 3 entails the installation of a 200 kW combined heat and power (CHP) system as well as replacement water-to-water heat pumps to replace the gas-fired heaters in the shop area. A CHP system is an on-site natural gas-powered generator that uses the waste heat from generation to heat a hot water loop that can in turn be used to heat the building.

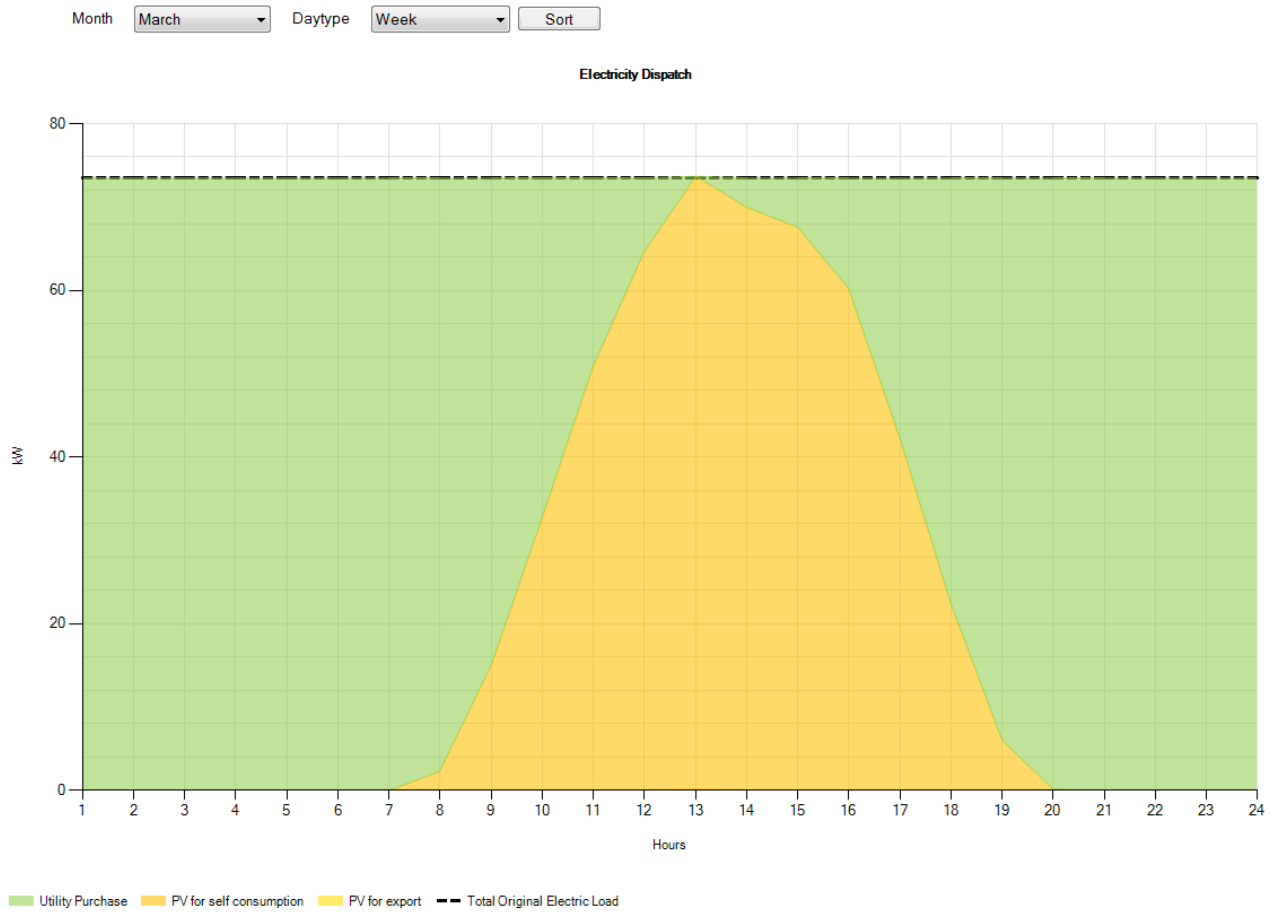
The benefits to a CHP system includes reduces energy costs as well as increased facility resiliency. Since the CHP system is powered from natural gas, the carbon footprint of the facility would increase by approximately 200 metric tons per year.

The graph below indicates the estimated daily load profile for a CHP system. The CHP system is expected to produce 100% of the facility's electricity.



Option 4 entails the installation of 107 kW of PV and a 700 MBH geothermal heating system. The geothermal heating loop would consist of numerous bore-holes as well as heat pumps to provide heat to the building. The water is pumped through the vertical bore-holes deep in the ground and uses the heat from the earth as a natural heat exchanger to heat the water. Once the water is pumped through the wells, it is re-circulated to the building loop and can be used to heat the building using heat pumps. This type of system typically replaced hot water boilers, but can also be used if gas-fired heating equipment is replaced with water-to-water heat pumps. This would eliminate most of the natural gas heating in the facility, which will save an estimated 124 metric tons of carbon emissions per year.

The electric load profile is shown below and mirrors the load profile for option 1, which has the same size PV system, but does not include the geothermal heating system.


Month
March
Daytype
Week
Sort
Electricity Dispatch
80
60
40
20
0
kW
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
Hours
Utility Purchase
PV for self consumption
PV for export
Total Original Electric Load

RECOMMENDATIONS

Based on the energy conservation analyses and DER analyses, the following actions are recommended:

Energy Conservation/ Operational improvements

- Install automated chemical injection to limit labor requirements for water treatment system

- Close large garage doors during winter months when possible to limit heat loss and improve indoor comfort levels

DERs

Based on the DER analyses, the most cost effective option to provide supplemental power generation as well as increase resiliency is to install a 200 kW microturbine CHP generator. Doing so will reduce energy costs as well as eliminate production losses from power outages.

An alternate option that will reduce the carbon footprint of the facility while also improving the facility's resiliency is Option 2- the PV and energy storage option, despite its loner payback period and lower return on investment.

The analyses in this report are high-level in nature and are intended to identify the most economically attractive options as well as present options to reduce carbon emissions and increase facility resiliency. Further investigation into these measures to confirm their feasibility may be necessary before installation.

SITE-SPECIFIC INVESTIGATION REPORT

OTSEGO COUNTY: ONEONTA BUSINESS PARK AND RAILYARDS

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NOTE:

The energy analyses in this report are high-level in nature. All recommendations made in this report require further verification before being implemented.

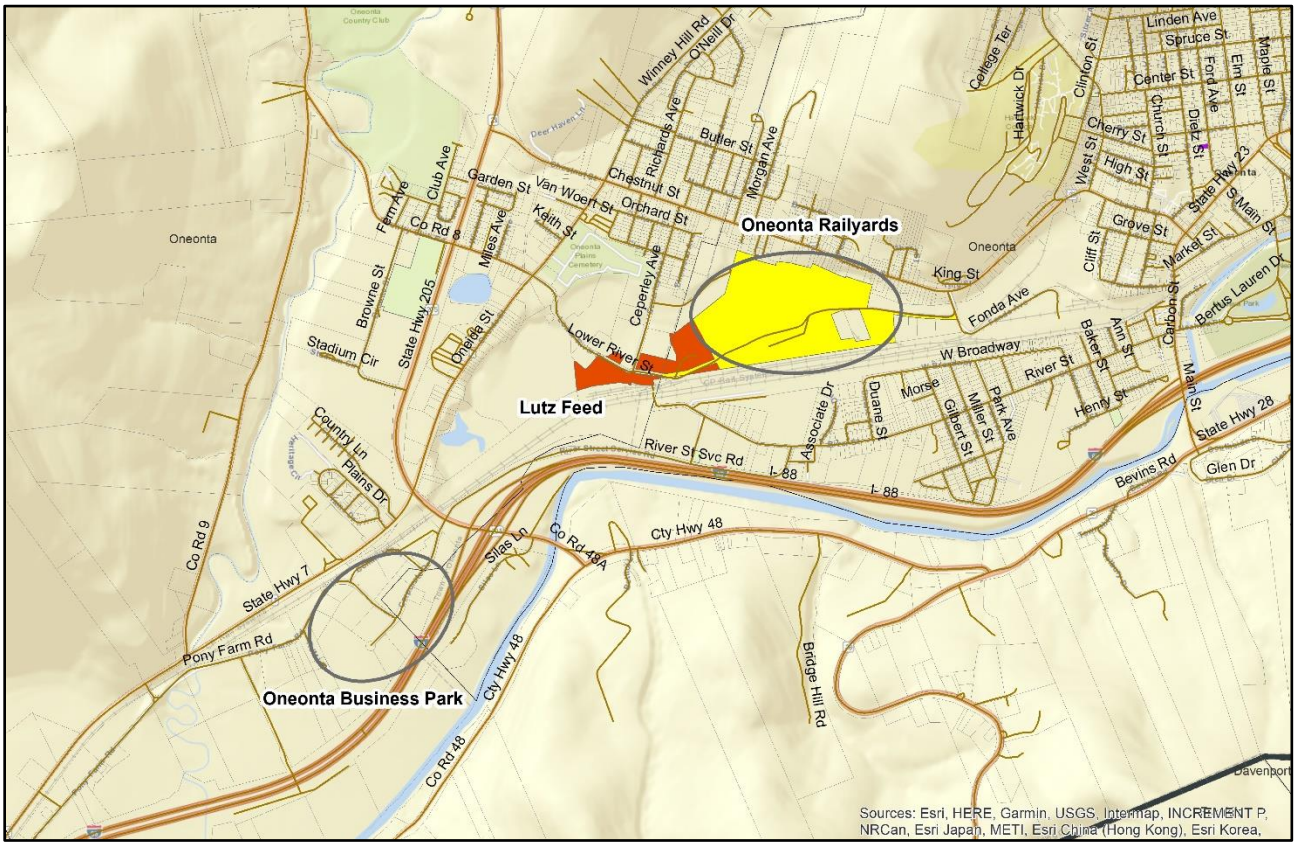
OVERVIEW

Two business parks are located in Oneonta: Oneonta Business Park and Railyards, which is currently in the process of being developed as a "shovel-ready" site. Natural gas service is currently provided to the Oneonta Business Park, however, NYSEG's natural gas customers in the business park are subject to interruptible service agreements.

In a survey of 7 facilities fed from the DeRutyer line between 2013 and 2018, a total of 4,167 hours of natural gas interruption were recorded, which equates to (173) days over the course of five winters. The limited gas supply has prevented some clients from moving to the business park in fear of not being able to adequately supply their business' energy needs.

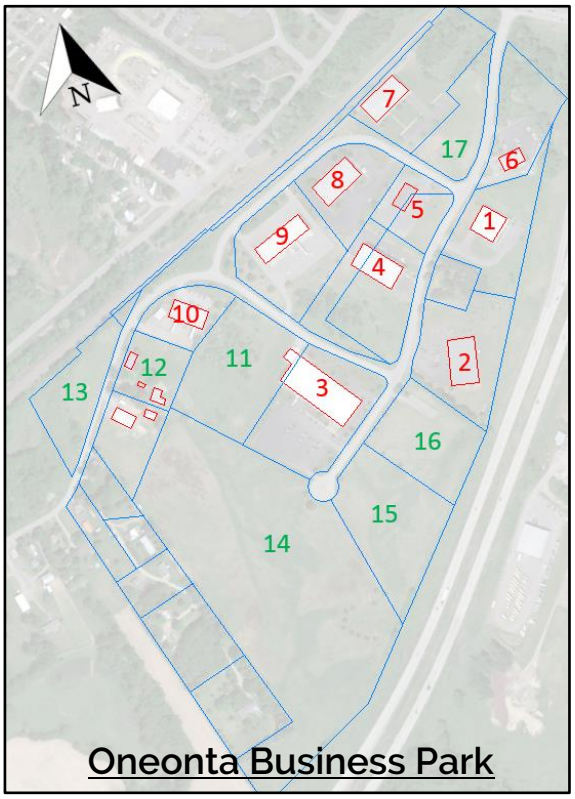
Although natural gas lines are present at the Oneonta Railyards, Otsego Now is not certain about the exact locations and the potential capacity of natural gas to serve businesses at the site. Otsego Now wishes to determine the extent that renewable energy or other distributed generation approaches can reduce the need for natural gas while accommodating business development at these sites.

The image below outlines the locations of the business parks relative to each other.



CURRENT INFRASTRUCTURE

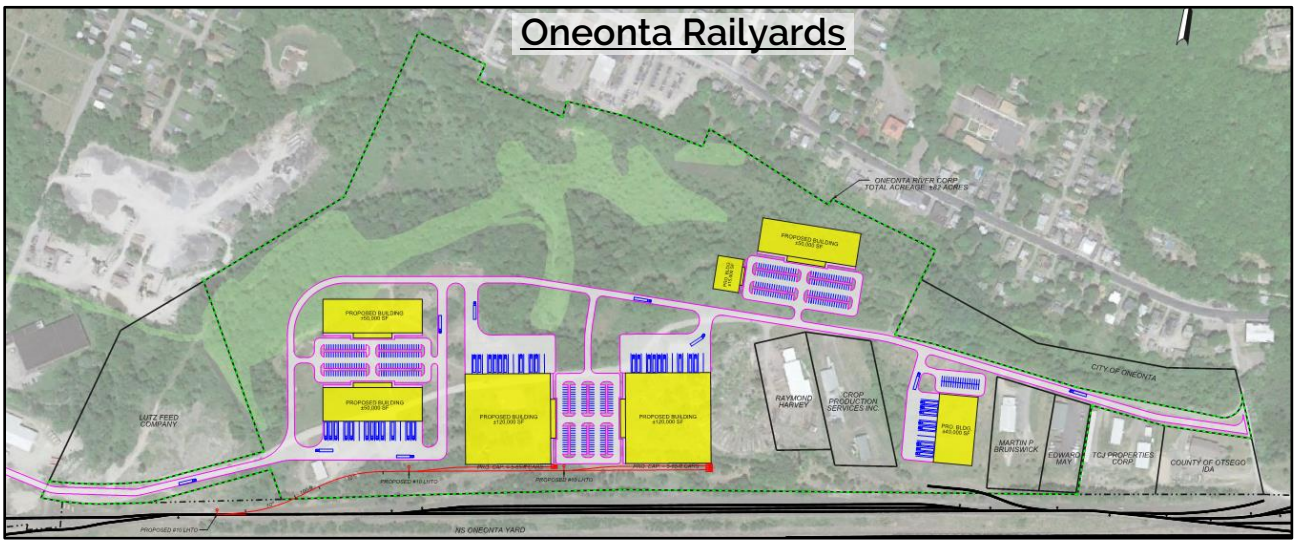
The buildings in each park and their purposes and sizes are listed below. Note that both sites have buildings that are not yet developed. The estimated purposing and size are listed for these, based on the property size and provided site plans, but may be subject to change as the sites are developed.



Oneonta Business Park Buildings

Number	Building/Property	Building Use	Estimated Square Feet
1	Green Mountain Electric Supply	Office	14,500
2	SD Optical	Design/manufactures eyewear	24,500
3	Michael Manno	Candy Wrapping	50,000
4	IOXUS	Battery Production	22,500
5	Swan Sales	Office	7,500
6	Time Warner	Commercial	6,800
7	Michael Manno	Commercial	21,500
8	B&K Coffee	Coffee Roasting	21,500
9	Hale Trans	Bus Garage	19,500
10	TS Pink	Manufacures Soap	13,000
11	Vacant Land for Sale	Light Manufacturing/Warehouse	20,000
12	Vacant Land for Sale	Light Manufacturing/Warehouse	10,000
13	Vacant Land for Sale	Light Manufacturing/Warehouse	10,000
14	Vacant Land for Sale	Light Manufacturing/Warehouse	200,000
15	Vacant Land for Sale	Light Manufacturing/Warehouse	50,000
16	Vacant Land for Sale	Light Manufacturing/Warehouse	20,000
17	Vacant Land for Sale	Light Manufacturing/Warehouse	7,500

Blue Text Indicates assumed data based on lot size and relative sizes of nearby facilities.



Railyards Buildings

Building/Property	Building Use	Estimated Square Feet
Oneonta Railyards - Proposed Building	Light Manufacturing/Warehouse	50,000
Oneonta Railyards - Proposed Building	Light Manufacturing/Warehouse	50,000
Oneonta Railyards - Proposed Building	Light Manufacturing/Warehouse	120,000
Oneonta Railyards - Proposed Building	Light Manufacturing/Warehouse	120,000
Oneonta Railyards - Proposed Building	Office	15,000
Oneonta Railyards - Proposed Building	Light Manufacturing/Warehouse	50,000
Oneonta Railyards - Proposed Building	Light Manufacturing/Warehouse	40,000
Raymond Harvey	Manufacturing	14,000
Crop Production Services, inc	Day Care	15,700
Martin P Brunswick	Restaurant/ golf simulator	7,930
Edward May	Office	5,080
TCJ Properties Corp	Private Storage	14,900
County of Otsego IDA	Office/Warehouse	8,800

Blue Text Indicates assumed data based on lot size and relative sizes of nearby facilities.

ENERGY DEMAND

Based on the building sizes and uses, the following table illustrates the estimated occupant density of each building, estimated annual energy usage and peak loads, thermal loads, and critical loads for each business. These tables are preliminary estimates and require further investigation before designing the microgrid.

Oneonta Railyards Electric Usage Data

Building #	1	2	3	4	5	6	7	8	9	10	11	12	13
Facility Name	Oneonta Railyards - Proposed Building	Oneonta Railyards - Proposed Building	Oneonta Railyards - Proposed Building	Oneonta Railyards - Proposed Building	Oneonta Railyards - Proposed Building	Oneonta Railyards - Proposed Building	Oneonta Railyards - Proposed Building	Raymond Harvey	Crop Production Services, inc	Martin P Brunswick	Edward May	TCJ Properties Corp	County of Otsego IDA
Facility Type	Office	Warehouse	Warehouse	Warehouse	Office	Office	Warehouse	Manufacturing	Day Care	Restaurant/ Golf Simulator	Office	Private Storage	Office/ Warehouse
Currently Developed?	N	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y
Parcel Acres	88.74							2	2.76	2	1.13	2	2.01
Facility Square Footage (proposed)	*50,000*	*50,000*	*120,000*	*120,000*	*15,000*	*50,000*	*40,000*	14,000	15,700	7,930	5,080	14,900	8,800
Number of occupants[1]	250	100	240	240	75	250	80	98	78.5	50	25.4	10	44
Hours of Operation/day	10	10	12	12	10	10	12	24	12	12	10	24	10
Day per Year	365	365	365	365	365	365	365	365	365	365	365	365	365
Energy Supply													
CBECS Total Mbtu/SF	99.8	35.8	35.8	35.8	99.8	99.8	35.8	35.8	82.1	249	99.8	35.8	99.8
CBECS Electric Mbtu/SF	58.3	16.7	16.7	16.7	58.3	58.3	16.7	16.7	29.7	153.5	58.3	16.7	58.3
CBECS Fuels Mbtu/SF	41.5	19.1	19.1	19.1	41.5	41.5	19.1	19.1	52.4	95.5	41.5	19.1	41.5
Electric Service Provider	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG
Annual Electric Usage (kWh)	855,000	245,000	588,000	588,000	256,500	855,000	196,000	68,600	136,590	356,850	86,868	73,010	150,480
Peak Demand (kW)[2]	350	350	840	840	105	350	280	98	109.9	55.51	35.56	104.3	61.6
Avg Load (kW)	97.6	28.0	67.1	67.1	29.3	97.6	22.4	7.8	15.6	40.7	9.9	8.3	17.2
Load Factor	0.28	0.08	0.08	0.08	0.28	0.28	0.08	0.08	0.14	0.73	0.28	0.08	0.28
Natural Gas Service Provider	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG
Natural Gas Usage (MMBtu)	2,073	954	2,290	2,290	622	2,073	763	267	823	757	211	284	365
Thermal Loads[3] Mbtu/SF	21.8	12.8	12.8	12.8	21.8	21.8	12.8	12.8	30.7	52.5	21.8	12.8	12.8
Critical Loads (Y/N)													
Heating	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Cooling	N	N	N	N	N	N	N	N	N	N	N	N	N
Lighting	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Process	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Y	N/A	N/A	N/A	N/A	N/A
Plug Loads	Y	N	N	N	Y	Y	N	Y	N	N	Y	N	N

Notes:

1) Occupancy assumed based on ASHRAE 62.1 occupancy densities for corresponding space types.

2) Assume 7 watts/sf

3) Thermal loads estimated based on 2012 CBECS data. Table E2: space heating + water heating

Oneonta Railyards Electric Usage Data

Building #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Facility Name	Green Mountain Electric Supply	SD Optical	Michael Manno	IOXUS	Swan Sales	Time Warner	Michael Manno	B&K Coffee	Hale Trans	TS Pink	Vacant Land for Sale	Vacant Land for Sale	Vacant Land for Sale	Vacant Land for Sale	Vacant Land for Sale	Vacant Land for Sale	Vacant Land for Sale
Facility Type	Office	Design/manufactures eyewear	Candy Wrapping	Battery Production	Office	Commercial	Commercial	Coffee Roasting	Bus Garage	Manufacures Soap	Light Manufacturing/ Warehouse	Light Manufacturing/ Warehouse	Light Manufacturing/ Warehouse	Light Manufacturing/ Warehouse	Light Manufacturing/ Warehouse	Light Manufacturing/ Warehouse	Light Manufacturing/ Warehouse
Currently Developed?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N	N
Parcel Acres																	
Facility Square Footage (proposed)	*14,500*	*24,500*	*50,000*	*22,500*	*7,500*	*6,800*	*21,500*	*21,500*	*19,500*	*13,000*	*20,000*	*10,000*	*10,000*	*200,000*	*50,000*	*20,000*	*7,500*
Number of occupants[1]	72.5	122.5	250	112.5	37.5	34	107.5	107.5	97.5	65	100	50	50	1000	250	100	37.5
Hours of Operation/day	10	10	10	10	10	12	10	10	10	10	10	10	10	10	10	10	10
Day per Year	365	365	365	365	365	365	365	365	365	365	365	365	365	365	365	365	365
Energy Supply																	
CBECS Total Mbtu/SF	99.8	35.8	35.8	35.8	99.8	99.8	99.8	35.8	35.8	35.8	35.8	35.8	35.8	35.8	35.8	35.8	35.8
CBECS Electric Mbtu/SF	58.3	16.7	16.7	16.7	58.3	58.3	58.3	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7
CBECS Fuels Mbtu/SF	41.5	19.1	19.1	19.1	41.5	41.5	41.5	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1
Electric Service Provider	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG
Annual Electric Usage (kWh)	247,950	120,050	245,000	110,250	128,250	116,280	367,650	105,350	95,550	63,700	98,000	49,000	49,000	980,000	245,000	98,000	36,750
Peak Demand (kW)[2]	101.5	171.5	350	157.5	52.5	47.6	150.5	150.5	136.5	91	140	70	70	1400	350	140	52.5
Avg Load (kW)	28.3	13.7	28.0	12.6	14.6	13.3	42.0	12.0	10.9	7.3	11.2	5.6	5.6	111.9	28.0	11.2	4.2
Load Factor	0.28	0.08	0.08	0.08	0.28	0.28	0.28	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Natural Gas Service Provider	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG	NYSEG
Natural Gas Usage (MMBtu)	601	467	954	429	311	282	891	410	372	248	382	191	191	3,816	954	382	143
Thermal Loads[3] Mbtu/SF	21.8	12.8	12.8	12.8	21.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8
Critical Loads (Y/N)																	
Heating	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Cooling	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Lighting	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Process	N/A	Y	Y	Y	N/A	N/A	N/A	Y	N/A	Y	Y	Y	Y	Y	Y	Y	Y
Plug Loads	Y	Y	Y	Y	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y

Notes:

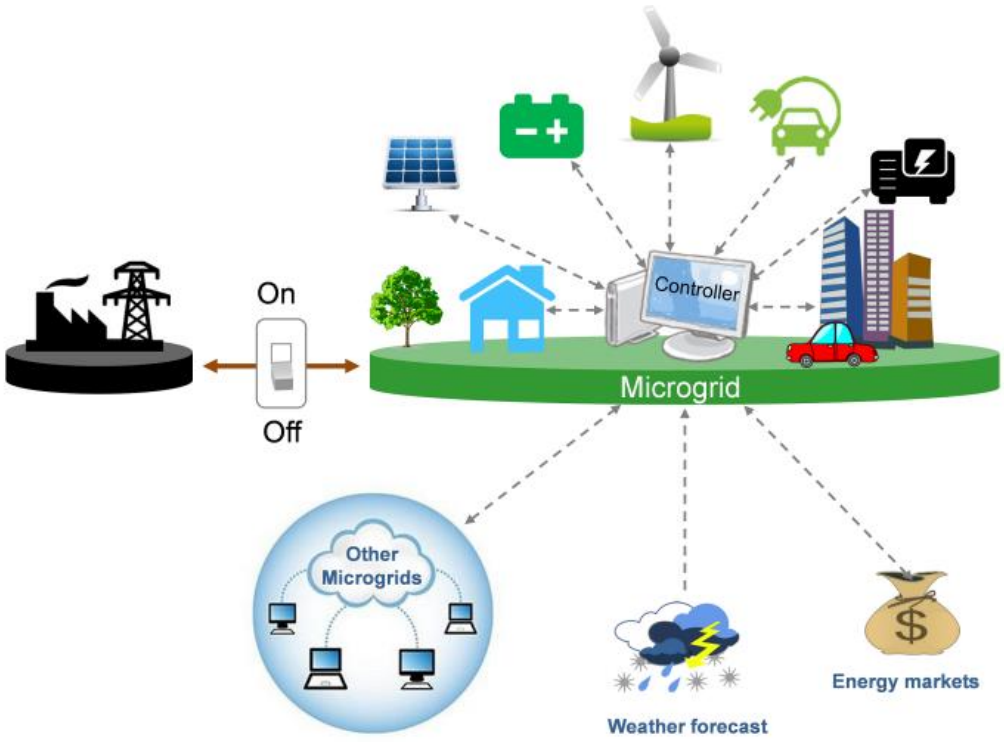
1) Occupancy assumed based on ASHRAE 62.1 occupancy densities for corresponding space types.

2) Assume 7 watts/sf

3) Thermal loads estimated based on 2012 CBECS data. Table E2: space heating + water heating

MICROGRID OBJECTIVES & APPROACH

A microgrid is defined as a group of interconnected loads and distributed energy resources (DERs) within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid. Microgrids can connect and disconnect from the grid so it can operate in what is referred to "grid-connected" and "islanded mode". The image below shows a high-level illustration of the basic concept behind gird-connected microgrids.



During island mode the DERs inside the microgrid supply electricity to all or a portion of the load. Often loads are classified as "critical" loads or "non-critical" loads that determine the DER capacities in island mode. For commercial/industrial microgrids, essential loads would entail all loads that are absolutely necessary to carry on with operations.

The objectives of the Oneonta Business Park and Railyards is to provide sustained electric and thermal energy to facilities until sufficient electric and natural gas infrastructure is developed. Due to the frequency of natural gas interruptions in the area, the DERs used in the microgrid design should not include technologies that use natural gas as fuel.

Two main types of microgrids are used for commercial & industrial parks. The first type is a grid-connected microgrid that allows the buildings to connect and disconnect from the grid. The other common type of microgrid is a remote microgrid, which is a completely independent system that does not have any reliance on central utility grids.

Grid-connected microgrids have the choice of taking service from the grid or using their own generated power to serve their customers. Advanced microgrid controllers are able to determine the optimal time to switch between sources based on which energy source is deemed most advantageous, especially when taking into consideration time-of-use electric rates and resource

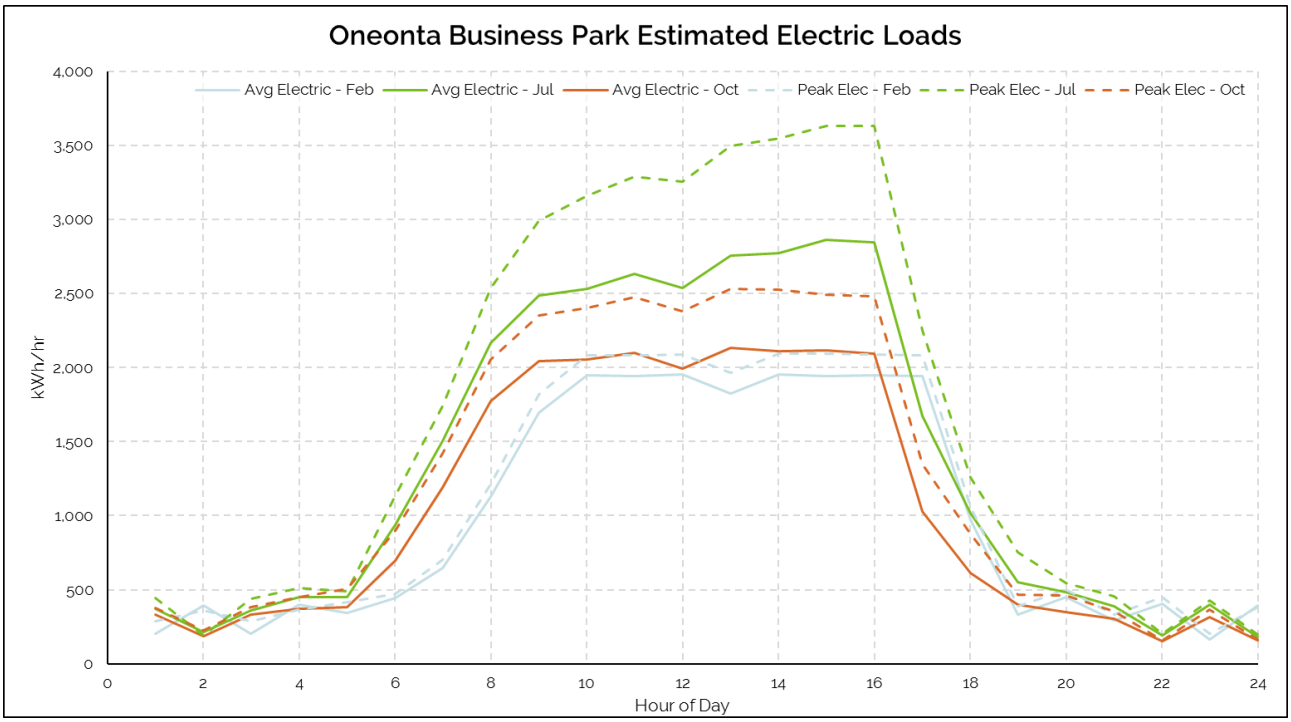
availability, such as solar production. In addition to this, grid-connected microgrids can take advantage of opportunities to accrue revenue from the grid by selling excess energy back to the grid. In the instance of a power outage, the microgrid has the ability to go into an island mode and disconnect from the grid. The microgrid then relied on its own generation and/or energy storage to supply the loads in the microgrid with no human intervention necessary. When the power outage is over, the controller will automatically switch back to the grid supply.

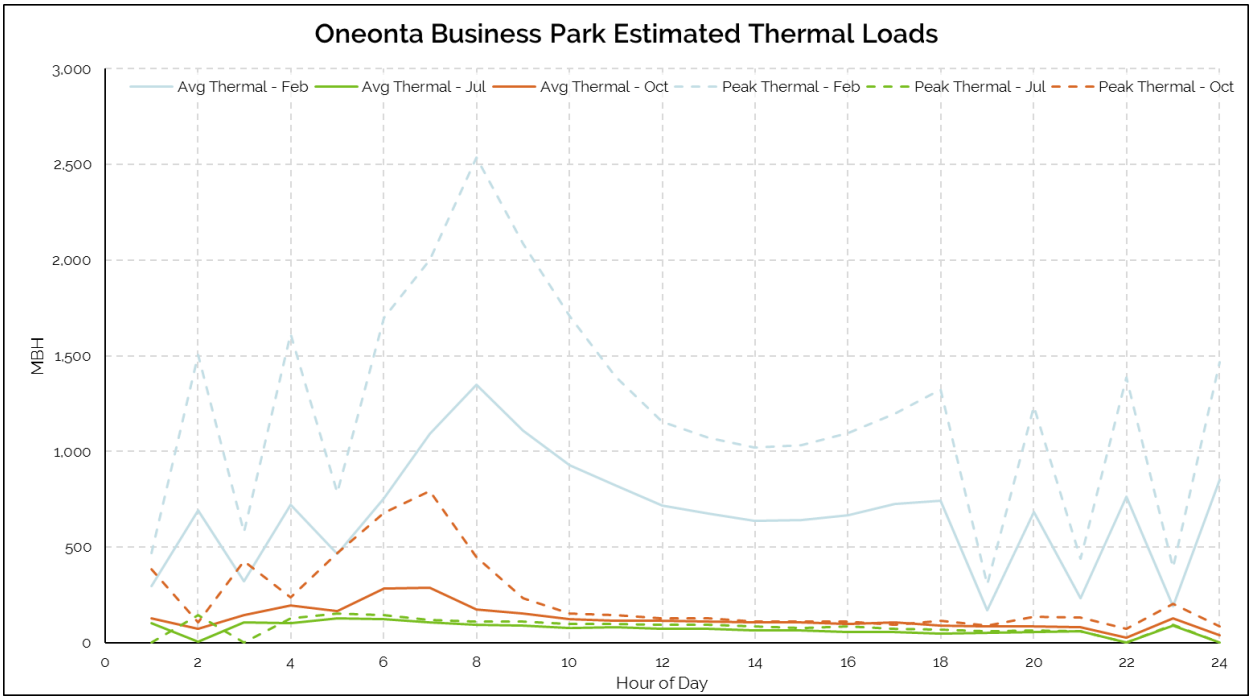
For the unique needs of Oneonta Business Park and Railyards, a grid-connected microgrid that has the capacity to support 100% of thermal loads and all critical loads is recommended. In order to alleviate concerns to new customers about limited natural gas supply, technologies with excess heat generation such as diesel CHP can be used to meet all non-process loads in the facilities. Supplemental electricity can also be provided using a variety of technologies such as solar PV, battery storage, geothermal heating and cooling systems, biomass heating systems, and thermal storage technologies.

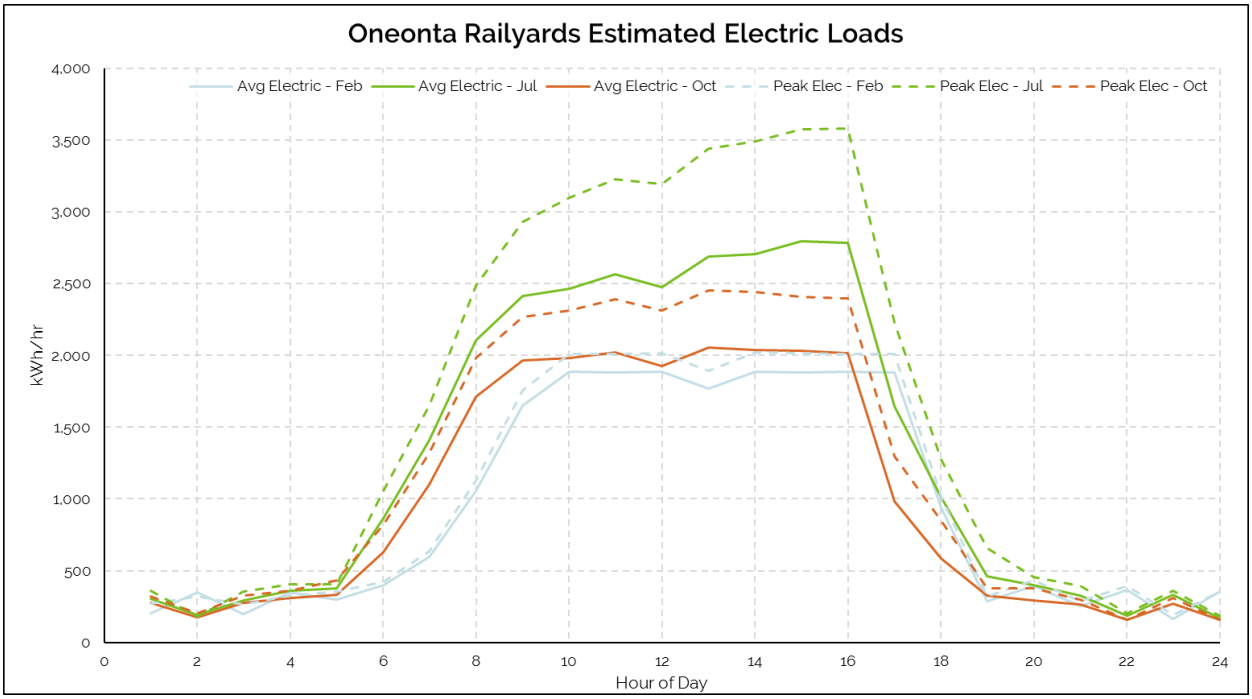
ESTIMATED LOAD PROFILES

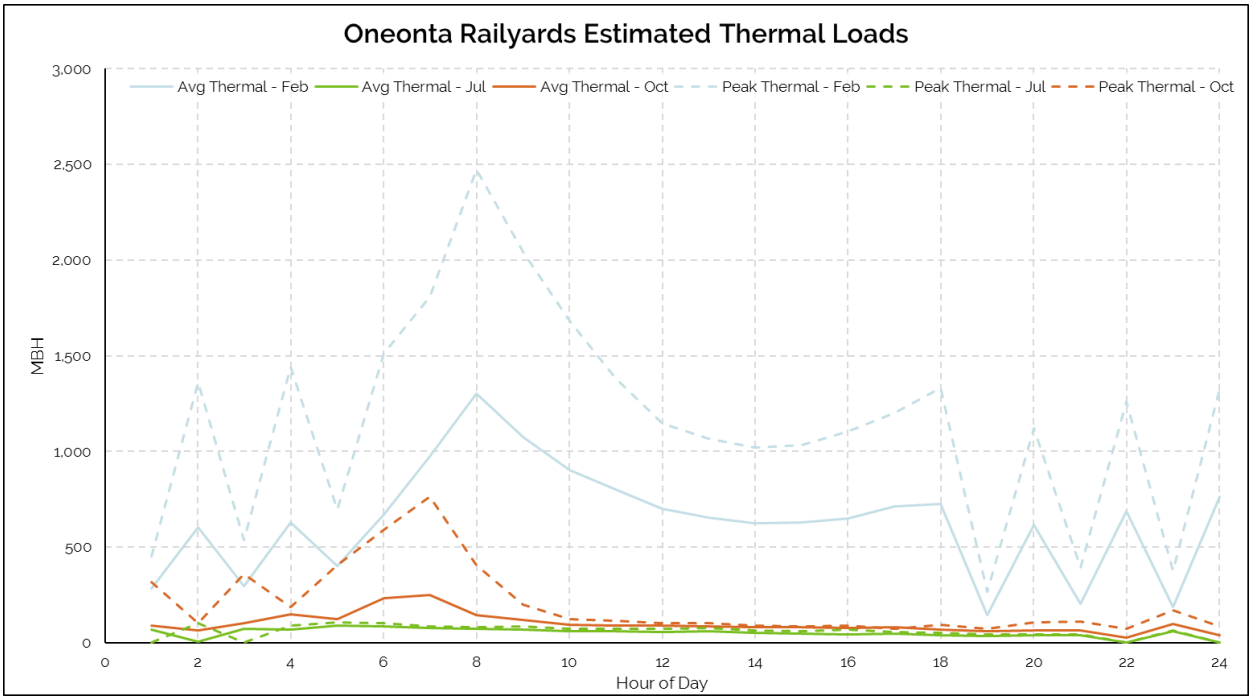
Based on the facility types and square footages a composite load profile for each microgrid was generated. The load profiles were generated based on a ratio of square footages to the total microgrid square footage multiplied by the DER CAM hourly load profiles for each building type. These profiles were then added together and scaled proportionally to estimate the composite hourly load profiles for both the Business Park and Railyards.

The thermal load profiles were generated using the same methodology and do not take into account process heating loads from manufacturing facilities. Further analysis and the deployment of submetering is recommended in order to more effectively quantify the electric and thermal demands of each building. Accurately quantifying these values will allow the engineers to select DERs more effectively in order to ensure all critical loads are met.



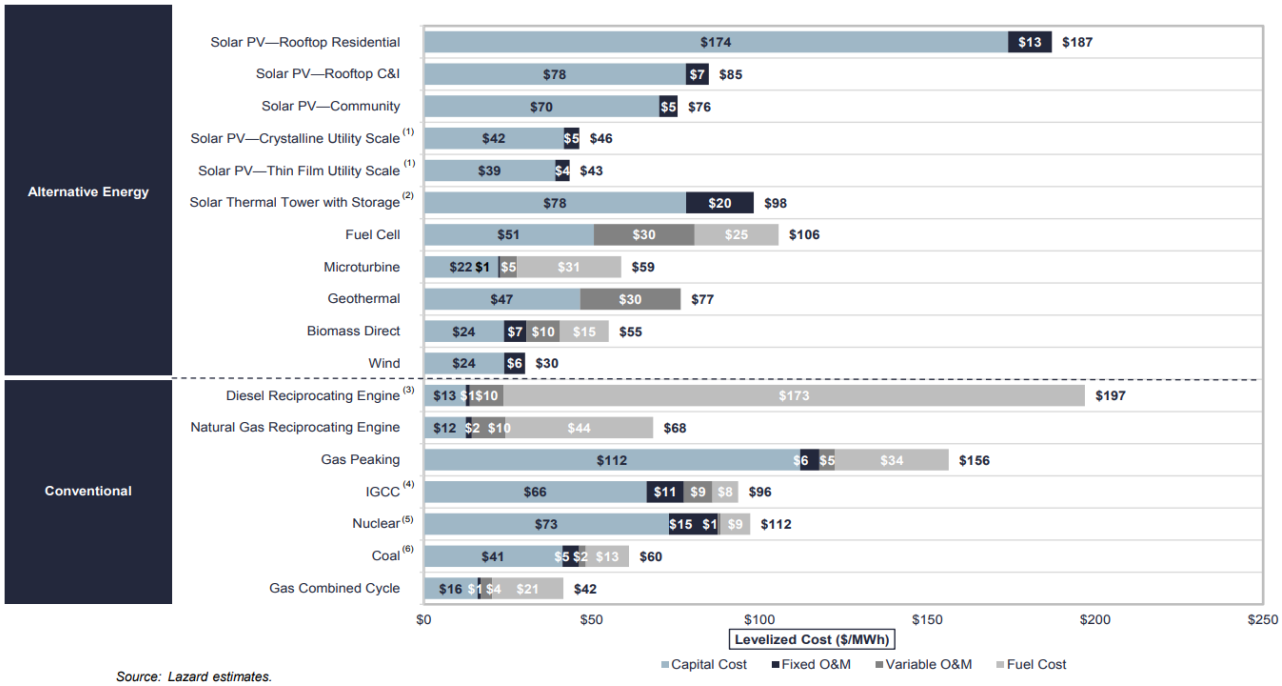

Oneonta Business Park Estimated Thermal Loads
Avg Thermal - Feb
Avg Thermal - Jul
Avg Thermal - Oct
Peak Thermal - Feb
Peak Thermal - Jul
Peak Thermal - Oct
MBH
3,000
2,500
2,000
1,500
1,000
500
0
0
2
4
6
8
10
12
14
16
18
20
22
24
Hour of Day


Oneonta Railyards Estimated Electric Loads
Avg Electric - Feb
Avg Electric - Jul
Avg Electric - Oct
Peak Elec - Feb
Peak Elec - Jul
Peak Elec - Oct
kWh/hr
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
2
4
6
8
10
12
14
16
18
20
22
24
Hour of Day


Oneonta Railyards Estimated Thermal Loads
Avg Thermal - Feb
Avg Thermal - Jul
Avg Thermal - Oct
Peak Thermal - Feb
Peak Thermal - Jul
Peak Thermal - Oct
MBH
3,000
2,500
2,000
1,500
1,000
500
0
0
2
4
6
8
10
12
14
16
18
20
22
24
Hour of Day

DER TECHNOLOGIES

A number of different technologies are available that are capable of generating power for businesses remotely that do not require electricity drawn from the grid. The graph below summarizes many of the most common technologies as well as their levelized cost of energy (LCOE) according to a 2017 study conducted by Lazard. The levelized cost of energy illustrates the net present value (sum of cash inflows and outflows over the course of its lifespan) divided by the amount of energy production in MWh. This is a common way of quantifying the average value of energy technology investments.



Source: Lazard estimates.

(1) Represents the low end of a utility-scale solar single-axis tracking system.
(2) Represents concentrating solar tower with 10-hour storage capability.
(3) Represents continuous operation.
(4) Incorporates 90% carbon capture and compression. Does not include cost of transportation and storage.
(5) Does not reflect decommissioning costs or potential economic impact of federal loan guarantees or other subsidies.
(6) Reflects average of Northern Appalachian Upper Ohio River Barge and Pittsburgh Seam Rail coal. Does not incorporate carbon capture and compression.

2017 Lazard

As shown in the graph, renewable technologies such as solar and wind energy have the greatest value to the customer that are competitive with conventional generation. This graph makes a number of assumptions and does not take into account the rapidly declining costs of ownership for renewables. The levelized cost of ownership is project-specific and varies based on the size and scope of work.

Based on the concern over natural gas supply, the following distributed energy resources are recommended:

1. Solar
2. Battery Storage
3. Diesel CHP generation
4. Geothermal heating and cooling

Each of these technologies have the capability of meeting load requirements of the facilities with a positive economic impact relative to purchasing energy from utilities. The tables below illustrate

approximate costs of these technologies, inputs and outputs, current available incentives in NYS, and some pros and cons of each technology. Installation costs are based off of experience with similar projects as well as current market values listed by the US DOE. NYS incentives are listed for commercial clients as of March of 2020 and may be subject to change. More information on each of these technologies can be found on the US DOE and EIA websites.

Solar PV	
Input: Sunlight Output: Electricity	
Advantages	Disadvantages
-Highest output per $ of installed cost -No carbon emissions	-Only produces electricity during daytime -Requires ample land/ rooftop space
Current NYS Incentives	Approximate Installed Cost
NY Sun: $0.35 per watt (subject to change)	$1.70/W to $2.50/W depending on size of application

Battery Storage	
Input: Electricity Output: Electricity	
Advantages	Disadvantages
-Load shifting to optimize time of use and increase resiliency -No carbon emissions	-High upfront cost -Penalty on net electric consumption from discharge losses
Current NYS Incentives	Approximate Installed Cost
NY Sun: $200 per kWh (subject to change)	$300 - $400 / kWh

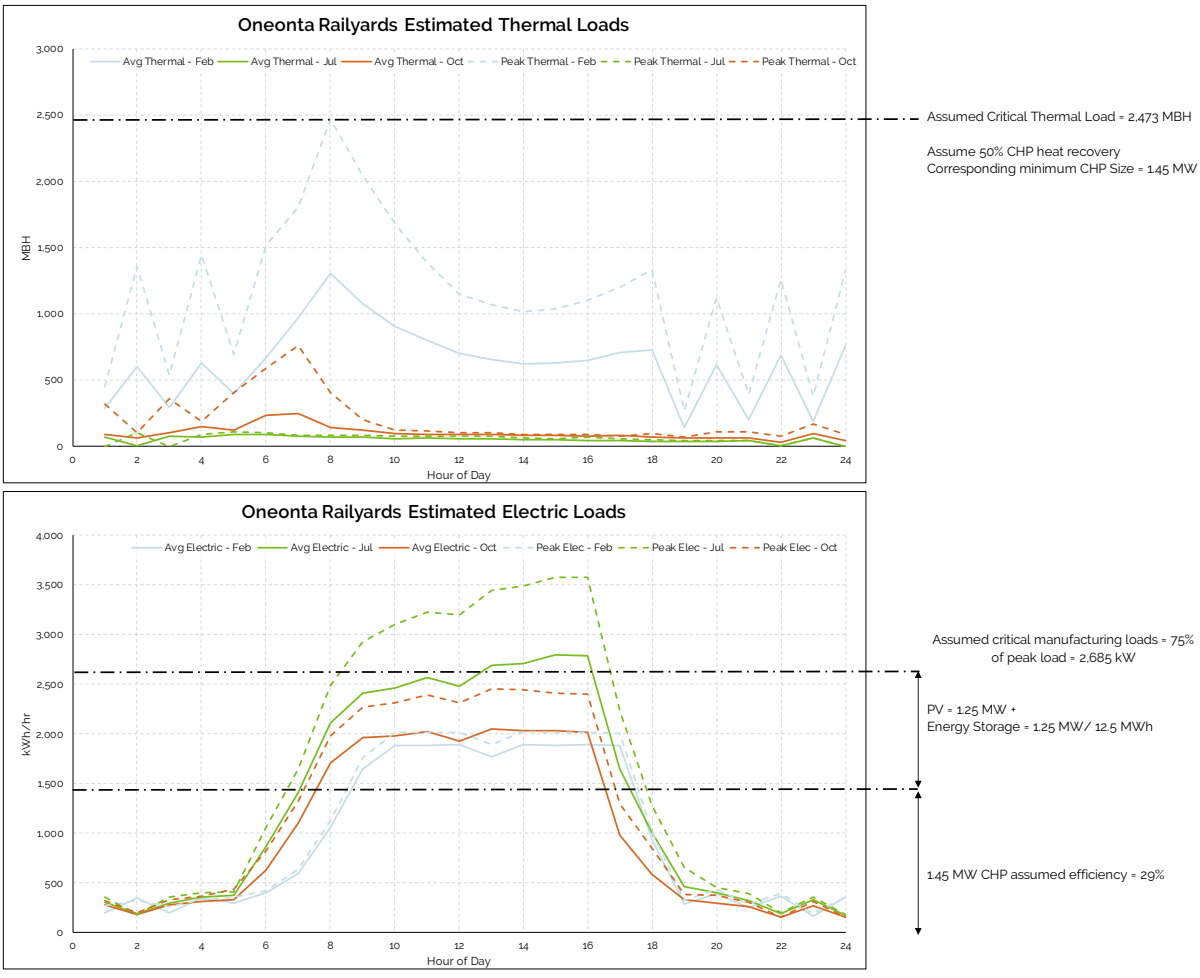
Combined Heat and Power (CHP)	
Input: Variety of Fossil Fuels Output: Electricity, Recoverable Heat	
Advantages	Disadvantages
-Heat recovered to increase building's net efficiency -Stable, constant energy supply	-Increased carbon footprint
Current NYS Incentives	Approximate Installed Cost
None	$2180/kW

Geothermal Heating/ Cooling Systems	
Input: Pumping Energy Output: Heating/Cooling of Water Loop	
Advantages	Disadvantages
-Uses ground as natural heat exchanger -Renewable heating and cooling systems	-Require heat pump heating/cooling systems -High upfront costs
Current NYS Incentives	Approximate Installed Cost
NYSERDA Ground Source Heat Pump Rebate: $1200/ton	$6,000 /ton

Preliminary DER Selections

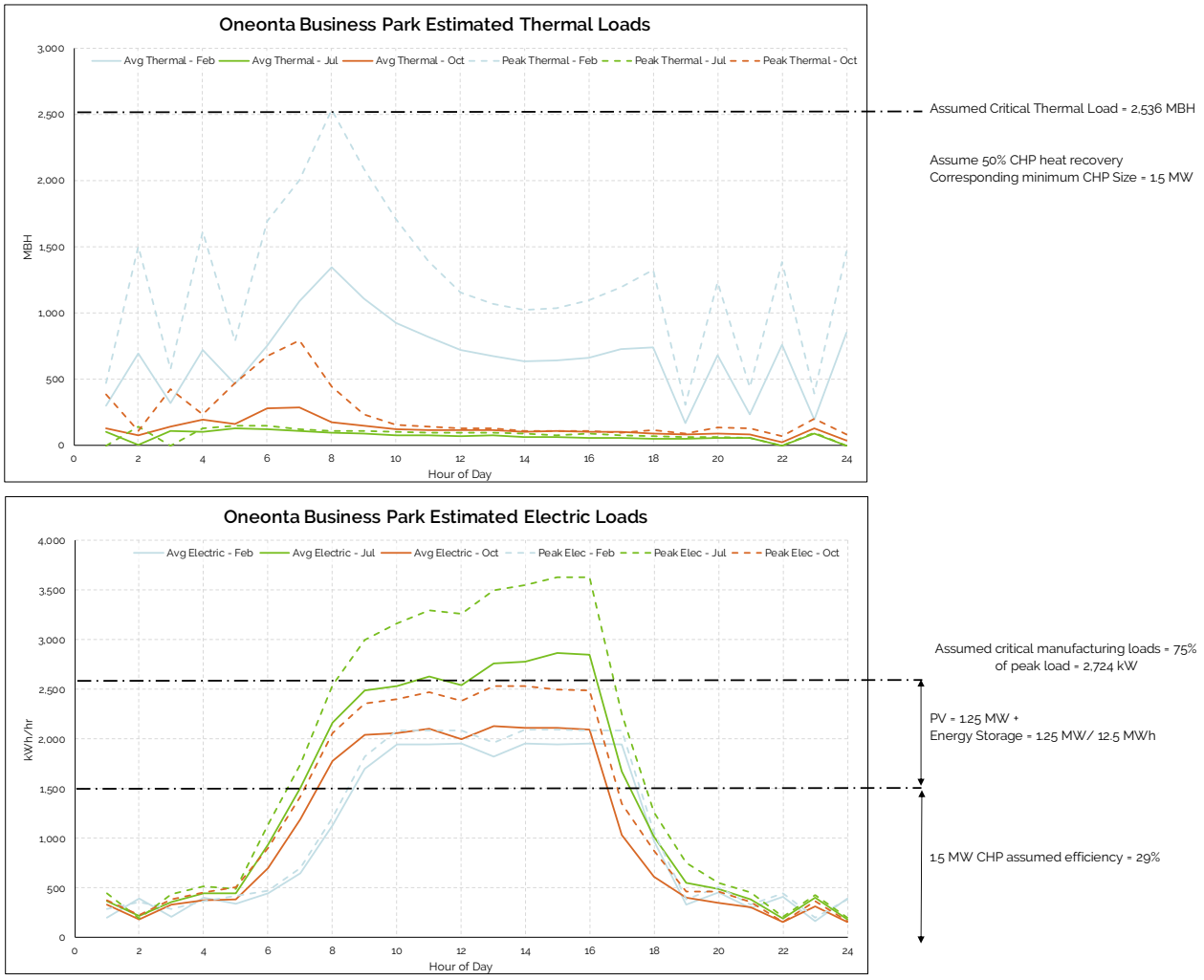
Based on the calculated peak electric and thermal loads for each building, composite load profiles were generated, shown below. Using these load profiles, the thermal loads are first to be met by CHP heat recovery. Then, the remainder of the critical loads are to be met with a combination of solar/ battery storage. Additional non-essential generation after the critical loads may be met, space-permitting.

This approach assumes a centralized generation site/sites with large equipment serving all of the buildings in the microgrid. Depending on the resiliency needed by the sites, more distributed generation at each building may be added. This approach will reduce the impact of equipment downtime on the grid, but will also likely increase the capital cost of the microgrid. Further DER CAM optimizations with more detailed information from all sites is recommended in order to recommend unique solutions that optimize the economic impact of the microgrid on its users.



Based on the preliminary analysis of the Railyards loading, it is recommended that the following generation technologies are installed according to the assumed loading:

- 1.45 MW Diesel CHP
- 1.25 MW PV
- 12.5 MW/ 12.5 MWh Battery Storage



Based on the preliminary analysis of the Railyards loading, it is recommended that the following generation technologies are installed according to the assumed loading:

- 1.5 MW Diesel CHP
- 1.25 MW PV
- 12.5 MW/ 12.5 MWh Battery Storage

Both microgrids have similar loading profiles and therefore have similar technologies recommended. It is important to note that a more detailed analysis is required that surveys each of the sites and their actual energy data before any concrete or detailed simulations are performed. The DER CAM modeling software is a recommended technology that is capable of this analysis and has the capacity to enter in site specific information for all buildings and generating an optimized solution based on the customer's needs.

COST ESTIMATES

Based on these recommendations, the following tables outline a preliminary cost estimate- including equipment costs, soft costs, and incentives.

Oneonta Railyards Preliminary Cost Estimate

Capital Investment	Unit	$/Unit	Cost	Incentives	Net Installation Cost
CHP	1.45 MW	$ 2,180	$ 3,161,000	$ -	$ 3,161,000
PV	1.25 MW	$ 1.80	$ 2,250,000	$ 437,500	$ 1,812,500
Battery Storage	12.5 MWh	$ 350	$ 4,375,000	$ 2,500,000	$ 1,875,000
Other (microgrid accessories)			$ 1,500,000		$ 1,500,000
NY Prize or National Grid				$ 3,500,000	$ (3,500,000)
Contingency		5%			$ 242,425
				Subtotal:	$ 5,090,925
Engineering & Design			$ 750,000		$ 750,000
Grid Engineering			$ 150,000		$ 150,000
OpCo Fees		4%	$ 333,940		$ 333,940
				Soft-Cost Subtotal:	$ 1,233,940
				TOTAL:	**$ 6,324,865**

Oneonta Business Park Preliminary Cost Estimate

Capital Investment	Unit	$/Unit	Cost	Incentives	Net Installation Cost
CHP	1.5 MW	$ 2,180	$ 3,270,000	$ -	$ 3,270,000
PV	1.25 MW	$ 1.80	$ 2,250,000	$ 437,500	$ 1,812,500
Battery Storage	12.5 MWh	$ 350	$ 4,375,000	$ 2,500,000	$ 1,875,000
Other (microgrid accessories)			$ 1,500,000		$ 1,500,000
NY Prize or National Grid				$ 3,500,000	$ (3,500,000)
Contingency		5%			$ 247,875
				Subtotal:	$ 5,205,375
Engineering & Design			$ 750,000		$ 750,000
Grid Engineering			$ 150,000		$ 150,000
OpCo Fees		4%	$ 338,300		$ 338,300
				Soft-Cost Subtotal:	$ 1,238,300
				TOTAL:	**$ 6,443,675**

NEXT STEPS

The next steps for the microgrids at the Oneonta Business Park and Railyards is to perform a detailed energy study that evaluates the energy needs of the facilities in the proposed microgrids on a more granular level and develops a comprehensive energy model that is able to simulate and identify the optimal combinations of technologies.

Items to evaluate in this study include, but are not limited to, the following:

- Utility tariff analysis
- Detailed critical load analysis for each property
- Distribution infrastructure and interconnection
- DER CAM modeling software multi-node simulation
- Detailed cost analysis

SITE-SPECIFIC INVESTIGATION REPORT

SCHOHARIE COUNTY: AMERICAN RECYCLING

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NOTE:

The energy analyses in this report are high-level in nature. All recommendations made in this report require further verification before being implemented.

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FACILITY DESCRIPTION

American Recycling Management LLC is a recycling center currently located in Jamaica Queens. The company is about to break ground on a new recycling center located in Schoharie County, NY. This location is intended to serve primarily as a trucking terminal with future plans to store 60-80 tons of organic waste per week on site.

The facility in Schoharie County is a 20,000 square foot facility with 4,800 square feet of office space and 112 acres. The facility design phase and bidding phase are complete and is commencing with construction in summer of 2020.

There are plans to store 10 trucks at this facility that collect recycling and take it to the landfill. The trucks are to be stored overnight inside the trucking terminal and then fill-up at a nearby gas station with diesel gas before going out to collect recycling. The trucks are expected to be driven an estimated 700 miles per day, 312 days per year.

American Recycling expressed interest in pursuing a net-zero carbon building if economically attractive.

UTILITY DATA & CARBON EMISSIONS

The projected energy consumption for the facility was estimated based on 2012 CBECS data from the US Department of Energy's Energy Information Agency. The building was split into two main types of usages and then estimated based on loading factors from similar facilities.

CBECS Data			
	Electric kBtu/SF	Natural Gas kBtu/SF	Total kBtu/SF
Office	54.3	23.5	77.8
Warehouse	22.5	10.3	32.8

	Office		Warehouse		Estimated Nat Gas	Estimated Electric	Total Electric	Gas Usage
Month	Electric	Nat Gas	Electric	Nat Gas	Loading Factor	Loading Factor	Usage (kBtu)	(kBtu)
Jan	18,274	21,878	28,524	30,245	19.4%	7.0%	46,798	52,123
Feb	18,274	22,790	28,524	31,506	20.2%	7.0%	46,798	54,295
Mar	18,274	15,193	28,524	21,004	13.4%	7.0%	46,798	36,197
Apr	20,101	9,116	28,524	12,602	8.1%	7.7%	48,626	21,718
May	22,842	3,039	28,524	4,201	2.7%	8.8%	51,367	7,239
Jun	24,670	0	28,524	0	0.0%	9.5%	53,194	0
Jul	27,411	0	28,524	0	0.0%	10.5%	55,935	0
Aug	28,325	0	28,524	0	0.0%	10.9%	56,849	0
Sep	23,756	1,519	28,524	2,100	1.3%	9.1%	52,280	3,620
Oct	21,015	6,077	28,524	8,402	5.4%	8.1%	49,539	14,479
Nov	19,188	15,193	28,524	21,004	13.4%	7.4%	47,712	36,197
Dec	18,274	18,232	28,524	25,205	16.1%	7.0%	46,798	43,436
1) Usages are al in kBTU based on 2012 CBECS data.							602,696	269,304

2) Assume NYS Average Electric Pricing = $0.13/kWh, according to NYSERDA published average utility rates.

3) Assume NYS Average Nautral Gas Pricing = $6.81/MMBtu, according to NYSERDA published average utility rates.

In addition to the building's energy usage, cost information was estimated based on current NYS average electric and natural gas prices. The fuel consumption was estimated based on the following information that was provided: 10 trucks, 200 miles per day, 312 days per year, and 4.8 miles per gallon.

Annual Total:	kBtu	kWh	$
Electric Consumption	602,696	176,640	$ 22,963
Annual Total:	kBtu	MMBtu	$
Natural Gas Consumption	269,304	269	$ 1,834

The following chart outlines the estimated carbon emissions from the facility based on the projected electric consumption, natural gas consumption, and diesel gas consumption.

EMISSIONS SUMMARY SHEET

Annual Electric Consumption

Annual Usage	Units	CO_2 (lbs)	CH_4 (lbs)	N_2O (lbs)
176,640	kWh	52,056	3.7	0.5

Annual Natural Gas Consumption

Annual Usage	Units	CO_2 (lbs)	CH_4 (lbs)	N_2O (lbs)
269	MMBTU	31,509	592.5	59.2

Annual Propane Consumption

Annual Usage	Units	CO_2 (lbs)	CH_4 (lbs)	N_2O (lbs)
0	gal propane	0	0.0	0.0

Annual #2 Fuel Oil Consumption

Annual Usage	Units	CO_2 (lbs)	CH_4 (lbs)	N_2O (lbs)
0	gal #2 oil	0	0.0	0.0

Annual Diesel Consumption

Annual Usage	Units	CO_2 (lbs)	CH_4 (lbs)	N_2O (lbs)
455,000	gal gasoline	10,190,180	375,375.0	75,075.0

Not including transportation usage.

Emissions from (Employee)Transportation

		CO_2 (lbs)	CH_4 (lbs)
15	Full Time Equivalent Employees	152,334	5,612
15	Average Commute Distance (miles)		
7	Days per Week	N_2O (lbs)	
2	Trips per day	1,122	
52	Weeks per Year		
Car (solo)	Mode of Transportation		

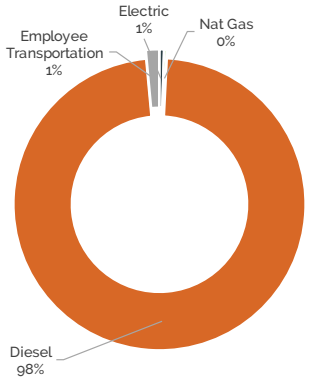
Site Emissions Factors

		CO_2	CH_4	N_2O	
Electricity					
1 kWh	=	0.2947	2.1E-05	3E-06	lbs
Natural Gas					
1 MMBTU	=	117	2.2	0.22	lbs
1 MBTU	=	0.117	0.0022	0.00022	lbs
1 kBTU	=	0.117	0.0022	0.00022	lbs
1 therms	=	11.7	0.22	0.022	lbs
1 decatherms	=	1.17	0.022	0.0022	lbs
1 CF Natural Gas	=	0.117	0.0022	0.00022	lbs
1 MCF Natural Gas	=	0.000117	2.2E-06	2.2E-07	lbs
Other Fuels					
1 gal #2 oil	=	22.7	0.92	0.18	lbs
1 MMBTU #2 oil	=	163.1	6.6	1.3	lbs
1 MMBTU propane	=	12.6	0.6	0.12	lbs
1 gal propane	=	138.3	6.6	1.3	lbs
1 gal gasoline	=	19.3	0.8	0.2	lbs

Transportation Emissions Factors

Mode	CO2 lbs/mile
Walk, Bike, Telecommute	0
Motorcycle	0.26
Heavy Rail	0.33
2-3 Carpool	0.39
Light Rail	0.44
Alternative Fuel Vehicle	0.44
Bus	0.68
Car (solo)	0.93

CARBON EMISSIONS SOURCES



SUM of Total Emissions

	CO_2	CH_4	N_2O
lbs	10,426,078	381,583	76,257
kg	4,728,380	173,053	34,584
Tons (US)	5,213	191	38
Metric Tons	4,728	87	17

Emissions Equivalencies

695 — Houses Energy Use

1,247 — Cars Removed from the Road

2,085 — Acres of Trees Planted

DER ANALYSIS

Based on the knowledge of the existing facility, a DER analysis was completed using the DER CAM modeling software. This software is an energy optimization tool with thousands of custom inputs that are used to model the optimal energy investments for the facility. Custom load profiles were generated based on the usage type of the facility and the DER CAM default load profiles for similar facility types.

American Recycling expressed interest in evaluating the economic feasibility of becoming a net zero carbon facility in addition to general energy generation technologies to reduce energy costs. The table below breaks down the 3 different options that were simulated, along with their carbon impacts and costs.

DER ANALYSIS SUMMARY TABLE

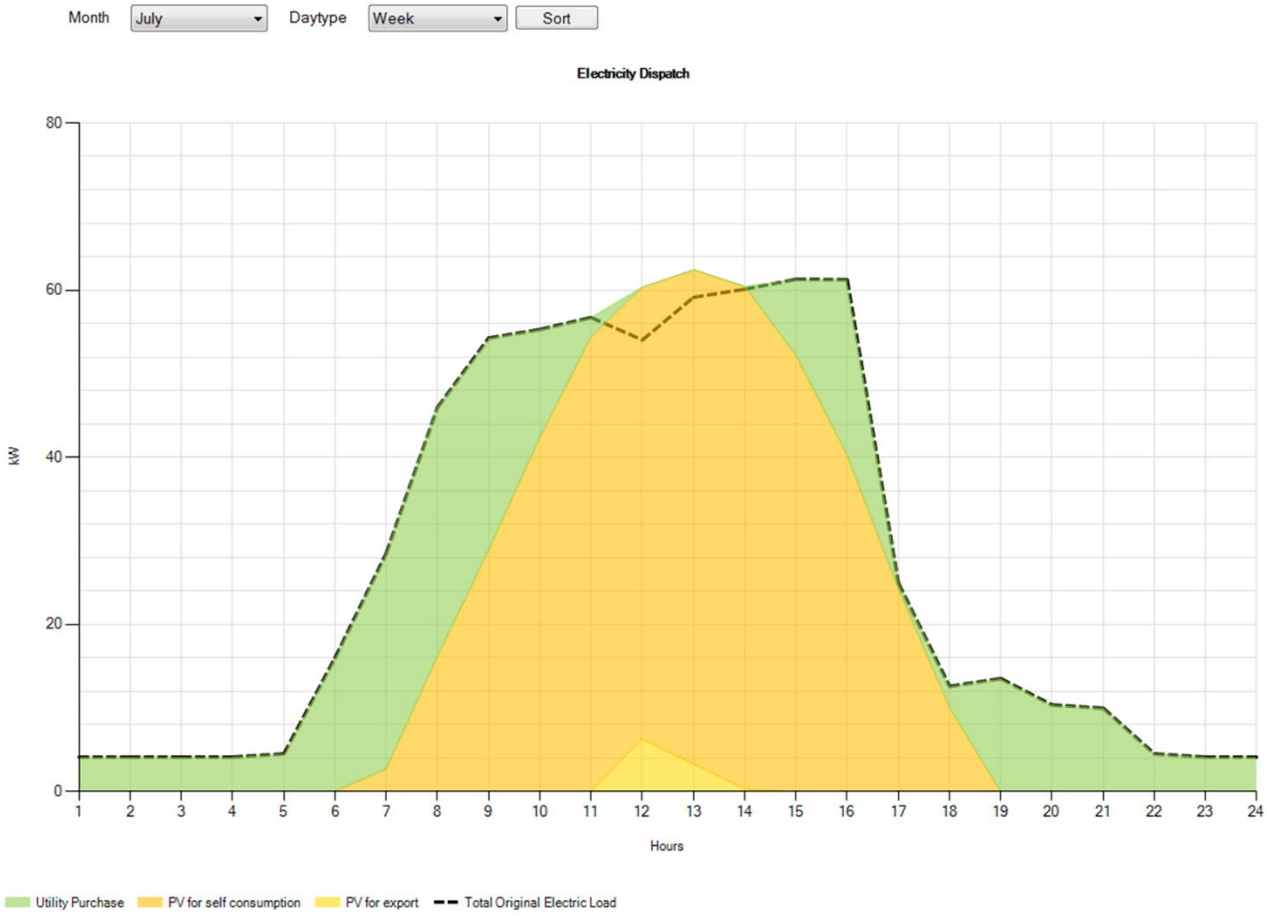
	BASE CASE	OPTION 1	OPTION 2	OPTION 3
Suggested DER Technologies	-	75 kW PV	94 kW PV 50kW/200kWH Battery Storage	72 kW PV 50 ton Geothermal Heat Pump System *Net Zero Carbon*
ANNUAL ENERGY CONSUMPTION & CARBON EMISSIONS				
Electric Purchase from Grid (kWh)	176,640	62,921	29,100	62,846
Peak Electric Demand from Grid (kW)	77	37	11	50
Monthly Electric Demand (kW)	707	427	85	418
On-Site Electric Generation	-	150,784	190,550	144,909
Natural Gas Usage (MMBtu)	269	269	269	0
Carbon Emissions (MT) w/o transportation	38	23	18	8
Electric Savings (kWh)	-	113,719	147,540	113,794
Natural Gas Savings (MMBtu)	-	0	0	269
Carbon Emisisons Savigns (MT) (before carbon offset)	-	15	20	30
ECONOMIC ANALYSIS				
Electric Costs	$22,963	$8,180	$3,783	$8,170
Natural Gas Costs	$1,834	$1,832	$1,834	$0
Total Energy Costs	$24,797	$10,012	$5,617	$8,170
Total Energy Cost Savings	-	$14,785	$19,180	$16,627
Estimated Maintenance Cost Savings	-	-$1,350	-$6,192	-$2,813
Carbon Offset Credits		-	-	$8,457
Net Savings		$13,435	$12,988	$5,357
Estimated DER Cost	-	$157,500	$373,900	$449,588
Estimated Incentives	-	$26,250	$112,900	$85,200
Net DER Cost	-	$157,500	$261,000	$364,388
Payback Period (Years)	-	11.7	20.1	68.0
Net Present Value	-	$140,593	$29,300	($239,614)
Internal Rate of Return	-	7.6%	2.8%	-4.6%

$0.011/kWh maintenance CHP
$2,176/kW total installed CHP
$18/kW maintenance solar PV
NYS PV incentive $0.35/W
$1.72/W installed solar PV > 1 MW
Assume 10 outages per year, $5,000 each in production losses
Carbon offset credit rate: $1.80/MT
Carbon emissions savings do not take into consideration transportation costs or carbon offset credits.

Option 1 entails the installation of a 75 kW solar array to provide supplemental electricity to the facility. It is recommended that the solar array is located either the rooftop of the building or on the ground, nearby.

The solar qualifies for the NY Sun program incentives, which currently offer a rate of $0.35 per watt of installed solar panels. In terms of economic outlook, this option is the most economically attractive option with the shortest payback and greatest return on investment.

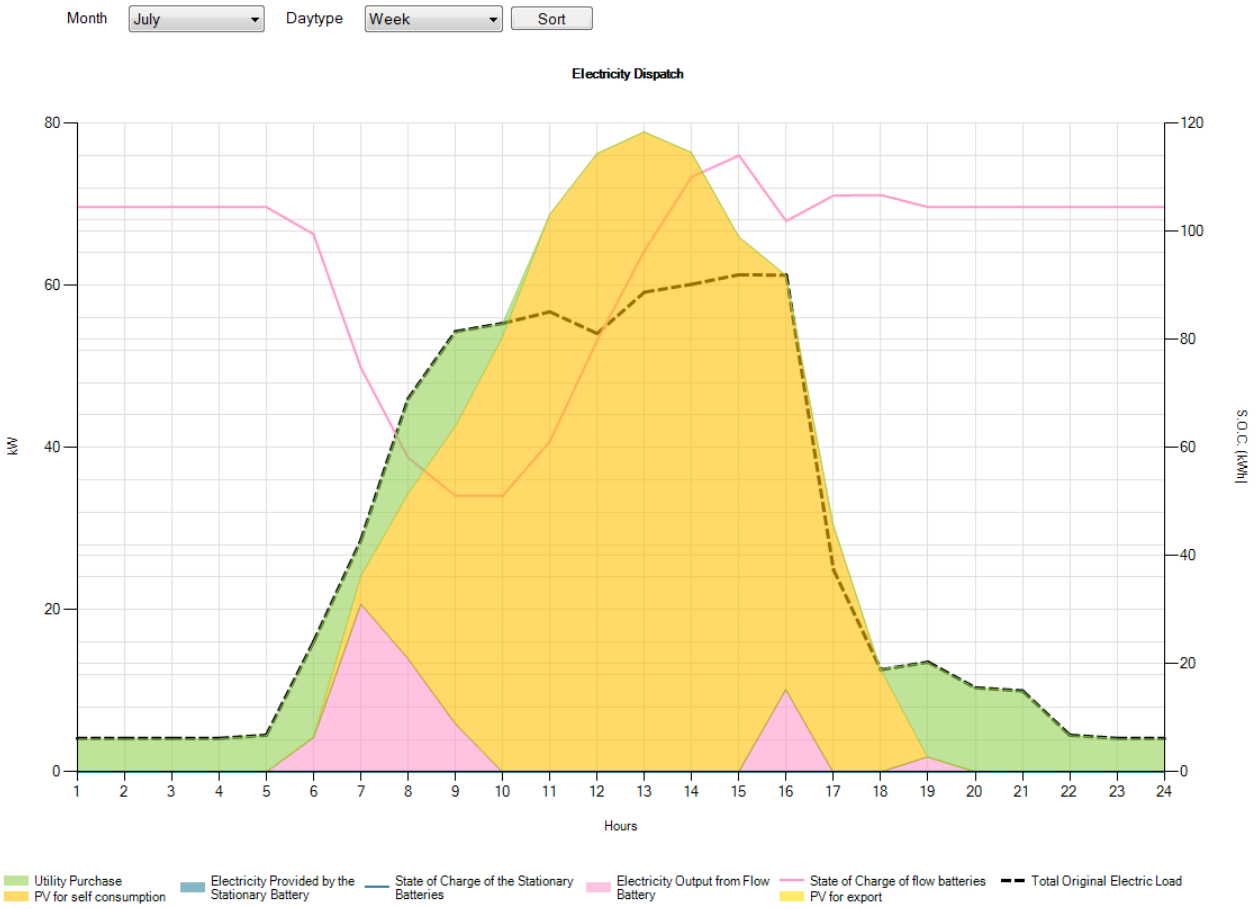
The graph below illustrates the load profile for the facility as well as the PV generation from option 1. The yellow portion of the graph illustrates electricity generated from PV and the remainder in green illustrates electricity purchased from the grid.



Option 2 entails the installation of a 94 kW solar array and 50 kW/ 200 kWh of flow battery storage to provide supplemental electricity to the facility. It is recommended that the solar array is located either the rooftop of the building or on the ground, nearby. The flow battery is typically located in a 40 ft storage container and can also be placed on the ground near the building.

The solar and battery storage qualify for the NY Sun program incentives, which currently offer a rate of $0.35 per watt of installed solar panels and $200 per kWh of battery storage. Due to the long payback of this option, it is only recommended if the site had issues with electric interruptions- which is not expected due to the location of the site.

The graph below illustrates the load profile for the facility as well as the PV generation and battery charging/discharging from option 2. The yellow portion of the graph illustrates electricity generated from PV, the pink represents the battery charging/discharging, and the remainder in green illustrates electricity purchased from the grid.

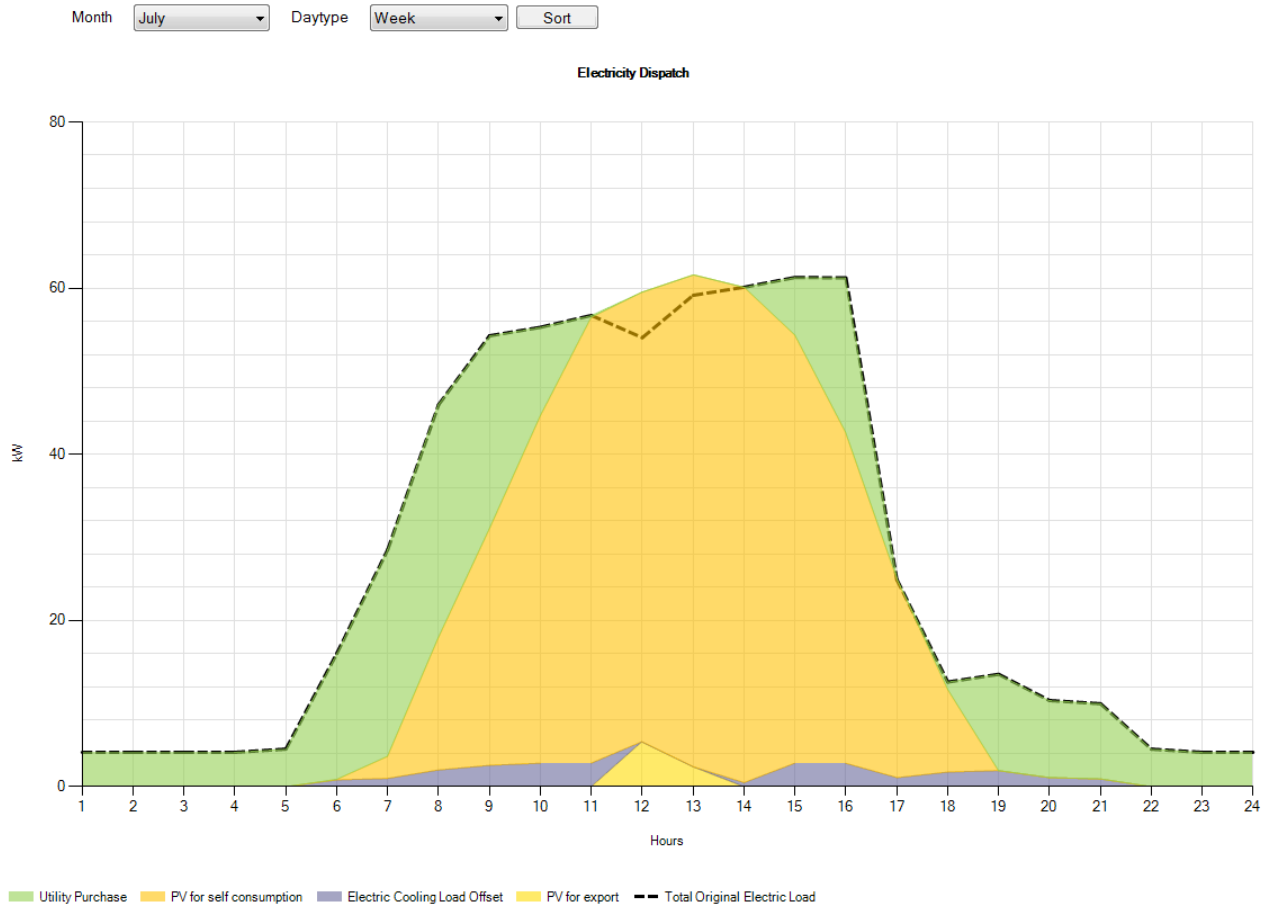


Option 3 entails the installation of a net zero carbon facility through the installation of a 72 kW PV system, 50 ton geothermal heating loop, and the purchase of carbon offset credits. It is recommended that the solar array is located either the rooftop of the building or on the ground, nearby.

The geothermal heating loop is intended to be a vertical loop- where water is pumped down through the ground via vertical bore holes. The ground is used as a natural heat exchanger that can heat the water during the winter and cool during the summer. Once the water is pumped though the ground, it is re-circulated through the building and used by water-to-water heat pumps to heat or cool the building. This system is intended to replace any gas heating and electric air conditioning that the facility may have.

The solar and geothermal systems both qualify for NYS incentives- as illustrated in the summary table above. Residual carbon emissions from electricity purchase, diesel purchase for the trucks, and staff transportation are offset using carbon offset credits. The facility's carbon footprint was calculated in accordance to LEED Zero standards, which account for all facility energy usage, trucking energy usage, as well as emissions from the worker's commuting back and forth to work. Assumptions for this calculation are included in the Utility Data & Carbon Emissions Section.

The graph below illustrates the load profile for the facility as well as the PV generation and battery charging/discharging from option 3. The yellow portion of the graph illustrates electricity generated from PV, blue illustrates equivalent cooling energy offset through the use of geothermal cooling, and the remainder in green illustrates electricity purchased from the grid.



RECOMMENDATIONS

Based on the energy analysis, two different options are recommended for the facility, depending on American Recycling's desire to achieve net zero carbon emissions:

The following actions are recommended solely based on **return on investment**:

- Option 1: 75 kW PV system

The following actions are recommended based on the facility's interest in a **net zero carbon** facility, despite higher upfront costs:

- Option 3: 72 kW PV system, 50 ton geothermal heating system, Carbon offset credits

It is recommended that one of the two measures listed above are installed, depending on the facility's desire to become a net zero carbon facility. It should be noted that if the facility were to pursue a geothermal heating system, it would be dependent on the facility switching to a heat pump heating/cooling system. Since the mechanical plans for the facility were not able to be provided, the cost estimate for this was not included. If American Recycling wishes to pursue this option, further evaluation is recommended in order to develop a more detailed cost estimate.

Based on the fuel efficiency of the vehicles and the fact that the vehicles account for 99% of the carbon emissions, it is recommended that the facility pursues opportunities for more fuel efficient or electric vehicles when the technology becomes available. This will help reduce energy costs as well as the carbon footprint of the facility.

It was noted that the facility plans to store 60-80 tons of organic waste on a weekly basis at this site in the future. When the facility achieves approval to store organic waste, it is recommended that an anaerobic digestion/CHP system is evaluated. This system breaks down the waste into biogas, which can then be used to power a CHP engine that can produce supplemental electricity. Due to the complexity of the system and interconnection options to the grid, further evaluation is recommended in order to determine the feasibility of this system.

SITE-SPECIFIC INVESTIGATION REPORT

TIOGA COUNTY: CROWN CORK & SEAL

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NOTE:

The energy analyses in this report are high-level in nature. All recommendations made in this report require further verification before being implemented.

FACILITY DESCRIPTION

Crown Cork & Seal is a 500,000 sf manufacturing facility located in Nichols, NY. The facility consists of 200,000 sf of manufacturing floor space, 294,000 sf of warehouse storage, and 6,000 sf of office space. Crown Cork & Seal produces several different types of aluminum beverage cans for a variety of beverage companies.

The manufacturing process involves taking large rolls of aluminum sheet metal, stamping and pressing the outline into a can shape and pressing them into the can shape. Once this is complete, paint is applied and the cans are sent into an oven to cure the ink. After this is complete, a spray coating is applied and the cans are sent through an oven once again to cure the coating. The cans are then necked at the top and packaged for distribution.

The daily production ranges from 7.5 - 9 million cans per day- valued at approximately 5 cents per can. Crown Cork & Seal employs 250 employees and is in operation 24 hours a day, 364 days a year.

The Nichols plant was constructed in 2017 and does not currently have any on-site generation. Crown Cork & Seal purchases their electric and natural gas supply from an ESCO and it is delivered by NYSEG.

Crown Cork & Seal has had periodic issues with electric outages ranging from seconds to minutes that results in an average of $5,000-$6,000 of losses per outage. It was noted that most of the outages occur during the months of March, August, and September.

EXISTING INFRASTRUCTURE

The Nichols facility is 100% heated and only has cooling in the office space. The space is heated by several rooftop air handling units and is fed using 100% outdoor air. During heating months excess heat is recovered from air compressors and re-circulated into the space. It was noted by staff that the facility currently has a -0.2 in. pressure differential, but it has no impact on the facility's manufacturing processes.

The office area is cooled and heated in individual zones using variable refrigerant flow cooling controlled by separate VAV boxes. The office area currently does not use any nighttime setback. The current manufacturing floor space is maintained between 61 and 73 degrees F, which varies based on proximity to loading areas and mechanical equipment.

The manufacturing space has several automated assembly lines that cut, press, paint, and heat treat the cans. The automated conveyors are run using 108 psi compressed air, fed by (7) Kaeser air compressors. The heat treatment ovens are gas-fired and the cans are washed using 150°F hot water. Eight hot water wash pumps are used to feed the washer machine and are controlled using variable frequency drives.

LED light fixtures are installed throughout the facility. The office area has occupancy sensors that control the lighting levels. Since the production area is in use 24/7, no occupancy sensors are needed there.

Crown Cork & Seal does not currently utilize any on-site generation. Staff members have expressed interest in evaluating distributed energy resources in order to determine its economic feasibility and impact on facility resiliency.

UTILITY DATA & CARBON EMISSIONS

Crown Cork & Seal currently purchases electricity from Constellation Energy that is supplied by NYSEG. Natural gas is supplied by NYSEG as well.

Crown Cork & Seal has had issues with brief electric interruptions that result in a loss of product equating to an estimated $50,000 per year. In most cases, the duration of these outages ranges from seconds to minutes, but is enough to disrupt production.

The following figures outline the electric and natural gas usages for the years 2018 and 2019. Corresponding carbon emissions, as outlines by LEED net zero guidelines are listed as well.

UTILTY DATA & EMISSIONS SUMMARY

ELECTRICITY	Annual Totals				CO_2 Emissions	
Annual Electric Usage	47,693,392	kWh	=	162,729,854 MBtu	6,374	Metric Tons
Peak Electric Demand	6282.12	kW				
Total Monthly Electric Demand	72219.84	kW				

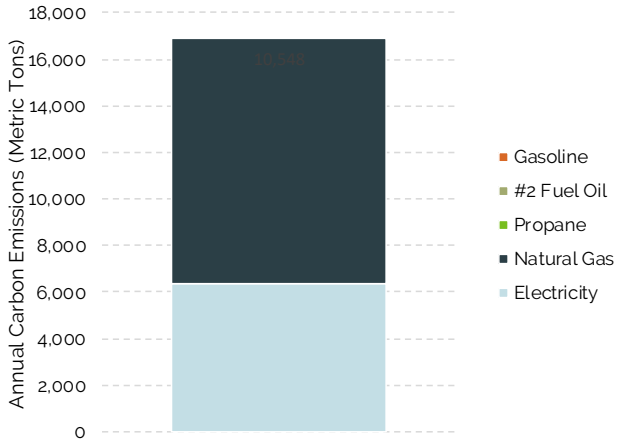
FOSSIL FUELS	Annual Totals				CO_2 Emissions	
Annual Natural Gas Usage	198,786	MMBtu	=	198,786,410 MBtu	10,548	Metric Tons
Annual Propane Usage	0	gal	=	0 MBtu	0	Metric Tons
Annual #2 Fuel Oil Usage	0	gal	=	0 MBtu	0	Metric Tons
Annual Gasoline Usage	0	gal	=	0 MBtu	0	Metric Tons
ANNUAL TOTALS				**361,516,264 MBtu**	**16922.1**	**Metric Tons**

Total Annual Electric Costs	$	2,653,205
Total Annual Natural Gas Costs	$	410,591
Total Annual Propane Costs	$	0
Total Annual #2 Fuel Oil Costs	$	0
Total Annual Gasoline Costs	$	0
TOTAL UTILITY COSTS	**$**	**3,063,797**

Blended Electric Rate ($/kWh)	$	-
Electric Demand Rate ($/kW)	$	0.057
Incremental Electric Usage Rate ($/kWh)	$	0.057
Natural Gas Rate ($/MMBtu)	$	1.945
Propane Rate ($/gal)	$	0.000
#2 Fuel Oil Rate ($/gal)	$	0.000
Gasoline Rate ($/gal)	$	0.000

ENERGY CONSUMPTION

CARBON EMISSIONS

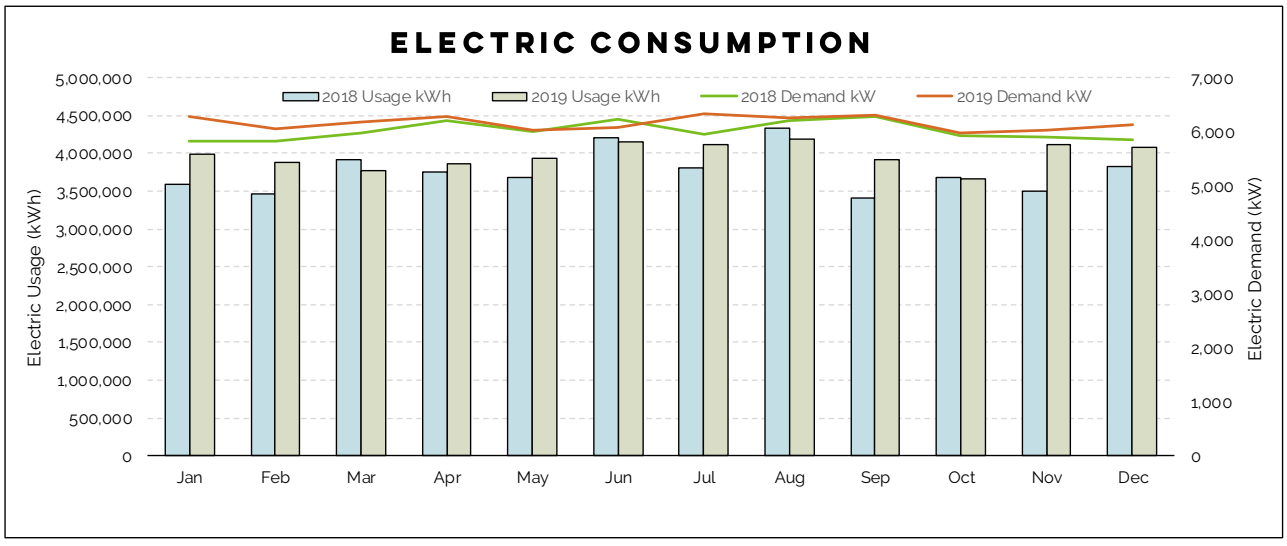


ELECTRIC UTILITY SUMMARY

Annual Electric Usage (kWh):	47,693,392	Electric Demand Rate ($/kW):	$ -
Peak Electric Demand (kW):	6,282.1	Blended Electric Rate ($/kWh):	$ 0.057
Annual Electric Demand (kW):	72,219.8	Incremental Electric Rate ($/kWh):	$ 0.057
		Total Annual Electric Costs:	$ 2,716,182

ELECTRIC UTILITY DATA

Month-Year	Days	Usage (kWh)	Peak Demand (kW)	Demand Cost	Demand Rate ($/kW)	Commodity Cost	Delivery Cost	Total Cost	Blended Rate
					2018				
Jan	31	3,677,456	5,930.4	$0	$0.00	$243,890	$61,331	$305,221	$0.083
Feb	28	3,492,555	5,905.2	$0	$0.00	$123,807	$45,903	$169,710	$0.049
Mar	31	3,830,719	5,842.2	$0	$0.00	$121,510	$66,614	$188,124	$0.049
Apr	30	3,585,875	5,825.4	$0	$0.00	$132,819	$53,633	$186,452	$0.052
May	31	3,464,420	5,835.9	$0	$0.00	$115,182	$85,205	$200,387	$0.058
Jun	30	3,917,667	5,973.4	$0	$0.00	$137,949	$82,683	$220,631	$0.056
Jul	31	3,754,973	6,208.6	$0	$0.00	$155,727	$79,346	$235,073	$0.063
Aug	31	3,687,177	6,012.3	$0	$0.00	$153,645	$76,007	$229,653	$0.062
Sep	30	4,208,065	6,228.6	$0	$0.00	$171,748	$83,532	$255,280	$0.061
Oct	31	3,800,252	5,961.9	$0	$0.00	$142,398	$71,470	$213,868	$0.056
Nov	30	4,328,091	6,213.9	$0	$0.00	$175,890	$71,824	$247,714	$0.057
Dec	31	3,411,963	**6,282.1**	$0	$0.00	$141,134	$59,958	$201,092	$0.059
		45,159,213	**72,219.8**	**$0**	**$0.00**	**$1,815,699**	**$837,506**	**$2,653,205**	**$0.059**
					2019				
Jan	31	3,993,122	6,285.3	$0	$0.00	$156,514	$65,209	$221,723	$0.056
Feb	28	3,884,634	6,051.1	$0	$0.00	$139,533	$53,756	$193,290	$0.050
Mar	31	3,767,193	6,188.7	$0	$0.00	$135,364	$74,422	$209,786	$0.056
Apr	30	3,860,749	6,275.8	$0	$0.00	$139,862	$76,301	$216,163	$0.056
May	31	3,934,110	6,023.8	$0	$0.00	$149,094	$96,232	$245,325	$0.062
Jun	30	4,150,884	6,073.2	$0	$0.00	$163,175	$87,731	$250,906	$0.060
Jul	31	4,117,511	**6,345.2**	$0	$0.00	$159,580	$98,163	$257,743	$0.063
Aug	31	4,192,295	6,248.6	$0	$0.00	$162,250	$84,173	$246,423	$0.059
Sep	30	3,924,154	6,305.2	$0	$0.00	$152,320	$81,998	$234,318	$0.060
Oct	31	3,671,015	5,969.2	$0	$0.00	$140,218	$71,126	$211,344	$0.058
Nov	30	4,113,631	6,037.5	$0	$0.00	$152,640	$74,056	$226,696	$0.055
Dec	31	4,084,094	6,133.0	$0	$0.00	$128,570	$73,895	$202,465	$0.050
		47,693,392	**73,936.6**	**$0**	**$0.00**	**$1,779,119**	**$937,063**	**$2,716,182**	**$0.057**

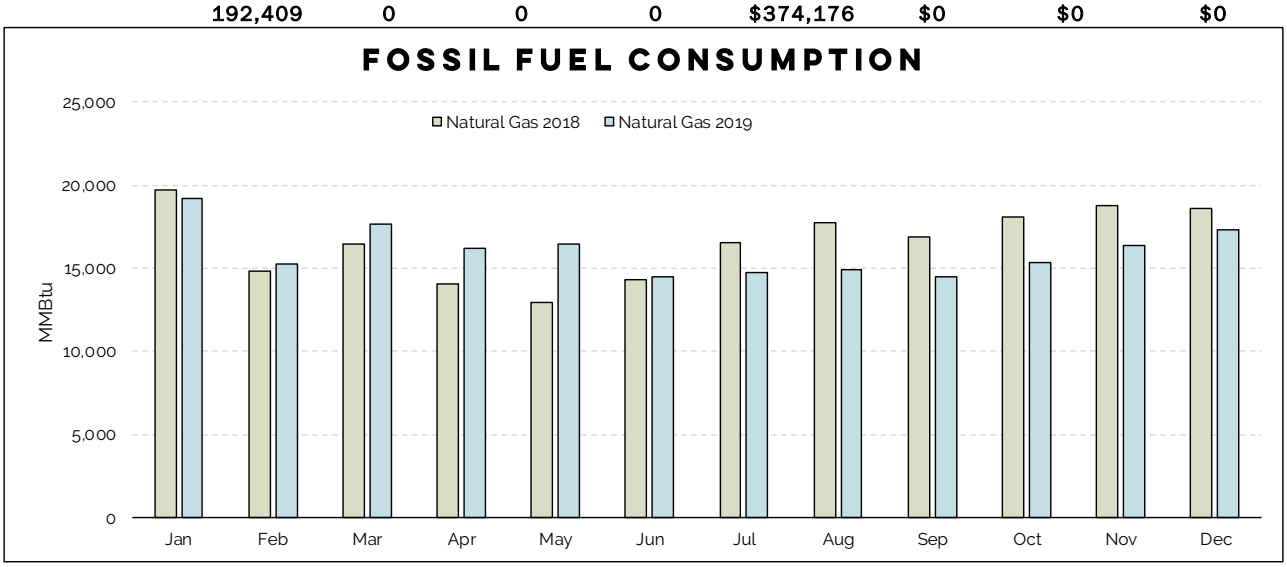


FOSSIL FUELS UTILITY SUMMARY

Natural Gas Usage (MMBtu):	192,409	Natural Gas Rate ($/MMBtu):	$ 1.945
Propane Usage (gal):	0.0	Propane Rate ($/gal):	$ 0.000
#2 Fuel Oil Usage (gal):	0.0	#2 Fuel Oil Rate ($/gal):	$ 0.000
Gasoline Usage (gal):	0.0	Gasoline Rate ($/gal):	$ 0.000

FOSSIL FUELS UTILITY DATA

Month-Year	Days	Natural Gas Usage (MMBtu)	Propane Usage (gal)	#2 Fuel Oil Usage (gal)	Gasoline Usage (gal)	Natural Gas Costs	Propane Costs	#2 Fuel Oil Costs	Gasoline Costs
					2018				
Oct-15	32	19,714	0	0	0	$39,219	$0	$0	$0
Nov-15	32	14,796	0	0	0	$30,462	$0	$0	$0
Dec-15	32	16,422	0	0	0	$33,357	$0	$0	$0
Jan-16	29	14,018	0	0	0	$29,075	$0	$0	$0
Feb-16	30	12,905	0	0	0	$29,179	$0	$0	$0
Mar-16	31	14,323	0	0	0	$31,867	$0	$0	$0
Apr-16	30	16,557	0	0	0	$36,097	$0	$0	$0
May-16	30	17,718	0	0	0	$36,141	$0	$0	$0
Jun-16	31	16,864	0	0	0	$34,683	$0	$0	$0
Jul-16	29	18,101	0	0	0	$36,159	$0	$0	$0
Aug-16	30	18,804	0	0	0	$37,384	$0	$0	$0
Sep-16	29	18,565	0	0	0	$36,968	$0	$0	$0
		198,786	**0**	**0**	**0**	**$410,591**	**$0**	**$0**	**$0**
					2019				
Oct-15	32	19,165	0	0	0	$32,489	$0	$0	$0
Nov-15	32	15,244	0	0	0	$26,786	$0	$0	$0
Dec-15	32	17,659	0	0	0	$30,298	$0	$0	$0
Jan-16	29	16,195	0	0	0	$28,169	$0	$0	$0
Feb-16	30	16,483	0	0	0	$32,560	$0	$0	$0
Mar-16	31	14,447	0	0	0	$29,958	$0	$0	$0
Apr-16	30	14,744	0	0	0	$30,472	$0	$0	$0
May-16	30	14,908	0	0	0	$31,716	$0	$0	$0
Jun-16	31	14,443	0	0	0	$30,881	$0	$0	$0
Jul-16	29	15,380	0	0	0	$32,581	$0	$0	$0
Aug-16	30	16,389	0	0	0	$33,246	$0	$0	$0
Sep-16	29	17,353	0	0	0	$35,020	$0	$0	$0
		192,409	**0**	**0**	**0**	**$374,176**	**$0**	**$0**	**$0**



EMISSIONS SUMMARY SHEET

Annual Electric Consumption

Annual Usage	Units	CO_2 (lbs)	CH_4 (lbs)	N_2O (lbs)
47,693,392	kWh	14,055,243	1,001.6	143.1

Annual Natural Gas Consumption

Annual Usage	Units	CO_2 (lbs)	CH_4 (lbs)	N_2O (lbs)
198,786	MMBTU	23,258,010	437,330.1	43,733.0

Annual Propane Consumption

Annual Usage	Units	CO_2 (lbs)	CH_4 (lbs)	N_2O (lbs)
0	gal propane	0	0.0	0.0

Annual #2 Fuel Oil Consumption

Annual Usage	Units	CO_2 (lbs)	CH_4 (lbs)	N_2O (lbs)
0	gal #2 oil	0	0.0	0.0

Annual Gasoline Consumption

Annual Usage	Units	CO_2 (lbs)	CH_4 (lbs)	N_2O (lbs)
0	gal gasoline	0	0.0	0.0

Not including transportation usage.

Emissions from Transportation

255	Full Time Equivalent Employees	CO_2 (lbs)	CH_4 (lbs)
15	Average Commute Distance (miles)	2,589,678	110,638
7	Days per Week		
2	Trips per day	N_2O (lbs)	
52	Weeks per Year	22,128	
Car (solo)	Mode of Transportation		

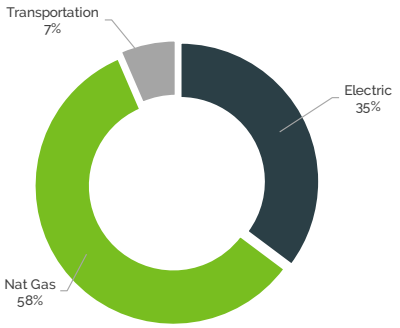
Site Emissions Factors

		CO_2	CH_4	N_2O	
Electricity					
1 kWh	=	0.2947	0.000021	3E-06	lbs
Natural Gas					
1 MMBTU	=	117	2.2	0.22	lbs
1 MBTU	=	0.117	0.0022	0.00022	lbs
1 kBTU	=	0.117	0.0022	0.00022	lbs
1 therms	=	11.7	0.22	0.022	lbs
1 decatherms	=	1.17	0.022	0.0022	lbs
1 CF Natural Gas	=	0.117	0.0022	0.00022	lbs
1 MCF Natural Gas	=	0.000117	0.0000022	2.2E-07	lbs
Other Fuels					
1 gal #2 oil	=	22.7	0.92	0.18	lbs
1 MMBTU #2 oil	=	163.1	6.6	1.3	lbs
1 MMBTU propane	=	12.6	0.6	0.12	lbs
1 gal propane	=	138.3	6.6	1.3	lbs
1 gal gasoline	=	19.3	0.8	0.2	lbs

Transportation Emissions Factors

Mode	CO2 lbs/mile
Walk, Bike, Telecommute	0
Motorcycle	0.26
Heavy Rail	0.33
2-3 Carpool	0.39
Light Rail	0.44
Alternative Fuel Vehicle	0.44
Bus	0.68
Car (solo)	0.93

CARBON EMISSIONS SOURCES



SUM of Total Emissions

	CO_2	CH_4	N_2O
lbs	39,902,931	548,970	66,004
kg	18,096,567	248,966	29,934
Tons (US)	19,951	274	33
Metric Tons	18,097	124	15

Emissions Equivalencies

2,660 Houses Energy Use

4,771 Cars Removed from the Road

7,981 Acres of Trees Planted

ENERGY CONSERVATION

Two energy conservation measures were identified as suitable for this facility. The table below outlines a summary of the estimated energy savings as well as the estimated cost of installation. Descriptions of the ECM are included below as well and calculations are included in Appendix A.

It should be noted that since this facility was recently constructed, many energy-efficient best practices were already in use, such as LED lighting, lighting occupancy sensors, heat recovery from major equipment, variable frequency drives on all pumps and fans not constantly operating at 100%, and a highly automated process line.

ECM SUMMARY TABLE

ECM	Measure Decription	Electric Savings (kWh)	Electric Cost Savings	Natural Gas Savings (therms)	Natural Gas Cost Savings	Total Cost Savings	Cost of Installation	Payback Period	Recommendation
1	Office Temperature Setback	1,841	$ 105	70	$ 136	$ 241	480	2.0	R
2	Neutralize Building Pressure	135,528	$ 7,718	4,396	$ 8,549	$ 16,268	75,000	4.6	R

Notes:
FE = Further Evaluation Needed, based on combination with other DERs.
R = Recommended
NR = Not Recommended
Demand Savings estimated based on ratio of calculated electric usage savings.

ECM 1: Office Area Temperature Setback

The office area is currently heated and cooled by multiple VRF units that serve each office area. The offices all have programmable thermostats that can be adjusted by the occupants. It was noted by staff that occupants adjust the temperatures based on their comfort levels and do not return the thermostats to their nighttime temperatures at the end of the day. This results in the space being heated or cooled to maintain temperatures that are not necessary for an unoccupied space during the night.

Programming all thermostats in the office area to be set back during the night will help reduce the amount of unnecessary heating or cooling that is conducted during the night time. Typical setback temperatures during the summer months are from 75-80 degrees F and during the winter are from 60-65 degrees F.

It should be noted that the main manufacturing floor is in operation 24/7 and therefore does not need to be set back.

ECM 2: Reduce Negative Building Pressure to Reduce Infiltration

During the site visit, it was noted that the building constantly operates at a -0.2 inch pressure differential. This was stated not to be the building's design intent, even though it does not have an effect on operations. Neutralizing the negative building pressure will reduce the building's infiltration rate and therefore reduce total building heat losses. Using an assumed 0.35 ACH of infiltration for the -0.2 inches of pressure, the total heat loss due to infiltration was estimated.

It was assumed that the cost of this action was an update to the existing controls system- which entails the staging of exhaust fans and air handling units. Variable frequency drives may be used as well to modulate the supply and exhaust fans in order to maintain the appropriate pressure.

DER ANALYSIS

The DER CAM modeling tool was used to model the energy load profiles of the facility and run an optimization of potential distributed energy resources based on economic impact to the facility. This modeling software has thousands of input variables that allow the user to input hourly load profiles throughout the course of a year, custom utility rates, custom costs and specifications of energy technologies, as well as desired outcomes in terms of the facility's energy outlook.

Several optimizations were ran to determine the most cost effective technology that fits the profile of the facility. The two scenarios below indicate the energy impacts of installing a ground mount PV system as well as a CHP system and their associated economic impacts on the facility.

DER ANALYSIS SUMMARY TABLE

	BASE CASE	OPTION 1	OPTION 2
Suggested DER Technologies	-	5 MW ICE CHP	7.1 MW Solar PV
DER CAM Optimization Inputs		*No restraints*	*CHP disabled*
ANNUAL ENERGY CONSUMPTION & CARBON EMISSIONS			
Electric Purchase from Grid (kWh)	47,693,392	3,937,610	36,049,249
Peak Electric Demand from Grid (kW)	6,282	1,341	6,327
Monthly Electric Demand (kW)	72,220	13,920	73,883
On-Site Electric Generation	-	43,755,782	11,644,143
Natural Gas Usage (MMBtu)	198,786	428,441	198,786
Carbon Emissions (MT)	16,961	23,313	15,401
Electric Savings (kWh)	-	43,755,782	11,644,143
Natural Gas Savings (MMBtu)	-	-229,654	0
Carbon Emisisons Savigns (MT)	-	-6,352	1,560
ECONOMIC ANALYSIS			
Electric Costs	$2,653,205	$224,250	$2,053,038
Natural Gas Costs	$410,591	$833,184	$386,578
Total Energy Costs	$3,063,797	$1,057,435	$2,439,615
Total Energy Cost Savings	-	$2,006,362	$624,181
Estimated Maintenance Cost Savings	-	-$481,314	-$127,800
Estimated Reduction in Production Losses from Outages		$50,000	$0
Estimated DER Cost	-	$10,880,000	$12,212,000
Estimated Incentives	-	-	$2,485,000
Net DER Cost	-	$10,880,000	$9,727,000
Payback Period (Years)	-	6.9	19.6
Net Present Value	-	$23,917,154	$1,362,917
Internal Rate of Return	-	14.2%	3.0%

$0.011/kWh maintenance CHP
$2,176/kW total installed CHP
$18/kW maintenance solar PV
NYS PV incentive $0.35/W
$1.72/W installed solar PV > 1 MW
Assume 10 outages per year, $5,000 each in production losses

The economic variables that were used to evaluate the options are as follows:

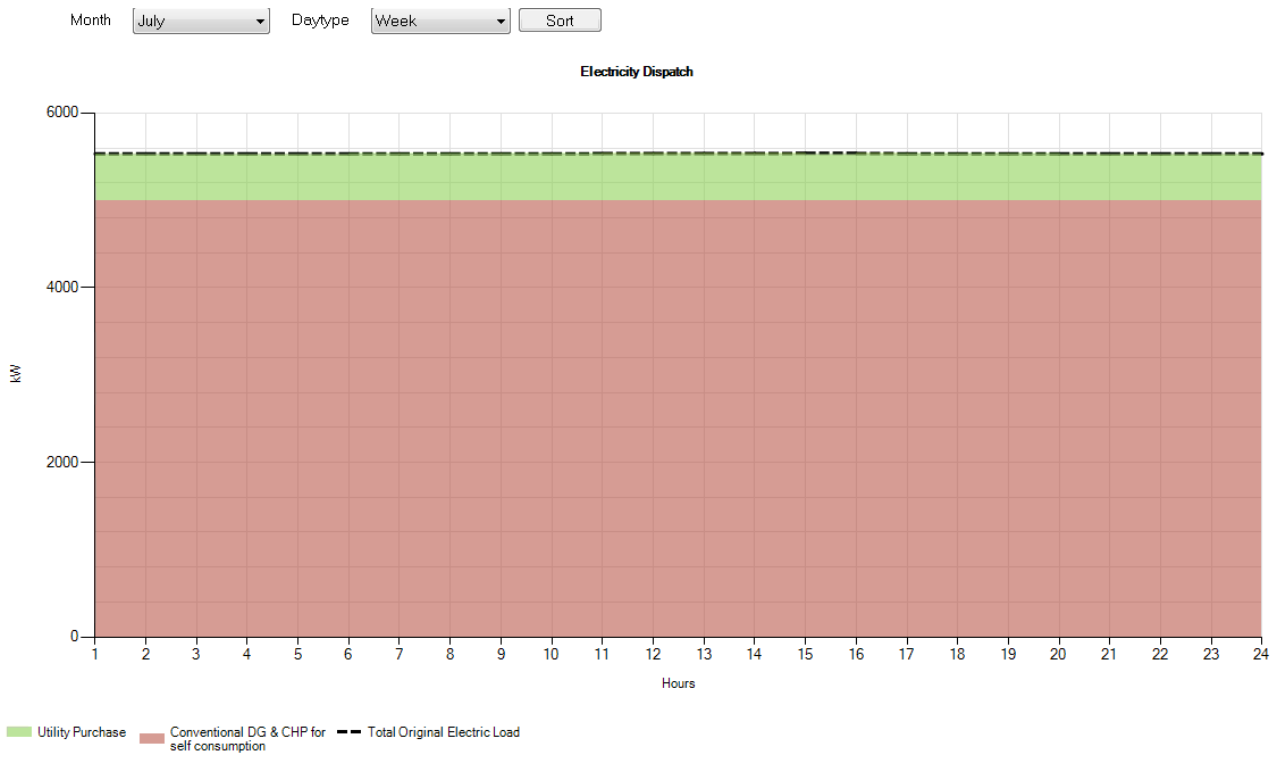
Net present value (NPV) is a method to determine the current value of all future cash flows during the project's lifespan, including initial capital investment. The higher the NPV, the greater the net return on investment is.

Internal Rate of Return (IRR) is the equivalent percentage increase or decrease in value of an investment over a set period. It is calculated by taking the difference between the expected value and original value, divided by the original value multiplied by 100.

Payback Period is the number of years it takes for the savings to equal the initial investment of the capital investment.

Option 1 entails the installation of a combined heat and power system (CHP) that generates a majority of the facility's electric load. CHP generators are essentially electric generators that run off of natural gas and use the waste heat from generation to help meet the building's heating loads. Since the facility uses a significant amount of energy generating heat for the manufacturing process, this makes Crown Cork & Seal an ideal candidate for CHP. The cost savings from CHP come from the reduced heating demands on the facility. In addition, having on-site generation will reduce the production losses from outages- which can save up to an estimated $50,000 a year.

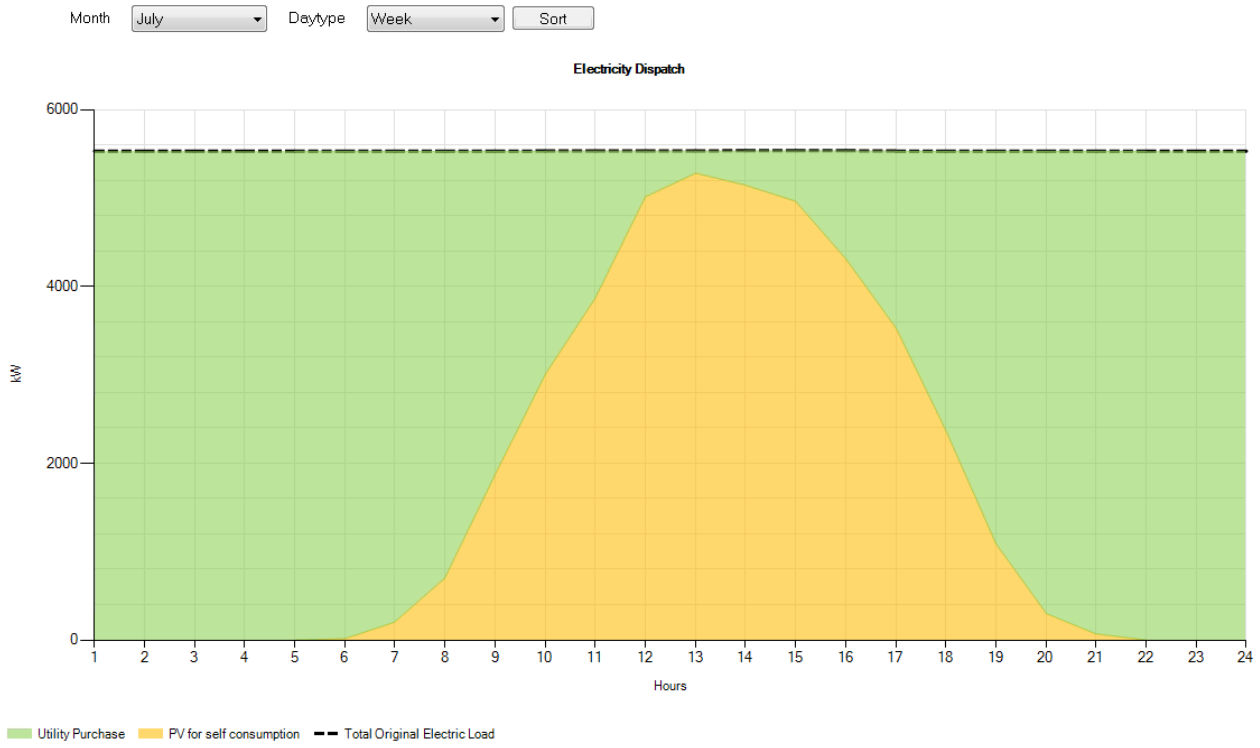
The graph below shows the daily load profile of the facility from the DER CAM outputs. The green shaded area indicated electricity purchased from the grid and the red shaded are indicates electricity generated from the CHP plant. It should be noted that since the facility is in operation 24/7 and has a very high percentage of its electric load from electric processes, the daily load profile appears to be relatively flat. This flat load profile is favorable to CHP technology so that the CHP generators can run at full load at all times- maximizing their return on investment.



Option 2 entails the installation of 7.1 MW of ground-mount solar in the land adjacent to the facility. The electricity generated from the solar array will supplement the power drawn from the grid, however, without energy storage, will not guarantee the reduction of power outages and loss of

equipment- since power is only generated during the daytime and not at night. It was determined by the DER CAM software that with the current load profile and electric rates, battery storage does not increase the net present value of the system.

Below is a load profile generated by DER CAM, outlining the total energy load profile and portions that are drawn from the grid versus being generated by the solar array. The yellow portion indicates solar generation throughout the days and green indicates the electricity purchased from the grid.



RECOMMENDATIONS

Based on the energy conservation analyses and DER analyses, the following actions are recommended in order to maximize economic return on investment:

-Establish nighttime temperature setbacks in office areas

-Reduce negative pressure in building to reduce infiltration

-Install 5 MW CHP system to increase facility resiliency and reduce energy costs

Implementing these measures will increase the facility's energy efficiency as well as increase resiliency to help protect from interruptions in production from power outages.

The analyses in this report are high-level in nature and are intended to identify the most economically attractive options. Further investigation into these measures to confirm their feasibility may be necessary before installation.

APPENDIX A: ECM CALCULATIONS

ECM 1 CALCULATIONS

Description: Nightime setback of office temperature setpoints

Totals:

Electric Savings (kWh)	Electric Cost Savings	Natural Gas Savings (therms)	Natural Gas Cost Savings	Total Cost Savings	Cost of Installation	Payback Period
1,841	$ 105	70	$ 136	$ 241	480	2.0

Blended Electric Rate ($/kWh): $ 0.057
Natural Gas Rate ($/therm): $ 1.945

Assumptions:

1) Office areas maintain average temperatures of 70 degrees year-round, day and night.
2) Winter night time setback = 60 deg F
3) Summer night time setback = 78 deg F

4) Number of units	1
5) Total tons for office space assuming 450 tons/sf	13.3333
6) Assumed SEER	13
7) Assumed HSPF	8.2
8) Assumed $EFLH_{Cooling}$	1662
9) Assumed $EFLH_{Heating}$	2423
10) Assume $F_{cooling}$	0.09
11) Assumed $F_{heating}$	0.02
12) Assumed $kBtu_{output}$/unit	1440

13) Cost of installation assumes in-house thermostat programming for 8 hrs at $60/hour

Equations Used:

Annual Electric Energy Savings

$$\Delta kWh = units \times \left[\left(tons/unit \times \left(\frac{12}{SEER} \right) \times EFLH_{cooling} \times F_{cooling} \right) + \left(kBTUh_{out}/unit \times \left(\frac{1}{HSPF} \right) \times EFLH_{heating} \times F_{heating} \right) \right]$$

Peak Coincident Demand Savings

$$\Delta kW = N/A$$

Annual Gas Energy Savings

$$\Delta therms = units \times \left[kBTUh_{in}/unit \times \left(\frac{1}{100} \right) \times EFLH_{heating} \times F_{heating} \right]$$

ΔkWh= 1841

Δtherms = 698 = 69.8 MMBtu

ECM 2 CALCULATIONS

Description: Reduce infiltration by eliminative negative pressure differential

Totals:

Electric Savings (kWh)	Electric Cost Savings	Natural Gas Savings (MMBtu)	Natural Gas Cost Savings	Total Cost Savings	Cost of Installation	Payback Period
135,528	$ 7,718	4,396	$ 8,549	$ 16,268	75,000	4.6

Blended Electric Rate ($/kWh): $ 0.057
Natural Gas Rate ($/therm): $ 1.945

Assumptions:

1) Assumed Building Average height = 30 ft.
2) Assumed difference in air tightness from negative pressure = 0.35 ACH
3) Building Volme = 15,000,000 CF
4) Installation costs assume approximately $75,000 of controls work that includes staging of enhaust fans and AHUs in order to maintain air quality requirements while redicing negative pressure differential in building.

Equations Used:

Building Volume = (square footage) * (avg height)

Energy Loss (Btu/hr) = $(T_{indoor} - T_{outdoor})$*(Volume)*(ACH)*0.005

Total Energy Loss = (Energy Loss (Btu/hr))*(Total number of hours)

Month	Avg Outdoor Air Temp (°F)	IndoorAir Temp (°F)	Heat Loss (Btu/hr)	Monthly Hours	Total MMBtu Heating Losses	Total kWh Cooling Losses
Jan	24	68	1,155,000	744	859	-
Feb	24	68	1,155,000	672	776	-
Mar	33	68	918,750	744	684	-
Apr	46	68	577,500	720	416	-
May	57	68	288,750	744	-	62,963
Jun	65	68	78,750	720	-	16,618
Jul	70	68	52,500	744	-	11,448
Aug	67	68	26,250	744	-	5,724
Sep	61	68	183,750	720	-	38,775
Oct	50	68	472,500	744	352	-
Nov	39	68	761,250	720	548	-
Dec	29	68	1,023,750	744	762	-
					4,396	135,528

SITE-SPECIFIC INVESTIGATION REPORT

TOMPKINS COUNTY: TOMPKINS COUNTY HUMAN SERVICES BUILDING

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NOTE:

The energy analyses in this report are high-level in nature. All recommendations made in this report require further verification before being implemented.

FACILITY DESCRIPTION

The Tompkins County Human Services Building is a four-story 71,200 square foot building constructed in 1998, and a one-story, 1,700 square foot addition built in 2014. The office building serves the Tompkins County Department of Social Services, Youth Services, and Probation and Community Justice. The building is open Monday through Fridays and is open between 8AM to 5PM. There are about 260 employees and a variable number of clients occupying the building throughout the day. While there is no existing back-up generator, the county has classified the building function as an essential service and would like to acquire a generator to provide at least partial electric service during a power emergency.

EXISTING INFRASTRUCTURE

The original building heating, cooling, and ventilation needs are served by central AC air handlers, two per floor, with heat rejection via condenser water cooling piped to a 200-ton cooling tower located on the roof. The air handlers are variable air volume units with distributed variable air volume (VAV) boxes containing reheat to provide zone control. Tempered outdoor air is provided by a supply fan ducted to each air handler. In addition to the condenser water system, three hot water piping systems are provided- air handler pre-heat, VAV box reheat, and perimeter heating.

The addition is served by a 4-ton, packaged rooftop air conditioning unit with a heating coil piped into the glycol/water preheat system.

The original heating plant consisted of three hydronic, non-condensing, natural gas-fired, 1.44 MMBTU Lochinvar (input) boilers. Reportedly, the building never called on all three boilers to fire and one boiler has been taken out of commission. A stacked, condensing style boiler was added in 2015. This dual unit boiler has an input capacity 1.7 MMBH with a 10:1 turndown ratio.

The air handler units and most of the circulating pumps have variable speed drives, however the tower water pump always operates in full flow condition.

A web-enabled building-wide energy Johnson Controls management control system monitors and controls all major mechanical equipment.

There is a solar panel installation on the roof of the building that is estimated to be 25 kW based on annual generation history. The system is in good condition and operational. Utility reports indicate that the system generated 29,930 kWh in 2019.

An inventory of the mechanical equipment is located in Appendix B, and photos of the equipment associated with the Energy Conservation Measures may be found in Appendix C.

UTILITY DATA & CARBON EMISSIONS

Tompkins County currently purchases electricity from Constellation New Energy Inc. and is delivered by NYSEG. Natural gas is supplied by NYSEG.

The following figures outline the electric and natural gas usages from February, 2019 through Jan, 2020. Corresponding carbon emissions are calculated using LEED net zero guidelines.

UTILTY DATA & EMISSIONS SUMMARY

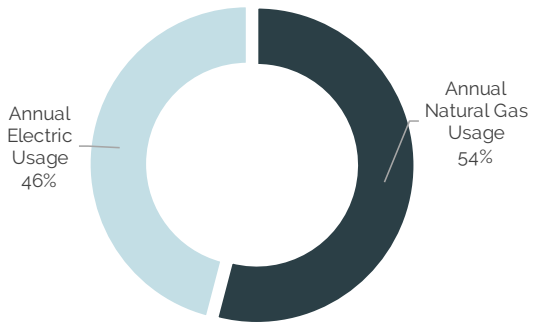
ELECTRICITY	Annual Totals				CO_2 Emissions	
Annual Electric Usage	793,300	kWh	=	2,706,740 MBtu	106	Metric Tons
Peak Electric Demand	286	kW				
Total Monthly Electric Demand	2909	kW				

FOSSIL FUELS	Annual Totals				CO_2 Emissions	
Annual Natural Gas Usage	3,188	MMBtu	=	3,188,000 MBtu	169	Metric Tons
Annual Propane Usage	0	gal	=	0 MBtu	0	Metric Tons
Annual #2 Fuel Oil Usage	0	gal	=	0 MBtu	0	Metric Tons
Annual Gasoline Usage	0	gal	=	0 MBtu	0	Metric Tons
ANNUAL TOTALS				**5,894,740 MBtu**	**275.2**	**Metric Tons**

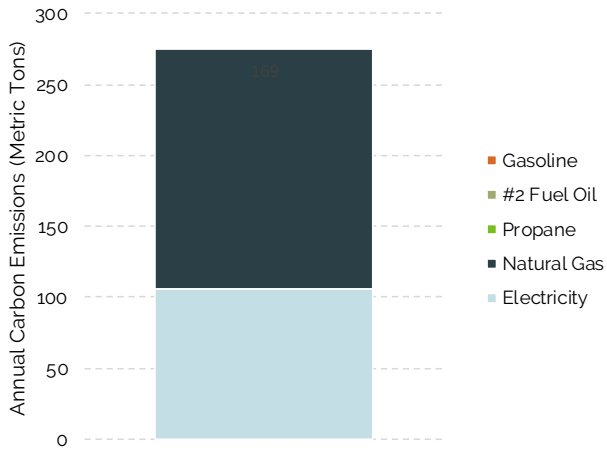
Total Annual Electric Costs	$	79,964
Total Annual Natural Gas Costs	$	8,926
Total Annual Propane Costs	$	0
Total Annual #2 Fuel Oil Costs	$	0
Total Annual Gasoline Costs	$	0
TOTAL UTILITY COSTS	**$**	**88,890**

Blended Electric Rate ($/kWh)	$	9.787
Electric Demand Rate ($/kW)	$	0.101
Incremental Electric Usage Rate ($/kWh)	$	0.065
Natural Gas Rate ($/MMBtu)	$	2.800
Propane Rate ($/gal)	$	0.000
#2 Fuel Oil Rate ($/gal)	$	0.000
Gasoline Rate ($/gal)	$	0.000

ENERGY CONSUMPTION



CARBON EMISSIONS

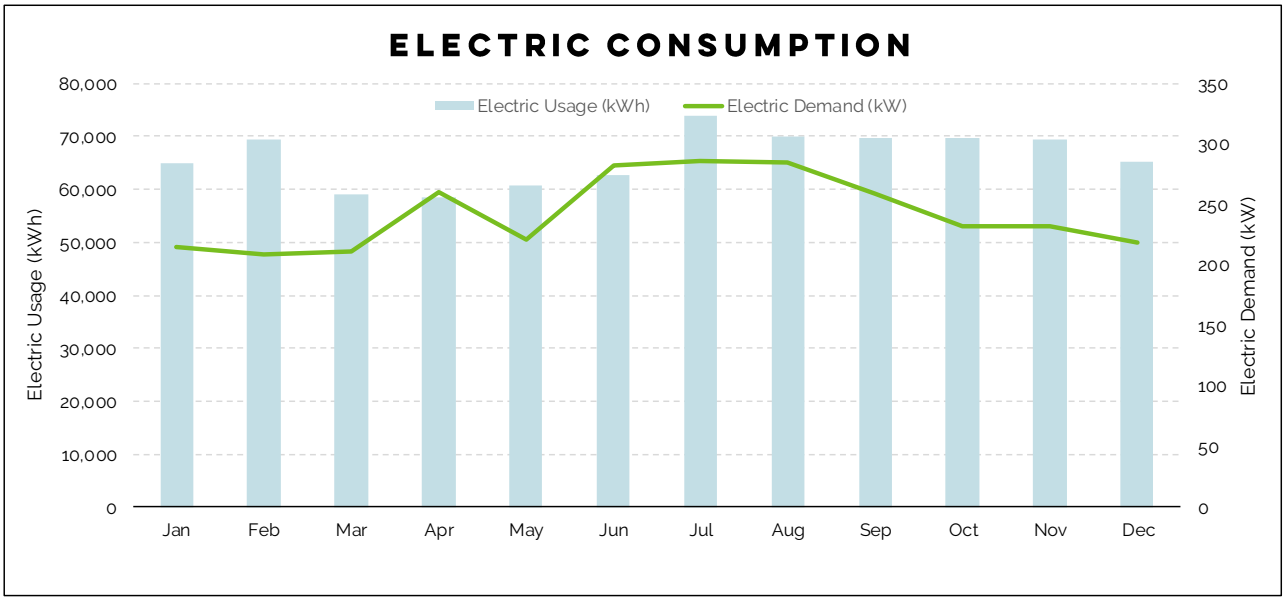


ELECTRIC UTILITY SUMMARY

Annual Electric Usage (kWh):	793,300	Electric Demand Rate ($/kW):	$ 9.787
Peak Electric Demand (kW):	286	Blended Electric Rate ($/kWh):	$ 0.101
Annual Electric Demand (kW):	2,909	Incremental Electric Rate ($/kWh):	$ 0.065
		Total Annual Electric Costs:	$ 79,964

ELECTRIC UTILITY DATA

Month-Year	Days	Usage (kWh)	Peak Demand (kW)	Demand Cost	Demand Rate ($/kW)	Usage Cost	Total Cost	Blended Rate
Fiscal Year 2019								
Feb-19	28	69,390	209	$1,993	$9.54	$4,184	$6,177	$0.089
Mar-15	31	59,073	211	$2,020	$9.57	$532	$2,552	$0.043
Apr-19	30	58,542	260	$2,488	$9.57	$7,109	$9,597	$0.164
May-19	31	60,655	221	$2,100	$9.50	$915	$3,015	$0.050
June-19	30	62,821	282	$2,676	$9.49	$7,671	$10,347	$0.165
Jul-19	31	73,765	286	$2,786	$9.74	$5,018	$7,804	$0.106
Aug-19	31	70,112	285	$2,798	$9.82	$4,564	$7,362	$0.105
Sep-19	30	69,727	258	$2,540	$9.83	$4,475	$7,015	$0.101
Oct-19	31	69,727	232	$2,540	$10.94	$4,475	$7,015	$0.101
Nov-19	30	69,342	232	$2,282	$9.84	$4,385	$6,667	$0.096
Dec-19	30	65,228	218	$2,141	$9.82	$4,097	$6,238	$0.096
Jan-20	31	64,918	214	$2,106	$9.83	$4,070	$6,176	$0.095
		793,300	**2,909**	**$28,470**	**$9.79**	**$51,494**	**$79,964**	**$0.101**



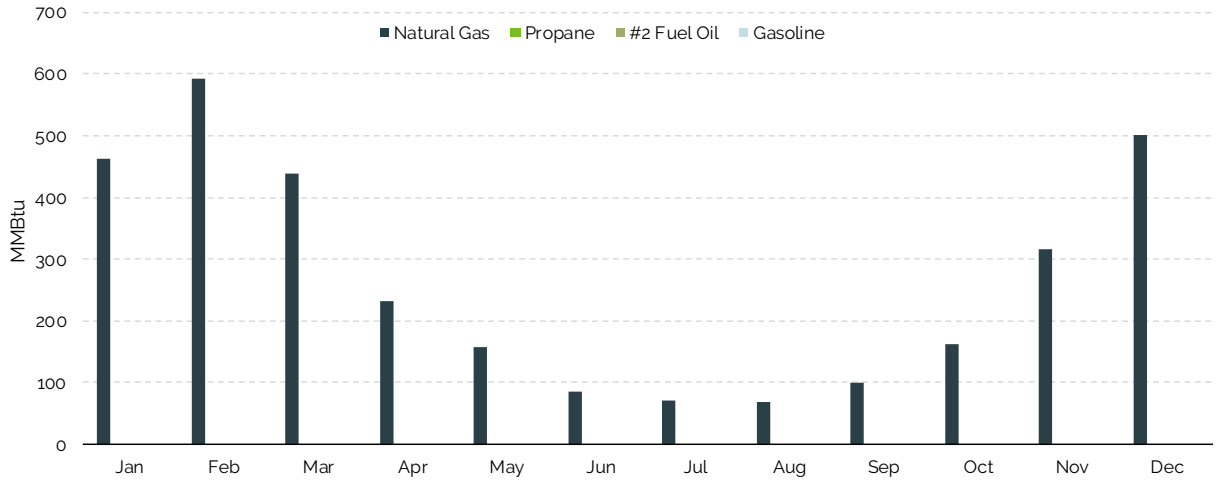
FOSSIL FUELS UTILITY SUMMARY

Natural Gas Usage (MMBtu):	3,188	Natural Gas Rate ($/MMBtu):	$	2.800
Propane Usage (gal):	0.0	Propane Rate ($/gal):	$	0.000
#2 Fuel Oil Usage (gal):	0.0	#2 Fuel Oil Rate ($/gal):	$	0.000
Gasoline Usage (gal):	0.0	Gasoline Rate ($/gal):	$	0.000

FOSSIL FUELS UTILITY DATA

Month-Year	Days	Natural Gas Usage (MMBtu)	Propane Usage (gal)	#2 Fuel Oil Usage (gal)	Gasoline Usage (gal)	Natural Gas Costs	Propane Costs	#2 Fuel Oil Costs	Gasoline Costs
Fiscal Year 2019									
Feb-19	28	593.0	0	0	0	$1,431	$0	$0	$0
Mar-15	31	438.3	0	0	0	$1,087	$0	$0	$0
Apr-19	30	232.0	0	0	0	$627	$0	$0	$0
May-19	31	157.6	0	0	0	$489	$0	$0	$0
June-19	30	85.3	0	0	0	$320	$0	$0	$0
Jul-19	31	70.6	0	0	0	$284	$0	$0	$0
Aug-19	31	69.7	0	0	0	$285	$0	$0	$0
Sep-19	30	98.8	0	0	0	$360	$0	$0	$0
Oct-19	31	162.8	0	0	0	$521	$0	$0	$0
Nov-19	30	317.1	0	0	0	$911	$0	$0	$0
Dec-19	30	500.4	0	0	0	$1,374	$0	$0	$0
Jan-20	31	462.4	0	0	0	$1,237	$0	$0	$0
		3,188	**0**	**0**	**0**	**$8,926**	**$0**	**$0**	**$0**

FOSSIL FUEL CONSUMPTION



EMISSIONS SUMMARY SHEET

Annual Electric Consumption

Annual Usage	Units	CO_2 (lbs)	CH_4 (lbs)	N_2O (lbs)
793,300	kWh	233,786	16.7	2.4

Annual Natural Gas Consumption

Annual Usage	Units	CO_2 (lbs)	CH_4 (lbs)	N_2O (lbs)
3,188	MMBTU	372,996	7,013.6	701.4

Annual Propane Consumption

Annual Usage	Units	CO_2 (lbs)	CH_4 (lbs)	N_2O (lbs)
0	gal propane	0	0.0	0.0

Annual #2 Fuel Oil Consumption

Annual Usage	Units	CO_2 (lbs)	CH_4 (lbs)	N_2O (lbs)
0	gal #2 oil	0	0.0	0.0

Annual Gasoline Consumption

Annual Usage	Units	CO_2 (lbs)	CH_4 (lbs)	N_2O (lbs)
0	gal gasoline	0	0.0	0.0

Not including transportation usage.

Emissions from Transportation

260	Full Time Equivalent Employees	CO_2 (lbs)	CH_4 (lbs)
15	Average Commute Distance (miles)	1,886,040	80,577
5	Days per Week		
2	Trips per day	N_2O (lbs)	
52	Weeks per Year	16,115	
Car (solo)	Mode of Transportation		

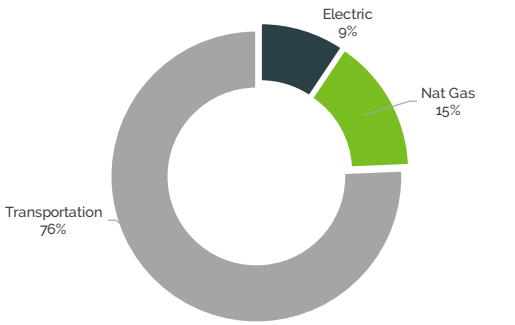
Site Emissions Factors

		CO_2	CH_4	N_2O	
Electricity					
1 kWh	=	0.2947	2.1E-05	3E-06	lbs
Natural Gas					
1 MMBTU	=	117	2.2	0.22	lbs
1 MBTU	=	0.117	0.0022	0.00022	lbs
1 kBTU	=	0.117	0.0022	0.00022	lbs
1 therms	=	11.7	0.22	0.022	lbs
1 decatherms	=	1.17	0.022	0.0022	lbs
1 CF Natural Gas	=	0.117	0.0022	0.00022	lbs
1 MCF Natural Gas	=	0.000117	2.2E-06	2.2E-07	lbs
Other Fuels					
1 gal #2 oil	=	22.7	0.92	0.18	lbs
1 MMBTU #2 oil	=	163.1	6.6	1.3	lbs
1 MMBTU propane	=	12.6	0.6	0.12	lbs
1 gal propane	=	138.3	6.6	1.3	lbs
1 gal gasoline	=	19.3	0.8	0.2	lbs

Transportation Emissions Factors

Mode	CO2 lbs/mile
Walk, Bike, Telecommute	0
Motorcycle	0.26
Heavy Rail	0.33
2-3 Carpool	0.39
Light Rail	0.44
Alternative Fuel Vehicle	0.44
Bus	0.68
Car (solo)	0.93

CARBON EMISSIONS SOURCES



SUM of Total Emissions

	CO_2	CH_4	N_2O
lbs	2,492,822	87,607	16,819
kg	1,130,531	39,731	7,628
Tons (US)	1,246	44	8
Metric Tons	1,131	20	4

Emissions Equivalencies

166 — Houses Energy Use

298 — Cars Removed from the Road

499 — Acres of Trees Planted

ENERGY CONSERVATION

Four energy conservation measures were identified as suitable for this facility. The table below outlines a summary of the estimated energy savings as well as the estimated cost of installation. Descriptions of the ECM are included below as well and calculations are included in Appendix A.

ECM SUMMARY TABLE

ECM	Measure Description	Electric Savings (kWh)	Electric Cost Savings	Natural Gas Savings (therms)	Natural Gas Cost Savings	Total Cost Savings	Cost of Installation	Payback Period (Years)	Note
1	LED Lighting Replacement	121,610	$ 12,161	0	$ -	$ 12,161	$17,800	1.5	R
2	Condensing Boiler Replacement	0	$ -	14,742	$11,425	$ 11,425	$75,000	6.6	R
3	VFD for Cooling Tower Pump	145,430	$ 14,543	0	$0.00	$ 14,543	$16,000	1.1	R
4	Energy Recovery Ventilation	31,778	$ 3,178	17,116	$ 13,265	$ 16,443	$65,000	4.0	FE
Sum of Recommended Measures:		298,818	$ 29,882	31,858	$24,690	$54,572	$173,800		

Notes:

FE = Further Evaluation Needed, based on combination with other DERs.

R = Recommended

NR = Not Recommended

Demand Savings estimated based on ratio of calculated electric usage savings.

ECM 1: Replacement of Current T8 Lights with LED lights

The majority of the light fixtures on all four floors consists of 2' x 4" recessed lights, with one to three lamps per fixtures. This ECM calls for replacement of about 973 lamps with LED bulbs for a 40% reduction of energy use and a lighting density of about 0.4 watts per square foot. The energy reduction calculated also includes the reduction of air conditioning resulting from less heat gain due to lighting. The simple payback for this measure is about 1.5 years.

ECM 2: Boiler Replacement with Condensing Style Boiler

The existing boiler plant consist of three 1,210 output MBH boilers, of which only two are currently operating. In addition to these, a stacked condensing boiler with 1,600 MBH output was installed within the last five years. In discussion with the facilities staff, it appears that replacing the existing non-condensing boiler with a second condensing boiler and removing the non-condensing boilers will provide enough boiler capacity to meet the heating load. It is also been assumed that the building can operate under low return water temperature for enough hours out of the year to allow the new boilers to operate in their high-efficiency condensing mode and save enough in energy costs to merit economic consideration. The simple payback for this measure is about 6.6 years. Given the age of the existing boilers and the need to replacement them in the near future, this measure can be considered an incremental cost between a non-condensing boiler and a condensing boiler.

ECM 3: Variable Speed Drive for the Cooling Tower Pump:

Two constant volume 25-horsepower pumps (lead/standby) pump condenser water from the indoor air conditioning system up to the rooftop cooling tower. The pumps operate at full speed year round and cannot communicate with the JCI building energy management control system. Related to this, efforts to shut-down the circulating water and rely on fan-powered tower airflow does not seem to provide sufficient cooling even under winter conditions. With the continuous operation of these pumps, variable speed drives would save energy by matching water flow with actual cooling load and outside air conditions. The simple payback of this measure is just over one year.

ECM 4: Energy Recovery for Ventilation Air

A 20,000 CFM supply fan located on the fourth floor provides ducted outside air to the buildings AC air handling unit. Relief air is ducted to the outside via large exhaust fans. The outside air is tempered for heating via a glycol duct coil; no pre-cooling is provided. An energy recovery wheel or a plate-and-frame heat exchanger can recover sensible and latent heat from the relief airstream to pre-temper the ventilation air by extracting heat in the winter and rejecting heat in the summer. This will reduce both boiler and mechanical air conditioning loading throughout the year. The higher cost of this option arises due to some unknowns and the tight configuration of the mechanical space. Ductwork modifications will be required to bring all, or most, of the relief air back to the outside air intake location. The cost estimates assumes that this modification can be achieved with only a minimal amount of ductwork modifications, Follow up investigation is recommended.

DER ANALYSIS

The DER CAM modeling tool was used to model the energy load profiles of the facility and run an optimization of potential distributed energy resources based on economic impact to the facility. This modeling software has thousands of input variables that allow the user to input hourly load profiles throughout the course of a year, custom utility rates, custom costs and specifications of energy technologies, as well as desired outcomes in terms of the facility's energy outlook.

Several optimizations were ran to determine the most cost effective technology that fits the profile of the facility and also allows the facility to achieve net zero carbon. The three scenarios below indicate the energy impacts of installing a ground mount PV system, a ground mount PV system with battery storage, and a ground mount PV system with geothermal wells.

DER ANALYSIS SUMMARY TABLE

	BASE CASE	OPTION 1	OPTION 2	OPTION 4
Suggested DER Technologies *(Sugested PV includes existing 25 kW system)*	-	735 kW PV	735 kW PV 800kW/ 6500kWh Battery Storage	735 kW PV 190 ton Geothermal System
ANNUAL ENERGY CONSUMPTION & CARBON EMISSIONS				
Electric Purchase from Grid (kWh)	793,300	-82,173	-82,173	-61,071
Peak Electric Demand from Grid (kW)	286	160	72	224
Monthly Electric Demand (kW)	2,909	1,642	652	2,142
On-Site Electric Generation	-	875,473	875,473	875,473
Natural Gas Usage (MMBtu)	3,188	3,188	3,188	1,020
Carbon Emissions (MT) with Transportation	1,131	1,016	1,016	903
Electric Savings (kWh)	-	875,473	875,473	854,371
Natural Gas Savings (MMBtu)	-	0	0	2,168
Carbon Emisisons Savigns (MT) (before carbon offset)	-	115	115	228
ECONOMIC ANALYSIS				
Electric Costs	$79,964	$10,732	$1,041	$16,998
Natural Gas Costs	$8,926	$8,926	$8,926	$2,856
Total Energy Costs	$88,890	$19,659	$9,968	$19,854
Total Energy Cost Savings	-	$69,231	$78,922	$108,744
Estimated Maintenance Cost Savings	-	-$12,780	-$17,280	-$18,543
Carbon Offset Credits		-$1,828	-$1,828	-$1,626
Net Savings		$54,623	$59,814	$88,575
Estimated DER Cost	-	$1,278,000	$1,533,900	$2,411,874
Estimated Incentives	-	$248,500	$395,300	$476,500
Net DER Cost	-	$1,029,500	$1,138,600	$1,935,374
Payback Period (Years)	-	18.8	19.0	21.9
Net Present Value	-	$190,056	$197,078	$47,444
Internal Rate of Return	-	3.3%	3.2%	2.2%

$18/kW maintenance solar PV
NYS PV incentive $0.35/W
$1.72/W installed solar PV > 1 MW
Assume 10 outages per year, $5,000 each in production losses
Carbon offset credit rate: $1.80/MT
Carbon emissions savings do not take into consideration transportation costs or carbon offset credits.
Assume 90% of existing natural gas usage is due to space heating.

The economic variables that were used to evaluate the options are as follows:

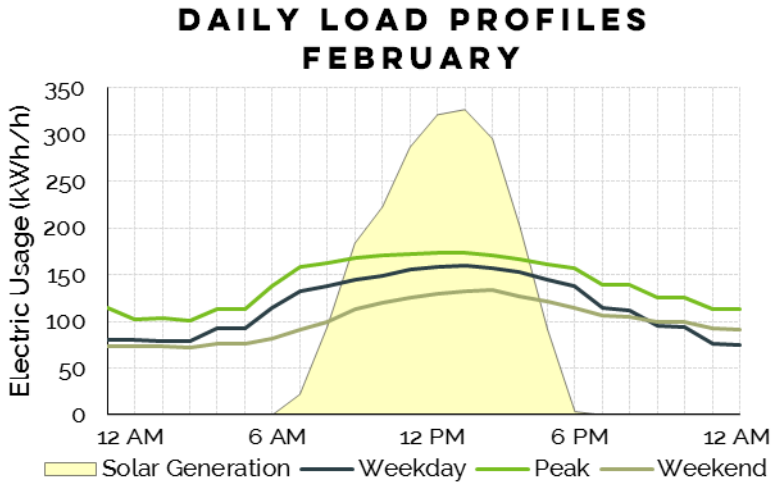
Net present value (NPV) is a method to determine the current value of all future cash flows during the project's lifespan, including initial capital investment. The higher the NPV, the greater the net return on investment is.

Internal Rate of Return (IRR) is the equivalent percentage increase or decrease in value of an investment over a set period. It is calculated by taking the difference between the expected value and original value, divided by the original value multiplied by 100.

Payback Period is the number of years it takes for the savings to equal the initial investment of the capital investment.

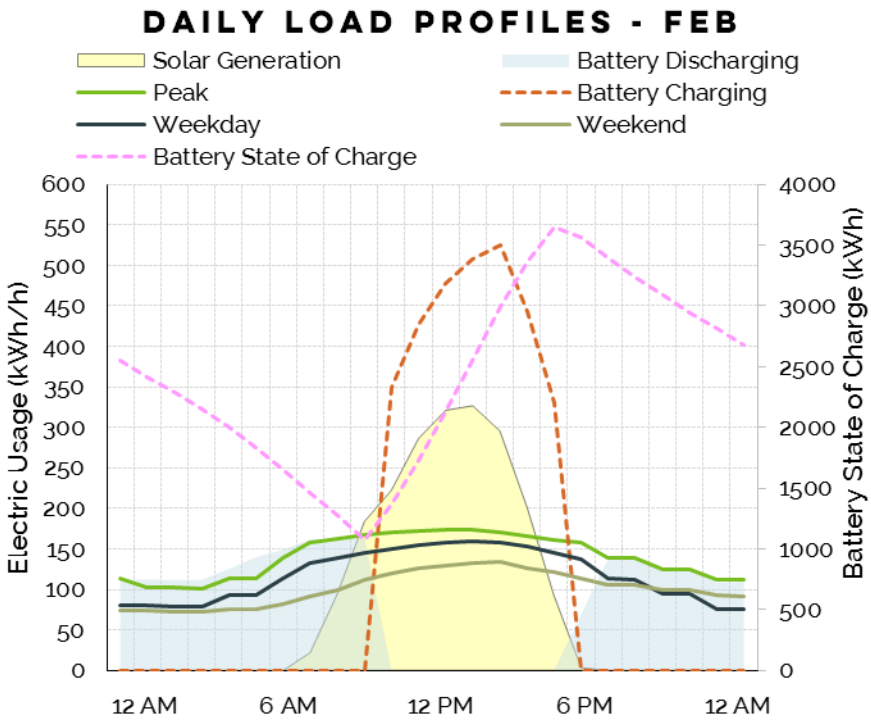
Option 1 entails the installation of a 710 kW PV system (in addition to the existing 25 kW) to provide supplemental electricity to the facility. The recommended installation of the solar panels are either ground-mount or on the rooftop- as long as the structural analysis deems the rooftop suitable for a rooftop PV system. The size of this installation also qualifies for net-metering should the county decide to locate to locate the panels on a separate property.

Solar arrays in New York State currently qualify for incentive dollars- lowering the estimated payback period to 15.5 years. The figure below shows the estimated load profile over the course of a 24 hour period. Note that due to the majority of the electric load being process loads, the load profile was assumed to be relatively flat. This option would help reduce energy costs and increase the facility's resiliency, but it would not completely eliminate issues associated with unexpected power outages throughout the year.



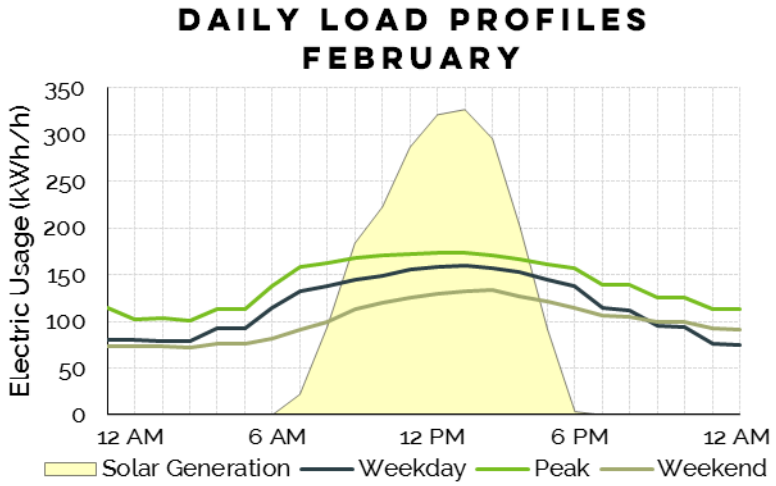
Option 2 entails the installation of a 735 kW PV system as well as 800 kW/65000 kWh flow batteries for energy storage. This option would require the solar panels to be placed on the ground and have the battery storage located nearby on the same meter. As in option 1, Tompkins County would have the option to locate the panels on a separate property and use net-metering to offset the energy usage at the main site.

Both the solar panels and energy storage qualify for NYS incentives. In addition, if located on-site, the battery storage would increase the facility's resiliency and serve as a source of backup generation. The estimated load profile below illustrates production by PV, charging and discharging of the battery storage, and electricity purchased from the grid.



Option 3 entails the installation of 735 kW of PV and a 190 ton geothermal heating system. The geothermal heating loop would consist of numerous bore-holes as well as heat pumps to provide heat to the building. The water is pumped through the vertical bore-holes deep in the ground and uses the heat from the earth as a natural heat exchanger to heat the water. Once the water is pumped through the wells, it is re-circulated to the building loop and can be used to heat the building using heat pumps. This type of system typically replaces hot water boilers, but can also be used if gas-fired heating equipment is replaced with water-to-water heat pumps. This would eliminate most of the natural gas heating in the facility, which will save an estimated 228 metric tons of carbon emissions per year.

The electric load profile is shown below and mirrors the load profile for option 1, which has the same size PV system, but does not have a significant impact from the geothermal heating system.



RECOMMENDATIONS

Based on the energy conservation analyses and DER analyses, the following actions are recommended in order to maximize economic return on investment, increase facility resiliency, and achieve net zero carbon:

- Replace T8 lights with LED lamps.
- Replace non-condensing boilers with condensing boiler.
- Install a variable speed drive (VSD) for the cooling tower pumps.
- Install a PV + battery storage system (Option 2)

A number of energy conserving measures have already been implemented by the County such as staggered-startup, night setback controls, variable speed drives on circulating pumps, and water conservation measures. Occupancy sensors were discussed but due to the open office layout of most of the floors and limited daylighting, lighting controls may not provide a reasonable return. Regular filter replacement is always recommended to reduce fan loads.

The County may also wish to look at instantaneous, point-of-use domestic water heaters to reduce standby and circulation losses, especially since the existing heater may be ending the end of life.

Each floor has a telecommunication room and only the first floor has a dedicated unit. To reduce unnecessary cooling loads in the winter, a split unit can be provided for each room on the remaining three floors.

Lastly the feasibility of a ground-source geothermal system was examined. The total cooling load of the building is about 190 tons. Using conservative estimates of 150 linear feet per ton and a 450 foot well depth, about 74 wells would be required. At a spacing of 20 feet apart, a well field of roughly a one-half acre in size would be required. The building's 100-foot by 120-foot parking lot could accommodate about 30 wells, or up to roughly half of the required area.

The analyses in this report are high-level in nature and are intended to identify the most economically attractive options. Further investigation into these measures to confirm their feasibility may be necessary before implementation.

APPENDIX A: ECM CALCULATIONS

ECM 1 CALCULATIONS

Description: LED Lighting Replacement

Totals:

Electric Savings (kWh)	Electric Cost Savings	Natural Gas Savings (therms)	Natural Gas Cost Savings	Total Cost Savings	Cost of Installation	Payback Period (years)
121,610	$ 12,161	$ -	$ -	$12,161	$17,800	1.5

Blended Electric Rate ($/kWh): $ 0.100
Natural Gas Rate ($/therm): $ 0.780

Assumptions:

1) Annual hours assume 15 hour days, 5 days per week and 52 weeks per year.
2) Blended cost (not including solar production offset) = $0.10 per kWh.
3) No reduction of fixtures count is assumed.
4) EER used to calculate kWh load is based on existing AC equipment and assumed to equal 10.0 given age of original equipment.

Equations Used:

See Worksheet.

ECM 2 CALCULATIONS

Description: Condensing Boiler Replacement

Totals:

Electric Savings (kWh)	Electric Cost Savings	Natural Gas Savings (therms)	Natural Gas Cost Savings	Total Cost Savings	Cost of Installation	Payback Period (Years)
0	$ -	14,742	$ 11,425	$ 11,425	$75,000	6.6

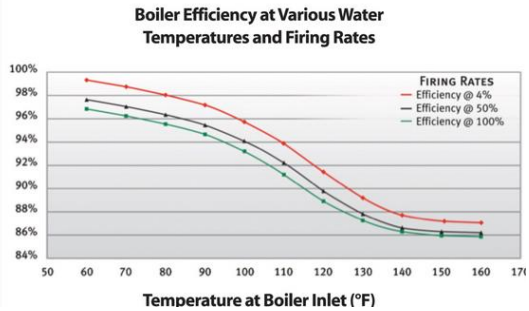
Blended Electric Rate ($/kWh): $ 0.100
Natural Gas Rate ($/therm): $ 0.78

Assumptions:

1) BIN Data reflects 24 hours per day operation, using TMY3 data for Ithaca, NY.
2) The inside design temp = 70˚F, therefore percent of the boiler loading = $(T^{INSIDE} - T^{OUTSIDE}) / T^{INSIDE}$
3) Based on a typical condensing boiler Thermal Efficiency profile of eff. Vs. return water temp.
4) Existing boilers assumed to be 80% efficiency.
5) The supply water tmeprature is based on a linear reset schedule of 180F HWS at -5F OA to 100F HWS at 60F OA; resulting in condensation conditions for about 80% of all heating hours.

Equations Used:

See Worksheet.



Note: The existing system consists of (3) 1,210 output MBH boilers (of which only 2 are operating) plus (1) stacked condensing boiler with a 1,600 MBH output. Original design was for the non-condensing Lochinvars only. If we assume N+1 design, heat load = 2,420 MBH. If two boilers provided 80% load, total load = 3,025 MBH. Capacity of two proposed (2) stacked condensing boilers (Lochinvars removed) is 1,600 x 2 = 3,200 MBH. This figure will be used for our assumed peak load (about 44 BTU-Hr per building square foot)

ECM 3 CALCULATIONS

Description: Variable Speed Drives (VSD) for Cooling Tower Pumps

Totals:

Electric Savings (kWh)	Electric Cost Savings	Natural Gas Savings (therms)	Natural Gas Cost Savings	Total Cost Savings	Cost of Installation	Payback Period (Years)
145,430	$14,543	$ -	$ -	$ 14,543	$16,000	1.1

Blended Electric Rate ($/kWh): $ 0.100
Natural Gas Rate ($/therm): $ 0.780

Assumptions:

1) Cooling hours are for Rochester, NY
2) Current pump operation is 100% 24/7/365.
3) Pump laws used to calculate energy reductions.
4) Pump speed is assumed to be linear with relation to temperature down to 32F, and zero below 32F.
5) Demand kW is not affected by this measure.

Equations Used:

See Worksheet.

ECM 4 CALCULATIONS

Description: Energy Recovery for Ventilation

Totals:

Electric Savings (kWh)	Electric Cost Savings	Natural Gas Savings (therms)	Natural Gas Cost Savings	Total Cost Savings	Cost of Installation	Payback Period (Years)
31,778	$ 3,178	17,116	$ 13,265	$ 16,443	$65,000	4.0

Blended Electric Rate ($/kWh): $ 0.100
Natural Gas Rate ($/therm): $ 0.78

Assumptions:

1) Heating BIN hours from TMY3 data for Ithaca, NY.
2) Cooling hrs for Rochester, building balance at 55F.
3) 80% boiler efficiency assumed for current boilers.
4) Average ERV wheel effectiveness assumed .6 for heating sensible and .5 for cooling sensible and
5) EER used to calculate kWh load is based on existing AC equipment and assumed to equal 10.0 given age of original equipment.
6) Blended cost (not including solar production offset) = $0.10 per kWh.
7) Demand kW is not considred for this measure.

Equations Used:

See Worksheet.

APPENDIX B: BUILDING EQUIPMENT INVENTORY

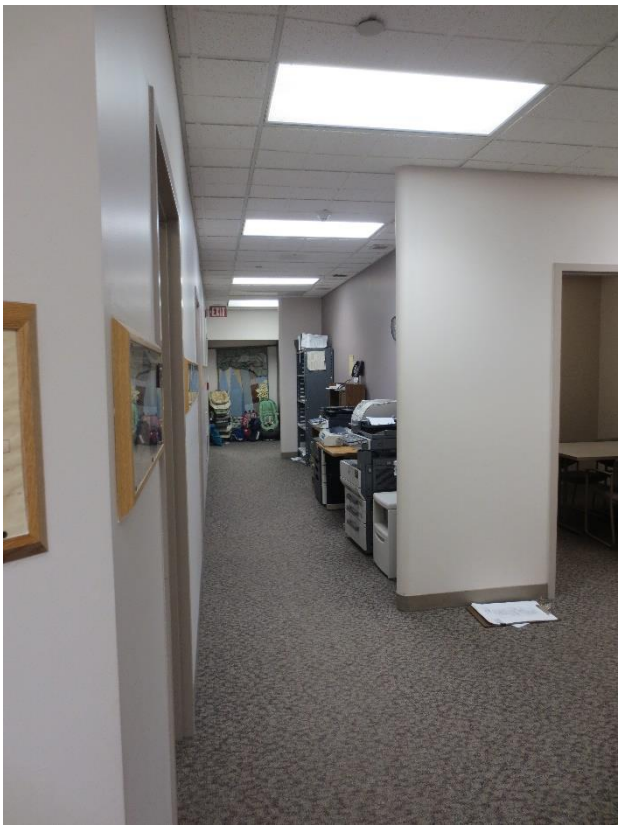
Project: Southern Tier 8 Regional Board

Demonstation Project Site Tompkins County Human Services Building

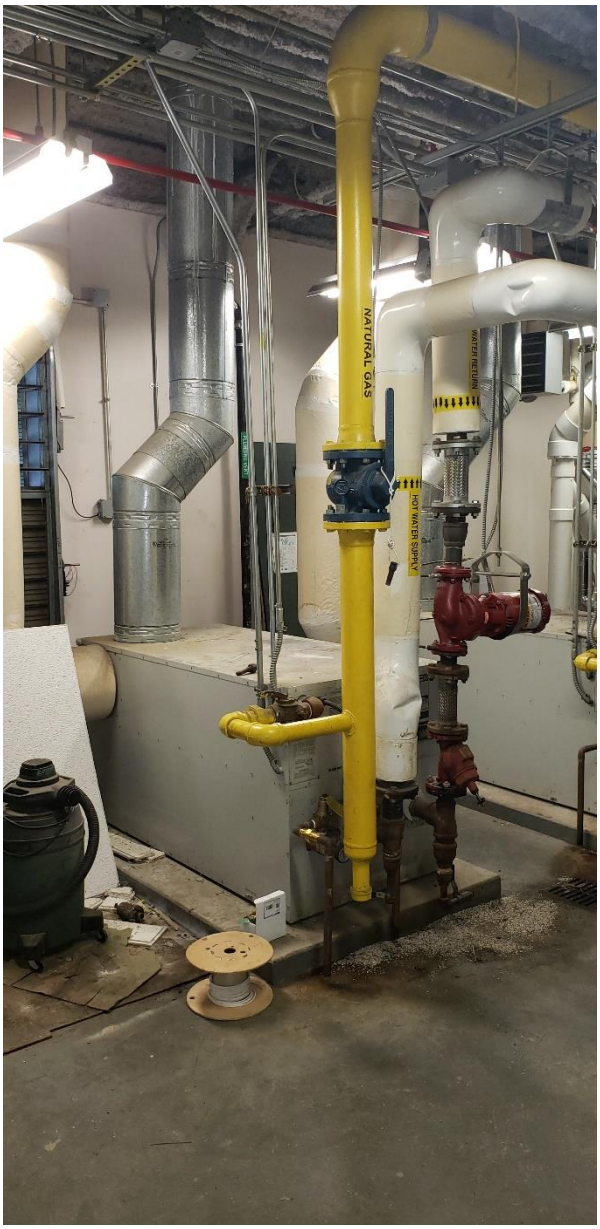
EXISTING EQUIPMENT - ELECTRIC

Item	Location	Existing Equipment	Area/Equipment Served	Existing Equipment Manufacturer / Model	Qty	Motor HP	Motor Efficiency	Install Date	Notes
	Exterior	Generator	Entire Building	Caterpillar c32	1				
1	4th floor MER	1,440 MBH water tube boiler	Entire Building	Copper Fin Tube	3		1996 (origina		Only one working.
2	4th floor MER	850 MBH condensing boiler	Entire Building	ModCon 850	2			Less than 10 years	County would like to add another condensing boiler & take original boilers out of service.
3	4th floor MER	Boiler pumps P-1, 2, 3	Entire Building	B&G Series 60 (61 gpm)	3	1	59.0%	1996	One for each boiler
4	4th floor MER	ACU Preheat pumps P-5, 6	AC unit preheat	B&G 1510 (300 gpm)	2	7.5	72.0%	1996	Lead/Standby
5	4th floor MER	VAV Reheat pumps P-7, 8	RH coils at VAV boxes	B&G 1520 (290 gpm)	2	7.5	71.0%	1996	Lead/Standby
6	4th floor MER	Radiator heating P-9, 10	Hydronic heating units	B&G 1510 (65 gpm)	2	2.0	60.0%	1996	Lead/Standby
7	Mech. Rm 418	Pump P-4	Supply fan F-1 HW coil	B&G Series 60 (50 gpm)	1	1.0	57.0%	1996	Uni
8	MER 158	AC-1 (14,400 cfm)	1st Floor South	Trane SWUD 38/20" wheel	1	20		1996	Unit has VFD fan drive and economizer coil
9	MER 158	AC-2 (11,00 cfm)	1st Floor North	Trane SWUD 32/18.3" wheel	1	15		1996	Unit has VFD fan drive and economizer coil
10	MER 220	AC-3 (11,000 cfm)	2nd Floor South	Trane SWUD 32/18.3" wheel	1	15		1996	Unit has VFD fan drive and economizer coil
11	MER 220	AC-4 (10,000 cfm)	2nd Floor North	Trane SWUD 29/18.3" wheel	1	10		1996	Unit has VFD fan drive and economizer coil
12	MER 319	AC-5 (11,000 cfm)	3rd Floor South	Trane SWUD 32/18.3" wheel	1	15		1996	Unit has VFD fan drive and economizer coil
13	MER 319	AC-6 (11,400 cfm)	3rd Floor North	Trane SWUD 29/18.3" wheel	1	10		1996	Unit has VFD fan drive and economizer coil
14	MER 418	AC-7 (14,000 cfm)	4th Floor - all	Trane SWUD 38/20" wheel	1	20		1996	Unit has VFD fan drive and economizer coil
15	Roof	Cooling Tower-200 Tons	Entire Building	Baltimore Air Coil F2464-M	1	25		1996	2-stage, axial flow, discharge hood dampers
16	4th floor MER	Supply Fan S-1 (20,000 cfm)	Entire Building	Trane C-375 utility fan	1	10		1996	belt drive
17	Corridors	Relief fans EF-1, 2, 3, 4	One relief fan per floor	Greenheck BSQ-160/130 (2,300-4,300 cfm)	4	1.5/.75		1996	Constant volume, belt drive
18	Copy Rooms	General exhaust EF-9, 20, 22	Copy Rooms	Greenheck SP-27 (300 cfm)	3	fract.		1996	Constant volume w/ speed switch, direct drive
19	Comm. Rm. Exh.	General exhaust EF-14 to 17)	Comm. Room, 1/floor	Greenheck CSP-27 (200 cfm)	4	0.25		1996	Constant volume w/ speed switch, direct drive
20	Corridors	Toilet exhaust EF-5, 6, 7, 8	Toilet rooms	Greenheck SQ80 and 90	4	1/4 & 1/3		1996	Constrant volume, direct drive
21	Corridors	Toilet exhaust fans EF-12	Toilet room	Greenheck SQ80-6 (150 cfm)	1	0.33		1996	Cpmstamt volume, direct drive
22	Kitchen	Kitchen Exhaust fan EF-13	Kitchen	Greenheck BSQ-170 (200 cfm)	2	0		1996	Cpmstamt volume, direct drive
23	Vestibules	Cabinet heaters CUH-1 thru 7	Vestibules and stairs	Trane FFHB	6	fract.			Integral thermostat
24	Distributed	VAV Boxes	Ductwork, each floor	Trane, non powered	98	--			reheat coil
25	Roof - addition	Packaged rooftop unit RTU-1	Addition	Trane Precedent THC 48 (4 tons) 14.9A/460V	1			2014	With duct glycol heating coil
26	Roof - addition	Toilet exhaust fan EF-13	Toilet	Penn Zephyr, 130 watts	1			2014	With speed controller

APPENDIX C: WALK-THROUGH PHOTOS



Typical T8 Light Fixtures



Existing Non-Condensing Boiler
(Lochinvar)

Condensing Boiler
(Modcom 1440)

V-Tech Cooling Tower Pump Drive

25-Horsepower Cooling Tower Pumps

Ventilation Supply Fan S-1 with Outside Air Intake Ductwork