PROJECT SUMMARY

CITY OF BINGHAMTON COMMUNITY MICROGRID COMPREHENSIVE FEASIBILITY STUDY

PROJECT SUMMARY

The Project was to study in detail the design, funding, and economics of a microgrid to connect key buildings in the flood prone City of Binghamton downtown area so they could continue to function in the event of a major grid outage. The project was performed under Stage 2 of the New York Prize Program. NY Prize is a first-in-the-nation competition funded by New York State Energy Research and Development Authority (NYSERDA) to help communities create microgrids - standalone energy systems that can operate independently in the event of a power outage.

At the confluence of two rivers, the Susquehanna and the Chenango, the City of Binghamton, New York has sustained more than its share of flood-related damages. Major floods occurred most recently in 2006 and 2011 when much of the City was inundated. During these events, the City either lost power or experienced diminished services of electricity, potable water, police and fire protection, as well as housing. Once implemented, a community microgrid will provide power to Critical Facilities and Places of Refuge which were affected during these two most recent major floods and will allow them to maintain operations for prolonged periods during a major grid outage. The design will greatly improve the resiliency of the surrounding area while significantly increasing the safety and well-being of residents, community organizations, public facilities and businesses in the City of Binghamton.

PROJECT STATISTICS

Client:	City of Binghamton, New York, USA
Program:	New York Prize Stage 2 funded and administered by New York State Energy Research & Development Authority (NYSERDA)
Project Type:	Community Microgrid Comprehensive Feasibility Study
Size:	3.2 MW (1.0 MW Microturbine CHP, 0.4 MW Reciprocating Engine Generator, 0.6 MW Solar PV, 1.2 MW Hydro) and 240 RT absorption chiller with 12.47 kV underground connection to all buildings, hot water distribution to 3 buildings and chilled water distribution to 1 building.
Estimated Project Cost:	US$8.5 million
Plant Location:	Downtown Area of City of Binghamton, NY
Plant Elevation:	850 feet above sea level

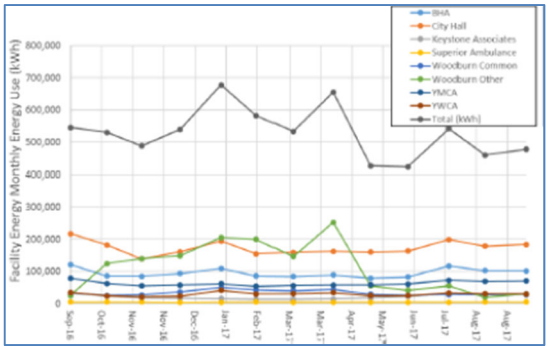
Interconnection Voltage:	12.47 kV
Primary Fuel:	Natural gas, solar and hydro
Back-up Fuel:	None
Connected Facilities:	7 Buildings including: • City Hall (Police, Fire and Emergency Management), • YMCA (including day and residential accommodations), • YWCA (including day and residential accommodations), • Binghamton Housing Authority (low income and senior housing), • Superior Ambulance (emergency services), • Woodburn Court (low income and senior housing), • Keystone Engineering (offices for City engineering support services)
Project Funding:	$1 million NYSERDA Funded Grant + $250,000 "In kind" Contribution from Study Team

PROJECT DESCRIPTION

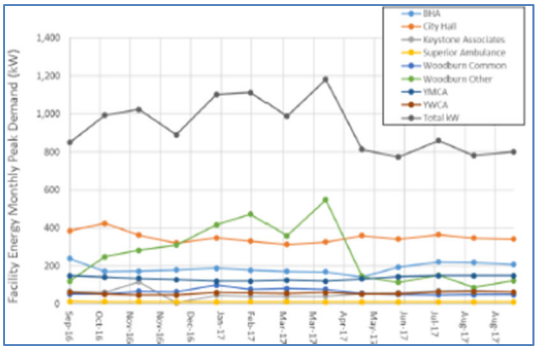
The initial evaluation of a microgrid for the City of Binghamton's downtown area was conducted under Stage 1 of the New York Prize Program managed by New York State Research and Development Authority (NYSERDA). There were over 100 potential microgrid project studies in New York State conducted under this initial Stage 1 programme. The preliminary study for the City of Binghamton was conducted by a study team including GE Consulting and Keystone Architects & Engineers. That study demonstrated that a community microgrid for this downtown area was technically and economically feasible and could provide significant benefit to the City. Bridgestone Associates was not part of the original Stage 1 study team.

For Stage 2, a much more detailed and comprehensive study of selected microgrid opportunities in New York State, Bridgestone Associates was invited by the City to participate with GE Consulting and Keystone Engineers, and to take a lead role in the technical evaluation of existing energy use, and the design of the microgrid's energy supply system. This included detailed energy efficiency evaluations of all facilities to be connected to the microgrid, design of thermal interconnection and distribution systems, and design of the planned Combined Heat and Power (CHP) plant.

In order to develop detailed hour-by-hour thermal and electrical profiles for the facilities connected to the microgrid, and therefore a total microgrid load profile, it was necessary for Bridgestone to develop a complete understanding of each of the seven facilities and their energy uses. Very little data on thermal and electrical energy use existed save monthly gas and electric bills. Only one building (City Hall) had electric meter interval data. As a result it was necessary to develop hour-by-hour electric use data through simulation and analysis of facility operations for the other six facilities. Similarly, it was necessary to develop hour-by-hour thermal use data through simulation and analysis of facility operations for all seven facilities.

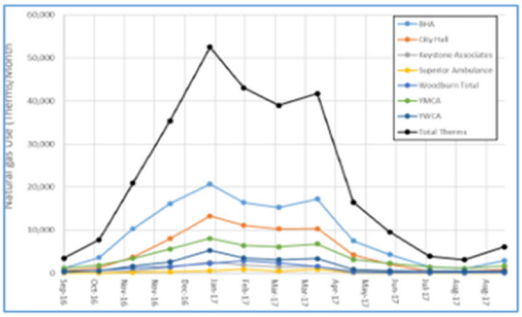


Monthly Electric Energy Usage Each Facility



Monthly Electric Peak Demand for Each Facility

To assist in developing these energy use profiles for each facility, and in order to identify opportunities for energy efficiency improvements, energy management, and demand control, Bridgestone conducted ASHRAE Level II energy audits of each facility. Copies of these audits and their results were made available to the management of each facility to allow them to implement any recommendations.


Monthly Thermal Usage

The primary goal of the microgrid is to be resilient in the event of a grid outage, and to allow the facilities to continue to function without undue interruption. One of the NYSERDA requirements was that the microgrid must be capable of operating for at least seven days disconnected from the grid, so it was determined that natural gas fired combined heat and power (CHP) would be the primary generation in the microgrid. The City has a dam on the Susquehanna River (Rockbottom Dam) from which approximately 1,200 kW of hydro power may be generated. While this will be an excellent source of low cost renewable power, during periods of major flooding of the river or during summer months with very low flow, hydro power production may be limited. For this reason the hydro plant was included in the microgrid as generation source for the City, but not included as a resilient generating resource for the microgrid.

Approximately 600 kW of solar photovoltaic generation from two roof mounted systems was also included in the microgrid as a generating resource for the City. Again, because of the intermittent nature of solar energy production, this generation resource was not included as a resilient resource.

Bridgestone developed a preliminary design for a 1,000 kW natural gas fired CHP plant with an additional 400 kW of natural gas stand-by generation. This CHP plant will be installed in a new building built above an underground parking lot on land to the south of City Hall. It will provide thermal energy in the form of high temperature hot water to the YMCA, Binghamton Housing Authority, and City Hall, and chilled water to City Hall. The YMCA will use the hot water for space conditioning, domestic hot water and to heat their swimming pool. BHA will use it for space

conditioning and domestic hot water. City Hall will receive hot water for domestic hot water and chilled water for cooling.

The CHP Plant will include three FlexEnergy GT333S microturbines each rated at 333 kW. Each of these includes a 280 kW Generator Braking Resistor that effectively provides a combined 840 kW load bank. This load bank allows the microturbines and the overall microgrid to handle large load transients that may occur due to switching on or off equipment or total buildings. The microturbines have black start capability in addition to the 400 kW standby generator.

Waste heat from the microturbines will be captured in a 240 RT absorption chiller that will provide both hot and chilled water. This chiller and a new cooling tower will be integrated with the existing City Hall cooling tower to provide additional capacity and redundancy.

The microturbines will have a supervisory controller that manages their operations and also communicates with the overall microgrid controller. The 400 kW standby generator controls will also be integrated into the overall microgrid control functions.

Power from the CHP plant will be supplied at 480 Volts to the low side of the existing 12.47kV/480V utility transformer at City Hall. From there it will be distributed underground through existing and new conduits to the other six facilities in the microgrid. There will also be a connection to the local utility at City Hall to allow export or import of power. However, the microgrid's generation is sufficient to provide the total power requirements of the seven facilities.

In addition to the work performed by Bridgestone, other team members conducted detailed analyses of overall system energy use and demand, electrical load flow and system stability, detailed financial and economic modeling, prepared an overall design of the electrical interconnections, and prepared detailed management and financing plans.

The overall study proved the economic, technical and environmental feasibility of the proposed microgrid and demonstrated many benefits to the City and its residents. The study was started in July 2017 and the final report submitted to NYSERDA in July 2019. NY Prize Stage 3 capital funding is being discussed with NYSERDA and New York State Government.