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NY PRIZE STAGE 1 FEASIBILITY ASSESSMENT

FINAL REPORT

CAYUGA COUNTY

NYSERDA AGREEMENT NO. 65759

APRIL 29, 2015

SUBMITTED BY COGEN POWER TECHNOLOGIES

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EXECUTIVE SUMMARY

PROPOSED MICROGRID CONFIGURATION

The microgrid to serve an industrial park located in Cayuga County could include the following facilities: the Cayuga Milk Ingredients manufacturing facility (CMI), the new Grober Group manufacturing facility (GGMF), the Cayuga-Onondaga BOCES, the Aurelius Volunteer Fire Department, Seneca-Cayuga ARC, Petr-All Gas Station, and the New York State Troopers Barracks. An aerial map of the proposed microgrid is included in Appendix A. Each of the microgrid customers will be electrically connected behind one NYSEG meter.

The proposed microgrid configuration is to install a new Combined Heat and Power (CHP) Plant in the industrial park to provide electricity to all customers, and thermal energy in the form of steam to CMI and the GGMF for their processes. The CHP Plant will be comprised of one 4.6 MW Gas Turbine Generator (GTG) that will operate on natural gas during normal operations, and have the capability to operate on propane in times of natural gas curtailment. Two on site propane storage tanks will be installed as part of the project. The propane storage will have enough capacity to run the CHP system for a week without any refills or daily deliveries.

Electricity will be generated at the CHP Plant on Eagle Drive, north of the existing CMI facility, and then be distributed to the microgrid customers through underground concrete duct banks and cables. Steam generated by the CHP Plant will serve CMI and the GGMF through an underground steam distribution system. The microgrid is anticipated to produce 28,488,000 kWh or 96.03% of total electricity annually for these seven facilities with the remainder of power imported through NYSEG. This system will remove 4 MW of demand from the utility system. With an electric reduction of this magnitude on the distribution system, the utility will have more capacity for other customers on the NYSEG utility system.

The microgrid capital costs for the design and construction is estimated at $24.34M[1], with an estimated annual savings range of $719,000 - $864,000 assuming all microgrid customers participate. The capital cost of $24.34M does not include any anticipated costs for financing of the project through a third party entity.

[1] 2016 dollars

NY PRIZE BENEFITS

The retention and expansion of manufacturing jobs is of utmost concern to New York State. Manufacturing jobs tend to be higher paying jobs providing employees and their families a higher living standard. Manufacturing jobs are known to have a ñmultiplier effectò, that is, for each job in the production of manufactured goods, there is a spin-off effect that has a positive impact on the creation of service sector jobs.

A key characteristic that sets this project apart is its focus on manufacturing sector customers. New York State is keenly interested in supporting the expansion and retention of manufacturing jobs, particularly in smaller communities where good paying manufacturing jobs can be the centerpiece of the local economy. This project is centered on current and additional prospective manufacturing operations that can support this NYS goal of retaining manufacturing facilities. Unlike many of the Stage 1 proposals in NY Prize, industry is at the heart of the Cayuga County microgrid project.

There are three anchor tenants: the Cayuga Milk Ingredients manufacturing plant, the soon-to-be finished Grober Group manufacturing facility, and the Cayuga-Onondaga BOCES. CMI plant is a participant in NYPAôs Recharge NY Program whose stated aim is to: ñprovide a more effective incentive for businesses to create jobs and make long term capital investments in New York State.ò[2] The lower energy cost and higher resiliency offered by the microgrid will greatly increase both businessesô ability to grow and for BOCES to serve the community (both in its normal operations and as a storm shelter). As with the Recharge NY program, such advancement of industry and manufacturing is directly tied to NYS policy goals.

The location of the generating assets will be on land zoned for industrial development where there is a large amount of vacant square footage at the site and adjacent to it. This will allow the footprint of the microgrid to grow over time if the demand from the current customer base grows, or the customer base itself expands (i.e. developing the industrial park with tenants). Several big box retailers, the Johnston Paper Company, as well as the Finger Lakes Mall are all within a few hundred feet of the site.

[2] Report on Effectiveness of ReCharge New York Power Program To Governor and Legislative Leaders, December 2015 http://www.nypa.gov/RechargeNY/ReChargeNYEff_2016.pdf

MUNICIPAL ORGANIZATIONS

There are two local municipal organizations can provide advantages to the proposed project. The first is the Cayuga County Industrial Development Association (IDA) whom owns the land for the proposed microgrid location and an entity whom can issue bonds to provide project financing. The second is the Cayuga County Public Utility Services Agency (ñCCPUSAò) which can aid the project in several ways:

- **Power Purchase** ï CCPUSA could purchase the excess energy generated by the microgrid and sell it back to existing CCPUSA customers and/or to the NYISO. The agency already has experience with creating tariffs and gaining PSC approval.
- **Operations** ï CCPUSA has expressed an interest in operating the microgrid as a municipal utility
- **Rights as a Municipal Utility** ï CCPUSA can has all rights to act as a utility, specifically the ability to cross rights of way and own distribution lines to create a lower combined cost for construction
- **Lower Taxes** ï Customers of CCPUSA do not pay sales tax on electricity which increases the value proposition to potential customers. CCPUSA could also purchase natural gas for the CHP Plant through a Public-Private Entity and develop an ñEnergy Service Agreementò with customers to avoid sales tax on natural gas

UTILITY INVOLVEMENT

The Cayuga County microgrid provides a unique opportunity for developing and testing the necessary systems and processes for NYSEG to become a microgrid platform provider in New York State. The microgrid system owner/operator (whether it be CCPUSA, Cogen, or a third party entity) will work with NYSEG and the Department of Public Service (DPS) staff to think creatively on how to integrate the team to create the most beneficial learning scenarios from this installation. The DPS will be in a unique position to be more directly involved in any potential utility services associated with this installation.

The Cayuga County microgrid project has the potential to benefit from the National Grid Reforming the Energy Vision (REV) demonstration project in Potsdam, NY. One particular opportunity would be associated with metering and billing. Since NYSEG already has/will have existing metering and billing practices in place for the proposed microgrid customers, this would create a new utility revenue in the form of service fees. For this particular project, it is possible for NYSEG to be the service provider of billing and financial transaction services.

Additionally, a significant issue remains regarding the ownership of the Medium Voltage (MV) switches and step down transformers at the BOCES substation. There would be a financial burden for the existing NYSEG unit station services to be removed and replaced with a privately owned facility substation. This project would be an opportunity to work out a structured procedure to buy, rent, or lease the facility substations from NYSEG. This could create another new utility revenue in the form of monthly fees and save the project the associated debt service to buy out the utility or replace with new.

Lastly, while this microgrid project would potentially eliminate some revenue streams from NYSEG in terms of lost electrical customers, there is the additional revenue stream created to supply fuel to the CHP Plant from the NYSEG natural gas distribution system. This project presents an opportunity to demonstrate revenue balancing implications between the two utility services (electrical vs. natural gas) to clearly show an overall financial impact to the utility company. A more holistic approach to microgrid services should look at all levels of potential revenue to the utility company.

EXPLORING OPPORTUNITIES FOR TESTING REV CONCEPTS

The Cayuga County microgrid project is distinct in many ways from the preponderance of NY Prize 1 winners. Its location is in a much less urban setting than many projects and its anchor tenants include industrial customers. Additionally, there are opportunities to explore new arrangements with a pre-existing municipal utility.

Should this project be fortunate to be selected for inclusion into NY Prize Stage 2, the team suggests building into the design, to the extent feasible and cost justified, an analysis of the value of ñDò, that is an empirical analysis of the ñvalue of distributed energy resourcesò, that may provide lessons learned, generalizable to the larger REV process. The following quotes from various Commission orders, demonstrates that establishing a sound rationale and empirical basis for LMP+ôDô is integral to the entire REV process:

ñThe Commission has stated that achieving a more precise articulation of the full value of distributed energy resources (ñDERò) is óa cornerstone REV issue.ôö[3]

ñThe development of the tools and methodologies required to fully implement an approach [for valuation of DER] on the óValue of Dô is likely a long term effort.ö[4]

ñ[the] óvalue of Dô can include load reduction, frequency regulation, reactive power, line loss avoidance, resilience and locational values as well as values not directly related to delivery service such as installed capacity and emission avoidance.ö[5]

ñThe óvalue of Dô takes different forms and values depending on the application. For example, the first major application for the ñvalue of Dò is valuing alternatives to long term investments such as traditional utility investment, investment in DSP infrastructure and non-wire alternatives. A second application is compensation mechanisms, which includes rate design, LMP+D payments, as the basis for the transition from NEM.ö[6]

The value that this project provides its local community is quite distinct from that of a microgrid in dense urban or suburban settings. Apart from lessons that might be learned and transferred regarding the value of a microgrid for serving industrial customers, providing input cost (energy price) stability to attract and retain businesses, and to explore mutually advantageous coordination with a municipal utility. These distinctly different project attributes may help fill experience and knowledge gaps that New York State has when trying to arrive at a comprehensive view of the benefits of microgrids, across all geographic and sectoral settings.

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[3] NYS PSC, Case 15-E-0082, Proceeding on a Community Net Metering Program, Order Establishing a Community Distributed Generation Program and Making Other Findings, (July 17, 2015) p. 24 (CDG Order)

[4] NYS PSC, CASE 15-E-0751, In the Matter of the Value of Distributed Energy Resources, Dec 23, 2015, Attachment A Page 1

[5] NYS PSC, NEM Interim Ceilings Order, p. 9.

[6] NYS PSC, CASE 15-E-0751, In the Matter of the Value of Distributed Energy Resources, Dec 23, 2015, Attachment A Page 3

For each of the REV goals, below is a summary table outlining how this project would address each of the items:

REV Goal	Advancement of that Goal
Cutting Greenhouse Gas Emissions 50% by 2050	ÅLarge scale combined heat and power (CHP) is core to the project providing significant efficiency benefits Å4.6 MW CHP Plant will save 5,270 tons per year of CO2equivalent (equal to 997 passenger vehicles)
Making energy more affordable for all New Yorkers	ÅThe Municipal utility may have flexibility to create new opportunities and revenue for streams for the microgrid lower bills for customers ÅEconomies of scale: allows design of larger, more efficient system to serve industrial and educational facilities
Improving our existing initiatives and infrastructure	ÅCayuga County is unique in that it supports New Yorkôs manufacturing sector. The State has a strong interest in creating and retaining manufacturing jobs ÅThree large anchor tenants make up the initial scope with a great deal of additional industrial and large retail facilities less than 1,000 feet from the CHP Plant
Helping clean energy innovation grow	Å Creates an opportunity to examine new and innovative financing structures, e.g. a non-profit, third party financing model that could significantly lower the cost of capital improving economic viability ÅThis is unlike many NY Prize submissions. Its in a lightly populated area and serves manufacturing customers. These distinctly different project attributes may help fill experience gaps in arriving at a comprehensive view of the benefits of microgrids, across ALL geographic and sectoral settings.
Building a more resilient energy system	ÅOn site propane storage tanks will provide back up fuel to the CHP Plant in an event, allowing the system completely island from utility in cases of grid outage or gas curtailment ÅProvides resiliency to an existing manufacturing facility, new business park, and BOCES Day Care Center which can serve as a storm shelter for the community
Creating new jobs and business opportunities	ÅBoosts the competitiveness of new business park, increasing its attractiveness and ability to draw additional industrial employers to the county

RECOMMENDED REGULATORY AND POLICY CHANGES

The known regulatory and policy changes that would need to be evaluated and resolved for this project to proceed include those that lie with NYSEG. After preliminary discussions with the utility and receiving feedback on a series of questions regarding the existing system, a list of the regulatory hurdles are below:

1) Rights of Way for crossing public roads
2) The aggregation of multiple electric services
3) Buying or leasing existing utility equipment

In 2008, issues one and two identified above have been successfully overcame by Cogen Power Technologies and National Grid at the Burrstone Energy Center CHP Plant, located in Utica, NY.

SECTION I
TASK 1: DEVELOPMENT OF MICROGRID CAPABILITIES

SUBTASK 1.1 MINIMUM REQUIRED CAPABILITIES

It is proposed at this time that the microgrid to serve the County of Cayuga will include the following facilities: Cayuga Milk Ingredients, the Grober Group manufacturing facility, Cayuga-Onondaga BOCES, the Seneca-Cayuga ARC, NYS Police Barracks, Aurelius Volunteer Fire Department, and a gas station. An aerial map of the proposed microgrid is included in Appendix A.

The Cayuga-Onondaga BOCES can serve as critical facility in the event of a natural disaster or prolonged utility outage to house community members of the City of Auburn. The population of the city of Auburn, NY is approximately 27,019 people[7]. In addition to the BOCES capability to house community members, neighbors CMI and the Grober Group manufacturing facility could take in employees and their families to provide additional shelter. Nearby, critical agencies such as the NYS Police Station, the Aurelius Volunteer Fire Department and gas station will be able to provide full service to the community during a prolonged utility outage. It is worthy to note that the Cayuga-Onondaga BOCES serves as the alternate command center for the Cayuga County Emergency Services due to their main office residing below flood level.

The primary generation source for the Combined Heat and Power (CHP) plant will be one (1) natural gas fired Solar Mercury 50 Gas Turbine Generator (GTG) exhausting to a heat recovery steam generator (HRSG). The GTG is capable of generating an average of 4.6 MW of electricity to be distributed to the microgrid customers.

The GTG will be operating and supplying power to the CMI microgrid electrical distribution system, which will normally be grid-connected. When the system is disconnected from the grid, the microgrid will be powered by the GTG operating in islanded mode.

When required, the microgrid can be intentionally separated from the utility grid, shed load, as required, and operate in islanded mode.

Under control of a Load Management System (LMS), the microgrid will have the capability to automatically separate from the grid on loss of utility power, shed load, as required, and operate in islanded mode. When normal utility power is

[7] July 2014 population of Auburn, NY cited from the U.S. Census Bureau.

restored, the LMS can automatically synchronize the generator to the grid and restore the shed loads.

Maintenance of the GTG will be provided under the manufacturer's extended service agreement, which includes OEM recommended preventative maintenance service inspections, parts and components, remote monitoring, reporting and troubleshooting, and on-site trouble calls. When an engine overhaul is required after 30,000 operating hours, a refurbished engine will be provided on an exchange basis to reduce the duration of the maintenance outage.

When connected to the grid, power generated by the GTG will be used for displacement of the microgrid utility load. Generator output in excess of the microgrid demand will be exported to the NYSEG system. When islanded, the LMS will control the output of the generator to follow the system load and maintain voltage within the limits of ANSI C84-1 standards. Non-essential load will be shed to ensure that the islanded system load does not exceed the capacity of the generator.

It is expected that two-way communication between the microgrid and NYSEG could be either Direct Transfer Trip (DTT) or Remote Terminal Unit (RTU). At this phase of the microgrid study, the communication requirements from NYSEG have not been identified. However, the CHP Plant will have the full capabilities to meet DTT or RTU requirements from the utility.

The microgrid can provide power to potentially seven (7) different facilities in Auburn. The diversity of customers includes a two manufacturing facilities (Cayuga Milk Ingredients and the Grober Group), a school (Cayuga-Onondaga BOCES), a not for profit disability center (Seneca-Cayuga ARC), a volunteer fire department, a police station, and a gas station.

The CHP Plant will operate on natural gas and will require an uninterruptable gas supply and delivery contract(s) to insure generation capability is always maintained. The CHP Plant would be able to provide all of the thermal energy required for CMI and the Grober Group facility; as well as the electrical energy required for the microgrid with the necessary load shedding in effect. Operators of the CHP will attempt to secure uninterruptable gas supply.

Forces of nature typical to the Auburn area include heavy precipitation, lightning and high winds associated with severe weather conditions. This could lead to downed power lines, localized flooding in some areas and travel disruptions due to heavy snow accumulations.

A new CHP Plant will be constructed to house the GTG, the HRSG, related auxiliary equipment and the Black Start Diesel Generator (BSDG) indoors. The gas compressor will be located outdoors in an acoustic weather-proof enclosure. Electricity generated by CHP the will be delivered to CMI and the microgrid customers through electrical duct banks. Electrical distribution equipment at the CHP will be located inside the building. These features will protect against disruption of services due to severe weather conditions. Steam generated by the CHP will be distributed to CMI and the Grober Group facility by underground piping systems providing protection from severed weather conditions.

No flooding of the microgrid area is expected as the area has suitable drainage to ensure run-off does not accumulate in significant quantities on the site.

There have not been any additional weather events that have caused upsets in electrical supply to CMI for extended periods. The typical scenario would be a power dip due to a feeder issue (lightning, ice) but that in most cases is momentary and returns. In the case of an extended feeder loss (cable failure), the second feeder was available and took care of the load.

The most common weather event to disturb CMI would be extreme cold winter months and snow storms resulting in gas curtailment from the utility. When a gas curtailments and snow storm occur simultaneously, the CHP Plant will require uninterruptable gas supply and delivery contracts to avoid disruption due to curtailment.

The project would include a 750 kW (to be confirmed) black start diesel generator to allow the CHP Plant to be started and operated in islanded mode to provide power and thermal energy supply to CMI and other microgrid customers.

The black start generator would be capable of providing sufficient power to supply the loads required to start up the GTG. The generator would supply the CHP Main Switchgear in an islanded mode. The loads of all microgrid customers would be adjusted using a Load Management System (LMS) to ensure the remaining loads do not exceed the power delivered by the GTG.

SUBTASK 1.2 PREFERABLE MICROGRID CAPABILITIES

A state-of-the-art Plant Control System (PCS) for the microgrid CHP equipment would provide supervisory controls and monitoring of the gas turbine generator (GTG), the heat recovery steam generator (HRSG), the gas compressor and the black start diesel generator. The PCS will also control and monitor the Load

Management System (LMS).

The Load Management System (LMS) is a custom logic controller-based automated system that will be used to monitor the available power supplies and loads making up the microgrid distribution system. A fiber optic network will connect the meters to the LMS to monitor these loads. If an event causes the power available to the distribution system to be less than the power required by loads connected to the system, the LMS would drop loads in accordance with a prearranged load shedding priority. This would occur when one or more utility feeds are lost and the load is greater than the power output of the GTGs. The LMS uses a high-speed automation controller to monitor and shed loads in milliseconds of an upset event.

The LMS performs the following functions in addition to load shed:

- Control the import/export of real and reactive power from the utility by controlling the output of gas turbine generator (GTG)
- Automatically shed load (with an LMS response time of 38 msec or less) upon loss of the utility
- Automatically shed load to maintain a minimum GTG capacity reserve;
- Provide manually initiated, automatic synchronization across main feeder breakers
- Provide automatic bus transfer control that will automatically close incoming breakers to restore power to either of the 13.2 kV busses 1 or 2 that has lost its supply
- The main LMS panel would connect to the microgrid data centerĝs power monitoring system to receive load and supply information.
- Monitor and display the open / closed status and power levels of 34.5 kV and 13.2 kV breakers

The CHP Plant will be installed as an energy efficient operation to minimize any additional new microgrid generation.

The CHP plant will power CMI and the remaining microgrid customers utilizing breakers in the CHP Plant 13.2kv switchgear. The distribution of power to the various customers will be through outdoor switchgear located on the north side for the Fire Department, Police Department, ARC, and Gas Station. The second set of switchgear will provide power to the new manufacturing facility and the BOCES. All ductbanks for this microgrid will utilize underground ductbank for the feeders.

Cogen Power Technologies has subcontracted the Pace Energy and Climate Center (Pace) to assist in the analysis of the Reforming Energy Vision (REV) as part of this study. Included as a part of the Pace energy analysis team are Thomas Bourgeois, Deputy Director; Daniel Leonhardt, Senior Energy Analyst; and Dr. Henrietta de Veer, Founder and Managing Partner of Adaptive Energy. Dr. Henrietta de Veer has been involved with the REV proceedings and will provide this microgrid project with the innovative ideas to embrace the REV platform. Further comments on the inclusion of REV ideas for the proposed microgrid will be addressed in the final report.

It is the responsibility of Cogen Power Technologies to provide the Facility Questionnaire and Microgrid Questionnaire to IEC to complete the CBA. These documents will be completed with respect to the microgrid customers, community, and utility. The report provided by IEC for the Cost-Benefit Analysis will be included in the final report for the feasibility study.

This project is expected to qualify for $2.4 million from NYSERDA under PON-2701 the Combined Heat and Power (CHP) Performance Program. It is assumed that the funding available under this program is public dollars which will be used for this project. The remainder cost of the project may be privately financed through energy investors familiar with the agreements and operations associated with a CHP Plant or through additional funding methods.

The microgrid will be powered by a Combined Heat and Power (CHP) facility using a Gas Turbine Generator (GTG) with low NOx burner technology. By displacing purchased electricity from the power grid and steam generated by gas and oil fired boilers, reductions in carbon dioxide emissions will be achieved.

The number of jobs created for operating the CHP Plant will be dependent on the ownership of the CHP Plant. The land where the CHP Plant would be located is currently a part of an industrial park being developed by the Cayuga County Public Utility Services Agency, Planning and Development Sector. Ownership and operations the CHP Plant have not been addressed at this time.

The existing power grid will be strengthened by the microgrid due to the reduced load stress on the utility's system. The innovative technology of the LMS and PCS system will be utilized to monitor the electrical systems of the entire microgrid.

SECTION II
TASK 2: DEVELOP PRELIMINARY TECHNICAL DESIGN COSTS AND CONFIGURATION

SUBTASK 2.1 PROPOSED MICROGRID INFRASTRUCTURE AND OPERATIONS

The combined heat and power plant (CHP), the distributed energy resource (DER) for this microgrid, will be located on Eagle Drive north of the existing Cayuga Milk Ingredients (CMI) property. The plant will be installed in a new building that will include new switchgear for the utility interconnection and distribution to CMI and the other microgrid customers. The plan showing the locations of these facilities and the anticipated Cable Layout Diagram is included in Appendix B. The CHP Plant Equipment Layout Diagrams are included in Appendix C. The simplified electrical single line diagram of the proposed microgrid is included in Appendix D.

The CHP plant will operate continuously to supply electricity to the microgrid and steam to the CMI and Grober Group dairy processing facilities. Excess electricity would be exported to the utility grid only when the 1) Real Time Location Based Market Price (LBMP), the price paid by the utility for purchasing power, is greater than the cost of generation; or 2) if a net metering reimbursement revenue stream can be developed. The normal CHP plant operation modes are as follows:

Å The gas turbine generator (GTG) would operate in electrical load follow mode to supply power to the microgrid. When the microgrid electrical load is high, the GTG would operate at full output with additional load supplied by import power from the utility. When the microgrid load is low there are two possible operating modes:

1) If the Real Time LBMP of electricity or no net metering arrangement has been granted is less than the cost of generating electricity, the GTG would operate at part load and the load management system would reduce the CHP plant output to prevent power export to the utility. In situations when the microgrid load is less than 50% of the GTG full load, the GTG would be operated at 50% output and excess electricity would be exported regardless of the price.

2) If the Real Time LBMP of electricity is greater than or equal to the cost of generating electricity, the GTG would operate at full load and export electricity not required by the microgrid.

Å Steam generated by the CHP would be distributed to the CMI and Grober plants using a newly constructed steam distribution system. Steam output from the HRSG can be increased by firing the duct burner. When the combined CMI and Grober steam load will at times be less than the unfired steam output of the HRSG, excess steam would then be condensed in an air-cooled condenser.

Boilers at the CMI and Grober facilities would remain in service and be maintained in hot standby mode when the CHP plant is in operation to allow for fast pickup of the total steam load in the event of the CHP unit tripped out of service. The existing heating equipment would have adequate capacity to supply the respective CMI and Grober heating load when the CHP unit is not available during scheduled maintenance or forced outages.

The CHP will operate at all times when available, it is expected to have an availability of 94-96%. Scheduled maintenance will be planned for off-peak electricity rate periods, when possible and extended maintenance outages will be planned during periods when the risk of severe weather conditions are low. This maintenance scheduling strategy would reduce the impact on plant demand charges and improve plant efficiency by continuing to minimize the steam generation from the less efficient CMI and Grober boilers.

The normal electrical configuration of the microgrid is shown on the single line diagram in Appendix D. The CHP is connected to the utility grid at the NYSEG Wright Ave Substation. The 34.5 kV switchgear located at the new CHP facility will be the connection point connecting the overhead line from the Wright Ave Substation to CMI and the CHP facility. Power generated at 12.47 kV from the CHP generator will be stepped up from 12.47 kV to 34.5 kV through an outdoor transformer located outside the CHP building. A 12.47 kV switchgear line up in the CHP building will have feeders to the BOCES campus and the Grober Group manufacturing plant. A feeder from the 12.47 kV switchgear would feed a step-down transformer and outdoor switchgear to provide 102/208 Volt power to the smaller microgrid loads (Aurelius Fire Department, Sunoco Gas Station, Seneca-Cayuga ARC and the NY State Police Station).

For emergency conditions:

Upon the loss of the utility feed, the utilities incoming feeder circuit breaker located in the CHP 34.5 kV switchgear will automatically be opened, isolating the microgrid from the utility. If the microgrid load exceeds the capability of the CHP, the Load Management System (LMS) would automatically attempt to shed microgrid loads connected to selected busses such that the GTG can operate in islanded mode with the remaining load. The LMS would have computational characteristics to determine the priority scheme of shedding breakers such that the generator would not be overloaded and at the same time would have some spinning reserve to support starting of certain loads.

Upon restoration of the utility feed, the LMS would synchronize the distribution system with the utility through the 34.5 kV incoming breaker. Once re-synchronized, the facility distribution system would revert to normal operation with the gas turbine generator running in parallel with the utility.

In the event of the GTG being off-line or a turbine trip during a utility outage, the black start generator (BSG) would start up automatically on a dead bus to supply the emergency CHP loads providing the power required to start the gas turbine generator. The automatic BSG would be initiated by its own synchronization panel. During the time when the GTG is off-line and there is a utility outage, each facility would rely on its own emergency power systems to provide power to critical loads.

SUBTASK 2.2 LOAD CHARACTERIZATION

The microgrid electrical load includes all of the loads of CMI and the other listed microgrid customer facilities. The monthly and annual loads are summarized in Table 1 of Appendix E giving average, minimum and maximum for each facility. These loads are presented graphically in Chart 1 in Appendix E. The monthly and annual electrical consumption for the individual facilities and the entire microgrid are provided in Table 2 of Appendix E.

The microgrid thermal load includes steam generated for the CMI and Grober plants. Steam will not be provided to the other microgrid customer facilities.

The microgrid monthly and annual thermal loads are summarized in Table 3 listing average, minimum and maximum for the system. This information is presented graphically in Chart 2.

Chart 3 in Appendix F shows the combined electrical load profile for the CMI Microgrid for one year. Hourly electrical loads for CMI and the Boces Campus were taken from, NYSEG's website. Electrical loads for ARC facility and the Aurelius Fire Station were estimated based on monthly billing data provided. The electrical load for the Grober facility was provided by the plant design team as an estimated average load and a NYSEG typical load profile for a high load factor facility was applied to obtain an hourly load profile.

Chart 4 in Appendix F shows the steam load profile for the combined CMI Microgrid plant loads for one year. The thermal loads (steam) for the CMI plant were estimated from natural gas usage data provided by CMI on a one-hour interval basis from their Process Information system. The steam loads for the Grober facility were provided by the plant design team as an estimated average load.

The average microgrid electrical load will be 3.25 MW, with a peak of 4.69 MW. Any excess electricity generated is available for export to the utility grid.

The rated output of the CHP will be greater than the average microgrid load and most peaks. In most cases the CHP will generate 100% of the microgrid requirements with excess generation capacity available for export to the utility grid.

When the GTG is down for maintenance or emergency repairs, all electricity required for the microgrid will be imported from the utility.

During emergency conditions where the electrical utility is unable to deliver electricity to the microgrid, the CHP will island from the system and generate electricity to meet the demand of the microgrid up to the full load output of the GTG. The CHP is capable of satisfying the CMI microgrid anticipated peak electrical load and therefore load shedding would not be required.

It should be noted that during a major emergency event, most facilities would not be maintaining "business as usual". This would lead to a natural reduction in electrical load, apart from load shedding.

Regular maintenance outages of the GTG would be planned for periods when natural disasters are least likely to occur. If the GTG were to trip during an emergency condition, the facilities connected to the microgrid would rely on their emergency power systems for critical loads.

The average steam load for the CHP will be 14,100 lb/hr with anticipated peaks of 25,500 lb/hr. The HRSG with duct firing is able to meet these loads under most operating conditions anticipated for the GTG (e.g. full load, part load).

For periods when the GTG is down for maintenance or emergency repairs, natural gas-fired boilers in the CMI and Grober plants will operate to meet the respective plant steam loads.

SUBTASK 2.3 DISTRIBUTED ENERGY RESOURCES CHARACTERIZATION

Type	Rating (kW/Btu)	Fuel
Combined Heat and Power	4.6 MW/25 MMBtu/hr	Natural Gas and Propane

The Distributed Energy Resources (DER) for the CMI microgrid will include a standalone combined heat and power (CHP) facility located on its own site near the CMI and Grober manufacturing plants on Eagle Drive.

CMI has two (2) 600 hp natural gas fired steam boilers generating saturated steam at 100 psig. The Grober plant will have two (2) 300 hp natural gas steam boilers also generating 100 psig saturated steam. Each plant will have the necessary auxiliary systems including, makeup water treatment systems, condensate return systems and boiler feedwater systems.

The CHP will include one (1) dual fuel gas turbine generators (GTG), discharging exhaust gases to a heat recovery steam generator (HRSG) equipped with gas-fired duct burner. The GTG will nominally be rated at 4.6 MW but at site conditions will typically generate 4.3 MW at the generator terminals. The HRSG would be capable of generating 13,400 lb/hr of steam with no duct firing but would be rated for 25,000 lb/hr of steam with maximum duct firing. Steam will be delivered from the HRSGs at a pressure of 100 psig at saturated conditions.

The CHP will be constructed on a green field site near the CMI plant as indicated on the Microgrid Layout drawing in Appendix A. The site will be developed to include a building housing the GTG, HRSG, auxiliary equipment, electrical room and control room. Also on the site will be a step-up transformer, fuel gas compressor, black start diesel generator and backup fuel (propane) storage tanks. The Site Plan and Equipment Plan drawings are included in Appendix C.

Under normal conditions, the CHP will operate, firing natural gas, connected to the utility and generating all of the power required by the microgrid. The utility will supply additional electricity only as needed. The steam demand of the CMI and Grober facilities will be met with steam generated by the HRSG using duct firing, when necessary, up to the maximum HRSG capacity. Additional steam will be generated by the boilers in the CMI and Grober plants only as required for each respective plant. At least one boiler will be kept on hot standby in each plant to serve as the backup steam supply in case the CHP GTG trips.

In the event of natural gas curtailment or a disruption of the natural gas supply, the GTG will continue to operate by firing propane but the HRSG will be limited to its unfired steam output. Steam availability to the CMI and Grober plants will therefore be limited since a natural gas disruption will also likely affect the boilers in these two facilities.

On loss of the utility electricity feed to the microgrid, the CHP will island from the system and generate electricity to meet the demand of the microgrid up to the full load output of the GTG. Load shedding may be required if the CHP were unable to meet the microgrid loads. Natural gas will continue to be the primary CHP fuel, as long as it is available but switch over to propane will occur, if required. The steam generation strategy of the CHP and the boilers at the CMI and Grober facilities will remain the same.

During the time when the GTG is off-line and there is a utility outage, emergency loads at each of the facilities connected to the microgrid distribution system would rely on their own emergency systems for power.

The operation of the CHP and the boilers at the CMI and Grober plants is not expected to be impacted by forces of nature. All of the critical equipment is located indoors or in suitable enclosures, protected from high winds and precipitation. Due to the elevation of the site, flooding has not previously occurred and is not anticipated in the future.

The primary fuel for the CHP is natural gas, delivered through an underground piping network and supplied by a system of underground pipelines. Disruptions in the gas supply are rare but can occur and could be precipitated by a natural disaster at some point along the supply system. Gas may be curtailed from time to time due to heavy demand or shortage of supply.

The backup fuel for the CHP is propane stored on-site in two (2) 55,000 USWG tanks. This is sufficient fuel storage to operate the GTG for at least 7 days. The duct burners will not be fired on the backup fuel resulting in some non-critical steam loads being limited or shutdown.

In the event of loss of grid power along with the shutdown (trip) of the CHP generator, a black start diesel generator will be available to restart the GTG and the auxiliary equipment needed to operate the HRSG.

The GTG is capable of part load operation from 50% load to 100% load allowing it to load-follow over a wide range. Under normal conditions, when the electrical load exceeds the combined capacity of the GTG, the GTG will operate at full load and load variations will be accommodated from the grid supply. If the load is less than the capacity of the GTG, the excess output of the GTG is available for export from the CHP to the utility. Exporting of electricity will be limited to periods when the price paid for electricity is greater than the cost to generate or if necessary to ensure the GTG does not operate at less than 50% load. However, if a net metering arrangement is developed, the GTG will operate at 100% load all of the time.

The HRSG steam generation can be varied between the unfired output to fully fired output by modulating duct burner firing between 0 and 100%. When the steam load is less than the output of the fully fired HRSGs, the steam output of the HRSGs will be controlled by regulating the duct burner firing rate. If the steam load falls below the unfired output of the HRSGs excess steam will be vented or condensed in an air-cooled condenser.

The microgrid's voltage and frequency are not expected to vary greatly from nominal as there are many loads and none of the loads are large enough to have any great effect on the voltage and frequency during load start-up or being taken off line. When connected to the utility, the microgrid's voltage and frequency will be controlled by the utility grid. When in islanded mode, the generator AVR and frequency control system will regulate the voltage and frequency and will be able to ride through voltage and frequency deviations. In an emergency event if the voltage or frequency were to deviate largely from normal, the generator protection relays will shut down the system.

SUBTASK 2.4 ELECTRICAL AND THERMAL INFRASTRUCTURE CHARACTERIZATION

Electrical Infrastructure Description

The normal electrical configuration of the microgrid is shown on the single line diagram in Appendix D. The CHP is connected to the utility grid at the NYSEG Wright Ave Substation. The 34.5 kV switchgear located at the new CHP facility will be the connection point connecting the overhead line from the Wright Ave Substation to CMI and the CHP facility. The incoming utility feeder will be connected to the 34.5 kV switchgear via circuit breakers equipped with a set of PTs on the line side of the CBs and sets of CTs and PTs along with utility revenue metering on the load side. Electronic relays will provide overcurrent and re-closure functionality and power meters provide power metering parameters.

Power generated at 12.47 kV from the CHP generator will be stepped up from 12.47 kV to 34.5 kV through an outdoor transformer located outside the CHP building. This transformer will have A and B differential relays which will also provide overcurrent protection. A 12.47 kV switchgear line up in the CHP building will have feeders to the BOCES campus and the Grober plant. A feeder from the 12.47 kV switchgear would feed a step-down transformer and outdoor switchgear to provide 102/208 Volt power to the smaller microgrid loads (Aurelius Fire Department, Sunoco Gas Station, Seneca-Cayuga ARC and the NY State Police Station). Feeder protection relays will be provided as well as overall bus protection relays along with required PTs and CTs.

Thermal Infrastructure Description

The CMI Microgrid energy infrastructure will serve only the CMI and Grober facilities. Other electrical consumers on the microgrid will not be connected to the thermal energy distribution systems.

Steam will be delivered from the CHP to CMI and Grober through an underground buried piping system with road crossings through underground utility tunnels as well. Condensate will be returned through a similar parallel piping system.

Electrical infrastructure associated with delivery of CHP generated electricity to the microgrid and distribution throughout the microgrid is routed underground via buried conduit and/or ductbanks. This infrastructure will not be exposed to the forces of nature as it is sheltered from severe weather conditions and the area is not prone to flooding. The protection for the steam and condensate piping is the same.

The normal electrical configuration of the microgrid is shown on the single line diagram in Appendix D. The microgrid will be connected to the utility grid at the NYSEG Wright AV2 Substation via an existing 34.5 kV overhead line. The 34.5 kV switchgear located at the new CHP facility will be the connection point. No additional infrastructure is required to isolate the microgrid from the utility.

Within the microgrid boundary, the two group substations will each include two 34.5 kV to 13.2/7.62 kV step-down transformers. The 34.5 kV incoming feeder to the CHP substation will be connected through a circuit breaker to the new CHP 34.5 kV switchgear. Protection for this feeder will include a set of PTs on the line side of the CBs and sets of CTs and PTs along with utility revenue metering on the load side. Electronic relays provide overcurrent and re-closure functionality and power meters. Synchronizing to the utility will be across the utility incoming feeder breaker.

SUBTASK 2.5 MICROGRID AND BUILDING CONTROLS CHARACTERIZATION

The microgrid will be controlled from the CHP control room which will be constantly manned by operators. If the grid supply is lost, disconnecting from the grid will take place automatically via the protection relay system and will be sensed by the Load Management System (LMS) which will shed the microgrid loads, if necessary, to match the generated supply with the remaining loads. Upon return of grid supply, the operators will be notified and they will initiate an auto-synchronization sequence via the LMS control system to close the utility breaker and reenergize any loads dropped by the LMS.

A black start generator, capable of providing sufficient power to supply the loads required to start up the GTG will be provided. The microgrid loads will be adjusted using the LMS to ensure the loads remaining do not exceed the power delivered by the GTG.

The microgrid's voltage and frequency are not expected to vary greatly from nominal as there are many loads and none of the loads are large enough to have any great effect on the voltage and frequency during load start-up or being taken off line. When connected to the utility, the microgrid's voltage and frequency will be controlled by the utility grid.

When in islanded mode, the generator AVR and frequency control system will regulate the voltage and frequency and will be able to ride through voltage and frequency deviations. In an emergency event if the voltage or frequency were to deviate largely from normal, the generator protection relays will shut down the system.

During the design phase of the project, the system will be modelled and a protection and coordination study will be undertaken to provide the protection settings for the various protection systems throughout the microgrid distribution system.

Data logging features will take place in the CHP control system's plant historian.

The microgrid and building controls will not be impacted by severe weather. The controls will be run off its own UPS supplies fed from 125 VDC battery and charger system. Both the LMS and PCS control systems will have redundant processors.

SUBTASK 2.6 INFORMATION TECHNOLOGY (IT)/TELECOMMUNICATIONS INFRASTRUCTURE CHARACTERIZATION

The microgrid's control systems will operate on a system consisting of managed switches, various cable types and protocols. The CHP building plant control system (PCS) will allow supervisory control and monitoring of the CHP equipment from a centralized control room via operator workstations connected via a network switch. The CHP generator will have a remote workstation allowing it to be controlled locally or from the control room. The black start diesel generator, gas compressor, HRSG and the 12.47 kV and the 480V switchgear can all be controlled and monitored from the control room as well as locally.

The LMS will be connected to the PCS allowing the LMS to be controlled and monitored from the CHP building plant control system. A fiber optic communication system will connect all the microgrid equipment to the LMS system for load management signals and power monitoring. Remote IO equipment will be located at each building in the system to allow the control systems to monitor the buildings' circuit breakers' positions and to open or close the breakers. A variety of control protocols may be used such as Ethernet IP, Modbus TCP/IP and Control Net using a variety of mediums such as copper Cat 6, hardwired analog and digital points, fiber optic multi- or single mode etc. The final configurations will depend on equipment and vendors selected.

The communications between the microgrid and the utility will be in accordance with the utility procedures and protocols. A phone will be available in the operator control room to call the grid control center if communications are required.

The operation of the microgrid is not effected by any loss of communications with the utility. The grid sources are detected by the protection relays (dead bus) to determine if the grid is offline or online. If the source has been offline and the operator wishes to synchronize to the grid when the grid is reenergized, the operator may call the grid control center to confirm if it is okay to do so. Communications with the utility will be in accordance with the utility procedures and protocols.

SECTION III

TASK 3: ASSESSMENT OF MICROGRID'S COMMERCIAL AND FINANCIAL FEASIBILITY

SUBTASK 3.1 COMMERCIAL VIABILITY – CUSTOMERS

It is difficult to quantify the exact number of individuals that would be affected if these loads were to go unserved. To simply look at the available statistics for the City of Auburn, over 27,381[8] people could be affected. This is under the assumption that the fire, police and gas services served by the microgrid were the only available agencies to provide these services in the event of a natural disaster. The BOCES could be used to house some of those community members. Additionally, the BOCES is the backup location for the Cayuga County Emergency Management Office (EMO) due to the primary office located below flood level.

Ancillary services that will be provided by this microgrid include the option to black start the CHP plant. Improved operation of the utility system will be realized due to the CHP Plant generating 28,488,000 kWh or 96.03% of total microgrid load that the utility will no longer have to generate and/or provide the generated electricity to other customers. The plant will take approximately 4.6 MW of demand off the utility system.

Cayuga Milk Ingredients (CMI), the new Grober Group Manufacturing Facility (GGMF), the Cayuga-Onondaga BOCES, the Aurelius Volunteer Fire Department, the Petr-All gas station, Seneca-Cayuga ARC, and NYS Troopers Barracks will all purchase electricity only from the microgrid. CMI and the GGMF will receive the steam generated from the CHP Plant.

Microgrid stakeholders for the proposed microgrid would include either the third party financing entity or Cogen Power Technologies (CPT) as the stakeholder. Installation of this project would benefit each of the microgrid customers and the City of Auburn population of 27,381 community members.

A third party financing entity or CPT will be the owner of the CHP Plant generating the power and the cables, conduits, and other equipment necessary for providing each of the customers with electricity. Once a third party financing partner is selected for this project, Cogen Power Technologies (CPT) will work with the financing entity to develop a Power Purchase Agreement (PPA) with each of the customers to recover the capital required for the project, the cost of generating

[8] Appendix M includes references for this statistic.

power, and annual maintenance fees. CPT will work with the financer to assist in where appropriate meters should be located to ensure that proper energy measurements are recorded for billing purposes.

CPT will utilize the approach and PPA's developed and used at their Burrstone Energy Center (BEC) plant with their three customers. These documents have been used since the plant started commercial operations in August 2009.

All microgrid customers will be supplied 100% of their electricity through the CHP Plant during both normal operations and during an islanded operation. When the CHP Plant is down for maintenance, all power will be supplied by NYSEG to each microgrid customer.

As mentioned previously, the financing entity will have a PPA with these customers and will manage each of the PPAs with the individual customers. Critical load customers make up 57% of the microgrid; Cayuga-Onondaga BOCES, the PetrAll gas station, the Aurelius Volunteer Fire Department, and the New York State Troopers Barracks. CPT will use the PPAs developed for their Burrstone Energy Center CHP Plant.

The plan for gaining customer acceptance of this project is to work with each of the customers to review the 1) potential savings, 2) reliability benefits, 3) environmental benefits, and 4) societal and community benefits which can be had from this project. It is the expectation that the savings brought forth will be enough to warrant customers to join the microgrid, however the additional customers be motivated to gain the additional reliability and community benefits as well. Preliminary discussions with the additional customers have already begun and the project has been well received.

The CHP Plant would provide 97% of both CMI's and GG's annual steam demand.

SUBTASK 3.2 COMMERCIAL VIABILITY – VALUE PROPOSITION

There are a variety of benefits that this project will bring to the Cayuga County community. The proposed microgrid will generate electricity for a two manufacturing facilities, a school, a fire department, a police station, a gas station, and a senior living home. This mix of customers checks off multiple critical facilities identified as desirable through NY Prize.

In the event that there was a natural disaster or super storm to affect the area, it is possible that CMI and the GGMF could house employees and their families to provide an energized shelter. The BOCES would be able to provide shelter for the students and additional community members. Furthermore, the BOCES is the backup location for the Cayuga County Emergency Management Office due to the primary office located below flood level.

In addition to the aforementioned facilities being able to provide shelter, the fire department, police barracks and gas station would have full operational capabilities during a natural disaster. As proven during Superstorm Sandy, it is critical to have gas stations available during an event as such.

There has been no feedback received from the utility on any benefits that would be recognized by the New York State Electric and Gas Corporation (NYSEG) with installation of this project. However, it is evident that there must be some system benefit. The microgrid is anticipated to produce 28,488,000 kWh or 96.03% of total electricity annually for these seven facilities. With an electric reduction of this magnitude on the distribution system, the utility will be able to distribute the power that is now not being consumed by the microgrid customers, to other customers on the NYSEG utility system. In addition, total demand for this system will be reduced by approximately 4.6 MW in this location.

The electrical interconnection process has not been completed yet; however the cost of interconnection would be expected to be within $100,000-$300,000 for the microgrid. This is not firm, nor provided by the utility, only an estimate based on experience at other projects (Albany Medical Center, St. Joseph's Hospital, Union College, etc.) completed by the Design-Build Team in National Grid territories, not NYSEG.

There is an opportunity for the utility to obtain additional revenue from this project by selling the existing customer transformers and vaults at fair market value. Since the utility did not outline any costs that would be associated with this project, further investigations will be uncovered in Stage 2.

The proposed business model for this microgrid would be for a third party financing entity to finance the construction of the project. Prior to construction of the system, the financing firm would enter into a Power Purchase Agreement (PPA) with each of the microgrid customers. It would be anticipated that the PPA would be contracted for a 15-20 year term. The term is typically determined by the amount of infrastructure costs that will have to be paid back by the customers over time. Although the customers will need to enter into the PPA, it is important to recognize the customers will still save money each year.

Each month, the microgrid customers would receive a bill from the microgrid owner. This bill would contain infrastructure recovery costs, CHP Plant fuel costs, and other negotiated costs. The model developed at BEC by CPT would be used.

SWOT ANALYSIS

Strengths

- Manufacturing facilities, a school, fire department, police station, and senior care facility are all included in the customer mix of the microgrid. Most of agencies are long term customers and will not be closing their business/operations during the 15-20 year PPA term.
- Most facilities included in the microgrid are mature organizations; therefore electricity consumption will not significantly increase/decrease over time. If the two manufacturing facilities were to increase their electric consumption, there is enough available capacity to supply the additional load.
- The fire department, gas station, police station, nursing home, and BOCES receive power from the utility at a lower voltage than the microgrid will provide. Therefore, by being electrically connected behind the 34.5kV utility meter, these customers will be favored under better utility rates. Second, CMI and GGMF will receive benefit from the power generated by the CHP Plant, not traditional electric generation.
- Including the CMI and GGMF manufacturing facilities as part of the microgrid would illustrate New York State's initiatives to promote manufacturing in the state.
- GGMF utilizes waste material from CMI to produce their end product.
- Both manufacturing facilities are new which poses less risk than existing manufacturing facilities with aged infrastructure, therefore the likelihood of ceasing production is less.

Weaknesses

- Due to diverse customer mix (manufacturing, public, and private) there are various channels may reflect potential project delays associated with establishing commercial terms and conditions of the PPA.

Opportunities

- The development of pilot tariffs to lower the delivery costs of natural gas and electricity to microgrid customers, lower the state taxes associated with the energy consumed, and allow net metering for any excess power sold back to the utility. These potential changes will significantly increase the financial benefit the microgrid customers will realize.

- For the utility to recognize there is a system benefit of 28,488,000 kWh taken off of the existing system and this financial benefit to be shared with the microgrid customers.
- To increase the number of construction jobs in the Capital Region during the construction period.

Threats

- The potential (but rare) threat of customers withdrawing from the microgrid.
- The inversion of natural gas and electricity prices. However, with the abundance of shale gas in the region and natural gas storage levels being at an all-time high, this should not be a viable concern for microgrid customers.
- The threat of the utility deciding not to support the project and try to halt the project due to their concerns with crossing public roads and aggregation of their customers electric services.
- Manufacturers may be tempted to close their doors and move to more economically friendly states or countries for production.

There are several characteristics to the proposed microgrid which have been identified below:

1) The aggregation of Multiple Customer Services behind the utility meter.
2) The purchase of existing NYSEG assets.
3) A robust Load Management System which will monitor loads as necessary during normal and emergency situation.
4) Installation of backup propane tanks for fuel storage at the CHP Plant to run the CHP system for one week without any refills.
5) The microgrid will provide power to a diverse customer mix of private, public, and manufacturing facilities.
6) The power lines will be installed underground and are immune to weather events. These power lines will be used to distribute power from the CHP Plant to each of the microgrid customers during normal operations and during loss of utility power.

The CHP and microgrid technologies that we are proposing have a long track record of success have been tried and are true to success. This project is scalable because the base project includes a solid thermal host, and adding the other microgrid customers to consume electricity allows the CHP Plant Gas Turbine to be larger which only increases efficiency, savings, and reliability. A microgrid as such will continue to remain scalable as long as the right mix of energy customers participates within a scalable physical proximity. The proposed project is a similar yet larger project than the existing Burrstone Energy Center located in Utica, NY.

A project of this magnitude serves many energy, policy, and societal benefits. Primarily, the fire department, gas station and police barracks will be able to operate with full capacity during a power outage to provide full services to community members. Additionally, community members and the Cayuga County EMO can be housed in the BOCES to provide shelter.

The microgrid will be designed to withstand any weather disruptions that are typical to the area. All of the electrical cables will be installed underground, in concrete encased duct back which will provide full resiliency against any weather phenomenon. If a severe weather event was to impact the area, the microgrid would be able to operate fully for a minimum of one week. This is due to the installation of the propane tanks as a secondary fuel source. The CHP Plant has the ability to operate for a longer duration via refueling trucks. 3D renderings of the CHP Plant are available in Appendix B.

The overall value proposition can be outlined below:

1) Each of the customers will save money, have more reliable power and have power available to their facilities during a prolonged utility outage.
2) An annual utility reduction in 28,488,000 kWh or 96.03% on their system.
3) Bette & Cring Construction, CHA Consulting, and Cogen Power Technologies ï the three companies that comprise the Design-Build team are all Upstate New York companies with headquarters in NYS to promote their standing in the state and the northeast for developing the complex microgrids.
4) Multiple construction jobs will be created throughout the installation and construction of this project.

At current commodity pricing, the savings that can be realized by this project can be in the range of $71,000-$864,000 the total of the microgrid customers. Analyses of the potential savings for various cases of the microgrid have been provided in Appendix G.

There are a variety of potential revenue streams that can be developed due to the installation of this microgrid. It is dependent on the participation of NYSERDA, NYSEG, and Public Service Commission to move forward with the development of these opportunities. Various revenue streams have been identified in a report issued by Pace Climate and Energy Center, included as Appendix H. The potential revenue streams are identified in Section 11.4 ñPotential Future Revenue Streamsò.

This project supports each of the REV goals as outlined in the table below:

REV Goal	**Advancement of that Goal**
Cutting greenhouse gas emissions 80% by 2050	ÅLarge scale combined heat and power (CHP) is core to the project providing significant efficiency benefits and reducing carbon emissions Å4.6 MW CHP Plant will save 5,270 tons per year of Carbon Dioxide equivalent (equal to 997 passenger vehicles)[9]
Making energy more afforable for all New Yorkers	ÅCCPUSA, the municipal utility may have flexibility to create new opportunities and revenue for streams for the microgrid lower bills for customers ÅEconomies of scale results in more customer savings. This allows design of larger, more efficient system to serve industrial, economical and service related agencies
Improving our existing initiatives and infrastructure	ÅThree large anchor tenants make up the initial scope with a great deal of additional industrial and large retail facilities less than 1,000 feet from the central plant
Helping clean energy innovation grow	ÅCreates an opportunity to examine new and innovative financing structures, e.g. a non-profit, third party financing model that could significantly lower the cost of capital improving economic viability ÅThis is unlike many NY Prize submissions. Itõs in a lightly populated

[9] Appendix I includes carbon reduction calculations from the EPA-CHP Partnership.

	area and serves manufacturing customers. These distinctly different project attributes may help fill experience gaps in arriving at a comprehensive view of the benefits of microgrids, across ALL geographic and sectoral settings.
Building a more resilient energy system	ÅProvides resiliency to an existing manufacturing facility, potentially a developing new business park, and a BOCES which can serve as a storm shelter for the community
Creating new jobs and business opportunities	ÅBoosts the competitiveness of new business park, increasing its attractiveness and ability to draw additional industrial employers to the county ÅCayuga is unique in that it supports New Yorkõs manufacturing sector. The State has a strong interest in creating and retaining manufacturing jobs

A robust Load Management System (LMS) would be installed to promote new technology. The LMS works by recognizing within 80 milliseconds that utility power has been lost, and isolating the CHP system from the utility to create and island and continue to provide uninterrupted power to the microgrid customers. The LMS will also detect and shed load where necessary on the microgrid loads to prevent the turbine from tripping offline.

SUBTASK 3.3 COMMERCIAL VIABILITY – PROJECT TEAM

The approach to gaining support from local government, community groups and residents would be similar to the approach that will be used to gain microgrid customer support. An overview of the project would be had with the appropriate groups, outlining the proposed scheme, customer savings, environmental benefits and societal benefits that would be a result of installation of this project.

The Design-Build team would consist of the following firms:

1) Bette & Cring Construction Group (B&C) as the General Contractor. Roles would include construction management, holding contracts with the client and subcontractors, cost estimating, project scope and budget, field management, subcontractor selection, self-performing construction work, providing the Payment and Performance Bond, and providing the Guaranteed Maximum Price (GMP) Guarantee.
2) Cogen Power Technologies (CPT) as the CHP Program Manager. Roles would include Development of GMP, manage interfaces with the client, design team, major equipment suppliers and utility; manage financial, technical, and scheduling aspects of major equipment contracts, testing and commissioning of the microgrid. It is anticipated that CPT will assist with at least the first year of operations and possibly more.
3) CHA Consulting, Inc. (CHA) as the Design Engineer of Record. Roles would include being the responsible design engineer of the microgrid system, interconnection with the utility and all necessary permits.

The third party financing partner and owner of this microgrid has yet to be identified; however there are a variety of entities in CPT's partnership pool that are capable of providing this financing structure. Additionally, Cogen Power Technologies has the capability to provide third party financing, ownership and operations.

NYSERDA, Cayuga County Public Utilities Services Agency (CCPUSA), the Cayuga-Onondoga BOCES, the Aurelius Volunteer Fire Department, and NYS Troopers Station are all public entities. The private entities included in this project are Cayuga Milk Ingredients, The Grober Group, Seneca-Cayuga ARC, the PetrAll gas station, and Bette & Cring.

The owner of this project has not been finalized, therefore comment on the financial strength cannot be provided. However, CPT and their parent company are a potential owner and routinely have annual revenues in the $100M-$200M range, successfully financed the $15M Burrstone Energy Center plant, and have completed the following CHP projects in NYS in the last six years:

Project	Value
Albany Medical Center 4.6 MW Albany, NY	$23 M
GUSC Biomass 1 MW Utica, NY	$18 M
St. Josephõs Hospital 4.6 MW Syracuse, NY	$15 M
Union College 1.8 MW Schenectady, NY	$14 M

Cogen Power Technologies (Cogen) has joined with CHA Consulting, Inc. (CHA), and Bette & Cring Construction (B&C) to form a proven team to has worked together for over 7 years and forged a strong complementary bond to deliver design-build CHP solutions across the Northeast as a team.

Cogen Power Technologies (Cogen) ï Our business is cogeneration - plain and simple. As a CHP program manager, integrator, and operator, Cogen provides client-focused comprehensive cogeneration solutions. Cogen has worked with a number of institutions - including Albany Medical Center and Utica College- to deliver successful CHP projects from feasibility studies to design through build-out and operation. Since 2007, we developed and now own and operate a cogeneration microgrid ï Burrstone Energy Center that serves Utica College, Faxton-St. Lukeõs Hospital, and St. Lukeõs Nursing Home, that has produced over 100 Million kilowatt hours of electricity. John Moynihan, Managing Partner of Cogen was the recipient of the 2014 North East Combined Heat and Power Initiative (NECHPI) Champion of the Year award.

CHA Consulting, Inc. (CHA) - With over 1400 employees and 50 offices, CHA is a highly diversified, full service engineering firm providing a wide range of planning and design services to clients for over 60 years. A licensed Mechanical, Electrical, and Structural Engineering firm headquartered in Albany, CHA has designed more than 20 different CHP plants, from 1 MW to over 110 MW, over the past 15 years in the US and Canada. CHAõs signature projects include Albany Medical Center CHP Plant and the 30 MW CHP plant installed at Cornell University. CHA has extensive experience with permitting coordination for gas supply and electrical system interconnection, and has been complimented by National Grid for its detailed, high quality application packages.

Bette & Cring (B&C) - Since 1999, Bette & Cring has been one of the region's largest General Contractors with offices in Latham and Watertown, NY. B&C has managed the design-build construction of six (6) CHP Plants including Burrstone Energy Center Microgrid, and Albany Medical Center CHP. B&C offers extensive experience in all phases of design, planning, and construction, and have constructed numerous commercial, institutional, and related capital projects over the past fifteen years. Our annual business volume was $133 Million in 2014.

Summary of Key Combined Heat & Power Projects - PROPOSER TEAM

PROJECT	TEAM			PRIME MOVERS			FEATURES		
	COGEN	CHA	B&C	CHP PLANT CAPACITY	STEAM CAPACITY	STEAM PRESSURE	CAMPUS MICROGRID	COMMUNITY MICROGRID	CRITICAL FACILITIES
Burrstone Energy Center CHP Microgrid Utica, NY	★		★	3.6 MW Gas Engine	7,000 pph	85 psig	★	★	★
Albany Medical Center CHP Plant Albany, NY	★	★	★	4.6 MW Gas Turbine	60,000 pph	85 psig	★		★
St. Joseph's Hospital CHP Plant Syracuse, NY	★	★	★	4.6 MW Gas Turbine	45,000 pph	85 psig	★		★
Cornell University CHP Plant Ithaca, NY		★		30 MW Gas Turbine	300,000 pph	400 psig	★		★
Kingston General Hospital/Queen's University CHP Microgrid Kingston, ON		★		15 MW Gas Turbine	150,000 pph	275 psig	★	★	★
Union College CHP Plant Schenectady, NY	★	★	★	1.75 MW Gas Turbine	45,000 pph	90 psig	★		★
GUSC Energy Biomass Plant Rome, NY	★	★	★	1 MW	40,000 pph	$16 Million			

CHP FEASIBILITY STUDIES (BY COGEN/CHA/B&C TEAM)

4.6 MW – St. Joseph's Hospital Cogeneration Plant, Syracuse, NY • 4.6 MW - Bay State Hospital Cogeneration Plant, Springfield, MA • 1.8 MW - Union College Cogeneration Plant, Schenectady, NY • 1 MW - Skidmore College Cogeneration Plant, Saratoga Springs, NY • 1 MW - Williams College Cogeneration Plant, Williamstown, MA • 555 kW Oneida Healthcare Facility, Oneida, NY • 10 MW - Central Pennsylvania Manufacturer

The General Contractor for this project would be Bette & Cring, LLC. Services provided would be construction management, holding contracts with the client and subcontractors, cost estimating, project scope and budget, field management, subcontractor selection, self-performing construction work, providing the Payment and Performance Bond, and providing the Guaranteed Maximum Price (GMP) Guarantee.

The proposed financing for this project has not been secured at this time. The approach for gaining a financial partner on the team for this project would be for CPT to reach out to a handful of pre-qualified third party financing entities that specialize in the development in CHP projects.

Including on the team is Thomas G. Bourgeois, Deputy Director and his team at the Pace Energy and Climate Center (Pace) who will aid in the regulatory advisement of the project. For more than 25 years, Pace has worked in New York and across the Northeast region engaging government, communities, businesses, and key stakeholders in action that leads to better energy and climate policy. Pace's diverse staff conducts research and analysis, finding solutions to meet today's complex energy and climate change challenges.[10]

Legal advisement for the project team will include Robert Loughney at Couch White, LLP. Couch White, LLP is a full-service business law firm with nationally-recognized leadership in the practice of energy and construction law. Their business law practice areas include banking, commercial and corporate law, environmental, renewable energy, land use, zoning and real estate development, government contracts, labor and employment, litigation, real estate and trusts, estates and business succession planning.[11] Couch White was the attorney used for the development of Burrstone Energy Center and was instrumental in helping to navigate through the same microgrid issues that face this project.

SUBTASK 3.4 COMMERCIAL VIABILITY – CREATING AND DELIVERING VALUE

The technologies chosen for this microgrid include electricity generation in the form of a Gas Turbine Generator (GTG) installed as part of a Combined Heat and Power (CHP) plant and controls for electric load control and load shedding. The CHP will provide electricity to CMI, GGMF, and the other microgrid loads and steam to the CMI and GGMF. Excess electricity generated would be available to sell into the NYISO controlled system. A GTG powered CHP supplying the electricity to the microgrid and steam to CMI and GGMF would result in reduced cost for the supply of energy to these facilities. This CHP technology is well proven as a reliable electricity supply system from previous similar installations. The addition of electrical loads from microgrid customers would improve the utilization of the GTG.

A key benefit of the CHP is that it can remain in operation during loss of utility supplied electricity and/or the loss of the natural gas fuel supply. Under normal conditions, the microgrid is connected to the utility system and can import electricity, as needed, when the system demand exceeds the generation capacity of the CHP. The GTG can fire natural gas or propane to power the microgrid while in islanded mode. This allows the microgrid to continue operation during loss of utility power, even if the natural gas supply is interrupted. Propane storage will be

[10] Cited per Pace Climate and Energy Center proposal to CPT dated November 5, 2015.
[11] Cited per Couch White, LLP website at http://www.couchwhite.com/about_us/

available on site with sufficient capacity to fuel the CHP for seven (7) days. Each microgrid facility will have its own emergency power supply system, if required, to handle life safety electrical loads and a black start generator will be available at the CHP to restart the GTG in case of a trip during a utility power outage. The CHP will also continue to supply steam to CMI and GGMF but when the CHP is firing propane, supply will be limited to the unfired output of the HRSG.

An additional benefit of the CHP is that it will potentially result in cost savings to CMI, GGMF and the other microgrid customers during normal operation due to improved efficiency of the combined generation of electricity and thermal energy resulting in lower cost energy being supplied to these facilities.

The challenge of employing the CHP technology will be to ensure that adequate electricity and steam can be supplied to all users during loss of the utility electricity supply. Although the installed generation capacity will in most cases meet the microgrid electrical load, load shedding will be required on some occasions to ensure that GTG capacity is not exceeded during high load periods. The challenge will be to effectively implement the load shedding in order to balance the needs of all facilities connected to the microgrid. Steam demand may at times exceed the steam output capacity of the CHP. During these periods, additional steam can be generated by the existing boilers at the CMI and GGMF plants firing natural gas when available. During a natural gas outage, these facilities will have to reduce steam loads to match the steam supply available from the CHP.

To ensure reliability of the CHP, a comprehensive maintenance schedule will be implemented requiring periodic shutdowns to conduct inspections and service the equipment. One of the challenges will be to schedule these shutdowns to avoid periods when forces of nature events are most likely to occur. The maintenance schedule will also aim to ensure that the length of scheduled outages are minimized.

The proposed location of the CHP Plant will be constructed in the existing Industrial Development Park near CMI and GGMF. There are currently no assets in this location that could be leveraged for this project. However, the Cayuga County Industrial Development Association owns the property which will be helpful to gain approval of the proposed plant. Additionally, each of the customers owns their own service entrance electrical switchgear that the CHP system will tie into.

The CHP will be operated by the third party owner operations team. The agreements will define how electrical load shedding will be handled among the microgrid customers and how steam shortages will be accommodated during natural gas outages

In cases where the unfired steam output of the HRSG exceeds the demand from CMI and GGMF, excess steam will be condensed in an air-cooled condenser. When the steam demand from CMI and GGMF exceeds the unfired output of the HRSG, the duct burner will be fired to increase the steam output to match the load.

A comprehensive electrical interconnection with the utility will have to be successfully navigated to ensure the proper requirements are met.

Special permissions for this project will need to come from the utility regarding the following items:

1) Rights of Way for crossing a public road
2) Aggregation of multiple electrical customers down to one
3) Leasing or buying existing utility infrastructure

The proposed approach for development and construction of this project will be a Design-Build method. Through this method, project costs can be minimized due to less engineering fees and this method significantly reduces the project duration for design and construction so that the microgrid customers may realize the benefits and savings sooner.

The community will recognize a variety of benefits from the deployment of this project. First being that in the event of a natural disaster, the microgrid facilities will be available to provide shelter to community members for a prolonged duration. Community members will also be provided full fire and police services during the event of a natural disaster. The gas station will be fully operational to provide fuel to community members as needed. Due to the savings the microgrid will bring the customers, this will result in a lower cost of service for community members. Also, there will be more energy available to the community from the utility since the microgrid will be producing its own. It is not expected that the community should incur any costs due to implementation of this project.

In order the utility to ensure that this project can benefit the microgrid customers and the community, the utility will need to provide cooperation with the following items:

1) Rights of Way for crossing a public road
2) Aggregation of multiple electrical customers down to one
3) Leasing or buying existing utility infrastructure

Each of the microgrid technologies that will be used as a part of this project have been previously implemented elsewhere. The Solar Turbines Taurus 70 has over 800 units worldwide, generating electricity and recovering the exhaust heat in a thermal application. The Load Management System (LMS) has been employed at a variety of sites, including Albany Medical Center and St. Josephôs Hospital specifically.

It is anticipated that the CHP Plant will operate at a minimum of 97% of the year, only unavailable during times of scheduled maintenance outages. Given the availability of the system, the system will be operating almost all year round to ensure that all of the goals of the system are being met.

A third party financing entity will act as the energy provider and issue monthly bills to the microgrid customers. The CHP Plant will generate power and distribute to the microgrid customers at the cost of generating power. An additional fixed monthly fee to recover the capital investment in the microgrid infrastructure and third party return on investment requirements will be applied. A small administrative fee may be included as well for the overall management and development of the monthly bills. Usage of the microgrid customers will be metered by the installation of standard revenue grade meters at each location.

This project is a slight variation of the successful microgrid implementation at Burrstone Energy Center in Utica, NY and therefore replicable. This approach is scalable and portable to any city or community in the country with an appropriate energy profile.

The barriers to market entry for this project lie solely with participation of the utility.

Based on past success at the Burrstone Energy Center, CPT feels very optimistic that this project is similar and on a grander scale and fully capable to step through the barriers of this project.

SUBTASK 3.5 FINANCIAL VIABILITY

A variety of savings analyses have been included in Appendix G is expected that the third party financing party would receive a portion of each of the customersô savings as a return on their investment.

In order for the microgrid customers to save money, the issues outlined in the SWOT Analysis in Section 3.2 regarding delivery charges of commodities, state taxes, etc. will need to come to fruition to enhance the economics to the customers and microgrid owner. Without these types of changes in the microgrid landscape, it will be difficult (if not impossible) for other projects that are not as robust as this project to materialize. The major incentive that will be required for this project to be deployed and successful is the $5M-$7M NYSERDA subsidy available through NY Prize.

A summary of the anticipated capital and operating costs of this microgrid have been included in Appendix J. The values provided in this table include the installation cost of the CHP Plant and microgrid connections, not any additional overhead of a third party financing firm.

The business model for this project will be profitable because all of the microgrid customers will save money.

The financing structure for this project during development, construction and operation has not been identified at this time due to no selection in a third party financing entity. Terms of the financing structure will be negotiated during the selection process.

SUBTASK 3.6 LEGAL VIABILITY

The proposed ownership of the CHP Plant and microgrid assets will fall under the third party financing entity or Cogen Power Technologies (CPT). The third party/CPT will act as an energy provider to the microgrid customers and have full ownership.

The project owner will be either the third party financing firm or CPT. The applicant is CPT. The approach to securing another entity who is not CPT is described in Section 3.3.

The Cayuga County Industrial Development Association (IDA) owns the property where the CHP Plant is proposed to be located. The IDA is looking to develop the industrial park; therefore securing access to this site will likely be promoted.

The approach to protecting the privacy rights of the microgrid customers would be to engage each customer individually to discuss if they would want their name associated with the project. All energy consumption would be monitored and measured by the installed measurement and verification (M&V) systems, not by NYSEG. Eliminating NYSEG and keeping the M&V more centralized within the

CHP operating system provides an additional level of privacy. Additionally, any contractual agreements between customers and the microgrid owner would be confidential.

The major regulatory hurdles that could implicate this project are:

1) Crossing public roads
2) The aggregation of multiple electric services
3) Buying or leasing existing utility equipment

The plan to address these issues is to follow the same path that was used at Burrstone Energy Center. Robert Loughney at Couch White, LLP will be hired to help navigate a waiver to cross public roads with the PSC and NYSEG support. The Burrstone Energy Center's waiver number through the PSC for this project is Case 07-E-0802 and included in Appendix K. Thomas G. Bourgeois of the Pace Energy and Climate Center has been included on the project team to navigate the aggregation of multiple electric services and the buying/leasing of existing utility equipment.

SECTION IV
TASK 4: DEVELOP INFORMATION FOR BENEFIT COST ANALYSIS

Each of the Facility Questionnaires and the Microgrid Questionnaire were submitted to IEC for proper analyzing for the Benefit Cost Analysis (BCA). The BCA result for this microgrid study is 0.6 without any days of power outages, with a Net Benefits ï Present Value of -$33,800,000. A second case for a BCA of 1.0 or greater was necessary to reach the BCA goal of 1.0 or greater. The BCA calculated that 2.0 days/year of major power outages would be needed to return a BCA of 1.0. With a BCA of 1.0, the Net Benefits ï Present Value is $1,200,000 and an Internal Rate of Return at 8.2%. The information provided by IEC for the BCA has been included in Appendix L.

SECTION V
TASK 5: FINAL WRITTEN DOCUMENTATION

The final presentation is scheduled to be held at the CCPUSA Department of Economic Development Office on May 10th. In attendance will be members from CCPUSA, NYSERDA, CHA, and CPT.

COGEN

SECTION VI
APPENDICES

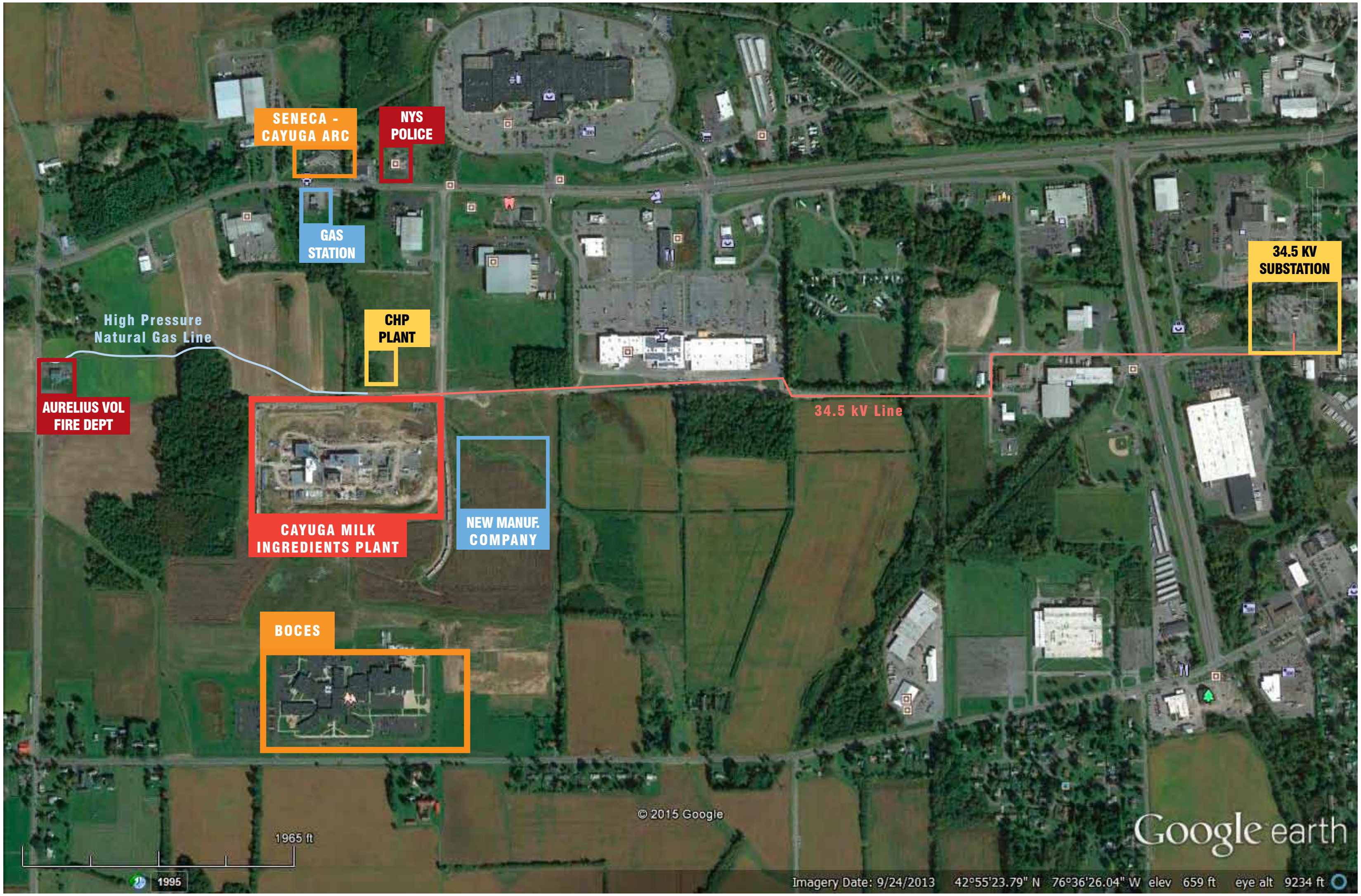
A. GEOGRAPHICAL LOCATION OF PROPOSED MICROGRID
B. ELECTRICAL CABLE LAYOUT DIAGRAM
C. CHP PLANT EQUIPMENT LAYOUT DIAGRAMS
D. ELECTRICAL SINGLE LINE DIAGRAMS
E. MONTHLY ENERGY LOADS
F. LOAD PROFILES
G. SAVINGS ANALYSIS BY CASE
H. PACE CLIMATE AND ENERGY CENTER ï NY PRIZE REPORT
I. CAPITAL AND OPERATING COSTS
J. BURRSTONE ENERGY CENTER PSC WAIVER
K. BENEFIT COST ANALYSIS
L. REFERENCES

Appendix A

Geographical Location of Proposed Microgrid

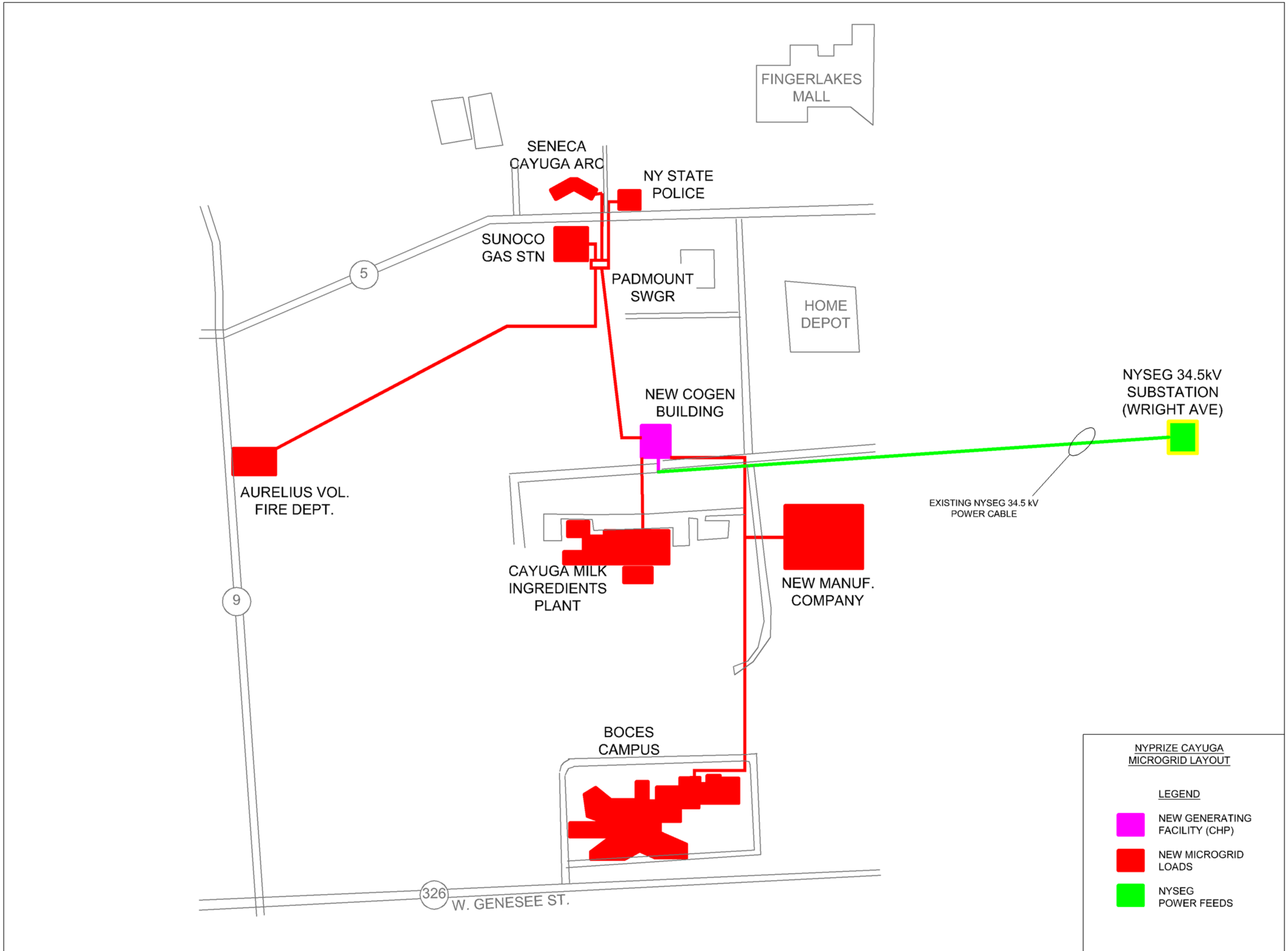
Area Map

COGEN POWER TECHNOLOGIES WITH CHA



APPENDIX B

ELECTRICAL CABLE LAYOUT DIAGRAM


FINGERLAKES MALL
SENECA CAYUGA ARC
NY STATE POLICE
SUNOCO GAS STN
5
PADMOUNT SWGR
HOME DEPOT
NEW COGEN BUILDING
NYSEG 34.5kV SUBSTATION (WRIGHT AVE)
AURELIUS VOL. FIRE DEPT.
EXISTING NYSEG 34.5 kV POWER CABLE
CAYUGA MILK INGREDIENTS PLANT
NEW MANUF. COMPANY
9
BOCES CAMPUS
326
W. GENESEE ST.
NYPRIZE CAYUGA MICROGRID LAYOUT
LEGEND
NEW GENERATING FACILITY (CHP)
NEW MICROGRID LOADS
NYSEG POWER FEEDS

APPENDIX C

CHP PLANT EQUIPMENT LAYOUT DIAGRAMS

PRELIMINARY

SITE PLAN
SCALE: 1"=100'-0"

0 100 200 300 FEET
SCALE: 1" = 100'-0"

NO.	SUBMITTAL / REVISION	APP'D	BY	YYYYMMDD
PA	ISSUED FOR REVIEW	BT	RM	2016/02/01

CHA
III Winners Circle, PO Box 5269 · Albany, NY 12205-0269
Main: (518) 453-4500 · www.chacompanies.com

Designed: | Drawn: RM | Checked:

NE YOR PRI E
C I ICROGRID CHP ACI I Y
A B RN, NE YOR

O ERA SI E P AN

Issue Date: 2016/02/01 | Project No.: 30603 | Scale: 1"=100'-0"

30603-5200

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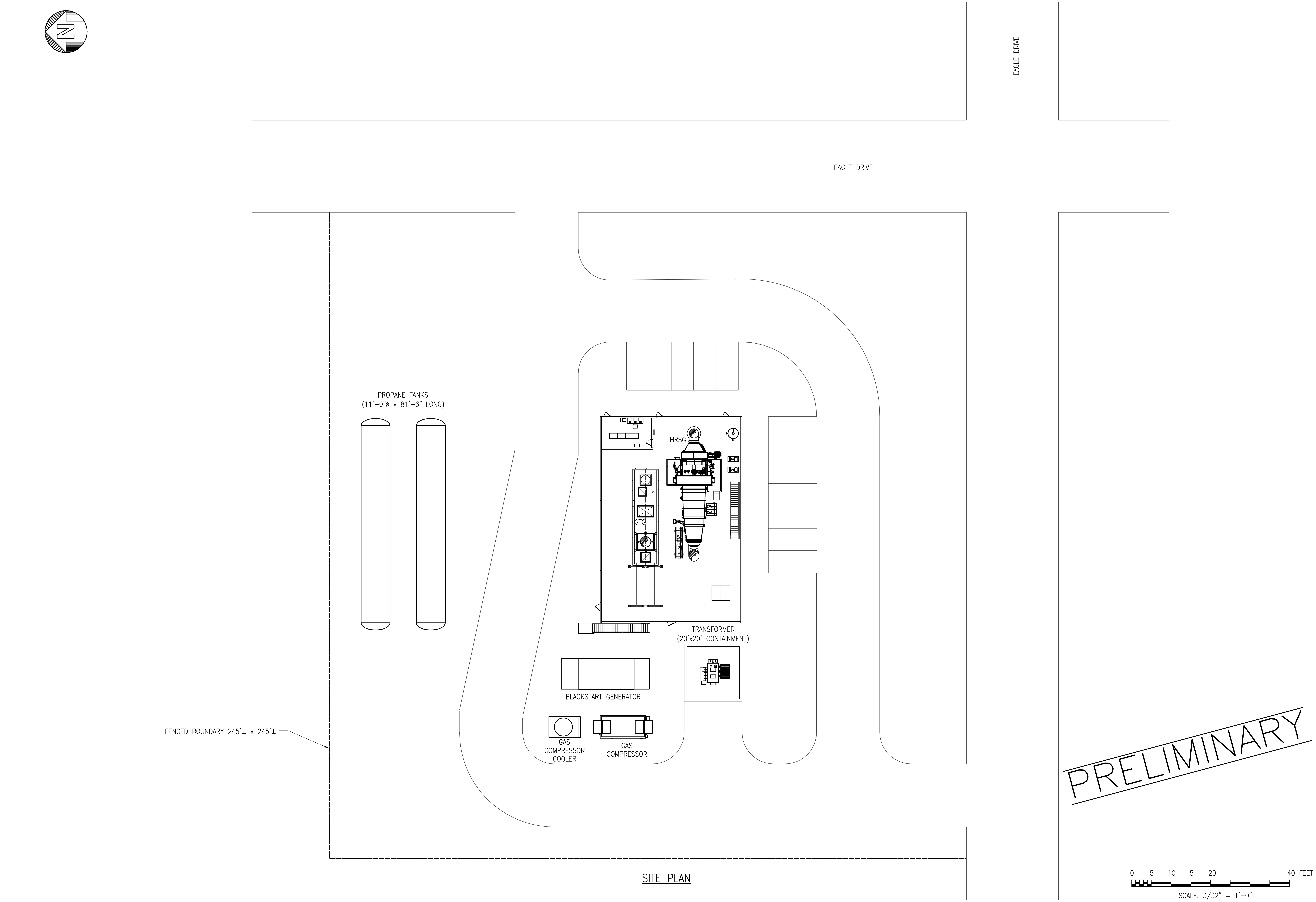

SITE PLAN

NO.	SUBMITTAL / REVISION	APP'D	BY	YYYY/MM/DD
PA	ISSUED FOR REVIEW	BT	RM	2016/02/01

CHA
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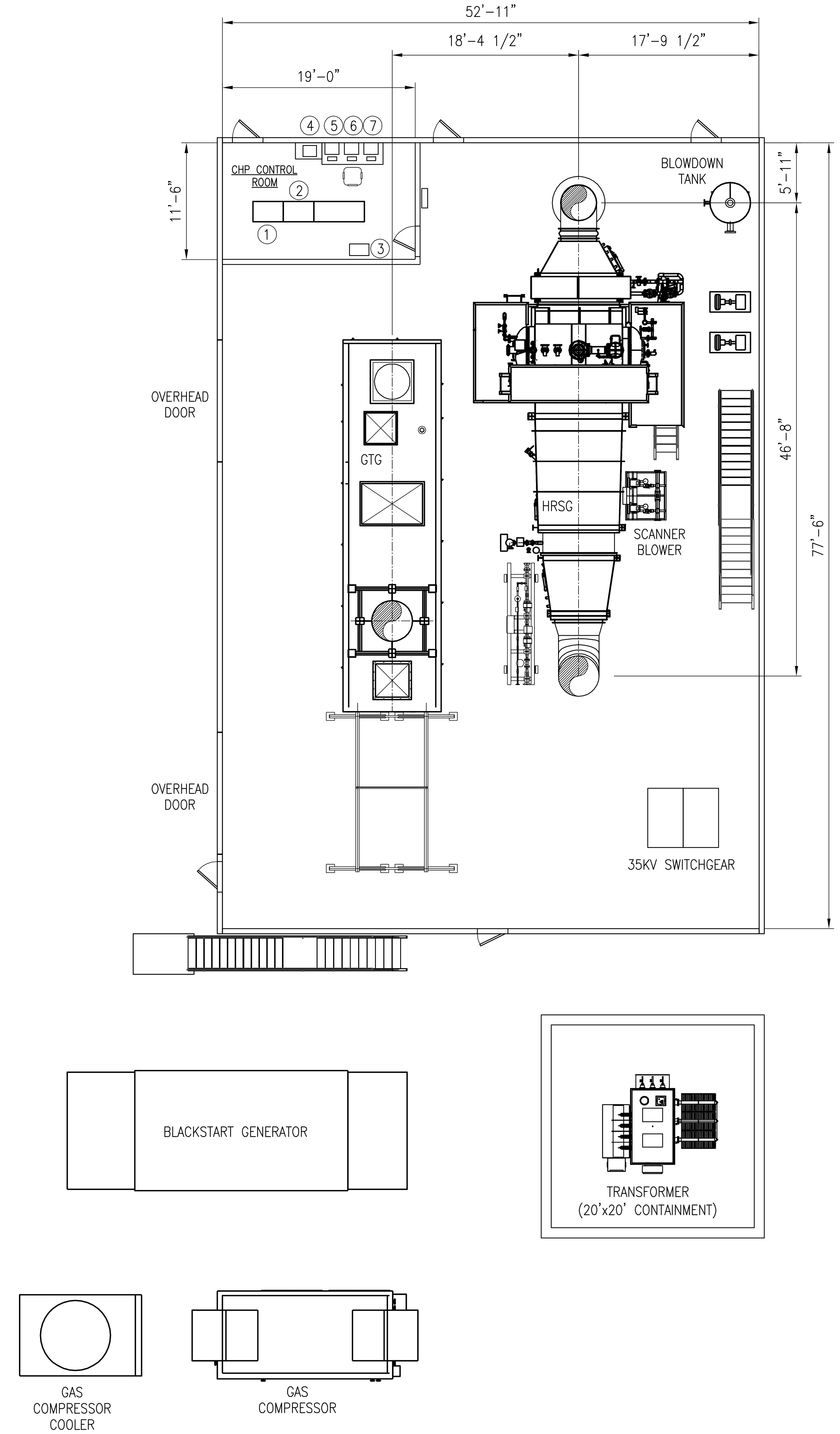
NE YOR PRI E
C I ICROGRID CHP ACI I Y
A B RN, NE YOR

SI E P AN

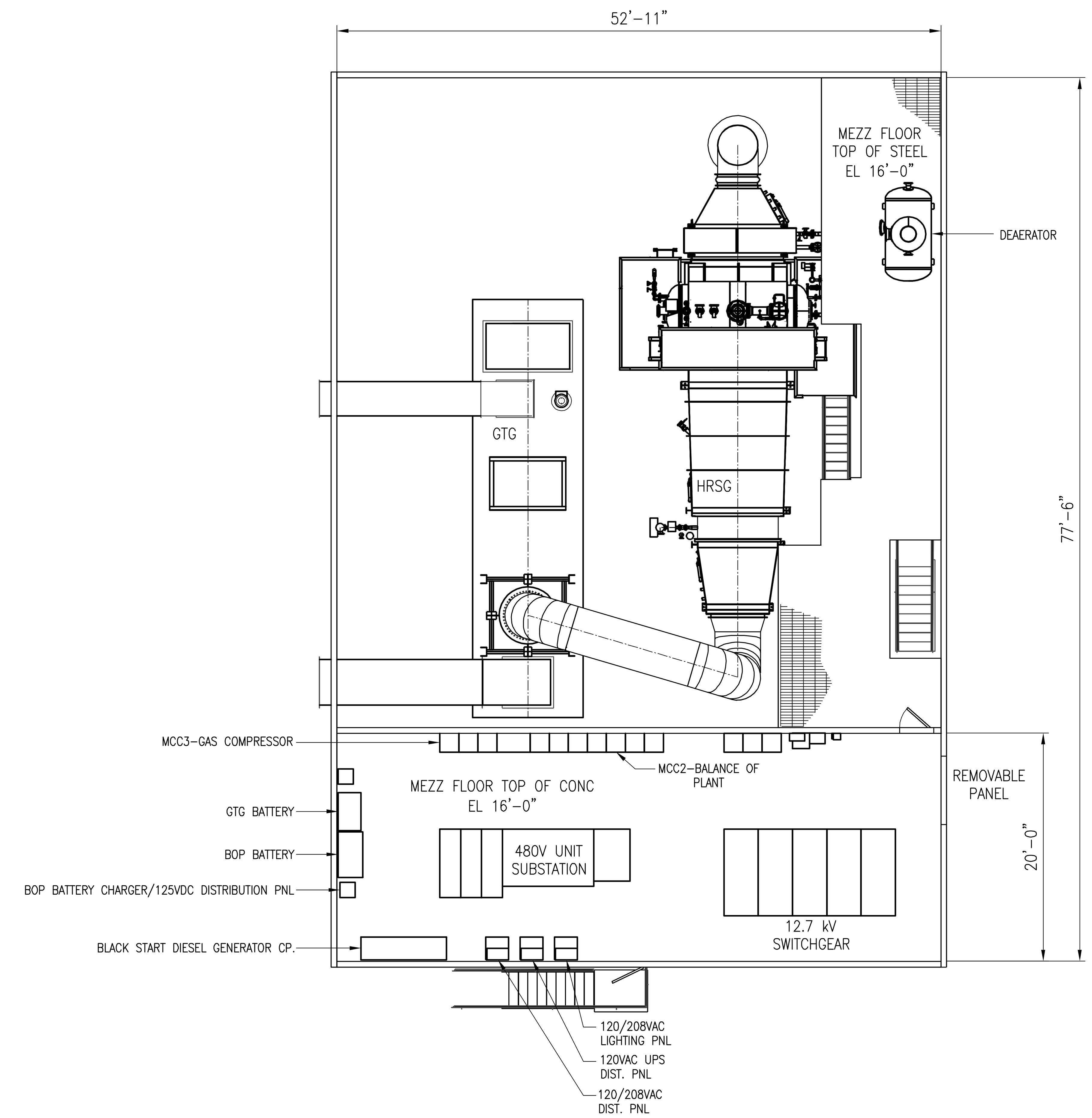
Issue Date: 2016/02/01 | Project No.: 30603 | Scale: 3/32=1'-0"

30603-5201

CHP CONTROL ROOM	
NO.	EQUIPMENT
1	SUB-LMS PANEL
2	BALANCE OF PLANT PLC
3	EMERGENCY STOP STATION
4	PRINTER #1
5	ENGINEERING WORK STATION
6	OPERATOR WORK STATION
7	SOLAR AUXILIARY DISPLAY UNIT



GROUND FLOOR PLAN - EL 0'-0"



MEZZANINE FLOOR PLAN - EL 16'-0"

PRELIMINARY

0 4 8 12 16 20 24 28 32 FEET
SCALE: 1/8" = 1'-0"

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PB	ISSUED FOR REVIEW	BT	RM	2016/02/01

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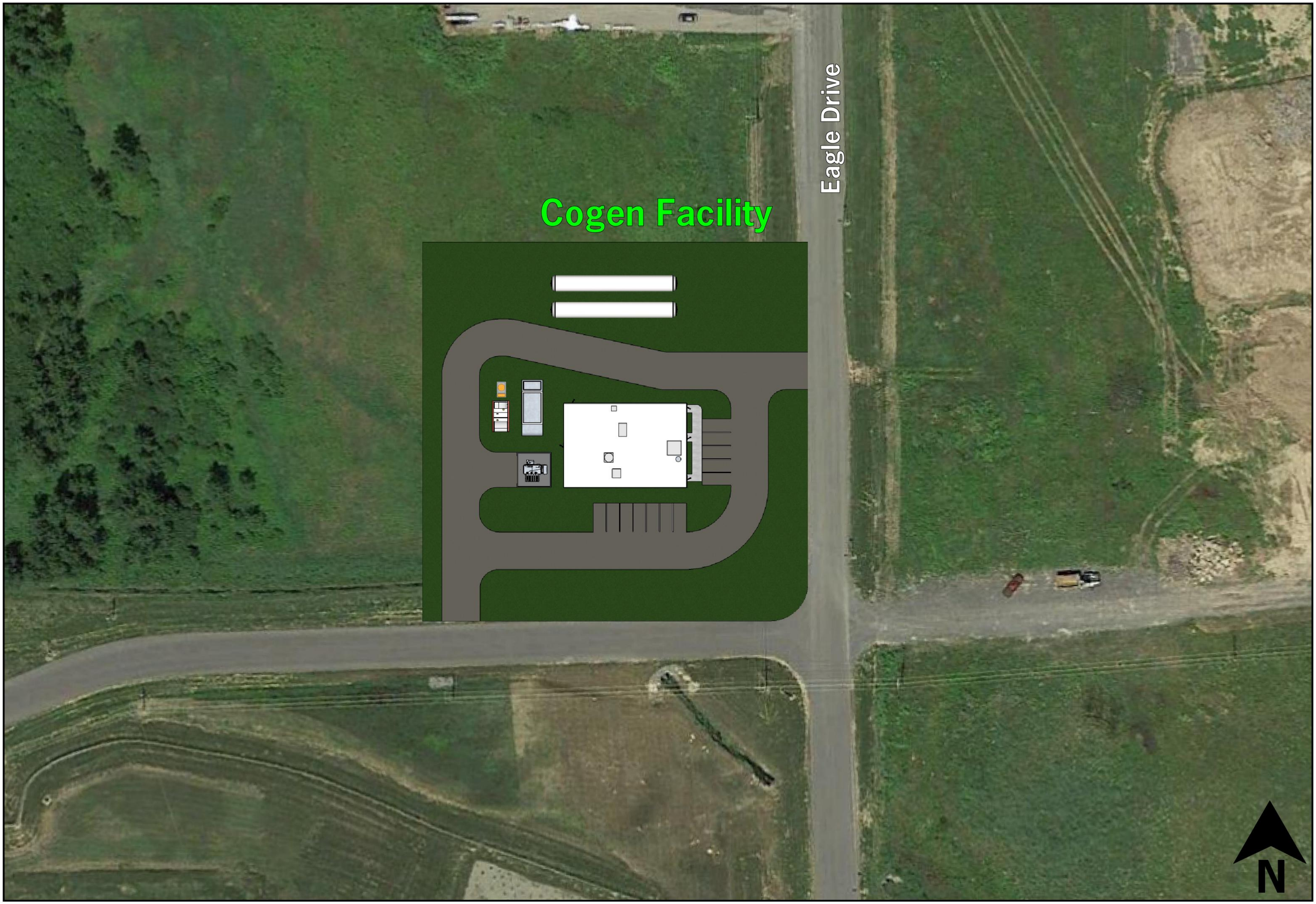
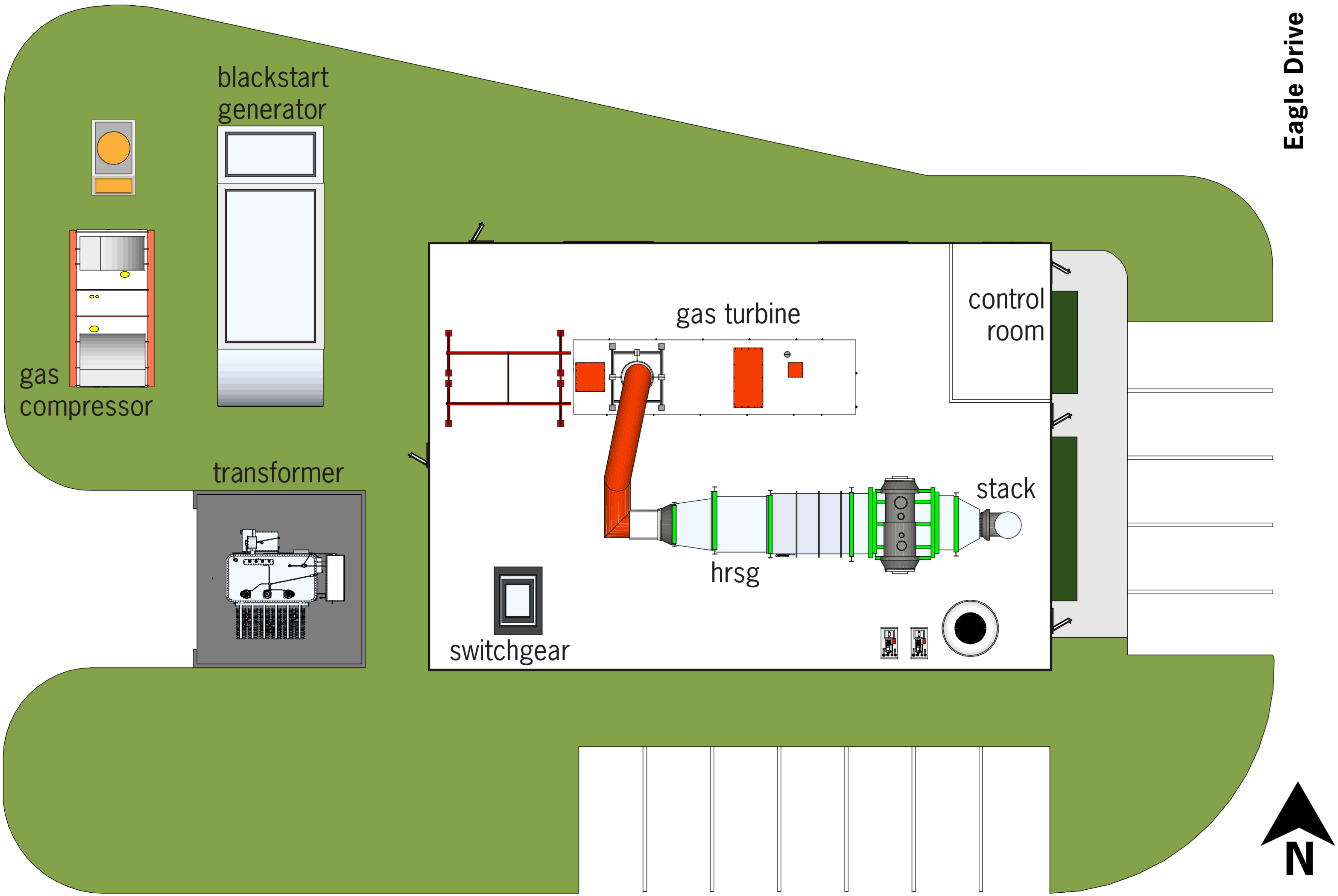
NE YOR PRI E
C I ICROGRID CHP ACI I Y
A B RN, NE YOR

E IP EN P AN

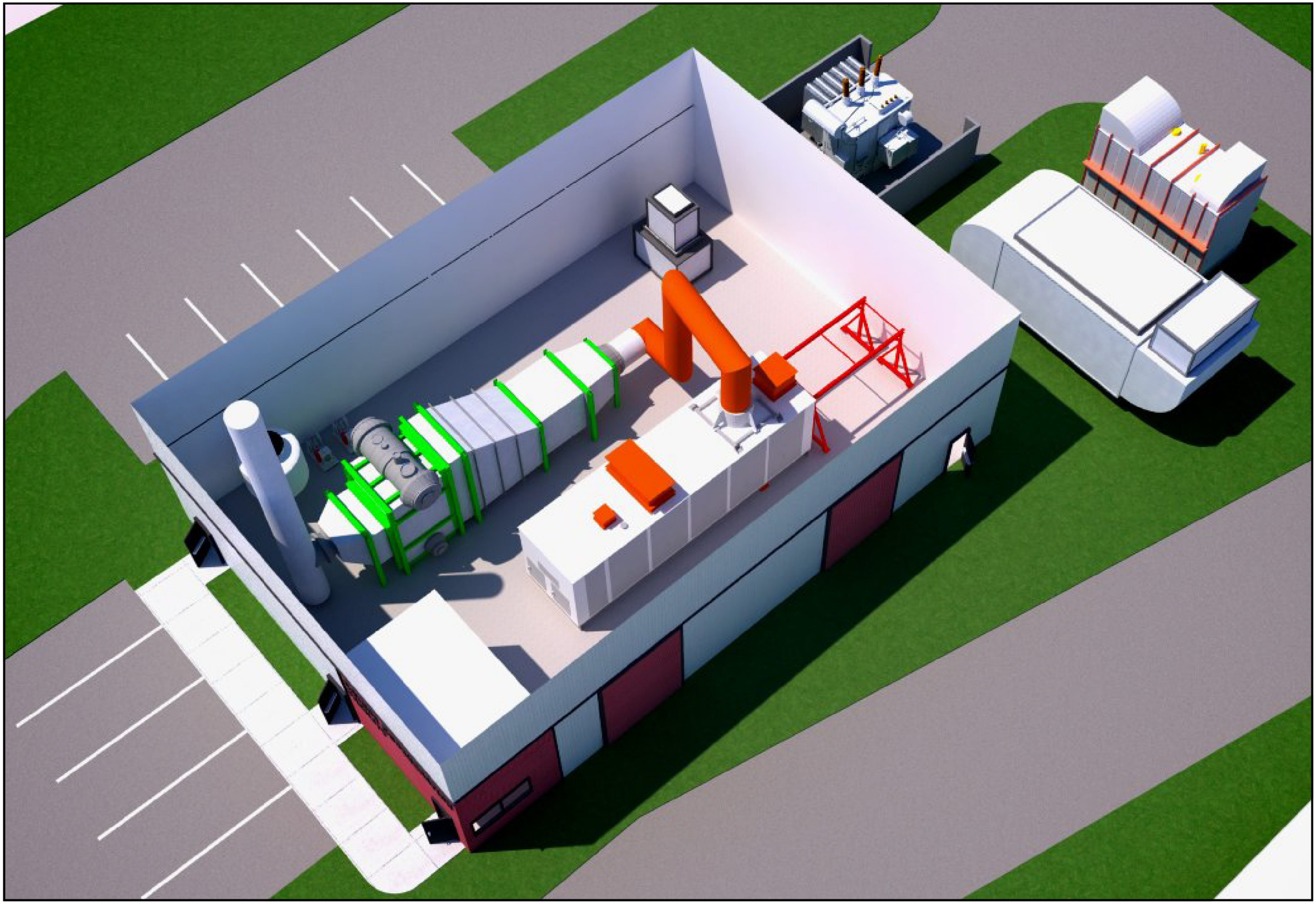
Issue Date: 2016/01/06 | Project No.: 30603 | Scale: 1/8"=1'-0"

30603-5202


Cogen Facility
Eagle Drive
N

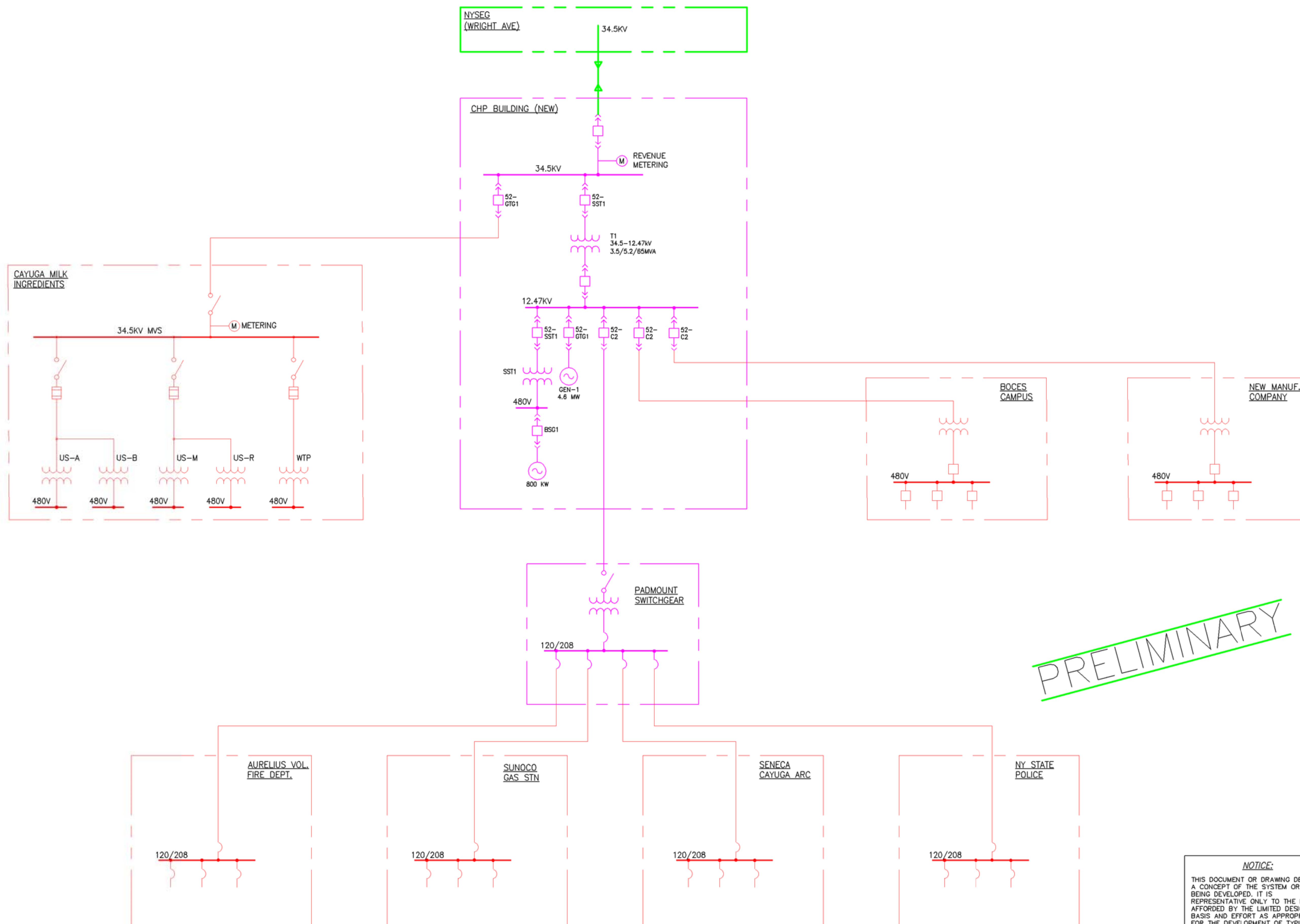

blackstart
generator
gas
compressor
transformer
gas turbine
control
room
stack
hrsg
switchgear
Eagle Drive
N


CAYUGA COGENERATION
FACILITY



APPENDIX D

ELECTRICAL SINGLE LINE DIAGRAMS



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THIS DOCUMENT OR DRAWING DEPICTS A CONCEPT OF THE SYSTEM OR PLANT BEING DEVELOPED. IT IS REPRESENTATIVE ONLY TO THE EXTENT AFFORDED BY THE LIMITED DESIGN BASIS AND EFFORT AS APPROPRIATE FOR THE DEVELOPMENT OF TYPICAL INITIAL CONCEPT DESIGN. IT IS BY NO MEANS A COMPLETE OR PRECISE REPRESENTATION OF THE SYSTEM OR PLANT TO BE CONSTRUCTED.

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COGEN POWER TECHNOLOGIES

CAYUGA
County of Cayuga, NY
MICROGRID STUDY

Rev.	Submittal / Revision	App'd	By	Date
PA	FOR REVIEW	TV	MMH	12/17/15

ELECTRICAL
34.5kV/12.47KV
OVERALL SINGLE LINE
DIAGRAM

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30603-6100

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APPENDIX E

MONTHLY ENERGY LOADS

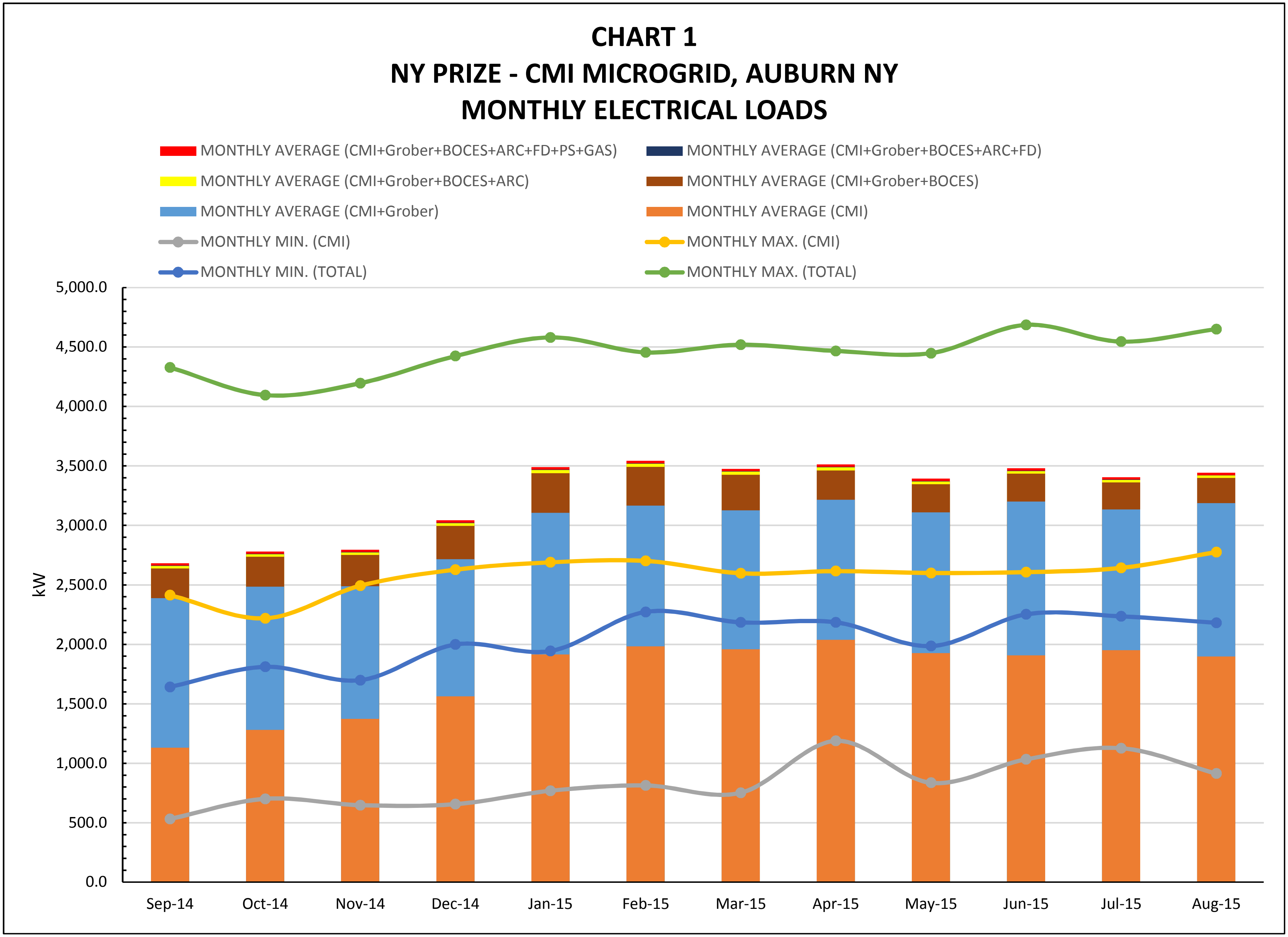


CHART 1
NY PRIZE - CMI MICROGRID, AUBURN NY
MONTHLY ELECTRICAL LOADS
MONTHLY AVERAGE (CMI+Grober+BOCES+ARC+FD+PS+GAS)
MONTHLY AVERAGE (CMI+Grober+BOCES+ARC+FD)
MONTHLY AVERAGE (CMI+Grober+BOCES+ARC)
MONTHLY AVERAGE (CMI+Grober+BOCES)
MONTHLY AVERAGE (CMI+Grober)
MONTHLY AVERAGE (CMI)
MONTHLY MIN. (CMI)
MONTHLY MAX. (CMI)
MONTHLY MIN. (TOTAL)
MONTHLY MAX. (TOTAL)
kW
5,000.0
4,500.0
4,000.0
3,500.0
3,000.0
2,500.0
2,000.0
1,500.0
1,000.0
500.0
0.0
Sep-14
Oct-14
Nov-14
Dec-14
Jan-15
Feb-15
Mar-15
Apr-15
May-15
Jun-15
Jul-15
Aug-15

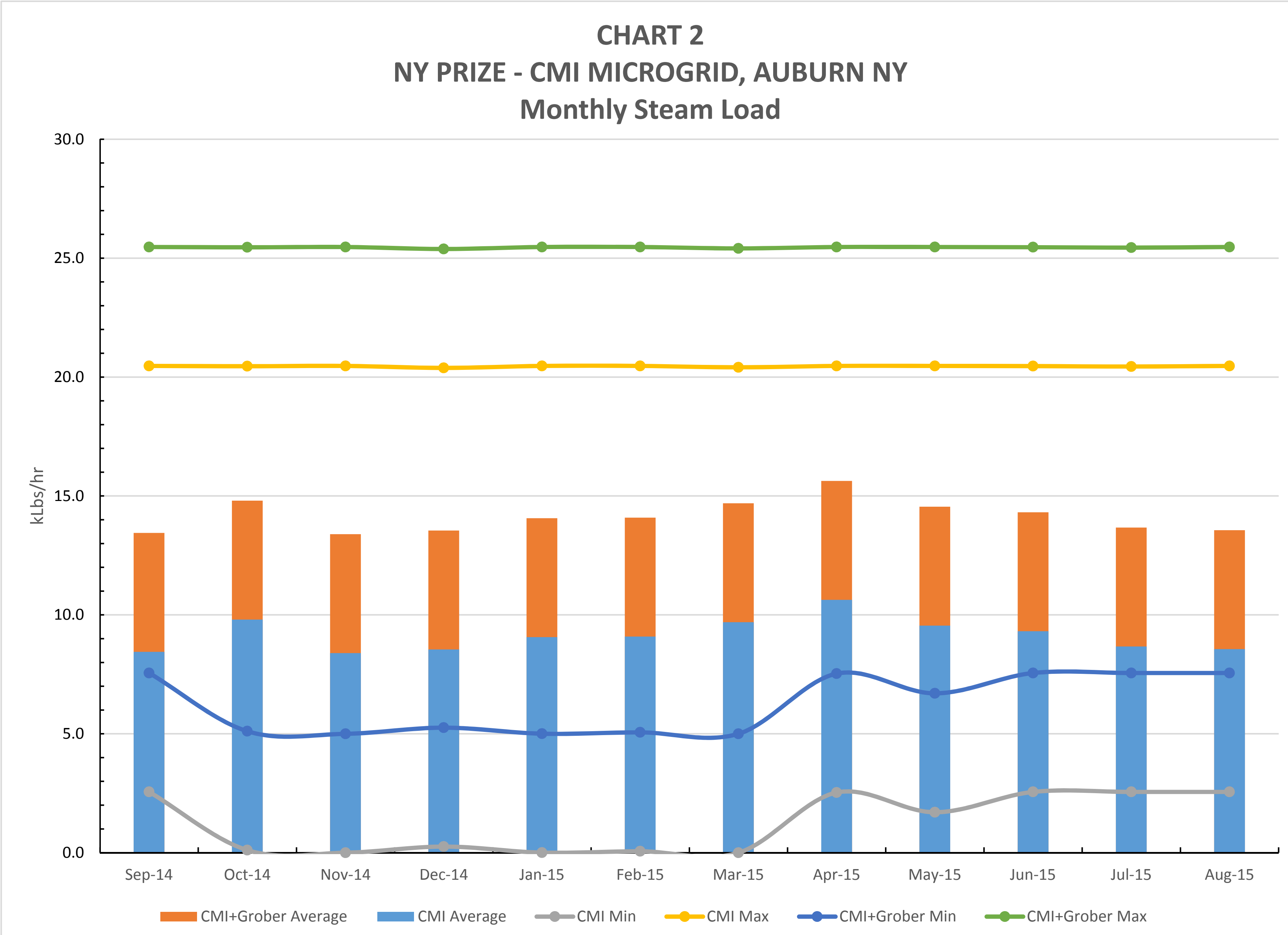


CHART 2
NY PRIZE - CMI MICROGRID, AUBURN NY
Monthly Steam Load
kLbs/hr
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Sep-14
Oct-14
Nov-14
Dec-14
Jan-15
Feb-15
Mar-15
Apr-15
May-15
Jun-15
Jul-15
Aug-15
CMI+Grober Average
CMI Average
CMI Min
CMI Max
CMI+Grober Min
CMI+Grober Max

NY PRIZE- AUBURN NY
CMI Microgrid

Project: 30603
Date: Feb 9/16

TABLE 1 - ELECTRIC LOAD SUMMARY

	CMI			Grober			BOCES			ARC		Fire Station		Police Stn & Gas Stn	Total		
	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Mean	Max.	Mean	Max.	Est.	Min.	Mean	Max.
	kW	kW	kW	kW	kW	kW	kW	kW	kW	kW	kW	kW	kW	kW	kW	kW	kW
Sep-14	532.1	1,130.3	2,413.4	886.7	1,257.4	1,563.5	91.4	250.2	555.5	20.8	60.0	2.8	7.8	20.0	1,642.3	2,681.5	4,328.0
Oct-14	701.1	1,280.2	2,218.9	794.7	1,203.7	1,494.5	97.2	252.8	505.4	19.8	51.2	3.1	7.8	20.0	1,811.1	2,779.6	4,095.6
Nov-14	647.9	1,372.5	2,492.7	802.7	1,115.4	1,408.8	118.5	263.8	526.7	19.9	40.0	3.8	10.8	20.0	1,699.0	2,795.3	4,195.9
Dec-14	656.3	1,562.5	2,628.2	845.8	1,152.4	1,395.1	107.6	280.6	529.7	23.0	40.0	3.9	10.8	20.0	1,998.8	3,042.5	4,423.9
Jan-15	769.1	1,914.1	2,689.6	835.0	1,190.6	1,458.3	119.5	333.4	564.4	26.4	40.0	4.0	10.0	20.0	1,944.3	3,488.6	4,581.0
Feb-15	813.5	1,981.6	2,701.7	859.2	1,183.8	1,449.5	217.2	325.8	512.8	27.2	40.8	4.1	10.0	20.0	2,272.7	3,542.5	4,454.7
Mar-15	752.3	1,958.5	2,597.7	832.7	1,167.5	1,420.9	124.4	298.3	519.4	26.6	43.2	4.2	9.0	20.0	2,184.7	3,475.1	4,519.3
Apr-15	1,188.3	2,037.0	2,615.8	780.9	1,178.7	1,444.6	91.7	245.7	532.4	26.1	48.8	3.9	9.0	20.0	2,184.9	3,511.5	4,467.0
May-15	835.8	1,926.1	2,600.1	788.3	1,182.4	1,541.5	92.5	237.1	528.4	23.3	54.4	3.4	8.3	20.0	1,985.5	3,392.3	4,448.4
Jun-15	1,032.9	1,906.8	2,606.9	846.2	1,292.4	1,615.3	88.3	235.0	489.5	21.6	55.2	3.3	8.3	20.0	2,252.2	3,479.1	4,686.2
Jul-15	1,126.7	1,949.2	2,642.9	827.5	1,185.1	1,474.7	91.7	225.6	526.9	22.0	60.0	3.1	7.3	20.0	2,235.0	3,405.0	4,545.3
Aug-15	913.5	1,896.6	2,775.9	841.4	1,290.3	1,641.3	87.9	211.3	426.3	20.8	52.8	3.0	7.3	20.0	2,181.1	3,441.9	4,650.4
Annual	**532.1**	**1,742.4**	**2,775.9**	**780.9**	**1,200.0**	**1,641.3**	**87.9**	**263.0**	**564.4**	**23.1**	**60.0**	**3.5**	**10.8**	**20.0**	**1,642.3**	**3,252.0**	**4,686.2**

Notes:

CMI loads are based on hourly utility data from September 2014 to August 2015
Grober loads are based on expected average load provided by designers and a typical NYSEG load profile
Boces loads are based on utility data for July 2014 to July 2015
ARC loads are based on monthly billing data from January to November 2014, December is estimated
Fire Station loads are based on monthly billing data from September 2014 to August 2015
A combined average load is assumed for the police station and gas station although these will be separate loads.

NY PRIZE- AUBURN NY
CMI Microgrid

Project: 30603
Date: Feb 9/16

TABLE 2 - ELECTRIC CONSUMPTION SUMMARY

	CMI	Grober	Boces	ARC	FD	PS&Gas	Total
	kWh	kWh	kWh	kWh	kWh	kWh	kWh
Sep-14	813,787	905,363	180,175	14,970	2,003	14,400	1,930,698
Oct-14	952,438	895,545	188,087	14,757	2,305	14,880	2,068,013
Nov-14	988,175	803,093	189,939	14,317	2,709	14,400	2,012,633
Dec-14	1,162,525	857,403	208,788	17,143	2,882	14,880	2,263,621
Jan-15	1,424,119	885,797	248,062	19,653	2,982	14,880	2,595,493
Feb-15	1,331,640	795,529	218,963	18,262	2,726	13,440	2,380,559
Mar-15	1,457,159	868,604	221,903	19,810	3,094	14,880	2,585,450
Apr-15	1,466,634	848,683	176,940	18,803	2,802	14,400	2,528,261
May-15	1,433,050	879,728	176,377	17,321	2,499	14,880	2,523,855
Jun-15	1,372,890	930,559	169,223	15,540	2,352	14,400	2,504,964
Jul-15	1,450,224	881,746	167,818	16,342	2,313	14,880	2,533,322
Aug-15	1,411,049	959,950	157,213	15,462	2,243	14,880	2,560,797
Annual	**15,263,689**	**10,512,000**	**2,303,487**	**202,379**	**30,910**	**175,200**	**28,487,666**

Notes:

CMI loads are based on hourly utility data from September 2014 to August 2015
Grober loads are based on expected average load provided by designers and a typical NYSEG load profile
Boces loads are based on utility data for July 2014 to July 2015.
ARC loads are based on monthly billing data from January to November 2014, December is estimated.
Fire Station loads are based on monthly billing data from September 2014 to August 2015

A combined average load is assumed for the police station and gas station although these are be separate loads.

NY PRIZE- AUBURN NY Project: 30603
CMI Microgrid Date: Feb 9/16

TABLE 3 - STEAM LOAD SUMMARY

	CMI			Grober	CMI+Grober		
	Min (kLbs/hr)	Mean (kLbs/hr)	Max (kLbs/hr)	Estimated (kLbs/hr)	Min (kLbs/hr)	Mean (kLbs/hr)	Max (kLbs/hr)
Sep-14	2.6	8.4	20.5	5.0	7.6	13.4	25.5
Oct-14	0.1	9.8	20.5	5.0	5.1	14.8	25.5
Nov-14	0.0	8.4	20.5	5.0	5.0	13.4	25.5
Dec-14	0.3	8.5	20.4	5.0	5.3	13.5	25.4
Jan-15	0.0	9.1	20.5	5.0	5.0	14.1	25.5
Feb-15	0.1	9.1	20.5	5.0	5.1	14.1	25.5
Mar-15	0.0	9.7	20.4	5.0	5.0	14.7	25.4
Apr-15	2.5	10.6	20.5	5.0	7.5	15.6	25.5
May-15	1.7	9.5	20.5	5.0	6.7	14.5	25.5
Jun-15	2.6	9.3	20.5	5.0	7.6	14.3	25.5
Jul-15	2.6	8.7	20.4	5.0	7.6	13.7	25.4
Aug-15	2.6	8.6	20.5	5.0	7.6	13.6	25.5
Annual	0.0	9.1	20.5	5.0	5.0	14.1	25.5

Notes:

CMI steam load estimated from gas usage data
Grober steam load is average provided by plant designers

APPENDIX F

LOAD PROFILES

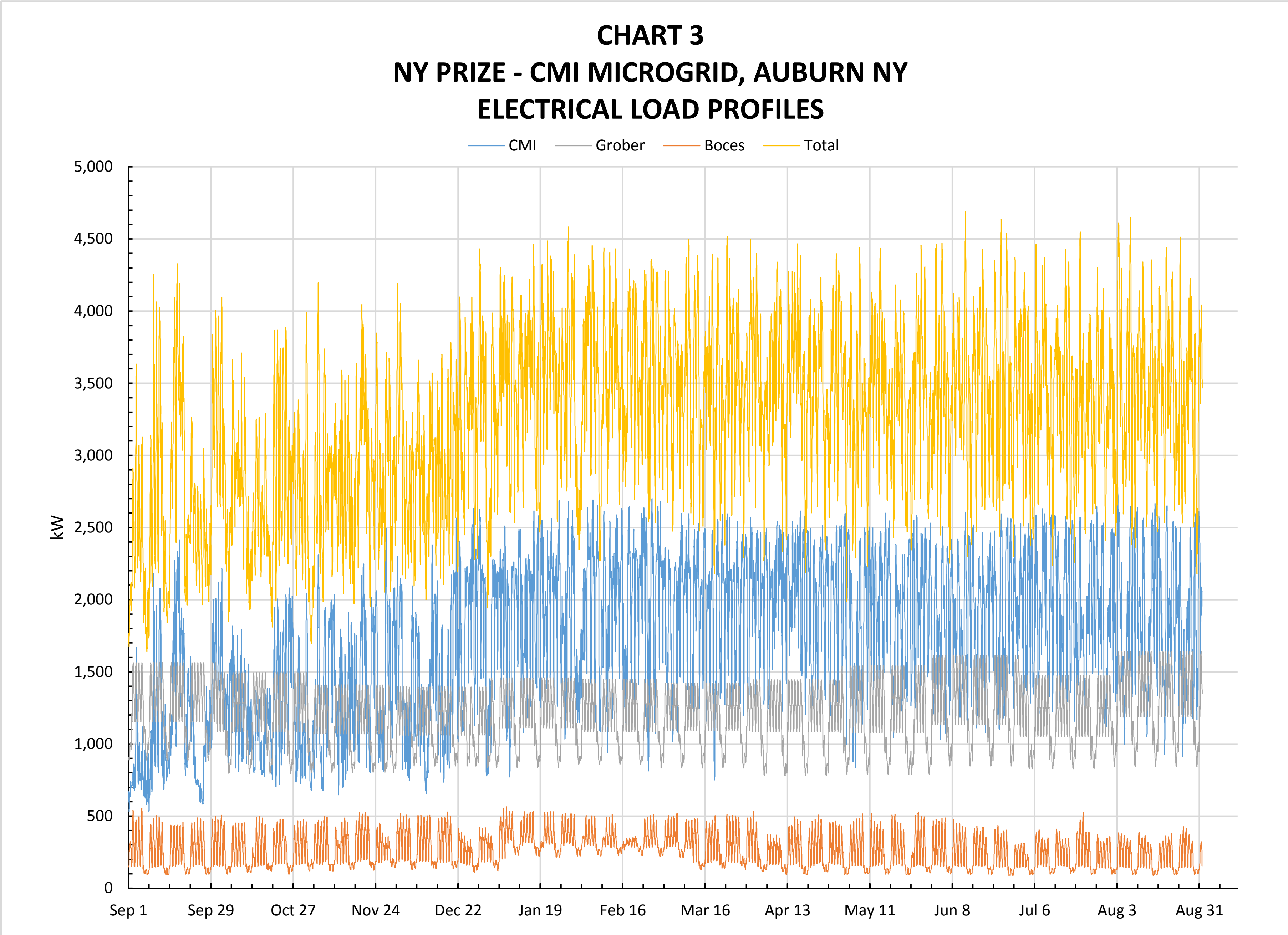


CHART 3
NY PRIZE - CMI MICROGRID, AUBURN NY
ELECTRICAL LOAD PROFILES
CMI
Grober
Boces
Total
kW
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Sep 1
Sep 29
Oct 27
Nov 24
Dec 22
Jan 19
Feb 16
Mar 16
Apr 13
May 11
Jun 8
Jul 6
Aug 3
Aug 31

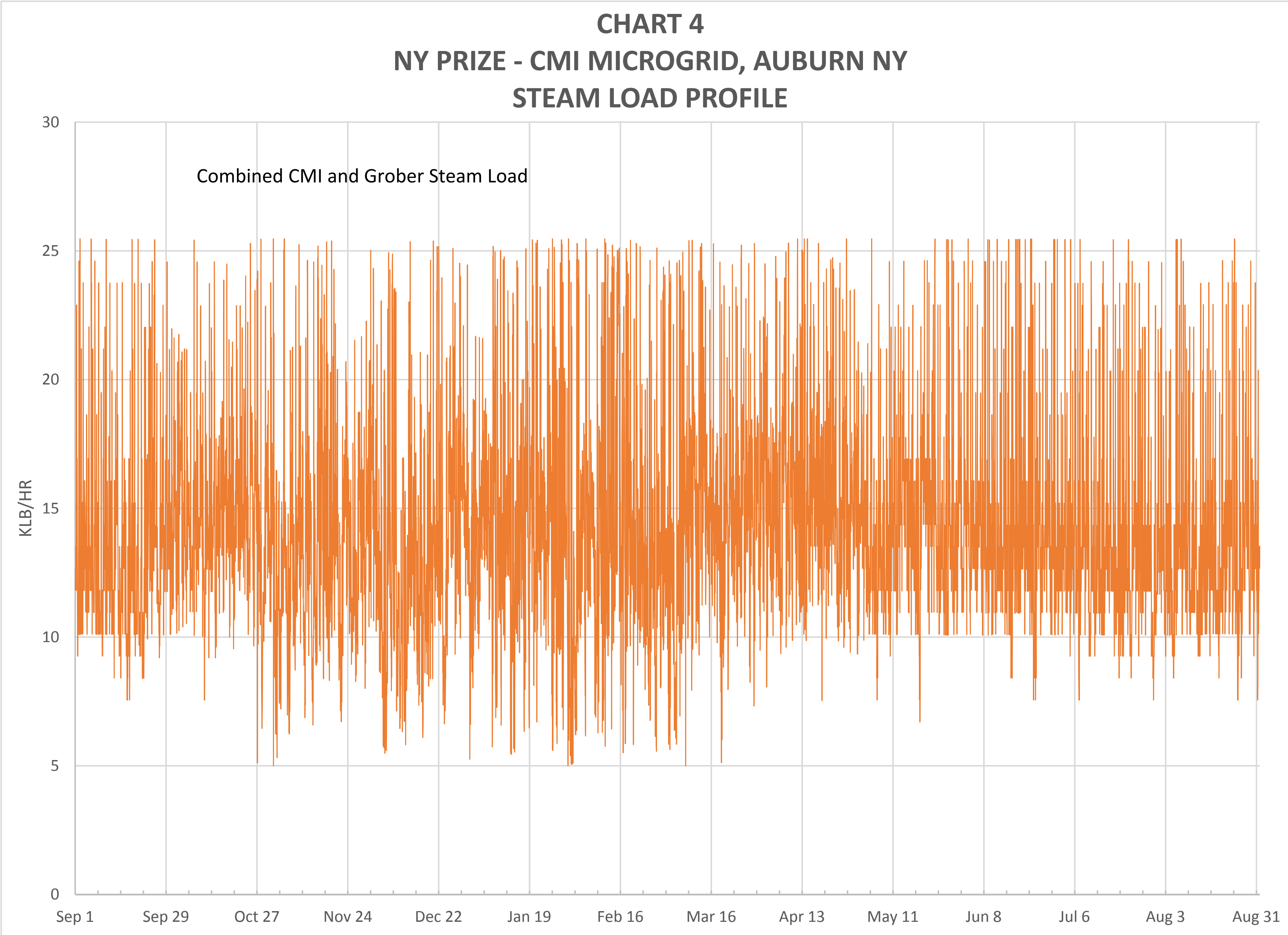


CHART 4
NY PRIZE - CMI MICROGRID, AUBURN NY
STEAM LOAD PROFILE
Combined CMI and Grober Steam Load
KLB/HR
0
5
10
15
20
25
30
Sep 1
Sep 29
Oct 27
Nov 24
Dec 22
Jan 19
Feb 16
Mar 16
Apr 13
May 11
Jun 8
Jul 6
Aug 3
Aug 31

COGEN

APPENDIX G

SAVINGS ANALYSIS BY CASE

COGEN POWERA1:K37 TECHNOLOGIES
NY PRIZE- CMI MICROGRID
MICROGRID CUSTOMER SAVINGS SUMMARY

Project: 30603
Date: Feb 17/16
Issue: 03

Inputs	1	2	3	4	5	6	7	8	9	10
Add Boces Load	yes	yes	yes	yes						
Add Arc Load	yes	yes	yes	yes						
Add Fire Dept	yes	yes	yes	yes						
Add Police and Service Stn Load	yes	yes	yes	yes						
Use CMI NG ESCO billing rates for Base Case	yes	yes	yes	yes						
Use CMI NG ESCO billings rates for Cogen Case	yes	yes	yes	no						
Gas Basis Reduction for Cogen Case	$0.50	$0.50	$0.50	$0.50						
Gas Basis Increase for Grober	$0.50	$0.50	$0.50	$0.50						
Electricity Sold at Retail Price	no	no	yes	no						
Gas Price Increase/Decrease	$0	$0	$0	$0						
Electricity Price increase/Decrease	$0	$0	$0	$0						
Microgrid Customer Elec Mark-up/Discount	no	yes	no	no						
Elec Markup/Discount Amount	$0.00	$10.00	$0.00	$0.00						
Microgrid Customer Steam Mark-up/Discount	yes	yes	yes	yes						
Steam Markup/Discount Amount	10%	10%	10%	10%						

Net Revenues/Savings	1	2	3	4	5	6	7	8	9	10
Third Party CHP Net Revenues	$91,925	$376,802	$175,550	$91,506						
Customer										
CMI	$196,402	$43,765	$227,098	$273,959						
Grober	$318,201	$213,081	$341,585	$361,297						
Boces Load	$83,289	$60,255	$89,365	$88,577						
Arc Load	$14,775	$12,751	$15,278	$15,290						
Fire Dept	$2,395	$2,086	$2,475	$2,469						
Police and Service Stn Load	$12,554	$10,802	$12,996	$12,951						
Total Customer	$627,616	$342,739	$688,797	$754,543						
Total Savings	$719,541	$719,541	$864,347	$846,049						
Vented Steam Potential Savings	$16,107	$16,107	$22,810	$14,589						

Difference in Cogen Savings	$0	$284,877	$83,625	-$419
Difference in Total Savings	$0	$0	$144,806	$126,508

COGEN

APPENDIX H

PACE CLIMATE AND ENERGY CENTER – NY PRIZE REPORT

Business Model Analysis

1 Cayuga Project Overview

The retention and expansion of manufacturing jobs is of utmost concern to New York State. Manufacturing jobs tend to be higher paying jobs providing employees and their families a higher living standard. Manufacturing jobs are known to have a “multiplier effect”, that is, for each job in the production of manufactured goods, there is a spin-off effect that has a positive impact on the creation of service sector jobs.

One of the unique and important attributes of the Cayuga project is that it is centered on a current and additional prospective manufacturing operation. Unlike many of the Stage 1 proposals in NY Prize, industry is at the heart of the Cayuga microgrid project in Auburn.

There are three anchor tenants: the Cayuga Milk Ingredients Plant, the soon to be built Grober Group manufacturing facility, and a BOCES educational center.[1] The Cayuga Milk Ingredients plant is a participant in NYPA’s Recharge NY Program whose stated aim is to: “provide a more effective incentive for businesses to create jobs and make long term capital investments in New York State.”[2] The lower energy cost and higher resiliency offered by the microgrid will greatly increase both businesses’ ability to grow and for BOCES to serve the community (both in its normal operations and as a storm shelter). As with the Recharge NY program, such advancement of industry and manufacturing is directly tied to NYS policy goals.

The location of the generating assets will be on land zoned for industrial development and there is a good deal of vacant square footage at the site and adjacent to it. This will allow the footprint of the microgrid to grow over time if the demand from the current customer base grows, or the customer base itself expands. Several big box retailers, the Johnston Paper Company, as well as the Finger Lakes Mall are all within a few hundred feet of the site.

1.1 Supporting the Expansion and Retention of Manufacturing Jobs

As note above. A key characteristic that sets this project apart is its focus on manufacturing sector customers. New York State is keenly interested in supporting the expansion and retention of manufacturing jobs, particularly in smaller communities where good paying manufacturing jobs can be the centerpiece of the local economy.

1.2 Financing Model

At Stage 1 of NY Prize, the project team has not done, nor was it expected that we would complete, a detailed description of the financing plan and the capital structure for this proposed project. However managing and optimizing the financial is a critical factor for the ultimate success of the project. Consequently the team has begun an early stage analysis of various financing models and the benefits that might accrue with each. We have identified some interesting and innovative alternative approaches that would be thoroughly developed in a Stage 2 analysis.

For example, one model that has come to our attention is the use of a non-profit, third party ownership financial model can add value to any project that benefits a non-profit organization (hospital, school district, etc.) or public tax exempt entity (town, city, county or state). The non-profit third party ownership model has the potential of offering a very attractive cost of capital. Third party ownership may be desirable for educational facilities, industry, and other entities

[1] http://www.cayboces.org/pages/Boces_Cayuga-Onondaga
[2] Report on Effectiveness of ReCharge New York Power Program To Governor and Legislative Leaders, December 2015 http://www.nypa.gov/RechargeNY/ReChargeNYEff_2016.pdf

that are concerned about adding additional debt to their own balance sheets. If they are able to find an off balance sheet solution, where the cost of capital remains competitive with the tax exempt rates that they are used to incurring, this might prove to be an interesting avenue of exploration.

As mentioned in the prior section, this microgrid would also be within the boundaries of a local municipal utility. This adds unique financing options in addition to its potential role in operations and/or as a customer of excess power.

1.3 Flexibility Offered By Potential Arrangements with Cayuga County Public Utility Services Agency ("CCPUSA")

Two local municipal organizations can provide advantages to the proposed project. The first is the Cayuga County Industrial Development Association (IDA) which can issues bonds to provide project financing. The second is the Cayuga County Public Utility Services Agency ("CCPUSA") which can aid the project in several ways:

- **Power Purchase** – CCPUSA could purchase the excess energy generated by the MG and sell it back to its customers and/or to the NYISO. The agency already has experience with creating tariffs and gaining PSC approval.
- **Operations** – CCPUSA has expressed an interest in operating the microgrid as a municipal utility
- **Construction** – CCPUSA can has all rights to act as a utility, specifically the ability to cross rights of way and own distribution lines to create a lower combined cost for construction
- **Lower Taxes** – Customers of CCPUSA do not pay sales tax on electricity which increases the value proposition to potential customers. CCPUSA could also purchase natural gas for the CHP Plant through a Public-Private Entity and develop an "Energy Service Agreement" with customers to avoid sales tax on natural gas

Additionally, there is also state incentive programs that may impact the Cayuga project.

NYPA – Recharge NY Program
This is an economic development power program designed to retain and create jobs through allocations of low-cost power. The Cayuga Milk Ingredients Plant is already a participant in this program and will not switch to the microgrid if this means a larger cost of energy (i.e., if they can no longer participate in the program). Our conversations with NYPA have indicated that participation in a microgrid was not envisioned when the program was designed. Whether migration to a microgrid would impact a customer's eligibility to continue to participate in the program, or renew their contract with it, has not been discussed within the Authority. Given NYPA's general support for microgrids as a whole we feel optimistic about their willingness to allow customers to continue to participate provided appropriate measurement and verification (M&V) measures are implemented. Such M&V would be an integral part of the microgrid's design and administration even if Recharge NY were not a factor. As such, they do not represent any additional cost burden.

1.4 Testing REV Concepts in an Industrial and Less Urban Setting

The Cayuga project is distinct in many ways from the preponderance of NY Prize 1 winners. Its location is in a much less urban setting than many projects. Its anchor tenants include industrial customers. There are opportunities to explore new arrangements with a pre-existing municipal utility. Should this project be fortunate to NY Prize Stage 2, the team suggests building into the design, to the extent feasible and cost justified, an analysis of the value of "D", that is an empirical analysis of the "value of distributed energy resources", that may provide lessons learned, generalizable to the larger REV process. The following quotes from various Commission orders, demonstrates that establishing a sound rationale and empirical basis for LMP+'D' is integral to the entire REV process.

The value that this project provides its local community is quite distinct from that of a microgrid in dense urban or suburban settings. Apart from lessons that might be learned and transferred regarding the value of a microgrid

For serving industrial customers

Providing input cost (energy price) stability to attract and retain businesses

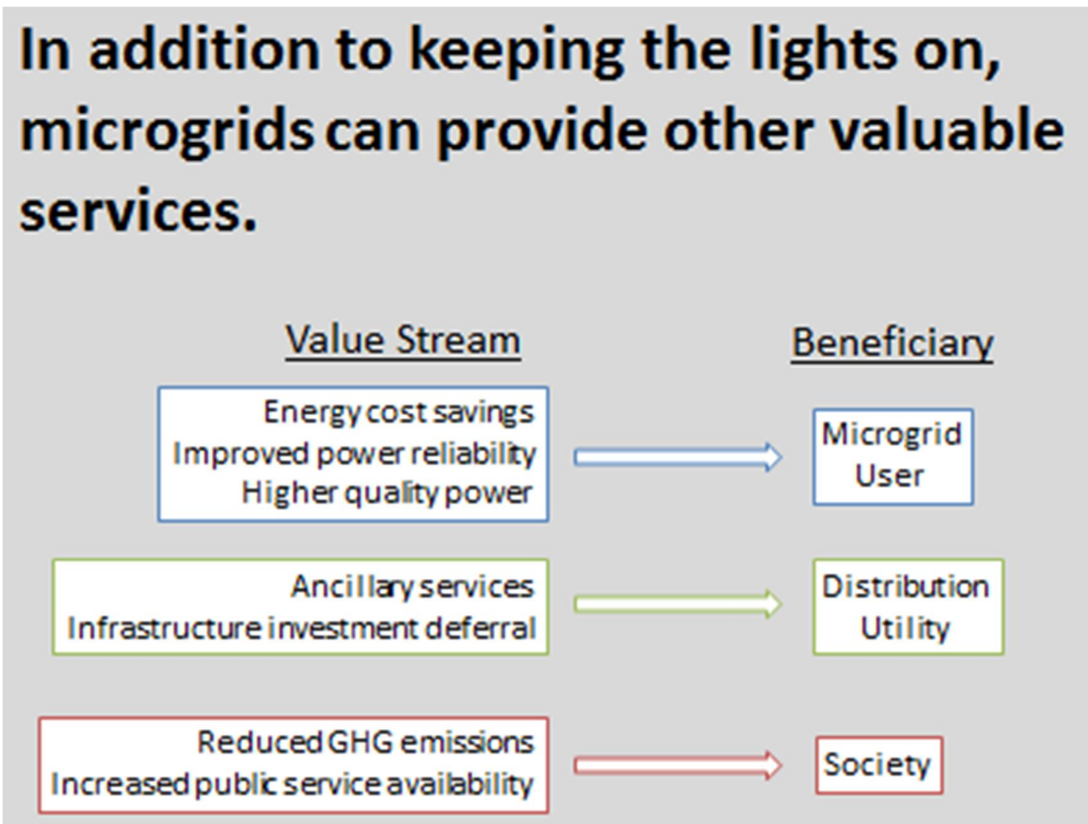
To explore mutually advantageous coordination with a municipal utility

These distinctly different project attributes may help fill experience and knowledge gaps that New York State has when trying to arrive at a comprehensive view of the benefits of microgrids, across ALL geographic and sectoral settings.

2 Microgrids – Overall Value Proposition

2.1 Beneficiaries

Three main groups benefit from the presence of microgrids: owner/users, the utility transmission and distribution grid, and societal at large.

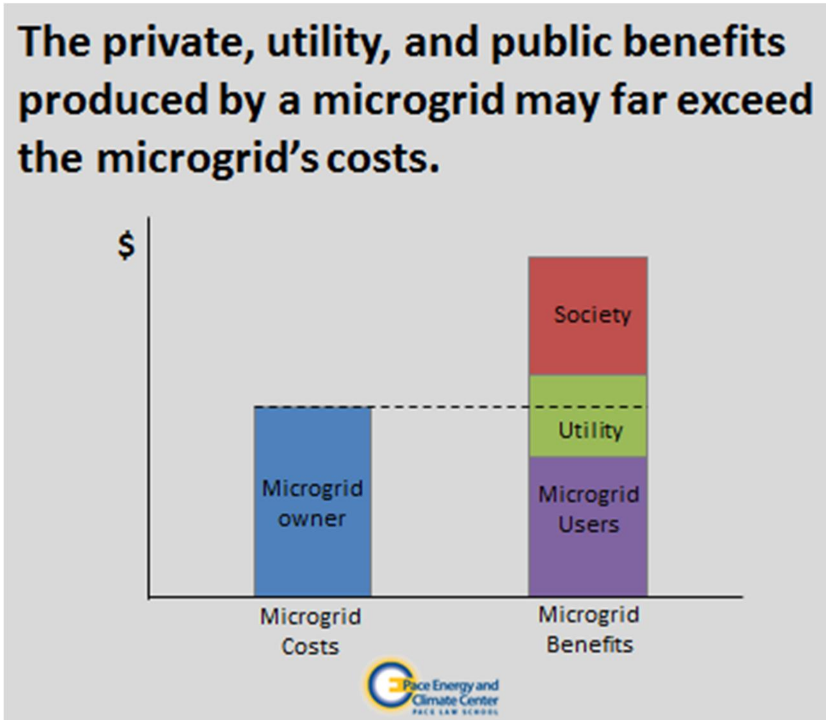


2.2 Total Benefits are Greater than Costs

NY Prize is an innovative, first-in-nation program that will speed the development of successful markets for multi-party microgrids. At this early stage of market development, New York is willing to invest some public funds in order to stimulate the market for projects with significant and demonstrable social benefits.

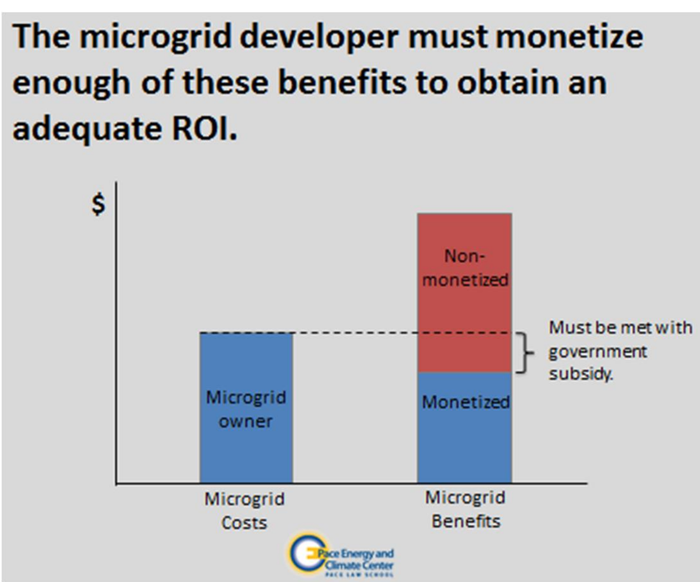
The ultimate objective is to create an environment where no public subsidies are required. Once REV markets are in place we can expect that high efficiency, environmentally superior, resilient microgrids will attract sufficient private sector investment capital, where they are economically viable.

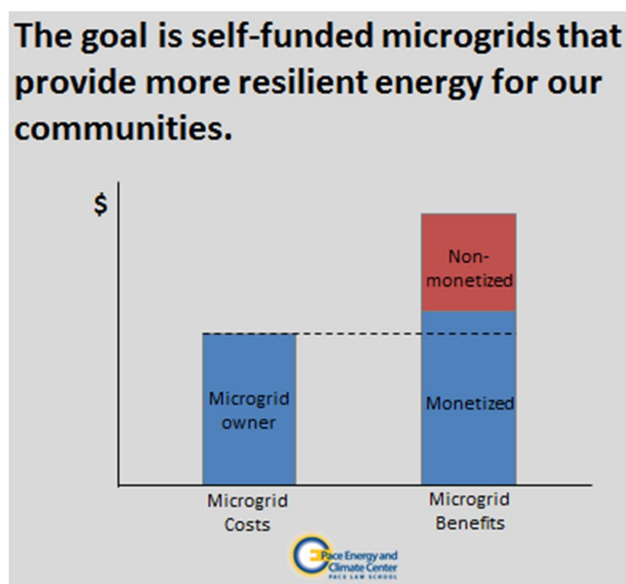
The sum of total benefits (to the end-user, the utility and society) are greater than the total costs. However, due to the fact that end-users aren't compensated for the utility benefits and societal benefits that they create, meritorious projects will not materialize. The owner will not invest unless the benefits that they receive outweigh the costs that they incur. At the current time, some form of government support is likely to be necessary, in order to stimulate such an investment.



2.3 New Markets Are Needed

The objective should be creation of new markets for microgrid owners to capture a greater share the presently non-monetized benefits that they create. Self-funded microgrid development will arise over time by making progress on two





fronts. A self-sustaining industry will come about in part as a result of a reduction over time in microgrid costs.

3 Capital Reserves

As with any business, the microgrid will need to maintain an appropriate level of working capital to ensure adequate liquidity. As an example, with the inherent volatility in energy markets the microgrid will need to keep sufficient capital reserves on hand to cope with spikes in the price of natural gas or electricity due to the delay between the utility billing periods and those of the microgrid's customers.

The economic viability of the microgrid necessitates a strategy for continuity of operations of their customers. If the microgrid is offline the customers can't be without electricity or heat. Backup electric and thermal energy costs can be costly and will erode the value proposition for the customer and the economic return to the project. The microgrid must have in place arrangements for continuity of service. Sufficient cash reserves, or lines of credit, allow quick response to emergencies and other service interruptions: malfunctioning equipment, damaged distribution systems, etc. Such situations may be covered in part by insurance policies. Payments from such policies can have long delays; sometimes measured in months. Continuity planning and adequate capital reserves will be needed to bridge such a gap.

4 Metering

All electrical customers within the microgrid will have advanced metering hardware capable of measuring data at least as frequently as the utility (e.g., 15 minute data points). Meters will also measure a number of electricity variables beyond consumption: demand, voltage level, voltage frequency, and reactive power. If measurements are taken more frequently than the utility they will be at round multiple thereof. The microgrid might sample more frequently, particularly if this would facilitate the microgrid's participation in new ISO or distribution level markets that we anticipate are going to be developed as a consequence of the NY PSC REV proceeding.

Distributed Energy Resources (DER) such as auto-DR loads and combined head and power equipment will be metered at least as frequently as the end users (see above). Technical control and administration protocols will likely necessitate real time, or near to real time, monitoring. Participation in future ISO (wholesale) or utility (distribution / retail) markets for services, will require sophisticated and fast response communications, controls, and metering.

5 Billing and Customer Risks

The generation resources will be designed to meet specifically modeled consumption patterns (after accounting for energy efficiency). Absent long-term procurement arrangements, customers may decide to scale back or opt-out of their anticipated consumption shares. Such an occurrence would negatively impact the microgrid's ability to service debt and would reduce returns to equity partners. Financing is a major component of capital cost. The risk of customer defection and revenue erosion must be addressed otherwise it will increase the cost of debt and equity and could severely impact economic viability. There should be a mechanism in place for the microgrid to ensure long-term commitments that reasonably under-gird multi-year revenue projections from the sale of electricity and thermal energy to customers. This obligation needs to be secure several years into the future in order to support repayment of debt and to insure reasonable expectations for return on equity.

The microgrid should secure a contractual minimum billing level from their customers to insure adequate revenue. Additionally, there should be exit fees associated with early withdrawal from the microgrid supply agreement (decreasing over time) perhaps backed through an encumbrance on the real estate or with an agreement from the local municipality to guarantee payment in the event of default.

Ideally, such obligations should be structured to have some degree of transferability. For example, a current customer might wish to scale back their usage. At the same time a current customer (or new one) may be adding capacity and have an increasing energy need. Customers should be allowed to engage in "energy services trading" amongst themselves provided it doesn't mean a reduction in minimum billing thresholds or other negative impact on the microgrids required cash-flow. This type of structure will bring greater liquidity to the contractual obligations that will simultaneously make the long term procurement decisions more palatable to microgrid participants and less risky for debt and equity providers.

Note that the above considerations apply to both the electrical and thermal outputs of the system. Both types of energy should have specific quotas or thresholds set lest the demand of thermal and electrical power output from the CHP resources become mismatched.

6 Thermal Energy

6.1 Combined Heat and Power – Unit Sizing

The microgrid will generate thermal energy from local combined heat and power (CHP) equipment. This thermal energy will be sold to customers to address their thermal loads (space heating, hot water, and/or cooling). Certain customers may opt to contract with the microgrid to provide some or all of their thermal need(s) thereby allowing them to remove or substantially downsize their own local boiler plants, water heaters, and/or air conditioning systems.

Thermal energy generation benefits greatly from economies of scale. By aggregating customer loads together a lower marginal cost per unit can be achieved which provides good earnings potential for the microgrid. Additionally, if customers are able to completely outsource this portion of their operations then their costs are reduced through lower staffing requirements, maintenance expenses, and freed up floor space. Such benefits can be priced into the charges for thermal energy that the microgrid levees on customers, further increasing profitability.

There are several points of risk that the microgrid business plan must thoroughly take account of. First, if decommissioning their own equipment, thermal customers will expect that the microgrid will be able to provide their full peak demand: they expect that their building should be well heated on very cold winter days, and cooled to their desired level of comfort on hot summer days. Failing to do this will not only represent a loss of revenue and reputation for the microgrid but may also subject it to legal liability or fines. This may require the system to be designed with higher than anticipated capacity or redundancy to ensure a safety margin. That increased capacity could mean a higher initial capital expenditure and/or a minor degradation in system efficiency which could erode profitability.

The business plan for the microgrid should thoroughly investigate the building envelopes and heating systems of their customers ahead of time. The microgrid should avoid a situation where they design their thermal system assuming a load based on an old building that is poorly sealed. If that building is later weatherized, or has its distribution system updated, this could result in a much lower thermal requirement from the microgrid. That reduced demand would decrease thermal energy revenues from that customer as well as decrease the efficiency of the system overall because it now runs at a lower overall utilization level. The latter issue can be somewhat guarded against through the use of more prime movers; 6-7 smaller capacity units rather than 3-4 larger ones with the same total output, for example. This would allow units to be cycled on and off with greater efficiency and would help ensure that, when they *are* running, they do so at nearer to 100%.

A minimum threshold of *electricity* consumption is something customers will likely feel comfortable committing to, especially if cooling loads don't figure highly into that minimum threshold. Lighting, equipment, machinery, etc. are used year round. So this is a viable option for that revenue stream. However, this may not be viable for customers for heating charges. Rightly or wrongly they may perceive this as a potential penalty for them in the event of a warm winter; something out of their control. Likewise if the microgrid is providing cooling services. Inspection of buildings to model thermal needs and right-sizing the system is the recommended course of risk mitigation, rather than minimum charges, for thermal revenue.

6.2 Natural Gas Procurement

The microgrid will purchase natural gas for use in CHP systems. New York's Distributed Generation Gas Service Classifications provide for a significant discount for qualifying systems where natural gas is purchased for use in CHP systems. This will allow for input cost savings improving the economic viability of the microgrid.

As fuel costs are the primary factor in the cost structure of the microgrid there may be value to hedging input fuel cost risks. This risk can be somewhat mitigated by long term supply contracts but the longest of these are typically four (4) years. Longer contracts typically charge a much higher premium, to account for the greater uncertainty, and this premium often costs more than the downside risk customers are looking to hedge against. Therefore, on a 15+ year time horizon this risk factor will still be present for the microgrid.

As noted above, New York State's DG gas service classifications do provide preferential natural gas rates which are lower for gas utilized in CHP installations. The microgrid may be able to offer those customers purchasing thermal energy an attractive value proposition while maintaining sufficient margins on electricity and useful thermal energy sales.

One additional factor is that the cost of natural gas in New York State is largely influenced by the price of natural gas. As prices for gas increase, so do those for electricity. So while fuel costs for the CHP system may increase, this is directly correlated to an increase in the cost of the electricity that would otherwise have to be purchased from the utility by the microgrid's customers.

7 Electricity – Microgrid Owned Distribution

This section assumed that most or all microgrid customers will be connected into a common electricity distribution system that is owned and operated by the microgrid. In this instance, individual customers will be aggregated and will appear to the utility as "one large load" at the point of common coupling.

7.1 Electricity Generation

Output from the CHP system will provide a large portion of the microgrid's income. The greater the portion of customer loads accounted for by the microgrid, assuming economically attractive aggregated thermal / electric load profiles, the greater the revenue generation for the microgrid. Realizing economies of scale and high levels of asset utilization by connecting and aggregating loads, is key to maximizing this revenue source. Running at/near full load levels the CHP equipment (with heat recovery), for as many hours per year as possible, increases efficiency and enhances profit margins. The microgrid business model assumes that local generation at one site can be consumed by other customers either through direct connection or, in the case of connection via utility infrastructure, at the "retail rate."[3]

7.2 Demand Charges

Combining all customers into a single aggregated load will, by definition, reduce the level of demand seen at the point of common coupling (PCC). Separate connections result in an *additive* calculation method where each customer's monthly peak is summed together regardless of the day or time it occurred. Aggregation results in a *coincidental* peak demand calculation which, by definition, cannot be higher than the additive method. Since it's highly unlikely that all customers on the microgrid will incur their peak demand at the same time and on the same day, this will result in savings on grid purchased electricity. Energy efficiency investments and on site generation from CHP will further reduce aggregate demand and associated charges.

This reduction in demand charges from supplemental electricity purchases made from the macrogrid will mean a lower cost for electricity purchases from the grid on a per kilowatt hour basis. Consequently customers will save relative to the T&D charges that they would otherwise incur had they remained full service customers purchasing electricity from a competitive supplier and paying T&D charges to the utility.

7.3 Electricity Procurement

For supplemental power demands, over and above that provided by the onsite generation, the microgrid will be able to competitively procure grid purchased electricity for the aggregate load of its customers. This allows for lower per-unit costs from third party suppliers. There should be a net savings between what individual customers would have paid, absent the microgrid, and the group procurement arrangement that the microgrid can negotiate. This margin can be

[3] Akin to virtual net metering, or passing benefits to customers via an "offset tariff" type of arrangement

shared with some part accruing to a more attractive price to connected microgrid customers and the remaining share going to profitability of the microgrid.

7.4 Time Variant Pricing

Time Variant Pricing (TVP), also known as hourly pricing and time of day pricing, adds additional complexity to the measurement and verification (M&V) procedures, increases customer billing complexity, and offers an additional source of potential revenue for the microgrid. The microgrid would be treated as a single large customer behind the common point of coupling. The microgrid should reserve space for battery storage to be added to the network.

The time difference in electricity prices for grid purchased electricity offers an arbitrage opportunity: charge the batteries up during less expensive time periods (e.g., at night) and discharge them in the grid during peak demand periods (e.g., 2-6 PM). The microgrid may choose to wait until after the system is up and running in order to get a more accurate measurement of specific usage profiles. However, a basis benefit-cost analysis for battery storage should be conducted as part of the phase 2 design.

The NYS REV proceeding is likely to advance the use of time variant pricing throughout the State. Having connectivity and physical space available for batter storage will allow the microgrid to more easily take advantage of new pricing schemes for electricity.

7.5 Customer Billing Procedure

The business model calls for microgrid customers to be billed for electricity from the microgrid at a fixed rate (with yearly escalation factors) while grid purchased electricity will be passed through at retail cost. Customer billing procedures, while not a source of financial risk, are a potential source of reputational risk.

The method by which local power is allocated to customers should be transparent and specifically spelled out in their contract. The cost of microgrid generated power will differ from the retail cost and on average it must be cheaper otherwise the value proposition of providing power at or less than current cost (with resiliency as a bonus) cannot be fulfilled.

At a minimum, retail prices for electricity will vary from month to month. If the microgrid is subject to time variant pricing this will increase the complexity of these calculations. In the latter case, prices vary from day to day and from hour to hour within the day and so microgrid generated power and supplemental power charges will need to take account of this.

The allocation method should take into account several key considerations including:

- When 100% of local microgrid electricity is being consumed, how is the output allocated among the customers? (Proportionally by average monthly load, by peak demand, by proportion on contracted minimum billing, or some other method?)
- How will demand charges (from the grid) be allocated among customers? Or will they be billed based on kWh only? If the former, how will the microgrid communicate the timeframe of the monthly peak demand to customers? In any case, will there be an incentive for customers to shift this demand? If subject to minimum demand billing in shoulder months, how are such charges allocated?

Customers will need key parameters included on their bills so that they can understand the variables that lead to specific costs.

7.6 Resiliency Configuration

The microgrid will not be able to supply peak demand to all customers when in island mode. Therefore the amount of electrical capacity allocated to customers during grid outages of extended duration should be clearly delineated in their contracts. The microgrid must ensure that customer's systems are configured to manage their load and make sure their thresholds are not exceeded. This may involve rewiring buildings and/or reconfiguring existing control systems. Likewise, their ability to join the microgrid must be contingent on installation and successful commissioning of this enabling equipment. It must be determined ahead of time whether the costs of these retrofits are to be embedded in the levelized cost of energy (LCOE) and borne by customers or paid for by them upfront.

As noted prior, the total cost of energy, including the embedded capital and operating cost of energy will be priced at a price per unit energy that gives connected customers a bill for electricity and purchased fuels that is less than or equal to their "business as usual" costs. The expected savings from an agreed upon baseline, as well as the amount of electric (and thermal where applicable) energy services that would be provided during islanded operations, must be clearly communicated and defined in their contracts.

The microgrid may wish to provide "additional" resiliency as a service. Suppose for example, it's determined that the services provided during an outage of extended duration would be X% of the total site demand and would encompass a specified list of life safety and critical infrastructure functions. It may be the case that a particular site would want additional capacity and more building services available. The microgrid may seek to negotiate a cost of "additional resiliency" and provide the financing of this into the microgrid contract. Furthermore, any additional operating expense that would be incurred by the microgrid to provide a "premium" resiliency service, on the demand of one site, would be an additional cost charged to that site. This would be especially valuable if the costs of capital for the microgrid is lower than the customer's and if the incremental operations cost of resiliency are such that customers seeking "premium resiliency" are willing to pay the marginal cost for capturing this incremental benefit. Both of these options that comprise a "premium resiliency package," and include incremental retrofit, capital financing and marginal operations costs are potential sources of additional revenue.

7.7 Demand Response

Some utilities offer their customers the option of participating in demand response programs. This typically involves the customer curtailing demand at a pre-set period after they've been notified of the time window in advance. The microgrid may be able to participate in this program through several possible methods:

- Microgrid dynamically curtails loads customer load (if they've opted in) scaling back HVAC systems and turning off ancillary equipment such as extra elevators
- Increases local generation to reduce the microgrid's draw from the utility
- Discharges batteries charged at off peak times

Programs typically give compensation for participation in the summer/winter season (paid out regardless of the number of DR events, even if that is zero). Additional payments are made for energy provided in each DR event. Penalties are levied if customers fail to curtail load when dispatched. Enrollment in this program is another source of revenue for the microgrid; possibly with some cost share to specific customers that curtail load (by turning down the intensity of air conditioning, for example).

7.8 Net Metering and Electricity Export

Inherent in the very structure of a microgrid, is the ability to "internally net meter" between various local distributed energy resources and across microgrid connected buildings. This cost offset, from building to building and from customer to customer, is a major factor in the overall value proposition.

The business plan does not identify the export of electricity to the grid as a source of revenue for the microgrid. However, the success of the business plan rests upon the ability of securing an agreement to sell electricity to the hospital at a rate sufficient to recover variable and fixed charges. In the normal course of business Samaritan hospital will receive ______ of its electricity requirements from generation sited at the RPI campus. The agreement should fairly compensate National Grid for the use of its distribution system.

8 NY ISO Incentives

There are a variety of revenue streams; existing, proposed and anticipated that may be available to support the economic viability of the microgrid projects. The projects proposed here are not likely to be able to take advantage of the existing NYISO programs. However, at this writing, the NY ISO has authorized a new Behind the Meter: Net Generation program (BTM:NG) This program is expected to be launched for the Winter period of 2016. It will not be available during the summer capability period until the 2017 Summer Capability period, which runs from June 1, 2017 – September 30, 2017.

NY ISO – Day-Ahead Demand Response Program (DADRP)
Program where participants bid into the Day-Ahead Market for load curtailment at a specific rate (i.e., $X/MWh). Accepted offers are notified by 11:00 a.m. of scheduled commitment for the next day (midnight-midnight) and a response is mandatory when selected (penalties are levied if participants fail to provide scheduled load reduction in real time). Note that the rules to permit behind-the-meter generation to participate are currently under review by FERC (Docket # EL13-74-000). Participants must provide an aggregate reduction of at least 1 MW. Offer floor price of $75/MWh.

NY ISO – Emergency Demand Response Program (EDRP)
Voluntary program, similar to DADRP but the ISO offers a specific price (locational based marginal price – LBMP) for electricity. Customers perform load reduction through interruptible loads or loads with a qualified behind-the-meter local generator. Minimum reduction is 100kW. Payment is based on measured energy reduction during an event, with a minimum rate of $500/MWh or the actual LBMP, if higher.

NY ISO – Installed Capacity (ICAP) Special Case Resources (SCR)
Similar to the EDRP except that customers offer into installed capacity (ICAP) auctions or may sell capacity in bilateral contracts. Customers perform load reduction through interruptible loads or loads with a qualified behind-the-meter local generator. Minimum reduction is 100kW. Note that for CHP this will generally require an "N+1" configuration of prime movers with the "extra" unit being brought online for participation in this program There is a mandatory response during reliability events for a minimum of four hours. Payments are based on sales made through ICAP auctions or bilateral contracts and additional payments are made based on performance in events & tests (LBMP with daily guarantee of strike price recovery).

NY ISO – Behind the Meter: Net Generation (BTM:NG)
This program[4] will allow participation in the wholesale market for customers that that have on-site generation capability that routinely serves a Host Load (e.g., on site user) and has excess generation capability after serving that Host Load. Resources will be allowed to participate in the energy, capacity, and ancillary services markets.

Generation resources for this program must:

- Be designed and operated to facilitate the business function of the on-site load by providing electricity in the regular course of business
- Meet NYSDEC requirements to operate under non-emergency conditions
- Have an effective interconnection agreement
- Meet minimum net generation requirements (see program details for exact formula)
- Have appropriate metering configurations
- Be responsive to dispatch instructions as a single entity interfacing with the grid

[4] This program is still in the design phase within the NYISO shared governance process. Currently the timeline for the incorporation of this program into NYISO tariffs is Q4 2016. For more info: http://www.nyiso.com/public/webdocs/markets_operations/committees/bic/meeting_materials/2015-12-09/agenda 8 BTMNG BIC Presentation.pdf

9 Incentives

New York offers numerous incentives that reduce the initial capital cost for qualifying distributed energy resource investments. Oftentimes the higher initial capital costs are a deterrent to cost effective investments in efficiency, CHP, and renewable energy resources. Distributed energy resources may require higher upfront capital outlays, with recurring savings over time that more than offset this higher initial costs.

NYSERDA CHP Programs

NYSERDA will provide financial incentives of up to $2.5M for CHP systems. These programs are currently being modified due to updates from the recently passed Clean Energy Fund (CEF). Prior programs include PONs 2568 & 2701. There is an incentives and services budget of $22 Million, set aside for CHP in calendar year 2016.

Targeted Utility/DSP DG Incentives

Strategically sited, appropriately configured and operated microgrids can allow the utility to defer or avoid significant distribution system capital expenditures. An example of one such program, now in existence is Con Edison's Case 14-E-0302 – Order Establishing Brooklyn/Queens Demand Management Program, issued and effective December 12, 2014. The BQDM program, currently in process with ConEd, offers a glimpse into how REV may drive incentives for CHP and DER.

Announced on December 8, 2015, qualifying CHP projects were being offered an incentive of $1,800/Kw. Projects will have to meet Con Ed and NYSERDA terms of performance and be operational by June 1, 2017, the start of the 2017 Summer Capability period.

Modified Accelerated Cost Recovery System (MACRS)

The microgrid will investigate which of the assets comprising the system can take advantage of this portion of the tax code,[5] a system by which entities can modify the way in which tangible assets are depreciated, to decrease their tax liability. For example, CHP systems qualify for the tax benefits accorded by the five year Modified Accelerated Cost Recovery System (MACRS). Accelerated depreciation generates savings to taxpayers by permitting them to take large percentages of their depreciation expense in qualifying physical capital in the early years of the investment. MACRS is only available to tax paying entities. Therefore, the choice of ownership model, for profit or not for profit, will determine the relevance of MACRS

Business Energy Investment Tax Credit (ITC)

Federal corporate tax credit: 10% for micro turbines and CHP. If not renewed through legislative action, the ITC will expire in 2016 http://programs.dsireusa.org/system/program/detail/658

- Maximum Incentive – Micro turbines: $200 per kW, all other eligible technologies: no limit
- Eligible System Size – Micro turbines: 2 MW or less, CHP: 50 MW or less[6]

As noted above, Investment Tax Credits, production tax credits and preferential depreciation treatment are mechanisms that are only available to for profit entities. If the legal form of ownership that is chosen for the Troy: RPI / Samaritan project involves 3rd party ownership by a taxpaying entity, then these incentives will come into play. However, if the legal form of ownership is a non-profit or government entity, then these ownership forms are not eligible for the tax credits reported above.

Tax Exempt Financing

[5] https://www.irs.gov/publications/p946/ch04.html

[6] Combined heat and power systems can only receive the full credit if the system has an electrical capacity of 15 MW or less, and a mechanical energy capacity of 20,000 HP or less, or an equivalent combination of electrical and mechanical energy capacities. Larger combined heat and power systems (up to a maximum of 50 MW and 67,000 HP) can qualify for a reduced tax credit equal to the ratio between the actual system capacity and 15 MW. For example, a 45 MW system can qualify for a tax credit worth 15/45 of the otherwise allowable credit.

The microgrid will investigate ownership structures, through local government participation, that would allow for the issuance of tax exempt bonds or other tax-advantaged and low-cost financing. This would allow for lower interest rates and longer tenors. Hospitals, universities, nursing homes, and assisted living facilities are often economically attractive candidates for microgrid operations as well as high priorities for the provision of resiliency services. These institutions may benefit from low interest debt financing available from sources such as the Dormitory Authority of the State of New York (DASNY).

State authorities will typically have the capability to issue debt across the state, whereas local issuers of tax-exempt bonds, such as a city, a town or a county, can only finance activities within that governmental unit's geographic boundaries. If the microgrid crosses a town's boundary this may restrict certain options. The eligible borrowers for tax-exempt bonds are defined in the federal tax code[7] as:

- Nonprofit healthcare
- Nonprofit higher education
- Nonprofit K-12 schools
- Other nonprofit institutions such as museums, YMCAs, and YWCAs
- Low-income multifamily housing
- Industry and manufacturing for defined types of exempt facilities

NYPA Financing
The cost of capital is an important factor in the economic viability of a microgrid. After fuel cost, financing costs are the second largest component of cost. As a consequence, the obvious opportunities for a project to bring down costs is to address fuel cost and financing charges.

The cost of capital at today's rates for projects of similar scale and of a similar credit rating would likely be significantly greater, absent the strategic advantage of NYPA financing. This advantage makes the economics and the project rate of return more favorable than would otherwise be the case.

10 Reforming the Energy Vision (REV)

Reforming the Energy Vision (REV) is New York's comprehensive strategy to align state regulatory policies, clean energy programs and the development of new and expanded retail and wholesale markets to transform the production, consumption and delivery of energy in the State. The New York Department of Public Service declared that "REV is a strategy to build a clean, resilient and affordable energy system for all New Yorkers. REV proposes to achieve several goals that support the mission of a clean, resilient energy system."

In the REV Track 1 Order[8] the Commission specified its policy on microgrids under REV, which is focused around five "attributes":

1. Ability to optimize system efficiency within the microgrid and advance REV objectives such as integration of clean distributed generation and addressing grid constraint
2. Interconnection with the larger utility system, assuming a DSP market that allows mutual benefits and services to be monetized
3. Resilience and the ability to island in the event of system outage, particularly where critical customer facilities are involved
4. The obligation to provide reliable power at just and reasonable rates within the microgrid
5. Consumer protections for residential customers as required by the Home Energy Fair Practices Act (HEFPA).[9]

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7 http://energy.gov/eere/tax-exempt-bond-financing-nonprofit-organizations-and-industries
8 *http://energy.pace.edu/sites/default/files/REV%20TRACK%201%20ORDER.pdf*, hereafter as "*Track 1 Order*"
9 *Id.*, at 112.

10.1 REV Track 1 Goals

As identified in the Track 1 Order for Reforming the Energy Vision (REV) there are six main goals. Each of these goals (listed in the below sections) will be achieved through the creation of a community microgrid that adheres to these attributes.

Enhanced customer knowledge and tools that will support effective management of their total energy bill

Most parties committing to joining a community microgrid will be private, government, or non-profit groups, who have analyzed the benefits and costs and decided that the former outweighs the latter, making them highly educated customers. The customers served will be better informed about their energy breakdown because of their participation in the microgrid, and the Special Purpose Entity (SPE) that oversees the microgrid will be managing energy production, distribution, and consumption, to ensure that everything is functioning efficiently.

Market animation and leverage of ratepayer contributions combined with system wide efficiency

(Note that this section addresses two of the six goals)

Under REV, utilities are urged to find innovative ways to put the ratepayers' dollars to work, specifically through contracting with outside sources of ancillary services. In the REV Staff Report and Proposal, the New York State Department of Public Service explains the value of microgrids, stating that they "support the overall utility grid, lightening the burden on congested infrastructure and avoiding investment in traditional system upgrades." By encouraging the implementation of ancillary services, like "frequency regulation, voltage support, and black start capability", the utilities will, as the REV Track 2 White Paper acknowledges, "optimize energy efficient and reliable electricity delivery," benefiting their own employees and business, as well as maximizing their use of revenue.

Another incidental ancillary service that a microgrid provides to the grid is a decrease in risk of total grid failure as a result of special circumstances, like a lapse in system security. As stated in the Track 1 Order, "[a] decentralized system… that is capable of segmentation and contains self-sufficient microgrids or similar configurations with appropriate firewalls, may be more resilient against the impacts of a wide scale cyber-attack." The utility also receives the benefit of having segments of the grid's design and infrastructure upgraded, e.g., with more resilient wiring and advanced methods of monitoring demand-response.

The establishment of a decentralized system featuring the use of community microgrids also improves system efficiency by lightening the load on utilities, especially during peak energy use hours. This is partially due to the use of energy storage, but also because of the addition of new energy sources, like PV arrays and CHP.

Fuel and resource diversity

The new sources of energy installed to power the microgrid improve the diversity of the energy market. While there is an initial installation cost to be accounted for, this can be offset by several incentives that these community microgrids can take advantage of.

System reliability and resiliency

Microgrids are especially important when it comes to system reliability and resiliency. Microgrids decentralize the electrical grid, and as stated in the Staff Report & Proposal, "during a utility grid outage, a microgrid can intentionally island itself to maintain critical loads." Subsisting only off of the power produced and stored in its community unit allows critical facilities within the microgrid to continue to have the capacity to serve the public in times of crisis or emergency, when the rest of the grid is down, without any danger of surges. Community microgrids that use underground wiring to create the islanded system are even more protected from outages due to storms or other weather events.

Reduction of carbon emissions

The energy mix consumed in these microgrid projects, partnered with the ancillary services provided, increase the efficiency of the energy consumed and decrease the amount of energy produced from fossil fuels, both of which lead to a reduction in carbon emissions.

If any more proof is needed of the success of a community microgrid partnering public and private stakeholders is needed, the multi-stakeholder microgrid in Utica, overseen by Burrstone Energy Center LLC, has been supporting the community since 2009. The group has even developed an algorithm that helps it make hourly decisions on how to most economically operate the plant, which could be applied in these projects if that is a concern that needs to be addressed.

10.2 Additional REV Initiatives

Several initiatives are underway that are expected to create new markets and revenue opportunities for microgrids and distributed energy resources generally.

New markets will take some time to develop. They are likely to take shape over a multi-year time frame. However there are some areas where DER's and microgrids can provide demonstrable support and value to the distribution utility.

Targeted Utility/DSP DG Incentives

Strategically sited, appropriately configure and operated microgrids can allow the utility to defer or avoid significant distribution system capital expenditures. An example of one such program, now in existence is Con Edison's Case 14-E-0302 – Order Establishing Brooklyn/Queens Demand Management Program, issued and effective December 12, 2014. The BQDM program, currently in process with ConEd, offers a glimpse into how REV may drive incentives for CHP. ConEd is working to reduce peak load demand on their Brownsville substation through energy efficiency and DER initiatives. One current incentive being offered is up to $1,800/kW for CHP installations. This is in addition to any incentives the customer may receive from NYSERDA or other sources. The incentives received cannot be >100% of the installed cost. A qualifying project must be operational by the start of the 2017 Summer Capability Period (June 1, 2017).

Distribution utilities are being encouraged to submit "non-wires" pilots. The incentive levels will vary from location to location as the value of avoided marginal distribution capacity costs are highly variable across the State.

The value of Microgrids, operating in the right locations and at the right time of day and season of the year is now being realized in New York State.

Operational Services

Microgrids, and the suite of DER resources that comprise them, can serve as dynamic assets supporting the grid. REV envisions new markets, at the distribution system level and in concert with the NYISO, to mirror new wholesale markets for DER services. Some of the new services that might be offered by appropriately designed, configured and operated microgrids include:

- Frequency regulation
- Volt-ampere reactive (VARs) compensation
- Demand response services

There is precedent for distributed energy resources to capture revenue streams for the value that they create in wholesale markets. Princeton University reports that they first implemented FERC 755 Frequency Regulation in January 2013. They initially started by offering a 1 MW grid load change, accomplished by changing gas combustion turbine output (up / down). They report[10] that payments were averaging $200,000 per MW/year PLUS a performance multiplier of up to 3X ($600,000). In addition to utilization of the gas turbine for measured grid load changes, they expect also to be utilizing VFD's for this purpose.

Princeton is also providing Synchronous Reserves (FERC 755) in the PJM market. They entered the Synchronous Reserves market in October 2012. They report that potential savings are $30,000/MW-year[11]

[10] "New Market Opportunities for CHP: Next Steps in Market Participation at Princeton and MIT. Presented at the International District Energy Association's 26th Annual Campus Energy Conference. February 18-22, 2013

[11] Ibid.

Solar Grid Storage (SGS) business focus is in the PJM Independent System Operator service territory. They are operating 4 storage projects in the PJM fast frequency regulation market. Response to FERC SGS has a pilot project at the Philadelphia Navy Yard, a stand-alone battery system. They have 2 projects in New Jersey co-located with PV projects at a commercial customer's site. What they describe as their flagship project is a solar microgrid at the Konterra Headquarters in Laurel, Maryland. It's a 500kW project providing frequency regulation services to PJM and backup power from the customer's 400kW PV parking lot canopy.[12]

Though not publicly released yet, we expect to see one or more new microgrid projects, sited in the PJM footprint, which will be designed to capture revenues from PJM markets for ancillary services.

10.3 Recommendations to Facilitate Microgrid Market Development

There has long been a recognition that Microgrid development is hampered by the absence of formal statutory or regulatory recognition. Microgrids exist in New York but are addressed by PSC on a case-by-case basis. There is no clear set of rules to guide a microgrid developer, thus creating significant uncertainty and market risk.[13]

The State of Connecticut addressed this matter, for certain types of customers and for particular public purposes. CT Public Act 13-298, section 39 authorizes that "a municipality, state or federal governmental entity authorized to distribute electricity across a public highway or street pursuant to section 39 of this act."

> Sec. 39. (NEW) (Effective July 1, 2013) The Public Utilities Regulatory Authority shall authorize any municipality or state or federal governmental entity that owns, operates or leases any Class I renewable energy source, as defined in section 16-1 of the general statutes, as amended by this act, Class III source, as defined in section 16-1 of the general statutes, as amended by this act, or generation source under five megawatts, to independently distribute electricity generated from any such source across a public highway or street, provided (1) any such source is connected to a municipal microgrid, as defined in subdivision (5) of subsection (a) of section 16-243y of the general statutes, as amended by this act, and (2) to ensure the reliability and availability of the microgrid delivery system and the safety of the public, such municipality or state or federal governmental entity shall engage the applicable electric distribution company, as defined in section 16-1 of the general statutes, as amended by this act, to complete the interconnection of such microgrid to the electric grid in accordance with the authority's interconnection standards. For purposes of this section, any such municipality or governmental entity shall not be considered an electric company, as defined in section 16-1 of the general statutes, as amended by this act.[14]

10.4 Potential Future Revenue Streams

The PSC has laid out their initial vision for the revenue streams that will be enabled for DER under REV as part of their Benefit-Cost Analysis (BCA) Staff Whitepaper. The REV proceeding is still a work in process and so the exact mechanisms and revenue streams, and the incentive models for them, have not yet been solidified.

While the precise mechanisms are not fully developed the fact that the PSC anticipates that DERs, including microgrids with CHP, will be able to compensated for the measured value that they provide to utility operations and planning is not in doubt.

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[12] TESTIMONY OF Christopher Cook President, Solar Grid Storage BEFORE THE HOUSE SUBCOMMITTEE ON ENERGY AND POWER LEGISLATIVE HEARING ON DISCUSSION DRAFT ON ACCOUNTABILITY AND DEPARTMENT OF ENERGY PERSPECTIVES ON TITLE IV: ENERGY EFFICIENCY JUNE 4, 2015

[13] Case 13-E-0030, et al. Collaborative Working Group 2 Meeting, Summary of NYC DG Collaborative. Presentation By: Robert Loughney, Couch White LLP and Tom Bourgeois Pace Energy & Climate Center, October 3, 2013

[14] Public Act No. 13-298 AN ACT CONCERNING IMPLEMENTATION OF CONNECTICUT'S COMPREHENSIVE ENERGY STRATEGY AND VARIOUS REVISIONS TO THE ENERGY STATUTES. Page 72 or 110.

Below we have summarized numerous expected services that DERs may provide, as they were discussed in the Staff Benefit-Cost Analysis (BCA) Whitepaper. We also note that the Commission has ordered that the utilities file an Initial Distributed System Implementation Plan (DSIP) June 30, 2016 and a Supplemental Plan September 30, 2016[15]

The importance of the DSIP is that it is expected that it will provide to market participants information on utility system needs and to identify opportunities for DERs to offer services to assist distribution system operation and distribution system capital investment requirements. The DSIP will also identify the mechanisms to deliver information that will facilitate market participation. It will define specific market mechanisms that will effectively elicit and compensate DER that can satisfy operations needs and capital investment requirements that have always been self-procured by the distribution utility.

The BCA Whitepaper indicates the range of various potential activities that provide value to the system. Historically DERs may have provided some of these values, though they were never measured, monitored, taken account of in utility planning and operations, and as a consequence they went uncompensated. In the future we expect that appropriately designed, configured and operated Microgrids with CHP, those that are in the right locations and operating at the right time of day and season of year, will be paid for the value(s) that it is creating for the utility system.

The precise available revenue streams will become clearer as the DSIP model(s) are fleshed out. However, it is illustrative to examine the categories that have been identified in the paper (and summarized below). Material is from Staff Whitepaper on Benefit-Cost Analysis in the Reforming Energy Vision Proceeding 14-M-0101, July 1, 2015. [16]

A key point to note is that a CHP centric microgrid is poised to take advantage of many of these revenue streams; though it would be rare for a project to be able to leverage all of them. Also, it will mean tighter constraints on the design, configuration, and operations of the microgrid. The developer will do their own internal BCA to determine if the costs of these tighter constraints are exceeded by the benefits of the extra revenue that can be brought in.

Avoided Generation Capacity (ICAP) Costs, including Reserve Margin: ICAP costs are driven by system coincident peak demand. Thus, this component of benefits applies to the extent to which the resources under consideration reduce coincident peak demand.

Avoided Energy – Location Based Marginal Pricing (LBMP): This includes costs for a number of other factors: (1) compliance costs of various air pollutant emission regulations including the Regional Greenhouse Gas Initiative and now-defunct SO2 and NOX cap-and-trade markets; (2) transmission-level line loss costs; and (3) transmission capacity infrastructure costs built into the transmission congestion charge.

Avoided Transmission Capacity Infrastructure and O&M: A portion of the Avoided Transmission Capacity Infrastructure and related O&M costs are included in both the Avoided Generation Capacity (ICAP) and Avoided Energy (LBMP) benefit categories. Transmission capacity and O&M costs are reflected in the difference between zonal ICAP clearing prices. Generation assets located in high load and congestion areas, such as New York City, the lower Hudson Valley, and Long Island, clear the ICAP market at a higher price in reflection of the fact that load serving entities in those areas are required to purchase generation from local assets due to restrictions on the transmission system, which precludes the purchase and transport of generation from cheaper assets further away from the load. Transmission congestion charges, related to the availability of transmission infrastructure to carry energy from zone to zone, are included in the LBMP. Both the ICAP prices and transmission congestion charges would be decreased in the event that additional transmission assets are built or load is reduced.

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[15] Case 14-M-0101, Proceeding on Motion of the Commission in Regard to Reforming the Energy Vision, Order Adopting Regulatory Policy Framework and Implementation Plan, (issued February 26, 2015) (Track I Order).

[16] http://www3.dps.ny.gov/W/PSCWeb.nsf/96f0fec0b45a3c6485257688006a701a/c12c0a18f55877e785257e6f005d533e/$FILE/Staff_BCA_Whitepaper_Final.pdf

Avoided Transmission Losses: A portion of the Transmission Loss costs are included in the LBMP, and are therefore partially counted already through the Avoided Energy (LBMP) benefit category as part of the costs included in the LBMP. To the extent that there are avoided transmission losses above and beyond what is included in the LBMP, such losses should be considered separately herein.

Avoided Ancillary Services: Required ancillary services, including spinning reserve, frequency regulation, voltage support and VAR support would be reduced if generators could more closely follow load. Certain projects will enable the grid operator to require a lower level of ancillary services or to purchase ancillary services from sources other than conventional generators at a reduced cost without sacrificing reliability.

Avoided Distribution Capacity Infrastructure: A utility's decision of what infrastructure to invest in, and when to make that investment, is generally driven by two factors: first, its need to meet the peak demand placed on its system; and second, the amount of available excess capacity on its system. The importance of these factors can vary depending upon the voltage at which an incremental load is connected to the utility grid.

Avoided O&M Costs: Certain projects could result in lower operation and maintenance costs, due to, for example, lower equipment failure rates, while other measures may increase operation and maintenance expenses due to, for example, increased DER interconnections. These changes in O&M should be determined by using the utility's activity-based costing system or work management system.

Avoided Distribution Losses: The difference in the amount of electricity measured coming into a utility's system from the NYISO or distributed generators and the amount measured by the Company's revenue meters at customer locations is defined as the "Loss" or "Losses" experienced on the Utility's system. Losses can be categorized as technical and non-technical losses, where technical losses are the amount of energy lost on the utility's system as heat and the magnetic energy required to energize various pieces of equipment used by the utility, and non-technical losses represent energy that is delivered but not registered by utility revenue meters. For the purposes of these analyses, the PSC will focus on technical losses. Technical losses can be further categorized into fixed and variable losses, and attributed to various pieces of equipment. While both fixed and variable losses are significant, actions taken by customers and the utility will have a greater impact on variable losses since fixed losses can only be reduced marginally by replacing equipment with lower loss models or removing equipment from service. Variable losses should be considered when a project increases or decreases the load served on a utility's system. The impact of the increased or decreased load should be considered for all levels which will be affected. For example, a self-supplying microgrid connected at a utility's transmission voltage would reduce transmission line losses, but not distribution line losses.

Net Avoided Restoration Costs: Projects such as automated feeder switching or improved diagnosis and notification of equipment conditions could result in reduced restoration times. To calculate this avoided cost, utilities could compare the number of outages and the speed and costs of restoration before and after the project is implemented. Such tracking would need to include the cause of each outage. The change in the restoration costs could then be determined.

Net Avoided Outage Costs: Avoided outage costs could be determined by first determining how a project impacts the number and length of customer outages then multiplying that expected change by an estimated cost of an outage. The estimated cost of an outage will need to be determined by customer class and geographic region. We note that outage mitigation often factors into a utility's decisions to invest in T&D infrastructure, so some portion of outage costs are already included in the Avoided T&D Infrastructure category described above.

Externalities: in addition to pecuniary costs and benefits, utilities need to consider out-of-market public costs and benefits that DER impose or provide. Many of these (such as land, water, and neighborhood impacts) will depend on the specific alternatives considered and will likely need to be weighed in a qualitative and judgmental way. However, the quantitative impact of three damaging gas emissions— SO_2, NO_x, and CO_2—are measured and modeled at the bulk level and can be estimated at the DER level. Both externality "taxes" and C&T programs result in a price being placed on each ton of damaging gas emitted, so both approaches "internalize" some or all of the external damage costs. This is important to keep in mind when valuing the net, or un-monetized, portion of marginal damage costs caused by bulk power generation. If externality prices were set high enough to equal marginal damage costs per ton emitted, wholesale LBMPs would fully reflect the social value of emission-free generation with respect to the pollutants covered by the emission pricing program.

Net Non-Energy Benefits: Non-energy benefits include, but are not necessarily limited to, such things as health impacts, employee productivity, property values, reduction of the effects of termination of service and avoidance of uncollectible bills for utilities. While Staff recognizes the existence of these costs and/or benefits, we propose that such difficult-to-quantify costs and benefits not be monetized at this time. However, when utilities consider specific alternatives, they should recognize any of these impacts when relevant, and weigh their impacts, quantitatively, when possible, and qualitatively, when not. For example, if a DER proposal for low and moderate income customers results in a reduction in the number of utility service terminations, the corresponding resource savings should be reflected in the SCT cost test results.

Wholesale Market Price Impacts: Distributed energy resources reduce the need for wholesale generation. DERs can obviate the need for calling on the next marginal generating unit. The marginal unit sets the price for all infra-marginal generators. That increase in price, which is avoided by DER, provides a benefit to all electricity consumers (reducing the price of energy and the price of demand). This is sometimes referred to as Demand Reduction Induced Price Effect (DRIPE).

APPENDIX I

CARBON REDUCTION CALCULATIONS

CHP Results

The results generated by the CHP Emissions Calculator are intended for educational and outreach purposes only; it is not designed for use in developing emission inventories or preparing air permit applications.

The results of this analysis have not been reviewed or endorsed by the EPA CHP Partnership.

Table 1

Annual Emissions Analysis

	CHP System	Displaced Electricity Production	Displaced Thermal Production	Emissions/Fuel Reduction	Percent Reduction
NO_x (tons/year)	9.94	9.66	6.86	6.58	40%
SO_2 (tons/year)	0.10	19.38	0.04	19.32	99%
CO_2 (tons/year)	19,939	17,142	8,016	5,219	21%
CH_4 (tons/year)	0.38	0.643	0.15	0.419	53%
N_2O (tons/year)	0.04	0.158	0.02	0.135	78%
Total GHGs (CO_2e tons/year)	19,958	17,204	8,024	5,270	21%
Fuel Consumption (MMBtu/year)	341,126	256,422	137,148	52,443	13%
Equal to the annual GHG emissions from this many passenger vehicles:				997	
Equal to the annual GHG emissions from the generation of electricity for this many homes:				652	

This CHP project will avoid yearly emissions of greenhouse gases by 5,270 tons of carbon dioxide e uivalent.

E ual to the annual greenhouse gas emissions from 997 passenger vehicles.

E ual to the annual greenhouse gas emissions from the generation of electricity used by 652 homes.

CHP Results

The results of this analysis have not been reviewed or endorsed by the EPA CHP Partnership.

Table 2

CHP Technology:	Combustion Turbine	
Fuel:	Natural Gas	
Unit Capacity:	3,390	kW
Number of Units:	1	
Total CHP Capacity:	3,390	kW
Operation:	8,460	hours per year
Heat Rate:	11,066	Btu/kWh HHV
CHP Fuel Consumption:	317,425	MMBtu/year
Duct Burner Fuel Consumption:	23,701	MMBtu/year
Total Fuel Consumption:	**341,126**	**MMBtu/year**
Total CHP Generation:	**28,684**	**MWh/year**
Useful CHP Thermal Output:	113,490	MMBtu/year for thermal applications (non-cooling)
	-	MMBtu/year for electric applications (cooling and electric heating)
	113,490	**MMBtu/year Total**

Table 3

Displaced On-Site Production for		Existing Gas Boiler
Thermal (non-cooling) Applications:	0.10	lb/MMBtu NOx
	0.00%	sulfur content
Displaced Electric Service (cooling and electric heating):		
	There is no displaced cooling service	

Table 4

Displaced Electricity Profile:	eGRID Fossil Fuel (2012 data)	
Egrid State:	'UP Upstate NY	
Distribution Losses:	9%	
Displaced Electricity Production:	28,684	MWh/year CHP generation
	-	MWh/year Displaced Electric Demand (cooling)
	-	MWh/year Displaced Electric Demand (electric heating)
	2,896	MWh/year Transmission Losses
	31,580	**MWh/year Total**

CHP Results

The results of this analysis have not been reviewed or endorsed by the EPA CHP Partnership.

Table 5

Annual Analysis for CHP	CHP System: Combustion Turbine	CHP System: Duct Burners		Total Emissions from CHP System
NO_x (tons/year)	8.75	1.19		9.94
SO_2 (tons/year)	0.09	0.01		0.10
CO_2 (tons/year)	18,554	1,385		19,939
CH_4 (tons/year)	0	0		0
N_2O (tons/year)	0	0		0
Total GHGs (CO_2e tons/year)	18,572	1,387		19,958
Fuel Consumption (MMBtu/year)	317,425	23,701		341,126

Table 6

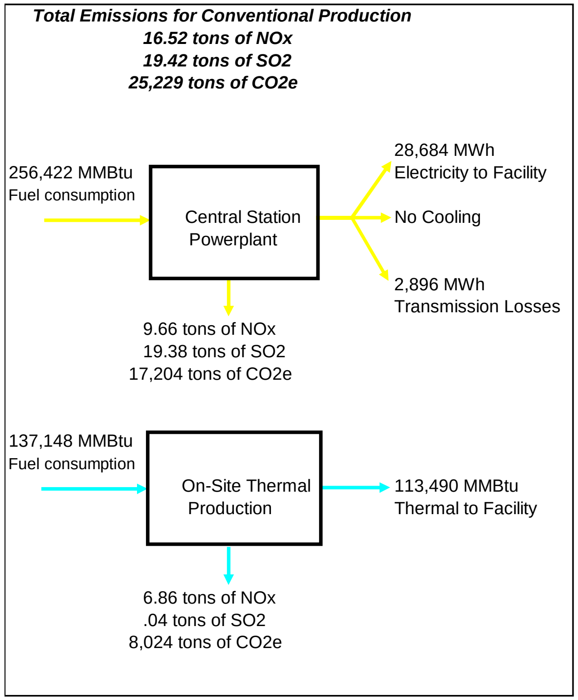
Annual Analysis for Displaced Production for Thermal (non-cooling) Applications				Total Displaced Emissions from Thermal Production
NO_x (tons/year)				6.86
SO_2 (tons/year)				0.04
CO_2 (tons/year)				8,016
CH_4 (tons/year)				0
N_2O (tons/year)				0
Total GHGs (CO_2e tons/year)				8,024
Fuel Consumption (MMBtu/year)				137,148

Table 7

Annual Analysis for Displaced Electricity Production	Displaced CHP Electricity Generation	Displaced Electricity for Cooling	Displaced Electricity for Heating	Transmission Losses	Total Displaced Emissions from Electricity Generation
NO_x (tons/year)	8.78	-	-	0.89	9.66
SO_2 (tons/year)	17.60	-	-	1.78	19.38
CO_2 (tons/year)	15,570	-	-	1,571.92	17,142
CH_4 (tons/year)	0.584	-	-	0.059	0.643
N_2O (tons/year)	0.143	-	-	0.014	0.158
Total GHGs (CO_2e tons/year)	15,627	-	-	1,578	17,204
Fuel Consumption (MMBtu/year)	232,908	-	-	23,514	256,422

CHP Results

The results of this analysis have not been reviewed or endorsed by the EPA CHP Partnership.



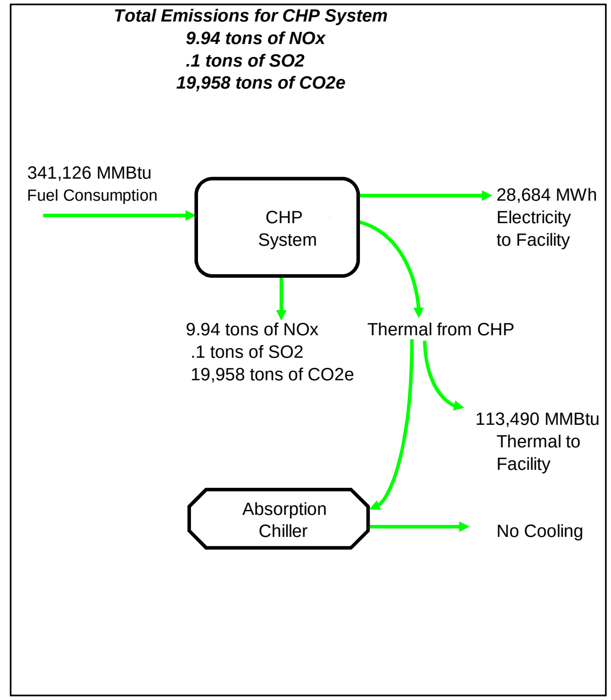


Table 8

Emission Rates	CHP System including Duct Burners	Combustion Turbine Alone	Displaced Electricity
NOx (lb/MWh)	0.69	0.61	0.61
SO2 (lb/MWh)	0.01	0.01	1.23
CO2 (lb/MWh)	1,390	1,294	1,086

Table 9

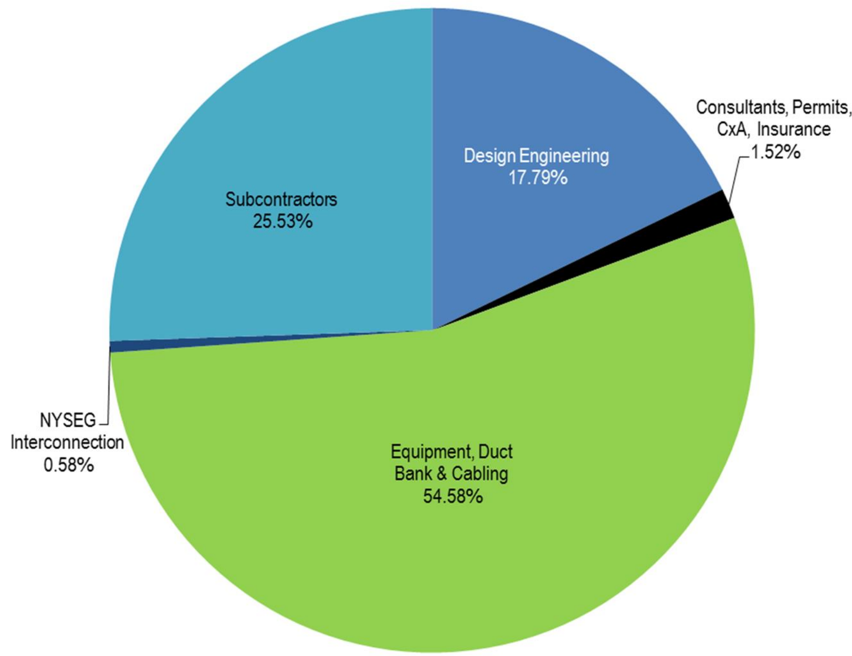
Emission Rates	Displaced Thermal Production
NOx (lb/MMBtu)	0.10
SO2 (lb/MMBtu)	0.00059
CO2 (lb/MMBtu)	116.90

APPENDIX J

CAPITAL AND OPERATING COSTS

CAPITAL COST

DESCRIPTION	2016 COST
Design Engineering	$4,330,772
Consultants, Permits, CxA, Insurance	$370,156
Equipment, Duct Bank & Cabling	$13,285,755
NYSEG Interconnection	$140,400
Subcontractors	$6,215,076
TOTAL	$24,342,158



OPERATING COST

COST PER YEAR	DESCRIPTION
$672,000	Annual turbine, HRSG, gas compressor, black start generator maintenance. Oil samples from each customer transformer, labor, and lab testing of oil samples, infrared inspections, minor part replacements

APPENDIX K

BURRSTONE ENERGY CENTER PSC WAIVER

STATE OF NEW YORK
PUBLIC SERVICE COMMISSION

At a session of the Public Service Commission held in the City of Albany on August 22, 2007

COMMISSIONERS PRESENT:

Patricia L. Acampora, Chairwoman
Maureen F. Harris
Robert E. Curry, Jr.
Cheryl A. Buley

Case 07-E-0802 - Burrstone Energy Center LLC – Petition For a Declaratory Ruling That the Owner and Operator of a Proposed Cogeneration Facility Will Not Be Subject to Commission Jurisdiction.

DECLARATORY RULING ON
EXEMPTION FROM REGULATION

(Issued and Effective August 28, 2007)

BY THE COMMISSION:

BACKGROUND

In a Petition filed on July 9, 2007, Burrstone Energy Center LLC (Burrstone) requests issuance of a Declaratory Ruling finding that the 3.6 MW cogeneration facility it intends to construct in Oneida County will not be regulated under the Public Service Law (PSL). Burrstone reports that it will provide electric and steam service to Faxton-St. Luke’s Health Care, Inc. (the Hospital), and electric service to Utica College (the College) and St. Luke’s Home Residential Health Care Facility, Inc. (the Home). Burrstone believes its facility, including its appurtenant distribution lines, is a qualifying cogeneration facility (QF) under PSL §2(2-a) and §2(2-d).

No responses to the Petition were received within the 21-day period prescribed under the Rules of Procedure, 16 NYCRR §8.2(c). That period expired on July 30, 2007.

THE PETITION

Burrstone begins by describing its cogeneration facility as consisting of four natural gas-fueled engine generators with a total capacity of approximately 3.6 MW that will operate in parallel with the system of the local utility, National Grid (Grid). The thermal output from the engine generators will be consumed by the Hospital in the form of steam and hot water, enabling it, through the installation of absorption chillers, to meet its cooling needs as well as its heating needs. The thermal energy usage, Burrstone asserts, will satisfy the requirements of the Public Utility Regulatory Policies Act of 1978 (PURPA) and PSL §2(2-a), enabling it to obtain QF status under both federal and state law.

Besides distributing electricity to the Hospital, the College, and the Home, Burrstone intends to sell excess electricity to Grid. The Hospital, the College and the Home will remain Grid customers, purchasing from it any electricity they need in excess of the cogeneration facility's production.

Its generators, Burrstone relates, will be installed in a separate building constructed on the Hospital's campus. From the cogeneration building, separate electric distribution systems will lead to the College, the Hospital, and the Home. To reach the College, Burrstone will install approximately 3,800 feet of underground cable that will cross underneath Champlin Avenue, a public street separating the Hospital and College campuses, and extend into the College campus. Thermal energy will be delivered to the Hospital through an approximately 50-foot pipeline. Burrstone anticipates commencing construction of the project soon, and is aiming to enter service by the first quarter of 2008.

The project, says Burrstone, will benefit the customers and will further important public policies. Burrstone emphasizes that the new cogeneration facility will replace older, less efficient facilities, including the Hospital's boilers that are more than 50 years old. Burrstone also notes that, because its cogeneration project will enable the customers to achieve significant energy savings and enhances service reliability, in conformance with public policies, it was able to obtain a grant of $1.0 million from the New York State Energy Research and Development Authority.

Asserting that it qualifies for the exemptions from regulation afforded to QFs under the PSL, Burrstone contends that it is a cogeneration facility under PSL §2(2-a), because it is sized at less than 80 MW, it generates electricity, and it produces thermal energy that is useful for commercial purposes. Its electric and steam distribution lines, Burrstone continues, are "related facilities" falling within the scope of the QF exemptions.

Burrstone cites the Nassau District and Nissequogue Rulings for the proposition that cogeneration facilities similar to its configuration have been granted the QF exemptions from regulation.[1] It notes that its electric and steam distribution lines are shorter than the lines that, in those Rulings, were deemed related facilities under PSL §2(2-d) because located "at or near" the cogeneration facilities.

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[1] Case 89-E-148, Nassau District Energy Corporation, Declaratory Ruling (issued September 27, 1989); Case 93-M-0564, Nissequogue Cogen Partners, L.P., Declaratory Ruling (issued November 19, 1993).

The only feature of its project that distinguishes it from the Nassau District and Nissequogue projects, Burrstone explains, is that those cogeneration facilities serve only one user owning property on both sides of a street. Its facility, Burrstone continues, will supply multiple users, with one user, the College, owning property separated from the others by a street. Burrstone asserts, however, that PSL §2(2-d) explicitly contemplates multiple users, in providing for inclusion within the definition of related facilities those needed to transmit electricity or steam to “users,” in the plural. That its electric line to the College crosses a street, Burrstone continues, does not remove the line from the scope of the §2(2-d) definition of related facilities. In both the Nassau District and Nissequogue Rulings, Burrstone emphasizes, distribution lines that crossed streets were treated as related facilities.

As a result, Burrstone believes its cogeneration facility, including the electric distribution line to the College, falls within the ambit of the exemptions from regulation granted to QFs, under PSL §2(3), §2(4), §2(13) and §2(22). Therefore, Burrstone concludes it is not, respectively, a corporation, person, electric corporation, or steam corporation for the purposes of the PSL.

DISCUSSION AND CONCLUSION

Under PSL §2(2-a), a cogeneration facility is defined as an electric generating plant sized at up to 80 MW, together with any related facilities located at the same project site, which simultaneously or sequentially produces electricity and thermal energy useful for industrial or commercial purposes. The electric and steam cogeneration facility that Burrstone intends to construct resembles the facilities found to satisfy the §2(2-a) statutory definition in the Nassau District and Nissequogue Rulings. As a result, its cogeneration facility falls within the ambit of the §2(2-a) criteria.

Under PSL §2(2-d), a cogeneration facility includes, besides the electric and steam cogeneration facility itself, “such transmission or distribution facilities as may be necessary to conduct electricity...or useful thermal energy to users located at or near a project site.”[2] The lines distributing electricity and steam from Burrstone’s cogeneration facility to users are similar to lines, including some that cross public streets, that were deemed related facilities in the Nassau District and Nissequogue Rulings, except that Burrstone’s lines are shorter and less extensive in scope. Since it was decided in those Rulings that the distribution facilities were located at or near the cogeneration facilities, notwithstanding the street crossings, we find that Burrstone’s distribution lines are located at or near its cogeneration facility even though one line crosses a street.

As Burrstone points out, the only distinction between its circumstances and those at issue in the Nassau District and Nissequogue Rulings is that, instead of serving one user owning property on two sides of a public street, it is furnishing electric service to multiple users, with one user owning property separated from the others by a street.[3] PSL §2(2-d), however, specifically contemplates multiple users, by providing that electricity may be distributed to “users,” in the plural, and does not require that users share property ownership rights.

[2] See Case 06-E-1203, Steel Winds Project LLC, Declaratory Ruling on Electric Corporation Jurisdiction (issued December 13, 2006).

[3] The College qualifies as a user because it consumes the electricity delivered to it for useful purposes.

Therefore, the electric and steam distribution facilities that Burrstone describes, with an electric distribution line extending across a property line and a public street to serve one of a number of multiple users, are related facilities falling within the exemption from regulation granted to cogeneration facilities.

Since Burrstone's proposed project is a cogeneration facility under PSL §2(2-a), and its electric and steam distribution lines are related facilities that are part of the cogeneration project under PSL §2(2-d), it qualifies for the exemptions from regulation set forth at PSL §§2(3), 2(4), 2(13) and 2(22). Therefore, Burrstone is not, respectively, a corporation, person, electric corporation or steam corporation for the purposes of the PSL.[4]

The Commission finds and declares:

1. The electric and steam generation and distribution facilities Burrstone Energy Center LLC describes in its Petition filed in this proceeding constitute a cogeneration facility as defined in the Public Service Law, and, accordingly, it is exempt from the provisions of the Public Service Law (except for Article VII).

2. This proceeding is closed.

By the Commission,

(SIGNED) JACLYN A. BRILLING
Secretary

[4] Burrstone is reminded that, under PSL §2(4), cogeneration facilities remain subject to PSL Article VII, if they build electric or gas transmission lines sized above the thresholds triggering application of that Article.

COGEN

APPENDIX L

BENEFIT COST ANALYSIS

Benefit-Cost Analysis Summary Report

Site 72 – City of Auburn

PROJECT OVERVIEW

As part of NYSERDA's NY Prize community microgrid competition, the City of Auburn has proposed development of a microgrid that would enhance the resiliency of electric service for the following facilities in Auburn and neighboring communities in Cayuga County:

- Cayuga Milk Ingredients and Grober Nutrition, two large dairy processing facilities;
- The Cayuga-Onondaga BOCES Regional Education Center, an education, training, and daycare facility;
- Arc of Seneca Cayuga, a service organization for individuals with intellectual and developmental disabilities;
- A New York State Police barracks facility;
- A Sunoco Gas Station and Express Mart; and
- The Aurelius Volunteer Fire Department (East Station), a volunteer fire station.

The microgrid would be powered by a new, 4.6 MW natural gas combined heat and power (CHP) unit to be located on Eagle Drive, near Cayuga Milk Ingredients. The operating scenario submitted by the project's consultants indicates that the CHP system would produce approximately 36,740 MWh of electricity per year, roughly 1.2 times the amount required to meet the average annual demand of the facilities listed above. During a major outage, the project's consultants indicate that the CHP system would supply all electricity required by the facilities.

To assist with completion of the project's NY Prize Stage 1 feasibility study, IEc conducted a screening-level analysis of the project's potential costs and benefits. This report describes the results of that analysis, which is based on the methodology outlined below.

METHODOLOGY AND ASSUMPTIONS

In discussing the economic viability of microgrids, a common understanding of the basic concepts of benefit-cost analysis is essential. Chief among these are the following:

- *Costs* represent the value of resources consumed (or benefits forgone) in the production of a good or service.
- *Benefits* are impacts that have value to a firm, a household, or society in general.
- *Net benefits* are the difference between a project's benefits and costs.
- Both costs and benefits must be measured relative to a common *baseline* - for a microgrid, the "without project" scenario - that describes the conditions that would prevail absent a project's development. The BCA considers only those costs and benefits that are *incremental* to the baseline.

This analysis relies on an Excel-based spreadsheet model developed for NYSERDA to analyze the costs and benefits of developing microgrids in New York State. The model evaluates the economic viability of a microgrid based on the user's specification of project costs, the project's design and operating characteristics, and the facilities and services the project is designed to support. The model analyzes a discrete operating scenario specified by the user; it does not identify an optimal project design or operating strategy.

The BCA model is structured to analyze a project's costs and benefits over a 20-year operating period. The model applies conventional discounting techniques to calculate the present value of costs and benefits, employing an annual discount rate that the user specifies – in this case, seven percent.[1] It also calculates an annualized estimate of costs and benefits based on the anticipated engineering lifespan of the system's equipment. Once a project's cumulative benefits and costs have been adjusted to present values, the model calculates both the project's net benefits and the ratio of project benefits to project costs. The model also calculates the project's internal rate of return, which indicates the discount rate at which the project's costs and benefits would be equal. All monetized results are adjusted for inflation and expressed in 2014 dollars.

With respect to public expenditures, the model's purpose is to ensure that decisions to invest resources in a particular project are cost-effective; i.e., that the benefits of the investment to society will exceed its costs. Accordingly, the model examines impacts from the perspective of society as a whole and does not identify the distribution of costs and benefits among individual stakeholders (e.g., customers, utilities). When facing a choice among investments in multiple projects, the "societal cost test" guides the decision toward the investment that produces the greatest net benefit.

The BCA considers costs and benefits for two scenarios:

- Scenario 1: No major power outages over the assumed 20-year operating period (i.e., normal operating conditions only).
- Scenario 2: The average annual duration of major power outages required for project benefits to equal costs, if benefits do not exceed costs under Scenario 1.[2]

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[1] The seven percent discount rate is consistent with the U.S. Office of Management and Budget's current estimate of the opportunity cost of capital for private investments. One exception to the use of this rate is the calculation of environmental damages. Following the New York Public Service Commission's (PSC) guidance for benefit-cost analysis, the model relies on temporal projections of the social cost of carbon (SCC), which were developed by the U.S. Environmental Protection Agency (EPA) using a three percent discount rate, to value CO_2 emissions. As the PSC notes, "The SCC is distinguishable from other measures because it operates over a very long time frame, justifying use of a low discount rate specific to its long term effects." The model also uses EPA's temporal projections of social damage values for SO_2, NO_x, and $PM_{2.5}$, and therefore also applies a three percent discount rate to the calculation of damages associated with each of those pollutants. [See: State of New York Public Service Commission. Case 14-M-0101, Proceeding on Motion of the Commission in Regard to Reforming the Energy Vision. Order Establishing the Benefit Cost Analysis Framework. January 21, 2016.]

[2] The New York State Department of Public Service (DPS) requires utilities delivering electricity in New York State to collect and regularly submit information regarding electric service interruptions. The reporting system specifies 10 cause categories: major storms; tree contacts; overloads; operating errors; equipment failures; accidents; prearranged interruptions; customers equipment; lightning; and unknown (there are an additional seven cause codes used exclusively for Consolidated Edison's underground network system). Reliability metrics can be calculated in two ways: including all outages, which indicates the actual experience of a utility's customers; and excluding outages caused by major storms, which is more indicative of the frequency and duration of outages within the utility's control. In estimating the reliability benefits of a microgrid, the BCA employs metrics that exclude outages caused by major storms. The BCA classifies outages caused by major storms or other events beyond a utility's control as "major power outages," and evaluates the benefits of avoiding such outages separately.

RESULTS

Table 1 summarizes the estimated net benefits, benefit-cost ratios, and internal rates of return for the scenarios described above. The results indicate that if there were no major power outages over the 20-year period analyzed (Scenario 1), the projectǒs costs would exceed its benefits. In order for the projectǒs benefits to outweigh its costs, the average duration of major outages would need to equal or exceed 2.0 days per year (Scenario 2). The discussion that follows provides additional detail on these findings.

Table 1. BCA Results (Assuming 7 Percent Discount Rate)

ECONOMIC MEASURE	ASSUMED AVERAGE DURATION OF MAJOR POWER OUTAGES	
	SCENARIO 1: 0 DAYS/YEAR	SCENARIO 2: 2.0 DAYS/YEAR
Net Benefits - Present Value	-$33,800,000	$1.2 million
Benefit-Cost Ratio	0.6	1.0
Internal Rate of Return	N/A	8.2%

Scenario 1

Figure 1 and Table 2 present the detailed results of the Scenario 1 analysis.

Figure 1. Present Value Results, Scenario 1 (No Major Power Outages; 7 Percent Discount Rate)

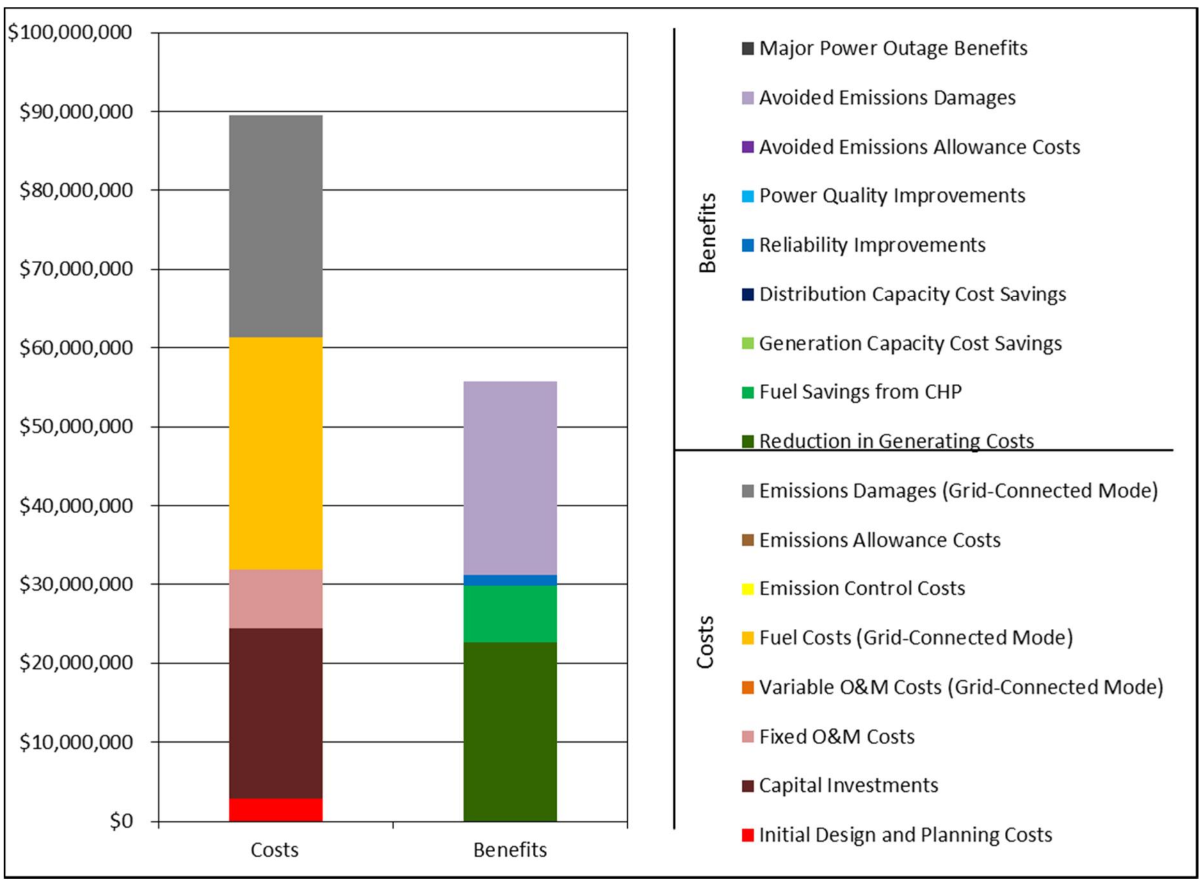

Table 2. Detailed BCA Results, Scenario 1 (No Major Power Outages; 7 Percent Discount Rate)

COST OR BENEFIT CATEGORY	PRESENT VALUE OVER 20 YEARS (2014$)	ANNUALIZED VALUE (2014$)
Costs		
Initial Design and Planning	$2,850,000	$251,000
Capital Investments	$21,500,000	$1,620,000
Fixed O&M	$7,620,000	$672,000
Variable O&M (Grid-Connected Mode)	$0	$0
Fuel (Grid-Connected Mode)	$29,300,000	$2,590,000
Emission Control	$0	$0
Emissions Allowances	$0	$0
Emissions Damages (Grid-Connected Mode)	$28,200,000	$1,840,000
Total Costs	**$89,500,000**	
Benefits		
Reduction in Generating Costs	$22,700,000	$2,000,000
Fuel Savings from CHP	$7,120,000	$628,000
Generation Capacity Cost Savings	$0	$0
Distribution Capacity Cost Savings	$0	$0
Reliability Improvements	$1,420,000	$126,000
Power Quality Improvements	$0	$0
Avoided Emissions Allowance Costs	$12,500	$1,100
Avoided Emissions Damages	$24,500,000	$1,600,000
Major Power Outage Benefits	$0	$0
Total Benefits	**$55,700,000**	
Net Benefits	**-$33,800,000**	
Benefit/Cost Ratio	**0.6**	
Internal Rate of Return	**N/A**	

Fixed Costs

The BCA relies on information provided by the project team to estimate the fixed costs of developing the microgrid. The project team's best estimate of initial design and planning costs is approximately $2.9 million. The present value of the project's capital costs is estimated at approximately $21.5 million, including costs associated with the new CHP unit; building modifications to accommodate the CHP unit; breakers and other control equipment; and cabling to connect the CHP system to the facilities served. The present value of the microgrid's fixed operations and maintenance (O&M) costs (i.e., O&M costs that do not vary with the amount of energy produced) is estimated at $7.6 million, based on an annual cost of $672,000.

Variable Costs

The BCA analysis also considers the project's variable costs, i.e., costs that are likely to vary with the amount of energy the microgrid produces. A significant variable cost associated with the proposed project is the cost of natural gas to fuel the CHP unit. To characterize these costs, the BCA relies on estimates of fuel consumption provided by the project team and projections of fuel costs from New York's 2015 State

Energy Plan (SEP), adjusted to reflect recent market prices.[3] Based on these figures, the present value of the project's fuel costs over a 20-year operating period is estimated to be approximately $29.3 million.

The analysis of variable costs also considers the environmental damages associated with pollutant emissions from the distributed energy resources that serve the microgrid, based on the operating scenario and emissions rates provided by the project team and the understanding that the system would not be subject to emissions allowance requirements. In this case, the damages attributable to emissions from the microgrid's CHP units are estimated at approximately $1.8 million annually. The majority of these damages are attributable to the emission of CO_2. Over a 20-year operating period, the present value of emissions damages is estimated at approximately $28.2 million.

The project team anticipates no other variable costs.

Avoided Costs

The development and operation of a microgrid may avoid or reduce a number of costs that otherwise would be incurred. These include generating cost savings resulting from a reduction in demand for electricity from bulk energy suppliers. The BCA estimates the present value of these savings over a 20-year operating period to be approximately $22.7 million. Cost savings would also result from improvements in fuel efficiency provided by the new CHP system. The BCA estimates the present value of fuel savings over the 20-year operating period to be approximately $7.1 million. The reduction in demand for electricity from bulk energy suppliers and for heating fuel would also curtail emissions of CO_2, SO_2, NO_x, and particulate matter from these sources, yielding emissions allowance cost savings with a present value of approximately $12,500 and avoided emissions damages with a present value of approximately $24.5 million.[4]

The project's consultants do not anticipate that the microgrid will provide peak load support or enable utilities to avoid the cost of expanding generation capacity or distribution networks.[5]

Reliability Benefits

An additional benefit of the proposed microgrid would be to reduce customers' susceptibility to power outages by enabling a seamless transition from grid-connected mode to islanded mode. The analysis estimates that development of a microgrid would yield reliability benefits of approximately $126,000 per year, with a present value of $1.4 million over a 20-year operating period. This estimate was developed using the U.S. Department of Energy's Interruption Cost Estimate (ICE) Calculator, and is based on the following indicators of the likelihood and average duration of outages in the service area:[6]

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[3] The model adjusts the State Energy Plan's natural gas and diesel price projections using fuel-specific multipliers calculated based on the average commercial natural gas price in New York State in October 2015 (the most recent month for which data were available) and the average West Texas Intermediate price of crude oil in 2015, as reported by the Energy Information Administration. The model applies the same price multiplier in each year of the analysis.

[4] Following the New York Public Service Commission's (PSC) guidance for benefit-cost analysis, the model values emissions of CO_2 using the social cost of carbon (SCC) developed by the U.S. Environmental Protection Agency (EPA). [See: State of New York Public Service Commission. Case 14-M-0101, Proceeding on Motion of the Commission in Regard to Reforming the Energy Vision. Order Establishing the Benefit Cost Analysis Framework. January 21, 2016.] Because emissions of SO_2 and NO_x from bulk energy suppliers are capped and subject to emissions allowance requirements in New York, the model values these emissions based on projected allowance prices for each pollutant.

[5] Impacts to transmission capacity are implicitly incorporated into the model's estimates of avoided generation costs and generation capacity cost savings. As estimated by NYISO, generation costs and generating capacity costs vary by location to reflect costs imposed by location-specific transmission constraints.

[6] www.icecalculator.com.

- System Average Interruption Frequency Index (SAIFI) – 1.03 events per year.
- Customer Average Interruption Duration Index (CAIDI) – 118.2 minutes.[7]

The estimate takes into account the number of residential and small or large commercial or industrial customers the project would serve; the distribution of commercial or industrial customers by economic sector; average annual electricity usage per customer, as provided by the project team; and the presence of backup generation among the customers.

It is important to note that the analysis of reliability benefits assumes that development of a microgrid would insulate the facilities the project would serve from outages of the type captured in SAIFI and CAIDI values. The distribution network within the microgrid is unlikely to be wholly invulnerable to such interruptions in service. All else equal, this assumption will lead the BCA to overstate the reliability benefits the project would provide.

Power Quality Benefits

Beyond the benefits noted above, the project team indicates that the microgrid would enable the facilities it serves to avoid power quality events; however, the team was unable to provide information on the current frequency of such events, which is necessary to quantify the benefits the microgrid would provide. All else equal, the lack of data on this issue may lead the analysis to understate the benefits of the proposed microgrid.

Summary

The analysis of Scenario 1 yields a benefit/cost ratio of 0.6; i.e., the estimate of project benefits is approximately 60 percent that of project costs. Accordingly, the analysis moves to Scenario 2, taking into account the potential benefits of a microgrid in mitigating the impact of major power outages.

Scenario 2

Benefits in the Event of a Major Power Outage

As previously noted, the estimate of reliability benefits presented in Scenario 1 does not include the benefits of maintaining service during outages caused by major storm events or other factors generally considered beyond the control of the local utility. These types of outages can affect a broad area and may require an extended period of time to rectify. To estimate the benefits of a microgrid in the event of such outages, the BCA methodology is designed to assess the impact of a total loss of power on the facilities the microgrid would serve. It calculates the economic damages that development of a microgrid would avoid based on (1) the incremental cost of potential emergency measures that would be required in the event of a prolonged outage, and (2) the value of the services that would be lost.[8,9]

Auburn's proposed microgrid project would serve a number of facilities during an extended outage. The project's consultants indicate that at present, backup generation capabilities exist only at the Cayuga-

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[7] The analysis is based on DPS's reported 2014 SAIFI and CAIDI values for New York State Electric and Gas.

[8] The methodology used to estimate the value of lost services was developed by the Federal Emergency Management Agency (FEMA) for use in administering its Hazard Mitigation Grant Program. See: FEMA Benefit-Cost Analysis Re-Engineering (BCAR): Development of Standard Economic Values, Version 4.0. May 2011.

[9] As with the analysis of reliability benefits, the analysis of major power outage benefits assumes that development of a microgrid would insulate the facilities the project would serve from all outages. The distribution network within the microgrid is unlikely to be wholly invulnerable to service interruptions. All else equal, this will lead the BCA to overstate the benefits the project would provide.

Onondaga BOCES Educational Center.[10] None of the facilities are likely to rent portable generators to maintain power during an outage. Consistent with other information provided by the project team, the analysis assumes that all facilities require a full 24 hours of service per day. The analysis further assumes that the Education Center could maintain services using backup generation, but that all other affected facilities would be unable to operate or provide services during a major power outage.[11]

Further information on the consequences of an outage for most of these facilities is not available. In the absence of more detailed information, the analysis values a loss of service based on estimates of the cost of a power interruption provided by the Department of Energy's ICE Calculator. Table 3 summarizes the value of service estimates provided by the ICE Calculator.

Table 3. Value of Maintaining Service, Scenario 2

FACILITY	FACILITY ECONOMIC SECTOR	VALUE PER DAY
Cayuga Milk Ingredients	Manufacturing	$742,618
Grober Nutrition	Manufacturing	$591,555
Cayuga-Onondaga BOCES Regional Education Center	All other industries	$133,422
All Other Facilities (Arc of Seneca Cayuga, NY State Police Barracks, Sunoco/Express Mart, and Volunteer Fire Department)	All other industries	$198,105

Based on these values and the other assumptions outlined above, the analysis estimates that in the absence of a microgrid, the average cost of an outage for the facilities of interest is approximately $1.5 million per day. As noted, these benefits are the product of assuming no backup generation and a full loss of services at all facilities other than the Education Center. Thus, the approach is likely to overstate the economic consequences of a major power outage.

Summary

Figure 2 and Table 4 present the results of the BCA for Scenario 2. The results indicate that the benefits of the proposed project would equal or exceed its costs if the project enabled the facilities it would serve to avoid an average of 2.0 days per year without power. If the average annual duration of the outages the microgrid prevents is less than this figure, its costs are projected to exceed its benefits.

[10] No information was provided on operating costs associated with the 205kW natural gas generator at the Education Center. The analysis assumes that the generator uses 2,583 cubic feet of natural gas per hour, or about 64 MMBtus of natural gas per day of operation. This translates to a daily operating cost of approximately $387.

[11] The applicant provided specific information only for the Cayuga dairy facility, indicating that the facility would experience a 100 percent loss of its ability to operate when no power is available. The analysis conservatively assumes the same for all the facilities served by the microgrid.

Figure 2. Present Value Results, Scenario 2 (Major Power Outages Averaging 2.0 Days/Year; 7 Percent Discount Rate)

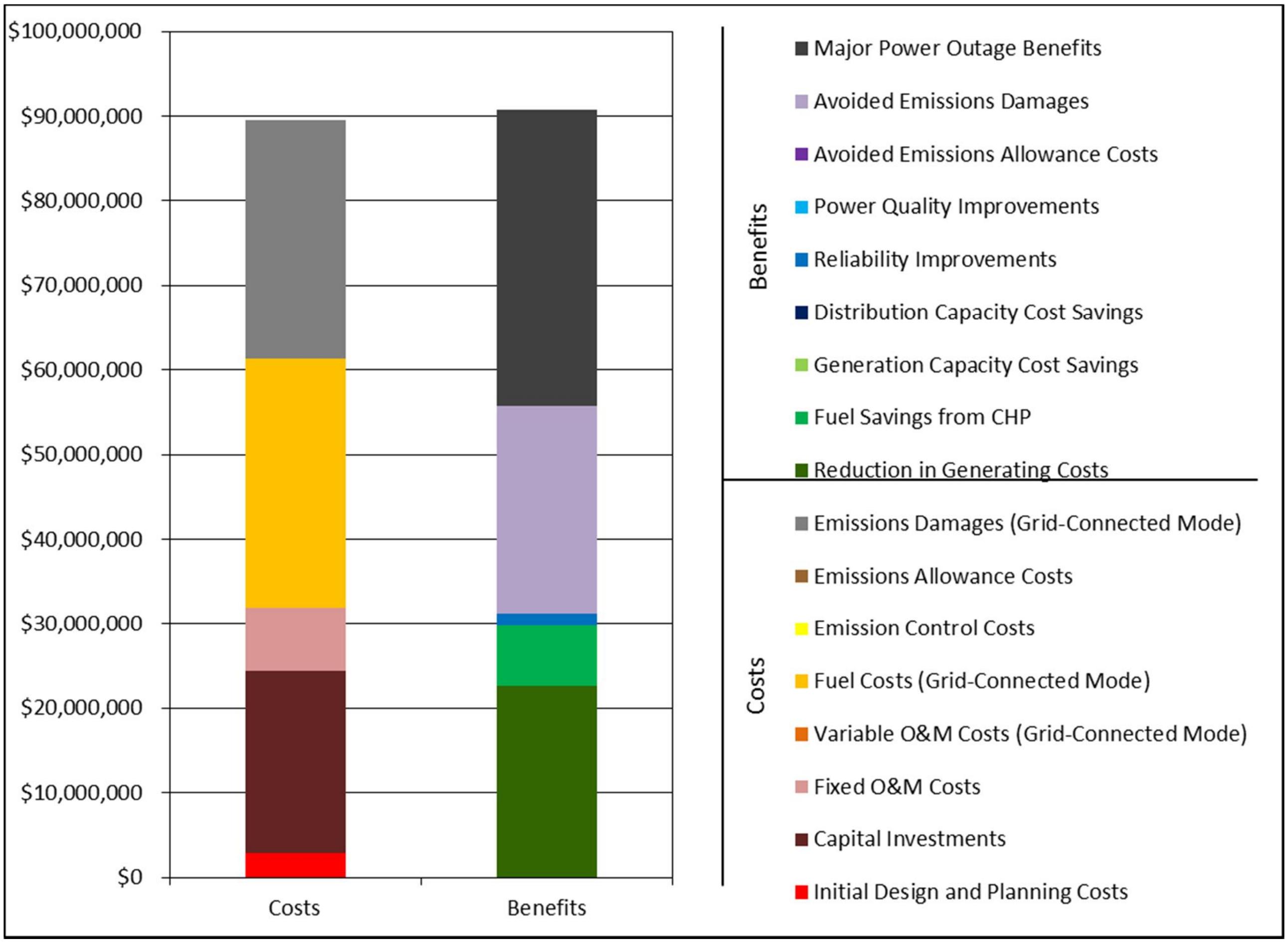

Table 4. Detailed BCA Results, Scenario 2 (Major Power Outages Averaging 2.0 Days/Year; 7 Percent Discount Rate)

COST OR BENEFIT CATEGORY	PRESENT VALUE OVER 20 YEARS (2014$)	ANNUALIZED VALUE (2014$)
Costs		
Initial Design and Planning	$2,850,000	$251,000
Capital Investments	$21,500,000	$1,620,000
Fixed O&M	$7,620,000	$672,000
Variable O&M (Grid-Connected Mode)	$0	$0
Fuel (Grid-Connected Mode)	$29,300,000	$2,590,000
Emission Control	$0	$0
Emissions Allowances	$0	$0
Emissions Damages (Grid-Connected Mode)	$28,200,000	$1,840,000
Total Costs	**$89,500,000**	
Benefits		
Reduction in Generating Costs	$22,700,000	$2,000,000
Fuel Savings from CHP	$7,120,000	$628,000
Generation Capacity Cost Savings	$0	$0
Distribution Capacity Cost Savings	$0	$0
Reliability Improvements	$1,420,000	$126,000
Power Quality Improvements	$0	$0
Avoided Emissions Allowance Costs	$12,500	$1,100
Avoided Emissions Damages	$24,500,000	$1,600,000
Major Power Outage Benefits	$35,000,000	$3,090,000
Total Benefits	**$90,700,000**	
Net Benefits	**$1,190,000**	
Benefit/Cost Ratio	**1.0**	
Internal Rate of Return	**8.2%**	

COGEN

APPENDIX M

REFERENCES

REFERENCES

U.S. Census Bureau. Population in the U.S., Auburn, NY. 24 July 2015. Accessed at: https://www.google.com/publicdata/explore?ds=kf7tgg1uo9ude_&met_y=population&idim=place:3603078&hl=en&dl=en